

SECTION 44 42 19.04
ROTARY POSITIVE DISPLACEMENT BLOWER

EQUIPMENT AND COMPONENT NUMBER(S)

BLR 3311: Aeration Blower 1.
BLR 3411: Aeration Blower 2.
BLR 3511: Aeration Blower 3.
BLR 3314: Air Scour Blower 1.
BLR 3414: Air Scour Blower 2.
BLR 3514: Air Scour Blower 3.
BLR-8011: Aerobic Digester Aeration Blower 1.
BLR-8012: Aerobic Digester Aeration Blower 2.
BLR-8013: Aerobic Digester Aeration Blower 3.
BLR-8014: Aerobic Digester Aeration Blower 4.

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
1. American Gear Manufacturers Association (AGMA).
 2. American National Standards Institute (ANSI).
 3. ASTM International (ASTM):
 - a. A48/A48M, Standard Specification for Gray Iron Castings.
 - b. A395/A395M, Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures.
 4. National Electrical Manufacturers Association (NEMA).
- B. Refer to Section 01 88 15, Anchorage and Bracing, for anchorage and bracing.
- C. Refer to the following sections for electrical requirements:
1. Section 26 05 02, Basic Electrical Requirements.
 2. Section 26 05 04, Basic Electrical Materials and Methods,
 3. Section 26 05 10, Network Communication Systems.
 4. Section 26 05 26, Grounding and Bonding for Electrical Systems.
 5. Section 26 20 00, Low-Voltage AC Induction Motors.
 6. Section 26 24 19, Low-Voltage Motor Control.
 7. Section 26 29 23, Low-Voltage Adjustable Frequency Drive System.
 8. Section 26 43 00, Surge Protective Devices.
- D. Refer to Section 40 91 00, Instrumentation and Control Components, for instrumentation and controls.

- E. Refer to Section 40 92 01, Control Panels, for control panels.
- F. Refer to Section 40 99 90, Package Control Systems, for packaged control systems.
- G. Refer to Section 43 32 56, Membrane Equipment System, for membrane air scour requirements.

1.02 DEFINITIONS

- A. Absolute Discharge Pressure: Pressure in pounds per square inch absolute (psia) at the blower discharge flange in relation to Job Site barometric pressure.
- B. Brake Horsepower (BHP): (Shaft) Standard curve horsepower required, corrected for pressure, temperature, and relative humidity at inlet conditions.
- C. Discharge Pressure: Pressure in pounds per square inch gauge (psig) at blower discharge flange at rated capacity.
- D. Inlet Cubic Feet per Minute (icfm): Volumetric rate of air at the inlet flange of the blower corrected to absolute pressure, temperature, and relative humidity. The pressure takes into account the inlet piping in filter pressure drops.
- E. Pressure Rise: Pressure developed within the blower between the inlet and outlet flanges. It is the discharge pressure less the inlet pressure measured at the discharge and inlet flanges, respectively.
- F. Standard Cubic Feet per Minute (scfm): Volumetric rate of air measured in standard cubic feet per minute at 68 degrees F, pressure of 14.2 psig, and relative humidity of 36 percent.

1.03 SYSTEM DESCRIPTION

- A. Provide blower systems, featuring rotary positive displacement blower(s) to supply air for:
 - 1. Membrane air scouring system.
 - 2. Aerobic digester system.
 - 3. Bioreactor system.
- B. Bioreactor system blowers are located in Building 32, Process Building. Membrane air scouring system blowers are located in Building 32, Process Building. Aerobic digester system blowers are located in Building 80, Digester Facility Building.
- C. Provide blower system, including, but not limited to, blowers, control panel, motors, drives, guards, drive couplings, baseplates, vibration isolators,

supports, inlet silencers, discharge silencers, bypass silencers, relief valves, flexible connectors, noise enclosures, spare parts, outside air filter, and miscellaneous appurtenances as necessary.

- D. Membrane air scouring system blowers are provided as part of Membrane Equipment System package in accordance with Section 43 32 56, Membrane Equipment System (Membrane Bioreactor).

