CITY OF LEMOORE

INDUSTRIAL PARK DEVELOPMENT
PHASE 1 & PHASE 2

Standard & Technical Specifications

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CONTENTS

STANDARD SPECIFICATIONS

Please refer to City of Lemoore Standard Specifications and Drawings, Updated October 2003 and as Amended thereafter; the SSFPWC “Greenbook” 2018 Edition, and the State of California Department of Transportation (CALTRANS) latest edition of Standard Specifications.

STANDARD SPECIFICATIONS

The City of Lemoore Standard Specifications and Drawings, Department of Public Works, dated October 2003 and as amended from time-to-time, are hereby referred to and incorporated herein as though set forth in full. It is recommended that bidders obtain the most current issue of these Specifications.

The Standard Specifications are available on the City of Lemoore’s website (https://lemoore.com/wp-content/uploads/2018/03/lemoore_standard_specifications.pdf) by clicking on Public Works Department and checking Standard Specifications.

If you do not have access to the Internet, copies of the Standard Specifications with Standard Drawings may be obtained for $60 at City Hall, Public Works Counter, 711 W Cinnamon Drive, Lemoore, CA, Telephone (559) 924-6744. (If mailed, a mailing charge of $15.00 per book will be required.)

INCORPORATION OF STATE STANDARDS

All public works shall be constructed in accordance with the appropriate provisions and construction details of the latest edition of Standard Specifications, published by the State of California Department of Transportation (CALTRANS), insofar as they may apply. In case of a conflict between the State Standard Specifications (referred to herein as State Standard Specifications) and this document, this document shall take precedence.

Measurement and payment clauses have been omitted from this document. Such clauses appear in the Special Provisions of publicly funded projects as needed. The measurement and payment clauses in the State Standard Specifications do not apply.

TECHNICAL SPECIFICATIONS

DIVISION 01 - GENERAL REQUIREMENTS

SECTION 01100 SUMMARY OF WORK

1.01 LOCATION AND DESCRIPTION OF WORK

This section describes the work to be performed for the Industrial Park Development project.

1.02 LOCATION AND DESCRIPTION OF CONTRACT

A. The work is located within the City of Lemoore. The work consists of constructing two new segments of roadway with all associated wet utilities, construction of a new detention basin and the construction of a new stormwater lift station and discharge station.

B. The work includes furnishing products, labor, tools, transportation, and services to construct including but not limited to the following:

Industrial Park Development

1. Demolish existing trees, site improvements, asphalt, vegetation, and curb.
2. Temporary stormwater pumping.
3. Dewatering
4. Construct concrete curb and gutter, sidewalk, lighting poles, electrical equipment pad, sitework, fencing, gate and cabinet.
5. Construction new asphalt roadway
6. Grading for roadway and stormwater basin
7. Installation of Stormwater & Sewer Piping and Manholes
8. Installation of 12” Water Main, Fire Hydrates & all associates valves and fittings
9. Furnish and install mechanical piping, valves, and equipment within lift station and wet well.
10. Furnish and install electrical and control equipment for new stormwater lift station and discharge station.

11. Commissioning and start-up services

12. Clean up and restore construction areas.

C. The work described in Section 01100 is an overall summary of the responsibilities of the Contractor and its relation to the City. It does not supersede the specific requirements of the other Contract Documents.

1.03 WORK SEQUENCE

A. The Contractor shall submit a Progress Schedule covering the entire work in accordance with Construction Schedule.

1.04 LAND FOR CONSTRUCTION PURPOSES

A. The Contractor shall be responsible to secure the rights to use land for construction purposes, storage of materials and equipment, and staging areas. The Contractor must make arrangements with the City prior to utilizing any lands of the City. Lands of the City may be made available for use by Contractor solely at the City's discretion.

B. The Contractor shall immediately move stored materials or equipment if any occasion arises, as determined by the City, requiring access to the storage area. Materials or equipment shall not be placed on the property of the City until the City has agreed to the location to be used forstorage.

C. The Contractor shall not enter any private property without written permission from the Owner of the property. The Contractor shall obtain written permission from the private property if the Contractor elects to encroach upon other lands and provide evidence of such permission in writing to the City prior to entering upon such lands.

1.05 UNFAVORABLE CONSTRUCTION CONDITIONS

A. During unfavorable weather, wet ground, or other unsuitable construction conditions, the Contractor shall confine his operations to work that will not be affected adversely by such conditions. No portion of the work shall be constructed under conditions that would affect adversely the quality of efficiency thereof, unless special means or precautions are taken by the Contractor to perform the work in a proper and satisfactory manner.

PART 2 - PRODUCTS (NOT APPLICABLE)
PART 3 - EXECUTION (NOT APPLICABLE) END OF SECTION

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SECTION 01300 SHOP DRAWINGS AND SUBMITTALS

PART 1 - GENERAL

1.01 WORK INCLUDED

A. General procedures and requirements for submittals, initial submittal, submittals required on the City's request, progress reports, shop drawings, product data and samples, notification of affected residences and businesses, and submittal forms.

1.02 RELATED WORK

A. General Conditions.

1.03 SUBMITTALS

A. Submit six copies of submittals unless otherwise stated. Submit electronic copy.

B. Submittals and samples shall be transmitted to the City or City's designated representative for distribution. All submittals and shop drawings shall be initially reviewed by the Engineer of Record for compliance with the project design.

C. Number submittals sequentially.

D. Shop Drawing Transmittal Form. The form included at the end of this section shall be used unless otherwise directed by the City. Submit a separate transmittal form for each submittal number. Submittals without the completed Contractor's Transmittal Form attached to each copy of each submittal listed in Schedule of Submittals will be returned without review and stamped "REJECTED."

E. Exceptions and departures from the Contract Documents shall be clearly noted, along with justification for each exception or departure. Otherwise, review or approval of submittals shall not constitute approval of exceptions or departures.

F. Stock or standard drawings will not be accepted for review unless full identification and supplementary information is shown thereon in ink or typewritten form.

G. Review of submittals shall proceed as follows:

1. Submit specified quantity of complete submittals together with the Contractor's submittal forms for review.

2. Submittals will be stamped "NO EXCEPTIONS TAKEN," "MAKE CORRECTIONS NOTED," "REVISE AND RESUBMIT," or "REJECTED." Three copies with a letter of

transmittal will be returned to the Contractor.

3. If drawing or data is stamped "REVISE AND RESUBMIT" or "REJECTED," make necessary corrections and resubmit documents in their entirety. The Contractor's submittal form transmitting revised documents shall show that documents comprise a re-submittal. Revisions and re-submittals shall be numbered as Revision #1, Revision #2, or as appropriate.

4. If changes other than those noted by the reviewer are made on a submittal before re-submittal, note such changes on re-submittal.

5. Revise and re-submit submittals as required, until confirmation of compliance is obtained.

H. Costs incurred by the City for third and subsequent re-submittals will be deducted from City's payment to the Contractor.

I. Allow not less than 15 working days for review and response to submittals unless otherwise approved by the City. Review may be delayed if contingent on receipt of other submittals. Upon timely written request by the Contractor, the City will make reasonable efforts to shorten review periods that may fall on the Contractor's critical path.

J. No work shall begin on the respective items of work which require a submittal until the submittals for those items of work have been approved in writing by the City. Fabrication or acceptance of delivery of products prior to receipt of the City's satisfactory return of applicable submittals shall be at the Contractor's risk.

1.04 INITIAL SUBMITTAL

A. Letter addressed to the City identifying the Contractor's superintendent, safety officer, and traffic control coordinator, including emergency telephone numbers and signature authorization, and listing names, addresses and telephones for subcontractors.

B. Names and addresses of the manufacturers furnishing products valued greater than either 5 percent of the contract value or $50,000. State locations of shops where manufacture will take place. State whether products are already designed or in production. Include a brief description of products proposed, including sizes and catalog numbers.

C. Submit items in 1.04 A and B above within 48 hours after bid opening.

1.05 SUBMITTALS ON REQUEST FOR SUPPLEMENTAL INFORMATION

A. Detailed construction schedule updates shall be submitted, to describe scheduling of elements of construction requiring the City's or Contractor's coordination with public, or other private parties or public agencies.

B. Supplemental information will be requested for "approved equals" and maybe requested when there is a question that a manufacturer's product conforms to Contract Documents. The City reserves right to require submittal of supplemental information as described herein before approval of product.

C. Certification of compliance with listed reference standards shall be submitted by manufacturers on the City's request. Failure of the City to request certification of compliance shall not serve as waiver of the Contractor's duty to comply with reference standards.

D. Transcripts of results of acceptance tests performed at point of manufacture of products furnished shall be submitted by manufacturers on the City's request.

E. Samples shall be submitted on the City's request.

F. Names and addresses of nearest local service representatives that maintain technical service personnel and complete inventory of spare parts and accessories shall be submitted on the City's request.

G. List of three installations in which products comparable in size, capacity and rating with those required in the Contract Documents are now in regular operation shall be submitted on the City's request. Include listing of size capacity or rating of each installation. Include name and telephone number of at least one reference responsible for operations at each installation whom the City may contact.

1.06 PROGRESS REPORTS

A. Daily log shall be submitted by the Contractor's superintendent on a one page form provided by the City. These logs shall be detailed with activities that took place during each day. Submit logs daily to the City Representative.

B. Schedule updates shall be submitted with monthly pay requests. If work falls behind schedule, monthly pay requests shall include revised schedules to demonstrate how the Contractor intends to bring work back on schedule.

C. Record drawings, consisting of one set of annotated plans and other drawings forming a part of the contract, showing installed locations of improvements and all changes made during construction, shall be available to the City for inspection throughout project. Record all deviations from the Contract Documents, including approved change orders field directives, using additional sketches or ink

revisions, immediately after installing each portion of the work. Show locations of underground piping, conduit, sensor lines, valves, capped ends, branch fittings, pull boxes and the work. Keep one current record copy of the Contract Documents, addenda, supplementary drawings, working drawings, change orders and clarifications at the site and in good order. Report changes and deviations promptly to the City Representative.

D. Partial payment requests may be withheld if daily logs, schedule updates or record drawings are damaged, lost or not kept current to satisfaction of the City.

1.07 SHOP DRAWINGS AND PRODUCT DATA

A. Shop drawings shall clearly show dimensions, clearances, slopes, floor space requirements, tolerances, conduit, anchor bolt sizes and embedments, finishes, performance characteristics, and weight and type of products. Shop drawings shall indicate the location at which products are to be installed, how equipment will be mounted, how it relates to adjacent structures or products, and how connection will be made between work under this contract and work under other contracts. Shop drawings shall show parts lists and details of appurtenances to be furnished with specified items, along with references to appropriate ASTM, and other reference standards and grades. Use of contract drawing reproductions for shop drawings is subject to rejection.

B. Catalog data shall clearly indicate applicable items when several products are covered on one page. Using black ink, indicate on submitted catalog data, specification section or plan reference being satisfied.

C. Installation or application instructions shall be the manufacturer's printed instructions including warranty requirements, clearances required and proper field procedures to deliver, handle, install and prepare product for use. In the absence of manufacturer's published literature, ASTM, AWWA or trade standards for proper installation will be accepted.

D. Operation and maintenance instructions shall be the manufacturer's printed instructions for correct operation and maintenance procedures for the product, along with data that must accompany the manual as directed by current regulations of government agency. Include operating instructions for each piece of equipment. Describe equipment function, operating characteristics, limiting conditions, operating instructions, startup procedures, normal and emergency conditions, regulation and control, and shutdown. Include preventative maintenance instructions. List warranty requirements. Explain and illustrate preventative maintenance tasks. Include lubrication charts, lists of acceptable lubricants, trouble shooting instructions, and lists of

required maintenance tools and equipment. List recommended spare parts, their costs, and ordering information for one manufacturer who can supply these parts. Index instructions for easy reference. Include information for installed equipment only.

E. The manufacturer's statement of responsibility shall be copy of form attached, signed by authorized factory representative for manufacturer whose product is being furnished.

F. Certification of compliance shall certify materials have been sampled, tested and found to comply with applicable reference standards.

G. Engineering calculations shall be clearly legible, and shall demonstrate compliance with state and local codes, applicable standards, and contract requirements. Calculations shall be sealed by a licensed professional engineer registered in California.

1. Seismic design calculations and restraint details for equipment and piping supports. Calculations shall be stamped by a Civil or Structural Engineer registered in the State of California.

H. Shop drawings for piping shall include the following:

1. Key or index showing locations of spools and fittings.
2. Order of installation. Each spool shall receive a unique mark number. No other spool or fitting, even on separate pipelines or casings included in the contract, shall have the same mark number. The sequential order of the mark numbers shall correspond to a logical order of installation for each pipeline.
3. Laying lengths, dimensions, clearances and tolerances for all spools and fittings.
4. Station and invert elevation of all grade changes and changes in horizontal alignment
5. Slopes of pipe not vertical or horizontal.
6. Horizontal and vertical alignment data for all curves, bends, tees and outlets.
7. Couplings and end types of all pipe, spools, fittings, outlets and adjacent valves or pipeline equipment.
8. Proposed linings and coatings for pipe, fitting and couplings.
9. How connections will be made between work under this contract and existing work or work under other

contracts.

10. Pipe and valve support sizes and locations including anchor bolt sizes and embedments.

11. Relationship of piping to other work.

I. Shop drawings for valves, pumps or pipeline equipment shall include the following:

1. Laying lengths and dimensions, clearances, tolerances and end types.

2. Weight and type of valves, pumps or equipment.

3. Valve and pump port sizes and tolerances.

4. Dimensions and orientation of actuators and pilot systems. Locations of actuator stops.

5. Proposed linings and coatings.

6. Performance characteristics.

7. Parts and materials lists and ratings and details of appurtenances to be furnished, along with references to appropriate ASTM, federal specifications and other reference standards and grades.

8. Piping and conduit attachments and sizes.

J. Shop drawings for structures shall include the following:

1. Lengths, widths, thicknesses, embedment, dimensions and tolerances of structural members.

2. Detailing of openings and wall penetrations including doors, windows, hatches, louvers, vents, ducts, and all floor, wall and door penetrations.

3. Connection details including applicable sizes, diameters, thickness, spacing, embedment and edge distances of bolts, anchors, rivets, nails, screws, spikes, connection plates, holdowns and other fasteners.

4. Welding details using standard ANSI/AWS 2.4 symbols and showing type, electrode, length, spacing and thickness of welds.

5. Materials listing and properties, including types, strengths and finishes of concrete, masonry, metals, wood, plastics and other construction materials.

K. Shop drawings for equipment shall include the following:

1. Dimensions, clearances and floor space requirements.

2. Weight and type of equipment.

3. Location where product will be installed.

4. Anchor bolt sizes and embedments.

5. Finishes and coatings.

6. Performance characteristics.

7. Parts and materials lists and ratings and details of appurtenances to be furnished, along with references to appropriate ASTM, federal specifications and other reference standards and grades.

8. Piping and conduit attachments and sizes.

9. Operation and maintenance manuals (separate submittal).

L. Shop drawings for electrically powered or controlled equipment shall include the following in addition to the above requirements for shop drawings for equipment:

1. Elevations showing arrangements and positions of all panel components including nameplates.

2. Electrical diagrams as needed to show wiring circuit schematics, single line diagrams, voltage wire numbers and identified interlocks and terminals.

3. Logic diagrams for programmable controllers or relays if used. Nameplate data showing nameplate material, height of letters, number of lines, inscriptions and dimensions.

1.08 SAMPLES

A. Furnish samples, finished as specified, and as intended to be used on or in work. Send samples to the City, prepaid.

B. Submit samples at least 31 days for approval prior to purchasing, fabricating, applying, or installing products. Allow at least 15 working days for review and return of samples.

C. Submit two of each sample, except for field samples. Attach the completed Contractor's submittal form to the sample. List items being transmitted, stating proposed use and location, product, color, trade name, lot, style, and model as appropriate.

D. Resubmit samples until acceptable. One of each sample will be returned to the Contractor upon acceptance.

E. Samples of finishes shall be 8 inch x 10 inch and shall be of

minimum thickness consistent with sample presentation. In lieu thereof, submit actual full-size item.

F. Samples of value may be returned to the Contractor for his use after review, analysis, comparison, and/or testing as may be required by the City.

G. Furnish one sample of approved products, colors, or textures to the City for final record. Show identification previously described including, if finish sample, manufacturer, mix proportion, name of color, building, Contractor, subcontractor, and surfaces to which applied on back of sample.

1.09 CONSTRUCTION PHOTOGRAPHS

A. Preconstruction photographs shall be submitted to the City before any work is performed that has the potential to disturb or modify public or private property, not owned by the City and that owned by the City but not considered to be affected by the proposed construction. Photographs shall be of sufficient quality and thoroughness to fully document preexisting damage or wear to photographed property for which the Contractor or City might be asked to compensate property owner were it not for photographic evidence of preexisting damage. Failure by the Contractor to submit preconstruction photographs may be taken by the City as evidence that subsequent claims by property owners for damage to their property can be rightfully attributed to the Contractor's actions.

1.10 NOTIFICATION OF AFFECTED RESIDENCES AND BUSINESSES

A. When working in existing streets, written notification, with the Contractor's 24- hour emergency phone number, shall be provided to residences and businesses fronting the project on either side of street. Notify these parties 72 hours in advance of construction that will affect these properties. Door-hangers or other means of notification shall be submitted and approved in advance by the City.

1.11 UNIT PRICES

A. Payment for submittals and re-submittals will be included in the price bid for those items of work for which the submittals are required.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION (NOT APPLICABLE)

END OF SECTION

SHOP DRAWING TRANSMITTAL FORM (SAMPLE)

PROJECT NAME:

FROM: DATE:

TO:

PROJECT NO:

ATTN:

SUBMITTAL NO:
REVISION NO:
SUBJECT OF SUBMITTAL:
SPECIFICATION SECTION(S):
PLAN SHEET NUMBER(S):

CONTRACTOR'S CERTIFICATION: Check & Complete either (A) or (B) below:

_____(A) We have reviewed in detail and certify that the material, equipment or construction procedure(s) contained in this submittal meet all the requirements specified in or shown on the Contract Documents, Construction Specifications and Construction Plans with no exceptions.

_____ (B) We have reviewed in detail and certify that the material, equipment or construction procedure(s) contained in this submittal meet all the requirements specified in or shown on the Contract Documents, Construction Specifications and Construction Plans except for the following deviations:

CONTRACTOR'S AUTHORIZED SIGNATURE:

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SECTION 01400 QUALITY REQUIREMENTS

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Inspection and testing laboratory qualifications, duties and responsibilities, the Contractor's quality control requirements, the City's inspection and testing.

1.02 RELATED WORK

A. Section 01300: Shop Drawings and Submittals

B. Section 01410: Testing and Inspection of Earthwork and Concrete

C. Section 01750: Start-up and Performance Testing

1.03 REFERENCE STANDARDS

A. Work shall conform to federal, state and all applicable building codes, and to Occupational Safety and Health Act (OSHA) Regulations. Nothing in the Contract Documents shall be interpreted as permission or direction to violate any governing code or ordinance.

1.04 QUALITY ASSURANCE

A. Only competent workers shall be employed on the work. Any person employed who is found to be incompetent, intemperate, troublesome, disorderly, or otherwise objectionable or who fails to perform work properly, acceptably and in accordance with manufacturers' installation and warranty requirements, shall be immediately removed from the work by the Contractor and not reemployed on the work.

B. Welders shall be AWS certified for the type of work they are performing.

C. Fabricators shall have 5-years minimum experience in the appropriate area of specialty and shall be approved by the City.

D. Testing agencies shall have 5-years minimum experience in the appropriate area of specialty and shall be approved by the City.

E. Deputy inspectors shall have 5-years minimum experience in the appropriate area of specialty and shall be approved by the City.

1.05 SUBMITTALS

A. Furnish the following submittals.

Submittal	**Description**
Certificates of Compliance	Furnish on the City's Request
Transcripts of Acceptance	Furnish on the City's Request as needed to verify quality of manufactured products
Manufacturer's Statement of Responsibility	Furnish on the City's Request

1.06 TESTING LABORATORY SERVICES

Where required by these specifications, the Contractor shall hire a City -approved independent laboratory to perform testing and certify results. Provide labor, products, tools, instruments, water, and power as directed for sampling for required tests.

A. Samples for testing shall be representative of final work product. Samples treated differently from final work product will not yield valid test results.

B. Tests of products shall follow commonly recognized standards of national technical organizations, and specified sampling and testing methods.

C. The Contractor shall pay for quality assurance testing unless otherwise shown.

D. Retest costs or other testing costs invoiced to the City and specified to be paid by the Contractor may be deducted from the Contractor's next progress payment in lieu of Contractor's direct payment of invoice (not applicable to developer-funded projects).

E. The City may test representative samples of each type and size of product furnished using an independent testing agency. Failure of samples to pass tests will be deemed sufficient cause to reject entire lot delivered.

1.07 CONTRACTOR'S QUALITY CONTROL

A. Arrange work to be readily accessible and easy to operate and maintain where detail drawings are not included in the Contract Documents, supplementary drawings or shop drawings and submittals.

B. Combinations of manufactured equipment shall be fully compatible and work safely and successfully as a unit. Furnish necessary mountings, couplings and appurtenances with each unit.

C. Relocations or adjustment of existing facilities noted in the Contract Documents shall be done as needed. If existing items are lost or damaged during construction, replace with new items of equal or better quality.

1.08 PROJECT CONDITIONS

A. Ascertain suitability of native soil for backfill before submitting bid. If native soil is found to be unsuitable, provide suitable material for meeting compaction requirements at no additional cost to the City.

B. Items furnished shall be capable of fulfilling their intended purpose in environment in which they are installed. Allow for local temperature

extremes, climatic conditions and corrosive environments where necessary to ensure proper functioning of furnished products.

1.09 UNIT PRICES

A. Payment for Contractor-provided testing required in the Contract Documents will be included in the price bid for items of work for which Contractor-provided testing is specified.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 – EXECUTION

3.01 INSPECTION

A. Products and work shall be subject to field and factory inspection and testing in accordance with standards required and defined in the Contract Documents. Waiver by the City of his right to inspect shall not relieve the Contractor of duties to comply with the Contract Documents.

B. The Contractor shall provide and pay for independent inspection, deputy inspection and testing services required by the ContractDocuments.

C. The City will provide certain inspection and testing duties not required of the Contractor under the Contract Documents. Performance of these tests and costs will be borne by the City; except that the Contractor shall pay cost of any failing test.

D. Inspection will be provided by the City's Representative. Inspection shall not be considered as direct control of the individual workman and his work. Inspections, tests, or approvals by the City 's Representative or others shall not relieve the Contractor from his duty to perform work in accordance with the Contract Documents.

E. Inspection and testing fees imposed by public agencies other than the City shall be paid for by the Contractor. If the Contract Documents, permits, laws, ordinances, rules, regulations or orders of public authorities having jurisdiction require work to be inspected, tested, or approved by some one other than the Contractor, give the City 's Representative timely notice of readiness. Submit the required certificates of inspection, testing or approval to the City's Representative.

F. Manufacturer's production facilities shall be open for inspection by the City or the City's Representative at all times during production of products furnished under this contract.

G. Notify the City's Representative of time and place of shop tests 10 working days before they begin. Prior to calling for factory inspection, complete operational checks, adjustments and pre-testing performed by the manufacturer.

H. Factory witnessed tests, where required shall be completed no sooner than 10 days after written notification is delivered to the City. The City will pay travel expenses for the City's personnel to and from the laboratory performance test location for first test only. Should test results indicate, in opinion of the City's Representative, that tested equipment fails to meet specified requirements, the City's Representative will notify the Contractor of performance test failure. The Contractor shall thereupon notify the manufacturer to reschedule testing and notify the City of time of retest. The manufacturer shall thereupon at no expense to the City, make modifications to or replace the equipment and perform additional tests as required to demonstrate compliance with the Specifications. Additional costs for job specific travel and subsistence shall be reimbursed to the City by the Contractor.

I. Maintain access to work area for the City and the City's Representatives. Permit authorized representatives and agents of federal or state agencies to inspect work, products, and other relevant data and records. Provide safe and proper facilities to access and observe work and to inspect or perform tests.

J. The City's Representative will inspect products after delivery and throughout construction process. Products will be subject to rejection at any time on account of failure to meet the Specifications even though samples may have been accepted as satisfactory at place of manufacture.

K. 3 working days before backfilling, request inspection from the City's Representative to verify proper installation of buried work.

L. Prior to completion of work, request inspection from the City's Representative to verify that no surfaces to receive product have defects or errors that could result in poor or potentially defective application or cause latent defects in workmanship.

M. If work is covered contrary to written instructions or is covered before the Contractor requests and receives inspection, it shall be uncovered at the Contractor's expense, if requested by the City 's Representative. Any replacement shall be at the Contractor's expense.

N. If the City's Representative considers it advisable that covered work be re- inspected or tested by others, at the City Representative's written request, the work shall be uncovered by the Contractor, furnishing necessary labor, products, and tools. If the work is found defective, the Contractor shall pay for uncovering, exposure, observation, inspection and testing and of satisfactory reconstruction. If the work is not found defective, the Contractor will be allowed an increase in Contract Price or an extension of Contract Time, or both, directly attributable to such uncovering, exposure, observation, inspection, testing and reconstruction, and a Change Order will be issued.

3.02 INSTALLATION/APPLICATION/ERECTION

A. Refer variances between the manufacturer's installation instructions and the Contract Documents to the City's Representative and Engineer or Record.

B. Construct walls plumb, straight, level, square and true.

C. Welds, unless otherwise shown, shall be continuous, watertight, and conforming to Structural Welding Code of American Welding Society. Welds shall be free of sharp points or edges.

D. Exposed surfaces shall be finished in appearance. Grind smooth exposed welds. Round or chamfer corners of exposed structural shapes for personnel protection.

E. Prime and paint exposed surfaces of ferrous products, piping, and conduit except for stainless steel or galvanized or sherardized surfaces or unless otherwise shown. Clean painted surfaces and touch up bare or marred spots with finish to match factory finish.

3.03 FIELD QUALITY CONTROL

A. Maintain complete set of the Contract Documents at job site field office or superintendent's truck at all times.

B. Frequency of sampling and testing shall be as specified in Section 01410 and shall be performed as necessary to document contract compliance.

C. Notify the City's Representative and regulating authorities 3 working days before field tests.

D. Perform field tests in presence of the City's Representative who will record results.

E. Remove rejected materials or equipment from job site. Work rejected by the City 's Representative for failure to comply with the Contract Documents, shall be removed within 10 calendar days after written notice of rejection, whether incorporated in work or not, unless repairs have been made to the City 's satisfaction.

F. Promptly replace rejected materials or equipment or workmanship in accordance with the Contract Documents without expense to the City. The Contractor shall bear cost of making good work of other contractors destroyed or damaged by such removal or replacement. If the Contractor does not act to remove rejected work within 10 calendar days after receipt of written notice, the City may remove such work and store products at the Contractor's expense.

G. Removal and replacement work shall be at the Contractor's expense.

H. Repair, correct or replace work failing tests or inspection. Repeat tests until results satisfy specifications.

I. Repair damage to work that is not cause for rejection.

END OF SECTION

SECTION 01410 TESTING AND INSPECTION OF EARTHWORK AND CONCRETE

PART 1 - GENERAL

1.01 SCOPE

A. This section addresses testing laboratory services and inspections required during the course of construction, as specified.

1.02 TESTING LABORATORY

A. Selection of Laboratory

Testing and inspections will be performed by the City or by an independent testing laboratory selected by the City.

B. Testing Requirements

Testing and inspection services which are performed will be in accordance with requirements of the Uniform Building Code, and as specified herein.

1.03 PAYMENTS

A. Tests Showing Compliance

Costs of initial testing and inspection, except as specifically modified herein, or specified otherwise in technical sections, will be paid by the City, providing such testing and inspection indicates compliance with the Contract Documents. Initial tests and inspections are defined as the first test and inspections as specified herein.

B. Tests Showing Failure

In the event a test or inspection indicates failure of a material or procedure to meet requirements of the Contract Documents, costs for retesting and re- inspection will be borne by the Contractor.

C. Additional Tests at the City's Request

Additional tests and inspections not specified herein but requested by the City, will be paid for by the City, unless result of such tests and inspections are found to be not in compliance with the Contract Documents, in which case the City will pay all costs for initial testing, as well as retesting and re-inspection, and then back-charge the Contractor.

D. Additional Test Due to Changes

Costs for additional tests or inspections required because of change in materials being provided or change of source or supply shall be paid by the Contractor direct to testing laboratory.

E. Correction of Deficiencies

Costs for construction activities that are required to correct deficiencies shall be borne by the Contractor.

F. Additional Tests to Assist Contractor

Cost of testing that is required solely for the convenience of the Contractor in his scheduling and performance of the work shall be borne by the Contractor.

1.04 AVAILABILITY OF SAMPLES

A. Acquisition of Samples

The Contractor shall make materials required for testing available and assist in acquiring these materials as directed by the Engineer. The samples shall be taken under the immediate direction and supervision of the Engineer.

B. Uncovering Construction

If construction that is required to be tested or inspected is covered up without prior notice or approval, such construction may be uncovered at the discretion of the Engineer.

C. Advance Notice for Inspections

Unless otherwise specified, the Contractor shall notify the Engineer a minimum of 10 working days in advance of required inspections. Extra construction activities resulting from a failure to notify the laboratory shall be paid for by the Contractor.

D. Cancellation of Tests or Inspection

The Contractor shall give sufficient advance notice to the Engineer in the event of cancellation or time extension of a scheduled test or inspection. Charges due to insufficient advance notice of cancellations or time extension shall be paid for by the Contractor.

1.05 REMOVAL OF MATERIALS

A. Unless otherwise directed, materials not conforming to the requirements of the Contract Documents shall be promptly removed from the project site.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 – EXECUTION

3.01 EARTHWORK

A. Engineer's Role

A City Representative will provide continuous inspection of fill and will field test fill and earth backfill as placed and compacted, and inspect excavations and subgrade before concrete is placed and provide periodic inspection of open excavations, embankments, and other cuts or vertical surfaces of earth. A City Representative will submit a report indicating that he has observed and tested fills and that in his opinion the fills were placed in accordance with the Specifications.

B. Removal of Unsatisfactory Material

The Contractor shall remove unsatisfactory material, reroll, adjust moisture, place new material, or in the case of excavations, provide proper protective measures, perform other operations necessary, as directed by a City Representative whose decisions and directions will be considered final.

C. A City Representative may require overexcavation of unsuitable materials from the trench and so order such overexcavation and stabilization of trench base in accordance with Section 02223.

D. Test and Inspection Procedure

1. General

Allow sufficient time for testing and evaluation of results before material is needed. A City Representative will be sole and final judge of suitability of all materials.

2. Tests

Laboratory compaction tests to be used will be in accordance with ASTM D1557-78.

3. Field Density Tests

Field density tests will be made in accordance with ASTM D1556 or ASTM D2922.

4. Use of Tested Materials

Materials in question may not be used pending test results.

5. Excavation and Embankment Inspection Procedure

Excavation and embankment inspection procedure: The Engineer will visually or otherwise examine such areas for bearing values.

3.02 TESTING OF CONCRETE

A. General

Notify the Engineer of brand and type of cement and sources of aggregates in time for review, sampling and testing, if required.

B. Number of Tests

At least four cylinders for each 100 cubic yards or each separate mix design of concrete of required strength in excess of 2,000 psi, or fraction thereof being placed each day will be taken.

C. Sampling Procedures

Cylinders will be taken so as to represent as nearly as possible the batch of concrete from which they are taken. Sampling procedures shall conform to ASTM C 172-82.

D. Test Cylinders

Test cylinders shall be made and cured in compliance with ASTM C 31-88, except as modified herein.

E. Test Procedures

Test cylinders from respective batches, one at age of 7 days, one at 14 days and one at age of 28 days. The fourth shall be tested as directed if concrete strength is under that specified. Cylinder testing procedures shall conform to ASTM C39- 86 for strength.

F. Slump Tests

Slump tests shall be taken as required by testing laboratory to certify compliance with the Contract Documents. Slump shall be tested in accordance with ASTM C143-89a.

G. Compressive Strength

Minimum compressive strength of test cylinders, in pounds per square inch, shall not be less than the specified required design strength.

H. Test Cores

If minimum strengths of test cylinders fall below those specified, the Engineer may require test cores from hardened concrete to be taken and tested. Each core test, if taken, shall consist of three cores. Costs of such cores and tests shall be borne by the Contractor. Cores shall be taken in accordance with ASTM C42-84a, from locations selected by the Engineer. The Contractor shall repair core holeswith dry-pack or a nonshrinking mortar.

1. Test Core Strength

Concrete tested by coring shall be considered acceptable if the average strength of three cores is equal to at least 85 percent of the minimum specified 28-day strength and if no single core strength is less than
75 percent of the minimum 28-day strength.

3.03 CONCRETE INSPECTIONS

A. An authorized inspector of the City will be present at all times during placing of structural, reinforced cast-in-place concrete. Before placing concrete he will inspect and approve (if satisfactory) accuracy of all formwork and quantity and placement of all reinforcing steel. Concrete construction activities shall not proceed until inspections are complete and the inspected construction is approved.

END OF SECTION

SECTION 01500 CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Furnish and install temporary facilities as hereunder specified, plus other unspecified temporary facilities, including labor, materials, services, utilities, and equipment as may be required for proper performance of the work, except as otherwise provided. Temporary facilities shall be approved by the City and other authorities having legal jurisdiction. Locate facilities as directed and maintain in safe and sanitary condition at all times until completion of the work.

1.02 SUBMITTALS

A. Storage yard description shall describe the Contractor's proposed methods for dust and noise control in storage areas to satisfaction of the City.

B. The property owner's written approval of storage yard shall be submitted along with City permit for use of property used as storage yard for project. Conform to setbacks and other conditions required by City regulations or permits.

1.03 CONSTRUCTION EQUIPMENT

A. Erect, equip, operate, and maintain construction equipment in strict accordance with applicable statutes, laws, ordinances, rules, and regulations of authorities having jurisdiction.

B. Provide and maintain scaffolding, staging, runways, and similar equipment as needed.

1.04 SAFETY PRECAUTIONS

A. Provide and maintain barricades, fencing, shoring, pedestrian walkways, including attached lights, other lights, and other safety precautions to guard against personal injury and property damage as prescribed by authority having jurisdiction.

B. Fully inform each subcontractor and material supplier as to requirements of applicable safety orders.

1.05 ROADS AND ACCESSWAYS

A. Entrance to Work Site: The Contractor and Contractor's employees and subcontractors shall use certain access roads or entrance ways as indicated on the Plans or directed by the City.

B. Maintain these roads in satisfactory condition during Contract time, and repair damages attributable to the work of this project at intervals needed. At completion of the Contract, roads and

entrance ways shall be left in condition at least equal to that existing at start of the Contract, or as indicated on the Plans.

1.06 SIGNS

A. Signs or Advertising: Not permitted, except that Contractor's name may be placed on field office.

1.07 SANITARY FACILITIES

A. Toilet Facilities: Provide sufficient suitably enclosed chemical toilets, conforming to ANSI Z4.3, with urinal for workmen.

B. Washing Facilities: Provide properly mounted and adequate wash sinks connected to water supply.

C. Drinking Water Facilities: Provide clean, sanitary and adequate drinking water.

1.08 TEMPORARY WATER

A. Contractor shall make arrangements for water required for construction purposes. Contractor shall coordinate with a water purveyor (City) for use and payment of temporary water. The Contractor shall obtain a construction water meter from the City and will pay all fees associated with the use of the meter include the cost of water used.

1.09 TEMPORARY ELECTRICAL FACILITIES

A. Provide such temporary electrical facilities as are necessary for the work, and to supply temporary lighting for work operations and temporary power for portable power driven tools and other Contractor equipment.

B. Pay temporary service installation and removal (commonly known as "up and down") charges by serving utility company.

1.10 SECURITY

A. The Contractor is responsible for security of work areas involved in this project during entire time of Contract. Make good all damages to work and loss of materials due to vandalism or theft, within this responsibility.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION (NOT APPLICABLE)

END OF SECTION

SECTION 01610 PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Basic requirements for all products used in the work.

1.02 RELATED WORK

A. Section 01300: Shop Drawings and Submittals

B. Section 01400: Quality Requirements

C. Section 01630: Product Substitution Procedures

1.03 QUALITY ASSURANCE

A. If products are furnished that differ from those shown and that require changes to enclosures, mounting and support structures, power and control circuitry or other work to accommodate furnished product, provide changes required at no additional cost to the City and of same quality as shown orspecified.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Products of listed acceptable manufacturers shall meet these Specifications notwithstanding the fact that manufacturer is "listed." The City reserves the right to reject submittals and products from "acceptable manufacturers" if they fail to demonstrate compliance with specifications.

2.02 MATERIALS AND EQUIPMENT

A. Products shall be new and of current design and manufacture, free from defects and imperfections that might affect serviceability of the product for its intended purpose, unless otherwise stated.

B. Products or work for which no Specifications are set forth shall be of the highest grade in quality and workmanship obtainable in the market from firms of established good reputation. Work shall be in compliance with the intent to secure the highest standard of products and construction.

C. Products and workmanship shall match the Contractor's submittals as reviewed by the City’s Representative.

D. Connections and mountings required to install products shall comply with connections and mountings shown in the Contract Documents and Submittals on a location-specific basis. Do not assume that approval of connections or mountings at a specific location constitutes approval of same at all locations.

E. Materials and materials sources shall be reviewed by the City at least 3 working days before use of materials in the work. However, information for materials and materials sources shall be submitted in accordance with SECTION 01300 of these Specifications.

F. Conform to federal, state and local regulations governing VOC content, percentage solids by volume, and other paint and solvent properties.

G. Similar items on project shall be products of same manufacturer.

H. Corresponding parts of identical products shall be interchangeable.

I. Materials for a complete paint or sealant system, including primer, finish coats, thinners, cleaners and drying agents, and other additives shall be the end products of one manufacturer to ensure product compatibility and unit responsibility.

J. Design and fabrication of products shall ensure products withstand stresses and loads, which may occur during testing, installation, start-up and normal operation.

K. Products shall be capable of fulfilling their intended purpose in the environment in which they are installed. Allow for local temperature extremes, climatic conditions and corrosive environments where necessary to ensure proper functioning of furnished products.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Furnish mounts, guides, bearing plates, flanges, anchor and attachment bolts and screws, saddles, supports, pads and skids necessary to securely mount products and equipment.

B. Tighten bolts to the manufacturers' specifications using torque wrenches. Unless otherwise directed, use appropriate lubricant when making up bolts.

C. The manufacturer's instructions and warranty requirements for installation, application, connection, erection, maintenance, operating, cleaning and conditioning of products shall be strictly followed.

END OF SECTION

SECTION 01630 PRODUCT SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.01 SCOPE

A. Acceptable manufacturers, approved alternates, and procedures for seeking product substitutions.

1.02 RELATED WORK

A. Section 01300: Shop Drawings and Submittals

1.03 GENERAL REQUIREMENTS

A. Deadline for receipt of substitution requests shall expire at 5:00 pm Pacific Standard Time 30 calendar days after the date of Notice to Proceed.

B. Standard Products—Information on products specified by reference standard shall be submitted in accordance with the requirements of Section 01300.

C. Proprietary Products—Where products or processes are specified by trade, patent or proprietary name, said specification, unless marked "no substitution," shall be deemed to be followed by the words "or equal as accepted in writing by the City." In such case substitution of similar products as “approved equals” will be considered under this section.

D. Selection of Proprietary Product—Where more than one proprietary name is specified, the Contractor may provide any one of the products specified. Only one manufacturer shall be used for each specific application throughout the work notwithstanding that similar materials or equipment of two or more manufacturers or producers may be specified for the same application.

E. Substitution Request Procedure—Submit a written request on the enclosed form for proposed substitutions to the City prior to the deadline. Submit proposed substitutions relating to a particular subcontract or trade in a single package. No substitution will be considered after the deadline for receipt of substitution requests has expired.

F. Contractor's Responsibility for Construction Modifications—Drawings have been detailed in compliance with the dimensions and ICBO Evaluation Report data for products specified. If a proposed substitute product is accepted by the City, the Contractor shall assume both the responsibility for construction modifications and additional costs required by reason of this acceptance. If the substitution results in a decrease in cost, potential savings to the

City may be submitted for consideration.

G. Systems of Like Manufacture—Where products are specified in groups to be furnished by one manufacturer, no substitution will be considered that is not similarly furnished by one manufacturer. Where the Contractor proposes to use a system of equipment other than that shown in the Contract Documents, the substitution shall be proposed as a complete system.

1.04 SUBMITTALS

A. Furnish the following submittals.

Submittal	**Description**
Substitution Request Form	Submit Substitution Request on form furnished at end of this section.
Contractor's Certification of Performance and Assumption of Liability	Submit Certificate of Performance certifying that the proposed substitution is equal to or better in all respects to the product specified and that the proposed substitution will, in all respects perform the function for which it is intended.
Certificate of Compliance	Required as needed to substantiate Product Substitutions
Dimensional Data	Required for Product Substitutions
Material Samples	Required as needed to substantiate Product Substitutions
Manufacturer's Statement of Responsibility	Required at the City's discretion for Product Substitutions.
Foundry or Test Record Transcripts	Required as needed to substantiate Product Substitutions
Material List and Ratings	Required as needed to substantiate Product Substitutions
Names and Addresses of Nearest Local Manufacturer's Representatives and List of Three Local Product Installations	Required for Product Substitutions (Use allotted space on attached Substitution Request Form)
Warranty	Furnish warranty equal to or better than warranty required for specified product.

B. Determination of Equality—The burden of proof of equality of the substituted item shall be on the Contractor. Acceptance of such substitutions is entirely at the discretion of the City.

C. List of Approved Substitutions—The City will issue to the Contractor a list setting forth those substitutions, which have been approved. No products proposed for substitution shall be ordered before the City approves them, in writing.

D. Products accepted as "approved alternates" shall, in the City's opinion, meet the following requirements:

1. Products shall be of equal quality, substance, function and color to those listed.

2. Products shall be standard products of a reputable manufacturer having regularly been engaged in the manufacture of the products furnished for a minimum of 5 years.

3. Products shall have a reputation for assuring long-lasting trouble-free service.

4. Factory-authorized, factory-trained and competent service personnel and stocked service parts shall be available within a 150 mile radius of the work, or as otherwise authorized by the City.

5. The manufacturer shall be capable of certifying compliance with listed reference standards.

E. The City reserves the right to reject product substitutions solely on the basis of maintenance economies of scale available through standardizing on manufacturers and minimizing spare parts inventories.

F. Denial of Substitution—If the proposed substitution is not equal to or better in every respect to that of the specified product, or was not submitted for acceptance in the manner outlined above, the Contractor shall furnish the specified products.

G. Responsibility for Coordinating Substitutions with Construction Trades—The Contractor shall inform all other trades, vendors, and subcontractors of the effects of substitutions on their work or products. Failure to notify shall not relieve the Contractor of his duty to make payments arising from alterations in specified products or methods needed to complete the work in an approved and acceptable manner.

1.05 CONTRACTOR'S RESPONSIBILITY FOR COST OF SUBSTITUTION REVIEWS

A. The Contractor shall pay all costs incurred to review Requests for Substitutions. Review costs shall be deducted on a regular basis from monthly progress payment.

1.06 SUBSTITUTION OF “INFERIOR” PRODUCTS

A. Products not meeting the above requirements shall, for purpose of this contract, be deemed “inferior” even if the product’s only shortcoming is that the Contractor failed to submit a substitution request prior to the stipulated deadline.

B. Substitution of "inferior" products shall not occur except where cost savings are offered to and accepted by the City in the form of a Change Order.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION (NOT APPLICABLE)

END OF SECTION

SUBSTITUTION REQUEST FORM

TO:

PROJECT NAME:

FROM CONTRACTOR:

We hereby submit for consideration the following product substitution of specified item for above project:

DRAWING OR SECTION NO.	**SHEET NUMBER OR PARAGRAPH**	**SPECIFIED ITEM**

PROPOSED SUBSTITUTION:

Attach complete dimensional information and technical data needed to substantiate product substitution, including ICBO reports and laboratory tests, if applicable.
Include complete information on changes to Drawings and/or Specifications which proposed substitution will require for its proper installation.

Where product substitutions are proposed at multiple locations, submit copies of plans showing in red each location where the product substitution is proposed.
Submit with request all necessary samples and substantiating data to prove equal quality and performance to that which is specified. Clearly mark manufacturer's literature to indicate equality in performance. Differences in quality of materials and construction shall be indicated.

Submit Manufacturer’s Statement of Responsibility.

Fill in Blanks Below:

A. Does the substitution affect dimensions shown on Drawings?
Yes_ No_ If yes, attach copy of plans and clearly indicate changes.

B. Will the undersigned pay for the changes to the building design, including engineering, detailing and review costs caused by the requested substitution?
Yes__ No___

C. What effect does the substitution have on other trades?

D. What effect does substitution have on applicable code requirements?

E. What is the ICBO Approval #?

F. Differences between proposed substitution and specified item:

G. List three installations where product is in use:

H. Address of Authorized Manufacturer's Representative:

I. Manufacturer's guarantees of the proposed and specified items are:
Same_ Different (Explain) _____

J. City's share of cost savings if substitution is approved $

SUBSTITUTION REQUEST FORM
CONTRACTOR'S CERTIFICATION OF PERFORMANCE AND ASSUMPTION OF LIABILITY FOR EQUAL PERFORMANCE

I certify that the proposed substitution is equal to or better in all respects to the product specified and that the proposed substitution will, in all respects perform the function for which it is intended.

Submitted By:

Signature_____ Title_____
Firm_____
Address_____
Telephone _____ Date_____

For Use by Design Engineer

__ Accepted
__Accepted as Noted
__ Not Accepted
__ Received Too Late
__ Approved as Alternate -See Bid Form

Signature must be by person having authority to legally bind his firm to the above terms. Failure to provide legally binding signature will result in retraction of approval

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SECTION 01740 CLEANING AND FINAL CLEANING

PART 1 - GENERAL

1.01 DESCRIPTION

A. Perform cleaning and disposal of work as specified to comply with local laws and ordinances with federal and local environmental and anti-pollution regulations.

1.02 PROGRESS CLEANING

A. General: Clean the site, work areas and other areas the Contractor is permitted to occupy by laws and regulations at least weekly. Dispose of materials lawfully according to laws and regulations:

1. Comply with requirements in NFPA 241, Standard for Safeguarding Construction, Alteration and Demolition Operations, for removal of combustible waste materials and debris.

2. Do not hold other materials more than 7 days during normal weather or 3 days if the temperature is expected to rise above 80ºF.

3. Provide suitable containers for storage of waste materials and debris.

4. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately.

B. Project:

1. Maintain project free of waste materials and debris.

2. Keep exterior dust generating areas wetted down.

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 the 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: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. Cutting and Patching: Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar materials.

H. Thoroughly clean piping, conduit, and similar features before applying paint or other finishing materials. Restore damaged pipe covering to its original condition.

I. Waste Disposal: Burying or burning waste materials on the site will not be permitted. Washing waste materials down sewers, storm drains or into waterways will not be permitted.

J. 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.

K. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

1.03 FINAL CLEANING

A. General: Provide final cleaning.

1. Complete the following cleaning and waste-removal operations before requesting inspection for certification of Substantial Completion:

a. Clean and remove from the project rubbish, waste material, litter, and other foreign substances.

b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.

c. Hose clean sidewalks and loading areas.

d. Leave water courses, gutters, and ditches open and clean.

e. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of spatter, grease, stains, fingerprints, films, and similar

foreign substances.

f. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, and similar spaces.

g. Sweep concrete floors broom clean in unoccupied spaces.

h. Remove tags and labels that are not permanent.

i. Touch up and otherwise repair and restore chipped, scratched, dented or otherwise marred surfaces to specified finish and match adjacent surfaces. Do not paint over “UL” and similar labels, including mechanical and electrical nameplates.

j. Wipe surfaces of mechanical and electrical equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances

k. 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.

l. Maintain the cleaning until the City occupies the project or portion thereof.

m. Leave project clean and in a neat and orderly condition satisfactory to the City.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

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SECTION 01750 START-UP AND PERFORMANCE TESTING

PART 1 - GENERAL

1.01 SUMMARY

A. This Section covers startup, testing, and adjusting requirements for all Mechanical and Electrical items of equipment and systems installed under this contract. Additional requirements may be specified in specific equipment specifications.

B. Startup shall include checkout of Contractor installed equipment and systems as required to verify proper installation and operation, and shall include all preliminary field test, equipment functional test, system startup and demonstration test, and performance test, the requirement of which are defined in this Section. Documentation of these activities and test results is considered part of the Startup.

C. The Contractor shall provide personnel, both supervisory and from applicable trades, that are experienced in startup testing as described in this document. The Contractor's personnel shall have the necessary experience to fully understand all startup requirements, to marshal the Contractor's resources providing the startup services, and to prepare all startup documentation, as specified.

D. Temporary facilities required to carry out the specified testing shall be installed and removed at the Contractor's expense. Contractor is responsible for coordination and delivery of power and water for all Preliminary Field Testing and Equipment Functional testing within the Contractor's scope of work. Contractor shall be responsible for any coordination with Mechanical and Electrical contractors necessary to conduct the Preliminary Field Test and Equipment Functional Test.

1.02 RELATED SECTIONS

A. Section 01300: Shop Drawings and Submittals

B. Section 01400: Quality Requirements

C. Section 01740: Cleaning and Final Adjustment

D. Section 01770: Closeout Procedures

E. Section 01783: Operating and Maintenance Data

F. Section 01820: Demonstration and Training

1.03 CONTRACTOR'S STARTUP TEAM, AND STARTUP MANAGEMENT PLAN

A. The Contractor shall provide the resources to plan, document, manage, and certify all Work included in, or directly related to the Preliminary Field Testing and Equipment Functional Testing of the Mechanical and Electrical equipment including System Startup and Demonstration Test, and Performance Test. The resources provided shall have experience, acceptable to City's Representative and Engineer of Record, in providing startup services for water facilities of a complexity similar to those included in the Work. The Contractor shall supply a list of resources to be used along with the applicable rates of pay.

B. The services to be managed and/or executed by the Contractor shall include the following task:

1. Provision of onsite startup personnel qualified in all elements of the startup process as defined in this section. This staff shall prepare and complete all startup and testing documentation related to the Preliminary Field Test and Equipment Functional Test.

2. Complete planning, development, and preparation of all testing procedures, and related documentation for the Preliminary Field Testing and Equipment Functional Testing of Mechanical and Electrical equipment as required by the Contract Documents and specifications. This includes the System Startup and Demonstration, and the Performance Testing.

3. All testing procedures and plans shall be submitted for review to City's Representative and Engineer of Record during the submittal process. The Contractor shall submit Startup Checklist of all equipment to the City's Representative and Engineer of Record for review during the submittal process.

4. Coordination of all manufacturers' startup activities including those required during System Startup and Demonstration Test and Performance Test, and their certification of proper installation and/or function as required by the Contract Documents and Specifications.

5. Preparation and/or compilation of all test reports for Preliminary Field Test, Equipment Functional Test, System Startup and Demonstration, Performance Test, and related submittals.

1.04 STARTUP SCHEDULE

A. The Contractor shall provide City's Representative and Engineer of Record with a plan reflecting the startup activities including preliminary field tests, equipment functional tests, system startup

and demonstration, and the performance test a minimum of 180 days prior to the commencement of preliminary field test activities. The Contractor shall keep his tests plan current to the duration of the tests and shall provide an updated copy to the Engineer and City on request.

B. The Contractor shall not begin the System Start Up and Demonstration Test until written authorization is provided by the City stating that the Contractor may commence System Start Up and Demonstration Testing.

1.05 STARTUP REPORTS AND RECORDS

A. Formal reporting and documentation of failures, malfunctions or defects, and repairs made during the entire startup process shall be maintained by the Contractor. An “Equipment Problem Report” form shall be used by the Contractor to document problems that arise during these tests, and their resolution.

B. Records of all Contractor required testing shall be compiled by the Contractor and submitted to the City. Prior to being submitted to the Owner, the Contractor shall certify that the results show that the tested equipment complies with the contract requirements. Records shall include all documentation assembled for the tests, all certifications, forms and check lists completed during the test, and sign-off forms. Records for equipment functional testing shall be compiled as separate documents for equipment within each system and shall be submitted within 48 hours of completion of the equipment functional tests for each piece of equipment.

1.06 UNIT PRICES

A. Payment for startup, including materials, equipment, devices, labor, travel costs, expenses, and maintenance items, required in the Contract Documents will be included in the price bid for items of work for which systems demonstration and startup is specified.

B. Payment for services of manufacturer's representatives will be included in the price bid for their products or items to which their products are appurtenant. No additional payment will be made for services or expenses needed for testing, startup or demonstration if duration of services needed to provide complete working system exceeds those expected or exceeds durations stated in writing in correspondence from manufacturer to the City, Contractor or other party.

PART 2 - PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 EQUIPMENT STARTUP AND TESTING

A. General:

1. Testing requiring City participation shall coordinated with the City. Notification of testing shall be provided a minimum of 10 working days in advance.

2. Testing shall be performed in presence of City representative(s).

B. Preliminary Field Tests: The preliminary field tests shall be carried out by the Contractor after the installation and shall serve as Quality Control verification that work and equipment have been installed in accordance with the specifications and manufacturer's recommendations. Preliminary field tests shall be documented in the format that is provided by the Engineer of Record.

Preliminary field test shall be performed on all Mechanical and Electrical equipment and shall include the following as a minimum:

1. Verify that safety equipment is in place.

2. Mechanical preliminary field tests:

   a. To extent possible, turn rotating equipment, operate valves and gates, and check for binding or interference.

   b. Piping pressure test.

   c. Gearboxes.

   d. Valves.

   e. Visual inspection of all mechanical equipment supplied and/or installed by the Contractor or others.

3. Electrical preliminary field tests:

   a. Insulation resistance testing of all power cables installed by the Contractors.

   b. Continuity testing of all power cables installed by the Contractor.

   c. Check incoming electric power for voltage amplitude and voltage balance.

   d. Check power draw of equipment.

C. Equipment Functional Testing:

1. Equipment functional testing shall be carried out by the Contractor, after completion of the preliminary field tests. Coordination of Mechanical and Electrical disciplines and manufacturer's representatives in order to facilitate equipment functional testing shall be the responsibility of the Contractor.

2. Equipment functional testing shall not be carried out until all Mechanical and Electrical preliminary field test on the item of equipment to be functionally tested have been completed and signed off by both the respective contractors, and City's Representative and Engineer of Record. Equipment functional testing shall test for proper operation and specified efficiency and capacity. Equipment and functional testing shall include initial equipment operation in the presence of the manufacturer's representative, City's Representative and Engineer of Record, where specified in the Contract Documents, and the requirement listed herein, unless exceptions or additions are indicated in the specific equipment sections or requirements waived, in writing, by the City's Representative and Engineer of Record.

3. Prior to equipment functional testing, the equipment shall be properly filled, by the Contractor, with oil and grease, and the Contractor shall furnish all power, personnel, water, fuels, oil, grease, and auxiliaries necessary for conducting Equipment Functional Testing of the equipment.

The Contractor shall furnish all chemicals required for disinfection activities following construction.

4. Equipment functional testing includes the Contractor's test operation of each piece of process and mechanical equipment, process and electrical equipment, and process control and instrumentation equipment. Where appropriate, equipment functional testing shall be conducted simultaneously with mechanical and electrical functional testing of the same piece of equipment. All moving parts of equipment and machinery shall be carefully tested for operation, and adjusted so all parts move freely and function to secure satisfactory operation. Where possible equipment shall be tested under continuous full load and in accordance with the specified requirements. If any part of the unit shows evidence of unsatisfactory or improper operation during the equipment functional tests corrections or repairs shall be made and the equipment retested.

5. All equipment shall be tested, where possible under actual or simulated operating conditions until all parts shall operate satisfactorily in all respects.

6. When specific sections of the specifications indicate that an operation check is required by the equipment manufacturer, the manufacturer's representative will make all necessary field adjustments and correct defects in materials or workmanship during the test

period.

7. All equipment installed under this contract, shall be placed into successful operation according to the written instructions of the specifications, equipment manufacturer, and the instructions of the manufacturer's field representative.

8. Equipment functional testing shall not be considered complete until all testing produces successful results, and all documentation of tests and all manufacturers' certifications required by the Contract Documents and specifications are submitted and accepted by City's Representative and Engineer of Record.

9. Qualified personnel from the Mechanical and Electrical subcontractor's crews who actually installed those portions of the work will be included as test personnel for all equipment functional tests involving Mechanical and Electrical work.

10. Functional testing shall be completed before system startup and demonstration testing commences.

D. Certificate of Proper Installation

1. At completion of equipment functional testing, Contractor shall furnish a written report prepared and signed by the manufacturer's authorized representative certifying equipment:

   a. Has been properly installed, adjusted, aligned and lubricated.

   b. Is free of any stresses imposed by connecting piping or anchor bolts.

   c. Is suitable for satisfactory full-time operation under full load conditions.

   d. Protective devices furnished as a part of the equipment package are properly installed and functioning.

   e. Control logic for start-up, shutdown, sequencing, interlocks and emergency shutdown has been tested and is properly operating.

2. Contractor shall co-sign all reports along with the manufacturer's representative and subcontractors.

E. System Start Up and Demonstration Test:

1. The Contractor shall conduct system start up and demonstration tests after successful completion of the equipment functional testing.

2. The start up and demonstration test shall be scheduled and planned by the Contractor and approved by City's Representative and Engineer of Record.

3. The system start up and demonstration testing shall be a minimum of 7 days of continuous operation of the entire facility, demonstrating that all portions of the facility operate as intended.

4. Any interruption in the 7-day continuous testing period of the facilities due to failure or malfunction of any of the equipment or process systems installed by the Contractor may result in restart of the testing period at the discretion of City's Representative and Engineer of Record.

5. The Contractor shall have obtained City's Representative and Engineer of Record's acceptance of its draft Operation and Maintenance Manuals in accordance with the requirements of the Contract closeout and construction progress documentation section prior to the commencement of any system start up and demonstration testing.

6. All preliminary and equipment functional testing shall have been completed by the Contractor prior to the commencement of system start up and demonstration tests.

7. The system start up and demonstration tests shall be conducted under the supervision of the City's Representative. The Contractor shall provide such trade labor, supervision, and start up personnel and equipment as is deemed appropriately by the City's Representative and Engineer of Record to assist where necessary during the system start up and demonstration tests.

8. The Contractor shall supply all consumables including but not limited to; oil, grease, and auxiliaries for the system start up and demonstration tests. All chemicals required will be provided by the Contractor.

9. All mechanical failures, malfunctions, defects in materials or workmanship, or other flaws, which appear during the test period and are attributable to Contractor's installation or Contractor supplied equipment, shall be immediately corrected by the Contractor.

10. All electrical failures, malfunctions, defects in materials or workmanship, or other flaws, which appear during the test

period and are attributable to Contractor's installation or Contractor supplied equipment, shall be immediately corrected by the Contractor.

11. System start up and demonstration testing shall be considered complete when, in the opinion of City's Representative and Engineer of Record, each system has operated satisfactorily without excessive power use, wear, or needed for lubrication, or requiring undue attention; and if all mechanical, and electrical equipment operates without excessive failure and in accordance with the requirements of the specifications.

12. Testing water shall be provided by the Contractor during the system start up and demonstration testing to initiate operation of each pump a minimum of once per day.

3.02 ACCEPTANCE OF WORK

A. When no other tests for acceptance are specified in the equipment sections, at the end of the performance testing, the system will be accepted if, in the opinion of City's Representative and Engineer of Record, it has operated satisfactorily without failure or malfunction, or requiring undue attention at any operating condition.

B. The Contractor shall submit certified reports for each system indicating the system meets functional requirements specified.

C. The City will countersign the report and it shall be a prerequisite for final completion.

END OF SECTION

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SECTION 01770 CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.01 REQUIREMENTS INCLUDED

A. Closeout Procedures

B. Project Record Documents

C. Operation and Maintenance Data

D. Guaranties, Warranties and Bonds

E. Spare Parts and Maintenance Materials

1.02 RELATED REQUIREMENTS

A. General Conditions of the Contract for Construction, and Supplementary Conditions: Fiscal provisions, legal submittals and other administrative requirements.

B. Section 01100: Summary of the Work

C. Section 01300: Shop Drawings and Submittals

D. Section 01500: Construction Facilities and Temporary Controls

E. Section 01740: Cleaning and Final Cleaning

F. Section 01781: Contractor's As-Built Drawings

G. Section 01783: Operating and Maintenance Data

H. Section 01787: Product Warranties

1.03 CLOSEOUT PROCEDURES

A. Comply with procedures stated in the General Conditions of the Contract for construction for inspection and acceptance of the work, payment and retention procedures.

B. The Contractor shall start developing and completing punch list items a minimum 30 calendar days prior to the end of the Contract time.

C. When the Contractor considers the work complete, the Contractor shall request, in writing, a final inspection to be conducted by the City. Prior to requesting a final inspection, the Contractor shall have the entire work completed in accordance with all Contract Requirements, including, but not limited to, all punch list items, and submittal of all documents and products listed in this section. It is

recommended that the Contractor request the final inspection as early as possible, and prior to the end of Contract time, to allow for completion of punch list items discovered to be incomplete during the final inspection and for a final re-inspection, to avoid assessment of liquidated damages.

D. Final cleaning shall be completed prior to occupancy or requesting a final inspection, whichever comes first.

1.04 SPARE PARTS AND MAINTENANCE MATERIALS

A. Provide products, spare parts, and maintenance materials in quantities specified in each section, in addition to that used for construction of work. Coordinate with the City Representative; deliver to project site, and obtain a receipt.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION (NOT APPLICABLE)

END OF SECTION

SECTION 01781 CONTRACTOR'S AS-BUILT DRAWINGS

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. The Contractor shall keep one accurate, legible set of as-built drawings at the site and available for review by the City in the Contractor's field office throughout the project.

1.02 RELATED WORK

A. Section 01300: Shop Drawings and Submittals

B. Section 01820: Demonstration and Training

1.03 SUBMITTALS

A. Furnish the following submittals.

Submittal	**Description**
As-Built Drawings	Required as described below

1.04 DETAILED REQUIREMENTS

A. As-built drawings shall be on a single set of full size project prints of the Contract Drawings and other drawings forming a part of the contract, showing installed locations of improvements and all changes made during construction.

B. As-built drawings shall show locations by key dimensions, depths, elevations of all of underground piping, conduit, sensor lines, valves, capped ends, branch fittings, pull boxes and work.

C. Show all as-built drawing changes in a contrasting color to the original.

D. In showing changes in the work, or added work, use the same legends used on the Contract Drawings. Show locations and elevations to the same level of accuracy as the original Contract Documents. Tie dimensions to a permanent point.

E. Report changes and deviations promptly to the City.

F. As-built drawings shall incorporate addenda, supplementary drawings, working drawings, change orders and clarifications.

G. As-built drawings shall incorporate survey notes, field notes and system demonstration logs.

H. Maintain as-built drawings on an up-to-date basis with all entries reviewed by the City.

I. Protect the as-built drawings from damage or loss.

J. As-built drawings shall clearly show all discrepancies between the Contract Documents and the installed work for all concealed construction, and for all work,

K. Concealed shall mean construction installed underground or in an area which cannot be readily inspected by use of access panels, inspection plates or other removable features.

L. Record information on how to maintain and/or service concealed work.

M. Make a record of finalized hydraulic and electrical equipment control settings in the appropriate tables and spaces provided on the as-built drawings.

N. All information recorded on the Contract Record Drawings shall be complete, accurate, and clearly legible.

1.05 CONSTRUCTION PHOTOGRAPHY

A. Digital photographic history of construction shall be provided on CD.

B. Photographs shall focus primarily on excavations, reinforcing, buried structures/pipes/conduits, and other non-visible improvements.

1.06 UNIT PRICES

A. Payment for as-built drawings required in Contract Documents will be included in the price bid for items of work for which as-built drawings are required.

B. Partial payment requests may be withheld if daily logs, schedule updates or as- built drawings are damaged, lost or not kept current to satisfaction of the City.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 – EXECUTION

3.01 GENERAL

A. Deliver the marked set of as-built drawings to the City prior to final acceptance of the work. City will use these as-built drawings to modify the original Mylars to create reproducible as-built drawings.

END OF SECTION

SECTION 01783 OPERATING AND MAINTENANCE DATA

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Operation and Maintenance Manual.

1.02 RELATED WORK

A. Section 01300: Shop Drawings and Submittals

B. Section 01750: Start-up and Performance Testing

C. Section 01787: Product Warranties

D. Section 01820: Demonstration and Training

1.03 SUBMITTALS

A. Furnish the following submittals.

Submittal	**Description**
Operation and Maintenance Manual	Furnish as described below
Equipment Data Sheets	Submit for equipment furnished under each specification section. Include data sheets in Operation and Maintenance Manual. Use attached form and follow format of attached sample Data Sheet to summarize equipment furnished, nameplate data, and equipment manufacturer's maintenance instructions and recommendations.

1.04 OPERATION AND MAINTENANCE MANUAL

A. Prepare and submit six copies of the Operation and Maintenance Manual and an electronic copy on USB flash drive. Deliver copies in D-ring binders tabbed and indexed by specification sections. Include table of contents. Each binder shall also include: directory, listing names, addresses and telephone numbers of the City Representative and Contractor. Label binders with project name.

B. Each section of the Operation and Maintenance Manual shall include the following information (where required by the Contract Documents) returned and stamped "approved:"

1. Appropriate design criteria.

2. Equipment data sheet describing function of equipment.

3. Parts list; including complete nomenclature, current costs,

and names and addresses of nearest vendor of parts.

