**SECTION 11000 – HIGH EFFICIENCY SCREW BLOWER SYSTEMS**

**Part 1.00 GENERAL**

1. **SUMMARY**

The contractor shall install high efficiency screw blower system(s) built by a qualified manufacturer. All components shall be furnished by a single manufacturer who shall be responsible for the performance and compatibility of the system.

1. **REFERENCES**

American National Standards Institute (ANSI) B16.1, B40.1

American Society of Mechanical Engineers (ASME) PTC 9

American Gear Manufacturers Association (AGMA)

American Society of Testing and Materials (ASTM)

Anti-Friction Bearing Manufacturers' Association (AFBMA) 9, 11

American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)

Institute of Electrical and Electronics Engineers (IEEE)

Mechanical Power Transmission Association

National Electrical Code (NEC)

National Electrical Manufacturers Association (NEMA) MG 1, ICS 6

National Fire Protection Association (NFPA) 70

Occupational Safety and Health Administration (OSHA)

Rubber Manufacturers Association (RMA)

Steel Structures Painting Council (SSPC)

Underwriters Laboratories (UL)

1. **SUBMITTALS**

The submittals shall consist of a bill of material listing all components the blower system manufacturer will deliver; component Manufacturer's catalog cut sheets listing materials of construction, performance curves/charts, standards of design, warranty statement; prime/paint coating system plus the following information:

* 1. COMPRESSOR
		1. BHP at: normal system operating conditions
		2. Discharge temperature at ambient temperature and normal system operating conditions.
		3. L10 bearing life calculations for each bearing.
	2. MOTOR
		1. 1/2, 3/4, full load efficiencies and power factors
		2. L10 bearing life calculations for each bearing.
	3. SILENCERS
		1. An attenuation performance curve for each type of silencer.
	4. PRESSURE RELIEF VALVE
		1. Set pressure
	5. Shop drawings of assembled system stating what items will be shipped to the job site assembled and those shipped loose for field assembly.
	6. Coupling drive calculations.
	7. A list of all exceptions and an explanation of each non-compliance with the specifications.
1. **QUALITY ASSURANCE**
	1. The blower system(s) will be built by a blower system supplier who has units at 50 or more waste water treatment plants, the same size or larger than those specified below, that have been in successful operation for fifteen or more years.
	2. All components shall be furnished by a single supplier who shall be responsible for the performance and compatibility of the system.
	3. The blower system manufacturer shall be an authorized warranty service center for the compressor provided.
	4. Unnamed manufacturers shall provide a complete technical submittal to the engineer for review at least 15 days prior to the published bid date noting all project specific system performances, curves, drawings, maintenance requirements, and any non-compliances with the specification to qualify for use on the project.
	5. Compressors, motors, and all primary components shall be manufactured in the United States with replacements and parts available from multiple sources within the United States.
2. **STORAGE & HANDLING**
	1. Care must be taken during unloading and handling of equipment to ensure against undue strain to the blower and motor. DO NOT use lifting straps or chains under the blower or motor. Lift from under the main frame, base or use base mounted lifting lugs (if provided).
	2. In storage blowers must be kept clean, free of moisture and rotated a minimum of 20 revolutions each week to maintain warranty. For storage in excess of four months, or in a damp or corrosive environment see the manufacturer's operation and maintenance manual.
3. **CONDITIONS OF SERVICE**

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| --- | --- |
| APPLICATION: |  |
| NUMBER OF BLOWERS: |  |
| SITE ELEVATION, FASL:  |  |
| MAXIMUM INLET TEMPERATURE, ºF: |  |
| MAXIMUM RELATIVE HUMIDITY, %: |  |
| SCFM ± 4 %: |  |
| ICFM ± 4 %: |  |
| DIFFERENTIAL PRESSURE, PSIG:  |  |
| MAX BHP REQUIRED: |  |
| RPM LIMIT AT ABOVE SCFM: |  |
| MOTOR SIZE, HP: |  |
| SOUND LIMIT REQ. @ 1 METER IN FREE FIELD, dBA: |  |

1. **WARRANTY**
	1. STANDARD WARRANTY

The manufacturer will provide a warranty stating that the blower system is warranted to be in accordance with the product specifications mutually agreed upon and to be free from defects in workmanship and materials. The blower system manufacturer’s product warranty will extend to all products supplied by the blower system manufacturer whether or not manufactured by the blower system manufacturer. This warranty shall terminate at twelve (12) months in service with the original user or eighteen (18) months from the date of shipment, whichever occurs first.