1.04 DESIGN REQUIREMENTS

- A. Design equipment with due regard to safety of operation, accessibility, and durability of parts, and complying with applicable OSHA, state, and local safety regulations.
- B. Each blower will receive outdoor air through a dedicated filter.
- C. Each blower system's blowers discharge into a main air discharge header.
- D. Intermittent and continuous operation in an indoor environment.
- E. Blower(s) shall start no more than four times per hour when operating in intermittent service.
- F. Blowers shall meet rated performance and sound level when operating at a maximum gear tip speed of 3,750 feet per minute. Operating speed shall not exceed 80 percent of rated speed.
- G. Maximum Sound Pressure Level: 93.5 dBA, factory calculated at a distance of 1 meter, with inlet and discharge silencers, measured with a sound enclosure.
- H. Performance Requirements:
1. Bioreactor System:

Design Conditions	
Blower ID	BLR-3311 BLR-3411 BLR-3511 BLR-3611
Number of Units Required	4
Design Capacity, scfm	610
Altitude, ft	6,700
Barometric pressure, psia	11.5
Inlet air temperature, degrees F (Guarantee Point)	78

Design Conditions	
Inlet air temperature range, degrees F	-18 min to 95 max
Relative humidity, % (Guarantee Point)	80
Discharge pressure at compressor discharge flange, psia	18.7
Blower pressure rise required, psi	7.3
Pressure relief valve setting, psig	*
Shaft brake horsepower, BHP ^{1,2}	37
¹ Includes main oil pump, if specified, and all gear and bearing frictional losses. ² Not to exceed motor nameplate horsepower at 1.0 service factor at the inlet air temperatures, pressure relief valve setting and altitude listed above. *The relief valve shall be set by the manufacturer to protect the blower from excessive differential pressure based on the design conditions specified.	

2. Membrane Air Scouring System:

Design Conditions	
Blower ID	BLR-3314 BLR-3414 BLR-3514
Design Capacity, scfm	As required by membrane equipment supplier
Design Capacity, icfm	As required by membrane equipment supplier
Maximum Capacity, icfm	As required by membrane equipment supplier
Altitude, ft	6,700
Barometric pressure, psia	11.5
Inlet air temperature, degrees F (Guarantee Point)	78
Inlet air temperature range, degrees F	-18 min to 95 max
Relative humidity, % (Guarantee Point)	20 - 80

Design Conditions	
Discharge pressure at compressor discharge flange, psia	As required by membrane equipment supplier
Blower pressure rise required, psi	As required by membrane equipment supplier
Pressure relief valve setting, psig	As required by membrane equipment supplier
Shaft brake horsepower, BHP ^{1,2}	As required by membrane equipment supplier
¹ Includes main oil pump, if specified, and all gear and bearing frictional losses. ² Not to exceed motor nameplate horsepower at 1.0 service factor at the inlet air temperatures, pressure relief valve setting and altitude listed above.	

- a. The blower pressure rise, to be determined by the membrane equipment system supplier, shall be sufficient to deliver air to the membrane air scour diffusers and shall account for simultaneous maximum flow, highest inlet temperature, all inlet and outlet piping pressure losses, all minor losses associated with valves, fittings, package inlet and inlet pipe silencers, a dirty inlet filter, maximum water surface level in the membrane tank during aeration, and any fouling that may occur on the diffusers.
3. Aerobic Digester System:

Design Conditions	
Blower ID	BLR-8011 BLR-8012 BLR-8013 BLR-8014
Number of Units Required	4
Design Capacity, scfm	600
Altitude, ft	6,700
Barometric pressure, psia	11.5
Inlet air temperature, degrees F (Guarantee Point)	78
Inlet air temperature range, degrees F	-18 min to 95 max
Relative humidity, % (Guarantee Point)	80

Design Conditions	
Discharge pressure at compressor discharge flange, psia	22.6
Blower pressure rise required, psi	11.1
Pressure relief valve setting, psig	*
Shaft brake horsepower, BHP ^{1,2}	55
¹ Includes main oil pump, if specified, and all gear and bearing frictional losses. ² Not to exceed motor nameplate horsepower at 1.0 service factor at the inlet air temperatures, pressure relief valve setting and altitude listed above. *The relief valve shall be set by the manufacturer to protect the blower from excessive differential pressure based on the design conditions specified.	

