

SECTION 113740 - POSITIVE DISPLACEMENT BLOWERS

Equipment and Component Numbers	
<u>Tag Number</u>	<u>Equipment Name</u>
ADB-01	Aerobic Digester Blower No. 1
ADB-02	Aerobic Digester Blower No. 2

PART 1 - GENERAL

1.01 SCOPE OF WORK:

A. The Manufacturer shall:

1. Provide positive displacement blower(s) with appurtenances as specified herein for the Aerobic Digester blower system. The number of blowers to be supplied will be in accordance with the ITB.
2. Each blower package shall include: Electric motors, variable frequency drives, onboard control cabinet with operator control panel, steel base and sound dampening enclosure, inlet filter/silencers, exhaust fans with thermostat control, discharge isolation valve, discharge expansion joint, discharge check valve and all necessary auxiliary equipment, appurtenances, and accessories, as shown, specified or required for a complete installation.
3. Each blower unit provided under this Specification shall be factory and field tested for compliance to the requirements specified herein. The blower shall be shipped completely assembled except that the appurtenances will be shipped loose for field installation by Owner.
4. Each blower system provided under this section shall be the end product of a single manufacturer in order to achieve standardization for appearance, operation, maintenance, spare parts, and manufacturer's service.
5. All motors, pumps, and bearings shall be designed for continuous duty and long operating life in a high humidity atmosphere. All motors and pumps shall be premium efficiency 460-volt, 60-hertz, 3-phase.
6. 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.

1.02 DEFINITIONS

- A. Standard cubic feet per minute (scfm) is understood to be air at 68 degrees F, 14.7 psia, and 36 percent relative humidity flowing at a rate of 1 cubic foot per minute.

1.03 REFERENCES

- A. ASME PCT – 10 Test Code on Compressors and Exhausters
- B. ABMA B10 – Metal Balls

C.ANSI B16.1 – Cast Iron Pipe Flanges and Flanged Fittings

1.04 SUBMITTALS

A. Submit the following Shop Drawing information:

1. Product Data: Furnish the following information:

- a. Complete list of all system components to be provided.
- b. Make, model, weight, and horsepower of each equipment assembly.
- c. Complete catalog information, descriptive literature, specifications, and identification of materials of construction. Also include information on all instrumentation. Identify all equipment and instruments with tag numbers.
- d. Standard and specialized equipment assembly cuts.
- e. Performance data for each type of equipment that will show compliance with specification requirements stated herein. Data must include the following:
 - i. Package model name
 - ii. Bare blower model name
 - iii. Design conditions as listed in this section
 - iv. Air flow in ICFM and SCFM for design conditions listed
 - v. Discharge pressure
 - vi. Motor size
 - vii. Package input power and specific performance per ISO 1217 Annex E
 - viii. Process air connection size
 - ix. Operating Voltage required for the blower package
 - x. Sound pressure and power levels
 - xi. Dimensions
 - xii. Package weight
 - xiii. Discharge temperature
 - xiv. Accessories being supplied
- f. Motor Manufacturer's data sheets including the following information:
 - i. Motor manufacturer's name and model number
 - ii. Efficiency class and %
 - iii. Efficiency at $\frac{1}{2}$, $\frac{3}{4}$, and full load
 - iv. Amp draw
 - v. Motor RPM
 - vi. Code letter
 - vii. Motor frame
- g. Horsepower demand over the operating range of the blower.
- h. Identification of outside utility requirements for each component such as air, water, power, etc. Include operating parameters for all required utilities.
- i. Suggested spare parts list to maintain the equipment in service for a period of 5 years. Include a list of special tools required for checking, testing, parts replacement, and maintenance with current price information.

