

SECTION 5B - SUBMERSIBLE WELL PUMP

5B-01 GENERAL

5B-01.01 SECTION INCLUDES: The Contractor shall provide and install a complete submersible type well pump including intake strainer, pump bowl assembly, column, surface pedestal and submersible electric motor.

5B-01.02 REFERENCES

- A. National Electrical Manufacturers Association (NEMA)
- B. ANSI B16.5-88, Pipe Flanges and Flanged Fittings; Addenda B16.5A-92.

5B-01.03 SUBMITTALS

- A. Shop Drawings - Submit the following to the Engineer for approval before fabrication and purchase in accordance with Section 1.0 of these specifications:
 - 1. Manufacturer's literature, illustrations and applicable data for the pumps.
 - 2. The shop drawings shall include details of pump assembly; installation layout and procedures; piping and electrical connections and requirements; types of materials used in pump construction; details on all pump accessories, such as couplings, line shaft, discharge head, etc.; dimensions of major components; weights, structural and operating features, space required, clearances, type of finish or shop coat, and other pertinent data.
 - 3. A list of manufacturer's recommended spare parts to be supplied, with the manufacturer's current price for each item. List bearings by the bearing manufacturer's numbers only.

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4. The following data shall be provided on the drive motor: Materials of construction, dimensions, rpm at full load, frequency, voltage, full load current, code and design letter, efficiency, horsepower, number of phases, time rating, temperature rise, service factor and bearing life rating. The submittal shall include motor manufacturer's recommended lubrication requirements.
- B. Performance Curves: The Contractor shall submit the following to the Engineer for approval, prior to shipment from the factory.
1. Submit manufacturer's certified performance curves for each pump and motor combination furnished illustrating pump characteristics of head, discharge flow, efficiency, impeller size, motor speed, and horsepower for the full range of head conditions specified.
 2. Curves shall be submitted on 8 1/2-inch by 11 inch sheets, at as large a scale as is practical. Curves shall be plotted from no flow at shut off head to maximum pump runout head and gallonage allowed by the manufacturer.
 3. Points of operation which cause bearing stress or shaft deflection in excess of the manufacturer's tolerances for continuous operation shall be indicated on the submitted curves.
- C. Submit the following for each proposed vertical turbine pump:
1. Pump Manufacturer's Name _____
 2. Pump Model No. _____
 3. Rated Capacity _____gpm

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4. Total Dynamic Head at Rated Capacity _____feet
5. Nominal Speed _____RPM
6. Number of Stages _____
7. Length of Pumping Unit _____feet
8. Outside Diameter of Bowl _____inches
9. Size of Column Pipe _____inches
10. Length of Column Pipe _____feet
11. Size of Suction Connection _____inches
12. Size of Discharge Connection _____inches
13. Length from Centerline of Suction/
Discharge inches Connection to
Underside of Discharge Head _____inches
14. Length From Underside of Discharge
Head to Bottom of Bowl Assembly _____feet
15. Size of Line Shaft _____inches
16. Type of Impellers _____
17. Discharge Head Model No. _____
18. Motor Manufacturer and Model No. _____
19. Motor NEMA Frame No. _____
20. Motor Horsepower _____hp
21. Motor Speed _____RPM
22. Motor Efficiency at Rated Capacity _____%

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- 23. Actual Bowl Efficiency at Rated Capacity (Adjusted for Staging) _____%
 - 24. Line Shaft Loss at Rated Capacity _____HP
 - 25. Brake Horsepower of Pumping Unit at Rated Capacity _____BHP
 - 26. Kilowatt Consumption Per Hour at Rated Capacity _____KW/hr
 - 27. Field Efficiency of System (Wire to Water) _____%
 - 28. Hydraulic Thrust at Rated Capacity _____pounds
 - 30. Total Thrust Load at Rated Capacity _____pounds
 - 31. Capacity of Motor Thrust Bearing _____pounds
 - 32. Inside Diameter of well casing _____inches
- D. Operating and Maintenance Instructions: Submit six (6) sets of operation and maintenance manuals. The operation and maintenance manuals shall have been prepared specifically for the model and type of pump furnished and shall not refer to other models and types of similar equipment. Disk copies of material submitted shall be provided in MS Word and AutoCAD 2000 version or later. The operation and maintenance manuals shall include but not be limited to the following:
- 1. Equipment function and description.
 - 2. Normal and limiting operating characteristics.
 - 3. Installation instructions (assembly, alignment and adjustment procedures).