1.05 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
 - a. Complete list of 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.
 - d. Standard and specialized equipment assembly cuts.
 - e. System layout, installation, and placing drawings for equipment, drivers, and bases.
 - f. Performance data for each type of equipment that will show compliance with specification requirements stated herein.
 - g. Horsepower demand over the operating range of the blower.
 - h. Detailed structural, mechanical, and electrical drawings showing the equipment fabrications and interface with other items. Include dimensions, size, and locations of connections to other work.
 - i. Motor: See requirements of Section 26 20 00, Low-Voltage AC Induction Motors.
 - j. Monitoring System:
 - 1) Catalog cuts of each blower control system component, including monitoring panel components.
 - 2) Wiring diagrams, including baseplate-mounted terminal junction box and equipment monitoring panel.
 - 3) Panel construction and face layout drawings.

- k. Anchorage and bracing drawings and cut sheets, as required by Section 01 88 15, Anchorage and Bracing.
 - l. Sound Enclosure:
 - 1) Complete description of sound enclosure and accessories.
 - 2) Calculated noise attenuation.
 - 2. Samples: Color samples for finish coating. If paint manufacturer of finish coat differs from manufacturer of prime coat, provide both manufacturers' written confirmation that materials are compatible.
- B. Informational Submittals:
- 1. Anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.
 - 2. Manufacturer's Certificate of Compliance, in accordance with Section 01 61 03, Equipment Basic Requirements.
 - 3. Factory calculated sound levels (dBA) of blower unit with silencers and sound enclosure.
 - 4. Identification of outside utility requirements for each component such as air, water, power, etc. Include operating parameters for required utilities.
 - 5. Special shipping, storage and protection, and handling instructions.
 - 6. Manufacturer's written installation instructions.
 - 7. List of special tools, materials, and supplies furnished with equipment for use prior to and during startup and for future maintenance.
 - 8. 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.
 - 9. Routine maintenance requirements prior to plant startup.
 - 10. Test Reports:
 - a. Factory test reports for blower and motor.
 - b. Field test procedures.
 - 11. Operation and Maintenance Data as specified in Section 01 78 23, Operation and Maintenance Data.
 - 12. Manufacturer's Certificate of Proper Installation, in accordance with Section 01 61 03, Equipment Basic Requirements.

1.06 EXTRA MATERIALS

- A. Furnish, tag, and box for shipment and storage the following spare parts, special tools, and materials:

Item	Quantity
Oil, synthetic	Sufficient gallons for standard oil change interval
Inlet Filters	Enough for 1 complete change per unit
Flexible Coupling	One complete set
Drive V-Belts (as applicable)	One complete set per unit
Special tools required to maintain or dismantle	One complete set for each unit

- B. Delivery: In accordance with Section 01 61 03, Equipment - Basic Requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. General:
- Where possible, provide end products of one manufacturer in order to achieve standardization for appearance, operation, maintenance, replacement, and manufacturer's service.
 - Manufacture spare parts to United States standard sizes and gauges.
- B. Materials, equipment, and accessories specified in this section shall be products of:
- Aerzen; Delta Blower Generation 5.
 - Or equal.

2.02 BLOWER COMPONENTS

- A. Physical Characteristics:
- Blower:
 - Rotary positive displacement type, driven by horizontal electric motor.
 - Casing: One-piece construction, ASTM A48/A48M, Class 30B close-grain cast iron strongly ribbed to prevent distortion at the specified operating conditions. Separate headplates of cast iron.

