SECTION 221329

SANITARY SEWERAGE PUMPS

PART 1 - GENERAL REQUIREMENTS

1.01 SUMMARY

A. This Section includes the following types of plumbing pumps:

1. Sewage ejectors

B. Related Sections: The following sections contain requirements that relate to this Section:

1. Division 3 Section "Concrete Work" for specifications on concrete and reinforcing materials and concrete placing requirements for sump basins and covers.
2. Division 22 Section “Coordination” for basic requirements for electrical components that are an integral part of packaged system components.
3. Division 22 Section "Basic Piping Material and Methods," for materials and methods for mechanical sleeve seals.
4. Division 22 Section “Sanitary Drainage and Vent Piping and Specialties” for sewage ejector discharge pipe material and installation requirements.
5. Division 23 Section “Direct-Digital Control for HVAC” for interlock of alarms with building automation system and alarm wiring.
6. Division 26 Section “Common Work Results for Electrical” required electrical devices.
7. Division 26 Sections "Enclosed Switches and Circuit Breakers" for field-installed disconnects.

1.02 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

1. Product data including standard performance curves, weights (shipping, installed, and operating), furnished specialties, and accessories, plus installation and start-up instructions.
2. Shop drawings showing layout and connections for plumbing pumps. Include setting drawings with templates, and directions for installation of foundation bolts, anchor bolts, and other anchorages.
3. Wiring diagrams detailing wiring for power, signal, and control systems; differentiating between manufacturer-installed wiring and field-installed wiring.
4. Maintenance data for plumbing pumps, for inclusion in Operating and Maintenance Manuals specified in Division 1 and Division 22 Section "General Plumbing Requirements."

5. Shop drawings showing basins with depth, inlet, outlet and vent locations, pit covers, float switches, non-clog check valves and shutoff valves.

1.03 QUALITY ASSURANCE

A. Hydraulic Institute Compliance: Design, manufacture, and install plumbing pumps in accordance with "Hydraulic Institute Standards."

B. National Electrical Code Compliance: Components shall comply with NFPA 70 "National Electrical Code."

C. UL Compliance: Control panels shall be listed and labeled by UL and comply with Standard 508A “Control Panels”.

D. NEMA Compliance: Electric motors and components shall be listed and labeled NEMA.

E. SSPMA Compliance: Test and rate sewage pumps in accordance with the Sump and Sewage Pump Manufacturers Association (SSPMA) Standards.

F. Single-Source Responsibility: Obtain plumbing pumps of the same type from a single manufacturer.

G. Manufacturers Standardization Society of the Valve and Fittings Industry (MSS) Compliance: Comply with the MSS Standard Practices below:

1. MSS SP 72 “Ball Valves with Flanged or Butt Welding Ends”
2. MSS SP 110 “Ball Valves, Threaded, Socket Welding, Solder Joint, Grooved and Flared Ends”

H. Valves shall be manufactured in plants located in the United States or certified that they comply with applicable ANSI, ASTM and MSS standards.

I. Design Criteria: The Drawings indicate sizes, profiles, connections, and dimensional requirements of plumbing pumps and are based on the specific manufacturer types and models indicated. Pumps having equal performance characteristics by other manufacturers may be considered, provided that deviations in dimensions and profiles do not change the design concept or intended performance as judged by the Architect. The burden of proof for equality of plumbing pumps is on the proposer.

1.04 SPARE PARTS

A. Furnish spare parts described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Mechanical Seals: One mechanical seal for each pump.

1.05 WARRANTY

A. Warranty on Pumps: Provide written warranty, signed by manufacturer, agreeing to replace/repair, within warranty period, pumps with inadequate or defective materials and workmanship, including leakage, breakage, improper assembly, or failure to perform as required; provided manufacturer's instructions for handling, installing, protecting, and maintaining units have been adhered to during warranty period. Replacement includes both parts and labor for removal and reinstallation.

