

**SPECIFICATIONS - DETAILED PROVISIONS**  
**Section 11005 - General Mechanical and Equipment Provisions**

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**SECTION 11005**  
**GENERAL MECHANICAL AND EQUIPMENT PROVISIONS**

**PART 1 - GENERAL**

**1.01 DESCRIPTION**

These General Mechanical and Equipment Provisions, which apply to all systems and equipment, are hereby made a part of each and all of the separate Sections of this Specification. Contractor shall direct the attention of all Subcontractors and suppliers of mechanical and related appurtenances for the Work to the provisions of the Contract Documents located in these specifications.

**1.02 MANUFACTURER'S EXPERIENCE**

Unless specifically named in the detailed Specifications, a manufacturer shall have furnished equipment of the type and size specified which has demonstrated successful operation and is in regular use.

**1.03 FACTORY INSPECTION**

The District or its representative may inspect fabricated equipment at the factory without cost to the Contractor. The Contractor shall notify the District in sufficient time so that factory inspection can be arranged. Factory inspection will be made after manufacturer has performed satisfactory checks, adjustments, tests and operations. Approval of equipment at the factory only allows the manufacturer to ship the equipment to the site, and does not constitute final acceptance by the District.

**1.04 STANDARD OF QUALITY**

Items of equipment are specified by the name of the manufacturer for the purpose of establishing a standard of quality and acceptable experience. Substitute equipment will be acceptable if it can be demonstrated to the District that the substitute is in strict accordance with the Specifications and equal in quality to those models specifically named. Manufacturers specified have been determined by the District to meet or exceed the minimum acceptable standard for the designated equipment style and model. Refer to the General Provisions for requirements pertaining to substitutions and equals. All mechanical equipment furnished under the Specification shall be new and of current design.

**1.05 ADAPTATION OF EQUIPMENT**

No responsibility for alteration of a planned structure to accommodate substitute equipment will be assumed by the District. Equipment which requires alteration of the structures will be considered only if the Contractor assumes all responsibility for making and coordinating all necessary alterations. All revisions to structures, mechanical, electrical, or other work made necessary by such substitution shall be approved by the District and the cost of said revisions, including cost of redesign, shall be made at the Contractor's expense. Refer to General Provisions.

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- A. Horsepower Ratings. Horsepower ratings specified and/or shown for the proposed equipment are in accordance with the best information available to the District. In the event any equipment item proposed by the Contractor should require motors with larger horsepower rating than indicated on Electrical Drawings, it shall be the Contractor's responsibility to provide the proper control equipment, required modifications to motor control centers, starting equipment, feeder and branch circuit, and accessories as required to make the installation comply with the electrical code and to prevent excessive voltage drop without added cost to the District.
- B. Equipment. Where equipment to be furnished is installed in an existing enclosure or adjacent to existing equipment, the Contractor shall field check the dimensions of existing equipment, location of conduits, etc., and shall familiarize himself with all existing conditions and difficulties to be encountered in performing such work.

#### 1.06 GUARANTEES AND WARRANTIES

The Contractor shall guarantee all equipment in accordance with the Conditions of the Contract. In addition to the general guarantee requirements, equipment guarantee shall cover (1) faulty or inadequate design; (2) improper assembly or erection; (3) defective workmanship or materials; and (4) leakage, breakage, or other failure. For equipment bearing a manufacturer's warranty in excess of one (1) year, furnish a copy of the warranty to District with District named as beneficiary. The period of all guarantees shall be initiated from the date of the District written acceptance of the Work.

#### 1.07 SUBMITTALS

Refer to Section F Labor and Construction, F-30 "Submittals" and to specific Divisions and Sections for additional submittal requirements.

- A. Shop Drawings. Shop drawings shall be submitted to the District in complete sets indexed by Specification paragraph and Drawing number describing the various equipment items or systems. Unless otherwise specified or directed, submit shop drawings for all mechanical equipment specified herein.
- B. Earthquake Design Data. Submit with the shop drawings complete calculations or test results, details of constructions, and method of attachment for all manufactured products showing compliance with Paragraph 3.11, "Earthquake Design and 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.
- C. Instruction Manuals. Prepare and submit instruction manuals covering all mechanical equipment and machinery specified herein.

