

Bidding Requirements, Contract Forms and Conditions of the Contract
ADDENDUM
Section 00900

ADDENDUM No. 7

Date February 2, 2016

City of Austin

Project Name Davis Water Treatment Plant Treated Water Discharge System

C.I.P. No. 2015.041

This Addendum forms a part of Contract and clarifies, corrects or modifies original Bid Documents, dated October 27, 2015. Acknowledge receipt of this addendum in space provided on bid form. Failure to do so may subject bidder to disqualification.

A. Project Manual Revisions:

1. Replace Section 11210 in its entirety and replace with the attached revised Section 11210.

This addendum consists of 18 page(s)/sheet(s).



Approved by OWNER



Approved by ENGINEER/ARCHITECT

END





2/2/2016

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SECTION 11210

HORIZONTAL SPLIT CASE PUMPS

PART 1 PART 1 GENERAL

1.01 SUMMARY

- A. This Section includes the furnishing and installation of constant speed and variable speed horizontal split case pumps as specified herein and as shown on PLANS. The pump and motor assembly is referred in this Section as the Pump Unit.

1.02 RELATED REQUIREMENTS

- A. PLANS show general arrangement, location, and basic dimensions. "Attachment A" to this Section designates performance and design requirements.
- B. Related work as called for on PLANS or specified elsewhere in this or other TECHNICAL SPECIFICATION Sections.

1.03 REFERENCES

The latest version of the publications listed below form a part of this Specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY OF TESTING AND MATERIALS (ASTM)

ASTM A36	Standard Specification for Carbon Structural Steel
ASTM A48	Standard Specification for Gray Iron Castings
ASTM A49	Standard Specification for Heat-Treated Carbon Steel Joint Bars, Microalloyed Joint Bars, and Forged Carbon Steel Compromise Joint Bars
ASTM A53	Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A108	Standard Specification for Steel Bars, Carbon, Cold Finished, Standard Quality
ASTM A181	Standard Specification for Carbon Steel, Forgings for General Purpose Piping
ASTM A276	Standard Specification for Stainless Steel Bars and Shapes
ASTM A283	Standard Specification for Low and Intermediate Tensile Strength Carbon
ASTM A536	Standard Specification for Ductile Iron Castings
ASTM A564	Standard Specification for Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes
ASTM A582	Standard Specification for Free-Machining Stainless Steel Bars
ASTM A743	Standard Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application.

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- ASTM B148 Standard Specification for Aluminum-Bronze Sand Castings
- ASTM B505 Standard Specification for Copper Alloy Continuous Castings
- ASTM B584 Standard Specification for Copper Alloy Sand Castings for General Applications

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

- ASME B16.5-2009 Pipe Flanges and Flanged Fittings

AMERICAN NATIONAL STANDARD INSTITUTE/HYDRAULIC INSTITUTE (ANSI/HI)

- ANSI/HI 1.1-1.2 Rotodynamic (Centrifugal) Pumps for Nomenclature and Definitions
- ANSI/HI 1.3 Rotodynamic (Centrifugal) Pumps for Design and Application
- ANSI/HI 1.4 Rotodynamic (Centrifugal) Pumps for Manuals Describing Installation, Operation and Maintenance
- ANSI/HI 14.6 Rotodynamic Pumps for Hydraulic Performance Acceptance Tests
- ANSI/HI 9.6.4 Rotodynamic (Centrifugal and Vertical) Pumps for Vibration Measurements and Allowable Values
- ANSI/HI 9.6.6 Rotodynamic Pumps for Pump Piping
- ANSI/HI 9.8 Pump Intake Design

AMERICAN NATIONAL STANDARD INSTITUTE/AMERICAN PETROLEUM INSTITUTE (ANSI/API)

- ANSI/API 610-2004 Centrifugal Pumps for Petroleum, Petrochemical and Natural Gas Industries

AMERICAN WATER WORKS ASSOCIATION (AWWA)

- AWWA E103-07 Horizontal and Vertical Line-Shaft Pumps

1.04 (NOT USED)

1.05 DESIGN AND PERFORMANCE CRITERIA

- A. The pump shall be a horizontal, split-case, double suction, double volute centrifugal pump with vertical suction and horizontal discharge, with horizontal motor, coupling, coupling guard, and pump supplied on a common structural steel base plate with motor. Accessories shall be furnished as required for a complete functioning pumping unit in accordance with the specified performance and installation conditions.
- B. Rotation shall be suitable for pumps installation as indicated on the drawings.
- C. The Contractor/pump manufacturer shall provide the design and construction drawings of the structural steel base as required for the selected pump sealed by a licensed professional engineer in the State of Texas.
- D. The design requirements for the pumps shall be as follows:
 - 1. Design requirements for the pumps shall be as specified in Attachment "A" at the end of this Specification Section.

