DIVISION 11

EQUIPMENT

SECTION 11210 – HORIZONTAL END SUCTION PUMPS

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. Provide all labor, materials, equipment, delivering, installing, testing, incidentals, and placing into service the horizontal end suction non-potable water pumps and all appurtenances as shown on the Drawings and more fully described hereinafter. The equipment to be furnished and installed shall be as shown on the Drawings and shall include pumps, motors, VFDs, control panels and control systems, and appurtenances, all tested and ready for operation.

B. Unless otherwise specified the pump manufacturer shall furnish each pumping unit complete with drive motor and all other components and shall be entirely responsible for the compatibility in all respects of all components furnished.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Submittals: Section 01300

B. Operating & Maintenance Manuals: Section 01780

C. Interior Process Piping: Section 11295

D. Variable Frequency Drives: Section 16446

E. Electrical: Division 16

1.03 MANUFACTURER

A. The pumping units shall be provided by a single manufacturer with a minimum of five (5) year's experience in designing and manufacturing pumping equipment of similar type, size and capacity. The pumps shall be manufactured by the Pentair – Aurora, Flowserve, Patterson, or approved equal.

B. To assure unity of responsibility, the pumps, motors, VFDs, and other auxiliary equipment, and materials specified in this Section shall be furnished and coordinated by the pump manufacturer (Manufacturer) who shall assume responsibility for the satisfactory operation of the entire pumping system including pumps, motors, VFDs, and accessories.

C. Replacement Parts Capability: The manufacturer shall have the ability to promptly furnish any and all interchangeable replacement parts as may be needed at any time within the expected life of the pumps. Upon request, the Contractor shall submit evidence of the proposed manufacturer's ability to promptly fill replacement orders.

D. Quality Assurance: All pumping units shall be of approved design and make products of manufacturers who have built equipment of similar type, size and capacity.

E. Additional Submittals: The Contractor shall submit, upon request, any additional information that the Engineer may deem necessary to determine the ability of the proposed manufacturer to produce the specified equipment.

F. Manufacturer Information: All manufacturer information required by the specifications shall be submitted by the Contractor within thirty (30) calendar days of the date of receipt of the Notice to Proceed.

Any additional information or data, specifically requested by the Engineer, concerning manufacturer's capabilities (especially relating to requirements described hereinbefore), shall be submitted by the Contractor within fourteen (14) calendar days of the receipt of the written request thereof, unless otherwise specified.

Approval of manufacturers or suppliers will not be given until all information required by the specifications or requested by the Engineer has been submitted and acceptable.

G. Disqualification of Manufacturer:

1. Poor performance of similar pumping equipment now in operation under the specified conditions of service and pump rating constitute grounds for disqualification of the pump manufacturer, supplier, or both, unless such poor performance has been corrected.

2. Failure to successfully comply with the provisions of subparagraphs A through H, inclusive, will constitute grounds for disqualification of pump manufacturer.

1.04 SUBMITTALS

A. General: The Contractor shall comply with the provisions of the specifications regarding submittals, unless otherwise specified herein.

B. At the time of submission, the Contractor shall, in writing, call the Engineer's attention to any deviations that the submittals may have from the requirements of the Engineer's Contract Drawings and Specifications.

C. The Contractor shall provide a notarized certification indicating that all pumping products meet the required Specifications.

D. Descriptive literature, catalog cuts, and dimensional prints clearly indicating all dimensions and materials of construction shall be submitted on all items specified herein to the Engineer for review and approval before ordering.

E. Content of Submittals: The following shall be included in submittals as a minimum. However, any additional information or data shall be added if and whenever requested by the Owner or the Engineer. Where applicable, submit separate data for each pump.

1. Descriptive Literature:

a. Dimensions

b. Materials of Construction (including required coating).

c. Performance Data.

1) Pump Impeller Size

2) GPM

3) TDH

4) BHP

5) RPM

6) Performance curves showing pump operation including shutoff head, operating point, and run-out.

7) Performance curves showing overall pump efficiencies.

8) Weight of pump

9) Horsepower rating of pump motor

2. Installation Information: Submit installation drawings and information for pump connections, connecting piping and valves, electrical connections, and auxiliary equipment.

   The Contractor shall submit all other drawings, material lists and other information specified, requested and/or necessary to show complete compliance with all details of the contract documents.

3. Test and Inspection Reports: A written report shall be submitted to the Engineer documenting testing and or inspection results.

4. Operation and Maintenance Manual: Manual shall contain all information necessary for proper operation and maintenance of pumping units, as well as the location of the nearest permanent service headquarters.

1.05 TESTS

A. Shop Tests:

1. All pumps shall receive a non-witness factory test.

2. The Manufacturer shall factory test all pumps prior to shipment in accordance with the Hydraulic Institute standards, latest version. Flow rate, total head and Input KW shall be tested and recorded for at least five points on the pump performance curve. Test shall be performed to demonstrate that the pumps meet ANSI/HI standards. A minimum speed curve shall be plotted on the performance curve based on the test data.

3. The Manufacturer shall furnish sworn certificates to the effect that the pump has passed the hydrostatic pressure tests.

4. Motor Tests: Each motor shall be given the standard commercial tests in the shop of the motor manufacturer, and certified copies of the test results shall be submitted to the Engineer.

5. Five (5) certified copies of the results of these tests are to be sent to the Engineer. Also included with the test curves shall be a certified bill of material list depicting quality of construction.

B. Field Tests:

1. The pumping units will be accepted upon the basis of the certified copies of the shop test and be subject to a four-hour field test of each unit. This test will be for the purpose of determining if each pumping unit will operate under installed conditions within a reasonable degree of correlation with the shop tests.

2. The Contractor shall give at least two (2) week's notice to the Owner when the field tests are to be accomplished so that the Owner may have a representative present at the said tests.

3. The field tests shall be made by the Contractor in the presence of and as directed by the Engineer.

4. Field tests shall be made on each pumping unit. During the test, each pump shall be run at maximum rated speed for at least three (3) rates of flow corresponding to minimum rate, design rate, and maximum rate of flows specified as evidenced by the corresponding total head shown by the pump gages; simultaneous ammeter readings shall be taken. Variation of the rate of flow shall be made by throttling the discharge valve (where applicable). The rated motor nameplate current and power shall not be exceeded at any rate of flow within the specified range.

5. Before any pump is rotated, the Contractor shall make certain that no debris is present in suction well, pumps or pipelines. Any internal damage done to equipment while starting up shall be assumed to be caused by debris and shall be replaced at the Contractor's expense. No pump shall be rotated under power unless submerged with liquid.

5. When water can be pumped, the Contractor shall commence pumping and shall have representatives from the pump manufacturer to start the pumps. When flow conditions are favorable, the Contractor or pump manufacturer shall in the presence of the Engineer, run a series of tests to establish the adequacy of the pumping units.

6. Field tests shall also conform to Part 3, Paragraph 3.03 as specified hereinafter.

C. Failure of Tests:

1. Any defects in the equipment or failure to meet the guarantees or requirements of the specifications shall be promptly corrected by the Contractor by replacements or otherwise. The decision of the Engineer as to whether or not the Contractor has fulfilled his obligations under the Contract shall be final and conclusive. If the Contractor fails or refuses to make these corrections or if the improved equipment, when tested, shall fail again to meet the guarantees of specified requirements, the Owner notwithstanding its having made partial payment for work and materials which have entered into the manufacture of said equipment, may reject said equipment and order the Contractor to remove it from the premises at his own expense.

2. In case the Owner rejects said equipment, then the Contractor hereby agrees to repay to the Owner all sums of money paid to him for said rejected equipment on progress certificates or otherwise on account of the lump sum prices herein specified, and upon the receipt of said sum of money the Owner will execute and deliver to the Contractor a bill of sale of all its rights, title, and interest in and to said rejected equipment; provided, however, that said equipment shall not be removed from the premises of the Owner until the Owner obtains from other sources the equipment to take the place of the rejected. The Owner hereby agrees to obtain said other equipment within a reasonable time and the Contractor agrees that the Owner may use the equipment furnished by him without rental or other charge until said other new equipment is obtained.

D. Responsibility During Test: The Contractor shall be fully responsible for the proper operation of equipment during tests and instruction periods and shall neither have nor make any claim for damage which may occur to equipment prior to the time when the Owner formally takes over the operation thereof.

E. Manufacturer's Representative: For all pumping units, the Contractor shall furnish the services of accredited representatives of the pump manufacturer who shall supervise the installation, adjustment, and field tests of each pumping unit and give instructions to the operating personnel. As one condition necessary to acceptance of any pumping unit, the Contractor shall submit a certificate from the manufacturer, stating that the installation of the pumping unit is satisfactory, that the unit is ready for operation, and that the operating personnel have been suitably instructed in the operation, lubrication, and care of the unit.

1.06 GUARANTEE PERIOD

A. After successful completion of tests and trials under operating conditions on all equipment, the Contractor shall guarantee all equipment, materials and workmanship from undue wear and tear, from mechanical and electrical defects, and from any failure whatever, for a minimum of one (1) year. This one (1) year minimum shall not replace a standard manufacturer's guarantee if it exceeds one (1) year.

1.07 PUMP WARRANTY

A. The Contractor guarantees and warrants that during the first one year of operation, the pumps will operate satisfactorily and continuously according to the pump schedule specified herein, and that after due notice has been given by the Owner, he or the pump manufacturer will proceed, within a reasonable time, to adjust, regulate, repair and renew at his own expense or perform such work as is necessary to maintain the guaranteed capacities, efficiencies and performances.

PART 2 - PRODUCTS

2.01 HORIZONTAL END SUCTION CERTIFUGAL PUMPS

A. Pump Requirements:

The pump shall be a centrifugal flexible-end coupled end suction pump, as shown on the Contract Documents and specified herein. The pump shall be designed and built for 24-hour continuous service at all points within the specified range of operation without overheating, without damaging cavitation, and without excessive noise or vibration.

B. Casing

The casing shall be ductile or cast iron flanged connections Flange connections shall be ASME/ANSI B16.1, Class 250. The casing shall tapped and plugged holes for gage and draining. Shall be furnished to allow for back pull out of the impeller without disturbing the casing or suction and discharge piping.

C. Impeller

The impeller shall be end suction centrifugal, made of ductile iron or bronze (ASTM B584). The impeller shall be statically and dynamically balanced. The impeller shall be keyed into the shaft.

D. Case Wear Ring

The pump casing shall be fitted with a case wear ring to minimize abrasive and corrosive wear. The casing ring shall be bronze.

E. Pump Shaft

The shaft shall be alloy steel (ANSI 1045), the motor shall be machined, providing a key slot, and drilled and tapped to accept the impeller fastener.

F. Coupling

Connect pump shaft to drive motor with a universal flexible coupling to compensate for minor misalignment and to permit removal of pump-rotating assembly and motor without removing piping. The entire rotating coupling shall be enclosed by a coupling guard. Coupling shall be sized to suitably transmit required driving torque.

G. Bearings

Bearings shall be greased ball bearings.
Minimum bearing life L_{10} of 17,500 hours.
The bearings shall be grease lubricated.

H. Bearing Housing

Bearing housing shall be cast iron and sealed to prevent contamination of the lubrication.

I. Shaft Sleeve

The pump shall be fitted with a bronze shaft sleeve to minimize shaft wear.

J. Seals

Shaft sealing shall be accomplished by means of mechanical seal. The mechanical seal assembly shall be silicon carbide, tungsten carbide, or Buna-N with 316 Stainless Steel metal parts.

K. Base

The pump and motor assembly shall be mounted to a rigid formed steel baseplate. The pump and drive mating surface shall be machined finished. The pump shall be supported from beneath

L. Pump Suction and Discharge Flange:

The pump discharge-mating flange and pump suction-mating flange shall be as shown on the drawings. The Contractor shall be responsible for any ancillary piping required to connect the pump to the existing piping. The piping is designed for a 6-inch suction line and a 4-inch discharge line, if a pump is selected without the previously described piping, the Contractor shall be responsible for any additional required piping.

2.02 PUMPING REQUIREMENTS

A. Pumps shall be manufactured by Aurora, Flowserve or Patterson shall comply to the following characteristics:

NPW Station 1

No. of Pumps	Shut-Off Head (Min) (Ft)	Design Point #1			Design Point #2			Max. Speed (RPM)	Max Motor HP Each Pump	Max. NSPHR (Feet)
		Flow (GPM)	Head (Ft.)	Min. Efficiency (%)	Flow (GPM)	Head (Ft.)	Min. Efficiency (%)			
2 (1 duty, 1 back up)	**121**	**800**	**77**	**72**	**1000**	**102**	**76**	**1780 RPM**	**40**	**28**

NPW Station 2

No. of Pumps	Shut-Off Head (Min) (Ft)	Design Point #1			Design Point #2			Design Point #3 [1]			Max. Speed (RPM)	Max Motor HP Each Pump	Max. NSPHR (Feet)
		Flow (GPM)	Head (Ft.)	Min. Efficiency (%)	Flow (GPM)	Head (Ft.)	Min. Efficiency (%)	Flow (GPM)	Head (Ft.)	Min. Efficiency (%)			
4 (3 duty, 1 back up)	225	800	217	68	1480	217	--	2700	217	71	3560 RPM	100 HP	30

[1] Design Point #3 to be met with all 3 pumps running at full speed.

B. Power supply shall be 480 volts, 3-Phase, 60 Hz, 4 wire service.

C. Motors shall be 460 volt, 3 phase, 60 Hz. Motors shall be premium efficiency design. The motor shall be non-overloading throughout the entirety of the pump performance curve.

D. Each pump shall be operated by VFD – see Specifications Division 16.

E. NPW Station 2 shall be able to operate at any flow rate between 800 and 2700 gpm at 210 feet of head.

2.03 PUMP ACCESSORIES AND OTHER

A. All pumps and controls shall be completely wired at the factory for power and control and shall be color-coded. All wiring outside the control cabinet shall be rigid conduit. All accessory equipment shall be permanently wired with suitable disconnecting means and overload protection.

B. Provide the following spare parts for each type of pump:

a. One (1) impeller
b. One (1) set of pump bearings
c. One (1) set of all gaskets

2.04 VARIABLE FREQUENCY DRIVES

A. The speed control for variable speed pumps shall be Variable Frequency Drives, as specified in Division 16 suitable for installation as shown on the Drawings.

B. The Variable Frequency Drives shall be supplied by the Manufacturer and shall be completely coordinated with the pumps and pump driving motors and shall include all internal auxiliaries required to meet the functional specifications.

C. The Variable Frequency Drives shall conform to all requirements stipulated in this Section and Division 16 Electrical, and shall be designed for a speed range of 50% to 100% of full load motor speed.

D. The Variable Frequency Drives shall be compatible with the motors provided by the Manufacturer.

PART 3 - EXECUTION

3.01 PREPARATION

A. Coordinate with other trades, equipment and systems to the fullest extent possible.

B. Take all necessary measurements in the field to determine the exact dimensions for all work and the required sizes of all equipment under this contract. All pertinent data and dimensions shall be verified by the Contractor.

3.02 INSTALLATION

A. Installation shall be in strict accordance with the manufacturer's instructions and recommendations in the locations shown on the Drawings.

B. The Contractor shall also provide from the pump supplier the service of a qualified start-up engineer (factory representative) who has had prior on-site start-up experience to assist in performing start-up, checkout and initial operation services of the pumping units. The start-up engineer shall also instruct the Owner's personnel on the operation and maintenance procedures for the station. Qualified supervisory services, including manufacturers' engineering representatives, shall be provided for a minimum of 4 man-days to insure that the work is done in a manner fully approved by the respective equipment manufacturer. The pump manufacturer's representatives shall specifically supervise the installation of the pump and the alignment of the connection piping. If there are difficulties in the start-up or operation of the equipment due to the manufacturer's design or fabrication, additional service shall be provided at no cost to the Owner. Services of the manufacturer's representatives and training shall be provided when the first pump is started, with follow-up visits upon start-up of each subsequent pump.

C. A certificate from the equipment manufacturer shall be submitted stating that the installation of his/her equipment is satisfactory, that the equipment is ready for operation and that the operating personnel have been suitably instructed in the operation, lubrication and care of each unit.

3.03 FIELD TESTS

A. During the field tests, observations shall be recorded of head, capacity, and motor input. All defects or defective equipment revealed by or noted during the tests shall be corrected or replaced promptly at the expense of the Contractor, and if necessary, the tests shall be repeated until results acceptable to the Engineer are obtained. The Contractor shall furnish all labor, piping, equipment, and materials necessary for conducting the tests. A report of the field tests shall be submitted to the Engineer.

B. A pre-operational check shall be completed by the manufacture's representative, the check shall include verification of pump and motor alignment, a check of proper motor rotation, and check pump and drive motors for proper lubrication.

C. After installation of the pumping equipment, and after inspection, operation, testing and adjustment have been completed by the manufacturer's representative, each pump shall be given a running test in the presence of the Engineer, such tests as necessary to indicate that the pumps, motors, and drives generally conform to the efficiencies and operating conditions specified and its ability to operate without vibration or overheating. The pumps and motors shall operate at the specified capacities in the range of heads specified without undue noise or vibration. Any undue noise or vibration in the pumps or motors, which is deemed objectionable by the Engineer, will be sufficient cause for rejection of the units.

D. A thirty-day operating period of the pumps will be required before acceptance. If a pump performance does not meet the Specifications, corrective measures shall be taken or the

pump shall be removed and replaced with a pump which satisfies the conditions specified. All test procedures shall be in accordance with Hydraulic Institute Standards certified results of tests shall be submitted. If pumps are accepted after thirty-day operating period, the Owner will pay all electric cost for the operation period. If the pumps are not accepted the Contractor will be responsible for the costs.

E. Provide, calibrate and install all temporary gauges and meters, shall make necessary tapped holes in the pipes, and install all temporary piping and wiring required for the field acceptance tests. Written test procedures shall be submitted to the Engineer for approval 30 days prior to testing.

F. Field Vibration Testing

a. After installation and as soon as conditions permit full speed operation, and in the presence of the Engineer, have the vibration tests performed in accordance with Hydraulic Institute Standards to (a) prove compliance with specified limitations, and (b) 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.

3.04 TRAINING

A. A factory representative shall provide a minimum of two (2) days, with eight (8) hours each day for a total of sixteen (16) person-hours of training to the Owner's operations staff concerning the recommended operation and maintenance of the equipment. Training shall be performed after substantial completion of the project with the use of operating equipment.

END OF SECTION

SECTION 11215 – BOOSTER PUMP STATION

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. Provide all labor, materials, equipment, delivery, testing, and incidentals required to install one buried factory built automatic booster pump station. The internal equipment shall include one constant speed booster pump, motors, piping and valves, sump pump, ventilation system, heater, automatic central control panel with starters and breakers, all internal wiring, and any other necessary incidentals required for a complete operational system. The boosted pump station shall not require any internal onsite construction except to install the power service and connect the water main. A spare pump shall be provided to the Owner.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Submittals: Section 01300

B. Operating & Maintenance Manuals: Section 01780

C. Concrete: Division 3

D. Access Hatches: Section 08370

E. High Performance Paints and Coatings: Section 09661

F. Interior Process Piping: Section 11290

G. Interior Process Valves: Section 11295

H. Electrical: Division 16

1.03 MANUFACTURER

A. The booster pump station shall be manufactured by Dakota Pump, Inc., Engineering Fluids, Inc., or approved equal.

B. The manufacturer shall have a minimum of 5 years' experience in design and manufacturing the specified equipment.

C. Replacement Parts Capability: The manufacturer shall have the ability to promptly furnish any and all interchangeable replacement parts as may be needed at any time within the expected life of the pumps. Upon request, the Contractor shall submit evidence of the proposed manufacturer's ability to promptly fill replacement orders.

D. Quality Assurance: All pumping units shall be of approved design and all products shall be design and constructed by manufacturers who have built equipment of similar type, size and capacity.

E. Additional Submittals: The Contractor shall submit, upon request, any additional information that the Engineer may deem necessary to determine the ability of the proposed manufacturer to produce the specified equipment.

F. Manufacturer Information: All manufacturer information required by the specifications shall be submitted by the Contractor within thirty (30) calendar days of the date of receipt of the Notice to Proceed.

Any additional information or data, specifically requested by the Engineer, concerning manufacturer's capabilities (especially relating to requirements described hereinbefore), shall be submitted by the Contractor within fourteen (14) calendar days of the receipt of the written request thereof, unless otherwise specified.

Approval of manufacturers or suppliers will not be given until all information required by the specifications or requested by the Engineer has been submitted and acceptable.

G. The entire equipment package specified shall be UL approved under the package pumping systems. The equipment shall have a UL label certifying the assembly is UL compliant.

H. Electrical components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.04 SUBMITTALS

A. General: The Contractor shall comply with the provisions of the specifications regarding submittals, unless otherwise specified herein.

B. At the time of submission, the Contractor shall, in writing, call the Engineer's attention to any deviations that the submittals may have from the requirements of the Engineer's Contract Drawings and Specifications.

C. The Contractor shall provide a notarized certification indicating that all pumping products meet the required Specifications.

C. Descriptive literature, catalog cuts, and dimensional prints clearly indicating all dimensions and materials of construction shall be submitted on all items specified herein to the Engineer for review and approval before ordering.

D. The Contractor shall be responsible for designing the slab under the booster pump station. The slab design shall be signed and stamped by a Professional Engineer registered in the Commonwealth of Kentucky. The slab design shall be submitted to the Engineer as part of the shop drawings submittal. The design criteria for the slab shall meet the design criteria listed on sheet S-0001.

E. Show fabrication and installation details for the booster pump station. Including detailed equipment assemblies and indicate dimensions: shipping, installed and operating weights; loads; required clearances; method of field assembly; components; electrical characteristics; and location and size of each field connection.

1. Wiring Diagrams: Power, signal and control

F. Manufacturer Seismic Qualification Certificate: submit certification that the packages booster pump station, accessories, and components will withstand seismic forces as defined by applicable codes. Indicate whether the certification is based on actual testing of assembled components or on calculation. Certification must also include the identification of the center or gravity and locate and describe mounting and anchorage provisions, and the installation requirements for the anchorage devices.

G. Content of Submittals: The following shall be included in submittals as a minimum. However, any additional information or data shall be added if and whenever requested by the Owner or the Engineer. Where applicable, submit separate data for each pump.

1. Descriptive Literature:

a. Dimensions

b. Materials of Construction (including required coating).

c. Performance Data.

1) Pump Impeller Size

2) GPM

3) TDH

4) BHP

5) RPM

6) Performance curves showing pump operation including shutoff head, operating point, and run-out.

7) Performance curves showing overall pump efficiencies.

8) Weight of pump

9) Horsepower rating of pump motor

2. Installation Information: Submit installation drawings and information for pump connections, connecting piping and valves, electrical connections, the sump pump, ventilation system, heater, automatic central control panel, and the enclosure.

   The Contractor shall submit all other drawings, material lists and other information specified, requested and/or necessary to show complete compliance with all details of the contract documents.

3. Test and Inspection Reports: A written report shall be submitted to the Engineer documenting testing and or inspection results.

4. Operation and Maintenance Manual: Manual shall contain all information necessary for proper operation and maintenance of pumping units, as well as the location of the nearest permanent service headquarters.

1.05 TESTS

A. Shop Tests:

1. All pumps shall receive a non-witness factory test.

2. The Manufacturer shall factory test all pumps prior to shipment in accordance with the Hydraulic Institute standards, latest version. Flow rate, total head and Input KW shall be tested and recorded for at least five points on the pump performance curve. Test shall be performed to demonstrate that the pumps meet ANSI/HI standards. A minimum speed curve shall be plotted on the performance curve based on the test data.

3. The Manufacturer shall furnish sworn certificates to the effect that the pump has passed the hydrostatic pressure tests.

4. Motor Tests: Each motor shall be given the standard commercial tests in the shop of the motor manufacturer, and certified copies of the test results shall be submitted to the Engineer.

5. Five (5) certified copies of the results of these tests are to be sent to the Engineer. Also included with the test curves shall be a certified bill of material list depicting quality of construction.

6. Before shipment, the station shall be tested at the factory at simulated field condition to assure that the unit meets the specified design and to check for leaks and excessive vibration, for correct operation of the automatic control system, and of all auxiliary equipment.

7. The pump station shall be tested in the factory for leaks in the welds.

B. Field Tests:

1. The pumping units will be accepted upon the basis of the certified copies of the shop test and be subject to a four-hour field test of each unit. This test will be for the purpose of determining if each pumping unit will operate under installed conditions within a reasonable degree of correlation with the shop tests.

2. The Contractor shall give at least two (2) week's notice to the Owner when the field tests are to be accomplished so that the Owner may have a representative present at the said tests.

3. The field tests shall be made by the Contractor in the presence of and as directed by the Engineer.

4. Field tests shall be made on each pumping unit. During the test, each pump shall be run at maximum rated speed for at least three (3) rates of flow corresponding to minimum rate, design rate, and maximum rate of flows specified as evidenced by the corresponding total head shown by the pump gages; simultaneous ammeter readings shall be taken. Variation of the rate of flow shall be made by throttling the discharge valve (where applicable). The rated motor nameplate current and power shall not be exceeded at any rate of flow within the specified range.

5. Before any pump is rotated, the Contractor shall make certain that no debris is present in suction well, pumps or pipelines. Any internal damage done to equipment while starting up shall be assumed to be caused by debris and shall be replaced at the Contractor's expense. No pump shall be rotated under power unless submerged with liquid.

5. When water can be pumped, the Contractor shall commence pumping and shall have representatives from the pump manufacturer to start the pumps. When flow conditions are favorable, the Contractor or pump manufacturer shall in the presence of the Engineer, run a series of tests to establish the adequacy of the pumping units.

6. Field tests shall also conform to Part 3, Paragraph 3.03 as specified hereinafter.

C. Failure of Tests:

1. Any defects in the equipment or failure to meet the guarantees or requirements of the specifications shall be promptly corrected by the Contractor by replacements or otherwise. The decision of the Engineer as to whether or not the Contractor has fulfilled his obligations under the Contract shall be final and conclusive. If the Contractor fails or refuses to make these corrections or if the improved equipment, when tested, shall fail again to meet the guarantees of specified requirements, the Owner notwithstanding its having made partial payment for work and materials which have entered into the manufacture of said equipment, may reject said equipment and order the Contractor to remove it from the premises at his own expense.

2. In case the Owner rejects said equipment, then the Contractor hereby agrees to repay to the Owner all sums of money paid to him for said rejected equipment on progress certificates or otherwise on account of the lump sum prices herein specified, and upon the receipt of said sum of money the Owner will execute and deliver to the Contractor a bill of sale of all its rights, title, and interest in and to said rejected equipment; provided, however, that said equipment shall not be removed from the premises of the Owner until the Owner obtains from other sources the equipment to take the place of the rejected. The Owner hereby agrees to obtain said other equipment within a reasonable time and the Contractor agrees that the Owner may use the equipment furnished by him without rental or other charge until said other new equipment is obtained.

D. Responsibility During Test: The Contractor shall be fully responsible for the proper operation of equipment during tests and instruction periods and shall neither have nor make any claim for damage which may occur to equipment prior to the time when the Owner formally takes over the operation thereof.

E. Manufacturer's Representative: For all pumping units, the Contractor shall furnish the services of accredited representatives of the pump manufacturer who shall supervise the installation, adjustment, and field tests of each pumping unit and give instructions to the operating personnel. As one condition necessary to acceptance of any pumping unit, the Contractor shall submit a certificate from the manufacturer, stating that the installation of the pumping unit is satisfactory, that the unit is ready for operation, and that the operating personnel have been suitably instructed in the operation, lubrication, and care of the unit.

1.06 GUARANTEE PERIOD

A. After successful completion of tests and trials under operating conditions on all equipment, the Contractor shall guarantee all equipment, materials and workmanship from undue wear and tear, from mechanical and electrical defects, and from any failure whatever, for a minimum of one (1) year from start-up. This one (1) year minimum shall not replace a standard manufacturer’s guarantee if it exceeds one (1) year.

1.07 WARRANTY

A. The Contractor guarantees and warrants that during the first one year of operation, the pumps will operate satisfactorily and continuously according to the pump schedule specified herein, and that after due notice has been given by the Owner, he or the pump manufacturer will proceed, within a reasonable time, to adjust, regulate, repair and renew at his own expense or perform such work as is necessary to maintain the guaranteed capacities, efficiencies and performances.

PART 2 - PRODUCTS

2.01 HORIZONTAL END SUCTION CERTIFUGAL BOOSTER PUMP

A. Pump Requirements:

The pump shall be a centrifugal flexible-end coupled end suction pump. The pump shall be designed and built for 24-hour continuous service at all points within the specified range of operation without overheating, without damaging cavitation, and without excessive noise or vibration. The boosted pump shall be controlled manually

B. Casing

The casing shall be ductile or cast iron flanged connections Flange connections shall be ASME/ANSI B16.1, Class 250. The casing shall tapped and plugged holes for gage and

draining. Shall be furnished to allow for back pull out of the impeller without disturbing the casing or suction and discharge piping.

C. Impeller

The impeller shall be end suction centrifugal, made of ductile iron or bronze (ASTM B584). The impeller shall be statically and dynamically balanced. The impeller shall be keyed into the shaft.

D. Case Wear Ring

The pump casing shall be fitted with a case wear ring to minimize abrasive and corrosive wear. The casing ring shall be bronze.

E. Pump Shaft

The shall be alloy steel (ANSI 1045). The motor shall be machined, providing a key slot, and drilled and tapped to accept the impeller fastener.

F. Coupling

Connect pump shaft to drive motor with a universal flexible coupling to compensate for minor misalignment and to permit removal of pump-rotating assembly and motor without removing piping. The entire rotating coupling shall be enclosed by a coupling guard. Coupling shall be sized to suitably transmit required driving torque.

G. Bearings

Bearings shall be greased ball bearings.
Minimum bearing life L_{10} of 17,500 hours.
The bearings shall be grease lubricated.

H. Bearing Housing

Bearing housing shall be cast iron and sealed to prevent contamination of the lubrication.

I. Shaft Sleeve

The pump shall be fitted with a bronze shaft sleeve to minimize shaft wear.

J. Seals

Shaft sealing shall be accomplished by means of mechanical seal. The mechanical seal assembly shall be silicon carbide, tungsten carbide, or Buna-N with 316 Stainless Steel metal parts.

K. Base

The pump and motor assembly shall be mounted to a rigid formed steel baseplate. The pump and drive mating surface shall be machined finished. The pump shall be supported from beneath

L. Pump Suction and Discharge Flange:

The pump discharge-mating flange and pump suction-mating flange shall be as shown on the drawings. The Contractor shall be responsible for any ancillary piping required to connect the pump to the existing piping. The piping is designed for a 6-inch suction line and a 4-inch

discharge line, if a pump is selected without the previously described piping, the Contractor shall be responsible for any additional required piping.

M. Power supply shall be 480 volts, 3-Phase, 60 Hz, 4 wire service.

N. Motors shall be single speed, 460 volt, 3 phase, 60 Hz. Motors shall be premium efficiency design. The motor shall be non-overloading throughout the entirety of the pump performance curve.

O. The pump shall be capable of delivering 100 gallons per minute (gpm) of water at 75 feet of total dynamic head. The pump shall have a maximum allowable speed of 3550 R.P.M. The maximum net positive suction head required (NPSHR) shall be 10 feet. The pump shall have a minimum shut off head of 82 feet and a minimum efficiency of 51%.

P. One pump shall be installed in the booster pump station and a spare shall be supplied to the Owner.

2.02 PIPING AND VALVES

A. Piping shall be ductile iron conforming to Section 11290 - Interior Process Piping.

B. Suction and discharge piping shall be 6-inches. Any fittings required shall be provided by the booster pump station manufacturer.

C. Pump isolation valves shall be a 6-inch manually operated gate valves confirming with Section 11295 – Interior Process Valves. A pump isolation valve shall be located on the suction and discharge side of the pump.

D. The Pump Check valve shall be in accordance with Section 11295 – Interior Process Valves and located on the discharge side of the pump.

2.03 CONTROL PANEL

A. The control panel shall be factory installed as an integral part of the booster pump; automatic for single-pump, constant-speed operation, with load control and protection functions. All circuit breakers, motor starters, and controls shall be incorporated in a NEMA 1 control panel.

B. The control panel shall be rated for 480 volt, 3-phase electrical service with individual circuit breakers downstream of main breaker for isolating motors during maintenance. Breakers shall be fully operable from front of controller or a dead-front inside main cover without turning off main power to the control panel.

C. All components shall be installed in the control panel in a manner so as to provide the minimum wire bending clearances per N.E.C.

D. The control panel shall conform to the National Electric Code specifications and shall be UL listed and labeled in accordance with UL standards. The panels must be UL listed.

E. Motor Overloading Protection: Overload relay in each phase and 4-20mA output for motor current to SCADA system.

F. Starting Device: on-off selector switch in cover of control panel.

G. Local-Off-Remote selector switch for local pump operation or remote SCADA on/off operation on front cover of panel.

H. Pump Operation: Pump is on-off manual control.

I. Instrumentation: Suction and discharge pressure gages.

J. Light: Running Light for pump and pump failure light.

K. The following auxiliary circuit breakers shall be provided:

a. Controls
b. Lights
c. Dehumidifier
d. Convenience Outlets
e. Sump pump
f. Heater
g. Exhaust fan
h. Spare
i. Spare

2.04 VENTILATION BLOWER

A. A wall mounted ventilation system shall work to exhaust air from the chamber and draw air into the chamber. Fresh air shall enter the chamber from above ground through a 180-degree bend with a screened opening. The exhaust air and air return piping shall be a minimum of 3 inches.

2.05 LIGHTS

A. Two (2) 40-watt fluorescent light fixtures shall be mounted on the ceiling to illuminate the station interior. A manual switch shall be located at the entrance.

2.06 DEHUMIDIFIER

A. A packaged dehumidifier with a sealed refrigeration type compressor rated at 1/5 horsepower shall be wall mounted and condensate shall be piped to the sump, using ½" polyethylene tubing. The dehumidifier shall operate on a 120-volt, single phase A.C. power source and be provided with a safety protection power cord of UL approved 3-wiring construction. The dehumidifier shall be capable of removing 25 pints of water in 24 hours when the room temperature is 80 degree Fahrenheit and at a sixty percent (60%) relative humidity. The dehumidifier shall have "Off" and "Continuous Run" positions. The dehumidifier shall be listed by Underwriters Laboratories.

2.07 HEATER

A. A wall mounted 500 watt auxiliary space heater shall be provided and controlled by an adjustable thermostat. The heater shall have a fan to provide even heat distribution throughout the chamber.

2.08 SUMP PUMP

A. A submersible sump pump shall be installed in the chamber sump pit. It shall have a heavy duty, close-coupled motor, in a cast iron housing and shall operate on 115 volt power. The minimum capacity of the sump pump shall be 1200 gallons per hour. A float switch, capable of operation in the depth of the sump pit, shall control the sump pump. The sump pump shall have a minimum 1-1/2 in discharge with a single swing check valve. The Sump Pump shall discharge at the surface, directed away from the structure.

2.09 CORROSION PROTECTION

B. All surfaces subject to rust and/or corrosion shall be cleaned in accordance with Section 09961 of the Specifications. All equipment shall be painted in accordance with Section 09961.

2.10 MODULAR STRUCTURE

A. The structure shall be a factory fabricated, assembled and tested, sized to house all equipment listed herein. The structure shall be suitable for direct bury with water-tight integrity.

