

**SPECIFICATIONS - DETAILED PROVISIONS**  
**Section 15351 - Sewage Pump Station, Vault Type**

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**SECTION 15351**  
**SEWAGE PUMP STATION, VAULT TYPE**

**PART 1 - GENERAL**

**1.01 DESCRIPTION**

The Contractor shall furnish all the labor and materials necessary to construct the pumping station in accordance with these specifications and as shown on standard drawings and construction drawings.

**1.02 VAULT AND WET WELL**

The Contractor shall furnish and construct the dry vault and wet well as shown on the drawings. The concrete used in the cover, base, walls, and top slabs shall comply with the requirements of Section 03300. The walls of the vault and manhole may be constructed of cast-in-place concrete or of precast concrete reinforced as shown on the drawings.

Precast concrete shall be manufactured by any process that will produce a dense, homogeneous concrete of first quality. The walls of the vault, manhole rings and roof slab shall have a minimum wall and slab thickness as shown on the drawings.

A galvanized steel ladder, Alhambra Foundry Type A-3400 or approved equal, shall be provided for the vault and galvanized steel steps ¾-inch in diameter. Alhambra Foundry Type A-3320 or approved equal, shall be provided in the wet well; each modified as necessary to meet current requirements of the State of California Division of Industrial Safety. The ladder shall be fastened to the wall by stainless steel bolts and anchors.

**1.03 SUBMITTALS**

The Contractor shall furnish to the Engineer required shop drawings of all equipment for review and acceptance before fabrication of such equipment. Drawings submitted for review shall include front views, sections, floor plans, anchoring details, and locations for conduit. Separate drawings shall be submitted for schematic and connection diagrams. Connection diagrams shall be completed for all electrical equipment furnished. Schematic diagrams shall have designated numbers corresponding with connection diagram terminal numbers. Should an error be found in a shop drawing during installation of equipment, the correction, including any field changes found necessary, shall be noted on the drawing and submitted for review again. All shop drawings shall be checked by the manufacturer's engineering department and shall be approved by the Contractor before submittal for review by the Engineer.

## **PART 2 - PRODUCTS**

### **2.01 MOTOR - PUMP UNITS**

Pump and motor shall be sized as indicated on the Bidding Sheet. In no case shall the nominal flow of the pumps be less than the amount necessary to create a two foot per second flow velocity in the force main.

### **2.02 BUBBLE CONTROL SYSTEM**

To control the operation of the pumps with variations of sewage level in the wet well, a bubble control system shall be provided complete with two air compressors; a "Tork Timer" time clock #8601, or approved equal, for switching to alternate compressors; A 0 to 100-inch pressure gage permitting manual adjustment of pump on-off levels at the control panel; "Allen Bradley" No. 836-C2A, or approved equal, pressure sensing switches for each pump; bubbler line from control center to wet well; and all appurtenances for proper operation of this system. Each compressor shall have a capacity of 3 cubic feet per hour at 6 pounds per square inch gage, and shall be Esso-Trol or approved equal. The unit shall be located in the motor control center as it is shown on Std. Dwg. SB-74.

### **2.03 AIR COMPRESSOR**

If called for by the construction drawings, the Contractor shall furnish and install an air compressor with motor and a horizontal receiver. This unit shall be installed in a louvered sheet metal box with doors per B-484, on the concrete slab above grade, as shown on the drawings. The compressor shall be two-stage, air cooled type and unless otherwise specified, shall be driven by a 5 Hp electric motor designed for 1760 rpm, 480 volt, 60 cycle, three-phase operation. A magnetic motor starting switch shall be provided in the motor control center. The horizontal air receiver shall be ASME stamped and approved and shall have a capacity of 80 gallons or as called for in the construction drawings. The compressor shall have a piston displacement not less than 19.8 cubic feet per minute and a minimum operating pressure of 100 psi, unless specified otherwise by the engineer. The complete 5 Hp unit shall be Model 5D3, as manufactured by Ingersoll-Rand, or approved equal. Other sizes shall be submitted for approval by the engineer.