4. Catalog data.

5. Shop drawings.

6. Installation or application instructions.

7. Operation and maintenance instructions.

8. Parts list.

9. Copies of guaranties and warranties.

10. Name, address and telephone number of supplier.

C. The CD shall be submitted in PDF format and organized with the appropriate software so that a "word search" can be performed to locate information.

D. Before requesting payment for 90 percent completion, submit two of the six required copies of the Operation and Maintenance Manual containing copies of material available at that time for review.

E. Within 30 days after approval by the two-copy submittal, submit the remaining four copies of Operation and Maintenance Manual.

1.05 UNIT PRICES

A. Payment for operation and maintenance manuals required in the Contract Documents will be included in the price bid for items of work for which sections of the Operation and Maintenance Manuals are required.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION (NOT APPLICABLE)

END OF SECTION

EQUIPMENT MAINTENANCE DATA SHEET

PREVENTIVE MAINTENANCE PROGRAM	**EQUIPMENT RECORD NUMBER**		
EQUIPMENT DESCRIPTION	**ELECTRICAL OR MECHANICAL DATA**		
Name:	Nameplate Horsepower:		
Serial No.:	Model:		
Vendor:	Catalog Number (polyphase motors):		
Vendor Address:	Type:		
	Manufacturer:		
Vendor Rep:	Voltage:	Measured Current:	Nameplate Current:
Phone:	Phase:	Overload Relay Setting:	rpm:

MAINTENANCE AND LUBRICATION WORK TO BE DONE	Frequency*

SPARE PARTS LIST		**FUSES/LAMPS/SEALS**		
Quantity	Part & Part Number	Qty	Size	Type & Ordering Description

WARRANTY AND OPERATING REQUIREMENTS AND REFERENCE

*D - Daily; W - Weekly; B - Biweekly; M - Monthly; Q - Quarterly; S - Semiannually; A - Annually

SAMPLE
EQUIPMENT MAINTENANCE DATA SHEET

PREVENTATIVE MAINTENANCE PROGRAM	**EQUIPMENT RECORD NUMBER**		
EQUIPMENT DESCRIPTION	**ELECTRICAL OR MECHANICAL DATA**		
Name: Influent Pump No. 1 Tag No.: P01-1	Nameplate Horsepower: 15 HP		
Serial No.: 123456ABC	Model: 140T Frame Serial No. 987654ZY Class F Insulation w/ Space Heater		
Vendor: ABC Pump Co.	Catalog Number (polyphase motors): M36999b		
Vendor Address: 1234 Richter Avenue Irvine, CA 92604	Type:		
	Manufacturer: DEF Motors, Inc.		
Vendor Rep: XYZ Equipment, Inc.	Voltage: 460	Measured Current: 18 amps	Nameplate Current: 20 amps
Phone: 949-752-0505	Phase: 3	Overload Relay Setting: 25 amps	rpm: 1,800

MAINTENANCE AND LUBRICATION WORK TO BE DONE	Frequency*
1. Operate valves and check such things as a) bearing temperature, b) changes in running sound, c) suction and discharge gage readings, d) pump discharge rate, and e) general condition of the drive equipment.	D
2. Check packing.	D
3. Check pumping unit for any dust, dirt or debris.	W
4. Lubricate bearing frame and motor bearings (consult manufacturer's instructions for type of grease or oil).	Q
5. Disassemble and change or repair the following: a) impeller, b) shafts, c) shaft sleeve, d) rotary seals, and e) sleeve bearings.	A

SPARE PARTS LIST		**FUSES/LAMPS/SEALS**		
Quantity	Part & Part Number	Qty	Size	Type & Ordering Description

WARRANTY AND OPERATING REQUIREMENTS AND REFERENCE
For manufacturer's instructions regarding installation, operation, maintenance and troubleshooting of this equipment, see Volume_____, Section_____.

*D - Daily; W - Weekly; B - Biweekly; M - Monthly; Q - Quarterly; S - Semiannually; A - Annually

SECTION 01787 PRODUCT WARRANTIES

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Warranties are required for all work furnished under this Contract.

1.02 RELATED WORK

A. Section 01300: Shop Drawings and Submittals

B. Section 01750: Start-up and Performance Testing

1.03 SUBMITTALS

A. Furnish the following submittals.

Submittal	**Description**
Warranty	For equipment bearing manufacturer's warranty in excess of 1 year, furnish copy of warranty to the City with the City named as beneficiary.

1.04 ONE-YEAR PRODUCT WARRANTIES

A. Warranties shall cover improper assembly or erection, defective workmanship and products, and incorrect or inadequate operation.

B. A 1-year warranty shall be furnished for all work and manufactured items from day of final acceptance unless otherwise stated. Warranty shall cover parts, labor, and prompt service for repair of defects, performance failure or damage due to normal wear and tear or due to any cause other than acts of God, or intentional or active and extreme abuse of the product.

C. In addition to the manufacturer's standard warranty, furnish services of factory- authorized and factory-trained serviceman to promptly provide repair service for mechanical equipment for the specified warranty period. This service shall include the cost of all replacement parts required during that period.

D. Provide duplicate, notarized copies. Execute the Contractor’s submittals and assemble documents executed by subcontractors, suppliers, and manufacturers. Provide table of contents and assemble in binder with cover.

E. Submit guaranties/warranties prior to requesting a final inspection.

1.05 ELEVEN-MONTH ANNIVERSARY WARRANTY INSPECTION

A. Warranty inspection shall be conducted during the 11th month following final acceptance of the work.

B. Locations found in warranty inspection where paving, coating, or paint has peeled, bubbled or cracked, and locations where rusting is evident will be considered a system failure. Repair defective work identified during warranty inspection by removing deteriorating paving, coating or paint system, cleaning surface, and repave, recoat or repaint with same system. Electrically test repaired painted areas. If the area of failure exceeds 25 percent of the total paved, coated or painted surface for pavement, coating or paint system on any structure or surface, remove and recoat entire paving, coating or paint system per original specification.

C. Other failed products found in warranty inspection shall be repaired per warranty requirements.

D. The City shall establish date for warranty inspection and shall notify the Contractor at least 30 days in advance. If notification of inspection date does not occur within 12 months after final acceptance, the first anniversary inspection shall be considered to be waived.

1.06 FIVE-YEAR PRODUCT WARRANTIES

A. A 2-year warranty shall be furnished for the following:

1. Submersible wastewater pumps

2. Vertical Lineshaft Pumps

B. The 2-year warranty shall cover parts, labor and prompt service for repair of defects, performance failure or damage due to normal wear and tear, due to infrequent maintenance or due to any cause other than acts of God or intentional or active and extreme abuse of the product. The warranty period shall extend 2 years beyond final acceptance of completed contract by the City.

1.07 UNIT PRICES

A. Payment for warranties required in the Contract Documents will be included in the price bid for items of work for which warranties are required.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION (NOT APPLICABLE)

END OF SECTION

SECTION 01820 DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.01 WORK INCLUDED

A. System demonstration and training of the City's personnel.

1.02 RELATED WORK

A. Section 01300: Shop Drawings and Submittals

B. Section 01750: Start-up and Performance Testing

C. Section 01783: Operating and Maintenance Data

1.03 SUBMITTALS

A. Furnish the following submittals.

Submittal	**Description**
System Demonstration Plan	Submit within 30 days following pre-construction meeting. Outline procedures proposed for final testing. Plan shall describe each system to be tested, test methods, test materials, test instruments and recorders, and results to be recorded. In addition to functional testing of each system, system demonstration plan shall include 10 consecutive days demonstration of operation of entire system as installed. A shorter demonstration period may be authorized solely by the City's Representative if external constraints make a 10 consecutive days test impractical. Procedures shall include demonstration of instruments, alarms, safety interlocks and back-up modes of operation. Procedures shall incorporate start-up and demonstration procedures recommended by manufacturers. The City may modify proposed procedures as deemed necessary to demonstrate system operation. System demonstration shall include operation of equipment through entire no-load to full-load range.
System Demonstration Log	Submit for final operations test period.
Training Outline	Submit for instruction program for the City's personnel.
Schedule	Submit schedule for the three activities mentioned above.

1.04 UNIT PRICES

A. Payment for system demonstration including materials, equipment, devices, labor, travel costs, expenses, and maintenance items, required in the Contract Documents will be included in the price bid for items of work for which systems demonstration and startup is specified.

B. Payment for operation and maintenance training required in the Contract Documents shall be included in the price bid for items of work for which operation and maintenance training is required.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 – EXECUTION

3.01 GENERAL

A. Demonstration and Training shall not occur until successful completion of performance testing and Acceptance by City, as specified in Section 01750.

3.02 SYSTEM DEMONSTRATION

A. System demonstration shall conform to the approved demonstration plan.

B. Demonstrations requiring City participation shall only be coordinated with the City. Notification of testing shall be provided a minimum of 10 working days in advance.

C. Perform systems demonstrations in presence of the City who will record results.

D. Start up and operate individual subsystems, pieces of equipment, instruments, etc.

E. Start up and operate system in its entirety allowing system automation to control all processes.

F. Defects and malfunctions disclosed during testing and system demonstration shall be corrected immediately. Work that fails to perform its intended function, and cannot be repaired, shall be replaced.

3.03 TRAINING OF CITY'S PERSONNEL

A. Conduct training and instruction program on system operation for persons designated by the City. Furnish services of qualified factory-trained instructors from applicable equipment manufacturers. Instruction shall cover basic operation theory, routine maintenance and repair, and "hands-on" operation of equipment. If not otherwise specified, base duration of program on complexity of equipment involved. Obtain the City 's approval of instruction adequacy before terminating program. Consult the City to schedule instruction.

B. The following training is required:

Item	Location	Classroom Training Duration	Field Training Duration	Approximate Number of Attendees
System Overview	On-Site	2 Hours	6 Hours	3-10 People
System Overview	On-Site	2 Hours	6 Hours	3-10 People

C. Due to scheduling of personnel, the City may require two training sessions on different days. Note that overlap of training and demonstration testing will not be allowed, unless otherwise approved in writing by City in the event that demonstration testing plan results in long gaps between observation of actual tests. The need for alternate days will be determined upon review of the schedule of activities as mentioned in Item 3.02B above.

D. Training sessions may be videotaped by the City for reference purposes and new employee orientation.

END OF SECTION

DIVISION 02 – SITEWORK

SECTION 02100 MOBILIZATION / DEMOBILIZATION / CLEANUP

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section describes the work necessary to mobilize, demobilize, and cleanup the project site.

1.02 RELATED WORK

A. Section 01100: Summary of Work

B. Section 01500: Construction Facilities and Temporary Controls

C. Section 01740: Cleaning and Final Cleaning

PART 2 - PRODUCTS

2.01 GENERAL

A. Provide all temporary and permanent materials, equipment, and labor required to accomplish the work as specified.

2.02 SECURITY FENCE

A. A security fence may be constructed for the protection of materials, tools, and equipment of the Contractor and lower-tier subcontractors. At completion of the work, remove fence from the site and restore the area. The security fence shall be constructed at the sole expense of the Contractor.

B. Provide access at any time and any necessary keys to City.

2.03 PARKING FACILITIES

A. Provide parking facilities for personnel working at the sites.

PART 3 - EXECUTION

3.01 CONSTRUCTION LAYOUT

A. Set up construction facilities in a neat and orderly manner within designated area at location of choice. Accomplish all required work in accordance with applicable portions of these Specifications. Confine operations to work area shown.

B. Some obstructions may not be shown. Bidders are advised to carefully inspect the existing facilities before preparing their bids. The removal and replacement of minor obstructions such as electrical conduits, water, waste piping, and similar items shall be

anticipated and accomplished, even though not shown or specifically mentioned.

C. Immediately bring to the attention of the City major obstructions encountered that are not shown on the Drawings, or could not have been foreseen by visual inspection of the site prior to bidding. The City will make a determination for proceeding with the work.

3.02 CONTAMINATION PRECAUTIONS

A. Avoid contamination of the work site. Do not dump waste oil, rubbish, or other similar materials on the ground.

3.03 CLEANUP OF CONSTRUCTION AREAS

A. During execution of the work, daily clean the site, adjacent properties, and public access roads and dispose of waste materials, debris, and rubbish to assure that grounds, and public and private properties are maintained free from accumulations of waste materials and rubbish. Provide containers for collection and disposal of waste materials, rubbish, and debris.

B. Upon completion of rehabilitation, remove from the site the rehabilitation and related equipment, and all debris, unused materials, temporary construction buildings, and other miscellaneous items resulting from or used in the operations. Replace or repair any facility that has been damaged during the construction work. Restore the site as nearly as possible to its original condition.

C. Remove all utility identification and construction-related marking to the satisfaction of the Engineer after completion of work or when requested by City.

END OF SECTION

SECTION 02222 PROTECTING EXISTING UNDERGROUND UTILITIES

PART 1 - GENERAL

This Section describes materials and procedures for protecting existing underground utilities.

1.01 RELATED WORK DESCRIBED ELSEWHERE

Refer to the following Specification section(s) for additional requirements:

A. Submittals: 01300

B. Trenching, Backfilling, and Compacting: 02223

C. Earthwork: 02300

1.02 SUBMITTALS

A. Furnish submittals in accordance with the requirements of Section 01300, Submittal Procedures.

PART 2 – PRODUCTS

Except as indicated on the drawings or as specifically authorized by the Engineer, reconstruct utilities with new material of the same size, type, and original quality as that removed.

PART 3 - EXECUTION

3.01 GENERAL

A. Replace "in kind" street improvements, such as curbs and gutters, ramps, barricades, traffic islands, signalization, fences, signs, mail boxes, etc., that are cut, removed, damaged, or otherwise disturbed by the construction.

B. Where utilities are parallel to or cross the pipeline trench but do not conflict with the permanent work to be constructed, follow the procedures given below and as indicated on the Drawings. Notify the utility owner 48 hours in advance of the crossing construction and coordinate the construction schedule with the utility owner's requirements. Obtain agency approval before submitting shop drawings for Owner review.

C. Determine the true location and depth of utilities and service connections which may be affected by or affect the Work. Determine the type, material, and condition of these utilities. Pothole all utilities, except those listed in the Contract Documents as already being potholed, prior to submitting pipe laying drawings. Submit a set of potholing plans to the Engineer prior to submitting laying diagrams.

In addition, expose all utilities at least 300 lineal feet in advance of the start of pipeline excavation.

3.02 PROCEDURES

A. PROTECT IN PLACE

Protect utilities in place, unless abandoned, and maintain the utility in service, unless otherwise specified on the Drawings or in the Specifications.

B. CUT AND PLUG ENDS

Cut abandoned utility lines (conduits) and plug the ends with brick and mortar or concrete plug. Plug utility lines with an 8-inch wall of brick and mortar or 8-inch concrete plug from the cut end of the pipe. Dispose of the cut pipe as unsuitable material.

C. PROVIDE TEMPORARY SUPPORT FOR ALL PIPELINES CROSSING THE PROPOSED TRENCH

All pipelines 18-inches in diameter or larger crossing over the proposed pipeline with less than 4 feet of clearance shall have a concrete support. Protect all pipelines less than 18-inches in diameter and crossing over the proposed water main with less than 2 feet of clearance by pouring a 1-sack sand/cement slurry from the top of the proposed pipeline to the bottom of the crossing pipeline.

D. ABANDONED UTILITIES

Remove and dispose of abandoned utilities within the trench excavation.

END OF SECTION

SECTION 02223 TRENCHING, BACKFILLING AND COMPACTING

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section describes materials, testing, and performance of trench excavation, backfilling, and compacting.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01300: Shop Drawings and Submittals

B. Section 02513: Asphalt Concrete Paving

C. Section 011005000: Piping Components

1.03 SUBMITTALS

A. Furnish submittals in accordance with the requirements of Section 01300, Shop Drawings and Submittals. The following submittals are required:

B. Submit Drawings showing excavation and shoring, bracing, or sloping for worker protection.

C. Submit six copies of a report from a testing laboratory verifying that backfill material conforms to the specified gradations or characteristics for pea gravel, granular material, imported sand, rock refill for foundation stabilization, and water.

1.04 PROTECTION OF EXISTING UTILITIES AND FACILITIES

A. General: Protect all existing sewer pipelines, water pipelines, gas mains, storm drains, culverts, or other facilities and structures that may be encountered in or near the area of the work.

B. Notification: Notify each agency having jurisdiction and make arrangements for locating each agency's facilities prior to beginning construction.

C. Damage: In the event of damage to any existing facilities during the progress of the work due to the failure of the Contractor to exercise proper precautions, pay for the cost of all repairs and protection to said facilities, at the Contractor’s sole expense. The Contractor's work may be stopped until repair operations are complete without cost to the City.

1.05 PROTECTION OF LANDSCAPING

A. General: Protect all trees, shrubs, fences, and other landscape items adjacent to or within the site unless directed otherwise in the Drawings. In the event of damage to landscape items, replace the

damaged items in a manner satisfactory to the City.

PART 2 - PRODUCTS

2.01 DEFINITION OF ZONES

A. Pavement Zone: The pavement zone shall include the asphaltic concrete (or portland cement concrete) and aggregate base pavement section placed over the trench zone.

B. Trench Zone: The trench zone shall include the portion of the trench from the top of the pipe zone to the bottom of the pavement zone in paved areas or to the final grade in unpaved areas.

C. Pipe Zone: The pipe zone shall include the full width of trench from the bottom of the pipe or conduit to a horizontal level 12 inches above the top of the pipe. Where multiple pipes or conduits are placed in the same trench, the pipe zone shall extend from the bottom of the lowest pipe(s) to a horizontal level 12 inches above the top of the highest or topmost pipe.

D. Pipe Base: The pipe base shall be defined as a layer of material immediately below the pipe zone and extending over the full trench width.

2.02 NATIVE EARTH BACKFILL -- TRENCH ZONE

A. Excavated native earth backfill shall be fine-grained non-organic materials free from peat, roots, debris, and rocks larger than 3 inches, and which can be compacted to the specified relative compaction.

2.03 BACKFILL -- PIPE ZONE AND PIPE BASE

A. Unless otherwise specified or shown on the Drawings, the pipe base and pipe zone backfill material shall be imported sand as specified herein.

2.04 IMPORTED SAND -- PIPE ZONE AND PIPE BASE

A. Imported sand used in the pipe zone or for the pipe base shall have the following gradation:

Sieve Size	**Percent Passing by Weight**
3/8-inch	100
No. 4	75 - 100
No. 30	12 - 50
No. 100	5 - 20
No. 200	0 - 15

B. Minimum sand equivalent shall be 30 per ASTM D 2419.

2.05 WATER FOR COMPACTION

A. Water used in compaction shall have a maximum chloride concentration of 500 mg/l, a maximum sulfate concentration of 500 mg/l, and shall have a pH of 7.0 to 9.0. Water shall be free of acid, alkali, or organic materials injurious to the pipe coatings.

PART 3 - EXECUTION

3.01 TESTING FOR COMPACTION

A. Perform compaction testing as described below.

B. Methods: Determine the density of soil in place by the sand cone method (ASTM D 1556) or by the nuclear method (ASTM D 2922 or D 3017).

C. Soil Moisture-Density Relationship: Determine the laboratory moisture-density relations of soils shall be determined per ASTM D 1557.

D. Cohesionless Materials: Determine the relative density of cohesionless materials by ASTM D 4253 and D 4254.

E. Sampling: Sample backfill materials per ASTM D 75.

F. Relative Compaction: Express "relative compaction" or “relative density” as the ratio, expressed as a percentage, of the in place dry density to the laboratory maximum dry density.

G. Compaction Compliance: Compaction shall be deemed to comply with the Specifications when none of the tests falls below the specified relative compaction.

3.02 COMPACTION REQUIREMENTS

A. Unless otherwise shown on the Drawings or otherwise described in the Specifications for the particular type of pipe installed, relative compaction in pipe trenches shall be as follows:

B. Pipe Base and Pipe Zone: Pipe base and pipe zone—90 percent relative compaction.

C. Trench Zone - Not beneath Paving: Backfill in trench zone not beneath paving— 90 percent relative compaction.

D. Trench Zone - Paved Areas: Backfill in trench zone in paved areas—90 percent relative compaction.

E. Foundation Stabilization: Rock refill material for foundation stabilization— 90 percent relative density.

F. Overexcavation: Rock refill for overexcavation—90 percent relative density. Test all imported or native materials before the start of compaction operations to determine the moisture density relationship for materials with cohesive components, and the maximum density for cohesionless materials. Variations in imported or native earth materials may require a number of base curves of the moisture-density relationship.

G. Unless noted otherwise, perform compaction tests at random depths and at 200-foot intervals, and as directed by the Engineer.

3.03 MATERIAL REPLACEMENT

A. Remove trenching and backfilling material, which does not meet the Specifications and replace at no additional expense to the City.

3.04 TRENCH WIDTHS

A. Pipe Diameter 10 Inches and Greater: Unless shown otherwise on the Drawings, trench widths in the pipe zone shall be equal to the pipe outside diameter plus 6 inches on each side of the pipe. Trench width at the top of the trench shall not be limited except where width of excavation would undercut adjacent structures and footings. In such cases, width of trench shall be such that there is at least 18 inches between the top edge of the trench and the structure or footing.

B. Pipe Diameter 8 Inches and Under: Excavation and trenching shall be true to line so that a clear space of not more than 8 inches or less than 6 inches in width is provided on each side of the largest outside diameter of the pipe in place measured at a point 12 inches above the top of the pipe. The largest outside diameter shall be the outside diameter of the bell on bell and spigot pipe.

C. Where the trench width, measured at a point 12 inches above the top of the bell of the pipe, is wider than the maximum set forth above, backfill the trench area around the pipe with crushed rock, Class B concrete, or slurry to form a cradle for the pipe at the discretion of the Engineer.

3.05 GRADE

A. Excavate trenches to the lines and grades shown on the Drawings with allowance for pipe thickness and for pipe base. If the trench is excavated below the required grade, refill the portion of the trench excavated below the grade with refill material at no additional cost to the City. Place the refill material over the full width of trench in compacted layers not exceeding 6 inches deep to the required grade less allowance for the pipe base. Remove hard spots that

would prevent a uniform thickness of pipe base. Before laying pipe sections, check the grade with a 10-foot straightedge and correct any irregularities. The trench bottom shall form a continuous and uniform bearing and support for the pipe at every point.

3.06 PIPE BASE THICKNESS

A. Thickness of the pipe base shall be as shown on the Drawings or as otherwise described in the Specifications for the particular type of pipe installed, but in no case shall the thickness be less than 4 inches.

3.07 DEWATERING

A. Means and Devices: Provide and maintain suitable and sufficient means and devices to continuously remove and dispose of all water entering the trench excavation during the time the trench is being prepared for the pipe laying, during the laying of the pipe, and until the backfill at the pipe zone has been completed. These provisions shall apply during the noon hour as well as overnight. Dispose of water of in a manner to prevent damage to adjacent property. Do not drain trench water through the pipeline under construction. Do not allow groundwater to rise above the bottom of the pipe until jointing compound has firmly set (if any) and the pipe is watertight.

B. Notification: Notify the City 48 hours prior to commencement of dewatering. Methods employed shall be in conformance with the City's existing NPDES permit.

3.08 STORAGE OF EXCAVATED MATERIAL

A. During trench excavation, store excavated material only within the work area. Do not obstruct roadways or streets. The safe loading of trenches with excavated material shall conform to laws and regulations.

3.09 FOUNDATION STABILIZATION

A. After the required excavation has been completed, the Engineer will inspect the exposed trench subgrade to determine the need for any additional excavation. It is the intent that additional excavation shall be conducted in all areas within the influence of the pipeline where unacceptable materials exist at the exposed subgrade. Overexcavation shall include the removal of all such unacceptable material that exists directly beneath the pipe base and to the depth required. The presence of unacceptable material may require excavating a wider trench. Backfill the overexcavated portion of the trench to the subgrade of the pipe base with refill material for foundation stabilization. Place foundation stabilization material over the full width of the excavation and compacted in layers (lifts) not

exceeding 6 inches in compacted depth, to the required grade.

3.10 TRENCH BACKFILLING AND COMPACTION

A. General: Trench backfilling shall conform to requirements of the detailed piping specification for the particular type of pipe and the following.

B. Pipe Base: Place the specified thickness of pipe base material over the full width of trench. Grade the top of the pipe base ahead of the pipe laying to provide firm, uniform support along the full length of the barrel of the pipe.

C. Bell Holes: Excavate holes at each joint to permit proper assembly and inspection of the entire joint.

D. Pipe Zone: After the pipe has been bedded, place pipe zone material simultaneously on both sides of the pipe, keeping the level of backfill the same on each side. Carefully place material around the pipe so that the pipe barrel is completely supported and that no voids or uncompacted areas are left beneath the pipe. Particular care shall be taken in placing material on the underside of the pipe to prevent lateral movement during subsequent backfilling. Compact material placed within the pipe zone by hand tamping only.

E. Trench Zone: Carefully deposit backfill material onto the backfill previously placed in the pipe zone. Free fall of the material shall not be permitted until at least 2 feet of cover is provided over the top of the pipe. Do not drop sharp or heavy pieces of material directly onto the pipe or the tamped material around the pipe.

F. Trench Backfill: Compact trench backfill to the specified relative compaction. Perform compaction by using mechanical compaction or hand tamping equipment. Unless specified otherwise, consolidation by jetting or flooding shall not be permitted. Do not use high impact hammer-type equipment except where the pipe manufacturer warrants in writing that such use will not damage the pipe.

G. Equipment: Do not use axle-driven or tractor-drawn compaction equipment within 5 feet of walls and structures.

3.11 IMPORT OR EXPORT OF BACKFILL MATERIAL

A. Excess Material: Remove and dispose of excess excavated soil material off the sites at no additional expense to the City. Dispose of excess soil material in accordance with laws and regulations.

B. Imported Material: Import, place and compact any additional backfill material necessary to return all grades to plus or minus 0.2 foot from the grade encountered at the beginning of construction or as shown on the Drawings, at no additional cost to the City.

3.12 MOISTURE CONTENT OF BACKFILL MATERIAL

A. During the compacting operations, maintain optimum feasible moisture content required for compaction purposes in each lift of the backfill material. Maintain moisture content throughout the lift at a uniform level. If placement is discontinued and proper moisture content not maintained, bring the upper layer back to proper moisture content by sprinkling, cultivating and rolling the backfill material before placing new material. At the time of compaction, the water content of the material shall be at optimum water content plus or minus 2 percentage points. Do not work material that contains excessive moisture to obtain the required compaction. Material having excessive moisture content may be dried by blading, discing, or harrowing to hasten the drying process.

END OF SECTION

SECTION 02300 EARTHWORK

PART 1 - GENERAL

1.01 DESCRIPTION

A. The Work of this section includes clearing and grubbing, demolition, removal and disposal of surplus and deleterious materials, trenching, excavation and backfilling at the locations indicated on the Plans. Earthwork shall include the removing, loading, transporting, depositing, and compaction in its final location of all materials, wet and dry, as required for purposes of construction of all facilities and such other purposes as indicated on the Plans; the furnishing, placing, and removing of all sheeting, shoring and bracing necessary to safely support the sides of the excavations; all pumping, ditching, draining, and other required measures for the removal or exclusion of water; the supporting of structures above and below the ground; all backfilling around the structures and all backfilling of trenches and pits; the disposal of excess excavated materials, and all other incidental earthwork as indicated on the Plans and as specified herein.

B. The Contractor shall furnish all tools, equipment, materials, and supplies and shall perform all labor necessary in connection with all earthwork and incidental appurtenant work, complete, as specified herein and as indicated on the Plans.

1.02 RELATED WORK DESCRIBED ELSEWHERE

A. Section 01410 – Testing and Inspection of Earthworkand Concrete

B. Section 02222 – Protecting Existing Underground Utilities

C. Section 02223 – Trenching, Backfilling and Compacting

1.03 SUBMITTALS

A. The Contractor shall furnish a sieve analysis for the underslab permeable filter material and any imported backfill for the structure. The Owner may wish to inspect and test backfill and permeable filter material at the source. Contractor shall not haul any materials to the site prior to material review and acceptance by the Owner.

B. The Contractor shall submit sealed and signed calculations and drawings for the sheeting and shoring system if required.

1.04 QUALITY ASSURANCE

A. General Earthwork and Grading Specifications

All earthwork and grading should be performed in accordance with all applicable requirements of CAL OSHA and the Owner, in addition to the provisions specified herein.

A. Grading Observation and Testing

All grading shall be accomplished subject to the observation and testing by the Owner and the Geotechnical Engineer as specified herein.

B. Prior to final acceptance of the finish graded site, the Contractor shall request a final survey for verification of grades and request a final site inspection with the Owner.

PART 2 - MATERIALS

2.01 ON-SITE MATERIALS

A. Materials excavated from the site may be used as fill provided they are free from organic matter and other deleterious materials, and particles greater than 6 inches in maximum dimension.

2.02 IMPORT MATERIAL

A. If imported soils are required to achieve the proposed grades, imported soils should have a maximum particle size of 4 inches and have an expansion index (EI) less than 20. Potential import soils should be sampled by the geotechnical engineer at the source, if possible, tested for expansion and maximum density, and approved by the geotechnical engineer prior to being used.

2.03 SUITABLE MATERIAL

A. As specified herein, shall be any material imported or excavated from the site that are free from shale, sod, large clods of earth, stones, roots, trash, lumber, and other debris that, in the opinion of the Owner, is suitable for use and can be readily compacted to the densities specified.

2.04 GRANULAR SOIL AND IMPORTED SAND

A. Whenever the term “granular soil” is used in the Plans and Specifications, it shall be defined as soil having a minimum sand equivalent of 30, as determined by the latest revision in accordance with State of California, Department of Transportation, Test Method No. Calif. 217, and not more than 20% of the material will pass through a 200-mesh sieve.

B. Whenever the term “imported sand” is used in the Plans and Specifications, it shall be defined as sand having a minimum sand equivalent of 30 as determined by the latest revision of Test Method No. Calif. 217.

2.05 STRUCTURE BACKFILL

A. Backfill shall consist of loose earth or sand free from stones, clods or other deleterious materials. When material for the excavation is

unsuitable for use in backfill, it shall be disposed of and suitable material which is capable of attaining the required relative density shall be arranged for and furnished by the Contractor at his expense.

PART 3 - EXECUTION

3.01 GENERAL

A. The Contractor shall perform all site grading, soil sterilant application, structure excavation, overexcavation and backfill, trench excavation and backfill for pipelines and conduits, and other earthwork required to complete the Work under this contract. Included are all necessary clearing, grubbing, grading, and excavation of all classes and of whatever substance encountered, stockpiling, backfilling, compaction, controlling water, bracing excavations, stabilizing subgrade, protecting existing structures and facilities, complying with conditions of permits and safety regulations, cleaning up debris, papers and loose rocks, restoring fences and other disturbed property, maintaining trees which are not permitted to be removed, and disposing of excess material, and such supplementary operations as are necessary to properly complete the entire Work indicated or specified.

3.02 EARTHWORK SUBJECT TO PERMIT CONDITIONS

A. Earthwork within public rights-of-way controlled by a state, county or city shall be in accordance with requirements and provisions of permits issued by those agencies for the construction within their respective rights-of-way. Such permit requirements and provisions which are more restrictive than those specified herein, shall take precedence and supersede the provisions of the Specifications.

3.03 PROTECTION OF WORKMEN

A. Excavation shall be so braced or sheeted so as to provide conditions under which workmen may work safely and efficiently at all times. The latest revisions of the rules, orders and regulations of the Division of Industrial Safety of the State of California shall be complied with.

3.04 PUBLIC SAFETY

A. Barriers shall be placed at each end of all excavations and such places as may be necessary along excavations to warn all pedestrian and vehicular traffic of such excavations. Lights shall also be placed along excavations from sunset each day to sunrise of the next day until such excavation is entirely refilled. Material for backfill or for protection of excavation in public roads from surface drainage shall be neatly placed and kept shaped so as to cause the least possible interference with public travel. Free access must be provided to all fire hydrants, water valves, meters, and private drives, or other property or facilities that may have

routine use.

3.05 SUPPORT OF ADJACENT PROPERTY

A. Excavations shall be so braced, sheeted, and supported that the ground alongside the excavation will not slide or settle, and all existing improvements of any kind, either on public or private property, will be fully protected from damage. Damage to adjacent property or to the Work occurring through settlements, water or earth pressures, slides, caves or other causes due to failure of lack of sheeting or bracing or improper bracing, or through negligence or fault of the Contractor in any other manner, shall be repaired by the Contractor as his own expense.

3.06 EXISTING IMPROVEMENTS

A. The Contractor's attention is directed to the possible existence of pipe and other underground improvements which may or may not be shown on the Plans. The Contractor shall preserve and protect any such improvements whether shown on the Plans or not. Where it is necessary to remove and replace or to relocate such improvements in order to prosecute the Work, they shall be removed, maintained, and permanently replaced by the Contractor at his expense, except as otherwise provided in the Contract Documents.

3.07 SURFACE DRAINAGE AND EROSION CONTROL

A. Control of Surface Drainage: Surface drainage shall be carefully controlled during and after grading to prevent ponding adjacent to and run off onto graded or natural slopes. Particular care will be required during construction to maintain the berms and swales needed to direct run off to the paved roads or other surface drainage facilities. The use of temporary erosion control facilities will also be needed to control erosion within or adjacent to the site and access road areas. The Contractor will be responsible to maintain all erosion control provisions onsite at all times and until the final landscaping provision or other drainage improvements are constructed.

B. Preservation of Existing Drainage: Except as shown on the Plans, existing drainage patterns shall be preserved. Where construction methods cause a temporary obstruction of drainage patterns temporary facilities adequate for expected flows and a means of emergency removal of the obstruction shall be provided.

3.08 DEWATERING

A. The Contractor is referred to subsection 306-5, "Dewatering" of the SSPWC "Greenbook 2018". The Contractor shall provide and maintain at all times during construction, ample means and devices with which to promptly remove and properly dispose of all water from any source entering the excavations or other parts of the

work. Dewatering shall be accomplished by methods, which will ensure a dry excavation and preservation of the final lines and grades of the bottoms of excavations.

B. Disposal of water from dewatering operations shall be the sole responsibility of the Contractor. Disposal methods shall conform to the Porter-Cologne Water Quality Control Act, 1974, the Federal Water Pollution Control Act Amendment of 1972; the California Code of Regulations, Title 23, Chapter 3; and Order No. R5- 2013-0074 and NPDES No. CAG995001 issued by the Regional Water Quality Control Board.

C. The Contractor shall dispose of the water from the work in a suitable manner without damage to adjacent property. Conveyance of the water shall be such as to not interfere with traffic flow or other construction. No water shall be drained into work built or under construction without prior consent of the Engineer. No water can be sent to the sewer system.

D. Water shall be desanded before disposal in any storm drain system. The system used for desanding the water shall be a baffled structure and shall provide not less than five minutes detention time and shall be designed to have a "flow- through" velocity not exceeding 0.2 feet per second at the anticipated peak flow. The desanding box shall be cleaned as required to maintain the detention time and flow-through limitations specified above.

3.09 CORRECTION OF FAULTY GRADES

A. Where excavation is inadvertently carried below pipe or concrete structure subgrade, it shall be rectified for a pipe by backfilling with approved sand or gravel compacted to 90% of maximum density, or for a structure with concrete containing four sacks of cement per cubic yard, all at the expense of the Contractor.

3.10 SURPLUS EXCAVATED MATERIAL

A. The Contractor shall make the necessary arrangements for and shall remove and dispose of all surplus excavated material, unless provided for in the Contract Documents. All costs for the disposal of surplus waste material shall be borne by the Contractor.

B. It is the intent of the Specifications that all surplus material not required for backfill or fill shall be disposed of by the Contractor outside the limits of the public rights- of-way, City property, and/or easements at no cost or liability to the City.

C. No excavated material shall be deposited on private property unless written permission from the property owner thereof is secured by the Contractor. Before the Owner will accept the Work as being completed, the Contractor shall file a written release

signed by all property owners with whom he has entered into agreements for disposal f surplus excavated material absolving the City from any liability connected therewith.

3.11 IMPORTED BACKFILL MATERIAL

A. Whenever the excavated material is not suitable for backfill, the Contractor shall at his own expense arrange for a furnish suitable imported backfill material which is capable of attaining the required relative density.

3.12 COMPACTION TESTS/STANDARD

A. Compaction tests will be made by the Owner's Representative or laboratory designated by him. The number of tests and their location and depth shall be determined by the City's Representative. The Contractor shall make all necessary excavations for compaction tests as directed by the Engineer and shall recompact these excavations to the densities as specified herein. The City will pay for the initial cost of all compaction tests. If the backfill compaction fails to meet the relative compaction requirements set forth herein, the Contractor shall pay for subsequent compaction tests in accordance with Section 01410, Testing and Inspection of Earthwork and Concrete.

B. Prior to placing compacted fill, the surfaces of all areas to receive fill should be scarified to a depth of at least six (6) inches. The scarified soil should be brought to near optimum moisture content and recompacted to a relative compaction of at least 90 percent relative compaction as determined by ASTM Test Method D 1557 unless otherwise noted on the plans or herein. Fill shall be tested for compliance with the recommended relative compaction and moisture conditions. Field density testing shall conform to ASTM D 1556, D 2922 and/or D 2937. Fill that is not in conformance with the grading recommendations should be removed and recompacted or otherwise handled as recommended by the geotechnical engineer at no additional cost to the City.

C. Fill and backfills should be spread in maximum eight (8) inch loose lifts, each lift brought to near optimum moisture content and compacted to a relative compaction of at least 95% under building pad and extending 5 feet beyond the outside edge of footings, and 90 percent elsewhere, in accordance with ASTM D 1557. Subsequent lifts should not be placed until the geotechnical engineer has approved the preceding lift.

D. Backfill around the buried structure should be brought up uniformly to maintain uniform loading on the structure.

3.13 SITE GRADING

A. Stripping: All vegetation and other deleterious materials should be

removed from the site. The project geotechnical engineer should be notified at the appropriate times to provide observation services during cleaning operations to verify compliance with the above recommendations. Voids created by clearing should be left open for observation by the geotechnical engineer. Should any unusual soil conditions or subsurface structures be encountered during site clearing and/or grading that are not described or anticipated herein, these conditions should be brought to the immediate attention of the project geotechnical engineer for corrective recommendations.

B. Excavation: After stripping, excavation shall be carried to the lines and grades indicated on the Plans or specified herein. All suitable excavated material shall be utilized to meet the embankment or roadway fills. Material in excess or not suitable for embankment shall be disposed of as specified herein for “Surplus Excavated Materials”.

C. Embankment: After stripping, areas to receive embankment or fill shall be benched, if sloping, and scarified to a depth of 6-inches, then compacted as specified for embankment. Embankments and roadway fills shall be compacted to a relative compaction of 90% unless otherwise specified on the Plans or in the Specifications.

D. If after stripping the ground is in a loose, un-compacted condition, it shall be compacted to a relative compaction of 90%. Unsuitable material shall not be deposited in a fill area where compaction is required.

E. The use of trucks, carryalls, scrapers, tractors, or other heavy hauling equipment shall not be considered as rolling in lieu of rollers, but the traffic of such hauling equipment shall be distributed over the fill in such a manner as to make use of the compaction afforded thereby as an addition to compaction by the use of rollers.

F. Haul routes shall be planned to avoid passing heavy off-highway equipment over pipelines with less than 6-feet of cover. Where crossings must be made, the Contractor shall provide concrete encasement or approved bridging.

G. Wall Backfill: Onsite soils possessing a very low expansion potential may be used for backfill of retaining walls. The project geotechnical engineer should approve all backfill used for retaining walls. All wall backfill should be placed in accordance with the recommendations presented in these specifications, and compacted to at least 90% of the laboratory standards.

H. Finish: All areas covered by the Work, including excavated and filled sections and transition areas, shall be uniformly graded to the elevations shown on the Plans. The finished surface shall be reasonably smooth, compacted, and free from any irregular surface changes. Edges of spoil and borrow areas shall be rounded to blend into natural contours. The degree of finish ordinarily

obtainable from a blade grader will be satisfactory for open areas, but hand grading and raking will be required around structures and walkways. The finished surface shall be not more than 0.1-foot above or below the establish grade and slope to prevent ponding.

3.14 STRUCTURE EXCAVATION/OVEREXCAVATION AND BACKFILLING

A. Excavation/Overexcavation: Excavation of all material of whatever nature necessary for the construction of structures and foundations shall be carried out to the lines and grades shown on the Plans and required to provide working clearance and safe construction slopes and to emplace shoring, sheeting, bracing, and other details which may be necessary.

B. The excavation should extend a minimum of 5 feet below the wet well. The exposed excavated area shall extend beyond the wet well footprint minimum of 5 feet. The overexcavation should be replaced by approved certified compacted fill.

C. The soils beneath the perimeter block wall alignment should be removed and recompacted to a depth of approximately 3-feet below the existing ground surface or at least 1-foot below the bottom of the proposed footing, whichever is deeper.

D. The soils beneath the proposed pavement area should be removed and re- compacted to a minimum depth of 1-foot below the proposed subgrade elevations. Removals should extend laterally the distance equal to the depths of overexcavation. All excavation bottoms should be evaluated by the geotechnical engineer during grading to confirm the exposed conditions are as anticipated and to provide supplemental recommendations if required.

E. Backfill material and compaction shall conform to the requirements in these specifications. Should the Contractor fail to compact soils to 95% of relative compaction per ASTM D1557, the Contractor shall stabilize the bottom of soft excavations by placing crushed or Class II aggregate base or by other methods approved by the City's Representative.

F. Before placing forms or rebar, Contractor shall coordinate with Owner's Representative to ensure that a geotechnical engineer inspects each subgrade.

G. Working Clearance: Except when concrete is authorized to be placed directly against excavated surfaces, the Contractor shall establish clear space at the sides of the excavation to facilitate from construction and removal and provide for the Contractor's excavation protective system.

H. Structure Backfill: backfill shall not be placed until the structure footings or other portions of the structure or facility have been inspected by the City's Representative and approved for backfilling. No backfill material shall be deposited against the back

of concrete retaining walls or reinforced concrete structures until the concrete has developed a compressive strength of not less than 3500 psi. Particular care shall be exercised when backfilling at the various structures to obtain adequate compaction beneath pipes connected thereto and to avoid injury or displacement of such pipes.

3.15 BLASTING AND EXPLOSIVES

A. Blasting or use of explosives is not permitted.

3.16 SOIL STERILANT

A. General: The Contractor shall treat the finished subgrade of specified areas with an approved soil sterilant.

B. Areas Requiring Soil Sterilant: All areas which are to receive bitumastic pavement, including embankments, walkways, drainage structures, parking, and road areas, require soil sterilant.

C. Other areas requiring soil sterilant are storage reservoir or pond surfaces which are to receive any lining material of less than 3-inches in thickness and lining perimeter areas to a distance of 5-feet form the edge of lining material.

D. Material and Application: The sterilant shall be applied in a liquid or dry form and at a uniform rate of not less than 8 ounces of dry sterilant per square yard in accordance with the manufacturer's directions. At the option of the Owner's Representative, the area shall then be lightly sprinkled with water to prevent loss of sterilant or scuffing.

3.17 SHEETING AND SHORING

A. The Contactor shall design, furnish, construct, and remove sheeting and shoring required for construction.

B. Shoring designer shall visit the site during installation and after completion of the installation of the system to visually monitor the performance of the sheeting and shoring system.

C. All shoring that extends below the bottom of the excavation shall be in firm contact with the surrounding soils.

3.18 FINAL CLEANUP

A. After backfilling has been completed, the site shall be dressed smooth and left in a neat and presentable condition, free of all cleared vegetation, rubbish and other construction wastes. Surplus rock which cannot be used for backfill shall be hauled away and disposed of by the Contractor. Areas next to structures where blade-type equipment cannot reach shall be hand raked.

END OF SECTION

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SECTION 02513 ASPHALT CONCRETE PAVING

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section includes materials, testing, and installation of asphalt concrete pavement, aggregate base course, herbicide, prime coat, tack coat, and seal coat.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01300: Shop Drawings and Submittals

B. Section 02223: Trenching, Backfilling and Compacting

1.03 SUBMITTALS

A. Submit eight copies of a report from a testing laboratory verifying that aggregate material contains less than 1 percent asbestos by weight or volume and conforms to the specified gradations and characteristics. Submit batch test results prior to permanent paving.

1.04 TESTING FOR COMPACTION

A. Test for subgrade and base compaction as described in Section 02223, Trenching, Backfilling and Compacting. Test for asphalt concrete compaction per Section 302-5 of the Standard Specifications “Greenbook”.

PART 2 - PRODUCTS

2.01 ASPHALT CONCRETE PAVING

A. Asphalt concrete paving shall conform to PG 64-10 as listed in Section 5 “Asphalt Concrete Pavement” of the Standard Specifications.

2.02 AGGREGATE BASE COURSE

A. Aggregate base shall be crushed aggregate base as specified in Section 5 “Asphalt Concrete Pavement” of the Standard Specifications. Aggregate shall contain less than 1 percent asbestos by weight or volume and should not exceed 3/4 inch in diameter.

2.03 PRIME COAT

A. Prime coat shall be slow curing (SC-70) in accordance with Section 5 “Asphalt Concrete Pavement” of the Standard Specifications.

2.04 TACK COAT

A. Tack coat shall conform with Section 5 “Asphalt Concrete Pavement” of the Standard Specifications and shall be either PG 64-10 paving asphalt or Grade SS-1h emulsified asphalt.

2.05 ASPHALT

A. Asphalt shall be PG 64-10. Asphalt content in the asphalt concrete shall be 5.5 percent to 6.0 percent.

2.06 AGGREGATE FOR ASPHALT CONCRETE

A. Aggregate shall be in accordance with Section 5 “Asphalt Concrete Pavement” of the Standard Specifications. Aggregate shall contain less than 1 percent asbestos by weight or volume.

2.07 SLURRY SEAL COAT

A. Seal slurry shall be Emulsion Aggregate Slurry with Type II grade aggregate per Section 5 “Asphalt Concrete Pavement” of the Standard Specifications.

2.08 HERBICIDE OR WEED KILLER

A. Use Spike 80W, Elanco Products Company; Pramitol 30 WP, CIBA-Geigy, or approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Apply prime coat to all areas to be paved. Producing, hauling, placing, compacting and finishing of asphalt concrete shall conform to Section 5 “Asphalt Concrete Pavement” of the Standard Specifications.

3.02 CONNECTIONS WITH EXISTING PAVEMENT

A. Where new paving joins existing paving, chip the existing surfaces 12 inches back from the join line so that there will be sufficient depth to provide a minimum of 1-1/2-inches asphalt concrete. Dispose of waste material offsite. Tack coat chipped areas prior to placing the asphalt concrete. Meet lines shall be straight and the edges vertical. Paint the edges of meet line cuts with liquid asphalt or emulsified asphalt prior to placing asphalt concrete. After placing the asphalt concrete, seal the meet line by painting with a liquid asphalt or emulsified asphalt and then immediately cover with clean, dry sand.

3.03 PREPARATION OF SUBGRADE

A. Excavate and shape subgrade to line, grade, and cross section

shown in the Drawings. The subgrade shall be considered to extend over the full width of the base course.

B. Compact the top 30 inches of subgrade (trench zone) to 90 percent relative compaction.

C. The finished subgrade shall be within a tolerance of ±0.08 of a foot of the grade and cross section shown and shall be smooth and free from irregularities and at the specified relative compaction.

3.04 COMPACTION OF AGGREGATE BASE AND LEVELING COURSES

A. Begin compaction and rolling at the outer edges of the surfacing and continue toward the center. Apply water uniformly throughout the material to provide moisture for obtaining the specified compaction. Compact each layer to the specified relative compaction before placing the next layer.

3.05 APPLYING HERBICIDE OR WEED KILLER

A. Apply weed killer or herbicide on base prior to placing pavement. Apply at the rate recommended by the manufacturer to control dawny brome grass, puncture vine, and plaintain. Apply from outside of curb to opposite outside of curb and for the full width of curbless roadways and parking areas.

3.06 PLACING PRIME COAT

A. Apply prime coat to the surface of the leveling course of aggregate base at the rate of 0.25 gallon per square yard per Section 5 “Asphalt Concrete Pavement” of the Standard Specifications.

3.07 PLACING TACK COAT

A. Apply tack coat on surfaces to receive finish pavement per Section 5 “Asphalt Concrete Pavement” of the Standard Specifications. Apply tack coat to metal or concrete surfaces that will be in contact with the asphalt concrete paving.

3.08 PLACING ASPHALT PAVING

A. Place asphalt paving to a minimum thickness of 5 inches unless otherwise shown in the Drawings. Install in accordance with Section 5 “Asphalt Concrete Pavement” of the Standard Specifications. Maintain existing cross sectional slope and crown of roadway.

3.09 COMPACTION OF ASPHALT CONCRETE PAVING

A. Compact until roller marks are eliminated and a density of 92 percent minimum to 98 percent maximum has been attained per ASTM D 2041.

3.10 APPLYING SLURRY SEAL COAT

3.11 After final paving, apply slurry seal coat per Section 5 “Asphalt Concrete Pavement” of the Standard Specifications at the rate of 10 to 18 pounds of dry aggregate per square yard to the repaved section and to any area damaged by the Contractor during construction. Replace obliterated striping in kind.

3.12 SURFACE TOLERANCE

A. After paving has been installed and compacted, spray water over the entire paved area. Correct any areas where water collects and does not drain away.

END OF SECTION

SECTION 02999 TEMPORARY HANDLING OF FLOW

GENERAL

1.1 THE REQUIREMENT

A. This Section includes temporary handling of stormwater (also referred to as temporary bypass pumping) at the existing Hess Basin Channel. Temporary handling of flows (THF) includes bypass pumping, piping, plugs, and other conveyance of flows to make connections into City storm drains. Furnish all labor, materials, and equipment required for temporary handling of flow, to facilitate the Work.

   a. The Contractor (or subcontractor) performing the temporary handling of flow work, including the supply, maintenance, set-up, removal, and daily monitoring of all temporary handling of flow systems shall meet the following requirements:

      i. The Contractor shall have at least five (5) years of experience in the specialty of temporary handling of flow systems.

   b. If the Contractor is unable to meet the above requirements, employ an experienced subcontractor to perform the temporary handling of flow work who meets the above requirements.

B. Provide bypass pumping at the existing Hess Basin Cannel. Bypass pumping shall be tested and operational prior to taking existing equipment offline. All emergency tie-in points and lay down areas for the emergency pumps must be designed and installed by the Contractor and accepted by the City. The Contractor shall be able to switch over to the emergency bypass pumping system within fifteen (15) minutes of an emergency.

C. Comply with the Regional Water Quality Control Board (RWQCB), California Department of Public Health, City and County permits and regulations. Cooperate with City staff and environmental agencies.

D. The bypass setup shall be designed to convey the following stormwater flows.

STATION	FLOW
Hess Basin	20,000 gpm

E. Provide the City, with written notice at fourteen (14) calendar days in advance for all required THF.

F. Furnish and maintain on-site bypass system on-site. Bypass system is subject to the requirements of this Specification section and shall be furnished with the required primary pumps, secondary pumps, suction and discharge piping, and other appurtenances as required herein.

1.2 TEMPORARY HANDLING OF FLOW

A. Route piping to the existing Hess Basin, as directed by the City. Coordinate with the City for location of pumps and discharge piping. Furnish 300 feet of pipe with required fittings at each station and install the required amount to discharge to the location acceptable to the City.

B. A specific Plan is required for each THF operation.

C. The THF system shall be completely installed and commissioned as deemed acceptable to the City prior to performing any THF work.

D. Demolition of existing Sump Station equipment shall not begin until the THF system is commissioned.

1.3 CONTRACTOR SUBMITTALS

A. Submit documentation which demonstrates that the Contractor (or subcontractor) performing the temporary handling of flow work has at least five years of experience in the specialty of temporary handling of flow systems.

B. Prepare and thirty (30) days prior to the planned implementation of the bypass system the following for each THF system installation.

a. Plans showing the details of the temporary handling of flow.

i. For bypass pumping, the plans shall include the arrangement of temporary pumping equipment, location of suction and discharge points, arrangement of suction and discharge piping, routing of bypass piping, method of protection for equipment and piping, locations where piping is buried and exposed, and locations of pipe ramps.

b. For temporary plugging of the storm drain system, the plans shall include location of plugs. The Plans shall also include location, details and type of level sensors, and locations of support equipment such as control panels and standby power if required.

c. A detailed written description of how the Contractor will temporarily handle flow. The Work sequence shall be step-by-step and shall start with the initial conditions and describe how and when the temporary handling of flow equipment and materials will be installed and commissioned, and the time and duration of each step.

i. A description of how the THF system will be controlled and operated. Describe the method of control, the procedure and time requirements for switching to the standby equipment, and alarm notification to the Contractor and the City.

d. A description, list and shop drawings of materials and equipment for temporarily handling flows and how and where the Contractor will use the materials and equipment.

e. Names, phone numbers and resumes of staff responsible for operating, monitoring and maintaining the THF system.

f. Hydraulic calculations for each THF system shall be prepared and signed by a Civil Engineer registered in the State of California. Calculations shall include bypass pumping suction and discharge pipe sizes. The engineer shall be experienced in the hydraulics of stormwater.

g. Inspection checklist, monitoring logs, and protocol for inspecting the bypass pumping system, plugs, and flow-through plugs.

h. Pump make, model, pump curve, net positive suction head requirement, efficiency, horsepower requirement, and speed. Complete list of features and details for the bypass pumps with certified pump characteristic curves identifying the duty point (flow and head) for the system. Indicate the noise levels for the pumps and confirm that the noise levels conform to the Project noise requirements.

i. Suction pipe length, diameter, and material.

j. Discharge pipe length, diameter, material, and joint type.

k. Shop drawings for temporary storm drain plugs.

l. Total design head (TDH) calculations including minor losses, and system curve (plotted over the pump curve).

m. Shop drawings for soundproof shields and sound attenuation equipment, in compliance with the County, the City of Lemoore noise ordinances.

n. Description of local and remote alarm system. Include datasheets for level sensors, auto-dialer, audible alarm and alarm light. Provide control schematics for local alarm system. Identify method of powering the local and remote alarm system.

o. Standby generator when required for pump controls and/or alarms. Include generator make, model, rating voltage, phase, noise rating, fuel type and fuel consumption. Indicate the noise levels for the generator and confirm that the noise levels conform to the noise requirements per the Contract Documents.

p. When controls are required to operate the THF system, provide the following:

    i. Instrumentation datasheets with a calibration and setpoint table.
    ii. Description of how the system will be controlled.

iii. Control schematic.

q. Submit a detailed testing and commissioning procedure for testing the THF system.

r. Submit a noise analysis showing that the maximum noise level for THF system does not exceed the allowable noise levels.

s. For temporary buried piping, provide a plan drawing showing the routing, depth, slope (if gravity), and pipe material. Provide a cross-section showing the pipe, backfill material and surface restoration material.

C. Submit a report documenting each spill as specified herein.

D. Submit temporary engine-generator set documentation as specified in article "TEMPORARY ENGINE-GENERATOR SET(S)" of this Specification section.

1.4 QUALITY ASSURANCE

A. General:
   a. Comply with the requirements specified herein and the applicable reference sections of the General Requirements and Additional General Requirements.

B. Contractor Qualifications:
   a. Comply with the requirements for the certifications, licenses, training, skills, experience, and other qualifications specified in Part 1 of this Specification.

PART 2 - PRODUCTS

2.1 PUMPING EQUIPMENT

A. Bypass duty and standby pumps shall be designed for solids handling applications, resistant to ragging, and capable of passing a 3-inch solid sphere. Pumps shall be self-priming with suction lift sufficient to avoid surcharge. The self-priming system shall allow the pumps to start dry and run dry without causing damage.

B. Pumps may be equipped with a vacuum-assisted self-priming device.

C. All engines shall be critically silenced for sound control and shall not exceed the maximum noise level ordinances for the jurisdictions affected. The maximum allowable noise level for critically silenced pumps shall be 70 dB at 30-feet. Regardless of the noise level, soundproofing shields not less than eight (8) feet high shall be furnished, installed, and maintained around each engine to absorb noise.

D. Pumps shall have a minimum total dynamic head (TDH) and flow capacities to

meet calculated in the accepted shop drawing hydraulic calculations.

E. In calculating the total dynamic head (TDH), the maximum C value permitted is 120 for steel or aluminum pipe, and 140 for plastic pipe. Minor losses and suction pipe losses shall be included in TDH calculations.

F. Pumps shall be capable of readily starting up after a non-operational period during no-flow conditions and be capable of operating 24 hours per day, while handling the full range of flows.

G. Redundant standby pumping shall be provided. Standby pump shall be sized to match the largest duty pump. Standby pumping equipment shall be at the site continuously during bypassing to provide standby pumping capacity.

H. Standby pumping equipment shall be fully connected to the suction and discharge piping of the duty pumps so the system is available at any time.

I. Bypass and standby pumps shall be Godwin, Rain for Rent, Thompson Pump, or equal.

2.2 BYPASS PIPING

A. General:
   a. Aboveground piping shall be high-density polyethylene (HDPE) pipe, steel with grooved couplings, or aluminum pipe with grooved couplings. HDPE pipe shall be butt-welded, and have a minimum wall thickness of SDR 17. For protection against damage, the bypass pipe shall be protected with appropriate barricades and signage. Barricades shall be provided for any area within the public right of way, and traffic control shall be provided for any piping within the roadway.

   b. Piping crossing driveways shall be routed below grade or provided with temporary road crossings and protected as shown on the Drawings. Submit locations to provide a temporary road crossing for review.

B. Suction Pipes
   a. Suction pipes shall have a minimum diameter of 16 inches and shall not be smaller than the pump intake. Suction pipes shall not cause a restriction in the flow.
   b. Do not allow a surcharge exceeding two (2) feet in the manhole or structure.

C. Discharge Pipes
   a. Discharge pipes shall have a minimum diameter of 16 inches.

2.3 TEMPORARY ROAD CROSSINGS

A. Temporary road crossings shall provide as a means of allowing traffic to cross the

above-ground bypass line. Temporary road crossings shall be capable of passing an H20 traffic load.

B. Outlet tees with inlet, outlet and bypass valves shall be provided upstream and downstream of each crossing.

C. Fit road crossings with a pressure gauge on the upstream end for monitoring pressure during bypass operation.

D. A ramp bypass shall be pre-fabricated for each size of ramp provided to allow removal and cleaning of the bypass ramp in the event of blockage.

E. Ramps shall be fitted with flexible high-visibility poles or flags to clearly indicate limits of the crossing to motorists. One (1) spare road crossing of each size shall be stored on the Project site for quick replacement of duty crossing if needed.

F. Provide crossings by Rain for Rent, Baker Corp., or equal.

2.4 VALVES

A. All valves used on the bypass system shall be open port gate, plug or ball valves.

2.5 TEMPORARY PLUGGING

A. Plugs shall be appropriate for the application. Plugs shall be a heavy-duty inflatable type with a steel rod through plug centerline, a retaining plate and an eye-lift on both ends. Plugs shall be new, made of natural rubber, and shall show no cracks and/or signs of damage. The plugs shall have a flexible sealing design to compensate for any irregular interior surface of the pipe.

B. Plug seating areas shall be cleaned prior to installation from grit, grease, and other materials and shall be restrained with metal cable 2 times greater in strength than the load on the plug.

2.6 LEVEL SENSORS WITH ALARM

A. Each bypass pumping suction wet well shall be fitted with a level monitoring system connected to an audible alarm and light to monitor the water level during bypass pumping operations. The level shall be monitored by a float, ultrasonic level device, radar level device or other means suitable for monitoring stormwater level and shall be either self-powered or powered from a standby generator.
B. Level shall be set to indicate a pumping failure as early as possible. Mounting height of the level sensor shall be acceptable to the City.

2.7 AUTO-DIALER

A. All alarms shall be transmitted to both the Contractor and the City with an auto-

dialer using cellular communications.

B. The auto-dialer shall be powered from a standby generator and/or a battery system to provide a continuous power supply.

2.8 CONTROL POWER

A. Furnish, install, and maintain a continuous control power source for the alarm indicating lights, level controls, audible alarms, and auto-dialer. If a standby generator is provided, then the generator shall meet the noise requirements per the Contract Documents. All requirements for power distribution shall be provided.

2.9 TEMPORARY ENGINE-GENERATOR SET(S)

A. Diesel-fueled generator set(s) shall be provided with weatherproof andsound-attenuated enclosure, where the relative loudness of the sound meets the local jurisdiction requirement.

B. Submit the specific characteristics of the diesel-fueled generator sets intended for use on this Project.

C. Furnish, install, maintain, and connect temporary diesel-fueled generator set(s) to provide a temporary power source(s).
   a. For each set, provide a fuel tank containing no less than the one hundred fifty percent (150%) of the set's full day usage.
   b. Provide proper grounding for each fuel tank and each generator set.
   c. Verify and comply with any local jurisdiction permit requirements for fuel delivery and onsite fuel storage.

D. For each diesel-fueled generator set, pre-wire a single Form "C" dry contact, rated 2 A, 250 V ac, for each of the following two (2) signals, to an external terminal block located in a readily accessible NEMA 4X terminal box mounted at the set:
   a. A TROUBLE combined alarm signal that includes the following:
      i. Diesel-fueled generator set malfunction.
      ii. Low fuel level (less than fifty percent (50%) of the full day usage left in the fuel tank).
   b. Generator RUN status.

E. Provide automatic remote dialing to notify the Contractor's designated personnel and City's designated personnel of the diesel-fueled generator set alarm conditions specified herein.

F. Ensure reliable operation and full-time availability of the diesel-fueled generator set(s) by performing the following:

   a. Inspect the set and its components at least once a day during the wet season (November through May), including both working and non-working days, and at least once a week otherwise.

b. Continuously monitor fuel availability to each diesel-fueled generator set. Fill up the fuel tank to the maximum allowable tank capacity specified elsewhere in this Specifications section, at least once a day.

PART 3 - EXECUTION

3.1 TEMPORARY HANDLING OF FLOW

A. Do not utilize any aboveground pumping systems in the public right-of-way, without written acceptance by the City.
B. Mobilize, set-up, operate, manage, monitor, maintain, operate, pressure test, replace damaged property and pay fines that may occur for any reason.
C. When handling flows by pumping, have at least one person on-site 24 hours per day to operate, monitor and maintain the THF system. This person shall be factory-trained and certified to operate, monitor and maintain the THF system, perform maintenance on all aspects of the THF system, activate the standby equipment, and perform periodical pump de-ragging, and shall be fully capable of operating all aspects of the bypass THF system.
D. Prior to being put into service, the bypass pump(s) shall be test-run for a minimum of two (2) hours. Obtain test water from the City. All modes of controls and alarms shall be exercised at least two (2) times in the presence of the Engineer prior to being placed into service.
E. Sound attenuating acoustic blankets shall be installed to provide an additional level of sound dampening over the critically silenced pump enclosures.
F. Furnish, install, and maintain traffic barricades and temporary chain link fencing around THF operations and equipment.
G. Construct, operate, maintain, and remove, without damage to existing structures, all temporary handling of flow facilities.
H. Develop a testing and commissioning procedure for the THF system for review and acceptance as part of the shop drawing review. The testing and commissioning procedure shall start with the initial conditions and describe a step-by-step process for each test. The Work requiring no flow into the existing lift station shall not commence until after the THF system is proven adequate in accordance with the accepted test procedure. The THF system shall be fully tested prior to commencing bypass operations including, as a minimum:
    a. Pressure testing of piping to at least 50 psi prior to introducing stormwater to the line.
    b. Inspection of the pipe for leaks and repair or replacement of leaking sections.
    c. Testing of the pumping system including standby pumps for a period of no less than two (2) hours.
I. An auto-dialer shall be employed during the THF operations to detect a high-level alarm in the suction wet well.
J. Test and commission the THF system to ensure proper operation and confirm there is no leakage. The testing and commissioning shall be acceptable to the Engineer before placing the THF system online and starting lift station rehabilitation activities. When pumping is utilized and as soon as the bypass system is proved to be operating as specified, stop the pump(s) and install and operate each standby pump to test its capability and establish a switchover time.
K. Test each auto-dialer for all alarms.
L. Meet with the Engineer prior to the implementation of each THF operation. The meeting shall be conducted by the Contractor. The purpose is to review the

complete functionality of the THF system including implementation sequence, method of operation, alarming, operational contingencies, SPCCP, OAOCP, training, THF system monitoring and maintenance, and traffic control.

M. Stormwater shall be handled in a manner so as not to create a public nuisance or health hazard.

N. At the completion of the THF Work, remove all temporary piping whether aboveground or buried, all equipment, materials, and supplies; and place the system back into normal operation. The surface shall be restored to its original condition after completion of the bypassing.

O. Furnish and maintain a pre-loaded truck of filled sandbags equal to 15 cubic yards available to utilize for emergency spill management.

P. Maintain standby and emergency equipment on-site.

Q. At a minimum, furnish the following emergency response equipment along with labor and materials necessary to implement emergency use of the following items in response to an overflow or spill;

    a. Two vacuum-capable tanker trucks and personnel reserved and on standby. Such equipment shall be available to the Project for on-site response within a 30-minute advance notice over 24 hours per day for the duration of the temporary handling of flow. Each tank truck shall have a minimum 3,000-gallon capacity.

    b. Emergency bypass pump:

        i. Provide an engine-driven at-large emergency bypass pump, as specified.

        ii. Provide flexible suction piping sized for the unconnected emergency bypass pump. Length shall be adequate to pump from a storm drain inlet.

    c. A minimum of two (2) 10-foot pipe spools of each size and type of pipe used on the bypass system together with matching repair couplings. Utilize these items, or alternative repair system as accepted by the Engineer to repair any bypass piping damaged during the Work.