- c. Bearings:
 - 1) Drive End Bearings: Fixed to control axial location of impeller assembly.
 - 2) Bearings and Gears: Lubricated by a splash type lubrication system on both ends of the rotors.
 - 3) Provide bearings with a positive lip type oil seal designed to prevent lubricant from entering airstream and a labyrinth seal on each shaft designed to reduce air leakage at point where shaft extends through headplate of blower casing.
 - 4) Make further provision to vent area between the two sealing systems to atmosphere to relieve excessive pressure on seals.
- d. Impellers:
 - 1) Straight, two-lobe involute type, rotating in opposite directions in a common casing without rubbing, liquid seals, or lubrication.
 - 2) Mount impellers and timing gears on shafts supported by antifriction bearings, fixed to control the axial location of impeller/shaft in the casing.
- e. Shafts:
 - 1) Cast iron, integral with impellers or alloy steel.
 - 2) Machine labyrinth seals into shaft to minimize air leakage.
- f. Direct-Drive Coupling (as applicable): Guard over coupling.
- g. Belt Drive (as applicable):
 - 1) V-belt drive with automatic belt tension device.
 - 2) Provide belt guard.
- 2. Motor:
 - a. Squirrel-cage ac induction type, meeting requirements of Section 26 20 00, Low-Voltage AC Induction Motors, and as specified herein.
 - b. Enclosure Type: TEFC as specified in Section 26 20 00, Low-Voltage AC Induction Motors.
 - c. Drive: Direct-drive coupling or V-belt drive.
- 3. Blower Support:
 - a. Baseplate: Cast iron or fabricated steel mounted on concrete equipment pad as shown on the Drawings.
 - b. Support Stand: Designed by manufacturer and reinforced to withstand anticipated loadings of blower, motor, inlet and discharge silencers, and associated piping.
 - c. Factory mount blower and motor as a package.
 - d. Provide vibration isolators to limit transmission of vibration to anchor points at floor.
- 4. Equipment Housing: Blower shall be supplied with a sound enclosure covering the entire blower package.

B. Functional Characteristics:

1. Blower:
 - a. Impellers:
 - 1) Positioned by timing gears to maintain proper clearances.
 - 2) Statically and dynamically balanced by removing metal from impeller body.
 - 3) Positively timed by a pair of accurately machined and carburized steel spur gears hardened to 58-62 Rockwell alloy timing gears manufactured to comply with AGMA. Gears mounted on shafts with tapered fit and secured by a locknuts.
2. Motor: Inverter duty rated.
3. Blower Support: Provide vibration isolators to limit transmission of vibration to anchor points at floor.
4. Equipment Housing: The sound enclosure shall be designed for easy inspection and maintenance of all blower package components. Quick release panels, each with at least two handle locations, shall provide easy and quick access for routine maintenance of the blower and the package components.

C. Performance Characteristics:

1. Blower:
 - a. Bearings: Support shaft and impeller assembly by single-row roller bearings or double-row spherical roller bearings sized for a minimum L10 rating of 100,000 hours.
 - b. Impellers: Provide impeller/shaft assemblies integrally cast from high-strength ASTM A395/A395M Type 60-45-15 ductile iron with a minimum tensile strength of 60,000 pounds per square inch.
 - c. Direct-Drive Coupling (as applicable):
 - 1) Service Factor: Minimum 1.5 on horsepower.
 - d. Belt Drive (as applicable):
 - 1) Minimum service factor of 1.4.
 - 2) Designed not to exceed allowable overhung load limits of blower and motor.
2. Motor:
 - a. Motor Horsepower:
 - 1) Membrane Air Scour Blower Horsepower: 10 hp.
 - 2) Digester Aeration Blower Horsepower: 75 hp.
 - 3) Bioreactor Blower Horsepower: 50 hp.
 - b. Nominal Speed: 1,750 rpm.
 - c. Rated Voltage: 460 volt, three-phase, 60 Hz.

- d. Motor Efficiency: Premium efficiency as specified in Section 26 20 00, Low-Voltage AC Induction Motors.
- e. Service Factor: 1.15.
- 3. Blower Support: None.
- 4. Equipment Housing: None.