The compressor shall be connected to the force main by ½-inch galvanized steel piping above-ground and a ½-inch Schedule 80 PVC pipe below-ground. An air pressure regulator shall be furnished and installed as shown on the drawings. This regulator shall be Mueller Series H-9303 or approved equal. The outlet pressure range shall be 0 to 100 psi, unless specified otherwise by the engineer. Gate, ball, and check valves suitable for operating air pressures of up to 200 psi shall be provided and installed as shown on the drawings.

### **2.04 GATE VALVES**

Shall conform to the requirements of Section 15345 "Gate Valves for Sewerage", or they may be the Mueller A-2370 Resilient Seat Gate Valve, or an approved equal.

#### 2.05 CHECK VALVES

Shall be designed for a water working pressure of not less than 150 psi and shall be single disc. swing type, externally spring loaded, "APCO" L.S. 6000, or approved equal.

At full open position, the area of the waterway shall not be less than the area of the proposed connecting pipe area. Flanged ends shall be faced and drilled, and back of flanges shall be spot-faced, in conformance with the "American 125-lb. Cast Iron Flange Standard".

Body seat rings shall be of bronze and of the removable type screwed into place. The disc shall seat tightly without slamming under specified working pressure. The disc shall have a bronze seat ring securely fastened to the disc. Hinge-pins shall be stainless steel and bushings shall be either of bronze or of stainless steel. Hinges shall be solid bronze or stainless steel.

Check valves shall be subject to hydrostatic test of not less than 300 psi.

#### 2.06 MOTOR CONTROL CENTER

Motor Control Center shall be completely fabricated, wired and tested at factory, and shall be as manufactured by Square "D" Model 5, Cutler-Hammer's Centerline, or approved equal. Motor Control Center shall have NEMA 3R enclosure and NEMO Type B wiring. Sizes of circuit breakers shall be as shown on Main-One-Line diagram, with interrupting capacities of 14,000 symmetrical amperes. Nameplates shall be laminated black plastic with engraved ¼" high white letters, and shall be fastened in place with screws. Manual transfer switch shall be of the size shown and shall be Westinghouse 3-pole Cat. No. MTSSM30100 EK. or approved equal.

### **PART 3 - EXECUTION**

#### 3.01 PIPING

The pump discharge piping shall be as shown on the drawings, and shall receive protective coatings as per Article 3.02.

#### 3.02 COATINGS

##### A. Exterior Ferrous and Galvanized Metals and Exterior Pre-Enameled Surfaces

1. The Contractor shall paint all exposed ferrous metal surfaces including pipe work, fittings, mechanical equipment, doors, door frames, etc., in the following manner:

Steel Structures Painting Council Specification SP-10 (Near-White Metal Blast Cleaning) shall be used as a surface preparation. Within 6 hours of prime coat of Koppers 622 Rust Penetrating Primer shall be applied to a thickness of 1.5 mils DFT (dry film thickness). Following the manufacturer's specified drying period, at least two coats of Koppers Glamortex 501 Enamel shall be applied to a DFT of 3.0 mils (1.5 mils each).

An approved alternate to the above system shall be a prime coat of Ameron 185 and at least two finish coats of Ameron 5401. Dry film thickness of the coats and total system shall be the same as for Koppers.

The finish color standard for this work shall be Koppers Desert Tan. Any deviations of color shall be submitted to the engineer as a color sample chip for approval.

2. Exposed galvanized metal surfaces shall be solvent cleaned (SSPC-SP1) and hand-tool cleaned (SSPC-SP2) prior to coating. A prime coat pre-treatment of Koppers 40 or Ameron 86 shall be applied prior to application of finish coats of Koppers Glamortex 501 or Ameron 5401. Finish color shall be Koppers Desert Tan, or approved equal.
3. Previously enameled exposed surfaces with unmatching colors such as electrical cabinets shall be repainted using the system specified for unfinished ferrous metals above except that surface preparation SSPC-SP6 shall be substituted by SSPC-SP7 (brush-off blast cleaning).