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2. Critical speed analysis: The Contractor shall require that the pump manufacturer perform critical speed analyses for the pumping assembly to identify and ensure that:
 - a. The first critical speed shall be at least 25 percent above the maximum pump speed;
 - b. Any blade excited resonant frequency shall be no closer than plus or minus 25 percent of the natural frequency of any part of the installed assembled pumping unit.
 3. Allowable Operating Range: The Contractor shall require that pump manufacturer identify the allowable operating region of the pump curves submitted. When the allowable operating region is limited by a factor other than vibration, that factor shall be submitted to the Engineer as part of the Shop Drawings.
- E. Seismic requirements:
1. The Contractor shall conform to the requirements of Seismic Design Data shown on Drawings.
- F. Equipment limitations:
1. Coordinate pump dimensions and weights with bridge crane specified in Section 14620 "Cranes, monorails and hoists".
 2. Design equipment so parts are readily accessible for inspection and repairs, easily duplicated and replaced, and suitable for service as required.
 3. Equipment shall be free from shock, vibration, and noise under load conditions.
 4. Bearings and similar parts shall have temperature rise not exceeding limit of safety and good practice for such parts.

1.06 SUBMITTALS

- A. Submit the following in accordance with Specification Sections 01300 "Submittals" and Specification Section 01730 "Operation and Maintenance Data".
- B. Shop Drawings
1. Equipment specifications and data sheets, with identification of all materials used and methods of fabrication. Designate materials by ASTM standards.
 2. Complete assembly, layout, cross section, installation and shop drawings, with clearly marked dimensions submitted in electronic format. Electronic files to be AutoCad latest version, drawn to scale. Submit electronic files on CD or DVD.
 3. Weights of equipment component parts, assembled weight of equipment, and total shipping weight. As applicable, include dynamic loads and weight when full.
 4. Manufacturer's product data and specifications for painting.
 5. Provide a scaled drawing showing the pump, motor, hoist and bridge crane including equipment weights, lifting attachments and clearances for equipment removal and maintenance.
 6. Pre-test pump curves on which the specified operating points are marked. Show efficiency and brake horsepower for the selected pump curve. Include moment of inertia of the completed pumping unit including driver, impeller, and liquid pumped. Include maximum combined hydraulic and static thrust and momentary axial thrust. Show required NPSH.
 7. Tabulated Data: Rated head, capacity, NPSH and break horsepower. Rated operated speed.
 8. Characteristic curves for variable speed pumps for maximum pump speed, minimum pump speed, and for speeds required to obtain minimum pump flow

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- and head conditions specified. Identify curves by speed and provide all curves on the sheet. Provide NPSH curve and efficiency for each speed.
 9. Submit certified and witness shop test procedures, the equipment to be used, plan and section drawings of the testing arrangements and manufacturer's sample form for reporting performance test results at least two weeks before the tests. The test shall conform to ANSI/HI 14.6, Grade E-1.
 10. Certified performance curves showing pumping head, capacity, horsepower and efficiency from shut-off to beyond minimum operating head at operating speed. In addition, include NPSH_R curves. The NPSH_R curve shall extend from the Allowable Operating Range limits as defined by Hydraulic Institute Standards.
 11. Testing procedure and balancing report for the balancing of the impeller and all shafts. Both static and dynamic balancing shall be completed. Certified results of dynamic balancing (prior to shipping).
 12. Submit certified performance curves at least two weeks prior to shipping the units from the factory. Provide copies of the data recorded during the test and methods of data reduction for determining certified tests results.
 13. Motor bearing temperature operating range for the service conditions specified.
 14. Field test procedure.
 15. Manufacturer's delivery, storage, and handling requirements.
 16. Manufacturer's installation instructions and recommendations.
 17. Certified setting plans, with tolerances, for anchor bolts.
 18. Schematic diagrams showing the wiring for each electrical or electro-mechanical equipment item, as well as interconnecting and point-to-point field wiring diagrams for wiring between all components provided under this specification.
 19. Documentation for instrumentation and control equipment provided under this Specification, said documentation to conform to the requirements specified under Division 17 – Instrumentation and Controls.
 20. Motor data per applicable Division 15 Specification Section
 21. Submit speed-torque characteristic of pump. Include pump inertia
 22. For variable speed pumping applications: The pump manufacturer shall submit notification of the recommended variable frequency drive type (Constant Torque, Variable Torque) necessary for the pump/motor manufacturer to satisfy the driven equipment performance requirements. Submittals to reflect the recommended type of variable frequency drive. The pump/motor manufacturer shall review the proposed VFD product data and submit notification that the proposed VFD is compatible with the driven equipment. The pumping unit submittal will not be approved without these aforementioned notifications.
 23. Dimensions/scaled drawings showing recommended vibration monitoring locations/quantities, vibration transmitter type (acceleration, velocity, etc.), vibration alarm/shutdown setpoints, and RTD temperature alarm/shutdown setpoints.
 24. Spare parts list indicating sizes, quantities, and part numbers of the items to be furnished, including any special tools required for assembly/disassembly of Pump Unit.
- C. Operation and Maintenance Manuals shall conform to the requirements of Specification Section 01730 "Operation and Maintenance Data".
- D. Certificates:
1. Metallurgical certificate from foundry for castings of pump components, including but not limited to: casing, impeller and shafts.
 2. Machining accuracy certificate showing that shaft fabrications were machined within OEM drawing tolerances.
 3. Material Certification:

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- a. Provide certification from the equipment manufacturer that the materials of construction specified are recommended and suitable for the service conditions specified and indicated. If materials others than those specified are proposed based on incompatibility with the service conditions, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated including an installation list of a minimum of five (5) installations in operation for a minimum of five (5) years. Provide proposed materials at no additional cost to Owner.
 - b. Where materials are not specified, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated.
4. Certification of welders in accordance with American Welding Society (AWS).
 5. Pump manufacturer's certification that the proposed suction length and proposed piping configuration will not adversely affect the pump's ability to meet design performance requirements. If straightening vanes or other suction improvements are needed as a requirement for this certification, submit proposed improvements prior to pump or suction piping fabrication for Engineer review. Contractor shall provide proposed improvements in accordance with pump manufacturer's recommendations at no additional cost to Owner.
 6. Certification that the centrifugal pump is compatible with the proposed pump motor and VFD equipment based on pump manufacturer's review of technical data for the other equipment.
- E. Reports:
1. Certified report of Resonant Frequency Analysis. Pump manufacturer shall provide whatever devices or supports necessary to meet the requirements of the analysis, at no additional cost to the Owner.
 2. Factory Tests: Furnish reports of witnessed and certified factory tests. No equipment shall be shipped from its place of manufacture before the witnessed and certified factory test reports have been approved by the Engineer.
 3. Field Tests: Furnish reports of field tests. Prior notification of field tests shall be submitted for all equipment at least two weeks before the tests.
 4. Installation Report: Furnish to ENGINEER copies of certified report prepared by manufacturer's technical representative certifying satisfactory installation, operation, and in service placement of units.

1.07 QUALITY ASSURANCE

- A. System Coordination:
1. CONTRACTOR retains overall responsibility to properly install, adjust, test, and place in operation the Pump Units.
 2. All pumps for each service provided under this Specification shall be the products of a single manufacturer. All motors for each service provided under this specification shall be the product of a single manufacturer. The pump manufacturer shall furnish the pumps and motors, as a complete and integral package to insure proper coordination, compatibility, and operation of the system.
 3. Coordinate start-up with pump manufacturer, motor manufacturer and pump control valve manufacturer.
- B. Manufacturer's Qualifications
1. The Contractor shall provide evidence to the Engineer that the manufacturer has a minimum of five (5) years experience, within the last ten (10) years, in the

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- design, manufacture, and supervision of installation of equipment of the type and size specified (or larger) under this Specification.
- 2. The Contractor shall provide evidence to the Engineer that equipment which was designed and manufactured by the manufacturer, and which is similar to the equipment required under this Specification, has been in continuous and successful operation in at least five (5) separate facilities for the past five (5) years.

C. Manufacturer's representative

- 1. Furnish services and training required in Section 01445, "Manufacturers Field Services" unless otherwise specified in this Specification Section.
- 2. The Contractor shall provide the services of a qualified manufacturer's service technician to:
 - a. Assist in the installation of the equipment;
 - b. Check the installation before the equipment is placed into operation;
 - c. Assist in the performance of field tests;
 - d. Assist in start-up of equipment; and
 - e. Train the plant operations and maintenance staff in the care, operation and maintenance of equipment.
- 3. The Contractor shall provide the services of the manufacturer's service technician at such times and for such duration of time as are needed to perform the tasks required of the representative as specified in Article 1.07.C.2 above. At a minimum, the services of the manufacturer's technician shall be provided as indicated herein below and any additional time required shall be provided at no additional cost to the Owner. The number of visits and person-days per visit indicated below shall be understood as referring to the total required services for the lot of equipment provided under this Specification. However, the Contractor is advised that the number of visits and person-days per visit indicated below do not include (and are to be understood as being in addition to) the motor manufacturer's technician services.

a. Installation:	2	visits of	3	person-days per visit
b. Field testing:	2	visits of	3	person-days per visit
c. Start-up:	1	visits of	5	person-days per visit
d. Training:	4	visits of	1	person-days per visit
- 4. The Contractor shall coordinate the manufacturer's representative services such that technicians from the pump, motor and discharge valve manufacturer are present simultaneously at the project site during field testing and startup of the pumps.
- 5. The Engineer reserves the right to require that any unused person-days from any visit be applied to any other specific visit.
- 6. Person-days shall be understood only as days spent on-site (not in transit).
- 7. Unless otherwise authorized by the Engineer, the manufacturer's technician shall be a direct employee of the equipment manufacturer or a factory trained technician, with at least five (5) years of experience in the installation, testing and start-up of equipment of the type provided under this Specification. Provide resume of the proposed manufacturer's technician for engineer approval before commencing of work. The manufacturer's sales and marketing personnel will not be accepted as manufacturer's technicians.
- 8. Reports: The Contractor shall submit a report from the manufacturer for each visit to the Site of the manufacturer's technician. The report shall provide complete information regarding the visit, including, but not limited to, dates, times, subject equipment, tasks performed, persons contacted, problems corrected, test results, training provided, and other pertinent information.
- 9. In addition to the above, the Contractor shall provide the services of person(s) authorized by the manufacturer to witness the unloading at the Site and, if stored,

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placing into storage the equipment provided under this Specification, and to ascertain the condition of said equipment. Manufacturers' sales and marketing personnel may be accepted as authorized person(s) to perform these specific tasks. The Contractor shall submit to the Engineer a report, completed by the authorized person(s) and certified by the equipment manufacturer, documenting the findings of the authorized person(s).