*(OPTIONAL EXTENDED WARRANTY)*

* 1. EXTENDED WARRANTY

The manufacturer will provide a warranty stating that the blower system is warranted to be in accordance with the product specifications mutually agreed upon and to be free from defects in workmanship and materials. The blower system manufacturer’s product warranty will extend to all products supplied by the blower system manufacturer whether or not manufactured by the blower system manufacturer. This warranty shall be in effect provided that the customer adheres to the warranty requirements. This warranty shall terminate five years from the date of shipment.

**PART 2.00 PRODUCTS**

1. **MANUFACTURERS**
	1. The blower system(s) shall be EE-PAC as manufactured by Universal Blower Pac, Inc., Noblesville, Indiana.
2. **CONSTRUCTION**
	1. COMPRESSOR

|  |  |
| --- | --- |
| IMPELLERS: | Ductile iron; static and dynamically balanced; operate without rubbing, liquid seals or lubrication, hybrid lobe profile. Straight lobed impellers shall not be acceptable.(OR HYBRID SCREW)Ductile iron, Teflon coated; static and dynamically balanced; operate without rubbing, liquid seals or lubrication, hybrid screw profile featuring internal compression. Straight lobed impellers and twisted impellers without internal compression shall not be acceptable.(OR VARIABLE HYBRID SCREW)Ductile iron, Teflon coated; static and dynamically balanced; operate without rubbing, liquid seals or lubrication, Variable pitch hybrid screw profile featuring internal compression. Impellers without variable pitch and internal compression shall not be acceptable. |
| SHAFTS: | Cast integrally with the impellers. |
| TIMING GEARS: | Helical. |
| LUBRICATION: | Oil Splash. |
| SEALS: | Labyrinth. |

*(OPTIONAL - SOUND LIMIT REQUIREMENT)*

* + 1. ATTENUATION
			1. It is the intention of this section of the contract documents to procure an acoustical enclosure for the specified blower system. The Enclosures shall be designed, assembled and inspected by Universal Blower Pac, Inc. at the manufacturing site with documentation provided to verify the noise reduction demanded in these documents. Noise attenuation shall be provided as necessary to reach the specified sound limit requirement at a distance of 1 meter from the operating equipment in a free field environment. All readings shall be taken by personnel experienced in the field of sound attenuation.
			2. The enclosure herein specified shall be designed and manufactured by the blower system manufacturer specifically for the equipment supplied. Units shall be designed to be picked up by a fork truck. Each acoustical enclosure shall be shipped completely assembled. Each enclosure shall ship installed on the blower system when feasible. No field assembly shall be permitted
			3. Absorption of sound waves shall be the basis of design for the enclosure. Where feasible, only the compressor shall be enclosed to meet the demanded sound level. Where necessary, the complete blower system will be enclosed to meet the level specified. With absorption considered, perforated metal inner skin retaining devices shall not be considered acceptable.
			4. Outer skin shall be a minimum 14 gauge powder coated galvannealed steel*.* Lesser gauges shall not be acceptable.
			5. Absorption media shall be 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/ft3 (24.03 kg/m3) 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/ft2h degrees F 0.25 per ASTM C 177 |

* + - 1. Any access plates installed on enclosure for venting or screening shall be installed with self-starting, self-locking zinc plated screws to promote tightness. Rivets or loose fitting panels which can loosen during operation will not be accepted. Slide-in panels showing a loose fit shall provide grounds for rejection. Panels shall be constructed as to compress media on installation providing tightness and maximum sound absorption.
			2. Each enclosure will 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.
			3. Each enclosure will be fitted with a weather hood covered acoustical intake vent rated for the SCFM listed in the "service" section and discharge pipe openings with sound seal.
			4. Oil fills and drain extensions, and weather/sound seals will be fitted on all enclosure penetrations as needed
			5. A cooling fan with acoustical vent shall be supplied installed on the enclosure. To ensure adequate cooling at all speeds the cooling fan will not be connected to the blower or motor shaft in any way.
	1. MOTOR

|  |  |
| --- | --- |
| DESIGN: | B, squirrel-cage, induction per NEMA MG1 & IEEE standards |
| HP:  | Nameplate greater than the brake horsepower at 10% above the relief valve set pressure as described in 1.03 D 2. |
| RPM:  | 1800 or 3600 |
| TYPE:  | TEFC |
| POWER:  | 460 Volt, 3 phase, 60 Hertz |
| INSULATION:  | Class F with class B rise |
| SERVICE FACTOR:  | 1.15 ( or 1.0 if used in conjunction with VFD) at power voltage and site elevation listed above |
| EFFICIENCY:  | "premium efficient" per latest edition of NEMA MG1 |

* + 1. The motor will be designed, constructed, warranted for two year operation by a constant-torque variable frequency drive for 10:1 turn down. The insulation shall meet or exceed the current NEMA MG1-31.4.4.2 and have a Class F thermostat in each phase. Motor and variable frequency drive must be capable of starting, accelerating and maintaining blower operating speed within the specified operating range on a continuous basis without overheating.
	1. COUPLING

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.