1. Warranty Period: One year from date of substantial completion.

PART 2 - PRODUCTS AND MATERIALS

2.01 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the following:

1. Sewage Pump High Level Alarms:

   a) Weil Pump Company
   b) Zoeller Pump Company
   c) SJE Rhombus

2. Submersible Sewage Ejectors:

   a) ABS Pump, Inc.
   b) FLYGT
   c) Weil Pump Company

3. Full Port Bronze Ball Valves – 2" and smaller:

MANUFACTURER	THREADED ENDS	SOLDER ENDS
Apollo	77C-100	77C-200
Hammond	8301A	8311A
Milwaukee	BA-400	BA-450
Nibco	T-585-70	S-585-70

4. Non-Clog "Flapper Type" Check Valves:

   a) Liberty Pumps "Series CVXXXC"
   b) Little Giant Pump Company "Series CV-SE"
   c) Zoeller Pump Company "Series 30"

5. Cast Iron "Sinking Ball Type" Non-Clog Check Valves - 2" and smaller:

   a) Flomatic"208".
   b) FLYGT "2002"
   c) GW Industries, Inc. "240T"

6. Basin Covers:

   a) Bilco
   b) U.S.F. Fabrication

7. Epoxy Basin Liner:

a) TNEMEC "PERMA-SHIELD H_2S" #Series 434 TNEMEC Liner or as specified by the Architect

2.02 PUMPS, GENERAL

A. Pumps: factory assembled and factory tested.

B. Preparation for shipping: After assembly and testing, clean flanges and exposed machined metal surfaces and treat with an anticorrosion compound. Protect flanges, pipe openings, and nozzles with wooden flange covers or with screwed-in plugs.

C. Motors: Conform to NEMA standards; single, multiple, or variable speed with type of enclosure and electrical characteristics as indicated; have built-in thermal-overload protection and grease-lubricated ball bearings. Select motors that are non-overloading within the full range of the pump performance curve.

D. Apply factory finish paint to assembled, tested units prior to shipping.

2.03 SIMPLEX SEWAGE PUMPS – ¾ HP AND SMALLER

A. General Description: Pumps shall be simplex centrifugal, direct connected, floor mounted, single stage type with cast iron body, stainless steel shaft, cast iron impeller, mechanical seal, permanently lubricated upper and lower ball bearings complete with integral inlet strainer, mechanical float switch, and power cord with ground.

B. Casing: Cast iron with integral cast-iron inlet strainer and legs to elevate the pump to permit flow into the impeller. Pump casing, volute and impeller shall pass a 2" diameter sphere. Vertical discharge with screwed female connection.

C. Impeller: Statically and dynamically balanced, open or semiopen, overhung, single suction, fabricated from cast iron, keyed to shaft and secured by a locking capscrew.

D. Pump and Motor Shaft: Stainless steel, with factory-sealed, upper and lower grease-lubricated ball bearings.

E. Seals: Single mechanical seal with carbon steel rotating ring, stainless-steel spring, ceramic seat, and Buna-N bellows and gasket.

F. Motor: NEMA 6 with class F insulation, hermetically sealed, 1750 RPM, capacitor start, air filled with built-in overload protection, with 3-conductor, waterproof cable and grounding plug.

G. Basin: Cast in place concrete or pre-cast concrete, refer to structural drawings.

1. Coat basin with two part epoxy basin liner.

H. Cover: Epoxy coated steel or aluminum gasketed round cover with holes for discharge piping, vent and conduits. Access cover shall be completely flush for all for discharge piping, vent and conduits entering or exiting the sump pit under the slab as indicated on the drawings.] [Provide integral or separate cover for valves.] [Provide cover rated for AASHTO H-20 loading.

I. Controls: NEMA 1, tethered float switch for "on-off" control with "piggy back" power cord connection for sump pump power cord.

2.04 SEWAGE PUMP HIGH LEVEL ALARMS

A. Alarm: Remote type 120V single phase with NEMA 4X enclosure, terminal block, 5 amp isolated alarm contact, alarm horn, alarm light, test-automatic-silence switch and mechanical float switch.