- D. Manufacturers' Certified Reports. Each equipment manufacturer, or his authorized representative, shall submit a notarized written report with respect to his equipment certifying that (1) the equipment has been properly installed and lubricated under his supervision, (2) the equipment is in accurate alignment, (3) he was present when the equipment was placed in operation, (4) he has checked, inspected, and adjusted the equipment as necessary, (5) the equipment is free from any undue stress imposed by connecting piping or anchor bolts, (6) has been satisfactorily operated under full load conditions, (7) he has inspected his equipment during the operational demonstrations and system validation tests to the extent specified, and (8) the equipment is fully covered under the terms of the guarantee.
- E. Submittals For Operational Demonstration and System Validation Tests
1. **Operation Demonstration.** When the Contractor's application for a progress payment equals or exceeds 75% of the Contract value for the first time, submit a detailed and comprehensive procedure plan for performance of each operation demonstration required. Identical equipment items may be covered under one plan. Include an estimated date and duration for each procedure and personnel required.
  2. **System Validation Tests.** When the Contractor's application for a progress payment equals or exceeds 75% of the Contract value for the first time, submit a detailed and comprehensive procedure plan for performance of each separate validation test and for each validation test that covers two or more systems. Each procedure plan shall describe and itemize the involved system, including associated electrical equipment and instrumentation and control systems, and shall include evidence of an organized step-by-step procedure properly coordinating the efforts of various trades and manufacturers' representatives involved and of the operation of the facilities. Procedures shall include an estimated duration and date for each procedure and the personnel required.
  3. **Procedure Plan Information.** In addition to the information specified above, each procedure plan shall include the following information as applicable.
    - a) Description of temporary procedure facilities, including Drawings and sketches as required to fully illustrate the facilities.
    - b) List of test materials and estimated quantities.
    - c) List of instruments, measuring and recording devices, and other test equipment, whether a part of the plant or furnished separately for temporary use.
    - d) Names of supervising and inspecting manufacturers.

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- e) Complete listing of all functional parameters to be observed and recorded.
  - f) Recording intervals.
4. Records Materials. Submit samples of the forms, charts, and other materials to be used in recording demonstration and validation test results.
  5. Results. Within 10 days after completion of each procedure plan submit 3 copies of all recordings and results of all operational demonstrations and system validation tests.
- F. Electric Motors. Conform with applicable requirements specified in Sections 16150 and 16151 herein.

#### 1.08 PRODUCT DELIVERY, STORAGE AND HANDLING

Box, crate, or otherwise enclose and protect equipment during shipment, handling, storage, and following installation until final acceptance of the project. Keep equipment dry and covered from exposure to weather. Store pumps, motor, electrical equipment, and equipment having anti-friction or sleeve bearings in weathertight storage facilities. Lift large equipment items only at the points designated by manufacturer.

- A. Factory Painted Surfaces. Protect against impact, abrasion, discoloration, and other damage. Repair damage as directed and approved (Refer to Section 09871).
- B. Electrical Equipment. Maintain electrical equipment, controls, and keep insulation dry at all times. Keep heaters in equipment connected and operating until equipment is placed in operation.

#### 1.09 JOB CONDITIONS

Drawings are diagrammatic and show the intended arrangement of principle apparatus, piping, and appurtenances. Conform to Drawings as closely as possible and exercise care to secure approved headroom and space conditions, neat arrangement of piping, valves, hangers, and like items, and to overcome structural interferences. Verify dimensions and conditions at the place of installation, and install materials and equipment in the available spaces. Submit written details and reasons for proposed deviations from Drawings and Specifications, and do not deviate therefrom unless authorized by Field Order or Change Order. If approved changes require alteration of structures or related work, make such alterations as approved in advance by District at no additional cost to District.

#### 1.10 EQUIPMENT

All equipment furnished shall be complete, ready for installation and operation. All bolts, nuts, washers, mounting plates, bed plates, bases, anchor bolts and other miscellaneous items necessary to form a complete, installed, operational system shall be furnished whether specifically specified or not.

## **PART 2 - PRODUCTS**

### 2.01 MATERIALS AND WORKMANSHIP

All equipment furnished shall be new and guaranteed free from defects in materials, design, and workmanship. It shall be the manufacturer's responsibility to ascertain the conditions and service under which the equipment will operate and to warrant that operation under these conditions shall be successful. All parts of the equipment shall be amply proportioned for all stresses that may occur during fabrication, erection, and intermittent or continuous operation.