- j. List special tools, materials, and supplies furnished with equipment for use prior to and during startup and for future maintenance.
 - k. Special shipping, storage and protection, and handling instructions.
 - l. Routine maintenance requirements prior to plant startup.
 - m. Coupling data: manufacturer, bearing life, etc.
 - n. Detailed installation instructions including wiring diagrams, anchor bolt templates, and any other information necessary to successfully install the blower.
2. Shop Drawings: Furnish the following information:
- a. Detailed Structural, Mechanical, and Electrical Drawings showing the equipment fabrications and interface with other items.
 - 1) Include dimensions, size, type, and locations of connections to other work or existing equipment.
 - 2) Include information on weights of all major equipment.
 - b. System layout, installation, and placing drawings for equipment, drivers, and bases.
 - c. Complete wiring diagrams of the blower protective monitoring system including baseplate-mounted terminal junction box and equipment monitoring panel.
 - d. Manufacturer's design for anchor bolts including the type, sizing, locations, and dimensions of the anchor bolts to be installed. Include anchor bolt templates for use during installation.
- D. Sound Attenuation Enclosure:
- 1. Submit detailed Drawings, technical information and specifications of close-fitting noise enclosure to be provided with each blower to reduce noise level such that blower noise level shall not exceed 75 dBA in any direction at one meter from the blower noise attenuating enclosure in free field conditions.
 - 2. Submit performance data for noise enclosures that will show compliance with noise reduction specifications stated herein.
 - 3. Submit performance data for the enclosures exhaust fans and exhaust fan thermostat controls.
 - 4. Provide manufacturer's guarantees that the noise enclosures will meet noise reduction specifications stated herein.
- E. Manufacturer's factory testing and selection results shall be submitted to the Engineer for approval prior to shipment as required in this Section. The submitted results and data must include the design point and 5 additional point covering the full operating speed range of the blower.
- F. Operations and Maintenance Manuals. Provide 3 hard copies and 1 electronic copy. At a minimum, each manual must include the following information:

- a. Table of Contents: Provide title of project; names, addresses, and telephone numbers of Engineer, subconsultants, and Contractor with name of responsible parties; schedule of products and systems, indexed to content of the volume.
 - b. For Each Product or System: List names, addresses, facsimile and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement parts.
 - c. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.
 - d. Control and Wiring Data:
 - i. Sequency of Operation
 - ii. Controls Diagram
 - iii. Color coded wiring diagrams as installed
 - e. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Do not use project record documents as maintenance Drawings.
 - f. Instructions: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.
 - g. Operating Procedures:
 - i. Startup procedures
 - ii. Break-in procedures
 - iii. Preventative Maintenance
 - iv. Calibration procedures
 - v. Emergency Shutdown
 - vi. Startup following emergency shutdown.
 - h. Maintenance Procedures:
 - i. Servicing and lubricating schedule and sequences
 - ii. Wearing parts replacement scheduling, including part numbers
 - iii. Product disassembly and assembly
 - iv. Alignment, adjustment, and testing procedures
 - v. Troubleshooting guide and repair instructions
 - i. Parts and Lubricants List
 - j. Testing Reports for factory and field testing included in this section.
 - k. Warranties and Bonds: Bind in copy of each.
- G. Field Test results and Vibration Report.
- H. Manufacturer's Certificate of Proper Installation and Certificate of Proper Operation.
- I. Written Manufacturer's Warranty.
- 1.05 DELIVERY, STORAGE, AND HANDLING
- A. Shipping:
1. Ship equipment, material, and spare parts complete, except where partial disassembly is required by transportation regulations or for protection of components.
 2. Pack all spare parts in containers bearing labels clearly designating the contents.
 3. Deliver spare parts at the same time as pertaining equipment.

B. Receiving:

1. Owner to inspect and inventory items immediately upon delivery to site and is responsible for storing and safeguarding equipment, material, instructions, and spare parts in accordance with manufacturer's written instructions.

1.06 WARRANTY

- A. The Manufacturer shall provide a full written warranty for all equipment under this section. The warranty period shall be 24 months from delivery of equipment or 18 months from substantial completion, whichever is shorter. If a defect is found during the warranty period, the Manufacturer shall remedy said defect at no cost to Owner.

1.07 SPARE PARTS AND SPECIAL TOOLS.

- A. One replacement filter for each inline filter system supplied.
- B. Complete set of special tools.

PART 2 - PRODUCTS

2.01 MANUFACTURER AND PRODUCTS

- A. All blowers and appurtenances for a specific application shall be supplied/manufactured by a single Manufacturer.

2.02 APPLICATIONS

- A. The blowers shall be tri-lobe, rotary screw, or hybrid screw direct drive positive displacement type blowers.
- B. Installation Location: Indoors
- C. Intake Type: Ambient air intake.
- D. Electrical equipment not located in the electrical building shall be NEMA 4X rated.
- E. Design Environmental Conditions:
 1. Maximum Inlet Air Temperature: 104 °F
 2. Relative humidity: 90 percent
 3. Site elevation: 1,241 ft msl (FFE of Blower Building)
 4. Gas handled: Ambient Air
- F. Aerobic Digester System (2 blowers)
 1. The blowers shall be installed for supplying air to the aerobic digester system through coarse bubble diffusers.
 2. Design Flow Rate: 2,198 SCFM
 3. Design Discharge Pressure: 14.0 psig

