100% PROJECT MANUAL

# COMMERCE 2.0 MGD GROVE CREEK WPCP

## COMMERCE, GEORGIA

for

## CITY OF COMMERCE

**BID DOCUMENTS**

March 2025

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**GMC PROJECT NUMBER**: CATL230033

STATE OF GEORGIA
GOODWYN MILLS CAWOOD, LLC
No.PEF007898
Exp.06.30.2026
CERTIFICATE OF AUTHORIZATION

GEORGIA
REGISTERED
No. PE051452
PROFESSIONAL
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03.19.2025
ENGINEER
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**COMMERCE 2.0 MGD GROVE CREEK**
**WATER POLLUTION CONTROL PLANT**

**FOR**

**CITY OF COMMERCE**

**COMMERCE, GEORGIA**

**GMC PROJECT NO. CATL230033**

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# SECTION 43 23 13 – REUSE VERTICAL TURBINE PUMPS

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Scope

1. To provide a single source responsibility for the manufacture, warranty, service, and operation of a prefabricated, skid mounted, fully automatic pumping system for reuse water.

B. Related Requirements:

1. Section 09 96 00 – High-Performance Coatings
2. Section 26 – Electrical
3. Section 27 – Communication
4. Division 40 – Process Integration
5. Section 40 05 13 - Common Requirements for Process Piping

### 1.2 REFERENCE STANDARDS

A. American Bearing Manufacturers Association:

1. ABMA 9 - Load Ratings and Fatigue Life for Ball Bearings.
2. ABMA 11 - Load Ratings and Fatigue Life for Roller Bearings.

B. ASME International:

1. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings.

C. ASTM International:

1. ASTM A29 - Standard Specification for General Requirements for Steel Bars, Carbon and Alloy, Hot-Wrought.
2. ASTM A536 - Standard Specification for Ductile Iron Castings.
3. ASTM A744 - Standard Specification for Castings, Iron-Chromium-Nickel, Corrosion Resistant, for Severe Service.

### 1.3 COORDINATION

A. Section 01 31 00 – Project Management and Coordination: Requirements for scheduling.

B. Coordinate installation and startup of Work of this Section with plant operations.

1.4 SCHEDULING

A. Section 01 31 00 – Project Management and Coordination: Requirements for scheduling.

B. Schedule Work of this Section to install pumps prior to connecting piping Work.

1.5 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Full set of mechanical drawings including skid dimensioning, connection dimensions, anchor bolt location and typical installation, and equipment layout, all to scale

C. Full electrical schematic, including three line power schematic, control ladder logic, PLC and SCADA system interface, labeled as to identification and function so as to be easily understood.

D. In order to assure that all welding will be accomplished according to ASME standards, submit copies of all fabricating employees' ASME Section IX pressure vessel certification and AWS D1.1 structural certification. Only those employees with said welding certificates submitted shall weld on the structural or piping portions of the system.

E. Properly indicated pump curves, whose total dynamic head includes pumping system internal losses, manufacturer's name (other than pumping system manufacturer), pump model number, and motor type, RPM and horsepower.

F. Properly marked cut sheets for each major component of the pumping system, both mechanical and electrical.

G. Copies of UL and ETL authorizations for control panels, and for complete pumping system.

H. Manufacturer's current ISO9001:2015 certificate.

I. Complete description of the system including:
1. Submittal schedule,
2. Shipment schedule after receipt of approved submittals,
3. Specification section number relevant to the submittal,
4. Technical information
    a. system model number,
    b. design GPM,
    c. rated system suction pressure or lift,
    d. rated system discharge pressure,
    e. voltage phase and frequency of required power,
    f. system approximate dry weight
    g. system footprint
5. Operation sequence,
6. Alarm sequence,
7. Mechanical major component properly marked cut sheets,
8. Electrical major component properly marked cut sheets,
9. Manufacturer recommended spare parts list,

10. SCADA interface (if required), whether via Ethernet of discrete components,
11. Post production features,
12. Owner's manual description,
13. Shipment method and carrier type,
14. Notes clarification and exceptions,
15. Receiving instructions,
16. Storage instructions
17. Warranty statement

1.6 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.

B. Project Record Documents: Record actual locations and final orientation of equipment and accessories.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Deliver materials in manufacturer's packaging, including application instructions.

C. Inspection: Accept materials on-Site in original packaging. Inspect for damage.

D. Store materials according to manufacturer's instructions.

1.8 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.

B. The Manufacturer and Contractor shall furnish a warranty extending twelve (12) months after substantial completion date of the project in its entirety.

PART 2 - PRODUCTS

2.1 MANUFACTURER

1. SyncroFlo, Inc., Norcross, Georgia

2. Or Pre-Approved Equal.

a. Reference Section 01 60 00 for product substitution procedures for information pertaining to alternate products

2.2 VERTICAL TURBINE PUMPS

A. Vertical turbine type pumps shall be supplied. The vertical turbine pumps shall be manufactured according to the standards of the Hydraulic Institute and to ANSI specification No. B58.1. Bowl assembly, column pipe, line-shaft, head shaft, and discharge head shall be of U.S. manufacture. The pumping systems manufacturer shall have a network of service centers which shall have available spare parts and trained pump technicians to handle service, repair and warranty procedures.

B. The cast iron discharge head shall have a working pressure of not less than 175 PSI and its discharge flat face flange pattern shall conform to ANSI 150 psi dimensions. Complete discharge head shall be hydrostatically tested at 250 PSI or greater.

C. A product lubricated high pressure stuffing box containing one John Crane 5610 mechanical seal. The discharge head stuffing box area shall also include an atmospheric drain port which will be piped off skid. Stuffing box bushing shall be from bearing bronze.

D. The head shaft shall be of the two piece type, 416 stainless steel and shall be turned and ground. The pump manufacturer shall include a method for adjusting the impeller running clearance at the top of the head shaft. Adequate space shall exist to couple the head shaft and the line shaft above the stuffing box. Coupling shall be extra heavy duty AISI 416 SS.

E. Column pipe shall be A53, Grade B schedule 40 material, in interchangeable sections not more than 5 feet in length. Pump line shaft shall be AISI 416 SS. The size of the shaft shall be no less than determined by ANSI specification B58.1, Section 4.2, Table 4. Bearing retainers shall be bronze with rubber bearings located at 5 foot intervals.

F. The pump bowls shall be ASTM A48 Class 30 cast iron free of detrimental defects, glass lined.

G. The enclosed impellers shall be from C83800 bronze. Semi-open type impellers shall not be accepted. Pump shaft shall be AISI 416 SS turned and ground. The shaft shall be supported by bronze bearings above and below each impeller. The suction bell bearing shall be extra long and permanently grease packed and sealed with a sand collar.

H. A stainless steel clip on type inlet strainer shall be mounted on the bottom of each pump. Inlet area shall not be less than 4 times the suction bell inlet area.

I. For vertical turbine pumps to be operated on VFD, pump submittal shall include calculations showing critical speed calculations for the pumps, and that the line shaft bearing spacing has been determined to avoid that critical speed throughout the expected range of pump speed on the VFD.

J. Vertical turbine pumps shall be as manufactured by Peerless, Model GL7ME.

K. Each pump shall be factory wet pit tested prior to shipment from the pump manufacturer’s facility. Shop tests shall prove conclusively that the characteristics of each pump with respect to pressure, duty, capacity, rating, efficiency, performance, function, or special requirements as specified herein comply fully with requirements specified herein and that each pump will operate in the manner specified or implied. Certified test data stamped by a registered profes

sional engineer shall be furnished and the approval of the Engineer obtained prior to shipment of pumping equipment.

L. Conditions of service:

| Pump No. | Duty Point | Pump TDH | % Efficiency | Horsepower | RPM |
|---|---|---|---|---|---|
| 2 | 200 GPM | 275’ | 76% | 25 | 3600 |

2.3 Vertical Hollow Shaft Motors:

A. Motors for main pumps shall be high thrust vertical hollow shaft design, WP-I enclosed, shall have a 1.15 service factor, and class F insulation.

B. Motors shall be wound for full voltage starting and shall be suitable for use with a variable frequency drive, conforming to MG1 Part 31.

C. Each motor shall include a steady bushing to be installed around the pump head shaft, set against the hollow shaft of the motor, and securely attached to the head shaft. Installation and attachment shall occur at the time of pump and motor installation.

D. For pump lengths over 20 feet, each motor shall be equipped with a non-reverse ratchet assembly to prevent counter rotation and possible damage to pump components.

E. Maximum pump run out horsepower shall not be greater than motor nameplate rating exclusive of service factor.

F. Motor shall be rated for continuous duty and be designed to carry the maximum thrust load of the pump.

2.4 Butterfly Isolation Valves

A. Body:

1. Shall be one-piece lug design with extended neck to allow for 2” of piping insulation.
2. Flange hole drilling per international flange standard as specified.
3. A non-corrosive bushing and a self-adjusting stem seal shall be provided. No field adjustment shall be necessary to maintain optimum field performance.

B. Disc:

1. Disc edge and hub on metal discs shall be spherically machined and hand polished for minimum torque and maximum sealing capability.

C. Stem:

1. Shall be one-piece design

2. Disc to stem connection shall be and internal double "D" design with no possible leak paths in the disc-to-stem connection. External disc-tostem connections such as disc screws or pins are not allowed.
3. Stem shall be mechanically retained in the body neck and no part of the stem shall be exposed to the line media.

D. Seat:

1. Shall be tongue-and-groove bonded seat with a primary hub seal and a molded flange O-ring suitable for weld-neck and slip-on flanges
2. The seat shall totally encapsulate the body isolating it from the line media and no flange gaskets shall be required.

E. Testing:

1. Valve shall be tested to 110% of the rated pressure.

F. Pressure Ratings:

1. Valve shall be rated for bubble-tight shut-off at pressure rating of Bi-directional and Dead–End Service 2"-20" (50mm-500mm) 250 psi (17.2 Bar)

G. Approvals & Certifications:

1. CE/PED Certification
2. NSF/ANSI 61-2008 Certification (Potable Water)
3. Bray Series 31H lug or approved equal.

2.5 Ball Valves.

A. Isolation valves shall be provided as full port ball valves in sizes 2.5" and smaller.

B. Valve shall be a two piece bronze full port ball valve.

C. Valve shall be sized for a maximum velocity of 7 fps.

D. Valve shall have adjustable packing, blow-out proof stem, RPTFE seats and stuffing box ring, hardened ball, and actuator mounting pad.

E. Stem and gland shall be from B16 bronze.

F. Ball shall be chrome plated, from B16 bronze.

G. Retainer and body shall be from B584-C84400 bronze.

H. Body seal shall be from PTFE.

I. Quarter turn manual actuator shall be from zinc plated steel, with Vinyl cover.

J. Valve shall be rated at 600 PSI CWP.

K. Pump isolation valve shall be model M100 as manufactured by American Valve or Apollo model 77-100 as manufactured by Conbraco.

2.6 Pump Check Valve.

Pump check valve shall be provided on the discharge of each pump. Check valve shall be of the silent type. Check valves shall begin to close as forward velocity diminishes and shall be fully closed at zero velocity preventing flow reversal.

A. Valve bodies shall be cast from CAST IRON ASTM A126, CLASS B and shall be free from blow holes, sand holes, and other impurities.

B. Seat shall be as manufactured from BRONZE ASTM B584, ALLOY C83600 and have a Buna-N insert for positive sealing to the disc.

C. Disc shall be as manufactured from BRONZE ASTM B584, ALLOY C83600.

D. Spring shall be as manufactured from STAINLESS STEEL T316, ASTM A313.

E. Bushing shall be as manufactured from BRONZE ASTM B16, ALLOY C36000

F. Retaining screws shall be as manufactured from STAINLESS STEEL T316, ASTM F879.

G. The valve design shall incorporate a center guided, spring loaded poppet, guided at opposite ends, having a short linear stroke that generates a flow area equal to the pipe diameter.

H. Valves shall be sized to permit full pump capacity to discharge through them without exceeding a pressure drop of 6 feet of water column.

I. Check valves through 10" shall be from series 1400BN rated at 400 psi working pressure.

J. Check valves greater than 10" shall be from series 1800BN rated at 200 psi working pressure.

K. Check valves shall be as manufactured by Val-Matic.

2.7 Welder Qualification.

A. Welders performing structural and pipe welds shall be certified to ASME section IX, and their certificates shall be on file with the manufacturer. Upon request by the engineer or owner, the certificates shall be made available for inspection.

B. All employees welding structural members shall have certificates on file exhibiting conformance to ASME AWS D1.1 structural welding.

2.8 Station base.

A. All equipment including, but not limited to, pumps, motors, valves, instrumentation and controls, shall be mounted on a common structural steel base to form a complete operating pumping system.

B. The pumping system base shall be designed and fabricated to provide proper structural support for all attached equipment if it is supported solely on the peripheral members. Internal members need not contact the floor. This design shall allow the pumping system to be mounted on a slab, a frost wall, or a basement foundation. The base shall supply sufficient rigidity to withstand the stresses of reasonable and competent transportation to site, off loading, installation, and operation.

C. Peripheral structural members shall be from channel or wide flange beam, ASTM A36.

D. Internal structural members shall be from ASTM A36 rectangular tubing or channel.

E. Base shall be of fully decked construction, with ¾" plate under the pumps and ¼" deck tread covering the remainder of the skid.

F. All employees welding structural members shall have certificates on file exhibiting conformance to ASME AWS D1.1 structural welding.

G. Provisions shall be made in the station base for off-loading and handling the station at the site.

2.9 Piping Support.

A. Piping support shall be manufactured from structural rectangular tubing, sized according to the weight and size of the piping to be supported.

B. Each tubing member shall be capped to prevent internal corrosion.

C. Vertical tubing members shall be solidly welded to the skid and shall support the weight of the piping when filled with water.

D. Horizontal tubing members shall be solidly welded to the vertical members, shall extend beyond the pipe OD, and shall support the weight of the piping when filled with water.

E. Piping shall be secured to the members through the use of piping U bolts designed for this purpose.

F. Thrust of the piping, whether the thrust is in the vertical or horizontal direction, shall be restrained on site by the installing contractor.

2.10 Pressure Gauges.

A. Manifold mounted pressure gauge:

1. A pressure gauge shall be mounted on the discharge header, complete with isolation ball valve.
2. Each gauge shall be filled to reduce wear due to vibration.
3. Gauge accuracy shall be within 0.5%, and shall comply with ASME B40.1 Grade 2A.
4. Gauge diameter shall be 4.5" minimum.
5. Gauge materials of construction:

    a. Connection and bourdon tube shall be from 316 stainless steel.
    b. Movement shall be from stainless steel with an internal stop at 1.3 times the gauge range.
    c. Dial shall be from white aluminum with black lettering and a stop at the 6 o'clock position.
    d. Pointer shall be adjustable from black aluminum.
    e. Turret style case shall be from black glass reinforced thermoplastic (PBTP), and shall have built in rear flange lugs, with a solid front and blow-out back, rated at NEMA 4X.
    f. Window shall be from acrylic.
    g. Window gasket shall be from Buna-N.
    h. Filling material shall be glycerin.

6. Range shall be selected so that operating pressure is in the mid-range of the gauge.
7. Gauge range shall in no case be less than 20% higher than the highest pressure attainable from the pumps at shutoff head conditions.
8. Gauge shall resist shocks to 100G.
9. Pressure gauge shall be model 233.34 as manufactured by Wika or equal.

B. Pump mounted pressure gauges:

1. A 2.5" pressure gauge shall be mounted on each pump discharge, complete with isolation ball valve.
2. Each gauge shall be filled to reduce wear due to vibration.
3. Gauge accuracy shall be rated as 2/1/2%, and shall comply with ASME B40.100 and EN 837-1.
4. Gauge materials of construction:

    a. Connection and bourdon tube shall be from copper alloy.
    b. Movement shall be from copper alloy with an internal stop at 1.3 times the gauge range.
    c. Dial shall be from white ABS with black lettering.
    d. Pointer shall be adjustable from black aluminum.
    e. Turret style case shall be from 304 stainless steel with vent plug and stainless steel crimp ring sealed with an EPDM O-ring.
    f. Window shall be from polycarbonate.
    g. Window gasket shall be from Buna-N.
    h. Filling material shall be glycerin.

5. Range shall be selected so that operating pressure is in the mid-range of the gauge.
6. Gauge range shall in no case be less than 20% higher than the highest pressure attainable from the pumps at shutoff head conditions.
7. Gauge shall be shock resistant.

8. Pressure gauge shall be model 213.53 as manufactured by Wika or equal.

2.11 Pressure Transmitter.

A. Pressure Transmitter shall be mounted on the system discharge and shall provide all pressure signals for the control logic.

B. Pressure Transmitter shall be supplied with an isolating ball valve.

C. Pressure Transmitter shall be a media isolated instrument, having no silicone oil, internal o-rings, or welds.

D. Pressure Transmitter wetted material shall be 17-4PH stainless steel NACE compatible housed in 304 stainless steel having a male threaded process connection.

E. Pressure Transmitter shall provide a 4-20 mA analog output linear with the sensed pressure, from a two wire 10-28 VDC supply, reverse polarity protected.