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4. Operation instructions (normal start-up and shutdown procedures, normal operating conditions and emergency situations, troubleshooting guide).
5. Lubrication and maintenance instructions.
6. Parts list with catalog numbers and predicted life of parts subject to wear.
7. Drawings - Cross sectional view, assembly and wiring diagrams.
8. Performance curves.

E. Factory Performance Test Data:

1. After acceptance of pump shop drawings, factory performance test data will be submitted for approval on the pumping units.
2. Tests shall be in accordance with the standards of the Hydraulic Institute including head, capacity, brake horsepower, pump efficiency, and NPSH.

5B-01.04 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. All parts shall be properly protected so that no damage or deterioration will occur during a prolonged delay from the time of shipment until installation is complete.
- B. Factory assembled parts and components shall not be dismantled for shipment unless permission is received in writing from the Engineer. Pumps shall be prepared for shipment in accordance with API Standard 610.
- C. Finished surfaces of all exposed pump openings shall be protected by wooden blanks.

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- D. Finished iron or steel surfaces not painted shall be properly protected to prevent rust and corrosion.
- E. After hydrostatic or other tests, all entrapped water shall be drained prior to shipment, and proper care shall be taken to protect parts from the entrance of water during shipment, storage, and handling.
- F. Each box or package shall be properly marked to show its net weight in addition to its contents.
- G. Pump shall be shipped and handled in such manner as to prevent damage. At the job site, pumps and motors shall be stored in clean, dry, and protected locations.

5B-01.05 WARRANTY AND GUARANTEES

- A. All equipment supplied under this section shall be provided with a limited warranty for a period of five (5) years by the manufacturer and an unlimited warrantee for two (2) years. Warranty periods shall commence upon SBMWD final acceptance.
- B. The equipment shall be under warranty to be free from defects in workmanship, design and materials. If any part of the equipment should fail during the warranty period, it shall be replaced at no expense to the SBMWD.
- C. The replacement or repair (including cost of parts and labor) of those items normally consumed in service, such as pump packing, oil, grease, and the like, shall be considered as part of routine preventive maintenance by the SBMWD.
- D. Certifications: Furnish the Engineer with a written certification signed by the manufacturer's representative, that the installed equipment:

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1. Has been installed per manufacturer's requirements.
2. Has been lubricated per manufacturer's instructions.
3. Has been accurately aligned and proper running clearances set.
4. Is free from undue stress imposed by piping or mounting bolts.
5. Is ready to be operated on a continuous basis, and is free from any known defects.

5B-02 PRODUCTS

5B-02.01 OPERATING CONDITIONS

[**Designer Note:** These values must be input for the site specific design conditions.]

1. Pump housing casing diameter _____inches
2. Well total depth _____ft
3. Static water level
 (below casing top) _____ft
4. Pumping level (at design flow) _____ft
5. Total pump head
 exclusive of column) _____ft
6. Required pump capacity _____ft
7. Well water temperature _____F
8. Expected operating flow range _____ to _____gpm
9. Distance from wellhead to starter _____ft
10. Operating voltage _____volts

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5B-02.02 **MATERIALS**

A. **Motor**

1. The submersible electric motor shall conform to the latest National Electrical Manufacturers Association (NEMA) specifications for submersible motors. The motor thrust bearing shall be sized to carry the weight of all rotating parts plus the hydraulic thrust of the motor regardless of the direction of rotation.
2. The motor shall be of squirrel cage induction type, suitable for across the line starting (and variable speed operation in conjunction with an adjustable frequency drive) and continuous operation in _____ F [Designer Note: Input the expected well water temperature.] water. The output shaft shall be 416 stainless steel. All fasteners exposed to the well water shall be of stainless steel.