B. Protective Coating of Buried Galvanized and Black Steel Pipe

1. Surface Preparation. Surfaces shall be cleaned in accordance with SSPC-SP-3 (Power Tool Cleaning).
2. Wrapping. Prior to wrapping the pipe with PVC tape, the pipe shall be primed using a primer recommended by the PVC tape manufacturer. After being primed, the pipe shall be wrapped with a 20-mil adhesive PVC tape, half-lapped, to a total thickness of 40 mils. Application shall be in accordance with the tape manufacturer's instruction.

C. Protective Coating of Buried Miscellaneous Ferrous Surfaces, Valves and Flanged Joints (Excluding Ductile Iron Pipe)

1. Surface Preparation. Surfaces shall be cleaned in accordance with SSPC-SP-3 (Power Tool Cleaning) or SSPC-SP-2 (Hand Tool Cleaning).

2. Coating. Surfaces shall receive two 8-mil thick coats of Koppers Bitumastic Super Tank Solution, or approved equal.

### 3.03 DUCTILE IRON PIPE AND FITTINGS

Ductile iron pipe shall be used for buried pipe prior to the first length of PVC force main as shown on the construction drawings. Pipe shall meet EMWD Specification 15333. Ductile iron fittings shall be mechanically jointed according to AWWA Table 10.1 and Standard C111/A21.11. Each joint shall be restrained from pressure thrust failure by a Tyler "Swivel Gland" or approved equal.

### 3.04 MOTOR CONTROL EQUIPMENT

All equipment shall meet the requirements of the latest edition of the application standards of the following organizations:

- A. USA Standards Institute (USASI), New York, NY.
- B. Institute of Electrical and Electronic Engineers (IEEE), New York, NY.
- C. National Electrical Manufacturer's Association (NEMA), New York, NY.
- D. National Board of Fire Underwriters (National Electrical Code).

### 3.05 RADIO TELEMETRY EQUIPMENT

The Contractor shall furnish and mount the following or approved equal radio telemetry equipment in a convenient location within the pump control section of the motor control center:

- A. Kingfisher Series II with Radio-Motorola MT 2000
  1. Frequency – 450 Mhz
- B. Add:
  1. 120 Volt Power Supply – with battery backup
  2. CPU – 768KB+256KFLASH
  3. Rack – 12 slot
  4. Radio Modem – RM
  5. Digital input card – DI-1
  6. Digital output card – DO-1

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7. Analog output card – AO-1
  8. Analog input card – AI-1
  9. Plus toolbox software
  10. All items 1 through 9 to be in one separate enclosure. Nema 12 as one complete independent unit.
- C. Antenna – PD6685-3 Celwave 10db YAGI
  - D. Line Kit – ½ superflex foam cable with “N” male connectors
  - E. RF Protection – Poly phaser IS-B50LN-C2
  - F. Provide terminal strips for incoming and outgoing wiring in the enclosure
  - G. Contact District for wire assignments list

The installation shall include all materials, equipment and accessories not specifically mentioned or noted on the drawings, but which are necessary to make a complete working installation of the radio telemetry system.

Prior to manufacture, the Contractor shall verify available frequencies for the above equipment with the EMWD Electrical Department (Mr. Zeigler).

### 3.06 ELECTRICAL WORK

- A. General. The Contractor shall furnish all labor, materials and transportation for the complete installation of all electrical conduit, wiring, motor control center and equipment, and all appurtenances as shown on the drawing and/or specified herein. The work shall include all electrical connections and wiring to all mechanical equipment to be installed by the Contractor. All material furnished shall be new and of the highest quality. The installation shall be complete, tested and ready for operation.
- B. Code Rules. All work shall be in accordance with the latest rules of the National Electrical Code, Electrical Safety Orders of the Department of Industrial Relations of the State of California, and any prevailing ordinances, rules, and regulations of the local governing bodies. Where drawings or specifications call for equipment and workmanship to be of better quality or higher standard than required by the above rules and regulations, then said drawings and specifications shall prevail. The Contractor shall obtain all permits and inspections and he shall pay all fees therefore. The Contractor shall deliver certificates of inspection to the Engineer.