* 1. DRIVE GUARD

Top, sides and bottom made of 14 gauge sheet steel with expanded metal front and back. Designed to allow ample ventilation for the drive, have an easy access cover and conform to applicable safety codes.

* 1. BASE
		1. A steel angle or channel skeleton-frame base, elevated on legs, with continuous welded joints shall be supplied. The base shall be provided with forklift slots to allow transport of the blower system. 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.
		2. The blower system shall be provided with vibration mounts under each leg to mitigate vibration to the foundation.

*(OPTIONAL SUB-BASE)*

* + 1. The blower system shall be mounted on a steel sub-base. The sub-base shall be constructed of structural steel and provided with forklift slots to allow transport of the complete system. If an acoustical enclosure is provided it shall be shipped completely assembled and anchored to the sub-base. The two base frames shall be bonded with a grounding strap.
	1. ACCESSORIES
		1. INLET FILTER
			1. Each blower shall have a filter with a paper media that removes 99.5% of 2 micron particles. The maximum pressure drop across the clean element and housing shall be less than 2-inches of water column.
			2. Filter shall be shipped installed on the inlet silencer and positioned for indoor service. Filter shall be Universal Silencer CF or equal.

*(OR)*

* + - 1. Filter shall be shipped installed on the inlet silencer and positioned for outdoor service. Filter shall be Universal Silencer CCF or equal.

*(OR)*

* + - 1. Filter shall be shipped loose for remote outdoor service. Filter shall be Universal Silencer CCF or equal.
		1. SILENCERS
			1. Silencers 3" and smaller shall be of the premium, straight-through absorptive type. Larger silencers shall be of the multiple-chamber design. Silencers will have acoustically packed nozzle next to blowers operating above transition speed. Silencers with threaded connections shall have ports on each end and those with flanged connections will have ports on the side and end. Multi-chamber silencer attenuation performance shall be at least 18 dB at 63 hertz, 23 dB at 125 hertz, 27 dB at 250 hertz and 31 dB at 500 hertz.
			2. Each blower shall have an inlet silencer with an air velocity of 4000 to 5700 feet per minute. Silencer shall be Progentex, Inc. series DS, RSI, DRSI, Universal Silencer, Inc. series U5, URB, RIS, Burgess Manning series CA, BMAI, BMSI Stoddard series L/C21, D13/L41, L61/63 or equal. Combination type inlet filter/silencers shall not be permitted.
			3. Each blower shall have a discharge silencer. Based on inlet CFM air velocity shall be 5500 to 7000 feet per minute. Silencer shall be Progentex, Inc. series DS, RS, DRS, Universal Silencer, Inc. series U5, URB, SD, Burgess Manning series CA, BMA, BMSS, Stoddard series L/C21, D13, D32/33 or equal. Combination type discharge silencer/base frames shall not be permitted.
		2. FLEXIBLE JOINT
			1. Each blower shall have an inlet and discharge flexible joint that matches the blower ports' size and type of connection. The joint’s elastomer must be rated higher than the maximum expected service temperature and pressure.
			2. Each blower shall have an external discharge flexible joint that matches the blower discharge silencer size. The joint’s elastomer must be rated higher than the maximum expected service temperature and pressure. The flexible joint shall ship installed on the system.
	1. VALVES
		1. PRESSURE RELIEF VALVE

Each blower shall be protected by a spring loaded pressure relief valve preset to start opening at half a PSIG above the PSIG listed in the "service" section, be full open at not more than 10% above the set pressure, and rated for the SCFM and PSIG listed in the "service" section. If the valve malfunctions it shall do so in the open condition to prevent blower damage.

* + 1. CHECK VALVE

Each blower shall have a discharge check valve with wafer connection, cast-iron body, cast-iron split discs and seal rated above the maximum anticipated discharge temperature. Valve shall be shipped installed on the system.