B. **Pump/Motor Coupling**

1. The coupling shall be of 416 stainless steel and shall be capable of transmitting the total torque of the unit, regardless of the direction of rotation.

C. **Inter-Connector**

1. The inter-connector shall be constructed of close-grained cast iron and shall connect the motor and bowl unit. It shall incorporate a bronze bearing with a length to shaft ration of at least 3:1. This bearing shall be protected from sand by a labyrinth type sand slinger. The inter-connector shall include a suction screen which has a net open area of at least 4 times the eye of the impeller. The screen shall be made of corrosion resistant material.

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D. Pump

1. The pump supplied under this specification shall be of the multi stage turbine type. It shall be fitted with a stainless steel (410 or 416) shaft. Impellers shall be of SAE 40 bronze or enamel lined cast iron. Bowls (impeller housings) shall be of close grained cast iron with allowances for replacement of the wear rings. Bowls shall include sufficient clearance for impeller movement resulting from the combination of thermal expansion, dead weight and hydraulic thrust.
2. Impellers shall be securely fastened to the shaft using stainless steel split bushings. Impellers shall be adjustable vertically by an external means.
3. Pump shaft bearings shall be of SAE 660 bronze and shall be located above and below each impeller. The length of the top and bottom bearings shall be a minimum of 3 times the shaft diameter.
4. The pump shall be designed for continuous operation in _____ F [Designer Note: Input the expected well water temperature.] water of the chemical character described in the attached analysis results. Pump shall be selected for a minimum efficiency at the design flow rate of _____. [Designer Note: Input the desired pump efficiency.]

E. Surface Plate

1. The base plate shall be constructed of carbon steel plate of a minimum 1" thickness and shall rigidly support the weight of the motor, column pipe, pump, cable bowl assembly and column of water. It shall be

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equipped with a nominal _____ inch,
[Designer Note: Input the desired flange
size.] ANSI B16.5, 150 lb flanged connection
for the production flow connection to the
system.

F. Column

1. The column pipe shall be standard weight carbon steel pipe sized for a velocity at peak flow of not greater than _____ (5) ft/sec.

G. Submersible Cable

1. The cable shall be sized to limit the voltage drop to less than 2% at the motor terminals. Three separate conductors shall be furnished. The conductor insulation shall be water and oil resistant and suitable for continuous immersion.
2. The length of the cable to be furnished shall be the sum of the pump setting depth, including the bowl assembly, plus one foot for each 50 feet of setting, plus _____ [Designer Note: Input the desired distance to the pump panel.] feet to extend from the well head to the pump panel or junction box. The cable will be suitably supported from the pump column.

5B-03 EXECUTION

5B-03.01 INSTALLATION

- A. Installation of pumping equipment shall be in strict accordance with the respective manufacturer's instructions and recommendations in the locations shown on the Drawings. Equipment shall be installed by experience and mechanically skilled workmen with previous experience in

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similar installations. Installation shall include furnishing the required oil and grease for initial operation. The grades of oil and grease shall be in accordance with the manufacturer's recommendations.

- B. All necessary piping, fittings, valves, air relief valves, vents, concrete foundation, anchor bolts, grouting, etc. shall be provided to insure a complete and satisfactory installation of the pumping equipment including pump, electric motor, line shafting, column pipe, electrical connections and piping connections.
- C. Install pressure gauges on the pump discharge piping as shown on the Drawings, including an isolation valve and pressure gauge at each location.
- D. Hardware: All anchor bolts, nuts and washers shall be Type 316 stainless steel. All brackets and the hardware items shall be Type 316 stainless steel.
- E. Install piping, fittings, valves and other appurtenances to the pump installation in accordance with the manufacturer's installation instructions, the requirements of referenced sections included with these specifications and as shown on the Drawings. Equipment shall be installed in a workmanlike manner so that individual equipment will function properly and freely and no individual parts shall be strained.
- F. Noise and Vibrations: All equipment containing moving parts shall be installed level and plumb, unless otherwise indicated in the Drawings or in the specifications; and shall be anchored securely in order that noise be suppressed to a minimum and that vibrations do not cause damage while in operation.