- C. Tests. The entire installation shall be free from improper grounds and from short circuits. After completion of wiring and energizing of services, the Contractor shall test all completed circuits and shall correct any defects that may exist.
- D. Conduit (Rigid)
1. All conduits shall be rigid steel pipe of new material and of standard manufacture, and shall meet all requirements of the National Electrical Code. Rigid steel pipe conduit shall be galvanized or sherardized with a lacquer or varnish on the inside and outside surfaces. All joints shall be screwed right and red-leaded.
  2. All metallic conduit installed directly in the earth shall be made up with red-leaded joints, and joints shall be painted with asphalt compound unless joints are precoated with polyvinyl chloride.
  3. Running threads shall not be used, and where some such device is necessary, Erickson couplings or approved equal shall be used. All conduits must be kept dry and free from water or debris with approved pipe plugs or caps during construction.
  4. All exposed conduit shall be installed straight and true with reference to adjacent construction and shall be supported by means of approved standard pipe straps or bracelets.
  5. All conduits entering outlet boxes, pull boxes or terminal cabinets shall be secured in place by means of two locknuts and one bushing shall be screwed over every conduit (in pull boxes, junction boxes, switch panels, etc.).
  6. Before any wire is drawn into the conduits, all boxes and conduits shall be cleaned of obstruction and dirt. Any moisture contained in the conduit system shall be blown out.
  7. All underground rigid conduits not shown encased in concrete or run in slab shall have a polyvinyl chloride coating as manufactured by Pittsburg Standard Conduit Company, Verona, Pennsylvania, or approved equal; or shall be prewrapped with a 20-mil adhesive polyvinyl chloride tape to a minimum thickness of 40 mils. Fittings and couplings shall first be primed then wrapped with polyvinyl chloride tape to a 400-mil thickness, in accordance with the manufacturer's instruction. If the contractor elects to install prewrapped conduit, a sample shall be submitted to the Engineer for approval prior to installation.
  8. All conduit ends shall be capped by the use of conduit pennies and bushings until placed in service.

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9. Conduits stubbed up through slabs shall be placed exactly in accordance with equipment requirements and shall be located within a curb or equipment base pad.
- E. Conduit Fittings and Boxes
1. All conduit fittings shall be galvanized steel. Conduits shall be Crouse-Hinds, Appleton, or approved equal.
  2. All pull boxes, junction boxes, outlet boxes, etc., shall be of galvanized steel unless otherwise noted on the drawings.
  3. All outside junction boxes and conduits shall be sealed with a galvanized gasketed cover screwed tightly to the box.
  4. All small boxes shall be packed with paper or other stuffing to prevent concrete or other foreign material from filling the boxes.
  5. The size of pull boxes and junction boxes shall be as required for this installation unless otherwise shown.
- F. Wire. The Contractor shall furnish all wire and cable to make a complete installation of the electrical equipment as outlined herein and as shown.
- G. Grounding. All conduit systems and metal frames of all equipment shall be permanently and effectively grounded to a ¾-inch diameter, 8-foot long copper-clad ground rod by means of approved ground clamps in accordance with the Electrical Safety Orders of the Department of Industrial Relations of the State of California.
- H. Alarm Circuits. The Contractor shall install a drywell flooding alarm system which shall include a float switch placed 6 inches above the floor, the alarm circuit, and the alarm relay in the pump control section of the panel. A second alarm for “high wet well” conditions shall be activated by a second float switch. This wet well alarm shall be capable of causing two lift station pumps to operate simultaneously. Location of the float switches are shown on the contract drawings.