All equipment shall be designed, fabricated, and assembled in accordance with the best modern engineering and shop practice. Individual parts shall be manufactured to standard sizes and gauges so that repair parts, furnished at any time, can be installed in the field. Like parts of duplicate units shall be interchangeable. Equipment shall not have been in service at any time prior to delivery, except as required by tests. Materials shall be suitable for service conditions. Iron castings shall be tough, close-grained gray iron free from blowholes, flaws, or excessive shrinkage and shall conform to ASTM A48. Except where otherwise specified, structural and miscellaneous fabricated steel used in items of equipment shall conform to the Standards of the American Institute of Steel Construction. All structural members shall be considered as subject to shock or vibratory loads. Unless otherwise specified, all steel which will be submerged, all or in part, during normal operation of the equipment shall have a minimum nominal thickness of 1/4-inch. Provide equipment and materials suitable for the service conditions and meeting standard specifications such as ANSI, ASME, AWWA, ASTM, NEMB, UBC, and UL. The location of the fabricator and his shop schedule shall be furnished to the District prior to the beginning of fabrication so that the District can schedule shop inspection.

### 2.02 LUBRICATION

- A. Lubricants. Provide lubricants of types recommended by equipment manufacturers, quantities sufficient for consumption prior to completion, testing, and final acceptance.
- B. Lubrication Systems. Lubrication of equipment shall ensure constant presence of lubricant on all wearing surfaces. Lubricant fill and drain openings shall be readily accessible. Easy means for checking the lubricant level shall be provided. Prior to testing and/or operation, the equipment shall receive the prescribed amount and type of lubricant as required by the equipment manufacturer. Equipment lubrication systems shall be systems that require attention during start up of shut down, and shall not waste lubricants.

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#### 2.03 STRUCTURAL STEEL FABRICATIONS

Conform to "Code of Standard Practice for Steel Buildings and Bridges" and "Specification for the Design, Fabrication and Erection of Structural Steel for Buildings" of the AISC unless otherwise indicated or specified. Design all fabrications for dynamic and vibratory loadings. Use structural steel shapes conforming to ASTM A36, A440, A500, A501, A570, A618, or equal, as applicable. Conform welding to AWS D1.1 Structural Welding Code. Galvanized specified items in accordance with ASTM A123, A153, or A386 as applicable; use galvanized bolts and fasteners with galvanized assemblies.

#### 2.04 EQUIPMENT BASES AND BEDPLATES

Mount equipment assemblies on a single heavy cast iron or welded steel bedplate unless otherwise shown or specified. Provide bases and bedplates with machined support pads, tapered dowels for alignment or mating of adjacent items, adequate openings to facilitate grouting, and openings for electrical conduits. Continuously weld seams and contact edges between steel plates and shapes, and grind welds smooth. Do not support machinery or piping on bedplates other than that which is factory installed. Provide jacking screws in equipment bases and bedplates to aid in leveling prior to grouting. Provide plates of minimum thickness of 1/4-inch. Pump bedplates shall include a drip lip and provisions for directing leakage to a single disposal point.

#### 2.05 ANCHORS AND SLEEVES

Each equipment manufacturer shall furnish the required anchor bolts, nuts, washers, and sleeves of adequate design for securing bases and bedplates to concrete bases. Provide sleeves of at least 1-1/2 times anchor bolt diameter. Anchor bolts shall be Type 316 stainless steel. Provide anchor bolts of length to allow for 1-1/2 inch of grout under baseplates and adequate anchorage into structural concrete unless otherwise shown or specified. Conform to designs for attachments to resist seismic forces, as applicable.

#### 2.06 SAFETY GUARDS

Cover belt or chain drives, fan blades, couplings, exposed shafts and other moving or rotating parts on all sides with safety guards conforming to all Federal, state, and local codes and regulations pertaining; conform to the most restrictive requirements. Safety guards shall be free of all sharp edges and corners. Use corrosion-resistant materials at least equivalent to hot-dip galvanized steel. Safety guards shall be fabricated from 16USS gauge, or heavier, galvanized or aluminum-clad steel or 1/2-inch mesh galvanized expanded metal. Design guards for easy installation and removal. Provide necessary supports, accessories, and fasteners, of hot-dip galvanized steel or stainless steel. Design guards in outdoor locations to prevent entrance of rain and dripping water.