4. Normal Operating Discharge Pressure: 10.2 psig
5. Design Maximum Blower Speed: 3600 RPM
6. Discharge Process Connection: Flanged, 10" diameter (field verification required)
6. Motor horsepower must not exceed 200 hp. Motors shall be 460V, 3PH, 60Hz with internal 120V space heaters. Heater shall be energized when unit is not operating.
7. On-board VFD.
8. Manufacturer's standard control cabinet with HMI, serial connection and analog I/O signals with terminal strip

2.03 GENERAL REQUIREMENTS

- A. Noise Level: At the performance conditions hereinafter specified, blower noise level not to exceed 75 dBA in any direction at one meter from the blower noise attenuating enclosure in free field conditions.
- B. Safety Devices: The completed Work shall include all necessary permanent safety devices, such as machinery guards, emergency stops and similar items required by OSHA, and other federal, state, and local health and safety regulations.
- C. Flanges and Pipe Threads: Flanges on equipment shall comply with ANSI BI6.1, Class 125; or BI6.5, Class 150, unless otherwise indicated. Threaded flanges and fittings shall have standard taper pipe threads complying with ANSI/ASME B1.20.1.
- D. Bearings:
 1. Bearings shall conform to the standards of the Anti-Friction Bearing Manufacturers Association, Inc. (AFBMA).
 2. Except where otherwise indicated, bearings of process equipment shall have a minimum L-10 life expectancy of 100,000 hours.
- E. Blower Manufacturer must provide an on-board control cabinet, operator control panel, and VFD as part of each blower. The VFD and control panel must be incorporated into the blower unit housing. The control cabinet must include an operator control panel/HMI and allow for full integration with the plant's existing SCADA system to allow the blower to be controlled through SCADA.

2.04 SYSTEM PERFORMANCE

- A. Blower Factory Performance Test:
 1. Conduct Certified 1 PSI Slip Test on each blower supplied under this Section.
 2. Each blower package provided by the Manufacturer must be guaranteed to provide performance to ISO 1217, Annex E.

2.05 BLOWER EQUIPMENT

- A. Impellers shall be screw type and shall operate without rubbing or liquid seals or lubrication. The impeller shall be precision machined to insure minimum gauged clearances at all points of rotation. Impeller assemblies shall permit thermal expansion over the specified service conditions.
- B. The complete rotating assembly, including shafts, impeller, motor, rotor and couplings, shall be dynamically balanced and center-timed for all speeds. The first critical speed shall not occur at less than 125% of maximum rotative speeds.
- C. Casings shall be one-piece, with separate headplates, and shall be made of close grained cast iron with flanged connections, equivalent to ASTM A48. The casing design shall incorporate channels at the discharge port to minimize pulsation.
- D. The impellers shall be timed by a pair of alloy steel helical gears. Gears shall transmit the required torque and maintain impellers in proper rotative position with a minimum AGMA service factor of two. Gears shall be keyed or tapered to the shaft.
- E. Blower shafts shall be alloy steel and shall be cast integrally with impellers.
- F. Impeller and shaft assembly shall be supported by spherical or cylindrical antifriction bearings. The minimum acceptable L10 design life at the blower's maximum rated speed and maximum rated differential pressure shall be no less than 100,000 hours. The system design shall allow removal and replacement of bearing without dismantling suction or discharge piping.
- G. Bearing Lubrication
 - 1. Gear-end bearings and timing gears shall be splash oil lubricated by the gears on the gear end.
 - 2. Drive-end bearings shall be splash oil lubricated by the gears on the drive end.
 - 3. Individual dedicated oil reservoirs shall be provided for the gear-end and drive-end splash lubrication systems. The oil reservoirs shall be externally mounted from the blower body to minimize heat transfer between the compression chambers and the oil reservoirs.
 - 4. Each oil reservoir must have at least one (1) drive end and one (1) gear end sight glass to allow visual inspection of the oil level and oil condition.
 - 5. Oil reservoirs shall be connected to the splash lubrication systems using braided stainless steel hoses with compression fittings.