### 3.07 EQUIPMENT TESTING

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

- A. 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.

- B. 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.
- C. 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.

### 3.08 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.

### 3.09 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.

### 3.10 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.

### 3.11 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.

### 3.12 MAINTENANCE BOND FOR PUMPING EQUIPMENT

The Contractor or his supplier shall provide a maintenance bond (see 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).

### **START-UP**

The Contractor shall diligently pursue all aspects of the start-up process. Contractor must work closely with the inspector assigned to the project and provide written notification of the start-up date a minimum of five (5) working days prior to start-up date. EMWD Construction Administrator will schedule EMWD personnel upon notice from EMWD inspector. Failure of the Contractor to be properly prepared for all phases of the start-up will result in back charges for EMWD personnel. A minimum of four (4) hours with overhead factor will be deducted from the Contractors due payment. The start-up checklist is being provided herein to assist the Contractor in facilitating start-up.

The following is a checklist for sewage lift station start-up. The Inspector will notify the Construction Administrator who in turn will notify others to be in attendance.

#### Engineering:

- Inspector
- Project Engineer conducts the testing
- Principal Electrical Engineer
- Principal Mechanical Engineer
- Construction Administrator
- Consultant Engineer

#### Operations:

- Pump Testing Representative
- Control Technician
- Electrical Technician
- Area/Plant Manager

#### Contractor

- Superintendent
- Pump Manufacturer Representative
- Electrical Contractor
- Control Systems Subcontractor

## **CHECK-LIST**

- A. Power (see electrical start-up procedures)
- B. Source of Water/Sewage for Test
- C. Is Pump Representative Available
- D. Is Pressure Gauge & Tap Available (Suction & Discharge if applicable)
- E. Are Set of Prints for System Available
- F. Electrical Ladder Logic/Schematic Drawings (as-built)
- G. Electrical wiring diagrams (as-built)
- H. Are Pump Curves Available
- I. Have Pump Controls Been Set (use elevations of bottom of wet well)
- J. Are Hydraulic Calculations and Operational Parameters Available (starts per hour, detention time, etc.)
- K. Is Punch List Available and Are All Major Portions of the Mechanical System Operable.
- L. Is Telemetry Complete and Operable
- M. Is Generator Fueled and Operable
- N. Are Results of Generator Load Test Available
- O. Have All Plugs and Bulkheads in Associated Sewer Been Located and Plans Made for Their Removal
- P. Are All Equipment Submittals Available

## **TEST PROCEDURES**

- A. Pump Controls/Telemetry
  1. Fill wet well to lead pump start elevation – observe pump start
  2. Fill to LAG pump start elevation – observe pump start
  3. Fill until high wet well level is reached – check for alarm
  4. Turn on pumps, allow system to pump down – record low level shut off

- B. System Hydraulics
  - 1. Install pressure gauge on discharge and suction piping
  - 2. Calculate wet well operating volume (start/stop lead pump) in gallons
  - 3. Time draw down in seconds for each pump in lead position, record discharge pressure & NPSH
  - 4. Plot pump performance on system curve for permanent record (minimum of 3 points) plus shut off head
  
- C. Appurtenance Check
  - 1. Locate and demonstrate operability of all valves
  - 2. Simulate power failure with pumps running to demonstrate check valve adjustment
  - 3. Demonstrate sump pump function (if applicable)
  - 4. Use rotameter to establish seal water flow (if present), record
  - 5. Bleed pressure to start air compressor, observe repressurization
  - 6. Record hour meter function
  - 7. Check mag meter accuracy
  
- D. Generator Check (if present)
  - 1. Simulate power failure, record generator start up time and performance (temperature, oil pressure, amperage, frequency), verify “line fail” alarm at headquarters
  - 2. Perform other tests as required by District Electrical and Gas Engine personnel
  