F. Pressure Transmitter shall have an accuracy of plus/minus 0.25% BFSL.

G. Resolution of the Transmitter shall be greater than the resolution of the analog to digital conversion for PLC operation.

H. Transmitter shall be rated for pressures greater than station discharge pressure, and shall provide gauge pressure output, rather than absolute pressure.

2.12 Magnetic Flowmeter.

The pumping system shall have a magnetic flow sensor installed, which shall be utilized for control and to display the pumping system flow rate, and to display total flow through the pumping system controller operator interface device (OIT). Flow meter shall be electro magnetic flow meter comprised of two major components, a primary head and a signal converter. Flow meter signal converter shall produce two separate signals, pulse and 4-20mA, in linear proportion to flow rate. Flow meter shall read flows from 0-40 fps, with a worst case inaccuracy of 0.5% of indicated value (not a percentage of full scale) at 1.3 fps or greater. Flows less than 1.3 fps shall have a lower accuracy with accuracy applying to indicated value (not full scale). Flow meter shall be sized so that maximum system flow lies between 16 and 24 fps through the meter. Meter shall be installed according to manufacturer's recommendations. Manufacturer shall have a US based manufacturing and assembly center. Flow meter shall be as manufactured by Krohne, without exception. Flowmeter shall be sized for maximum expected flow rate through the pumping system, and not as a line sized flowmeter.

A. Primary Head: The flow tube shall be a ANSI B16.5 class 150 flanged for sizes less than 24" and AWWA class D flanged for sizes above 24" with a 304SS spool. Wetted liner shall be hard rubber. Liner shall extend beyond the ends of the flow tube and over the flange faces. Liner shall remain stable and in place under a 500 mBar absolute vacuum or pressure situation. Liner shall be rated for the medium pumped. Magnetic coils shall be wound by the flow meter manufacturer and held in place in such a way as to prevent any fluctuation in the magnetic field

generated. Magnetic coils in flow tubes 6" and smaller shall be epoxied together through a fusion bonding process, which renders the magnetic coil a single solid piece with no loose windings. Electrodes shall be from Hastelloy C4. They shall be inserted from the inside of the flow tube, and shall be sealed along their length. Electrodes sealed at one or more discrete points shall not be accepted. The wires connecting the electrodes to the primary head shall be fastened in place along their entire length to prevent the transmission of erroneous data or signal noise acquired through signal wire movement. All wiring shall be brought into the primary head connection box and terminated. The shroud protecting the coils and electrodes shall be welded in place, and internally pressure tested to 1.5 atmospheres with air pressure. On completion, the flow tube shall be finish painted on all outside metallic surfaces. Primary head shall be NEMA 6 rated.

B. Signal Converter: The signal converter shall be NEMA 4X rated, and shall house the microprocessor-based electronics required for magnet excitation and flow measurement. Functions and data requirements shall be set by either a PC or by a hand held programmer. Unit shall process flow using a bipolar pulsed DC signal. Power supply shall be 115/230VAC 48-64 Hz. Outputs shall be 4-20 mA and pulsed output scalable at 0-100Hz or 0-1000 Hz for full scale range. Signal converter shall also include a binary output to indicate direction of flow.

C. Grounding rings: Where magnetic flow meters are placed in a pipeline that insulates the water from ground (e.g. epoxy lined steel pipe or plastic pipe) grounding rings are required at both ends of the flow meter to eliminate electrical eddy currents that may exist within the medium being pumped. Grounding rings and flow meter body must be grounded properly., in accordance with manufacturer's recommendations.

D. Calibration and Testing: Meter shall be hydraulically calibrated on a testing device that is at least 10 times more accurate than the meter, and shall not be calibrated against a master meter. Each and every flow meter produced by the flow meter manufacturer shall be flow tested and hydraulically calibrated according to this procedure. Manufacturer's test and calibration equipment shall be internationally certified, and shall be re-certified every three years. Calibration shall be accomplished through direct volumetric comparison, on rigs certified as having a measurement error of equal to or less than 0.03%. A calibration certificate shall be issued for each and every flow meter produced by the flow meter manufacturer. Calibration certificate shall be traceable to the US National Bureau of Standards. Meters shall be calibrated under standard conditions to a measurement error of less than 0.50% of rate.

E. Best resolution of flowmeter shall be with 5 diameters of straight pipe upstream of the center of the flowmeter, and 2 such diameters downstream of the center of the meter. In space critical situations, the meter manufacturer shall authorize the system manufacturer to attach 90 degree elbows directly to both flanges of the meter, without compromising the accuracy to worse than 1% of indicated value (not full scale). Meter manufacturer shall have provided system manufacturer with a written authorization and test data, which shall be kept on file at the system manufacturer's place of business, and made available for inspection on request.

F. Stainless steel grounding rings, properly bonded, shall be provided at the inlet and outlet of the flowmeter, when the piping is non conductive, to arrest any electrical eddy currents in the water that could affect the meter accuracy.

2.13 Coating System

A. Coating system shall be equivalent to the ISO 12944 coating system C4 for medium corrosive environment application where high humidity and some air pollution may occur.

B. All steel surfaces shall be prepared to at least SSPC-SP6, abrasive blast cleaning.

C. Upon completion of preparation, all steel surfaces must be immediately coated with PPG's Amercoat 385PA red primer containing zinc phosphate, or equivalent by Tnemec or Sherwin Williams, to a DFT of 4.0-8.0 mils.

D. Primer shall be oven cured after application to improve adhesion.

E. Intermediate coat shall be PPG's Amercoat 450HAcrylic Aliphatic Polyurethane, or equivalent by Tnemec or Sherwin Williams, applied to a DFT of 2.0-5.0 mils.

F. Intermediate coat shall be oven cured after application to improve adhesion.

G. Cover coat shall be PPG's Amercoat 450HAcrylic Aliphatic Polyurethane, or equivalent by Tnemec or Sherwin Williams, applied to a DFT of 2.0-5.0 mils.

H. Cover coat shall be oven cured after application to improve adhesion.

I. Each coat shall be of a color different than the previous color, to make holidays in the coating obvious. Finish coat shall be safety blue.

2.14 Bolts.

A. All bolts and nuts used in the assembly of the pumping system shall be zinc plated grade 5. As required in specific locations to protect the finish and prevent loosening, bolts shall be provided with washers and lock washers.

2.15 Control Enclosure.

A. Controls, except VFDs, shall be housed in a NEMA 4X enclosure.

B. The control enclosure shall be constructed of 12 gauge steel and the back plate assembly shall be constructed of 12 gauge steel.

C. All indicating lights, reset buttons, selector switches and the operator interface device (OIT) shall be mounted on enclosure door and shall be rated NEMA 4X.

D. All internal components shall be mounted and secured to the removable back plate assembly. All equipment and wiring shall be mounted within the enclosure and labeled for proper identification.

E. All adjustments and maintenance shall be able to be done from the front of the control enclosure.

F. A complete wiring circuit and legend with all terminals, components, and wiring identification shall be provided.

G. Equipment shall be provided within the controls enclosure to assure compliance with current NEC and UL codes.

H. A dedicated terminal strip shall be provided near the bottom of the enclosure to which shall be connected the remote signals for the SCADA system.

2.16 Lightning and Surge Arrestor.

A. Electrical equipment shall be protected by a U.L. 1449 Third Edition Listed SPD to suppress voltage surges on incoming power.

B. SPD shall be connected to the line side of the pumping system landing lugs and shall be properly grounded.

C. The device shall be rated according to IEEE C62.41.1-2002, C62.41.2-2002, and C63.45-2002 to provide a surge capacity of no less than 50kA per phase.

D. Response time shall not be greater than 1 nanosecond.

E. SPD shall withstand no less than 5000 3kA impulses, 8x20µs, or 1000 10kA impulses, 8x20µs.

F. Manufacturer of SPD shall be ISO 9001:2000 certified, and shall have an ISO 17025:2005 test lab.

2.17 Main Disconnect Switch.

A. A main disconnect switch shall be provided to isolate all controls and motor starting equipment from incoming power.

B. Main disconnect shall have a through the door operator, and shall be sized in accordance with current NFPA 70 and UL requirements.

C. Disconnect shall be as manufactured by Eaton, ABB, or Schneider Electric .

D. Disconnect’s short circuit rating shall not be less than 10,000 amps.

2.18 Control Power.

A. Power for the controls shall be provided by a control power transformer which shall provide 120 volt, single phase power for the pumping system control operation.

B. Control power transformer shall not be used for any load other than controls.

C. The control power transformer shall be protected on the primary side by control limiting fuses of adequate size and voltage rating.

D. All control components on the load side of the transformer shall be protected by time delay circuit breakers of adequate size.

E. The control power transformer shall be as manufactured by Micron Industries or pre-approved equal.

2.19 Circuit Breaker VFD Disconnect.

A. A circuit breaker disconnect shall be provided in the control panel to isolate each VFD from incoming power and provide short circuit protection.

B. UL/CSA short-circuit interrupting capacity rating of the circuit breaker shall be not less than 25,000 amps.

C. Disconnect shall be as manufactured by Eaton or Schneider Electric .

D. Disconnect's short circuit rating shall not be less than 25,000 amps.

2.20 Variable Frequency Drive.

A. Variable frequency drives shall be Mitsubishi model F700, without exception.

B. The Drive shall be solid state, with a Pulse Width Modulated (PWM) output. The drive shall utilize the latest isolated gate bipolar transistor (IGBT) technology. VFD must include all of the following features.

C. Control Specifications:

1. Control System – selectable as high carrier frequency PWM control (V/F control), optimum excitation control, and simple magnetic flux vector control
2. Output frequency range – 0.5-400 Hz
3. Frequency Setting Resolution:

    a. Voltage input: 0.015Hz from 0 to 60Hz for 0 to 10V =12bit resolution;
    b. Voltage input: 0.03Hz from 0 to 60Hz 0 to 5V = 11bit resolution;
    c. Milliamp input: 0 to 20mA at approximately 11bit resolution;
    d. Voltage input: -10V to +10V = 11bit resolution;
    e. Voltage input: 0 to ±5V = 10bit resolution.
    f. Digital Input: 0.01Hz

4. Frequency accuracy:

    a. Analog input: Within ±0.2% of the max. output frequency (25°C ± 10°C)
    b. Digital Input: Within 0.01% of the set output frequency

5. Voltage/Frequency Characteristics: Base frequency can be set from 0 to 400Hz. Constant torque/variable torque pattern or adjustable 5 points V/F can be selected.

6. Starting Torque: 120% (3Hz) when set to simple magnetic flux vector control and slip compensation
7. Acceleration/Deceleration Time Setting: 0 to 3600s (acceleration and deceleration can be set individually), linear or S-pattern acceleration/deceleration mode can be selected
8. Stall Prevention Operation Level: Operation current level can be set (0 to 150% adjustable), whether to use the function or not can be selected

D. Operation Specifications:

1. Frequency Setting Signal:

   a. Analog Input: 0 to 10V, 0 to 5V, 4 to 20mA, -10 to +10V, -5 to 5V can be selected.
   b. Digital Input: Four-digit BCD or 16-bit binary using the setting dial of the operation panel (when used with the option FR-A7AX)

2. Start Signal: Available individually for forward and reverse rotation. Start signal automatic self-holding input (3-wire input) can be selected.

3. Operational Functions:

   a. Maximum and minimum frequency settings,
   b. Frequency jump operation,
   c. External thermal relay input selection,
   d. Polarity reversible operation,
   e. Automatic restart after instantaneous power failure operation,
   f. Continuous operation at an instantaneous power failure,
   g. Commercial power supply-inverter switchover operation,
   h. Forward/reverse rotation prevention,
   i. Operation mode selection,
   j. PID control,
   k. Computer link operation (RS-485).

4. Output Signal Selection (Choose up to seven points, one point per function unless otherwise indicated):

   a. Inverter running,
   b. Up-to-speed,
   c. Instantaneous power failure/undervoltage,
   d. Overload warning, output frequency detection,
   e. Second output frequency detection,
   f. Electronic thermal relay function pre-alarm,
   g. PU operation mode,
   h. Inverter operation ready,
   i. Output current detection,
   j. Zero current detection,
   k. PID lower limit,
   l. PID upper limit,
   m. PID forward rotation, reverse rotation output,
   n. Commercial power supply-inverter switchover MC1,
   o. Commercial power supply- inverter switchover MC2,

p. Commercial power supply-inverter switchover MC3,
q. Fan fault output,
r. Heat sink overheat pre-alarm,
s. Inverter running start command on,
t. Deceleration at an instantaneous power failure,
u. PID control activated,
v. During retry,
w. During pid output suspension,
x. Life alarm,
y. Input mc stop signal,
z. Power savings average value update timing,
aa. Current average monitor,
bb. Alarm output 2,
cc. Maintenance timer alarm,
dd. Remote output,
ee. Minor failure output,
ff. Alarm output.
gg. Open collector output (5 points),
hh. Relay output (2 points)
ii. Alarm code of the inverter can be output (4 bit) from the open collector.

5. Pulse/Analog Output (select one of the following):

a. Output frequency,
b. Motor current (steady or peak value),
c. Output voltage,
d. Frequency setting value,
e. Running speed,
f. Converter output voltage (steady or peak value),
g. Electronic thermal relay function load factor,
h. Input power,
i. Output power,
j. Load meter,
k. Reference voltage output,
l. Motor load factor,
m. Energy saving effect,
n. PID set value,
o. PID process value, pulse train output
p. AM terminal function selection, analog output

E. Display Specifications:

1. Operating Status:

a. Output frequency,
b. Motor current (steady or peak value),
c. Output voltage,
d. Alarm indication,
e. Frequency setting,
f. Running speed,

g. Converter output voltage (steady or peak value),
h. Electronic thermal load factor,
i. Input voltage,
j. Output voltage,
k. Road meter,
l. Cumulative energization time,
m. Actual operation time,
n. Motor load factor,
o. Cumulative energization power,
p. Power saving effect,
q. Cumulative saving power,
r. PID set point,
s. PID process value,
t. PID deviation value,
u. Inverter I/O terminal monitor,

2. Alarms

Displayed when the protective function is activated, and the output voltage/current/frequency/cumulative energization time right before the protection function was activated and the past 8 alarm definitions are selected to be stored.

3. Interactive Guidance - Operation guide and trouble shooting with a help function

F. Protective and Warning Functions:

1. Overcurrent during acceleration,
2. Overcurrent during constant speed,
3. Overcurrent during deceleration,
4. Overvoltage during acceleration,
5. Overvoltage during constant speed,
6. Overvoltage during deceleration,
7. Inverter protection thermal operation,
8. Heat sink overheat,
9. Instantaneous power failure occurrence,
10. Undervoltage,
11. Input phase failure,
12. Motor overload,
13. Output side ground fault overcurrent,
14. Output phase failure,
15. External thermal relay operation,
16. PTC thermistor operation,
17. Option alarm,
18. Parameter error,
19. PU disconnection,
20. Retry count excess,
21. CPU alarm,
22. Power supply short for operation panel,
23. 24vdc power output short,
24. Output current detection value over,

25. Inrush resistance overheat,
26. Communication alarm (inverter),
27. Analog input alarm,
28. Internal circuit alarm (15v power supply),
29. Fan fault,
30. Overcurrent stall prevention,
31. Overvoltage stall prevention,
32. Electronic thermal pre-alarm,
33. PU stop,
34. Maintenance timer alarm,
35. Parameter write error,
36. Copy operation error,
37. Operation panel lock.

G. Environment Requirements:

1. Ambient Temperature: -10ºC to +50ºC (non-freezing)
2. Ambient Humidity: 90% RH or less (non-condensing)
3. Storage temperature: -20ºC to +65ºC (applicable for a short period in transit, etc.)
4. Atmosphere: NEMA 4X
5. Altitude: Maximum 1000 meters (3300 feet) MSL
6. Vibration: 5.9m/s2 or less

H. Variable Torque Ratings:

Three phase VFDs are to be derated by 40% for single phase input, three phase output operation. All Mitsubishi F700 VFDs rated for single phase input, three phase output operation have been tested and certified for use on single phase input power.

1. 240 volt, single phase, class: 1/2-75 hp, UL & cUL listed
2. 240 volt class: 1-200 hp at 200-240/3/60
3. 480 volt, single phase, class: 1/2-200 hp, UL & cUL listed
4. 480 volt class: 1-1000 hp at 380-480/3/60

2.21 Microprocessor Controls, Variable Speed.

All control logic shall be handled by an industrial microprocessor logic controller accessible through a 7” high definition widescreen graphic operator interface which shall provide data entry and read-out capabilities. Controller shall provide demand controlled sequential pump start up, shutdown and alarm features through its pressure sensing, flow sensing and voltage sensing devices. Controller shall be provided with a built in memory. Controller shall operate VFDs using dual PID loops, one for acceleration, and one for pressure maintenance. All logic for system control, and timing shall be handled by the controller.

A. Control software shall be parameter driven, fully documented, and allow user to easily change all operational parameters.