2.05 SEWAGE EJECTORS

A. General Description: Pumps shall be duplex centrifugal, direct connected, floor mounted, single stage grinder type with cast iron body, stainless steel shaft, cast iron impeller, mechanical seal, permanently lubricated upper and lower ball bearings complete, control panel, mechanical float switch, and power cords with grounds.

B. Casing: Cast iron with integral cast-iron legs to elevate the pump to permit flow into the impeller. Pump casing, volute and impeller shall pass a 2" diameter sphere. Horizontal discharge companion flange and rail retrieval system.

C. Rail Retrieval System: Provide with cast iron floor elbow, gasket, anchor bolts, yoke, pipe guides, stainless steel rope, and upper guide bracket.

D. Impeller: Statically and dynamically balanced, open or semiopen, overhung, single suction, fabricated from cast iron, keyed to shaft and secured by a locking capscrew.

E. Impeller: Statically and dynamically balanced enclosed, overhung, single suction, fabricated from bronze, keyed to shaft and secured by a locking capscrew. Grinder shall be a 440c stainless steel rotating cutter attached to the motor shaft with stationary shredder ring attached to the pump inlet.

F. Pump and Motor Shaft: Stainless steel, with factory-sealed, upper and lower grease-lubricated ball bearings.

G. Seals: Single mechanical seal with carbon steel rotating ring, stainless-steel spring, ceramic seat, and Buna-N bellows and gasket.

H. Seals: Tandem mechanical seals mounted in cast iron body seal chamber with upper seal of carbon rotating ring, stainless-steel spring, ceramic seat, and Buna-N bellows and gasket and lower seal of silicon carbide rotating ring, stainless-steel spring, silicon carbide seat, and Buna-N bellows and gasket.

I. Motor: Hermetically sealed, with built-in overload protection, air filled, 1750 RPM, NEMA class B insulation capable of a maximum continuous operating temperature of 120F, 3-conductor and waterproof cable.

J. Basin: Fiberglass reinforced plastic, PVC plastic is not acceptable, with a minimum wall thickness of 3/16", 2" wide retainer ring at the basin bottom and every four feet and factory pipe penetration connection kits. Refer to the drawings for basin dimensions.

K. Basin: Cast in place concrete or pre-cast concrete, refer to structural drawings.

1. Coat basin with two part epoxy basin liner.

L. Cover: Epoxy coated steel or aluminum gasketed round cover with holes for discharge piping, vent and conduits. Access cover shall be completely flush for all for discharge piping, vent and conduits entering or exiting the sump pit under the slab as indicated on the drawings.] [Provide integral or separate cover for valves.] [Provide cover rated for AASHTO H-20 loading.

M. Controls: NEMA 4X fiberglass dead front door enclosure, complete with lockable combination circuit breaker magnetic motor starter and 3 leg overload protection for each motor; internal test-off-automatic selector switches, overload relays and indicator lights, resets, 120V control circuit transformer fused on primary and secondary, automatic alternator for alternating lead-lag pump selection and to provide for both pumps to operate simultaneously under high level condition, hour meter for each pump, high level alarm horn and light with test-off-automatic switch, moisture sensor alarm light for each pump, auxiliary alarm contacts for each alarm condition and terminal board for connection of lines, pumps, and level sensors. Circuit breakers shall have minimum AIC rating as indicated on the Electrical Drawings. Control panel shall have a unit short circuit current rating equal to or greater than the available short circuit current as indicated on the electrical drawings. [Controls shall be configured for terminating one incoming power feeder. Refer to control drawings for interlock of alarm contacts with the building automation system.