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5B-03.02 FACTORY SERVICE REPRESENTATIVE

- A. For each pump supplied, the Contractor shall arrange for the services of a qualified factory service representative. The period of service shall be a minimum of one day for each pump supplied and shall not be considered complete until the items listed hereafter are completed.
- B. The duties of the service representative shall be as follows: After the equipment has been installed but before it is operated by others, the representative shall inspect the completed installation for soundness (no damaged or cracked components), completeness, correctness of setting and alignment, that the pumps are free from stresses imposed by attached piping, and for the adequacy and correctness of packing, sealing, and lubricants. The service representative shall start-up the equipment and instruct the SBMWD's personnel in proper operation and maintenance procedures. The responsibility of the Contractor with regard to start-up shall be fulfilled when the start-up is complete, the equipment is functioning properly and has been accepted by the SBMWD.
- C. The service representative shall submit to the Engineer six copies of a signed report of the result of his inspection, adjustments and start-up. The report shall include descriptions of the inspection, adjustments made, and the start-up. The report shall also include a statement that the equipment is ready for permanent operation and that nothing in the installation will render the manufacturer's warranty null and void. Final payment shall not be made to the Contractor until this report has been submitted to and approved by the Engineer.

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5B-03.03 INSPECTION AND TESTING

- A. After pump has been completely installed, the Contractor shall conduct, in the presence of the Engineer, testing of all mechanical equipment and piping as in operation to demonstrate capacity, correct alignment, smooth operation, proper adjustment, and freedom from noise, vibration, over-heating and leaking, and to ensure satisfactory compliance with the specifications. All defects shall be corrected. The Contractor shall supply all oil, grease, electric power, water and all other material necessary to complete the field tests.
- B. If the pump performance does not meet the Specifications, corrective measures shall be taken by the Contractor, or pump shall be removed and replaced with a pump which satisfies the conditions specified.
- C. Motor Field Testing: Motor shall be disconnected from the pump and run for four (4) hours. Following the run-in test, reconnect the motor to the pumping equipment and reinstall all coupling guards.
- D. Pump Field Testing:
 - 1. Upon completion of all the mechanical work, the Contractor shall conduct testing as specified herein to demonstrate that the equipment performs in accordance with all specifications.
 - 2. The Contractor shall perform initial testing of the equipment to insure himself that the tests listed in the Demonstration Test paragraph below can be completed.
 - 3. The Demonstration Test shall demonstrate that all items of these Specifications have been met by the equipment, as installed, and shall include the following tests:

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- a) That the pump can deliver the specified pressure and discharge flow at rated efficiency.
 - b) That the pump controls perform satisfactorily.
4. In the event that the equipment does not meet the Demonstration Test, the Contractor shall, at his own expense, make sure changes and adjustments in the equipment which he deems necessary and shall conduct further tests until written certification is received from the Engineer.

5B-03.04 DISINFECTION

- A. Pump Disinfection: Prior to installing the pump in the suction barrel, all interior and exterior parts of the pump coming in contact with the water shall be disinfected with a five percent (5%) chlorine solution (chlorine bleach). The method of disinfecting the pump shall be approved by the Engineer or his representative prior to installing the pump.
- B. Well Casing and Piping Disinfection: Piping, valves, fittings, well casing, and appurtenances installed to connect the pump to water mains, and any water mains installed by the Contractor, shall be disinfected and flushed in accordance with Section 3, construction methods and control.

5B-03.05 PUMP CURVES

- A. Submit to the Engineer six (6) of the certified performance curve for each pump, 8 1/2-inch by 11-inch in size, laminated in plastic. The pump curve shall indicate the pump number, type of service, manufacturer, model number, serial number, location in the plant and other data specific to the pump as required above for submittals.