B. Conditions that shall be displayed on the controller's operator interface terminal (OIT):

1. Discharge pressure
2. Current flow rate
3. Total gallons pumped
4. Each alarm on its occurrence, retained until reset.
5. Each pump run time hours and tenths
6. Selection of manual or automatic alternation sequence.
7. Automatic or manual adjustment (selectable) of VFD speed, if pump H-O-A switches are in Auto.

C. Panel face switches and lights:

1. Individual pump run lights – Green LED
2. General alarm light – Red LED
3. Control power on light – White LED
4. Individual pump Hand/Off/Automatic switches
5. Alarm reset pushbutton
6. Local-Off-Remote switch

D. All pumping system shutdowns shall be of the controlled type which sequence pumps off at user selectable intervals.

E. 7" high definition widescreen graphic operator interface shall be mounted on the control panel door.

1. This device shall allow the operator to view and modify each register in the PLC.
2. The device shall allow for display and modification of all timer values, set points, lockout times, etc.

F. PLC shall be MicroLogix 1400 as manufactured by Allen Bradley, and shall be capable of Ethernet interface to a variety of SCADA platforms, via 2 serial ports with F1/DH485/Modbus RTU/DNP3/ASCII protocol support and a built-in Ethernet port, which shall support Ethernet/IP peer-to-peer messaging.

G. HMI shall be a Maple Systems HMI5070NH color touch screen.

2.22 SCADA Interface.

A. SCADA system's RTU shall be connected to the dedicated terminal strip within the controls enclosure. RTU shall be provided, installed, and connected to the terminal strip on site by others.

B. Set of auxiliary analog signals including:

1. Discharge Pressure (AO)
2. Flow Rate (AO)

C. Set of auxiliary contacts including:

1. Each Pump Call (DI)

2. Each Pump Running (DO)
3. Each Pump Fault (DO)
4. General Alarm (DO)

2.23 Sequence of Operation:

A. General items applying to each alarm circuit shall include a display of condition, the illumination of a red indicating light, and manual or automatic reset of condition.

B. Alarm sequence

1. Low Water Level Alarm. Low water level alarm shall serve to protect the pumps from the adverse effects of running dry. Alarm shall be activated when level in the supply reservoir reaches a critical low level. Alarm shall cause the pumps to be retired in an orderly manner. Alarm shall not be capable of being overridden. Alarm shall not allow any pumps to run, whether in the "Hand" or "Automatic functions of the selector switch until level has been restored and alarm has been reset. Indication of the alarm shall be displayed visually on the control panel door. Alarm shall be equipped with visual indication and automatic reset.
2. High Discharge Pressure Alarm. High Discharge Pressure alarm circuit shall shut down pumping system if discharge pressure reaches a predetermined high level. Operator interface device (OIT), mounted in enclosure door, shall signal high discharge pressure. Pumping system shall not operate until pressure is reduced and alarm has been reset. Alarm shall be equipped with visual indication and automatic reset.
3. Low Discharge Pressure alarm. Low Discharge Pressure alarm circuit shall shut down pumping system in the event discharge pressure drops below normal level. Operator interface device (OIT), mounted in enclosure door, shall signal low discharge pressure. Pumping system shall operate until alarm has been manually reset. Alarm shall be equipped with visual indication and manual override.
4. Main phase failure and low voltage safety circuit shall retire the pumping system if it experiences low voltage, phase failure or phase reversal as monitored at line-side of control enclosure. Phase monitor shall have a time delay to allow for transient low voltage during motor starting and to allow maximum motor protection Operator interface device (OIT), mounted in enclosure door, shall signal phase failure for any affected pump.
5. System Thermal Purge. Thermal purge shall include a temperature sensor and valve for each pump. Thermal sensor shall open the solenoid valve when it experiences a water temperature in excess of 140 degrees F. Valve shall be a 1/4" brass two way valve. Valve, when actuated, shall purge water from the pump discharge, to atmosphere. A 1/2" line to drain shall be provided on site by the installing contractor. Thermal purge shall not be considered as an alarm, but its function shall be considered as normal operation. There shall be no indication of its operation, other than warm water discharge, and it shall not shut down any pumps.
6. Plugged Strainer Alarm. A differential pressure switch shall be mounted across the strainer (single basket, dual basket, wye type or other type of strainer) to determine if the strainer has become plugged. Contact closure in the DP switch shall activate an alarm within the control panel. Indication of the alarm shall be displayed visually on the control panel door. Alarm shall be equipped with visual indication and automatic reset.

C. Functional Sequence, Pressure and Flow Sequencing

1. Equal sized pumps shall be alternated based on accumulated run time, the pump having the least run time starting as lead.
2. In the event a pump has failed to run or start, or if its switch is turned off, PLC shall shift the pumping sequence to utilize the remaining pumps.
3. Lead pump shall start immediately on a reduction in discharge pressure (10 psid factory default value).
4. PLC shall control pump's VFD to maintain discharge pressure regardless of flow rate.
5. Lag pump shall start on a reduction in discharge pressure (10 psid factory default value) as maintained for a time (10 seconds default value).
6. PLC shall control pumps' VFDs to maintain discharge pressure regardless of flow rate.
7. Lag pump shall retire when flow has decreased to 80% of the lead pump's capacity (100 GPM default value) as maintained for a time (30-45 seconds default value).
8. PLC shall control pump's VFD to maintain discharge pressure regardless of flow rate.
9. Lead pump shall retire when flow has decreased to zero as maintained for a time (30-45 seconds default value).

2.24 Controls Requirements.

A. All control enclosures and controls shall have been manufactured on the pumping system manufacturer's site by the pumping system manufacturer.

B. In order to assure complete system integration, Manufacturer, without exception, shall maintain a fully equipped UL and ETL authorized panel shop at his facility under the same roof as the fabrication, painting, and assembly of the mechanical components.

C. Manufacturer, without exception, shall be authorized by Underwriters' Laboratories to label its manufactured control panels as UL Listed under category NITW/NITW7.

D. Manufacturer, without exception, shall conform to the latest edition of NFPA 70 in the manufacturing of its control panels.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.

B. Verify layout and orientation of pumps, accessories, and piping connections.

## 3.2 SYSTEM FACTORY ELECTRICAL TEST

A. The entire control system shall be electrically tested as an assembled unit at the manufacturer's facility prior to shipment. Pressure and flow signals may be simulated through use of analog signals generators. Results of test shall be made available to the engineer upon request.

## 3.3 UNLOADING AND SETTING SUPERVISION

A. Setting of the pumping system, pumps and motors, and connection to discharge and power, anchoring of the pumping system, and thrust blocking of the discharge piping that is connected to the pumping system shall be the responsibility of the installing contractor and not the manufacturer.

B. Crane to off-load and set the pumping system onto the concrete slab shall be provided by installing contractor.

C. Manufacturer shall inform the contractor, prior to system shipment, of the calculated weight of the pumping system.

## 3.4 START UP

A. When discharge piping, electrical connections, and electrical inspection have been completed, the pumping system manufacturer shall be contacted for start up.

B. A minimum one week notice shall be given to manufacturer prior to scheduled start up date.

C. Field testing:

1. During start up, the complete pumping system shall be inspected for proper installation, and shall be given a running test of normal start and stop, and fully loaded operating conditions.
2. During this test, each pump shall demonstrate its ability to operate without undue vibration, or overheating and shall demonstrate its general fitness for service.
3. All defects shall be corrected and adjustments made at the expense of the pumping system manufacturer.
4. Test shall be repeated until satisfactory results are obtained.

D. Start up assistance shall be limited to one day.

E. After the station startup has been completed, but before the technician leaves the job site, a training session shall be given to the owner and/or the owner's representative to familiarize them with the pumping system operation, maintenance and adjustments.

## 3.5 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Requirements for inspecting and testing.

B. Section 01 70 00 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.

END OF SECTION 43 23 13

# SECTION 43 25 13 - SUBMERSIBLE CENTRIFUGAL PUMPS

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes: Submersible centrifugal pumps at Yard Drain Pump Station (YDPS) with controls, rails, accessories, and appurtenances.

B. Related Requirements:

1. Section 03 31 00 - Anchorage In Concrete.
2. Div. 26 - Execution requirements for electrical connections to equipment specified by this Section.
3. Section 33 05 16.13 - Precast Concrete Utility Structures for wetwell and valve vault.
4. Section 40 05 13 - Common Work Results for Process Piping: Piping components, appurtenances, and identification requirements common to process piping systems.

### 1.2 REFERENCE STANDARDS

A. ASTM International:

1. ASTM A48 - Standard Specification for Gray Iron Castings.
2. ASTM A276 - Standard Specification for Stainless Steel Bars and Shapes.

B. National Electrical Manufacturers Association:

1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

### 1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit information concerning materials of construction, fabrication, and protective coatings.

C. Certified Pump Curves.

D. Shop Drawings:

1. Submit detailed dimensions for materials and equipment, including wiring and control diagrams, performance charts and curves, installation and anchoring requirements, fasteners, and other details.
2. Include Manufacturer's specified displacement tolerances for vibration at operational speed specified for pumps.

E. Manufacturer's Certificate: Certify that pump and accessories meet or exceed specified requirements.

1. Certify installation is completed according to manufacturer's instructions.

F. Manufacturer's Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.

G. Source Quality-Control Submittals: Indicate results of factory tests and inspections.

H. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

I. Manufacturer Reports: Indicate that equipment has been installed according to manufacturer's instructions.

## 1.4 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for closeout procedures.

B. Project Record Documents: Record actual locations and final orientation of equipment and accessories.

## 1.5 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.

B. Furnish five-year Manufacturer's warranty for pumps and components.

## 1.6 QUALITY ASSURANCE

A. The pump Manufacturer shall have a minimum of 1,000 units of similar type pumps, installed and operating for no less than five (5) years in the United States.

B. The pump Manufacturer shall perform the following inspections and tests on each pump before shipment from factory:

1. Impeller, motor rating and electrical connections shall first be checked for compliance to the customer's purchase order.
2. A motor and cable insulation test for moisture content or insulation defects shall be made.
3. Prior to submergence, the pump shall be run dry to establish correct rotation and mechanical integrity.
4. The pump shall be run for 30 minutes, submerged a minimum of six (6) ft under water.
5. After operational test No.4, the insulation test (No.2) is to be performed again.

C. A written report stating the foregoing steps have been performed shall be supplied with each pump at the time of shipment upon request.

D. The pump cable end will be sealed with a high quality protective covering, to make it impervious to moisture or water seepage prior to electrical installation.

1.7 SPARE PARTS

A. The equipment manufacturer shall provide one (1) set of recommended spare parts, including control panel spare parts. The equipment manufacturer shall provide a complete list of recommended spare parts, including control panel spare parts.

B. The equipment manufacturer shall provide any special tools required to service, maintain, repair, and disassemble the pumps.

1.8 WARRANTY

A. The pump manufacturer shall warrant the units being supplied to the Owner against defects in workmanship and material for a period of five (5) years or 10,000 hours under the Municipal Wastewater - Permanent Installation Warranty Policy.

PART 2 - PRODUCTS

2.1 SUBMERSIBLE PUMPS

A. Schedule:

1. Yard Drain Pumps:
   a. YDPS Pump No.1 (P8010)
   b. YDPS Pump No.2 (P8020)

2. Return Activated Sludge (RAS) Pumps:
   a. RAS Pump No.1 (P4310)
   b. RAS Pump No.2 (P4320)

3. Waste Activated Sludge (WAS) Pumps:
   a. WAS Pump No.1 (P4330)
   b. WAS Pump No.2 (P4340)

B. Manufacturers:

1. Flygt.
2. ABS.
3. Or Pre-Approved Equal.

   a. Specifications and equipment arrangements for the equipment referenced are based on Flygt. Changes to the arrangement indicated in the specifications and in the plan set shall be at the expense of the installing Contractor. No change orders will be issued to the contractor for modifications to the laying length, footprint, concrete layout, electrical, mechanical, etc.

C. Design Criteria:

1. Yard Drain Pumps:

    a. Quantity: 2
    b. Design Point of Each Pump: 1,600 GPM @ 58 ft TDH
    c. Static Head: 29 - 43 ft depending on wetwell water level
    d. Motor: 35 HP, 460 V, 3 Phase, 60 Hz

2. RAS Pumps:

    a. Quantity: 2
    b. Design Point of Each Pump: 1,400 GPM @ 32 ft TDH
    c. Static Head: 20.5 – 25.5 ft depending on wetwell water level
    d. Motor: 20 HP, 460 V, 3 Phase, 60 Hz

3. WAS Pumps:

    a. Quantity: 2
    b. Design Point of Each Pump: 200 GPM @ 55 ft TDH
    c. Static Head: 46.5 – 51.5 ft depending on wetwell water level
    d. Motor: 10 HP, 460 V, 3 Phase, 60 Hz

4. Each pump shall be furnished with a submersible electric motor suitable for continuous submergence, a cast iron discharge connection with anchor bolts, upper guide bar bracket, 45 ft of stainless steel lifting chain, and 100 ft of hypalon jacketed type SPC cable, P-MSHA approved and sized according to N.E.C. and ICEA standards.
5. The pumps shall be capable of handling raw, unscreened sewage. The discharge connection elbow shall be permanently installed in the wet well along with the discharge piping. The pumps shall be automatically connected to the discharge connection elbow when lowered into place, and shall be easily removed for inspection or service. There shall be no need for personnel to enter pump well. Sealing of the pumping unit to the discharge connection elbow shall be accomplished by a simple linear downward motion of the pump. A sliding guide bracket shall be an integral part of the pump unit. The entire weight of the pumping unit shall be guided by no less than two 304 stainless steel guide rails and pressed tightly against the discharge connection elbow with metal-to-metal contact. Sealing of the discharge interface by means of a diaphragm, o-ring, or other devices will not be acceptable. No portion of the pump or the guide support system other than the discharge connection shall bear directly on the floor of the sump. The pump, with its appurtenances and cable, shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 65 ft.

## 2.2 ACCESSORIES

A. The pumps shall be furnished with the following accessories:

1. Discharge connections for duplex pump station.
2. 304 stainless steel rail system with top, bottom, and intermediate guide bars.
3. 304 stainless steel Flygt Grip Eye lifting chain, or equal.
4. Detachable Mechanical Hoist and two (2) base mounts (one for each pump).
5. 304 stainless steel electrical cable holders.
6. 304 stainless steel chain hook.

7. 304 stainless steel control panel.
8. Float switches and mounting hardware with one spare. Manufacturer shall be Anchor Scientific or Flygt. Substitutes and "or equals" are not acceptable. The cable shall be of sufficient length such that it can be routed in conduit to the pump control panel without splicing.
9. 316 stainless steel or Titanium submersible pressure transducer and mounting hardware with one spare. Manufacture shall be Cerlic, Endress & Hauser, or KPSITM. Substitutes and "or equals" are not acceptable. The cable shall be of sufficient length such that it can be routed in conduit to the pump control panel without splicing.
10. Anchor bolts for rail system and pump discharge base shall be 316 stainless steel.
11. Covers shall be delivered to the precast wetwell supplier for installation in the wetwell top slab as specified in Section 33 05 16.13 - Precast Concrete Utility Structures.

B. Lifting Chain:

1. Minimum Length: Wetwell depths plus 5 ft
2. Material: 304 stainless steel
3. Load Rating: Sufficient to permit lifting and lowering the pump

C. Detachable Mechanical Hoist:

1. Furnish one (1) detachable mechanical hoist to lift the pumps out of the wet well.
2. Manufacturer shall be responsible for sizing the hoist for the weights of pumps.
3. Manufacturer shall furnish two (2) base mounts for the mechanical hoist.
4. Contractor shall be responsible for installing the base mounts on the precast top of or adjacent to the pump station.

## 2.3 PUMP CONSTRUCTION

A. Major pump components shall be of gray cast iron, Class 35B, with smooth surfaces devoid of blow holes and other irregularities. Where watertight sealing is required, o-rings made of nitrile rubber shall be used. All exposed nuts and bolts shall be of AISI-type 304 stainless steel. All surfaces coming into contact with sewage, 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. The impeller shall be coated with an acrylic dispersion zinc phosphate primer.

B. All mating surfaces where watertight sealing is required shall be machined and fitted with nitrile rubber o-rings. Fitting shall be such that sealing is accomplished by metal-to-metal contact between machine surfaces. This will result in controlled compression of nitrile rubber o-rings without the requirement of a specific torque limit. No secondary sealing compounds, rectangular gaskets, elliptical o-rings, grease or other devices shall be used.

C. The cable entry water seal design shall preclude specific torque requirements to insure a watertight and submersible seal. The cable entry shall be comprised of a single cylindrical elastomer grommet, flanked by washers, all having a close tolerance fit against the cable outside diameter and the entry inside diameter and compressed by the entry body containing a strain relief function, separate from the function of sealing the cable. The assembly shall bear against a shoulder in the pump top. The cable entry junction chamber and motor shall be separated by a stator lead sealing gland or terminal board, which shall isolate the motor interior from foreign

material gaining access through the pump top. Epoxies, silicones, or other secondary sealing systems shall not be considered acceptable.