N. VFD Controls: NEMA 4 enclosure with dead front door with lockable through door disconnect, programmable logic controller (PLC), lockable combination circuit breaker magnetic motor starter and 3 leg overload protection with reset for each motor, internal test-off-automatic pump run switches, 120V control circuit transformer fused on primary and secondary, terminal board for connection of pumps and level sensors and lightening arrestor. Provide with power "on" indicator light, overload relays, high level alarm relay, light and horn, second pump running alarm relay, failsafe relay, PLC Failure alarm relay, moisture sensor alarm for each pump, temperature limiter circuit alarm for each pump, auxiliary alarm contacts for each alarm condition. Provide with level transmitter with base and (3) redundant float switches. Circuit breakers shall have minimum AIC rating as indicated on the Electrical Drawings. Control panel shall have a unit short circuit current rating equal to or greater than the available short circuit current as indicated on the

electrical drawings. Controls shall be configured for terminating one incoming power feeder. Refer to control drawings for interlock of alarm contacts with the building automation system.

1. Touchscreen operator interface for monitoring and adjustment of the programmable controller variables with virtual on-off-automatic selector switch for each pump, high level alarm, pump running indicators, thermal overload indicator for each pump, moisture indicator for each pump and virtual hour meter for each pump. Second pump running alarm. PLC shall alternate lead-lag pump selection and to provide for two pumps to operate simultaneously under high level condition with third pump as standby. PLC shall alternate standby pump as "first "on" pump" after end of each pumping cycle.
2. Programmable Logic Controller (PLC): Designed specifically for the control of pumps with variable speed drives capable of receiving two analog pressure inputs, analog flow input, automatic pump alternating and On-line field modified data entries for staging pumps, with software memory stored in non-volatile EPROM memory, furnish with user interface keypad with LED display.
3. Variable Speed Drive: The variable speed drives (VFD) shall be adjustable frequency which employ a pulse width modulated inverter. The drive shall include built in diagnostics. Diagnostics shall be annunciated through the alpha numeric keypad. The drive shall be listed UL, ETL and/or CSA. To ensure safety of the equipment, the VFD shall include these protective features and options:

a) NEMA 1 enclosure.
b) Static instantaneous over-current and over-voltage trip.
c) Static over-speed (over-frequency) protection.
d) Line or fuse loss and under-voltage protection.
e) Power unit over-temperature protection.
f) Motor inverse time overload protection.
g) Input fused disconnect or circuit breaker.
h) Total voltage harmonic distortion from the VFD shall be less than 5% to meet IEEE requirements.
i) Speed meter.
j) Automatic restart after power failure or minor drive fault. The drive shall attempt a minimum of two restarts before a complete drive shut-down.
k) Power on light.
l) Manual speed potentiometer or control capability through the keypad.
m) Hand/Off/Automatic Switch or Manual/Automatic Switch with start/stop pushbutton.
n) Test switch
o) VFD fault light and reset.
p) Output to the PLC and integral LED display
q) The VFD shall be microprocessor based and utilize digital input for all parameter adjustments. The VFD shall include a digital display for monitoring system

parameters and for first fault indication, and digital input programming capability on the main logic board.

r) The VFD shall operate on a frequency range of 1 to 66 Hz with resolution of 0.1% of base speed with analog input or 0.025% with digital input and have accuracy within 0.05% of set point. VFD shall operate in environment of 0 to 40 degrees C, 3,300 feet altitude and 95% non-condensing humidity without derating.

s) All control circuit voltages shall be physically and electrically isolated from power circuit voltages.

4. All VFD's shall be tested/run in the equivalent of NEMA 1 enclosure and burned in at rated ambient (40° C) with a fully loaded motor.