- D. Painting: The equipment provided under this Specification shall be shop cleaned, primed, and finish painted, and field painted in accordance with the requirement of Specification Section 09902 "Painting and protective coatings".

1.08 DELIVERY, STORAGE AND HANDLING

- A. Manufacturer shall carefully prepare the pump for shipment to minimize the likelihood of damage during shipment. Cavities shall be drained of water. Equipment shall be properly supported and securely attached to skids. Openings shall be covered in a manner to protect both the opening and interior.
- B. Deliver, unload, and store products on site in a manner that prevents damage. Use special care to prevent damage from temperature and condensation.

1.09 SPARE PARTS

- A. For each pump size, provide spare parts that are identical to an interchangeable with similar parts installed.
1. One set of all pump shaft bearings.
 2. One set of all special tools required.
 3. One complete set of shaft sleeves.
 4. One complete set of gaskets.
 5. One complete set of wearing rings with fasteners.
 6. One complete set of mechanical seals.
- B. All spare parts shall be plainly tagged, marked for identification and reordering and shall be delivered properly boxed.

PART 2 PART 2 PRODUCTS

2.01 MANUFACTURER(S)

- A. Patterson Pumps Company.
- B. Sulzer
- C. or approved equal.

2.02 MATERIALS AND/OR EQUIPMENT

- A. General
1. Pump units shall be suitable for pumping filtered chlorinated water from the clearwells to the finish water transmission mains. The maximum and minimum temperature of the pumped fluid is specified in Attachment "A".
 2. Pump unit drive motors shall be as specified in Attachment "A" and in Section 15172 and in Section 15175.

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3. Pumping unit to yield performance stable and free from noise or vibration throughout operating range. From run-out head to shut-off head, the Head vs. Capacity curve shall be constantly rising without a 0 or reverse slope.
4. Pumps shall be manufactured in accordance with the latest Hydraulic Institute Standards and manufactured under the certification of ISO-9001:2008.
5. Pumping assemblies, including pump and motor, shall operate within vibration and bearing temperature limits specified over the full operable range of the pump performance. Motors shall be non-overloading under any condition of operation specified and indicated without operating in the motor service factor.
6. Equip pumping units with all specified and required accessories, including lifting attachments, pressure gages, drain connections, and motor temperature and vibration sensors.
7. Apply a never seize compound to all bolts.
8. Provide isolation sleeves and washers when stainless steel hardware is used on dissimilar materials.
9. The pumps shall be capable of temporary operation at or near shut off head for four (4) minutes to allow for opening and closing of the pump discharge control valve as the pump starts or stops.

B. Impeller

1. The impeller shall be enclosed double suction type of cast tin bronze ASTM B584 or Aluminum bronze ASTM B148.
2. Statically and dynamically balance each impeller.
3. Impellers shall be precision cast in one piece with smooth flow contours to promote maximum efficiency.
4. Impellers shall be secured to the shaft through a precision fit and full-length key.
5. The impeller skirt shall have sufficient metal thickness to allow machining for installation of impeller wear rings.
6. If impeller wear rings are not available, provide a duplex stainless steel (ASTM A890) impeller and casing wear ring.

C. Casing

1. The casing shall be made of close-grained cast iron conforming to ASTM A48 CL40 or ductile iron conforming to ASTM A536 Gr 65-45-12 of sufficient thickness and suitable ribbed to withstand all stresses and test pressures and to prevent excessive deflection due to hydraulic thrust loads.
2. Casing shall withstand a hydrostatic test of 150% of shut-off head or 200% of the head at the rated condition, whichever is greater.
3. Casing shall consist of upper and lower half castings containing the volute and suction passages. Bearing housings shall either be integrally cast with the lower half of the casing or separately cast and provided with a registered fit to the lower half casing and doweled in place once accurately aligned with the casing bore.
4. Casing shall be axially split along the horizontal shaft centerline with flat-faced suction and discharge flanges and mounting feet cast integral with the lower half casing.
5. Casing shall be lined-bored to assure concentricity and angular alignment.
6. The upper and lower half casings shall be double volute doweled to permit easy removal and accurate replacement of the upper half for inspection and maintenance. The upper half casing shall be completely removable without disturbing the suction or discharge piping connections.
7. Suction and discharge connections shall be sized to reduce hydraulic friction losses and to reduce turbulence and pipe noise. All suction and discharge flanges shall be designed for straight through nut-and-bolt flange connections. Suction flange shall be 125 lb. ANSI drilling and the discharge flange 125 lb. ANSI drilling.