D. Each pump shall be provided with a tandem mechanical rotating shaft seal system. Seals shall run in an oil reservoir. Lapped seal faces must be hydrodynamically lubricated at a constant rate. The lower seal unit, between the pump and oil chamber, shall contain one stationary and one positively driven tungsten carbide ring. The upper seal unit, between the oil sump and motor housing, shall contain one stationary tungsten carbide ring and one positively driven rotating tungsten carbide ring. Each interface shall be held in contact by its own spring system. The seals shall require neither maintenance nor adjustment but shall be easily inspected and replaceable. The following seal types shall not be considered acceptable or equal to the dual independent seal specified: shaft seal without positively driven rotating members, or conventional double mechanical seals containing either a common single or double spring acting between the upper and lower units. Cartridge type seal systems shall not be acceptable.

E. Each pump shall be provided with an oil chamber for the shaft sealing system. The oil chamber shall not require an oil pressure equalizer ring for oil pressure compensation. The drain and inspection plug, with positive anti-leak seal shall be easily accessible from the outside.

F. The area about the exterior of the lower mechanical seal in the cast iron housing shall have cast in an integral concentric spiral groove. This groove shall protect the seals by causing abrasive particulate entering the seal cavity to be forced out away from the seal due to centrifugal action.

G. The pump shall have shall have a separate seal leakage chamber to capture any leakage past the upper secondary mechanical seal. The leakage chamber shall have a float type switch that will signal if the chamber should reach 50% capacity.

H. The pump shaft shall rotate on two permanently lubricated bearings with an L-10 bearing life of 50,000 hours when operating at any usable portion of the pump curve. The upper bearing shall be a single roller bearing. The lower bearing shall be a two row angular contact bearing to compensate for axial thrust and radial forces. Single row bearings shall not be acceptable.

I. Pump and motor shaft shall be the same unit. The pump shaft is an extension of the motor shaft. Couplings shall not be acceptable. The shaft shall be AISI-type 431 stainless steel.

J. The impeller shall be of gray cast iron, ASTM A-48 Class 35B, dynamically balanced, semi-open, multi-vane, back swept, screw-shaped, non-clog design. The impeller leading edges shall be mechanically self-cleaned automatically upon each rotation as they pass across a spiral groove located on the volute suction. The leading edges of the impeller shall be hardened to Rc 60 and shall be capable of handling solids, fibrous materials, heavy sludge and other matter normally found in wastewater. The screw shape of the impeller inlet shall provide an inducing effect for the handling of up to 5% sludge and rag-laden wastewater. The impeller to volute clearance shall be readily adjustable by the means of a single trim screw. The impellers shall be locked to the shaft, held by an impeller bolt and shall be coated with alkyd resin primer.

K. The pump volute shall be a single piece gray cast iron, ASTM A-48, Class 35B, non-concentric design with smooth passages of sufficient size to pass any solids that may enter the impeller. Minimum inlet and discharge size shall be as specified. The volute shall have integral spiral-shaped, sharp-edged groove(s) that is cast into the suction cover. The spiral groove(s) shall provide the sharp edge(s) across which each impeller vane leading edge shall cross during rotation

so to remain unobstructed. The internal volute bottom shall provide effective sealing between the multi-vane semi-open impeller and the volute.

L. The pump volute shall be manufactured to accommodate a device designed by the pump Manufacturer to produce a flushing action at the start of the pump cycle. Water from the pump will be forced through the device into the wet well as a jet flushing stream. This device is mounted on the pump and is based on the ejector principle with a ball as a closing device. The operation is automatic and induced by the pump flow and pressure. Electrical components or cabling shall not be accepted.

## 2.4 MOTOR

A. 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 °C (356 °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 stator shall be heat-shrink 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 designed for continuous duty handling pumped media of 40 °C (104 °F) and capable of no less than 30 evenly spaced starts per hour. The rotor bars and short circuit rings shall be made of cast aluminum. Thermal switches set to open at 125 °C (260 °F) 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. 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.

B. The combined service factor (combined effect of voltage, frequency and specific gravity) 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 current and torque.

C. 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 65 ft.

D. 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.

E. Motors shall be sufficiently cooled by the surrounding environment or pumped media. If not sufficient, a cooling jacket shall be required.

2.5 CONTROLS

A. Furnish and install pump control panel for only the Yard Drain pump station in NEMA 4X stainless steel enclosure (FCP8010)

1. Pumps shall be controlled by the level monitor system.
2. For each pump there shall be included individual motor circuit breakers, motor soft starter, three phase overload protectors, manual reset, hand-off automatic selector switches, running lights, ammeters and elapsed time meters.
3. Provide phase failure/undervoltage relay to de-energize motors and include auxiliary contacts for remote indication.
4. Provide alarm system consisting of an alarm light and horn, with silencing switch.
5. Provide 24 V control circuit transformer with disconnect and overload protection.
6. Provide duplex weather proof convenience outlet.
7. Provide terminal strips for interface wiring between control panel and pump station.
8. Controls shall automatically alternate the operation of the pumps.
9. Provide two (2) 20 amp, one (1) pole breakers in the control panel as spares.

B. Automatic Mode:

1. The pump(s) shall operate/run based on wetwell water level. The pumps shall operate at constant speed. The pumps shall also alternate automatically between lead pump and lag pump cycles. Pumps On/Off level shall be set at the control panel by the operator.

C. Hand Mode:

1. In Hand mode, the pumps shall be operated via HOA selector switch locally at the control panel.

D. Wetwell Low Water Level:

1. When the Low Water Level float switch is activated, all operating pumps shall stop running immediately.

E. High Water Level Alarm:

1. Furnish and install a high water level alarm horn and light at the pump control panel. The unit shall be factory constructed on top of the pump control panel. The unit shall consist of a loud audible horn with manual adjustment for pitch; a flashing red light with a 100 watt bulb and red vapor proof globe and guard, and a control center for horn silencer with reset and test switches.

F. Liquid Level Sensors:

1. Furnish and install an submersible level transducer for automatic control of pumps and provide float switches for Low Water Level and High Water Level, in case of submersible level transducer failure/fault. The High Water Level float switch shall initiate an alarm and SCADA contacts. The Low Water Level float switch shall be hardwired to shut pumps off in any condition and send an alarm to SCADA. The submersible level transducer shall meet the requirements of Section 40 72 43.

G. SCADA:

1. The pump control panel shall be furnished with dry contacts for communication with SCADA. Field wiring from pump control panel to SCADA panel shall be the responsibility of System Integrator.
2. The following data shall be made available to the SCADA system:

    a. Pump Run/On
    b. Pump Fault
    c. Wetwell Water Level – 4-20 mA
    d. High Water Level Alarm
    e. Low Water Level Alarm
    f. Pump Station Flow – Provide provisions to accept 4-20 mA and transmit signal from magnetic flow meter provided separately

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.

B. Verify layout and orientation of pumps, accessories, and piping connections.

### 3.2 INSTALLATION

A. Install pumps and accessories where indicated on Drawings and according to Manufacturer's instructions.

B. Provide and connect piping, accessories, and power and control conduit and wiring to make system operational, ready for startup.

C. Flush piping with clean water.

### 3.3 FIELD QUALITY CONTROL

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.

B. Pre-Operational Checks:

1. Check pump and motor alignment.
2. Check for proper motor rotation.
3. Check pump and drive units for proper lubrication.

C. Startup and Performance Testing:

1. The pump shall be tested at start-up and voltage, current, and other significant parameters recorded. The manufacturer shall provide a formal test procedure and forms for recording data. Only factory certified service personnel shall perform start-up service. Proof of certification shall be required prior to equipment approval.

D. Verify pump performance by performing time-drawdown test or time-fill test.

E. Check pump and motor for high bearing temperature and excessive vibration.

F. Check for motor overload by taking ampere readings.

G. Equipment Acceptance:

1. Adjust, repair, modify, or replace system components that fail to perform as specified, and rerun tests.
2. Make final adjustments to equipment under direction of manufacturer's representative.
3. Document adjustments, repairs, and replacements in manufacturer's field services certification.

H. Manufacturer Services: Furnish services of Manufacturer's representative experienced in installation of products furnished under this Section for no less than one (1) trip of one (1) day on-Site for installation, inspection, field testing, and instructing Owner's personnel in maintenance of equipment.

I. Furnish installation certificate from equipment Manufacturer's representative attesting equipment has been properly installed and is ready for startup and testing.

## 3.4 DEMONSTRATION

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for demonstration and training.

B. Demonstrate equipment startup, shutdown, routine maintenance, and emergency repair procedures to Owner's personnel.

END OF SECTION 43 25 13

# SECTION 43 26 13 - SUBMERSIBLE CHOPPER PUMPS

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes: Submersible chopper pumps at Influent Pump Station (IPS).

B. Related Requirements:

1. Division 26 – Electrical.

### 1.2 REFERENCE STANDARDS

A. ASTM International:

1. ASTM A48 - Standard Specification for Gray Iron Castings.
2. ASTM A276 - Standard Specification for Stainless Steel Bars and Shapes.

B. National Electrical Manufacturers Association:

1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

### 1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit information concerning materials of construction, fabrication, and protective coatings.

C. Shop Drawings:

1. Submit detailed dimensions for materials and equipment, including wiring and control diagrams, performance charts and curves, installation and anchoring requirements, fasteners, and other details.
2. Include Manufacturer's specified displacement tolerances for vibration at operational speed specified for pumps.

D. Manufacturer's Certificate: Certify that pumps and accessories meet or exceed specified requirements.

1. Certify installation is completed according to manufacturer's instructions.

E. Manufacturer's Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.

F. Source Quality-Control Submittals: Indicate results of factory tests and inspections.

G. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

H. Manufacturer Reports: Indicate that equipment has been installed according to manufacturer's instructions.

1.4 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for closeout procedures.

B. Project Record Documents: Record actual locations and final orientation of equipment and accessories.

1.5 QUALITY ASSURANCE

A. In the performance affidavit, the Manufacturer must certify to the Contractor and the Owner, that the Contract Documents have been examined, and that the equipment will meet in every way the performance requirements set forth in the Contract Documents for the application specified.

B. The performance affidavit must be signed by an officer of the company manufacturing the equipment, and witnessed by a notary public.

C. The performance affidavit must include a statement that the equipment will not clog or bind on solids typically found in raw wastewater applications.

1.6 WARRANTY

A. The contractor shall submit Manufacturer's standard warranty and performance affidavit for equipment to be furnished in accordance with this section. The warranty for workmanship and materials shall be five (5) years from pump startup.

1.7 SPARE PARTS

A. The pump Manufacturer shall furnish one (1) set of recommended spare parts.

B. The pump Manufacturer shall furnish a complete list of recommended spare parts.

C. The pump Manufacturer shall furnish any special tool for the Owner to service, maintain, repair, and disassemble the pumps.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

1. Vaughan Model S8P.
2. Or Pre-Approved Equal.
    a. Specifications and equipment arrangements for the equipment referenced are based on Vaughan Model S8P. Changes to the arrangement indicated in the specifications and in the plan set shall be at the expense of the installing Contractor. No change orders will be issued to the contractor for modifications to the laying length, footprint, concrete layout, electrical, mechanical, etc.

2.2 DESCRIPTION

A. Schedule:

1. Influent Pump No.1 (P1010)
2. Influent Pump No.2 (P1020)
3. Influent Pump No.3 (P1030)

B. Submersible chopper pumps and all appurtenances as specified.

C. The pump shall be specifically designed to pump waste solids at heavy consistencies without plugging or dewatering of the solids. Materials shall be chopped/macerated and conditioned by the pump as an integral part of the pumping action.

D. The pump must have demonstrated the ability to chop through and pump high concentrations of solids such as plastics, heavy rags, grease and hair balls, wood, paper products and stringy materials without plugging, both in tests and field applications.

2.3 PERFORMANCE AND DESIGN CRITERIA

A. Quantity of Pumps: 3

B. Design Point of Each Pump: 2275 GPM @ 165 ft

C. Motor: 200 HP, 1750 RPM, 460 V, 3 phase, 60 Hz, 1.0 SF, inverter duty

D. Discharge Size: 8 in

E. Impeller Material: Cast steel, heat treated to minimum Rockwell C 60

F. Service Liquid: Raw wastewater

2.4 PUMP CONSTRUCTION

A. Casing, Back Plate and Wear Plate: The pump casing shall be of volute design, spiraling outward to the Class 125 flanged centerline discharge. Casing and back plate shall be cast ductile iron with all water passages to be smooth, and free of blowholes and imperfections for good flow characteristics. Backplate shall include a replaceable Rockwell C 60 alloy steel wear plate with back cutter set for 0.030 - 0.050" clearance to cut against the rotating impeller pumpout vanes for removing fiber and debris.

B. Impeller: The impeller shall be semi-open type with pump out vanes to reduce seal area pressure. Chopping/maceration of materials shall be accomplished by the action of the cupped and sharpened leading edges of the impeller blades moving across the cutter bar at the intake openings, with a set clearance between the impeller and cutter bar of 0.015-0.025”. Impeller shall be cast steel heat treated to minimum Rockwell C 60 and dynamically balanced. The impeller shall be keyed to the shaft and shall have no axial adjustments and no set screws. Pumps with open type impellers or impellers without pump out vanes on the back plate shall not be allowed on this project. Additionally, impellers that mount directly to the motor shaft shall not be allowed as this results an unacceptable overhang from the impeller to the lowest mechanical seal.

C. Cutter Bar Plate: The cutter bar plate shall be recessed into the pump casing and shall contain at least two (2) shear bars extending diametrically across the intake opening to within 0.025” - 0.050” of the rotating external cutter tooth for the purpose of preventing intake opening blockage and wrapping of debris at the shaft area. Chopper pumps utilizing individually mounted shear bars shall not be acceptable. Cutter bar shall be alloy steel heat-treated to minimum Rockwell C 60.

D. Upper Cutter: The upper cutter shall be threaded into the wear plate behind the impeller, designed to cut against the pump-out vanes and the impeller hub, reducing and removing stringy materials from the mechanical seal area. Upper cutter shall be cast steel heat treated to minimum Rockwell C 60. The upper cutter teeth are positioned as closely as possible to the center of shaft rotation to minimize cutting torque and nuisance motor tripping. The ratio of upper cutter cutting diameter to shaft diameter in the upper cutter area of the pump shall be 3.6 or less.

E. External Cutter: The external cutter shall be used to eliminate binding or build-up of stringy materials at the pump inlet. The external cutter shall consist of opposing cutter wings which shear against the outside surface of the shear bars and the anvil, an integral cast tooth which shears against the adjacent surface of the shear bars, and a hex head sufficiently sized for ease of removal. The external cutter shall be cast steel and heat treated to a minimum Rockwell C 60.

F. Cutter Nut: The cutter nut shall be used to affix the impeller to the shaft, and to eliminate binding or wrapping of stringy materials at the pump inlet. The cutter nut shall consist of a hex head sufficiently sized for ease of removal and shall include an integral cast anvil which shears against the adjacent surface of the segment bars on the cutter bar. The cutter nut shall be cast steel heat treated to a minimum 60 Rockwell C Hardness. Due to the solids handling demand in this application, nuts, bolts, or other impeller securing devices that lack the ability to cut debris from the pump suction shall not be allowed on this project.

G. Pump Shafting: The pump stub shaft and impeller shall be supported by ball bearings. Shafting shall be heat treated steel, with a minimum diameter of 1.5 inches in order to minimize

deflection during solids chopping. Mounting the pump impeller directly to the motor shaft shall not be allowed on this project as this results in an unacceptable overhang distance from the impeller to the lowest mechanical seal.

H. Bearing Housing: Bearing housing shall be ductile cast iron and machined with piloted bearing fits for concentricity of all components. Piloted motor mount shall firmly align motor on top of bearing housing.

I. Thrust Bearings: Shaft thrust in both directions shall be taken up by two (2) back-to-back mounted single-row angular contact ball bearings or a matched set of face-to-face tapered roller bearings with a minimum L-10 life rated 100,000 hours. A pump mechanical seal shall be provided to isolate the bearings from the pumped media. The pump seal, as well as the thrust bearings shall be oil bath lubricated in the bearing housing by ISO Grade 46 oil.

J. Pump Mechanical Seal: The mechanical seal shall be located immediately behind the impeller hub to maximize the flushing available from the impeller pumpout vanes. The seal shall be a screw in, cartridge-type mechanical seal with Viton O-rings and silicon carbide faces. This cartridge seal shall be pre-assembled and pre-tested so that no seal settings or adjustments are required from the installer. Any springs used to push the seal faces together must be shielded from the fluid to be pumped. The cartridge shall also include an integral, heat-treated stainless steel seal sleeve and a ductile iron seal gland.

K. Automatic Oil Level Monitor: An oil level switch shall be mounted at the top of the wet well, with a hose feeding down to the side of the bearing housing to monitor oil level and shut off the motor in event of low oil level. A relay shall be included for mounting in the pump control panel. The hose shall have a minimum length of 50 ft.

L. Shaft Coupling: The submersible motor shall be close coupled directly to the pump shaft using a solid sleeve coupling, which is keyed to both the pump and motor shafts. Slip clutches and shear pins between the shaft and the motor shall not be acceptable.