#### 2.07 DRIVE UNITS

Provide drive units designed with a AGMA rating and service factor suitable for 24 hour continuous duty service under operating load, constructed to preclude oil leakage around shafts. Drive unit housings shall be constructed of high grade cast iron, welded steel, or other suitable material. Thermal rating of each unit shall exceed the design load or proper cooling devices shall be provided. All drives shall be designed specifically for the service conditions under which they are to operate.



- A. Motor Ratings. Provide drive motors having nameplate horsepower rating at least equal to 110 percent of the theoretical brake horsepower required to drive equipment under full load for conditions specified, including all losses in speed reducers and power transmission. Refer also to Section 16150.
- B. V-Belt Drives. Equip each V-belt with a sliding base or other suitable tension adjustment. Where motors are mounted above the driven machine on a pedestal, the belt tensioning shall be accomplished by four studs which are double nutted to the motor plate to raise and lower the motor plate. Hinges with jacking screw to tension the belts shall not be used. Provide drives having a service factor of at least 1.6 at maximum torque using nameplate rating of driving motor.

## 2.08 GEARS

Provide oil-lubricated totally-enclosed gear reducers and increasers.

- A. Service Ratings. Each gear shall have a nameplate service horsepower rating equal to the nameplate rating of the driving motor. Each gear shall have mechanical and thermal capacity equal to, or greater than an equivalent horsepower determined by multiplying the service horsepower rating by the specified service factor recommended by AGMA for heavy duty service, except each set of worm gears shall have a minimum service factor of 1.50.
- B. Thermal Rating. Obtain thermal rating for the equivalent horsepower without auxiliary cooling equipment such as heat exchangers. Design units to operate continuously for the conditions specified in a location where ambient temperatures vary from 30° to 130° F. If a cooling coil is required, provide minimum 1-inch diameter tubing and a 1-inch solenoid supply water valve with the gear.
- C. Bearings. Provide anti-friction bearings throughout, designed to give 20,000 hours B100 life for the specified horsepower in continuous operation, of proportions, mounting and adjustment consistent with acceptable modern practices for applied radial and thrust loads at speeds involved. Provide thrust bearing rates at 1-1/2 times the maximum thrust loadings involved.
- D. Gear Nameplates. Equip each gear with an AGMA nameplate which shows service horsepower, actual service factor for actual mechanical or thermal rating as applicable, and AGMA gear Class I rating.

## 2.09 ELECTRICAL MOTORS FOR MECHANICAL EQUIPMENT

Conform with applicable requirements of Division 16.

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#### 2.10 CONTACTS

For interlock or failure indicating contacts specified to be supplied as part of equipment, provide SPDT switches rated for 120 VAC, 60 Hz at 5 amperes resistive or 3 amperes inductive loading, terminated at screw-type barrier strips in a NEMA 4 enclosure, unless otherwise shown or specified.

#### 2.11 GAUGES

Gauges shall be installed in the suction (where applicable) and discharge piping of each pump and blower. The gauges shall be 4-inch diameter, liquid filled and shall include a petcock (Corp stop) between the pump/blower piping and the gauge. For solids bearing or corrosive fluids, a diaphragm gauge isolator shall be provided. Suction gauges shall be of the compound type and shall have a range as shown on the Drawings. Discharge gauge ranges shall be a standard commercially available range as shown on the drawings.

#### 2.12 NAMEPLATES AND DATA PLATES

Provide Type 302, 304, or 316 stainless steel nameplates of ample size with embossed or preprinted lettering, fastened to the equipment in a prominent place with corrosion-resisting pins. On nameplates, display manufacturer, serial number, date of manufacture, model number and essential operating characteristics. Inscribe data plates with specific or directed information.

#### 2.13 PAINTING

Conform to applicable requirements of Section 09871 "Coating System for Water Pumping Plants" and following requirements unless modified or superseded under other Sections.

- A. Factory Painting. On mechanical equipment, drives, starters, control panels and other similar self-contained or enclosed components, apply a factory primer and high-quality oil-resistant baked industrial enamel finish. Paint or otherwise protect surfaces that are inaccessible after assembly by a method which provides protection for the life of the equipment.
- B. Shop Priming. Apply one or more shop coats of metal primer on surfaces to be finish painted at the site to protect surfaces until finished. Use primers specified for the required paint system in Section 09871.
- C. Rust Preventive. Coat machined, polished, or other ferrous surfaces, and non-ferrous surfaces, which are not to be painted, with rust preventive compound, Dearborn Chemical No-Ox-Id 2W, Houghton Rust Veto 344, Rust-Oleum 4-9, or approved equal.