6. High temperature and low-level switches shall be provided in each external oil reservoir.
 7. Grease lubrication is not acceptable.
- H. Blower Seals:
1. There shall be four (4) piston ring type labyrinth seals at each end of each rotor to minimize leakage and maintenance costs.
 2. The cavity between the air-side and oil-side seals shall be vented through threaded ports to allow external purging or containment of any lubricating oil or process gas that may have migrated past the seals. Enough ports shall be incorporated in the design to ensure that the cavity is vented from the bottom no matter what blower drive-to-driven shaft orientation is utilized.
 3. A vent cavity shall be provided on all four (4) sets of piston ring type labyrinth seals. The two (2) vent holes located on the bottom side of the blower shall be left open. The vent holes at other locations shall be closed off with threaded metal plugs.
 4. The input drive shaft seal shall be a high temperature radial lip type seal with Viton elastomers. The seal design shall incorporate a replaceable wear sleeve on the input drive shaft.
- I. Motor shall be direct connected to the compressor with a grid-flex type coupling having at least 2.0 service factor above the motor nameplate horsepower. Belt drives or gearing mechanisms shall NOT be acceptable.
- J. The drive guard shall be fully enclosed, easily removable, and designed to meet current OSHA recommendations and CE standards. Guard shall be 14-gauge sheet steel with expanded metal front and back. Guard shall allow ventilation for the drive and have an accessible access cover.
- K. Base shall be steel angle or channel skeleton-frame, elevated on legs, with continuous welded joints. Bare base weight shall equal 50% or more of the compressor's weight, but not less than 100 pounds. Machined feet shall be supplied to mount and level the compressor. The inlet filter, inlet silencer, compressor, motor, drive, drive guard, discharge silencer, valves, interconnecting piping, supports and all other accessories shall be shipped assembled on the base to the extent allowable by trucking.
- L. The base shall include rubber vibration isolators in a steel footing equipped with mounting holes for anchoring purposes.

2.06 POSITIVE DISPLACEMENT BLOWER PACKAGE

- A. The positive displacement blower package shall include motor, positive displacement blower, sound dampening enclosure discharge check and isolation valves, and accessories to form a fully functional, pre-tested, factory assembled system. The blower system shall be suitable for installation in outdoor conditions. All electrical equipment shall be rated NEMA 4X.
- B. Oil drains from the blower drive-end and gear-end lubricating oil sumps shall be piped to the front of the base for ease of maintenance. The drain valves shall be a ball valve with a

fully retained and gasketed threaded cap.

- C. The motor mounting base shall include all necessary provisions to permit proper blower/motor alignment.

2.07 CONNECTIONS

- A. Provide flexible piping connections on the discharge of each blower. Connections shall be the single arch, reinforced expansion joint type with control rods. Flexible connection material of construction shall be suitable for 400 degrees F service condition.
- B. Connections shall be designed to mate with ANSI 125-pound flanges.
- C. Connections shall have a working pressure range of at least 19 psig to 5 inches Hg vacuum and a working temperature rating of at least 400 degrees F.

2.08 ACCESSORIES

- A. External Intake Filter/Silencers and Internal Intake Silencer
 1. Blower air intake shall originate from the exterior of the sound enclosure. Intake filter/silencer shall be remote mount on the exterior of the blower enclosure to be mounted/assembled in the field. The blower air intake shall be located as far as possible from the sound attenuating enclosure mechanical ventilation discharge location to prevent recirculation.
 2. Air intake filters shall be integral to the intake silencer. The filter element shall be the cartridge type fabricated from a cleanable polyester felt media with an efficiency of 99 percent on 3-micron particles. The rated capacity of the filter shall be a minimum of 2,000 scfm with a clean pressure drop of less than or equal to 2 inches of water.
 3. Intake filters shall be provided with a filter restriction gauge pre-piped and panel mounted on the front exterior of the sound enclosure.
 4. A separate multi-chamber absorptive intake silencer shall be located in interior of the blower enclosure. The internal intake silencer shall be integral to the blower enclosure and shall not require field mounting/assembly.
 5. Intake Filter/Silencer and Intake Silencer Manufacturer
 - a. Stoddard
 - b. Universal Silencer
 - c. ProGENTEX
 - d. Approved Equal