B. The modular structure shall consist of a pump chamber and entrance chamber. Both chambers shall be constructed of ASTM A36 steel plates sized to house all listed equipment with a minimum height of 7 feet. Steel plates shall be continuously welded to make for a water and gas tight structure. The walls shall have a minimum thickness of ¼-inch, the top and bottom shall have a minimum steel plate thickness of 3/8-inc, or as required by the manufacturer's structural design.

C. The steel plates shall be design adequately resistant all loading including hydrostatic pressure, live and dead loads, and bury depth loading. The structural concrete floor below the modular structure shall be designed to adequately transfer all loading in accordance with the Contract Documents. The design criteria for the slab shall meet the design criteria listed on sheet S-0001. The structural concrete floor shall be designed by a Registered Engineer in the Commonwealth of Kentucky. The concrete floor shall comply with all requirements of Division 3 – Concrete.

D. The modular structure shall consist of an 18 inch diameter by 10 inches deep sump pit. The floor of the pump chamber shall be sloped toward the sump. A rubber mat shall be fastened to the floor walkway.

E. A watertight connection must be achieved where any pipes penetration the modular structure. A steel pipe sleeve shall be used to pass piping through the chamber walls. The sleeve shall be welded for water tightness to both sides of the wall and filled with link seals.

F. A steel access ladder shall be welded to the entrance and pump chamber walls. The ladder shall be meet OSHA requirements.

G. The entrance chamber shall be at grade and sized as required to replace the largest piece of equipment, with a minimum size clear opening of 36 inches by 30 inches. The hatch shall meet all requirements of Specification Section 08370 – Access Hatches.

H. Pump chamber and entrance chamber shall be one piece or shall be welded together for water tightness.

PART 3 - EXECUTION

3.01 PREPARATION

A. Coordinate with other trades, equipment and systems to the fullest extent possible.

B. Take all necessary measurements in the field to determine the exact dimensions for all work and the required sizes of all equipment under this contract. All pertinent data and dimensions shall be verified by the Contractor.

3.02 INSTALLATION

A. Installation shall be in strict accordance with the manufacturer's instructions and recommendations in the locations shown on the Drawings.

B. The Contractor shall be responsible for designing the slab under the booster pump station. The slab design shall be signed and stamped by a Professional Engineer registered in the Commonwealth of Kentucky. The slab design shall be submitted to the Engineer as part of the shop drawings submittal. The Contractor will be responsible for anchoring the station to the concrete slab per manufacturer's recommendations.

C. The Contractor shall also provide from the manufacturer the service of a qualified start-up engineer (factory representative) who has had prior on-site start-up experience to assist in performing start-up, checkout and initial operation services of the pumping units. The start-up engineer shall also instruct the Owner's personnel on the operation and maintenance procedures for the station. Qualified supervisory services, including manufacturers' engineering representatives, shall be provided for a minimum of 2 man-days to insure that the work is done in a manner fully approved by the respective equipment manufacturer. The manufacturer's representatives shall specifically supervise the installation of the pump and the alignment of the connection piping. If there are difficulties in the start-up or operation of the equipment due to the manufacturer's design or fabrication, additional service shall be provided at no cost to the Owner. Services of the manufacturer's representatives and training shall be provided when the station is installed.

D. A certificate from the equipment manufacturer shall be submitted stating that the installation of his/her equipment is satisfactory, that the equipment is ready for operation and that the operating personnel have been suitably instructed in the operation, lubrication and care of each unit.

3.03 FIELD TESTS

A. During the field tests, observations shall be recorded of head, capacity, and motor input. All defects or defective equipment revealed by or noted during the tests shall be corrected or replaced promptly at the expense of the Contractor, and if necessary, the tests shall be repeated until results acceptable to the Engineer are obtained. The Contractor shall furnish all labor, piping, equipment, and materials necessary for conducting the tests. A report of the field tests shall be submitted to the Engineer.

B. A pre-operational check shall be completed by the manufacturer's representative, the check shall include verification of pump and motor alignment, a check of proper motor rotation, and check pump and drive motors for proper lubrication.

C. After installation of the pumping equipment, and after inspection, operation, testing and adjustment have been completed by the manufacturer's representative, each pump shall be given a running test in the presence of the Engineer, such tests as necessary to indicate that the pumps, motors, and drives generally conform to the efficiencies and operating conditions specified and its ability to operate without vibration or overheating. The pumps and motors shall operate at the specified capacities in the range of heads specified without undue noise or vibration. Any undue noise or vibration in the pumps or motors, which is deemed objectionable by the Engineer, will be sufficient cause for rejection of the units.

D. A thirty-day operating period of the pumps will be required before acceptance. If a pump performance does not meet the Specifications, corrective measures shall be taken or the pump shall be removed and replaced with a pump which satisfies the conditions specified. All test procedures shall be in accordance with Hydraulic Institute Standards certified results of tests shall be submitted. If pumps are accepted after thirty-day operating period, the Owner will pay all electric cost for the operation period. If the pumps are not accepted the Contractor will be responsible for the costs.

E. Provide, calibrate and install all temporary gauges and meters, shall make necessary tapped holes in the pipes, and install all temporary piping and wiring required for the field acceptance tests. Written test procedures shall be submitted to the Engineer for approval 30 days prior to testing.

F. After installation, charge systems and test for leaks, Repair leaks and retest until no further leaks exist.

G. Field Vibration Testing

a. After installation and as soon as conditions permit full speed operation, and in the presence of the Engineer, have the vibration tests performed in accordance with Hydraulic Institute Standards to (a) prove compliance with specified limitations, and (b) 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.

3.04 TRAINING

A. A factory representative shall provide a minimum of eight (8) person-hours of training to the Owner's operations staff concerning the recommended operation and maintenance of the equipment. Training shall be performed after substantial completion of the project with the use of operating equipment. Training shall be separate from the start-up period.

END OF SECTION

SECTION 11279 - SAMPLERS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Labor, materials, and equipment necessary for furnishing the fabrication, production, installation, and erection of the items specified in this Section as shown on Drawings or listed on Schedule.

B. Related Documents: Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1.

1.02 SUBMITTALS

A. Shop Drawings: Submit in accordance with Section 01300, Shop Drawings covering the items included under this Section.

B. Test and Inspection Report: Submit a written report to Engineer documenting testing and/or inspection results. The report shall be prepared in accordance with this specifcation.

C. Operation and Maintenance Manuals: Submit in accordance with requirements of Section 01780, operation and maintenance manuals for items included under this Section.

D. Warranty: Submit in accordance with Section 01782, warranties covering the items included under this Section.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with specified requirements, manufacturers offering products which may be incorporated in Work include:

1. Peristaltic Samplers:

    a. Manning Environmental Inc., Model YB

    b. Hach / American Sigma, AS950.

    c. Teledyne ISCO, 5800 Series.

2.02 EQUIPMENT

A. Peristaltic Samplers:

1. The refrigerated sampler shall be designed for indoor and outdoor installations with the cabinet constructed of corrosion and UV-resistant plastic or molded fiberglass. The refrigerated sample compartment shall have a minimum of 1-1/2 inches of rigid foam insulation on the walls and bottom and 3 inches minimum on the top. The temperature control system shall maintain 4 degrees C in the refrigerated compartment in ambient temperatures from 32 to 120 degrees F. Frost-free operation shall be provided and the

refrigeration system shall be coated for corrosion protection. The controller and sample compartment shall be independently lockable. The sampler shall have adjustable base pads for leveling and a means for anchoring the unit to a concrete pad using stainless steel components.

2. The sampler shall incorporate a high-speed peristaltic pump for collection of the sample liquid. The sample pump shall produce a minimum intake velocity of 2 feet per second at 15 feet vertical lift in a 3/8-inch I.D. intake tube. Pump shall be capable of purging the system before and after each sample. The duration of the purge cycle shall be automatically adjusted for the varying intake line length. The sampler shall be capable of rinsing the intake line with the source liquid prior to sample collection. The sample stream shall be a direct tubing path from sample source to sample bottle. Each sampler shall be provided with a 316 stainless steel, low-profile intake strainer.

3. All electromechanical components shall be protected from humidity and corrosive gases within a sealed housing conforming to NEMA 4X and 6 standards. For submersible watertight, dust-tight, corrosion-resistant, and ice-resistant operation. The housing shall contain an internal desiccant and a means to indicate replacement.

4. The sampler shall be equipped with a non-contact liquid-sensing system whereby pump flow rate is calculated every collection cycle and pumping time automatically adjusted, ensuring constant sample volume even with changing lift. To prevent overflows, the controller shall automatically reject program entries which exceed the capabilities of the storage container.

5. If a sample is not obtained the unit shall be capable of purging and repeating the collection cycle.

6. Each sampler shall be complete with 2 (1 jar in use, 1 spare) wide-mouth, 2-1/2-gallon and 5-gallon polypropylene composite sampler jars with caps for use in obtaining composite samples, or two 24-bottle sets with caps (1 jar in use, 1 spare) for use in obtaining discrete samples with each type using minimum 470 ml polyethylene or polypropylene bottles. The sampler shall be capable of accepting composite or discrete samples without replacing the unit. Type shall be as indicated on Schedule.

7. Provide 25 feet of 3/8-inch polyethylene intake tubing, and the equivalent of 10 pump tubing change-outs.

8. Controller:

    a. Sampler shall operate on 115 volt, 1 phase, 60 hertz power supply and shall have NEMA 4X and 6 rated termination box for connection to exterior analog signal devices.

    b. Housing shall be rated to meet NEMA 4X, 6 and IP67 requirements. Controller shall have a battery backup to protect the program and stored data in the event of 115 volt power interruption.

    c. Provide junction boxes, manufacture connection cables, relay boxes etc. as required to for operation with inputs and output signals shown on Drawings or specified.

    d. User interface with preprogrammed logic shall be provided with easy access to configure sampler functions and be capable of operation in a timed, flow-paced (4-20 mA external signal), variable volume (4-20 mA external signal) and contact closure modes of operation. In the timed mode, the interval between samples shall be adjustable in 1-minute increments from l to 9,999 minutes. In the flow-paced mode, the sampler shall be capable of totalizing from 1 to 9,999, 12 VDC pulses. In contact

closure mode the sampler will collect a present sample volume upon receiving either a contact closure or DC pulse input signal. The unit shall be capable of retaining a minimum of 3 complete sampling programs/routines in memory.

e. Output signals provided include:

1) Missed Sample

2) General Fault

3) Unit in Manual

9. Accessories. If noted in Schedule provides the accessories listed below.

10. Enclosures: Provide fiberglass enclosure where indicated on Drawings or on Schedule. Enclosure shall be constructed of 1-piece molded, fiberglass-reinforced plastic, capable of withstanding winds of 130 miles per hour. Provide doors with latches and a closed-cell, neoprene gasket for a weathertight seal.

a. Standard features shall include a flanged-bottom perimeter for bolt-down to pad using stainless steel hardware, removable door, rain-proof vents, 2 ground fault duplex receptacles, and 1-inch rigid foam insulation in the walls and ceiling. A 500 watt, 120 VAC thermostatically controlled heater, thermostatically controlled exhaust fan and a 60 watt light and switch shall also be provided. Size of enclosure shall be as indicated on Schedule. Enclosures shall be provided by the same supplier as the samplers.

11. Sample chamber: Sample chamber shall be shipped loose for field installation as shown. Chamber shall be constructed of PVC and designed to be installed in the sample pump discharge piping system with minimum 100 gpm flow capacity and configured to accept the sampler suction tubing to obtain a mid-stream sample. Inlet and outlet chamber diameters shall be 2 and 3 inches respectively and chamber body shall have a removable cover for cleaning and access to the sampling probe inlet.

12. Alarm relays: Provide relays for minimum 4 outputs. Relays shall be mounted in the sampler control unit or provided in a NEMA 4X enclosure for external mounting.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Equipment shall be installed as detailed in the documents and as recommended by manufacturer.

B. Electrical power shall be 120 VAC and hard-wired to the unit.

C. An experienced, competent, and authorized representative of the manufacturer or supplier of each item of equipment shall visit Site of Work a minimum of 2 times, once prior to installation to review installation procedures with Contractor and once after installation to inspect, check, adjust if necessary, and approve the equipment's installation. The equipment supplier's representative shall revisit Site as often as necessary until all trouble is corrected and the equipment installation and operation is satisfactory to Engineer.

D. Manufacturer's representative shall provide all necessary tools and testing equipment required including noise level and vibration sensing equipment.

E. Each equipment supplier's representative shall furnish to Owner, through Engineer, a written report certifying that the equipment:

1. Has been properly installed and lubricated;
2. Is in accurate alignment;
3. Is free from any undue stress imposed by connecting piping or anchor bolts;
4. Has been operated under full load condition and that it operated satisfactorily to Engineer;
5. That Owner's Representative has been instructed in the proper maintenance and operation of the equipment; and
6. Furnish Owner a copy of all test data recorded during the installation check including noise level and vibration readings.

3.02 TRAINING

A. A factory representative shall provide a minimum of two (2) days, with eight (8) hours each day for a total of sixteen (16) person-hours of training to the Owner’s operations staff concerning the recommended operation and maintenance of the equipment. Training shall be performed after substantial completion of the project with the use of operating equipment.

END OF SECTION

SECTION 11285 - SLIDE GATES

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. Gates shall be furnished with all necessary accessories for a complete installation and shall be the latest standard products of a manufacturer regularly engaged in the production of equipment of this type. All slide gates shall be furnished by the same manufacturer.

1.02 SUBMITTALS

A. Descriptive literature, catalog cuts, and dimensions\al prints clearly indicating all dimensions and materials of construction, shall be submitted on all items specified herein.

1. Gate stem design torque ratings.

B. Comply with the requirements of Section 01300.

PART 2 - PRODUCTS

2.01 MANUFACTURER

A. Gates shall be Series 25 (Channel Gates) and Series 20 (Sluice Gates) as manufactured by Waterman, Rodney Hunt (Fontaine) or approved equal.

B. Portable gate operators shall be E.H. Wachs, Pow-R-Drive II, or approved equal.

2.02 STAINLESS STEEL SLUICE GATES (CG, CW and S)

A. Gates and operators shall be supplied with all the necessary parts and accessories indicated on the Drawings, specified herein, or otherwise required for a complete properly operating installation and shall be the latest standard product of a manufacturer regularly engaged in the production of stainless steel water control gates.

B. Except as modified or supplemented herein, all gates and operators shall conform to the applicable requirements of AWWA C561 (latest edition).

C. Gates shall be substantially watertight under the design head conditions (maximum design head shall be taken as the height of the slide unless otherwise specified). Leakage shall not exceed 0.05 gallon per minute per foot of seal periphery under the design seating head and 0.10 gallon per minute per foot of seal periphery for the design unseating head of under 20 feet. For an unseating head of 20 feet or more, the maximum allowable leakage shall not exceed the rate per foot of perimeter specified by the following equation:

Gallon per minute per foot of perimeter = 0.10 + [0.0025 x (unseating head in feet – 20)]

The gate's sealing system shall have been tested through a cycle test in an abrasive environment and should show that the leakage requirements are still obtained after 25,000 cycles with a minimum deterioration. Certification of this testing shall be provided to the Engineer or Owner upon request.

D. Gates shall be self-contained of the rising stem configuration. Self-contained gates shall be provided with a yoke made of structural members or formed plates. The maximum deflection shall be 1/360 of the gate's span.

E. Gate frames shall be constructed of structural members or formed plate welded to form a rigid one-piece frame. The frame shall be suitable for mounting on a concrete wall at the end of a pipe opening, surface mounted on flume or channel walls or with embedded frames inside of channels as shown. The frame configuration shall be of the flush-bottom type unless shown or noted otherwise in Schedule and shall allow the replacement of the top and side seals without removing the gate frame from the wall.

F. The slide shall consist of a flat plate reinforced with formed plates or structural members to limit its deflection to 1/720 of the gate's span under the design head.

G. The guides shall be made of UHMWPE and shall be of such length as to retain and support at least two-thirds (2/3) of the vertical height of the slide in the fully open position.

H. The side seals for gates shall be made of UHMWPE of the self-adjusting type. A compression cord shall ensure contact between the UHMWPE guide and the gate in all positions. The sealing system shall maintain efficient sealing in any position of the slide and let the water flow only below the slide plate. The bottom seal shall be made of resilient neoprene set into the bottom member of the frame and shall form a flush-bottom. Seals shall perform equally well in seating and unseating configurations.

I. The operating stem shall be of stainless steel designed to transmit in compression at least 2 times the rated output of the operating manual mechanism with a 40 lb. effort on the crank or handwheel. The stem shall have a slenderness ratio (L/R) less than 200. The threaded portion of the stem shall have machined cut threads of the Acme type. Where an electric operator is used, the stem design force shall not be less than 1.25 times the output thrust of the electric motor in the stalled condition. For stems in more than one piece and with a diameter of 1¾ inches and larger, the different sections shall be joined together by solid couplings. Stems with a diameter smaller than 1¾ inches shall be pinned to an extension tube. The couplings shall be grooved and keyed and shall be of greater strength than the stem.

J. Gates having width equal to or greater than two (2) times their height shall be provided with two (2) lifting mechanisms connected by a tandem shaft.

K. Stem guides shall be fabricated from type 304L stainless steel and shall be equipped with an UHMWPE bushing. Guides shall be adjustable and shall be spaced in accordance with the manufacturer's recommendation. The L/R ratio shall not be greater than 200.

L. Rising stem gates shall be provided with a clear polycarbonate stem cover. The stem cover shall have a cap and condensation vents as well as clear mylar position indicating tape. The tape shall be field applied to the stem cover after the gate has been installed and positioned.

M. Operators and gears shall be provided by the gate manufacturer as indicated in the Schedule. Each operator shall be designed to operate the gate under the maximum specified seating and unseating heads by using a maximum effort of 40 lb. on the crank or handwheel or chainwheel, and shall be able to withstand, without damage, an effort of 80 lb.

N. Manually operated gates shall have an operating nut with size that works with the portable gate operator. Operating nut can be separate or part of the hand wheel or chain wheel such that when hand wheel or chain wheel is removed operating shall be exposed and accessible for operation with portable operator. The operating nut orientation and access shall be coordinated with the portable operator requirements during shop drawing submittals.

O. All bearing and gears shall be totally enclosed in a weather tight housing. The pinion shaft of crank operated mechanisms shall be constructed of stainless steel and supported by roller or needle bearings. The crank shall be removable and fitted with a corrosion resistant rotating handle. The maximum crank radius shall be 15 inches and the maximum handwheel diameter shall be 24 inches.

P. Wall thimble shall be provided where shown or indicated on Schedule. The wall thimble shall be stainless steel with thickness as required to resist all operating forces and equipped with flanges and water collar. Air release / grout holes shall be provided to facilitate flow of concrete underneath when mounted in wall forms.

Q. Materials for the gate shall be as follows:

Part	**Material**
Frame, Yoke, Stem Guides, Slide, Stem Extension	Stainless Steel ASTM A-276, Type 304L
Side Seals, Stem Guide Liner	UHMWPE ASTM D-4020
Bottom seal	Neoprene ASTM D-2000, Grade 2 BC-510
Compression cord	Nitrile ASTM D-2000 M6BG 708, A14, B14, EO14, EO34
Threaded stem	Stainless Steel ASTM A-276, Type 303 MX
Fasteners	ASTM F593 and F594, GR1 for Type 304 and GR2 for Type 316
Pedestal, Handwheel, Crank	Tenzaloy aluminum
Gasket (between frame and wall)	EPDM ASTM 1056
Stem Cover	Polycarbonate ASTM A-707
Lift Nut	Manganese bronze ASTM B584 Alloy 432
Wall Thimble	Stainless Steel ASTM A-276, Type 304L

2.03 GATE ACTUATORS

A. The actuator shall consist of an electric motor, worm gear reduction, absolute position encoder, electronic torque sensor, mechanically and electronic reversing motor circuit (no contactors), electronic control, protection, and monitoring package, manual override hand wheel, valve interface bushing, 32-character graphical LCD (Liquid Crystal Display), and local control switches all contained in an enclosure that is sealed in accordance with certifications listed below. Actuator design life shall be at least one million drive sleeve turns.

B. If actuator is listed in Schedule for throttling service motor shall be capable of 1,200 starts per hour. For open-close service motor shall be capable of 60 start per hour.

C. Unless noted otherwise in Schedule actuators and gearing shall be sized to move the gate at a rate of 12” per minute.

D. The power transmission shall be completely bearing-supported, and consist of a hardened alloy steel worm and bronze alloy worm gear; oil-bath lubricated using synthetic oil designed specifically for extreme pressure worm and worm gear transmission service.

E. The motor shall be three-phase, 480VAC, 60-cycle with Class F insulation and a thermistor embedded within the motor windings to prevent damage due to overload. The motor shall be easily removed through the use of a plug-in connector and shaft coupling.

F. Valve position shall be sensed by an 18-bit, optical, absolute position encoder with redundant position sensing circuits designed for Built-In-Self-Test [BIST]. Each of the position sensing circuits shall be redundant permitting up to 50% fault tolerance before the position is incorrectly reported. The BIST feature shall discern which failures signal a warning only and which require a warning plus safe shutdown of the actuator. Open and closed positions shall be stored in permanent, nonvolatile memory. The encoder shall measure valve position at all times, including both motor and hand wheel operation, with or without power present, and without the use of a battery. The absolute encoder will be capable of resolving ±7° of output shaft position over 10,000 output drive rotations.

G. An electronic torque sensor shall be included. The torque limit may be adjusted from 40-100% of rating in 1% increments. The motor shall be de-energized if the torque limit is exceeded. A boost function shall be included to prevent torque trip during initial valve unseating and during extreme arctic temperature operation (-50°C), and a “Jammed Valve” protection feature, with automatic retry sequence, shall be incorporated to de-energize the motor if no movement occurs.

H. The control module shall include power and logic circuit boards, control transformer, and at least two primary power protection fuses, all mounted to a steel plate and attached in the control compartment with captive screws. The use of O rings or other such devices to secure the control boards shall not be permitted. The module shall be easily removed through the use of plug-in connectors. The module shall also include a reversing contactor, local control switches, 32-character graphical LCD, and LED indicators. It shall also be Bluetooth ready. All internal wiring shall be flame-resistant, rated 105°C, and UL/CSA listed. Voltage shall be selectable via a jumper included on the power board.

I. The reversing contactor shall be electronic type, no contactors. The control module shall also include an auto reversal delay to inhibit high current surges caused by rapid motor reversals. The control transformer shall include vacuum-impregnated coils and dual primary fuses.

J. A Phase Correction circuit shall be included to correct motor rotation faults caused by incorrect site wiring. The phase correction circuit shall also detect the loss of a phase and disable operation to prevent motor damage. The monitor relay shall trip and an error message shall be displayed on the LCD screen when loss of phase occurs and indicate the fault for Remote operation.

K. Discrete remote control may be configured as 2, 3, or 4 wires for open-stop-close control. Remote control functions may be powered by external 24 VDC, 125 VAC, or the actuator’s internal supply 24 VDC supply. The voltage values for signal threshold shall be 19.2V AC/DC and 5.0V AC/DC respectively. The maximum load for 24Vdc is 2mA. The internal supplies shall be protected against over current and short circuits faults and utilize optical isolation to minimize electro-magnetic interference. Discrete control shall have an isolated common.

L. ESD (Emergency Shut Down) provision shall be included in each actuator. The actuator shall permit up to three inputs for ESD and they shall be configurable. The ESD signal shall override any existing signal (except LOCAL, STOP, and INHIBIT) and send the valve to its configured emergency position. The ESD may also be configured to override LOCAL, STOP, and/or INHIBIT. Provision for an isolated common shall be provided.

M. Inhibit movement provision shall be included in each actuator. The actuator shall permit up to three inputs for Inhibits and they shall be configurable. Provision for an isolated common shall also be provided.

N. Terminals shall be included to connect the electronic controls package, including display, to a back-up 24 VDC power source. As a standard alternative the actuator shall have the ability to maintain the status and alarm contacts in order to update status to the control room and also provides status visibility on the LCD screen without main power applied. It should be configurable for at least one hour and, once main power is restored, be available for the next unforeseen power outage. The use of an integral battery is prohibited.

O. A dedicated circuit to prevent undesired valve operation in the event of an internal circuit fault or erratic command signal shall be included. A single point failure will not result in erratic actuator movement. An open or short-circuit in the internal circuit board logic shall not energize the motor contactor, nor shall a single fused control relay contact fail to deenergize the motor contactor. The command inputs shall be optically coupled and require a pulse width of at least 250 ms to 350 ms to turn on or off. In the event of an internal circuit fault, an alarm shall be signaled by tripping the Monitor Relay and through LCD indication.

P. Four latched status contacts rated 125VAC, 0.5A and 30VDC, 2 amps shall be provided for remote indication of valve position, configured as 1-N/O and 1-N/C for both the open and closed positions. Two contacts may be configured to represent any other actuator status; mid-travel position, switched to local, overtorque, motor over temperature, manual operation, switched to remote, switched to stop, valve moving, close torque switch, open torque switch, hardware failure, ESD active, inhibits active, valve jammed, analog IP (input) lost, lost phase, and network controlled.

Q. A monitor relay shall be included and shall trip when the actuator is not available for remote operation. Both N/O and N/C contacts shall be included, rated 125VAC, 0.5A and 30VDC, 2 amps. The monitor relay shall be configurable for three additional fault indications; lost phase, valve jammed, and motor overtemp. The yellow LED shall blink when the monitor relay is active.

R. The ACP (Actuator Control Panel) cover & module shall use solid-state Hall-effect devices for local communication and configuration. The use of reed switches on the module is prohibited. A 32-character, graphical LCD shall be included to display valve position as a percent of open, 0-100%, and current actuator status. “STATUS OK” shall be displayed for an operable actuator. If the actuator is not operable, the appropriate alarm shall be displayed. The alarm shall be continuously displayed until the actuator is operable. Red, green, and yellow LEDs shall be included for open, close, stopped, and moving indication. The Red and Green LEDs shall be reversible. A padlockable LOCAL-STOP-REMOTE switch and an OPEN-CLOSE switch shall be included for local valve actuator control. The control switches shall not penetrate the controls cover and shall be designed to electrically isolate the actuator’s internal components from the external environment. The OPEN-CLOSE switch may be configured for maintained or push-to-run (inching) control.

S. The device shall be non-intrusive - All calibration shall be possible without removing any covers and without the use of any special tools. All calibration shall be performed in clear text languages, no icons shall be used. The languages shall be English, Spanish, French, German, Portuguese, Italian, Mandarin, Russian, Malay, and Katakana. All calibration shall be performed by answering the “YES” and “NO” questions displayed on the LCD. “YES” is signaled by using the OPEN switch and “NO” by using the CLOSE switch, as indicated adjacent to the switches. A configurable password option shall be available to prevent unauthorized changes.

T. Double sealed terminal compartment & Terminal block - All customer connections shall be located in a terminal chamber that is separately sealed from all other actuator components. Site wiring shall not expose actuator components to the environment. The internal sealing within the terminal chamber is suitable for NEMA 4, 6, and IP68 to 15M for 96 hours or as listed on Schedule. The chamber shall include screw-type terminals, three for power and 54 for control, for site connections. Three conduit entries, available as: (2) - 1.25" NPT (M32) and (1)-1.5" NPT (M40) shall be located in the terminal chamber.

U. Coatings - The actuator shall be IP 66 rated and coated with a polymer powder coat. The coating system shall be suitable for an ASTM B117 salt spray test of 1500 hours. External fasteners shall be stainless steel or high-strength carbon steel that has been chromate-hexavalent coated, and then top coated with a high-strength, high-endurance polymer. The fasteners shall be suitable for an ASTM B117 salt spray test of 500 hours.

V. A handwheel and declutch lever shall be provided for manual operation. The handwheel shall not rotate during electric operation nor can a seized motor prevent manual operation. Changing from motor to manual operation is accomplished by engaging the declutch lever. Energizing the motor shall return the actuator to motor operation. The lever to enable the declutch shall be padlockable to permit motor operation only.

W. The actuator shall include a removable torque or thrust bushing to mate with the valve shaft.

X. Diagnostic facilities shall be included to accumulate and report the performance of the motor, encoder, contactor, cycle time, handwheel operations, actuator ID, firmware revision, and output turns. In addition, a torque profile of the reference baseline valve stroke and the last valve stroke shall be included. A feature for reset shall be provided. All diagnostic information shall be displayed on the LCD. Diagnostics shall also include an FDA (Frequency Domain Analysis) feature. The Frequency Domain Analysis methodology shall capture torque, position or speed values at regular time intervals while the actuator is motoring, and calculate the resulting data set with a Fast Fourier Transform [FFT]. The resulting information shall be used to isolate any components in the mechanical drive train that may exhibit excessive wear or may effect normal actuator operation. FDA and resultant fault indications shall be displayed via the graphical LCD. The actuator shall contain the ability for diagnostics information to be downloaded to a PC or PDA via both IRDA and Bluetooth ports.

Y. Factory testing - Every actuator shall be factory tested to verify: rated output torque, output speed, handwheel operation, local control, control power supply, valve jammed function, all customer inputs and outputs, motor current, motor thermistor, LCD and LED operation, direction of rotation, microprocessor checks, and position-sensor checks. A report confirming successful completion of testing shall be included with the actuator.

Z. Acceptable manufacturers for valve actuators are Rotork, Limitorque, EIM, or approved equal

2.04 ACTUATOR CERTIFICATIONS

A. Non-hazardous (Weatherproof/Submersion) Certifications

1. IEC 529 protection code IP68; minimum 7 meters for 72 hours continuous

2. USA & CSA; NEMA 3, 4, NEMA 4X, NEMA 6

B. Standard Hazardous Global certifications:

1. FM – Class I, Groups B, C & D, DIV.1 and Class II, Groups E, F, & G, T4

   a. T4A temperature classification is acceptable w/ operational times < 15 min.

2. ATEX Eex d IIB T4 ATEX II 2 G, CENELEC Norm EN50014 and EN50018

3. ATEX Eex d IIC T4 ATEX II 2 G, CENELEC Norm EN50014 and EN50018

   a. T4A temperature classification is acceptable w/ operational times < 15 min.

4. CSA – Class I, Groups B, C & D, DIV.1 and Class II, Groups E, F, & G, T4

5. IEC Eexd IIB T4, IIB T4

6. IEC Eexd IIC T4, IIC T4

2.05 ACTUATOR OPTIONS

A. Lost power buffer

1. After the actuator has been powered by line power for one hour, it shall automatically withstand most power outages while maintaining the correct state of the S status contacts, even if the user repositions the actuator manually with the handwheel. To maximize its self-power time while the line power is lost, the actuator will place itself in its lowest possible power usage mode. The LCD will darken (sleep mode) until it is needed to be viewed. The LCD can be activated by moving the black knob to OPEN (YES) or by moving the actuator with the handwheel. After 10 seconds of inactivity, the LCD will return to sleep mode.

2. The use of batteries to perform this function shall be prohibited.

B. Analog Position Transmitter (APT)

1. Provide a non-contacting, internally powered, electrically isolated position transmitter shall be included to provide a 4-20 mA signal that is proportional to valve position.

C. Modutronic Option

1. If noted on Schedule for throttling service provide a controller that alters valve position in proportion to a 4-20 mA analog command signal shall be included. Positioning shall be accomplished by comparing the command signal to an internal position feedback. The internal feedback shall be of the non-contacting type. An automatic pulsing feature to prevent overshoot at the setpoint shall be included. Proportional bands, deadband, signal polarity, motion inhibits time, and fail position shall be adjustable through the LCD. Deadband shall be adjustable to 0.5% full span.

D. Relays for Status and Alarms

1. Up to eight additional latching output contacts rated 250 VAC/30 VDC, 5 amps and configurable to represent any actuator status in either N/O or N/C state shall be available: mid-travel position, switched to local, overtorque, motor over temperature, manual operation, switched to remote, switched to stop, valve moving, close torque switch, open torque switch, hardware failure, ESD active, inhibits active, valve jammed, analog IP (input) lost, lost phase, and network controlled.

F. Device Net (DN)

1. Valve motor operators shall be Devicenet capable, with full control and status functionality available for remote operation and monitoring.

2.06 PORTABLE GATE OPERATORS

A. Portable gate operator drive shall consist of lightweight aluminum gear box, two stage reduction, planetary gearing and steel ring and pinion secondary drive.

B. Operator shall include a carrying case.

C. Other features:

1. 110 VAC, 15 amp power supply

2. NEMA 3 rated

3. Peak torque: 800 fl-lbs

4. Adjustable torque control knob

5. Adjustable max torque set point factory preset not to exceed the design rating of the gate stems as determined during shop drawing review.

6. Forward and reverse control knob

7. GRI Ground fault interrupter

8. Revolution counter with LCD screen push button reset counts, 1/10 revolution increments

9. Forward and reverse counting capability.

10. Contractor shall provide two (2) portable gate operators.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Sluice gates shall be installed in accordance with the manufacturer's recommendations.

3.02 TRAINING

A. A factory representative shall provide a minimum of two (2) days, with eight (8) hours each day for a total of sixteen (16) person-hours of training to the Owner's operations staff concerning the recommended operation and maintenance of the equipment. Training shall be performed after substantial completion of the project with the use of operating equipment.

END OF SECTION

SECTION 11290 - INTERIOR PROCESS PIPING

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. Provide all labor, materials, equipment and services required to furnish and install all plant process piping as shown on the Drawings and specified herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Interior Process Valves: Section 11295
B. Water Piping: Section 02505
C. Valves: Section 02515
D. Piping furnished with equipment is included in the specific equipment item.

1.03 SUBMITTALS

A. The Contractor shall comply with the requirements of Section 01300 of these specifications.

B. A notarized certification shall be furnished for all pipe and fittings which verifies compliance with all applicable specifications.

C. A Registered Professional Engineer shall certify piping support system design.

D. The Contractor shall submit shop drawings on the pipe supporting system, including type and size of supports, applied hanging loads at each hander support location, product data indicating safe hanging loads for each hanger, and details on thrust anchorage and all their locations.

PART 2 - PRODUCTS

2.01 DUCTILE IRON PIPE/DUCTILE IRON FITTINGS

A. Flanged ductile iron pipe shall conform to the latest revisions of ANSI/AWWA C115/A 21.15. Bolt pattern of flange shall be in accordance with ANSI/AWWA C115/A 21.15 (which is equivalent to ASME/ANSI B16.1, Class 125 flange bolt pattern). Pipe shall have pressure class 250 rating. Gaskets shall be synthetic rubber ring gaskets with a thickness of 1/8 inch. Nuts and bolts shall be in accordance with ASME/ANSI B18.2.1, ASME/ANSI B18.2.2, ASME/ANSI B1.1, and ASTM A307

   Flanged fittings shall conform to the latest revisions of ANSI/AWWA C110/A 21.10 or ANSI/AWWA C153/A 21.53 (compact fittings). Gaskets shall be in accordance with ANSI/AWWA C111/A 21.11. Fittings shall have pressure class rating of 250 psi. Bolt pattern of flange shall be in accordance with ANSI/AWWA C115/A 21.15 (which is equivalent to ASME/ANSI B16.1, class 125 flange bolt pattern).

B. All exposed iron pipe to be field painted shall be furnished with an external coating of rust inhibitive primer, such as Tnemec Series 1 OmniThane, Sherwin-Williams Corothane I GalvaPac, or equal. Pipe manufacturer shall be responsible for compatibility of shop applied coatings with the field paint systems and products specified in Division 9, Section 09961. Do not apply asphalt or bituminous coatings on pipe to be painted.