M. Stainless Steel Nameplates: Nameplate shall be attached to the pump and drive motor giving the manufacturer's pump model, serial number, rated capacity, head, speed and all pertinent data.

N. Motor:

1. Electrical Characteristics: As specified in Division 26 – Electrical.

    a. Voltage: 460 V, 3 Phase, 60 Hz.

2. Submersible Motor: The submersible motor shall be U/L or FM listed and suitable for explosion proof Class I, Group C & D, Division I hazardous locations, rated at 200 HP, 1750 RPM, 460 V, 60 Hz and 3 phase, 1.0 service factor with Class F insulation, inverter duty, and 15 minute in air continuous duty. Motor shall have tandem mechanical seals in oil bath and dual moisture sensing probes. Moisture sensors must be connected to indicate water intrusion. The lower motor seal shall be exposed only to the lubricant in the pump bearing housing, with no exposure to the pumped media. Motor shall include two (2) normally closed automatic resetting thermostats connected in series and embedded in adjoining phases. The thermostats must be connected per local, state, and/or the National Electric Code to maintain hazardous location rating and to disable motor

starter if overheating occurs. Motor frame shall be cast iron, and all external hardware and shaft shall be stainless steel. Motor shall be sized for non-overloading conditions.

3. The motor shall be protected by following sensors:

    a. 2 bi-metal thermal switches for thermal control of the stator.
    b. Moisture/Temperature detection relay:

        1) The pump Manufacturer shall supply a moisture/temperature detection relay for installation in the pump control panel.
        2) The unit shall apply a low voltage AC signal across the moisture sensors to detect moisture in the motor. A moisture condition is considered present if the resistance between the sensors drops below the setting on the relay.
        3) The relay shall also monitor the temperature condition of the motor via the motor thermostats which are normally in the closed position.

## 2.5 ACCESSORIES

A. Guide Rail System:

1. Provide a guide rail system consisting of two (2) stainless steel guide rails, cast ductile iron pump guide bracket, cast ductile iron discharge elbow with mounting feet and Class 125 flanges, 316 stainless steel upper guide rail mounting bracket, and 316 stainless steel intermediate guide rail stiffener brackets every 10 ft.

B. Surface Preparation:

1. The pump exterior shall be solvent washed, sandblast cleaned and coated with 30 MDFT Tnemec Perma-Shield PL Series 431 epoxy. The submersible motor shall be coated with the motor Manufacturer's standard paint coating for wastewater service.

## 2.6 PUMP CONTROLS

A. Each pump motor shall be equipped with a variable frequency drive (VFD) sized for the appropriate voltage and power. The VFD shall be included in the influent chopper pump package by pump Manufacturer. A control panel shall be included in the pump package to control all influent chopper pumps and shall be capable of communicating to the SCADA panel.

B. VFD:

1. Schedule:

    a. Influent Chopper Pump No.1 VFD (VFD1010)
    b. Influent Chopper Pump No.2 VFD (VFD1020)
    c. Influent Chopper Pump No.3 VFD (VFD1030)

2. The influent chopper pump VFD shall be ABB ACQ580, or pre-approved equal by Engineer. VFD shall conform to Section 26 29 23 - Variable Frequency Drives.
3. Each VFD unit shall be installed in a NEMA 12 fan cooling cabinet suitable for indoor installation. All VFD units shall be installed in the IPS electrical building.

C. Control Panel:

1. Schedule:

a. Influent Pumps Factory Control Panel (FCP1000)

2. Pump control panel shall have an HMI touch screen for operator input, wetwell water level, pump speed, pump status, and alarms at the IPS.
3. Pump control panel shall have a PLC for automatic control of pumps. The PLC shall be Siemens S7-1200, or pre-approved equal by Engineer.
4. Pump control panel shall be furnished with a communication module of Modbus TCP/IP protocol for connection to the new SCADA panel located in the IPS electrical building. Field wiring from the pump control panel to the SCADA panel shall be the responsibility of System Integrator.
5. Pump control panel shall be NEMA 12 rated for indoor installation, or NEMA 4X rated for outdoor installation.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.

B. Verify layout and orientation of pumps, accessories, and piping connections.

### 3.2 INSTALLATION

A. Install pumps and accessories where indicated on Drawings and according to manufacturer's instructions.

B. Provide and connect piping, accessories, and power and control conduit and wiring to make system operational, ready for startup.

C. Flush piping with clean water.

### 3.3 FIELD QUALITY CONTROL

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.

B. Pre-Operational Checks:

1. Perform all start-up checklist items per pump Manufacturer.
2. Check for proper motor rotation.

C. Startup and Performance Testing:

1. Operate pump at design point for continuous period of one (1) hour, under supervision of Manufacturer's representative and in presence of Engineer/Owner.

D. Verify pump performance by performing time-drawdown test or time-fill test.

E. Check pump and motor for high bearing temperature and excessive vibration.

F. Check for motor overload by taking ampere readings.

G. Equipment Acceptance:

1. Adjust, repair, modify, or replace system components that fail to perform as specified, and rerun tests.
2. Make final adjustments to equipment under direction of manufacturer's representative.
3. Document adjustments, repairs, and replacements in manufacturer's field services certification.

H. Manufacturer Services: Furnish services of Manufacturer's representative experienced in installation of products furnished under this Section for no less than one (1) trip of two (2) day on-Site for installation, inspection, field testing, and instructing Owner's personnel in maintenance of equipment.

I. Furnish installation certificate from equipment manufacturer's representative attesting equipment has been properly installed and is ready for startup and testing.

## 3.4 DEMONSTRATION

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for demonstration and training.

B. Demonstrate equipment startup, shutdown, routine maintenance, and emergency repair procedures to Owner's personnel.

END OF SECTION 43 26 13

# SECTION 43 41 46 - POLYETHYLENE TANKS AND ACCESSORIES

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section includes polyethylene tanks for storage of the following chemicals:

1. Bulk Tanks
   a. Caustic soda (NaOH).
   b. Polyaluminum Chloride (PAC).

B. Related Requirements:

1. Section 03 30 00 - Cast-In-Place Concrete.
2. Division 40 – Process Interconnections.
3. Division 43 – Process Gas and Liquid Handling, Purification, and Storage Equipment.
4. Section 46 33 41 – Liquid Chemical Feed Systems
5. Section 46 33 83 - Liquid Chemical Feed Accessories

### 1.2 REFERENCE STANDARDS

A. American Society of Mechanical Engineers:

1. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
2. ASME B16.42 - Ductile Iron Pipe Flanges and Flanged Fittings: Classes 150 and 300.
3. RTP-1 – Reinforced Thermoset Plastic Corrosion Resistant Equipment.

B. America Society for Testing and Materials:

1. D618 Conditioning Plastics and Electrical Insulating Materials for Testing
2. D638 Tensile Properties of Plastics
3. D790 Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
4. D883 Definitions of Terms Relating to Plastics
5. D1505 Density of Plastics by the Density-Gradient Technique
6. D1525 Test Method for Vicat Softening Temperature of Plastics
7. D1693 Test Method for Environmental Stress-Cracking of Ethylene Plastics
8. D1998 Standard Specification for Polyethylene Upright Storage Tanks
9. D2765 Degree of Crosslinking in Crosslinked Ethylene Plastics as Determined by Solvent Extraction
10. D2837 Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials
11. D3892 Practice for Packaging/Packing of Plastics
12. F412 Definitions of Terms Relating to Plastic Piping Systems

C. ARM (Association of Rotational Molders) Standards: Low Temperature Impact Resistance (Falling Dart Test Procedure)

D. ANSI Standards: B-16.5 Pipe Flanges and Flanged Fittings

E. OSHA Standards: 29 CFR 1910.106 Occupational Safety and Health Administration, Flammable and Combustible Liquids

F. UBC CODE: Uniform Building Code 2006 Edition

G. IBC CODE: International Building Code 2009 Edition

H. CBC Code: California Building Code 2010 Edition

I. NSF/ANSI Standard 61 – Drinking Water System Components (Type II resin)

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit information concerning materials of construction, fabrication, and protective coatings.

C. Shop Drawings: Submit detailed certified dimensional Shop Drawings showing tank size, layout of accessories, and anchoring system.

D. Manufacturer's Certificate:
1. Certify that products meet or exceed specified requirements.
2. Certify that products are suitable for chemical usage in this application.
3. Submit certified list of tank installations, storing same chemical and concentration, in service for period of not less than five years.

E. Owner Installation Certificate: Obtain from equipment manufacturer's representative and submit, attesting equipment has been properly installed and is ready for startup and testing.

F. Delegated Design Submittals: Submit signed and sealed design calculations and assumptions for determination of shell thickness, nozzle reinforcement, and special elements of vessel construction and support.

G. Test and Evaluation Reports:

1. Submit certified data on physical properties of laminates being used to include laminate tensile modulus and flexural modulus in hoop and axial directions, and data on laminate makeup to include number and thickness of layers and layer glass content.
2. Submit certified factory test results.

H. Manufacturer's Instructions: Submit detailed instructions on installation requirements, including tank handling procedures, anchoring, and layout.

I. Source Quality-Control Submittals: Indicate results of shop/factory tests and inspections.

J. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

K. Manufacturer Reports: Submit certification after installation that tanks have been installed according to manufacturer's instructions.

L. Qualifications Statements:

1. Submit qualifications for manufacturer, installer, and licensed professional.
2. Submit manufacturer's approval of installer.

## 1.4 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for closeout procedures.

B. Project Record Documents: Record actual locations and final orientation of tank and accessories.

C. Operation and Maintenance Data: Submit maintenance instructions for tank and accessories.

## 1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years' documented experience.

B. Installer: Company specializing in performing Work of this Section with minimum three years' documented experience and approved by manufacturer.

## 1.6 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Inspection: Accept tanks on-Site. Inspect tanks for damage.

C. Store products in areas protected from weather, moisture, or possible damage; do not store products directly on ground; handle products to prevent damage to interior or exterior surfaces.

## 1.7 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.

B. The Contractor shall furnish a warranty extending twelve (12) months after substantial completion date.

C. The Manufacturer shall furnish a three year warranty for replacement due to breakage, yellowing, abrasion, loss of light transmission, and coating delamination. Furnish three year manufacturer's warranty on fittings and accessories supplied by the tank manufacturer.

PART 2 - PRODUCTS

2.1 TANKS

A. Manufacturers:

1. The equipment, polyethylene tanks, shall be manufactured by:

   a. Snyder Industries, Inc.
   b. Assmann USA.
   c. PolyProcessing, Inc.
   d. Or approved equal.

2. Specifications and equipment arrangements for the polyethylene tanks are based on Synder Industries, Inc. Changes to the arrangement indicated in the specifications and in the plan set shall be at the expense of the installing contractor. No change orders will be issued to the contractor for modifications to the laying length, footprint, concrete layout, electrical, mechanical, etc.

B. Description:

1. This specification covers upright, cylindrical, flat bottom, single wall tanks molded in a one-piece seamless construction by the rotational molding process (laminated or fabricated tanks will not be accepted). The tanks are designed for above-ground, vertical installation and are capable of containing chemicals at atmospheric pressure. Included are requirements for materials, properties, design, construction, dimensions, tolerances, workmanship, and appearance. Tank capacities are from 500 gallon (1,816 L) up to gallon (62,453 L).
2. Use materials of construction to resist and retain process fluid without leakage or damage to structural integrity of tank; use same resin throughout construction of each tank.
3. Minimum thickness: 0.187 inch.
4. Vertical, non-sloping flat bottom; integral closed top.
5. Furnish liquid level gage sight glass, with flanges, indicating 10 to 90 percent of tank capacity.

C. Polyethylene Storage Tank Schedule:

1. BT8100

   a. Material Stored: Sodium Hydroxide (Caustic) (25%)
   b. Chemical Specific Gravity: 1.28
   c. Configuration: Vertical Tank
   d. Dimensions: 120”Ø x 194” nom
   e. Capacity: 8,500 gallon
   f. Insulation: Yes
   g. Heat Tracing: Yes
   h. Tank Material: HDLPE or XLPE
   i. Fitting Material: PVC
   j. Gasket Material: Viton, FKM, FPM, or approved equal
   k. Bolt Material: Hastelloy C276, poly encapsulated or approved equal

l. Accessories: Sight Level Gage, Down Pipes and Fill Pipes, External Fill Pipes, Ultrasonic Level Indicator, FRP Ladder and Tank Nameplate.
m. Fittings:

1) 1 – 4" Vent
2) 2 – 3" flanged top mounted, for liquid level (LE8100 and reverse level indicator)
3) 1 – 2" nozzle, top mounted, for fill
4) 1 – 3" side bottom drain
5) 1 – 3" overflow positioned above the volume elevation
6) 1 – 18" ID manway in top
7) 1 – 2" flanged side bottom chemical feed pump piping connection

2. BT8200

a. Material Stored: Polyaluminum Chloride (25%-35%)
b. Chemical Specific Gravity: 1.19-1.21
c. Configuration: Vertical Tank
d. Dimensions: 120"Ø x 194" nom
e. Capacity: 8,500 gallon
f. Insulation: Yes
g. Heat Tracing: Yes
h. Tank Material: HDLPE or XLPE
i. Fitting Material: PVC
j. Gasket Material: EPDM
k. Bolt Material: Hastelloy C276, poly encapsulated or approved equal
l. Accessories: Sight Level Gage, Down Pipes and Fill Pipes, External Fill Pipes, Ultrasonic Level Indicator, FRP Ladder and Tank Nameplate.
m. Fittings:

1) 1 – 4" Vent
2) 2 – 3" flanged top mounted, for liquid level (LE8100 and reverse level indicator)
3) 1 – 2" nozzle, top mounted, for fill
4) 1 – 3" side bottom drain
5) 1 – 3" overflow positioned above the volume elevation
6) 1 – 18" ID manway in top
7) 1 – 2" flanged side bottom chemical feed pump piping connection

D. Materials

1. Tanks are classified according to type as follows and it is the responsibility of the purchaser to specify Type I or Type II.

a. Type I – Tanks molded from cross-linkable polyethylene resin.
b. Type II - Tanks molded from linear polyethylene resin (not cross-linkable resin).

2. The material used shall be virgin polyethylene resin as compounded and certified by the manufacturer. Type I tanks shall be made from crosslinked polyethylene (XLPE) resin as manufactured by ExxonMobil Chemical, or resin of equal physical and chemical properties. Type II tanks shall be made from high density linear polyethylene (HDLPE)

resin as manufactured by ExxonMobil Chemical, or resin of equal physical and chemical properties.

3. All polyethylene resin material shall contain a minimum of a U.V. 15 stabilizer as compounded by the resin manufacturer. Pigments may be added at the purchaser's request, but shall not exceed 0.25% (dry blended) of the total weight.
4. See mechanical properties of Type I and Type II tank materials in Table 1.1 and 1.2 below.

**Table 1.1: Type I tank material: Cross-linked (XLPE)**

| PROPERTY | ASTM | VALUE |
|---|---|---|
| Density (Resin) | D1505 | 0.938-0.946 g/cc |
| Tensile (Yield Stress 2"/min) | D638 | 2830 - 3000 PSI |
| Elongation at Break (2"/min.) | D638 | 700 - 800% |
| ESCR (100% Igepal, Cond. A, F50) | D1693 | >1000 hours |
| ESCR (10% Igepal, Cond. A, F50) | D1693 | >1000 hours |
| Vicat Softening Degrees F. Temperature | D1525 | 250 |
| Flexural Modulus | D790 | 87,000 – 110,000 PSI |

**Table 1.2: Type II tank material: High density Linear (HDLPE)**

| PROPERTY | ASTM | VALUE |
|---|---|---|
| Density (Resin) | D4883 | 0.941-0.948 g/cc |
| Tensile (Yield Stress 2"/min) | D638 | 3000 PSI |
| Elongation at Break (2"/min.) | D638 | >1000% |
| ESCR (100% Igepal, Cond. A, F50) | D1693 | 550 hours |
| ESCR (10% Igepal, Cond. A, F50) | D1693 | 50 hours |
| Vicat Softening Degrees F. Temperature | D1525 | 235 |
| Flexural Modulus | D790 | 130,000 PSI |

E. Design Criteria:

1. The minimum required wall thickness of the cylindrical shell at any fluid level shall be determined by the following equation, but shall not be less than 0.187 in. thick.

T = P x O.D./2 SD = 0.433 x S.G. x H x O.D./2 SD
T = wall thickness
SD = hydrostatic design stress, PSI
P = pressure (.433 x S.G. x H), PSI
H = fluid head, ft.
S.G. = specific gravity, g/cm^3
O.D. = outside diameter, in.

a. The hydrostatic design stress shall be determined by multiplying the hydrostatic design basis, determined by ASTM D2837 using rotationally molded samples, with a service factor selected for the application. The hydrostatic design stress is 600 PSI at 73 degrees Fahrenheit for Type I and Type II materials. In accordance with the formula in 9.1, the tank shall have a stratiform (tapered wall thickness) wall.
b. The hydrostatic design stress shall be derated for service above 100 degrees Fahrenheit and for mechanical loading of the tank.
c. The standard design specific gravity shall be 1.5 or 1.9.