5. Sequence of operation:

a) Minimum run speed is 48Hz or 1400 rpm

b) The sewage ejector shall be in automatic mode.

c) When the water level rises from the level of pumps "off" to the level of first pump "on", the PLC shall start the lead pump. The PLC shall modulate the pump speed to maintain the water level in the pit at the level of first pump "on".

d) If water level rises to the water level of second pump "on", the PLC shall start the lag pump with a minimum run speed of 1400 rpm and the first pump will run with a minimum run speed of 1400 rpm. The PLC shall modulate the pumps speed to maintain the water at the level of second pump "on". When water level drops to the level of first pump "on", the PLC shall stop the lead pump.

e) When the PLC runs the pump at 48Hz or 1400 rpm and the water level drops to the level of pump "off", the PLC shall stop the pump. The lag pump shall start for the next control sequence. If a pump runs continuously for 24 hours, the PLC shall stop the lead pump and start the lag pump.

6. Safeties:

a) High Level Alarm

1) When the water level rises to the level of "high level alarm" an audible alarm shall sound and an alarm signal shall be sent to the BMS or local building alarm system.

b) Second Pump Running Alarm

1) When the water level rises to the level of second pump "on", an alarm signal shall be sent to the BMS or local building alarm system.

c) Moisture Sensor Alarm

1) When the moisture sensor in each pump senses moisture, an alarm "light" shall appear in the touch screen and an alarm

signal shall be sent to the BMS or local building alarm system.

d) High Temperature Sensor Alarm

1) When the temperature sensor in each pump senses moisture, an alarm "light" shall appear in the touch screen and an alarm signal shall be sent to the BMS or local building alarm system.

e) Level Transmitter Failure and Alarm

1) If the level transmitter fails to send control signal to the PLC, the PLC shall shift control of the pumps via the failsafe relay to use the float switches to control the pumps at full speed. When water level rises to the water level of first pump "on", lead pump shall start. When water level drops to the level of pumps "off" the lead pump shall stop. The lag pump shall start for the next control sequence

2) When the level transmitter fails to send control signal to the PLC, an alarm "light" shall appear in the touch screen and an alarm signal shall be sent to the BMS or local building alarm system.

f) PLC Failure and Alarm

1) If the PLC has loss of power or logic failure, the failsafe relay shall use the float switches to control the pumps at full speed. When water level rises to the water level of first pump "on", lead pump shall start. When water level drops to the level of pumps "off" the lead pump shall stop. The lag pump shall start for the next control sequence

2) The failsafe relay shall send a "PLC Failure Alarm" alarm signal to the BMS or local building alarm system.

O. Level Controls: Pole mounted tethered float switches with chord grips, pole mounting plate and cover. Float switches shall be 120V 3 amp single pole normally open that closes on the rise for pump "off", first pump "on" second pump "on" and high level alarm.

P. Junction Box: NEMA 6P enclose of fiberglass reinforced polyester with fully gasketed cover, terminal strip and inlets and outlets for four control and two power connections.

Q. Remote Alarm Panel: NEMA 1 enclosure with individual 115v power source, alarm lights for high water alarm, standby pump running and control power failure with alarm buzzer with silencing switch and auxiliary alarm contacts for each alarm condition. Refer to control drawings for interlock of alarm contacts with the building automation system.

R. Disconnect: Disconnect is provided under Division 26 Section “Enclosed Switches and Circuit Breakers”.

2.06 BALL VALVES

A. Ball Valves, 2 Inch and Smaller: Meeting MSS SP 110, Class 150, 600-psi CWP; two-piece construction; with ASTM B 584 cast bronze, full port, blowout-proof stem and chrome-plated brass ball, with replaceable "Teflon" or "TFE" seats and seals, solder or threaded ends and vinyl-covered steel handle.

B. Cast Iron Body Ball Valves, 2-1/2” and larger: Meeting MSS SP 72, 200-psi CWP, maximum operating temperature of 140F; two piece cast iron body meeting ASTM A126 Class B with flanged ends, 304 stainless steel full port ball and shaft, ductile iron handle, PTFE gasket, stem seal and seat.

2.07 CHECK VALVES

A. Non Clog “Flapper Type” Check Valves, 2 Inch and Smaller: Flapper type with PVC body compression end fittings with Buna-N “O” ring and Buna-N flapper with PVC shields.