### **PART 3 - EXECUTION**

#### **3.01 COORDINATION**

The Drawings show in a diagrammatic form the arrangements desired for the principle apparatus, piping, and similar appurtenances, and shall be followed as closely as possible. Proper judgment must be exercised in carrying out the work to secure the best possible headroom and space conditions throughout, to secure neat arrangement of piping, valves, fixtures, hangers, and similar appurtenances, and to overcome local difficulties and interferences of structural conditions wherever encountered.

The Contractor shall take all measurements for his work at the installation sites, verify all subcontractor drawings and be responsible for the proper installation, within the available space for the apparatus specified and shown on the Drawings, and must secure the approval of the District for any variations before making any changes.

Refer to pertinent Sections for items of equipment to be assembled of several components under the unit responsibility of one manufacturer. To coordinate this requirement, the Contractor shall monitor and verify the unit responsibility processes and submit the following information to the District in writing on a monthly basis:

- A. Shipment dates of the various components to the unit responsibility manufacturers.
- B. Scheduled dates of factory tests by unit responsibility manufacturers.
- C. Scheduled shipments dates to site of unit responsibility items.
- D. Scheduled arrival date, installation date and start-up date.

#### **3.02 INSPECTION**

Inspect each item of equipment for damage, defects, completeness, and correct operation before installing. Inspect previously installed related work and verify that it is ready for installation of the equipment.

#### **3.03 PREPARATION**

Prior to installing equipment, ensure that installation areas are clean and that concrete or masonry operations are completed. Maintain the areas in a broom-clean condition during installation operations. Clean, condition, and service equipment in accordance with the reviewed Instruction Manuals and requirements in other Sections of these Specifications before installing.

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#### 3.04 MANUFACTURERS' SUPERVISION AND INSTALLATION CHECK

Each equipment manufacturer shall furnish the services of an authorized representative specially trained and experienced in the installation of his equipment to (1) supervise the equipment installation in accordance with the reviewed Instruction Manual, (2) be present when the equipment is first put into operation, (3) inspect, check, adjust as necessary, and approve the installation, (4) repeat the inspection, checking, and adjusting until all trouble or defects are corrected and the equipment installation and operation are acceptable, (5) witness and supervise operational demonstrations and system validation tests to the extent specified, and (6) prepare and submit the specified Manufacturers' Certified Report. Include all costs for representatives service in the Contract Price.

#### 3.05 INSTALLATION

- A. Structural Fabrications. Conform to the AISC Code and Specification references in Article "Structural Steel Fabrications."
- B. Equipment. Conform to reviewed Instruction Manuals. Employ skilled craftsmen experienced in installation of the types of equipment specified. Use specialized tools and equipment, such as precision machinist levels, dial indicators, gauges, and micrometers, as applicable. Produce acceptable installations free of vibration or other defects.
- C. Anchor Bolts. Deliver bolts with templates or setting drawings and verify that bolts are correctly located before structural concrete is placed.
- D. Base and Bedplate Grouting. Do not place grout until initial fitting and alignment of connected piping is completed. Level and align equipment on the concrete foundations, then entirely fill the space under base or bedplates with grout. Bevel exposed grout at 45 degree angle, except round exposed grout at horizontal surfaces for drainage. Trowel or point exposed grout to a smooth dense finish and damp cure with burlap for three days. When grout is fully hardened, remove jacking screws and tighten nuts on anchor bolts. Check the installation for alignment and level, and perform approved corrective work as required to conform to the tolerances given in the applicable Instruction Manual.

#### 3.06 FIELD QUALITY CONTROL

- A. General. All costs for performing operational demonstrations and system validation tests shall be included in the Contract Price, and no extra payment will be made to the Contractor due to overtime, weekend, or holiday labor costs required to perform and complete the demonstrations and validation tests. Requirements specified in this Article are in addition to the demonstration and test requirements specified under other Sections of these Specifications.

1. Operational Demonstration and Systems Validation Testing shall be performed by the Contractor in accordance with the approved procedure plans to demonstrate to the District's satisfaction that:
  - a) All components of the process systems defined herein, the complete systems, and the new plant systems are fully completed and operable.
  - b) All units, components, systems, and the entire plant systems operate with the efficiency, repeatability, and accuracy indicated and specified.
  - c) All components, systems, and the entire plant conform to the Contract Documents and the reviewed shop drawings, samples, construction manuals, materials lists, and other reviewed submittals.
  