C. Protecto 401 Ceramic Epoxy Interior Lining

   1. Condition of ductile iron prior to surface preparation

      All ductile pipe and fittings shall be delivered to the application facility without asphalt,

cement lining, or any other lining on the interior surface. Because removal of old linings may not be possible, the intent of this specification is that the entire interior of the ductile iron pipe and fittings shall not have been lined with any substance prior to the application of the specified lining material and no coating shall have been applied to the first six inches of the exterior of the spigot ends.

2. Lining Material

   The standard of quality is Protecto 401™ Ceramic Epoxy. The material shall be an amine cured novolac epoxy containing at least 20% by volume of ceramic quartz pigment. Any request for substitution must be accompanied by a successful history of lining pipe and fittings for sewer service, a test report verifying the following properties, and a certification of the test results.

   a. A permeability rating of 0.00 when tested according to Method A of ASTM E-96-66, Procedure A with a test duration of 30 days.

   b. The following test must be run on coupons from factory lined ductile iron pipe:

      (1) ASTM B-117 Salt Spray (scribed panel) - Results to equal 0.0 undercutting after two years.

      (2) ASTM G-95 Cathodic Disbondment 1.5 volts @ 77°F. Results to equal no more than 0.5 mm undercutting after 30 days.

      (3) Immersion testing rated using ASTM D-714-87.

         i. 20% Sulfuric acid—No effect after two years.

         ii. 140°F 25% Sodium Hydroxide—No effect after two years.

         iii. 160°F Distilled Water—No effect after two years.

         iv. 120°F Tap Water (scribed panel)—0.0 undercutting after two years with no effect.

      (4) ASTM G-22 90 Standard practice for determining resistance of Synthetic Polymeric materials to bacteria. The test should determine the resistance to growth of Acidithiobacillus Bacteria and should be conducted at 30 degrees centigrade for a period of 7 days on a minimum of 4 panels. The growth must be limited only to trace amounts of bacteria.

   c. An abrasion resistance of no more than 3 mils (.075 mm) loss after one million cycles using European Standard EN 598: 1994 Section 7.8 Abrasion Resistance.

3. Application

   a. Applicator

      The lining shall be applied by a certified firm with a successful history of applying linings to the interior of ductile iron pipe and fittings.

   b. Surface Preparation

      Prior to abrasive blasting, the entire area to receive the protective any substance that can be removed by solvent, shall be solvent cleaned to remove those substances. After the surface has been made free of grease, oil or other substances, all areas to receive the protective compounds shall be abrasive blasted using sand or grit abrasive media. The entire surface to be lined shall be struck with the blast media so that all rust, loose oxides, etc., are removed from the surface. Only slight stains and

tightly adhering oxide may be left on the surface. Any area where rust reappears before lining must be re-blasted.

c. Lining

After surface preparation and within 12 hours of surface preparation, the interior of the pipe shall receive 40 mils nominal dry film thickness. No lining shall take place when the substrate or ambient temperature is below 40°F. The surface also must be dry and dust free. If flange pipe or fittings are included in the project, the lining shall not be used on the face of the flange.

d. Coating of Bell Sockets and Spigot Ends

Due to the tolerances involved, the gasket area and spigot end up to 6 inches back from the end of the spigot end must be coated with 6 mils nominal, 10 mils maximum using Protecto 401™ Joint Compound. The Joint Compound shall be applied by brush to ensure coverage. Care should be taken that the Joint Compound is smooth without excess buildup in the gasket seat or on the spigot ends. Coating of the gasket seat and spigot ends shall be done after the application of the lining.

e. Number of Coats

The number of coats of lining material applied shall be as recommended by the lining manufacturer. However, in no case shall this material be applied above the dry thickness per coat recommended by the lining manufacturer in printed literature. The maximum or minimum time between coats shall be that time recommended by the lining material manufacturer. To prevent delamination between coats, no material shall be used for lining which is not indefinitely recoatable with itself without roughening of the surface.

f. Touch-Up and Repair

Protecto 401™ Joint Compound shall be used for touch-up or repair in accordance with manufacturer's recommendations.

4. Inspection and Certification

a. Inspection

All ductile iron pipe and fitting linings shall be checked for thickness using a magnetic film thickness gauge. The thickness testing shall be done using the method outlined in SSPC PA-2 Film Thickness Rating.

The interior lining of all pipe barrels and fittings shall be tested for pinholes with a non-destructive 2,500 volt test. Any defects found shall be repaired prior to shipment.

Each pipe joint and fitting shall be marked with the date of application of the lining system along with its numerical sequence of application on that date and records maintained by the applicator of his work.

b. Certification

The pipe or fitting manufacturer must supply a certificate attesting to the fact that the applicator met the requirements of this specification, and that the material used was as specified.

5. Handling

Lined pipe and fittings must be handled only from the outside of the pipe and fittings. No

forks, chains, straps, hooks, etc. shall be placed inside the pipe and fittings for lifting, positioning, or laying. The pipe shall not be dropped or unloaded by rolling.

Care should be taken not to let the pipe strike sharp objects while swinging or being off loaded. Ductile iron pipe should never be placed on grade by use of hydraulic pressure from an excavator bucket or by banging with heavy hammers.

D. Ductile iron fittings shall conform to AWWA C 110 with flanges faced and drilled 125-pound. Fittings shall have interior lining and exterior coating same as the pipe.

2.02 POLYVINYL CHLORIDE (PVC) PLASTIC PRESSURE PIPE

A. PVC Pressure Pipe, 3" and Smaller: Polyvinyl chloride plastic pipe shall be ASTM D 1785 Schedule 80 or F441 CPVC, Schedule 80 with solvent weld joints. Fittings shall be ASTM D 2467 Schedule 80 socket type. All socket type connections shall be made with PVC solvent cement complying with ASTM D 2564 PVC solvent cement shall be furnished from the same supplier as the PVC pipe. Provide socket-threaded adapters for connection to threaded appurtenances where required.

2.03 WALL PIPE AND SLEEVES

A. All wall pipe shall be furnished with cast or welded collar water stops in the positions shown on the Drawings. Welding of water stop collars on pipe shall be accomplished by the wall pipe manufacturer in their shop. All centrifugally cast wall pipe shall be ductile iron meeting the requirements of AWWA C151 for the pipe barrel, conforming to the pressure rating of the pipeline in which installed, and in no case be lighter than Class 53.

B. All statically cast wall pipe shall be ductile iron meeting the requirements of AWWA C110 for fittings. Mechanical joint end and cast-on flange end wall pipe shall conform to AWWA C110 and welded flange wall pipe shall conform to AWWA C115. Where flanged or mechanical joint bell ends are flush with the wall, they shall be drilled and tapped for stud bolts which are to be of 300 Series stainless steel.

C. The length of all wall pipe shall be not less than the thickness of the wall in which installed. Wall pipe shall have the same pressure rating as connecting pipe. All wall pipe shall be AWWA C401 lined. The outside of wall pipes shall be left uncoated and shall be field primed for painting on the portion exposed, uncoated where embedded and field coated with standard bituminous coated where buried.

D. Contractor may have the option to install wall pipe flush face-to-face of wall in lieu of the dimensioned length wall pipe shown on the Drawings, in order to eliminate form penetrations. This option will be subject to Engineer`s review at each wall pipe location and covers both flanged and mechanical-joint bell-end wall pipe. Embedded flanged and MJ bell-end bolt holes shall be tapped for stud bolts; tapped bolt holes in embedded flanges shall be plugged for protection during concrete pouring.

E. All pipe wall sleeves shall be plain end galvanized steel pipe of diameter noted on Drawings and length to fit flush face-to-face of wall.

2.04 INTERLOCKING LINK PIPE SEALS

A. In all locations indicated on the Drawings, interlocking link pipe seals shall be used in lieu of lead packing a pipe wall sleeve. Seals shall be modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and wall sleeve. Links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and nut. After the seal assembly is positioned in the sleeve, tightening of the bolts shall cause the rubber sealing elements to expand and provide an absolutely water-tight seal between the pipe and wall

sleeve. Seals shall be "Link-Seal" as manufactured by Thunderline Corporation, Wayne, Michigan, or approved equal.

B. The Contractor shall determine the required diameter of each individual wall opening according to the manufacturer's recommendations before ordering and installing the seal. Pipe shall be accurately centered in the sleeve and the link seals shall be sized, installed and tightened in accordance with the manufacturer's instructions.

2.05 COUPLINGS AND ADAPTERS

A. Flexible couplings shall be of the sleeve type with a middle ring, two round-wedge shaped rubber gaskets at each end, two following rings together and compress the gasket against the pipe. Flexible couplings shall be steel with minimum wall thickness of the middle ring or sleeve installed on pipe being 5/16-inch for pipe smaller than 10 inches, 3/8-inch for pipe 10 inches or larger. The minimum length of the middle ring shall be 5-inches for pipe sizes up to 10 inches and 7 inches for pipe 10 inches to 30 inches. The pipe stop shall be removed. Gaskets shall be suitable for 250 psi pressure rating or at rated working pressure of the connecting pipe. Couplings shall be harnessed and be designed for 250 psi.

B. Flanged adapters shall have one end suitable for bolting to a pipe flange and the other end of flexible coupling similar to that described hereinbefore. All pressure piping with couplings or adapters shall be harnessed with full threaded rods spanning across the couplings or adapters. The adapters shall be furnished with bolts of an approved corrosion resistant steel alloy, extending to the adjacent pipe flanges. Flanges on flanged adapter (unless otherwise indicated or required) shall be faced and drilled ANSI B16.1 Class 125.

C. Flexible couplings and flanged adapters shall be as manufactured by Dresser, Rockwell, or equal, per the following, unless otherwise specified and/or noted on the Drawings:

1. Steel couplings for joining same size, plain-end, steel, cast iron, and PVC plastic pipe -

Dresser	Smith-Blair
Style 253 (2"-15")	4ll
Style 38/138 (18" & above)	

2. Transition couplings for joining pipe of different outside diameters-

Dresser	Smith-Blair
Style 162 (4"-12")	413 steel (2"-24")
Style 62 (2"-24")	415 steel (6"-48")
	433 cast (2"-16")
	435 cast (2"-12")

3. Flanged adapters for joining plain-end pipe to flanged pipe, fittings, valves and equipment.

Dresser	Smith-Blair
Style 227 cast (3"-12")	912 cast (3"-12")
Style 128 steel (3"-48" D.I. Pipe)	913 steel (3"-24" D.I. Pipe)
Style 128 steel (2"-96" steel pipe)	

2.06 FLANGED JOINTS

A. Flange bolts and nuts shall be ASTM A 307, Grade B and shall have hexagonal heads. All bolts, nuts and studs for flanged pipe in submerged locations shall be of 300 Series stainless steel. The flanges shall be drawn together until the joint is perfectly tight, with bolts of a length such that they will not project greater than 1/4-inch from the nut nor fall short of the end of the nut when drawn up. No washers shall be used. Gaskets shall be carefully

fabricated prior to installation and must be suitable for pressure rating for the pipe for which it is used.

B. All flanges (unless otherwise indicated or required) shall be faced and drilled ANSI B16.1 125-pound for ductile iron and ANSI B16.5 150-pound for steel.

C. At the Contractor's option, and at no additional expense to the Owner, the following patented SBR flange gaskets or approved equal may be substituted for standard sheet packing ring gaskets in ductile iron flanged pipe:

1. TORUSEAL by American Cast Iron Pipe Company

2. FLANGE-TYTE by United States Pipe & Foundry Company

When using such gaskets, flange bolts shall be torqued to manufacturer's recommended torque values.

PART 3 - EXECUTION

3.01 INSTALLATION OF PIPING

A. Materials shall be new and of the best grade and quality; workmanship shall be first class in every respect.

B. Each piece of iron pipe and each fitting shall be plainly marked at the foundry with class number and weight.

C. Where indicated on the Drawings, plain-end pipe shall be joined by means of flanged adapters or flexible couplings which shall be Rockwell, Dresser, or equal.

D. All pipe couplings shall be designed to safely withstand the operating pressure of the lines in which they are installed. All couplings shall be shop primed with an approved rust inhibitive primer.

E. Taps and connections to piping shall be made as required to connect equipment, sample lines, etc., and where otherwise shown on the Drawings.

F. Piping shall be installed straight and true, parallel or perpendicular to walls, with approved offsets around obstructions. Standard pipe fittings shall be used for changing direction of piping. No mitered joints or field fabricated pipe bends are permitted unless accepted by the Engineer.

G. All piping, fittings, valves and other accessories shall be thoroughly cleaned of dirt, chips and foreign matter before joint connections are made.

H. All plastic pipe shall be adequately supported and braced. Support spacing shall not exceed the recommendations of the Plastics Pipe Institute.

I. Teflon tape shall be used on all plastic pipe threaded connections.

J. Field cut male threads on plastic pipe shall be made with plastic pipe threading dies.

K. The annular space of plain wall sleeves shall be packed tight with lead wool to within 3/4" of wall face and then patch grouted flush to wall face with non-staining nonshrink grout, Masterflow 713 by Master Builders, Sonogrout by Sonneborn-Contech, or equal.

L. All pipe sleeves passing through walls or floors of chlorine feed and storage areas shall be provided with gas tight seals.

M. All pipe threads shall conform to ANSI B2.1.

N. Piping shall be erected to provide for expansion and contraction.

O. Screwed or soldered unions shall be provided in all small piping as required to permit convenient removal of equipment, valves and piping accessories from the piping system.

P. Dielectric insulating couplings or brass adapters shall be used whenever the adjoining materials being connected are of dissimilar material such as connections between copper tubing and steel pipe.

Q. All inside piping shall be color coded, stenciled and label tagged for identification as specified in Division 9.

3.02 HANGERS AND SUPPORTS

A. It shall be the Contractor's responsibility to furnish a complete system of pipe supports, to provide expansion joints and to anchor all piping. The pipe support system shall be installed complete with all necessary inserts, bolts, nuts, rods, washers, miscellaneous steel, and other accessories.

B. All supports and parts shall conform to the latest requirements of ANSI B31.1, except as supplemented or modified by the requirements of this Specification or as detailed on Drawings. Supporting devices shall be designed in accordance with the best practice and shall not be unnecessarily heavy. Sufficient hangers and supports shall be installed to provide a working safety factor of not less than 5 for each hanger. Hangers shall have a minimum spacing in accordance with ANSI B31.1. Point loading hangers are not acceptable. Supports shall be designed to adequately support pipe so as not impose loads on equipment.

C. In some instances, expansion joints have been shown on the drawings, but no attempt has been made to indicate every expansion joint for piping included under this portion of the specifications. Portions of the piping are shown on the detail drawings. Some of the piping, however, is shown only on the schematics.

D. Reaction Anchorage and Blocking

All piping exposed in interior locations and subject to internal pressure in which flexible connectors are used shall be blocked, anchored, or harnessed, as shown on the drawings, or as directed by the Engineer to preclude separation of joints.

E. Pipes with centerlines less than 6 feet from the floor and in the pipe gallery under the bridge crane shall be supported from below. Pipe support spacing shall not exceed 6 feet on center. Expansion joints for plastic shall not exceed 30 feet. Unless otherwise shown or authorized by the Engineer, piping running parallel to walls shall be placed approximately 1½ inch out from the face of wall and at least three inches below ceiling.

F. Hangers, supports, brackets, stanchions, concrete inserts and related hardware located in corrosive areas shall be constructed of corrosion resistant materials.

1. In the pump station wet wells, grit tanks, junction chamber, all flow channels including flume channels and any other compartments and vaults – 316 stainless steel with blue Teflon coated nuts and bolts.

2. In the Truck Loading, Screening and Grit Handling areas, 304 or 316 stainless steel, hot dip galvanized with epoxy paint. Nuts bolts and hardware shall be stainless steel or galvanized.

In other non-corrosive areas materials shall be stainless steel, galvanized steel, galvanized malleable iron, or galvanized wrought iron.

G. Pipe Supports

1. Pipes support from underneath shall have pipe saddle supports with cast iron stanchion saddle with U-Bolts. Assemblies shall be Anvil Figure 265, Elcen Figure or approved equal. All rigid hangers shall provide a means of vertical adjustment after erection.

2. Pipe hangers shall be clevis style, galvanized, Anvil Figure 260, or approved equal.

3. Pipe hanger sway struts shall be Anvil Figure C-211 Stainless Steel, or approved equal.

H. Concrete Inserts

1. Concrete inserts shall be provided at locations to support piping where structural steel supports are not readily available. Inserts shall be located so that the total load on any insert does not exceed the manufacturer's recommended maximum load. The location of all inserts shall be approved by the Engineer.

2. Where it is necessary to anchor supports to hardened concrete or complete masonry, expansion anchors of the type described in the anchor bolt and expansion anchors section shall be used. All expansion anchors shall be sized as required for the service with minimum safety factor of five.

3. Individual concrete inserts shall be Grinnell 282, Unistrut M26, or equal. Continuous concrete inserts shall be Unistrut P-3200 Series, Fee and Mason, or equal.

4. Insert materials shall be stainless steel or galvanized.

I. Brackets and Anchors

1. For suspended piping, anchors shall be centered, as closely as possible, between expansion joints, and between elbows and expansion joints. Anchors shall hold the pipe securely and shall be sufficiently rigid to force expansion and contraction movement to take place at expansion joints and elbows.

2. Thrust Anchors: Anchorage shall be provided as required to resist thrust due to changes in diameter or direction, or dead ending of pipelines. Anchorage shall be required wherever bending stresses exceed the allowable for the pipe.

3. Brackets and anchors shall be installed as required. They shall be Unistrut P-1000 Series with all parts galvanized, Grinnel 199 painted with rust inhibitive primer, or equal, or fabricated steel meeting ASTM A36, and be painted with a rust inhibitive primer.

J. Guides

1. Pipe guides shall be provided adjacent to sliding expansion joints in accordance with the recommendations of the National Association of Expansion Joint Manufacturers.

K. Anti-Seize Compounds

1. An anti-seize compound shall be applied to all nuts and bolts.

L. Contact between dissimilar metals shall be prevented.

M. In all cases where piping is in contact with a concrete or metal pipe support, a 1/8-inch thick teflon, neoprene rubber, or plastic strip shall be placed under all piping at the point of bearing. Each strip shall be cut to fit the entire area of contact between pipe and support and shall be neat.

N. Location

1. In general, the piping work under this contract shall be done in accordance with the arrangements shown on the drawings. The runs of piping are, in part, diagrammatic and the Contractor shall without extra cost run the piping as directed by the Engineer at the time of installation, so as to best fit the conditions in the building, and so that no piping shall pass through beams or other structural members in such a way as to impair their strength.

2. Special care shall be exercised to keep all piping in the building in locations as shown on the drawings and to install the risers and horizontal runs so as to occupy a minimum space.

3. Changes in runs and location to meet field conditions shall be done at no extra cost to the Owner.

4. All horizontal lines carrying liquids shall be pitched to facilitate draining and all low points shall be provided with 3/4 inch hose bibs suitable for the material being handled, located so that the entire system can be drained.

5. Expansion joint locations shall coincide with building control joints and as shown on the drawings.

O. All piping, valves, hanger, and supports shall be painted in accordance with Division 9.

3.03 TESTING

A. See Section 02351 – Sewage Collection Lines and Section 02352 – Sewage Force Mains for testing requirements for all interior process piping.

END OF SECTION

SECTION 11295 - INTERIOR PROCESS VALVES

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. Provide all labor, materials, equipment and services required to furnish and install all new valves as shown on the Drawings and/or specified herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Water Piping: Section 02505
B. Valves: Section 02515
C. Interior Process Piping: Section 11290
D. Valves furnished with equipment are included with equipment specifications.

1.03 SUBMITTALS

A. Descriptive literature, catalog cuts, and dimensional prints clearly indicating all dimensions and materials of construction, shall be submitted on all items specified herein to the Engineer for review before ordering. Comply with provisions of Section 01300.

B. At the time of submission, the Contractor shall, in writing, call Engineer's attention to any deviations that the submittals may have from the requirements of the Engineer's Contract Drawings and Specifications.

PART 2 - PRODUCTS

2.01 PLUG VALVES (P)

A. All plug valves shall be eccentric plug valves unless otherwise specified.

B. Valves shall be of the non-lubricated eccentric type with flanged ends faced and drilled per ANSI B16.1 125 lb, unless otherwise noted. Valves shall be drilled per ANSI B16.1 250 lb when located on a line with piping greater than 125 psi requirements.

C. Valve bodies shall be flushing body type and made of ASTM A126 Class B cast iron. Valves shall be furnished with a 1/8" welded overlay seat of not less than 95% pure nickel. Seat area shall be raised, with raised surface completely covered with weld to insure that the plug face contacts only nickel. Screwed-in seats shall not be acceptable.

D. Plugs shall be made of ductile iron and have a cylindrical seating surface eccentrically offset from the center of the plug shaft. The interference between the plug face and body seat, with the plug in the closed position, shall be externally adjustable in the field with the valve in the line under pressure. Plug shall be resilient faced with neoprene or hycar, suitable for use with sewage.

E. Valves shall have replaceable sleeve type bearings and grit seals at the upper and lower journals.

F. Valve shaft seals shall be of the multiple V-ring type and shall be externally adjustable and repackable without removing the bonnet or actuator from the valve under pressure. Valves utilizing O-ring seals or non-adjustable packing shall not be acceptable.

G. Valve pressure ratings shall be 175 psi through 12" and 150 psi for 14" through 72". Each valve shall be given a hydrostatic and seat test with test results being certified when required by the specifications.

H. Manually operated valves 4-inch and larger shall have a worm gear actuator, stainless steel input shaft and handwheel operator. Manually operated valves 3-inch and smaller shall have a lever operator. All gearing shall be enclosed in a semi-steel housing and be suitable for running in a lubricant with seals provided on all shafts to prevent entry of dirt and water into the actuator. The actuator shaft shall be stainless steel and the quadrant shall be supported on permanently lubricated bronze bearings. Actuators shall clearly indicate valve position and an adjustable stop shall be provided to set closing torque and to provide seat adjustment to compensate for change in pressure differential or flow direction change. All exposed nuts, bolts and washers shall be stainless steel.

I. Any cylinder actuators shall be equipped with 2-inch square operating nuts to allow manual valve operation in case of supply failure.

J. Valves shall provide drip tight shutoff up to the full pressure rating. Valves shall be provided with adjustable limit stops and rotate 90 degrees from fully opened to fully closed.

K. Valves located 6 feet or more above the floor shall be furnished with chain wheel operators.

L Valves shall have rectangular port openings for throttling service, and shall open to 100% of the corresponding pipe diameter.

M. Plug valves shall be as manufactured by DeZurik, or approved equal.

N. Substitution of materials of construction other than that indicated in the above specifications an/or not in accordance with the AWWA C517 standard shall not be allowed.

2.02 CUSHIONED CHECK VALVES – AIR (CC)

A. The valve is a counterweighted, rubber seated check valve with attached cushion chamber whose function is to permit flow in only one direction, close tightly when its discharge side pressure exceeds its inlet pressure, and to close without a slam or bang.

B. The swing check valve shall be constructed with heavy cast iron or cast steel body with a bronze or stainless steel seat ring, a non-corrosive shaft for attachment of weight and lever, and complete non-corrosive shockless chamber.

C. It shall absolutely prevent the return of water, oil or gas back through the valve when the inlet pressure decreases below the delivery pressure. The valve must be tight seating, and must be shockless in operation. The seat ring must be renewable.

D. The cushion chamber shall be attached to the side of the valve body externally and so constructed with a piston operating in a chamber that will effectively permit the valve to be operated without any hammering action. The shock absorption shall be by air, and the cushion chamber shall be so arranged that the closing speed will be adjustable to meet the service requirements.

E. The valve disc shall be of cast iron or cast steel and shall be suspended from a non-corrosive shaft which will pass through a stuffing box and be connected to the cushion chamber on the outside of the valve.

F. All material and workmanship shall be first class throughout and the purchaser reserves the right to inspect this valve before shipment.

G. The valves will be DeZurik (APCO) 250 Series, Golden-Anderson Industries, Inc. Fig. No. 250-D, 125# or equal, unless otherwise noted. Valves shall be drilled per ANSI B16.1 250 lb when located on a line with piping greater than 125 psi requirements.

2.03 CUSHIONED CHECK VALVES - OIL (CCO)

A. The valve shall have heavy-duty body of high strength cast iron or ductile iron with integral flanged ends per ANSI 125 pound, B16.1.

B. Valve disc shall have a renewable, resilient seat ring and be held in place by a follower ring and stainless steel screws, and shall seal tightly against the 316 stainless steel body seat ring.

C. The valve shall have a bottom or side mounted hydraulic buffer to permit free open and positive non-slam closure of the disc. The hydraulic control buffer shall make contact with the disc during the last 10% of closure to control the valve disc until the shut-off in a manner to prevent slam and water hammer. The last 10% of closure shall be externally adjustable to suit operating conditions. The hydraulic control buffer and oil system shall be removable without need to remove the entire valve and oil system shall be totally independent from the main line to prevent corrosion or contamination to the main line media.

D. The valve disc shall be ductile iron, utilizing a double clevis hinge to prevent disc tipping and be connected to a ductile iron disc arm. The disc arm assembly shall be suspended from the stainless steel shaft. The pivot shaft shall be sealed at both ends where it passes through the body by means of replaceable O-rings in a removable bronze cartridge.

E. Disc arm shall be ductile iron or fabricated of high strength steel and be suspended from and keyed to an 18-8 stainless steel shaft completely above the waterway and supported at each end by heavy lead-free bronze bushings. Valve shall utilize one or two counterweights.

F. The valve shall swing open smoothly at pump start and provide two-stage closing upon pump shutdown. Valve shall close quickly through the initial portion of closure and at a controlled rate of speed for the final pre-determined portion of its closing stroke to minimize surges associated with pump shut down by allowing a nominal amount of backflow through the valve during closing.

G. All material and workmanship shall be first class throughout and the purchaser reserves the right to inspect this valve before shipment.

H. The valves will be DeZurik (APCO) 6000 Series BMB F1, Golden-Anderson Industries, Inc. Fig. No. 25-DXH, 125# or equal, unless otherwise noted. Valves shall be drilled per ANSI B16.1 250 lb when located on a line with piping greater than 125 psi requirements.

2.04 STANDARD SWING CHECK VALVES (C)

A. Standard swing check valves shall meet the requirements of ANSI/AWWA C508. Check valves shall be cast or ductile iron body with end flanges conforming to ASME B16.1 Class 125. Resilient to metal type seat shall be provided with stainless steel seating surface mechanically attached to machined body area with the buna-N seat material integral with or mechanically attached to the disc. Check valves shall be of the balanced single disc type with the disc hinged at the top, with outside lever and adjustable weight or spring. A clear waterway opening equal to the full area of the connecting pipe shall be provided when the valve is open.

B. Disc shall be shall be cast or ductile iron.. Hinge pins shall be one piece stainless steel and protrude through both sides of the body. Bronze or stainless steel bushings with adjustable packing or O-ring seal shall be provided where pins pass through the valve body.

C. Valves shall be interior coated with epoxy meeting requirements NSF/ANSI 61 approved epoxy in accordance with AWWA C550 and, as minimum, be painted with primer on the exterior.

D. Standard swing check valves shall be manufactured by Clow Valve Co., G.A. Valves (Golden Anderson) or equal.

2.05 RUBBER INLINE CHECK VALVES (RC)

A. Rubber inline check valve shall be a two-piece split configuration, of cast iron. Rubber sheet gaskets, cut to match the profile of the body halves shall seal the two halves. Valve body shall be drilled and tapped for a supplied clean out plug on the top of the body and flushing connections on the bottom of the body supplied with plugs

B. The check sleeve is to be of the fabricated elastomer “duckbill” type. The sleeve shall be one-piece rubber construction with fabric reinforcement. The inlet port shall have an integral flange, drilled to be retained by the flange bolts and acting as the gasket between pipe and valve. The port area shall contour down to a duckbill, which shall allow passage of flow in one direction while preventing reverse flow.

C. Rubber inline check valves shall be manufactured by Red Valve Co., Inc. Series 39 or equal

2.06 SEWAGE AIR AND VACUUM VALVES (ARV)

A. Sewage air and vacuum valves shall be installed as shown on the Contract Drawings.

B. Air valves for submersible pumps shall be designed to allow large quantities of air to escape out the orifice when the pump is started and close watertight when the liquid enters the valve. The air valve shall also permit large quantities of air to re-enter through the orifice when the pump is stopped to prevent a vacuum from forming in the pump column.

C. The float shall be stainless steel, designed to withstand a minimum of 1,000 psi. The float shall be center-guided and not free floating for positive seating. The valve body shall be cast iron, ASTM A 48.

D. Valve shall meet requirements of ANSI/AWWA C512 and be a long body design with inlet and outlet size, joints type and orifice size as listed in Valve Schedule. Valve shall be designed BUNA-N or other seat material as required to work effectively in working pressure range indicated on Schedule. If no range in indicated provide valve for 20 to 100 psi working pressure range. The valve body shall be cast iron with a stainless steel float and internal parts. Each valve shall be provided with its own resilient seated gate valve to isolate it from the pumped liquid and shall come with attachments for back flushing.

E. Sewage air and vacuum valves shall be manufactured by Dezurik / APCO, Crispin, Val-Matic Valve & Mfg. Corp or equal.

2.07 SEWAGE COMBINATION AIR VALVE (AV)

A. Sewage Combination Air Valves shall be installed at the high points of the force main and at various locations as shown on the Contract Drawings.

B. Air valves shall be automatic float operated valves designed to exhaust air during the filling of a piping system and close upon liquid entry. The valve shall open during draining or if a negative pressure occurs. The valve shall also release accumulated air from a piping system while the system is in operation and under pressure.

1. The valve seat shall provide complete shut off to the full valve pressure rating.

2. Valves shall incorporate a full port orifice, a seal plug assembly, and an upper and lower float to provide a rolling resilient seal.

3. The seal shall be a one-piece design and include a large orifice and a small orifice and each shall open or close as needed to allow release or intake of air as the demand on the system regulates.

4. Valve shall be designed to intake or discharge a minimum of 100 SCFM of air with a 3.5-psi differential pressure.

C. Materials

1. Valve cover, lower float, stem, washer, spring, nuts and bolts: 316 Stainless Steel.

2. Upper float: Foamed polypropylene.

3. O-rings: Buna-N.

4. Seal plug assembly and base and body: 316 Stainless Steel.

D. All Sewage Combination Air Valves on the force main shall be ARI model no. D-025 as manufactured by A.R.I. Flow Control Accessories, Kfar Charuv, Israel, or equal. Sizes shall be based on the pipeline diameter as noted herein:

Pipe Diameter	3" – 8"	10" – 16"	18" – 20"	24" – 48"
Air Valve Size	2"	3"	4"	6"

2.08 SEWAGE COMBINATION AIR VALVE for SURGE CONTROL (SV)

A. Combination Air Valves shall be automatic float operated valves designed to exhaust air at a controlled rate during the filling of a piping system and close upon liquid entry. The valve shall open during draining or if a negative pressure occurs and allow large volume of air to enter. Controlled and smooth discharge of air during positive hydraulic transients shall reduce pressure spikes in the piping system. The valve shall also release accumulated air from a piping system while the system is in operation and under pressure..

B. Materials

1. Valve cover, lower float, stem, washer, spring, nuts and bolts: 316 Stainless Steel

2. Air Release Seal: EPDM.

3. O-rings: EPDM.

4. Drain Valve: 316 Stainless Steel.

5. Float guide rod Assembly: 316 Stainless Steel.
6. Air & Vacuum Seal Assembly combination of: EPDM, RN, Steel and 316 Stainless Steel.
7. Flow Enhancer: ABS

C. All combination air valves for surge control shall be manufactured by ARI model no. D-026 as manufactured by A.R.I. Flow Control Accessories, Kfar Charuv, Israel, or equal.

2.09 SOLID-WEDGE GATE VALVES (GV)

A. Solid-wedge gate valves shall be manufactured by Kennedy Valve Group, American R/D 100 Line series, or equivalent. Valves shall be manufactured to provide a clear and unobstructed water way when in the fully open position.

B. Solid-wedge gate valves shall conform to AWWA C500 – Metal-Seated Gate Valves for Water Supply Service, rated for a minimum working pressure of 150 PSIg at 70° F. The wedge shall be of one solid piece. End connections shall be flanged joint.

C. Exposed Solid-wedge gate valves shall be of the flanged, outside screw and yoke (OS&Y) type, with flanges to comply with ANSI B16.1.

D. The body, bonnet, wedge, and gland shall conform to ASTM A536 for ductile iron. The handwheel and nut shall be of ductile iron.

E. Provide a full-port body design with full-port completely through the entire valve body and seat rings to allow for pigging of pipelines.

F. Provide chain wheels as described in Section X-XX “Valve Operators.”

G. Provide valve body guides and tracks with a bronze bearing surface throughout the entire travel of the bottom side of a horizontally installed valve. The contact area shall comply with ASTM B21 Bronze.

H. Provide a two-part NSF-61-approved liquid epoxy on the exterior and interior of the valve.

2.10 RUBBER DUCK BILL BACKWATER CHECK VALVE (DC)

A. Rubber duck bill check valve bodies shall be of all elastomer construction with bottom and top of valve either flat or flared and with the joint type as shown on Drawing or indicated on Schedule. The outlet end of valve shall be either curved or straight as required by the manufacturer.

B. Unless otherwise noted valves shall have 150 lb pattern flange joints with 316 stainless steel backer ring.

C. Acceptable manufacturers are Red Valve, Proco Products, Inc or equal.

2.11 PRESSURE-REDUCING VALVE (PRV)

A. Pressure-Reducing Valves shall be pilot-controlled, hydraulically operated, differential-piston-actuated and capable of providing outlet pressure of 80 psi under working pressures up to 150 psi at 70° F. The set pressure shall be field-adjustable, from 0% to 110%. The valve shall be operated by line pressure and shall use the pilot system to open, close, or throttle the differential piston main valve.

B. The main valve body shall be globe-style, constructed of ductile-iron conforming to ASTM A536 with integral flanges, faced and drilled per ANSI B16.42.

C. The valve shall be full-ported so that when fully open the flow area through the valve is no less than the area of its nominal pipe size.

D. The main valve shall operate on the differential piston principle such that the area on the underside of the piston is no less than the pipe area and the area on the upper surface is greater than that of the underside.

E. The valve piston shall be fully guided ontis outside diameter and all guiding and sealing surfaces shall be bronze, complying with ASTM B21 Bronze specifications.

F. The valve shall be fully capable of operating in any position without the need of springs and shall not incorporate stems, stem guides, or spokes in the waterway. A visual position indicator shall be provided. Throttling shall be achieved via long, stationary vee-ports located downstream of the seat and not by the seat itself.

G. The main valve shall be serviceable in the line through a single flanged top cover that provides easy access to all components.

H. The valve shall be coated with NSF-61 certified epoxy on internal surfaces in accordance with the latest revision of AWWA C550

I. The pilot system shall be factory pre-piped, installed on the main valve and tested as an assembly.

J. The system shall incorporate opening and closing speed control valves. Sufficient isolating valves and pipe unions shall be provided to facilitate removal and maintenance of the pilot system without disturbing the main valve.