B. Non Clog “Sinking Ball Type” Check Valves: Sinking ball type with cast iron body, steel ball with hollow core and Buna-N coating. Valve body shall be configured for unobstructed flow. Valves 2” and smaller with screwed ends and valves 2-1/2” and larger with flanged ends.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer’s installation instructions.

B. General: Comply with the manufacturer's written installation and alignment instructions.

C. Install pumps in locations and arrange to provide access for periodic maintenance, including removal of motors, impellers, couplings, and accessories.

D. Support pumps and piping separately so that the weight of the piping system does not rest on the pump.

3.02 EXAMINATION

A. Examine areas, equipment foundations, and conditions with Installer present, for compliance with requirements for installation and other conditions affecting performance of plumbing pumps. Do not proceed with installation until unsatisfactory conditions have been corrected.

B. Examine rough-in for plumbing piping systems to verify actual locations of piping connections prior to installation.

3.03 CONNECTIONS

A. General: Install valves that are same size as the piping connecting the pump.

B. Install discharge pipe sizes equal to or greater than the diameter of the pump nozzles. Sewage ejector discharge pipe material is specified in Division 22 Section "Sanitary Drainage and Vent Piping and Specialties".

C. Install a non-clog check valve in an accessible location or where indicated on the drawings. Install a full port ball valve on the discharge side of sewage ejectors downstream of the check valve.

D. Electrical wiring and connections are specified in Division 26 Section "Common Work Results for Electrical".

E. Install sewage ejector inlets or outlets to sump basins in the field at the required elevation. Seal penetrations with mechanical link seals. Mechanical link seals are specified in Division 22 Section "Basic Piping Material and Methods." See drawings for inlet and outlet elevations.

F. Coordinate interlock of sewage pump high level, two moisture sensor, two high temperature shutdown, and two overload alarms with building automation system. Alarm wiring and alarm interlock with the building automation system are specified in Division 23 Section "Direct-Digital Control for HVAC".

G. Coordinate interlock of sewage pump high level, two moisture sensor, two high temperature shutdown, two overload alarms, second pump running alarm, PLC failure alarm and level transmitter failure alarm with building automation system. Alarm wiring and alarm interlock with the building automation system are specified in Division 23 Section "Direct-Digital Control for HVAC".

3.04 FIELD QUALITY CONTROL

A. Pressure Testing: Perform a pressure test on the discharge assembly. The test pressure shall be twice that of the shut off head of the pump.

B. Valve Testing: After piping systems have been tested and put into service, but before final adjusting and balancing, inspect valves for leaks. Adjust or replace packing to stop leaks; replace valves if leak persists.

3.05 STARTUP

A. Final Checks Before Start-Up: Perform the following preventative maintenance operations and checks before start-up:

1. Lubricate oil-lubricated bearings.

2. Remove grease-lubricated bearing covers and flush the bearings with kerosene and thoroughly clean. Fill with new lubricant in accordance with the manufacturer's recommendations.
3. Disconnect coupling and check motor for proper rotation. Rotation shall match direction of rotation marked on pump casing.
4. Check that pump is free to rotate by hand. For pumps handling hot liquids, pump shall be free to rotate with the pump hot and cold. If the pump is bound or even drags slightly, do not operate the pump until the cause of the trouble is determined and corrected.

B. Starting procedure for pumps with shutoff power not exceeding the safe motor power:

1. Prime the pump, opening the suction valve, closing the drains, and prepare the pump for operation.
2. Start motor.
3. Open the discharge valve slowly.
4. Observe the leakage from the stuffing boxes and adjust the sealing liquid valve for proper flow to ensure the lubrication of the packing. Do not tighten the gland immediately, but let the packing run in before reducing the leakage through the stuffing boxes.
5. Check the general mechanical operation of the pump and motor.

C. If the pump is to be started against a closed check valve with the discharge shut-off valve open, the steps are the same except that the discharge shut-off valve is opened some time before the motor is started.

END OF SECTION