- E. Electrical Start-up Procedures
  - 1. Prior to startup the electrical system is checked by electrical engineer when requested by Inspection. The electrical service is green tagged if meets code and specifications.
  - 2. If a pre-startup is requested, the project engineer, electrical engineer, inspector and contractor’s reps, in come cases, are present and a mock test is performed to verify everything is working as a system plus the controls/logic and radio are set up and functioning correctly. In this manner bugs can be taken care of prior to the official startup.
  - 3. When the official startup is called, electrical engineer, inspector, project engineer, electrical control technician, operations pump test crew and operations manager of the area are present along with the contractor’s electrical, mechanical and in some cases the electrical control contractor, pump reps, vfd reps are present.
  - 4. The inspector is in charge of the startup and directs the testing procedures as to what he wants to see and what parameters need to be met system wise.

- 5. The EMWD support people are there to verify final control operations, pump efficiencies, help with recording electrical and system data. Also, any major EMWD systems that need to be opened or closed are done by EMWD staff.
- 6. All electrical controls for PLC's and radio operation are looked at with reference to fail alarms, high/low pressure alarms, ground fault relays, pilot light indications for motor stop running and other indications for proper sequence of operation. The radio inputs and outputs are verified, the motor amperages and voltages are read to ensure the nameplate data is met.
- 7. Wet well float levels, system pressures, flows, limits are confirmed.
- 8. VFD's and starters are examined to ensure they are adjusted and have the correct parameters for operation by factory reps. contractor and EMWD.
- 9. If buildings are involved, lighting, receptacles, panel boards and other electrical devices are perused to find any discrepancies and noted.
- 10. Chlorination systems, scrubbers, cranes and switchboards are also viewed to ensure they are what we specified and meet code. We are concerned with ensuring installations haven't any electrical code violations.

**TEST RESULTS**

Engineering Department by: \_\_\_\_\_

- A. Name of Lift Station: \_\_\_\_\_
- B. Address (*Use electric meter address – list nearest cross street*):  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
- C. Designed By: \_\_\_\_\_
- D. Constructed By: \_\_\_\_\_
- E. Project Engineer: \_\_\_\_\_
- F. Inspector: \_\_\_\_\_
- G. Attachments (*check if present*):
  - \_\_\_\_\_ Construction Drawings
  - \_\_\_\_\_ Electrical Drawings
  - \_\_\_\_\_ System Hydraulic Calculations
  - \_\_\_\_\_ Pump Curves
  - \_\_\_\_\_ All Equipment Submittals

**SYSTEM TESTS**

A. Pump Control and Telemetry

Lead Pump Start Elevation \_\_\_\_\_ inches

Lag Pump Start Elevation \_\_\_\_\_

High Wet Well Level Alarm \_\_\_\_\_

Pump Shut-Off Elevation \_\_\_\_\_

**COMMENTS:**

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B. System Hydraulics and Equipment

Operating Span (inches between lead start/stop) \_\_\_\_\_

Operating Volume (gallons) \_\_\_\_\_

	Drawdown Time (Seconds)	Discharge Pressure (PSIG)	Amperage	Calculated GPM
Pump #1				
Pump #2				
Pump #3				

Motor Data	#1	#2 (If Different)	#3 (If Different)
Make			
Model			
Serial Number			
Type			
Frame			
H.P.			
RPM			
Motor Efficiency			



Pump Data	#1	#2 (If Different)	#3 (If Different)
Make			
Model			
Serial Number			
Type			
RPM			
Rated Head (ft.)			
Rated GPM			
NPSH (Running)			
Impeller Size (installed)			
Impellor Size (max.)			
Pump Efficiency			
Overall Efficiency			