2. Scope of Demonstrations and Validation Testing. Operational demonstrations and system validation tests are required for all work, equipment, and systems specified in these Specifications including all associated and related electrical systems and control devices.
  - a) Equipment and work to be operationally demonstrated are defined as individual equipment items such as pumps, compressors, mixers, sludge collecting mechanisms, belt press and like equipment items. Demonstrations shall be performed simultaneously on groups of identical equipment items and groups of items supplied by one manufacturer to the extent feasible.
  - b) Systems to be validation tested are defined as complete systems that perform a discrete process function of the plant such as chemical systems, sludge collection system, sludge dewatering system, and similar systems. Each system shall include associated structures, tanks, piping, utilities, instrumentation and controls, and like related items. Two or more separate systems shall be validation tested simultaneously when necessary to validate an entire discrete plant function.
  
3. Prerequisite Conditions. Operational demonstrations and validation testing shall not commence for any equipment item or system until all related structures, piping, electrical, instrumentation, control, and like work has been installed, tested, and connected in compliance with the pertaining requirements specified elsewhere in the Specifications.

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4. **Demonstration and Testing Materials.** Furnish materials, natural gas and/or electrical power for operation demonstrations and validation tests. Use fresh water to fill tanks, wells, piping, and systems that contain water or wastewater in normal operation. Use the specified chemicals or chemical systems but do not exceed the "in service" concentrations. Furnish temporary facilities as required such as by-pass or re-circulation piping, diversions, storage, and similar facilities. Use procedures that conserve testing materials and avoid wastage, especially with respect to large quantities of fresh water and electrical power.
  5. **Inspection and Supervision by Manufacturers.** Perform operational demonstrations and system validation testing under continuous inspection by the District. Technical representatives of the various equipment manufacturers shall be present at the start of the operational demonstrations, shall examine their equipment at least twice near the beginning and end of the validation tests, shall supervise the start up and adjustment procedures, and shall perform all other services necessary for the manufacturer's certified reports required herein.
  6. **Correction of Defects.** Immediately correct all defects and malfunctions disclosed by demonstrations and validation tests using approved methods and new materials for repairs as required. Interruption time necessary for corrective work shall be added to the specified total demonstration and validation test periods.
  7. **Acceptance.** Satisfactory completion and approval of required operational demonstrations and system validation testing is one of the conditions precedent to the District's acceptance of the work and does not constitute final acceptance. Refer to the Conditions of the Contract.
- B. **System Validation Tests.** All equipment components of each system shall have successfully completed the required operational demonstration before the system is validation tested. Perform validation testing in accordance with the approved procedure plan.
1. **Test Period.** Test each system, including standby systems, by continuous operation in "in-service" condition for not less than 24 consecutive hours, with no interruptions except for normal maintenance or corrective work.
  2. **Testing Methods.** Operate systems continuously 24 hours a day under constant inspection of trained operators. Cycle system operation from full load to light load and back to full load each 24 hours; cause variable speed equipment to cycle through the applicable speed range at a steady rate of change. Induce simulated alarm and distressed operating conditions, and test controls and protective devices for correct operation in adjusting system functions or causing system shutdown.

3. Simulation of Conditions. Subject to Contractor's request and District's review in each case, the Contractor may simulate certain operating conditions relating to flow rates, water levels, and malfunctions. Permission for simulations will be granted only where it is unwise or impossible to obtain the conditions covered by the capability of ranges or equipment. The simulation methods shall reflect reasonable anticipated operating conditions.
4. Ranges for Testing.
  - a) Flow Metering Systems shall be tested at not less than 3 values corresponding approximately to a minimum, average and maximum capacity, respectively.
  - b) Liquid Level Indicating Systems shall be tested at not less than 5 levels corresponding approximately to low, average, normal, maximum and high alarm levels, respectively. Low-low and high-high level alarms and system reaction shall also be tested where equipment or instruments are required to react to such conditions.
  - c) Remotely Controlled Valves shall demonstrate suitable operation both from local control and remote controls. As a minimum, these procedures shall include full-open and full-close positioning. Each test shall be repeated not less than 3 times for non-throttling and non-modulating valves. In addition to these minimum requirements, and subject to approval, all throttling valves and modulating valves shall be operated at not less than 3 intermediate positions and shall demonstrate the ability of each valve to hold the set position under operating conditions.
  - d) Variable Speed Equipment shall demonstrate accurate response to speed controlling devices and controls within the required operating ranges. Actual output shaft speeds of manually adjustable speed equipment shall be validated by measurement of shaft speeds versus speeds shown by equipment instruments.
5. Automatic Response of Equipment. Response of equipment to appropriate manual or automatic controls, or combinations of both automatic and manual controls, shall be demonstrated to be correct and accurate. Where applicable, all components shall be tested for both manual and automatic operation. Where a component performs more than one function, every function shall be validated.
  - a) Pumping Equipment shall respond accurately and reliably to liquid level, pressure and/or flow rate signals from appurtenant reservoirs, pipes or wet wells. Automatic alternation and back-up pump functions shall also be validated.