B. Internal Blower Discharge Silencer:

1. Silencers shall be provided as an integral part of each blower enclosure located in the interior of the blower enclosure. The internal discharge silencer shall be integral to the blower enclosure and shall not require field mounting/assembly.
2. The blower discharge silencers shall be a heavy-duty industrial combination multi-chamber adsorptive silencer designed for positive displacement blowers operating above and below the transition speed. They shall have acoustic absorption sections at the inlets and arrangements of ported tubes and snubbing chambers.
3. The units shall be fabricated of welded steel and suitable for operating conditions of 19 psig pressure and 5 inches of mercury vacuum at temperatures up to 115 degrees F on the intake side and 19 psig at temperatures up to 400 degrees F on the discharge side. Absorptive material shall be polyester or other inert fiber. Fiberglass, or any material that may deteriorate over time, will not be accepted. End connections shall be 125-pound steel flanges sized to match blower connection size at the blower connections. The connections shall be drilled to match flexible connectors supplied. Silencer shall be ASME code stamped pressure vessel rated.
4. The silencers shall effectively attenuate pulses produced by the blowers and shall attain the following minimum attenuation characteristics at design conditions. Inlet/discharge silencer pressure drop shall not exceed 11.0 inches of water.

<u>Intake Section</u>							
Octave Band							
Mid Frequency (Hertz)	63	125	250	500	1,000	2,000	4,000
Attenuation, db	18	23	28	31	30	27	23

<u>Discharge Section</u>							
Octave Band							
Mid Frequency (Hertz)	63	125	250	500	1,000	2,000	4,000
Attenuation, db	18	23	28	31	30	27	23

5. Discharge Silencer Manufacturer

- a. Stoddard
 - b. Universal Silencer
 - c. ProGENTEX
 - d. Approved Equal
- C. Provide a pressure gauge on the discharge outlet of the blower. Pressure gauge shall be Ashcroft Model 1279 liquid filled, Ashcroft Model 1279 Plus or Equal. Provide gauge with suitable scale range. Pressure gauge shall be pre-piped and panel mounted to the front exterior of the sound enclosure.
 - D. Provide a temperature gauge on the discharge outlet of the blower. Pressure gauge shall be Ashcroft Model 1279 liquid filled, Ashcroft Model 1279 Plus or Equal. Provide gauge with suitable scale range. Temperature gauge shall be pre-piped and panel mounted to the front exterior of the sound enclosure.
 - E. Provide a Perspex gauge cover for all gauges mounted on the front exterior of the sound

enclosure.

- F. Pressure Relief Valve:
1. Provide a spring-loaded, pressure relief valve on the discharge of each blower designed to relieve 1.5 times the design blower flow rate (scfm) at the design operating discharge pressure. Pressure relief valve shall be set to relieve at one (1) PSI above the design discharge pressure.
 2. Valve manufactured of seat material suitable for 400 degrees F operating temperature.
 3. Pressure Relief Valve Manufacturer
 - a. Kunkle Model 337
 - b. Approved Equal
- G. Pressure Switch:
1. Provide an adjustable pressure switch on the discharge of each Blower with a setting range of 5 psi to 15 psi. Pressure switch shall be set to activate at one (1) PSI higher than the Pressure Relief Valve set point. On reaching High pressure set point, send a signal to the motor starter/VFD to shut down motor/blower.
 2. Pressure Switch Manufacturer
 - a. Ashcroft B Series (fixed differential type)
 - b. Equal by Siemens or GE
- H. Manufacturer must provide anchor bolt sizing. Anchor bolts will be procured by the Owner in accordance with the anchoring requirements determined by the Manufacturer.
- I. Sound Attenuating Blower Enclosure
1. Furnish close-fitting blower noise enclosure for the blower.
 2. Outer skin shall be a minimum 16-gauge powder coated galvanized steel.
 3. Absorption media shall be at minimum a nominal 2-inch thick resilient material capable of returning to its original form after compression. Media shall have an overall weight of not less than 1.6 pounds per cubic foot. Media sheets shall have an upper oil resistant layer a minimum of three mils in thickness to protect the integrity of the media. Absorption media shall be interior and be fitted to each exterior facet and show contact at all points. Media shall be snug fit, be complete with pressure sensitive adhesive and held in place with washers, studs and cap nuts manufactured from corrosive resistant materials. All adhesives used in anchoring studs or other items in structure shall be high temperature industrial material rated for the application. Any acoustical material used shall conform to the following:

COLOR:	Charcoal Grey
DENSITY:	1.6 lbs/ft ³ (24.03 kg/m ³) per ASTM D3574-86 test A
TEAR STRENGTH:	2.0 ppi (3.5 N/cm) per ASTM 3574-86 test F
TENSILE STRENGTH:	20 psi (135 kPa) per ASTM 3574-86 test E
ELONGATION:	110 % per ASTM D3574-86 test E
COMPRESSION:	Max. 10% ASTM D3574-86 test D
HEAT RESISTANCE:	Per ASTM D3574-86 test K
HUMIDITY:	Per ASTM D3574-86 test J
FLAMMABILITY:	MVSS 302 UL-94 HBF and SAES - 369(b)
SERVICE TEMPERATURE:	-40 degrees F to +212 degrees F cont. (250 int)
THERMAL CONDUCTIVITY:	BTU-in/ft ² h degrees F 0.25 per ASTM C 177