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8. Upper half casing shall have a drilled and tapped connection at the highest point on the casing for the purpose of pump priming and/or air release. Lower half casing shall be drilled and tapped to allow for drainage piping and pressure gages connection.
9. Provide air valve assembly to be installed on the highest point of the casing.
10. Provide pump feet integral in the bottom half of the casing. Design pump feet and casing for hydraulic thrust not less than two times the shutoff head times the area of discharge nozzle and acting at the centerline of the discharge nozzle.
11. Machine internally as unit, and provide with eye bolts or other lifting devices for lifting.
12. Position of discharge piping connection as shown on drawings.

D. Wear Rings

1. Wear rings shall be provided on both the impeller and casing so that clearances can be maintained throughout the life of the rings and minimize recirculation.
2. Removable, made of material that will resist corrosion and erosion. Casing rings shall be ASTM B505, C90500 or approved equal and impeller rings, shall be ASTM B148, C95800 or approved equal, with the wearing surfaces parallel to the axis of rotation.
3. Securely fastened to prevent any relative motion and designed for easy replacement.
4. If impeller wear rings are not available, provide a duplex stainless steel (ASTM A890) impeller and duplex stainless steel (ASTM A890) casing wear ring.

E. Bearings

1. Radial bearings: anti-friction, oil lubricated bearings per Attachment A for both the inboard and outboard ends of the pump.
2. Thrust bearing: anti-friction oil lubricated, installed at the outboard end.
3. Bearings shall be designed for an L10 life of 100,000 hours per AFBMA at best efficiency point.
4. Bearings shall be of standard sizes to ensure interchangeability and accessible for easy replacement.
5. Anti-friction bearings shall be roller or ball type and oil lubricated.
6. For each bearing, furnish and install:
 - a. Sight glass
 - b. Oil reservoir
 - c. Oil fill and drain connection, including fill line filter and cap and drain valve and plug.
7. Provide bearing temperature and vibrations monitoring systems as specified in Contract Documents.

F. Shaft

1. The pump shaft shall be forged steel in accordance with AISI 4340 or approved equal. If impeller wear rings are not available, provide a duplex stainless steel (ASTM A890) pump shaft.
2. The pump shaft shall be a straight non-tapered shaft, precision machined to a smooth finish over the entire length with appropriate grinding and polishing at bearing areas, and free from harmful and damaging vibrations.
3. Seal areas and bearing journals subject to wear and corrosion shall be fitted with replaceable stainless steel sleeves conforming to ASTM A276, Type 316 or approved equal.
4. Shaft diameter shall be sized to prevent torsional deflection, flexural deflection, whipping and vibrating. Shaft will be of sufficient size to transmit the full driver horsepower with a minimum of 2.0 safety factor. Shaft deflection for all conditions

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5. on the pump performance curve shall be limited to 0.002 inches maximum measured at the seal, or 75% of the wear ring clearance, whichever is less. Shaft shall be manufactured to meet stiff shaft construction with a critical speed at least 25% in excess of actual maximum operating speed, in order to prevent vibration and fatigue.
6. Shaft shall be accurately machined along its entire length. A keyway shall be machined at the coupling end. No threads shall be machined adjacent to the impeller.
7. Design shaft assembly so assembly can be removed and replaced without disturbing suction and discharge connections.
8. Provide Teflon gaskets or O-rings to prevent leakage between shaft and sleeves.

G. Sealing Box

1. Split mechanical seals manufactured by Chesterton, Style 442 T2 or approved equal.
 - a. All components of the seal shall be split in half including the elastomers, gland, rotary and stationary seal faces and rotary holder.
 - b. The seal shall be able to be installed outside of the stuffing box without any equipment disassembly required.
 - c. Hydraulically balanced design to provide maximum interchangeability without equipment modification.
 - d. The stationary seal face shall be mechanically loaded with multiple springs to ensure no leakage when the pump is shut off. The springs shall be isolated from the pumped product in order to eliminate potential corrosion or clogging problems.
 - e. The gland halves shall have an interlock mechanism to prevent distortion at the gland halves.
 - f. The seal shall be capable of sealing 200 psig at 1800 RPM.
2. Materials:
 - a. Gland: Type 316 stainless steel
 - b. Rotary holder: Type 316 stainless steel
 - c. Hardware: Type 316 stainless steel
 - d. Springs: Elgiloy to prevent chlorine stress corrosion
 - e. Rotating Faces: Reaction Bonded Silicone Carbide
 - f. Stationary Faces: Reaction Bonded Silicone Carbide
 - g. Elastomers: Viton
3. Provide external piping, valving, vent connection, and filter assembly for seal water line from pump volute.
4. Seals to be installed in the pumps at the jobsite by the seal manufacturer's filed service technician.

H. Baseplate

1. The Contractor shall provide and embed the anchor bolts for securing the pump/motor base plate to the foundation pad. Other bolting and shimming material and all other appurtenances shall be furnished by the Contractor for a complete installation of the pumping unit baseplate. Anchor bolts shall be designed for a minimum of 2 times the maximum expected load or higher if recommended by the pump manufacturer. Anchor bolt sizing calculations, sized for the applicable Seismic zone, and signed and stamped by a Professional Engineer registered in the state of Texas shall be provided by the Pump Manufacturer as part of the product data submittal.
2. Mount pump and driver on common structural steel base designed to withstand deflections due to hydraulic loads or motor torque and to support pump and motor in proper alignment and prevent harmful or damaging vibrations.