K. Pilots, controls, piping, and fittings shall be corrosion-resistant copper, bronze, or brass.

L. Install protective strainers upstream of pressure-reducing valves.

M. Pressure-reducing valves shall be manufactured by GA Industries or equivalent.

2.12 MOTOR-OPERATED FLOW CONTROL VALVE (FCV)

A. Motor-operated control valves shall be of the globe-body configuration, with internal vee-port construction. The valve shall be installed with an externally-mounted, multi-turn motor operator that functions to position the valve by means of a rising stem extending through the valve cover.

B. The valve shall be of an internal piston design such that the only moving part within the valve is a one-piece piston. The piston shall be guided through its entire stroke and along its entire circumference by a stationary liner installed in the valve. The seat opening of the liner shall be no less than the pipe area. The liner shall include longstroke stationary vee-ports with a total flow area no less than the pipe flow area. The liner shall be designed to provide a non-corrosive, metallic seating surface attached to the valve body.

C. Throttling shall be achieved via long, stationary vee-ports located downstream of the seat and not by the seat itself. The vee-ports shall be located downstream of the seating surfaces in order to direct any cavitation downstream of the seating surfaces.

D. It shall be possible to replace the piston, liner, and body seat through the valve cover. Sprayed, plated, or coated seating surfaces directly on the valve body are not acceptable.

E. The valve shall be capable of operating in any position. The flow area throughout the entire valve body shall be no less than the pipeline flow area.

F. The valve body shall be a one-piece casting of ductile iron per ASTM A536 with integral flanges.

G. The valve shall be furnished with a single cover through which all internal valve components can be inspected, repaired, and/or replaced.

H. The piston and liner shall be of bronze construction. All other internal valve trim shall be of bronze or stainless steel construction.

I. The valve shall be furnished with a renewable seat ring of Buna-N or other suitable resilient

material attached to the valve piston for tight closure. All other valve seals shall be of Buna-N or other suitable resilient material.

2.13 BASKET-TYPE PIPELINE STRAINER (Simplex)

A. Basket-type simplex strainers shall be constructed of ASTM A126-Grade B cast iron, epoxy painted for additional corrosion resistance.

B. Strainer shall be provided with a clamped, quick-open cover using a buna o-ring seal cover rated at 200 PSI at 100° F.

C. The strainer shall be supplied with a side drain, as standard.

D. Pressure class and flange drilling shall be ANSI Class 125.

E. The strainer basket shall be of 304 stainless steel material with perforated sides and a solid bottom. The design shall be a straight-through flow path with a minimum 40% open area ratio.

F. Units larger than 8” in diameter shall have removable, adjustable leg brackets.

G. Four-inch diameter basket strainers shall be supplied with 1/16” perforations. Six-inch to ten-inch diameter strainers shall be supplied with 1/8” perforations. Slanted straining elements shall be provided with a bow-shaped integral handle for ease of removal.

H. Strainer bodies shall be cast to include manufacturer, model number, and size, or shall be provided with stainless steel tag rivted to strainer body or under cover.

I. Basket strainers to be model BS-55-CI as manufactured by Titan Flow Control, Inc., Lumberton, NC, or approved equal

2.14 VALVE OPERATORS

A. Valve operators shall be as shown on the plans and specified herein and in Section 2.05.

B. Valves located six (6) feet or more from floor level shall be furnished with chain wheel operators or chain level operators. Chains shall extend to within four (4) feet off the floor. All NRS floor stands and geared operators shall be indicating type.

2.15 VALVE ACTUATORS

A. The actuator shall consist of an electric motor, worm gear reduction, absolute position encoder, electronic torque sensor, mechanically and electrically interlocked reversing motor contactor, electronic control, protection, and monitoring package, manual override hand wheel, valve interface bushing, 32-character graphical LCD (Liquid Crystal Display), and local control switches all contained in an enclosure that is sealed in accordance with certifications listed below.. Actuator design life shall be at least one million drive sleeve turns.

B. If actuator is listed in Schedule for throttling service motor shall be capable of 1,200 starts per hour. For open-close service motor shall be capable of 60 start per hour.

C. Unless noted otherwise in Schedule actuators and gearing shall be sized to stroke the valve from open to close or vice versa in approximately 1 minute for open-close service and 2 minutes for throttling service.

D. The power transmission shall be completely bearing-supported, and consist of a hardened alloy steel worm and bronze alloy worm gear; oil-bath lubricated using synthetic oil designed specifically for extreme pressure worm and worm gear transmission service.

E. The motor shall be three-phase/60-cycle with Class F insulation and a thermistor embedded within the motor windings to prevent damage due to overload. The motor shall be easily removed through the use of a plug-in connector and shaft coupling.

F. Valve position shall be sensed by an 18-bit, optical, absolute position encoder with redundant position sensing circuits designed for Built-In-Self-Test [BIST]. Each of the position sensing circuits shall be redundant permitting up to 50% fault tolerance before the position is incorrectly reported. The BIST feature shall discern which failures signal a warning only and which require a warning plus safe shutdown of the actuator. Open and closed positions shall be stored in permanent, nonvolatile memory. The encoder shall measure valve position at all times, including both motor and hand wheel operation, with or without power present, and without the use of a battery. The absolute encoder will be capable of resolving ±7° of output shaft position over 10,000 output drive rotations.

G. An electronic torque sensor shall be included. The torque limit may be adjusted from 40-100% of rating in 1% increments. The motor shall be de-energized if the torque limit is exceeded. A boost function shall be included to prevent torque trip during initial valve unseating and during extreme arctic temperature operation (-50°C), and a “Jammed Valve” protection feature, with automatic retry sequence, shall be incorporated to de-energize the motor if no movement occurs.

H. The control module shall include power and logic circuit boards, control transformer, and at least two primary power protection fuses, all mounted to a steel plate and attached in the control compartment with captive screws. The use of O rings or other such devices to secure the control boards shall not be permitted. The module shall be easily removed through the use of plug-in connectors. The module shall also include a reversing contactor, local control switches, 32-character graphical LCD, and LED indicators. It shall also be Bluetooth ready. All internal wiring shall be flame-resistant, rated 105°C, and UL/CSA listed. Voltage shall be selectable via a jumper included on the power board.

I. The reversing contactor shall be mechanically and electrically interlocked to prevent simultaneous energizing of the open and close coils. The control module shall also include an auto reversal delay to inhibit high current surges caused by rapid motor reversals. The control transformer shall include vacuum-impregnated coils and dual primary fuses.

J. A Phase Correction circuit shall be included to correct motor rotation faults caused by incorrect site wiring. The phase correction circuit shall also detect the loss of a phase and disable operation to prevent motor damage. The monitor relay shall trip and an error message shall be displayed on the LCD screen when loss of phase occurs and indicate the fault for Remote operation.

K. Discrete remote control may be configured as 2, 3, or 4 wires for open-stop-close control. Remote control functions may be powered by external 24 VDC, 125 VAC, or the actuator’s internal supply 24 VDC supply. The voltage values for signal threshold shall be 19.2V AC/DC and 5.0V AC/DC respectively. The maximum load for 24Vdc is 2mA. The internal supplies shall be protected against over current and short circuits faults and utilize optical isolation to minimize electro-magnetic interference. Discrete control shall have an isolated common.

L. ESD (Emergency Shut Down) provision shall be included in each actuator. The actuator shall permit up to three inputs for ESD and they shall be configurable. The ESD signal shall override any existing signal (except LOCAL, STOP, and INHIBIT) and send the valve to its configured emergency position. The ESD may also be configured to override LOCAL, STOP, and/or INHIBIT. Provision for an isolated common shall be provided.

M. Inhibit movement provision shall be included in each actuator. The actuator shall permit up to three inputs for Inhibits and they shall be configurable. Provision for an isolated common shall also be provided.

N. Terminals shall be included to connect the electronic controls package, including display, to a

back-up 24 VDC power source. As a standard alternative the actuator shall have the ability to maintain the status and alarm contacts in order to update status to the control room and also provides status visibility on the LCD screen without main power applied. It should be configurable for at least one hour and, once main power is restored, be available for the next unforeseen power outage. The use of an integral battery is prohibited.

O. A dedicated circuit to prevent undesired valve operation in the event of an internal circuit fault or erratic command signal shall be included. A single point failure will not result in erratic actuator movement. An open or short-circuit in the internal circuit board logic shall not energize the motor contactor, nor shall a single fused control relay contact fail to deenergize the motor contactor. The command inputs shall be optically coupled and require a pulse width of at least 250 ms to 350 ms to turn on or off. In the event of an internal circuit fault, an alarm shall be signaled by tripping the Monitor Relay and through LCD indication.

P. Four latched status contacts rated 125VAC, 0.5A and 30VDC, 2 amps shall be provided for remote indication of valve position, configured as 1-N/O and 1-N/C for both the open and closed positions. Two contacts may be configured to represent any other actuator status; mid-travel position, switched to local, overtorque, motor over temperature, manual operation, switched to remote, switched to stop, valve moving, close torque switch, open torque switch, hardware failure, ESD active, inhibits active, valve jammed, analog IP (input) lost, lost phase, and network controlled.

Q. A monitor relay shall be included and shall trip when the actuator is not available for remote operation. Both N/O and N/C contacts shall be included, rated 125VAC, 0.5A and 30VDC, 2 amps. The monitor relay shall be configurable for three additional fault indications; lost phase, valve jammed, and motor overtemp. The yellow LED shall blink when the monitor relay is active.

R. The ACP (Actuator Control Panel) cover & module shall use solid-state Hall-effect devices for local communication and configuration. The use of reed switches on the module is prohibited. A 32-character, graphical LCD shall be included to display valve position as a percent of open, 0-100%, and current actuator status. “STATUS OK” shall be displayed for an operable actuator. If the actuator is not operable, the appropriate alarm shall be displayed. The alarm shall be continuously displayed until the actuator is operable. Red, green, and yellow LEDs shall be included for open, close, stopped, and moving indication. The Red and Green LEDs shall be reversible. A padlockable LOCAL-STOP-REMOTE switch and an OPEN-CLOSE switch shall be included for local valve actuator control. The control switches shall not penetrate the controls cover and shall be designed to electrically isolate the actuator’s internal components from the external environment. The OPEN-CLOSE switch may be configured for maintained or push-to-run (inching) control.

S. The device shall be non-intrusive - All calibration shall be possible without removing any covers and without the use of any special tools. All calibration shall be performed in clear text languages, no icons shall be used. The languages shall be English, Spanish, French, German, Portuguese, Italian, Mandarin, Russian, Malay, and Katakana. All calibration shall be performed by answering the “YES” and “NO” questions displayed on the LCD. “YES” is signaled by using the OPEN switch and “NO” by using the CLOSE switch, as indicated adjacent to the switches. A configurable password option shall be available to prevent unauthorized changes.

T. Double sealed terminal compartment & Terminal block - All customer connections shall be located in a terminal chamber that is separately sealed from all other actuator components. Site wiring shall not expose actuator components to the environment. The internal sealing within the terminal chamber is suitable for NEMA 4, 6, and IP68 to 15M for 96 hours. The chamber shall include screw-type terminals, three for power and 54 for control, for site connections. Three conduit entries, available as: (2) - 1.25" NPT (M32) and (1)-1.5" NPT (M40) shall be located in the terminal chamber.

U. Coatings - The actuator shall be coated with a polymer powder coat. The coating system

shall be suitable for an ASTM B117 salt spray test of 1500 hours. External fasteners shall be stainless steel or high-strength carbon steel that has been chromate-hexavalent coated, and then top coated with a high-strength, high-endurance polymer. The fasteners shall be suitable for an ASTM B117 salt spray test of 500 hours.

V. A handwheel and declutch lever shall be provided for manual operation. The handwheel shall not rotate during electric operation nor can a seized motor prevent manual operation. Changing from motor to manual operation is accomplished by engaging the declutch lever. Energizing the motor shall return the actuator to motor operation. The lever to enable the declutch shall be padlockable to permit motor operation only.

W. The actuator shall include a removable torque or thrust bushing to mate with the valve shaft.

X. Diagnostic facilities shall be included to accumulate and report the performance of the motor, encoder, contactor, cycle time, handwheel operations, actuator ID, firmware revision, and output turns. In addition, a torque profile of the reference baseline valve stroke and the last valve stroke shall be included. A feature for reset shall be provided. All diagnostic information shall be displayed on the LCD. Diagnostics shall also include an FDA (Frequency Domain Analysis) feature. The Frequency Domain Analysis methodology shall capture torque, position or speed values at regular time intervals while the actuator is motoring, and calculate the resulting data set with a Fast Fourier Transform [FFT]. The resulting information shall be used to isolate any components in the mechanical drive train that may exhibit excessive wear or may effect normal actuator operation. FDA and resultant fault indications shall be displayed via the graphical LCD. The actuator shall contain the ability for diagnostics information to be downloaded to a PC or PDA via both IRDA and Bluetooth ports.

Y. Factory testing - Every actuator shall be factory tested to verify: rated output torque, output speed, handwheel operation, local control, control power supply, valve jammed function, all customer inputs and outputs, motor current, motor thermistor, LCD and LED operation, direction of rotation, microprocessor checks, and position-sensor checks. A report confirming successful completion of testing shall be included with the actuator.

Z. Acceptable manufacturers for valve actuators are Rotork, Limitorque, EIM, or approved equal.

2.16 ACTUATOR CERTIFICATIONS

A. Non-hazardous (Weatherproof/Submersion) Certifications

1. IEC 529 protection code IP68; minimum 7 meters for 72 hours continuous

2. USA & CSA; NEMA 3, 4, NEMA 4X, NEMA 6

B. Standard Hazardous Global certifications:

1. FM – Class I, Groups B, C & D, DIV.1 and Class II, Groups E, F, & G, T4

   a. T4A temperature classification is acceptable w/ operational times < 15 min.

2. ATEX Eex d IIB T4 ATEX II 2 G, CENELEC Norm EN50014 and EN50018

3. ATEX Eex d IIC T4 ATEX II 2 G, CENELEC Norm EN50014 and EN50018

   a. T4A temperature classification is acceptable w/ operational times < 15 min.

4. CSA – Class I, Groups B, C & D, DIV.1 and Class II, Groups E, F, & G, T4

5. IEC Eexd IIB T4, IIB T4

6. IEC Eexd IIC T4, IIC T4

2.17 ACTUATOR OPTIONS

A. Lost power buffer

1. After the actuator has been powered by line power for one hour, it shall automatically withstand most power outages while maintaining the correct state of the S status contacts, even if the user repositions the actuator manually with the handwheel. To maximize its self-power time while the line power is lost, the actuator will place itself in its lowest possible power usage mode. The LCD will darken (sleep mode) until it is needed to be viewed. The LCD can be activated by moving the black knob to OPEN (YES) or by moving the actuator with the handwheel. After 10 seconds of inactivity, the LCD will return to sleep mode.

2. The use of batteries to perform this function shall be prohibited.

B. Analog Position Transmitter (APT)

1. A non-contacting, internally powered, electrically isolated position transmitter shall be included to provide a 4-20 mA signal that is proportional to valve position.

C. Modutronic Option

1. If noted on Schedule for throttling service a controller that alters valve position in proportion to a 4-20 mA analog command signal shall be included. Positioning shall be accomplished by comparing the command signal to an internal position feedback. The internal feedback shall be of the non-contacting type. An automatic pulsing feature to prevent overshoot at the setpoint shall be included. Proportional bands, deadband, signal polarity, motion inhibits time, and fail position shall be adjustable through the LCD. Deadband shall be adjustable to 0.5% full span.

D. Relays for Status and Alarms

1. Up to eight additional latching output contacts rated 250 VAC/30 VDC, 5 amps and configurable to represent any actuator status in either N/O or N/C state shall be available: mid-travel position, switched to local, overtorque, motor over temperature, manual operation, switched to remote, switched to stop, valve moving, close torque switch, open torque switch, hardware failure, ESD active, inhibits active, valve jammed, analog IP (input) lost, lost phase, and network controlled.

E. Device Net (DN)

1. Valve motor operators shall be Devicenet capable, with full control and status functionality available for remote operation and monitoring. Refer to Section 18100 for actuator control signals and communication protocols.

PART 3 - EXECUTION

3.01 INSTALLATION

A. All valves shall be installed in accordance with the manufacturer's recommendations.

END OF SECTION

SECTION 11310 - NON-CLOG SUBMERSIBLE SEWAGE PUMPS

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. Provide all labor, materials, equipment, delivering, installing, testing, and placing into service all pumping equipment and with all appurtenances associated with the Lift Stations complete as shown on the Drawings and more fully described hereinafter. The equipment to be furnished and installed shall be as shown on the Drawings and shall include pumps, motors, VFDs, guide rails, access hatches, control panels and control systems, and appurtenances, all tested and ready for operation.

B. Unless otherwise specified the pump manufacturer shall furnish each pumping unit complete with drive motor and all other components and shall be entirely responsible for the compatibility in all respects of all components furnished.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Submittals: Section 01300

B. Operating & Maintenance Manuals: Section 01780

C. Products Furnished But Not Installed Under This Section: Anchor bolts shall be installed under Section 03300 in accordance with certified prints furnished by the pump manufacturer.

1.03 SYSTEM DESCRIPTION

A. Design Requirements: A minimum system head curves for each pump application are included herein. Duty points for each pump are indicated on the system curves.

B. Performance Requirements: Except where noted, each pump shall be designed to operate continuously at the intersection of its pump curve and the minimum system curve with available net positive suction head as shown without cavitation and without requiring throttling to prevent cavitation or overloading the motor. Multiple pumps running concurrently shall also satisfy the above condition.

1. Performance curves of variable speed pumps at maximum speed shall intersect the system curves, and pumps shall be designed for operation at that duty point unless otherwise noted in the Pumping Requirements.

C. Suction Requirements: Velocities at the pump casing inlet shall not exceed 20 feet per second at the specified duty point. The pump manufacturer shall provide suction reducing elbows if required to provide a reduction of not more than 2 standard pipe diameters per fitting between the suction header and the pump casing inlet.

D. Characteristic Curves: Constant speed pumps' characteristic curves must have a continuous test rise from duty point to shutoff head. Shutoff head must be a minimum of 10 feet above duty point unless stated otherwise in the Pumping Requirements.

1. Variable speed pumps' characteristic curves shall have a minimum shutoff head as noted in the Pumping Requirements.

2. The discharge head will consist of the static lift plus the friction head in the discharge piping.

3. The total dynamic head stated under Pumping Requirements shall be developed by the pumping units. Any losses incurred between the suction and discharge connections furnished with the pump are not included

4. Pumps shall be used to pump sewage and shall be of the nonclog type. The diameter of the impeller furnished shall not be greater than the percentage listed in the Pumping Requirements of the largest impeller which can be installed in the pump unless specifically approved by Engineer.

5. Pump speeds shall not exceed the speeds listed in the Pumping Requirements. The pumps shall be arranged as nearly as the types will permit to those indicated on Drawings with center throw discharge and direction of rotation as required by the installation.

1.04 MANUFACTURER

A. The pumping units shall be provided by a single manufacturer with a minimum of five (5) year's experience in designing and manufacturing pumping equipment of similar type, size and capacity. The pumps shall be manufactured by the Xylem Corporation Flygt Division, Sulzer-ABS, or approved equal.

B. To assure unity of responsibility, the pumps, motors, VFDs, guide rails and access hatches and other auxiliary equipment, and materials specified in this Section shall be furnished and coordinated by the pump manufacturer (Manufacturer) who shall assume responsibility for the satisfactory operation of the entire pumping system including pumps, motors, VFDs, and accessories.

C. Replacement Parts Capability: The manufacturer shall have the ability to promptly furnish any and all interchangeable replacement parts as may be needed at any time within the expected life of the pumps. Upon request, the Contractor shall submit evidence of the proposed manufacturer's ability to promptly fill replacement orders.

D. Quality Assurance: All pumping units shall be of approved design and make products of manufacturers who have built equipment of similar type, size and capacity.

E. Additional Submittals: The Contractor shall submit, upon request, any additional information that the Engineer may deem necessary to determine the ability of the proposed manufacturer to produce the specified equipment.

F. Manufacturer Information: All manufacturer information required by the specifications shall be submitted by the Contractor within thirty (30) calendar days of the date of receipt of the Notice to Proceed.

Any additional information or data, specifically requested by the Engineer, concerning manufacturer's capabilities (especially relating to requirements described hereinbefore), shall be submitted by the Contractor within fourteen (14) calendar days of the receipt of the written request thereof, unless otherwise specified.

Approval of manufacturers or suppliers will not be given until all information required by the specifications or requested by the Engineer has been submitted and acceptable.

G. Disqualification of Manufacturer:

1. Poor performance of similar pumping equipment now in operation under the specified conditions of service and pump rating constitute grounds for disqualification of the pump manufacturer, supplier, or both, unless such poor performance has been corrected.

2. Failure to successfully comply with the provisions of subparagraphs A through H, inclusive, will constitute grounds for disqualification of pump manufacturer.

1.05 SUBMITTALS (SHOP DRAWINGS)

A. General: The Contractor shall comply with the provisions of the specifications regarding submittals, unless otherwise specified herein.

B. At the time of submission, the Contractor shall, in writing, call the Engineer's attention to any deviations that the submittals may have from the requirements of the Engineer's Contract Drawings and Specifications.

C. The Contractor shall provide a notarized certification indicating that all pumping products meet the required Specifications.

D. Descriptive literature, catalog cuts, and dimensional prints clearly indicating all dimensions and materials of construction shall be submitted on all items specified herein to the Engineer for review and approval before ordering.

E. Content of Submittals: The following shall be included in submittals as a minimum. However, any additional information or data shall be added if and whenever requested by the Owner or the Engineer. Where applicable, submit separate data for each pump.

1. Descriptive Literature:

    a. Dimensions

    b. Materials of Construction (including required coating).

    c. Performance Data.

        1) Pump Impeller Size

        2) GPM, TDH, BHP, RPM

        3) Recommended minimum pump operating flow rate

        4) Performance curves showing pump operation including shutoff head, operating point, and run-out.

        5) Performance curves showing hydraulic and overall pump efficiencies.

        6) Weight of pump and base support elbow

        7) Horsepower rating of pump motor

        8) Cable lifting system component cut sheets with arrangement drawing showing cable routing, intermediate cable support spacing, bracket mounting and cable end protection terminal box location.

2. Installation Information: Submit installation drawings and information for pump connections, connecting piping and valves, electrical connections, and auxiliary equipment.

    The Contractor shall submit all other drawings, material lists and other information specified, requested and/or necessary to show complete compliance with all details of the contract documents.

3. Operation and Maintenance Manual: Manual shall contain all information necessary for proper operation and maintenance of pumping units, as well as the location of the nearest permanent service headquarters.

1.06 TESTS

A. Shop Tests:

1. All pumps shall receive a non-witness factory test.

2. The Manufacturer shall factory test all pumps prior to shipment in accordance with the Hydraulic Institute standards, latest version. Flow rate, total head and Input KW shall be tested and recorded for at least five points on the pump performance curve. Test shall be performed to demonstrate that the pumps meet ANSI/HI 11.6 acceptance grade 1U for all specified points. The five points shall include the points specified in pump performance table in Paragraph 2.02.

3. The Manufacturer shall perform hydrostatic test on the pressure-containing parts in accordance with ANSI/HI 11.6. Test shall be conducted on each pump prior to shipment.

4. The Manufacturer shall perform the following test on each pump prior to shipment from factory:

   a. Megger motor and pump for insulation breaks or moisture.

   b. Prior to submergence, the pump shall be run dry and checked for correct rotation.

   c. Pump shall be run for a minimum of 30 minutes in a submerged condition.

   d. The pump shall be removed from test tank, meggered immediately for moisture and upper and lower seal unit shall be checked for water intrusion.

   e. A written certification test report regarding the above tests shall be submitted for approval prior to shipment.

5. Five (5) certified copies of the results of these tests are to be sent to the Engineer. Also included with the test curves shall be a certified bill of material list depicting quality of construction.

B. Field Tests:

1. The pumping units will be accepted upon the basis of the certified copies of the shop test and be subject to a four-hour field test of each unit. This test will be for the purpose of determining if each pumping unit will operate under installed conditions within a reasonable degree of correlation with the shop tests.

2. The Contractor shall give at least two (2) week's notice to the Owner when the field tests are to be accomplished so that the Owner may have a representative present at the said tests.

3. The field tests shall be made by the Contractor in the presence of and as directed by the Engineer.

4. Field tests shall be made on each pumping unit. During the test, each pump shall be run at maximum rated speed for at least three (3) rates of flow corresponding to minimum rate, design rate, and maximum rate of flows specified as evidenced by the corresponding total head shown by the pump gages; simultaneous ammeter readings shall be taken. Variation of the rate of flow shall be made by throttling the discharge

valve (where applicable). The rated motor nameplate current and power shall not be exceeded at any rate of flow within the specified range.

5. Before any pump is rotated, the Contractor shall make certain that no debris is present in suction well, pumps or pipelines. Any internal damage done to equipment while starting up shall be assumed to be caused by debris and shall be replaced at the Contractor's expense. No pump shall be rotated under power unless submerged with liquid.

5. When water can be pumped, the Contractor shall commence pumping and shall have representatives from the pump manufacturer to start the pumps. When flow conditions are favorable, the Contractor or pump manufacturer shall in the presence of the Engineer, run a series of tests to establish the adequacy of the pumping units.

6. Field tests shall also conform to Part 3, Paragraph 3.03 as specified hereinafter.

C. Failure of Tests:

1. Any defects in the equipment or failure to meet the guarantees or requirements of the specifications shall be promptly corrected by the Contractor by replacements or otherwise. The decision of the Engineer as to whether or not the Contractor has fulfilled his obligations under the Contract shall be final and conclusive. If the Contractor fails or refuses to make these corrections or if the improved equipment, when tested, shall fail again to meet the guarantees of specified requirements, the Owner notwithstanding its having made partial payment for work and materials which have entered into the manufacture of said equipment, may reject said equipment and order the Contractor to remove it from the premises at his own expense.

2. In case the Owner rejects said equipment, then the Contractor hereby agrees to repay to the Owner all sums of money paid to him for said rejected equipment on progress certificates or otherwise on account of the lump sum prices herein specified, and upon the receipt of said sum of money the Owner will execute and deliver to the Contractor a bill of sale of all its rights, title, and interest in and to said rejected equipment; provided, however, that said equipment shall not be removed from the premises of the Owner until the Owner obtains from other sources the equipment to take the place of the rejected. The Owner hereby agrees to obtain said other equipment within a reasonable time and the Contractor agrees that the Owner may use the equipment furnished by him without rental or other charge until said other new equipment is obtained.

D. Responsibility During Test: The Contractor shall be fully responsible for the proper operation of equipment during tests and instruction periods and shall neither have nor make any claim for damage which may occur to equipment prior to the time when the Owner formally takes over the operation thereof.

E. Manufacturer's Representative: For all pumping units, the Contractor shall furnish the services of accredited representatives of the pump manufacturer who shall supervise the installation, adjustment, and field tests of each pumping unit and give instructions to the operating personnel. As one condition necessary to acceptance of any pumping unit, the Contractor shall submit a certificate from the manufacturer, stating that the installation of the pumping unit is satisfactory, that the unit is ready for operation, and that the operating personnel have been suitably instructed in the operation, lubrication, and care of the unit.

1.07 GUARANTEE PERIOD

A. After successful completion of tests and trials under operating conditions on all equipment, the Contractor shall guarantee all equipment, materials and workmanship from undue wear and tear, from mechanical and electrical defects, and from any failure, for a minimum of one (1) year. This one (1) year minimum shall not replace a standard manufacturer’s guarantee if it exceeds one (1) year.

1.08 PUMP WARRANTY

A. Submersible Pump Warranty: The pump manufacturer shall warrant the pumps against defects in workmanship and materials for a period of 5 years under normal use, operation, and service. During the first 18 months pump manufacturer shall cover 100% of the parts and labor costs. During the remaining portion of the warranty period pump manufacturer shall include a progressive schedule of cost sharing for all parts that fail or are faulty. Excluded from warranty is damage due to normal wear and tear. The warranty period shall commence at time of substantial completion..

PART 2 - PRODUCTS

2.01 SOLIDS HANDLING SUBMERSIBLE SEWAGE PUMPS

A. Pump Design:

The pump(s) shall be automatically and firmly connected to the discharge connection, guided by no less than two parallel guide bars extending from the top of the station to the wet well mounted discharge connection. There shall be no need for personnel to enter the wet-well. Sealing of the pumping unit to the discharge connection shall be accomplished by a machined metal-to-metal watertight contact. Sealing of the discharge interface with a diaphragm, O-ring or profile gasket will not be acceptable. The entire weight of the pump/motor unit shall be borne by the pump discharge elbow. No portion of the pump/motor unit shall bear on the sump floor directly or on a sump floor mounted stand.

Power and pilot cable supports shall be provided and consist of a wire braid sleeve with attachment loops or tails to connection to the under side of the access frame.

B. Pump Construction:

Major pump components shall be of gray cast iron, ASTM A-48, Class 35B, with smooth surfaces devoid of blow holes or other casting irregularities. All exposed nuts or bolts shall be AISI type 316 stainless steel. All metal surfaces coming into contact with the pumped media, other than stainless steel, shall be protected by a factory applied spray coating of acrylic dispersion zinc phosphate primer with a polyester resin paint finish on the exterior of the pump.

Sealing design shall incorporate **metal-to-metal contact** between machined surfaces. Pump/Motor unit mating surfaces where watertight sealing is required shall be machined and fitted with Nitrile or Viton rubber O-rings. Joint sealing will be the result of controlled compression of rubber O-rings in two planes and O-ring contact of four sides without the requirement of a specific bolt torque limit. Rectangular cross-sectioned rubber, paper or synthetic gaskets that require specific torque limits to achieve compression shall not be considered as adequate or equal. No secondary sealing compounds, elliptical O-rings, grease or other devices shall be used.

C. Cooling System:

Each pump/motor unit shall be provided with an integral, self-supplying cooling system. The motor water jacket shall encircle the stator housing and shall be of cast iron, ASTM A-48, Class 35B. The water jacket shall thus provide heat dissipation for the motor regardless of whether the motor unit is submerged in the pumped media or surrounded by air. After passing through a classifying labyrinth, the impeller back vanes shall provide the necessary circulation of the cooling liquid, a portion of the pumpage, through the cooling system. Two cooling liquid supply pipes, one discharging low and one discharging high within the jacket,

shall supply the cooling liquid to the jacket. An air evacuation tube shall be provided to facilitate air removal from within the jacket.

Any piping internal to the cooling system shall be shielded from the cooling media flow allowing for unobstructed circular flow within the jacket about the stator housing. Two cooling liquid return ports shall be provided. The internals to the cooling system shall be non-clogging by virtue of their dimensions The cooling jacket shall be equipped with two flanged, gasketed and bolted inspection ports of not less than 4" diameter located 180° apart. The cooling system shall provide for continuous submerged or completely non-submerged pump operation in liquid or in air having a temperature of up to 40°C (104°F), in accordance with NEMA standards. Restrictions limiting the ambient or liquid temperatures at levels less than 40°C are not acceptable.
or

The unit shall be provided with a closed loop cooling system adequately designed to allow the motor to run continuously under full load while in an unsubmerged or minimally submerged condition. A cooling jacket shall surround the stator housing, and an environmentally safe non-toxic propylene glycol solution shall be circulated through the jacket by an axial flow circulating impeller attached to the main motor shaft. The coolant shall be pumped through an integrated heat exchanger in the base of the motor whenever the motor is running, allowing excess heat to be transferred to the process liquid. The use of external heat exchangers, fans, or the supply of supplemental cooling liquid shall not be accepted.

D. Cable Entry Seal:

The cable entry seal design shall preclude specific torque requirements to insure a watertight and submersible seal. The cable entry shall consist of dual cylindrical elastomer grommets, flanked by washers, all having a close tolerance fit against the cable outside diameter and the cable entry inside diameter. The grommets shall be compressed by the cable entry unit, thus providing a strain relief function. The assembly shall provide ease of changing the cable when necessary using the same entry seal. **The cable entry junction chamber and motor shall be sealed from each other, which shall isolate the stator housing from foreign material gaining access through the pump top. Epoxies, silicones, or other secondary sealing systems shall not be considered acceptable.**

E. Motor:

Submersible sewage pumps shall be constructed to be explosion-proof, Class I, Division 1, Group D, construction except when indicated otherwise on Schedule

The pump motor shall be high efficiency and NEMA B design, induction type with a squirrel cage rotor, shell type design, housed in an air filled, watertight chamber. The stator windings shall be insulated with moisture resistant Class H insulation rated for 180^{O}C (356^{O}F). The stator shall be insulated by the trickle impregnation method using Class H monomer-free polyester resin resulting in a winding fill factor of at least 95%. The motor shall be inverter duty rated in accordance with NEMA MG1, Part 31.The stator shall be heat-shrunk fitted into the cast iron stator housing. The use of multiple step dip and bake-type stator insulation process is not acceptable. The use of bolts, pins or other fastening devices requiring penetration of the stator housing is not acceptable.

The motor shall be specifically designed for submersible pump usage and designed for continuous duty pumping media of up to 40°C (104°F) with an 80°C temperature rise and capable of at least the number of evenly spaced starts per hour listed on Schedule. The junction chamber shall be sealed off from the stator housing and shall contain a terminal board for connection of power and pilot sensor cables using compressible elastomeric grommet arrangement which can be easily reused for cable removal and reinstalling and also

acts as a strain relief device. The motor and the pump shall be produced by the same manufacturer.

The motor service factor shall be a minimum of 1.15. The motor shall have a voltage tolerance of plus or minus 10%. The motor shall be designed for operation up to 40°C (104°F) ambient and with a temperature rise not to exceed 80°C. A performance chart shall be provided upon request showing curves for torque, current, power factor, input/output kW and efficiency. This chart shall also include data on starting and no-load characteristics.

The power cable shall be sized according to the NEC and ICEA standards and shall be of sufficient length to reach the junction box without the need of any splices. The outer jacket of the cable shall be oil resistant chloroprene rubber. The motor and cable shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of at least 65 feet.

The motor horsepower shall be adequate so that the pump is non-overloading throughout the entire pump performance curve from shut-off through run-out.

F. Pilot Cable:

The pilot cable shall be designed specifically for use with submersible pumps and shall be type SUBCAB (Submersible Cable). The cable shall be shielded, multi-conductor type with a chloroprene outer jacket and the tinned copper conductors insulated with ethylene-propylene rubber. The conductors shall be arranged in twisted pairs. The cable shall be rated for 600 Volts and 90°C (194°F) with a 40°C (104°F) ambient temperature and shall be approved by Factory Mutual (FM). The cable length shall be adequate to reach the junction box without the need for splices.

G. Bearings:

The pump shaft shall rotate on at least three grease-lubricated bearings. The upper bearing, provided for radial forces, shall be a single roller bearing. The lower bearings shall consist of at least one roller bearing for radial forces and one or two angular contact ball bearings for axial thrust.

The minimum ABMA L_{10} bearing life shall be 100,000 hours at any point along the usable portion of the pump curve at maximum product speed.

H. Mechanical Seal:

Each pump shall be provided with a tandem mechanical shaft seal system consisting of two totally independent seal assemblies. The lower seal shall be independent of the impeller hub. The seals shall operate in a lubricant reservoir that hydrodynamically lubricates the lapped seal faces at a constant rate. The lower, primary seal unit, located between the pump and the lubricant chamber, shall contain one stationary and one positively driven rotating corrosion resistant **tungsten-carbide** seal ring.

The upper, secondary seal unit, located between the lubricant chamber and the motor housing, shall contain one stationary and one positively driven rotating corrosion resistant **tungsten-carbide** seal ring. Each seal interface shall be held in contact by its own spring system. The seals shall require neither maintenance nor adjustment and shall be capable of operating in either clockwise or counter clockwise direction of rotation without damage or loss of seal. For special applications, other seal face materials shall be available.