4. Access plates installed on enclosure for venting or screening shall be installed with self-starting, self-locking zinc plated screws. Riveted, slide in or loose fitting panels shall not be accepted.
5. Enclosure shall have service doors covering at least 80 percent of each side. Hinges for the doors shall be full length and designed for the weight of the door provided. Door shall have a minimum 180 degree swing. All surfaces and edges shall be free of burs and sharp edges. The doors shall lock closed using ½ turn telescoping "T" handles.
6. Enclosure shall be fitted with a weather hood covered acoustical intake vent rated for the SCFM listed in the "Service Conditions" section and discharge pipe openings with sound seal.
7. Oil fills and drain extensions, and weather/sound seals shall be fitted on all enclosure penetrations.
8. The blower intake shall originate outside the blower enclosure. The blower enclosure shall have a separate mechanical ventilation system to prevent blower overheating.
9. Provide a minimum of two (2) mechanical cooling fans with acoustical vents in the blower enclosure with each fan sized to operate at 75%, and 150% combined, of the calculated minimum air flow rate to ensure continuous blower operation at 100 F ambient air conditions. Fans shall be controlled by a thermostat control in the enclosure. Fans shall not be connected to the compressor/motor shaft.

10. Enclosure ambient air intakes for the control cabinet and VFD must be equipped with filtered louvers or intakes rated for both indoor and outdoor service.
11. Design/Performance Features: At the performance conditions specified herein, blower noise level not to exceed 75 dBA in any direction at one meter from the blower noise attenuating enclosure in free field conditions.
12. Provide a high temperature switch in the blower enclosure.

2.09 VALVES

A. Butterfly Valve (Air Service)

- a. Provide one (1) lug style, two-piece ASTM A 126 Class B ANSI B16.1 per blower loose for installation by Owner.
- b. Materials of construction: ductile iron ASTM A 536 or cast iron body, one piece type 316 SST thin-profile disc and stem, heavy-duty stem bushing, NBR stem seal, FKM (viton) replaceable resilient seat
- c. Pressure rating: 75 psi pressure bi-directional bubble-tight
- d. Temperature rating: 300 degrees F
- e. Process connections: ANSI B16.1 class 125 flanges
- f. Supply reduced disc diameter, if available
- g. Hand actuators shall be 10 position locking type
- h. Manufacturers and products:
 - i. Bray Controls Series 21
 - ii. Dezurik style BOS

B. Check Valves for Pressurized Air Service:

- a. Provide one (1) Wafer-style, dual plate check valve with spring per blower loose for installation by Owner.
- b. Materials of construction: 316 SST body, 316 SST internals and disc, 316 SS spring and silicone seal.
- c. Temperature rating: 500 degrees F
- d. Manufacturers and Products:
 - i. Flexi-Hinge Series 504.
 - ii. Approved Equal

2.10 CONTROL CABINET AND OPERATOR CONTROL PANEL

- A. Provide an on-board control panel for each blower under this section as part of the blower package. Each control panel shall have the functionality specified herein.
- B. All electrical connections that are not factory assembled and shipped complete shall only require Owner to connect wires between junction boxes installed on the Equipment by the Supplier.
- C. The on-board control cabinet and operator control panel must be designed and furnished as part of the blower package by the Manufacturer. Main control components shall include all equipment required for a complete and functional system for the design

conditions and requirements specified herein. to include variable frequency drives, cooling fans, unit heater, short circuit and overload protection, control power transformer, alarm relay, status relay, and terminal points for interconnection with ancillary equipment. The panel must include an HMI screen mounted on the exterior of the blower enclosure to allow manual, local control.