2.03 ACCESSORIES

A. Physical Characteristics:

- 1. Blower Inlet Filter-Silencer:
 - a. Furnish manufacturer's standard inlet air filter-silencer to remove particulate from the inlet air stream.
 - b. Filter and filter frame shall be constructed of synthetic material, suitable for filtering moist air without decomposition of the filter.
- 2. Discharge Silencers: Located within equipment housing.
- 3. Flexible Connectors:
 - a. Pressure spool, single arch, expansion joint type with 125-pound ANSI flanges, sized to match blower flanges.
 - b. Install on each blower at inlet and outlet flange.
 - c. Thrust restraint rods on discharge if not otherwise restrained.
- 4. Check Valve: The Blower shall have a check valve integral to package to prevent backflow when blower is not in operation. The valve shall be the manufacturer's standard.
- 5. Safety Relief Valve:
 - a. Blower manufacturer's standard.
 - b. Sized to relieve entire discharge flow without overloading blower.
 - c. Furnish one for each blower.
 - d. Install inside blower sound enclosure.
- 6. Noise Enclosure:
 - a. Total Noise Enclosure: See Design Requirements for performance criteria.
- 7. Lifting Lugs: Provide suitably attached for equipment assemblies and components weighing over 100 pounds.
- 8. Equipment Identification Plates: Provide 16-gauge Type 316 stainless steel identification plate securely mounted on each separate equipment component in a readily visible location. Plate shall bear 3/8-inch-high engraved block type black enamel filled equipment identification number and letters indicated in this specification.
- 9. Furnish manufacturer approved vibration isolation pads for mounting blower skid to concrete.

B. Functional Characteristics:

- 1. Blower Inlet Filter-Silencer: The blower will receive main process air through ducted inlet from exterior of building. Wall-mounted air intake

will be fitted with inlet filter for first of two-stage filtration and supplied per Section 40 27 01, Process Piping Specialties. Second of two-stage filtration shall be within the blower enclosure.

2. Discharge Silencers: Designed to reduce pulsation from rotary lobe blowers at blower operating timing gear speed to meet performance requirements.
3. Flexible Connectors: None.
4. Check Valve: None.
5. Safety Relief Valve: Per manufacturer.
6. Noise Enclosure: None.
7. Lifting Lugs: None.
8. Equipment Identification Plates: None.

C. Performance Characteristics:

1. Blower Inlet Filter-Silencer: None.
2. Discharge Silencers:
 - a. For timing gear speeds below transition speeds, use a multi-chambered reactive type silencer, and for timing gear speeds at or above transition speed, use a multi-chambered reactive and absorptive type silencer packed.
 - b. Inlet/Outlet Air Velocity: 5,500 feet per minute, maximum.
 - c. Pressure Loss: 6 inches of WC maximum, through silencer at design flow rate.
3. Flexible Connectors:
 - a. Operating Temperature Rating: 250 degrees F.
4. Check Valve: None.
5. Safety Relief Valve: None.
6. Noise Enclosure: None.
7. Lifting Lugs: None.
8. Equipment Identification Plates: None.

2.04 INSTRUMENTATION AND CONTROLS

- A. General: Instrumentation and controls work of this section shall be in accordance with Section 40 99 90, Package Control Systems, Section 40 91 00, Instrumentation and Control Components, and Section 40 92 10, Control Panels. External signal interfaces are required to interface the blower system with the plant SCADA. For the membrane air scour blowers, the membrane control panel LCP-3202, shall directly control the blowers and provide means for automatic and manual control. Provide items not specifically called out which are required to implement functions required for proper system operation. Control panels provided with the membrane air scour blowers shall provide hardwired functions. Automatic control functions shall be integrated to the LCP-3202. See other sections for

additional requirements. Process aeration blowers and Digestion aeration blowers have no local control panels and are controlled remotely.

B. Physical Characteristics:

1. Instrumentation and Controls:
 - a. Pressure 1-gauge, manufacturer's standard.
 - b. Pressure 2-gauge and switch, manufacturer's standard.
 - c. Temperature 2-gauge and switch, manufacturer's standard, prewired to local control panel and mounted integral to the blower package system, located directly after blower discharge.
 - d. Discharge pressure switch, manufacturer's standard.
 - e. Discharge pressure transmitter, manufacturer's standard.
 - f. Suction pressure switch, manufacturer's standard.
2. Control Panel:
 - a. In accordance with Section 40 92 01, Control Panels.
 - b. Mounting:
 - 1) Bioreactor Aeration Blower: None.
 - 2) Membrane Air Scour Blower: Blower Cabinet.
 - 3) Aerobic Digester Aeration Blower: None.
3. Shop/Factory Finishing: Furnish manufacturer's standard finish.