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3. Material: ASTM A36 fabricated structural steel.
 4. Provide with provisions for grouting, for anchor bolts and to collect leakage.
 5. Machined mounting surface shall be coplanar to 0.002", and shall extend 2" beyond pump and driver feet on all sides with a 125 micro inch Ra finish.
 6. After leveling and alignment, the base shall be grouted and completely filled with a non-shrinking grout per manufacturer recommendations.
 7. A flexible coupling and an enclosed type coupling guard shall be provided.
- I. Couplings:
1. Non lubricated, polyurethane flex material type
 2. Split design
 3. Spacer type
 4. Manufacturer: Rexnord Omega or approved equal.
- J. Vibrations Monitoring:
1. At a minimum furnish and install the quantity and type of vibration indicating transmitters as shown on PLANS and as specified herein, in Section 15172 and in Section 15175.
 2. Furnish and install vibration indicating transmitters for the following measuring points:
 - a. Pump non-drive end bearing: Furnish and install a total of three transmitters at this location, one dedicated to x-axis sensing, one dedicated to y-axis sensing and one dedicated to z-axis sensing
 - b. Pump drive end bearing: Furnish and install a total of two transmitters at this location, one dedicated to x-axis sensing and one dedicated to y-axis sensing
- K. Painting: Per Specification Section 09902, "Painting and Protective Coatings" as follows:
1. Shop painting: Factory applied Primer and Finish Paint
 - a. Pump Case: Per "Potable Water Treatment Plant Equipment, Piping – Submerged" from "Table 1 - System Schedule".
 2. Provide additional shop paint coating for touch-up to all surfaces after shop testing is completed and equipment accepted.
 3. During installation and after approved testing by the Engineer, apply touch-up paint to all scratched, abraded and damaged shop painted surfaces. Coating type and color shall match shop painting.
 4. All coatings and linings in contact with the pumped fluid shall be suitable for use with potable water and shall be NSF61 approved.

2.03 SOURCE QUALITY CONTROL

- A. Shop Tests:
1. All of the shop tests required under this Specification shall, in addition to being certified by the manufacturer, be witnessed by the Owner's representatives. Provide a minimum of 30 days written notice to the Engineer prior to shop testing.
 2. Certified shop tests shall be performed for all equipment provided under this Specification. Standard performance test will be conducted as specified in ANSI/HI 14.6 for Centrifugal Pump Tests Grade E-1, and all test data shall be submitted for approval by the Engineer prior to shipment. Test and record speed, flow, head, and horsepower. Certified copies of the calculated anticipated pump field performance curves shall be submitted, including head, capacity, efficiency, total brake horsepower, NPSH and required submergence.
 3. Constant speed pump: the actual pump shall be tested with one job motor. One job motor can be used to test all the pumps of the same size.

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4. Variable speed pump: the test to include actual job pump, motor and VFD.
5. Hydrostatic Testing: Each pump rotating assembly and discharge head shall be hydrostatically tested at not less than the greater of the following, and in full compliance with the ANSI/HI 14.6:
 - a. 200% of the pressure which would occur when the pump is operating at the rated condition of the pump or,
 - b. 150% of the pressure which occur when the pump is operating at rated speed against a closed discharge valve.
6. Run pump at full speed rating point for 60 minutes prior to start of any testing.
7. Performance of the pumping units shall be within the tolerances as specified in ANSI/HI 14.6, when operated at design speed and capacity (Rating Point in Pump Schedule attached as Appendix "A").
8. Full speed tests:
 - a. Test pump at the conditions specified and indicated and take no less than seven operating points between shutoff and runout. Test conditions must be at the conditions specified and indicated.
 - b. Take readings to determine flow, differential pressure, rpm, horsepower and efficiency
 - c. Operate pump for not less than one hour and take readings to determine that the pump will operate as specified and indicated without cavitation at the specified minimum head condition with not more than the specified NPSH available.
9. Variable speed tests
 - a. Conduct tests as specified above for full speed at reduced speeds except that tests for cavitation at runout are not required.
 - b. Run one speed test at speed required to discharge the minimum rating point specified and indicated with one point of test at the minimum rating point.
 - c. Run a second test at a speed approximately midway between full and minimum speed.
 - d. Any additional test runs should be equally spaced between prior tests.
10. All instruments, meters and other measurement devices used during the tests shall be calibrated within 90 days of the tests. Copies of the certificates of calibration shall be submitted to the Owner's representative prior to witnessing the tests.
11. In the event that specified tests indicate that pump or motor will not meet specifications, Engineer has the right to require additional complete witnessed tests for all pumps and motors at no additional cost to the Owner.
12. Repeat tests until specified results are obtained. If impellers are trimmed or modifications made to the pumps, pump assemblies must be retested.
13. Correct or replace promptly all defects or defective equipment revealed by or noted during tests at no additional cost to the Owner.
14. Submit certified copies of all the test result to the Engineer for review prior to the shipment of the motors from their place of manufacture.
15. All test measurements shall be taken with calibrated instruments and all procedures shall conform to the test code of the Hydraulic Institute unless modified herein.
16. Factory tests as outlined above shall be witnessed by the Owner's representatives. The manufacturer shall include cost for one (1) factory trip, each trip attended by four (4) Owner's representatives, per factory trip, and for a duration of up to 5-standard business days per factory trip, and eight (8) standard business hours per business day. The cost of meals and incidental expenses during each trip shall be Owner's responsibility.