R. Provide the names of at least two (2) full-time personnel who can be contacted 24 hours per day by telephone and who are available to go to the Project site at any time to address on-site emergencies. Provide notification of any substitution in writing at least two (2) days in advance.

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DIVISION 03 – CONCRETE

SECTION 03200 CONCRETE REINFORCEMENT

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section includes furnishing, fabricating, and installing all concrete reinforcement steel, welded wire fabric, couplers, and concrete inserts for use in reinforced concrete construction.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01330: Shop Drawings and Submittals
B. Section 03300: Cast-In-Place Concrete
C. Section 03260: Concrete Joints and Accessories
D. Section 03600: Grout

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Codes: The Building Code, as referenced herein, shall be the 2016 California Building Code
B. Commercial Standards (as latest revised)

American ConcreteInstitute (ACI)

ACI315 - Details and Detailing of Concrete Reinforcement
ACI318 - Building Code Requirements of Reinforced Concrete
ACI350 - Code Requirements for Environmental Engineering Concrete Structures

American Society for Testing and Materials (ASTM), Latest Edition

ASTM A 82 - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement

ASTM A 615 - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement

1.04 SUBMITTALS

A. Furnish shop-bending diagrams, placing lists, and drawings of all reinforcement steel prior to fabrication in accordance with the requirements of Section 01330.

B. The Contractor shall furnish shop bending drawings, placing lists, bar splices and drawings of all reinforcing steel and concrete inserts prior to fabrication. Each bending list submitted shall be complete, including corner bars as required. Furnishing such list shall not be constructed that the list will be reviewed for accuracy. The CONTRACTOR shall be fully responsible for accuracy of dimensions and details, and said dimension and details will be checked in the field by the ENGINEER at the time of placement. Said details of reinforcement steel for fabrication and erection shall conform to ACI 315 and the requirements indicated. The shop bending diagrams shall show the actual lengths of bars, to the nearest inch

measured to the intersection of the extensions (tangents for bars of circular cross section) of the outside surface.

C. Where mechanical couplers are required or permitted to be used to splice reinforcement steel, submit manufacturer's literature which contains instructions and recommendations for installation for each type of coupler used; certified test reports which verify the load capacity of each type and size of coupler used; and shop drawings which show the location of each coupler with details of how they are to be installed in the formwork.

D. If reinforcement steel is spliced by welding at any location, submit mill test reports which shall contain the informationnecessary for the determination of the carbon equivalent as specified in AWS D1.4. Submit a written welding procedure for each type of weld for each size of bar which is to be spliced by welding; merely a statement that AWS procedures will be followed is not acceptable.

E. Mill test certificates shall be submitted to the ENGINEER to certify that the reinforcing steel meets the specified requirements.

1.05 QUALITY ASSURANCE

1. If requested by the ENGINEER, furnish samples from each heat of reinforcement steel delivered in a quantity adequate for testing. Costs of initial tests will be paid by the OWNER. Costs of additional tests due to material failing initial tests shall be paid by the CONTRACTOR.

2. If reinforcement steel is spliced by welding at any location, submit certifications of procedure qualifications for each welding procedure used and certification of welder qualifications, for each welding procedure, and for each welder performing the Work. Such qualifications shall be as specified in AWS D1.4.

3. If requested by the ENGINEER, furnish samples of each type of welded splice used in the Work in a quantity and of dimensions adequate for testing. At the discretion of the ENGINEER, radiographic testing of direct butt-welded splices will be performed. Provide assistance necessary to facilitate testing. Repair any weld which fails to meet the requirements of AWS 01.4. The costs of testing will be paid by the OWNER; except, the costs of all tests which fail to meet specified requirements shall be paid by the CONTRACTOR at no increase in cost to the OWNER or City.

4. Concrete reinforcement placement shall be specially inspected per the 2016 California Building Code, table 1704.4

PART 2 - PRODUCTS

2.01 REINFORCEMENT STEEL

A. Reinforcement steel for all cast-in-place reinforced concrete construction shall conform to the following requirements:

1. Bar reinforcement shall conform to the requirements of ASTM A 615 for Grade 60 Billet Steel Reinforcement or as otherwise indicated.

2. Welded wire fabric reinforcement shall conform to the requirements of ASTM A 185 and the details indicated; provided, that welded wire fabric with longitudinal wire of W4 size wire and smaller shall be either provided in flat sheets or in rolls with a core diameter of not less than 10 inches; and provided further, that welded wire fabric with longitudinal wires larger than W4 size shall be provided in flat sheets only.

3. Spiral reinforcement shall be cold-drawn steel wire conforming to the requirements of ASTM A 82.

B. Accessories

1. Accessories shall include all necessary chairs, slab bolsters, concrete blocks, tie wires, clips, supports, spacers, and other devices to position reinforcement during concrete placement.

2. Bar supports shall conform to ACI 315.

3. Tie wires shall be 16-guage minimum, black, soft annealed.

4. All reinforcement shall be retained in place true to indicated lines and grades, by the use of approved high density "adobes", stainless steel chairs or plastic spacers and shim plates (to support spacers for floor and footing reinforcing). High-density adobes shall, as a minimum, be no less in compressive strength or cement content in which it will be cast. Adobes manufactured from plastic or cement content will not be accepted. Brick, broken, concrete masonry units, spalls, rocks or similar materials shall not be used for support of reinforcing steel.

5. Plastic spacers shall be Preco Barspan Wheels, as manufactured by the Preco Corporation (Telephone: 1-800-645-1258), Space Wheel, as supplied by Altlas Construction Supply, Inc., or equal.

6. The portions of all accessories in contact with the formwork shall be made of concrete, plastic, or steel coated with a 1/8-inch minimum thickness of plastic, which extends at least *1'2* inch from the concrete surface. Plastic shall be gray in color.

2.02 MECHANICAL COUPLERS

A. Mechanical couplers shall be provided where

indicated and where approved by the ENGINEER. The couplers shall develop a tensile strength which exceeds 125 percent of the yield strength of the reinforcement bars being spliced at each splice.

B. Where the type of coupler used is composed of more than one component, all components required for a complete splice shall be supplied. This shall apply to all mechanical splices, including those splices intended for future connections.

C. The reinforcement steel and coupler used shall be compatible for obtaining the required strength of the connection. Straight threaded type couplers shall require the use of the next larger size reinforcing bar or shall be used with reinforcing bars with specially forged ends which provide upset threads which do not decrease the basic cross section ofthe bar.

D. Couplers shall be Lenton Form Saver as manufactured by Erico Products; Dowel Bar Splicer System as manufactured by Richmond Screw Anchor Company; or equal.

2.03 WELDED SPLICES

A. Welded splices shall be provided where indicated and where approved by the ENGINEER. All welded splices of reinforcement steel shall develop a tensile strength which exceeds 125 percent of the yield strength of the reinforcement bars which are connected.

B. All materials required to conform the welded splices to the requirements of AWS D1.4 shall be provided.

2.04 EP OXYGROUT

A. Epoxy for grouting reinforcing bars shall be specifically formulated for such application, for the moisture condition, application temperature, and orientation of the hole to be filled. Epoxy grout shall meet the requirements found in Section 03600 Grout.

PART 3 - EXECUTION

3.01 GENERAL

A. All reinforcing steel and other appurtenances shall be fabricated and placed in accordance with the requirements specified herein, and as indicated on the Plans.

3.02 FABRICATION

A. Reinforcement steel shall be accurately formed to the dimensions and shapes shown, and the fabricating details shall be prepared in accordance with ACI 315 and ACI 318, except as modified by the plans.

B. Stirrups and tie bars shall be bent around a pin having a diameter not less than 1-1/2 inch for No.3 bars, 2-inch for No. 4 bars, and 2-1/2 inchfor No. 5 bars. Bends for other bars shall be made around a pin having a diameter not less than six times the minimum thickness, except for bars larger than 1 inch, in which case the bends shall be made around a pin of 8 bar diameters.

C. The Contractor shall fabricate reinforcement bars for structures in accordance with bending diagrams, placing lists, and placing drawings.

3.03 PLACING

A. Reinforcement steel shall be accurately positioned as shown, and shall be supported and wired together to prevent displacement. Thesupports shall be of sufficient strength and stability to maintain the reinforcement in place throughout the concreting operations. Supports must be completely concealed in the concrete and shall not discolor or otherwise mar the surface of the concrete. Where concrete is to be placed on the ground, supporting concrete blocks (or adobes) shall be used, in sufficient numbers to support the bars without settlement, but in no case shall such support be continuous. All concrete blocks used to support reinforcement steel shall be tied to the steel with wire ties, which are embedded in the blocks.

B. Tie wires shall be bent away from the forms in order to provide the specified concrete coverage.

C. Bars additional to those shown which may be found necessary or desirable by the Contractor for the purpose of securing reinforcement in position shall be provided by the Contractor at its own expense.

D. Placing Tolerances: Unless otherwise specified, reinforcement placing tolerances shall be within the limits specified in Section 7.5 of ACI 318 except where in conflict with the requirements of the Building Code.

E. Bars may be moved as necessary to avoid interference with other reinforcement steel, conduits, or embedded items. If bars are moved more than one bar diameter, or enough to exceed the above tolerances, the resulting arrangement of bars shall be as acceptable to the Engineer.

F. Place reinforcing steel a minimum of 2-inches clear of any

metal pipe or fittings.

3.04 SPLICING

A. Reinforcement bar splices shall only be used at locations shown. When it is necessary to splice reinforcement at points other than where shown, the character of the splice shall be as acceptable to the Engineer. Splices in adjacent bars shall be staggered at least 8 feet unless otherwise noted.

B. Unless specified or shown otherwise, the bars at a lap splice shall be in contact with each other.

C. The length of the lap for reinforcement bars, unless otherwise shown, shall be in accordance with ACI 318 for a Class B splice. In no case shall the lap be less than 40 diameters of the spliced bars.

D. Unless shown otherwise, where bars are to be lapped spliced at joints in the concrete, all bars shall project from the concrete first placed, a minimum length equal to the lap splice length indicated. All concrete or other deleterious coating shall be removed from dowels and other projecting bars by wire brushing or sandblasting before the bars are embedded in subsequent concrete placement.

3.05 BENDING OR STRAIGHTENING

A. Steel bending process shall conform to the requirements of ACI 318.

B. Reinforcement shall not be straightened or rebent in a manner that will injure the material.

C. Bars with kinks or bends not shown shall not be used.

D. All bars shall be bent cold.

E. No bars partially embedded in concrete shall be field-bent except as shown or specifically permitted by the Engineer.

3.06 REINFORCEMENT AROUND OPENINGS

A. Where reinforcing steel has to be cut to permit passage of pipe or to create openings, additional reinforcing shall be as detailed on the Plans.

3.07 CLEANING AND PROTECTION

A. Reinforcement steel shall at all times be protected from conditions conducive to corrosion until concrete is placed around it.

B. The surfaces of all reinforcement steel and other metalwork to be in contact with concrete shall be thoroughly cleaned of all dirt, grease, loose mill scale and rust, grout, mortar and other foreign substances immediately before the concrete is placed. Where there is delay in depositingconcrete, reinforcement shall be reinspected and, if necessary recleaned.

C. Steel reinforcement placed in the work shall be stored under cover to prevent rusting and shall be placed on blocking such that no steel touches any ground surface.

END OF SECTION

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SECTION 03260 CONCRETE JOINTS AND ACCESSORIES

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. This section includes joints in concrete at the locations indicated, complete.

1.02 RELATED WORK SPECIFICIED ELSEWHERE

A. SECTION 01300- Shop Drawings and Submittals

B. Section 03300- Cast-in-Place Concrete

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Federal Specifications

1. TT-S-0227E(3) Sealing Compound, elastomeric type, Multi• component for Caulking, Sealing, and Glazing Buildings and Other Structures).

B. U.S. Army Corps of Engineers Specifications

1. CRD-C572PVC Waterstop. C.

Commercial Standards (Latest Edition)

1. ASTM A 775 Specification for Epoxy-Coated Reinforcing Steel Bars

2. ASTM C 920 Specification for Elastomeric Joint Sealants

3. ASTM D 412 Test Methods for Rubber Properties in Tension

4. ASTM D 624 Test Method for Rubber Property- Tear Resistance

5. ASTM D 638 Test Method for Tensile Properties of Plastics

6. ASTM D 746 Test Method for Brittleness Temperature of Plastics and Elastomers by Impact

7. ASTM D 747 Test Method for Apparent Bending Modulus of Plastics by Means of a Cantilever Beam

8. ASTM D 1056 Specification for Flexible Cellular Materials Sponge or Expanded Rubber

9. ASTM D 1752 Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction

10. ASTM D 2240 Hardness Test Method for Rubber Property—Durometer Hardness

1.04 TYPES OF JOINTS

A. Construction Joints: When fresh concrete is placed against a hardened concrete surface, the joint between the two pours is called a construction joint. Unless otherwise indicated, all joints in water bearing members shall be provided with a waterstop and/or sealant groove of the shape indicated. The surface of the first pour may also be required to receive a coating of bond breaker as indicated.

B. Contraction Joints: Contraction joints are similar to construction joints except that the fresh concrete shall not bond to the hardened surface of the first pour, which shall be coated with a bond breaker. The slab reinforcement shall be stopped 4 1/2 inches from the joint; which is provided with a sleeve- type dowel, to allow shrinkage of the concrete of the second pour. Waterstop and/or sealant groove shall also be provided when indicated.

C. Control Joints: The function of the control joint is to provide a weaker plane in the concrete, where shrinkage cracks will probably occur. A groove, of the shape and dimensions indicated, is formed or saw-cut in the concrete. This groove is afterward filled with a joint sealant material as indicated below.

1.05 SUBMITTALS

A. Waterstops: Prior to production of the material required under this contract, qualification samples shall be submitted. Such samples shall consist of extruded or molded sections of each size or shape to be used, and shall be accomplished so that the material and workmanship represents in all respects the material to be provided under this contract. The balance of the material to be used under this contract shall not be produced until after the ENGINEER has reviewed the qualification samples.

B. Joint Sealant: Prior to ordering the sealant material, submit for the ENGINEER'S review sufficient data to show general compliance with the requirements of the Contract Documents.

C. Certified test reports from the sealant manufacturer on the actual batch of material being supplied indicating compliance with the above requirements shall be furnished the ENGINEER before the sealant is used on the job.

D. Shipping Certification: Furnish written certification from the manufacturer as an integral part of the shipping form, to show that all of the material shipped to this project meets or exceeds the physical property requirements of the Contract Documents. Supplier certificates are not acceptable.

E. Joint Location: Submit placement shop drawings showing the location and type of all joints for ENGINEER's approval.

F. Copies of Waterstop Welding Certification: To be provided by manufacturer or authorized agent of manufacturer. Every person who is to be involved with waterstop installation is required to have individual Certification on file with ENGINEER, which states said individuals are certified and trained to install waterstop per manufacturer's recommendations and specifications.

G. Manufacturer's information demonstrating compliance of the following with indicated requirements:

1. Preformed joint filler.

2. Backing rod.

3. Bond breaker.

4. Waterstop.

H. Provide written Guarantee per Part 1.08

1.06 QUALITY ASSURANCE

A. Waterstop Inspection: It is required that all waterstop field joints shall be subject to rigid inspection, and no such work shall be scheduled or started without having made prior arrangements with the ENGINEER to provide for the required inspections. Not less than 24 hours' notice shall be given to the ENGINEER for scheduling such inspections.

B. All field joints in waterstops shall be subject to rigid inspection for misalignment, bubbles, inadequate bond, porosity, cracks, offsets, and other defects which would reduce the potential resistance of the material to water pressure at any point. All defective joints shall be replaced with material which shall pass said inspection, and all faulty material shall be removed from the

site and disposed of by the CONTRACTOR at no additional cost to the City.

C. The following waterstop defects represent a partial list of defects which shall be grounds for rejection:

1. Offsets at joints greater than 1/16 inch or 15 percent of material thickness, at any point, whichever is less.

2. Exterior crack at joint, due to incomplete bond, which is deeper than 1/16 inch or 15 percent of material thickness, at any point, whichever is less.

3. Any combination of offset or exterior crack which will result in a net reduction in the cross section of the waterstop in excess of 1/16- inch or 15 percent of material thickness at any point, whichever is less.

4. Misalignment of joint which result in misalignment of the waterstop in excess of 1/2 inch in 10 feet.

5. Porosity in the welded joint as evidenced by visual inspection.

6. Bubbles or inadequate bonding which can be detected with a penknife test. If, while prodding the entire joint with the point of a pen knife, the knife breaks through the outer portion of the weld into a bubble, the joint shall be considered defective.

7. Visible signs of separation when the cooled splice is bent by hand at any sharp angle.

8. Any evidence of burned material.

D. Waterstop Samples: Prior to use of the waterstop material in the field, a sample of a prefabricated (shop-made) mitered cross and a tee constructed of each size or shape of material to be used shall be submitted to the ENGINEER for review. These samples shall be prefabricated (shop-made) so that the material and workmanship represent in all respects the fittings to be provided under this contract. Field samples of prefabricated (shop- made) fittings (cross, tee, etc.) will be selected at random by the City or City's Representative for testing by a laboratory at the City's expense. When tested, they shall have a tensile strength across the joints equal to at least 600 psi.

1.07 CONSTRUCTION JOINT SEALANT

A. Prepare adhesion and cohesion test specimens as indicated, at intervals of 5 working days while sealants are being installed.

B. The sealant material shall show no signs of adhesive or

cohesive failure when tested in accordance with the following procedure in laboratory and field tests:

1. Sealant specimen shall be prepared between two concrete blocks (1 inch by 2 inches by 3 inches). Spacing between the blocks shall be 1 inch. Coated spacers (2 inches by 1 1/2 inches by 1/2 inch) shall be used to insure sealant cross-sections of 1/2 inch by 2 inches with a width of 1-inch.

2. Sealant shall be cast and cured according to manufacturer's recommendations except that curing period shall be not less than 24 hours.

3. Following curing period, the gap between blocks shall be widened to 1 1/2 inch. Spacers shall be used to maintain this gap for 24 hours prior to inspection for failure.

1.08 GUARANTEE

A. Furnish a 5 year written guarantee of the entire sealant installation against faulty and/or incompatible materials and workmanship, together with a statement that the CONTRACTOR agrees to repair or replace, to the satisfaction of the City, at no additional cost to the City, any such defective areas which become evident within said 5 year guarantee period.

PART 2- PRODUCTS

2.01 PVC WATERSTOPS

A. General: Waterstops shall be extruded from an elastomeric polyvinyl chloride compound containing the plasticizers, resins, stabilizers, and other materials necessary to meet the requirements of these Specifications. No reclaimed or scrap material shall be used. Obtain from the waterstop manufacturer and furnish to the ENGINEER for review, current test reports dated within the last 3 years and a written certification of the manufacturer that the material to be shipped to the job meets the physical requirements as outlined in the U.S. Army Corps of Engineers Specification CRD C572 and those listed herein.

B. Flatstrip and Center-Bulb Waterstops: Flatstrip and center-bulb waterstops shall be as manufactured by: Earth Shield, Lake Elsinore, CA; Progress Unlimited, Inc., New York, New York; Greenstreak Plastic Products Co., St. Louis, Missouri; or equal; provided, that at no place shall the thickness of flat strip waterstops, including the center bulb type, be less than 3/8 inch.

C. Waterstop Testing Requirements: When tested in accordance with the

standards, the waterstop material shall meet or exceed the following requirements:

Physical Property, Sheet Material	**Value**	**ASTM Std.**
Tensile Strength-min (psi)	2,000	D 638, Type IV
Ultimate Elongation-min (percent)	350	D 638, Type IV
Low Temp Brittleness-max (degrees F)	-35	D 746
Stiffness in Flexure-min (psi)	600	D 747
Accelerated Extraction (CRD-C572)		
Tensile Strength-min (psi)	1,500	D 638, Type IV
Ultimate Elongation-min (percent)	300	D 638,Type IV
Effect of Alkalies (CRD-C572)		
Change in Weight (percent)	+0.25/-0.10	------
Change in Durometer, Shore A	+5	D 2240
Finish Waterstop		
Tensile Strength-min (psi)	1,400	D 638, Type IV
Ultimate Elongation-min (percent)	280	D 638, Type IV

2.02 JOINT SEALANT

A. Joint sealant shall be polyurethane polymer designed for bonding to concrete which is continuously submerged in water. No material will be acceptable which has an unsatisfactory history as to bond or durability when used in the joints of water retaining structures.

B. Joint sealant material shall meet the following requirements (73 degrees F and 50 percent R.H.):

Work Life	45 - 180 minutes
Time to Reach 20 Shore "A" Hardness (at 77 degrees F, 200 gr quantity)	24 hours, maximum
Ultimate Hardness (ASTM D 2240)	20 - 45 Shore "A"
Tensile Strength (ASTM D 412)	200 psi, minimum
Ultimate Elongation (ASTM D 412)	400 percent, minimum
Tear Resistance (Die C ASTM D 624)	75 pounds per inch of thickness, minimum
Color	Light Grav

C. All polyurethane sealants for waterstop joints in concrete shall conform to the following requirements:

1. Sealant shall be two-part polyurethane with the physical properties of the cured sealant conforming to or exceeding the requirements of ANSI/ASTM C 920 or Federal Specification TT-S-0227 E(3) for two-part material, as applicable.

2. For vertical joints and overhead horizontal joints, only "nonsag" compounds shall be used; all such compounds shall conform to the requirements of ANSI/ASTM C 920 Class 25, Grade NS, or Federal Specification TT S 0227 E(3), Type II, Class A.

3. For plane horizontal joints, the self-leveling compounds which meet the requirements of ANSI/ASTM C 920 Class 25, Grade P, or Federal Specification TT-S-0227 E(3), Type I shall be used. For joints subject to either pedestrian or vehicular traffic, a compound providing nontracking characteristics, and having a Shore "A" hardness range of 35 to 45, shall be used.

4. Primer materials, if recommended by the sealant manufacturer, shall conform to the printed recommendations of the sealant manufacturer.

D. All sealants, wherever shown, or required hereunder shall be PSI 270 as manufactured by Polymeric Systems Inc.; Elastothane 227R as manufactured by Pacific Polymers; Sikaflex 2C, as manufactured by Sika Corporation; or equal.

E. Sealants for nonwaterstop joints in concrete shall

conform to the requirements of Section 07900 Joint Sealers.

2.03 JOINT FILLER

A. Joint filler for expansion joints in waterholding structures shallbe neoprene conforming to ASTM D 1056,Type 2C5-E1.

B. Joint filler material in other locations shall be of the preformed nonextruding type joint filler constructed of cellular neoprene sponge rubber or polyurethane of firm texture. Bituminous fiber type will not be permitted. All nonextruding and resilient-type preformed expansion joint fillers shall conform to the requirements and tests set forth in ASTM D 1752 for Type I, except as otherwise indicated.

2.04 BACKING ROD

A. Backing rod shall be an extruded closed-cell, polyethylene foam rod. The material shall be compatible with the joint sealant material used and shall have a tensile strength of not less than 40 psi and a compression deflection of approximately 25 percent at 8 psi. The rod shall be 1/8 inch larger in diameter than the joint width except that a 1-inch diameter rod shall be used for a %-inch wide joint.

2.05 BOND BREAKER

A. Bond breaker shall be Super Bond Breaker as manufactured by Burke Company, San Mateo, California; Select Cure CRB as manufactured by Select Products Co., Upland, California; or equal. It shall contain a fugitive dye so that areas of application will be readily distinguishable.

PART 3 ·EXECUTION

3.01 INSTALLATION OF WATERSTOPS

A. The waterstop shall be correctly positioned in the forms so that the center of the waterstop is located as indicated on the Drawings. Waterstops shall be inspected during placement of concrete. If the waterstop moves, it shall be reset by the CONTRACTOR at his expense.

B. In cases where performed joint material is used in conjunction with the waterstop, allowance shall be made for equal waterstop embedment on each side in the concrete.

C. Waterstop shall be held in pace in the forms by use of a split form or other approved method that will positively hold the waterstop in

the correct position and to the correct alignment. Horizontal waterstops shall be bent up during placing of concrete until the concrete has been brought to the level of the waterstop; additional concrete shall then be placed over the waterstop, after which the concrete shall be thoroughly vibrated.

D. All horizontal and vertical waterstops, which are not accessible during pouring, shall be tied off in two directions every 12 inches in such a manner that bending over one way or another is prevented.

E. A hog-ring may be driven through both ends of the waterstop to facilitate placing and tying of waterstops to reinforcing steel forms or form-ties.

F. When any waterstop is installed in the concrete on one side of a joint, while the other half or portion of the waterstop remains exposed to the atmosphere for more than 2 days, suitable precautions shall be taken to shade and protect the exposed waterstop from direct rays of the sun during the entire exposure and until the exposed portion of the waterstop is embedded in concrete.

3.02 SPLICES IN WATERSTOPS

A. All waterstops shall be properly spliced and joints shall be checked for strength and pinholes after splicing.

B. All waterstops shall be fully continuous for the extent of the joint. Splices necessary to provide such continuity shall be accomplished in conformance to printed instructions of manufacturer of the waterstop. Splices shall be strong enough to develop a pulling force of 75 percent of the strength of the waterstop, and shall be watertight.

C. Factory made splices shall be furnished and installed for all waterstop intersections including vertical 90 degree bends, horizontal ties and crosses and as indicated on the Drawings.

D. Butt joints of the ends of two identical waterstop sections may be made while the material is in the forms.

E. All joints with waterstops involving more than two ends to be jointed together, and all joints which involve an angle cut, alignment change, or the joining of two dissimilar waterstop sections shall be prefabricated prior to placement in the forms, allowing not less than 24-inch long strips of waterstop material beyond the joint. Upon being inspected and approved, such prefabricated waterstop joint assemblies shall be installed in the

forms and the ends of the 24-inch strips shall be butt welded to the straight run portions of waterstop in place in the forms.

3.03 JOINT CONSTRUCTION

A. Setting Waterstops: In order to eliminate faulty installation that may result in joint leakage, particular care shall be taken of the correct positioning of the waterstops during installation. Adequate provisions must be made to support and anchor the waterstops during the progress of the Work and to insure the proper embedment in the concrete. The symmetrical halves of the waterstops shall be equally divided between the concrete pours at the joints. The center axis of the waterstops shall be coincident with the joint openings. Maximum density and imperviousness of the concrete shall be insured by thoroughly working it in the vicinity of all joints.

B. In placing PVC waterstops in the forms, means shall be provided to prevent them from being folded over by the concrete as it is placed. Unless otherwise indicated, all waterstops shall be held in place with light wire ties on 12 inch centers which shall be passed through the edge of the waterstop and tied to the curtain of reinforcing steel. Horizontal waterstops, with their flat face in a vertical plane, shall be held in place with continuous supports to which the top edge of the waterstop shall be tacked. In placing concrete around horizontal waterstops, with their flat face in a horizontal plane, concrete shall be worked under the waterstops by hand so as to avoid the formation of air and rock pockets.

C. In placing centerbulb waterstops in expansion joints, the centerbulb shall be centered on the joint filler material.

D. Waterstop in vertical wall joints shall stop 6 inches from the top of the wall where such waterstop does not connect with any other waterstop and is not to be connected to for a future concrete placement.

E. Joint Location: Construction joints, and other types of joints, shall be provided where indicated. When not indicated, construction joints shall be provided at 25 foot maximum spacing for all concrete construction, unless noted otherwise. Where joints are indicated spaced greater than 40 feet apart, additional joints shall be provided to maintain the 25 foot maximum spacing. The location of all joints, of any type, shall be submitted for acceptance by the ENGINEER.

F. Joint Preparation: Special care shall be used in preparing concrete surfaces at joints where bonding between two sections of concrete is required. Unless otherwise indicated, such bonding will be required at all horizontal joints in walls. Surfaces shall be prepared

in accordance with the requirements of Section 03300. Except on horizontal wall construction joints, wall to slab joints or where otherwise indicated, at all joints where waterstops are required, the joint face of the first pour shall be coated with a bond breaker as indicated herein.

G. Construction Joint Sealant: Construction joints in water-bearing floor slabs, and elsewhere as indicated, shall be provided with tapered grooves which shall be filled with a construction joint sealant. The material used for forming the tapered grooves shall be left in the grooves until just before the grooves are cleaned and filled with joint sealant. After removing the forms from the grooves, alllaitance and fins shall be removed, and the grooves shall be sand-blasted. The grooves shall be allowed to become thoroughly dry, after which they shall be blown out; immediately thereafter, they shall be primed, bond breaker tape placed in the bottom of the groove, and filled with the construction joint sealant. The primer used shall be supplied by the same manufacturer supplying the sealant. No sealant will be permitted to be used without a primer. Care shall be used to completely fill the sealant grooves. Areas designated to receive a sealant fillet shall be thoroughly cleaned, as outlined for the tapered grooves, prior to application of the sealant.

H. The primer and sealant shall be placed strictly in accordance with the printed recommendations of the manufacturer, taking special care to properly mix the sealant prior to application. The sides of the sealant groove shall not be coated with bond breaker, curing compound, or any other substance which would interfere with proper bonding of the sealant. All sealant shall achieve final cure at least 7 days before the structure is filled with water.

I. All sealant shall be installed by a competent waterproofing specialty contractor who has a successful record of performance in similar installations. Before Work is commenced, the crew doing the Work shall be instructed as to the proper method of application by a representative of the sealant manufacturer.

J. Thorough, uniform mixing of two-part, catalyst-cured materials is essential; special care shall be taken to properly mix the sealer before its application. Before any sealer is placed, arrange to have the crew doing the Work carefully instructed as to the proper method of mixing and application by a representative of the sealant manufacturer.

K. Any joint sealant which, after the manufacturer's recommended curing time for the job conditions of the Work hereunder, fails to fully and properly cure shall be completely removed; the groove

shall be thoroughly sandblasted to remove all traces of the uncured or partially cured sealant and primer, and shall be resealed with the indicated joint sealant. All costs of such removal, joint treatment, resealing, and appurtenant work shall be at no additional cost to the City.

END OF SECTION

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SECTION 03300 CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.01 DESCRIPTION

A. The section describes methods and material for providing cast-in-place structural concrete for lift station structure including forming, mixing, placing, curing, repairing and finishing.

B. Concrete for control building, perimeter wall footing, and other miscellaneous construction shall conform to the requirements in the Greenbook.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01300: Shop Drawings and Submittals
B. Section 03200: Concrete Reinforcement
C. Section 03260: Concrete Joints and Accessories
D. Section 04220: Concrete Unit Masonry

1.03 REFERENCED SPECIFICATIONS, CODES AND STANDARDS

a. Codes
   i. The Building Code, as referenced herein, shall be the 2016 California Building Code
   ii. ACI 318-14 - Building Code Requirements for Reinforced Concrete
   iii. ACI 350-06 - Code Requirements for Environmental Engineering Concrete Structures

b. Federal Specifications
   i. UU-B-790A (Int. Amd. 1) Building Paper, Vegetable Fiber (Kraft, Waterproofed, Water Repellant and Fire Resistant)

c. Commercial Standards

American Concrete Institute (ACI), latest edition

- ACI 301 - Specifications for Structural Concrete for Buildings
- ACI 304 - Guide for Measuring, Mixing, Transporting and Placing Concrete
- ACI 306 - Cold Weather Concreting
- ACI 309 - Consolidation of Concrete
- American Society for Testing and Materials (ASTM), latest edition
- ASTM C31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field
- ASTM C33 - Standard Specification for Concrete Aggregates
- ASTM C39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
- ASTM C94 - Standard Specification for Ready-Mixed Concrete
- ASTM C143 - Test Method for Slump of Hydraulic Cement Concrete
- ASTM C150 - Standard Specification for Portland Cement
- ASTM C156 - Test Method for Water Retention by Concrete Curing Materials
- ASTM C173 - Test Method for Air Content of Freshly Mixed Concrete by the

Volumetric Method
- ASTM C192 - Practice for Making and Curing Concrete Test Specimens in the Laboratory
- ASTM C231 - Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
- ASTM C233 - Test Method for Air-Entraining Admixtures for Concrete
- ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete
- ASTM C306 - Method of Test for Compressive Strength of Chemical-Resistant Resin Mortars
- ASTM C494 - Standard Specification for Chemical Admixtures for Concrete
- ASTM C778 - Standard Specification for Standard Sand
- ASTM C881 - Standard Specification for Epoxy-Resin Based Bonding Systems for Concrete

d. Standard Specifications for Public Works Construction, 2018 Edition (Greenbook).

1.04 SUBMITTALS

The following shall be submitted:

A. Aggregates: Provide certificate of aggregate compliance with ASTM C33 and source of supply and location of all materials.

B. Provide notarized mill certificates from the cement manufacturer indicating that the portland cement used in the concrete complies with ASTM C150.

C. Concrete Mix Design: Prior to beginning the work, the Contractor shall submit to the Engineer, for review, preliminary concrete mix designs that shall show the proportions and gradations of all materials proposed for concrete specified herein in accordance with Contractor Submittals. The mix designs shall be designed by an independent testing laboratory acceptable to the Engineer. Costs for mix design are the responsibility of the Contractor.

D. Ready Mix Concrete: Provide delivery tickets or weightmaster certificate per ASTM C94 indicating weight of aggregates, sand, cement, admixtures and water and the number of cubic yards of concrete furnished, which will be compared against the approved mix design.

E. Concrete Admixtures: Provide the manufacturer's catalog information and certificate of compliance with these Specifications.

F. Nonshrink Grout: Provide the manufacturer's data, certificate of compliance and specific instructions for use.

G. Forming

1. The Contractor shall be solely responsible for the adequacy of the forming, shoring and bracing design, and shall be designed by a California-registered engineer.

2. Stamped drawings and calculations shall be submitted for the City's records but will not be reviewed by the Engineer for suitability or technical accuracy.

1.05 QUALITY ASSURANCE

A. General

1. Tests on component materials and for compressive strength and shrinkage of concrete will be performed as specified herein. Test for determining slump will be in accordance with the requirements of ASTM C 143.

2. The cost of all laboratory tests for qualification of mix designs on cement, aggregates, and concrete, including strength and shrinkage testing will be borne by the CONTRACTOR. The cost of all field testing during construction on cement, aggregate and subsequent concrete including strength and shrinkage will be borne by the CONTRACTOR. However, the CONTRACTOR will be charged for the cost of any additional tests and investigation on work performed which does not meet the Specifications. The laboratory must meet or exceed the requirements of ASTM C 1077.

3. Concrete for testing shall be supplied by the CONTRACTOR at no cost to the City, and the CONTRACTOR shall provide assistance to the ENGINEER in obtaining samples, and disposal and cleanup of excess material.

B. Concrete Tests

1. Mold and cure cylinders in accordance with ASTM C31.

2. Compression tests shall conform to ASTM C39 and ASTM C192.

3. Slump test shall conform to ASTM C143.

4. Concrete delivered at site shall also be tested for air-entrainment per ASTM C173.

C. Evaluation and Acceptance of Concrete

1. Evaluation and acceptance of the compressive strength of concrete shall be according to the requirements of ACI 318, Chapter 5 "Concrete Quality," and as specified herein.

2. A statistical analysis of compression test results will be performed according to the requirements of ACI 214. The standard deviation of the test results shall not exceed 640 psi, when ordered at equivalent water content as estimated by slump.

3. If any concrete fails to meet these requirements, immediate corrective action shall be taken to increase the compressive strength for all subsequent batches of

the type of concrete affected.

4. When the standard deviation of the test results exceeds 640 psi, the average strength for which the mix is designed shall be increased by an amount necessary to satisfy the statistical requirement that the probability of any test being more than 500 psi below or the average of any three consecutive tests being below the specified compressive strength is 1 in 100. The required average strength shall be calculated by Criterion No. 3 of ACI 214 using the actual standard of deviation.

5. All concrete which fails to meet the ACI requirements and these Specifications, is subject to removal and replacement at no additional cost to the City.

D. Shrinkage Tests

1. Drying shrinkage tests will be made for the trial batch specified in the paragraph 2.11, the first placement of each class of concrete, and during construction to insure continued compliance with these specifications.

2. Drying Shrinkage specimens shall be 4" x 4" x 11" prisms with an effective gauge length of 10-inches fabricated, cured, dried, and measured in the manner outlined in ASTM C157 and modified as follows: Specimens shall be removed from molds at an age of 23±1 hours after trial batching, shall be placed immediately in water at 73°±3°F for at least 30 minutes, and shall be measured within 30 minutes thereafter to determine original length and then submerged in saturated lime water at 73°±3°F. Measurement to determine expansion expressed as a percentage of original length shall be made at age 7 days. This length at age 7 days shall be the base length for drying shrinkage calculations. Specimens then shall be stored immediately in a humidity control room maintained at 73°±3°F and 50% ± 4% relative humidity for the remainder of the test. Measurements to determine shrinkage expressed as percentage of base length shall be made and reported separately for 7, 14 & 21 days of drying after 7 days of moist curing.

3. The maximum concrete shrinkage for specimens cast in the laboratory from the trial batch, as measured at 21-day drying age or at 28-day drying age shall be 0.036 percent or 0.042 percent respectively. The Contractor shall only use a mixed design for construction that has first met the trial batch shrinkage requirements.

4. The maximum concrete shrinkage for specifics cast in the field shall not exceed the trial batch maximum shrinkage requirements by more than 20 percent.

5. If the required shrinkage limitation is not met during construction, the Contractor shall take any or all the following actions, at no additional cost to the City, for securing the specified shrinkage requirements. These actions may include changing the source of aggregates, cement and/or admixtures; reducing water content; washing of aggregate to reduce fines; increasing the number of construction joints; modifying the curing requirements; or other actions designed to minimize shrinkage or the effect of shrinkage.

E. Construction Tolerances: Set and maintain concrete forms and perform finishing operations so as to ensure that the completed Work is within the tolerances specified herein. Surface defects and irregularities are defined as finishes and are to be distinguished from tolerances. Tolerance is the specified permissible variation from lines, grades, or dimensions shown. Where tolerances are not stated in the Specifications, permissible deviations will be in accordance with ACI 117.

1. The following non-cumulative construction tolerances are hereby established and apply to finished walls and slab unless otherwise shown:

Item	**Tolerance**
Variation of the constructed linear outline from the established position in plan	In 10 feet: 1/4-inch; In 20 feet or more: 1/2- inch
Variation from the level or from the grades shown	In 10 feet: 1/4-inch; In 20 feet or more: 1/2-inch
Variation from the plumb	In 10 feet: 1/4-inch; In 20 feet or more: 1/2- inch
Variation in the thickness of slabs and walls.	Minus 1/4-inch; Plus 1/2-inch
Variation in the locations and sizes of slabs and wall openings	Plus or minus 1/4-inch

F. Field Compression Test

1. Compression test specimens will be taken during construction from the first placement of each class of concrete specified herein and at intervals in accordance with ACI 301 to insure continued compliance with these specifications. Each set of test specimens will be a minimum of 5 cylinders.

2. Compression test specimens for concrete shall be made in accordance with Section 9.2 of ASTM C31. Specimens shall be 6-inch diameter by 12- inch high cylinders. Compression tests shall be performed in accordance with ASTM C39. One test cylinder will be tested at 7 days, one test cylinder will be

tested at 14 days, and one test cylinder will be tested at 28 days. The remaining 2 cylinders will be held to verify test results, if needed.

PART 2 - PRODUCTS

2.01 CONCRETE COMPOSITION

A. Concrete shall be composed of portland cement, fine aggregate, coarse aggregate, water, and specified additives so proportioned and mixed as to produce a plastic workable mixture in accordance with requirements of this section of the Specifications and suitable to the specific conditions of placement.

2.02 PORTLAND CEMENT

A. Portland cement shall be standard brand portland cement conforming to the requirements of ASTM C150, for Type II/V cement.

2.03 AGGREGATES

A. Aggregates shall comply with ASTM C 33 and shall be free from any substances that will react with the cement alkalies.

B. The maximum size aggregate shall be 1 inch and the aggregate shall be uniformly well graded from coarse through fine.

C. Aggregates shall conform to the requirements for combined grading set forth in Section 0130001 of the SSPWC and shall be graded “C” unless otherwise specified.

2.04 WATER

A. Water for mixing shall be potable, clean, fresh and free from injurious amounts of oil, acid, chlorides, sulfates, alkali or organic matter, and other impurities. Water shall conform to ACI 301.

2.05 AIR-ENTRAINING AGENTS

A. Air-entraining agents shall meet the requirements of ASTM C 260 and ASTM C 233.

B. Sufficient air-entraining agent shall be used to provide a total air content of 3 to 4 percent; provided that, when the mean daily temperature in the vicinity of the worksite falls bellow 40□F for more than 1 day, the total air content provided shall be 5 to 7 percent.

C. Grace Construction Products' Darex AEA, or Master Builder's MICROAIR, or Sika Chemical Corporation's AER, or approved equal are acceptable products.

2.06 ADMIXTURES

A. Admixtures shall be required at the Engineer's discretion or, if not required, may be added at the Contractor's option to control the set, effect water reduction, and increase workability. In either case, the additive of an admixture shall be at the Contractor's expense. The use of an admixture shall be subject to acceptance by the Engineer. Admixtures specified herein shall conform to the requirements of ASTM C494. The use of an admixture shall not reduce the minimum specified cement content or the specified amount of air-entrainment. Admixtures shall contain no calcium chloride, tri-ethanolamine or fly ash. All admixtures used in any mix design shall be manufactured and supplied by the same admixture company to insure compatibility.

B. Water Reducing Admixtures: Approved water reducing additives, which do not affect the reinforcing, may be added to maintain the maximum water content below that specified herein. Water reducing additives shall conform to ASTM C494, Type A or D.

2.07 PROPORTIONING CONCRETE

A. General

1. Concrete shall be composed of cement, admixtures, aggregates and water. The exact proportions in which these materials are to be used for different parts of the work will be determined during the trial batch. In general, the mix shall be designed to produce a concrete capable of being deposited so as to obtain maximum density and minimum shrinkage and, where deposited in forms, to have good consolidation properties and maximum smoothness of surface. The proportions shall be changed whenever necessary or desirable to meet the required results at no additional cost to the City. All changes shall be subject to review by the Engineer.

B. Adjustments to Mix Design

1. The mixes used shall be changed whenever such change is necessary or desirable to secure the required strength, density, workability, and surface finish and the Contractor shall be entitled to no additional compensation because of such changes.

C. Consistency

1. The amount of water to be used shall be the amount necessary to produce a plastic mixture of the specified slump and to control shrinkage.

2. Maximum slump shall be four inches when tested in accordance with ASTM Specifications C-143. Regardless of the measured slump, the maximum allowable water-cement ratios shall be as specified herein.

D. Unless noted otherwise on the drawings, Compressive Strength, Water/Cement Ratio and Cement Content: The 28-day compressive strength of concrete shall be 4,500 psi with a minimum of 7 sacks cement per cubic yard of concrete. Maximum water/cement ratio shall be 0.42.

2.08 CURING MATERIALS

A. Materials for curing concrete as specified herein shall conform to the following requirements:

1. Liquid membrane curing compound shall conform to ASTM C309 Type I Clear (suitable for application on horizontal and vertical surfaces) immediately after finishing in accordance with the manufacturer's printed instructions. Concrete curing compound shall be Select Cure Seal AC- 309 as manufactured by Select Products Company, Upland, California, or American 309 Acrylic Sealer as manufactured by American Concrete Systems, Inc., San Diego, California, or MB 429 as manufactured by Masterbuilders, Cleveland, Ohio, or equal. The curing compound shall contain a fugitive dye so that areas of application will be readily distinguishable.

2. Polyethylene sheet for use as concrete curing blanket shall be white, and shall have a nominal thickness of 6 mils. The loss of moisture when determined in accordance with the requirements of ASTM C 156 shall not exceed 0.055 grams per square centimeter of surface.

3. Polyethylene-coated waterproof paper sheeting for use as concrete curing blanket shall consist of white polyethylene sheeting free of visible defects, uniform in appearance, having a nominal thickness of 2 mils and permanently bonded to waterproof paper conforming to the requirements of Federal Specifications UU-B-709A (Int.Amd.1). The loss of moisture, when determined in accordance with the requirements of ASTM C-156, shall not exceed 0.055 gram per square centimeter of surface.

4. Polyethylene-coated burlap for use as concrete curing blanket shall be 4-mil thick, white opaque polyethylene film impregnated or extruded into one side of the burlap. Burlap shall weigh not less than 9 ounces per square yard. The loss of moisture, when determined in accordance with the requirements of ASTM C 156, shall not exceed 0.055

grams per square centimeter of surface.

5. Curing mats shall be heavy shag rugs or carpets or cotton mats quilted at 4 inches on center. Curing mats shall weigh a minimum of 12 ounces per square yard when dry.

2.09 FORMS

A. Forms shall be used, whenever necessary, to confine the concrete, to shape the concrete to the required lines and grades, and to obtain a thoroughly compacted dense concrete through proper vibrating.

B. The forms shall have sufficient strength and rigidity to hold the concrete and to withstand the necessary pressure, tamping and vibration, without deflection from the prescribed lines.

C. The forms shall be accurately constructed of clean lumber. The surface of forms against which concrete is placed shall be smooth and free from irregularities, dents, sags or holes.

2.10 MISCELLANEOUS MATERIALS

A. Dampproofing/Waterproofing: Below grade wall areas shall be coated with MEL- ROL LM as manufactured by W.R. Meadows, or approved equal.

B. Epoxy Bonding Agent: The epoxy-bonding agent shall be an epoxy-resin-based product intended for bonding new mortar to hardened concrete and shall conform to ASTM C 881. The bonding agent shall be Sikadur 32 Hi Mod LPL, as manufactured by Sika Corporation, or approved equal.

C. Repair Mortar: Repair mortar shall be a two-component, cement-based product specifically designed for structurally repairing damaged concrete surfaces. The repair mortar shall exhibit the properties of high compressive and bond strengths and low shrinkage. A medium-slump repair mortar shall be used on horizontal surfaces, and a non-sag, low-slump repair mortar shall be used on vertical or overhead surfaces. Repair mortar shall be SikaTop Plus (horizontal application: Series 111, vertical and overhead application: Series 123 Plus), as manufactured by Sika Corporation, or approved equal.

D. Non-Shrink Grout: Non-shrink grout shall be a non-metallic cement-based product intended for filling general construction voids or grouting of base plates for equipment or structural members. The non-shrink grout shall exhibit the properties of high compressive and bond strengths and zero shrinkage, and shall be capable of mixing to a variable viscosity ranging from a dry pack to a fluid consistency as required for the application. The non-shrink grout shall be Sika Grout 212, as manufactured by Sika Corporation, or approved equal.

E. Epoxy Adhesive: Epoxy adhesive shall be a high-modulus epoxy-resin-based product intended for structural grouting of anchor bolts and dowels to concrete. The epoxy adhesives shall conform to ASTM C 881. A pourable, medium- viscosity epoxy shall be used on horizontal surfaces, and a heavy-bodied, non- sag epoxy gel shall be used on vertical surfaces. The epoxy adhesives shall be Sikadur High-modulus, high-strength, structural, epoxy paste adhesive series, as manufactured by Sika Corporation, or approved equal.

2.11 TRIAL BATCH AND LABORATORY TESTS

A. Before placing any concrete, a testing laboratory designated by the ENGINEER shall prepare a trial batch of structural concrete, based on the preliminary concrete mixes submitted by the CONTRACTOR. During the trial batch the aggregate proportions may be adjusted by the testing laboratory using the two coarse aggregate size ranges to obtain the required properties. If one size range produces an acceptable mix, a second size range need not be used. Such adjustments shall be considered refinements to the mix design and shall not be the basis for extra compensation to the CONTRACTOR. All concrete shall conform to the requirements of this Section, whether the aggregate proportions are from the CONTRACTOR'S preliminary mix design, or whether the proportions have been adjusted during the trial batch process. The trial batch shall be prepared using the aggregates, cement and admixture proposed for the project. The trial batch materials shall be of a quantity such that the testing laboratory can obtain 3 drying shrinkage, and six compression test specimens from each batch. The cost of laboratory trial batch tests for each specified concrete strength shall be borne by the CONTRACTOR.

B. The determination of compressive strength will be made by testing 6-inch diameter by 12-inch high cylinders; made, cured and tested in accordance with ASTM C 192 and ASTM C 39. Three compression test cylinders will be tested at 7 days and 3 at 28 days. The average compressive strength for the three cylinders tested at 28 days for any given trial batch shall not be less than 125 percent of the specified compressive strength.

C. A sieve analysis of the combined aggregate for each trial batch shall be performed according to the requirements of ASTM C 136. Values shall be given for percent passing each sieve. Fine and coarse aggregate shall be tested for compliance with ASTM C 33 and as required herein.

D. Cement shall be tested for compliance with ASTM C 150 and as required herein.

PART 3 - EXECUTION

A.01 CONCRETE QUALITY

A. Concrete shall conform to the requirements of Part 2. The required proportions shall be assembled, well mixed, transported, placed, consolidated, finished and cured as hereinafter specified. Concrete shall be uniformly dense and sound, free from faults, cracks, voids, honeycomb and other imperfections.

B. If not called for specifically and unless specified otherwise hereunder, concrete requirements shall follow ACI 301 where applicable.

A.02 MIXING

A. Concrete shall be batched in fully automatic or semi-automatic stationary plants or approved portable batch type plants, and mixed in stationary or truck mixers. Mixing equipment and mixing procedures shall be subject to the approval of the Engineer.

B. Site-Mixed Concrete

1. Conform to ACI 304 except as modified by these Specifications.

2. Use a batch-type mixer capable of combining the aggregates, cement, and water within the specified time into a thoroughly mixed and uniform mass and discharging the mixture without segregation.

3. Use supporting equipment that can accurately proportion the cement, the coarse and fine aggregates, the admixtures, and the water that enters the mixing drum. Proportion the cement and aggregate by weight.

4. Discharge each entire batch before recharging. Do not allow the volume of the mixed materials per batch to exceed the manufacturer's recommendations.

5. Mixing time shall be as follows:

a. For mixer of capacity of 1 cubic yard or less, 1-1/2 minutes after batching is completed.

b. For mixers of capacities larger than 1 cubic yard, 1-1/2 minutes plus 1/2 minute for each additional 2 cubic yard capacity or fraction thereof in excess of 1 cubic yard.

c. The mixer shall revolve at a uniform rate as specified by the manufacturer for the mixing equipment.

C. Ready-Mixed Concrete

1. Provide central-mixed concrete conforming to ASTM C-94 except as modified by these Specifications.

2. Limit the haul time of central-mixed concrete so that the specified slump is attained without the onsite addition of water that will cause the mix design water-cement ratio to be exceeded. In no event shall the time exceed 90 minutes from the batch plant to the completion of the pour, unless specifically approved by the Engineer.

3. Use truck-transported, dry-batched concrete or mix on the job site when haul time is excessive. Do not retemper partially-hardened concrete.

A.02 PLACEMENT OF CONCRETE

B. Placement shall conform to ACI 304 except as modified by these Specifications.

C. Coordinate the sequence of concrete placement in advance of that placement to assure that construction joints will occur only as designed. Provide the City with a copy of the sequence of placement in advance of placement.

D. Notify the City prior to scheduled placement of concrete in any portion of the work. This notification shall be such time in advance of the operation as the City deems necessary to observe the preparations at the location of the proposed concrete placing. All forms, steel, anchors, ties, inserts, and other embedded items shall be in place before the Contractor's notification of readiness is given to the City.

E. Pipe, conduit, dowels, and other ferrous items required to be embedded in concrete construction shall be so positioned and supported prior to placement of concrete that there will be a minimum of 2 inches clearance between said items and any part of the concrete reinforcement. Securing such items in position by wiring or welding them to the reinforcement will not be permitted.

F. Schedule sufficient conveying, vibrating and trowelling equipment for continuous concrete placing, program backup equipment, and the actions to be taken in case of an interruption in placing. Provide extra concrete vibrators. Test the concrete vibrators the day before placing concrete.

G. Do not place concrete until all water entering the spaces to be filled with concrete has been properly cut off or has been diverted by pipes or other means and carried out of the forms, clear of the work. Do not deposit concrete underwater, or allow still water to rise on any concrete until the concrete has attained its initial set. Do not permit water to flow over the newly deposited concrete in such

manner and velocity that will damage the surface finish.

H. Where a moisture barrier is installed, do not puncture the moisture batter by stakes or any other concrete accessory.Deposit concrete at or near its final position to avoid segregation caused by rehandling or flowing. Do not deposit concrete in large quantities in one place to be worked along the forms with a vibrator. Do not drop concrete freely into place from a height greater than 4 feet below the ends of ducts, chutes, or buggies. Concrete shall be uniformly deposited during the process of depositing and in no case after depositing shall any portion be displaced in the forms more than 6 feet in horizontal direction, Concrete in forms shall be deposited in uniform horizontal layers not deeper than 2 feet, and each layer shall be placed while the previous layer is still soft.

I. Use mechanical vibration in placing concrete to eliminate rock pockets and voids, to consolidate each layer with that previously placed, to completely embed reinforcing bars and fixtures, and to bring just enough fine material to exposed surfaces to produce a smooth, dense, and even texture. The number of high frequency vibrators in use shall be ample to consolidate the incoming concrete to a proper degree within 15 minutes after it is deposited in the forms. Use external vibrators for consolidating concrete when the concrete is otherwise inaccessible for adequate consolidating, provided the forms are constructed rigidly enough to resist displacement or damage from external vibration.

J. Do not place concrete during rainstorms. Protect concrete placed immediately before rain to prevent rainwater from coming in contact with it. Keep sufficient protective covering on hand at all times for this purpose.

K. Unforeseen cold joints in walls shall be roughened and then covered with a pure mixture of cement and water of approximately 1-inch thickness, before the pour may be continued.

L. Horizontal waterstops in floor shown on the Drawings, shall be lifted up, then the concrete shall be placed under the waterstop, the waterstop shall then be laid down on that concrete, additional concrete shall be placed on top of that waterstop to the approximate finish level of the concrete, where upon the concrete shall be thoroughly vibrated in one continuous motion from one end of the waterstop to the other end without skipping any areas. Visual observation shall be performed by the CONTRACTOR to ensure that voids under waterstops do not exist.

M. Cold joints in mat foundation and roof slabs other than indicated shall be avoided.

N. Where concrete is to be placed against old concrete (any concrete which is greater than 60 days of age), the surface of the old

concrete shall be thoroughly cleaned and roughened by sandblasting (exposing aggregate) prior to the application of an epoxy bonding agent.

A.03 TEMPERATURE OF CONCRETE

B. The temperature of concrete when it is being placed shall be not more than 100°F nor less than 40°F in moderate weather, and not less than 50°F in weather during which the mean daily temperature drops below 40°F.

C. In cold weather concreting, concrete ingredients shall not be heated to a temperature higher than that necessary to keep the temperature of the mixed concrete, as placed, from falling below the specified minimum temperature. All methods and equipment for heating of water and aggregate shall be subject to the approval of the Engineer and shall conform to ACI 306. Ground shall be free from frost or ice when concrete is placed upon or against them.

D. In hot weather concreting, the Contractor shall employ effective means, such as precooling of aggregates and mixing water using ice or placing at night, as necessary to maintain the temperature of the concrete, as it is placed, below 100□F. All methods and equipment for cooling of water and aggregate shall be subject to the approval of the Engineer and shall conform to ACI 305.

E. Concrete shall be placed in the structure within 1 1/2 hours after introduction of the cement into the mix.

F. The Contractor shall be entitled to no additional compensation for the foregoing requirements.

A.04 CONCRETE FINISHES

B. Immediately upon the removal of forms, voids shall be neatly filled with cement mortar, non-shrink grout, or epoxy bonding agent and repair mortar as required for the application and as directed by the City.

C. The surfaces of concrete exposed to view shall be smooth and free from projections or depressions.

D. Exposed conformed surfaces of concrete, such as horizontal or sloping surfaces, shall be screeded to a uniform surface, steel-troweled to densify the surface, and finished to a light broom finish.

A.05 PROTECTION AND CURING OF CONCRETE

B. The Contractor shall protect all concrete against damage. Exposed surfaces of new concrete shall be protected from the direct rays of the sun by covering them with plastic film wrap and by keeping them damp for at least 7 days after the concrete has been placed, or by using an approved curing process. Exposed surfaces shall be protected from frost by covering with tarps for at least 5 days after pouring.

A.06 REPAIRS TO DAMAGED CONCRETE SURFACES

A. Minor surface damage to hardened cast-in-place or precast concrete may be repaired, at the discretion of the City, using the specified materials in accordance with the manufacturer's recommendations and the following procedures:

B. General Purpose: Remove loose and deteriorated concrete by mechanical means, sandblasting or high-pressure water blasting. Clean all debris from the area and apply non-shrink grout in a 1/4-inch minimum thickness, at the desired consistency, ranging from a dry pack, to a fluid-poured into a formed area, according to the application. Cure the material as for concrete in accordance with this specification

END OF SECTION

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SECTION 03462 PRECAST CONCRETE VAULTS

PART 1 - GENERAL

1.01 DESCRIPTION

This section includes the materials, manufacture, and installation of precast concrete vaults, vault frames and covers.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01300, Shop Drawings and Submittals

B. Section 02300, Earthwork

C. Section 03300, Cast-in-Place Concrete

D. Section 09900, Painting and Coating

1.03 SUBMITTALS

A. Stamped calculations and drawings by a California Registered Engineer shall be submitted conforming to Section 01300, Shop Drawings and Submittals.

PART 2 - MATERIALS

2.01 PRECAST CONCRETE VAULT

A. Precast concrete vaults and covers shall be manufactured in a plant specifically designed for that purpose and shall conform to the shapes and dimensions indicated on the plans.

B. Design loads shall consist of dead load, live load, impact, and in addition, loads due to water table and any other loads that may be imposed upon the structure. Live loads shall be for HS-20 per AASHTO standard specifications for highway bridges. Design wheel load shall be 16 kips. The live load shall be that which produces the maximum shears and bending moments in the structure.

C. Concrete shall have minimum compressive strength of 4,000 psi conforming with ASTM C 94.

D. The vault floor shall be treated such that a non-skid surface is provided.

E. Precast vault shall be manufactured by Utility Vault, Jensen Precast or approved equal.

2.02 VAULT FRAMES AND COVERS

A. Vault frame and covers shall be of the type and size shown on the plans.

B. For manhole openings, manhole ring, adaptor, and cover shall be cast iron conforming to ASTM A 48.All covers must be HS-20 traffic rated unless specified otherwise.

2.03 JOINT SEALING COMPOUND

A. The joint sealing compound shall be a permanently flexible plastic material complying in every detail to Federal Specification SS S-00210 (GSA-FSS) dated July 26, 1965. “Conseal”, "Quickseal," or approved equal.

2.04 WATERPROOFING

A. Waterproofing shall be formulated to comply with Federal Specification SS-A- 701. Grace Dehydratine 4 or approved equal.

PART 3 - EXECUTION

3.01 EARTHWORK

A. Excavation and backfill for precast concrete vaults shall be in accordance with Section 02300 and the requirements herein.

B. The Contractor shall prepare an excavation large enough to accommodate the structure and permit grouting of openings and backfilling operations.

C. The bottom of the structure shall be placed on 6-inches of compacted, crushed rock sub-base, graded level and to the proper elevation as shown on the plans, unless otherwise indicated by the Engineer.

3.02 INSTALLATION

A. Openings or "knockouts" in precast concrete vaults shall be located as shown on the drawings and shall be sized sufficiently to permit passage of the largest dimension of pipe and/or coupling flange. Upon completion of installation, all voids or openings in the vault walls around pipes shall be filled with 3,000-psi concrete or mortar, using an approved epoxy for bonding concrete surfaces.

B. After the structure and all appurtenances are in place and approved, backfill shall be placed such that finished grade is sloped away from vault (in unpaved areas) or such that vault is flush with finished grade (in paved areas) to the original ground line or to the limits designated on the plans, unless otherwise indicated by the Engineer.

C. All joints between precast concrete vault sections shall be made watertight using preformed mastic material. The sealing compound shall be installed according to the manufacturer's recommendations

to provide a watertight joint that remains impermeable throughout the design life of the structure. All joints shall be filled with dry-pack non-shrink grout.

D. Frames and covers shall be built up so that the cover is flush with the surrounding surface unless otherwise specified on the plans or by the Owner's Representative in the field. The Contractor is responsible for placing the cover at the proper elevation where paving is to be installed and shall make all necessary adjustments so that the cover meets these requirements.

E. Waterproofing shall be applied to the exterior walls of all buried vaults in accordance with the manufacturer's instructions and Section 09900 Painting and Coating. Protection shall be placed over the waterproofing to prevent damage.

END OF SECTION

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SECTION 03600 GROUT

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. This section describes methods and materials to provide grout.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. SECTION 01300– Shop Drawings and Submittals

B. Section 03300 – Cast-in-Place Concrete

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Commercial Standards

- American Society for Testing and Materials (ASTM) latest edition
  ASTM C33 - Concrete Aggregates
- ASTM C40 - Standard Test for Organic Impurities in Fine Aggregates for Concrete
- ASTM C88 - Standard Test for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
- ASTM C117 - Standard Test for Material Finer Than 0.075 mm (No. 200) Sieve in Mineral Aggregates by Washing
- ASTM C136 - Sieve Analysis for Fine and Coarse Aggregates
- ASTM C150 - Portland Cement
- ASTM C289 - Standard Test for Potential Reactivity of Aggregates (Chemical Method)
- ASTM C494 - Chemical Admixture for Concrete
- ASTM E329 - Recommended Practice for Inspection and Testing Agencies for Concrete, Steel, and Bituminous Materials as Used in Construction

B. CALTEST. No. 217 Method of Test for Sand Equivalent

C. US Army Corps of Engineers (CRD) Specifications:

CRD-C621 - Specification for Nonshrink Grout

1.04 SUBMITTALS

A. The Contractor shall submit information in accordance with Section 01300, Submittal Procedures, to substantiate compliance with this specification. In addition, the following specific information shall be submitted.

1. A. Certificate of Compliance with applicable ASTM requirements for Portland cement and fine aggregate.

B. Manufacturer's technical literature for admixtures indicating compliancewith applicable specifications.

C. Grout mix design.

1.05 TESTS

A. To demonstrate conformance with the specified requirements for grout, the Contractor will employ the services of an independent testing laboratory which complies with the requirements of ASTM E329. The testing laboratory shall sample and test grout materials as required in this section. Costs of testing laboratory services shall be borne by the Contractor. In addition, the Owner may sample and test grout materials to check compliance with these specifications.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Cement: Portland cement shall Type II/V conform to the requirements of ASTM C150.

B. Aggregate

a. General: Aggregate shall be nonreactive and shall be washed before use. When sources of aggregate are changed, test reports shall be provided for the new material. The test specified shall be performed prior to commencing grout work.

b. Fine Aggregate: Fine aggregate shall be hard, dense, durable particles of either sand or crushed stone regularly graded from coarse to fine and shall conform to ASTM C33 as modified herein. When tested in accordance with ASTM C136, gradation shall be such that 100% by weight will pass a standard No. 8 mesh sieve and no less than 45% by weight will pass a standard No. 40 mesh sieve. Variation from the specified gradations in individual tests will be acceptable if the average of three consecutive tests is within the specified limits and the variation is within the permissible variation listed below:

U.S. standard tests, percent sieve size	Permissible variation in individual
30 or coarser	2
50 or finer	0.5

Other tests shall be in accordance with the following specifications:

Test	Test Method	Requirements
Organic Impurities	ASTM C40	Color lighter than Standard
Amount of Material Passing No. 200 Sieve	ASTM C117	3% maximum by weight
Soundness	ASTM C88	10% maximum loss with sodium sulfate
Reactivity	ASTM C289	Innocuous aggregate
Sand Equivalent	CALTEST No. 217	Minimum 80

c. Admixtures

- General: Admixtures shall be compatible with the grout. Calcium chloride or admixtures containing calcium chloride are not acceptable. Admixtures shall be used in accordance with the manufacturer's recommendations and shall be added separately to the grout mix.
- Water Reducing Retarder: Water reducing retarder shall be ASTM C494 Type D and shall be Master Builders Pozzolith 300-R, Sika Corporation Plastiment, or equal.
- Lubricant for Cement Pressure Grouting: Lubricant additive for cement pressure grouting shall be Intrusion Prepakt Intrusion Aid, Sika Intraplast N, or equal.

d. Water: Water for washing aggregate, for mixing and for curing shall be free from oil and deleterious amounts of acids, alkalies, and organic materials; shall not contain more than 1,000 mg/L of chlorides as C1-, nor more than 1,300 mg/L of sulfates as SO4; and shall not contain an amount of impurities that may cause a change of more than 25% in the setting time of the cement nor a reduction of more than 5% in the compressive strength of the grout at 14 days when compared with the result obtained with distilled water. Additionally, water used for curing shall not contain an amount of impurities sufficient to discolor the grout.

C. All products and materials in direct contact with potable water must be NSF/ANSI 61 certified. These materials include portland cement, aggregate, admixtures, grout, etc.

2.02 GROUT

A. Drypack Grout: One part portland cement and 2 parts fine aggregate, by volume. Grout shall be of a consistency suitable for the intended purpose and shall be used immediately after mixing.

B. Cement Grout: Cement grout shall be a mixture of one part cement, two parts sand, proportioned by volume, admixtures for pressure grouting, and sufficient water to form a workable mix.