C. Functional Characteristics:

1. Instrumentation and Controls:
 - a. Bioreactor Aeration Blowers: In accordance with Section 40 99 90, Package Control Systems.
 - b. Membrane Air Scour Blowers: In accordance with Section 40 99 90, Package Control Systems, and Section 43 32 56, Membrane Equipment System. External signal interfaces are required to interface with the MES control system. Provide items not specifically called out which are required to implement functions required for proper system operation.
 - c. Digester Blowers: In accordance with Section 40 99 90, Package Control Systems.
2. Control Panel: In accordance with Section 40 92 01, Control Panels.
3. Control Panel External Interfaces: None.
4. System Operation:
 - a. Functional Requirements:
 - 1) Provide at each panel:
 - a) RESET pushbutton and associated logic for the common FAIL alarms. When alarm condition occurs, indicate associated condition at panel. Local indication of alarm condition shall remain until condition has been corrected and RESET pushbutton pressed.

- b) Control logic to monitor operation of blower and provide a contact closure output to motor control center when prestartup or operating conditions are normal. Open contact if a HIGH differential air pressure between blower inlet and outlet condition or HIGH discharge air temperature is detected.
- c) Indicate blower shutdown and problem using latching relays.

D. Performance Characteristics:

- 1. Instrumentation and Controls: None.
- 2. Control Panel: In accordance with Section 40 92 01, Control Panels.
- 3. System Operation: None.
- 4. Shop/Factory Finishing: None.

2.05 SOURCE QUALITY CONTROL

A. Blower Performance Test:

- 1. Notify Contracting Officer at least 7 days prior to performing test.
- 2. Perform on the blower actually furnished in accordance with manufacturer's established criteria.
- 3. Test each blower for a minimum of 1 hour after stabilization at conditions near the performance ratings for mechanical integrity and flow performance.
 - a. Perform at or above specified performance pressure rise.
 - b. Tolerance on Flow: Plus or minus 4 percent, after correction to rated conditions.
- 4. Measure power consumption using a calibrated wattmeter.
- 5. Test Report: Confirm capacity and power, complete with data and calculations used in the test.

B. Motor Test: See Section 26 20 00, Low-Voltage AC Induction Motors.

2.06 FACTORY FINISHING

- A. Physical Requirements: Provide manufacturers' standard finish system.
- B. Functional Characteristics: None.
- C. Performance Characteristics: None.

PART 3 EXECUTION

3.01 INSTALLATION

- A. In accordance with manufacturer's written instructions.
- B. Anchor Bolts: Accurately place using templates furnished by manufacturer and as specified in Section 05 50 00, Metal Fabrications.
- C. Install blower package on vibration isolators and anchor bolts in strict accordance with manufacturer's written instructions.

3.02 FIELD TESTING AND FACILITY STARTUP

- A. Field Testing and Facility Startup shall be in accordance with the requirements of Section 01 91 14, Equipment Testing and Facility Startup.
- B. Facility startup specifies the order and prerequisites for the following tests of the equipment:
 - 1. Field functional testing.
 - 2. Software operational testing.
 - 3. Performance testing.
 - 4. Demonstration testing.
- C. All Field Testing and Facility Startup shall be performed using a qualified representative provided by the Manufacturer as specified in Section 01 91 14, Equipment Testing and Facility Startup, Section 01 43 33, Manufacturers' Field Services, and as elaborated upon in this section.

3.03 FIELD QUALITY CONTROL

- A. Functional Test: Prior to facility startup, conduct on each Blower System, assisted by manufacturer's representative, for correct rotation, proper alignment and connection, quiet operation, and satisfactory specified performance.

3.04 MANUFACTURER'S SERVICES

- A. Manufacturer's Representative:
 - 1. Present at Site designated by the Contracting Officer for minimum person-days listed below, travel time excluded:
 - a. 3 person-days for installation assistance and inspection.

- b. 3 person-days for functional testing and completion of Manufacturer's Certificate of Proper Installation.
- c. 11 person-days for post-startup training of Government's personnel.

END OF SECTION