C. Appurtenance Check

1. Valve Function: \_\_\_\_\_
2. Check Valve Adjustment: \_\_\_\_\_
3. Sump Pump Function: \_\_\_\_\_
4. Seal Water Flow (GPM): \_\_\_\_\_
5. Compressor Function: \_\_\_\_\_
6. Hour Meter Function: \_\_\_\_\_
7. Mag-Meter: \_\_\_\_\_
8. Ventilation Function: \_\_\_\_\_
9. Odor Control Equipment: \_\_\_\_\_
10. Potable Water (RP Device): \_\_\_\_\_
11. Lighting: \_\_\_\_\_
12. Plans Made to Change to District Locks: \_\_\_\_\_
13. Have District-keys Padlock for MCC: \_\_\_\_\_

COMMENTS:

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- D. Generator/Electrical  
Perform tests as instructed by District Gas Engine and Electrical Personnel

Electrical Test Procedures for Main Switch, Motor Control Center and Control Panel:

1. Items to be tested:
  - a) Circuit Breakers
  - b) Control Logic for Each Unit
  - c) Motors
  - d) Radio and Telemetry
  - e) Pressure Transmitters and Set Point Controller
  - f) Flowmeters
  - g) Flow Recorders

The devices shall be in proper working order and all work necessary for their safe operation shall be complete. If for any reason a unit device fails any step of the checkout, all test activities may be terminated until corrections are made. Any delays incurred from repairs and retesting shall be at the contractor's expense.

2. Recommended Test Apparatus:
  - a) Current Drawings of the Equipment/System
  - b) Ammeter
  - c) Voltmeter
  - d) Circuit Breaker Tester
  - e) Megger
  - f) Ground Tester
  - g) Ohmmeter
  - h) Point to Point Check-Out Device (Light, Ohmmeter or Buzzer)
  - i) Phase Rotation Meter
  - j) 4-20 ma Source

3. Test Procedure

All of the components shall be tested and/or calibrated to ensure they comply with the specifications and the drawing requirements. The results of the tests, where applicable, shall be recorded on test data sheets provided herein.

Test Log and Data Records

Data sheets shall be provided to record checkout progress. After completion of each test, sign and date each item on the sheet as required. If any item has a deficiency and requires repair or retesting, check it off in the deficiency box and add it to the deficiency list.

The following basic tests are required to be performed:

- a) Functional Testing Control Logic
- b) Low Voltage Insulation Resistance Testing (Motors, Feeder, Wiring)
- c) Overload Device Test (Circuit Breakers, Starters)

**FUNCTIONAL TESTING**

This procedure is provided to assist field personnel in the drawing versus wiring checkout for systems. The checkout should be implemented in the order indicated below.

A. Drawing Checkout

Verify a drawing is correct by performing the following:

- 1. Ensure all the devices shown are in the correct location
- 2. Ensure labels on the wires match drawing
- 3. Verify the terminal block wiring is designated correctly
- 4. Verify all device nameplates are correct and they agree with bills of materials and the drawings/submittal data

B. Point-To-Point Checkout

The objective of a point to point wiring check is to verify the actual wiring and terminal identification is in agreement with wiring and schematic diagrams.

*The following procedure for the point to point checkout shall be closely adhered to if it is to be effective:*

1. Compare the number of wires on each device/block with that shown on the wiring/schematic diagram.
2. Ring out each wire to assure continuity to each device and no shorts, grounds or opens exist. Lift wires, operate relay contacts, etc., as necessary so each wire is isolated to check continuity.

When discrepancies are found, it will be necessary to study the wiring and schematic diagrams to determine how the wiring must be modified to make the circuit operate. If a circuit modification is necessary and the wiring is simple to change, work with the inspector and contractor to correct it, and as-built the drawing.

*When making changes to the drawings, use the color red for additions and the color green for deletions.*

C. Objective

The objective of functional testing is to verify the circuit functions as it is depicted on the schematic diagram. Testing is to be done after the point-to-point checkout has been completed.

Prior to energizing the circuitry, re-attach lifted wires and clear any shorts or grounds.

Each pump control is to be tested by operating each device and observing the results. It may be necessary to measure voltage across the contact or at a point in the circuit to determine proper operation. In cases where it is not feasible to operate an actual device, it shall be permissible to jumper the contact at a point closest to the device. As each device is checked and found operable the appropriate lines on the schematic shall be yellowed out. Any discrepancies shall be resolved and documented immediately.