C. Nonshrink Grout: Nonshrink grout shall be nonrusting non-metallic aggregate grout.

D. Epoxy Grout: Epoxy grout shall be Master Builders Concresive 1380, Sika Corporation Sikdur 35, as applicable, or equal.

2.03 PRESSURE GROUTING EQUIPMENT

A. Pressure grouting equipment shall include a mixer and holdover agitator tanks and shall be designed to place grout at pressures up to 50 psi. Gages shall be designed to place grout at pressures up to 50 psi. Gages shall be provided to indicate pressure used. The mixer shall be provided with a meter capable of indicating to 1/10th of a cubic ft the volume of grout used.

PART 3 - EXECUTION

3.01 GENERAL

A. Holes required for grouting shall be blown clean. Horizontal holes for grouting shall be drilled at a slight downward angle to facilitate holding the grout until setting is complete. Bonding compound for use with grout is specified in Section 03300, Cast-in-Place Concrete.

3.02 DRYPACK GROUT

A. Drypack grout shall be used for built-up surfaces, setting miscellaneous metal items and minor repairs. Grout used under minor bearing plates shall also be drypack grout.

B. Surfaces required to be built up with drypack grout shall be roughened by brushing, cleaned, and coated with bonding compound specified in Section 03300, Cast-in-Place Concrete, before the application of the grout. The drypack grout shall be applied immediately following the application of the bonding compound in bands or strips to form a covering of the required thickness. The covering shall be smooth. Construction joints in the grout shall be sloped and shall be cleaned and wetted before application is resumed.

C. Drypack grout shall be cured in accordance with Section 03300, Cast-in-Place Concrete.

D. Grout shall not be placed when ambient temperature is below 40°F or when it is likely that the ambient temperature will fall below 40°F during or within 48 hrs of placement, unless adequate protection is provided.

3.03 CEMENT GROUT

A. Cement grout shall be used for filling nonbearing portions of equipment pads and pressure grouting.

B. Except for the specialized equipment for pressure grouting, mixing and placing apparatus shall be similar to that normally used for cast-in-place concrete. Diluted grout shall be agitated to keep ingredients mixed.

3.04 NONSHRINK GROUT

A. Nonshrink grout shall be used for the bearing surfaces of machinery and equipment bases, column baseplates and bearing plates. Nonshrink grout also shall be used for setting bolts and reinforcing steel in holes for grouting.

B. Where specified, nonshrink grout shall meet the requirements of CRD-C621. Grout shall be placed in accordance with manufacturer's instructions.

3.05 EPOXY GROUT

A. Epoxy grout shall be used for repairing cracks by pressure grouting, and repairing structural concrete. Epoxy grout shall be HILTI CI 060 EP, Simpson CRACK-PAC, or approved equal. Concrete shall be primed in accordance with the grout manufacturer's instructions.

3.06 PRESSURE GROUTING

A. Prior to grouting, systems and holes to be grouted shall be washed clean. Washing is not required for grouting soil voids outside pipe cylinders or casing pipes. Grouting, once commenced, shall be completed without stoppage. In case of breakdown of equipment, the Contractor shall wash out the grouting system sufficiently to ensure fresh grout and adequate bond and penetration will occur upon restarting the grouting operation. Grout pressure shall be maintained until grout has set.

END OF SECTION

DIVISION 04 – METALS

SECTION 05120 STRUCTURAL STEEL AND MISCELLANEOUS METALWORK

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section includes materials, fabrication, and installation of structural steel, connecting bolts, expansion anchors, eyebolts, and stainless-steel fasteners.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01300: Shop Drawings and Submittals

B. Section 03300: Cast-in-Place Concrete

1.03 DESIGN CRITERIA

A. Structural Connections and Framing: AISC specifications for the design, fabrication, and erection of structural steel for buildings.

1.04 SUBMITTALS

A. Submit drawings in accordance with SECTION 01300and the following.

B. Submit drawings of all fabricated items. Show dimensions and reference materials of construction by ASTM designation and grade.

C. Submit drawings and manufacturers information of all miscellaneous specialties such as ladders, hatches, and gratings. For grating and hatches installed in existing structures, include Contractor’s field measurements of existing structures in the shop drawing submittal.

PART 2 - PRODUCTS

2.01 STRUCTURAL STEEL

A. Structural shapes (W) shall conform to ASTM A 992.

B. Angles, plates, bars and items of miscellaneous metalwork shall conform to ASTM A36.

C. Hollow structural sections (HSS) shall conform to ASTM A500, Gr B.

D. All structural steel shall be hot-dipped galvanized, unless noted otherwise.

2.02 BOLTS

A. Steel anchor bolts shall conform to ASTM A 307.

B. Steel connection bolts shall conform to ASTM A 325.

C. Provide self-locking nuts or lockwashers and plain nuts where shown in drawings.

D. Stainless-steel bolts shall be ASTM A 193, Grade B8M, or ASTM F 593, Type 316. Nuts shall be ASTM A 194, Grade 8M, or ASTM F 594, Type 316. Use ASTM A 194 nuts with ASTM A 193 bolts; use ASTM F 594 nuts with ASTM F 593 bolts. Provide washer for each nut and bolthead. Washers shall be of the same material as the nuts.

2.03 BEVELED WASHERS

A. Washers for American Standard beams and channels shall be square or rectangular, tapered in thickness, and smooth.

2.04 WELDING ELECTRODES

A. Welding electrodes for structural steel shall conform to AWS A5.5. Use electrodes in the E-70 series. Welding electrode for aluminum shall be 4043 filler metal. Use Type 347 electrode for stainless steel.

2.05 EMBEDDED EYEBOLTS

A. Eyebolts shall be of the welded-eye type, carbon steel.

2.06 EXPANSION ANCHORS

A. Expansion anchors shall be HILTI Kwik Bolt 3 in masonry or Kwik Bolt TZ in concrete, or Simpson Wedge-All in masonry or Simpson Strong-Bolt in concrete, or approved equal.

2.07 LADDERS

A. Fabrication and erection of the ladders shall be in accordance with the Specification for the Design, Fabrication and Erection of Structural Steel for Buildings of the latest edition of the A.I.S.C. Manual, and Section 01100910.27 of the latest edition of the OSHA standards, except as specified herein. Ladders shall be of welded steel construction and galvanized after fabrication, or stainless steel where indicated on the plans. Ladder rungs inside wet environments shall be fabricated with nurls for slip protection.

2.08 LADDER UP SAFETY POST

A. Ladder up safety post shall be installed on ladder at access hatches. Safety post shall be manufactured of high strength steel with a telescoping tubular section that locks automatically when fully

extended, and shall be hot dip galvanized. Upward and downward movement shall be controlled by a stainless- steel spring balancing mechanism. Safety post shall be assembled and fastened to the ladder rungs in accordance with the manufacturer's instructions. Safety post shall be manufactured by the Bilco Company.

2.09 GRATING

A. Grating shall be galvanized steel of the size shown on the plans.

B. Grating shall support a minimum live load of 250 psf.

C. The gratings shall be secured in place by at least four (4) acceptable removable- type fasteners per grating panel.

D. The ends of each grating section shall be banded with bearing bars. All free and supported bar ends around perimeter and around cutouts shall be banded. All openings for fixtures or pipes, which require the cutting of three main bars or more, shall be finished in a similar manner as the ends.

E. Where fiberglass grating is indicated, it shall conform to ASTM E-84, Class I, as manufactured by McNichols Co., or approved equal. Grating shall have a square grid pattern, and a gritted surface. All edges and openings shall be banded. Grating shall sustain a minimum of 200 pounds per square foot at a maximum of ¼-inch deflection.

2.10 ACCESS HATCHES

A. Access hatches shall be of the size and type indicated on the plans.

B. Traffic rated hatch shall be of the size and type indicated on the plans, as manufactured by The BILCO Company, Halliday Products, US Foundry, or approved equal.

2.11 PREFABRICATED STAIRS

A. Prefabricated stairs shall be of the size indicated on the plans. Prefabricated risers and stair treads shall be hot-dipped galvanized. Treads shall be non0-skid with open perforations for sure footing. Railings shall be fastened to the prefabricated stair and shall be hot-dipped galvanized or painted tubular steel. Landing brackets and base anchor brackets shall be supplied. Submit structural calculations for pre-fabricated stairs and anchors.

B. Prefabricated stairs shall be manufacturered by Industrial Products, fsiIndustries, or approved equal.

PART 3 - EXECUTION

3.01 FABRICATION AND ERECTION

A. Fabricate miscellaneous metal items to straight lines and true curves. Drilling and punching shall not leave burrs or deformations. Continuously weld permanent connections along the entire area of contact. Exposed work shall have a smooth finish with welds ground smooth. Joints shall have a close fit with corner joints coped or mitered and shall be in true alignment. Unless specifically indicated on the drawings, there shall be no bends, twists, or open joints in any finished member nor any projecting edges or corners at intersections. Conceal fastenings wherever possible. Built-up parts shall be free of warp. Exposed ends and edges of metal shall be slightly rounded. All boltholes shall be 1/16 inch in diameter larger than bolt size. Measure cast-in-place bolt locations in the field before drilling companion holes in structural steel beam or assembly.

B. Clean the surfaces of metalwork to be in contact with concrete of rust, dirt, grease, and other foreign substances before placing concrete.

C. Set embedded metalwork accurately in position when concrete is placed and support it rigidly to prevent displacement or undue vibration during or after the placement of concrete. Unless otherwise specified, where metalwork is to be installed in recesses in formed concrete, said recesses shall be made, metalwork installed, and recesses filled with dry-pack mortar in conformance with Section 03300.

3.02 WELDING

A. Perform welding on steel by the Shielded Metal Arc Welding (SMAW) process. Welding procedures shall comply with AWS B3.0.

B. Perform welding on aluminum by the Gas Metal Arc (MIG) or Gas Tungsten Arc (TIG) process, per the AWS Welding Handbook.

C. Provide a minimum of two passes for metal in excess of 5/16 inch thickness.

D. Produce weld uniform in width and size throughout its length with each layer of weldment smooth; free of slag, cracks, pinholes, and undercuttings; and completely fused to the adjacent weld beads and base metal. Avoid irregular surface, non-uniform bead pattern, and high crown. Form fillet welds of the indicated size of uniform height and fully penetrating. Accomplish repair, chipping, and grinding of welds in manner that will not gouge, groove, or reduce the base metal thickness.

3.03 BOLTING

A. Use steel bolts to connect structural steel members. Use stainless-steel bolts to connect structural aluminum members. When stainless steel bolts are in contact with dissimilar metals, insulating sleeves

and phenolic washers shall be incorporated to electrically isolate the bolts.

B. Drive bolts accurately into the holes without damaging the thread. Protect boltheads from damage during driving. Boltheads and nuts shall rest squarely against the metal. Where bolts are to be used on beveled surfaces having slopes greater than 1 in 20 with a plane normal to the bolt axis, provide beveled washers to give full bearing to the head or nut. Where self-locking nuts are not furnished, bolt threads shall be upset to prevent the nuts from backing off.

3.04 Bolts shall be of the length that will extend entirely through but not more than 1/4 inch beyond the nuts. Draw boltheads and nuts tight against the work. Tap boltheads with a hammer while the nut is being tightened. After final tightening, lock the nuts.

3.05 ANCHOR BOLTS

A. Preset bolts and anchors by the use of templates. For mechanical equipment (pumps, compressors, blowers), do not use concrete anchors set in holes drilled in the concrete after the concrete is placed.

B. For static items (storage tanks, heat exchangers), use either preset anchor bolts or use capsule anchors set in holes drilled in the concrete after the concrete is placed.

C. After anchor bolts have been embedded, protect their threads by applying grease and by having the nuts screwed on until the time of installation of the equipment or metalwork.

3.06 EXPANSION ANCHORS

A. Installation shall be per manufacturer’s instructions.

3.07 CONTROL OF FLAME CUTTING

A. Do not use a gas-cutting torch in the field for correcting fabrication errors on any member in structural framing. Use a gas-cutting torch only on minor members when the member is not under stress.

3.08 GALVANIZING

A. All structural steel shapes, plates, bars and fabricated assemblies required to be galvanized shall, after the steel has been thoroughly cleaned of rust and scale, be galvanized in accordance with the requirements of ASTM A 123. Any galvanized part that becomes warped during the galvanizing operation shall be straightened.

B. Bolts, anchor bolts, nuts and similar threaded fasteners, after being properly cleaned, shall be galvanized in accordance with

the requirements of ASTM A 153.

C. Field repairs to galvanizing shall be made using ZRC 221 Galvanizing Compound, or approved equal.

END OF SECTION

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DIVISION 05 – FINISHES

SECTION 09900 PAINTING AND COATING

1.01 DESCRIPTION OF WORK

This Section describes materials and application of painting and coating systems for exposed metal surfaces, buried metal surfaces and surfaces in contact with concrete, excluding welded steel reservoirs.

1.02 SUBMITTALS

A. Submit manufacturer's data sheets showing the following information.

1. Recommended surface preparation.

2. Minimum and maximum recommended dry-film thicknesses per coat for prime, intermediate, and finish coats.

3. Percent solids by volume.

4. Recommended thinners.

5. Statement verifying that the selected prime coat is recommended per the manufacturer for use with the selected intermediate and finish coats.

6. Application instructions including recommended application, equipment, humidity and temperature limitations.

7. Submit certification that all coatings conform to applicable local Air Quality Management Authority rules and regulations for products and application.

8. Product data sheets and Material Safety Data sheets for all products.

B. Color

All colors shall be per Owner Standards. The Contractor shall submit color samples to the Owner for their approval well in advance of painting operation.

C. Experience

The Coating subcontractor shall hold a current C-33 painting and decorating license and have a minimum of 5 years practical experience and successful history in the application of specified products to surfaces. He shall substantiate this requirement by furnishing a list of six references of similar projects.

1.03 REFERENCE SPECIFICATIONS AND STANDARDS

A. Perform work in accordance with the latest editions of the following ASTM, SSPC and NACE standards and publications, and all Federal, State, Municipal, and agency regulations, codes, laws, and rules. Errors or omissions of any law or regulation from this Specification, will not relieve compliance with any law or regulation necessary for performing the painting and coating operations.

American Society for Testing and Materials (ASTM) Publication:

ASTM D1653	*Test Method for Water Vapor Permeability of Organic Coating Films*
ASTM D2200	*Pictorial Surface Preparation Standards for Painting Steel Surfaces*
ASTM D3960	*Practice for Determining Volatile Organic Contents (VOC) of Paints and Related Coatings*
ASTM D4258	*Practice for Surface Cleaning Concrete for Coating*
ASTM D4259	*Standard Practice for Abrading Concrete*
ASTM D4585	*Standard Practice for Testing Water Resistance of Coatings Using Controlled Condensation*
ASTM E84	*Test Method for Surface Burning Characteristics of Building Materials*

Federal Specifications (Fed. Spec.) Publications:

Fed. Spec. TT-C-555	*Coating, Textured (for Interior and Exterior Masonry Surfaces)*

The Society for Protective Coatings; formally known as Steel Structures Painting Council (SSPC) Specifications:

SSPC-SP-1	*Solvent Cleaning*
SSPC-SP-2	*Hand Tool Cleaning*
SSPC-SP-5/NACE 1	*White Metal Blast Cleaning*
SSPC-SP-6/NACE 3	*Commercial Blast Cleaning*
SSPC-SP-7/NACE 4	*Brush-Off Blast Cleaning*
SSPC-SP-10/NACE 2	*Near-White Blast Cleaning*

1.04 QUALITY ASSURANCE

A. Quality assurance procedures and practices shall be utilized to monitor all phases of surface preparation, application and inspection throughout the duration of the project. Procedures or practices not specifically defined herein may be utilized provided they meet recognized and acceptable professional standards and are approved by the Owner.

B. All materials furnished and all work performed under the Contract shall be subject to inspection by the Owner. The Contractor shall be held strictly to the true intent of the Specifications in regard to quality of materials, workmanship, and diligent execution of the Contract.

C. Work performed in the absence of prescribed inspection may be required to be removed and replaced under the proper inspection, and the entire cost of

removal and replacement, including the cost of all materials which may be furnished by the Owner and used in the work thus removed, shall be borne by the Contractor, regardless of whether the work removed is found to be defective or not. Work covered up without the authority of the Owner, shall, upon order of the Owner, be uncovered to the extent required, and the Contractor shall similarly bear the entire cost of performing all the work and furnishing all the materials necessary for the removal of the covering and its subsequent replacement, as directed and approved by the Owner.

D. Except as otherwise provided herein, the cost of inspection will be paid by the Owner.

E. The Owner will make, or have made, such tests as he deems necessary to assure the work is being accomplished in accordance with the requirements of the Contract. In the event such tests reveal non-compliance with the requirements of the Contract, the Contractor shall bear the cost of such corrective measures deemed necessary by the Owner, as well as the cost of subsequent retesting. It is understood and agreed that the making of tests shall not constitute acceptance of any portion of the work, nor relieve the Contractor from compliance with the terms of the Contract.

1.05 COMPLIANCE WITH REGULATORY REQUIREMENTS

All applicable federal, state, and local regulatory agency requirements shall be complied with during the course of the work. The Contractor's attention is directed to the following list of agency requirements that generally apply to coatings work; the Contractor is responsible for identifying and complying with any other agencies or requirements not listed.

A. OSHA - Personnel protection during all phases of work, including exposure to airborne solvents, dust, and lead.

B. CAL/OSHA - Personnel protection; requirements may supersede OSHA regulations.

C. California Title 22 - Environmental requirements, including definition of abrasive blast materials and residue relative to hazardous waste disposal requirements.

D. Local Air Quality Management District - Environmental requirements for limiting airborne emissions from equipment, products, and methods of operation.

E. NSF/ANSI 61 – Coating systems for surfaces in contact with potable water shall be NSF/ANSI Standard 61 approved.

1.06 SAFETY AND HEALTH REQUIREMENTS

A. Ventilation, electrical grounding, and care in handling coatings, paints, solvents and equipment are important safety precautions during coating and painting projects. Conform with safety requirements set forth by regulatory agencies applicable to the construction industry and manufacturer's printed instructions and material safety data sheets. Personal protective life saving equipment for persons working in or about the project site must be provided and the use of required.

B. The Contractor's safety officer will demonstrate to the Owner, or his representative, that respirators used on the project meet OSHA 29 CFR 1910.134, Respiratory Protection for Workers, and comply with the coating manufacturer's Material Safety and Data Sheets (MSDS) for respiratory protection. Whenever in doubt, fresh air masks will be used in conjunction with a gas monitor to periodically measure LEL.

C. A "tank-watch" safety person who is trained in the use of a gas monitor for measuring LEL and oxygen levels during tank and confined space coating operations must be provided.

PART 2 - MATERIALS

2.01 GENERAL

A. The Contractor shall use only suitable coating materials as recommended by the manufacturer.

B. The volatile organic content (VOC) of the applied coatings, as determined in accordance with ASTM D3960, shall comply with prevailing air pollution regulations.

C. All materials shall be those of current manufacturer and shall meet all applicable regulations for the application and intended service. All coats of any particular coating system shall be approved by the manufacturer for the intended service. In the event that a product specified herein is no longer manufactured or does not meet current regulations, the Contractor shall provide a substitute, currently manufactured product of at least equal performance which meets all applicable regulations subject to Owner's approval, at no additional cost.

D. All materials shall be delivered to the jobsite in their original, unopened containers bearing the manufacturer's name, brand, and batch number. Protective coating materials shall be standard products produced by recognized manufacturers who are regularly engaged in production of such materials for essentially identical service conditions, such as those listed below, or equal:

1. 3M Coatings
2. Carboline
3. International / Devoe Coatings
4. Sherwin Williams Co.
5. Tnemec

E. All surfaces to be coated or painted shall be in the proper condition to receive the material specified before any coating or painting is done. Sandblast or prepare only as much surface area as can be coated in one day. All sharp edges, burrs, and weld spatter shall be removed. All concrete surfaces shall cure 30 days prior to coating or painting. All materials of a specified painting system, including primer, intermediate, and finish coats, shall be produced by

the same manufacturer. Thinners, cleaners, driers, and other additives shall be as recommended by the paint manufacturer for the particular coating system.

F. Surface preparation, prime coatings, and finish coatings for the various systems are specified herein. Unless otherwise noted, all intermediate and finish coats shall be of contrasting colors. It is the intent that the coating alternates specified herein serve as a general guide for the type of coating desired.

2.02 SURFACES NOT TO BE PAINTED

Unless noted otherwise, the following surfaces shall not be painted:

1. Stainless Steel;
2. Metal letters;
3. Grease fittings;
4. Nameplates;
5. Aluminum or Fiberglass grating;
6. Brass and copper tubing above grade
7. Buried pipe, unless specifically required in the piping specification.
8. Surfaces not intended to be painted shall be removed, masked, or otherwise protected. Drop cloths shall be provided to prevent paint materials from falling on or marring adjacent surfaces. Working parts of mechanical and electrical equipment shall be protected from damage during surface preparation and painting process. All masking materials shall be completely removed and surfaces cleaned at completion of the painting operation.

2.03 COATING SYSTEMS FOR EXPOSED METAL

A. System No. C-1--Exposed Metal, Damp Environment Type: Inorganic zinc, high build epoxy, Polyurethane.

Service Conditions: Use on metal structures, steel piping, valves, fittings, and appurtenances subjected to continuous water condensation, or occasional immersion or splashing.

Surface Preparation: As required by Manufacturer's published recommendations.

Prime Coat: One coat of 3-3.5 mils dry-film thickness. Coating shall be Tnemec Hydro-Zinc Series 94-H20, Devoe "Catha Coat 302V", SW Corothane Galvapac 2K 100, or approved equal.

Intermediate Coat: Apply to a dry-film thickness of 4-6 mils. Coating shall be Tnemec 'Hi-Build Epoxoline II Series L69", Devoe "Devran 224V", SW Macropoxy 646-100 or approved equal.

Finish Coat: One coat of 3 mil dry-film thickness. Coating shall be Tnemec "Endura Shield Series 1080", Devoe "Devthane 379H", SW WB Acrolon 100, or

approved equal.

B. System No. C-2--Exposed Metal, Atmospheric Weathering Environment Type: High build epoxy and Polyurethane.

Service Conditions: Use on metal structures, steel and ductile iron piping, pumps, valves, fittings, and appurtenances subject to sunlight or atmospheric weathering.

Surface Preparation: As required by Manufacturer's published recommendations.

Prime Coat: One coat of 6-8 mils dry-film thickness. Coating shall be Tnemec 'Hi-Build Epoxoline II Series L69", Devoe Bar-Rust 231LV, SW Macropoxy 646 100, or approved equal.

Finish Coat: Two coats of 2-3 mil dry-film thickness each coat. Coating shall be Tnemec "Endura Shield Series 1080", Devoe "Devthane 379H", SW WB Acrolon 100 or approved equal.

C. System No. C-3--Exposed Non-ferrous Metal and Galvanized Steel

Type: High solids epoxy coating and polyurethane.

Service Conditions: Use to coat non-ferrous and galvanized steel pipe, fittings, and appurtenances.

Surface Preparation: SSPC-SP5/NACE 1 White metal blast cleaning, as required by Manufacturer's published recommendations.

Prime Coat: Apply to a dry-film thickness of 6-8 mils. Coating shall be Tnemec 'Hi-Build Epoxoline II Series L69", Devoe "Devran 224V", SW Macropoxy 646 100, or approved equal.

Finish Coat: One coat of 2-3 mil dry-film thickness. Coating shall be Tnemec "Endura Shield Series 1080", Devoe "Devthane 379H", SW WB Acrolon 100, or approved equal.

D. System No. C-4—Fusion-Bonded Epoxy Lining System for Pipe

Type: Fusion Bonded Epoxy Coating.

Service Conditions: Use to coat interior surfaces of ferrous metal valves, interior surfaces of pump barrels, interior and exterior of submerged ferrous piping, fittings, etc.

Surface Preparation: As required by Manufacturer's published recommendations.

Application: The coating shall be applied in one coat for a final minimum DFT of 12 to 14 mils.

Preparation and Application shall be performed by a company approved by the coating manufacturer to apply their products. Written proof of manufacturer's approval shall be submitted with shop drawings.

Product: 3M Skotchkote 134, or equal.

2.04 COATING SYSTEM FOR BURIED METAL

A. System No. D-1 -- Buried Metal

Type: Polyamidoamine Epoxy paint having a minimum volume solids of 63%.

Service Conditions: Use to coat buried metal (flanges, steel pipe coating holdbacks, bolts and nuts, fittings, flexible pipe couplings, structural steel etc.).

Surface Preparation: SSPC SP-10.

Prime Coat: One coat of 6-8 mils dry-film thickness. Products: Tnemec 'Hi-Build Epoxoline II Series L69", Devoe "Devran 224V", SW Macropoxy 646-100, or approved equal.

Finish Coats: One coat of 6-8 mils dry-film thickness. Products: Tnemec 'Hi-Build Epoxoline II Series L69", Devoe "Devran 224V", SW Macropoxy 646-100, or approved equal.

2.05 COATING SYSTEM FOR METAL IN CONTACT WITH CONCRETE

A. System No. E-1--Aluminum and Concrete Insulation

Type: Polyamidoamine Epoxy paint having a minimum volume solids of 63%.

Service Conditions: Use to coat areas of aluminum grating, gates, stairs, or structural members in contact with concrete.

Surface Preparation: SSPC SP-1.

Prime Coat: One coat of 4-6 mils dry-film thickness. Products: Tnemec 'Hi-Build Epoxoline II Series L69", Devoe "Devran 224V", SW Macropoxy 646-100, or approved equal.

Finish Coats: One coat of 4-6 mils dry-film thickness. Products: Tnemec 'Hi-Build Epoxoline II Series L69", Devoe "Devran 224V", SW Macropoxy 646-100, or approved equal.

2.06 COATING SYSTEM FOR EXPOSED PVC PIPE

A. System No. F-1--Exposed PVC Pipe

Type: Pigmented Polyurethane Enamel coating having a minimum volume solids of 52%.

Service Conditions: Use to coat all exposed PVC, CPVC or RFP piping.

Surface Preparation: Clean and dry surfaces prior to application of coating to SSPC SP-1, then lightly abrade surfaces with medium grain sandpaper.

Finish Coat: Apply to dry-film thickness of 5 mils. Coating shall be Tnemec Series 71, Devthane 379H, SW WB Acrolon 100, or approved equal.

2.07 COATING SYSTEM FOR CONCRETE SURFACES

A. System No. G-1-Interior and Exterior Surfaces of Concrete Vaults

Type: Penetrating Sealer and High Build Epoxy

Color: White

Service Conditions: Use to coat interior and exterior surfaces of concrete vaults.

Surface Preparation and Application: In accordance with manufacturer's recommendations.

Exterior Coating:

Prime Coat: Apply 1-2 mils DFT Devoe Coatings Pre-prime 167

Finish Coat: Apply 8-12 mils DFT of Devoe Coatings Bar-Rust 231LV; Tnemec Pota-Pox Series L140, SW Macropoxy 5500

PART 3 - EXECUTION

3.01 WEATHER CONDITIONS

Coating shall not be applied in the rain, wind, snow, mist, or fog or when steel or metal surface temperatures are less than 5°F above the dew point.

Coating shall not be applied when the relative humidity is above 85%, the air temperature is above 90° F, or the temperature of the metal to be painted is above 120°F.

Alkyd, chlorinated rubber, inorganic zinc, silicone aluminum, or silicone acrylic paints shall not be applied if air or surface temperature is below 40°F or expected to be below 40°F within 24 hours.

Epoxy, coal tar epoxy, acrylic latex, and polyurethane paints shall not be applied on an exterior or interior surface if air or surface temperature is below 60°F or expected to drop below 60°F within 24 hours.

3.02 SURFACE PREPARATION

A. General: Sandblast or prepare only as much surface area as can be coated in one day. All sharp edges, burrs, and weld spatter shall be removed. Epoxy-coated pipe that has been factory coated shall not be sandblasted.

B. SSPC Specifications: Wherever the words “solvent cleaning”, “hand tool cleaning”, “wire brushing”, or “blast cleaning”, or similar words are used in these specifications or in paint manufacturer’s specifications, they shall be understood to refer to the applicable SSPC (Steel Structures Paint Council, Surfaces Preparation Specifications, ANSI A159.1) specifications listed below:

SP-1 Solvet Cleaning

SP-2 Hand Tool Cleaning

SP-3 Power Tool Cleaning

SP-5 White Metal Blast Cleaning

SP-6 Commercial Blast Cleaning

SP-7 Brush-Off Blast Cleaning

SP-8 Pickling
SP-10 Near White Blast Cleaning

Oil and grease shall be removed from aluminum and copper surfaces in accordance with SSPC SP-1 using clean cloths and cleaning solvents.

Weld spatter and weld slag shall be removed from metal surfaces. Rough welds, beads, peaked corners, and sharp edges including erection lugs shall be ground

smoothly in accordance with SSPC SP-2 and SSPC SP-3.

Welds shall be neutralized with a chemical solvent that is compatible with the specified coating materials using clean cloths and chemical solvent.

C. Abrasive Blast Cleaning

Dry abrasive blast cleaning shall be used for metal surfaces. Do not recycle or reuse contaminated blast particles.

Dry clean surfaces to be coated by dusting, sweeping, and vacuuming to remove residue from blasting. Apply the specified primer or touch-up coating within the period of an 8-hour working day. Do not apply coating over damp or moist surfaces. Re-clean prior to application of primer or touch-up coating any blast cleaned surface not coated within said 8-hour period.

Prevent damage to adjacent coatings during blast cleaning. Schedule blast cleaning and coating such that dust, dirt, blast particles, old coatings, rust, mill scale, etc., will not damage or fall upon wet or newly coated surfaces.

3.03 SURFACES TO BE COATED

A. Above Ground and Exposed Piping: Coat above ground and exposed piping or piping in vaults and structures as described in this Section or the various piping specifications and as specified herein. Color shall be as specified herein or as required by the Owner.

B. Valves and Fittings: Coat valves and fitting as described in this Section or the various technical specifications. Valves and fittings above ground or in vaults and structures, shall match the color of the connecting piping. Factory applied coatings that do not match the color of adjacent piping shall be top coated with System No. C-2 finish coat. Surface shall be prepared per paint manufacturer's requirements.

C. Metal Tanks: Coat metal tanks in accordance with Section 09910.

D. Buried Items: Coat buried flanges, nuts and bolts, valves, flexible pipe couplings, exposed rebar from thrust blocks, and valve boxes per System No. D-1 unless otherwise specified in the particular specifications for those items.

E. Structural Steel: Structural steel shall be hot-hip galvanized per the structural plans and specifications. In addition, exposed structural steel located in vaults, or immersed in water shall be coated as described in the exposed metal and immersed metal coating system sections.

F. Pipe Supports: Coat pipe supports in vaults the same as the adjacent piping. If pipe is PVC, coat pipe supports per System No. C-1.

G. Exposed Indoor Galvanized Electrical Conduit: Coat exposed indoor galvanized electrical conduit per System No. C-3.

H. Mechanical Equipment: Coat mechanical equipment, such as pumps, in accordance with System C-1 or C-2.

I. Aluminum in Contact with Concrete: Aluminum surfaces in contact with concrete

shall be coated per System No. E-1.

3.04 PROCEDURES FOR THE APPLICATION OF COATINGS

A. General

1. The recommendations of the coating manufacturer shall be followed, including the selection of spray equipment, brushes, rollers, cleaners, thinners, mixing, drying time, temperature and humidity of application, and safety precautions.

2. Coating materials shall be kept at a uniform consistency during application. Each coating shall be applied evenly, free of brush marks, sags, runs, and other evidence of poor workmanship. A different shade or tint shall be used on succeeding coating applications to indicate coverage where possible. Finished surfaces shall be free from defects or blemishes.

3. Only thinners recommended by the coating manufacturer shall be used. If thinning is allowed, do not exceed maximum allowable amount of thinner per gallon of coating material.

4. Apply a brush coat of primer on welds, sharp edges, nuts, bolts, and irregular surfaces prior to the application of the primer and finish coat. The brush coat shall be done prior to and in conjunction with the spray coat application. Apply the spray coat over the brush coat.

5. Apply primer immediately after blast cleaning and before any surface rusting occurs, or any dust, dirt, or any foreign matter has accumulated. Reclean by blast cleaning those surfaces that have become surface colored or become moist prior to coating application.

B. Paint Mixing

Multiple-component coatings shall be prepared using all the contents of each component container as packaged by the paint manufacturer. Partial batched shall not be used. Multiple-component coatings that have been mixed beyond their pot life shall not be used. Small quantity kits for touch-up painting and for painting other small areas shall be provided. Only the components specified and furnished by the paint manufacturer shall be mixed. For reasons of color or otherwise, additional components shall not be intermixed, even within the same generic type of coating.

C. Field touch Up of Shop-Applied Prime Coats

1. Organic Zinc Primer: Surfaces that are shop primed with inorganic zinc primers shall receive a field touch up of organic zinc primer to cover all scratches or abrades areas. Organic zinc coating system shall have a minimum volume solids of 54% and a minimum zinc content of 14 pounds per gallon. Coating shall be of the converted epoxy, epoxy phenolic, or urethane type and shall be manufactured by the prime coat and finish coat manufacturer.

2. Other Primers: Surfaces that are shop primed with other than inorganic

zinc primer shall receive a field touch up of the same primer used in the original prime coat.

3.05 DRY-FILM THICKNESS TESTING AND REPAIR

A. Coating Thickness Testing: Coating thickness specified for steel surfaces shall be measured with a magnetic-type dry-film thickness gauge. Dry-film thickness gauge shall be provided by the Contractor, as manufactured by Mikrotest or Elcometer. Each coat shall be checked for the correct dry-film thickness. Measurement shall not be made until a minimum of eight (8) hours after application of the coating. Non-magnetic surfaces shall be checked for coating thickness by micrometer measurement of cut and removed coupons. The Contractor shall repair coating at all locations where coupons are removed.

B. Holiday Testing: The finish coat (except zinc primer and galvanizing) shall be tested by the Contractor in the presence of the Owner for holidays and discontinuities with an electrical holiday detector of the low-voltage, wet-sponge type. The detector shall be provided by the Contractor as manufactured by Tinker& Rasor or K-D Bird Dog, or approved equal.

C. Repair: If the item has an improper finish color, insufficient film thickness, or holidays, the surface shall be cleaned and top-coated with the specified paint material to obtain the specified color and coverage. Visible areas of chipped, peeled, or abraded paint shall be hand or power-sanded, feathering the edges. The areas shall then be primed and finish coated in accordance with the specifications. Work shall be free of runs, bridges, shiners, laps, or other imperfections.

3.06 CLEANUP

Upon completion of all painting and coating work, the Contractor shall remove all surplus materials and rubbish. He shall repair all damage and shall leave the premises in a clean and orderly condition.

END OF SECTION

DIVISION 06 – EQUIPMENT

SECTION 011001000 EQUIPMENT GENERAL PROVISIONS

PART 1 - GENERAL

1.01 WORK OF THIS SECTION

A. The WORK of this Section includes providing general requirements for the WORK of applicable Sections of these Specifications. Unless there are more restrictive requirements in the individual Sections, the provisions of this Section shall apply.

B. The WORK of this Section applies to the WORK of the following Sections:

1. Section 011001100 Pumps, General

2. Section 011001216 Vertical Lineshaft Mixed Flow Pumps

3. Section 11316 Submersible Non-Clog Pumps

1.02 RELATED SECTIONS

A. The WORK of the following Sections applies to the WORK of this Section. Other Sections of the Specifications, not referenced below, shall also apply to the extent required for proper performance of this WORK.

1. SECTION 01300 Submittals

2. Section 011006040 Electric Motors

1.03 CODES

A. The WORK of this Section shall comply with the latest editions of the following codes:

1. California Mechanical Code (CMC)

2. California Plumbing Code (CPC)

3. California Fire Code (CFC)

4. California Electrical Code (CEC)

5. California Building Code (CBC)

1.04 SPECIFICATIONS AND STANDARDS

A. Except as otherwise indicated, the applicable standards of the following organizations apply to the WORK of this Section:

1. American Society for Testing and Materials (ASTM)

2. American National Standards Institute (ANSI)

3. American Society of Mechanical Engineers (ASME)
4. American Water Works Association (AWWA)
5. National Electrical Manufacturers Association (NEMA)

B. The current editions of the following apply to the WORK of this Section:

1. ABMA 9 Load Ratings and Fatigue Life for Ball Bearings
2. ABMA 11 Load Ratings and Fatigue Life for Roller Bearings
3. ANSI B16.1 Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250, and 800
4. ANSI B16.5 Pipe Flanges and Flanged Fittings, Steel, Nickel Alloy, and Other Special Alloys
5. ANSI/ASME B1.20.1 General Purpose Pipe Threads (Inch)
6. AWWA C206 Field Welding of Steel Water Pipe

C. All chemicals, materials, and coatings specified in this section or other related sections that will come into contact with potable water shall be certified in accordance with ANSI/NSF Standards 60 and/or 61.

1.05 SHOP DRAWINGS AND SAMPLES

A. The following shall be submitted in compliance with Section 01300:

1. Manufacturer's product data including catalogue cuts.
2. Equipment name, identification number and specification numbers.
3. Shop drawings showing details, dimensions, anchorage details, and installation of equipment with all special fittings, appurtenances and required clearances.
4. Shipping weights.
5. Calculations of equipment anchorage forces and anchorage details, signed by a California Registered Engineer.
6. Certification that the single manufacturer accepts the indicated unit responsibilities.
7. Parts list with materials of construction by ASTM reference and grade.
8. List of at least 5 installations and telephone numbers, where identical equipment has been used.
9. Torsional and lateral vibration analysis reports.

1.06 OWNER'S MANUAL

A. In addition to the requirements of Section 01300, the following shall be included in the OWNER'S MANUAL:

1. Manufacturer's catalog including installation instructions.

2. Manufacturer's operating and maintenance procedures including lubricating instructions.

3. Manufacturer's certification that products comply with the indicated requirements.

4. Bearing L-10 life calculations.

5. Certification that products have been factory-tested and found to conform with the contract requirements.

6. Certification that the WORK has been field-tested and the WORK complies with the indicated requirements.

7. Equipment tolerances

8. Electrical data including control and wiring diagrams.

9. Address and telephone number of local service representative.

1.07 SERVICES OF MANUFACTURER

A. Inspection, Startup, and Field Adjustment: An authorized service representative of the manufacturer shall visit the site and witness the following:

1. Installation of the equipment.

2. Inspection, checking, and adjusting the equipment.

3. Startup and field-testing for proper operation.

4. Performing field adjustments to ensure that the equipment installation and operation comply with the Specifications.

B. Instruction of OWNER'S Personnel:

1. An authorized service representative of the manufacturer shall instruct the OWNER'S personnel in the operation and maintenance of the equipment, including step-by-step troubleshooting with necessary test equipment. Training shall be specific to the models of equipment provided.

2. The representative shall have at least one year of qualified experience in training covering the relevant subjects described in paragraph 01100.

3. Training shall be scheduled a minimum of 3 weeks in advance of the first session.

4. Training materials shall remain with the trainees.

5. The OWNER may videotape the training sessions for later use with the OWNER'S personnel.

C. Local Service: The manufacturer shall have a local service agency (within 50 miles of the site) which maintains properly trained personnel and adequate spare parts and is able to respond and complete repairs within 24 hours.

1.08 FACTORY INSPECTIONS AND TESTING

A. The CONTRACTOR shall be responsible for all costs associated with inspection and testing of materials, products, or equipment at the place of manufacture. This shall include costs for travel, meals, lodging, and car rental for (two) OWNER-designated inspectors for the number of days indicated to complete such inspections or observations, if the place of manufacture, fabrication and factory testing is more than fifty (50) miles outside the geographical limit of the City. The CONTRACTOR shall not be responsible for salary or salary-related costs of the inspectors.

B. Product Testing: Products shall be tested at the factory for compliance with the indicated requirements. The CONTRACTOR shall provide the CONSTRUCTION MANAGER a written notification of testing dates at least 2 weeks in advance of testing, unless more advance notice is specified elsewhere.

C. Balancing: Rotating elements of equipment, except small, commercially packaged equipment, shall be statically and dynamically balanced at the factory prior to final assembly. The CONTRACTOR shall furnish certified copies of all test results.

1.09 FIELD TESTING

A. Testing: Products shall be field-tested for compliance with the indicated requirements.

B. Witnesses: The OWNER and the CONSTRUCTION MANAGER (at the option of either) reserves the right to witness field tests.

1.10 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Delivery of Materials: Products shall be delivered in original, unbroken packages, containers, or bundles bearing the name of the manufacturer. Materials delivered onsite without an approved submittal for verification shall be rejected and payment withheld.

B. Storage: Products shall be carefully stored in a manner that will prevent damage and in an area that is protected from the elements.

C. Protection of Equipment: Equipment shall be boxed, crated, or otherwise protected from damage and moisture during shipment, handling, and storage. Equipment shall be protected from exposure to corrosive fumes and shall be kept thoroughly dry at

all times. Pumps, motors, drives, electrical equipment, and other equipment with anti-friction or sleeve bearings shall be stored in weather tight storage facilities prior to installation. For extended storage periods, plastic equipment wrappers shall not be used to prevent accumulation of condensate in gears and bearings. Gears and bearings to be stored for extended periods shall be containerized suitable for export shipment.

D. Investigation of Failed Products: Prior to disposal of failed products, the CONTRACTOR shall investigate the causes of failure and submit a report to the CONSTRUCTION MANAGER, who will subsequently direct the CONTRACTOR for disposal.

1.11 UNIT RESPONSIBILITY

A. Equipment systems made up of two or more components shall be provided as a unit by the manufacturer of the driven equipment. The manufacturer of the driven equipment shall assume the unit responsibility. Unless otherwise indicated, the CONTRACTOR shall cause each system component to be furnished by the manufacturer with unit responsibility. The extent of the manufacturer's responsibilities shall include engineering the specified equipment, preparation of all submittal materials, coordinating manufacture and procurement, compatibility and shipment of all specified components, design of all equipment supports, providing installation and testing specialists to assist the CONTRACTOR in completing the installation and commissioning the equipment, furnishing factory certified specialists to train the OWNER's staff, and the production and submission of specified operation and maintenance manuals. The CONTRACTOR is responsible to the OWNER for performance of all systems as indicated. The CONTRACTOR shall ensure the submittal of a Certificate of Unit Responsibility signed by the manufacturer with unit responsibility.

1.12 TORSIONAL AND VIBRATION ANALYSIS

A. Torsional Analysis: The drive train shall be free from torsional critical which produce combined (steady plus transient torque induced) stresses exceeding 30 percent of the material's elastic limit (but no more than 18 percent of the material's ultimate tensile strength) at any speed from 20 percent below to 30 percent above the operating speeds required by the specified operating conditions, or during startup, shutdown or drive control transients. One analysis is required for each piece of unique equipment and for each set of identical equipment assigned to the same application. This general requirement is applicable under the individual equipment specifications or the equipment type general specifications where more detailed torsional, vibration, critical speed, and/or shaft deflection analyses may be required.

B. The CONTRACTOR shall submit to the CONSTRUCTION MANAGER a torsional and lateral vibration analysis of the following equipment, in accordance with Section 01300. The analysis shall be performed by a specialist who has performed, in the recent past, a torsional and lateral vibration analysis on at least one project of comparable size and complexity. The specialist shall be approved by the CONSTRUCTION MANAGER.

1. All vertical pumps with universal joints and extended shafts.

2. All other equipment where indicated.

During construction and testing of all engine driven equipment and all gear driven equipment, the torsional analysis specialist shall visit the site and conduct a field torsiograph test on one randomly selected unit in each set of these equipment to verify the desktop torsional analysis. The test shall be conducted on selected accessible portions of the rotating equipment when operating throughout the full range of specified operating conditions.

PART 2 - PRODUCTS

2.01 GENERAL

A. General: Only products meeting the indicated requirements shall be provided.

B. Manufacturers: Products shall be new, of current manufacture, and shall be the products of reputable manufacturers specializing in the manufacture of such products.

C. Products: Materials shall be suitable for the intended purpose and free of defects and shall be recommended by the manufacturer for the application indicated.

D. No Endorsement: The listing of a manufacturer shall not be construed as an endorsement of a particular manufacturer's product, nor shall it be construed that a named manufacturer's standard product will comply with the indicated requirements. No preference is implied by the order of listing of named manufacturers, and the listings are not intended to be comprehensive. The manufacturer listings are only an indication that the OWNER and DESIGN CONSULTANT believe that the named manufacturers are capable of producing equipment and products which will satisfy the indicated requirements.

2.02 GENERAL REQUIREMENTS

A. Noise Level: When in operation, no piece of equipment shall exceed the OSHA noise level requirements for a one hour exposure.

B. Personal Hearing Protection: The WORK includes multiple sets of three pairs of high attenuation hearing protectors complying with the requirements of ANSI S12.6 and producing a noise level reduction of 25 dBA at a frequency of 500 Hz. The hearing protectors shall have fluid filled ear cushions and an adjustable, padded headband. One set of hearing protectors shall be stored in a weatherproof, labeled, steel cabinet which shall be mounted in a location near each noise producing equipment installation.

C. Service Factors: Service factors shall be applied in the selection and design of mechanical power transmission components where so indicated in individual Sections. When not indicated there, minimum service factors shall be 1.25.

D. Welding: Except as otherwise indicated, welding shall comply with ANSI/AWWA D100 and AWWA C206 and the following:

1. Composite fabricated steel assemblies which are to be erected or installed inside a hydraulic structure, including any fixed or movable structural components of mechanical equipment, shall have continuous seal welds and shall prevent entrance of air or moisture.

2. Welding shall be by the metal-arc method or gas-shielded arc method described in the American Welding Society's "Welding Handbook" as supplemented by other AWS standards. Qualification of welders shall comply with AWS Standards.

3. In assembly and during welding, the component parts shall be clamped, supported, and restrained to minimize distortion and for control of dimensions. Weld reinforcement shall comply with the AWS code. Upon completion of welding, weld splatter, flux, slag, and burrs left by attachments shall be removed. Welds shall be repaired to produce a workmanlike appearance with uniform weld contours and dimensions. Sharp corners of material which is to be painted or coated shall be ground to a minimum of 1/32-inch on the flat.

E. Identification of Equipment Items: Each item of equipment shall have an indelible, legible identifying mark corresponding to the equipment number indicated.

F. Vibration Level: Except as otherwise indicated, equipment subject to vibration shall be provided with restrained spring-type vibration isolators or pads complying with the manufacturer's written recommendations.

G. Shop Fabrication: Shop fabrication shall be performed in accordance with the shop drawings.

H. Tolerances: The variation in length of members without machine finished ends and which are to be framed shall not exceed 1/16-inch for members 30 feet or less and shall not exceed 1/8-inch for members over 30 feet.

I. Machine Finish: The type of finish shall be the most suitable for the application in micro-inches complying with ANSI B46.1. The following finishes shall be used:

1. Surface roughness of surfaces in sliding contact shall not exceed 63 micro-inches.

2. Surface roughness shall not exceed 250 micro-inches except where a tight joint is indicated.

3. Surface roughness for other mechanical parts shall not exceed 500 micro-inches.

4. Surface roughness of contact surfaces of shafts and stems that pass through stuffing boxes and contact surfaces of bearings shall not exceed 32 micro-inches.

J. Seismic Design: Seismic design and anchorage shall be designed per 2016 CBC using the following design requirements:

Seismic Importance Factor, $I_P = 1.5$
Risk Category = III
Mapped Spectral Response Accelerations: $S_S = 0.948g$, $S_1 = 0.342g$
Site Class = D
Spectral Response Coefficients: $S_{DS} = 0.708g$, $S_{D1} = 0.392g$
Seismic Design Category = D

2.03 EQUIPMENT SUPPORTS AND FOUNDATIONS

A. Equipment Supports: Equipment supports, anchors, and restrainers shall be designed for static, dynamic, wind, and seismic loads. The design horizontal peak ground acceleration shall be in accordance with paragraph 2.02 J above.

2.04 PIPE HANGERS, SUPPORTS, AND GUIDES

A. Pipe connections to equipment shall be supported, anchored, and guided to minimize stresses and loads on equipment flanges and equipment.

2.05 FLANGES AND PIPE THREADS

A. Flanges on equipment shall comply with ANSI B16.1, Class 125; or B16.5, Class 150, unless otherwise indicated. Threaded flanges and fittings shall have standard taper pipe threads complying with ANSI/ASME B1.20.1.

2.06 COUPLINGS

A. Flexible couplings shall be provided between the driver and the driven equipment to accommodate slight angular misalignment, parallel misalignment, end float, and to minimize shock loads. Where required for vertical shafts, 3-piece spacer couplings or universal type couplings for extended shafts shall be installed.

B. The equipment manufacturer shall recommend the size and type of coupling required for each specific application.

C. Taper-lock bushings may be used where indicated.

D. Where universal type couplings are indicated, they shall be of the needle bearing type construction, equipped with commercial type grease fittings. Bearings shall be sized in accordance with ABMA 11, using a 1.25 service factor, for the same L-10 life expectancy as the driven equipment, but not less than 50,000 hours.

2.07 SHAFTING

A. General: All shafting shall be continuous between bearings and shall be sized properly to transmit the power required. Keyways shall be provided in accordance with standard practice.

B. Materials: Shafting materials shall be selected for the type of service and torque transmitted and the effect of corrosive gases, moisture, and fluids shall be considered. Unless otherwise specified, materials shall conform to the following:

1. Low carbon cold-rolled steel shafting: ASTM A 108, Grade 1018.

2. Medium carbon cold-rolled shafting: ASTM A 108, Grade 1045.

3. Corrosion-resistant shafting: stainless steel or Monel, whichever is most suitable for the intended service.

C. Differential Settlement: Where differential settlement between the driver and the driven equipment is indicated, an extension shaft with 2 sets of universal type couplings shall be provided.

2.08 BEARINGS

A. Bearings shall conform to the standards of the Anti-Friction Bearing Manufacturers association, Inc. (ABMA).

B. Bearing selection shall include the following criteria: fitting practice, mounting, lubrication, sealing, static rating, and housing strength.

C. Re-lubricatable type bearings shall be equipped with an Alemite type hydraulic grease fitting in an accessible location.

D. All lubricated-for-life bearings shall be factory-lubricated with the manufacturer's best recommended grease to insure maximum bearing life and best performance.

E. Except where otherwise indicated, bearings for process equipment shall be selected for a minimum L-10 life expectancy of 50,000 hours for intermittent service and 100,000 hours for continuous service, in accordance with ABMA 9 or 11. Anti-friction bearings for pumps with discharge nozzle sizes 14 inches in diameter or greater, or pumps with a shaft diameter greater than 4 inches, shall be selected for an L-10 life expectancy of 100,000 hours in accordance with ABMA 9 or 11. Bearings for other elements in the rotating system such as motors, intermediate shaft bearings, right-angle gears, and flywheel bearings shall be selected using the same criteria as specified for the driven equipment, but not less than 50,000 hours. This requirement supersedes any specified bearing life in the detailed specification sections. Calculations supporting the selection of bearing sizes shall be included in the Owner’s Manual.

F. Bearing housings shall be of cast iron or steel and the bearing mounting arrangement shall be in accordance with the published standards of the manufacturer. Split-type housings may be used.

G. Unless otherwise indicated, sleeve-type bearings shall have a Babbitt or bronze liner.

2.09 GEARS AND GEAR DRIVES

A. Except as otherwise indicated, gears shall be of the helical or spiral-bevel type, designed and manufactured in accordance with AGMA Standards, with a minimum service factor of 1.7, a minimum L-10 bearing life of 60,000 hours at the worst combination of specified operating conditions, in accordance with ABMA 9 or 11, and a minimum efficiency of 94 percent. Worm gears shall not be used.

B. Gear speed reducers or increasers shall be of the enclosed type, oil- or grease-lubricated and fully sealed, with a breather to allow air to escape but keep dust and dirt out. The casing shall be of cast iron or heavy duty steel construction with lifting lugs and an inspection cover for each gear train. An oil level sight glass and an oil flow indicator shall be provided and installed for easy reading.

C. Gears and gear drives as part of an equipment assembly shall be shipped fully assembled for field installation.

D. Material selections shall comply with AGMA values and the manufacturer's recommendations. Input and output shafts shall be properly designed for the service and load requirements. Gears shall be computer-matched for minimum tolerance variation. The output shaft shall have 2 positive seals to prevent oil leakage.

E. Oil level and drain location shall be readily accessible. Oil coolers or heat exchangers with all required appurtenances shall be included where indicated.

F. Where gear drive input or output shafts connect to couplings or sprockets, the gear drive manufacturer shall supply matching key.

2.10 DRIVE GUARDS

A. Power transmission, prime movers, machines, shaft extensions, and moving machine parts shall be guarded. Unless otherwise indicated for corrosive environment, the guards shall be constructed of minimum 10 gauge expanded, flattened steel with smooth edges and corners, galvanized after fabrication and securely fastened. Where required for lubrication or maintenance, guards shall have hinged and latched access doors.

2.11 FLEXIBLE CONNECTORS AND DUAL PIPE COUPLINGS

A. Flexible connectors shall be installed in piping connections to engines, blowers, compressors, and other vibrating equipment in accordance with the requirements of the ANSI B31.1.

B. Dual pipe couplings, separated by an 18-inch pipe spool unless otherwise indicated, shall be installed on the suction and discharge of all pumps - inboard of the isolation valves. Dual pipe couplings, separated by not less than two pipe diameters nor more than 5 feet, shall be installed on all piping where it exits a structure. Couplings shall be restrained where required. Dual flexible pipe joints may be used where indicated in buried pipe applications in lieu of dual pipe couplings. Flexible connectors are not permitted where dual pipe couplings are specified.

2.12 GASKETS AND PACKINGS

A. Packing around valve stems and reciprocating shafts shall be of compressible material, compatible with the fluid being used. Chevron-type "V" packing shall be Garlock No. 432, John Crane "Everseal," or equal.

B. Packing around rotating shafts (other than valve stems) shall be "O"-rings, stuffing boxes, or mechanical seals, as recommended by the manufacturer.

2.13 TOOLS AND SPARE PARTS

A. Tools: The WORK includes one complete set of special tools recommended by the manufacturer for maintenance and repair of each separate type of equipment; tools shall be stored in tool boxes, and identified with the equipment number by means of stainless steel or solid plastic name tags attached to the box.

B. Spare Parts: All equipment shall be furnished with the manufacturers' recommended spare parts, as indicated in the individual equipment Sections. Spare parts shall be

tagged by project equipment number and identified as to part number, equipment manufacturer, and subassembly component (if appropriate). Spare parts subject to deterioration such as ferrous metal items and electrical components shall be properly protected by lubricants or desiccants and encapsulated in hermetically sealed plastic wrapping.

2.14 NAMEPLATES

A. Equipment nameplates of stainless steel shall be engraved or stamped and fastened to the equipment in accessible locations with stainless steel screws or drive pins. Nameplates shall contain the manufacturer's name, model, serial number, size, characteristics, and appropriate data describing the machine performance ratings.

2.15 OVERLOAD PROTECTION

A. General: Where indicated or as required to match equipment being replaced, mechanical or electronic overload protection devices shall be installed on equipment. Overload protection devices shall be compatible with the existing control systems at each site.

2.16 ANCHOR BOLTS, NUTS AND WASHERS

A. Unless otherwise specified, the CONTRACTOR shall provide Type 316 stainless steel anchor bolts and washers, and Type 416 stainless steel or other corrosion resistant, non-galling alloy nuts.

PART 3 – EXECUTION

3.01 INSTALLATION

A. General: Products and equipment shall be installed in accordance with the manufacturer's written installation instructions, the requirements of this Section, the requirements of the individual equipment specifications, and as indicated.

B. Alignment: Journeymen millwrights shall perform alignment of equipment furnished under this Section and any referencing section. Carpenters, laborers or any other trades are specifically excluded from performing this work. In locations where such trades are not available, the CONTRACTOR shall retain the services of a firm specializing in this type of work to perform the setting and alignment work. The CONTRACTOR shall submit the qualifications of the proposed firm to the CONSTRUCTION MANAGER for acceptance prior to performing the work. The CONSTRUCTION MANAGER shall personally witness final alignment procedures for each item of equipment as a condition precedent to beginning any work.

C. Lubricants: The CONTRACTOR shall provide for each item of mechanical equipment a supply of the lubricant required for the commissioning period. Lubricants shall be of the type recommended by the equipment manufacturer and shall be products of the OWNER's current lubricant supplier. The CONTRACTOR shall limit the various types of lubricants by consolidating them, with the equipment manufacturer's approval, into the least number of different types. Not less than 90 days before the date shown in his construction schedule for starting, testing and adjusting equipment, the CONTRACTOR shall provide the OWNER with three

copies of a list showing the required lubricants, after consolidation, for each item of mechanical equipment. The list shall show estimated quantity of lubricant needed for a full year's operation, assuming the equipment will be operating continuously.

3.02 COUPLINGS

A. Couplings shall be installed in accordance with the manufacturer's installation instructions.

3.03 INSULATING CONNECTION

A. Insulating connections shall be installed in accordance with the manufacturer's instructions.

3.04 PIPE HANGERS, SUPPORTS, AND GUIDES

A. Hangers, supports, and guides shall be installed in compliance with ANSI/ASME B31.1.

3.05 BOLTS AND MISCELLANEOUS METALS

A. Provide and install where required for proper installation of equipment.

3.06 PACKAGED EQUIPMENT

A. When any system is provided as pre-packaged equipment, coordination shall include space and structural requirements, clearances, utility connections, signals, outputs and features required by the manufacturer including safety interlocks.

3.07 PROTECTIVE COATING

A. Equipment shall be painted and coated in accordance with individual equipment sections. Non-ferrous metal and corrosion-resisting steel surfaces shall be coated with grease or lubricating oil. Coated surfaces shall be protected from abrasion or other damage during handling, testing, storing, assembly, and shipping.

END OF SECTION

SECTION 1100 PUMPS, GENERAL

A. The WORK of this Section includes providing general requirements for pumps and pumping appurtenances and providing special tools and spare parts.

B. The WORK also includes coordination of design, assembly, testing and installation.

C. The WORK of this Section applies to the following Sections:

1. Section 11316 Submersible Non-Clog Pumps

2. Section 1216 Vertical Lineshaft Mixed Flow Pumps

1.02 RELATED SECTIONS

A. The WORK of the following Sections applies to the WORK of this Section. Other Sections of the Specifications, not referenced below, shall also apply to the extent required for proper performance of this WORK.

1. Section 01300: Shop Drawings and Submittals

2. Section 1000 Equipment General Provisions

3. Section 16040 Electric Motors

1.03 SPECIFICATIONS AND STANDARDS

A. Specifications and standards shall comply with Section 011001000 and shall include the following:

1. ANSI/HI 1.1-1.6 Centrifugal Pumps

2. ANSI/HI 2.1-2.6 Vertical Pumps

3. ANSI/HI 9.6.4 Centrifugal and Vertical Pumps. Vibration Measurements and Allowable Values.

4. Hydraulic Institute (See applicable ANSI/HI Standard) Standards

5. NEMA MG1 Motors and Generators

6. All chemicals, materials, and coatings specified in this section or other related sections that will come into contact with potable water shall be certified in accordance with ANSI/NSF Standards 60 and/or 61.

1.04 SHOP DRAWINGS AND SAMPLES

A. In addition to the requirements of Division 11 and the material listed in the detailed specification, the following shall be submitted in compliance with Section 01300:

1. Pump name, identification number, and specification Section number.

2. Performance data curves showing head, capacity, horsepower demand, net positive suction head required (NPSHR), minimum submergence (for vertical turbine pumps), and pump efficiency over the entire operating range of the pump. The equipment manufacturer shall indicate separately the head, capacity, horsepower demand, overall efficiency, NPSHR, and minimum submergence (for vertical turbine pumps) required at the design flow conditions and the maximum and minimum flow conditions. A family of performance curves at intervals of 100 rpm from minimum speed to maximum speed shall be provided for each centrifugal pump equipped with a variable speed drive. For fixed speed driven pumps, the family of performance curves shall cover maximum diameter, rated and minimum diameter impellers.

3. Limits shall be indicated on the performance curves recommended for stable operation without cavitation or excessive vibration. The stable operating range shall be as wide as possible based on actual hydraulic and mechanical tests.

4. Assembly and installation drawings including shaft size, seal, coupling, bearings, anchor bolt plan, part nomenclature, bill or materials, outline dimensions, and shipping weights.

5. Data in accordance with Section 011006040 – Electric Motors, for the electric motor proposed for each pump or Section 011001300 – Diesel Engines, for the diesel engine proposed for each vertical lineshaft mixed flow pump.

6. Wiring diagram of field connections with identification of terminations between existing Local Control Panels, junction terminal boxes, and equipment items.

7. Completed pump data sheets.

B. Operations and Maintenance Information: The CONTRACTOR shall submit information on pumps in accordance with the requirements of Section 01783 - Operations and Maintenance Data.

C. Spare Parts List: The CONTRACTOR shall submit a Spare Parts List that contains the required information for each pump Section.

D. Factory Test Data: The CONTRACTOR shall submit signed, dated, and certified factory test data for each pump system which requires factory testing, submitted before shipment of the equipment.

E. Certifications: The CONTRACTOR shall submit the following certifications:

1. Manufacturer's certification of proper installation.

2. CONTRACTOR's certification of satisfactory field testing.

1.05 FACTORY TESTING

A. Performance Curves: Centrifugal pumps shall have a continuously rising curve toward the shut- off head and in no case shall the required horsepower at any point on the performance curve exceed the rated horsepower of the motor or engine.

B. Performance Confirmation: Pumps, drives, and motors shall be factory-tested to confirm specified requirements in accordance with the applicable ANSI/HI Pump Standards Test Code for Centrifugal, Vertical, Rotary, and Reciprocating Pumps, and test data shall be recorded. Tests shall be performed on all pumps and motors of sizes 25 horsepower and larger. Prototype model tests will not be acceptable.

1. Test data shall include the following:

a. Hydrostatic test results: Hydraulic test results with, unless otherwise specified, a minimum of 6 readings between shutoff head and 25 percent above design capacity. Certified pump curves showing head/flow, horsepower, efficiency and NPSHR curves. Certification that the pump horsepower demand will not exceed the rated motor horsepower beyond a 1.0 service rating at any point on the curve.

b. Motor test results NPSH margin test results, if NPSH margin tests are required

2. Factory Tests of Motors: All pump motors of sizes 100 horsepower and larger, shall be assembled, tested, and certified at the factory and the working clearances checked to insure that all parts are properly fitted. The tests shall comply with ANSI/IEEE 112 and ANSI/IEEE 115 standards, including heat, running and efficiency tests.

3. Hydrostatic Tests: All pressure sustaining parts shall be subjected to factory hydrostatic tests. Hydrostatic tests for centrifugal and axial flow pumps shall conform to the requirements of API 610.

4. Performance Guarantee: Unless specified otherwise, pump performance, including NPSHR for centrifugal and axial flow pumps, shall be guaranteed by the pump manufacturer to the most restrictive tolerances set forth in the applicable ANSI/HI Standard. The guarantee shall be in writing, shall be signed by an officer of the manufacturing corporation and shall be notarized. Under no circumstances shall deviations from specified operating conditions, though allowed by the referenced standards, result in overload of the driver furnished with the equipment, nor shall such deviations result in power requirements greater than the drivers nameplate rating.

5. Witnessed Tests: Witnessed pump performance tests shall be in accordance with the applicable ANSI/HI test standard. NPSHR tests shall also be performed for centrifugal and axial flow pumps to confirm the data used to establish NPSHA margin for column type (axial flow and vertical turbine) pumps shall be performed using the method described for Figure 2.6.3 or Figure 2.6.4 in ANSI/HI 2.6. All NPSHR tests shall extend from 10

percent to 120 percent of Best Efficiency Flow at full speed, or to not less than 10 percent (in terms of flow) past the flow at Operating Condition B, whichever is greater. Not less than ten data points shall be developed during the test. Failure to achieve guaranteed performance (capacity and head, efficiency or NPSHR) shall be cause for rejection. Tolerances shall be the most restrictive set forth in the applicable standard. All test procedures shall be in strict conformance with the referenced standards, except prediction of performance of a trimmed impeller from test data of the larger impeller will not be permitted. If trimming is required, the pump shall be retested. Under no circumstances shall deviations from specified operating conditions, though allowed by the referenced standards, result in overload of the driver furnished with the equipment, nor shall such deviations result in power requirements greater than the drivers nameplate rating.

6. Non-Witnessed Tests: Where non-witnessed tests are permitted, centrifugal and axial flow pumps shall be tested in accordance with ANSI/HI 1.6 or 2.6, as applicable. Not less than ten data points shall be developed during the test. NPSHR tests shall also be performed to confirm the data used to establish NPSHA margin as specified in paragraph 11175-1.9G. NPSHR tests for column type (axial flow and vertical turbine) pumps shall be performed using the method described for Figure 2.6.3 or Figure 2.6.4 in ANSI/HI 2.6. All NPSHR tests shall extend from 10 percent to 120 percent of Best Efficiency Flow at full speed, or to not less than 10 percent (in terms of flow) past the flow at Operating Condition B, whichever is greater. Failure to achieve guaranteed performance (capacity and head, efficiency or NPSHR) shall be cause for rejection. Tolerances and restrictions shall be as set forth above for witnessed tests. The CONTRACTOR shall furnish the CONSTRUCTION MANAGER with not less than two weeks advance written notice of the date and place of the non-witnessed tests.

7. In the event of failure of any pump to meet any of the specified requirements or efficiencies, the CONTRACTOR shall make all necessary modifications, repairs, or replacements to conform to the requirements of the Contract Documents and such pump shall be retested at no additional cost to the OWNER, until found satisfactory.