- D. The control cabinet shall be suitable for 460VAC, 3 Phase, 60 HZ service.
- E. The control cabinet and operator control panel must be designed to operate in an ambient temperature range of -4°F to +140°F.
- F. The operator control panel shall be suited for the specified conditions as previously listed and include an industrial PC with processing software that will allow for the control, regulation, and monitoring of the blower package, along with allowing the display and modification of machine settings and external communication.
 - 1. The control panel shall include a stabilized 24VDC power supply and real time clock with a scheduling timer.
 - 2. A buffer battery with a ten (10) year lifetime shall be included for protection of system memory and internal clock.
 - 3. The controller shall include touch key controls with LED indications on important functions.
 - 4. The controller display shall be LED backlit with a plain text and graphical display capable of displaying the blower packages status in various languages.
 - 5. The controller shall utilize “Radio Frequency Identification” (RFID) Technology, which ensures secure log-in for users and service personnel so service work and system changes can be performed only by authorized and qualified personnel.
 - 6. The controller shall include an integrated web server.
 - 7. The controller shall include an SD card slot for the manual loading of updates and recording of controller specific process data.
 - 8. The controller shall include an expansion slot for communicating with various industrial protocols/plant monitoring systems.
 - 9. The controller sensor connections shall be via a central I/O module with labelled connections.
 - 10. The controller shall include displayable operating and maintenance hour counters for major components.
 - 11. The controller shall have the ability to be timed controlled via up to 10 programmable timers.

12. The controller shall shut down the blower package in the event of a motor overload, high blower differential temperature, high blower differential pressure, high sound enclosure temperature, in-correct rotation, loss of drive or external failure signal.
 13. The controller shall have a programmable and selectable auto re-start after loss of power.
- G. Provide relay for each mechanical ventilation fan that will energize upon fan operation and de-energize upon fan stop.
- H. Provide RTDs with local controllers mounted in the blower enclosure to monitor bearing temperature at gear end and drive end bearings. Local controllers shall output a digital high temperature alarm.
- I. Each blower package must be capable of operating in the following modes:
1. Automatic: Blower is controlled from SCADA. Provide communications system compatible with the Owner's existing SCADA system.
 2. Hand: Blower controlled manually at the operator control panel installed on each blower package.
 3. Off: Blower is interlocked from manual or automatic operation
- J. Operator control panel functions shall, at a minimum, include the following digital and analog inputs/outputs for controlling and monitoring each blower package:
1. Main motor, sound enclosure ventilation fan motor and electrical cabinet ventilation fan motor.
 2. Emergency (stop push button)
 3. Incoming power monitor relay for phase failure, undervoltage, overvoltage, and phase sequence
 4. Blower inlet and discharge temperature
 5. Blower inlet and discharge pressure
 6. Filter differential pressure
 7. Sound enclosure temperature
 8. Oil temperature and oil level
- K. The operator control panel PLC must have sufficient connections for the Owner to communicate the following digital and analog input/output signals to the plant PLC network via I/O communications as well as serial connections and necessary programming to convey equivalent signals via ethernet/IP protocol. Provide 20% spare connections on all PLC communication cards.

1. Remote on/off (DI)
 2. Remote reset of fault message (DI)
 3. Remote no external failure (DI)
 4. Blower running signal (DO)
 5. Blower on signal (DO)
 6. Group alarm signals (DO)
 - a. High Discharge Pressure
 - b. High Motor Temperature
 - c. VFD Fault
 - d. Low Oil Level
 - e. High Oil Temperature
 - f. Enclosure Ventilation Fan faults
 7. Group warning signals (DO)
 - a. High Discharge Pressure
 - b. High Motor Temperature
 - c. Low Oil Level (gear end and drive end)
 - d. High Oil Temperature (gear end and drive end)
 8. Remote 4-20mA blower speed signal (AI)
 9. 4-20mA speed output from inverter (AO)
- L. Blower control wiring terminals shall be suitable for connection to an external conductor, size No. 14 or larger. If necessary, blower vendor shall furnish all ancillaries; e.g., terminal junction box, cable, to achieve this feature. Provide stainless steel terminal junction box.

2.11 Variable Frequency Drives (VFDs)

- A. Provide on-board VFD as part of the blower package. VFD must be compatible with the motor and be the manufacturer's standard VFD for the blower.
- B. The blower enclosure must be designed to provide cooling for the VFD when

operating in an environment with 104°F ambient conditions.