Should both seals fail and allow fluid to enter the stator housing, a port shall be provided to direct that fluid immediately to the stator float switch to shut down the pump and activate an alarm. Any intrusion of fluid shall not come into contact with the lower bearings.

The following seal types shall not be considered acceptable nor equal to the dual independent seal specified: shaft seals without positively driven rotating members, or conventional double mechanical seals containing either a common single or double spring acting between the upper and lower seal faces. No system requiring a pressure differential to offset pressure and to effect sealing shall be used.

Each pump shall be provided with a lubricant chamber for the shaft sealing system. The lubricant chamber shall be designed to prevent overfilling and to provide lubricant expansion capacity. The drain and inspection plug, with positive anti-leak seal shall be easily accessible from the outside. The seal system shall not rely upon the pumped media for lubrication. The motor shall be able to operate continuously while non-submerged without damage while pumping under load.

Seal lubricant shall be FDA Approved, nontoxic.

I. Pump Shaft:

Pump and motor shaft shall be a solid continuous shaft. The pump shaft shall be the extension of the motor shaft. Couplings shall not be acceptable. The motor shaft shall be of 400 series stainless steel. Impeller shall be securely bolted to the shaft

J. Impeller:

Impellers shall be constructed of hard iron or duplex stainless steel. The impeller shall be a rotodynamic semi-open, solids handling type capable of passing solids either due to internal clearances or other features to facilitate solids processing including a wear plate with groove. The wear plate to impeller clearance shall be easily adjustable without the need for disassembly of the pump or the need to add or remove shims. The impeller may include pump out vanes on the upper shroud to reduce axial thrust and minimize clogging due to debris accumulation around the mechanical seal. The impeller shall be dynamically balanced to the ISO 1940 G6.3 standard to provide smooth, vibration free operation.

K. Wear Rings:

A wear ring system shall be used to provide efficient sealing between the volute and suction inlet of the impeller. Each pump shall be equipped with a stainless steel insert that is drive fitted to the volute inlet.

This pump shall also have a stainless steel impeller wear ring heat-shrink fitted onto the suction inlet of the impeller.

L. Volute:

Pump volute(s) shall be single-piece gray cast iron, Class 35B, non-concentric design with smooth passages large enough to pass any solids that may enter the impeller. Minimum inlet and discharge size shall be as specified.

M. Protection:

When listed under Pumping Requirements provide pump protection items:

1. Motor Thermal Switches. All stators shall incorporate thermal switches in series to monitor the temperature of each phase winding. Should high temperature occur, the thermal switches shall open, stop the motor, and activate an alarm in the control panel.

2. Seal Leak Sensor. A seal leak sensor shall be provided to monitor upper bearing or motor chamber vibration.

3. Bearing Temperature Sensor. Lower and upper bearing temperature sensors shall be provided. The sensor shall directly contact the outer race of the thrust bearing providing for accurate temperature monitoring.

4. Motor Cavity Leakage Sensor. A leakage sensor shall be provided to detect water in the stator chamber. The Float Leakage Sensor (FLS), a small float switch, shall be used to detect the presence of water in the stator chamber. When activated, the FLS will stop the motor and activate an alarm. USE OF VOLTAGE SENSITIVE SOLID STATE SENSORS SHALL NOT BE ALLOWED.

5. Vibration Sensor. A vibration sensor shall monitor upper bearing pump vibration.

6. Terminal Box Moisture Sensor. A cable terminal box moisture sensor shall be provided.

7. Pump Monitoring Electrical Enclosure. A separate enclosure shall be provided for monitoring relays for installation next to or on the side of the pump VFD panels. Outputs for each signal shall be provided with Ethernet compatibility.

N. Pump Discharge Flange:

The pump base mount discharge elbow with mating flange shall be provided. Pump discharge elbow shall be anchored to wet well floor and have integral mounts for lower ends of 316 stainless steel pipe guide rails. Guide rail system shall include top mounting bracket and intermediate bracing as required for deep installations. Pump guide system shall consist of 2 guide pipes and shall be non-sparking.

O. Pump Retrieval and Cable Lift System:

Each pump shall be supplied with an engineered pump retrieval and cable management (deep lift) system specifically designed to control the power and pilot cables during pump removal and installation, accommodate cable removal at grade, temporary support and protect exposed ends of cables while pump is detached for maintenance or inspection. Deep lift system components shall be engineered and tested to work together with intermediate cable grips and cable hangers spaced as required to work with pump, hatch and junction box layouts shown on Drawings. Pump cabling components shall have predetermined spacing for efficient installation in the field. To facilitate cable management during pump removals the pump terminal box design shall be user friendly and allow cable removal and reconnection without the need for special tools or sealants. Pump guide rails shall be modified if required to work with the lift system. Cable lift components will generally consist of:

1. Specially fabricated pump bail designed to mechanically interlock with pump lift assembly.

2. Pump lift assembly l rated for weight of pump plus cabling with safety factor

3. Lift guide that attaches to hoist hook and pump guides

4. Pump mounted cable yoke or other means to neatly manage cables and prevent twisting during installation and retrieval.

5. One lot of cable grips

6. Upper cable support bracket(s) with slots for each pump cable and arranged to fit with cable yoke

7. Cable hanging flanges store cable in wet well

8. Cable storage enclosure boxes to protect and secure cable terminations

2.02 PUMPING REQUIREMENTS

IPS Pumps (large) 1A, 1B, 2A and 2B

No. of Pumps	Shut-Off Head (Min) (Ft)	Duty Point		Max. Speed (RPM)	Motor HP/Min Each Pump	Minimum Pump Suction Inlet Dia. (Inches)
		Flow (GPM)	Head (Ft.)			
4	130	16,250	64	900	335	20
		Min Flow Duty Point				
		6,000	50			

A. Motors shall be 480 volt, 3 phase, 60 Hz.

B. Each pump shall be operated by VFD – see Specifications Division 16.

C. Maximum allowable NPSHr at intersection of pump curve and minimum system curve is 27 feet.

D. Impeller furnished shall not be greater than 94% of the largest pump impeller.

E. Provide pump protection items 1 thru 7.

F. Each pump shall have its own double door access hatch. Each hatch door shall have a small approximately 8" x 12" flip door to allow the pump cables to pass through when the main hatch door is closed.

G. Pump shall be capable while operating with VFD control at the Minimum Flow duty point listed above continuously without damage to the pump or motor.

IPS Pumps (small) 1C, 1D, 2C and 2D

No. of Pumps	Shut-Off Head (Min) (Ft)	Duty Point		Max. Speed (RPM)	Motor HP/Min Each Pump
		Flow (GPM)	Head (Ft.)		
4	92	1,200	70	1,800	34

A. Motors shall be 480 volt, 3 phase, 60 Hz.

B. Each pump shall be operated by VFD – see Specifications Division 16.

C. Maximum allowable NPSHr at intersection of pump curve and minimum system curve is 16 feet.

D. Impeller furnished shall not be greater than 94% of the largest pump impeller

E. Provide pump protection items 1, 2 & 7.

F. Each pair of pumps shall share a double door access hatch. Min hatch size is 3' x 4' with hinges on the 3' sides. Each hatch main door shall have a small approximately 6" x 8" flip door to allow the pump cables to pass through when the main hatch door is closed

WWS Pumps No. 1 thru 5

No. of Pumps	Shut-Off Head (Min) (Ft)	Duty Point		Max. Speed (RPM)	Motor HP/Min Each Pump	Minimum Pump Suction Inlet Dia. (Inches)
		Flow (GPM)	Head (Ft.)			
5	185	13,900	127	900	670	20

A. Motors shall be 4,160 volt, 3 phase, 60 Hz.

B. Each pump shall be operated by VFD – see Specifications Division 16.

C. Maximum allowable NPSHr at intersection of pump curve and minimum system curve is 26 feet.

D. Impeller furnished shall not be greater than 92% of the largest pump impeller.

E. Provide pump protection items 1 thru 7

F. Each pump shall have its own double door access hatch. Each hatch door shall have a small approximately 8" x 12" flip door to allow the pump cables to pass through when the main hatch door is closed.

2.03 PUMP ACCESSORIES AND OTHER

A. All pumps and controls shall be completely wired at the factory for power and control and shall be color-coded. All wiring outside the control cabinet shall be rigid conduit. All accessory equipment shall be permanently wired with suitable disconnecting means and overload protection.

B. Contractor shall be responsible for supply of appropriate lengths of lifting chain, submersible power cable, and MG Hi conductor submersible cable.

C. Access hatches for wet well and valve pit shall be as specified in Section 08370 of these specifications. Dimensions shall be as noted on the Drawings or as required by pump manufacturer.

2.04 VARIABLE FREQUENCY DRIVES

A. The speed control for pumps shall be Variable Frequency Drives, as specified in Division 16 suitable for installation as shown on the Drawings.

B. The Variable Frequency Drives shall be supplied by the Manufacturer and shall be completely coordinated with the pumps and pump driving motors and shall include all internal auxiliaries required to meet the functional specifications.

C. The Variable Frequency Drives shall conform to all requirements stipulated in this Section and Division 16 Electrical, and shall be designed for a speed range of 50% to 100% of full load motor speed.

D. The Variable Frequency Drives shall be compatible with the motors provided by the Manufacturer.

2.05 GUIDE RAILS

A. The pumping station shall be furnished with the necessary, stainless steel upper guide holder and level sensor cable holder.

B. Lower guide holders shall be integral with the discharge connection. Dual guide rails shall be of Schedule 40, welded two-inch minimum diameter, Type 316 stainless steel pipe of the length required by the Drawings. Single guide rails and guide cables are not acceptable.

C. Intermediate guide brackets shall be furnished and installed so that the maximum length of unsupported guide rails will be no longer than 20 feet, and shall be fabricated of Type 316 stainless steel.

D. Stainless steel cable holders including the cable hooks shall be fabricated from Type 316 stainless steel plate. Sharp corners and edges shall be ground smooth to prevent abrasion and cutting of electrical cable insulation. The cable holder shall be of sufficient length and strength to provide support for each separate cable, except that the pump power and lift cables may use the same hook position, provided the cables do not foul one another and the lift cable is easily accessed from the hatch opening.

2.06 SOURCE QUALITY CONTROL

A. Shop Tests: Prior to shipment, each pump shall be fully tested on water at the manufacturer's plant. The purpose of the shop tests shall be to demonstrate that the pumps to be provided shall meet the requirements of the Specifications and, if applicable, the Special Warranties included in the Agreement.

1. Tests shall consist of running the pumps with furnished impeller at their rated capacity, head, and speed, or range of speeds if furnished with variable speed drives, and at such other conditions of head and capacity to properly establish a performance curve or family of curves (minimum of 3 different speeds) in the case of variable speed units. Performance data including efficiency and horsepower shall be collected and noted as part of the performance curve.

2. All pumps shall be tested in accordance with the standards of the Hydraulic Institute Level A. Certified copies of the test results and the performance curves, for each of the pumps to be furnished, shall be submitted to Engineer and approved prior to shipment of the pumps to the Project.

3. Generally, pumps shall be tested as a complete assembly including drive and motor. If the pumps are tested separately from the motors, or variable speed drives and motors, Contractor shall submit to Engineer, certified performance curves of the equipment to be furnished as guaranteed by the manufacturer. These certified curves shall be obtained either from actual tests of the equipment to be furnished or from tests of equipment of the same size and construction. The motor manufacturer's curves shall supply all the

necessary information concerning the equipment as indicated for the complete shop tests.

4. When pumps are tested separately from the variable speed drives, Contractor shall test one of each size drive complete with the actual motor to be furnished. Each drive and motor shall be tested at the specific speeds, torques, and power requirements for the duty point conditions required for any performance guarantee provisions of the Contract.

B. Additional Submersible Pump Testing

1. The pump manufacturer shall perform the following tests on each pump before shipment from the factory:

a. Execute a standard commercial motor test.

b. Prior to submergence, the pump shall be dry and be checked for correct rotation.

c. Pump shall be run for 30 minutes in a submerged condition. The pump shall be tested as a complete assembly including variable frequency drive.

d. Pump shall be removed from test tank, meggered immediately for moisture, oil plugs removed for checking lower seal; inspection plug removed for checking of upper seal and possible water intrusion of stator housing. If plugs are not provided, check for intrusion of water using a moisture probe.

e. A written certified test report giving the above information shall be supplied with each pump at the time of shipment.

f. All ends of pump cables will be fitted with a rubber shrink fit boot to protect cable prior to electrical installation.

PART 3 - EXECUTION

3.01 PREPARATION

A. Coordinate with other trades, equipment and systems to the fullest extent possible.

B. Take all necessary measurements in the field to determine the exact dimensions for all work and the required sizes of all equipment under this contract. All pertinent data and dimensions shall be verified by the Contractor.

3.02 INSTALLATION

A. Installation shall be in strict accordance with the manufacturer’s instructions and recommendations in the locations shown on the Drawings. Anchor bolts shall be set in accordance with the manufacturer’s recommendations and setting plans.

B. The Contractor shall also provide from the submersible pump supplier the service of a qualified start-up engineer (factory representative) who has had prior on-site start-up experience to assist in performing start-up, checkout and initial operation services of the pumping units. The start-up engineer shall also instruct the Owner's personnel on the operation and maintenance procedures for the station. Qualified supervisory services, including manufacturers’ engineering representatives, shall be provided for a minimum of 4 man-days to insure that the work is done in a manner fully approved by the respective equipment manufacturer. The pump manufacturer’s representatives shall specifically supervise the installation of the pump and the alignment of the connection piping. If there are difficulties in the start-up or operation of the equipment due to the manufacturer’s design or

fabrication, additional service shall be provided at no cost to the Owner. Services of the manufacturer's representatives and training shall be provided when the first pump is started, with follow-up visits upon start-up of each subsequent pump.

C. A certificate from each equipment manufacturer shall be submitted stating that the installation of his/her equipment is satisfactory, that the equipment is ready for operation and that the operating personnel have been suitably instructed in the operation, lubrication and care of each unit.

3.03 FIELD TESTS

A. During the field tests, observations shall be recorded of head, capacity, and motor input. All defects or defective equipment revealed by or noted during the tests shall be corrected or replaced promptly at the expense of the Contractor, and if necessary, the tests shall be repeated until results acceptable to the Engineer are obtained. The Contractor shall furnish all labor, piping, equipment, and materials necessary for conducting the tests. A report of the field tests shall be submitted to the Engineer.

B. After installation of the pumping equipment, and after inspection, operation, testing and adjustment have been completed by the manufacturer's representative, each pump shall be given a running test in the presence of the Engineer, such tests as necessary to indicate that the pumps, motors, and drives generally conform to the efficiencies and operating conditions specified and its ability to operate without vibration or overheating. The pumps and motors shall operate at the specified capacities in the range of heads specified without undue noise or vibration. Any undue noise or vibration in the pumps or motors, which is deemed objectionable by the Engineer, will be sufficient cause for rejection of the units.

C. A thirty-day operating period of the pumps will be required before acceptance. If a pump performance does not meet the Specifications, corrective measures shall be taken or the pump shall be removed and replaced with a pump which satisfies the conditions specified. All test procedures shall be in accordance with Hydraulic Institute Standards certified results of tests shall be submitted.

D. Provide, calibrate and install all temporary gauges and meters, shall make necessary tapped holes in the pipes, and install all temporary piping and wiring required for the field acceptance tests. Written test procedures shall be submitted to the Engineer for approval 30 days prior to testing.

E. Field Vibration Testing

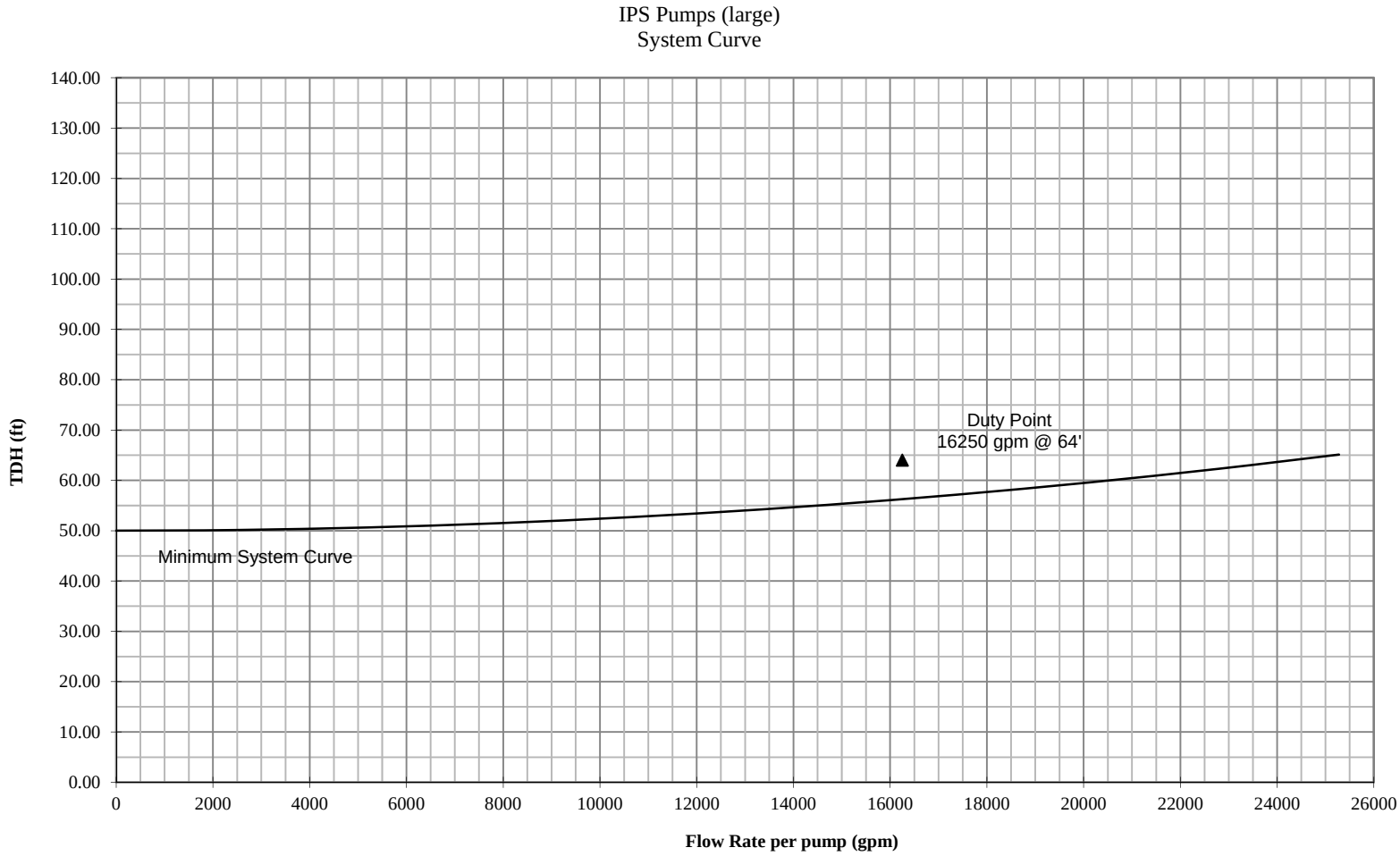
   a. After installation and as soon as conditions permit full speed operation, and in the presence of the Engineer, have the vibration tests performed in accordance with ANSI/HI 11.6 on each unit to (a) prove compliance with specified limitations, and (b) prove that there are no field installed resonant conditions due to misalignment, the foundation, or the connecting piping and its supports, when operating at any speed within the specified operating range.

3.04 TRAINING

A. A factory representative shall provide a minimum of two (2) days, with eight (8) hours each day for a total of sixteen (16) person-hours of training to the Owner's operations staff concerning the recommended operation and maintenance of the equipment. Training shall be performed after substantial completion of the project with the use of operating equipment.

SYSTEM HEAD CURVES are provided on the following pages.

END OF SECTION


IPS Pumps (large)
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100.00
90.00
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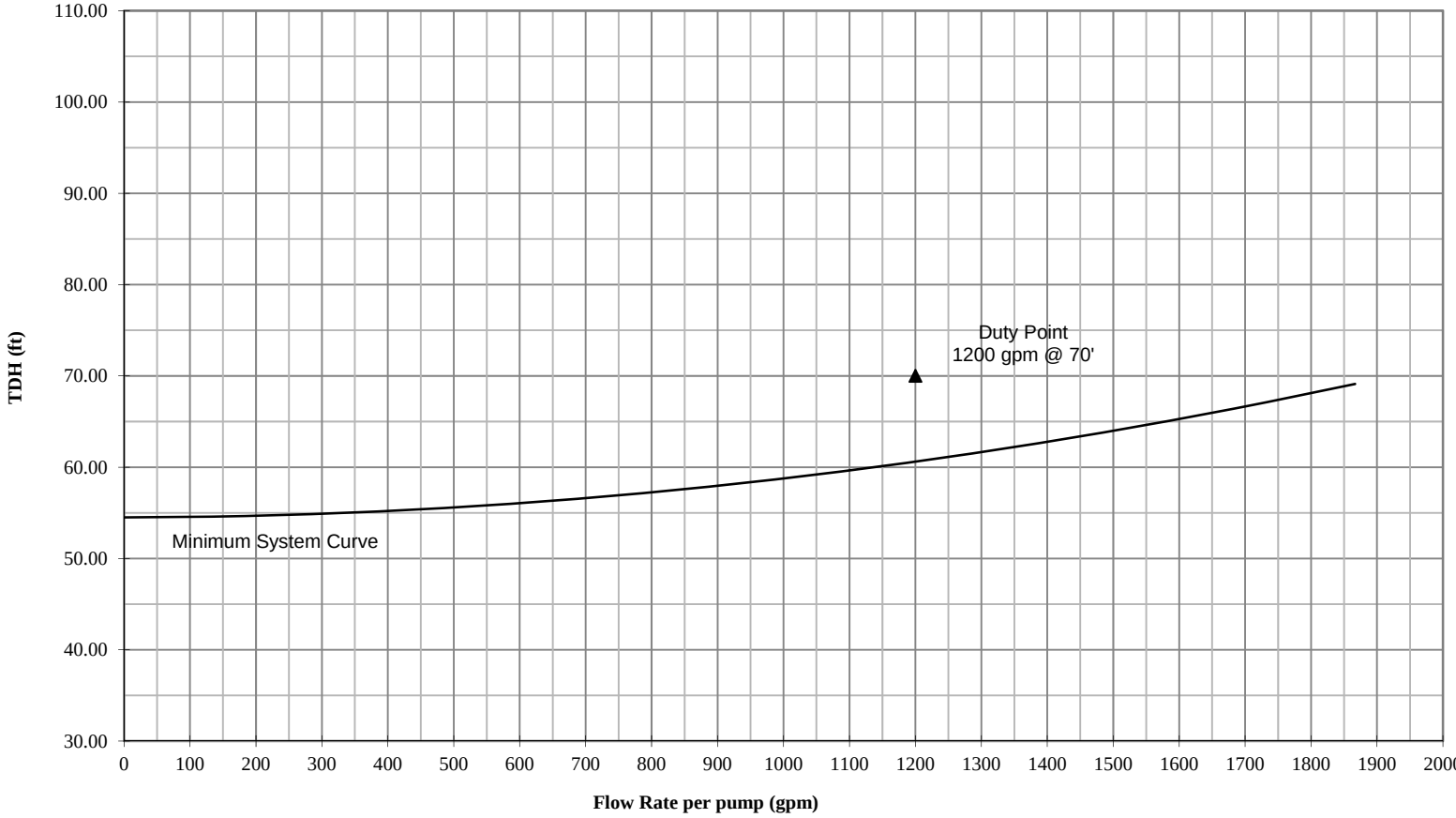
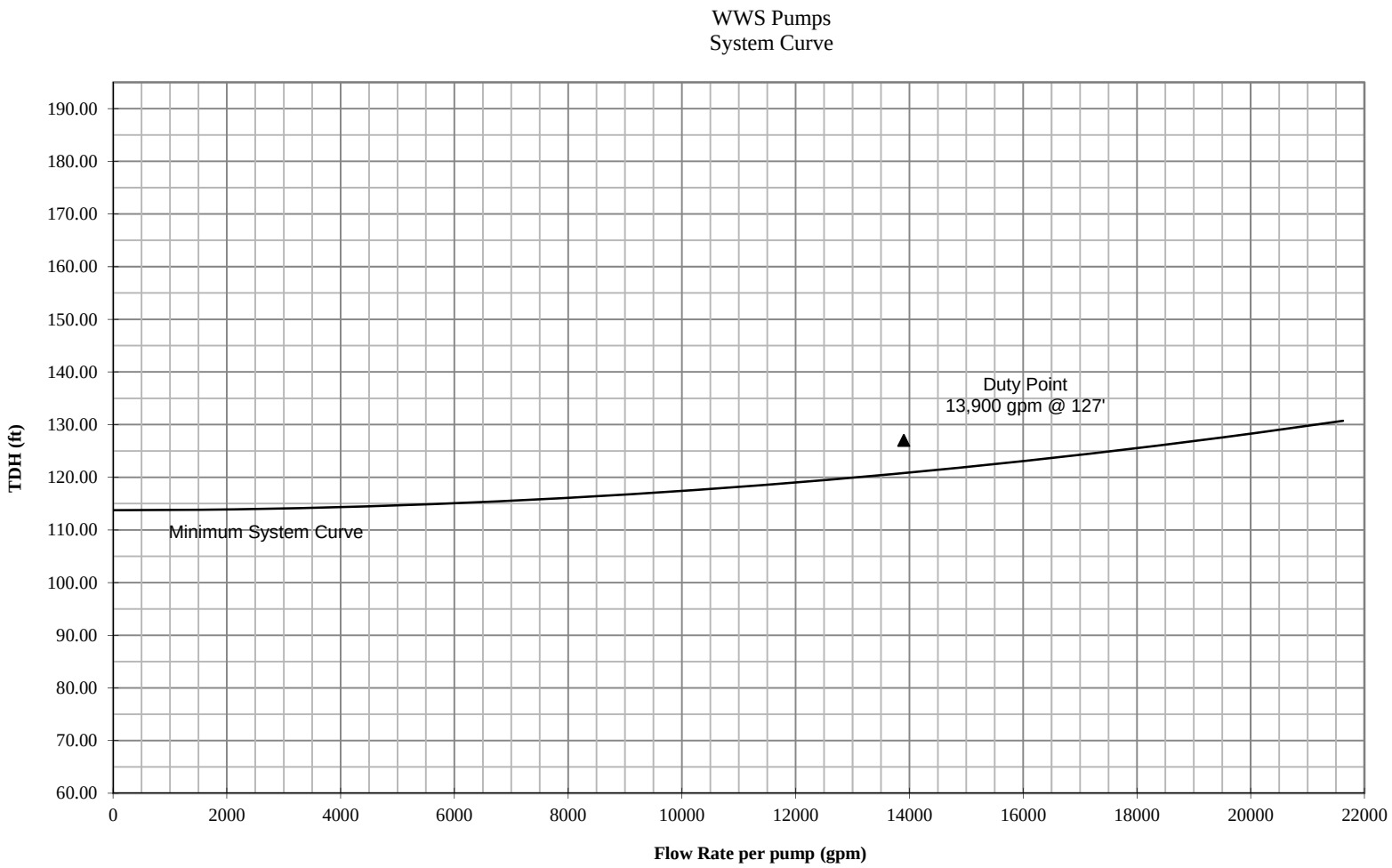
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
TDH (ft)
Duty Point
16250 gpm @ 64'
Minimum System Curve
0
2000
4000
6000
8000
10000
12000
14000
16000
18000
20000
22000
24000
26000
Flow Rate per pump (gpm)

IPS Pumps (Small)
System Curve




WWS Pumps
System Curve
190.00
180.00
170.00
160.00
150.00
140.00
130.00
120.00
110.00
100.00
90.00
80.00
70.00
60.00
TDH (ft)
Duty Point
13,900 gpm @ 127'
Minimum System Curve
0
2000
4000
6000
8000
10000
12000
14000
16000
18000
20000
22000
Flow Rate per pump (gpm)

SECTION 11312 - NON-CLOG SUBMERSIBLE SUMP PUMPS

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. Provide all labor, materials, equipment, delivering, installing, testing, incidentals, and placing into service the submersible sewage pumps and all appurtenances as shown on the Drawings and more fully described hereinafter. The equipment to be furnished and installed shall be as shown on the Drawings and shall include pumps, motors, VFDs, guide rails, access hatches, control panels and control systems, and appurtenances, all tested and ready for operation.

B. Unless otherwise specified the pump manufacturer shall furnish each pumping unit complete with drive motor and all other components and shall be entirely responsible for the compatibility in all respects of all components furnished.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Submittals: Section 01300

B. Operating & Maintenance Manuals: Section 01780

C. Interior Process Piping: Section 11295

D. Variable Frequency Drives: Section 16446

E. Electrical: Division 16

1.03 MANUFACTURER

A. The pumping units shall be provided by a single manufacturer with a minimum of five (5) year's experience in designing and manufacturing pumping equipment of similar type, size and capacity. The pumps shall be manufactured by the Xylem Corporation Flygt Division, Sulzer-ABS, KSB or approved equal.

B. To assure unity of responsibility, the pumps, motors, VFDs, guide rails and access hatches and other auxiliary equipment, and materials specified in this Section shall be furnished and coordinated by the pump manufacturer (Manufacturer) who shall assume responsibility for the satisfactory operation of the entire pumping system including pumps, motors, VFDs, and accessories.

C. Replacement Parts Capability: The manufacturer shall have the ability to promptly furnish any and all interchangeable replacement parts as may be needed at any time within the expected life of the pumps. Upon request, the Contractor shall submit evidence of the proposed manufacturer's ability to promptly fill replacement orders.

D. Quality Assurance: All pumping units shall be of approved design and make products of manufacturers who have built equipment of similar type, size and capacity.

E. Additional Submittals: The Contractor shall submit, upon request, any additional information that the Engineer may deem necessary to determine the ability of the proposed manufacturer to produce the specified equipment.

F. Prior to manufacture, a statement shall be forwarded to the Engineer indicating that the required vibration analyses outlined in this Part have been made and that the specified

limitations will be met. For the dynamic analysis described, minimum and maximum operating speeds will be in accordance with the operating speeds required to satisfy the conditions of operation specified in Paragraph 2.02. The pump manufacturer shall perform the dynamic analysis presented in the following paragraph.

1. Structural dynamic analysis of the combined pump and motor - The structural dynamic analysis shall predict that no first or second bending mode frequencies will exist within a pump speed and vane pass frequency range from 20 percent below minimum operating speed of 50% to 20 percent above maximum operating speed.

2. Lateral rotodynamic analysis - The lateral rotodynamic analysis shall identify and predict that the first lateral critical speed shall be at least 20 percent above the maximum pump speed and vane pass frequency or 20 percent below the minimum pump speed. Any pump component excited resonant frequency shall be no closer than plus or minus 20 percent of the natural frequency of any part of the installed assembled pumping unit. Any lateral rotordynamic frequencies not satisfying the +/- 20% margins shall not result in a forced damped response that will allow contact between the shaft and journal bearings.

3. Torsional rotodynamic analysis shall identify and predict that no torsional natural frequencies occur within a range extending from ten percent below to ten percent above the specified pump operating speed and vane pass frequency range. Any torsional rotor dynamic frequencies not satisfying the +/- 10% margins shall not result in a forced damped response that will reduce fatigue life of the rotor below infinite.

4. Campell diagrams shall be submitted, documenting the structural lateral, rotating component lateral, and torsional analysis results, graphically demonstrating the separation margins specified above.

G. Disqualification of Manufacturer:

1. Poor performance of similar pumping equipment now in operation under the specified conditions of service and pump rating constitute grounds for disqualification of the pump manufacturer, supplier, or both, unless such poor performance has been corrected.

2. Failure to successfully comply with the provisions of subparagraphs A through H, inclusive, will constitute grounds for disqualification of pump manufacturer.

1.04 SUBMITTALS

A. General: The Contractor shall comply with the provisions of the specifications regarding submittals, unless otherwise specified herein.

B. At the time of submission, the Contractor shall, in writing, call the Engineer's attention to any deviations that the submittals may have from the requirements of the Engineer's Contract Drawings and Specifications.

C. The Contractor shall provide a notarized certification indicating that all pumping products meet the required Specifications.

D. Descriptive literature, catalog cuts, and dimensional prints clearly indicating all dimensions and materials of construction shall be submitted on all items specified herein to the Engineer for review and approval before ordering.

E. Content of Submittals: The following shall be included in submittals as a minimum. However, any additional information or data shall be added if and whenever requested by the Owner or the Engineer. Where applicable, submit separate data for each pump.

1. Descriptive Literature:

    a. Dimensions

    b. Materials of Construction (including required coating).

    c. Performance Data.

        1) Pump Impeller Size

        2) GPM

        3) TDH

        4) BHP

        5) RPM

        6) Performance curves showing pump operation including shutoff head, operating point, and run-out.

        7) Performance curves showing overall pump efficiencies.

        8) Weight of pump

        9) Horsepower rating of pump motor

2. Installation Information: Submit installation drawings and information for pump connections, connecting piping and valves, electrical connections, and auxiliary equipment.

    The Contractor shall submit all other drawings, material lists and other information specified, requested and/or necessary to show complete compliance with all details of the contract documents.

3. Test and Inspection Reports: A written report shall be submitted to the Engineer documenting testing and or inspection results.

4. Operation and Maintenance Manual: Manual shall contain all information necessary for proper operation and maintenance of pumping units, as well as the location of the nearest permanent service headquarters.

1.05 TESTS

A. Shop Tests:

1. All pumps shall receive a non-witness factory test.

2. The Manufacturer shall factory test all pumps prior to shipment in accordance with the Hydraulic Institute standards, latest version. Flow rate, total head and Input KW shall be tested and recorded for at least five points on the pump performance curve. Test shall be performed to demonstrate that the pumps meet ANSI/HI 11.6 acceptance grade 1U for all specified points. The five points shall include the points specified in pump performance table in Paragraph 2.02.

3. The Manufacturer shall perform hydrostatic test on the pressure-containing parts in accordance with ANSI/HI 11.6. Test shall be conducted on each pump prior to shipment.

4. The Manufacturer shall perform the following test on each pump prior to shipment from factory:

    a. Megger motor and pump for insulation breaks or moisture.

    b. Prior to submergence, the pump shall be run dry and checked for correct rotation.

    c. Pump shall be run for a minimum of 30 minutes in a submerged condition.

    d. The pump shall be removed from test tank, meggered immediately for moisture and upper and lower seal unit shall be checked for water intrusion.

    e. A written certification test report regarding the above tests shall be submitted for approval prior to shipment.

5. Five (5) certified copies of the results of these tests are to be sent to the Engineer. Also included with the test curves shall be a certified bill of material list depicting quality of construction.

B. Field Tests:

1. The pumping units will be accepted upon the basis of the certified copies of the shop test and be subject to a four-hour field test of each unit. This test will be for the purpose of determining if each pumping unit will operate under installed conditions within a reasonable degree of correlation with the shop tests.

2. The Contractor shall give at least two (2) week's notice to the Owner when the field tests are to be accomplished so that the Owner may have a representative present at the said tests.