8. All test results (data sheets, test logs and generated performance curves) shall be signed and certified correct by an officer of the manufacturing corporation and shall be notarized.

9. Upon completion of testing, curves shall be produced showing pump performance (head, efficiency, NPSHR (if applicable), and power required versus capacity) at full speed and predicted performance at speeds requiredto meet all other indicated operating conditions. The test results shall be certified and notarized as noted above and submitted to the CONSTRUCTION MANAGER. The pumps shall not be shipped until authorized, in writing, by the CONSTRUCTION MANAGER. Final acceptance of the equipment will depend on satisfactory operation after installation.

1.06 FIELD TESTS

A. All pumping units shall be field-tested after installation to demonstrate proper operation, without excessive noise, vibration, cavitation, and overheating of bearings. The field testing shall be performed in the presence of an experienced field representative of the manufacturer of the equipment, who shall certify in writing that the equipment and controls have been properly installed, aligned, lubricated, adjusted, and readied for operation and shall witness the following:

1. Pump performance shall be documented by obtaining concurrent readings, showing motor voltage, amperage, pump suction head, and pump discharge head, for at least 4 pumping conditions at the respective pump rpm. Each power lead to the motor shall be checked for proper current balance.

2. Determination of bearing temperatures by a contact-type thermometer. A running time of at least 20 minutes shall be maintained for this test, unless liquid volume available is insufficient for a complete test.

1.07 DESIGN REQUIREMENTS FOR CENTRIFUGAL AND AXIAL FLOW PUMPING EQUIPMENT

A. General: Provisions and requirements contained in this paragraph (1.8) apply specifically to centrifugal and axial flow pumps, both vertical and horizontal, commonly falling into the generic types covered by ANSI/HI 1.1 through 1.6 and 2.1 through 2.6. More restrictive requirements, where found in individual pump specifications, shall supercede requirements of this paragraph. This paragraph does not apply, except by specific reference, to positive displacement pumps of any type. Centrifugal and axial flow pumping equipment shall conform to the requirements of paragraph 2.1.1, API 610. All components in the rotating elements in the drive train, including equipment supports and supports for rotating elements, shall be selected and designed to function without damage for disassembly at reverse rotational speeds up to 150 percent of maximum operational speed during flow reversals through the pump. The complete pumping unit shall operate without overload on any component at any point along the pump's entire full-speed operating curve. Pumps required by virtue of the specified operating conditions to operate against a closed or throttled valve for any period of time exceeding five seconds, shall be furnished with drivers sized to operate continuously at the power requirement for that condition even though the power requirements at the rated condition may be less.

B. Pump Selection: Pumps shall be selected to place all specified continuous duty operating conditions within the manufacturer’s Allowable Operating Range as defined in ANSI/HI 9.6.3. Unless otherwise specified in individual pump specifications, rated conditions and all other continuous duty full speed operating conditions specified in the detailed pump specifications shall fall within the manufacturers Preferred Operating Range as defined in ANSI/HI 9.6.3. The Preferred Operating Range shall be not less than that specified in paragraph 2.1.12, API 610. Proposed pump selections shall be selected to allow not less than a five percent increase in head, as specified in paragraph 2.1.4 of API 610. Variable speed operation to achieve this objective will not be considered. Pump selections proposing maximum diameter impellers for the proposed pump model

and casing size will not be accepted. Pumping equipment shall be suitable for the operating modes described in the detailed pump specifications and other relevant portions of the Contract Documents. All pumps shall be designed in accordance with applicable portions of ANSI/HI 1.1 B 1.6, 2.1 B 2.6 and ANSI/HI 9.1 B 9.6 and the requirements of this Section. The pumps shall be specifically designed to pump the fluids described in the detailed pump specifications and shall operate without clogging or fouling caused by material in the pumped fluid at any operating condition within the range of service specified. The pumps shall operate without cavitation or damaging vibration over the entire specified range of flow and head. Unless otherwise indicated, the pump head capacity curves shall slope in one continuous curve within the specified operating conditions. No points of reverse slope inflection capable of causing unstable operation will be permitted within the specified zone of continuous duty operation. Pumps with head/capacity curves as described in paragraph 9.6.3.3.12 of ANSI/HI 9.6.3 are specifically prohibited if these characteristics will cause unstable operation within the specified range of operating conditions and where startup/shutdown conditions entail operation against a slow opening/closing valve.

C. Critical Speeds and Natural Frequencies: Unless otherwise specified for variable speed pumping equipment or for custom engineered pumping equipment, the complete pumping unit, including all related frames, supports, enclosures, and casings, shall be free from dangerous critical speeds from 20 percent below to 30 percent above the operating speeds required to achieve the performance characteristics specified. The logarithmic decrement for each damped natural frequency within this range shall be greater than +0.3.Unless otherwise specified, the CONTRACTOR shall furnish documentation demonstrating compliance with this requirement for all pumping equipment with discharge nozzle sizes 6 inches in diameter and greater.

D. Impeller Clearances and Keyways: The radial clearance between the tip of the impeller vane and diffuser or volute vanes shall be not less than 3 percent and 6 percent, respectively, of impeller diameter. The ratio of liquid channel widths (diffuser or volute/impeller) shall be not less than 1.15 nor more than 1.3 for diffuser pumps and 1.4 B 1.5 for volute-type pumps. Impeller keyways for multistage diffuser-type pumps shall be cut at differing positions on the impeller shaft to avoid multiple simultaneous vane passing pulses.

E. Component Design Criteria:

1. General: Unless otherwise indicated, combined stresses in steel frames and supports shall not exceed those permitted by the AISC Manual of Steel Construction. Combined stresses in cast, forged, rolled or fabricated pressure retaining components, frames and supports shall not exceed that allowed for the given material in Section VIII, Division 1 of the ASME Code. Design pressures for pressure-retaining parts shall be not less than twice the pumps shutoff head at the manufacturer’s listed maximum operating speed. The term A combined stresses @ in this paragraph shall mean the sum of all operating stresses, including stresses induced by dynamic and static forces as developed via the analysis procedures stipulated in this section. Dynamic forces shall include both steady state and transient stresses induced by operating conditions.

2. Anchorage: Unless otherwise indicated, anchor bolts for vertical volute-type and vertical axial flow pumps shall be designed to restrain twice the forces developed by operation of the pump at maximum speed against a closedvalve with no restraint at the pump inlet and discharge flanges. Bases for horizontal pumps shall be designed to provide common support for the pump and motor (and flywheel, if one is specified). All vertical (column type) pumps with unit weights (including drive, if supported by the pump) weighing more than 1,000 pounds and all volute type pumps with nozzle sizes 16 inches in diameter and greater and all separately supported motors shall be supported on a sole plate provided by the pump manufacturer.

3. Torsional and Combined Shaft Stresses: The pump rotor shall be free from torsional critical.

4. Shaft Deflection: Pump shafts on volute type pumps shall be designed to provide sufficient stiffness to operate without distortion or damaging vibration throughout the range of service specified. Shaft deflection at the face (impeller side) of the shaft seal shall be limited to no more than 1.5 mils at any continuous operating condition within the zone described by the specified continuous duty operating conditions.

5. Bearings: Unless otherwise specified, anti-friction bearings shall be selected for an LB10 life expectancy.

PART 2 - – PRODUCTS

2.01 GENERAL

A. General: Pumping equipment shall comply with this Section, and the detailed pump specification.

B. Combinations of Equipment: Pumping equipment shall be new and shall incorporate all necessary mechanisms, couplings, electric/diesel motor and drives, gears,shafts, appurtenances, and mounting.

C. Tools shall include one pressure grease gun for each type of grease required for pumps and motors.

D. Spare Parts: Spare parts shall include for each pump two (2) complete sets of seals, packing, gaskets, nuts, bolts, washers, wear rings, lantern ring removal tools, and a set of spare bearings as well as all parts indicated in the detailed pump specifications.

E. Nameplates shall indicate rated head and flow, impeller size and pump speed. Flywheel nameplates shall include manufacturer, serial number, model, weight, and moment of inertia.

2.02 MATERIALS

A. All materials shall be suitable for the intended application; materials not specified shall be high-grade, standard commercial quality, free from all defects and imperfection

that might affect the serviceability of the product for the purpose for which it is intended, and shall conform to the following requirements:

1. Cast iron pump casings and bowls shall be either close-grained gray cast iron or ductile iron, conforming to ASTM A278 Class 30, or ASTM A395 respectively.

2. Bronze pump impellers shall conform to ASTM B62, or ASTM B584, where dezincification does not exist.

3. Pump shafts shall be constructed from materials identified under the respective pump types. Miscellaneous stainless steel parts shall be of Type 316.

4. All anchor bolts, nuts, and washers shall be Type 416 stainless steel.

B. Protective Coatings: Pumps shall be protected with coatings as specified in the individual equipment specifications.

2.03 ACCESSORIES

A. Pressure Gauges: Pressure gauges shall be installed at pump suction (when suction piping is present) and at discharge lines. Pressure gauges shall be mounted at a location selected to minimize the effect of vibrations.

B. Pump Suctions: Compound gauges shall be installed at pump suctions and where subject to shock or vibrations, the pressure gauges shall be wall-mounted or attached to Type 316 stainless steel channel floor stands located where they will not impede pump maintenance access and connected to the pump by means of flexible connectors.

C. Local Control Panels: All Local Control Panels shall be NEMA rated.

D. Lifting Eyes: Pumps and nozzles shall be provided with lifting eyes to permit removal and/or disassembly.

2.04 PUMP REQUIREMENTS

A. Pumps shall comply with the following:

1. Lubrication: Except as otherwise indicated, line shaft bearings of vertical turbine mixed flow, and propeller pumps shall be utility water-lubricated and deep-well pumps and pumps with enclosed line shafts shall have fresh water- or oil-lubricated bearings and seals.

2. Handholes: Handholes on pump casings shall be designed to follow the contours of the casing to avoid any obstructions in the water passage.

3. Umbrellas: For column pumps, the inlet wet well design is based upon the geometric relationships described in ANSI/HI 9.8, and a bell intake velocity of 5.5 fps shall be assumed. If the bell intake velocity for a proposed pump will exceed 5.5 fps, the pump manufacturer shall furnish and install an umbrella fitted to the pump inlet bell that will effectively reduce the intake velocity to 5.5 fps, at no additional cost to the OWNER.

4. Drains: Gland seals, air valves, and cooling water drains, and drains from variable speed drive equipment shall be piped to the nearest floor drain, with galvanized steel pipe or copper tube; an air separation complying with the Uniform Plumbing Code shall be provided.

5. Grease Lubrication: Unless otherwise specified, all vertical propeller, mixed-flow, and turbine pumps, (other than deep well pumps), shall be equipped with a stainless steel tube designed for lubrication of bottom bearing.

6. Mechanical Seals: Shafts for pumps specified with mechanical seals shall be furnished with no reduction in size through the seal area. Hard/hard facesshall be used. The seal design must be such that the dynamic o-ring moves towards a clean surface as the face wears and the springs are not in the fluid pumped to avoid fouling. The cartridge/split seal shall be a single balanced design capable of 400 psig service with o-ring secondary seals. For ease of equipment maintenance split seals shall be preferred, such as the Chesterton 442, Burgmann VGH, or approved equal. Should an unsplit cartridge design be used, acceptable designs include AES CURC, Chesterton 155, or approved equal. Materials shall be carbide or carbon faces, 316SS metals, Hastelloy/Elgiloy springs, and Viton elastomers. The mechanical seal shall be drilled and tapped for connection of a clean water purge supply. Material of construction shall be stainless steel. For vertical (not vertical turbine) pumps an automated air vent shall be installed to vent the stuffing box of air.

7. Bearing Temperatures: Where possible, the bearing temperature at the worst loading condition and ambient temperature shall not exceed 150 degrees F. Where this is not possible, all exposed bearings shall be effectively shielded with permanent metal safety guards to prevent accidental contact by operators

2.05 SOLE PLATES FOR VERTICAL CENTRIFUGAL AND AXIAL FLOW PUMPS

A. Sole plates for vertical column type pumps and separately mounted vertical pumps, shall be designed to be installed on the concrete foundation curbs shown and shall be milled flat to within 0.002-inch per foot in all directions on the face mating with the pump support. Prior to milling, sole plates shall have the words “THIS SIDE DOWN” permanently affixed to the underside using welding rod material.

2.06 BASEPLATES AND DRIVE UNIT SUPPORTS

A. Base-plates for horizontal pumps shall be fabricated and finished in accordance with paragraph 3.3, API 610. All base-plates shall be designed for grouting on the housekeeping pads specified.

B. Drive unit supports for separately mounted vertical pump drives shall be of fabricated steel, ASTM A36. Drive unit supports shall be designed to span an opening in the floor sufficient to allow removal for the complete pump. Rolled steel beams shall be provided to stiffen the support and a fabricated steel drive unit support pedestal with a plate milled flat within two light bands shall be provided to mate with the drive enclosure. The support shall be designed to be supported on a sole plate embedded in a housekeeping pad at the edges of the floor opening or as indicated. Other details for the drive unit support shall be as indicated.

2.07 BALANCE

A. Balancing for centrifugal and axial flow pumps with nozzle sizes 6 inches in diameter and greater shall conform to the requirements set forth in API 610, paragraph 2.8.4.1. All balance logs, certified correct and signed by an officer of the manufacturing corporation and notarized, shall be included in the Owners Manual.

PART 3 - - EXECUTION

3.01 GENERAL

A. Installation shall comply with the requirements of this Section, and the requirements of the detailed pump specifications. Equipment with pump discharge sizes 10 inches in diameter and greater shall be installed under the presence of a factory authorized installation specialist or specialists. Under no circumstances shall any installation procedures take place without the installation specialists present. Equipment and anchor bolt installation procedures shall conform to the requirements as specified by the Manufacturer.

B. Sole plates, if provided as required by this Section, where required by the equipment manufacturer's recommendation, or any section referencing this section, shall be leveled in the presence of a factory authorized installation specialist to a maximum tolerance of 0.002-inches/foot in all directions. Where the equipment manufacturer requires more stringent tolerances, those tolerances shall prevail.

3.02 ALIGNMENT

A. Equipment furnished under this Section and any referencing section shall be aligned as per the manufacturer's recommendations. Field-testing shall be performed as specified in Part 1 of this Section.

3.03 VIBRATION

A. Vibration of installed pumps shall be measured in accordance with ISO 10816 for all pumps with variable speed drives and pumps with shaft power requirements 25 horsepower and greater. An independent testing laboratory specializing in this work, retained by the CONTRACTOR but acceptable to the CONSTRUCTION MANAGER, shall perform the measurements and shall submit the results directly to the CONSTRUCTION MANAGER. RMS vibration velocity on any component when the pump is operating at any specified continuous duty operating condition shall not exceed the limits established for the appropriate machine by Tables 2-5 and 2-6 in API 610. For all installed pumps, vibration at the specified continuous duty operating conditions shall be measured by the independent testing laboratory noted above. Vibration measurement results shall be included in the Owners Manual.

3.04 TRAINING

A. Training shall conform to the requirements of paragraph 11000-1.7B and the individual equipment specifications. Unless otherwise indicated, the training requirement is waived for constant speed pumping equipment with nozzle sizes 4 inches in diameter and smaller and for all centrifugal and axial flow pumps with

connected power requirements 10 horsepower and less. The training session for maintenance personnel shall include complete field and shop disassembly and subsequent reassembly of one complete pumping unit selected by the CONSTRUCTION MANAGER.

END OF SECTION

SECTION 1216 VERTICAL LINESHAFT MIXED FLOW SOLIDS HANDLING PUMPS

1.01 WORK OF THIS SECTION

A. The WORK of this Section includes providing vertical lineshaft solids hanlding mixed flow pumps at the City's storm water pump station. Each pump shall consist of (but not limited to) a bowl assembly with suction bell and strainer, discharge column assembly, angle gear and shaft assembly, electric motor, driver/motor support, support plate and all related appurtenance necessary to provide complete pump replacement. Equipment furnished under this Section shall comply with the requirements of this Section and Section 011001100.

B. The CONTRACTOR shall cause the equipment specified under this Section, including motors/drivers, to be furnished by the pump manufacturer. The CONTRACTOR shall furnish a Certificate of Unit Responsibility Assignment as provided in Section 011001100.

1.02 RELATED SECTIONS

A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.

1. SECTION 01300– Submittals
2. Section 01783 Operating and Maintenance Data
3. Section 011001000 – Equipment General Provisions
4. Section 011001100 – Pumps General
5. Section 011006040 – Electric Motors

1.03 SPECIFICATION ANS STANDARDS

A. Specification and standards shall comply with Section 011001000 and 11100. Where this Section is silent on any subject, item or equipment, the requirements of Section 011001100 shall govern.

1.04 SUBMITTALS

A. Submittal requirements shall be as set for in Section 01300, 01783, 11000 and 11100 and with additional items as noted below:

B. Action Submittals: Submit the following:

1. Shop Drawings:
   a. Fabrication, assembly, installation, and wiring diagrams.

b. Details on discharge head assembly, line shafts, line shaft bearings, bearing retainers, discharge column pipe, embedded baseplate and anchor bolts.

2. Product Data:

a. Descriptive literature including cross-sectional views of the pumps indicating the materials of construction and preliminary dimension prints of pumps and diesel engine drivers/electric motors.

b. Performance curves for the complete pump assemblies showing the relationship between head and capacity, efficiency, brake and motor horse-power, and NPSH from shut-off head to the minimum operating head specified. Curves shall be corrected for pump losses and shaft friction horse-power losses. Pump losses shall include column and discharge head losses. Define the preferred and allowed operating range for the pumps and anticipated bearing life when operating within these regions.

c. Impeller type.

d. Bowl, shaft, and driver/motor WR square.

e. Maximum down thrust at design points and shutoff, and maximum up thrust.

f. Weight of pumps and drivers/motors (including all components).

g. Driver/Motor manufacturer, type, enclosure, phase, voltage, rated horsepower, full load and locked rotor amperage, temperature rating, and expected minimum life under design conditions, minimum efficiency at 1/2, 3/4 and full load, and descriptive literature including description of driver/motor insulation, for each type of driver/motor to be furnished.

h. A list of deviations from the Contract Documents.

i. Vibration analysis.

j. Detailed pump base drawing showing that the driver/motor bolt arrangement achieves the driver/motor/termination box orientation shown on the Drawings.

C. Informational Submittals: Submit the following:

1. Certificates:

a. Copy of paint certification.

2. Source Quality Control Submittals:

a. Results from certified shop tests

b. Names and addresses of the nearest factory authorized service

organization.

3. Experience Qualifications: A list of at least 10 installations of the same pump type which meet the experience requirements indicated below. Include the following information for each project:

   a. Name of facility, owner of facility, contact name, address, and telephone number.

   b. Fluid pumped, capacity, head, horsepower, and speed.

   c. Pump model number and size.

   d. Year installed.

   e. Local Maintenance Facility Qualifications: Service facility name, address, telephone number, and name of responsible manager.

   f. Experience record of local facility.

D. Closeout Submittals: Submit the following:

   1. Operation and Maintenance Data:

      a. Submit complete Installation, Operation and Maintenance Manuals, including, test reports, maintenance data and schedules, description of operation, and spare parts information.

      b. Furnish Operation and Maintenance Manuals in conformance with the requirements of Section 01783, Operating and Maintenance Data.

1.05 OWNER'S MANUAL

A. Owner's Manual requirements shall be as set forth in Section 011001000 and 11100.

1.06 FACTORY TESTS

A. Each pump shall be factory tested in accordance with the requirements established in Section 011001100 and shall be a non-witnessed test.

1.07 PUMPED FLUID AND OPERATING CONDITIONS

A. Pumped Fluid: The fluid to be pumped is storm water which may have floating and submerged debris. The fluid is anticipated to range between 45 degrees F and 85 degrees F and contain minor amounts of dissolved substances.

B. Installation Environment: The pumps will be installed above an existing structure and wet well as shown on the drawings. The Pump discharge heads will be in the wet well, and the motor and shaft will be installed in the existing dry well.

C. System Operation: The pumps will be operated using soft-starters and electric motors, as described in Section 011007110

1.08 QUALIFICATION REQUIREMENTS

A. Manufacturer shall have a minimum of ten years of experience producing substantially similar equipment and shall be able to show evidence of at least ten installations in satisfactory operation for at least five years. The pump manufacturer shall have performed torsional analysis of pump, driver/motor assembly, installation, start-up, and operator training instruction.

B. The manufacturer shall have a local service facility in California capable of installation, alignment, parts replacement and stocking parts of pumps of the same size or larger as the units in this Section.

1.09 WARRANTY

A. The pump manufacturer shall warrant the pump and driver/motor assemblies against material and workmanship defects for a period of 2 years, which starts on the date of Substantial Completion of the Project. The CONTRACTOR shall submit the manufacturer's warranty document before final acceptance.

PART 2 - PRODUCTS

2.01 PUMP MANUFACTURER

A. The vertical line shaft and vertical turbine pumps shall be manufactured by one of the following or engineer approved equal:

1. Cascade
2. Peerless Verti-line
3. Morrison
4. Patterson

B. Pumps shall conform to the requirements and operational conditions indicated in this Section of the specifications.

2.02 OPERATING CONDITIONS

A. Pump Data: Each Pump Shall have the following approximate performance characteristics at 100-percent speed:

HESS STORM WATER LIFT STATION				
Design Conditions	**Hess SD Lift Station Pump 1**	**Hess SD Lift Station Pump 2**	**Hess SD Lift Station Pump 3**	**Hess SD Lift Station Pump 4**
Shut Off Head (ft)	4.5	4.5	4.5	4.5
Lubrication	Oil	Oil	Oil	Oil
Flow (gpm)	3,000	8,300	8,300	8,300
TDH (ft)	22	22	22	22
Min. Bowl Efficiency (%)	85	85	85	85
Pump Column Diameter (in)	12	24	24	24
Discharge Diameter	12	24	24	24
Drive Type	-	-	-	-
Drive Power (HP, Non-Overloading)	-	-	-	-
Driver Electrical Requirements	460/3PH/60	460/3PH/60	460/3PH/60	460/3PH/60
Pump Speed (RPM Nominal)	1800	900	900	900

2.03 DETAILS OF CONSTRUCTION

A. The pumps shall be specifically designed to pump the fluid and shall comply with the requirements specified under Section 011001100.

B. Design

1. Rotation

a. The pump will be counterclockwise rotation when viewed from the driver end looking at the pump.

2. Impeller

a. The impeller shall be of bronze construction conforming to ASTM B584, C83600 or Type 303 stainless steel. They shall be of one-piece construction, mixed flow design, and shall be of the non-clogging type. The waterways through the impeller shall have extremely smooth contours, devoid of sharp corners, so as to promote maximum efficiency.

b. The impeller is to be balanced and secured to the shaft by means of a stainless steel drive collet for bowl shafts 1-15/16" diameter and smaller. For bowl shafts larger than 1-15/16" impellers shall be secured to the shaft using a combination of a thrust washer, key and/or snap rings.

c. Impellers shall be adjustable by means of a top shaft-adjusting nut.

3. Bowls

a. The bowls shall be made of close-grained cast iron conforming to ASTM A48 CL30 or cast steel construction. Castings shall be free from blowholes, sand holes and shall be accurately machined and fitted to close dimensions.

b. Bowls 8" and above shall be flange connected. Bowls below 8" nominal diameter may use either flanged or threaded connections.

c. Bowls shall be designed with smooth passages to ensure efficient operation and their interior shall be coated with Tnemec N140 Pota-Pox Plus, or equal.

d. The casing shall be hydrostatically tested to 1.5 times the design head or 1.25 times the shutoff head whichever is greater.

4. Impeller Shaft

a. Impeller shaft shall be of stainless steel construction conforming to ASTM A582 (416 stainless steel).

b. The shaft shall be supported by bronze or neoprene bearings located on both sides of each impeller.

c. Impeller shaft coupling shall be of stainless steel construction conforming to ASTM A582 (Type 416 stainless steel).

5. Wear Rings

a. Wear rings shall be provided on both the impellers and bowls on bowls of nominal diameter of 8" or larger so that clearances can be maintained throughout the life of the rings and minimize recirculation. Bowls of 6" and 7" nominal diameter shall incorporate bowl wear rings only.

b. Impeller wear rings shall be of the radial-type.

c. Bowl wear rings shall be of the radial-type.

d. Wear rings shall be attached to the impellers and bowls using an interference fit and Loctite.

e. Wear rings shall be bronze conforming to ASTM, B505 C93200.

6. Column

a. Total length of discharge column shall be as required to meet the pump setting requirement as shown on the drawings.

b. Column pipe in sizes 4” through 12” diameter shall be furnished in interchangeable sections not over ten feet in length, and shall be connected with threaded, sleeve-type couplings. Column pipe 14” diameter and larger shall be flanged and furnished in interchangeable sections not over ten feet in length.

c. Threaded column sections shall be connected with threaded, sleeve-type couplings. Column joints are to be butted to insure perfect column alignment after assembly.

7. Line Shaft

a. The line shaft shall be of ample size to transmit the torque and operate the pump without distortion or vibration.

b. The line shaft shall be made of carbon steel conforming to AISI 1045 and be furnished in interchangeable sections not over ten feet in length and shall be fitted with stainless steel replaceable sleeves at each bearing and conforming to AISI 304 material. Alternatively, the line shaft may be constructed of Type 416 stainless steel.

c. The line shaft shall be coupled with extra-strong threaded steel couplings machined from solid bar steel.

d. The line shaft bearings shall be of bronze and/or neoprene construction within a bronze bearing holder.

e. The line shaft bearings shall be retained in bronze guides that are fitted into the column coupling and secured in place by the butted column pipe ends.

8. Discharge Head Assembly

a. The pump discharge head shall be of the below ground type of either cast iron or fabricated steel construction with an ANSI 125# discharge flange.

b. The pumps shall be furnished complete with base platesfabricated from structural steel, ASTM A36, and shall be designed to support the weight of the pumping unit and other loads to which the unit may be subjected during operations.

c. A drive shaft of the same material as the line shaft shall extend through the sealing assembly of the discharge head and be coupled to a vertical solid shaft driver using a coupling to permit easy field removal of the mechanical seal.

d. The shaft sealing assembly shall consist of a cast iron packing box or container, cast iron packing gland, bronze packing box bushing, stainless steel packing gland nuts and bolts and mechanical seal.

e. Packing box shall be rated for 175 PSI.

f. Discharge head openings shall be fitted with guards to prevent access to the rotating shaft and/or coupling.

9. Motors

a. See Specification Section 011006040 Electric Motors.

10. Vibration Limitations

a. The limits of vibration as set forth in the standards of the Hydraulic Institute shall govern.

11. Testing

a. A certified factory hydrostatic and performance test shall be performed on each bowl assembly in accordance with Hydraulic Institute Standards, latest edition. Tests shall be sufficient to determine the curves of head, input horsepower, and efficiency relative to capacity from shutoff to 150% of design flow. A minimum of six points, including shutoff, shall be taken for each test. Atleast one point of the six shall be taken as near as possible to each specified condition.

b. Results of the performance tests shall be certified by a California Registered Professional Engineer and submitted for approval before final shipment.

PART 3 - EXECUTION

3.01 SERVICES OF VENDOR/MANUFACTURER

A. Inspection, Startup, and Field Adjustment: The manufacturer's representative shall be present at the site for three (3) workdays, to furnish the services required.

B. Instruction of the Utility's Personnel: The training representative of the manufacturer shall be present at the site for one (1) working days to furnish the services required.

C. For the purposes of this Section, a working day is defined as an eight hour period at the site, excluding travel time.

D. The CONSTRUCTION MANAGER may require that the inspection, startup and field adjustment services above be furnished in three separate trips.

3.02 INSTALLATION

A. CONTRACTOR shall install the equipment in accordance with installation requirements of Section 011001100 – Pumps, General.

B. Install pumps on existing reinforced concrete structure. Provide non-shrink grout layer between existing structure and underside of the mounting flange. The pump and baseplate shall fit through the existing roof hatch, and the pump column and discharge flange shall fit through the existing floor opening. Provide two-piece soleplate to install between the pump baseplate and existing floor opening.

C. Install the pumps, drivers/motors and related equipment per the manufacturer's written recommendations.

END OF SECTION

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SECTION 11316
SUBMERSIBLE NON-CLOG PUMPS

PART 1 - **GENERAL**

1. THE REQUIREMENT

   i. Furnish and install submersible pumps with associated piping and appurtenances, including pump base, SS guild rails, and supports complete and operable in accordance with the Contract Documents.

   ii. The requirements of Section 11100 - Pumps, General apply to this Section.

   iii. The Supplier shall examine the site conditions, intended application, and operation of the pump system and recommend the pump which will best satisfy the indicated requirements.

   iv. Coordinate with hatch manufacturer in accordance with Section 07720 – Roof Hatches and Accessories.

2. SUBMITTALS

   i. Submittal requirements shall be as set for in Section 01300, 11000 and 11100 and with additional items as noted below:

   ii. Submittals shall include the following:

Submittal	**Description**
Shop Drawings	Required for complete pumping assembly including volutes, impellers, drive assemblies, shafts, bearings, seals, and shaft guards.
	Required for motor and motor controls under electrically controlled equipment shop drawing requirements.
	Required for anchor bolts. Show placement, embedment, and edge distances as required by UBC. Show projections from concrete.
Catalog Data	Required per catalog data requirements of Sections 01300.
Installation Instructions	Required per installation instruction requirements of Sections 01300 and 01783.
O & M Instructions	Required per operation and maintenance instruction requirements of Sections 01300 and 01783.
Certificate of Compliance	Submit pump system certification per certificate of compliance requirements of Sections 01300.
	Submit coating system and application certification per certificate of compliance requirements of Section 01300.

Manufacturer's Statement of Responsibility	Required per manufacturer's statement of responsibility requirements of Section 01300. Include statement that the pumps installed comply with the Contract Documents.
Test Record Transcripts	Before shipping pumping units, submit certified pump curves from factory tests. Where variable speed drives are provided, submit certified pump curves in 100-rpm increments throughout the operating range of the pump. Include a written report stating the date and location that the pumps were tested and certifying that the certified pump curves are accurate and comply with the specifications.
	Before shipping pumps, submit certified vibration test report stating that pump and motor assembly has been tested and vibration falls within limits allowed by Hydraulic Institute Standards.
Motor Data	Required per motor data requirements of Section 01300. Include mounting details
Testing Procedures	Submit written test procedures in advance of all pump tests.
Warranty	Furnish a 5-year 10,000-hour warranty from date of final acceptance for all units. Warranty shall bear appropriate serial numbers.

3. OPERATING AND MAINTENANCE MANUAL

    i. Operation and Maintenance Manual shall be furnished in accordance with Section 01783 – Operating and Maintenance Data.

4. QUALITY ASSURANCE

    i. Pump manufacturer and model shall be as described on the Drawings or Engineer approved equal.

    ii. The manufacturer shall provide a 1-year equipment warranty.

5. SPARE PARTS

    i. Provide all spare parts anticipated to be required for the first 2 years of operation. Manufacturer shall clearly define quantity, description of part and associated part numbers as part of manufacturer's scope of supply.

ii. Spare parts shall be placed in a separate container clearly marked as “Spare Parts.” All parts shall be identified and clearly labeled with applicable part numbers.

6. PUMPED FLUID AND OPERATING CONDITIONS

i. Pumped Fluid: The fluid to be pumped is storm water which may have floating and submerged debris. The fluid is anticipated to range between 45 degrees F and 85 degrees F and contain minor amounts of dissolved substances

ii. Installation Environment: The pump and discharge elbow will be installed in an existing wet well as shown on the drawings. The guiderails will extend to the roof of the existing pumping station structure.

iii. System Operation: The pumps will be operated using soft-starters andelectric motors, as described in Section 17110

PART 2 - **PRODUCTS**

1. GENERAL

a. Each pump shall be equipped with a immersible electric motor connected for operation on 460 volts, 3 phase, 60 hertz suitable for submersible pump applications.

b. The pumps shall be Flygt N-series, or approved equal.

c. Operating Conditions: Capacity and Head requirements for each submersible pump shall be specified within the plans.

The WORK of this Section shall be suitable for operation under the following conditions at 60 Hz:

Pump Name	Design Flow Capacity (gpm)	Total Dynamic Head (ft)	Rated HP	VFD Service	Discharge Flange
1	915	36	15	NO	6 in
2	915	36	15	NO	6 in

2. NON-CLOG TYPE

a. Pump Design: The pump shall be automatically and firmly connected

to the discharge connection, guided by Sch 40 stainless steel guide bars extending from the top of the station to the discharge connection. There shall be no need for personnel to enter the basins. Sealing of the pumping unit to the discharge connection shall be accomplished by a machined metal to metal watertight contact. No portion of the pump shall bear directly on the sump floor.

b. A Pump Construction: Construction of the submersible non-clog pumps shall conform to the following requirements:

    i. Major pump components shall be of gray cast iron, ASTM A-48, Class 35B or 40, with smooth surfaces devoid of blow holes or other irregularities. All exposed nuts or bolts shall be AISI type 304 or 316 stainless steel construction. All metal surfaces coming into contact with the pumpage, other than stainless steel or brass, shall be protected by a factory applied spray coating of acrylic dispersion zinc phosphate primer with a two-part epoxy paint finish on the exterior of the pump.

    ii. Sealing design shall incorporate metal-to-metal contact between machined surfaces. Critical mating surfaces where watertight sealing is required shall be machined 0and fitted with Nitrile or Viton rubber O-rings. Fittings will be the result of controlled compression of rubber O-rings in two planes and O- ring contact of four sides without the requirement of a specific torque limit.

    iii. Rectangular cross sectioned gaskets requiring specific torque limits to achieve compression shall not be considered as adequate or equal. No secondary sealing compounds, elliptical O-rings, grease or other devices shall be used.

c. Cooling System: Each unit shall be provided with an adequately designed cooling system.

    i. The water jacket shall encircle the stator housing; thus, providing heat dissipation for the motor regardless of the type of installation. Impeller back vanes shall provide the necessary circulation of the cooling liquid through the water jacket. The cooling media channels and ports shall be non-clogging by virtue of their dimensions. External cooling and seal flushing shall not be required.

    ii. The cooling system shall provide for continuous pump

operation in liquid temperature of up to 104 DEGREES F. Restrictions below this temperature are not acceptable.

d. Cable Entry Seal: The cable entry seal design shall not require specific torque requirements to insure a watertight and submersible seal. The cable entry shall consist of a single cylindrical elastomer grommet, flanked by washers, all having a close tolerance fit against the cable outside diameter and the entry inside diameter and compressed by the body containing a strain relief function, separate from the function of sealing the cable. The assembly shall provide ease of changing the cable when necessary using the same entry seal. The cable entry junction chamber and motor shall be separated by a terminal board, which shall isolate the interior from foreign material gaining access through the pump top. Epoxies, silicones, or other secondary sealing systems shall not be considered acceptable.

e. Motor:

   i. The pump motor shall be premium efficiency, induction type with a squirrel cage rotor, shell type design, housed in an air filled, watertight chamber, NEMA B type. The stator windings and stator leads shall be insulated with moisture resistant Class H insulation rated for 180°C or better. The use of bolts, pins or other fastening devices requiring penetration of the stator housing is not acceptable. The motor shall be designed for continuous duty handling pumped media of (40°C) (104°F) and capable of up to 15 evenly spaced starts per hour. The rotor bars and short circuit rings shall be made of cast aluminum. The motor and pump shall be designed and assembled by the same manufacturer.

   ii. The power cable shall be sized according to the NEC and ICEA standards and shall be of sufficient length to reach the junction box without the need of any splices. The outer jacket of the cable shall be oil resistant chloroprene rubber. The motor and cable shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 25 feet.

f. Bearings: The pump shaft shall rotate on two or more permanently greased bearings. Motor bearings shall be permanently grease lubricated. The upper bearing shall be a single roller bearing. The lower bearing shall be a two row angular contact bearing to compensate for axial thrust and radial forces. Single row lower bearings are not acceptable.

g. Mechanical Seal:

i. Each pump shall be provided with a tandem mechanical shaft seal system consisting of two totally independent seal assemblies. The seals shall operate in a lubricant reservoir that hydrodynamically lubricates the lapped seal faces at a constant rate. The lower, primary seal unit, located between the pump and the lubricant chamber, shall contain one stationary and one rotating silicon-carbide seal ring. The upper, secondary seal unit, located between the lubricant chamber and the motor housing, shall contain one stationary aluminum oxide seal ring and one rotating carbon seal ring. Each seal interface shall be held in contact by its own spring system. The seals shall require neither maintenance nor adjustment nor depend on direction of rotation for sealing.

ii. Each pump shall be provided with a lubricant chamber for the shaft sealing system. The lubricant chamber shall be designed to prevent overfilling and to provide lubricant expansion capacity. The drain and inspection plug, with positive anti-leak seal shall be easily accessible from the outside. The seal system shall not rely upon the pumped media for lubrication. The motor shall be able to operate dry without damage while pumping under load.

h. Pump Shaft: Pump and motor shaft shall be the same unit. The pump shaft is an extension of the motor shaft. Couplings shall not be acceptable. The pump shaft shall be of 420 stainless steel or carbon steel C1035 and shall be completely isolated from the pumped liquid. Maximum deflection shall not exceed 0.002” at the primary shaft seal.

i. Impeller: The impeller(s) shall be 25% chrome cast iron hardened to meet ASTM A-532 (Alloy III A), dynamically balanced, semi-open, multi-vane, back swept, screw-shaped, non-clog design. The impeller leading edges shall be mechanically self-cleaned automatically upon each rotation as they pass across a spiral groove located on the volute suction. The leading edges of the impeller shall be hardened to Rc 60 and shall be capable of handling solids, fibrous materials, heavy sludge and other matter normally found in stormwater. The screw shape of the impeller inlet shall provide an inducing effect for the handling of up to 5% sludge and rag-laden stormwater. The impeller to volute clearance shall be readily adjustable by the means of a single trim screw. The impeller shall be locked to the shaft, held by an impeller bolt and shall be coated with alkyd resin primer.

j. Volute: Pump volute(s) shall be single-piece gray cast iron, Class 40 or 35B, non-concentric design with smooth passages large enough to pass any solids that may exit the impeller. The motor shall be attached to the volute by stainless steel bolts. The motor unit with impeller attached, shall be removable from the volute without requiring removal of the impeller and without disturbing the watertight integrity of the motor unit.

3. PROTECTION

a. Each pump motor stator shall incorporate three thermal switches, one per stator phase winding and be connected in series, to monitor the temperature of the motor. Should the thermal switches open, the motor shall stop and activate an alarm. A float switch shall be installed in the seal leakage chamber and will activate if leakage into the chamber reaches 50% chamber capacity, signaling the need to schedule an inspection.

b. The thermal switches and float switch shall be connected to a Mini CAS control and status monitoring unit. The Mini CAS unit shall be designed to be mounted in the pump motor starter as shown on plans. Contractor to coordinate with the Motor Control Center supplier for Mini CAS unit installation.

c. All submersible, non-clog pumps supplied for the work in this section shall be UL/FM approved for use in Class I, DIV-1 areas (Explosion-proof).

PART 3 - **EXECUTION**

1. SERVICES OF VENDOR/MANUFACTURER

a. Inspection, Startup, and Field Adjustment: The manufacturer's representative shall be present at the site for three (3) workdays, to furnish the services required.

b. Instruction of the Utility's Personnel: The training representative of the manufacturer shall be present at the site for one (1) working day to furnish the services required.

c. For the purposes of this Section, a working day is defined as an eight-hour period at the site, excluding travel time.

d. The CONSTRUCTION MANAGER may require that the inspection, startup and field adjustment services above be furnished in three separate trips.

2. INSTALLATION

   a. CONTRACTOR shall install the equipment in accordance with installation requirements of Section 11100 – Pumps, General.

END OF SECTION

DIVISION 06 – MECHANICAL

SECTION 011005000 PIPING COMPONENTS

A. The Contractor shall furnish and install all piping systems shown and specified, in accordance with the requirements of the contract documents. Each system shall be complete with all necessary fittings, hangers, supports, anchors, seismic restraints, expansion joints, flexible connectors, valves, accessories, heat tracing, insulation, lining and coating, testing, disinfection, excavation, backfill and encasement to provide a functional installation.

B. The piping shown in the drawings is intended to define the general layout, configuration, routing, method of support, pipe size, and pipe type. The drawings are not pipe construction or fabrication drawings. It is the Contractor's responsibility to develop the details necessary to construct all mechanical piping systems, to accommodate the specific equipment provided, and to provide and install all spools, spacers, adapters, connectors, and other appurtenances for a complete and functional system.

1.02 RELATED SECTIONS

The work of the following Sections applies to the work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this work.

A. Section 05120: Miscellaneous Metals

B. Section 09900: Painting and Coating

C. Section 011005020: Pipe Supports

D. Section 011005044: Hydrostatic Testing of Pipelines

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. The work of this Section shall comply with the current editions of the following codes as adopted by the agency or the political jurisdiction.

1. Uniform Mechanical Code

2. Uniform Plumbing Code

3. Uniform Fire Code

B. Commercial Standards: All equipment, products, and their installation shall be in accordance with the following standards, as applicable, and as indicated in each Section:

1. American Society for Testing and Materials (ASTM)

2. American National Standards Institute (ANSI)

3. American Society of Mechanical Engineers (ASME)

4. American Water Works Association (AWWA)

5. American Welding Society (AWS)

6. American Iron and Steel Institute (AISI)

7. National Fire Protection Association (NFPA)

1.04 CONTRACTOR SUBMITTALS

A. The Contractor shall submit the complete shop drawings and certificates, test reports, affidavits of compliance, of all piping systems for review by the Construction Manager in accordance with the requirements in the General Conditions, Section 01300 - Submittals, and as indicated in the individual piping Sections. The shop drawings shall include dimensions and details on pipe joints, fittings, fitting specials, harnessed joints, valves, and appurtenances, and shall include the design calculations and material lists. The submittals shall include the detailed layout, spool, or fabrication drawings that show all pipe spools, spacers, adapters, connectors, fittings, and pipe supports and seismic restraints necessary to accommodate the equipment and valves provided in a complete and functional system.

B. Inspection: All pipes shall be subject to inspection at the place of manufacture. The Contractor shall notify the Construction Manager in writing of the date for the start of each phase of pipe production and the dates for the proof of design tests. The notification shall be given at least 14 days prior to the start of the pipe manufacture. During the manufacture of the pipe, the Construction Manager shall be given access to all areas where manufacturing is in progress and shall be permitted to make all inspections necessary to confirm compliance with the Specifications.

C. Tests: Except where otherwise indicated, all materials used in the manufacture of the pipe shall be tested in accordance with the applicable Specifications and standards. The welds shall be tested as indicated. The Contractor shall perform all tests at no additional cost to the Owner. Copies of all test reports shall be furnished to the Construction Manager.

D. Welding Requirements: All welding procedures used to fabricate pipe shall be prequalified under the provisions of ANSI/AWS D1.1. The welding procedures shall be required for, but not necessarily limited to, longitudinal and girth or spiral welds for the pipe cylinders, spigot and bell ring attachments, reinforcing plates and

ring flange welds, and plates for lug connections.

E. Welder Qualifications: All 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 by an independent local, approved testing agency not more than 6 months prior to commencing the work on the pipeline. Machines and electrodes similar to those used in the work shall be used in the qualification tests. The Contractor shall furnish all the material and bear the expense of qualifying the welders at no increased cost to the Owner.

1.05 MANUFACTURER'S SERVICE REPRESENTATIVE

Where the assistance of a manufacturer's service representative is advisable in order to construct pipe joints, supports, or special connections, the Contractor shall furnish such assistance at no additional cost to the Owner.

1.06 MATERIAL DELIVERY, STORAGE, AND PROTECTION

All piping materials, fittings, valves, and accessories shall be delivered in a clean and undamaged condition and shall be stored off the ground to provide protection against oxidation caused by ground contact. All defective or damaged materials shall be replaced with new materials.

1.07 CLEANUP

After completion of the work, all remaining pipe cuttings, joining and wrapping materials, and other scattered debris, shall be removed from the site by the Contractor. The entire piping system shall be handed over to the Owner in a clean and functional condition.

PART 2 - PRODUCTS

2.01 GENERAL

A. All pipes, fittings, and appurtenances shall be furnished in accordance with the requirements of the applicable sections of Divisions 2 and 15.

B. Pipe Supports: All pipes shall be adequately supported in accordance with the requirements of Section 011005020: Pipe Supports, and as indicated.

C. Lining: The thickness, application, and curing of the pipe lining shall be in accordance with the requirements of the applicable sections of Division 2, 9, and 15, unless otherwise indicated.

D. Coating: The thickness, application, and curing of pipe coating shall be in accordance with the requirements of the applicable Sections of Divisions 9and 15, unless otherwise indicated. Pipes

installed above ground or in structures shall be field-painted in accordance with Section 09900 Painting and Coating.

E. Pressure Rating: All piping systems shall be designed to sustain a pressure of 1.25 times the test pressure or higher as called out in the Specifications.

F. Piping Couplings: Compression style couplings on buried piping shall have a shop-applied protective coating suitable for buried service. All couplings shall be from the same manufacturer.

G. Grooved Piping Systems: Grooved couplings on buried piping shall be bonded. All grooved fittings, couplings, and valves shall be from the same manufacturer.

2.02 PIPE FLANGES

A. Flanges: Where the design pressure is 150 psi or less, the flanges shall conform to either ANSI/AWWA C207 Class D or ANSI B16.1/B16.5 Class 125/150 Pound. Where the design pressure is greater than 150 psi, up to a maximum of 275 psi, the flanges shall conform to either ANSI/AWWA C207 Class E, Class F, or ANSI B16.5 150 pound class. Where the design pressure is greater than 275 psi up to a maximum of 700 psi, the flanges shall conform to ANSI B16.5 300 pound class. The flanges shall have flat faces and shall be attached with bolt holes straddling the vertical axis of the pipe unless otherwise shown. Attachment of the flanges to the pipe shall conform to the applicable requirements of ANSI/AWWA C207.

B. Blind Flanges: Blind flanges shall be in accordance with ANSI/AWWA C207. All blind flanges for pipe diameters 12-inches and over shall be provided with lifting eyes in form of welded or screwed eyebolts.

C. Flange Coating: All machined faces of metal blind flanges and pipe flanges shall be coated with a temporary rust-inhibitive coating to protect the metal until the installation is completed.

D. Flange Bolts: All bolts and nuts shall be Type 316 stainless steel and conform to Section 05120 Miscellaneous Metalwork. Studs and bolts shall extend through the nuts a minimum of 1/4-inch. All-thread studs shall be used on all valve flange connections, where space restrictions preclude the use of regular bolts.

E. Insulating Flanges: Insulated flanges shall have bolt holes 1/4-inch diameter greater than the bolt diameter.

F. Insulating Flange Sets: Insulating flange sets shall be provided where shown on the drawings. Each insulating flange set shall consist of an insulating gasket, insulating sleeves and washers and a steel washer. Insulating sleeves and washers shall be one piece when the flange bolt diameter is 1 1/2 inches or smaller and shall be made of acetal resin. For bolt diameters larger than 1-1/2

inches, insulating sleeves and washers shall be two-piece and shall be made of polyethylene or phenolic. Steel washers shall be in accordance with ASTM A
325. Insulating gaskets shall be full-face.

G. Insulating Flange Manufacturers, or Equal:

1. Reflange by Taylor Forge, Houston, Texas

2. PSI Products, Inc., Gardena, California.

3. Calpico, Inc.

H. Flange Gaskets: Gaskets for flanged joints shall be full-faced, 1/8-inch thick compressed sheets of asbestos-free aramid fiber base, with a nitrile binder and nonstick coating, suitable for temperatures to 700°F, a pH of 1 to 11, and pressures to 1,000 psig. Blind flanges shall have gaskets covering the entire inside face of the blind flange and shall be cemented to the blind flange. Ring gaskets will not be permitted.

I. Flange Gasket Manufacturers, or Equal:

1. John Crane, Style 2160.

2. Garlock, Style 3000.

2.03 THREADED INSULATING CONNECTIONS

A. General: Threaded insulating bushings, unions, or couplings, as appropriate, shall be used for joining threaded pipes of dissimilar metals and for piping systems where corrosion control and cathodic protection are involved.

B. Materials: Threaded insulating connections shall be of nylon, Teflon, polycarbonate, polyethylene, or other nonconductive materials, and shall have ratings and properties to suit the service and loading conditions.

2.04 GROOVED END COUPLINGS

A. General: Grooved end couplings shall be provided where shown. The couplings shall conform to the requirements of ANSI/AWWA C606. The bolts and nuts shall conform to the requirements of Section 05500 Miscellaneous Metalwork. All gaskets for grooved end couplings shall be compatible with the piping service and fluid utilized, in accordance with the coupling manufacturer's recommendations. The wall thickness of all grooved piping shall conform to the coupling manufacturer's recommendations to suit the highest expected pressure. To avoid stress on the equipment, all equipment connections shall have rigid- grooved couplings, or harness sets in sizes where rigid couplings are not available, unless

thrust restraint is provided by other means. The Contractor shall have the coupling manufacturer's service representative verify the correct choice and application of all couplings and gaskets, and the workmanship, to assure a correct installation.

B. Manufacturers of Couplings for Steel Pipe, or Equal:

1. Victaulic Style 41 or 44 (banded, flexible).

2. Victaulic Style 07 or HP-70 (grooved, rigid).

C. Manufacturers of Ductile Iron Pipe Couplings, or Equal:

1. Victaulic Style 31 (grooved, rigid), furnished with flush seal gaskets.

D. Manufacturers of Couplings for PVC Pipe, or Equal:

1. Victaulic Style 775, furnished with radius cut or standard roll grooved pipe ends.

2.05 SLEEVE-TYPE FLEXIBLE COUPLINGS

A. Construction: Sleeve-type couplings shall be provided where indicated on the drawings, in accordance with ANSI/AWWA C219 unless otherwise indicated on the drawings, and shall be of steel with steel bolts, without a pipe stop, and shall be of sizes to fit the pipe and fittings. The middle ring shall be not less than 1/4- inch in thickness and shall be either 5 or 7-inches long for sizes up to and including 30-inches, and 10-inches long for sizes greater than 30-inches for standard steel couplings, and 16-inches long for long-sleeve couplings. The followers shall be a single-piece contoured mill section welded and cold- expanded as required for the middle rings. They shall be of sufficient strength to accommodate the number of bolts necessary to obtain adequate gasket pressures without excessive rolling. The shape of the follower shall be of such design as to provide positive confinement of the gasket. The bolts and nuts for buried couplings shall be Type 316 stainless steel. The bolts and nuts for exposed couplings shall conform to the requirements of Section 05120 Miscellaneous Metalwork and shall be coated in accordance with Section 09900 - Protective Coating. Buried sleeve-type couplings shall be fusion bonded epoxy lined and coated at the factory in accordance with AWWA C213, and shall also receive a petrolatum/wax tape coating.

B. Pipe Preparation: The ends of the pipe, where indicated, shall be prepared for flexible steel couplings. Plain ends for use with couplings shall be smooth and round for a distance of 12-inches from the ends of the pipe, with an outside diameter of not more than 1/64-inch smaller than the nominal outside diameter of the pipe. The middle ring shall be tested by cold-expanding a minimum of one percent beyond the yield point, to proof-test the weld to the strength of the parent metal. The weld of the middle ring shall be

subjected to an air test for porosity.

C. Gaskets: The gaskets for sleeve-type couplings shall be a rubber-compound material that will not deteriorate from age or exposure to air under normal storage or use conditions. Gaskets for wastewater and sewerage applications shall be Buna "N," grade 60, or equivalent suitable elastomer. The gaskets shall be immune to attack by the impurities normally found in water or wastewater. All gaskets shall meet the requirements of ASTM D 2000, AA709Z, meeting Suffix B13 Grade 3, except as noted above. All gaskets shall be compatible with the piping service and fluid conveyed. The rubber in the gasket shall meet the following specifications:

1. Color: Jet Black.

2. Surface: Nonblooming.

3. Durometer Hardness: 74" 5.

4. Tensile Strength: 1,000 psi minimum.

5. Elongation: 175 percent minimum.

D. Insulating Couplings: Where insulating couplings are required, both ends of the coupling shall have a wedge-shaped gasket that assembles over a rubber sleeve of an insulating compound in order to obtain insulation of all coupling metal parts from the pipe.

E. Restrained Joints: Sleeve-type couplings on pressure lines shall be harnessed unless thrust restraint is provided by other means. The harnesses shall conform to the requirements of the appropriate reference standard, to the requirements specified herein, or to the drawings.

1. Joint Harnesses for Sleeve-Type Couplings on Steel Water Pipelines: The bolts and stud materials shall conform to ASTM A307, Grade B. The nuts shall conform to ASTM A563, Grade A, heavy hex. The lug material shall conform to one of the following: ASTM A36; ASTM A283 Grade B, Grade C, or D; or ASTM A285, Grade C. The lug dimensions shall be as shown in AWWA Manual M11. The lugs shall be Type P for pipe from 6- through 10-inch diameter, and Type RR for pipe 12-inch diameter and larger.

2. End Thrust: Joint harnesses shall be designed to accommodate a design working pressure of 150-psi plus a surge allowance of one-half times the design working pressure (75-psi).

3. Coating of Joint Harnesses: Coatings for joint harnesses shall be fusion bonded epoxy. The buried joint harnesses shall be coated with a petrolatum/wax tape coating.

F. Manufacturers, or Equal:

1. Dresser, Style 38.

2. Ford Meter Box Co., Inc., Style FC1 or FC3.

3. Smith-Blair, Style 411.

2.06 FLEXIBLE CONNECTORS

A. Flexible connectors shall be installed in all piping connections to engines, compressors, and other vibrating equipment, and where shown on the drawings. Flexible connectors for service temperatures up to 180°F shall be flanged, reinforced neoprene or butyl spools, rated for a working pressure of 40 to 150 psi, or reinforced, flanged duck and rubber, as best suited for the application, unless otherwise shown. Flexible connectors for service temperatures above 180°F shall be flanged, braided stainless steel spools with inner, annular, corrugated stainless steel hose, rated for minimum 150-psi working pressure, unless otherwise shown on the drawings. The connectors shall be 9-inches long, face-to-face flanges, unless otherwise shown on the drawings. The final material selection shall be approved by the manufacturer. The Contractor shall submit to the Construction Manager the manufacturer's shop drawings and calculations.

2.07 EXPANSION JOINTS

A. All piping subject to expansion and contraction shall be provided with sufficient means to compensate for such movement, without exertion of undue forces to the equipment or structures. This may be accomplished with expansion loops, bellow-type expansion joints, or sliding-type expansion joints. Expansion joints shall be of stainless steel, monel, rubber, or other materials best suited for each individual service. The Contractor shall submit to the Construction Manager the detailed calculations and manufacturer's shop drawings, guaranteeing satisfactory performance of all proposed expansion joints, piping layouts showing all anchors and guides, and information on materials, temperature and pressure ratings. Single and double arch rubber expansion joints shall be General Rubber Corp. series 1101 and 1102 heavy-duty expansion joints. These joints will be restrained with four galvanized steel tie rods. The nuts will be hand tightened.

2.08 BALL AND SOCKET TYPE EXPANSION JOINTS

A. Flexible expansion joints shall be installed in the locations indicated on the drawings and shall be manufactured of 65-45-12 ductile iron conforming to the material requirements of ASTM A536 and ANSI/AWWA C153/A21.53. The foundry certification of the material shall be readily available upon request.

B. Each flexible expansion joint shall be pressure tested prior to shipment against its own restraint to a minimum of 350 psi (250 psi for flexible expansion joints 30 inches diameter and larger). A minimum 2:1 safety factor, determined from the published pressure rating, shall apply. Factory Mutual approval for the 12-inch and smaller sizes is required.

C. Each flexible expansion joint shall consist of an expansion joint designed and cast as an integral part of a ball and socket type flexible joint, having a minimum per ball deflection of: 20 degrees, 3" – 12"; 15 degrees, 14" – 36", 48" and 4- inches minimum expansion. Additional expansion sleeves shall be available and easily added or removed at the factory or in the field. Both standardized mechanical joint and flange end connections shall be available.

D. All internal surfaces (wetted parts) shall be lined with a minimum of 15 mils of fusion bonded epoxy conforming to the applicable requirements of ANSI/AWWA C213 and shall be holiday tested with a 1500 volt spark test conforming to said specification. Sealing gaskets shall be constructed of EPDM. The coating and gaskets shall meet ANSI/NSF-61.

E. All external surfaces shall be coated with catalyzed coal tar epoxy conforming to the material requirements of AWWA C210. Encase the expansion joint in two layers of 40 mil polyethylene sleeves, meeting ANSI/AWWA C105/A21.5.

F. The manufacturer's certification of compliance to the above standards and requirements shall be readily available upon request. The Owner shall reserve the right to inspect the manufacturer's facility for compliance. All flexible expansion joints shall be FLEX-TEND as manufactured by EBAA Iron, INC. or approved equal.

2.09 PIPE THREADS

A. All pipe threads shall be in accordance with ANSI/ASME B1.20.1.

2.10 AIR AND GAS TRAPS

A. Air and gas pipes shall be sloping to low points, provided with drip legs, shutoff valves, strainers and traps. The traps shall be piped to the nearest drain. Air and gas traps shall be not less than 150-pound iron body float type with copper or stainless steel float. Bracket, lever, and pins shall be of stainless steel. Drain traps shall have threaded connections.

B. Manufacturers, or Equal:

1. Armstrong Machine Works.

2. Spirax Sarco, Inc.

PART 3 - EXECUTION

3.01 GENERAL

A. All pipes, fittings, and appurtenances shall be installed in accordance with the requirements of Divisions 2, 5, 9 and 15. The lining manufacturer shall take full responsibility for the complete, final product and its application. All pipe ends and joints at screwed flanges shall be epoxy-coated, to assure continuous protection.

B. Where core drilling is required for pipes passing through existing concrete, core drilling locations shall be determined by radiograph of concrete construction to avoid damage to the embedded raceways and rebars.

END OF SECTION

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SECTION 011005010 BASIC MECHANICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Basic requirements for products that are specified in the following divisions.

1. Division - Equipment

2. Division - Mechanical

3. Division – Electrical

1.02 SYSTEM DESCRIPTION

A. Furnish and install complete operating mechanical systems including appurtenant structural, mechanical and/or electrical mountings or connections required for compliance with manufacturer's installation requirements, for compliance with applicable building codes and standards, and as needed to permit systems to perform all functions required by the Contract Documents and described in the manufacturer's printed literature.

1.03 QUALITY ASSURANCE

A. Before shipping; operate valves, motors, pumps, actuators and mechanical equipment at the factory to ensure products are complete and in working condition.

B. Piping systems and elements shall comply with ASME Codes, and appropriate ASTM, API or AWWA standards.

C. Welders on steel pressure piping work shall be AWS certified as boiler and pressure vessel welders per Section IX Part A of AWS B2.1 as required by AWWA C200 paragraph 3.3.3.1.

D. Products requiring electrical connection shall be listed and classified by Underwriters Laboratories, Inc., as suitable for the purposeshown.

E. Wiring terminations shall match branch circuit conductor quantities, sizes, and materials shown. Enclose terminal lugs in terminal box sized to NFPA 70.

F. If products are furnished which differ from those shown and which require changes to enclosures, mounting and support structures, power and control circuitry or other work to accommodate furnished product, provide changes required at no additional cost to the Owner and of same quality as shown.

1.04 REFERENCES

A. ANSI/AWS 2.4 Standard Symbols for Welding, Brazing and Nondestructive Examination ANSI B1.1 Unified Screw Threads.

B. ASME Boiler and Pressure Vessel Code, Section VIII, Rules for Construction of Pressure Vessels, Division 1.

C. ASME B31.3 Process Piping.

D. ANSI/AWS B2.1 Standard Welding Procedure Specifications.

E. AWWA C200 Steel Water Pipe 6-inch and Larger.

F. NFPA 70 National Electrical Code.

1.05 SUBMITTALS

A. Shop Drawings for piping shall include the following:

1. Key or index showing locations of spools and fittings.

2. Order of installation. Each spool shall receive a unique mark number. No other spool or fitting, even on separate pipelines or casings included in the contract, shall have the same mark number. The sequential order of the mark numbers shall correspond to a logical order of installation for each pipeline.

3. Laying lengths, dimensions, clearances and tolerances for all spools and fittings.

4. Station and invert elevation of all grade changes and changes in horizontal alignment.

5. Slopes of pipe not vertical or horizontal.

6. Horizontal and vertical alignment data for all curves, bends, tees and outlets.

7. Couplings and end types of all pipe, spools, fittings, outlets and adjacent valves or pipeline equipment.

8. Proposed linings and coatings for pipe, fitting and couplings.

9. How connections will be made between work under this contract and existing work or work under other contracts.

10. Pipe and valve support sizes and locations including anchor bolt sizes and embedments.

11. Relationship of piping to other work.

B. Shop drawings for valves, pumps, or pipeline equipment shall include the following:

1. Laying lengths and dimensions, clearances, tolerances and end types.

2. Weight and type of valves, pumps, or equipment.

3. Valve and pump port sizes and tolerances.

4. Dimensions and orientation of actuators and pilot systems. Locations of actuator stops.

5. Proposed linings and coatings.

6. Performance characteristics.

7. Parts and materials lists and ratings and details of appurtenances to be furnished, along with references to appropriate ASTM, Federal Specifications and other reference standards and grades.

8. Piping and conduit attachments and sizes.

C. Shop drawings for structures shall include the following:

1. Lengths, widths, thickness, embedment, dimensions and tolerances of structural members.

2. Detailing of openings and wall penetrations including doors, windows, hatches, louvers, vents, ducts, and all floor, wall and door penetrations.

3. Connection details including applicable sizes, diameters, thickness, spacing, embedment and edge distances of bolts, anchors, rivets, nails, screws, spikes, connection plates, holdowns and other fasteners.

4. Welding details using standard ANSI/AWS 2.4 symbols and showing type, electrode, length, spacing and thickness of welds.

5. Materials listing and properties, including types, strengths and finishes of concrete, masonry, metals, wood, plastics and other construction materials.

D. Shop drawings for equipment shall include the following:

1. Dimensions, clearances and floor space requirements.

2. Weight and type of equipment.

3. Location where product will be installed.

4. Anchor bolt sizes and embedments.

5. Finishes and coatings.

6. Performance characteristics.

7. Parts and materials lists and ratings and details of appurtenances to be furnished, along with references to appropriate ASTM, Federal Specifications and other reference standards and grades.

8. Piping and conduit attachments and sizes.

9. Operation and Maintenance Manuals (separate submittal).

E. Shop drawings for electrically powered or controlled equipment shall include the following in addition to the above requirements for shop drawings for equipment:

1. Elevations showing arrangements and positions of all panel components including nameplates.

2. Electrical diagrams as needed to show wiring circuit schematics, single line diagrams, voltage wire numbers and identified interlocks and terminals.

3. Logic diagrams for programmable controllers or relays if used.

4. Nameplate data showing nameplate material, height of letters, number of lines, inscriptions and dimensions.

F. Shop drawings for replacement items shall include field measurements needed to verify fit in existing spaces.

G. Catalog data shall clearly indicate applicable items when several products are covered on one page. Using black ink, indicate on submitted catalog data, specification section or plan reference being satisfied.

H. Installation or application instructions shall be the manufacturer's printed instructions including warranty requirements, clearances required and proper field procedures to deliver, handle, install and prepare product for use. In the absence of manufacturer's published literature, ASTM, AWWA or trade standards for proper installation will be accepted. If no instructions at all are submitted for installing or applying an item of Work, the City reserves the right to stop work on the subject item at any time, and to retain experts of its choosing to prepare appropriate installation or application instructions to control the Contractor's work.

I. Operation and maintenance instructions shall be the

manufacturer's printed instructions for correct operation and maintenance procedures for product, along with data which must accompany manual as directed by current regulations of government agency. Include operating instructions for each piece of equipment. Describe equipment function, operating characteristics, limiting conditions, operating instructions, startup procedures, normal and emergency conditions, regulation and control, and shutdown. Include preventative maintenance instructions. List warranty requirements. Explain and illustrate preventative maintenance tasks. Include lubrication charts, lists of acceptable lubricants, trouble shooting instructions, and lists of required maintenance tools and equipment. List recommended spare parts, their costs, and ordering information for 1 manufacturer who can supply these parts. Index instructions for easy reference. Include information for installed equipment only.

J. Manufacturer's statement of responsibility shall be copy of form attached, signed by authorized factory representative for manufacturer whose product is being furnished.

K. Certificate of compliance shall certify materials have been sampled, tested and found to comply with applicable reference standards.

L. Engineering calculations shall be clearly legible, and shall demonstrate compliance with state and local codes, applicable standards, and contract requirements. Calculations shall be sealed by a California-registered and licensed professional engineer.

M. Foundry or test record transcripts shall fully describe required tests in accordance with specified test standards.

N. In addition, furnish the following submittals:

Submittal	Description

Motor Data	Submit the following data in tabular form for each motor: • Equipment driven • Motor locked rotor and full load currents • Voltage • Power factors & efficiencies at full load, ¾ load and ½ load • Motor housing material and winding material • NEMA design letter, code letter and insulation class • Ambient temperature and maximum elevation for which motor is designed to operate continuously • Service factor • Temperature rise • Type of enclosure • Bearing life • Dynamic balance • Nameplate data • Speed/torque/current at 100% voltage • Overload device catalog number • Overload device current range and setting. • Energy efficiency rating
Schedule for lubrication and run-in procedures	Submit 2 weeks before beginning procedures.
Welder Qualification Certificates	Submit on City's request.
Warranty	Unless otherwise stated, furnish 1-year warranty from date of final acceptance.