D. Summary

Functional testing is complete when all discrepancies have been resolved and all circuits checked and the system is ready for service.

### **LOW VOLTAGE INSULATION RESISTANCE TESTING (Megger Test)**

The low voltage insulation resistance test is a *non-destructive test* which shall be performed on each item of electrical equipment indicated by the next section. The purpose is to evaluate the condition of the insulation from the standpoint of damage, contamination or deterioration experienced in shipment, installation or prolonged operation of the device. This procedure shall apply to electrical equipment with voltages up to 600 volts AC.

A. Items to be Tested

The equipment subjected to low voltage insulation resistance testing is as follows:

1. Transformers
2. AC Panels
3. Motors
4. Feeders
5. Motor Control Centers
6. Ground System (OHMS to ground)

Generally, equipment containing electronic sub-assemblies such as signal conditioners, set point controllers, timing circuits and metering circuits shall be tested with these items isolated from the test voltage source.

B. Safety Considerations:

Prior to commencing with the test, de-energize all circuits necessary to safely perform the test. Use a meter to verify that all circuits are de-energized. Use insulating tape to wrap exposed ends of cables or other devices which may present an outside shock hazard to personnel. Use Tag out procedures for any necessary devices.

Use ground jumpers wherever possible to prevent buildup of capacitive charges during test preparations and at the end of test to drain off charges to motors, etc.

C. Test Procedure

Preliminary Instructions

Remove circuits from service and use a voltmeter between terminals and ground for voltage. Inspect all test setups to determine the range of the test activity and to verify there are no parallel circuits paths. (Measured resistance values can be drastically affected by the presence of peripheral cables and devices.) Use the guard feature of the megger, if available to maximize the accuracy of the test by reducing surface leakage currents from uninvolved circuit elements.

Procedure

Conduct the low voltage insulation resistance test as follows:

1. Disconnect and isolate the equipment to be tested.
2. Verify terminal voltages are at zero.
3. Verify proper operation and setup of test equipment.
4. Connect the megger to the circuit to be tested.
5. Remove grounding jumpers from the circuit under test.
6. Set test voltage to a value above the rating of the equipment under test. (Use 500 volt for ratings up to 240 volts AC and 1000 volts for ratings above 240 volts AC.)
7. Apply the test voltage and wait for the resistance reading to stabilize. (Reading should be steady at 1 megohm + as a minimum after 1 minute. If not, check for loose connections, arcing, moisture, etc.)
8. Read and record insulation resistance data using the attached *Insulation Test Results Data Sheet*
9. Before disconnecting the test apparatus, wait 1 minute after de-energizing the test voltage. This allows any charge buildup in the test circuit to dissipate.
10. Verify zero voltage at the test terminals.
11. Disconnect the test set and jumpers.
12. Perform tests on additional circuits or equipment, as necessary.

At the end of the test, restore the circuit(s) or devices to pretest condition.

**RADIO/TELEMETRY**

The radio/telemetry system shall be checked to verify the radio is functional and will transmit back to the EMWD central control with all the status and alarms points wired as indicated on the drawings.

- A. Items to be Tested
  - 1. Interrogate I/O for status and alarm signals
  - 2. Verify connections from pressure transmitters, flow recorders, flow meters and set point controller
  - 3. Antenna connections to be verified, antenna orientation
  - 4. Verify continuity of telemetry cable
  
- B. Equipment Needed
  - 1. Multimeter
  - 2. Interrogator test set connect to a remote radio (District supplied)
  - 3. Wattmeter (for antenna)
  - 4. Biddle Radar Test Set (District supplied)
  
- C. Test Procedure
  - 1. Verify all analog/digital signal conductors are terminated, to the individual I/O points as indicated by the drawings.
  - 2. Address radio.

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