3. The field tests shall be made by the Contractor in the presence of and as directed by the Engineer.

4. Field tests shall be made on each pumping unit. During the test, each pump shall be run at maximum rated speed for at least three (3) rates of flow corresponding to minimum rate, design rate, and maximum rate of flows specified as evidenced by the corresponding total head shown by the pump gages; simultaneous ammeter readings shall be taken. Variation of the rate of flow shall be made by throttling the discharge valve (where applicable). The rated motor nameplate current and power shall not be exceeded at any rate of flow within the specified range.

5. Before any pump is rotated, the Contractor shall make certain that no debris is present in suction well, pumps or pipelines. Any internal damage done to equipment while starting up shall be assumed to be caused by debris and shall be replaced at the Contractor's expense. No pump shall be rotated under power unless submerged with liquid.

5. When water can be pumped, the Contractor shall commence pumping and shall have representatives from the pump manufacturer to start the pumps. When flow conditions are favorable, the Contractor or pump manufacturer shall in the presence of the Engineer, run a series of tests to establish the adequacy of the pumping units.

6. Field tests shall also conform to Part 3, Paragraph 3.03 as specified hereinafter.

C. Failure of Tests:

1. Any defects in the equipment or failure to meet the guarantees or requirements of the specifications shall be promptly corrected by the Contractor by replacements or otherwise. The decision of the Engineer as to whether or not the Contractor has fulfilled his obligations under the Contract shall be final and conclusive. If the Contractor fails or

refuses to make these corrections or if the improved equipment, when tested, shall fail again to meet the guarantees of specified requirements, the Owner notwithstanding its having made partial payment for work and materials which have entered into the manufacture of said equipment, may reject said equipment and order the Contractor to remove it from the premises at his own expense.

2. In case the Owner rejects said equipment, then the Contractor hereby agrees to repay to the Owner all sums of money paid to him for said rejected equipment on progress certificates or otherwise on account of the lump sum prices herein specified, and upon the receipt of said sum of money the Owner will execute and deliver to the Contractor a bill of sale of all its rights, title, and interest in and to said rejected equipment; provided, however, that said equipment shall not be removed from the premises of the Owner until the Owner obtains from other sources the equipment to take the place of the rejected. The Owner hereby agrees to obtain said other equipment within a reasonable time and the Contractor agrees that the Owner may use the equipment furnished by him without rental or other charge until said other new equipment is obtained.

D. Responsibility During Test: The Contractor shall be fully responsible for the proper operation of equipment during tests and instruction periods and shall neither have nor make any claim for damage which may occur to equipment prior to the time when the Owner formally takes over the operation thereof.

E. Manufacturer's Representative: For all pumping units, the Contractor shall furnish the services of accredited representatives of the pump manufacturer who shall supervise the installation, adjustment, and field tests of each pumping unit and give instructions to the operating personnel. As one condition necessary to acceptance of any pumping unit, the Contractor shall submit a certificate from the manufacturer, stating that the installation of the pumping unit is satisfactory, that the unit is ready for operation, and that the operating personnel have been suitably instructed in the operation, lubrication, and care of the unit.

1.06 GUARANTEE PERIOD

A. After successful completion of tests and trials under operating conditions on all equipment, the Contractor shall guarantee all equipment, materials and workmanship from undue wear and tear, from mechanical and electrical defects, and from any failure whatever, for a minimum of one (1) year. This one (1) year minimum shall not replace a standard manufacturer’s guarantee if it exceeds one (1) year.

1.07 PUMP WARRANTY

A. The Contractor guarantees and warrants that during the first one year of operation, the pumps will operate satisfactorily and continuously according to the pump schedule specified herein, and that after due notice has been given by the Owner, he or the pump manufacturer will proceed, within a reasonable time, to adjust, regulate, repair and renew at his own expense or perform such work as is necessary to maintain the guaranteed capacities, efficiencies and performances.

PART 2 - PRODUCTS

2.01 SOLIDS HANDLING SUBMERSIBLE SEWAGE PUMPS

A. Pump Requirements:

Each pump shall be designed to operate continuously at the intersection of the pump curve and the minimum system curve with available net positive suction head as indicated without cavitation and without requiring throttling to prevent cavitation or overloading the motor.

Submersible sewage pumps shall be explosion proof, Class I, Division 1, Group D construction except when indicated on the schedule.

B. Pump Design:

The pump(s) shall be automatically and firmly connected to the discharge piping when lowered into place on the discharge connection, guided by guide bars extending from the top of the access to the wetwell-mounted discharge connection. The pump shall be of a close fit to have minimum leakage at the discharge flange. The design shall be easily removable, requiring no bolts, nuts or other fasteners to remove. There shall be no need for personnel to enter the wet-well. Each pump shall be fitted with a stainless steel chain of adequate strength and length to permit raising the pump for inspection and removal. Sealing of the pumping unit to the discharge connection shall be accomplished by a machined metal-to-metal watertight contact or O-ring watertight contact. The entire weight of the pump/motor unit shall be borne by the pump discharge elbow. No portion of the pump/motor unit shall bear on the sump floor directly or on a sump floor mounted stand. Each pump shall be fitted with 316 stainless steel lifting cable. The working load of the lifting system shall be 50% greater than the pump unit weight.

Power and pilot cable supports shall be provided and consist of a wire braid sleeve with attachment loops or tails to connection to the under side of the access frame.

C. Pump Construction:

Major pump components shall be of gray cast iron, ASTM A-48, Class 35B, with smooth surfaces devoid of blow holes or other casting irregularities. All exposed nuts or bolts shall be a minimum AISI type 304 stainless steel. All metal surfaces coming into contact with the pumped media, other than stainless steel, shall be protected by a factory-applied spray coating of acrylic dispersion zinc phosphate primer with a polyester resin paint finish on the exterior of the pump.

Sealing design shall incorporate **metal-to-metal or O-ring contact** between machined surfaces. Pump/Motor unit mating surfaces where watertight sealing is required shall be machined and fitted with Nitrile or Viton rubber O-rings. Joint sealing will be the result of controlled compression of rubber O-rings in two planes and O-ring contact of four sides without the requirement of a specific bolt torque limit. Rectangular cross-sectioned rubber, paper or synthetic gaskets that require specific torque limits to achieve compression shall not be considered as adequate or equal. No secondary sealing compounds, elliptical O-rings, grease or other devices shall be used.

D. Cooling System:

Each pump/motor unit shall be provided with an integral cooling system. The motor water jacket shall encircle the stator housing and shall be of cast iron, ASTM A-48, Class 35B. The water jacket shall thus provide heat dissipation for the motor regardless of whether the motor unit is submerged in the pumped media or surrounded by air. After passing through a classifying labyrinth, the impeller back vanes shall provide the necessary circulation of the cooling liquid, a portion of the pumpage, through the cooling system. Two cooling liquid supply pipes, one discharging low and one discharging high within the jacket, shall supply the cooling liquid to the jacket. An air evacuation tube shall be provided to facilitate air removal from within the jacket.

Any piping internal to the cooling system shall be shielded from the cooling media flow allowing for unobstructed circular flow within the jacket about the stator housing. Two cooling liquid return ports shall be provided. The internals to the cooling system shall be non-clogging by virtue of their dimensions. Drilled and threaded provisions for external cooling and, seal flushing or air relief are to be provided. The cooling jacket shall be equipped with two flanged, gasketed and bolted inspection ports of not less than 4" diameter located 180° apart. The

cooling system shall provide for continuous submerged or completely non-submerged pump operation in liquid or in air having a temperature of up to 40°C (104°F), in accordance with NEMA standards. Restrictions limiting the ambient or liquid temperatures at levels less than 40°C are not acceptable.

or

The unit shall be provided with a closed loop cooling system adequately designed to allow the motor to run continuously under full load while in an unsubmerged or minimally submerged condition. A cooling jacket shall surround the stator housing, and an environmentally safe non-toxic propylene glycol solution shall be circulated through the jacket by an axial flow circulating impeller attached to the main motor shaft. The coolant shall be pumped through an integrated heat exchanger in the base of the motor whenever the motor is running, allowing excess heat to be transferred to the process liquid. Cooling systems that circulate the pumped medium through the cooling jacket, or those that use a toxic cooling liquid shall not be acceptable. The use of external heat exchangers, fans, or the supply of supplemental cooling liquid shall not be accepted.

E. Cable Entry Seal:

The cable entry seal design shall preclude specific torque requirements to insure a watertight and submersible seal. The cable entry shall consist of dual cylindrical elastomer grommets, flanked by stainless steel washers, all having a close tolerance fit against the cable outside diameter and the cable entry inside diameter. The grommets shall be compressed by the cable entry unit, thus providing a strain relief function. The assembly shall provide ease of changing the cable when necessary using the same entry seal. **The cable entry junction chamber and motor shall be sealed from each other, which shall isolate the stator housing from foreign material gaining access through the pump top. Epoxies, silicones, or other secondary sealing systems shall not be considered acceptable.**

F. Motor:

The pump motor shall be a NEMA B design, induction type with a squirrel cage rotor, shell type design, housed in an air filled, watertight chamber. The stator windings shall be insulated with moisture resistant Class H insulation rated for 180^{O}C (356^{O}F). The motor shall be inverter duty rated in accordance with NEMA MG 1, Part 3. The stator shall be heat-shrunk or press fitted into the stator housing. The use of bolts, pins or other fastening devices requiring penetration of the stator housing is not acceptable.

The motor shall be specifically designed for submersible pump usage and designed for continuous duty pumping media of up to 40°C (104°F) with an 80°C temperature rise and capable of at least 15 evenly spaced starts per hour without overheating. The rotor bars and short circuit rings shall be made of cast aluminum. Thermal switches shall be embedded in the stator end coils to monitor the temperature of each phase winding. These thermal switches shall be used in conjunction with and supplemental to external motor overload protection and shall be connected to the control panel. The junction chamber shall be sealed off from the stator housing and shall contain a terminal board for connection of power and pilot sensor cables using threaded compression type terminals. The use of wire nuts or crimp-type connectors is not acceptable. The motor and the pump shall be produced by the same manufacturer.

The motor service factor (as defined by the NEMA MG1 Standard) shall be a minimum of 1.15. The motor shall have a voltage tolerance of plus or minus 10%. The motor shall be designed for operation up to 40°C (104°F) ambient and with a temperature rise not to exceed 80°C. A performance chart shall be provided upon request showing curves for torque, current, power factor, input/output kW and efficiency. This chart shall also include data on starting and no-load characteristics.

The power cable shall be sized according to the NEC and ICEA standards and shall be of sufficient length to reach the junction box without the need of any splices. The outer jacket of the cable shall be oil resistant chloroprene rubber. The motor and cable shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of at least 65 feet.

Pump cable and pilot cable shall be removable with connections between the cable wires and motor leads made on a terminal boards. Cable seal shall be made with a compressible elastomeric grommet arrangement which can be easily reused for cable removal and reinstalling and also acts as a strain relief device

The motor horsepower shall be adequate so that the pump is non-overloading throughout the entire pump performance curve from shut-off through run-out.

G. Pilot Cable:

The pilot cable shall be designed specifically for use with submersible pumps and shall be type SUBCAB (Submersible Cable).

H. Bearings:

The pump shaft shall rotate on at least three grease-lubricated bearings. The upper bearing, provided for radial forces, shall be a single roller bearing. The lower bearings shall consist of at least one roller bearing for radial forces and one or two angular contact ball bearings for axial thrust.

Bearings shall be permanently grease lubricated with minimum ABMA L_{10} bearing life shall be 100,000 hours at any point along the usable portion of the pump curve at maximum product speed.

The lower bearing housing shall include an independent thermal sensor to monitor the bearing temperature. If a high temperature occurs, the sensor shall activate an alarm and shut the pump down.

I. Mechanical Seal:

Each pump shall be provided with a tandem mechanical shaft seal system consisting of two totally independent seal assemblies. The lower seal shall be independent of the impeller hub. The seals shall operate in a lubricant reservoir that hydrodynamically lubricates the lapped seal faces at a constant rate. The lower, primary seal unit, located between the pump and the lubricant chamber, shall contain one stationary and one positively driven rotating corrosion resistant **tungsten-carbide or silicon-carbide** seal ring.

The upper, secondary seal unit, located between the lubricant chamber and the motor housing, shall contain one stationary and one positively driven rotating corrosion resistant **tungsten-carbide or silicon carbide** seal ring. Each seal interface shall be held in contact by its own spring system. The seals shall require neither maintenance nor adjustment and shall be capable of operating in either clockwise or counter clockwise direction of rotation without damage or loss of seal. For special applications, other seal face materials shall be available.

Should both seals fail and allow fluid to enter the stator housing, a port shall be provided to direct that fluid immediately to the stator float switch to shut down the pump and activate an alarm. Any intrusion of fluid shall not come into contact with the lower bearings.

The following seal types shall not be considered acceptable nor equal to the dual independent seal specified: shaft seals without positively driven rotating members, or

conventional double mechanical seals containing either a common single or double spring acting between the upper and lower seal faces. No system requiring a pressure differential to offset pressure and to effect sealing shall be used.

Each pump shall be provided with a lubricant chamber for the shaft sealing system. The lubricant chamber shall be designed to prevent overfilling and to provide lubricant expansion capacity. The drain and inspection plug, with positive anti-leak seal shall be easily accessible from the outside. The seal system shall not rely upon the pumped media for lubrication. The motor shall be able to operate continuously while non-submerged without damage while pumping under load.

Seal lubricant shall be FDA Approved, nontoxic.

J. Pump Shaft:

Pump and motor shaft shall be a single piece unit. Pump motor shaft shall be of 300 series stainless steel. Speed for the pumps shall not exceed the value indicated on the Schedule. The pump shaft shall be the extension of the motor shaft. Couplings shall not be acceptable. The pump shaft shall be of carbon steel ASTM A 572 Grade 50 or Stainless Steel AISI 420 and shall be completely isolated from the pumped liquid.

K. Impeller:

Impellers shall be constructed of ASTM A48 Class 30 minimum gray cast iron. The impeller shall be a rotodynamic semi-open, solids handling type capable of passing solids either due to internal clearances or other features to facilitate solids processing including a wear plate with groove. The wear plate to impeller clearance shall be easily adjustable without the need for disassembly of the pump or the need to add or remove shims. The impeller may include pump out vanes on the upper shroud to reduce axial thrust and minimize clogging due to debris accumulation around the mechanical seal. The impeller shall be dynamically balanced to the ISO 1940 G6.3 standard to provide smooth, vibration free operation.

L. Wear Rings:

A wear ring system designed for abrasion resistance shall be used to provide efficient sealing between the volute and suction inlet of the impeller. Each pump shall be equipped with a Nitrile rubber coated steel, cast iron, or brass ring insert that is drive fitted to the volute inlet.

This pump shall also have a stainless steel impeller wear ring heat-shrink fitted onto the suction inlet of the impeller.

M. Volute:

Pump volute(s) shall be single-piece gray cast iron, Class 35B, non-concentric design with smooth passages large enough to pass any solids that may enter the impeller. Minimum inlet and discharge size shall be as specified.

N. Protection:

All stators shall incorporate thermal switches in series to monitor the temperature of each phase winding. Should high temperature occur, the thermal switches shall open, stop the motor and activate an alarm in the control panel.

A lower bearing temperature sensor shall be provided. The sensor shall directly contact the outer race of the thrust bearing providing for accurate temperature monitoring.

A leakage sensor shall be provided to detect water in the stator chamber. The Float Leakage Sensor (FLS), a small float switch, shall be used to detect the presence of water in the stator

chamber. When activated, the FLS will stop the motor and activate an alarm. USE OF VOLTAGE SENSITIVE SOLID STATE SENSORS SHALL NOT BE ALLOWED.

The thermal switches, FLS and the lower bearing temperature monitor shall be connected to a MAS (Monitoring and Status) monitoring unit. The MAS shall be designed to be mounted in the motor control center.

O. Pump Discharge Flange:

The pump discharge-mating flange shall be as shown on the drawings.

P. Pump Intake

A flared fitting shall be located on the pump intake as shown on the drawings.

2.02 PUMPING REQUIREMENTS

A. Pumps shall be manufactured by Xylem Corporation, Flygt Division, Sulzer ABS or KSB and shall comply to the following characteristics:

WWS Wet Well Sump Pumps No. 1 and 2

No. of Pumps	**Shut-Off Head (Min) (Ft)**	**Design Point #1**	**Static Head (Ft.)**	**Max. Speed (RPM)**	**Motor HP/Max Each Pump**
		1 pump running			
		Flow (GPM)			
2 (1 operational, 1 back up)	**50**	**Head (Ft.)**	**26.5 Ft. Max 20.5 Ft Min**	**1200 RPM**	**5 HP**
		125 GPM			
		35 Ft.			

B. Power supply shall be 480 volts, 3-Phase, 60 Hz, 4 wire service.

C. Motors shall be 460 volt, 3 phase, 60 Hz.

2.03 PUMP ACCESSORIES AND OTHER

A. All pumps and controls shall be completely wired at the factory for power and control and shall be color-coded. All wiring outside the control cabinet shall be rigid conduit. All accessory equipment shall be permanently wired with suitable disconnecting means and overload protection.

B. All pump motors shall be provided with stator temperature sensor switches and stator housing leak detector.

C. The pump/motor assembly shall be suitable for use in Class I, Division 1, Group D hazardous locations.

D. Contractor shall be responsible for supply of appropriate lengths of lifting chain, submersible power cable, and MG Hi conductor submersible cable.

E. Access hatches for wet well and valve pit shall be as specified in Section 08370 of these specifications. Minimum dimensions shall be as noted on the Drawings, pump manufacturer shall size and provide access hatches for each pump.

F. Guide System: A sliding guide bracket shall be an integral part of the pumping unit and the pump casing shall have a machined connecting flange to connect with the cast iron discharge connection, which shall be bolted to the floor of the sump and designed as to receive the pump connecting flange without the need of any bolts or nuts.

1. Guide rail system shall be designed to be nonsparking through the use of removable bronze or nonmetallic inserts at points of contact.

2. Sealing of the pumping unit to the discharge connection shall be accomplished by a single linear downward motion of the pump guided to and pressing tightly against the discharge connection. Sealing at the discharge connection by a means to insure a tight connection. Necessary guide bars shall be furnished. Guide bars shall be of stainless steel pipe or an approved stainless steel cable or "T" or "U" bar guide rail system.

2.05 GUIDE RAILS

A. The pumping station shall be furnished with the necessary, stainless steel upper guide holder and level sensor cable holder.

B. Lower guide holders shall be integral with the discharge connection. Dual guide rails shall be of Schedule 40, welded two-inch minimum diameter, Type 316 stainless steel pipe of the length required by the Drawings. Single guide rails and guide cables are not acceptable.

C. Intermediate guide brackets shall be furnished and installed so that the maximum length of unsupported guide rails will be no longer than 20 feet, and shall be fabricated of Type 316 stainless steel.

D. Stainless steel cable holders including the cable hooks shall be fabricated from Type 316 stainless steel plate. Sharp corners and edges shall be ground smooth to prevent abrasion and cutting of electrical cable insulation. The cable holder shall be of sufficient length and strength to provide support for each separate cable, except that the pump power and lift cables may use the same hook position, provided the cables do not foul one another and the lift cable is easily accessed from the hatch opening.

PART 3 - EXECUTION

3.01 PREPARATION

A. Coordinate with other trades, equipment and systems to the fullest extent possible.

B. Take all necessary measurements in the field to determine the exact dimensions for all work and the required sizes of all equipment under this contract. All pertinent data and dimensions shall be verified by the Contractor.

3.02 INSTALLATION

A. Installation shall be in strict accordance with the manufacturer’s instructions and recommendations in the locations shown on the Drawings. Anchor bolts shall be set in accordance with the manufacturer’s recommendations and setting plans.

B. The Contractor shall also provide from the submersible pump supplier the service of a qualified start-up engineer (factory representative) who has had prior on-site start-up experience to assist in performing start-up, checkout and initial operation services of the pumping units. The start-up engineer shall also instruct the Owner's personnel on the operation and maintenance procedures for the station. Qualified supervisory services, including manufacturers' engineering representatives, shall be provided for a minimum of 4 man-days to insure that the work is done in a manner fully approved by the respective equipment manufacturer. The pump manufacturer's representatives shall specifically supervise the installation of the pump and the alignment of the connection piping. If there are difficulties in the start-up or operation of the equipment due to the manufacturer's design or fabrication, additional service shall be provided at no cost to the Owner. Services of the manufacturer's representatives and training shall be provided when the first pump is started, with follow-up visits upon start-up of each subsequent pump.

C. A certificate from each equipment manufacturer shall be submitted stating that the installation of his/her equipment is satisfactory, that the equipment is ready for operation and that the operating personnel have been suitably instructed in the operation, lubrication and care of each unit.

3.03 FIELD TESTS

A. During the field tests, observations shall be recorded of head, capacity, and motor input. All defects or defective equipment revealed by or noted during the tests shall be corrected or replaced promptly at the expense of the Contractor, and if necessary, the tests shall be repeated until results acceptable to the Engineer are obtained. The Contractor shall furnish all labor, piping, equipment, and materials necessary for conducting the tests. A report of the field tests shall be submitted to the Engineer.

B. After installation of the pumping equipment, and after inspection, operation, testing and adjustment have been completed by the manufacturer's representative, each pump shall be given a running test in the presence of the Engineer, such tests as necessary to indicate that the pumps, motors, and drives generally conform to the efficiencies and operating conditions specified and its ability to operate without vibration or overheating. The pumps and motors shall operate at the specified capacities in the range of heads specified without undue noise or vibration. Any undue noise or vibration in the pumps or motors, which is deemed objectionable by the Engineer, will be sufficient cause for rejection of the units.

C. A thirty-day operating period of the pumps will be required before acceptance. If a pump performance does not meet the Specifications, corrective measures shall be taken or the pump shall be removed and replaced with a pump which satisfies the conditions specified. All test procedures shall be in accordance with Hydraulic Institute Standards certified results of tests shall be submitted. If pumps are accepted after thirty-day operating period, the Owner will pay all electric cost for the operation period. If the pumps are not accepted the Contractor will be responsible for the costs. Without a rain event, the operation of the facility for testing will be activated using the throttling gate within the diversion structure.

E. Provide, calibrate and install all temporary gauges and meters, shall make necessary tapped holes in the pipes, and install all temporary piping and wiring required for the field acceptance tests. Written test procedures shall be submitted to the Engineer for approval 30 days prior to testing.

F. Field Vibration Testing

a. After installation and as soon as conditions permit full speed operation, and in the presence of the Engineer, have the vibration tests performed in accordance with ANSI/HI 11.6 on each unit to (a) prove compliance with specified limitations, and (b) 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.

3.04 TRAINING

A. A factory representative shall provide a minimum of two (2) days, with eight (8) hours each day for a total of sixteen (16) person-hours of training to the Owner's operations staff concerning the recommended operation and maintenance of the equipment. Training shall be performed after substantial completion of the project with the use of operating equipment.

END OF SECTION

SECTION 11313 - NON-CLOG SUBMERSIBLE RECYCLE PUMPS

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. Provide all labor, materials, equipment, delivering, installing, testing, incidentals, and placing into service the submersible sewage pumps in the recycle pump station and all appurtenances as shown on the Drawings and more fully described hereinafter. The equipment to be furnished and installed shall be as shown on the Drawings and shall include pumps, motors, VFDs, guide rails, access hatches, control panels and control systems, and appurtenances, all tested and ready for operation.

B. Unless otherwise specified the pump manufacturer shall furnish each pumping unit complete with drive motor and all other components and shall be entirely responsible for the compatibility in all respects of all components furnished.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Submittals: Section 01300

B. Operating & Maintenance Manuals: Section 01780

C. Interior Process Piping: Section 11295

D. Variable Frequency Drives: Section 16446

E. Electrical: Division 16

1.03 MANUFACTURER

A. The pumping units shall be provided by a single manufacturer with a minimum of five (5) year's experience in designing and manufacturing pumping equipment of similar type, size and capacity. The pumps shall be manufactured by the Xylem Corporation Flygt Division, Sulzer-ABS, KSB or approved equal.

B. To assure unity of responsibility, the pumps, motors, VFDs, guide rails and access hatches and other auxiliary equipment, and materials specified in this Section shall be furnished and coordinated by the pump manufacturer (Manufacturer) who shall assume responsibility for the satisfactory operation of the entire pumping system including pumps, motors, VFDs, and accessories.

C. Replacement Parts Capability: The manufacturer shall have the ability to promptly furnish any and all interchangeable replacement parts as may be needed at any time within the expected life of the pumps. Upon request, the Contractor shall submit evidence of the proposed manufacturer's ability to promptly fill replacement orders.

D. Quality Assurance: All pumping units shall be of approved design and make products of manufacturers who have built equipment of similar type, size and capacity.

E. Additional Submittals: The Contractor shall submit, upon request, any additional information that the Engineer may deem necessary to determine the ability of the proposed manufacturer to produce the specified equipment.

F. Manufacturer Information: All manufacturer information required by the specifications shall be submitted by the Contractor within thirty (30) calendar days of the date of receipt of the Notice to Proceed.

Any additional information or data, specifically requested by the Engineer, concerning manufacturer's capabilities (especially relating to requirements described hereinbefore), shall be submitted by the Contractor within fourteen (14) calendar days of the receipt of the written request thereof, unless otherwise specified.

Approval of manufacturers or suppliers will not be given until all information required by the specifications or requested by the Engineer has been submitted and acceptable.

G. Disqualification of Manufacturer:

1. Poor performance of similar pumping equipment now in operation under the specified conditions of service and pump rating constitute grounds for disqualification of the pump manufacturer, supplier, or both, unless such poor performance has been corrected.

2. Failure to successfully comply with the provisions of subparagraphs A through H, inclusive, will constitute grounds for disqualification of pump manufacturer.

1.04 SUBMITTALS

A. General: The Contractor shall comply with the provisions of the specifications regarding submittals, unless otherwise specified herein.

B. At the time of submission, the Contractor shall, in writing, call the Engineer's attention to any deviations that the submittals may have from the requirements of the Engineer's Contract Drawings and Specifications.

C. The Contractor shall provide a notarized certification indicating that all pumping products meet the required Specifications.

D. Descriptive literature, catalog cuts, and dimensional prints clearly indicating all dimensions and materials of construction shall be submitted on all items specified herein to the Engineer for review and approval before ordering.

E. Content of Submittals: The following shall be included in submittals as a minimum. However, any additional information or data shall be added if and whenever requested by the Owner or the Engineer. Where applicable, submit separate data for each pump.

1. Descriptive Literature:

a. Dimensions

b. Materials of Construction (including required coating).

c. Performance Data.

1) Pump Impeller Size

2) GPM

3) TDH

4) BHP

5) RPM

6) Performance curves showing pump operation including shutoff head, operating point, and run-out.

7) Performance curves showing overall pump efficiencies.

8) Weight of pump

9) Horsepower rating of pump motor

2. Installation Information: Submit installation drawings and information for pump connections, connecting piping and valves, electrical connections, and auxiliary equipment.

   The Contractor shall submit all other drawings, material lists and other information specified, requested and/or necessary to show complete compliance with all details of the contract documents.

3. Test and Inspection Reports: A written report shall be submitted to the Engineer documenting testing and or inspection results.

4. Operation and Maintenance Manual: Manual shall contain all information necessary for proper operation and maintenance of pumping units, as well as the location of the nearest permanent service headquarters.

1.05 TESTS

A. Shop Tests:

1. All pumps shall receive a non-witness factory test.

2. The Manufacturer shall factory test all pumps prior to shipment in accordance with the Hydraulic Institute standards, latest version. Flow rate, total head and Input KW shall be tested and recorded for at least five points on the pump performance curve. Test shall be performed to demonstrate that the pumps meet ANSI/HI 11.6 acceptance grade 1U for all specified points. The five points shall include the points specified in pump performance table in Paragraph 2.02.

3. The Manufacturer shall perform hydrostatic test on the pressure-containing parts in accordance with ANSI/HI 11.6. Test shall be conducted on each pump prior to shipment.

4. The Manufacturer shall perform the following test on each pump prior to shipment from factory:

   a. Megger motor and pump for insulation breaks or moisture.

   b. Prior to submergence, the pump shall be run dry and checked for correct rotation.

   c. Pump shall be run for a minimum of 30 minutes in a submerged condition.

   d. The pump shall be removed from test tank, meggered immediately for moisture and upper and lower seal unit shall be checked for water intrusion.

   e. A written certification test report regarding the above tests shall be submitted for approval prior to shipment.

5. Five (5) certified copies of the results of these tests are to be sent to the Engineer. Also included with the test curves shall be a certified bill of material list depicting quality of construction.

B. Field Tests:

1. The pumping units will be accepted upon the basis of the certified copies of the shop test and be subject to a four-hour field test of each unit. This test will be for the purpose of determining if each pumping unit will operate under installed conditions within a reasonable degree of correlation with the shop tests.

2. The Contractor shall give at least two (2) week's notice to the Owner when the field tests are to be accomplished so that the Owner may have a representative present at the said tests.

3. The field tests shall be made by the Contractor in the presence of and as directed by the Engineer.

4. Field tests shall be made on each pumping unit. During the test, each pump shall be run at maximum rated speed for at least three (3) rates of flow corresponding to minimum rate, design rate, and maximum rate of flows specified as evidenced by the corresponding total head shown by the pump gages; simultaneous ammeter readings shall be taken. Variation of the rate of flow shall be made by throttling the discharge valve (where applicable). The rated motor nameplate current and power shall not be exceeded at any rate of flow within the specified range.

5. Before any pump is rotated, the Contractor shall make certain that no debris is present in suction well, pumps or pipelines. Any internal damage done to equipment while starting up shall be assumed to be caused by debris and shall be replaced at the Contractor's expense. No pump shall be rotated under power unless submerged with liquid.

5. When water can be pumped, the Contractor shall commence pumping and shall have representatives from the pump manufacturer to start the pumps. When flow conditions are favorable, the Contractor or pump manufacturer shall in the presence of the Engineer, run a series of tests to establish the adequacy of the pumping units.

6. Field tests shall also conform to Part 3, Paragraph 3.03 as specified hereinafter.

C. Failure of Tests:

1. Any defects in the equipment or failure to meet the guarantees or requirements of the specifications shall be promptly corrected by the Contractor by replacements or otherwise. The decision of the Engineer as to whether or not the Contractor has fulfilled his obligations under the Contract shall be final and conclusive. If the Contractor fails or refuses to make these corrections or if the improved equipment, when tested, shall fail again to meet the guarantees of specified requirements, the Owner notwithstanding its having made partial payment for work and materials which have entered into the manufacture of said equipment, may reject said equipment and order the Contractor to remove it from the premises at his own expense.

2. In case the Owner rejects said equipment, then the Contractor hereby agrees to repay to the Owner all sums of money paid to him for said rejected equipment on progress certificates or otherwise on account of the lump sum prices herein specified, and upon the receipt of said sum of money the Owner will execute and deliver to the Contractor a bill of sale of all its rights, title, and interest in and to said rejected equipment; provided, however, that said equipment shall not be removed from the premises of the Owner until the Owner obtains from other sources the equipment to take the place of the rejected. The Owner hereby agrees to obtain said other equipment within a reasonable time and the Contractor agrees that the Owner may use the equipment furnished by him without rental or other charge until said other new equipment is obtained.

D. Responsibility During Test: The Contractor shall be fully responsible for the proper operation of equipment during tests and instruction periods and shall neither have nor make any claim for damage which may occur to equipment prior to the time when the Owner formally takes over the operation thereof.

E. Manufacturer's Representative: For all pumping units, the Contractor shall furnish the services of accredited representatives of the pump manufacturer who shall supervise the installation, adjustment, and field tests of each pumping unit and give instructions to the operating personnel. As one condition necessary to acceptance of any pumping unit, the Contractor shall submit a certificate from the manufacturer, stating that the installation of the pumping unit is satisfactory, that the unit is ready for operation, and that the operating personnel have been suitably instructed in the operation, lubrication, and care of the unit.

1.06 GUARANTEE PERIOD

A. After successful completion of tests and trials under operating conditions on all equipment, the Contractor shall guarantee all equipment, materials and workmanship from undue wear and tear, from mechanical and electrical defects, and from any failure whatever, for a minimum of one (1) year. This one (1) year minimum shall not replace a standard manufacturer’s guarantee if it exceeds one (1) year.

1.07 PUMP WARRANTY

A. The Contractor guarantees and warrants that during the first one year of operation, the pumps will operate satisfactorily and continuously according to the pump schedule specified herein, and that after due notice has been given by the Owner, he or the pump manufacturer will proceed, within a reasonable time, to adjust, regulate, repair and renew at his own expense or perform such work as is necessary to maintain the guaranteed capacities, efficiencies and performances.

PART 2 - PRODUCTS

2.01 SOLIDS HANDLING SUBMERSIBLE SEWAGE PUMPS

A. Pump Requirements:

Submersible sewage pumps shall be explosion proof, Class I, Division 1, Group D construction except when indicated on the schedule.

B. Pump Design:

The pump(s) shall be automatically and firmly connected to the discharge connection, guided by no less than two parallel guide bars extending from the top of the station to the wet well mounted discharge connection. The design shall be easily removable, requiring no bolts, nuts or other fasteners to remove. There shall be no need for personnel to enter the wet-well. A guide rail assembly shall utilize two (2) bars extending from the base elbow to the top of the station. Each pump shall be fitted with a stainless steel chain of adequate strength and length to permit raising the pump for inspection and removal. Sealing of the pumping unit to the discharge connection shall be accomplished by a machined metal-to-metal watertight contact or a field replaceable Nitrile rubber profile gasket or O-ring. The entire weight of the pump/motor unit shall be borne by the pump discharge elbow. No portion of the pump/motor unit shall bear on the sump floor directly or on a sump floor mounted stand. Each pump shall be fitted with 316 stainless steel lifting cable. The working load of the lifting system shall be 50% greater than the pump unit weight.

Power and pilot cable supports shall be provided and consist of a wire braid sleeve with attachment loops or tails to connection to the under side of the access frame.

C. Pump Construction:

Major pump components shall be of gray cast iron, ASTM A-48, Class 35B, with smooth surfaces devoid of blow holes or other casting irregularities. ASTM No. 80-55-06 is also acceptable. All exposed nuts or bolts shall be a minimum AISI type 304 stainless steel. The outer surfaces of the pump shall be protected by suitable painting systems including a two-component high-solid top coating.

Sealing design shall incorporate **metal-to-metal or O-ring contact** between machined surfaces. Pump/Motor unit mating surfaces where watertight sealing is required shall be machined and fitted with Nitrile or Viton rubber O-rings. Joint sealing will be the result of controlled compression of rubber O-rings in two planes. Housing interfaces shall meet with metal to metal contact between machined surfaces, and sealing shall be accomplished without the requirement of a specific bolt torque limit. Rectangular cross-sectioned rubber, paper or synthetic gaskets that require specific torque limits to achieve compression shall not be considered as adequate or equal. No secondary sealing compounds, elliptical O-rings, grease or other devices shall be used.