*(OPTIONAL)*

* + 1. ISOLATION VALVE

Each blower shall have a discharge isolation valve. Valves less than two inches in diameter will be ball valves. Valves 2-inches and larger shall be cast-iron wafer-body butterfly type with a locking handle. Valves more than eight feet above the floor shall have a chain wheel operator. The temperature rating of the seat must exceed the maximum anticipated discharge temperature. The valve shall be shipped installed on the system.

* 1. INSTRUMENTS
		1. FILTER RESTRICTION GAUGE

Each inlet filter shall have a filter restriction gauge that progressively measures vacuum in the filter element. A visual indicator, with a manual reset, shall lock at the current vacuum when the blower is shut off.

* + 1. PRESSURE GAUGE

Each blower shall have a 2 1/2" diameter, stainless steel case, brass bourdon tube, liquid filled, 1/4 NPT connection pressure gauge with a 0-15 PSIG scale on systems operating up to 10 PSIG and 0-30 PSIG for higher pressures. Gauge shall have a 1/4" brass snubber and isolation valve. Gauge shall be Winters 800 or equal.

*(OPTIONAL)*

* + 1. THERMOMETER

Each blower shall have a 3" diameter, hermetically-sealed stainless-steel case and ring, glass window, external zero calibrator, 1% accuracy, bimetal-type thermometer with a 50-300 ºF scale on systems up to 10 PSIG, 50-500 ºF for higher pressure and a corrosion resistant thermowell. The thermometer shall be Winters T30025 or equal.

*(OPTIONAL REPLACES THERMOMETER)*

* + 1. THERMOMETER / TEMPERATURE SWITCH

Each blower shall have a high discharge air temperature switch and thermometer. The thermometer shall have an easy to read 3-1/4” dual scale dial thermometer and a 3A 250VAC / 2A 250VDC SPDT relay in a 304 stainless steel housing. Color coordinated pointers display the current process temperature and set point. A front adjustment knob controls the set pointer. The internal mechanical switch movement prevents the set point pointer from sticking to the process indicating pointer. Brass wetted internal materials have 3 percent accuracy. The thermometer shall have a 10.5’ stainless steel capillary with ½” NPT process connection. The electrical connections shall be finger-safe screw terminals. A u-clamp mounting bracket shall be included for mounting to the acoustical enclosure surface.

*(OPTIONAL)*

* + 1. PRESSURE SWITCH

Each blower shall have a NEMA \_\_\_ (indoor: 1, outdoor: 4) high discharge pressure switch.

*(OPTIONAL)*

* + 1. FILTER DIFFERENTIAL VACUUM SWITCH

Each filter shall have a NEMA \_\_\_ (indoor: 1, outdoor: 4) differential vacuum switch factory preset at 20" WC vacuum.

*(OPTIONAL)*

* + 1. VFD CONTROL PANEL

Each blower system shall have a factory-mounted and wired NEMA 3R control panel. Each panel shall have NEMA rated components (constant torque variable frequency drive, circuit breaker with interlocking door handle, 3-leg motor overload protection, 120 volt control transformer, door mounted overload reset pushbutton, door mounted run indicating light, door mounted HOA selector switch, terminals for field connection and power/control for the enclosure cooling fan).

*(OPTIONAL)*

* + 1. REPLACEMENT PARTS

Each blower shall be furnished with the following spare parts:

One spare filter element

Synthetic Lubricants for \_\_\_\_\_\_ (start-up, 6 months, 1 year)

* 1. COATINGS

All equipment shall be cleaned to SSPC-SP 3 and receive a 2-3 mil DFT shop coat of phenolic alkyd, zinc-chromate, red iron oxide, rust inhibitive universal primer. The blower systems shall then receive a finish coat of Coronado Alkyd Enamel, 139 series, 50% gloss, high temperature paint. The coat shall be 2-3 mil DFT.

* 1. MANUALS

One operation and maintenance manual shall be provided for each size of blower.

**PART 3.00 EXECUTION**

1. **ERECTION/INSTALLATION APPLICATION**
	1. The following points must be followed to ensure an adequate installation:
		1. The blower pad must be located on the equivalent of compacted soil substructure, which will allow the pad to remain flat, rigid, and free of resonant frequencies within the operating range of the equipment.
		2. The blower must be anchored using bolts intended specifically for dynamic loading.
		3. The unit must be installed and leveled per the manufacturer’s instructions supplied in the O&M manual.
2. **START-UP AND TESTING**
	1. The blower system supplier shall provide the services of a factory trained technician to check installation, verify proper operation and train the owner’s personnel in proper maintenance procedures. Start-up services shall be a minimum of one day.

*(OPTIONAL)*

* 1. A PTC-9 slip test report shall be supplied for each size of blower.