O. All manufacturer's equipment that requires the tightening of materials or bolts to join, secure or otherwise fasten equipment shall submit with the shop drawing information the maximum torque required to properly join, secure or otherwise fasten said materials or equipment.

P. Use of contract drawing reproductions for shop drawings is subject to rejection.

1.06 DELIVERY, STORAGE AND HANDLING

A. Manufacturer’s instruction and warranty requirements for delivery, storage and handling of products shall be strictly followed.

B. Deliver products to job site in manufacturer's original, unopened, labeled packaging. Tag or label packages as needed to identify contents and name of equipment of which contents form a part.

C. Oil lubricated gearing, bearings, and other lubricated components shall be shipped with oil soluble protective coating as described in warranty requirements or recommended by manufacturer. Coating shall provide protection for 1 year after final acceptance.

D. Only products of approved manufacturers shall be delivered and stored at the site.

E. Do not accept delivery of equipment not meeting Contract requirements.

F. Store materials in a protected area at a temperature between 35°F and 110°F.

G. Store products so as to preserve their quality and fitness for the work. Locate stored products and equipment to be incorporated in the work to facilitate prompt inspection. The Contractor shall be responsible for damage or loss to products until Final Acceptance.

H. Protect products against moisture, weather, temperature extremes, dust, debris, tampering, vandalism, ultraviolet radiation, or damage from improper handling, storage, or exposure. Protect exposed metals from rust and corrosion even though they will be sandblasted or otherwise cleaned before painting.

I. Store flammable products to conform to city, county, state and federal safety codes for storage of flammable materials.

J. Cover pipe ends with rubber, plastic, or canvas to prevent intrusion or contamination.

K. Openings on valves and equipment shall be covered, plugged or capped.

L. Stringing of pipe along right of way shall be done in a manner that will not interfere with free passage of vehicles.

M. Store items not designed for outdoor exposure off ground and under cover.

N. Handle products with care and using proper equipment according to manufacturer's recommendations. Lift large heavy items only at points designated by manufacturer. Do not drop, drag, bump, or handle products in a manner that causes bruises, cracks, scratches or other damage. Use padded slings and hooks for lifting as needed to prevent damage. Improper handling shall be cause to reject mishandled products.

O. Coated pipe, valves and other products shall be lifted, lowered or suspended using rubber or canvas belt slings or pneumatic-tired cradles. Sling width shall equal or exceed pipe or product diameter. Do not handle coated products using ropes, hooks, chains, calipers or cables. Store such materials on padded skids.

P. Inspect each product item for damage, defects, completeness and correct operation before installing.

Q. Before installation, swab joints and interiors of piping materials to remove foreign matter.

R. Notify the City in writing if delivered or stored product is damaged. Exterior surfaces of delivered items shall be in perfect unblemished condition. Do not repair damaged products without prior written approval.

S. Clean and protect machined surfaces and shafting from corrosion using proper type and amount of coating as described in warranty requirements to assure protection to 1 year after final acceptance.

T. Maintain records for the City’s review of deliveries to show the Contractor's order number, purchase order number and equipment number. Include labeling or shipping tag in records.

PART 2 - PRODUCTS

2.01 GENERAL PRODUCT REQUIREMENTS

A. Products shall be new and of current design and manufacture, free from defects and imperfection that might affect serviceability of the product for its intended purpose, unless otherwise stated.

B. Products or work for which no technical specifications are set forth shall be of the best grade in quality and workmanship obtainable in the market from firms of established good reputation, or, if not ordinarily carried in stock, shall conform to usual standards for first class products of the kind required, considering the use to which they are to be put. Work shall be in full conformity and harmony with

the intent to secure the best standard of products and construction.

C. Products and workmanship shall match the Contractor's submittals as approved by the City.

D. Connections and mountings required to install products shall comply with connections and mountings shown in the Contract Documents and Submittals on a location-specific basis. Do not assume that approval of connections or mountings at a specific location constitutes approval of same at all locations.

E. Conform to federal, state and local regulations governing VOC content, percentage solids by volume, and other paint and solvent properties.

F. Corresponding parts of identical products shall be interchangeable.

G. Materials for a complete paint or sealant system, including primer, finish coats, thinners, cleaners and drying agents, and other additives shall be the end products of one manufacturer to ensure product compatibility and unit responsibility.

H. Design and fabrication of products shall ensure products withstand stresses and loads which may occur during testing, installation, start-up and normal operation.

I. Products shall be capable of fulfilling their intended purpose in the environment in which they are installed. Allow for local temperature extremes, climatic conditions and corrosive environments where necessary to ensure proper functioning of furnished products.

2.02 MATERIALS

A. Dissimilar metals, when used in conjunction with each other, shall have suitable insulation provided between adjoining surfaces to eliminate direct contact and resultant current. Insulation shall be bituminous impregnated felt, heavy bituminous coatings, nonmetallic separators, washers, or other approved materials.

B. Mating ends of pipe shall match.

C. Mating ends of valves, meters, and couplings shall match ends of adjacentpipe.

D. Minimum working pressure of valves, couplings and fittings shall equal or exceed class of pipe to which they are attached or 150 psi, whichever is higher.

2.03 EQUIPMENT

A. Stainless steel or brass inscribed nameplates shall be securely fastened in conspicuous locations for mechanical equipment having moving parts. Show manufacturer's name, year of

manufacture, serial number, principal rating data and equipment item number. Nameplates shall be in English and use American measuring units.

B. Valves shall be marked to show name of manufacturer, year of manufacture, size of valve, maximum working pressure, and arrow to show direction offlow.

C. Valves shall close drip tight.

D. Motors shall meet, as minimum requirements, the published standards, rules and regulations of NEMA, ANSI and IEEE as to application, manufacture and tests. Motor windings shall be insulated and braced for full voltage operation.

E. Motors shall develop sufficient torque for required service throughout acceleration range at voltage 10 percent less than motor nameplate rating. Motors shall develop sufficient torque when started using reduced voltage starters.

F. Provide grounding lugs inside conduit boxes for motor frame grounding.

G. Motor grease lubricated bearings shall be regreasable with a grease reservoir above the bearing to ensure proper flow of lubricating oil. Regreasing must purge grease cavity above bearings to ensure an adequate supply of fresh grease.

H. Grease fittings shall be standard button-head type. Grease fittings shall be serviceable by a single type of grease gun. Extend fittings as necessary to provide easy access, or as directed by the City.

I. Furnish special tools, wrenches and appliances needed to adjust, operate, maintain or repair mechanical equipment supplied.

PART 3 - EXECUTION

3.01 PREPARATION

A. Carefully lay out work in advance to minimize cutting, channeling, chasing or drilling of structural pads or elements. Cuts, channeling, drilling, or welding required to accommodate mechanical or electrical equipment shall be reviewed in advance with the City. Repair damage to structures, piping equipment or finishes using skilled workers of appropriate trades.

B. Relocations or adjustment of existing facilities needed to facilitate construction must be approved in writing by the City and subsequently relocated or adjusted by the Contractor as directed. If existing items are lost or damaged during construction, replace

with new items of equal or better quality.

C. Make field measurements needed to fabricate and install work before ordering or beginning work. Make minor changes in alignments and dimensions as needed to remedy or avoid utilities and structural conflicts.

D. Clean and wire brush flange faces of pipe, valves and pipeline equipment before joining to adjacent flanges. Flange bolts and nuts shall be cleaned by wire brushing, threads lubricated with oil and graphite and nuts tightened uniformly and progressively.

E. Threaded pipe joints shall be cleaned by wire brushing or swabbing. Apply Teflon joint compound or Teflon tape to pipe threads before installing threaded valves.

F. For existing facilities, make field measurements needed to install mechanical equipment before submitting shop drawings or ordering. Make minor changes in dimensions and alignments as needed to avoid utilities or structural conflicts.

3.02 INSTALLATION

A. Maintain complete set of Contract Documents at jobsite field office or superintendent's truck at all times.

B. Install mechanical equipment according to manufacturer’s installation and warranty requirements. Manufacturer’s requirements for installation, application, connection, erection, maintenance, operating, cleaning, conditioning and startup of products shall be strictly followed.

C. Install mechanical equipment to tolerances recommended by the manufacturer. Unless otherwise shown, install mechanical equipment true and level using precision gauges and levels.

D. Refer variances between the manufacturer’s installation instructions and Contract Documents to the City.

E. Before welding, abutting joints shall be free of strain.

F. Do not force fit or spring pipe, conduit or equipment into place. Corrective measures for cases of poor alignment shall be approved in advance by the City.

G. Deflections at joints shall fall within the manufacturers' published tolerance limits.

H. Mitered piping joints are not permitted.

I. Pipe bends shall conform to ASME B31.3 and be free from wrinkles, creases or corrugations.

J. Water pipe bends shall use approved AWWA fittings.

K. Pipe threads shall be cut with sharp dies and made up with an approved thread sealing compound. Threads to be seal welded shall be made up dry. Do not use Teflon sealers.

L. Upon request by the City, during performance test, furnish services of factory- authorized manufacturer's representative to inspect and approve, in writing, installation of mechanical equipment furnished by that manufacturer, to place it into operation, to assist in necessary adjustments and tests and to instruct operating personnel in equipment operation and maintenance.

M. Epoxy coated pipe, valves and fittings shall be fabricated and installed without cutting, notching or welding.

N. Install valves and equipment so as to be easy to operate and service. Where the geometry of manufactured valves and equipment and field conditions bring about a condition where it is difficult or impossible for an average worker to operate or service an installed valve or piece of equipment, notify the City of the conflict before installing the valve or piece of equipment.

O. Provide stem extensions on buried valves where the depth of the valve nut exceeds 4 feet. Pin valve extensions to the valve operating nut.

P. Unless otherwise shown, coat valves as specified in Section 09800, Painting and Coating.

Q. Exposed surfaces shall be finished in appearance. Grind smooth exposed welds. Round or chamfer corners of exposed structural shapes for personnel protection.

R. Prime and paint exposed surfaces of ferrous products, piping, and conduit except for stainless steel or galvanized or sherardized surfaces or unless otherwise shown. Clean painted surfaces and touch up bare or marred spots with finish to match factory finish.

S. Paint and coat in workmanlike manner so as to produce an even film of uniform thickness. Pay attention to edges, angles, flanges, corners, crevices, and joints to insure that they have been thoroughly cleaned and that they receive specified thickness of paint or coating. Finished surfaces shall be free from runs, drops, ridges, waves, shiners, laps, brush marks, and variations in color, texture and finish. The hiding shall be so complete that addition of another coat would not increase the hiding. Apply coats so as to produce film of uniform thickness.

T. Repair damage to work that is not cause for rejection.

U. Repair, correct or replace work failing tests or inspection. Repeat tests until results satisfy specifications. Repair damages resulting from tests.

V. Furnish mounts, guides, bearing plates, flanges, anchor and attachment bolts and screws, saddles, supports, pads and skids necessary to securely mount products and equipment.

W. Tighten bolts to manufacturers' specifications using torque wrenches. Unless otherwise directed, use lubricant such as Copperkote when making up bolts.

X. Manufacturer's instructions and warranty requirements for installation, application, connection, erection, maintenance, operating, cleaning and conditioning of products shall be strictly followed.

3.03 FIELD QUALITY CONTROL

A. Pipework, valves, fittings, tanks and appurtenances shall have no leaks at design pressures.

B. If flanges leak under pressure testing, nuts and bolts shall be loosened or removed, the gasket reseated or replaced, bolts and nuts reinstalled or retightened and the joints retested.

C. Eleven month warranty inspection shall be conducted prior to release of bonds. Any work failing to comply with specifications or performance standards stated in manufacturers submittals or printed promotional literature will at that time be tagged as defective and scheduled for repair. Repair all defective work in strict accordance with the Contract Documents and to the satisfaction of the City.

3.04 ADJUSTING, LUBRICATING, AND CLEANING

A. Pre-startup checkout shall be conducted upon completion of Work. Clean foreign material. Lubricate equipment in accordance with manufacturer's instructions. To extent possible, turn rotating equipment, operate valves and gates, and check for binding or interference. Check incoming electric power for voltage amplitude and voltage balance. Check motor driven equipment for correct rotation. Check power draw of equipment. Verify that safety equipment is in place.

B. Debugging, tuneup and adjustments shall be done as needed.

C. Lubricate mechanical equipment in accordance with manufacturer's instructions. Lubricating oils and greases shall be of type and viscosity recommended by manufacturer. Furnish lubricants with

flushing oils as recommended by manufacturer. Following flushing, fill oil lubrication system with "run-in" oil as recommended by manufacturer. Run in equipment at no load condition for 2 hours. Drain and flush equipment again with flushing oil and refill with lubricant recommended by manufacturer.

D. Upon request by the City, during performance test, furnish services of factory- authorized manufacturer's representative to inspect and approve, in writing, installation of mechanical equipment furnished by that manufacturer, to place it into operation, to assist in necessary adjustments and tests and to instruct operating personnel in equipment operation and maintenance.

END OF SECTION

Manufacturer's Statement of Responsibility

Project Name: _____

Specification Section Number: _____

Item: _____

City: _____

Contractor: _____

Supplier: _____

We have reviewed the applicable sections of the Contract Documents describing requirements for our product, including Sections entitled "Submittals", "Quality Control", "Material and Equipment", "Starting of Systems", "Contract Closeout", "Operating and Maintenance Data and Training", "Painting and Coating", "Basic Mechanical Requirements", "Basic Electrical Requirements".

Before shipping, we certify that we shall review Contractor's submittals from other manufacturers who will supply products that interface with our product, and may affect our product's performance. In addition we state that it is our intent to request and review data concerning quality of water, soils or any other materials which may contact or adversely impact the performance of our product.

Should we have cause to believe that our product is, for any reason, incompatible with an interfacing product or material, we will inform the City of our concern before we ship our product. In such case, we will not ship our product until our concerns have been satisfactorily resolved.

We further understand that the City reserves the right to request a factory authorized representative's written approval of installation, application and/or erection of our product as described in the Section of the Contract Documents entitled “Starting of Systems”, before paying Contractor for our product.

_____

Authorized Factory Representative

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SECTION 011005020 PIPE SUPPORTS

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

The Contractor shall provide the pipe supports, hangers, stanchions, guides, and anchors, complete, in accordance with the Drawings and Specifications.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Division Mechanical

1.03 CONTRACTOR SUBMITTALS

Shop Drawings: Shop drawings shall be submitted in accordance with Section 01300 and shall include the following information at a minimum:

A. Drawings of the pipe supports, hangers, anchors, stanchions and guides;

B. Calculations for supports and anchors.
   1. Structural calculations stamped by an engineer registered in the state of California, shall be provided for custom designed or custom fabricated pipe support systems.

PART 2 - PRODUCTS

2.01 GENERAL

A. Code Compliance: All piping systems and pipe connections to equipment shall be properly anchored and supported to prevent undue deflection, vibration, dislocation due to seismic events and line pressures, and stresses on piping, equipment, and structures. All supports and parts thereof shall conform to the requirements of ANSI/ASME B31.1 - Power Piping, except as supplemented or modified below. The supports for plumbing piping shall be in accordance with the latest edition of the applicable plumbing code or local administration requirements. There shall be no visible sagging between supports. The supports shall be of acceptable standard design and in compliance within MSS-SP-58 and SP-69 and all government codes, where applicable. All supports of the same type shall be identical, varying only with size, and the product of one manufacturer or fabricator.

B. Structural Members: Wherever possible, the pipes shall be supported from structural members. Where it is necessary to frame structural members between existing members, such supplementary members shall be provided by the Contractor at no additional cost to the Owner. All supplementary members shall be in accordance with the requirements of the building code and the American institute of Steel

Construction and shall be acceptable to the Owner.

C. Clevis Hangers: Clevis hangers shall be capable of supporting the pipe in all conditions of operation, allowing free expansion and contraction of the piping, and preventing excessive stress on the equipment. All hangers shall have a means of vertical adjustment after erection. The hangers shall be designed to prevent becoming disengaged by any movement of the supported pipe. Hangers that are subject to shock, seismic disturbances, or thrust imposed by the actuation of safety valves shall include hydraulic shock suppressors. All hanger rods shall be subject to tensile loading only. Clevis hangers shall conform to Federal Specification WW-H- 171E and Manufacturers Standardization Society SP-69, Type 1. Clevis hangers shall be supported from concrete inserts or beam clamps, as required on the plans.

D. Bracket Supports: Bracket supports shall be the welded medium or heavy-duty type and conform to Federal Specification WW-H-171E/mss SP-69, Types 32 and 33.

E. Riser Supports: Where practical, the risers shall be supported on each floor with riser clamps and lugs, independent of the connected horizontal piping.

F. Freestanding Piping: Freestanding pipe connections to equipment such as chemical feeders and pumps shall be firmly attached to steel frames fabricated from angles, channels, or I-beams anchored to the structure. The exterior, free-standing overhead piping shall be supported on fabricated pipe stands consisting of pipe columns anchored to concrete footings, with horizontal, welded steel angles and U- bolts or clamps securing the pipes.

G. Pipe Stanchions: Pipe stanchion supports shall be utilized to support above grade piping. Pipe stanchion supports shall be of the flange support, saddle clamp support, and flange cradle support types designed to support the weight of piping, valves, fittings, and other appurtenances while resisting horizontal and vertical movement due to thrust and seismic forces. All pipe stanchion supports shall be constructed of Type 304 Stainless Steel.

H. Materials of Construction:

1. General: All pipe support assemblies, including framing, hardware, and anchors, shall be steel construction, galvanized after fabrication, unless otherwise indicated.

2. Corrosive: All piping in chemical and corrosive areas shall be supported with support assemblies, including framing, hardware, and anchors, constructed of Type 316 stainless steel or FRP, unless otherwise indicated.

3. Point Loads: Any meters, valves, heavy equipment, and other

point loads on PVC, CPVC, and other plastic pipes shall be supported on both sides, according to the manufacturer's recommendations to avoid undue pipe stresses and failures. To avoid point loads, all supports on PVC, and other plastic piping shall be equipped with extra wide pipe saddles or galvanized steel shields.

I. Noise Reduction: To reduce the transmission of noise in piping systems, all copper tubes in buildings and structures shall be wrapped with a 2-inch wide strip of rubber fabric or similar, suitable material at each pie support, bracket, clip, or hanger.

2.02 SUPPORT SPACING

A. Supports for piping with the longitudinal axis in approximately a horizontal position shall be spaced to prevent excessive sag, bending, and shear stresses in the piping, with special consideration given where components such as flanges and valves impose concentrated loads. The pipe support spacing shall not exceed the maximum spans in the tables below. For temperatures other than ambient temperatures, or those listed, and for other piping materials or wall thicknesses, the pipe support spacings shall be modified in accordance with the pipe manufacturer's recommendations. Vertical supports shall be provided to prevent the pipe from being overstressed from the combination of all loading effects. All required piping, tubing, fittings, valves and appurtenances shall be rigidly supported from the structures by acceptable supports, hangers, inserts, or clamps, with adequate provisions for expansion and contraction. Support shall be provided at, or near, changes in direction, hubs, joints, valves, appurtenances, branches, inlets and outlets from the equipment in accordance with the equipment manufacturer's recommendations, and elsewhere within 3 feet of couplings in accordance with the manufacturer's recommendations, and as specified along with the following support spacings:

1. Support Spacing for Steel Pipe:

Nominal Pipe Diameter (inches)	**Maximum Span (feet)**
1/2	6
3/4	8
1-1/4 to 2	10
3	12
4	14
6	15
8 and 10	15
12 and 14	18

16 and 18	20
20 and Greater	20

2. Support Spacing for Ductile-Iron Pipe:

Nominal Pipe Diameter (inches)	**Maximum Span (feet)**
All Diameters	Two supports per pipe length or 10 feet (one of the 2 supports located at joint)

3. Support Spacing for Copper Tubing:

Nominal Pipe Diameter (inches)	**Maximum Span (feet)**
1/2 to 1-1/2	6
2 to 4	10
6 and Greater	12

4. Support Spacing for PVC or CPVC Pipe:

Nominal Pipe Diameter (inches)	Maximum Span (feet)
1/2	4
3/4	4.5
1	5
1-1/4	5.5
1-1/2	5.75
2	6.25
3	7.5
4	8.25
6	10
8	11
10	12.25
12	13.25

B. Vertical piping shall be supported as follows:

1. At maximum intervals of 10 feet, except plastic pipe which shall be supported at maximum intervals of 3.5 feet.

2. Where pipes changes direction from horizontal to vertical, or vertical to horizontal, the pipes shall be supported on the horizontal runs within 2 feet of the change in direction by supports specified in Part 2 of these Specifications.

3. At all points necessary to ensure rigid construction by approved pipecollars, clamps, or brackets or wall rests.

2.03 MANUFACTURED SUPPORTS

A. Stock Parts: Where not specifically indicated, designs that are generally accepted as exemplifying good engineering practice and use stock or production parts shall be utilized wherever possible. Such parts shall be locally available, new, of the best commercial quality designed and rated for the intended purpose.

B. Manufacturers, or approved equal shall be:

1. Unistrut Corp.

2. Anvil

3. B-Line

2.04 COATING

A. Galvanizing: Unless otherwise indicated, all fabricated pipe supports other than stainless steel or non-ferrous supports shall be blast-cleaned after fabrication and hot-dip galvanized in accordance with ASTM A 123 - Specifications for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

B. Other Coatings: Other than stainless steel or non-ferrous supports all supports shall receive protective coatings in accordance with the requirements of Section 09900 – Painting and Coating.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General: The drawings indicate the type of pipe supports to be installed. Not all pipe supports are shown on the drawings. The Contractor shall install pipe supports at all locations required to adequately support the pipe and pipe appurtenances and in accordance with these Specifications. All pipe supports, hangers, brackets, anchors, guides, and inserts shall be fabricated and installed in accordance with the manufacturer's printed instructions and ANSI/ASME B31.1 - Power Piping. All concrete inserts for pipe hangers and supports shall be coordinated with the formwork.

B. Appearance: Pipe supports and hangers shall be positioned to produce an orderly, neat piping system. All hanger rods shall be vertical, without offsets. The hangers shall be adjusted to line up groups of pipes at the proper grade for drainage and venting, as close to ceilings or roofs as possible, without interference with other work.

3.02 FABRICATION

A. Quality Control: Pipe hangers and supports shall be fabricated and installed by experienced welders and fitters, using the best welding procedures available. Fabricated supports shall be neat in appearance without sharp corners, burrs, and edges.

END OF SECTION

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SECTION 011005044 HYDROSTATIC TESTING OF PRESSURE PIPELINES

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section describes the requirements and procedures for pressure and leakage testing of all welded and flanged steel, ductile iron pipe (DIP), and high- density polyethylene (HDPE) pressure mains.

1.02 REFERENCE STANDARDS

A. AWWA C600: Installation of Ductile Iron Water Mains and Their Appurtenances

1.03 SUBMITTALS

A. Submit shop drawings in accordance with Section 01300, Shop Drawings and Submittals.

B. Submit plan for testing pressure pipeline. Plan should indicate source of water to fill pipeline, locations of temporary air release valves and blow-offs, equipment and materials required to deliver the potable water to the testing area, temporary thrust block locations and proposed point of discharge of the test water.

C. Submit request for potable water source from the City 4 working days in advance of testing date.

1.04 REQUIREMENTS PRIOR TO TESTING

A. All piping, valves, fire hydrants, services, and related appurtenances shall be installed prior to testing.

B. The pipe trench shall have trench zone backfill placed and compacted with a minimum of 3.0-feet of material over the pipe.

C. All concrete anchor blocks shall be allowed to cure until a minimum strength of 2,500 psi is achieved before testing.

D. Pressure tests on exposed and aboveground piping shall be conducted only after the entire piping system has been installed and attached to pipe supports, hangers or anchors as shown on the Plans.

1.05 CONCURRENT HYDROSTATIC TESTING AND DISINFECTION OF PIPELINES

A. Hydrostatic testing of pipelines shall be performed prior to or concurrently with the disinfection operations. In the event repairs are necessary, as indicated by the hydrostatic test, the City may require additional disinfection testing. Any costs associated with additional disinfection testing after said repairs shall be borne by

the Contractor at no additional cost to the City.

1.06 CONNECTION TO EXISTING MAINS

A. Hydrostatic testing shall be performed prior to connections to existing mains. Authorization for connection to the existing system shall be given only on the basis of acceptable hydrostatic, disinfection and bacteriological test results. Connection to existing mains shall be performed in accordance with Section 011005000, General Piping Systems and Appurtenances.

PART 2 - PRODUCTS

2.01 WATER

A. Potable water shall be used for hydrostatic testing of potable and recycled water mains when such testing is performed separately from disinfection operations.

B. Potable water shall be supplied by a City-approved source. Make-up water for testing shall also be potable water.

C. A chlorinated water solution, in accordance with Section 011005041, shall be used to charge the line and for make-up water when hydrostatic testing and disinfection operations are combined.

2.02 CONNECTIONS

A. Testing water shall be supplied through a metered connection equipped with an approved backflow prevention device at the point of connection to the potable water source used.

B. The Contractor shall provide any temporary piping needed to deliver potable water to the piping that is to be tested.

PART 3 - EXECUTION

3.01 GENERAL

A. The Contractor shall provide the City with a minimum of 4 working days notice prior to the requested date and time for hydrostatic tests.

B. The Contractor shall furnish all labor, materials, tools, and equipment for testing.

C. Temporary blocking during the tests will be permitted only at temporary plugs, caps or where otherwise directed by the City.

D. All valves and appurtenances shall be operated during the test period. The test shall be conducted with valves in the open position.

E. At the onset of testing, all valves, air vacuum assemblies, blowoffs, and services shall be monitored for possible leakage and repairs made, if necessary, before the test proceeds. The appurtenances shall be monitored through the duration of the testing.

F. For pipe with porous lining, such as cement mortar, the pipe shall be filled with water and placed under a slight pressure for a minimum of two working days prior to the actual hydrostatic test.

3.02 FIELD TEST PROCEDURE

A. Test pressure shall be a minimum of 1.25 times the rated working pressure of the pipe at the highest point along the test section; however, the test pressure shall not exceed the rated pressure of the valves when the pressure boundary of the test section includes closed resilient-seated gate valves or butterfly valves. Test pressure shall not exceed pipe or thrust restraint design pressures. The hydrostatic test shall be performed for a minimum of 2 hours. The test pressure shall not vary by more than 5 psi for the duration of the test.

B. Valves shall not be operated in either direction at a differential pressure exceeding the rated valve working pressure.

C. Before applying the specified test pressure, air shall be expelled completely through pipe and appurtenances to be tested. Air shall be released through services, fire hydrants, air release valves, or other approved locations.

D. Any exposed pipe, fittings, valves, hydrants, and joints shall be examined carefully during the test. Any damaged, or defective pipe, fittings, valves, hydrants, or joints discovered following the pressure test shall be repaired or replaced, and test shall be repeated.

E. Testing allowance shall be defined as the quantity of makeup water that must be supplied into the pipeline or valved section thereof to maintain pressure within five psi of the specified test pressure after the pipe has been filled with water and the air has been expelled and the system has stabilized. Testing allowance shall not be measured by a drop in pressure in a test section over period of time.

F. No pipe installation will be accepted if the amount of makeup water is greater than that determined by the following formula:

$$L = \frac{S \cdot D\sqrt{P}}{133{,}200}$$

Where:

L = testing allowance (makeup water), in gallons per hour
S = length of pipe tested in feet
D = nominal diameter of the pipe in inches
P = average test pressure during the hydrostatic test in pounds per square inch (gauge)

Formula is based on testing allowance of 11.65 gpd/min/in of nominal diameter at a pressure of 150 psi. Testing allowance at varying pressures per Table 6A of AWWA C600.

No leakage is allowed for flanged, screwed, grooved, or welded pressure pipe.

G. When hydrants are in the test section, the test shall be made against the main valve in the hydrant including the lateral in the pressure test.

H. Acceptance shall be determined on the basis of testing allowance. If any test of laid pipe discloses a testing allowance greater than that specified, repairs or replacements shall be accomplished in accordance with the specifications.

I. All visible leaks are to be repaired regardless of the allowance used for testing.

END OF SECTION

SECTION 011005051 INSTALLATION OF PRESSURE PIPELINES

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section describes the installation of pressure pipelines fabricated of ductile iron, high density polyethylene (HDPE), and welded steel; pipeline closures and connections and pipeline encasement.

1.02 SUBMITTALS

A. Furnish submittals in accordance with the requirements of Section 01330, Shop Drawings and Submittals.

PART 2 - PRODUCTS

Refer to the various referenced sections for material requirements.

PART 3 - EXECUTION

3.01 DELIVERY AND TEMPORARY STORAGE OF PIPE AT SITE

A. On-Site Storage Limitation: On-site pipe storage shall be limited to a maximum of 1 week, unless exception is approved in writing by the City.

B. Care of Pipe: Take care to avoid cracking of the cement mortar coating and/or lining on steel pipe. If necessary, use plastic sheet caps to close pipe ends and keep coatings and linings moist.

3.02 HANDLING OF PIPE

A. Moving Pipe: Lift pipes with handling beams or wide belt slings as recommended by the pipe manufacturer. Do not use cable slings. Handle pipe in a manner to avoid damage to the pipe. Do not drop pipe or dump it from trucks or into trenches under any circumstances.

B. Internal Pipe Braces: Maintain internal braces placed in steel pipes until backfilling is completed.

C. Pipe Caps: Do not remove plastic caps placed over the ends of steel pipe until the pipe is ready to be placed in the trench. Plastic caps may be opened temporarily to spray water inside the pipe for moisture control.

D. Inspection of Pipe: Inspect the pipe and accessories for defects prior to lowering into the trench. Repair or replace any defective, damaged or unsound pipe. Remove all foreign matter or dirt from the interior of the pipe before lowering into position in the trench.

3.03 PLACEMENT OF PIPE IN TRENCH

A. General: Dewatering, excavation, shoring, sheeting, bracing, backfilling material placement, material compaction, compaction testing, and pipe laying requirements and limitations shall be in accordance with Section 02223, Trenching, Backfilling and Compacting.

B. Sanitation of Pipe Interior: During laying operations, do not place tools, clothing, or other materials in the pipe.

C. Prevention of Entry into Pipe: When pipe laying is not in progress, including lunch- hour, close the ends of the pipe using vermin-proof plugs constructed in a manner to also prevent entry by children.

D. Laying Pipe on Grades over 10 Percent: Pipes shall be laid uphill whenever the grade exceeds 10 percent.

E. Pipe Base Thickness: Pipe base thickness shall be as specified in Section 02223, Trenching, Backfilling and Compacting.

F. Depressions at Joints and Pipe Sling Points: Dig depressions into pipe base material to accommodate the pipe bell and external joint filler form, and to permit removal of the pipe handling slings.

G. Placement of Pipe on Pipe Base: Lower pipe onto the bedding and install to line and grade its full length on firm uniform bearing except at the bell and at sling depressions. Unless specified otherwise, the tolerance on grade shall be 1/4 inch; the tolerance on line shall be 1 inch. Measure grade along the pipe invert.

H. Pipe Installation: Install pipe without springing, forcing, or stressing the pipe or any adjacent connecting valves or equipment. Prevent pipe from being displaced by water entering trench. Replace damaged or displaced pipe or return it to specified condition and grade.

I. Trench Curvature and Pipe Deflection: Use the radius of curvature of the trench to determine maximum length of pipe section that can be used without exceeding the allowable deflection at a coupling or fitting. Refer to the various referenced sections on pipe by type for allowable deflection. The deflection at any flexible joint shall not exceed that prescribed by the manufacturer of the pipe. Follow the manufacturer's printed installation guide outlining the radius of curvature that can be negotiated with pipe sections of various lengths.

J. Equipment for Installation of Pipe: Provide and use proper implements, tools, and facilities as recommended by the pipe manufacturer’s standard printed installation instructions for safe and efficient execution of the work. Carefully lower all pipe, fittings, valves, and accessories into the trench using suitable equipment in such a manner as to prevent damage to pipe and fittings. Do not drop pipe or accessories or dump them into the trench.

K. Cutting and Machining Pipe: Cut and machine the pipe in accordance

with the pipe manufacturer's standard procedures for this operation. Do not cut pipe with a cold chisel, standard iron pipe cutter, nor any other method that may fracture the pipe or produce ragged, uneven edges.

3.04 ASSEMBLING RUBBER RING JOINTS

A. Cleaning Ends of Pipe: Clean the ends of the pipe to be joined of foreign material.

B. Lubrication: After placing pipe in trench, apply a non-toxic water soluble vegetable soap solution to the inside of the bell of the pipe in the trench and to the rubber gasket and spigot groove of the pipe to be installed. Stretch the rubber gasket into the groove of the spigot end of the pipe and distribute uniformly around the circumference.

C. Joint Assembly: Without tilting the pipe to be installed, insert the spigot into the bell of the pipe. Use come-alongs or pipe jacks to drive spigot end home horizontally. Maintain the joint recess recommended by pipe manufacturer for made-up joints. Where deflections at joints are required for curved alignment, do not exceed the allowable joint opening on one side. Use a feeler gauge to verify proper placement of each gasket.

3.05 FLANGED CONNECTIONS

A. Bolthole Alignment: Set pipe with flange boltholes straddling the pipe’s horizontal and vertical centerlines.

B. Nuts and Bolts: Lubricate nuts and bolts with an anti-seize compound prior to installation.

C. Flange Wrapping: Wrap flanges that connect with buried valves or other equipment with sheet polyethylene film as specified for the valves and equipment. The wrap shall extend over the flanges and bolts and be secured around the adjacent pipe circumference with tape.

D. Coating: Coat flanges and non-stainless steel bolts as specified in Section 09900, Painting and Coating.

3.06 INSTALLATION OF BENDS, TEES, AND REDUCERS

A. Install fittings utilizing standard installation procedures. Lower fittings into trench by acceptable means without damage to the fittings. Attach device used for lowering fitting into trench around exterior of fitting for handling. Do not attach the device through the fittings interior for handling. Connect fittings to pipe or other facility, and check joint to insure a sound and proper joint.

3.07 COMPLETION OF INTERIOR JOINTS FOR MORTAR-LINED PIPES 20-INCHES IN DIAMETER AND SMALLER

A. Preparation: Insert a tight-fitting swab or squeegee in the joint end of

the pipe to be joined.

B. Application of Cement Mortar: When ready to insert the spigot, coat the face of the cement mortar lining at the bell with a sufficient amount of stiff cement mortar to fill the space between adjacent mortar linings of the two pipes to be joined.

C. Removal of Excess Mortar: Immediately after joining the pipes, draw the swab or squeegee through the pipe to remove all excess mortar and expel it from the open pipe end.

3.08 PIPELINE CLOSURE ASSEMBLIES

A. General: Use pipeline closure assemblies to unite sections of pipeline laid from opposite directions; to adjust the field length of the pipeline to meet structures, other pipelines, and points established by design stations, and to close areas left open to accommodate temporary test bulkheads for hydrostatic testing. Use either follower ring design or butt strap design. Install follower ring closures as recommended by the pipe manufacturer.

B. General Requirements for Cement Mortar Lining for Closure Assemblies: Line closure assemblies with cement-mortar to a mortar thickness at least equal to the adjoining standard pipe sections. Clean the steel with wire brushes and a cement and water wash coat applied prior to applying the cement mortar. Where more than a 4-inch joint strip of mortar is required, place welded wire mesh reinforcement having a 2-inch by 4-inch pattern of No. 13 gauge over the exposed steel. Install the mesh so that the wires on the 2-inch spacing run around the pipe's circumference. Crimp the wires on the 4-inch spacing to support the mesh 3/8-inch from the metal surface. The interior mortar shall have a steel-troweled finish to match adjoining mortar lined pipe sections.

C. Lining Closure Assemblies for Pipes 20-Inches in Diameter and Smaller: For lining of closure assemblies on pipelines 20-inches in diameter and smaller, provide threaded 4-inch nipples with galvanized plugs around the perimeter of the closure at third-point intervals to facilitate mortar lining of the interior surface.

D. Mortar Coating Exterior Surfaces of Closure Assemblies: Reinforce the exterior of closure assemblies with wire mesh as described in Paragraph C above. Coat the surface with mortar, or a poured concrete encasement to cover all steel to a minimum thickness of 1-1/2 inches. Protect exterior mortar to retard drying while curing. Pour concrete and vibrate it on one side of the closure assembly only, until mortar or concrete is visible on the opposite side, after which the coating can be completed over the top of the assembly.

3.09 OPERATIONS INCIDENTAL TO JOINT COMPLETION

A. Plan joint completion to accommodate temporary test bulkheads

for hydrostatic testing.

3.10 COMPLETION OF EXTERIOR PIPE JOINT FOR CEMENT-MORTAR COATED PIPE

A. Fill outside joint recess with cement-mortar grout using a fabric form placed around the joint and secured with steel straps. Pour and rod grout from one side only until it is visible on the opposite side. After approximately one hour, top off the joint with additional grout.

3.11 THRUST RESTRAINT

A. Provide thrust restraint on pressure pipelines as shown on the Plans, and install them as shown on the Plans and at all rubber-gasketed fittings that are not otherwise restrained. Install thrust restraint at all valves, tees, crosses, ends of pipelines, and at all changes of direction of the pipeline greater than 10 degrees deflection either vertically or horizontally when joints are not otherwise restrained. See Section 011005000, General Piping System and Appurtenances, for requirements of thrust restraint systems.

3.12 ABOVE GROUND PIPING INSTALLATION/SUPPORT

A. General: Installation of above ground pipeline materials and appurtenances include requirements for buried pipeline materials and appurtenances as applicable.

B. Supports: Adequately support all exposed pipe with devices of appropriate design. Where details are shown, the supports shall conform thereto and shall be placed as indicated, provided that the support for all piping shall be complete and adequate as herein specified, whether or not supporting devices are specifically called for. Pipe hangers and supports shall conform to the requirements of the latest editions of the MSS-SP58 and SP69 and ANSI/ASME B31.1.

C. Grooved-End Pipe and Fittings: Install grooved-end pipe and fittings in accordance with the coupling manufacturer's recommendations and the following:

1. Clean loose scale, rust, oil, grease, and dirt from the pipe or fitting groove. Apply the coupling manufacturer's gasket lubricant to the gasket exterior including lips, pipe ends, and housing interiors.

2. Tighten couplings alternately and evenly until coupling halves are seated.

3.13 TESTING

A. All piping shall be hydrostatically pressure-tested in accordance with Section 011005044: Hydrostatic Testing of Pressure Pipelines.

END OF SECTION

SECTION 011005056 DUCTILE-IRON PIPE AND FITTINGS

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section includes materials and installation of ductile-iron pipe, fittings, linings and coatings for sewer and stormwater force mains.

1.02 REFERENCE STANDARDS

A. The publications listed below form part of this specification to the extent referenced and are referred to in the text by the basic designation only. Reference shall be made to the latest edition of said standards unless otherwise called for.

ANSI B1.1	Unified Inch Screw Threads
ASTM A193	Standard Specification for Alloy- Steel and Stainless-Steel Bolting Materials for High- Temperature Service
ASTM A 307	Standard Specification for Carbon Steel Bolts and Studs
ASTM C 150	Standard Specification for Portland Cement
ASTM A 536	Standard Specifications for Ductile Iron Castings
AWWA C105	Polyethylene Encasement for Ductile Iron Pipe
AWWA C110	Ductile Iron Fittings
AWWA C111	Rubber Gasket Joints for Ductile Iron Pipe and Fittings
AWWA C115	Flanged Ductile Iron Pipe with Threaded Flanges
AWWA C150	Thickness Design of Ductile Iron Pipe
AWWA C151	Ductile Pipe, Centrifugally Cast
AWWA C153	Ductile Iron Compact Fittings
AWWA C217	Cold Applied Petroleum Wax Tape Coatings
AWWA C600	Installation of Ductile Iron Water Mains
AWWA C606	Grooved and Shouldered Type Joints

1.03 RELATED WORK SPECIFIED ELSEWHERE

A. Shop Drawings and Submittals: Section 01300

B. Trenching, Backfilling and Compacting: Section 02223

C. Cast-in-Place Concrete: Section 03300

D. Painting and Coating: Section 09900

E. Hydrostatic Testing of Pressure Pipe: Section 011005044

1.04 SUBMITTALS

The following items shall be submitted in accordance with Section 01300 and complete the review process prior to shipping of ductile-iron pipe and fittings:

A. An affidavit of compliance with AWWA C110, C111, C115, C150, C151, C153, and the requirements of this specification.

B. Manufacturer's information relating to dimensions, weight, thickness, lining and coating for pipe and fittings conforming to AWWA C151, C110 and C153.

C. Copy of current test reports confirming the hydrostatic design of AWWA C153 fittings.

D. Copy of test report on physical properties of rubber compound used in gaskets.

E. Calculations supporting selected wall thickness.

F. Calculations demonstrating that each proposed restrained joint arrangement can resist the applied forces.

G. Submit tabulated layout schedule and drawing showing location and dimensions of pipe and fittings including:

1. Pipe station and invert elevation at each change of grade and alignment.

2. Components of curves and bends, both in horizontal and vertical alignment. Including pipe lengths required (to create curvature).

3. The limits of each segment of pipe class, (indicate pressure or thickness class), restrained joints and deflection angle between pipe lengths. For combined horizontal and vertical curves, provide true angular deflection at the joint.

4. Locations and details of bulkheads for field hydrostatic testing of the pipeline.

5. Locations of closures for length adjustment and for construction convenience.

6. Locations of appurtenances and other points for draining and/or filling.

7. Locations of valves and other mechanical equipment.

H. Joint details.

1.05 QUALITY ASSURANCE

A. The manufacturer of each shipment of pipe shall be required to supply a statement certifying that each lot or load of pipe and fittings has been subjected to and met the tests specified for ductile iron pipe and fittings per AWWA C110, C111, C115, C150, C151, and

C153, as applicable.

B. Ductile-iron pipe shall bear indelible identification markings as required by AWWA C151.

C. All pipe shall have a home mark on the spigot end to indicate proper penetration when the joint is made.

1.06 DELIVERY, STORAGE, AND HANDLING

Delivery, storage, and handling of ductile-iron pipe and fittings shall follow the recommendations of AWWA C600 and as specified herein:

A. Handling of pipe shall be performed with lifts, cranes, or other suitable equipment and devices. Slings, hooks, or pipe tongs shall be padded and used in such a manner as to prevent damage to the pipe, linings, and coatings. The pipes shall not be dropped or dragged.

B. During transport, the pipe shall be supported and secured against movement using padded devices in such a manner to prevent damage.

C. Stored pipe shall be protected from damage and kept free from dirt and foreign materials by closing the ends of the pipe. Other pipeline materials shall be protected by appropriate packaging or wrapping. Gaskets shall be stored in a cool location out of direct sunlight. Bolts, nuts, and washers shall be handled and stored in a dry location in a manner that will ensure proper use with respect to types and sizes.

D. Pipe laid out for installation shall be placed on earth berms or timber cradles adjacent to the trench in the numerical order of installation.

E. Maintain plastic end caps on all pipe and fittings in good condition until the pipe is ready to be installed in the trench.

F. Under no circumstances shall ropes or other devices be attached through the fitting's interior for handling.

1.07 POLYETHYLENE ENCASEMENT

A. Polyethylene encasement in tube form shall be provided for all buried ductile iron pipe and fittings per AWWA C105.

PART 2 - MATERIALS

2.01 DUCTILE-IRON PIPE

A. Ductile iron pipe shall be manufactured in accordance with

ANSI/AWWA C150/21.50 and ANSI/AWWA C151/21.51 (except for pipe lining) and shall be of the sizes and thickness or pressure classes shown herein.

B. Unless supported by calculations signed and sealed by a registered engineer or otherwise specified, buried ductile iron pipe shall be furnished within the following classes except for pipe with threaded flanges or shoulders, or pipes with grooved joints.

Pipe and Fitting Size Diameter (in)	Minimum Thickness Class per AWWA C151
Under 6-inch	52
6-inch to 16-inch	52
20-inch to 24-inch	52
30-inch to 36-inch	52
42-inch to 60-inch	52

C. Minimum thickness class for pipe having threaded flanges or threaded shoulders shall be Class 53.

D. Minimum thickness class for pipe having grooved end joints or flanged ends shall be as shown in the following table unless otherwise noted on the Drawings:

Pipe and Fitting Size (Diameter, in.)	Minimum Thickness Class per AWWA C151
16-inch and smaller	Class 53
18-inch	Class 54
20-inch	Class 55
24-inch	Class 56

E. All ductile iron pipe shall be lined in accordance with Parts 2.07 and 3.07 herein.

2.02 FITTINGS

A. General:

1. Ductile-iron fittings shall be manufactured per AWWA C110, C111, C115, C150, C151, and C153. Gray-iron and cast-iron fittings or flanges shall not be used.

2. Ductile-iron fittings manufactured per AWWA C153 shall be installed on pipe 12 inches and smaller only.

3. Joints for buried pipe joints and pipe fittings shall be flexibly restrained joints per U.S. Pipe TR Flex in accordance with AWWA C110, C111, and C153. Non-buried joints shall be flanged.

4. Except as amended herein, or otherwise shown on the approved Plans, joints for ductile-iron fittings shall have a pressure rating equal to or greater than the adjacent piping.

5. Joints in buried piping may be of the push-on, flanged or mechanical-joint type per AWWA C111 except where particularly specified on the approved Drawings.

6. Joints that are above ground, within structures, or submerged shall be flanged unless otherwise shown on the approved Plans.

B. Unless otherwise specified, ductile-iron flanges shall be in accordance with AWWA C115, rated at a working pressure of 250 psi.

1. Maximum working pressure of flanges shall as specified in AWWA or ASME/ANSI. Flanges shall be solid and integrally cast per AWWA C110 or shop-threaded per AWWA C115. Hollow-back flanges, gray-iron or cast-iron flanges and threading of flanges in the field are not permitted.

2. Where threaded flanges are used, the pipe or spool piece to which they are connected will be hydrostatically tested at the shop prior to installation. The pipe section or spool piece shall be hydrostatically tested for 15 minutes at the pressure rating of the flanges. No leaks shall be permitted.

C. Plain ends shall conform to the requirement of AWWA C151 and to the dimensions included within AWWA C110 to accept a mechanical joint, push-on joint, flanged coupling adaptor, flexible coupling, or grooved coupling.

D. The exterior surfaces of all pipe and fittings shall be factory coated with a minimum 1-mil thick petroleum asphaltic material per AWWA C110 and C151.

E. All ductile iron pipe and fittings shall be lined in accordance with Parts 2.07 and 3.07 herein.

2.03 GASKETS

A. Gaskets shall be furnished in accordance with Section 011005000.

2.04 BOLTS AND NUTS FOR FLANGES

A. Bolts and nuts shall be 316 SST and furnished in accordance with Section 011005000.

2.05 COUPLINGS

A. Couplings shall be furnished in accordance with Section 011005000.

2.06 PAINTING AND COATING

A. Buried ductile-iron pipe shall receive an asphaltic coating in accordance with AWWA C151.

B. Materials for coating of pipe and fittings located above ground and in structures shall be in accordance with Section 09900, Systems C-1 and C-2.

C. Materials for coating buried mechanical joint and hardware shall be in accordance Section 09900, System D-1.

2.07 DUCTILE IRON PIPE AND FITTING LINING

A. All ductile pipe and fittings shall be delivered to the application facility without asphalt, cement lining or any other lining on the interior surface. The removal of old linings may not be possible; the intent of this specification is that the entire interior of the ductile iron pipe and fittings shall not be lined with any substance prior to the application of the specified lining material and no coating shall have been applied to the first 6 inches of the exterior of the spigot ends.

B. The lining material used shall be Protecto 401 Ceramic Epoxy or approved equal. The material shall be an amine cured novalac epoxy containing at least
20 percent by volume of ceramic quartz pigment. Any request for substitution must be accompanied by a successful history of lining pipe and fittings for sewer or stormwater service, a test report verifying the following properties, and a certification of the test results.

C. A permeability rating of 0.00 when tested according to Method A of ASTM E-96- 66, Procedure A with a test duration of 30 days.

D. The following tests must be run on coupons from factory lined ductile iron pipe:

1. ASTM B-117 Salt Spray (scribed panel)—
Results to equal 0.0 undercutting after 2 years.

2. ASTM G-95 Cathodic Disbondment 1.5 volts @ 77°F—
Results to equal no more than 0.5 mm undercutting after 30 days.

3. Immersion testing rated using ASTM D-714-87.

a. 20 Percent Sulfuric Acid—No effect after 2 years.

b. 140ºF 25 Percent Sodium Hydroxide—No effect after 2 years.

c. 160°F Distilled Water—No effect after 2 years.

d. 120°F Tap Water (scribed panel)—No undercutting 2 years with no effect.

E. An abrasion resistance of no more than 3 mils (0.075 mm) loss after onemillion cycles European Standard EN598: 1994 Section 7.8 Abrasion Resistance.

2.08 IMPORTED GRANULAR MATERIAL FOR PIPE AND TRENCH ZONES

A. Imported granular material for use in pipe and trench zones shall be in accordance with Section 02223.

2.09 CONCRETE

A. Concrete for thrust and anchor blocks shall be in accordance with Section 03300.

2.10 POLYETHYLENE ENCASEMENT

A. Polyethylene encasement shall be furnished in accordance with Section 011005000.

2.11 TRACER WIRE

A. Tracer wire shall be furnished in accordance with Section 011005000.

2.12 WARNING/IDENTIFICATION TAPE

A. Warning/identification tape shall be furnished in accordance with Section 011005000.

2.13 RESTRAINING JOINTS

A. All buried joints on the project shall be restrained with TR Flex joints. Flanged joints may be used in certain cases and approved by the City. All adapters and appurtenances shall be provided for a complete operating system.

PART 3 - EXECUTION

3.01 GENERAL

A. At all times when the work of installing pipe is not in progress, including worker break times, ends of the pipe shall be closed with

a vermin-proof and child-proof cap or plug. Do not permit trench water to enter the pipe. Do not place tools, clothing, or other materials in the pipe. The Contractor shall maintain the interior of the pipe in a sanitary condition free from foreign materials.

3.02 TRENCHING, BACKFILLING AND COMPACTING

A. Trenching, backfilling and compacting shall be performed in accordance with Section 02223.

3.03 DEWATERING

A. The Contractor shall provide and maintain at all times during construction ample means and devices to promptly remove and dispose of all water from any source entering trench excavations or other parts of the work in accordance with Section 02223. Any damage caused by flooding of the trench shall be the Contractor's responsibility.

B. Dewatering shall be performed by methods that will maintain a dry excavation, preservation of the final lines and grades and protection of all utilities. If flooding of the trench does occur, the Contractor shall immediately dewater and restore the trench. Damaged or altered pipeline appurtenances or trench materials shall be repaired or replaced as directed by the Engineer.

3.04 PIPE INSTALLATION

The Contractor shall furnish and install all pipe, specials, fittings, closure pieces, valves, supports, bolts, nuts, gaskets, jointing materials, and all other appurtenances as shown on the approved Plans and as required to provide a complete and workable installation. Install pipe in the trench as follows:

A. Inspect each pipe and fitting before lowering the pipe or fitting into the trench. Inspect the interior and exterior protective coatings. Patch damaged areas in the field with material recommended by the protective coating manufacturer. Thoroughly clean the ends of the pipe. Remove foreign matter and dirt from inside of the pipe and keep pipe clean during and after installation.

B. Install pipe according to the manufacturer's approved order of installation. Install pipes uphill if the grade exceeds 10 percent. Lower the pipe onto the bedding at the proper lines and grades.

C. The manufacturer's printed installation guide outlining the radius of curvature that can be negotiated with pipe sections of various lengths shall be followed, except they shall not exceed the deflections allowed in AWWA C600 according to joint type. Combined deflections at rubber gasket or flexible coupling joints shall not exceed that recommended by the manufacturer.

D. The pipe shall have firm bearing along its full length, and bell holes shall be provided at each joint to permit visual inspection of the joint and prevent the pipe from being supported by the bell end or coupling.

E. Pipe Assembly:

1. Push-On Type: Assemble the pipe joint using a lubricant acceptable by the pipe and gasket manufacturer. Insert the spigot end into the bell or coupling to the proper insertion mark. Check that the elastomeric ring has not left the groove during assembly by passing a feeler gauge around the completed joint. Drive spigot ends of the pipe into bell ends in accordance with the manufacturer's recommendations. Stabbing shall not be permitted.

2. Mechanical Joint Type: Assembly of mechanical joint fittings shall be in accordance with the manufacturer's recommendations regarding installation.

F. During installation operations, do not place tools, clothing, or other materials in the pipe.

G. At all times when pipe laying is not in progress, the open end of the pipe shall be closed with a tight-fitting cap or plug to prevent the entrance of foreign matter into the pipe. These provisions shall apply during the break periods as well as overnight. In no event shall the pipeline be used as a drain for removing water that has infiltrated into the trench. The Contractor shall maintain the inside of the pipe free from foreign materials and in a clean and sanitary condition until its acceptance by the City. When the work requires and the size of the pipe allows entry of personnel into the pipe, the Contractor shall comply with all federal and state regulations for confined space entry. Work inside pipelines shall not be undertaken until all the tests and safety provisions of the Code of Federal Regulations 1910.146, and the General Industry Safety Orders of the California Code of Regulations, Title 8, Section 5159 for confined space entry have been performed and the area is verified as safe to enter.

3.05 INSTALLING BURIED FITTINGS

Buried ductile iron fittings shall be installed in accordance with Section 011005056.

A. The City Representative will inspect all fittings prior to installation for damage to the interior protective coatings. Patch damaged areas in the field with material similar to the original.

B. For mechanical joint fittings, clean the bell socket and the plain end of the pipe of all foreign material and dirt. Place the gland on the pipe spigot with the lip extension toward the plain end. Lubricate the pipe spigot and gasket. Use the same lubricant as supplied by the

pipe manufacturer. Install the gasket on the pipe spigot with the narrow edge of the gasket toward the plain end. Insert the pipe into the bell socket and press the gasket firmly into the gasket recess. Keep the joint straight during assembly. Push the gland towards the socket and center it around the pipe with the gland lip against the gasket. Insert bolts and hand tighten nuts. Make joint deflection after assembly but before tightening bolts. Uniformly tighten bolts and nuts in a progressive diametrically opposite sequence, and torque nuts to 75- to 90-foot pounds with a calibrated torque wrench.

C. For push on joint fittings, clean the bell ends of the fitting of all foreign material and dirt. Insert the gasket in the groove of the bell and make sure the gasket faces the correct direction. Feel that the gasket is completely and evenly seated in the groove. When pipe is cut in the field, bevel the plain end prior to installation. Lubricate the exposed gasket surface and the beveled pipe spigot with the same lubricant supplied by the pipe manufacturer. Insert the spigot into the bell and force it slowly into position. Keep the joint straight while pushing. Make joint deflection after the joint is assembled.

D. When necessary to deflect pipe from a straight line in either the horizontal or vertical plane, do not exceed the following joint deflection angles for buried fittings. The angles shown are for each joint of a ductile iron fitting and are maximum deflections.

Nominal Pipe Size (inches)	**Maximum Joint Deflection (degrees)**
12-inch and smaller	3.5
14-inch to 20-inch	3
24-inch	2.5

3.06 FLANGED PIPE AND FITTINGS

Flanged connections shall be installed where indicated on the approved Drawings.

A. Bolt holes shall straddle the horizontal and vertical centerlines.

B. The bolts, nuts and flange faces shall be thoroughly cleaned by wire brush prior to assembly.

C. Bolts, nuts and washers shall be lubricated with an approved anti-seize compound.

D. Assemble all bolts, nuts and washers in the flange.

E. All nuts shall be tightened in an alternating "star" pattern to the manufacturer's recommended torque with a calibrated torque wrench.

F. If flanges leak under pressure testing, loosen or remove the nuts and bolts, reset or replace the gasket, reinstall or retighten the bolts

and nuts, and retest the joints. Joints shall be watertight. Replace galled, cracked, or distorted bolts and nuts.

G. Coat all exposed portions of bolts, nuts and washers with a non-oxide grease and encase in polyethylene wrap in accordance with Section 011005000.

H. Coat the exterior of exposed flanges, bolts and nuts located aboveground or within vaults in accordance with Section 09900.

3.07 DUCTILE IRON PIPE AND FITTING LINING

A. The lining shall he applied by a certified firm with a successful history of applying linings to the interior of ductile iron pipe and fittings.

B. Prior to abrasive blasting, the entire area to receive the protective compound shall be inspected for oil, grease, etc. Any areas where oil, grease, or any substance that can be removed by solvent is present shall be solvent cleaned using the guidelines outlined in DIPRA-1 Solvent Cleaning. After the surface has been made free of grease, oil or other substances, all areas to receive the protective compounds shall be abrasive blasted using sand or grit abrasive media. The entire surface to be lined shall be struck with the blast media so that all rust, loose oxides, etc. are removed from the surface. Only slight stains and tightly adhearing annealing oxide may be left on the surface. Any area where rust appears before lining must be reblasted.

C. After the surface preparation and within 8 hours of surface preparation, the interior of the pipe shall receive 40-mils nominal dry film thickness of Protecto
401. No lining shall take place when the substrate or ambient temperature is below 40°F. The surface also must be dry and dust free. If flange pipe or fittings are included in the project, the lining shall not be used on the face of the flange.

D. Due to the tolerances involved, the gasket area and spigot end up to 6 inches back from the end of the spigot end must be coated with 6-mils nominal, 10-mils maximum Protecto Joint Compound. The joint compound shall be applied by brush to ensure coverage. Care should be taken that the joint compound is smooth without excess buildup in the gasket seat or on the spigot ends. Coating of the gasket seat and spigot ends shall be done after the application of the lining.

E. The number of coats of lining material applied shall be as recommended by the lining manufacturer. However, in no case shall this material be applied above the dry thickness per coat recommended by the lining manufacturer in printed literature. The maximum or minimum time between coats shall be that time

recommended by the lining material manufacturer. No material shall be used for lining that is not indefinitely recoatable with itself without roughening of the surface.

F. Protecto Joint Compound shall be used for touch-up or repair in accordance with manufacturer's recommendations.

G. Inspection

1. All ductile iron pipe and fitting linings shall be checked for thickness using a magnetic film thickness gauge. The thickness testing shall he done using the method outlined in SSPC-PA-2 Film Thickness Rating.

2. The interior lining of all pipe and fittings shall be tested for pinholes with a nondestructive 2,500 volt test. Any defects found shall be repaired prior to shipment.

3. Each pipe joint and fitting shall be marked with the date of application of the lining system along with its numerical sequence of application on that date and records maintained by the applicator of his work.

H. The pipe or fitting manufacturer must supply a certificate attesting to the fact that the applicator met the requirements of this specification, and that the material used was as specified.

I. Protecto 401 lined pipe and fittings must be handled only from the outside of the pipe and fittings. No forks, chains, straps, hooks, etc. shall be placed inside the pipe and fittings for lifting, positioning, or laying. The pipe shall not be dropped or unloaded by rolling.

J. Procedures for sealing cut ends and repairing field damaged areas of Protecto 401 lined pipe and fittings:

1. Remove burrs caused by field cutting of ends or handling damage and smooth out the edge of the lining if rough.

2. Remove all traces of oil, grease, asphalt, dust, dirt, etc.

3. Remove any damaged lining caused by field cutting operations or handling and clean any exposed metal by sanding or scraping. Sandblasting or power tool cleaning roughening is also acceptable. It is recommended that any loose lining be removed by chiseling, cutting, or scraping into well adhered lined area before patching. Be sure to overlap at least 1 inch of lining in the area to be repaired.

4. With the area to be sealed or repaired absolutely clean and suitably roughened, apply a coat of Protecto Joint Compound using the following procedure:

a. Mixing Procedure—The repair kit for Protecto 401 contains two small cans of Protecto Joint Compound. Protecto Joint Compound is a two-component epoxy and the contents of the small container shall be mixed with the contents of the large container. If less than the full contents of each can is to be mixed, the material may be mixed using the mixing ratio printed on the labels. After Part B is added to Part A, the mixture shall be thoroughly agitated. All activated material must be used within one hour of mixing.

b. Application of Material—After the material has been thoroughly mixed, it can be applied to the prepared surface by brush. Brushing is usually best due to the fact that the areas to be repaired are usually small. Practices conducive to a good coating are contained in the technical data sheet for Protecto Joint Compound and should be followed.

5. It is important to coat the entire freshly cut exposed metal surface of the cut pipe end. To ensure proper sealing, overlap at least 1 inch of the lining with this repair material.

3.08 POLYETHYLENE ENCASEMENT

A. Polyethylene encasement shall be installed in accordance with Section 011005000.

3.09 MECHANICAL JOINT CONNECTIONS

A. Mechanical joint connections shall be installed in accordance with Section 011005000.

3.10 COUPLINGS FOR DUCTILE-IRON PIPE

A. Mechanical type flexible couplings shall be installed where shown on the Plans and in accordance with Section 011005000.

3.11 CONCRETE

A. Concrete thrust and anchor blocks shall be installed in accordance with Section 03300 and the Standard Drawings. Prior to filling the pipeline with water, refer to Section 03300 for the minimum concrete curing time required.

3.12 TRACER WIRE

A. Tracer wire shall be installed in accordance with Section 011005000.

3.13 WARNING/IDENTIFICATION TAPE

A. Warning/identification tape shall be installed in accordance with Section

011005000.

3.14 HYDROSTATIC TESTING

A. Field hydrostatic testing shall be performed in accordance with Section 011005044.

END OF SECTION

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SECTION 011005076 CEMENT-MORTAR LINED AND COATED STEEL PIPE

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section describes materials, fabrication, installation, and testing of cement mortar-lined and coated steel pipe, in accordance with the applicable requirements of AWWA C200, C205, C206, C207, C208, C210, C222, M11, and in accordance with City Standards.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 02223, Trenching, Backfilling, and Compacting

B. Section 09900, Painting and Coating

C. Section 011005000, General Piping Requirements and Appurtenances

D. Section 011005044, Hydrostatic Pressure Testing of Pressure Pipelines

1.03 SUBMITTALS

Submit the following in accordance with Section 01300 and additional requirements specified herein:

A. Manufacturers' literature in accordance with the Supplementary Conditions and additional requirements specified herein:

1. Spigot and bell protective coating.

2. Thread lubricant for bolts and nuts.

3. Welding rods for field welding.

B. Manufacturers' certificates of compliance with prescribed industry standards(i.e. AWWA C200, C205, and C208, ASTM C150, etc.).

C. Detail drawings of:

1. Steel Pipe

2. Fittings

3. Joints

4. Butt Straps

5. Bulkheads and means of attachment to pipe

6. Outlets to be attached to the pipe

D. Mill test reports covering the physical and chemical properties of the steel furnished. One complete chemical analysis shall be furnished for each heat from which steel is rolled.

E. Layout profile drawings showing:

1. The location, length, plate thickness, location of welded seams, and designation by number of each steel pipe section and fabrication to be furnished and installed.

2. The pipe invert station and elevation at all changes in gradient or horizontal alignment.

3. The station and invert elevation to which the spigot end of each pipe, within the limits of horizontal or vertical curve, will be laid.

4. The elements of curves and bends, both in horizontal and vertical alignment, including elements of the resultant true angular deflections in cases of combined curvature.

5. The limits of each reach of double-welded lap joint.

6. The limits of encasement in jacked casing.

7. Details and locations of bulkheads for hydrostatic testing of pipeline.

8. Order of installation and locations of closures for length adjustment and for construction convenience.

9. Notes of points of access for placement of mortar lining and removal of test bulkheads.

10. Locations of manholes and other points of access.

11. Locations of valves and other mechanical equipment.

12. Paint type and thickness where joints and other cement-mortar holdbacks occur.

13. Call out types and sizes, and dimensions of grooved-end collars, flanges, reinforcing collars, wrapper plates, and crotch plates.

14. Incorporate pothole information into the pipe layout drawings, showing the size, depth, and station of each utility potholed.

1.04 INSPECTION

A. The City reserves the right to inspect materials, production, or testing of pipe at the manufacturer's plant. City shall be notified at least 48 hours prior to commencement of the manufacture of pipe.

1.05 QUALITY ASSURANCE

A. All pipe provided by the manufacturer shall be certified as new pipe.

B. Manufacturer's qualifications: The Contractor shall provide products from a manufacturer experienced in design and manufacture of pipe materials for the purpose required, and who has at least five (5) years of experience in the manufacture of like products. The manufacturer of the steel cylinder shall be responsible for all requirements of these specifications. Manufacturers must be pre-approved by the City prior to submission of bids. The manufacturers pre- approved are Ameron, Northwest Pipe Company, and Rosco Moss.

PART 2 - MATERIALS

2.01 STEEL PLATE

A. Steel shall be ASTM A 36, ASTM A 283 Grade C or D, ASTM A 1011 Grade 30, 33 or 36, having a 0.25% maximum carbon content. Pipe materials shall conform to the requirements of the "AWWA Standard for Steel Water Pipe 6 Inches and Larger" (AWWA C200).

2.02 PIPE

A. Steel pipe shall conform to AWWA C200 and be manufactured using the spiral weld process. Steel plate used in the manufacture and fabrication of steel pipe shall meet the requirements of AWWA C200. All longitudinal and girth seams, whether straight or spiral, shall be butt-welded using an approved electric-fusion- weld process. The nominal diameter shown on the Drawings shall be considered to be the inside diameter after lining, within allowable tolerances accepted in the submittals. The steel cylinder OD shall be rounded to increments of 0.125", and shall be the same OD for all pressure classes of a given nominal diameter.