D. Cooling System:

Each pump/motor unit shall be provided with an integral cooling system. A stainless steel or carbon steel motor cooling jacket shall encircle the stator housing, providing for dissipation of motor heat regardless of the type of pump installation. An integrated axial-flow propeller shall be located between the inner and outer mechanical seals providing a positive flow and circulation of the cooling liquid. The cooling liquid shall pass the stator housing with the help of an inner cooling mantle to create a narrow space and in combination with turbulent flow providing a superior heat transfer. The cooling system shall have one fill port and one drain port integral to the cooling jacket. The cooling system shall provide for continuous pump operation in liquid or in air having a temperature of up to 40 degrees C (104 degrees F). Restrictions limiting the ambient or liquid temperatures at levels less than 40 degrees C are not acceptable. Fans or blowers are not acceptable.

or

The unit shall be provided with a closed loop cooling system adequately designed to allow the motor to run continuously under full load while in an unsubmerged or minimally submerged condition. A cooling jacket shall surround the stator housing, and an environmentally safe non-toxic propylene glycol solution shall be circulated through the jacket by an axial flow circulating impeller attached to the main motor shaft. The coolant shall be pumped through an integrated heat exchanger in the base of the motor whenever the motor is running, allowing excess heat to be transferred to the process liquid. The use of external heat exchangers, fans, or the supply of supplemental cooling liquid shall not be accepted.

E. Cable Entry Seal:

The cable entry seal design shall preclude specific torque requirements to insure a watertight and submersible seal. The cable entry shall consist of dual cylindrical elastomer sleeves, flanked by stainless steel washers, all having a close tolerance fit against the cable outside diameter and the cable entry inside diameter. The sleeves shall be compressed by the cable entry unit, thus providing a strain relief function. The assembly shall provide ease of changing the cable when necessary using the same entry seal. **The cable entry junction chamber and motor shall be sealed from each other, which shall isolate the stator housing from foreign material gaining access through the pump top. Epoxies, silicones, or other secondary sealing systems shall not be considered acceptable.**

F. Motor:

The pump motor shall be a NEMA B design, induction type with a squirrel cage rotor, shell type design, housed in an air filled, watertight chamber. The stator windings shall be insulated with moisture resistant Class H insulation rated for 180^{O}C (355^{O}F). The motor shall be inverter duty rated in accordance with NEMA MG 1, Part 3. The stator shall be heat-shrunk or press fitted into the stator housing. The use of bolts, pins or other fastening devices requiring penetration of the stator housing is not acceptable.

The motor shall be specifically designed for submersible pump usage and designed for continuous duty pumping media of up to 40°C (104°F) with an 80°C temperature rise and capable of at least 15 evenly spaced starts per hour without overheating. The rotor bars and short circuit rings shall be made of cast aluminum. Thermal switches shall be embedded in the stator lead coils to monitor the temperature of each phase winding. These thermal switches shall be used in conjunction with and supplemental to external motor overload protection and shall be connected to the control panel. At least one analogue sensor shall be embedded in the phase windings to enable continuous measurement and recording of temperature. The junction chamber shall be sealed off from the stator housing and shall contain a terminal board for connection of power and pilot sensor cables using threaded compression type terminals. The use of wire nuts or crimp-type connectors is not acceptable. The motor and the pump shall be produced by the same manufacturer.

The motor service factor (as defined by the NEMA MG1 Standard) shall be a minimum of 1.15. The motor shall have a voltage tolerance of plus or minus 10%. The motor shall be designed for operation up to 40°C (104°F) ambient and with a temperature rise not to exceed 80°C. A performance chart shall be provided upon request showing curves for torque, current, power factor, input/output kW and efficiency. This chart shall also include data on starting and no-load characteristics.

The power cable shall be sized according to the NEC, CSA and IEC standards and shall be of sufficient length to reach the junction box without the need of any splices. The outer jacket shall be made of chlorinated polyethylene rubber CPE with low absorption and with mechanical flexibility to withstand the pressure at the cable entry. The motor and cable shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of at least 65 feet. The power cable shall be approved for conductor temperature up to minimum 90 degrees C.

The motor horsepower shall be adequate so that the pump is non-overloading throughout the entire pump performance curve from shut-off through run-out.

G. Pilot Cable:

The pilot cable shall be designed specifically for use with submersible pumps and shall be type SUBCAB (Submersible Cable).

H. Bearings:

The pump shaft shall rotate on at least three grease-lubricated bearings. The upper bearing, provided for radial forces, shall be a single roller bearing. The lower bearings shall consist of a double row of angular contact ball bearings.

The minimum ABMA L_{10} bearing life shall be 100,000 hours at any point along the usable portion of the pump curve at maximum product speed.

The lower bearing housing shall include an independent thermal sensor to monitor the bearing temperature. If a high temperature occurs, the sensor shall activate an alarm and shut the pump down.

I. Mechanical Seal:

Each pump shall be provided with a positively driven dual, tandem mechanical shaft seal system consisting of two totally independent seal assemblies, each with an independent spring system. The seals shall require neither maintenance nor adjustment and shall be capable of operating in either clockwise or counter clockwise direction of rotation without damage or loss of seal function. The outer primary seal, located between the pump and seal chamber shall, shall contain one stationary and one positively driven rotating corrosion resistant **tungsten-carbide or silicon-carbide** seal ring.

The inner, secondary seal unit, located between the seal chamber and the seal inspection chamber shall be an active seal. The inner seal shall contain one stationary and one positively driven rotating corrosion resistant **tungsten-carbide or silicon carbide** seal ring. Each seal interface shall be held in contact by its own spring system. The seals shall require neither maintenance nor adjustment and shall be capable of operating in either clockwise or counter clockwise direction of rotation without damage or loss of seal. For special applications, other seal face materials shall be available.

Should both seals fail and allow fluid to enter the stator housing, an alarm shall stop the pump before the fluid comes into contract with the lower bearings, or the stator.

The following seal types shall not be considered acceptable nor equal to the dual independent seal specified: shaft seals without positively driven rotating members, or conventional double mechanical seals containing either a common single or double spring acting between the upper and lower seal faces. No system requiring a pressure differential to offset pressure and to effect sealing shall be used.

Each pump shall be provided with a lubricant chamber for the shaft sealing system. The lubricant chamber shall be designed to prevent overfilling and to provide lubricant expansion capacity. The drain and inspection plug, with positive anti-leak seal shall be easily accessible from the outside. The seal system shall not rely upon the pumped media for lubrication. The motor shall be able to operate continuously while non-submerged without damage while pumping under load.

Seal lubricant shall be FDA Approved, nontoxic.

J. Pump Shaft:

Pump and motor shaft shall be a solid continuous shaft. The pump shaft shall be the extension of the motor shaft. Couplings shall not be acceptable. The pump shaft shall be of carbon steel ASTM A 572 Grade 50 or Stainless Steel ASTM 431 and shall be completely isolated from the pumped liquid.

K. Impeller:
Impellers shall be constructed of ASTM A48 Class 30 minimum gray cast iron. The impeller shall be a rotodynamic semi-open, solids handling type capable of passing solids either due to internal clearances or other features to facilitate solids processing including a wear plate with groove. The wear plate to impeller clearance shall be easily adjustable without the need for disassembly of the pump or the need to add or remove shims. The impeller may include pump out vanes on the upper shroud to reduce axial thrust and minimize clogging due to debris accumulation around the mechanical seal. The impeller shall be dynamically balanced to the ISO 1940 G6.3 standard to provide smooth, vibration free operation.

M. Volute:

Pump volute(s) shall be single-piece non-concentric gray cast iron, Class 35B, non-concentric design with smooth passages large enough to pass any solids that may enter the impeller. Minimum inlet and discharge size shall be as specified.

N. Protection:

All stators shall incorporate thermal switches in series to monitor the temperature of each phase winding. Should high temperature occur, the thermal switches shall open, stop the motor and activate an alarm in the control panel.

A lower bearing temperature sensor shall be provided. The sensor shall directly contact the outer race of the thrust bearing providing for accurate temperature monitoring.

Any leakage that occurs from the mechanical seals shall be gathered in a separate leakage chamber. A float leakage sensor shall deter water entering the leakage chamber. When activated, the control shall stop the motor and activate an alarm.

The thermal switches, FLS and the lower bearing temperature monitor shall be connected to a MAS (Monitoring and Status) monitoring unit. The MAS shall be designed to be mounted in the motor control center.

O. Pump Discharge Flange:

The pump discharge-mating flange shall be as shown on the drawings.

2.02 PUMPING REQUIREMENTS

A. Pumps shall be manufactured by Xylem Corporation, Flygt Division, and KSB shall comply to the following characteristics:

Large Pump:

No. of Pumps	**Shut-Off Head (Min) (Ft)**	**Design Point #1**	**Design Point #2**	**Static Head (Ft.)**	**Max. Speed (RPM)**	**Motor HP/Max Each Pump**
		2 pumps running	**1 pump running**			
		Total Flow (GPM)	**Flow (GPM)**			
3 (2 operational, 1 back up)	**75**	**Head (Ft.)**	**Head (Ft.)**	**37**	**1800 RPM**	**28 HP**
		2300 GPM	1250 GPM			
		47.5 Ft.	43.4 Ft.			

Small Pump:

No. of Pumps	Shut-Off Head (Min) (Ft)	Design Point Flow (GPM)	Static Head (Ft.)	Max. Speed (RPM)	Motor HP/Max Each Pump
1	**104**	**Head (Ft.)** 640 GPM 52.3 Ft.	**37**	**1800 RPM**	**15 HP**

B. Power supply shall be 480 volts, 3-Phase, 60 Hz, 4 wire service.

C. Motors shall be 460 volt, 3 phase, 60 Hz.

D. The three (3) large pumps shall be operated by VFD – see Specifications Division 16. The one (1) small pump w

E. A spare pump shall be provided for the small pump.

F. Pump models shall be as follows, or approved equal

1. Xylem Corporation - Flygt : Large: NP 3171 MT 3~ 437
   Small: NP 3153 HT 3~464

2. Sulzer – ABS: Large: XFP155J-CB2
   Small: XFP100E CB1

3. KSB : Large: KRT K 150-315/156XG-S
   Small: KRT E – 80-251/114XG-S

F. The pumps shall operate throughout the entire operating range with the maximum vibration velocity in inches per second RMS unfiltered, measured in the field, shall be less than the requirements of ANSI/HI 11.6-latest edition.

2.03 PUMP ACCESSORIES AND OTHER

A. All pumps and controls shall be completely wired at the factory for power and control and shall be color-coded. All wiring outside the control cabinet shall be rigid conduit. All accessory equipment shall be permanently wired with suitable disconnecting means and overload protection.

B. All pump motors shall be provided with stator temperature sensor switches and stator housing leak detector.

C. The pump/motor assembly shall be suitable for use in Class I, Division 1, Group D hazardous locations.

D. Contractor shall be responsible for supply of appropriate lengths of lifting chain, submersible power cable, and MG Hi conductor submersible cable.

E. Access hatches for wet well and valve pit shall be as specified in Section 08370 of these specifications. Minimum dimensions shall be as noted on the Drawings, pump manufacturer shall size and provide access hatches for each pump.

2.04 VARIABLE FREQUENCY DRIVES

A. The speed control for variable speed pumps shall be Variable Frequency Drives, as specified in Division 16 suitable for installation as shown on the Drawings.

B. The Variable Frequency Drives shall be supplied by the Manufacturer and shall be completely coordinated with the pumps and pump driving motors and shall include all internal auxiliaries required to meet the functional specifications.

C. The Variable Frequency Drives shall conform to all requirements stipulated in this Section and Division 16 Electrical, and shall be designed for a minimum speed range of 50% to 100% of full load motor speed.

D. The Variable Frequency Drives shall be compatible with the motors provided by the Manufacturer.

2.05 GUIDE RAILS

A. The pumping station shall be furnished with the necessary, stainless steel upper guide holder and level sensor cable holder.

B. Lower guide holders shall be integral with the discharge connection. Dual guide rails shall be of Schedule 40, welded two-inch minimum diameter, Type 316 stainless steel pipe of the length required by the Drawings. Single guide rails and guide cables are not acceptable.

C. Intermediate guide brackets shall be furnished and installed so that the maximum length of unsupported guide rails will be no longer than 20 feet, and shall be fabricated of Type 316 stainless steel.

D. Stainless steel cable holders including the cable hooks shall be fabricated from Type 316 stainless steel plate. Sharp corners and edges shall be ground smooth to prevent abrasion and cutting of electrical cable insulation. The cable holder shall be of sufficient length and strength to provide support for each separate cable, except that the pump power and lift cables may use the same hook position, provided the cables do not foul one another and the lift cable is easily accessed from the hatch opening.

PART 3 - EXECUTION

3.01 PREPARATION

A. Coordinate with other trades, equipment and systems to the fullest extent possible.

B. Take all necessary measurements in the field to determine the exact dimensions for all work and the required sizes of all equipment under this contract. All pertinent data and dimensions shall be verified by the Contractor.

3.02 INSTALLATION

A. Installation shall be in strict accordance with the manufacturer's instructions and recommendations in the locations shown on the Drawings. Anchor bolts shall be set in accordance with the manufacturer's recommendations and setting plans.

B. The Contractor shall also provide from the submersible pump supplier the service of a qualified start-up engineer (factory representative) who has had prior on-site start-up experience to assist in performing start-up, checkout and initial operation services of the

pumping units. The start-up engineer shall also instruct the Owner's personnel on the operation and maintenance procedures for the station. Qualified supervisory services, including manufacturers' engineering representatives, shall be provided for a minimum of 4 man-days to insure that the work is done in a manner fully approved by the respective equipment manufacturer. The pump manufacturer's representatives shall specifically supervise the installation of the pump and the alignment of the connection piping. If there are difficulties in the start-up or operation of the equipment due to the manufacturer's design or fabrication, additional service shall be provided at no cost to the Owner. Services of the manufacturer's representatives and training shall be provided when the first pump is started, with follow-up visits upon start-up of each subsequent pump.

C. A certificate from each equipment manufacturer shall be submitted stating that the installation of his/her equipment is satisfactory, that the equipment is ready for operation and that the operating personnel have been suitably instructed in the operation, lubrication and care of each unit.

3.03 FIELD TESTS

A. During the field tests, observations shall be recorded of head, capacity, and motor input. All defects or defective equipment revealed by or noted during the tests shall be corrected or replaced promptly at the expense of the Contractor, and if necessary, the tests shall be repeated until results acceptable to the Engineer are obtained. The Contractor shall furnish all labor, piping, equipment, and materials necessary for conducting the tests. A report of the field tests shall be submitted to the Engineer.

B. After installation of the pumping equipment, and after inspection, operation, testing and adjustment have been completed by the manufacturer's representative, each pump shall be given a running test in the presence of the Engineer, such tests as necessary to indicate that the pumps, motors, and drives generally conform to the efficiencies and operating conditions specified and its ability to operate without vibration or overheating. The pumps and motors shall operate at the specified capacities in the range of heads specified without undue noise or vibration. Any undue noise or vibration in the pumps or motors, which is deemed objectionable by the Engineer, will be sufficient cause for rejection of the units.

C. A thirty-day operating period of the pumps will be required before acceptance. If a pump performance does not meet the Specifications, corrective measures shall be taken or the pump shall be removed and replaced with a pump which satisfies the conditions specified. All test procedures shall be in accordance with Hydraulic Institute Standards certified results of tests shall be submitted. If pumps are accepted after thirty-day operating period, the Owner will pay all electric cost for the operation period. If the pumps are not accepted the Contractor will be responsible for the costs. Without a rain event, the operation of the facility for testing will be activated using the throttling gate within the diversion structure.

D. Provide, calibrate and install all temporary gauges and meters, shall make necessary tapped holes in the pipes, and install all temporary piping and wiring required for the field acceptance tests. Written test procedures shall be submitted to the Engineer for approval 30 days prior to testing.

E. Field Vibration Testing

   a. After installation and as soon as conditions permit full speed operation, and in the presence of the Engineer, have the vibration tests performed in accordance with ANSI/HI 11.6 on each unit to (a) prove compliance with specified limitations, and (b) 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.

3.04 TRAINING

A. A factory representative shall provide a minimum of two (2) days, with eight (8) hours each day for a total of sixteen (16) person-hours of training to the Owner's operations staff concerning the recommended operation and maintenance of the equipment. Training shall be performed after substantial completion of the project with the use of operating equipment.

END OF SECTION

SECTION 11318 - SAMPLE PUMPS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Labor, materials, and equipment necessary for fabrication, production, installation and erection of the items specified in this Section, as shown on Drawings or listed on Schedule.

B. Products Furnished But Not Installed Under This Section: Anchor bolts shall be installed under Division 3, Concrete, in accordance with certified prints furnished by the equipment manufacturer.

C. Related Documents: Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1, apply to Work of this Section.

1.02 REFERENCES

A. Reference Standards:

1. ASA Class 125 Flange Dimensions.

2. 440C Stainless steel alloy.

1.03 SUBMITTALS

A. Shop Drawings: Submit in accordance with Section 01300, Shop Drawings covering the items included under this Section.

B. Test and Inspection Report: A written report shall be submitted to Engineer documenting testing and/or inspection results. The report shall be prepared in accordance with this Section.

C. Operation and Maintenance Manuals: Submit in accordance with requirements of Section 01780, operation and maintenance manuals for items included under this Section.

D. Warranty: Submit in accordance with requirements of Section 01782, warranties covering the items included under this Section.

1.04 SYSTEM RESPONSIBILITY

A. Pump manufacturer may rely upon information on Pump Schedule pertaining to steady-state operating conditions (flow, TDH, NPSHA, etc.). However, pump manufacturer shall be responsible to review this Specification Section, Section 16220, relevant pipework Drawings, schematics, and electrical and instrumentation Drawings to ensure that equipment offered is suitable for the purposes intended by the Contract Documents. Refer questions and clarifications to Engineer.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with the specified requirements, manufacturers offering products which may be included in Work include:

1. Self-Priming Centrifugal:

a. Gorman-Rupp.

b. ITT / Goulds / Marlow.

2.02 EQUIPMENT

A. The pumps shall have the capacities and duty points as shown on Schedule.

B. Duty points as indicated on Schedule relate to maximum system heads and are for pump selection.

C. Except where noted, each pump shall be designed to operate continuously at the intersection of its pump curve with available net positive suction head as shown without exceeding 85percent of the 1.0 or 1.15 service factor of the pump motor, without cavitation and without requiring throttling to prevent cavitation.

D. Self-Priming Centrifugal Pump:

1. Self-priming centrifugal pumps shall be provided as shown on Drawings and listed on Schedule.

2. The pump shall be a solids handling, self-priming centrifugal pump capable of repriming with a suction lift of 20 feet when handling trash-laden liquids containing a maximum of 1-inch-diameter spherical solids.

3. The pump shall have 1-1/2-inch IPS threaded female suction and discharge ports. Discharge of pump shall be equipped with a 1-1/2-inch hand plug such that initial priming may be accomplished without disturbing the discharge manifold.

4. Pump shall be easily disassembled for cleaning without disturbing suction or discharge piping. A separate suction elbow with O-ring gaskets held in place by a manually operated yoke device shall allow access to the suction check valve and the impeller eye for cleanout of these components. The swing away yoke device shall be affixed to a removable cover plate. The cover plate shall be easily removed. The cover shall be sealed to the pump tank by reusable, recessed O-ring. Removal of cover plate shall allow complete access to liquid chamber, semi-open nonclog impeller, volute, and mechanical shaft seal.

5. The semi-steel impeller shall be mounted on the extended motor shaft and shall be properly keyed to shaft and held tight by a locknut and lockwasher to prevent anti-rotation release.

6. The shaft seal shall be a self-lubricating mechanical type consisting of ceramic rotating member operating against a carbon stationary element with Buna-N boot and stainless steel spring loading.

7. The pump shaft and bearing assembly shall be housed in a rugged cast iron housing. Grease lubricated bearings shall be of proper type to handle axial and radial loadings and shall be of the shielded design. They shall be satisfactory for either direct-coupled operation or belt driven arrangements throughout the full horsepower requirements of the pump.

8. Furnish and install upper and lower guide holder.

2.03 SOURCE QUALITY CONTROL

A. Tests:

1. Prior to shipment, each pump shall be fully tested on water at manufacturer's plant. If pump manufacturer supplies the driving motor, pump and motor shall be assembled and tested as a unit. Tests shall consist of checking the unit at its rated speed, head, capacity, efficiency, and brake horsepower and at such other conditions of head and capacity to properly establish the performance curve. Certified copies of test reports shall be submitted. The standards of the Hydraulic Institute shall govern the procedures and calculations for these tests.

2. In case the pumps are tested separately from the motors, Contractor shall furnish certified characteristic curves of the motors to be provided as guaranteed by motor manufacturer. These characteristic curves shall be obtained either from actual tests from the motors to be provided or from tests of motors of the same size and type of construction.

PART 3 - EXECUTION

3.01 ERECTION

A. Equipment provided under this Section shall be fabricated, assembled, erected, and placed in proper operation condition in full conformity with detail Drawings, specifications, engineering data, instructions, and recommendations of equipment manufacturer approved by Engineer.

3.02 FIELD QUALITY CONTROL

A. An experienced, competent, and authorized representative of the manufacturer or supplier of each item of equipment shall visit Site of Work a minimum of 2 times, once prior to installation to review installation procedures with Contractor and once after installation to inspect, check, adjust if necessary, and approve the equipment's installation. The equipment supplier's representative shall revisit Site as often as necessary until all trouble is corrected and the equipment installation and operation is satisfactory to Engineer.

B. Manufacturer's representative shall provide all necessary tools and testing equipment required including noise level and vibration sensing equipment.

C. Each equipment supplier's representative shall furnish to Owner, through Engineer, a written report certifying that the equipment:

1. Has been properly installed and lubricated;
2. Is in accurate alignment;
3. Is free from any undue stress imposed by connecting piping or anchor bolts;
4. Has been operated under full load condition and that it operated satisfactorily to Engineer;
5. That Owner's Representative has been instructed in the proper maintenance and operation of the equipment; and
6. Furnish Owner a copy of all test data recorded during the installation check including noise level and vibration readings.

3.03 TRAINING

A. A factory representative shall provide a minimum of two (2) days, with eight (8) hours each day for a total of sixteen (16) person-hours of training to the Owner’s operations staff concerning the recommended operation and maintenance of the equipment. Training shall be performed after substantial completion of the project with the use of operating equipment.

SAMPLE PUMP SCHEDULE

Pump No.:	SP-1
Number of Units:	2
Service:	Influent Sample Pump
Type:	Self-priming Centrifugal
Location:	Grit Tank Influent Channel/Pipe Gallery
Capacity (gpm):	60
Total Dynamic Head (feet):	30
NPSHA (feet):	Flooded Suction
Motor Description:	460/3/60
Remarks:	Provide one pump spare for shelf storage

END OF SECTION

SECTION 11322 - DEGRITTING EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Labor, materials, and equipment necessary for fabrication, production, installation, and erection of the items specified in this Section as shown on Drawings or listed on Schedule.

B. Related Sections: Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 Specification Sections and the following sections apply to the Work of this Section.

1.	Section 05500	Metal Fabrications
2.	Section 05520	Handrails and Railings
3.	Section 05530	Grating

C. Products Furnished But Not Installed Under This Section: Anchor bolts shall be installed under Section 03250, in accordance with certified prints furnished by equipment manufacturer.

1.02 REFERENCE STANDARDS

A. Reference Standards:

1. AFBMA Standards
2. AGMA Standards
3. AISC Standards
4. ANSI B-16.1
5. ASTM A 36
6. ASTM A 48
7. ASTM A 53
8. ASTM A 167
9. ASTM A 240
10. ASTM A 276
11. ASTM A 312
12. ASTM A 479

1.03 SYSTEM DESCRIPTION

A. System shall consist of the following components:

1. Grit concentrator mounted in a concrete tank (Eutek HeadCell)

2. Grit pump

3. Grit washing and classification unit (Eutek Slurry Cup)

4. Grit dewatering escalator (Eutek Snail)

5. Control valves and accessories

6. Control panels and controls logic programming

B. Performance: Degritting equipment shall remove grit with minimum efficiencies as good as those listed on Schedule. Grit for removal is defined as particles having specific gravity of 2.65

or greater and size for capture by mesh. Grit shall be discharged from the classifier in low moisture condition.

1. The Grit Concentrator unit shall be placed in a concrete tank and receive the incoming screened flow. The Grit Concentrator shall provide sufficient surface area to remove the specified grit particles from the specified peak flow and concentrate the grit in a sump at the bottom of the unit. The de-gritted effluent from the Grit Concentrator shall be weir discharged as shown.

2. The Grit Concentrator shall be all-hydraulic, self-activating and shall not require internal moving parts.

3. The Grit Pump shall convey the concentrated grit slurry from the underflow of the Grit Concentrator to the Grit Washing / Classification unit.

4. The Grit Washing / Classification unit shall receive the underflow from the Grit Concentrator. The unit shall be mounted above and discharge the concentrated and washed grit slurry to the Grit Dewatering Escalator. The de-gritted overflow shall be discharged upstream of the Grit Concentrator.

5. The Grit Dewatering Escalator shall receive the underflow from the Grit Washing / Classification unit and allow the washed grit to settle in its integral clarifier. A slow moving belt shall carry the grit to the point of discharge allowing it to dewater during transport. The de-gritted overflow shall be discharged upstream of the primary grit removal equipment.

6. The Grit Concentrator technology shall be designed utilizing Computational Fluid Dynamics (CFD) and field data to verify its flow regime, headloss and grit removal characteristics.

1.04 SUBMITTALS

A. Shop Drawings: Submit in accordance with Section 01300, Shop Drawings covering the items included under this Section.

1. Dimensional general arrangement drawings.

2. Manufacturer's catalog data and descriptive literature including equipment weights and performance data.

3. Written recommended procedures for job site storage, handling, and installation of the equipment.

4. Electrical and P&ID diagrams.

5. Control panel, electrical and instrument component data.

   a. Interconnects to all components outside the panel

   b. Door layout

   c. Interior layout

   d. Wiring diagrams

   e. PLC address points for remote monitoring and control

B. Test and Inspection Report: A written report shall be submitted to Engineer documenting testing and/or inspection results. The report shall be prepared as noted in this Section.

C. Record Information:

1. At Project closeout, submit record drawings of installed products, in accordance with requirements of Section 01770 and Section 01785.

2. Programming hardcopy and a CD including initial set point and startup settings.

D. Operation and Maintenance Manuals: Submit in accordance with requirements of Section 01780, operation and maintenance manuals for items included under this Section.

E. Warranty: Submit in accordance with requirements of Section 01782, warranties covering items included under this Section.

1.05 MAINTENANCE

A. Extra Materials:

1. Provide one set for each grit system:

a. 1 grit snail set of bearings

b. 1 grit snail set of gaskets

c. 1 grit snail scraper blade

d. 1 slurry cup baffle

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with specified requirements, manufacturers offering products which may be incorporated in Work include:

1. The grit removal equipment package shall be assembled by the following manufacturer:

a. Hydro International.

2. Grit Pumps:

a. Hayward Gordon – Torus Model

b. Weir / Wemco, Model C.

2.02 MATERIALS

A. Grit Concentrator:

1.	Trays	LDPE
2.	Support Frame	304 Stainless Steel
3.	Grit Collector	304 Stainless Steel

B. Grit Pump:

1.	Casing	Hi-Chrome iron, ASTM A532-75 Class III, Type A, minimum 700 Brinell hardness
2.	Impeller	Hi-Chrome iron, ASTM A532-75 Class III, Type A, minimum 700 Brinell hardness
3.	Wear Plate	Hi-Chrome iron, ASTM A532-75 Class III, Type A, minimum 700 Brinell hardness

C. Washing and Classification Unit:

1.	Dished Heads	304 Stainless Steel
2.	Side Walls	304 Stainless Steel

D. Escalator:

1.	Housing	304 Stainless Steel
2.	Liner	Polyurethane
3.	Conveyor Belt	Two Ply Polyester Reinforced
4.	Cleats	Neoprene with Aluminum Reinforcing
5.	Cleat Hinges	Neoprene
6.	Scraper	HDPE

E. Access Platforms:

1.	Platforms, walkways, landing	Aluminum
2.	Ladders, stairs	Aluminum

2.03 EQUIPMENT AND COMPONENTS

A. General Requirements: Provide manufacturer's standard pre-engineered degritting system which will comply with or fulfill the requirements of Schedule sheets at the end of this Section. Where components are not otherwise indicated, provide standard components, published by manufacturer, as included in standard pre-engineered degritting systems and as required for a complete system.

B. Grit Concentrator:

1. The Grit Concentrator shall have a maximum surface loading rate of 18.4 gpm/square foot to ensure adequate surface area for settling and specified particle removal efficiency.

2. The Grit Concentrator shall be characterized by a controlled boundary layer flow to enhance settleable solids concentration and removal.

3. The Grit Concentrator shall be all-hydraulic consisting of self cleaning corrosion resistant, non-metallic trays with no moving parts within the unit.

4. All flow passages shall be self-cleaning and free of sharp projections or fittings that may snag stringy or fibrous materials.

5. Water shall be continuously supplied to the solids underflow sump.

6. Grit Concentrator trays shall be constructed with a minimum ¼ inch thick LDPE on the pans and sidewalls.

7. The stack of trays shall securely fit into a stainless steel support frame. The support frame shall fit and secure to the bottom of the grit tank.

8. A stainless steel grit collector mounted in the concrete grit tank and incorporate the flanged underflow and threaded fluidizing pipe connections.

9. All pipe flanges shall conform to ANSI B16.1 bolt patterns.

10. Valves and Accessories

    a. One (1) 1" bronze globe valve to regulate the system water flow rate to the grit collector

    b. One (1) 1" bronze ball valve for shut off

    c. One (1) 1" 8-40 gpm acrylic flow meter

.

C. Grit Pumps:

1. Recessed impeller, vortex-type grit pumps shall be provided where shown on Drawings and listed on Schedule.

    a. Pump casings shall be 2-piece, vertically split type, with inlet designed so that impeller can be withdrawn without removing discharge casing and/or disturbing discharge piping. Casing shall be of suitable thickness for abrasive service.

    b. Case thickness shall be minimum of 9/16 inch for 3-inch pump, 3/4 inch for 4-inch and 6-inch pumps, and 7/8 inch for 8-inch pump with normal casting tolerances. Removable suction piece shall have a minimum thickness of 1 inch for 3-inch pump, 1-1/4 inches for 4-inch pump, and 1-1/2 inches for 6-inch pump, with normal casting tolerance at the area of maximum wear.

    c. Pump shall be completely open from suction to discharge with no wearing rings or impeller faceplates required. Internal clearances shall be equal to the discharge diameter so that all material which will pass through the discharge will pass through pump.

    d. Impeller shall be recessed. Impeller shall be mounted completely out of flow path between pump inlet and discharge connections so that the solids pumped are not required to flow through the impeller. Impeller shall be babbitted to tapered shaft, secured by impeller bolt and locked against reverse rotation. Impeller shall be of cup-type design such that blade ends are surrounded by integral rim, which direct flow to center of volute, minimizing particle impact and reducing wear and degradation.

    e. Removable wearplate shall be provided back of impeller and be designed to direct flow from behind impeller to center of volute for maximum protection to the casing.

    f. Shaft shall be protected through packing area by a removable chrome-plated steel shaft sleeve.

1) Stuffing box shall contain Two independently mounted mechanical face type seals.

2) The oil chamber shall act as a barrier to trap moisture and provide sufficient time for a planned shutdown. The oil shall also provide lubrication to the internal seal

3) Standard Bergman, U/L approved seals shall be provided. The inner seal shall be provided with carbon rotating face and ceramic stationary face. The outer seal shall be provided with a solid tungsten carbide rotating face and a silicon carbide or tungsten carbide stationary face

4) The outer seal construction shall be designed for easy replacement.

5) The outer seal assembly will be designed to allow solids and particles to be thrown away from the seal face.

g. Bearings shall be grease or oil bath lubricated with oil reservoir sealed at either end to prevent entrance of foreign matter. The thrust bearings mounted back to back preceded by a single row angular contact ball bearing for maximum protection from all thrust loads. The bearing housing shall be equipped with a pressure venting device or grease relief port and an oil lubricated bearing furnished with oil fill, level, and drain taps.

1) Bearings shall be selected to provide minimum L10 rating life of 17,500 hours

2) The motor shall be designed to limit the bearing temperature rise to a maximum of 60^{o} C under full load conditions

h. The common pump and motor base shall be suitably constructed to support the full weight of pump and motor and shall be provided with suitable anchor bolt holes.

i. Belts and sheaves shall be provided to drive the pump at a speed to meet rated conditions. An enclosed belt guard shall be provided.

j. Motors: Motors shall comply with the specifications set forth in Section 16220, and with details outlined on attached Schedule. Motors shall be explosion proof construction and shall be non overloading at all points on the performance curve of the impeller selected to meet the duty point including horsepower requirements of the drive. At no point shall the required brake horsepower exceed 85 percent of the motor nameplate horsepower multiplied by the motor service factor. The load conditions for these pumps shall be the maximum horsepower at any point on the characteristic curve from shutoff head to static head (static head is assumed to be zero unless otherwise shown).

k. Testing: Pumps shall be fully tested with water at manufacturer's plant before shipment. The driving motor and pump shall be assembled and tested as unit. Tests shall consist of checking the unit at its rated speed, head, capacity, efficiency and brake horsepower, and any other conditions of head and capacity to properly establish the performance curve. Certified copies of test reports shall be submitted. Standards of the Hydraulic Institute shall govern the procedures and calculations for these tests.

1) In case pumps are tested separately from motors, Contractor shall furnish certified characteristic curves of motors to be furnished as guaranteed by motor manufacturer. These characteristic curves shall be obtained either from actual tests of motors to be furnished or from tests of motors of same size and type of construction.

D. Grit Washing Unit

1. The Grit Washing / Classification unit shall be designed to handle grit slurry underflow from the Grit Concentrator.

2. The Grit Washing / Classification unit shall be characterized by a dominant, strong free vortex which utilizes centrifugal and gravitational forces and secondary boundary layer velocities to effect the separation, collection and classification of grit from the unit's inflow.

3. Defining characteristics of the dominant free vortex / secondary boundary layer velocity type units are as follows:

    a. Dominating increasing tangential velocity profile toward the center of the unit.

    b. The ability to handle increasing flows with no loss of the specified grit removal efficiency and with increasing headloss requirements.

    c. The ability to classify (wash) the grit from lighter organic material to meet the specified organic solids content.

    d. No requirements for electrical or mechanical components, flow deflecting / guiding weirs or baffles, or compressed air lines within the unit to meet the specified performance.
    e. Continuous removal of washed, clean grit.

4. The Grit Washing / Classification unit shall be all-hydraulic with no moving parts within the unit

5. The grit underflow from the Grit Washing / Classification unit shall be transported by gravity to the Grit Dewatering Escalator unit.

6. Fluidizing Water shall be continuously supplied to the Grit Washing / Classification unit

7. The Grit Washing / Classification unit shall be fabricated from stainless steel. The dished and flanged heads shall be 1/4 inch thick. The vessel walls shall be 3/16 inch thick.

8. A coating of Belzona shall be applied to the inside bottom part of the Grit Washing / Classification body to add a secondary layer of abrasion resistance.

9. The Grit Separation / Classification unit shall be designed to withstand a maximum working pressure of 14.7 psig. The actual maximum pressure at the inlet shall be no more than 14.7 psig.

10. A minimum 18 inch diameter access shall be provided in the top of the Grit Washing / Classification unit. All internal elements shall be removable from inside the unit.

11. The Grit Washing / Classification unit shall be free standing on three legs and mounted above a Grit Dewatering Escalator unit. Clearance shall be provided between the bottom of the grit underflow pipe and the Dewatering Unit clarifier surface.

12. The Grit Washing / Classification unit shall include a Hydraulic Valve (HV) to deliver a continuous flow of “washed” grit slurry to the dewatering unit. The HV shall have no mechanical or moving parts.