- b) Auxiliary Equipment Items such as automatic samplers, annunciators, alarms, and like items shall respond accurately and reliably to every condition for which they are programmed, in the manner specified.
- C. Recording of Data. Neat and comprehensive records of each operational demonstration or validation test shall be maintained by the Contractor. Each portion of the demonstration or validation procedure shall be described with all components itemized. Records shall be prepared on forms in a step-by-step fashion paralleling the approved plans. Forms shall list for each condition:
- Step taken;
  - Result anticipated;
  - Result obtained;
  - If incorrect, corrective action taken; and
  - Retest result.
  - The last two steps shall be repeated until all systems operate as required.
1. **Recording Devices.** Instruments, gauges, and other sensor and display devices forming a part of the various systems shall be employed for data acquisition to the extent applicable. The Contractor shall furnish all other instruments, gauges, recorders, and test devices as required, types conforming to the approved procedure plans.
  2. **Information and Intervals.** All applicable data such as, but not limited to, water and other liquid levels, pressures, head differentials, duration of runs, instrument readings, chemical feed rates, voltage settings, drive speeds, motor running currents, torque, voltage, GPM, pressures, clarity, residual chlorine and related information, as applicable, and in accordance with the approved procedure plans, shall be recorded at the start and finish of every operational demonstration and at maximum 8-hour intervals during system validation tests, unless shorter intervals are specified elsewhere.
  3. **Repetitions.** When a repeat of the same demonstration or validation test is required to verify the results, the repeat procedure shall be indicated on the recorded date by numerical indication, date, and time.

### 3.07 CONSOLIDATION OF DEMONSTRATION, TESTING, AND INSTRUCTION REQUIREMENTS

Operational demonstrations, system validation testing, and instruction of the District's personnel may be performed simultaneously, subject to prior approval of the extent of consolidation in each case.



### 3.08 SOUND LEVEL TESTING AND WORKER PROTECTION

Measure the sound level developed by all mechanical and electrical equipment provided under the Contract Documents. Perform testing in all rooms and spaces containing such equipment during the final operation test program with all equipment operating. Use an OSHA approved instrument and record the highest sound level developed when measured according to OSHA standards in each room and space. Deliver a copy of records to the District.

### 3.09 IN-SERVICE CHECKS

As a part of the work, an in-service check of each system required to be validation tested shall be performed twice during the period of the Contractor's guarantee by qualified technical representatives of the various system manufacturers, including manufacturers of equipment and components within systems. Checks shall be detailed and complete, requiring not less than 8 hours at the site, and shall be performed under the observation and to the satisfaction of the District's Plant Superintendent or his designated representative. All costs for in-service checks shall be included in the Contract Price.

- A. Notification. The Plant Superintendent shall be notified in writing at least 10 days before the performance of each in-service check. The proposed dates for checking shall be changed if required by the Plant Superintendents.
- B. Consultation. At the time of each in-service check, the manufacturer's technical representatives shall consult with the Plant Superintendent to review the Operation and Maintenance Manual and the pertinent operational and maintenance problems encountered, and shall furnish technical advice and recommendations to the Plant Superintendent.
- C. Schedule. Initial in-service checks shall be performed approximately 6 months after final acceptance of the plant. The second in-service check shall be performed within 30 days of the end of the Contractor's guarantee period.
- D. Reports. A written report of each in-service check signed by the appropriate manufacturer or his representative, shall be delivered to the Plant Superintendent within 10 days following the check. The report shall describe the checking procedure in detail, and shall state all advice and recommendations given to the Plant Superintendent.