B. Pipe shall be designed per the working pressure as shown the project drawings, plus a surge allowance of 60-psi. Pipe design shall be in accordance with AWWA M11 with the following exceptions:

1. Steel cylinder thickness shall be minimum 10 gauge (0.1345-inches) thick for pipe with diameters less than 30-inches. Pipe 30-inches in diameter and greater shall have a minimum wall thickness of 7 gauge (0.1793- inches).

2. The minimum wall thickness shall be 7 gauge (0.1793-inches) for all pipe, regardless of size and pressure rating, inside or within 10 feet of structures, vaults and other significant pipe appurtenances (such as blow- offs,

manways, PRV vaults, valve vaults, meter vaults, pump station, etc.); under building slabs; wherever the pipe is to be installed or jacked inside pipe casings; and wherever pipe penetrations are required.

C. Pipe shall be bedded and backfilled per the Standard Drawings for Construction.

D. Pipe is to be furnished in maximum 48-foot net laying lengths with shorter lengths, field trim pieces, and closure pieces as required by the Drawings for the location of elbows, tees, in-line valves, access points or as required for construction. The pipe fabricator shall prepare a pipe laying schedule showing the location of each piece by mark number with station and invert elevation at each bell end.

2.03 FITTINGS

A. Definition: A fitting shall be defined as a piece of pipe other than a straight length of pipe. Elbows, manhole sections, reducers, and sections of pipe with outlets shall be considered fittings.

B. Fittings shall comply with AWWA C208 for working pressures and dimension conformance. Pipe material shall be of the same material and pressure class as the adjoining pipe as shown on the Drawings. The minimum radius of elbows shall be 2 ½ times the pipe diameter and the maximum miter angle on each section of the elbow shall not exceed 11 ¼-degrees. If elbow radius is less than 2 ½ times the pipe diameter, stresses shall be checked per AWWA M11 and the pressure class increased if necessary.

C. Materials: Material for fittings shall be the same as the pipe. Cement-mortar lining and I.D. dimensions shall be the same as the specified pipe.

D. Allowable Stresses: Allowable circumferential stress at the design internal pressure shall not be greater than 40% of minimum yield stress. Minimum wall thickness of steel fitting shall be the same as the pipe of same size per ANSI B36.10.

E. Welded Fittings: Welded fittings shall meet the requirements of AWWA C208, Standard for Dimensions for Fabricated Steel Water Pipe Fittings and AWWA C200, Manufacturing Requirements for Standard Steel Pipe and Fittings, or approved equal.

2.04 FLANGES

A. Where the design pressure is 150 psi or less, flanges shall conform to AWWA C207, Class D.

Where the design pressure is greater than 150 psi up to a maximum of 275 psi, flanges shall conform to AWWA C207 Class

E.

AWWA flanges shall not be exposed to test pressures greater than 125 percent of rated capacity. For higher test pressures, the next higher rated AWWA flange shall be selected.

B. Shop lining and coating shall be continuous to the end of the pipe or back of the flange. Flange faces shall be shop coated with a soluble rust preventive compound. Blind flanges shall be fusion epoxy lined and coated.

2.05 GASKETS FOR FLANGED JOINTS

A. Gaskets shall meet the requirements set forth in Section 011005000, General Piping Requirements and Appurtenances.

2.06 FLANGE INSULATION KITS

A. Flange insulation kits shall meet the requirements set forth in Section 011005000, General Piping Requirements and Appurtenances.

2.07 OUTLETS

A. Outlets up to 3-1/2-inches shall be “Threadolet” type per AWWA Manual M-11, Figure 13.26. Outlets shall be 3,000-pound WOG forged steel per ASTM A 105 or ASTM A 216, Grade WCB. Threads shall comply with ANSI B2.1. Outlets shall be Bonney Forge Co. “Thredolet”, Allied Piping Products Co. “Branchlet,” or approved equal. Outlets greater than 3-1/2-inches shall be flanged outlets.

2.08 LENGTH OF PIPE SECTIONS

A. Pipe sections shall be limited to 48 feet or less. For sections longer than 30 feet, spreader beams and lifting straps shall be used to lift pipe sections at the third points.

2.09 SHOP JOINTS

A. All shop joints shall be double butt welded.

B. When plate flanges are made from butt-welded segments, the joints between segments shall not be placed adjacent to longitudinal joints in adjoining steel plate sections. Flanges made from butt-welded segments shall be stress relieved.

2.10 FIELD JOINTS

A. Where called for in the plans or needed for thrust restraint, joints shall be either full-thickness fillet-welded lap joints, or tied rubber gasket joints. Where thrust restraint is not required, joints shall be

either full-thickness fillet-welded lap joints, or rubber gasket joints bonded as shown in the Plans or Standard Drawings.

B. Butt-strap joints shall be used for field closures.

2.11 PRODUCT MARKING

A. Each length of straight pipe and each special shall be plainly marked at the bell end and on the cement mortar lining on the bell end to identify the design pressure or head, the steel wall thickness, the date of manufacture, and the proper location of the pipe item by reference to the layout schedule. For beveled pipe, the degree of bevel and the point on the circumference to be laid uppermost shall be shown.

2.12 PAINTING AND COATING

A. Above Grade Piping: Cement mortar coating shall not be applied on all above grade piping. Said piping shall be shop primed and painted in accordance with Section 09900.

B. General: Unless noted otherwise, buried pipe shall be cement-mortar coated per AWWA C205.

C. Grooved-End Couplings: Grooved-end couplings shall be coated the same as the adjacent pipe.

2.13 LINING

A. Above Grade Piping: Cement mortar lining shall not be applied on all above grade piping. Said piping shall be shop primed and painted in accordance with Section 09900.

B. Buried Piping: unless otherwise noted, interior surfaces of pipe and fittings shall be cleaned and lined in the shop with cement-mortar lining applied centrifugally in conformance per AWWA C205.

C. The pipe ends shall be left bare where field welded joints occur as shown on the Project Drawings. Ends of the linings shall be left square and uniform. Feathered or uneven edges will not be permitted. Defective linings as identified in AWWA C205 shall be removed from the pipe wall and shall be replaced to the full thickness required. Defective linings shall be cut back to a square shoulder in order to avoid feather edged joints.

D. Fittings shall be cement-mortar lined per AWWA C205. Pipe and fittings too small to cement-mortar line may be lined with AWWA C210 epoxy or AWWA C222 polyurethane.

E. Cement-mortar lining shall be kept moist during storage and shipping. The Contractor shall provide a polyethylene or other

suitable bulkhead on the ends of the pipe and on all special openings to prevent drying out the lining. All bulkheads shall be substantial enough to remain intact during shipping and storage until the pipe is installed.

2.14 CEMENT

A. Cement for cement-mortar lining shall be ASTM C 150, Type II or V. Cement for cement-mortar coating shall be ASTM C 150, Type V.

2.15 OUTLETS, AND PASS HOLES

A. Location

Outlet sleeves shall be vertical if on top of the pipe and normal to the pipe in other locations, unless otherwise shown on the Drawings. Outlets shall be installed at the stations shown, and the Contractor shall install closures where required to conform to the designated locations subject to the following provision:

Except where detailed on the Drawings, no outlet shall be installed with its centerline less than 3 feet from the end of a section of steel pipe, and the stations of the manholes may be shifted to provide the 3-foot-minimum distance so long as the Contractor confirms that there will be no interference with existing pipes, conduits, or other structures resulting from the deviation from the specified locations.

B. Pass Holes for Convenience

1. The Contractor may provide, at his own expense, additional flanged outlets in the steel pipe for use in passing hose, lead wires, equipment, or materials into the pipe. Such additional outlets shall conform to the specifications for manholes and outlets including collars, saddles, or pads welded securely to the pipe.

2. The Contractor also may provide, at his own expense, forged steel threaded outlets for use in passing hose or lead wires into the pipe. The outlets shall be tapped with standard pipe thread, be welded to the pipe, and closed after use with solid forged steel plugs. The plugs shall not project beyond the inner surface of the pipe shell. The pipe thread in the outlet shall be retapped to correct any distortion caused by welding, and a seal weld made by at least two passes shall be applied around the outside of the plug after it has been inserted in final position in the field.

3. All outlets, plugs, and closures shall be coated inside and outside to match the adjacent coated surfaces in the same manner as specified for outlets and as required at field joints in the pipe.

2.16 RUBBER GASKETS

A. Rubber gaskets for bell and spigot type joints shall conform to AWWA standards.

PART 3 - EXECUTION

3.01 GENERAL

A. Fittings:

1. Dimensions shall be per AWWA C208.

2. Allowable circumferential stress at the design internal pressure shall not exceed 40% of minimum yield stress.

3. Outlet reinforcement at branches and openings shall be determined by the procedure in ANSI B31.3, paragraph 304.3, and Appendix H. If reinforcement is required, it shall be accomplished as described below.

a. The type of reinforcement for fittings with outlets shall be selected from the following table:

R	**Type of Reinforcement**
Max. 0.5	Collar
Max. 0.7	Wrapper Plate
To 1.0	Crotch Plate

$$\text{Where } R = \frac{\text{I.D. Outlet}}{\text{I.D. main run} \times \sin B}$$

Where B = Angle between the longitudinal axis of the main run and the branch.

b. For collar reinforcement, select an effective shoulder width "W" of a collar from the inside surface of the steel outlet to the outside edge of the collar, measured on the surface of the cylinder of the main run, such that:

$$W = (1/3 \text{ to } 1/2) \times \frac{\text{I.D. outlet}}{\sin B}$$

The minimum thickness "T" of the collar is determined by:

$$T = \frac{P \times \text{I.D. main run} \times \text{I.D. outlet} \times (2 - \sin B)}{4 \times F \times W \times \sin B}$$

Where, P = Design internal pressure
F = Allowable design stress (40% of minimum yield stress)
B = Angle between the

longitudinal axis of the main run and the branch.

Collars may be oval in shape or rectangular with rounded corners.

a. For a wrapper plate, the above collar formula shall be used except that the wrapper is of thickness “T,” its total width is (2W + I.D. outlet/Sin B), and it wraps entirely around the main pipe.

b. Base crotch plate design on Swanson, H.S. et al., Design of Wye Branches for Steel Pipes, summarized in AWWA Manual M 11.

c. Long Radius Curves and Vertical Curves:

1) For curved alignment, straight or beveled pipe of normal or one-half normal lengths pulled partially open on one side of the joint may be used with a welded mitered bend of up to 10 degrees next to the joint ring. Pipes with a bend in excess of 10 shall be designed as fittings.

2) Joints shall not be pulled more than one-half of the watertight extensibility provided by the bell and spigot design.

3.02 FABRICATION

A. Pipe fabrication shall conform to the requirements of the “AWWA Standard for Steel Water Pipe 6 Inches and Larger” (AWWA C200).

B. Field welding shall be in accordance with “AWWA Standard for Field Weldingof Steel Water Pipe” (AWWA C206).

3.03 JOINT RING PROTECTIVE COATING

A. The exposed portion of joint rings shall be coated per Section 09900.

3.04 SHOP HYDROSTATIC TEST

A. The steel cylinder with joint rings shall be stressed to 75 percent of the minimum yield stress of the steel. Pipe shop testing shall conform to the requirements of the “AWWA Standard for Steel Water Pipe 6 Inches and Larger” (AWWAC200).

3.05 SHOP TESTING OF FITTINGS

A. Dye Penetrant Test: Seams in fittings that have not been previously shop hydrostatically tested shall be tested by the dye penetrant method as described in ASME Boiler and Pressure Vessel Code Section VIII, Appendix B.

B. Air-Soap Test: In addition to the dye penetrant method of testing, the air-soap method with air at 5 psi shall be used on joints susceptible to being tested by such a method.

C. Pressure Test in Lieu of Dye Penetrant Test: In lieu of the dye penetrant method of testing, completed fittings may be hydrostatically tested using the field hydrostatic test pressure or 125 percent of the design pressure, whichever is higher.

3.06 DELIVERY OF SMALL PARTS

A. Small parts, consisting of gaskets, bolts, nuts, washers, jumper rods, and flange insulation kits, shall be delivered to the job site in suitable containers, each marked to identify the contents.

3.07 INSTALLATION

A. Pipe shall be installed in accordance with the requirements of Section 011005000.

END OF SECTION

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SECTION 011005101 VALVES AND ACTUATORS

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. This section includes providing valves and valve actuators including epoxy coating, installing, adjusting, and testing of valves and where buried valves are indicated, valve boxes to grade, with covers, stem extensions, and position indicators.

B. Single Vendor: Where two or more valves of the same type or size are required, the valves shall all be produced by the same manufacturer.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01300 – Shop Drawing Submittals

B. Division: Mechanical

C. Division: Electrical

1.03 VALVE SCHEDULE (3-INCH AND LARGER)

Provide valves where called for on the Drawings and as specified herein.

1.04 SPECIFICATIONS AND STANDARDS

The current editions of the following standards apply to the work of this section:

A.	ANSI B16.1	Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800
B.	ANSI B16.5	Pipe Flanges and Flanged Fittings, Steel Nickel Alloy and Other Special Alloys
C.	ANSI/ASME B1.20.1	General Purpose Pipe Threads (Inch)
D.	ANSI/ASME B31.1	Power Piping
E.	ASTM A 36	Specification for Structural Steel
F.	ASTM A 48	Specification for Gray Iron Castings
G.	ASTM A 126	Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
H.	ASTM A 536	Specification for Ductile Iron Castings
I.	ASTM B 148	Specification for Aluminum-Bronze Castings
J.	ANSI/AWWA C500	Gate Valves for Water and Sewerage Systems

K.	ANSI/AWWA C502	Dry-Barrel Fire Hydrants
L.	ANSI/AWWA C504	Rubber Seated Butterfly Values
M.	ANSI/AWWA C506	Backflow Prevention Devices – Reduced Pressure and Double Check Valve Types
N.	AWWA C508	Swing-Check Valves for Waterworks Service, 2 inches through 24 Inches NPS
O.	ANSI/AWWA C509	Resilient-Seated Gate Valves for Water and Sewage Systems
P.	AWWA C550	Protective Interior Coatings for Valves and Hydrants

1.05 SUBMITTALS

The following shall be submitted in compliance with Section 01300:

A. Manufacturer's product data including catalog cuts.

B. Manufacturer's installation instructions.

C. Shop drawings showing the details and dimensions.

D. Manufacturer's certification that the products comply with the indicated requirements.

E. Schedule of valves indicating the valve identification and locations.

F. Manufacturer's certification that the epoxy coatings have been factory tested and comply with the indicated requirements.

PART 2 - MATERIALS

2.01 GENERAL

A. All valves shall be new and of current manufacture. All materials shall be suitable for the intended application. Materials not specified shall be high-grade standard commercial quality, free from defects and imperfections that may affect the serviceability of the product for the purpose for which it is intended.

B. Where buried, valves shall be provided with valve boxes and valve extensions.

C. Where "stainless steel", "SS", or "SST" valve type is indicated on drawings, all metallic valve components in contact in the process shall be constructed of stainless steel (grade 316 unless noted otherwise) in lieu of the metallic materials specified herein.

D. Valve Operators: Where indicated, valves shall include electric operators recommended by the manufacturer. Operators of the same type shall be furnished by the same manufacturer. Valve operators,

regardless of type, shall be installed, adjusted, and tested by the valve manufacturer at the manufacturing plant.

E. Nuts and Bolts: Nuts and bolts on valve flanges, bodies and supports shall comply with the following, where applicable:

1. The nuts shall be capable of developing the full strength of the bolts. Threads shall be coarse thread series conforming to the requirements of the American Standard for Screw Heads. Bolts and caps screws shall have hexagon heads and nuts shall be heavy hexagon series.

2. The length of the bolts shall be such that after joints are made up, each bolt shall extend through the entire nut, but in no case by more than ½-inch beyond the nut.

3. Nuts and bolts shall be Type 316 stainless steel unless otherwise indicated.

F. Valve Labeling: Except as otherwise indicated, a label shall be provided on all valves exclusive of hose bibbs. The label shall be 1/16-inch plastic or stainless steel, a minimum of 2 inches by 4 inches in size, and shall be permanently attached to the valve. All valve bodies shall be permanently marked in accordance with MSS SP25 - Standard Marking Systems for Valve, Fittings, Flanges, and Unions.

G. Protective Coatings

1. Ferrous valves shall be fusion epoxy coated in accordance with Section 09900.

2. Where, in the Owner's opinion, because of the nature of the item being coated it would be impossible to use the fusion-bonded powder epoxy method without causing damage to the item, the use of a liquid epoxy, factory applied by the manufacturer of the item being coated, will be permitted. Said liquid epoxy shall be 3-M Company epoxy primer and "Scotchkote" 312 or 134, or DeVoe Coating Co., Devran 184, or equal as approved by the Owner.

3. Application of the coating shall be in accordance with the manufacturer's instructions, provided that, if liquid epoxy is permitted, it shall be applied in not less than three spray coats to give the required total thickness.

H. Accessories: All valves shall be furnished complete with the accessories required to provide a functional system.

I. All check valves regardless of the location, size, or type shall be placed in the horizontal position or vertical up position. If a check valve is to be placed on the discharge of the pump, the check valve

shall be placed near the discharge of the pump prior to any appurtenances except an air valve, pressure switch, and/or pressure transmitter.

J. Manufacturers: All valve manufacturers shall have a successful record of not less than 5 years in the manufacture of the valves provided.

2.02 BALL VALVES - PLASTIC BODY TYPE

A. Manufacturer: One of the following or equal:

1. Spears
2. Asahi America
3. Chemtrol Division, NIBCO Inc.

B. General:

1. Type: Non-lubricated and capable of sealing in either direction of flow.

2. End connection: True union.

3. Operator handle: Lever.

C. Materials:

1. Body: Polyvinyl chloride (PVC)

2. Ball: Polyvinyl chloride (PVC)

3. Seats: TFE (Teflon)

2.03 BALL VALVES – METAL TYPE

A. General: Unless otherwise indicated, general-purpose metal ball valves in diameters 3-inches and smaller than shall have manual lever operators s. Ferrous surfaces of the valves where contact with water is indicated shall be coated conforming to Section 09900: Painting and Coating.

B. Body: All ball valves up to 1 1/2-inch diameter (inclusive) shall have bronze two or three piece bodies with threaded ends for a pressure rating of not less than 600-psi WOG. Valves 2-inches to 3-inches in diameter shall have bronze two or three piece bodies with flanged ends for a pressure rating of ANSI 125 psi or 150 psi unless otherwise indicated.

C. Balls: The balls shall be solid chrome plated brass or bronze, or Type 316 stainless steel, with full port openings.

D. Stems: The valve stems shall be of the blowout proof design, of bronze, Type 316 stainless steel, or other acceptable construction, with reinforced Teflon seal.

E. Seats: The valve seats shall be of Teflon or Buna-N, for bi-directional service and easy replacement.

F. Manufacturers, or Equal:

1. Jamesbury Corporation

2. Jenkins Bros.

3. William Powell Company

2.04 Worcester Controls

2.05 CHECK VALVES – PLASTIC BALL TYPE

A. Valves:

1. Ball type.

2. Polyvinyl Chloride (PVC).

3. Double union-type end connections.

4. Seals: Viton.

B. Manufacturers: One of the following or equal:

1. Spears

2. Chemtrol Division of Celanese Piping Systems, Inc.

3. R.G. Sloane Company, Inc.

2.06 CHECK VALVES – RUBBER FLAPPER SWING CHECK VALVES

A. Service: Stormwater

B. Style: Rubber Flapper Swing Check, Flanged-End Connections

C. Closure Control: Oil Controlled Side Mounted Cylinder

1. Manufacturer's representative shall provide onsite adjustment of closing speeds with consideration to transient conditions.

D. Body: Valve body and cover shall be fabricated with ductile iron conforming to ASTM A 536 with flanged ends conforming to ANSI B16.1.

E. Flapper: The valve disc shall be fabricated of NBR.

F. Coatings and Linings:

1. Liquid epoxy, 12 mil minimum, for valve interior and exterior.

G. Manufacturer:

1. Dezurik APCO CRF 100

2. Or equal.

2.07 CHECK VALVES – DUAL DISC SPRING LOADED CHECK VALVES

A. Service: Stormwater

B. Style: Dual Disc Spring Loaded, Wafer

C. Discs: The valve disc shall be fabricated of 316 stainless steel ASTM A240.

D. Wing Support: The valve wing support shall be fabricated from 316 Stainless Steel ASTM A276.

E. Spring: the spring shall be fabricated of 316 stainless steel.

F. Elastomer seal: the seal shall be Buna N.

G. All fasteners and spring pins shall be 316 stainless steel.

H. Coatings and Linings:

1. Liquid epoxy, 12 mil minimum, for valve interior and exterior.

I. Manufacturer:

1. US Valve

2. Dezurik

3. Or equal.

2.08 CHECK VALVE - BRONZE IN-LINE 2” AND SMALLER

A. Service: Water, Air

B. Features:

C. Materials:

1. Body: Cast Bronze C84400

2. Retainer: ASTM B16 Brass

3. Spring: AISI 316 Stainless Steel

4. Ball: RPTFE, 15% Glass Filled

5. Stem: ASTM B16 Brass

D. Connections: Threaded

E. 200 psi minimum pressure rating

F. 5 psi cracking pressure

G. Manufacturers and Products:

1. Apollo, 61 series

2. Or Equal

2.09 GATE VALVES

A. Buried gate valves shall be of the inside screw type and shall be designed for repacking under line pressure. All valves shall have vertically opening gates.

B. Gate valves shall be resilient-seated gate valves conforming to ANSI/AWWA C509. Valves shall be gray or ductile iron conforming to ASTM A 126 or A 395. The minimum design working pressure shall be 200 psi for 3-inch through 12-inch valves and 150 psi for 16-inch through 20-inch valves. Resilient-seated gate valves shall have cast or ductile iron bodies with flanged, bell, or mechanical joint ends as shown on the drawings or in accordance with the Owner's standards. Valves shall have rubber-coated cast iron disc, flanged bonnet, bronze stem, O-ring seals, and operators with handwheel or square nut except as otherwise indicated. Opening direction shall be counterclockwise. Interior and exterior of valves shall be fusion- bonded epoxy coated.

C. Manufacturers

Resilient-seated gate valves shall be manufactured by one of the following (or equal):

1. U.S. Pipe Metroseal

2. Mueller Company

3. American Flow Control

4. Clow Corporation

2.10 PLUG VALVES – ECCENTRIC TYPE

A. GENERAL

1. Valves shall be of the non-lubricated eccentric type with ASTM A126 Class B Cast Iron body and bonnet; Buna-N resilient faced plug; Type 316 sintered Stainless Steel body and bonnet bearings; PTFE thrust bearing; and Buna-N V-type packing. Valve ends shall be flanged in accordance with ANSI

B16.1/B16.5 Class 125/150. Valves shall be epoxy-coated in the water passages.

2. Valves shall be operated by lever or gear operator unless otherwise shown. Valves 6-inch and larger shall be equipped with handwheel gear operators, lubricated and sealed to prevent entry of dirt and water into the operator. All shaft bearings shall be furnished with permanently lubricated bearing surfaces. The operator shall clearly indicate valve position.

3. Valves for sewage or solids service shall be installed with the seat end toward the pump. Valve bodies shall be rotated so that stem is on a horizontal axis with the valve plug opening up and out of the flow path. Handwheel gear operator shall be oriented so that handwheel faces upward.

4. All valves shall be new and of current manufacture. The Contractor shall furnish and install each specific type of valve from a single manufacturer and use it throughout the work. Valves shall be furnished in the sizes and in accordance with the type of ends as shown on the Plans and as herein specified.

5. Valves shall be provided with stem extension if depth of valve nut exceeds 5 feet.

6. The manufacturer shall have manufactured tight-closing valves of the valve type intended for use for a period of at least 5 years.

7. All valves shall have a rated minimum working pressure of at least 175 psi and shall be of appropriate pressure class for the pipe connecting to them. All valves shall be certified to meet the test pressure as specified and shall have a rated working pressure that exceeds the full working pressure specified.

8. Connections: Valves shall have connector ends in compliance with the Standard Design Requirements and as shown on the Plans. Where not indicated, the valves shall have the same type of connection as the pipeline in which valves are to be installed and conform to the Specifications.

9. Bolts, nuts and washers shall be furnished in accordance with Section 011005000.

10. Polyethylene encasement shall be in accordance with Section 011005000.

11. Painting and Coating: All valves referenced in this section shall be painted and coated, interior and exterior, in accordance with Section 09900, Painting and Coating.

B. Plug Valves, 8-inches and Smaller

1. Plug valves shall conform to AWWA C517-05. Valves shall be eccentric plug valves with full port (100% port) openings. Valves shall be fully rated bi- directional, drip tight to pressures up to 175-psi bi-directional.

2. Plug valves shall be constructed of the following materials:

Description	**Material**
Body	Cast Iron, ASTM A126, Class B
Plug	Ductile Iron, ASTM A536
Resilient Plug Facing	Chloroprene
Grit Excluder	PTFE
O-Rings	Non-asbestos filler in Styrene-Butadiene Rubber Binder
Bonnet	Cast Iron, ASTM A126, Class B
Bonnet Bearing	316L Stainless Steel
Packing	NBR Acrylonitrile-Butadiene, V-type
Screws/Bolts/Nuts/Bearings/Studs	Stainless Steel

C. Coatings and Linings:

1. Liquid epoxy, 12 mil minimum, for valve interior and exterior.

D. Valve Operators

1. For buried locations, 4-inch and 6-inch valves shall have high head extensions. Extend extensions to the valve box and provide 6 inches of clearance between the valve box lid and the injector assembly.

2. For buried locations valves 8 inches and larger shall have watertight gear housings, 2-inch AWWA operating nut, sealant extension pipe, and sealant injector assembly. Extend the sealant extension pipe to the valve box and bring the sealant injector assembly to a point 4 inches below the surface of the lid.

3. Valves 8-inches and smaller, located above ground or in vaults and structures shall have lever operators.

E. Manufacturers: Valves and operators shall be as manufactured by Homestead Industries, DeZurik Corporation, or approved equal.

2.10 PRESSURE REGULATING VALVES

A. Pressure Regulating Valves (2 Inches and Smaller)

General: Small air and water pressure regulating valves shall be of the spring- loaded diaphragm type with a minimum pressure rating of 250

psi, with bronze body, nickel alloy or stainless steel seat, and threaded ends. Each valve shall be furnished with a built-in or separate Type 316 stainless steel strainer and union ends.

B. Manufacturers

Products shall be manufactured by one of the following (or equal):

1. Small pressure regulating valves:

a. Watts Regulator Company

b. Wilkins Regulator

2.11 SOLENOID VALVE - NORMALLY CLOSED 1-1/4 INCHES AND SMALLER

A. Service: Air. Water

B. Features:

1. Two-way internal pilot operated diaphragm type electrically actuated solenoid valve

2. CLOSED when de energized.

3. Brass body

4. Resilient seat suitable for air or water

5. Solenoid coil molded epoxy

6. Solenoid enclosure NEMA 250, Type 4

7. Electrical: NEMA Class A, 120 volts ac, 60 Hz

8. Minimum operating pressure differential no greater than 0 psig, maximum operating pressure differential not less than 350 psig.

C. Manufacturers:

1. ASCO.

2. Or equal.

2.12 MISCELLANEOUS VALVES

A. Corporation Stops

Unless otherwise indicated, corporation stops shall be made of materials suitable for the chemicals being handled or injected, and shall have screwed ends with corporation thread or pipe thread, as required.

B. Manufacturers

Products shall be manufactured by one of the following (or equal):

1. Backflow preventer valves
    a. Fence
    b. Mueller
    c. American Flow Control
    d. Watts
2. Corporation stops
    a. AY McDonald
    b. James Jones
    c. Mueller Company (Grinnel Corporation)

2.13 VALVE OPERATORS

A. Manual Operators

1. General: Unless otherwise indicated, all valves and gates shall be furnished with manual operators. Valves in sizes up to and including 3-½ inches shall have direct acting lever or handwheel operators of the manufacturer's best standard design. Larger valves and gates shall have gear-assisted manual operators, with an operating pull of maximum 60 pounds on the rim of the handwheel. All buried and submerged gear-assisted valves, all gates, all gear-assisted valves for pressures higher than 250 psi, all valves 30 inches in diameter and larger, and where so indicated, shall have worm-gear operators, hermetically sealed and grease-packed, where buried or submerged. All other valves 4 inches to 24 inches in diameter may have traveling-nut operators, or worm-gear operators as indicated.

2. Buried Valves: Unless otherwise indicated, all buried valves shall have extension stems to grade, with wrench nuts located within 6 inches of the valve box cover, position indicators, and cast-iron or steel pipe extensions with heavy valve boxes with stay-put, hot-dip galvanized covers, and operating keys. Where so indicated, buried valves shall be in cast-iron, concrete, or similar valve boxes with covers of ample size to allow operation of the valve operators. Covers of valve boxes shall be permanently labeled in accordance with the Owner’s standards. All nuts and bolts shall be Type 316 stainless steel.

3. Manual Worm-Gear Operator: The operator shall consist of a single or double reduction gear unit contained in a weather-proof cast-iron or steel body with cover and a minimum of 12-inch

diameter handwheel. The operator shall be capable of 90-degree rotation and shall be equipped with travel stops capable of limiting the valve opening and closing. The operator 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 17-4 PH or similar stainless steel. All gearing shall be accurately cut with hobbing machines. Ball or roller bearings shall be used throughout. Operator output gear changes shall be mechanically possible by simply changing the exposed or helical gearset ratio without further disassembly of the operator. All gearing shall be designed for a 100 percent overload. All nuts and bolts shall be Type 316 stainless steel.

PART 3 - EXECUTION

3.01 VALVE INSTALLATION

A. General: Valves, operating units, stem extensions, valve boxes, and accessories shall be installed in accordance with the manufacturer's installation instructions. Valves shall be independently supported to prevent stresses on the pipe. Valves shall be hydrostatically tested at a minimum of 1.5 times the rated working pressure, in accordance with Section 011005044.

B. Coating Inspection: Coating thickness shall be checked with a nondestructive magnetic type thickness gauge. Coating integrity shall be tested in accordance with AWWA C550-90 Subsection 5.3.3. All pinholes shall be marked, repaired and retested. No pinholes or other irregularities will be permitted in the final coating. If small local repairs are necessary, they shall be made using a liquid epoxy recommended by the manufacturer of the epoxy with which the item was initially coated. The surface must first be hand tool cleaned in accordance with SSPC-SP-2 (Hand Tool Cleaning). The repair epoxy material shall be applied in accordance with the manufacturer's instructions.

C. Access: Valves shall be installed to provide easy access for operation, removal, and maintenance and to prevent interferences between the valve operators and structural members or handrails.

D. Valve Accessories: Where combinations of valves, sensors, switches, and controls are indicated, the combinations shall be properly assembled and installed to ensure that the systems are compatible and operating properly.

E. Cleaning:

1. Flanges shall be cleaned by wire brushing before installing flanged valves. Flange bolts and nuts shall be cleaned by wire brushing, and threads lubricated with oil and graphite. Nuts shall be tightened uniformly and progressively. If flanges leak under pressure testing, nuts and bolts shall be loosened or

removed, the gasket reseated or replaced, the bolts and nuts reinstalled or retightened, and joints retested. Joints shall be watertight.

2. Threaded joints shall be cleaned by wire brushing or swabbing. Teflon joint compound or Teflon tape shall be applied to pipe threads before installing threaded valves. Joints shall be watertight.

F. VALVE PRESSURE TESTING

1. All valves, 4 inches in diameter and larger, shall be individually pressure tested upon arrival at the construction site in accordance with City Standards. The Contractor shall procure the services of sales representative for the valve or an independent contractor who has the proper equipment to pressure test the valves. The pressure test shall be adjusted to the type and class of valve being tested. The factory certification information shall be available at the site to compare to the test results. Any valve that exhibits leaking during the test procedure shall be rejected and replaced at no additional cost to the City.

2. After field pressure test of individual valves, valves shall be tested again along with the connecting pipelines and in accordance with Section 011005044, Hydrostatic Testing of Pressure Pipelines. Any parts of valves, operators, or control and instrumentation systems whose pressure rating is less than the test pressure shall be isolated and protected.

3.02 MANUFACTURER'S CUSTOMER SERVICE

A. The manufacturer's authorized representative shall be available for customer service during installation and start-up, and to train personnel in the operation, maintenance and troubleshooting of the valve.

B. The manufacturer shall also make customer service available directly from the factory in addition to authorized representatives for assistance during installation and start-up, and to train personnel in the operation, maintenance and troubleshooting of the valve.

END OF SECTION

SECTION 011005310 PVC PRESSURE PIPE, SOLVENT-WELDED

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. The Contractor shall provide polyvinyl chloride (PVC) pressure pipe, complete and in place, in accordance with the Contract Documents.

B. The requirements of Section 011005000, Piping, General, apply to the work of this section.

C. See Section 011005051 Installation of Pressure Pipes for more information.

D. This section specifies PVC pressure pipe with solvent-welded, flanged, or screwed joints.

1.02 SUBMITTALS

A. The Contractor shall provide to scale isometric pipe layout drawings on all chemical piping within or under the building. Product data sheets on all piping, fittings, gaskets, and solvent shall be provided.

B. See requirements in Section 01300.

PART 2 - PRODUCTS

2.01 PIPE MATERIAL

A. PVC pipe shall be made from all new rigid unplasticized polyvinyl chloride and shall be normal impact class 12454-B, Schedule 80, unless otherwise indicated, in accordance with ASTM D 1785 Specification for Poly Vinyl Chloride (PVC) Plastic Pipe, Schedules 40, 80, and 120.

2.02 PIPE JOINTS

A. Pipe joints shall be solvent-welded with solvent cement in accordance with ASTM D 2564 - Specification for Solvent Cements for Poly Vinyl Chloride (PVC) Plastic Piping Systems, and with primer in accordance with ASTM F 656 - Specification for Primers for use in Solvent Cement Joints of Poly Vinyl Chloride (PVC) Plastic Pipe and Fittings. Screwed joints that are necessary to match up to threaded valves or fittings shall be made up with Teflon tape only. Flanged joints shall be made with solvent-welded PVC flanges, drilled to ANSI/ASME B 16.5 - Pipe Flanges and Flanged Fittings, Class 150, unless otherwise indicated. Gaskets shall be ANSI 150-pound full face, 1/8-inch thick neoprene. Primer and cements shall be suitable for use with the chemicals proposed. Proof of suitability

shall be provided from the manufacturer. Written verification from manufacturer shall be provided with submittals. Solvent cement and primer shall be NSF listed.

2.03 FITTINGS

A. Solvent Welded Fittings: Solvent-welded fittings shall be Schedule 80 PVC fittings in accordance with ASTM D 2467 - Specification for Socket-Type Poly Vinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 80.

B. Threaded Fittings: Threaded fittings shall be Schedule 80 PVC fittings in accordance with ASTM D 2464 - Specification for Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.

C. Flanged Fittings: Flanged fittings shall be Schedule 80 fabricated PVC fittings with 150-pound flanged to ANSI/ASME B 16.5.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General: All PVC pipes shall be installed in a neat and workmanlike manner, properly aligned, and cut from measurements taken at the site to avoid interferences with structural members, architectural features, openings, and equipment. Exposed pipes shall afford maximum headroom and access to equipment, and where necessary all piping shall be installed with sufficient slopes for venting or drainage of liquids and condensate to low points. All installations shall be acceptable to the Engineer. The Contractor shall obtain the assistance of the pipe manufacturer's field representative to instruct the pipe fitters in the correct installation and support of all PVC piping. Written notification from the pipe manufacturer is required.

B. Supports and Anchors: All piping shall be firmly supported with fabricated or commercial hangers or supports in accordance with Section 011005301, Pipe Supports. Where necessary to avoid stress on equipment or structural members, the pipes shall be anchored or harnessed. Expansion joints and guides shall compensate for pipe expansion due to temperature differences.

C. Valves and Unions: Unless otherwise indicated, all connections to fixtures, groups of fixtures, and equipment shall be provided with a shutoff valve and union, unless the valve has flanged ends. Unions shall be provided at threaded valves, equipment, and other devices requiring occasional removal or disconnection.

D. Procedures outlined in ASTM D 2774 - Underground Installation of Thermoplastic Pressure Pipe. In addition, recommendations and guidelines within Harrington's Engineering Handbook, latest edition.

3.02 PIPE PREPARATION

A. Prior to installation, each pipe length shall be carefully inspected, flushed clean of any debris or dust, and be straightened, if not true. Ends of threaded pipes shall be reamed and filed smooth. All pipe fittings shall be equally cleaned before assembly.

3.03 PIPE JOINTS

A. Threaded Joints: Pipe threads shall conform to ANSI/ASME B1.20.1 - Pipe Threads, General Purpose (inch), and shall be full and cleanly cut with sharp dies. Not more than three threads shall remain exposed after installation. All joints shall be made with Teflon tape.

B. Solvent-Welded Joints: Solvent-welded joints shall be made with fresh primer and solvent cement on clean, dry pipe ends. The primer and cement cans shall be kept closed at all times and the joints shall be made up at the recommended ambient temperatures, to the pipe manufacturer's written recommendations. All pipe ends shall be inserted to the full depth of the socket.

C. Flange Joints: Flanged joints shall be made with gaskets and Type 316 stainless steel bolts and nuts. Care shall be taken not to over-torque the bolts.

3.04 INSPECTION AND FIELD TESTING

A. Inspection: All finished installations shall be carefully inspected for proper joints and sufficient supports, anchoring, interferences, and damage to pipe, fittings, and coating. Damage shall be repaired to the satisfaction of the Owner.

B. Field Testing: Prior to enclosure or burying, all piping systems shall be pressure tested for a period of not less than one hour, without exceeding the tolerances listed in the piping schedule. Where no pressures are indicated, the pipes shall be subject to 1-1/2 times the maximum working pressure. The Contractor shall furnish all test equipment, labor, materials, and devices at no extra cost to the Owner.

1. Leakage may be determined by loss of pressure, soap solution, chemical indicator, or other positive and accurate method. All fixtures, devices, or other accessories which are to be connected to the lines and which would be damaged if subjected to the test pressure shall be disconnected and ends of the branch lines shall be plugged or capped as required during the testing procedures.

2. Leaks shall be repaired to the satisfaction of the Owner,

and the system shall be re-tested until no leaks are found.

END OF SECTION

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DIVISION 07 – ELECTRICAL

SECTION 011006000 GENERAL ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. It is the intent of this section of the Specifications that the Contractor furnishes all labor, supervision, tools, equipment, and materials necessary for erecting complete and ready for continuous use, a tested and working electrical system, substantially as indicated on the Plans and hereinafter specified.

B. These Specifications are intended to provide a broad outline of the work and equipment required, but are not intended to include all the details of design and construction. The Owner reserves the right to make minor changes to the location of the equipment at no cost change in the contract.

C. The electrical plans are diagrammatic, approximately to scale. However, they shall not be used for exact locations. The Contractor shall verify all dimensions from the detailed drawings and approved shop drawings and shall coordinate these dimensions with the actual field conditions. Actual distances, locations, and elevations will be governed by field conditions.

D. Allowance has been made in the design for the number of conduits, cables and conductors that the Owner considers adequate for feeding various drives and equipment. These circuits and diagrams are based on available data pertaining to a particular design of equipment and portray the systems that the Owner has chosen to affect the required operation and level of control. Equipment provided by the Contractor (even though of the make and model specified) may differ in detail, arrangement, connections or form from that shown.

E. The plans do not, and are not intended to, show all equipment (including but not limited to pull boxes and junction boxes) required nor to indicate all mechanical or structural difficulties that may be encountered that would necessitate routing alteration, offsets, or fittings. Items not specifically mentioned in these Specifications or noted on the Plans or approved shop drawings, but which are obviously necessary to make a complete working installation, shall be deemed to be included herein.

F. Discrepancies shown on the different Plans, between the Plans and actual field conditions, or between the Plans and Specifications shall be promptly brought to the attention of the Owner for a decision.

G. All electrical equipment shall be capable of operating successfully at full-rated load, without failure, when the ambient temperature of the air is 40°C except where specified otherwise.

H. Electrical conductors including cable, bus bars, etc. shall be copper, except where specified otherwise.

I. Without limiting the generality of other requirements of these Specifications, arrange for the submittal, by the subcontractor, of a reproducible Mylar of the complete schematics and wiring diagrams or drawings to include all installed field and panel conduit and piping/tubing runs and routing, tray systems, supports, mounting details, point to point diagrams with a cable, wire, tube and termination numbers. Drawings shall be a record of work as actually constructed and shall be labeled as "Record Drawings."

1.02 SCOPE OF WORK

A. General: The Contractor shall provide all the materials and equipment, and perform all the work necessary for the complete execution of the electrical work as shown on the electrical plans and as specified, including electrical work indicated on other Plans that is specifically included in the electrical work. The Contractor shall provide all labor and materials not specifically shown on the Plans or specified herein, yet required to ensure proper and complete operation of any system(s) or design intent inherent in the project except as specifically excluded.

B. In general, the electrical work shall consist of, but not be limited to, the items listed as follows:

1. Motor control center

2. Manual transfer switch

3. Generator service receptacle

4. Panelboards

5. Transformers

6. All conduit, wiring and connections for work specified elsewhere in these Specifications and as shown on the Drawings.

1.03 CODES AND STANDARDS

A. All the equipment and materials shall conform to the latest revision of the following standards:

1. State of California Administrative Code, Title 8, Electrical Safety Orders

2. American National Standards Institute (ANSI)

3. Institute of Electrical and Electronic Engineers (IEEE)

4. National Electrical Manufacturers Association (NEMA)

5. Underwriters' Laboratories (UL)

6. Insulated Power Cable Engineers Association (IPCEA)

7. American Society for Testing and Materials (ASTM)

8. National Electrical Code (NEC)

9. California Building Code (CBC)

B. Responsibility for complying with all applicable government regulations shall be as required in the Special Conditions.

C. All electrical equipment and materials, and the design, construction, and installation thereof, shall comply with all applicable provisions of the Federal Occupational Safety and Health Act (OSHA), state building standards, and applicable local codes and regulations.

D. Where the Plans or these Specifications call for equipment and workmanship to be of better quality or higher standard than required by the above codes, standards, rules, and regulations, then said Plans and Specifications shall prevail. Nothing on the Plans or in these Specifications shall be construed to permit work in violation of the above codes, standards, rules, and regulations and the Contractor shall be held responsible for any work that is not acceptable.

E. In case of differences between the building codes, specifications, state law, local ordinances, industry standards, utility company regulations, fire insurance carrier's requirements, and the contract documents, the most stringent shall govern. The Contractor shall promptly notify the Owner in writing of such differences.

1.04 COORDINATION OF WORK AND TRADES

A. Electrical work shall conform to the construction schedule and progress of other trades. The electrical construction shall be performed in cooperation with all other trades so that a neat and orderly arrangement of the work as a whole shall be obtained.

B. Before any work is started, the Contractor shall verify with the equipment manufacturers that equipment dimensions and arrangements will allow for equipment installation in the spaces provided for on the Plans for switchboards, panelboards, motor control centers, transformers, and other major items of electrical

equipment or apparatus and that the installation indicated will provide for all required ventilation, clearances, access, and work space.

C. Before installing any equipment, materials, or raceways, the Contractor shall examine the complete set of Plans and Specifications and approved shop drawings and verify all dimensions and space requirements. All equipment utilized as "approved equal" to the specified manufacturers' reference shall be Contractor-coordinated in all aspects for the assurance of proper space, mounting, installation, testing and related operation.

1.05 COORDINATION OF THE ELECTRICAL SYSTEM

A. The Contractor shall verify all actual equipment and motor full-load and locked rotor current ratings. The necessary minimum equipment, wire, and conduit sizes are shown on the Plans. If the Contractor furnishes equipment of different ratings, the Contractor shall coordinate the actual current rating of equipment furnished with the branch circuit conductor size, the controller size, the motor starter, and the branch circuit over-current protection. The branch circuit conductors shall have a carrying capacity of not less than 125 percent of the actual full-load current rating. The size of the branch circuit conductors shall be such that the voltage drop from the overcurrent protection devices up to the equipment shall not be greater than 2 percent when the equipment is running at full load and rated voltage.

B. The motor running overcurrent protection devices shall be rated or selected to trip at no more than 125 percent of the motor full-load current rating for motors marked to have a temperature rise not over 40°C or motors marked with a service factor not less than 1.15, and at no more than 115 percent for all other types of motors.

C. The motor branch circuit overcurrent protection device shall trip open in 30 seconds or less on locked-rotor current of the motor. This device shall also protect the motor branch circuit conductors and the motor control apparatus against overcurrent due to short-circuits or grounds. The motor control circuits shall have overcurrent protection of the type indicated on the plans.

1.06 PERMITS AND INSPECTIONS

A. The Contractor shall obtain all permits and inspections and he shall pay all fees, therefore, as indicated in the Special Provisions. At the conclusion of the work on the project, the Contractor shall furnish to the Owner, properly executed, all required certificates of final inspection and approval before the work will be accepted as complete. The Owner will inspect the daily construction progress for conformance with the Plans and Specifications.

1.07 EQUIPMENT, MATERIALS AND WORKMANSHIP

A. It is the intent of these Specifications and of the Plans to secure high quality in all equipment and materials, and to require first-class workmanship, in order to facilitate trouble-free operation and minimum maintenance of the electrical system.

B. All equipment and materials shall be new, listed by UL, and bear the UL label, unless exception to this requirement is inherent to an individual item specified herein, or an exception is otherwise granted by the Owner.

C. Equipment and materials shall be the products of reputable, experienced manufacturers. Similar items in the project shall be the products of the same manufacturer. All equipment and materials shall be of industrial grade and standard of construction, shall be of sturdy design and manufacture, and shall be capable of long, reliable, trouble-free service.

D. All work, including installation, connection, calibration, testing and adjustment, shall be done by qualified, experienced personnel who are technically skilled in their trades, are thoroughly instructed, and are competently supervised. The resulting complete installation shall reflect professional quality work, employing industrial standards and methods.

1.08 SEISMIC REQUIREMENTS

The equipment and major components including the motor control center, generator receptacle assembly, and control panel shall be suitable for and certified by actual seismic testing to meet all applicable seismic requirements of the California Building Code (CBC). Guidelines for the installation consistent with these requirements shall be provided by the equipment manufacturer and based upon testing of representative equipment. Equipment certification acceptance criteria shall be based upon the ability for the equipment to be returned to service immediately after a seismic event within the above requirements without the need for repairs. Seismic anchorage calculations shall be submitted for each major component. These calculations shall be signed and stamped by a structural engineer registered in the State of California.

1.09 AREA DESIGNATIONS

For purposes of defining electrical enclosure and electrical installation requirements of this project, certain areas have been classified on the Plans and in these Specifications as defined below. Electrical equipment and installations within these areas shall conform to the code requirements for the areas involved.

A. General Purpose Locations

Electrical work installed in areas that are not specifically classified

shall be "general purpose." Workmanship, materials, and enclosures in these locations shall comply with the general requirements of this Specification.

In all areas, raceway shall be PVC coated rigid steel conduit; entrances shall be threaded; fittings shall have gasketed covers located at a low point to drain the fitting or conduit system. Threaded hardware shall be stainless steel. Mounting brackets shall be galvanized after fabrication. Instruments and control cabinets, panels, switchboards, cover plates, and motor control centers located outdoors shall be "weatherproof." Enclosures shall be mounted with a 1/4-inch air space from walls unless otherwise noted on the plans.

B. Classified Areas

All equipment installed in classified areas shall be complied with NFPA 820. Equipment installed in lift station shall be rated Class I, Division II hazardous locations. Conduits shall be sealed when leaving these locations.

1.10 SUBMITTALS

Shop drawings shall be submitted for the following items of major equipment in accordance with General Conditions and as indicated in Division sections.

A. Motor control center, NEMA 3R enclosure, manual transfer switch, portable generator connection assembly, panelboards, transformers, conduits, enclosures, lighting systems, and other major equipment or apparatus.

B. Control panels and other specially fabricated or custom-made equipment.

C. Seismic calculations.

D. The Contractor shall submit a detailed test procedure checklist to verify proper operation of the electrical system in accordance with the General Operations section of these Specifications.

1.11 GROUNDING

A. A grounding system shall be installed in accordance with the National Electrical Code and all state and local codes and regulations. The grounding system shall bond together and effectively ground all exposed non-energized metal surfaces containing energized parts, devices or conductors, all building steel, all metallic electrical raceways and the neutrals of all transformers. An equipment grounding conductor shall be installed in all conduits carrying power to be sized in accordance with NEC Article 250-122.

1.12 WARNING SIGNS

A. Permanent warning signs shall be mounted at all mechanical equipment that may be started automatically or from remote locations. Signs shall be made in accordance with Porcelain Enamel Institute Specification S-103 and shall be suitable for exterior use. Mounting details shall be in accordance with manufacturer's recommendation. Signs shall be located as approved by the Owner.

B. Warning signs shall be 7-inches high by 10-inches wide, colored yellow and black, on not less than 18-gauge vitreous enameling stock. Sign shall read:

CAUTION
THIS EQUIPMENT STARTS AUTOMATICALLY

1.13 QUALITY ASSURANCE

A. The plans indicate diagrammatically the desired location and arrangement of outlets, conduit runs, equipment, and other items. Exact locations shall be determined in the field based on the physical size and arrangement of equipment, finished elevations, and obstructions. Locations indicated on the Plans, however, shall be adhered to as closely as possible.

B. All conduit and equipment shall be installed in such a manner as to avoid all obstructions, preserving headroom, and keeping openings and passageways clear. Luminaires, switches, convenience outlets, and similar items shall be located as indicated on the Plans. Where these Plans do not indicate exact locations, such determined locations shall be approved by the Owner. Where equipment is installed without approval and must be moved, it shall be moved without additional cost.

C. The installation of all materials and equipment shall be accomplished by workmen skilled in this type of work and installation shall be coordinated in the field with other trades so that interferences are avoided.

D. The Contractor shall provide adequate means for and shall fully protect all finished parts of the materials and equipment against damage from any cause during the progress of the work and until accepted by the Owner.

E. All materials and equipment, both in storage and during construction, shall be covered in such a manner that no finished surfaces will be damaged, marred, or splattered with water, foam, plaster, or paint, and all moving parts shall be kept clean and dry.

F. The Contractor shall replace or have refinished by the manufacturer, all damaged materials or equipment, including face plates of panels

and switchboard sections, at no additional expense.

1.14 TESTING

A. The Contractor shall perform and record the tests described hereinafter and any other tests that may be required by the Owner or other authorities having jurisdiction. The entire electrical installation shall be tested, adjustments made, and defects corrected as an obligation under the work of this section. The Contractor shall furnish all necessary replacement parts and labor necessary due to damage resulting from damaged equipment or from test and correction of faulty installation.

The following testing, as a minimum, shall be accomplished:

1. Insulation resistance tests

2. Continuity test of all wiring

3. Completely test the grounding system with a low ohm resistance meter under simulated service conditions to assure compliant operation of the wiring and the proper functioning of all equipment.

4. Test for short circuits in the system

5. Test for all luminaire connections

6. Complete operational test on all equipment

7. Verify field performance and operation of electrical system utilizing the approved testing procedure.

B. The Contractor shall test all power and control feeder circuits in the presence of the Owner by means of a 1,000-volt megohmeter to ensure that they are free of open circuits and grounds before energizing.

C. The Contractor shall perform a functional checkout on control circuits. The checkout shall consist of energizing each control circuit and operating each control, alarm, or malfunction device, and each interlock in turn to verify that the specified action occurs.

D. After each electrical installation is complete, it shall be tested thoroughly to demonstrate that the entire system is in proper working order and in accordance with the Plans and Specifications. In no case shall the tests be less than those outlined hereinafter.

1.15 COORDINATION STUDY

A. The Contractor shall provide a complete coordination study of relays, fuses, circuit breakers, and all other protective devices.

B. The coordination study shall include the entire distribution system starting with the smallest 480 volt, 3 phase, 60 Hz circuit protective device on the load end to the nearest protective device on the power company's line side, or for work in the OWNER's existing facilities, to the nearest protective device on the OWNER's distribution system.

C. The study shall include, but not be limited to the following:

1. A tabulation of all protective relay and circuit breaker trip settings and recommended fuse sizes and types.

2. Motor starting profiles for all motors sized 50 hp and above.

3. Transformer damage curves and protection evaluated in accord with ANSI/IEEE C57.109.

4. Coordination curve(s) from the power company if available.

D. The Contractor shall be responsible for obtaining all of the required relay, fuse, and circuit breaker coordination curves; transformer damage curves; motor data; etc., for all new and existing electrical equipment.

E. The Contractor shall be responsible for coordinating with the Power Company to obtain the required protective device curves.

F. The Contractor shall be responsible for all field work required to obtain necessary data on existing relays, circuit breakers, fuses, and transformers to be included in the coordination study.

G. The coordination study shall be bound in a standard 8½ by 11 inch sized report. The study shall be provided in accordance with the submittal section. Final selection of all protective device settings or sizes shall be subject to review and acceptance by the Engineer.

H. The Contractor shall provide a database of input information for the complete electrical installation including voltage, ampere, and fault current ratings of the switchboards and motor control centers; insulation ratings and sizes of wiring; identification of conduit types; and circuit breaker ratings and settings, available fault current from the utility.

I. The coordination study shall be signed and stamped by an electrical engineer registered in the State of California.

1.16 CLEANUP

A. All parts of the electrical materials and equipment shall be left in a clean condition. Exposed parts shall be clean of cement, plaster and other materials, and all oil and grease spots shall be removed with a non-flammable cleaning solvent. Such surfaces shall be

carefully wiped and all cracks and corners scraped out.

B. During the progress of the work, the Contractor shall clean up after his men and shall leave the premises and all portions of the site in which he is working free from debris and surplus materials.

PART 2 - PRODUCTS

2.01 GENERAL

A. Equipment used for the same purpose shall be of the same make. Outdoor equipment, luminaires, and wiring devices shall be of approved weatherproof construction or shall be in a weatherproof enclosure.

PART 3 - EXECUTION (NOT USED)

END OF SECTION

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SECTION 011006040 ELECTRIC MOTORS

PART 1 - GENERAL

1.01 WORK OF THIS SECTION

A. The Contractor shall provide electric motors, accessories, and appurtenances, complete and operable, in accordance with the Contract Documents. The provisions of this section apply to all electric motors.

1.02 RELATED SECTIONS

A. The work of the following section applies to the work of this section. Other sections, not referenced below, shall also apply to the extent required for proper performance of this work.

1. Section 011001100 – Pumps General

2. Section 011006050 – Basic Electrical Materials and Methods

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Except as otherwise indicated, the current editions of the following apply to the work of this section:

1.	ANSI/NEMA MG 1	Motor and Generator
2.	ANSI/NEMA MG12.53	Motor Testing
3.	ANSI/IEEE 112	Standard Test Procedure for Polyphase Induction Motors and Generators
4.	IEEE 43	Recommended Practice for Testing Resistance of Rotating Machinery
5.	IEEE 841	Recommended Practice for Chemical Industry Severe-Duty Squirrel Cage Induction Motors
6.	IEEE RP-841	Recommended Practice for Chemical Industry Severe Duty Squirrel Cage Induction Motors

1.04 CONTRACTOR SUBMITTALS

A. Shop Drawings and Catalog Data: Submit shop drawings and catalog data submittals in accordance with Section 01300, Submittals.

B. Motor Data: Complete motor data shall be submitted in the shop drawings for driven machinery. Motor data shall include:

1. Machine name and specification number of driven machine.
2. Name of the motor manufacturer.
3. Motor type or model and dimension drawing. Include motor weight.
4. Nominal horsepower.
5. NEMA design.
6. Enclosure.
7. Frame size.
8. Winding insulation class and temperature rise class.
9. Voltage, phase and frequency ratings.
10. Service factor.
11. Full load current at rated horsepower for application voltage.
12. Full load speed.
13. Guaranteed minimum full load efficiency. Also provide nominal efficiencies at 1/2 and 3/4 load.
14. Type of thermal protection or overtemperature protection, if included.
15. Wiring diagram for devices such as motor leak detection, temperature, or space heaters, as applicable.
16. Space heater voltage and full load amperes, as applicable.
17. Bearing data, with recommended lubricants for relubricatable type bearings.
18. If used with a variable frequency controller, provide written verification that motor is inverter duty type and that insulated bearings are included. Indicate minimum speed at which motor may be operated for the driven machinery.
19. Power factor at 1/2, 3/4 and full load.
20. Recommended size for power factor correction capacitors to improve power factor to 0.95 (lagging) when operated at full load.
21. Dimensions and location of all conduit termination boxes.
22. Quantity and size of conduit openings for each conduit box. Openings shall accommodate the quantity and size of conduits indicated on the Drawings.

23. Winding Temperature Setpoints: Alarm, Shutdown

24. Bearing Temperature Setpoints: Alarm, Shutdown

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Identical Motors: Electric motors driving identical machines shall be identical.

B. Maximum Motor Loading: Maximum motor loading shall in all cases be equal to nameplate horsepower rating or less, exclusive of service factor and as verified with the approved submittal data of the driven machinery.

C. Minimum Motor Horsepower: All motors shall be sized to carry continuously all loads that may be imposed through their full range of operation. The motor horsepower shall be not less than the estimated minimum specified for each driven machine. If the estimated minimum horsepower specified is not adequate to satisfy the foregoing restrictions or any other requirements of these Specifications, the motor with the required horsepower shall be supplied at no additional cost to the Owner. In addition, any changes caused by increase in motor horsepower shall be made by the Contractor at no additional cost to the Owner; such changes may involve circuit breakers, magnetic starters, motor feeder conductors, conduit sizes, etc.

D. Exempt Motors: Motors that are for valve operators, submersible pumps, or motors that are an integral part of standard manufactured equipment, i.e., non- NEMA mounting, common shaft with driven element, part of domestic or commercial use apparatus, may be excepted from these Specifications to the extent that such variation reflects a necessary condition of motor service or a requirement of the driven equipment.

2.02 DESIGN REQUIREMENTS

A. General: All electric motors shall comply with ANSI/NEMA MG 1 - Motor and Generator.

B. NEMA Design: Electric motors shall be NEMA Design B, (except as indicated in the equipment specifications for motors controlled for variable speed operation and other special motors,) constant speed squirrel-cage induction motors having normal starting torque with low starting current. In no case shall starting torque or breakdown torque be less than the value in ANSI/NEMA MG 1. Motors shall be suitable for the starting method indicated on the Electrical Drawings. Motors for pumps operated from a VFD shall be “inverter duty” rated. Inverter duty rating shall be clearly labeled on the motor

nameplate.

C. Motor Voltage Ratings: Motors shall have voltage ratings in accordance with the following, unless otherwise indicated:

1. Motors below 1/3 hp shall be rated 115 V, single-phase, 60-Hz. Dual voltage motors rated 115/230 V, 115/208 V, or 120-240 V are acceptable, provided all leads are brought out to the conduit box.

2. Motors 1/3 hp and larger shall be rated 230 V, or 460 V, 3-phase, 60-Hz, as required and as indicated. Dual voltage motors rated 230/460 V or 208/230/460 V are acceptable, provided all leads are terminated in the conduit box at the motor.

D. Insulation: All three-phase motors shall be furnished with Class F insulation, rated to operate at a maximum ambient temperature of 104°F and at the altitudes where the motors will be installed and operated, without exceeding Class B temperature rise limits stated in ANSI/NEMA MG 1-12.42. Single-phase motors shall have Class F insulation with temperature rise not to exceed the insulation class.

E. Motors in Nonhazardous Areas: Motors shall have a service factor of 1.15 unless otherwise indicated.

F. Motors for submersible pump shall be immersible type electric motor. The cable entry shall be watertight and submersible seal.

G. Motor Enclosure:

1. Motors for Vertical Lineshaft Mixed Flow Pumps shall be solid shaft or hollowshaft type with Explosionproof enclosures and complied with NFPA 820.

H. Vertical Hollow Shaft Motors: Motors for vertical turbine solids handling the Lift Station. Lift Station shall be vertical hollow-shaft (VHS) type with anti-reversing ratchet system.

I. High Efficiency Motors:

1. Motors with a nameplate rating of 1 hp and above shall be NEMA premium efficiency units with nominal efficiencies meeting the NEMA published values. Motors shall be stamped with the efficiency on the nameplate with the caption "NEMA Nominal Efficiency" or "NEMA Nom. Eff." Such motors shall have efficiencies determined by the test as set forth in ANSI/IEEE 112-Standard Test Procedure for Polyphase Induction Motors and Generators, Method B.

2. Efficiency Index: Efficiency index, nominal efficiency, and minimum efficiency shall be defined in accordance with

ANSI/NEMA MG 12.53 - Motor Testing; these values shall be stated in the shop drawing submittal.

2.03 ACCESSORY REQUIREMENTS

A. General: Horizontal motors 3 hp and larger, and all vertical motors, shall have split-type cast metal conduit boxes. Motors other than open drip-proof shall be gasketed. Conduit boxes shall be sized one size larger than the standard conduit box. Motors less than 3 hp shall have the manufacturer's standard conduit boxes. Conduit boxes shall be provided with conduit openings to accommodate the quantity and size of conduits as indicated on the Drawings.

B. Lifting Devices: All motors weighing 265 pounds or more shall have suitable lifting eyes for installation and removal.

C. Special Requirements: Refer to individual equipment specifications for special requirements such as motor winding thermal protection, multi-speed windings, etc.

D. Grounding Lugs: Provide motor grounding lug suitable to terminate ground wire, sized as indicated on the Drawings.

E. Nameplate: All motors shall be fitted with a permanent, stainless steel nameplate indelibly stamped or engraved with NEMA Standard motor data, in conformance with NEMA MG-1-10.40.

2.04 MOTOR THERMAL PROTECTION

A. Single Phase Motors: All single-phase 120, 208, or 230 V motors shall have integral thermal overload protection or shall be inherently current limited.

B. Thermostats: Winding thermostats shall be snap action, bi-metallic, temperature- actuated switch. Thermostats shall be provided with one normally open contact. The thermostat switch point shall be pre-calibrated by the manufacturer. Thermostats shall be provided for all 3 phase pump motors. Provide separate terminal box for thermostats.

2.05 MOTOR SPACE HEATER

A. Provide motor space heater as indicated on the drawings. Provide separate terminal box for space heater.

2.06 MOTOR BEARINGS

A. Bearing Life: All motors greater than 2 hp shall have bearings designed for a minimum rated L-10 life of 10 years or 100,000 hours, whichever comes first.

B. Fractional Horsepower: Fractional horsepower through 2-hp motors shall be furnished with Lubricated-for-Life ball bearings.

C. Horizontal Motors over 2 Horsepower: Motors larger than 2-hp shall be furnished with relubricatable ball bearings.

D. Vertical Motors over 2 Horsepower: Vertical motors larger than 2-hp shall be furnished with relubricatable ball, spherical, roller, or plate type thrust bearings. Lubrication shall be per the manufacturer's recommendation for smooth operation and long life of the bearings.

2.07 MANUFACTURERS

A. The Contractor's designated equipment supplier shall have the responsibility to select and supply suitable electric motors for the driven equipment. The choice of motor manufacturer shall be subject to review by the Construction Manager. Such review will consider the future availability of replacement parts and compatibility with driven equipment. Acceptable manufacturers include the following, or equal:

1. U.S. Motors.
2. Baldor
3. GE

PART 3 - EXECUTION

3.01 INSTALLATION

A. Motor installation shall be performed in accordance with the motor manufacturer's written recommendations and the written requirements ofthe manufacturer of the driven equipment.

B. Electrical work involving connections, controls, switches, and disconnects, shall be as indicated in Division 16.

C. Capacitors shall be connected to the output terminals of the motor starter. Motor overload elements shall be adjusted downwards to reflect the reduction in line current resulting from power factor correction.

3.02 FACTORY TESTING

A. Motors rated 100 hp and larger shall be factory tested in conformance with ANSI/IEEE 112, IEEE 43 - Recommended Practice for Testing Resistance of Rotating Machinery, and NEMA MG-2. Test reports shall include heat run, performance, bearing (temperature, noise), locked rotor, speed torque, no-load saturation, surge, and megohmmeter/dielectric absorption ratio. Test report shall indicate test procedure and instrumentation used to measure and record data.

B. Test report shall be certified by the motor manufacturer's test personnel and be submitted.

C. Sound Levels

1. The sound pressure level measured at five feet from the motor shall not exceed 90 dB(a) reference 0.0002 microbars for drip-proof and weather protected motors and 95 dB(a) for totally enclosed motors.

3.03 FIELD TESTING

A. The Contractor shall perform the following field tests:

1. Inspect each motor installation for any deviation from rated voltage, phase or frequency; or improper installation.

2. Visually check for proper phase and ground connections. Verify that multi- voltage motors are connected for proper voltage.

3. Check winding and bearing temperature detectors and space heaters for functional operation.

4. Test for proper rotation before connection to the driven equipment.

5. Test insulation (megger test) of all new as well as reused motors in accordance with NEMA MG-1. Test voltage shall be 1000 VAC plus twice the rated voltage of the motor.

END OF SECTION

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SECTION 011006050 BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

This section includes the following:

A. Grounding electrodes and conductors.

B. Equipment grounding conductors.

C. Bonding methods and materials.

D. Conduit and equipment supports.

E. Equipment and anchoring.

F. Anchors and fasteners.

G. Nameplates and labels.

H. Wire markers.

I. Raceway markers.

1.02 REFERENCES

A. NECA (National Electrical Contractors Association) - “Standard Practice of Good Workmanship in Electrical Construction.”