- C. The blower drive system shall use a constant torque, AC variable frequency drive using pulse width modulation technology (PWM), integrally mounted and wired into the blower package control cabinet from the factory.
- D. VFD and motor combination to meet IES2 efficiency standard.
- E. The blower drive shall “soft start” to allow for unlimited motor starts per hour.
- F. The blower drive control and data input shall be via bus system from the blower controller as sole and central operating unit and communication interface.
- G. The blower drive shall come completely programmed and parametrized. An SD card slot shall be provided for updates.
- H. The blower drive shall have an integrated DC link reactor. The DC link reactor shall smooth voltage peaks, bridge commutation gaps and reduce the effects of harmonics on the inverter and line supply.
- I. The blower drive shall include a class A noise suppression line (RFI) filter either integrated to the power module or preinstalled and wired between the power feed and power module.
- J. The blower drive shall be protected from Electro Magnetic Interference by utilizing shielded motor connection cables.
- K. Approved Manufacturers and Products:
 - i. Siemens
 - ii. Approved Equal

2.12 FACTORY FINISHING

- A. Shop prepare, prime, and finish coat all ferrous metal components of the blower, motor, table-top base and all related accessory and equipment items in accordance with manufacturer’s standard coating system for packaged blower equipment to be installed at a wastewater treatment plant.

PART 3 - EXECUTION

3.01 GENERAL

- A. Packaged Equipment: When any system is provided as pre-packaged equipment, coordination shall include space and structural requirements, clearances, utility connections, signals, outputs, and features required by the manufacturer including safety

interlocks.

3.02 INSTALLATION

- A. Owner to install in accordance with the manufacturer's recommendations. Mount blower package on existing concrete slab. Anchor bolts shall be accurately placed with templates. Coat bolt thread projections with lubricant to facilitate future nut removal.
- B. Adjust blower assemblies such that the driving units are properly aligned, plumb, and level within blower manufacturer's tolerances with the driven units and all interconnecting shafts and couplings so that a proper hot alignment results. Flexible couplings shall not be considered to compensate for misalignment.
- C. All strain from attached piping shall be eliminated from the blower, and any evidence of blower or driver misalignment, noisy operation, or other signs of improper setting shall be corrected by the Contractor. Care during storage, installation, and lubrication shall be in strict accordance with the manufacturer's recommendations.
- D. Filter Startup: Prior to startup, the filter housings shall be cleaned of any trash, loose dirt or dust by vacuuming and hand wiping. The inside walls of the intake pipe shall be thoroughly cleaned of dust and dirt also. This procedure is to ensure that particles from inside the filter housing and intake pipe do not enter the blower during startup.
- E. Lubricants: The installation includes oil and grease for initial operation.

3.03 FACTORY TESTING

- A. The equipment specified herein shall pass the manufacturer's standard factory test prior to shipment. Certification of the results of these tests shall be submitted to the Engineer. Factory testing shall at minimum include the following:
 - 1. All critical dimensions of the blower components actually provided by the manufacturer shall be verified and documented prior to assembly.
 - 2. The rotating parts of each blower actually provided by the manufacturer shall be statically and dynamically balanced before final assembly. The blower alone shall operate without excessive vibration.
 - 3. Each blower actually provided by the manufacturer shall be slip tested. The Slip RPM shall be documented. Each bare blower provided by the manufacturer shall be operated at its maximum rated speed and differential pressure for thirty (30) minutes. A document certifying that the supplied blowers conform to the design specifications shall be provided.
- B. On completion of final assembly of the packaged blower and prior to shipment, each packaged blower shall be mechanically run for a minimum of fifteen (15) minutes.

3.04 FIELD TESTS AND INSPECTIONS

- A. Functional Test: All equipment described herein shall be inspected for proper alignment, proper connection, normal operation, and satisfactory performance by means of a

functional test.

- B. Performance Tests: To demonstrate that each system furnished is installed and performs in accordance with all provisions of these Specifications, the Owner, with the assistance of the Manufacturer, will conduct performance tests for a 30 day period. Tests shall demonstrate proper operation of each of the blower assemblies at the specified design point, at which time data shall be recorded on the pressure rise, temperature rise, capacity, sound pressure level, air flow rate, and horsepower requirements of the blower assemblies. A qualified representative of the system supplier shall be present to witness the start of performance test, analyze data, and certify the system performance.
- C. In the case of a nonconforming system, all corrections and modifications required to correct deficiencies to supplied equipment shall be made at the Manufacturers sole expense.

3.05 MANUFACTURERS REPRESENTATIVE

- A. Provide manufacturer's representative for a minimum of two (2) days total to perform installation inspection and field testing.
- B. Provide manufacturer's representative for a minimum of one (1) day total to perform operations and maintenance training.
- C. Days are defined as minimum 8 hours availability at the site during normal working hours. All times are exclusive of travel time.
- D. Provide a manufacturer's signed Certificate of Proper Installation and Certificate of Proper Operation for each blower under this Section.

END OF SECTION