2. The minimum required wall thickness for the cylinder straight shell must be sufficient to support its own weight in an upright position without any external support.

3. The top head must be integrally molded with the cylinder shell. The minimum thickness of the top head shall be equal to the top of the straight wall. The top head of tanks with 2000 or more gallons of capacity shall be designed to provide a minimum of 1300 square inches of flat area for fitting locations.
4. Tanks with 2000 or more gallons of capacity shall have a minimum of 3 lifting lugs integrally molded into the top head. The lifting lugs shall be designed to allow erection of an empty tank.
5. The tank shall be designed to provide a minimum of 4 tie-down lugs integrally molded into the top head. The tie-down lugs shall be designed to allow tank retention in wind and seismic loading. Refer to section 12.8 for tank tie-down accessories.

Note: The designed specific gravity of the tank shall be based upon the actual chemical, its' concentration and temperature. From these factors it can be determined if polyethylene can be used and if so which family of polyethylene is to be used. There are chemical applications where both the (cross-linked - Type 1) XLPE and HDLPE (high-density linear - Type 2) resin will work. There are also applications where only one of these families of resin is recommended. If FDA or NSF 61 is required the Type II HDLPE resin will be required.

## 2.2 NOZZLES AND ATTACHMENTS

A. Fittings - Threaded Bulkhead

1. Threaded bulkhead fittings are available for below liquid installation depending on the tank diameter and the placement of the fitting in the tank. Fittings must be placed away from the tank knuckle radius' and flange lines. Consult the manufacturer for placement questions. The maximum allowable size for bulkhead fittings placed on a curved sidewall section of tanks 48 in. to 142 in. in diameter is 2 inch size. Tank wall thickness must be considered for bulkhead fitting placement. The maximum wall thickness for each fitting size is shown below. The following chart is based upon PVC and CPVC fittings. Contact the manufacturer for other fitting materials

| Fitting Size | Maximum Wall Thickness |
|---|---|
| 1/2 in. | 2 in. |
| 3/4 in. | 2 in. |
| 1 in. | 2 in. |
| 1 1/4 in. | 2 in. |
| 1 1/2 in. | 2 in. |
| 2 in. | 2 in. |
| 3 in. | 2.125. (Flat Surface Only) |

2. The bulkhead fittings shall be constructed of PVC or other specified material. Gaskets shall be a minimum of 1/4" thickness and constructed of 40-50 durometer EPDM, 60-70 durometer Viton, or other specified material.

B. Fittings - Bolted Double 150 lb. Flange Fittings

1. Bolted double flange fittings are required for below liquid level installation for sizes above 2 in. depending on the tank diameter and the placement of the fitting in the tank. Fittings must be placed away from tank knuckle radius' and flange lines. Consult the manufacturer

for placement questions. Bolted double flange fittings provide the best strength and sealing characteristics of any tank fitting available. Allowable fittings sizes based on tank diameter for curved surfaces are shown below.

| Tank Diameter | Maximum Bolted Fitting Size Allowable |
|---|---|
| 48 in. - 86 in. | 3 in. |
| 90 in. - 102 in. | 6 in. |
| 120 in.- 142 in. | 8 in. |

a. The bolted double flange fittings shall allow tank wall thickness up to 2 1/2 in.

2. The bolted double flange fitting shall be constructed with 2 ea. 150 lb. flanges, 2 ea. 150 lb. flange gaskets, and the correct number and size of all-thread bolts for the flange specified by the flange manufacturer. The flanges shall be constructed of PVC Type I, Grade I, or other specified material.
3. Gaskets shall be a minimum of 1/4" thickness and constructed of 40-50 durometer EPDM, 60-70 durometer Viton or other specified material. There shall be a minimum of 4 ea. full thread bolts.
4. The bolts diameter is to meet ASNI standards based upon the flange size. The bolts may have gasketed flanged metal heads or bolt heads encapsulated in Type II polyethylene material. The encapsulated bolt shall be designed to prevent metal exposure to the liquid in the tank and prevent bolt rotation during installation. The polyethylene encapsulation shall fully encapsulate the bolt head. The polyethylene shall be color coded to distinguish bolt material (white - 316 S.S., yellow - Hastelloy C276, green - Titanium). Each encapsulated bolt shall have a gasket to provide a sealing surface against the inner flange.
5. Standard orientation of bolted double flange fittings shall have bolt holes straddling the principal centerline of the tank in accordance with ANSI/ASME B-16.5 unless otherwise specified.

C. Fittings - Bolted Stainless-Steel Fittings

1. Bolted stainless steel fittings are available for below liquid level installation depending on the tank diameter and the placement of the fitting in the tank. Fittings must be placed away from tank knuckle radius' and flange lines. Consult the manufacturer for placement questions. Allowable fittings sizes based on tank diameter for curved surfaces are shown below.

| Tank Diameter | Maximum Bolted Fitting Size Allowable |
|---|---|
| 48 in. | 3 in. |
| 64 in. - 142 in. | 4 in. |

a. The bolted stainless-steel fittings shall allow tank wall thickness up to 2 1/2 in.

2. The bolted stainless-steel fittings shall be constructed with a minimum of 4 fully threaded 3/8 in. studs. Each fitting shall have one gasket and two flanges. The gasket shall be compressed between the inside of the tank wall surface and the inside flange of the fitting. The stainless-steel fittings come standard with female x female pipe threads. The fittings shall be constructed of Type 316 stainless steel. Gaskets shall be a minimum of 1/4"

thickness and constructed of 40-50 durometer EPDM, 60-70 durometer Viton or other specified material.

D. Fittings - Siphon Tube Fittings

1. Siphon tubes may be added to the fittings specified in sections 11.1, 11.2 and 11.3. Siphon tubes will allow these fittings, when used as drainage fittings, to provide better tank drainage.

E. Fittings - Molded Outlet

1. The outlet fitting shall be an integral part of the tank and provide complete drainage of liquid through the sidewall of a flat bottom container without the use of a special support structure or concrete pad.
2. The tank attachment shall be constructed from a PVC schedule 80 male adapter and is standard in 2,3,4 or 6 in. sizes on select tank sizes. This provides a schedule 80 pipe socket attachment (Except for the 6 in. size). Other outlet attachments are available in a variety of materials. The fitting orifice shall not be less than schedule 80 interior pipe size per ANSI B36.10-1979. O-rings shall be constructed of 70 +/- 5 durometer Viton, FKM, FPM, or approved equal. The inside diameter of the outlet is to be molded and is not to be drilled out to increase chemical flow.

F. Fittings - Self-Aligning Threaded Bulkhead

1. Self-Aligning fittings are available for installation in vapor phase applications on curved surfaces depending on the spherical dome radius and the placement of the fitting on the tank dome. Fittings must be placed away from tank radiuses. Consult the manufacturer for placement questions. The maximum allowable size for self-aligning fittings placed on a spherical section of the tank is shown below.

| Tank Diameter | Maximum Fitting Size Allowable |
|---|---|
| 45 in. - 48 in. | 2 in. |
| 64 in. - 142 in. | 3 in. |

2. Tank thickness and fitting angle may need to be considered for self-aligning fitting placement. The maximum thickness and installation angle for fitting sizes are shown below.

| Fitting Size | Maximum Angle | Maximum Thickness |
|---|---|---|
| 1 in. | 27 degrees | 1.000 in. |
| 2 in. | 25 degrees | 0.750 in. |
| 3 in. | 20 degrees | 1.0 in. |

3. The self-aligning fittings shall be constructed of PVC or CPVC. Gaskets shall be a minimum of 1/4" thickness and constructed of 40-50 durometer EPDM, 60-70 durometer Viton, or other specified material.

G. Vents

1. Each tank must be properly vented for the type of material and flow rates expected. Vents must comply with OSHA 1910.106 (f) (2) (iii) or other accepted standard. All tanks must be vented for atmospheric pressure as well as any pressure created by filling and emptying the tank. Some applications may require a sealed tank with a vent line going to a scrubber system for proper chemical safety. Venting equipment should be sized to limit pressure or vacuum in the tank to a maximum of 1/2" of water column (0.02 psi). U-Vents are offered in sizes from 1 in. to 6 in. with or without mesh insect screening. U-Vents with mesh screening may require additional sizing due to reduced air-flow rates. Consult the manufacturer for necessary venting and placement information.
2. All u-vents shall be constructed of PVC or other specified materials.
3. When a tank is being filled from a pressurized tanker truck or rail car steps need to be taken to avoid pressurizing the tank. The tank may require a secondary surge protection lid to avoid any pressure build up. The surge protection lid is to be a 14” or 18” hinged and be design that it is self-closing.

H. Flange Adapters

1. Flange adapters may be purchased as optional equipment to adapt threaded or socket fitting outlets to 150 lb. flange connections for connection to piping system components. Flange adapters are available in PVC, CPVC or other specified materials. Flange adapter construction shall utilize schedule 80 components in sizes ranging from ¾” to 8” depending on material required.

I. Flexible Connections

1. All tank fitting attachments shall be equipped with flexible couplers or other movement provisions provided by the tank customer. The tank will deflect based upon tank loading, chemical temperature and storage time duration. Tank piping flexible couplers shall be designed to allow 4% design movement. Movement shall be considered to occur both outward in tank radius and downward in fitting elevation from the neutral tank fitting placement.
2. The flexible connection is to be manufactured of the same material as the tank or a compatible material approved by the project engineer. If an elastomer flexible connection is used control bolts are required if recommended by the manufacturer. The flexible connection is to be designed for a minimum of 4% movement. The flexible connection is to be designed with 150# flange connections to allow for attachment to the tank and the piping system. The flexible connection is to be attached as close as possible to the tank to reduce stress.

## 2.3 SOURCE QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Requirements for testing, inspection, and analysis.

B. Factory Test Report:

1. Certify through visual inspection of tanks after fabrication that Acceptance Level II requirements of ASTM D2563 are met.
2. Certify following during shop inspection:

    a. Compliance with Drawing dimensions.

b. Surface cure by acetone wipe test; no surface tackiness is permitted.
c. Liquid tightness by minimum 24-hour hydrostatic test.

C. Certificate of Compliance: When fabricator is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at fabricator's facility conforms to Contract Documents.

1. Specified shop tests are not required for Work performed by approved fabricator.

## 2.4 ACCESSORIES

A. Reverse Level Indicators

1. Furnish and install liquid level indicators on the exterior of the storage tanks. The level indicator shall be actuated by a float within the tank through a polypropylene tape with high visibility numbers in feet and inches to a weighted indicator on a pulley system. All wetted parts, parts subject to condensation or exposure to the atmosphere within the tank shall be suitable non-corrosive durable material approved by the Engineer. The indicator board shall be marked in one hundred-gallon increments and labeled every 500 gallons. All moving parts shall be vapor tight fully enclosed but easily accessible for maintenance. The indicator shall utilize the 3” top opening in the tank and shall be mounted on the side wall of the tank with appropriate anchor materials.

B. Ultrasonic Level Indicator

1. Per Specification 40 72 13 - Ultrasonic Level Meter
2. The ultrasonic enclosure is to be an all plastic design with a NEMA 4X rating. The ultrasonic transducer is to have a 12” dead band and beam with a 20 ft range. The supply voltage can be 110, 220 VAC or 24 VDC. The connection to the tank is to be 2” or 3” NPT.
3. The ultrasonic level indicator shall provide a visual display of liquid level in the tank showing gallonage in measurement of hundreds of gallons along with 4-20 mA output for other alarm or control systems as well as four independent contacts capable of handling 10 amps each. Each contact can be programmed to operate in different opening and closing methods (7 modes). Contacts can be used to control pumps, valves, alarms, etc.

C. Fill Stations

1. A permanent fill station shall be constructed as shown on the drawings and shall be fitted with quick couplers. Quick Coupler Adaptors and caps for making quick connections shall be Kamlok 633A and 634B, respectively or equal. Couplers for Sodium Hypochlorite shall be titanium

D. Manway and Fill Cap (Non-sealed)

1. Fill caps shall be in a 10 in. vented-threaded style on various tank sizes with a minimum opening diameter of 7.125 in. Cap attachment shall be provided with all standard 10 in. cap placements with a polyurethane cap tie. Check the manufacturer’s specification drawing for availability and position.
2. Manways shall be 18 in. vented or non-vented threaded design or hinged style (minimum opening diameter of 15 in.) and a 24 in. vented or non-vented threaded or hinged style

(minimum opening diameter of 22 in.) on various tank sizes. Check the manufacture's specification drawing for availability and position.

3. All caps and manways shall be constructed of polyethylene material.

E. Bolted Sealed Top Manway

1. Sealed manways are shall be 18 or 24 in. sizes depending on availability in tank size. Consult the manufacturer for placement positions.
2. The sealed manway shall be constructed of polyethylene material. The bolts shall be polypropylene or other specified material. The gaskets shall be closed cell, crosslinked polyethylene foam and Viton O-rings to seal the bolts.

F. Surge Protection Lid

1. The hinged lid is to be manufactured of polyethylene. The lid will be a 14 in. size with 11 in. access opening or 18" with 15" access. The opening of the lid is to be restricted by a tether. The lid is to be designed so that it will close when the pressure has been released. Check SII specification drawing for availability and position.

G. Down Pipes and Fill Pipes

1. Down pipes and fill pipes shall be prepared per the customer approved drawings and specifications. All down pipes and fill pipes shall be supported at 5 ft. maximum intervals with support structures. Standard support structure design shall utilize bulkhead fitting tank attachments or welded attachments on Type II tanks. All designs shall be done according to the specific needs of the customer.
2. All down pipes and fill pipes shall be constructed of PVC or other specified materials.

H. Tank Attachments – External Fill Pipes - Optional on certain tanks

1. External fill pipes shall be prepared per the customer approved drawings and specifications. All external fill pipes shall be supported at 3 ft. maximum intervals with a support structure independent of the tank (ground supported). All designs shall be done according to the specific needs of the customer.
2. All external fill pipes shall be constructed of PVC or other specified materials.

I. Ladders

1. Ladders shall be constructed of stainless steel or FRP.
2. Safety cages shall be provided with ladders as optional equipment unless required by OSHA standards.
3. All ladders shall be designed to meet applicable OSHA standards. Reference: OSHA 2206; 1910.27; fixed ladders.
4. Ladders must be mounted to the tank to allow for tank expansion and contraction due to temperature and loading changes. All top ladder mounts shall be connected to integrally molded in attachment lugs that allow for tank movement due to temperature and loading changes.

J. Tie Down Systems

1. The tie down system shall be designed to withstand 150 MPH wind loads. Tie down systems must meet seismic requirements per IBC 2009 / CBC 2010 code with seismic loads ≤ .445g (Seismic Design Category "D" - Fa=1.0, Fv=1.5, Ss=1.4, S1=0.5). Anchor bolts shall be provided by the contractor per the calculations and the base plates for the system. A registered engineer's wet stamped calculations and or drawings may be required.
2. The tie down system shall be offered galvanized, 304 or 316 stainless steel.
3. Mild steel parts shall be deburred and galvanized.

K. Tank Nameplate

1. Mark each tank with encapsulated paper tag or stainless-steel nameplate not less than 4 by 6 inches in size; attach to outside of tank wall.
2. Print the following information on nameplates:

   a. Name of manufacturer.
   b. Capacity in gallons.
   c. Manufacturer serial number.
   d. Year built.
   e. Maximum specific gravity.
   f. Design pressure and temperature.
   g. Resin.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.

B. Verify layout and orientation of tank accessories and piping connections.

### 3.2 PREPARATION

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation preparation.

B. Thoroughly clean chemical storage tank pad, removing loose concrete, dust, and other debris. Place two layers of building paper on pad according to tank manufacturer's recommendations prior to placing tank.

### 3.3 INSTALLATION

A. Install chemical storage tank as indicated on Drawings and according to manufacturer's instructions.

B. Connect piping to tank.

C. Install tank accessories not factory mounted to complete installation.

D. Heat Tracing: Install heat tracing and tank heating systems in accordance with the manufacturers' printed in instructions

3.4 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Requirements for inspecting and testing.

B. Section 01 70 00 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.

C. Field Testing:

1. Hydrostatically test each chemical storage tank by filling with water to the overflow pipe level.
2. Conduct test minimum of 48 hours.
3. No leakage permitted.
4. Adjust, repair, modify, or replace components of system failing to perform as specified, and rerun tests.

D. Furnish services of manufacturer's representative experienced in installation of products supplied for not less than two, eight-hour days on-Site for installation inspection, field testing, and instructing Owner's personnel in maintenance of equipment.

E. Obtain Installation Certificate from equipment manufacturer's representative attesting equipment has been properly installed and is ready for startup and testing, and furnish to Owner.

END OF SECTION 43 41 46

# SECTION 43 53 54 - BLOWERS

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Blower package including accessories as specified herein.
   a. Quantity: 2
   b. Blower Application: Aerobic Digester
   c. All equipment specified in this section shall be designed and furnished by the blower manufacturer, who shall be responsible for the suitability and compatibility of all included equipment per this section.

B. Related Sections:

1. Section 40 90 00 – Instrumentation and Control for Process Systems
   a. Blower package controls are to be supplied by the System Integrator and are not part of the blower package.
2. Div. 26 - Execution requirements for electrical connections to equipment specified by this Section.