### 3.10 PUMPS

This article covers general stipulations applicable to the plant pumps. All applicable parts of this Section shall also apply:

- A. Equipment Testing. The purpose of equipment testing is to demonstrate that the pump units meet the specified requirements.

## General Mechanical and Equipment Provisions

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1. Tests shall be performed on the actual assembled unit over the entire operating range on the certified performance curve. Prototype model tests will not be acceptable.
2. All pumps 10 to 50 horsepower shall be factory-tested in accordance with the above specifications. Pumps larger than 50 horsepower may be subject to a "factory witness test" attended by a District representative. The District shall be notified at least 2 weeks in advance such that a representative can witness the pump testing. Certified test results shall be submitted to the Engineer for approval prior to shipment.
3. Pump curves shall reflect data secured during actual test runs and shall be signed by a responsible representative of the pump manufacture. Test reports and procedures shall conform to applicable requirements of the Hydraulic Institute Standards.

- B. Installation. The Contractor shall install all pumping equipment in strict accordance with the manufacturer's instructions. Care shall be used in handling to avoid bumping, twisting, dropping, or otherwise damaging the equipment.

All pump manufacturers shall furnish the services of factory-trained personnel as required to examine the installation, supervise start-up of equipment installed, and repair the equipment at no additional expense to the District.

- C. Field Acceptance Test. The contractor under this specification shall have full responsibility for the proper installation and performance of said pumping equipment, including furnishing the services of a pumping equipment Field Service Engineer to inspect equipment installation, and to adjust, if necessary, any portion of the pumping equipment required herein. The manufacturer's Field Service Engineer shall assist the District in the proper conduct of pumping unit field acceptance tests. The pump units shall perform in the field as shown on the certified pump curves furnished by the Contractor. Tests shall also demonstrate operation without cavitation, vibration, overheating of moving parts, and excessive noise. The Contractor and pump manufacturer shall make necessary corrections to achieve smooth pump operation. In the event the tests reveal noncompliance of the workmanship or equipment, the Contractor shall either make alterations as necessary or replace the pumps in order to meet the requirements of the specifications at no additional cost to the District.
- D. CERTIFICATION OF INSTALLATION. The Contractor shall submit a letter to the District confirming that all pumping equipment was inspected, operation checked, and installation approved in writing by the respective pumping equipment supplier.

- E. WARRANTY. All pumping equipment shall carry an extended warranty for a two year period from the date of **acceptance**. All warranties shall be turned into the District prior to project completion.
  
- F. MAINTENANCE BOND FOR PUMPING EQUIPMENT. The contractor or his supplier shall provide a maintenance bond (EMWD Standard form C-14 or C-14.1) from a bonding company acceptable to the District equal to 100% of the pumping equipment value (including motors, pumps and pump assemblies) for a two (2) year term starting when the District has accepted the contracted work. Equipment and/or components failing within this period due to deficiency in design, workmanship or material shall be removed, replaced, and reinstalled at no cost to the District, and said replacement shall be guaranteed for two years continuous service. The maintenance bond shall be submitted to the District prior to the performance test of the pump(s).

### 3.11 EARTHQUAKE DESIGN AND RESTRAINT

All manufacturer equipment supplied under this Contract shall be designed, constructed and attached to resist stresses produced by seismic forces specified in this Section. Equipment that does not vibrate during normal operation shall be rigidly attached. Equipment that vibrates during normal operation shall attached by means of isolators with mechanical stops that limit movement in all directions unless it can be demonstrated by calculations that such stops are not required. Equipment or portions of equipment that move during normal operation shall be restrained with mechanical devices that prevent displacement unless it can by demonstrated by calculations that such restraints are not required.

- A. Work Included. The work included in this Paragraph includes, but is not limited to, the following equipment items:
  - 1. Pipe supports and hangers.
  - 2. Electrical control panels.
  
- B. Minimum Earthquake Forces. The minimum earthquake forces shall be those prescribed for Essential Facilities by the Uniform Building Code and applicable supplements as published by the International Conference of Building Officials, 5360 South Workman Mill Road, Whittier, California 90601, or as specified in the "Soil Investigation Report," whichever is greater.

Contractor shall submit shop drawings, details and data herein before specified in Section F General Conditions, F-30, "Submittals."

**END OF SECTION 11005**

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