13. The Grit Washing / Classification Unit shall have a single 1-1/2 inch NPT pipe stub for connection of the system water.

14. The unit shall have one (1) 1.5" grit underflow connection, one (1) 3" threaded drain connection and one (1) 1.5" NPT fluidizing water connection for the Hydraulic Valve supply and Hydraulic Valve backwash.

15. Valves and Accessories

    a. One (1) 1.5” bronze ball valve for utility water supply shut off.

    b. One (1) 1.5” bronze globe valve to regulate water flow to the HV.

    c. One (1) 1.5” NEMA 7 brass solenoid valve to automate system water to the HV.

    d. One (1) 1.5” NEMA 7 brass solenoid valve to automate system backwash water.

    e. One (1) 0-100 psig pressure gauge to monitor the utility water delivery pressure.

    f. One (1) 0-30 psig pressure gauge (Pd) to monitor the pressure in the grit slurry discharge (underflow) line.

    g. One (1) 0-30 psig pressure gauge (Pi) to measure the inlet pressure to the Grit Washing / Classification unit.

    h. Three (3) ¼” bronze ball valves to isolate the pressure gauges.

    i. One (1) 0-35 gpm SS flow meter.

    j. Slurry Cup shall be provided with an access platform complete with stairs and handrail adequately sized to maintain and observe operation. Platforms shall be configured to fit with the grit escalator and supports arranged to not interfere with equipment below.

E. Grit Dewatering Escalator

1. The Grit Dewatering Escalator unit shall be designed to capture and dewater concentrated, washed grit slurry from the Grit Washing / Classification unit.

2. The Grit Dewatering Escalator unit clarifier shall be designed based on a settling rate not to exceed 3.2 gpm/ft^2.

3. The tail roll mechanism shall be self-cleaning. As the belt rotates with the tailroll at the bottom of the unit the belt cleats shall lift from the belt to provide a gap of at least a 1-inch. The Grit Dewatering Escalator unit belt shall be provided with 2” openings to allow transfer of fine solids internal to the belt to the underside of each cleat. The tailroll shall be fitted with a scraper, which shall also function as an internal belt scraper.

4. The Grit Dewatering Escalator shall be provided with an integral square clarifier which shall provide at least 3 inches of freeboard.

5. The housing for the Grit Dewatering Escalator belt shall be fitted under the clarifier. The housing for the Grit Dewatering Escalator belt shall be stainless steel with urethane bonded to the internal surfaces. The belt housing shall be inclined at 30 degrees.

6. The belt housing shall be provided with clean out plates and one (1) flanged drain.

7. The Grit Dewatering Escalator unit shall be supplied with a belt made of 1/8 inch x 1/32 inch two-ply polyester reinforced continuous conductor belting. The belt cleats shall be 3-3/8” X 4-9/16” of molded 60 Durometer neoprene and aluminum reinforced and shall be

vulcanized on the belt. The cleats shall attach to the belt with minimum 5/32 inch thick neoprene hinges.

8. The Grit Dewatering Escalator unit shall be provided with a 9-3/4 inch diameter lagged headroll. The headroll shall be adjustable to allow take-up of slack in the Grit Dewatering Escalator belt. Adjustment of the headroll shall not affect the headroll retainer plate, scraper, or drive unit.

9. The Grit Dewatering Escalator unit shall be provided with a headroll scraper having 1/4 inch thick high density polyethylene (HDPE) contact surfaces with a 1/4 inch thick HDPE retainer plate. Both retainer plate and scraper shall be loaded to keep belt cleats closed tightly around the headroll during operation.

10. The Grit Dewatering Escalator unit shall be provided with a tailroll designed to mount internally to the unit belt housing with external sealed bearings.

11. The Grit Dewatering Escalator unit support structure shall be as shown on the general arrangement drawing and anchored to a stable base.

12. The Grit Dewatering Escalator unit shall be supplied with a factory installed rinse bar system. The system shall include:

    a. Two spray bars located above the belt and below the clarifier liquid level to enhance grit washing

    b. One spray bar located at the bottom of the clarifier as a tailroll area rinse

13. Drive Unit

    a. The Grit Dewatering Escalator shall be provided with a drive unit consisting of the motor and the helical gear reducer, mounted as a single integrated unit. All Bearings shall be anti-friction, ball, or roller type bearings

    b. The helical gear reducer shall have hardened alloy steel gears accurately cut to shape

    c. A mechanical torque-limiting clutch shall be mounted on the headroll gear assembly to prevent an accidental overload of the drive unit and belt

    d. The drive speed shall be adjusted by a variable speed drive housed in the control enclosure. The belt speed shall be adjustable from 1-5 ft/min

14. Valves and Accessories

    a. One (1) 3” eccentric cast iron plug valve located on the unit drain

    b. One (1) 1” NEMA 7 brass solenoid valve to automate the water to the rinse bar system.

    c. Two (2) 1” bronze ball valves to manually shut off flow to the rinse bar system.

    d. One (1) 1” bronze globe valve to manually regulate flow to the tailroll spray bar.

    e. One (1) 3/4” bronze ball valve to manually shut off the top rinse bars.

    f. One (1) 1-10 gpm acrylic flow meter.

g. One (1) motion sensor installed on the side of the Grit Dewatering Escalator unit to detect movement of the headroll scraper arm.

F. Finishes

1. All stainless steel surfaces shall be acid washed.

2. All non submerged surfaces shall be glass bead blasted to a uniform finish.

G. Controls

1. One main control panel shall be provided for entire grit package system. The control system shall be provided by the manufacture and shall have VFD's, switches, indicator lights starters and other components as necessary to operate the system. The main panels shall have painted NEMA 12 enclosures and suitable for mounting as shown.

2. Panel enclosures shall be furnished with a flange mounted disconnect switch, main circuit breaker, control power transformer, surge arrester and be suitable for connection to a 480 volt, 3-phase, 60 Hertz feeder circuit.

3. Main control panel shall be equipped with escalator drive motor VFD, grit pump starters, Allen Bradley MicroLogix 1400 PLC with Ethernet port, Ethernet communication and all required indicating lights, push buttons, selector switches and alarm lights.

4. The main control panel PLC's shall meeting the requirements of Section 17311.

5. Panel construction shall be in conformance with Section 17430.

6. All PLC monitored data and HMI information shall be made available to via Ethernet to Owner's SCADA system. Manufacturer shall coordinate with Contractor for addressing and tagging.

7. Controls logic will allow only one grit train to backwash at a time.

8. Control system will include operator input and adjustment for:

a. Hand-Off– Auto selector switch

b. Elapsed time meters

c. Reset Buttons

d. Escalator on off time adjustment

e. Escalator belt speed

f. Grit pump speed

g. Grit pump stop

h. Escalator on time adjustment

i. Escalator off time adjustment

j. Escalator speed adjustment

k. Escalator off time delay adjustment

9. Control System will accept the following inputs:
    a. Grit system start enable
    b. Start grit system
    c. Stop grit system
    d. Pause escalator for truck changing
    e. Enable escalator start
    f. Grit pump assignments
    g. Grit pump start enable
    h. Wet weather mode
    i. Dry weather mode
    j. Discharge conveying system fault
10. Control system will provide output:
    a. Grit pump start request
    b. Grit pump assignment in Local or Remote
    c. Grit pump running
    d. Grit pump fault
    e. Truck loading pause timer alarm
    f. Escalator call to start
    g. Escalator running
    h. Escalator fault
    i. Slurry cup fault
    j. Classifier backwash in progress
    k. Classifier blowdown in progress
11. Local controls stations
    a. Grit Pump Local Station shall be NEMA 4X stainless steel.

1) E-Stop
2) Hand-Off –Remote
3) Start Stop

b. Classifier and Escalator Local Station shall be NEMA 7 copper free aluminum complying with NEMA 3R and NEMA 4 requirements.

1) Escalator E-stop
2) Hand-Off-Remote
3) Escalator Start and Stop Push Buttons
4) Slurry Cup Backwash
5) Fail Light
6) Fail Reset Button

PART 3 - EXECUTION

3.01 ERECTION

A. Equipment furnished and installed under this Section shall be fabricated, assembled, erected, and placed in proper operating condition in full conformity with detail drawings, specifications, engineering data, instructions, and recommendations of equipment manufacturer as approved by Engineer.

3.02 INSPECTION:

A. Prior to commencing degritting system installation, inspect basins and piping, as constructed, verify all critical dimensions, and examine supporting structure and all other conditions under which work is to be installed. Notify Contractor in writing of any dimensional discrepancies or other conditions detrimental to the proper installation or performance of degritting system Work. Do not proceed with installation until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

3.03 INSTALLATION OF DEGRITTING SYSTEM:

A. Comply with manufacturer's instructions and recommendations for Work required during installation.

B. Coordination: Coordinate degritting system Work with work of other trades, for proper time and sequence to avoid construction delays. Use benchmarks, lines and levels designated by Contractor, to ensure dimensional coordination of Work.

C. Lubricate operating parts of systems as recommended by manufacturers.

D. An experienced, competent, and authorized representative of the manufacturer or supplier of each item of equipment shall visit Site of Work a minimum of 2 times, once prior to installation to review installation procedures with Contractor and once after installation to inspect, check, adjust if necessary, and approve the equipment's installation. The equipment supplier's representative shall revisit Site as often as necessary until all trouble is corrected and the equipment installation and operation is satisfactory to Engineer.

E. Manufacturer's representative shall provide all necessary tools and testing equipment required including noise level and vibration sensing equipment.

F. Each equipment supplier's representative shall furnish to Owner, through Engineer, a written report certifying that the equipment:

1. Has been properly installed and lubricated;
2. Is in accurate alignment;
3. Is free from any undue stress imposed by connecting piping or anchor bolts;
4. Has been operated under full load condition and that it operated satisfactorily to Engineer;
5. That Owner's Representative has been instructed in the proper maintenance and operation of the equipment; and
6. Furnish Owner a copy of all test data recorded during the installation check including noise level and vibration readings.

3.04 FIELD QUALITY CONTROL

A. Protection: At time of Substantial Completion of degritting system Work (or portion thereof), provide suitable protective coverings, barriers, devices, signs or such other methods or procedures to protect equipment from damage or deterioration. Maintain protective measures throughout remainder of construction period.

3.05 OPERATION AND MAINTENANCE TRAINING

A. Provide services of manufacturer's service representative to instruct Owner's personnel in operation and maintenance of equipment. Training shall include start-up and shutdown, servicing and preventative maintenance schedule and procedures, and troubleshooting procedures plus procedures for obtaining repair parts and technical assistance.

1. Manufacturer’s representative shall provide two (2) days consisting of eight (8) hours each day for a total of sixteen (16) person hours of on-Site training.
2. Review operating and maintenance data contained in the operating and maintenance manuals.
3. Schedule training with Owner, provide at least 7-day prior written notice to Engineer.

GRIT EQUIPMENT SCHEDULE

GRIT CONCENTRATOR

Number of Units:	2
Location:	Grit Tanks
Peak Hydraulic Flow:	35 mgd
Grit Capacity (cubic feet per hour):	46 Total (23 Each)
Removal Efficiency at Peak Flow:	95%
Of Grit Larger than Mesh Size:	150 microns
Secondary Flow Point:	23 mgd
Removal Efficiency at Secondary Flow:	95%
Of Grit Larger than Mesh Size:	106 microns
Max Headloss at Peak Flow:	12-inches
Max Headloss at Secondary Flow:	6-inches
Under Flow Connection Diameter/Type:	6-inches/Flanged
Flushing Water Connection Diameter/Type:	1-inch/NPT

GRIT PUMP

Service:	Grit Concentrator Underflow
Number of Units:	3
Installation (Horizontal or Vertical):	Horizontal
Capacity (gpm):	400 gpm
Total Head (feet):	24
Minimum NPSHA at Duty Point:	30’
Minimum Shutoff Head:	31’
Maximum Pump Speed:	1,800
Speed Adjustment:	VFD
Motor:	
Volt:	480
Phase:	3
Enclosure:	TEFC
Minimum HP:	10

Remarks: 1. Grit pump capacity shall be verified by grit system manufacture to work with grit quantities and slurry cup sizing.

GRIT WASHING AND CLASSIFICATION UNIT

Number of Units:	2
Location:	Screen Room
Size:	42-inch diameter
Removal Efficiency in Flow Range:	95% in range of 350 to 550 gpm
Of Grit Larger than Mesh Size:	75 microns
Design Flow / Headloss:	400 gpm / 65-inches
Minimum Flow / Headloss:	350 gpm / 50-inches
Maximum Flow / Headloss:	550 gpm / 124-inches
Influent Connection:	6-inch flange
Effluent Connection:	8-inch flange
Underflow Connection:	3-inch NPT
NPW Connection:	1.5-inch NPT
Of Grit Larger than Mesh Size:	106

Remarks: 1. Flow range is determined by the grit system manufacturer.

GRIT DEWATERING ESCALATOR

Number of Units:	2
Location:	Screen Room
Size:	2 cyd/hr with 60-inch square
Belt Width:	12-inches
Removal Efficiency in Flow Range:	95%
Of Grit Larger than Mesh Size:	75 microns

Grit in the dumpster shall contain less than 15% volatile solids and greater than 60% total solids

Overflow Connection:	6-inch flange
Drain Connection:	3-inch flange
NPW Connection:	1-inch NPT
Speed Adjustment:	Variable Speed
Motor:	
Volt:	480
Phase:	3
Enclosure:	Explosion-Proof
Minimum HP:	0.33

END OF SECTION

SECTION 11330 - SCREENING EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Labor, materials, and equipment necessary for fabrication, production, installation and erection of the items specified in this Section as shown on Drawings or listed on Schedule.

B. Related Documents: Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 Specification Sections, including Section 01780, apply to Work of this Section.

1.02 SUBMITTALS

A. Shop Drawings: Submit in accordance with requirements of Section01300, Shop Drawings covering the items included under this Section.

1. Dimensional general arrangement drawings including discharge chutes, hoppers, screen equipment and compactor information.

2. Electrical and P&ID diagrams.

3. Control panel, electrical and instrument component data.

a. Interconnects to all components outside the panel

b. Door layout

c. Interior layout

d. Wiring diagrams

e. PLC address points (mapping) for remote monitoring and control

4. Headloss calculations for conditions listed on Schedule with clean and 30% blinded conditions.

5. Screen and frame rigidity loading calculations for full blinded condition with zero downstream elevation.

B. Test and Inspection Report: A written report shall be submitted to Engineer documenting testing and/or inspection results. The report shall be prepared as noted under this Section.

C. Record Information:

1. At Project closeout, submit record drawings of installed products, in accordance with requirements of Section 01770 and 01785.

2. Programming hardcopy and a CD including initial set point and startup settings.

D. Operation and Maintenance Manuals: Submit in accordance with requirements of Section01780, operation and maintenance manuals for items included under this Section.

E. Warranty: Submit in accordance with requirements of Section01782, warranties covering the items included under this Section.

1.03 QUALITY ASSURANCE

A. The screen compactor and screen equipment provided under this Section shall be from the same manufacturer.

1.04 MAINTENANCE

A. Extra Materials:

1. Provide one set for each mechanically cleaned screen:

a. 2 rake bars

b. 5 feet of chain

c. 1 pair of wiper arm wear pads

d. 1 year supply of all lubricants

2. Provide one set for each compactor

a. 1 screw brush

b. 1 set wear bars

c. 1 year supply of all lubricants

3. Controls

a. Two sets of spare fuses of each type used

b. One indicating lamp for each type used

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with the specified requirements, manufacturers offering products which may be included in Work are:

1. Inclined Mechanically Cleaned Bar Screen and Compactor:

a. Headworks Type MS1 Bar Screen and Compactor Model SW320.

b. Huber.

c. Duperon.

2.02 INCLINED MECHANICALLY CLEANED BAR SCREEN

A. Frame

1. The Screen Frame shall be supplied in one piece requiring no field assembly.

2. The screen shall be designed to be pulled out of the channel and shall be installed at the incline angle listed on Schedule.

3. Framework of screen shall be constructed of Grade 304 stainless steel with minimum thickness 0.1575-inch. Frame parts shall be braced as necessary to ensure a rigid structure. The side frames shall be minimum 0.1575-inch formed to a channel profile. The bottom thickness shall be minimum 0.1575-inch. The frame shall have support beams with U-profile thickness of 0.156-inch on the front above the maximum water line. Wraparound stainless steel stiffeners with a thickness of 0.1575-inch formed to a channel profile shall be placed along the Screen Frame above the maximum design water depth for rigidity. No braces, gussets or stiffeners shall be inside the Screen Frame that will allow for screenings to collect.

4. All parts shall be designed and manufactured to handle the forces that may be exerted during fabrication, shipping, erection and operation. Jamming of the rake shall cause the motor to stall before causing a structural failure. All components including the gear reducer shall withstand without damage the full stalling torque of the drive motor.

5. Frame shall be supported and anchored on the operating floor and rest on the bottom of the channel.

6. Anchors shall be 304 stainless steel and provided by the manufacture or the Contractor in accordance with manufacturer requirements.

7. All connecting hardware shall be minimum 304 stainless steel.

8. Neoprene rubber seals with a minimum thickness of 0.25-inches and 304 stainless steel backing plates shall be mounted along the upstream edges of the frame inside the channel.

9. The lower entry shall consist of a curved plate to direct flow into the bars.

10. Covers shall be easily removable and equipped with turn locks and handles for easy maintenance. Covers shall be either clear impact-resistant polycarbonate material 0.25-inches thick or 304 stainless steel minimum 0.047-inches thick.

11. A discharge chute (thickness of 4mm (.1575” min.) shall be provided for each screen to divert screenings discharged from the screen into the compactor. The discharge chute shall be made of Grade 304 Stainless Steel. The discharge chute shall be mounted at an angle of 30 degrees. Panels are positioned on both sides to protect from splashing.

    a. The discharge chute and top of screen shall be fully enclosed. The top of the frame shall be covered with a 3mm (11 gauge min.) type 304 stainless steel cover, bolted to the front and back of the screen frame. The sides of the top cover shall be bent to overlap the side frames.

    b. The discharge chute shall be enclosed from the top of the frame to the bottom of the chute. The chute and chute enclosure shall be manufactured from a single piece of 4mm (.1575” min.) type 304 stainless steel material. The enclosure shall include an access opening with cover. The cover shall be easily removable for maintenance. The cover shall be made of 10mm (.375” min.) clear, impact resistant, polycarbonate to allow for visual inspection during screen operation. The polycarbonate cover shall

have stainless steel handles and be attached to the chute enclosure by four (4) quick release clamps.

B. Bar Screen and Deadplate

1. The bar rack shall consist of 304 stainless steel bars with taper cross section 0.31-inch by 0.15-inch thick by 1.57-inch wide. Bars shall be removable and replaceable without welding or cutting. Top end of bars shall extend minimum 7.8" above high water level and be fastened to the dead plate. Arrange and assemble bars accurately to provide the clear spacing indicated on Schedule. The dead plate shall be constructed of not less than 0.1575-inch-thick 304 stainless steel and adequately braced, true and flat to provide close clearance with the rake tines.

C. Screen Cleaning

1. The raking tines shall have the tooth profile precision cut from a single continuous bar of sufficient thickness and depth to insure adequate stiffness and strength to cope with the specified duty cycle. The rakes shall run in guides on both sides to ensure engagement. The rakes shall clean the bars from the upstream side of the screen. The rakes shall be fabricated from stainless steel Grade 304. The rake material thickness shall be as follows:

   a. Rake bar thickness minimum 0.4724-inches

   b. Reinforcement profile minimum 0.2362-inches

   c. Side sheet thickness minimum0.375-inches

2. The rake capacity shall be as follows:

   a. Capacity/Rake Bar: 0.183 f^3/ft [0.017m^3/meter] Screen Field Width (SFW) Total Screen Capacity at approx.10 second cleaning interval (ft^3/h) = 0.183 f^3 x SFW (ft) x 360

   b. Total Screen Capacity at approx. 5-second cleaning interval (ft^3/h) = 0.183 f^3 x SFW (ft) x 720

3. S.S. rakes should have a shovel shape to prevent screenings from falling back to the channel. Flat rakes without this feature are not permitted. Rake tines shall penetrate into the screen bar spacing to insure that screenings are completely cleared during each lifting operation. Rake tines are mechanically engaged into the screen bars. During each cleaning stroke, the raking tines shall engage into the bottom of the bar screen grids at the channel invert. Drive chains, chain guides, chain sprockets, bearings, and axles shall be fully replaceable without having to remove the screen from the channel.

4. The drive mechanism for the rakes shall incorporate a solid shaft constructed of stainless steel Grade 304. The drive shaft shall be a solid shaft constructed of type 304 stainless steel

5. The Upper Sprocket shall be solid and made of type 304 stainless steel. The Upper Sprocket shall have a 160 mm pitch and a tooth width of minimum 27 mm.

6. Upper Bearings shall be UCFX 4 – Bolt Flange Bearings or equal mounted in the Take-Up Frame assembly. The bearings shall be grease-lubricated. The take up screw shall be an Acme Lead Screw made of 18-8 stainless steel.

7. The Lower Sprocket shall be solid and made of type 304 stainless steel. The Lower Sprocket shall have a (125 mm or 160 mm) pitch, a tooth width of minimum 27 mm and a bore of 70 mm.

8. Bearings for lower submerged sprockets shall be of proven self-lubricating PE (Polyethylene) material and be maintenance-free. A ceramic collar-type Headworks® Technox Zirconia Diamond Ceramic shall be bonded onto the stub shaft. No metallic lower bearings or bushing shall be allowed.

9. Chains shall be Heavy Duty roller type with a minimum weight of 6 lbs/ft and made of Grade 304 Stainless Steel of high tensile strength and resistance to corrosion. Chain rollers must be Stainless Steel. The average ultimate strength of the chain shall be minimum 31,000 pound-force (137,500 Newtons). Chain Pins shall be a Stainless Steel and hardened

10. A Chain guide shall be securely fixed to the Screen frame for the full height of travel and shall not protrude into the flow. The type of chain guide, thickness of material and size is an L-Profile 2.65"/1.38"/0.19" (65/35/5mm), Material Grade 304 Stainless Steel.

11. Screenings transported to the top of the screen shall be discharged positively by means of a scraper mechanism to the discharge chute. The scraper mechanism shall be fitted with a compression spring that allows the scraper to return to its resting position smoothly without any shock. A scraper blade made of a combination of synthetic and other material shall be provided on the scraper.

D. Drive Mechanism

1. The drive motor shall be an inverter duty rated motor with a 1.0 service factor, rated for continuous duty. The motor shall be controlled by a VFD (variable frequency drive), rated for continuous operation in a Class 1 Div 1 rated area. The drive unit, including the reduction gearbox, shall be directly shaft- mounted and shall be positioned to facilitate maintenance work.

2. Motors shall meet the requirements of Section 16220.

3. The rake mechanism shall be capable of 2 cleaning speeds. Normal speed shall have an approximate ten second cleaning interval and high speed shall have an approximate five second cleaning interval.

4. On meeting a blockage, the device shall be able to automatically reverse the direction of travel of the raking mechanism for an adjustable distance and revert to the forward motion to try and clear the blockage. This reversing action can occur a maximum of three times for any one obstruction. The device shall re-set automatically if the blockage causing the initial overload condition is cleared; or, should the blockage remain upon the completion of the fourth attempt, the screen shall be tripped and an alarm generated. The reverse function shall be effective only in the low speed mode.

5. Speed reducer shall be fully enclosed of the helical or bevel gear type. Minimum B-10 bearing life shall be 100,000 hours. Reducer shall meet the AGMA standards for moderate shock, 24-hour, Class II service with a service factor of 1.25 minimum.

E. Safety Pull Cords

1. Screens shall be equipped with safety trip cords.

F. Sensors

1. Radar level sensors will be provided by the integrator. The main plant control system will provide ON, OFF, LOW SPEED and HIGH SPEED commands to the screening contractors control panel

2.03 COMPACTOR

A. Shafted screw compactor shall consist of a shafted screw, sieve zone, wash zone, press zone, transport zone, collection pan and discharge tube.

1. Compactor shall be designed for the quantity of screenings and shall provide the volume reduction and dryness of discharged screenings as listed on Schedule.

2. Compactor be installed at an incline on support legs designed for all loading conditions and with 4-inches height adjustment.

3. Compactor shall be of 304 stainless steel construction.

B. Shafted Screw Assembly

1. Screw shall consist of a spiral welded to mechanical tubing. The mechanical tubing shall be welded to an end shaft. Screw shall be manufactured from one (1) concentric flight formed from 304 stainless steel and welded to form a single spiral.

2. Diameter of the shafted screw assembly shall be 12-inches and consistent over its length. One nylon abrasive resistant brush shall be tack welded to the screw.

3. Screw pitch shall reduce to 66% of the screw outer diameter in the press zone with the final quarter pitch hard faced.

C. Sieve Zone

1. The sieve zone shall tubular in design with an integral collection pan and an inlet chute to accept screenings from the bar screen.

2. The Sieve Zone shall be manufactured from minimum 11 gauge Grade 304 stainless steel and minimum 14 gauge perforated grade 304 stainless steel. The perforations shall be 0.125-inches diameter.

3. The Sieve Zone shall include one inlet hopper to direct screenings from its associated mechanically cleaned bar screen into the compactor. The inlet hoppers shall be constructed of 14 gauge grade 304 stainless steel and shall be bolted to the transport zone of the U-Trough.

D. Wash Zone

1. The wash zone shall tubular in design with an integral collection pan located directly under the zone. The wash zone shall wash screenings and reduce the organic content.

2. The wash zone shall be constructed of minimum 11 gauge perforated grade 304 stainless steel plate and minimum 14 gauge grade 304 stainless steel plate. The perforations shall be 0.125-inches diameter.

3. The wash zone shall consist of a spray header fitted with two (2) spray nozzles to provide cleaning of screenings before compacting. The wash zone supply water shall be approximately 10 GPM at 40psi. The wash zone shall include a solenoid valve to control the flow of water into the Wash Zone. The Wash zone shall include a solenoid valve, isolation ball valve and manual flow control valve shipped loose to control the flow of water.

E. Transport Zone

1. The transport zone shall be tubular in design and constructed of minimum 11 gauge grade 304 stainless steel.

2. The transport zone shall be fitted with wear bars constructed of minimum 3/8" thick carbon steel. The wear bars shall be bolted from the outside of the transport zone.

F. Press Zone

1. The press zone design shall tubular in design with an integral collection pan located directly under the zone.

2. The press zone shall be constructed of minimum 11 gauge grade 304 stainless steel.

G. Collection Pan

1. The U shaped collection pan shall be located directly under the sieve zone, be constructed of 304 stainless steel minimum 14 gauge thickness and connected to the compactor with quick release clamps.

2. Periodically flush water shall be sprayed into the collection pan to remove organics and other fine particles to drain. The collection pan water supply shall be approximately 10 gpm at 40 psi. Typically flush water will run 5 seconds out of every 20 seconds and be operator adjustable. Collection pan shall be equipped with a 3-inch diameter flanged drain connection.

H. Discharge Tube

1. The discharge tube shall be fabricated from minimum 14 gauge 304 stainless steel and configured with bends and discharge height as shown. Tube shall increase in diameter over its length to minimize plugging. Manufacturer shall provide discharge tube supports.

2. Contractor is responsible to coordinate the discharge tube termination with the receiving hopper.

I. Drive System

1. Drive motor have the minimum horse power as listed on Schedule and shall be rated for a Class 1 Div 1 area.

2. Speed reducer shall be fully enclosed of the helical or bevel gear type. Minimum B-10 bearing life shall be 100,000 hours. Reducer shall meet the AGMA standards for moderate shock, 24-hour, Class II service with a service factor of 1.25 minimum.

J. Safety Pull Cord

1. Compactors shall be equipped with safety trip cords.

K. Sensors

1. A proximity sensor shall be provided to detect the screw rotation. The sensor shall be mounted towards the discharge end of the compactor and away from the drive. When when the screw is supposed to be moving and the sensor records zero movement of the screw the system shall immediately stop and initiate an alarm contact. Provide appropriate timing mechanism and interlocks to allow for proper startup from stopped position.

L. Finishes

1. After all fabrication and welding has been completed all stainless steel surfaces shall be glass Bead Blasted prior to equipment assembly. The Bead Blast shall remove all weld discoloration and surface contaminants and provide for Spontaneous Passivation as recognized in ASTM A380-99.

2.04 CONTROLS

A. The control system for the screens and compactors shall be provided by the manufacture and shall consist of two main control panels, one for Screens 1, 2 with associated compactors and another for Screens 3 and 4 with associated compactors. The main panels shall have painted NEMA 12 stainless steel enclosures and suitable for wall or floor mounting. Provide threaded hubs in sufficient quantity for all cables and conenctions to sensors, floats, SCADA, power, etc.

B. Panel enclosures shall be furnished with a flange mounted disconnect switch, main circuit breaker, control power transformer, surge arrester and be suitable for connection to a 480 volt, 3-phase, 60 Hertz feeder circuit.

C. Main control panel shall be equipped with screen drive motor VFD, compactor FVNR starter, Allen Bradley 1400 PLC, an HMI, Ethernet communication with copper to fiber media converter and all required indicating lights, push buttons, selector switches and alarm lights.

D. The main control panel PLC's shall meeting the requirements of Section 17311.

E. Panel construction shall be in conformance with Section 17430.

F. All PLC monitored data and HMI information shall be made available to via Ethernet to Owner's SCADA system. Manufacturer shall coordinate with Contractor for addressing and tagging.

G. Control system will include operator input and adjustment for:

1. On – Off switch
2. Wash water Open-Close-Auto
3. Flush water Open-Close-Auto
4. Elapsed time meters
5. Reset Buttons
6. Low speed water differential set level (From Owner PLC)
7. High speed water differential set point (From Owner PLC)
8. High-High water level set point (From Owner PLC)
9. Screen exercise run timers
10. Compactor On delay timer
11. Compactor Off Delay timer
12. Compactor wash water solenoid on timers
13. Compactor flush water solenoid on timers

H. Control system will accept inputs:

1. Screen start
2. Compactor Start
3. Truck Loading Start
4. Truck Loading Complete
5. Discharge Screw Conveyor Jammed
6. Low Speed run command
7. High Speed run cammand
8. High High input

I. Control system will provide output:

1. Screen in remote
2. Compactor in remote
3. Screen running
4. Call to start Compactor
5. Compactor running
6. Screen common fault alarm
7. Compactor common fault alarm
8. E-stop or Safety trip cord

J. Local controls stations NEMA 7 copper free aluminum complying with NEMA 3R and NEMA 4 shall be provided for each piece of equipment.

1. Screen Local Station
    a. Hand-Off –Remote
    b. Forward-Off-Reverse (Reverse with spring return)
    c. E-stop
    d. Running Light

e. Alarm Light

2. Compactor Local Station

a. Hand-Off-Remote

b. Start and Stop

c. E-stop

d. Running Light

e. Alarm Light

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verification of Conditions: Contractor shall be responsible for field verification of Conditions. Verification shall include, but shall not be limited to, opening dimensions, height clearances and channel dimensions and ability to install as a unit without major modifications to the structure.

3.02 PREPARATION

A. Surface Preparation and Protection: The surface preparation and protection for any mechanism damaged during transit to Site shall be in accordance with Section 09961.

3.03 ERECTION

A. Equipment provided under this Section shall be fabricated, assembled, erected, and placed in proper operation condition in full conformity with detail drawings, specifications, engineering data, instructions, and recommendations of equipment manufacturer approved by Engineer.

3.04 INSTALLATION

A. The equipment shall be erected in strict conformance with manufacturer's recommendations. Prior to start-up the manufacturer shall certify in writing that the completed installation is in accordance with manufacturer's recommendations.

B. An experienced, competent, and authorized representative of the manufacturer or supplier of each item of equipment shall visit Site of Work a minimum of 2 times, once prior to installation to review installation procedures with Contractor and once after installation to inspect, check, adjust if necessary, and approve the equipment's installation. The equipment supplier's representative shall revisit Site as often as necessary until all trouble is corrected and the equipment installation and operation is satisfactory to Engineer.

C. Manufacturer's representative shall provide all necessary tools and testing equipment required including noise level and vibration sensing equipment.

D. Each equipment supplier's representative shall furnish to Owner, through Engineer, a written report certifying that the equipment:

1. Has been properly installed and lubricated;
2. Is in accurate alignment;
3. Is free from any undue stress imposed by connecting piping or anchor bolts;
4. Has been operated under full load condition and that it operated satisfactorily to Engineer;

5. That Owner's Representative has been instructed in the proper maintenance and operation of the equipment; and
6. Furnish Owner a copy of all test data recorded during the installation check including noise level and vibration readings.

3.05 FIELD QUALITY CONTROL

A. Mechanical Bar Screen Testing: After completion of the installation, the screening unit shall be tested by Contractor in the presence of Engineer. Contractor shall test the equipment under "dry" conditions. The tests shall indicate that the equipment operates properly, has necessary clearances, operates without overheating or overstressing of any parts, provides positive overload protection, and in all other respects meets all requirements of the Specifications. The tests shall be conducted under the supervision of the manufacturer's representative.

B. Inspection: After completion of installation the manufacturer's factory representative shall inspect the installation of all equipment installed in this Section. Following field testing, manufacturer's factory representative shall inspect the equipment to verify that the mechanism operates properly and that there was no damage to the equipment during installation and testing.

C. Manufacturer's Field Service: Manufacturer shall provide the services of a factory-trained service engineer, specifically trained on the type of equipment specified to assist in the installation and start-up of the equipment and train personnel in the operation and maintenance of the equipment as listed below in this Section.

3.06 CLEANING

A. Contractor shall be responsible for the cleaning of all equipment provided under this Section, prior to acceptance by Owner.

3.07 PROTECTION

A. The equipment provided in this Section shall be protected during shipment in accordance with manufacturer's recommendations. In cases where the equipment is to be stored on-site until installation, Contractor shall store equipment according to manufacturer's recommendations.

B. Once installed and prior to acceptance Contractor shall protect the equipment from any damage. If damage occurs, it shall be rectified promptly prior to acceptance by Owner.

3.08 OPERATION AND MAINTENANCE TRAINING

A. Provide services of manufacturer's service representative to instruct Owner's personnel in operation and maintenance of equipment. Training shall include start-up and shutdown, servicing and preventative maintenance schedule and procedures, and troubleshooting procedures plus procedures for obtaining repair parts and technical assistance.

1. Manufacturer’s representative shall provide two (2) days consisting of eight (8) hours each day for a total of sixteen (16) person hours of on-Site training
2. Review operating and maintenance data contained in the operating and maintenance manuals.
3. Schedule training with Owner, provide at least 7-day prior written notice to Engineer.

SCREENING EQUIPMENT SCHEDULE

	Inclined Bar Screen	**Compactors**
No. of Units:	4	4
Type:	Mechanically Cleaned	Shafted Screw
Location:	Screen Room	Screen Room
Capacity:		
Average:	16 mgd	
Maximum:	50 mgd	104 cf/hr uncompacted
Channel Width:	4’-6”	
Channel Depth:	11’	
Bar Rack:		
Bar Clear Spacing:	0.25”	
Angle of Inclination:	5 deg from Vertical	
Height of Screen Field:	10’	
Screenings Volume Reduction (min):		50%
Screenings Moisture Content (max):		65%
Motor Description:	480/3/60, TEEP	480/3/60, TEEP
Speed Variation:	Variable Speed	Constant
Minimum HP:	5	5
Maximum Speed:	1,800 rpm	1,200 rpm

END OF SECTION