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17. In the event that testing of the pumps cannot be completed in the time specified above, the Contractor shall bear cost for additional factory trip for witness testing at no additional cost to the Owner.
18. Prior tests on similar or identical pumps are not acceptable.

2.04 ADJUSTABLE SPEED DRIVE EQUIPMENT

- A. Provide adjustable speed drive equipment as specified in Attachment A and Division 16.

PART 3 EXECUTION

3.01 - 3.02 (NOT USED)

3.03 ERECTION/INSTALLATION/APPLICATION AND/OR CONSTRUCTION

- A. Installation of equipment and materials provided under this Specification Section shall be in accordance with the manufacturer's recommendations and the approved shop drawings.
- B. Install pumping units on a concrete pad and align thereon.
 1. Coupling halves must be disconnected and only reconnected after alignment.
 2. Set base on metal shims placed directly under the part of the base carrying the greatest weight and spaced close enough to provide uniform support.
 3. Dowel pump and drive to baseplate after alignment in field to facilitate realignment after disassembly.
- C. After installation of pump equipment, bring piping into direct axial alignment with pump discharge. Flange faces shall fit closely and squarely. The pump discharge shall have no strain imposed upon it by piping misalignment.
- D. Final Coupling Alignment:
 1. Perform only after base is installed and piping is connected and pump nozzle connections tested in accordance with paragraph 3.02.E
 2. If realignment is required piping must be disconnected prior to alignment, piping reconnected and alignment checked prior to connecting coupling halves.
 3. After alignment is correct, grout using high grade non-shrink grout, fill entire base and leave no gaps or voids. Do not imbed leveling nuts in grout.
- E. Test piping connections, to prove the pump nozzles are installed with the pipe in a free supported state without need to apply vertical or horizontal pressure to align piping with pump nozzles, by removing all flange bolts and checking flange to flange alignment.
- F. Install split mechanical seal. Split mechanical seal to be installed by the seal manufacturer's field service representative or the pump manufacturer shall provide seal manufacturer approved installation procedure to factory install seals.
- G. Special Precautions: Before starting the pumps the Contractor to check the following:
 1. Check that pump rotating elements are free
 2. Check rotation of motor with pump drive disconnected.
 3. Check flow and pressure of cooling water used for motor windings is adequate.
 4. Check settings of the pumps control valve and air vacuum valve.
- H. After start-up and testing as specified below, shut down pump and recheck alignment of coupling. Check in all directions and follow manufacturer's instructions.

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- I. After unit has been operated within the allowable operating range for one week, check couplings for misalignment and correct as necessary.
- J. After completion of all procedures specified above, clean and touch up any damaged coating system as required.

3.04 REPAIR/RESTORATION (NOT USED)

3.05 FIELD QUALITY CONTROL

- A. Provide a minimum of 30 days written notice to the Engineer prior to field testing.
- B. After installation of pumping equipment, and after inspection, operation, testing and adjustment have been completed by the Contractor, and supervised/inspected by the manufacturer's technical representative, conduct running test for each individual pump system in the presence of Engineer to determine the ability of the pumps, motors, pump control valves and instrumentation to operate like a coordinated system. Check each individual pump system's ability to operate within vibration and temperature limits specified, and to deliver its rated capacity under specified conditions. Vibration tests to prove that there are no field installed resonant conditions due to misalignment, the foundation, or the connecting piping and its supports, when operating at any speed within the specified operating range. During tests, observe and record head, capacity, motor inputs, noise, vibration, pump bearing house and motor bearing temperature. Promptly correct or replace all defects or defective equipment revealed by or noted during tests, at no additional cost to the Owner, and repeat tests until specified results that are acceptable to the Engineer are obtained. Contractor shall provide labor, material, equipment, and piping for conducting tests.
- C. Provide vibration signature testing for the pump and drive assembly including both "Bump Test" and vibration profiles and field torsional critical speed tests. Provide testing in accordance with ANSI/HI 9.6.4-2009, Centrifugal and Vertical Pump for Vibration Measurements and Allowable Values, except as modified herein:
 - 1. Vibration readings, shall not exceed 0.12-in./sec. RMS, unfiltered
 - 2. Submit written report with analysis conclusion, exhibits of where measurements were made, etc. Report shall contain complete analysis of findings, problems encountered, if any, and probable cause and specific recommendations for any corrective action.
 - 3. Vibration testing shall be conducted by a highly qualified and independent testing firm specializing in the analysis and testing of rotating equipment. Testing firm shall be selected and retained by the pump manufacturer and approved by the OWNER.
- D. Test Duration: The tests shall be conducted for a continuous period of 2 hours minimum at each speed, or until bearing temperatures are constant for 3 consecutive readings (whichever is longer) at each condition specified and indicated.
- E. Contractor to provide all equipment, flow meters and test gauges for conducting tests.
 - 1. Contractor shall provide calibrated test gauges for all permanently installed gauges and portable calibrated flow meters for all pumping systems.
 - 2. All calibrations must be within 30 days of the field testing.
 - 3. The testing will not be started and will not be accepted until the calibrated testing equipment stated above is operational and all certifications have been submitted.
- F. Water for testing can be potable water from the clearwells. Contractor is responsible for disposal of water used for testing.