### 1.2 SCOPE

A. Contractor:

1. Furnish, unload, store and install positive displacement blower equipment with accessories necessary to provide a complete operational system as shown on the plans and as specified.

2. Shall be responsible for startup and training activities under the direction of the qualified manufacturer’s representative.

### 1.3 QUALITY ASSURANCE

A. Manufacturers’ Qualifications:

1. All equipment furnished under this section shall be manufactured in a plant whose quality management system is certified / registered as being in conformity with ISO 9001 and who shall assume complete responsibility for the design and performance of the blower package.
2. All equipment furnished under this section shall be new, unused, and shall be the standard product of the manufacturer, who shall have a minimum of 10 years’ experience in producing blower packages and be able to produce evidence of at least 5 installations of similar size in satisfactory operation in the United States, if requested.

B. Factory Tests:

1. All cast parts to be manufactured in a plant whose quality management system is certified / registered as being in conformity with ISO 9001.
2. All critical dimensions of the blower components provided by the manufacturer shall be verified and documented prior to assembly.
3. On completion of final assembly of the packaged blower and prior to shipment, each blower package shall be mechanically run at the prescribed design conditions to confirm machine operation.
4. Each blower package provided by the manufacturer shall be guaranteed to provide performance to ISO 1217, Annex C.

C. Reference Standard:

1. American Society of Testing and Materials (ASTM)
2. National Electrical Manufacturers Association (NEMA)
3. Occupational Safety and Health Act (OSHA)
4. National Electrical Code (NEC)
5. American Gear Manufacturers Association (AGMA)
6. Anti-Friction Bearing Manufacturers Association (AFBMA)
7. International Organization of Standardization (ISO)
8. International Electrotechnical Commission (IEC)
9. German Institute for Standardization (DIN)

## 1.4 SUBMITTAL

A. Manufacturer's standard submittal for establishing compliance to this section shall include the following items; following submittal procedures in accordance with Section 01 33 00
1. Table of contents
2. A complete and detailed list of any and all variations to the specification
3. Descriptive literature, bulletins, and/or catalog cut sheets of the equipment
4. Scope of supply
5. Blower package performance data sheets showing at least the following:
    a. Package model name
    b. Bare blower model name
    c. Design conditions as listed in this section
    d. Air flow in ICFM and SCFM for design conditions listed
    e. Discharge Pressure
    f. Motor size
    g. Brake horse power required for blower
    h. Bare blower speed with percentage of its maximum speed
    i. Process air connection size
    j. Operating Voltage required for both main motor and enclosure ventilation fan
    k. Sound pressure and power levels
    l. Dimensions
    m. Package weight
    n. Discharge temperature
    o. Accessories being supplied
6. Installation Data sheets

7. Manufacturer's standard performance curve showing blower rpm, pressure differential, capacity in ICFM, blower shaft horsepower, temperature rise at standard conditions
8. Blower package drawing showing all important details required for installation including dimensions, anchor bolt locations, size and location of connections to other works and weight of equipment.
9. Motor manufacturer's data sheet showing at least the following:
    a. Motor manufacturer's name and model number
    b. Efficiency class and %
    c. Efficiency at ½, ¾, and full load
    d. Amp draw
    e. Motor RPM
    f. Code letter
    g. Motor frame
10. Electrical connection diagram for motor, enclosure ventilation fan and any blower accessory requiring an electrical connection.
11. Inlet filter documentation
12. Data sheets for supplied instrumentation and accessories
13. Spare parts overview drawing
14. Recommend spare parts list
15. Paint specification for blower package
16. Maintenance overview
17. Blower startup check list
18. Lubrication requirements
19. SDS sheet (oil)
20. Warranty information
21. Manufacturer's standard for equipment standards
22. Compliance with Machinery Standards for sound and performance certificate

B. Manufacturer's standard Operation and Maintenance Manual shall include the following sections; following submittal procedures in accordance with Section 01 33 00
1. Regarding this document
2. Technical Data for the blower package
3. Safety and Responsibility
4. Design and Function
5. Installation and operating conditions
6. Installation
7. Initial Start-Up
8. Operation
9. Fault Recognition and Rectification
10. Maintenance
11. Spare parts, Operating Materials, Service
12. Decommissioning, storage and transport
13. Annex with drawings and diagrams

## 1.5 PRODUCT DELIVERY, HANDLING AND STORAGE

A. Delivery and handling of Equipment:
1. Manufacturer and Contractor shall coordinate the delivery schedule for just in time delivery to minimize the period the Blower package is on site before installation.

2. Contractor shall unload and inspect all equipment and materials against reviewed shop drawings at the time of delivery. Any damage shall be reported to the freight company immediately upon receipt.
3. Equipment and materials damaged or not meeting the requirements of the reviewed shop drawings shall be immediately returned for replacement or repair.
4. Each box or shipping crate shall be properly marked to show its net weight and its contents.

B. Storage:
1. Contractor shall prepare for storage and label all equipment and materials after they have been inspected. The Contractor shall be responsible for the equipment and materials while in storage.
2. Contractor shall prepare for storage and label all equipment and materials after they have been inspected. The Contractor shall be responsible for the equipment and materials while in storage.

## 1.6 SPARE PARTS

A. Furnish the following manufacturer's recommended routine maintenance spare parts for each blower package provided:
1. Two (2) integral inlet silencer filter elements
2. Lubrication for first year of operation
3. One (1) belt set
4. One (1) tube of motor grease (50HP or larger)

B. All parts shall be furnished in clearly identified packaging

## 1.7 WARRANTY

A. The manufacturer shall warrant the bare blower being supplied against all defects in workmanship and materials for a period of sixty (60) months from date of startup, not to exceed sixty-six (66) months from date of shipment from the manufacturer of the blowers. All other package components shall be warranted for a period of twelve (12) months from the substantial completion, not to exceed eighteen (18) months from the date of shipment.

B. The contractor shall be responsible for proper storage of the equipment so as to remain in "as shipped" condition. If the equipment remains in storage at the job site for longer than six (6) months before installation, the contractor shall provide factory service personnel for a complete inspection of the equipment. Any work necessary to restore the equipment to "as shipped" condition shall be the responsibility of the contractor.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. The equipment specified herein is intended to be standard equipment for use in low pressure air systems and be supplied by a single manufacturer or authorized sales representative to assure uniform quality, ease of maintenance, and minimal parts storage.

B. Manufacturers:

1. Kaeser Compressors, Inc.
   a. Package: GBS1050M
   b. Blower: Sigma B205

2. Or Pre-Approved Equal.
   a. Reference Section 01 60 00 for product substitution procedures for information pertaining to alternate products

C. Plan layouts, weights, and pertinent specification language used in the design have been based upon Kaeser Compressors, Inc. equipment. Any changes required to accommodate equipment other than the basis of design shall be provided by the Contractor at no additional expense to the Owner. Furthermore, a complete and detailed deviation list from the specification shall be provided with proposal.

2.2 DESIGN CRITERIA

A. Standard Conditions for SCFM:
1. Elevation: 14.7 PSIA (0’ elevation)
2. Temperature: 68 deg F
3. Relative Humidity 36%

B. Design (site) Conditions for ICFM:
1. Elevation: 14.2 PSIA (912’ elevation)
2. Maximum Blower Inlet Temperature: 113 deg F
3. Relative Humidity*: 50%
   *Relative humidity at maximum blower inlet temperature

C. Performance Data:
1. Application: Aerobic Digester
2. Quantity: 2
3. Blower Packaged Controlled by a VFD: YES
4. Flow Required: 3100 SCFM
5. Blower Package Discharge Pressure: 9.5 PSIG
6. Motor Horsepower: 175 HP
   a. Motor shaft power shall account for belt losses in addition to internal package losses
   b. The motor shall not operate in its service factor at design conditions.
   c. VFD efficiency loss shall be accounted for.
7. Power supply voltage:

a. Main Motor: 460v/3ph/60hz
b. Enclosure ventilation fan motor: 115v/1ph/60hz

8. % of Maximum Blower Speed at 60hz: <= 81%
9. Sound pressure level = 75 dB(A) *
10. Sound power level = 94 dB(A) *

*In accordance with ISO 2151, +/- 3 dB(A), with insulated piping.

2.3 BLOWER PACKAGE CONFIGURATION:

A. Installation Location: Indoor

B. Inlet Configuration: Ambient

C. All components and instrumentation are to be mounted and pre-piped; no field installation shall be required by the contractor. The manufacturer shall be responsible for all aspects of the engineering, from the blower package's air inlet to its discharge connection.

2.4 DESIGN CRITERIA:

A. Blower Type:
1. The bare blower shall be mounted for vertical air flow, be of the oil-free, positive displacement, rotary three lobe type, designed for air or other inert gas service, and belt driven via electric motor
2. The bare blower assembly must operate at the effective value for vibration velocity in frequency range A and B, according to VDI 3836.

B. Material:
1. AISI, ASTM, GJL, GLS, DIN, etc.…, numbers types, and grades specified are typical of material composition and quality, equivalent materials will be considered.

C. Housing:
1. The casing shall be made of high strength, close grained, cast iron, and shall be adequately ribbed to prevent casing deflection and facilitate cooling. Casing shall be of EN GG 20 material.
2. The casing shall be precision machined to allow for minimum clearances.
3. The casing shall include channels integrated on the discharge to reduce blower pulsation and dampen noise
4. The casing shall include threaded atmospheric vent ports between its air-side and oil-side labyrinth seals for safe separation of the conveying and oil chamber.
5. Inlet and discharge ports shall be drilled and tapped for studs to allow solid connection of mating surfaces. Through bolting shall not be allowed. Flange style blower ports, which may be subject to loading, causing cylinder distortion, shall not be allowed.
6. Bearing fits shall be precision machined to ensure accurate positioning of the rotors in the casing.

D. Rotors:
1. The rotors shall be precision machined out of a one piece casting made of EN GGG 50 material. Stub shafts or two-piece impellers shall not be allowed.

2. The rotor assemblies shall be statically and dynamically balanced to ISO standard 1940/1- Q2.5 (turbine rotor). Modifications to the face of the rotors for balancing purposes are not acceptable.
3. The rotors shall be a tri-lobe design in order to minimize pulsation and noise.
4. The rotor must be solid or closed-end to prevent build-up of contaminants inside the rotor causing imbalance.
5. Cored rotors must be closed using threaded iron plugs which are permanently fixed. Impeller end caps of stamped sheet metal shall not be allowed.
6. The rotors shall have an integral sealing strip for improved efficiency.
7. The rotors shall operate without rubbing, liquid seals or lubrication in the air chamber.

E. Cover Plates:
1. The gear-end and drive-end cover plates shall be high strength, close grained, cast iron made of EN GG 20 material. Aluminum cover plates shall not be allowed.
2. The cover plates shall have a precision machined sealing face.
3. The drive-end cover plate shall include at least two precision machined holes to allow for the use of fitting bolts to accurately align the opening for the input shaft seal.

F. Timing Gears:
1. The rotor timing gears shall be precision machined and ground from alloy steel made from case hardened 16 MnCr5 material.
2. Each timing gear shall be straight cut and beveled to quality standard 5f 21, which will eliminate axial bearing loads and ensure long life as well as quiet operation. Helical gears, which cause axial loading, shall not be allowed.
3. Each timing gear shall be manufactured in accordance with:
   a. DIN 3960, Specifications for Spur Gear Sets
   b. DIN 3961 & Din 3962, Tolerances for Spur Gear Mesh
   c. DIN 3964, Specifications for Shaft Centering
4. The timing gear set shall be taper-mounted on the rotors. Keyed, hub mounted, taper-pinned, or splined shaft timing gear mounting designs are not acceptable.

G. Bearings:
1. All four rotor shaft support locations shall incorporate large, heavy-duty, full complement, cylindrical roller bearings with PEEK cages, designed with at least 5-times the dynamic capacity of ball bearings. Ball bearings shall not be allowed.
2. The bearing maximum speeds must be at least two times the maximum recommended blower speed
3. The bearings minimum acceptable L10 design life shall be as follows;
   a. At least 40,000 hours at blower's maximum rated speed and maximum rated differential pressure
   b. At least 100,000 hours at design conditions

H. Lubrication:
1. Both the gear end and the drive end of the blowers shall be oil splash lubricated via a disc slinger for minimal maintenance and long service life. Grease lubricated bearings in the blower are not acceptable.
2. The lubrication design shall ensure adequate lubrication of the timing gears and bearings.
3. The drive-end and gear-end oil chambers must not be interconnected and each oil chamber shall have a domed design sight glass to allow visual inspection of oil level and oil condition, viewable from the front of the blower.

4. Blower to be factory filled with a synthetic lubricating fluid that is rated for the design conditions specified.

I. Rotor Seal Assembly:
   1. Each rotor shall include one labyrinth seal assembly on each end, four assemblies in total per blower.
   2. Each seal assembly shall consist of the following;
      a. Oil splash guard ring.
      b. Shaft guide wear sleeve with vent holes located between the dual air and oil ring seals. Wear sleeve shall protect the blower casing.
      c. Four piston ring type labyrinth seals made from heat treated GG/42CrMo4 material. Two seals located on the air side and two seals located on the oil side of the grooved rotor sleeve. The use of rubber lip seals shall not be allowed.
      d. Grooved rotor sleeve which will protect the rotor shaft and be used to hold the four piston ring seals.

J. Input Shaft Seal Assembly: (Compak BBC, CBC, DBC, and EBC series)

   1. The input drive shaft seal shall be a high temperature radial lip type seal made from Viton elastomer. The seal shall prevent oil leakage from where the input shaft goes thru the drive end cover.

   2. The seal design shall incorporate a replaceable wear sleeve on the input drive shaft.
      a. The sleeve exterior to be tungsten carbide coated to reduce friction and wear.
   3. The input shaft seal design must allow for the lip seal and the shaft sleeve to be replaced without removing the drive end cover plate.

K. Input Shaft Seal Assembly: (Compak FBC and HBC series)
   1. The input drive shaft seal shall be a sliding ring type mechanical seal that will prevent oil leakage from where the input shaft goes thru the drive end cover plate
   2. The mechanical seal assembly shall consist of the following;
      a. Replaceable wear sleeve on the input drive shaft
      b. Cover plate with a machined sealing surface
      c. Mechanical sliding ring seal
   3. The input shaft seal design must allow for the mechanical seal assembly to be replaced without removing the drive end cover plate

2.5 MOTORS:

A. Drive Motor:
   1. Motor shall be designed, manufactured, and tested in accordance with the latest revised editions of NEMA MG-1, IEC, DIN, ISO, IEEE, ANSI, and AFBMMA standards as applicable and shall be capable of continuous operation
   2. Motor must meet or exceed Energy Independence and Security Act (EISA 2007) standards for NEMA Premium efficiency. It shall also be marked with a Department of Energy Certification Compliance Number to assure compliance.
   3. Motor shall comply with Low Voltage Directive 2006/95/EC or equivalent and be UL listed.