B. NETA ATS (International Electrical Testing Association) - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

C. NFPA 99 (National Fire Protection Association) - Health Care Facilities.

1.03 SYSTEM DESCRIPTION

A. Grounding systems use the following elements as grounding electrodes:

1. Rod electrode.

B. Anchor and fasten electrical products to building elements and finishes as follows:

1. Conduit placed against concrete or masonry above ground shall be fastened to the concrete with pipe straps or one-hole conduit clamps attached to the concrete by means of expansions anchors and bolts.

2. Factory-made pipe straps shall be one-hole malleable iron or two-hole galvanized clamps for rigid steel conduits.

Straps shall be PVC-coated for PVC-coated rigid conduits.

3. Pipe hangers for individual conduits shall be factory made, consisting of a pipe ring and threaded suspension rod. The pipe ring shall be malleable iron, split and hinged, or shall be springable wrought steel. Rings shall be bolted to or interlocked with the suspension rod socket. Rods shall be 3/8 inch for 2-inch conduit hangers and smaller and shall be 2 inch for
2-1/2-inch conduit hangers and larger.

4. Hanger straps, rods, or pipe supports under concrete shall be attached to inserts set at the time the concrete is poured. Under wood, use bolts, lag bolts, or lag screws; under steel joints or trusses, use beam clamps.

5. Wire, perforated strap, or plumber's tape shall not be used in the support of conduit. Conduit shall not be secured to suspended ceiling hanger wires or to the suspended ceiling structure.

C. Identify electrical components as follows:

1. Nameplate for each electrical distribution and control equipment enclosure.

2. Nameplate for identification of individual wall switches and receptacles, and control device stations.

1.04 DESIGN REQUIREMENTS

A. Select materials, sizes, and types of anchors, fasteners, and supports to carry loads of equipment and raceway, including weight of wire and cable in raceway.

1.05 SUBMITTALS

A. Submittals shall be in accordance with the General Conditions.

B. Product Data: Submit grounding electrodes and connections, fastening components, and nameplates.

C. Test Reports: Indicate overall resistance to ground.

1.06 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of components and grounding electrodes.

1.07 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products

specified in this section with a minimum of 3-years documented experience.

1.08 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

PART 2 - PRODUCTS

2.01 ROD ELECTRODES

A. Material: Copper-clad steel.

B. Diameter: 3/4 inch

C. Length: 10 feet

2.02 MECHANICAL CONNECTORS

A. Description: Copper alloy connectors, suitable for grounding and bonding applications, in configurations required for particular installation.

2.03 EXOTHERMIC CONNECTIONS

A. Product Description: Exothermic materials, accessories, and tools for preparing and making permanent field connections between grounding system components.

2.04 GROUNDING WIRE

A. Material: Stranded copper.

B. Size: As indicated on the Drawings.

2.05 GROUNDING WELL COMPONENTS

A. Well Pipe: 12 inch NPS by 24-inch long concrete pipe with belled end.

B. Well Cover: Cast iron with legend "GROUND" embossed on cover.

2.06 ANCHORS AND FASTENERS

A. Materials and Finishes: Corrosion resistant.

2.07 EQUIPMENT PADS AND ANCHORING

A. All floor-standing equipment shall be mounted on raised concrete pads. Pad size and height shall be as indicated on the Plans. Pads not indicated shall extend out 4 inches beyond enclosure and shall be 4 inches above finished grade.

B. All equipment shall be securely anchored to pads. Anchorage shall

be in accordance with OSHA and other applicable standards for earthquakeprotection. All panels shall be designed, constructed and attached to resist stresses produced by seismic forces.

C. Earthquake Design Data

Submit with the shop drawings a complete set of detailed calculations or test results, details of constructions, and method of attachment for all panels showing compliance with earthquake design restraint. The calculations and details shall be signed by a professional engineer who has demonstrated proficiency in structural engineering or civil engineering and is registered in the state of California. The calculations shall be performed specifically for this job, during the time frame of the job and be dated by the Engineer performing them. No control panels shall be delivered and mounted at project without approved submittal data.

2.08 NAMEPLATES AND LABELS

A. Nameplates: Engraved three-layer laminated plastic, black letters on white background.

B. Letter Size: 1/4-inch letters.

C. Nameplate shall identify equipment and/or function.

D. Convenience receptacles shall be identified with originating panel and circuit number (for example, PNLA, Cir #3).

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify final backfill and compaction has been completed before driving rod electrodes.

3.02 INSTALLATION

A. Grounding and Bonding Installation:

1. Install electrodes at locations as indicated on the Plans.

2. Install grounding well pipe with cover as indicated on the Plans. Install the well pipe top flush with finished grade.

3. Grounding continuity for underground duct banks may be maintained by the installation of a bare copper conductor installed in the concrete envelope. Ground continuity shall be maintained through all manholes and pull boxes. All metal parts in manholes shall be connected to the grounding system.

4. Install bonding meeting regulatory requirements.

5. Metallic raceways shall be terminated with double lock nuts and bushings. Conduits terminating in switch boards and motor control centers shall be equipped with grounding bushing and connected to equipment ground bus.

6. All metallic raceway, non current-carrying parts of the electrical system shall be grounded.

7. Install separate, green insulated conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing.

8. Locate and install anchors, fasteners, and supports in accordance with NECA “Standard Practice of Good Workmanship in Electrical Construction.”

9. Do not fasten supports to pipes, ducts, mechanical equipment, or conduit.

10. Do not use spring steel clips and clamps.

11. Do not use powder-actuated anchors.

12. Do not drill or cut structural members.

B. Supports:

1. Fabricate supports from structural steel or formed steel members. Rigidly weld members or install hexagon head bolts to present neat appearance with adequate strength and rigidity. Install spring lock washers under nuts.

2. Install surface mounted cabinets and panelboards with a minimum of four anchors.

3. In wet and damp locations, install steel channel supports to stand cabinets and panelboards 1-inch off the wall.

C. Identification Components:

1. Degrease and clean surfaces to receive nameplates.

2. Install nameplate parallel to equipment lines.

3. Secure nameplate to equipment front using adhesive.

4. Secure nameplate to inside surface of door on recessed panelboard in finished locations.

3.03 FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA ATS, except Section 4.

B. Grounding and Bonding: Perform inspections and tests listed in NETA ATS, Section 7.13.

END OF SECTION

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SECTION 011006051 MISCELLANEOUS ELECTRICAL DEVICES

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. This section includes materials and installation of miscellaneous electrical devices and equipment, such as disconnect switches, time switches, intrusion alarm switches, and intrusion override key switches.

1.02 RELATED SECTIONS

A. Section 011006000 – General Electrical Requirements

1.03 SUBMITTALS

A. Submit shop drawings in accordance with the General Conditions.

B. Submit ratings and characteristics including voltage ratings, continuous current ratings, conduit entry restrictions, and enclosure type and dimensions.

PART 2 - MATERIALS

2.01 DISCONNECT SWITCHES

A. Provide heavy duty single throw disconnect switch of the voltage and amperage shown on the Drawings. The switch shall be housed in a NEMA 3R enclosure (outdoor) or NEMA 1 (indoor) and shall meet UL 98 standards for enclosed switches and NEMA KA-1. The switch shall be horsepower rated and shall have a quick-make, quick-break switching mechanism. Disconnect shall have a pad lockable operating handle.

2.02 INTRUSION ALARM SWITCHES

A. Provide concealed magnetic contact type switch with SPDT contacts ratedfor 24-volt d-c and 10 volt-amperes. Switches shall be UL listed.

B. Provide magnetic contact switches with stainless steel flex cable, GE Series 2500, or approved equal.

2.03 INTRUSION OVERRIDE KEY SWITCHES

A. Intrusion override key switches shall be the access control type. Key switches shall come complete with mortise cylinder and 24-volt a-c/d-c SPDT maintained contacts. Key the lock to match District's master key.

B. Intrusion override key switches shall be Square D 30.5mm, Class 9001, 2 position key switch # KS11K1H13.

PART 3 - EXECUTION

3.01 INSTALLING INTRUSION ALARM SWITCHES

A. The switches shall be interfaced with the PLC. Mount switch on inside door frame such that when the door is opened, the normally closed switch contacts shall close and, when door is closed, the normally closed switch contacts shall open.

3.02 INSTALLING INTRUSION OVERRIDE KEY SWITCHES

A. Key switch shall be flush mounted on the Telemetry Panel as shown on the Drawings. Mount 48 inches above finished floor or grade.

3.03 FIELD TESTING

A. Operate each disconnect switch three times, under load, and verify that all phases of the load are disconnected each time.

B. Thermostats: Adjust thermostats above and below the ambient temperature. Verify that the equipment controlled operates per the plans or other sections of these specifications.

C. Intrusion Alarm and Override Switches: Verify operation by closing and opening each door or hatch and operating key switch and checking receipt of signals at the PLC.

D. Photoelectric Switch: Simulate nighttime by placing object over sensor or witness nighttime automatic controls. Verify lights turn on and off.

END OF SECTION

SECTION 011006123 WIRE AND CABLE

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. This section includes wire and cable; nonmetallic-sheathed cable; and wiring connectors and connections.

1.02 REFERENCES

A. NECA 1-2010 “Standard Practice of Good Workmanship in Electrical Construction.”

B. NETA ATS (International Electrical Testing Association) - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.03 SYSTEM DESCRIPTION

Product Requirements: Provide products as follows:

A. Stranded conductor for feeders and branch circuits 10 AWG and smaller.

B. Stranded conductors for control circuits.

C. Power conductors not smaller than 12 AWG.

D. Conductor not smaller than 14 AWG for control circuits.

1.04 DESIGN REQUIREMENTS

A. All conductors shall be copper.

1.05 SUBMITTALS

A. Submittals shall be in accordance with General Conditions.

B. Product Data: Submit for building wire and each cable assembly type.

C. Test Reports: Indicate procedures and values obtained.

D. Project Record Documents: Record actual locations of components and circuits.

1.06 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with a minimum of 3-years documented experience.

1.07 FIELD MEASUREMENTS

A. Verify field measurements are as indicated on the drawings.

1.08 COORDINATION

A. Where wire and cable destination is indicated and routing is not shown, determine routing and lengths required.

B. Wire and cable routing indicated is approximate unless dimensioned.

PART 2 - PRODUCTS

2.01 WIRE

A. Product Description: Single conductor insulated wire.

B. Conductor: Copper.

C. Insulation Voltage Rating: 600 volts.

D. Insulation: NFPA 70; Type THHN/THWN/THWN2 insulation for feeders and branch circuits. Sizes 8 and larger shall be rated THWN2.

E. Conductors shall have thermoplastic, solid color thermosetting, polyvinyl chloride insulation with nylon jacket. The insulated conductors shall conform to Underwriter's Laboratories standards for type THHN/THWN2. The overall jacket for a multi-conductor cable shall be polyvinyl chloride.

F. Wire and cable designated "Shielded" on the Drawings and required for the instrumentation signal circuits shall be shielded cable. Signal voltage and current will be 24 volts DC and 4-20 milliamperes DC, respectively. The cables shall be 600 volt AC rated, with a laminated aluminum-polyester tape shield and a copper drain wire, with a plastic jacket over all, and shall be UL approved as type TC tray cable, 90°C in dry locations, and 75°C in wet locations. The conductors in the cable shall be stranded and twisted bare copper wires with a minimum of seven strands and insulated with a minimum thickness of 0.020 inch of flame retardant and moisture resistant, high quality, cross-linked, polyethylene insulation. The wires shall be color coded and covered with a minimum of 0.001/0.001 inches of laminated aluminum-polyester tape shield and a #20 AWG tinned and stranded copper drain wire, with a minimum of ten strands. Over the twisted and shielded cable assembly, there shall be a minimum thickness of 0.045-inches of moisture, flame, and sunlight resistant, polyvinyl chloride (PVC) outer jacket.

G. All conductors shall be soft-drawn copper, 97 percent conductivity minimum.

H. All conductors within fluorescent fixtures shall have type AVA or RHH 600 volt insulation except fixtures with approved wireways for 75°C wire.

I. Instrumentation cable shall be single or multi-conductor

shielded pairs as indicated. Conductors shall be No. 16 AWG coated copper.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify mechanical work likely to damage wire and cable has been completed.

B. Verify raceway installation is complete and supported.

3.02 PREPARATION

A. Completely and thoroughly swab raceway before installing wire.

3.03 INSTALLATION

A. Route wire and cable to meet project conditions.

B. Install wire and cable in accordance with NECA “Standard Practice of Good Workmanship in Electrical Construction.”

C. Neatly train and lace wiring inside boxes, equipment, and panelboards.

D. Identify and color code wire and cable. Identify each power and control conductor with tube type wire markers, indicating the conductor’s circuit designation and starting, ending, and splice locations.

E. Wire in Raceway:

1. Pull conductors into raceway at same time.

2. Install wire 4 AWG and larger with pulling equipment with tension monitored.

3. Wire lubricants shall be UL approved.

F. Cable:

1. Protect exposed cable from damage.

2. Use suitable cable fittings and connectors.

G. Wiring Connections:

1. Clean conductor surfaces before installing lugs and connectors.

2. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.

3. All low DC and AC (below 100V) voltages and signals shall

be grounded separately from above power grounds. 600 volt conductors, No. 8 AWG and larger, shall be terminated spliced with compression type connectors and insulated with three layers of UL-approved vinyl insulating tape. 600 volt conductors, No. 10 AWG and smaller, shall be spliced with pre- insulated coil spring type connectors. Terminations and splices in all motor connection boxes shall be made with compression type connectors.

4. Termination splices shall be insulated with varnished cambric tape, overlapped with three (3) layers of a high temperature, UL-approved, tape.

5. Control conductors shall be spliced with pre-insulation crimp type connectors and terminated with split tongue pre-insulated, crimp type connectors.

H. Splicing

1. Wires and cables for control and power circuits shall be continuous without splices between terminals, except where otherwise specifically approved by the Engineer. All splices shall be made in an approved manner. Mechanical connectors and terminal devices shall be the soldered-type, or the compression-type that is indented or crimped on to the conductor.

2. Splices and terminations of instrument cable shall be with pre-insulated crimp type connectors. Shields shall be electrically continuous at spliced joints with two layers of UL-approved electrical insulating tape over splices. Connectors for terminations shall be split tongue or ring type. Shields shall be grounded at the receiving end of cables.

3. Splices in manholes and underground pull boxes for 600-volt conductors and below shall be waterproofed using encapsulating epoxy resin splice kits.

3.04 WIRE COLOR

A. General

1. Wire and cable shall be factory color coded by integral pigmentation with a separate color for each phase and neutral. On conductors larger than 8 AWG, color tape or colored plastic bands will be permitted.

2. Each system shall be color coded and shall have it maintained throughout.

Phase	120/240	120/208	277/480 Volts	Control Wires	DC Conductors
A	Black	Black	Brown	Purple	Blue
B	Red	Red	Orange		
C	N/A	Blue	Yellow		
Neutral	White	White	Gray		
Ground	Green	Green	Green		

B. Neutral Conductors: White. When two or more neutrals are located in one conduit, individually identify each with proper circuit number.

C. Branch Circuit Conductors: Install three or four wire home runs with each phase uniquely color coded.

D. Feeder Circuit Conductors: Uniquely color code each phase.

E. Ground Conductors:

1. For 6 AWG and smaller: Green.

2. For 4 AWG and larger: Identify with green tape at both ends and visible points including junction boxes.

3.05 FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA ATS, except Section 4.

B. Perform inspections and tests listed in NETA ATS, Section 7.3.1.

END OF SECTION

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SECTION 011006130 RACEWAY AND BOXES

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. This section includes conduit and tubing, surface raceways, wireways, outlet boxes, pull and junction boxes, and handholes.

1.02 REFERENCES

A. ANSI C80.1 (American National Standards Institute) - Electrical Rigid Steel Conduit.

B. NECA 1-2010 “Standard Practice of Good Workmanship in Electrical Construction.”

C. NEMA FB 1 (National Electrical Manufacturers Association) - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.

D. NEMA OS 1 (National Electrical Manufacturers Association) - Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.

E. NEMA OS 2 (National Electrical Manufacturers Association) - Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports.

F. NEMA RN 1 (National Electrical Manufacturers Association) - Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.

G. NEMA TC 2 (National Electrical Manufacturers Association) - Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80).

H. NEMA TC 3 (National Electrical Manufacturers Association) - PVC Fittings for Use with Rigid PVC Conduit and Tubing.

I. NEMA 250 (National Electrical Manufacturers Association) - Enclosures for Electrical Equipment (1000 Volts Maximum).

1.03 SYSTEM DESCRIPTION

A. Raceway and boxes located as indicated on the Drawings, and at other locations required for splices, taps, wire pulling, equipment connections, and compliance with regulatory requirements. Raceway and boxes are shown in approximate locations unless dimensioned. Provide raceway to complete wiring system.

1.04 DESIGN REQUIREMENTS

A. Minimum Raceway Size: 3/4 inch unless otherwise specified. Where conduit sizes are not shown, they shall be one size larger than required by NEC.

B. All wiring, except as specifically noted, shall be in conduit.

C. All wiring runs in earth outside the building shall be installed in PVC coated rigid steel conduit with minimum of 30 inches below finished grade. Conduits for electric utility services shall be Schedule 40 PVC conduit encased in concrete. PVC conduit shall have PVC coated rigid steel risers.

D. Unless specifically noted otherwise, all exposed raceway shall be rigid galvanized steel or PVC coated rigid galvanized steel.

1.05 SUBMITTALS

Product Data: Submit shop drawings for the following in accordance with General Conditions.

A. Liquid-tight flexible metal conduit.

B. Nonmetallic conduit.

C. Raceway fittings.

D. Conduit bodies.

E. Surface raceway.

F. Wireway.

G. Pull and junction boxes.

H. Handholes.

1.06 CLOSEOUT SUBMITTALS

Submit project record documents that:

A. Record actual routing of all conduits.

B. Record actual locations and mounting heights of outlet, pull, and junction boxes.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.

B. Protect PVC conduit from sunlight.

1.08 COORDINATION

A. Coordinate mounting heights, orientation and locations of outlets

mounted above counters, benches, and backsplashes.

PART 2 - PRODUCTS

2.01 PVC COATED STEEL CONDUIT AND FITTINGS

A. Product Description: Rigid steel conduit with external PVC coating, 40 mils thick, shall comply with UL-6 and NEMA RN 1. Conduit and fittings shall be manufactured by Perma-Cote, Calbond, Thomas & Betts, or approved equal.

B. PVC coated steel fittings and bodies shall comply with NEMA FB 1. Fittings with external PVC coating shall match the conduit.

2.02 RIGID METAL CONDUIT

A. Product Description: rigid metal conduit shall be hot dipped, zinc coated galvanized steel manufactured in accordance with ANSI C80.1, UL-6, and Federal Specification WW-C-581E.

2.03 LIQUIDTIGHT FLEXIBLE METAL CONDUIT

A. Product Description: Interlocked galvanized construction with a smooth moisture and oil-proof abrasive-resistant reopened jacket.

B. Fittings: NEMA FB 1.

2.04 NONMETALLIC CONDUIT

A. Product Description: NEMA TC 2; Schedule 40 PVC rated for 90°C.

B. Fittings and Conduit Bodies: NEMA TC 3.

C. Install non-metallic conduit for electric and telephone utility services or as otherwise specifically indicated on the Plans. The plastic conduit shall be installed in accordance with the manufacturer’s printed recommendations. Bends, sweeps, end-bells, and other fittings, as required, shall be of the same material as the conduit.

2.05 OUTLET BOXES

A. Sheet Metal Outlet Boxes: NEMA OS 1 one-piece knockout type, galvanized steel.

1. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; furnish 1/2-inch male fixture studs where required.

2. Concrete Ceiling Boxes: Concrete type.

B. Weatherproof Outlet Boxes: Nonferrous metal with threaded conduit entry and gasketed covers.

C. Cast Boxes: NEMA FB 1, Type FD, cast feralloy. Furnish gasketed cover by box manufacturer.

2.06 PULL AND JUNCTION BOXES

A. Sheet Metal Boxes: NEMA OS 1, galvanized steel.

B. Pull boxes shall be painted with two coats of primer and one finished coat of light gray enamel, ANSI No. 61.

C. Boxes shall be fabricated of structural quality flat rolled steel sheet free from irregularities, mill scale, surface corrosion, or other defects and shall be neatly and accurately formed with corners mitered and sides joined by continuous welding. After fabrication, each box and cover shall be galvanized.

D. Galvanizing shall be in accordance with the requirements of ASTM Standard A123. The galvanizing shall stand seven 1-minute immersions when tested in accordance with the methods set forth in ASTM Standard A239. Articles shall be straightened after galvanizing, if necessary, to remove wavy surfaces or distortion.

E. Cast-Type Boxes

Cast-type boxes shall be malleable iron with cadmium finish or copper-free aluminum with threaded hubs for installation on exposed conduit work outdoors, in vaults, and miscellaneous structures as shown on the Drawings. Cast-type boxes shall be Crouse-Hinds "Condulets," Appleton Electric Products "Unilets," or equal.

F. Underground Pull boxes

1. Pull boxes shall be precast type designed and manufactured for heavy traffic loading with heavy duty, hot dipped galvanized steel, traffic type covers.

2. All pull boxes shall have bolt-down covers complete with fiber gaskets for a weather-tight fit.

3. All joints between precast sections shall be sealed.

4. Box covers shall be permanently identified as follows:

a. Telephone service - "T"

b. Electrical systems 600 volts and less - "E"

G. Pull boxes shall be code gauge steel with removable covers

secured with machine screws. The pull box shall be painted with two coats of primer and one finished coat of light gray enamel, ANSI No. 61. Pull boxes shall meet all code requirements as to size for number and size of conduits terminating.

H. Weatherproof pull boxes shall be hot dip galvanized with two coats of primer paint and one coat of enamel, ANSI No. 61 gray. Covers shall be gasketed and made completely weathertight.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify outlet locations and routing and termination locations of raceway prior to rough-in.

3.02 INSTALLATION

A. Install work in accordance with state and municipality standards.

B. Install raceway and boxes in accordance with NECA 1-2010 "Standard Practice of Good Workmanship in Electrical Construction."

C. Ground and bond raceway and boxes in accordance with Section 011006050.

D. Fasten raceway and box supports to structure and finishes in accordance with Section 011006050.

E. Identify raceway and boxes in accordance with Section 011006050.

F. Arrange raceway and boxes to maintain headroom and present neat appearance.

3.03 INSTALLATION - RACEWAY

A. Raceway routing is shown in approximate locations unless dimensioned. The exact locations shall be determined by the Contractor to suit the structural details. Route raceways to complete wiring system.

B. Support raceway using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.

C. Do not support raceway with wire or perforated pipe straps. Remove wire used for temporary supports.

D. Do not attach raceway to ceiling support wires or other piping systems.

E. Route exposed raceway parallel and perpendicular to walls.

F. Route conduit in and under slab from point-to-point.

G. Maintain clearance between raceway and piping for maintenance purposes. Conduit shall be kept at least 6 inches from the covering on hot water pipes, 18 inches from the covering on flues and breechings, and 3/4 inch from all water- bearing walls, unless shown otherwise on the Plans. The open ends of all conduits shall be sealed during the construction of the facility. Use approved conduit unions where union joints are necessary. Running threads will not be permitted.

H. Exposed conduit, stubbing up through floor slab into bottom of exposed panels, cabinets, or equipment, shall be lined up, properly spaced, and shall be straight and plumb. Conduits shall be installed at sufficient depth below slab to eliminate any part of the bend above top of slab.

I. Cut conduit square using saw or pipe cutter; de-burr cut ends.

J. Join nonmetallic conduit using cement as recommended by the manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for a minimum of 20 minutes.

K. Install conduit hubs to fasten conduit to sheet metal boxes in damp and wet locations and to cast boxes.

L. Install no more than equivalent of three 90-degree bends between boxes. Install conduit bodies to make sharp changes in direction, as around beams. Install factory elbows for bends in metal conduit larger than 2-inch size.

M. Avoid moisture traps; install junction box with drain fitting at low points in conduit system.

N. Install suitable pull cord of 200-pound strength in each empty raceway except sleeves and nipples.

O. All spare conduits shall be stubbed up to a flush coupling and plugged. Conduit shall run continuously between outlets and shall be provided with conduit junction boxes where connections are made, except in special pull boxes where indicated on the Plans.

P. Flexible steel conduit may be used in runs from adjacent junction boxes to motors, benches, and in certain locations where, for structural or other reasons, it is impractical to use rigid conduit and where specific permission to do so has been granted by the Owner. Flexible conduit shall be used with PVC coated steel conduit fittings and bushings. All exposed conduits and all conduit stub-ups shall be PVC jacketed steel.

Q. Threading shall be done with dies with guide sleeves bored out

to allow for increased diameter of conduit. Conduit bends shall be made with next larger size EMT bender or next larger sized shoe bushed for proper fit. Cuts or damaged areas shall be repaired with an approved paste material.

3.04 CONDUIT FITTINGS AND OUTLET BOXES

A. Cast, non-ferrous fittings shall be installed for all exposed conduits including fittings for switches and receptacles. Fittings installed in pipe and filter gallery or exterior to buildings shall have a PVC coating bonded to the surface and a PVC sleeve extended from all hubs. Stainless-steel screws shall be used to attach the cover to the conduit fitting.

B. All outlet boxes that finish to an exposed concrete block surfaces shall have 2-1/8-inch deep tile rings and shall be set to allow concrete block facing over the ring to frame the opening. Tile rings shall not be grouted into exposed concrete block walls. Center outlet in course of concrete block.

C. Standard plaster rings will not be accepted.

D. Unless otherwise specified or noted on the Plans, boxes for the various outlets shall be as follows:

1. For light outlet boxes, use minimum of 4 inches square, 2-1/8 inches deep, equipped with plaster ring and fixture-supporting device as required by the unit installed.

2. For wall switch outlets, use 4-inch boxes with single or two-gang boxes with gang plaster rings for more than two switches, unless noted otherwise on the Plans.

3. For convenience outlets, use 4-inch boxes with single-gang plaster rings. All conduit fittings, sealing devices, junction boxes, and devices used in hazardous areas shall be UL approved and as manufactured by Crouse- Hinds or Appleton.

E. Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.

F. Do not install flush mounting box back-to-back in walls; install with minimum 6 inches separation.

G. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.

H. Install stamped steel bridges to fasten flush mounting outlet box between studs.

I. Install flush mounting box without damaging wall insulation

or reducing its effectiveness.

J. Install adjustable steel channel fasteners for hung ceiling outlet box.

K. Do not fasten boxes to ceiling support wires or other piping systems.

L. Support boxes independently of conduit.

M. Install gang box where more than one device is mounted together. Do not use sectional box.

N. Install gang box with plaster ring for single device outlets.

3.05 INTERFACE WITH OTHER PRODUCTS

A. Install conduit to preserve fire resistance rating of partitions and other elements, using materials and methods in accordance with Section 011006050.

B. Locate outlet boxes to allow luminaries positioned as indicated on the Drawings.

C. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.

3.06 ADJUSTING

A. Adjust flush-mounting outlets to make front flush with finished wall material.

B. Install knockout closures in unused openings in boxes.

3.07 CLEANING

A. Clean interior of boxes to remove dust, debris, and other material.

B. Clean exposed surfaces and restore finish.

END OF SECTION

SECTION 011006140 WIRING DEVICES

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. This section includes convenience receptacles, generator receptacles, light switches and device plates.

B. Related Sections:

1. Section 011006130 - Raceway and Boxes: Outlet boxes for wiring devices.

1.02 REFERENCES

A. NECA 1-2010 “Standard Practice of Good Workmanship in Electrical Construction.”

B. NEMA WD 1 (National Electrical Manufacturers Association) - General Requirements for Wiring Devices.

C. NEMA WD 6 (National Electrical Manufacturers Association) - Wiring Device - Dimensional Requirements.

1.03 SUBMITTALS

A. Product Data: Submit the manufacturer's catalog information for each type of receptacle, switch and device plate showing dimensions, colors, ratings and configurations.

1.04 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with a minimum of 3 years of experience.

B. All devices shall be U.L. listed.

1.05 EXTRA MATERIALS

A. Furnish two of each style, size, and finish wall plate.

PART 2 - PRODUCTS

2.01 RECEPTACLES

A. Product Description: NEMA WD 1, heavy-duty general use receptacle.

B. Device Body: Brown plastic.

C. Configuration: NEMA WD 6, type as indicated on the Drawings.

D. Convenience Receptacle: Type 5-20.

E. GFCI Receptacle: Convenience receptacle with integral ground fault circuit interrupter to meet regulatory requirements. Receptacles shall be rated 20 amperes and comply with UL-943.

F. Weatherproof Receptacle: Convenience receptacle with polycarbonate NEMA 3R “while-in-use” cover to protect electrical connections when receptacle is being used. Weatherproof receptacles shall comply with NEC 406.8(B)(1).

G. Explosion-Proof Receptacles: Provide explosion-proof receptacles for areas identified as “Hazardous Area” in the Drawings or where receptacle is labeled “explosion proof.” Provide explosion–proof outlet of the cast malleable iron type with sealing chamber to house receptacle. Unit shall be of dead front design with spring-loaded cover utilizing receptacle outlet as indicated. Provide watertight self-adjusting matching plug capable of securely locking to outlet with no danger of being accidentally withdrawn. Receptacle outlet shall be activated only after plug is inserted and rotated manually. Receptacle shall comply with NEC Class I, Division I, Groups B, C and D. Provide Appleton “U-Line” series, Crouse-Hinds ENR series, or equal.

2.02 COVER PLATES

A. Provide engraved or etched cover plates to indicate equipment or area served for pilot switches, control circuit switches, three-gang or larger gang switches, and switches from which the equipment controlled cannot be readily seen. Lettering shall be 1/8 inch high with filler of black color. Provide a separate nameplate mounted above receptacle for receptacles without cover plates or where engraving or etching is impractical. Nameplate shall be as described in Section 011006050 except with 1/8-inch-high lettering.

B. In wet areas, areas subject to hosing down, areas identified as “CorrosiveArea,” or where indicated, use individually gasketed weatherproof cover plates.

1. Switch plates shall be gray polycarbonate lift-cover type.

2. Receptacle plates shall be polycarbonate and NEMA 3R rated while in use. Manufacturer shall be Tay Mac Corporation or equal.

C. Provide satin stainless 430 plates in all remaining locations.

D. Decorative Cover Plate: Smooth Type 302 stainless steel.

E. Weatherproof Cover Plate: Gasketed cast metal plate with hinged and gasketed device cover.

2.03 PORTABLE GENERATOR RECEPTACLE

A. Manufacturer: Appleton

B. Service receptacles shall be 600 volt, 400 ampere, 4 poles circuit breaking, weather resistant, raintight receptacles. The receptacles shall be reverse service type with recessed male contact assembly. The receptacles shall have a back box angle adapter and screw on dust cover with chain.

2.04 SWITCHES

Switches shall be NEMA WD 1, molded composition, brown, specification grade, single pole, three-way and four-way as shown in the Drawings.

A. 120- or 277-Volt Lighting: Provide switches rated 20 amperes, 120/277-volt a-c. Provide quiet operation, toggle-type switches.

B. Switches with Pilot Lights: Provide switches with 125-volt, neon light with red jewel that is lighted when the switch is ON.

C. Explosion-Proof Switches: Provide explosion-proof switches for areas identified as “Hazardous Area” in the Drawings. Provide factory-sealed tumbler switches, 20 amperes, 120/277-volt AC. Comply with NEC Class I, Division I, Groups C and D and Class II, Division I, Groups E, F, and G. Provide Appleton EDS series, Crouse-Hinds EDS series, or equal.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that outlet boxes are installed at proper height.

B. Verify that wall openings are neatly cut and completely covered by wall plates.

C. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

3.02 PREPARATION

A. Clean debris from outlet boxes.

3.03 INSTALLATION

A. Install in accordance with NECA 1-2010 “Standard Practice of Good Workmanship in Electrical Construction.”

B. Install devices plumb and level.

C. Install switches with OFF position down.

D. Do not share neutral conductor on load side of dimmers.

E. Install receptacles with grounding pole on top.

F. Connect wiring device grounding terminal to outlet box with bonding jumper and branch circuit equipment grounding conductor.

G. Install decorative plates on switch, receptacle, and blank outlets.

H. Connect wiring devices by wrapping solid conductor around screw terminal. Install stranded conductor for branch circuits 10 AWG and smaller. When stranded conductors are used in lieu of solid, use crimp on fork terminals for device terminations. Do not place bare stranded conductors directly under device screws.

3.04 INTERFACE WITH OTHER PRODUCTS

A. Coordinate locations of outlet boxes provided under Section 011006130 to obtain mounting heights as specified and as indicated on the Drawings.

3.05 FIELD QUALITY CONTROL

A. Inspect each wiring device for defects.

B. Operate each wall switch with circuit energized and verify proper operation.

C. Verify each receptacle device is energized. Test each receptacle with a circuit tester that checks voltage, polarity, and grounded conditions. Repair or replace defective receptacles and repeat the test.

D. Test each receptacle device for proper polarity.

E. Test each GFCI receptacle device for proper operation. GFI receptacles shall be tested with the circuits energized. Devices shall be tested with a portable GFI receptacle tester capable of circulating 7.5 mA of current, when plugged in, between the “hot” line and “ground” to produce tripping of the receptacle. Resetting and tripping shall be checked at least twice at each GFI receptacle.

F. Portable Generator Receptacle:

1. Provide the Owner 7 days’ advance notice for receptacle testing. The Owner will transport their portable generator to the site and make connections to the receptacle.

2. Verify correct voltage on all three motor control center phases while powered from the generator.

3. Bump motors to verify correct phase rotation. Reconnect terminations within the motor control center if rotation is not correct.

3.06 ADJUSTING

A. Adjust devices and wall plates to be flush and level.

3.07 CLEANING

A. Clean exposed surfaces to remove splatters and restore finish.

END OF SECTION

SECTION 011006442 PANELBOARDS

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. This section includes distribution panelboards.

B. Related Sections:

1. Section 011006050 – Basic Electrical Materials and Methods.

2. Section 011006443 – Motor Control Center.

1.02 REFERENCES

A. NECA (National Electrical Contractors Association) -Standard of Installation.

B. NEMA AB 1 (National Electrical Manufacturers Association) - Molded Case Circuit Breakers.

C. NEMA ICS 2 (National Electrical Manufacturers Association) - Industrial Control and Systems: Controllers, Contactors, and Overload Relays Rated Not More Than 2000 Volts AC or 750 Volts DC.

D. NEMA ICS 5 (National Electrical Manufacturers Association) - Industrial Control and Systems: Control Circuit and Pilot Devices.

E. NEMA KS 1 (National Electrical Manufacturers Association) - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).

F. NEMA PB 1 (National Electrical Manufacturers Association) - Panelboards.

G. NEMA PB 1.1 (National Electrical Manufacturers Association) - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.

H. NETA ATS (International Electrical Testing Association) - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.03 SUBMITTALS

A. Shop Drawings (in accordance with the General Conditions): Indicate outline and support point dimensions, voltage, main bus ampacity, short circuit ampere rating, circuit breaker arrangement and sizes.

B. Product Data: Submit catalog data showing specified

features of standard products.

1.04 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of panelboards and record actual circuiting arrangements.

B. Operation and Maintenance Data: Submit spare parts listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

1.05 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with a minimum of 3-years documented experience.

PART 2 - PRODUCTS

2.01 DISTRIBUTION PANELBOARDS

A. Product Description: NEMA PB 1, circuit breaker type panelboard.

B. Panelboard Bus: Copper, current carrying components, ratings as indicated on the Drawings. Furnish copper ground bus in each panelboard.

C. Minimum short circuit rating: 10,000 amperes rms symmetrical or as shown on the Drawings.

D. Molded Case Circuit Breakers: NEMA AB 1, circuit breakers with integral thermal and instantaneous magnetic trip in each pole. Furnish circuit breakers UL listed as Type HACR for air conditioning equipment branch circuits. Circuit breakers shall be pad-lockable.

E. Enclosure: Panelboard shall be installed in a section of the motor control center as shown on the Drawings.

F. Cabinet Front: Surface.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install panelboards in accordance with NEMA PB 1.1 and NECA "Standard of Installation."

B. Install panelboards plumb.

C. Install filler plates for unused spaces in panelboards.

D. Provide typed circuit directory for each branch circuit panelboard. Revise directory to reflect circuiting changes to balance phase loads.

E. Install engraved plastic nameplates in accordance with Section 011006050.

F. Ground and bond panelboard enclosure according to Section 011006050. Connect equipment ground bars of panels in accordance with NEC Article 517

3.02 FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA ATS, except Section 4.

B. Perform circuit breaker inspections and tests listed in NETA ATS, Section 7.6.

END OF SECTION

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SECTION 011006443 MOTOR CONTROL CENTER

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. This section includes the motor control center.

1.02 RELATED SECTIONS:

A. Section 011006442 – Panelboards

B. Section 011006445 – Manual Transfer Switch

C. Section 011006461 – Dry Type Transformers

1.03 REFERENCES

A. IEEE C62.41 (Institute of Electrical and Electronics Engineers) - Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.

B. NEMA AB 1 (National Electrical Manufacturers Association) - Molded Case Circuit Breakers.

C. NEMA KS 1 (National Electrical Manufacturers Association) - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).

D. NEMA ICS 2 (National Electrical Manufacturers Association) - Industrial Control and Systems: Drives, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC.

E. NEMA ICS 2.3 (National Electrical Manufacturers Association) - Instructions for the Handling, Installation, Operation, and Maintenance of Motor Control Centers.

F. NEMA ICS 3 (National Electrical Manufacturers Association) - Industrial Control and Systems: Factory Built Assemblies.

G. NEMA ICS 5 (National Electrical Manufacturers Association) - Industrial Control and Systems: Control Circuit and Pilot Devices.

H. NETA ATS (International Electrical Testing Association) - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.04 SUBMITTALS

A. Submittals shall be in accordance with the General Conditions.

B. Shop Drawings: Indicate front and side views of enclosures with

overall dimensions shown; conduit entrance locations and requirements; nameplate legends; size and number of bus bars for each phase, neutral, and ground; electrical characteristics including voltage, frame size and trip ratings, withstand ratings, NEMA rating of enclosure, ventilation calculations, ventilation equipment ratings, and time and current curves of equipment and components. Provide single line diagram for motor control center.

C. Provide anchorage calculations in accordance with specification Section 011006050.

D. Product Data: Submit electrical characteristics including voltage, frame size and trip ratings, fault current withstand ratings, and time-current curves of equipment and components.

E. Test Reports: Indicate field test and inspection procedures and test results.

1.05 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations, configurations, and ratings of motor control centers and major components.

B. Operation and Maintenance Data: Submit a replacement parts list for drives.

1.06 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section as further noted below.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver in 60-inch maximum width shipping splits, individually wrapped for protection, and mounted on shipping skids.

B. Store in clean, dry space. Maintain factory wrapping or provide additional canvas or plastic cover to protect units from dirt, water, construction debris, and traffic.

C. Handle in accordance with NEMA ICS 2.3. Lift only with lugs provided. Handle carefully to avoid damage to motor control center components, enclosure, and finish.

1.08 ENVIRONMENTAL REQUIREMENTS

A. Conform to NEMA ICS 2 service conditions during and after installation of motor control centers.

1.09 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

PART 2 - PRODUCTS

2.01 MOTOR CONTROL CENTER

A. General

The entire motor control center shall be designed, manufactured, interconnected, assembled and tested by a single manufacturer including all bussing, power cabling and transition sections to ensure system operation and seismic integrity. Material and equipment shall be new and current, delivered to the site completely wired, tested and ready for installation. The motor control center shall consist of one or more enclosed vertical sections joined together to form a rigid, freestanding assembly. The construction of the motor control center shall meet the requirements set forth by Underwriters' Laboratories publication UL 845, NEMA publication number ICS-2-322 and the National Electric Code. Sections purchased from separate sources and interwired in the field by an electrical contractor will not be accepted. The installing contractor shall be responsible for changes in the facilities work made necessary from installation of equipment other than specified, without additional cost. Verify all work with the equipment manufacturer.

B. Product Description: NEMA ICS 3, Class I, Type B motor control center and shall include no interwiring between control units. Type B wiring shall include terminal blocks mounted on lift out brackets in the units. Terminal blocks shall be conventional track mounted solderless box type.

C. Dimensions: The overall dimensions of the MCC shall not exceed that shown on the Drawings.

D. Main Overcurrent Protection: Molded case circuit breaker.

E. Feeder Tap Units: Molded case thermal-magnetic circuit breakers or motor circuit protectors, as indicated on the Drawings.

F. Voltage Rating: As shown on plans

G. Integrated Equipment Short Circuit Rating: Min 65,000 amperes rms symmetrical at 480 volts.

H. Configuration: Units front mounting only, accessible from front only.

I. Enclosure: NEMA ICS 6, Type 3R.

J. Enclosure Ventilation: Ventilation fans shall be provided for the NEMA 3R enclosure. Fans shall be sized by the manufacturer to provide adequate ventilation in the enclosure to maintain temperatures within the enclosure within the temperature ranges

specified by the manufacturer of the electrical equipment to be installed within the enclosure. The submittal shall include the ratings of the ventilation fans and calculations to demonstrate that the ventilation provided meets the electrical equipment manufacturer's temperature requirements. Calculations shall be based upon 50 degree C ambient temperature outside the NEMA 3R enclosure. Conduit and wiring and control for fans shall be provided and installed by motor control center manufacturer.

K. Literature and Drawings

The manufacturer shall have printed literature and brochures describing the standard series (not a one of a kind fabrication). Unless otherwise specified herein, all performance data and other information shall be as on the manufacturer's literature.

L. Seismic Requirements

Motor control center shall meet seismic requirements as stated in specification Section 011006050. Submit certification that motor control center meets seismic requirements and provide anchorage calculations.

M. Vertical Sections

1. Vertical sections shall support the horizontal and vertical combination starter units, 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 90 inches high and shall have 7-gauge steel, 3-inch high removable lifting angle and two 1-1/2 inch high base channels. Complete control center line-ups shall be divided into shipping splits no wider than approximately 60 inches. 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. The 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 of undue expense. Removable end closing plates shall be provided to close off openings on the end 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 one space factor, or 12 inches, of unit mounting space. Vertical sections shall allow for seven 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 form the vertical to horizontal wireway. Wireways shall be in accordance with the wireway sections contained in this document.

N. Horizontal Wireways

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 be clear of all bussing and 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.

O. 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.

P. Bus Bars

1. A fully rated horizontal ground bus 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. Both ends of all splice connections shall be made with at least two bolts and shall employ the use of Belleville washers in the connection. Each bolt shall be independently capable of handling the load. 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 with two bolts and each bolt shall be independently capable of handling the load.

3. The main horizontal buses shall be made of copper and the entire length shall be electrolytically tin plated to provide maximum protection to the bus bars from normal or adverse atmospheric conditions.

4. Bus supports shall be formed to 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 have an ampere rating as indicated on the Drawings. Vertical bus rating shall be a minimum of 600 amperes for adequate current carrying capacity or as noted on the Drawings. Continuous current ratings shall be in accordance with temperature specifications set forth by UL, ANSI and NEMA standards.

6. A copper ground lug shall be provided in each incoming line vertical section capable of accepting #8 to 250 kcmil cable. A horizontal and vertical tin plated 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. Ground bus shall be tin plated copper (600 ampere minimum) and have a cross-sectional area equal to 28 percent of the main horizontal bus cross sectional area. 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 stall shall make contact with ground bus before the power bus contact is made.

Q. Bus Barriers

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 sides 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.
Shutters shall automatically open when a unit is inserted and automatically close when a unit is removed, so that personnel are not exposed to live vertical bus bars and so that the bus is isolated from arcing faults.

R. Main Incoming Lug Compartments

1. A front accessible lug compartment shall be provided with suitable lugs to accommodate the incoming cables as noted on the Drawings. The compartment shall be located in the bottom most unit space of the section to accommodate the user's cables entering the motor control center. The main incoming lug compartment shall be covered by a hinged door for maintenance access. This door shall be held closed with captive type screws to discourage unauthorized access. A unit door padlock attachment shall also be provided to lock the door in the closed position with one 5/16-inch diameter shackle padlock. This attachment shall also accept a meter type seal. All lug connections, bus work bolts, etc. shall be torque tightened to the manufacturer’s specifications.

2. Combination starter units shall consist of solid state starters, variable frequency drives, motor circuit protectors, 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 wireways 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 withstandability.

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.

S. Unit Plug-On

For convenient unit connection to bus bars, unit plug-on contacts shall be provided on circuit breaker units, 225 ampere and smaller. 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 tin plated and 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.

T. Unit Doors

Each unit shall have a door securely mounted with rugged concealed-type hinges that 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 its 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.

U. Unit Support Pan

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.

V. Unit Saddles

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.

W. Disconnect Operators

An external operator handle shall be supplied for each switch and breaker. This mechanism shall be engaged with the disconnect device 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 operation 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. All disconnect handles for switches or circuit breakers shall not extend more than 6 feet-7 inches above the floor or working platform.

X. Power Monitor

Provide a power monitor suitable for mounting in the MCC. The monitor shall be nonresettable and provide a digital display of kwH on the front of the monitor. The monitor shall provide pulsed input to the PLC for accumulation of kwH and 4- 20 mA input to the PLC for KW indication. The monitor shall be provided with all CTs and PTs required for functionality of the power monitor. All components of the power monitor shall be mounted in the MCC.

The monitor shall provide individual harmonic analysis up to the 63rd harmonic and shall measure percent distortion and magnitude. The monitor shall provide a compliance check to IEEE-519.

The power monitor shall be Tesco or approved equal.

Y. Manufacturers:

1. Tesco
2. Allen Bradley
3. Cutler Hammer
4. Or Approved Equal

2.02 FULL-VOLTAGE NON-REVERSING DRIVES

A. Product Description: NEMA ICS 2, AC general-purpose Class A magnetic drive for induction motors rated in horsepower.

B. Control Voltage: 120 volts, 60 hertz.

C. Overload Relay: NEMA ICS 2; solid state.

D. Product Options and Features:

1. Auxiliary Contacts: NEMA ICS 2, as indicated on the Drawings.

2. Cover Mounted Pilot Devices: NEMA ICS 5, heavy-duty oil-tight type.

3. Pilot Device Contacts: NEMA ICS 5, Form Z, rated A150.

4. Pushbuttons: Recessed type.

5. Indicating Lights: LED type.

6. Selector Switches: Rotary type.

7. Relays: LED indicating, NEMA ICS 5.

8. Control Power Transformers: 120 volt secondary, as scheduled.

2.03 SURGE PROTECTION

A. Surge Protection

1. Product

a. Motor Control Center Housing: The unit shall be housed in a NEMA Size 1 Stab-in MCC housing (bucket).

b. Integral Fused Disconnect Switch: The unit shall include an integral fused and safety interlocked disconnect switch located in the unit enclosure with an externally mounted manual operator on the face of the housing. Each switch shall disconnect all ungrounded circuit from the distribution system to enable testing and maintenance without interruption of the power to the facility's distribution system. The switch shall be rated for 600 VAC. Each current carrying ungrounded circuit conductor connected to the facility's distribution system shall be individually fused with 200,000 AIC rated fuses (one 200,000 AIC fuse per phase) in order to provide maximum fault current protection. The unit shall be UL 1449 listed with the integral fused disconnect switch and the UL 1449 suppression rating for this configuration shall be provided.

c. Suppression/Filter System: High-performance suppression system. The unit shall include an engineered solid-state high- performance suppression system, utilizing arrays of fused non-linear voltage dependent metal oxide varistors with similar operating characteristics. The suppression system's components shall optimally share surge currents in a seamless, low-stress manner assuring maximum performance and proven reliability. The suppression system shall not use gas tubes, spark gaps, silicon avalanche diodes or other components that might short or crowbar the line, thus leading to interruption of normal power flow to or system upset of connected loads. The suppression system shall not incorporate non-field replaceable fusing of any other components, which may degrade performance or long-term reliability of the suppression system.

The unit shall include a high frequency extended range tracking filter and shall be UL 1283 listed as an electromagnetic interference filter. The filter shall reduce fast rise-time, high frequency, error producing transients and electrical line noise to harmless levels, thus eliminating disturbances, which may lead to system upset. The filter shall provide attenuation throughout the frequency spectrum of 100 Hz to 100 MHZ with insertion loss at the benchmark frequencies as follows:

Attenuation Frequency	**100 KHz**	**1 MHZ**	**10 MHZ**	**100 MHZ**
Insertion Loss (ratio)	50 to 1	350 to 1	500 to 1	250 to 1
Insertion Loss (dB)	34	51	54	48
Note: Standardized insertion loss data obtained utilizing MIL-STD-E220A 50 ohm insertion loss methodology.				

Suppression/Filter System Connections: All internal wiring associated with the suppression/filter system and subject to surge currents shall utilize low-impedance copper bus bar and/or #8 AWG copper conductor or larger. All internal connections associated with the suppression/filter system and subject to surge currents shall be make with compression solderless-type lugs and shall be bolted to the bus bars in order to reduce overall system impedance. No plug-in component modules, quick-disconnect terminals or printed circuit boards shall be used in surge current- carrying paths.

d. Integral Test Point: The unit shall incorporate an integral test point allowing easy off-line diagnostic testing. High voltage impulses are injected into the

suppression filter system verifying clamping levels and operational integrity via the optional diagnostic test set.

e. Remote Status Monitor Contacts: Unit shall include Form C dry contacts (NO or NC) to facilitate connection to a building management system in order to monitor the on-line status of the unit. The contacts shall be normally open or normally closed and shall close or open upon failure of the suppression system and/or fuse.

f. Disturbance Counters: Unit shall include two highly accurate solid-state six-digit liquid crystal displays that discriminate between and exhibit both common mode (L-G) and normal mode (L-L or L-N) disturbances. The disturbance counters shall utilize self-contained lithium batteries with a nominal life of 10 years. Reset function shall be secure and remotely located.

2. Documentation

The following documentation shall be required with the shipment of the surge suppression unit:

a. Equipment Manual: The manufacturer shall furnish an equipment manual with installation, operation, and maintenance instructions for the specified unit. A list of customer-replaceable spare parts shall be included in the unit's installation, operation and maintenance instructions. All spare parts shall be quickly and easily field-replaceable. The maintenance instructions shall include the recommended testing schedule to verify system integrity.

b. Drawings: Electrical and mechanical drawings shall be provided by the manufacturer that show unit dimensions, weights, mounting provisions, connection details and layout diagram of the unit.

c. MCOV Testing: The unit shall be factory tested and burned in at the applicable MCOV for a minimum of 1 hour.

2.04 MOLDED CASE CIRCUIT BREAKER

A. Product Description: NEMA AB 1, molded-case circuit breaker.

B. Field-Adjustable Trip Circuit Breaker: Circuit breakers with frame sizes 200 amperes and larger have mechanism for

adjusting short time, long time and pickup current setting for automatic operation.

C. The main circuit breaker shall be 100 percent rated.

D. Circuit breakers shall be pad-lockable.

2.05 SOURCE QUALITY CONTROL

A. Shop inspect and perform standard productions tests for each drive in accordance with the manufacturer's standards.

B. Make the completed motor control center available for inspection at the manufacturer's factory prior to packaging for shipment. Notify the Owner at least 7 days before inspection is allowed.

C. Allow witnessing of factory inspections and tests at the manufacturer's test facility. Notify the Owner at least 7 days before inspections and tests are scheduled.

2.06 MINI CAS RELAY UNIT

A. Mini CAS relay unit for seal fail & high temperature detection in submersible pump will be provided by submersible pump supplier and install in the MCC motor starter as show on plans. Contractor to coordinate with both pump and MCC supplier for installation.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify surfaces are suitable for motor control center installation.

3.02 INSTALLATION

A. Install in accordance with NEMA ICS 2.3.

B. Tighten accessible bus connections and mechanical fasteners after placing motor control center.

C. Select and install heater elements in motor drives to match installed motor characteristics.

D. Install engraved plastic nameplates in accordance with Section 011006050.

E. Ground and bond motor control centers in accordance with Section 011006050.

3.03 IDENTIFICATION

A. 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 bakelite nameplate fastened to the outside of the unit door for ease in identification and for making changes when regrouping units.

3.04 CONTROL

A. Relays, control switches and indicating lights shall be provided as specified in this section and as indicated on the Plans.

B. Two spares of each of the following devices shall be provided:

1. Relay with four contacts

2. Reset switch

3. Indicating light

C. Relays shall be mounted in the control panel and wired to a terminal block. Reset switches and indicating lights shall be mounted on each pump starter enclosure door and wired to a terminal block with a nameplate labeled below each device.

D. The control drawings indicate the anticipated control scheme, but field conditions and Owner requests may require the addition of relays, auxiliary contacts, and wiring to make minor control changes. The Contractor shall include in his bid the amount required to effect changes amounting to at least 5 percent of the control wiring and devices without additional cost to the Owner.

3.05 FINISH

A. All metal structural and unit parts shall be completely painted using an electrode position 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 for improvement of paint adhesion. The paint process shall consist of cleaning, rinsing, phosphating, four pre-paint rinses, painting, three post-paint rinses, a bake cure, and cool down. Paint shall be Acrylic-Melamine Electrode Position Baked Enamel, #49 medium light gray per ANSI Z55.1-1967. Removable push button operator plates, flange mounted operator handles and trim plates, and top horizontal wire trough cover plates shall be painted shall be painted a contrasting light gray.

3.06 FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA ATS, except Section 4.

B. Perform inspections and tests listed in NETA ATS, Section 7.16.

END OF SECTION

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SECTION 011006448 ELECTRICAL CONTROLS AND RELAYS

PART 1 - GENERAL

1.01 SUMMARY

A. This section includes pushbutton and selector switches, control stations, relays, time delay relays, control power transformers, and control panels.

1.02 REFERENCES

A. NECA (National Electrical Contractors Association) - Standard of Installation.

B. NEMA ICS 1 (National Electrical Manufacturers Association) - Industrial Control and Systems: General Requirements.

C. NEMA ICS 4 (National Electrical Manufacturers Association) - Industrial Control and Systems: Terminal Blocks.

D. NEMA ICS 5 (National Electrical Manufacturers Association) - Industrial Control and Systems: Control Circuit and Pilot Devices.

E. NEMA ICS 6 (National Electrical Manufacturers Association) - Industrial Control and Systems: Enclosures.

F. NEMA ST 1 (National Electrical Manufacturers Association) - Specialty Transformers (Except General Purpose Type).

1.03 SUBMITTALS

A. Section 01300 - Submittal Procedures: Submittal procedures.

B. Shop Drawings: Comply with NEMA ICS 1 and indicate control panel layouts, wiring connections and diagrams, dimensions, and support points.

C. Product Data: Submit catalog data for each component showing electrical characteristics and connection requirements.

1.04 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with a minimum of 3-years documented experience.

1.05 COORDINATION

A. Install control switches and indicating lights, as indicated on the Drawings.

PART 2 - PRODUCTS

2.01 CONTROL SWITCHES

A. Product Description: NEMA ICS 5, heavy-duty, oil-tight devices.

B. Selector Switch Operator: Rotary.

C. Pushbutton Operator: Push to actuate-type.

D. Indicating Lights: Indicating lights for mounting in motor control centers or motor starter enclosures shall be round, oil-tight type, complete with color of lens indicated and legend plate. Lights for mounting in control panels shall be square with single or multi-function indication as indicated. All lights shall be 120-volt AC. Provide 12 spare lamps. All indicating lights shall have push to test feature.

E. Control switches for mounting in motor control centers or motor starter enclosures shall be round. Control switches for mounting in control panels shall be square push to actuate type.

F. Provide legend plates to indicate function.

G. Provide quantity of contact blocks for functionality as required on the Drawings.

2.02 MAGNETIC CONTROL RELAYS

A. Product Description: NEMA ICS 5, magnetic control relay.

B. Contacts: Form C.

C. Contact Ratings: Class A150.

D. Coil Voltage: 120 volts, 60 Hz., AC.

E. Enclosure: NEMA ICS 6, to meet conditions of installation.

2.03 TIME DELAY RELAYS

A. Product Description: NEMA ICS 5, time delay relay with time delay as indicated on the drawings.

B. Contacts: Form C.

C. Contact Ratings: Class A150.

D. Coil Voltage: 120 60 Hz., AC

E. Enclosure: NEMA ICS 6, Type 1.

2.04 LIMIT SWITCH

A. Manufacturers:

1. Tesco
2. Allen Bradley Model 802.
3. Or approved Equal

B. Product Description: NEMA ICS 5, heavy duty, lever-operated double pole, double pole contacts shall be rated 5 amperes, 120-volt inductive load limit switch.

C. Contacts: Form C.

Limit switches shall be mounted on all equipment as indicated or specified and shall be equipped with proper mounting hardware and actuator.

D. Contact Ratings: Class A150.

E. Enclosure: NEMA ICS 6, to meet conditions of installation.

2.05 CONTROL POWER TRANSFORMER

A. Product Description: NEMA ST 1, machine tool transformer with isolated secondary winding.

B. Power Rating: As indicated on the Drawings.

C. Voltage Rating: 480 volts primary; 120 volts secondary.

2.06 TERMINAL BLOCKS

A. Product Description: NEMA ICS 4, terminal blocks.

B. Power Terminals: Unit construction type with closed back and tubular pressure screw connectors, rated 600 volts.

C. Signal and Control Terminals: Modular construction type, suitable for channel mounting, with tubular pressure screw connectors, rated 300 volts.

D. Include ground bus terminal block, with each connector bonded to enclosure.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install in accordance with NECA “Standard of Installation.”

B. Install individual relays and time delay relays in enclosures.

C. Install enclosures and boxes plumb. Anchor securely to wall

and structural supports at each corner in accordance with Section 011006050.

D. Install cabinet fronts plumb.

E. Make electrical wiring interconnections as indicated on the Drawings.

F. Install engraved plastic nameplates in accordance with Section 011006050.

G. Ground and bond controls and relays in accordance with Section 011006050.

END OF SECTION

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SECTION 011006461 DRY TYPE TRANSFORMERS

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. This section includes two-winding transformers.

1.02 RELATED SECTIONS:

A. Section 011006443 – Motor Control Center

1.03 REFERENCES

A. NEMA ST 20 (National Electrical Manufacturers Association) - Dry-Type Transformers for General Applications.

B. NETA ATS (International Electrical Testing Association) - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.04 SUBMITTALS

A. Product Data: Submit outline and support point dimensions of the enclosures and accessories, unit weight, voltage, KVA, and impedance ratings and characteristics, tap configurations, insulation system type, and rated temperature rise.

B. Test Reports: Indicate loss data, efficiency at 25, 50, 75 and 100 percent rated load, and sound level.

1.05 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record the actual locations of the transformers.

1.06 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with a minimum of 3-years documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Store in clean, dry space. Maintain factory wrapping or provide additional canvas or plastic cover to protect the units from dirt, water, construction debris, and traffic.

B. Handle in accordance with the manufacturer's written instructions. Lift only with lugs provided. Handle carefully to avoid damage to transformer internal components, enclosure, and finish.

PART 2 - PRODUCTS

2.01 TWO-WINDING TRANSFORMERS

A. Product Description: NEMA ST 20, factory-assembled, air-cooled, dry type transformers. Transformer shall be UL listed.

B. Primary Voltage: As indicated on the Drawings.

C. Secondary Voltage: As indicated on the Drawings

D. Insulation system and average winding temperature rise for rated KVA as follows:

1. 10-500 KVA: Class 220 with 80°C rise.

E. Winding Taps:

1. Two 0.5 percent taps above and below normal.

2. Sound Levels: Maximum sound levels shall be at a minimum of 3 dBA below those indicated in NEMA ST-20 for the KVA rating indicated in the drawings.

F. Basic Impulse Level: 10 Kv.

G. Ground core and coil assembly to the enclosure by means of a visible flexible copper grounding strap.

H. Mounting:

1. 10-75 KVA: Suitable for mounting in a motor control center or floor mounting.

I. Coil Conductors: Continuous copper windings with terminations brazed or welded.

J. Enclosure: NEMA ST 20, Type 1. Furnish lifting eyes or brackets.

K. Isolate core and coil from enclosure using vibration-absorbing mounts.

L. Nameplate: Include transformer connection data.

2.02 SOURCE QUALITY CONTROL

A. Production test each unit according to NEMA ST20.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify mounting supports are properly sized and located.

3.02 INSTALLATION

A. Set transformer plumb and level.

B. Use flexible conduit for connections to transformer case.

C. Support transformers in accordance with Section 011006050.

D. Provide seismic restraints.

E. Install grounding and bonding in accordance with Section 011006050.

3.03 FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA ATS, except Section 4.

B. Perform inspections and tests listed in NETA ATS, Section 7.2.1.

3.04 ADJUSTING

A. Measure primary and secondary voltages and make appropriate tap adjustments.

END OF SECTION

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SECTION 011006510 LUMINAIRES

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. This section includes interior and exterior luminaires, lamps, ballasts, and accessories.

1.02 REFERENCES

A. ANSI LM80 - IES Approved Method of Measuring Lumen Maintenance of LED Light Sources.

B. UL 1598 “Luminaires”

C. UL 844 “Luminaires for Use in Hazardous (Classified) Locations”

1.03 SUBMITTALS

A. Shop Drawings in Accordance with the General Conditions: Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.

B. Product Data: Submit dimensions, ratings, and performance data.

1.04 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with a minimum of 3-years documented experience.

1.05 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.06 MAINTENANCE MATERIALS

A. Furnish two of each plastic lens type.

B. Furnish one replacement lamps for each lamp installed.

C. Furnish two of each ballast type.

PART 2 - PRODUCTS

2.01 INTERIOR LUMINAIRES

A. Product Description: Complete interior luminaire assemblies, with features, options, and accessories as scheduled.

2.02 LIGHT EMITTING DIODE (LED) LIGHT SOURCES

A. Product Description: Complete LED luminaire including driver as shown on the Drawings.

B. LED luminaires shall have a correlated color temperature (CCT) of 3000K ±300K.

C. LED luminaires shall pass 3G vibration testing in accordance with ANSI C136.31.

D. Luminaires shall produce no measurable light at or above 90 degrees.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install accessories furnished with each luminaire.

B. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.

C. Install specified lamps in each luminaire.

D. Ground and bond interior luminaires in accordance with Section 011006050.

3.02 FIELD QUALITY CONTROL

A. Operate each luminaire after installation and connection. Inspect for proper connection and operation.

3.03 ADJUSTING

A. Aim and adjust luminaires.

3.04 CLEANUP

A. Remove dirt and debris from enclosures.

B. Clean photometric control surfaces as recommended by the manufacturer.

C. Clean finishes and touch up damage.

D. Clean all luminaire reflectors, globes, lenses, and diffusers that appear noticeably dirty.

E. Replace all burned out lamps.

3.05 PROTECTION OF FINISHED WORK

A. Relamp luminaires having failed lamps at substantial completion.

END OF SECTION

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DIVISION 08 – INSTRUMENTATION AND CONTROLS

SECTION 011007100 FIELD-MOUNTED INSTRUMENTS

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. This section includes materials and installation of the following calibrated field mounted instruments:

1. Float/Level Switches.

2. Tubing, valves, fittings, and manifolds.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 011007110 – General Operations.

1.03 SUBMITTALS

A. Submit shop drawings in accordance with Section 01300.

PART 2 - MATERIALS

2.01 TUBING, VALVES, FITTINGS, AND MANIFOLDS

A. Instrument tubing connections between process lines and instruments shall be ½ inch in diameter with 0.035-inch seamless wall, annealed ASTM A 269, Type 316 stainless steel, or as indicated on the Drawings.

B. Fittings shall be Type 316 stainless-steel double ferrule design. Fittings shall be Swagelok, Parker CPI, or approved equal.

C. Valves shall be full port ball valves with Type 316 stainless-steel body and Teflon seats and packing. Valves shall be Parker CPI, Whitey, or approved equal.

2.02 FLOAT/LEVEL SWITCHES

A. Float switch body shall be a mercury-free self-counterweighted floating switch designed for the automation of pumps in sewage water applications.

B. Body shall be constructed of polypropylene and consist of a double airtight chamber with high-pressure melted polypropylene re-injection sealing to ensure a perfect seal against infiltration.

C. A potted SPDT magnetic reed switch rated 100 VA minimum at up to 250 Volts shall be mounted inside the float and connected to a multi-stranded, 2 conductors plus ground, PVC jacketed cable.

Cable length to be field verified by contractor.

D. The float switches shall be model FSW2 floats as manufactured by Dwyer or approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Provide the services of qualified factory-trained servicemen to assist in the installation of the instrumentation and control system equipment.

B. Install each item in accordance with manufacturer's recommendations and in accordance with the CONTRACT DOCUMENTS. Instruments require access for periodic calibration or maintenance. Instruments shall be mounted so they are accessible while standing on the floor.

C. All items shall be mounted and anchored using Type 316 stainless steel hardware, unless otherwise noted.

D. All field instruments shall be rigidly secured to walls, stands or brackets, as required, by the manufacturer or as shown on the Drawings. Mounting instruments on handrails will not be allowed.

3.02 START-UP, CALIBRATION, AND TESTING AND TRAINING

A. Calibration of Instruments:

1. All instruments are to be field calibrated and witnessed by the Owner through their entire range or with the required setpoints prior to start-up. Factory calibrated instruments are required to be recalibrated in the field prior to start-up and witnessed by the Owner.

B. Primary Sensors/Transducers and Field Instruments:

1. Provide on-site operation and maintenance training by Equipment Suppliers and/or the equipment manufacturer representatives prior to placing the equipment in continuous operation.

2. Training shall accomplish the following:

a. Provide instruction covering procedures for routine, preventive and troubleshooting maintenance and equipment calibration.

END OF SECTION