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- G. If required, take corrective action and have the Pump Units retested to ensure full compliance with the specified requirements. Remove and replace equipment at no additional cost to the Owner with equipment that will meet all requirements specified and indicated if unable to demonstrate to the Engineer that units will perform the service specified and indicated. All costs associated with the field tests or any required corrective action shall be borne by the Contractor.
- H. The vibration analysis indicated above shall be repeated 6 months after signature testing, in the presence of Engineer and Owner. A report shall be prepared comparing the results of the 6-month tests with the results of the signature tests. Significant worsening of the vibration, to be determined by the ENGINEER, during the 6-month tests shall require corrective action and retesting.

3.06 ADJUSTING

- A. Manufacturer's technical representative to inspect, check, assist in making adjustments if necessary, and approve for placing in operation.

3.07 - 3.10 (NOT USED)

1.11 MEASUREMENT AND PAYMENT

No separate measurement or payment for work performed under this Section. Include cost of same in Contract price bid for work of which this is a component part.

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ATTACHMENT A

Pump Characteristics		
Pump Designation	MSPS-MSP-2; MSPS-MSP-4	MSPS-MSP-3; MSPS-MSP-5; MSPS-MSP-6
Number of Units	2	3
Materials Being Pumped	Filtered Water Chlorinated	Filtered Water Chlorinated
Constant or Variable Speed	Constant	Constant
Configuration	HSC, Bottom Suction	HSC, Bottom Suction
Radial bearing type (inboard and outboard)	Anti-friction, oil lubricated	Anti-friction, oil lubricated
First Rated Point		
Rated Capacity at first rated point (gpm)	6,945	13,890
Total Dynamic Head at first rated point (ft) (1)*	189	189
Minimum Efficiency at first rated point	84%	86.4%
Second Rated Point		
Rated Capacity at second rated point (gpm)	5,200	10,400
Total Dynamic Head (TDH) at second rated point (ft) (1)*	200	209
Minimum Efficiency at second rated point	73%	81%
Minimum Efficiency at TDH of 160 ft.	88%	82%
Maximum NPSHr for TDH higher than 140 ft. (ft)	28	28
Maximum flow at TDH of 140-ft (GPM)	11,000	17,350
Minimum Continuous Flow (GPM)	4,800	10,700
Minimum Pump Head at runout conditions (ft)	130	140
Maximum Pump Speed (rpm)	1,200	900
Electrical Motor Characteristics		
Horsepower	550	1,000
Nominal Speed (rpm)	As required	As required
Environment	Indoor	Indoor
Enclosure Type	TEWAC	TEWAC
Voltage	12.5 KV	12.5 KV
Phase/Cycle (Hertz)	3	3
Specification Section	15175	15175
()* Indicates footnotes following.		
1.	Does not include internal losses in pump.	

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Pump Characteristics	
Pump Designation	MSPS-BWP-1
Number of Units	1
Materials Being Pumped	Filtered Water Chlorinated
Constant or Variable Speed	Variable Speed
Configuration	HSC, Bottom Suction
Radial bearing type (inboard and outboard)	Ball, oil lubricated
First Rated Point	
Rated Capacity at first rated point (gpm)	16000
Total Dynamic Head at first rated point (ft) (1)*	55
Minimum Efficiency at first rated point	87%
Second Rated Point	
Rated Capacity at second rated point (gpm)	16000
Total Dynamic Head (TDH) at second rated point (ft) (1)*	26
Minimum Efficiency at second rated point	78%
Third Rated Point	
Rated Capacity at second rated point (gpm)	9500
Total Dynamic Head (TDH) at second rated point (ft) (1)*	18
Minimum Efficiency at second rated point	86%
Forth Rated Point	
Rated Capacity at second rated point (gpm)	9000
Total Dynamic Head (TDH) at second rated point (ft) (1)*	40
Minimum Efficiency at second rated point	82%
Maximum NPSHr for all speed and all flow range(ft)	24
Maximum Pump Speed (rpm)	600
Electrical Motor Characteristics	
Horsepower	300
Nominal Speed (rpm)	As required
Environment	Indoor
Enclosure Type	TEFC
Voltage	480 V
Phase/Cycle (Hertz)	3
Specification Section	15172
() * Indicates footnotes following.	
1.	Does not include internal losses in pump.

END OF SECTION