4. Motor must be inverter rated with impulse peak resistance in accordance with IEC 60034-1:2010 or equivalent for operation with an IGBT frequency converter or equivalent
5. Motor horsepower nameplate rating shall not be exceeded at the design discharge pressure when operating at 60hz
6. The temperature rise of the motor windings shall not exceed IEC and NEMA standards when the motor is operated continuously at the rated horsepower, rated voltage, and frequency in ambient conditions at 104ºF / 40ºC
7. Motor shall be suitable for Full Load/Direct On-line starting, Solid State Ramp starting, VFD, and/or Wye-Delta reduced current starting
8. Motor to be supplied, mounted and aligned by the blower package manufacturer
9. VFD controlled motor (=>75HP) shall have an isolated non drive end "B-side" bearing
10. Motor shall confirm to the following:
    a. Motor Voltage: 460v/3ph/60hz
    b. Type: Squirrel cage induction
    c. Speed: Single
    d. Torque: Constant
    e. Service Factor: 1.15
    f. Enclosure: TEFC
    g. Mounting: Horizontal
    h. Speed: up to 3,600 rpm @ 60 hz (maximum)
    i. Design: A
    j. Duty Cycle: continuous (24hr/day)
    k. Winding Insulation: F
    l. Temperature rise: B
    m. Thermal motor protection: Positive Temperature Coefficient (PTC) thermistors (one per winding) wired in series. The use of thermostats is not allowed
        1) Connection of the PTC thermistors to the control system and signal processing is not part of the blower manufacturer's scope of supply
    n. Conduit box location: Top
    o. Wiring Connection: Terminal strip inside conduit box. Use of wire nuts for connection of motor wiring to power source shall not be allowed
    p. Bearing L10 life: >40,000 hours
    q. Bearing lubrication: Grease
    r. Bearing type:
        1) ≤ 40 HP: Permanently greased
        2) ≥50HP: Regreaseable
            a) Lubrication fittings must be located towards the front of the blower package so that both bearings can be safely lubricated while the blower package is running.
            b) Grease drain holes to be closed for protection of the environment. A spent grease cavity in the bearing cover should be large enough to hold spent grease required for 40,000 operating hours.
    s. Bearing design: Cantilever forces (belt drive)
    t. Condensation winding 110v heater: No
11. Motor shall be as manufactured by Siemens
12. Connection and control of the drive motor to the control system is not part of the blower manufacturer's scope of supply

B. Sound enclosure ventilation fan motor:
    1. Motor voltage: reference Performance Data – power supply voltage

2. Motor shall be UL listed
3. Motor starter/ overload protection is the responsibility of the control system provider
4. The fan motor should turn "on" when the main motor starts and turn "off" 10 minutes after the main motor stops. Controlling the fan motor via a thermostat shall not be allowed.
5. Connection and control of the fan motor to the control system is not part of the blower manufacturer's scope of supply

## 2.6 BLOWER PACKAGE

A. Drive:
1. The blower shall be driven by the drive motor through a V-belt drive assembly designed to meet the blower conditions specified with a 1.2 or larger service factor
    a. V-belts shall have a XPZ/XPB profile with embedded low-stretch polyester tension cords. The v-belts shall be designed for high rotational speeds and be heat and oil resistance. Ribbed, banded, or multi groove belts shall not be allowed
    b. Sheaves shall have a SPZ/SPB profile and be balanced to G16 for below 30m/s and G6.3 for sheaves above 30m/s
    c. Keyed taper bushing shall be used for easy installation and removal. QD type bushings shall not be allowed
2. The blower drive must have a fully enclosed guard which protects the operator when the blower package enclosure is open while in operation
    a. Belt guard shall be OSHA approved
    b. The belt guard made from the manufacturer's standard sheet metal, shall be designed to duct the cooling air flow from the drive motor fan across the front of the blower to supplement blower input shaft seal cooling
    c. The mounting fasteners for the belt guard shall be retained on the housing to prevent loss during maintenance
3. Belt tension shall be accomplished by the use of a motor swing base and automatic tensioning assembly
    a. The drive motor shall be mounted on a pivoting swing base with an axial adjustment for proper alignment of the v-belts. The weight of the drive motor shall provide the primary belt tension. The use of a sliding motor mount shall not be allowed
    b. A tensioning assembly consisting of a threaded rod with spring shall be used to adjust the v-belt tension to prevent belt slippage and efficiently transmit power to the blower. It shall include a visual indication showing whether or not the v-belt tension is within the correct belt tension range
    c. Adjustment of the tensioning assembly shall be accomplished without removal of the guard or loosening of the motor mounting bolts
    d. The design of the swing base with tensioning assembly shall prevent the swing base from falling and creating a personnel hazard in the event of a belt failure. The tensioning assembly adjusting nut shall raise the motor swing base facilitating v-belt changes without the use of pry bars or jacks

B. Inlet Silencer:
1. An inlet silencer designed for the frequency range of the blower, shall be provided to reduce the noise of the blower package as specified

a. The inlet silencer shall be of carbon steel construction and be of the wear-free absorptive type, directly connection to the inlet port of the blower, and shall be mounted horizontally
b. The inlet silencer shall be lined with replaceable polyether absorptive material.
c. The inlet silencer shall have an integral filter designed to protect the blower from particulates. It shall be located between the absorptive material and the blower inlet
    1) The filter element shall be a washable and reusable polyester element for minimal pressure drop
    2) The filter efficiency shall meet ASHRAE 52.2 MERV7 50-70%% @ 3-10 microns corresponding to EN779 G4
    3) The filter element integral to the silencer shall be supplied no matter if the inlet configuration of the silencer is ambient or piped. If required on piped inlet configuration, any additional filtration or screening at the inlet location of the piped inlet air source is not the responsibility of the blower manufacturer
    4) Filter element shall be removable without disconnecting the inlet duct
d. The filter maintenance cover and element must be removable by hand (without the use of tools)
e. The pressure loss thru the inlet silencer assembly shall be accounted for in the motor horsepower selection of the blower package

C. Base frame with integrated discharge silencer:
1. The blower base frame with integrated discharge silencer shall be designed for the frequency range of the blower, shall be provided to reduce the noise of the blower package as specified
    a. The blower base frame shall be of formed steel construction and designed for horizontal mounting of blower with vertical air flow. Flange-mounting only of the bare blower to the blower base frame shall not be allowed, additional support by use of the base frame shall be required; preventing the loading of the blower casing and discharge silencer shell
    b. The blower base shall incorporate the pivoting motor swing base and tensioning assembly to insure proper alignment of the drive assembly
    c. The discharge silencer shall be an integral part of the base frame
    d. The discharge silencer type shall be a combination of absorption, reflection and diffusion
        1) The design of the discharge silencer shall incorporate a solid outer and perforated inner cylinder with absorptive material in between the cylinders
            a) Absorptive material shall be long, flexible, knotted polyester fibers to allow for lowering the noise and heat emissions inside the sound enclosure. The use of mineral wool shall not be allowed
        2) The discharge silencer shall have connections ports for pressure relief, discharge pressure, and discharge temperature. Unused ports shall be capped or plugged
    e. The pressure loss thru the discharge silencer assembly shall be accounted for in the motor horsepower selection of the blower package

D. Blower Sound Enclosure:
1. A sound enclosure shall be provided which fully covers the blower, motor, drive assembly, inlet silencer, blower base frame with integrated discharge silencer, and be shipped fully assembled

a. The sound enclosure shall be the product of the blower manufacturer to insure proper integration of blower package components
b. The sound enclosure shall meet the sound level specified
c. The sound enclosure acoustic material shall comply to FMVSS 302 with a burning rate B or lower than 100 mm/min
d. The sound enclosure assembly shall be of self-supporting bolted steel panel construction on a fabricated steel skid
    1) All maintenance removable panels or doors shall be located in the front of the sound enclosure and must have a slotted key lock. A door key shall be provided. All maintenance panels shall meet OSHA weight requirements
    2) The enclosure base shall be designed to enclose the full bottom of the sound enclosure and include fork lift guides for easy transportation and installation
e. The sound enclosure ventilation cooling air circuit shall be separate from the process air circuit. Mixing of the two air circuits within the enclosure shall not be allowed
f. The sound enclosure shall have a set of inlet louvers positioned on the blower-side of the enclosure to allow for the flow of ambient cooling air across the blower oil sumps
g. A screened inlet louver shall be located on the back of the enclosure and designed to provide a laminar flow of ambient cooling air across the blower drive motor
h. The sound enclosure ventilation air exhaust and the ventilation fan shall be located at the top of the sound enclosure
    1) The ventilation fan shall be sized to provide adequate cooling of the blower package at all blower speeds
    2) The ventilation fan voltage shall be as specified and run concurrent with the main motor. The ventilation fan shall not be controlled by a thermostat
i. The back of the sound enclosure shall have predrilled holes with grommets for easy pass-thru of electrical wiring
j. When installed outdoor, reference Blower Package Configuration Part 2.3. An outdoor stainless steel weather hood shall be installed on top of the enclosure to protect the unit from the elements. The weather hood shall be designed to allow access to the sound enclosure and panel mounted instruments

E. Blower Package Accessories:
1. Pressure Relief Valve
    a. The relief valve(s) shall be factory installed within sound enclosure. Relief valve may not be shipped loose for field installation in the discharge piping.
    b. The relief valve(s) shall be spring type and must be sized for 100% of the design flow specified. Weighted relief valves shall not be used
    c. The relief valve(s) shall be set to protect the blower from excessive differential pressure based on the design conditions specified. A seal shall be affixed that must be broken if set point is changed
    d. The relief valve(s) exhaust shall be vented out of the sound enclosure. Exhaust vented into the sound enclosure shall not be allowed
    e. The relief valve shall be ASME Section VIII, UV, CE, and PED certified
    f. The relief valve shall be manufactured by Kunkle
2. Check Valve
    a. A check valve to prevent back flow through the blower shall be factory installed and not shipped loose for field installation in the discharge piping
    b. The check valve flapper shall be swing type made from a steel disc embedded in a high temperature silicone elastomer. The valve shall be designed so that, in the

event of failure, the valve element is retained in the valve housing. Split disc or center hinged designs shall not be used

c. The check valve capacity shall exceed the blower package's maximum discharge pressure and temperature

3. Flexible Connector
   a. An elastomeric compensator/flex connector shall be provided to isolate the connection of the blower package to the self-supporting system piping. Restraining rods shall not be used. Flex connectors located between the bare blower and silencers shall not be allowed
   b. The flexible connector capacity shall exceed the blower package's maximum discharge pressure and temperature
   c. Discharge connection
      1) 4" and smaller connection, a web reinforced silicone rubber sleeve with corrosion resistant clamps shall be provided. (Compak BBC, CBC, and DBC series)
      2) 6" and larger connection, an ANSI/DIN flanged arch-type EPDM web reinforced connector shall be provided. (Compak EBC, FBC, and HBC series)
   d. Piped Inlet connection – When required, Reference Blower Package Configuration 2.3.
      1) 6" or smaller connection, a web reinforced silicone rubber sleeve with corrosion resistant clamps shall be provided. (Compak BBC, CBC, DBC and EBC series)
      2) 8" and 10" piped inlet connection, an arch-type EPDM web reinforced sleeve with corrosion resistant clamps shall be provided. (Compak FBC series)
      3) 10" ANSI/DIN flanged inlet connection, an ANSI/DIN flanged arch-type EPDM web reinforced connector shall be provided. (Compak HBC series)
4. Blower instrumentation gauges
   a. The following gauges shall be pre-piped and panel mounted on the front of the sound enclosure. Gauges shall not be shipped loose for field installation
   b. Discharge pressure gauge
      1) The discharge pressure gauge shall measure the pressure at the discharge of the blower.
      2) The discharge pressure gauge shall be dual unit (English – PSI / Metric – Bar) with a range of 0 – 23 psi (0 – 1.6 bar). Minimum dial diameter shall be 2 ½", made with a stainless steel case and be glycerin filled for pulsation dampening
   c. Discharge temperature gauge with adjustable switch
      1) The discharge temperature gauge shall measure the temperature at the discharge of the blower package
      2) The discharge temperature gauge shall be dual unit (English - ºF / Metric - ºC) with a range from 32 – 392ºF (0 – 200ºC) and include an adjustable set point dial. Minimal dial diameter shall be 2 ½", made with a black plastic case and have a liquid filled measuring system that is converted by a Bourdon tube into a rotary movement of the pointer. The rotary movement of the pointer spindle shall operate a SPDT microswitch through a lever system. Voltage rating up 220v, 5amps
      3) The high temperature set point shall be as recommended by the blower manufacturer

4) Connection of the switch to the control system is not part of the blower manufacturer's scope of supply. The switch shall be wired to shut down the blower package when actuated

d. Filter differential pressure gauge

1) The filter differential pressure gauge shall measure the pressure difference from ambient to the back side of the filter that is integral to the blower package's inlet silencer. When the filter starts to become dirty, the resistance shall be shown on a resettable red dial indicating when the filter shall be changed

5. Oil Drains

a. An oil drain from the blower drive-end and gear-end lubricating oil sumps shall be separately piped to the front of the blower base with flexible tubing. Common fill and drain shall not be allowed

b. Each oil drain shall include a drain valve installed for ease of maintenance. The drain valves shall be 90° nickel plated brass valves and include a fully retained gasketed threaded cap to prevent accidental discharge of the blower lubricant

6. Vibration Isolators

a. Vibration isolators shall be provided between the base frame with integrated discharge silencer and sound enclosure skid to prevent transmission of vibration to the foundation

b. A ground wire shall be installed between the blower base and the sound enclosure base to allow for grounding of the complete blower package

F. Optional Blower Package Accessories – the following options shall be supplied

1. Unloaded start valve

a. The blower package when started with a "wye-delta" or "soft/reduced start" starter shall include a diaphragm operated, mechanical unloaded start valve that is mounted between the blower and the discharge check valve

b. The unloaded start valve shall allow the blower drive motor to accelerate unloaded up to full speed before the discharge check valve opens

2. Inlet filter differential pressure switch

a. The blower package shall include an installed filter differential pressure switch that shall measure the pressure differential across the integral inlet silencer's filter

b. The filter differential pressure switch shall be field adjustable up to .73 PSI (50 mbar) and factory set at .5 PSI (35 mbar)

c. The filter differential pressure switch shall be a SPDT switch, Voltage rating up to 250v, 10A

d. Connection of the switch to the control system is not part of the blower manufacturer's scope of supply. The switch shall be wired to shut down the blower package when actuated

3. Discharge Pressure Switch

a. The blower package shall include an installed discharge pressure switch that shall measure discharge pressure of the blower

b. The discharge pressure switch shall be field adjustable

c. The discharge pressure switch shall be a SPDT switch, Voltage rating up to 250v, 1A

d. Connection of the switch to the control system is not part of the blower manufacturer's scope of supply. The switch shall be wired to shut down the blower package when actuated

4. Enclosure Safety Switch

a. The blower package shall include an installed enclosure safety switch that shall thermostatically measure the temperature inside of the blower package's enclosure
b. The enclosure safety switch shall be field adjustable and set at 140 deg F (60 deg C)
c. The enclosure safety switch shall be a SPDT switch, Voltage rating up to 250v, 2.5 A
d. Connection of the switch to the control system is not part of the blower manufacturer's scope of supply. The switch shall be wired to shut down the blower package when actuated. It shall not be wired to turn on the enclosure vent fan

5. Oil Temperature Switch (Compak DBC, EBC, FBC and HBC series)
   a. The blower shall include an installed oil temperature switch, one for each oil sump that shall measure the oil temperature in each oil sump of the blower
   b. The oil temperature switch shall be preset at 248 deg F (120 deg C)
   c. The oil temperature switch shall be a SPST switch, Voltage rating up to 250v, 10 A
   d. Connection of the switch to the control system is not part of the blower manufacturer's scope of supply. The switch shall be wired to shut down the blower package when actuated
6. Oil Level Monitoring (Compak DBC, EBC, FBC, and HBC series)
   a. The blower shall include and installed oil level monitoring, one for each oil sump that shall measure the oil level in each oil sump of the blower
   b. The oil level monitor shall be preset for low oil condition
   c. The oil level monitor shall be a SPST switch, Voltage rating up to 250v, .5 A
   d. Connection of the monitor to the control system is not part of the blower manufacturer's scope of supply. The monitor shall be wired to shut down the blower package when actuated
7. Enclosure Heater Assembly
   a. The blower package when installed where temperatures could be between 5 to 23º F shall include an installed 115v/1ph/60hz enclosure heater with a thermostatically controlled switch that shall heat the inside of the enclosure
   b. The enclosure heater switch shall be field adjustable and be factory set to come on at 41 deg F (5 deg C)
   c. Connection of the enclosure heater system to the control system is not part of the blower manufacturer's scope of supply
8. Instrumentation Junction Box
   a. The blower package shall include an instrumentation junction box where all the provided instrumentation is wired to a terminal strip making for a central electrical connection point (except for the main blower drive motor)
   b. Connections from the instrumentation junction box to the control system are not part of the blower manufacturer's scope of supply

G. Nameplates:
1. The blower package shall have at least two weather proof corrosion resistant type nameplates which includes the manufacturer name, model number, year, max pressure difference, equipment number, part number, serial number, voltage, phase, HP, motor rpm, rated temperature, and FLA attached on the outside and inside of the blower package

H. Anchor Bolts and Hardware
1. Anchor bolts, washers, hex nuts, and all other fastening hardware shall be stainless steel and be supplied by the contractor

I. Paint Specification:
   1. The blower manufacturer is responsible for surface preparation, priming and finish coating of the blower package and components requiring paint in accordance with the manufacture's standard procedures. Field painting of blower equipment or supplying components that are only prime painted is not acceptable
      a. Cast parts are to be painted with a two-part gray epoxy primer and two-part top coat
      b. Fabricated parts are to be painted with a two-part gray epoxy primer and two-part top coat
      c. Sound enclosure parts are to be powder coated
         1) Panels and base paint finish shall be pretreated by de-greasing and phosphate cleaning, then powder coated to a thickness of 70 µm -100 µm on both sides
   2. The blower package to be painted the blower manufacturer's standard colors

PART 3 - EXECUTION

3.1 INSTALLATION

A. The blower package shall be handled and installed in accordance with the manufacturer's recommendations and instructions as shown in the location on the drawings

B. Contractor shall field verify all dimensions and elevations. The engineer shall be notified of any specific differences

C. The blower package shall arrive on site ready for installation. Aligning, adjusting and filling the blower with lubrication shall not be required by the contractor

3.2 FIELD QUALITY CONTROL

A. Furnish the services of a manufacturer's authorized representative for proper installation to inspect and approve the installation, and to supervise a test run of the blower package.

B. After the installation and test run has been completed; the blower package shall be given a field test in the presence of the Engineer to verify that operation is satisfactory and in compliance with the Specification. If the blower package does not meet the Specification, corrective measures shall be taken to ensure the machine meets compliance

3.3 TRAINING

A. Furnish the services of a manufacturer's authorized representative, who will instruct plant personnel in the operation and maintenance of the blower package. All procedures shall be covered including preventive maintenance, method of controlling the blower package and troubleshooting.

END OF SECTION 43 53 54