SECTION 11081
BLOWER, HIGH SPEED TURBO

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Bid Documents, including Special Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Furnish, install, startup and test the following:
   1. Four (4) high speed turbo blowers (300-BL-11, 300-BL-12, 300-BL-13, and 300-BL-14) in sound attenuation enclosures to provide the required quantity of air to the secondary treatment systems of Plants No. 1, 2, 3, and 4. The blowers shall operate at the conditions specified in Tables 1 and 2 on this Section.
   2. A local control panel integrated into each blower enclosure, consisting of a disconnect switch, variable frequency drive or inverter, PLC based control system, alarms, indicator lights, push-buttons, and related controls. In lieu of a PLC based control system a microprocessor installed in each blower that works with a PLC based master control panel may be used. If a microprocessor controller is used, provide a spare pre-loaded controller in lieu of program software backup.
   3. A master control panel and an aeration control package as described in Section 11610 "Aeration Basin Air Flow Control System."
   4. The blowers, accessories, and controls shall be complete and operable. Blowers and accessories shall include the following:
      a. High speed turbo blower with direct connected drive motor.
      b. Inlet filter.
      c. Inlet and discharge silencer.
      d. Discharge check valve.
      e. Blow-off valve.
      f. Blow-off silencer.
      g. Flexible connectors.
      h. Butterfly outlet valves.
      i. Local control panels (LCP).
      j. Master control panel (MCP).
      k. Instrumentation and electrical control system.
         1) Variable frequency drive or inverter to vary the speed of the blower motor.
         2) Pressure, temperature, vibration and flow monitoring devices.
      l. Accessories, consisting of gauges, anchor bolts, and related items necessary for a complete and operable system.
      m. Sound attenuation enclosure.
      n. Installation assistance, equipment startup, performance testing, and placing in service.
      o. Training of OWNER'S Personnel.
   5. Refer to P&ID's, Drawings, and Division 17 Sections regarding the control logic and description for additional equipment monitoring and control information as applicable.
   6. The blowers will be located in the existing blower building as shown on the drawings.

1.3 REFERENCES

A. References: Following is a list of standards, which might be referenced in this Section:
   1. ASME International (ASME):
      a. PTC-10 Performance Test Code on Compressors and Exhausters
      b. PTC-19.2 Pressure Measurement
      c. PTC-19.3 Temperature Measurement

d. PTC-19.5 Flow Measurement

2. Institute of Electrical and Electronics Engineers, Inc.(IEEE):
   a. 519 – Recommended Practices and Requirements for Harmonic Control in Electrical Power systems
3. National Electrical Manufacturer's Association (NEMA): MG-1, Motors and Generators.
4. National Fire Protection Association (NFPA): NFPA 70, National Electric Code.

1.4 PERFORMANCE REQUIREMENTS

A. Performance Requirements:
   1. Operation:
      a. All equipment, including controls and drives specified herein, shall be specifically designed for the service and the environment to be encountered.
      b. The turbo blowers will be connected to an existing air header that supplies air to the secondary treatment systems of Plants No. 1, 2, 3 and 4. The turbo blowers will operate in parallel
      c. Designed and capable of either continuous or intermittent operation of up to 6 times per hour.
      d. Operate without surge, vibration, hunting, abnormal noise, or excessive heat throughout the entire range of operating conditions. PLC or microprocessor must have the capability to dynamically adjust the blowers speed to prevent these possible conditions.
      e. Blower's head-capacity curve shall slope downward continuously (but not necessarily at the same slope) with increasing capacity and decreasing head.
      f. Blowers with curves that reflect two possible capacities for a given pressure (head) will not be acceptable.
      g. Conditions specified herein shall be defined in ASME PTC-10 with pressures and temperatures specified herein refer to stagnation conditions. Inlet conditions are defined as the conditions that exist at the inlet flange of the blower or the discharge cone.
      h. Blower shall be designed to handle filtered air for the rated conditions listed in Tables 1 and 2.
   ~~2. Operation in conjunction with several existing blowers in parallel shall be possible without special requirements. The condition of several units running in parallel with different air flow settings shall be met and the safety margin between delivery pressure and surge pressure shall be maintained at the same value for each machine operating in parallel.~~
   2. Blower manufacturer shall inform CONTRACTOR regarding any additional requirements, such as piping changes, external wiring and conduit requirements, and related work required, from that shown on the Drawings. All changes shall be accomplished at no change in the Contract project.

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Table 1 Blower Operating Conditions	
Parameter	**Value**
Environmental Conditions	
Barometric Pressure	14.37
Relative Humidity, Maximum	100%
Inlet/Ambient Temperature, Maximum	110°F
Inlet/Ambient Temperature, Minimum	0°F
Site Elevation, Feet	636.0
Ambient Temperature Control	None; blower equipment will be exposed to ambient temperature.
Design Conditions	
Initial Pressure Loss, Clean Inlet Filter Silencer	½" W.C.
Design Discharge Pressure without Inlet Filter Pressure Loss.	7.4 psig
Blower Turndown from Rated Maximum Flow	40%
Maximum Discharge Air Temperature	210°F
Blower Assemblies No. 1,2 and 3:	
Mark	~~300-BL-11~~ 300-BL-11 (future), 300-BL-12, and 300-BL-13
Quantity	~~1~~ 2
Location	Blower Building
Capacity at Full Speed and Design Discharge Pressure	1,105 scfm
Capacity at Maximum Turndown and Design Discharge Pressure	663 scfm
Motor, hp, Minimum (1)	50
Wire-to-Air Power Efficiency at Design Condition, Minimum (2) Wire-to-Air Power at Design Condition, Maximum	64% 41.7 kW

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Table 2
Blower Operating Conditions
(continued)

Parameter	Value
Blower Assembly No. 4:	
Mark	300-BL-14
Quantity	1
Location	Blower Building
Capacity at Full Speed and Design Discharge Pressure	560 scfm
Capacity at Maximum Turndown and Design Discharge Pressure	336 scfm
Motor, hp, Maximum(1)	30
Wire-to-Air Power Efficiency at Design Condition, Minimum (2) Wire-to-Air Power at Design Condition, Maximum	58.5% 22.6 kW

Notes:
(1) Motor shall be non-overloading at the minimum and maximum ambient temperatures at all points.
(2) Wire kW efficiency of the blower unit, including the blower, motor efficiency, intake filter, VFD or inverter, and cooling system, shall not be less than specified as measured by factory test in accordance with ASME PT-10.

B. Noise Requirement: After reaching operational speed, noise emission from the blower system shall not exceed 85 dBA at a distance of five (5) feet from the equipment in any direction.

C. Structural Performance: All equipment, supports, anchors and fasteners shall be of adequate strength to withstand loads associated with starting, turbulence, thrusts, thermal expansion and contraction, and other loads encountered under normal operating conditions.

D. The equipment, sizes, materials, and arrangements described are based on recommendations by equipment manufacturers and shall be considered minimum limits of acceptability. The equipment manufacturer shall be responsible for design, arrangement, and performance of all equipment supplied under this Section. Arrangements other than those shown on Drawings shall be subject to the ENGINEER'S approval.

1.5 SUBMITTALS

A. Product Data: Provide construction details, material descriptions, dimensions of individual components and profiles, rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: Provide plans, elevations, sections, details, and attachments to other work.
1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Specific design parameters for this project as specified herein.
3. Layout, sizes, types and materials of construction for equipment to be furnished.
4. Power Guarantee: Submit guaranteed wire to air kW values in accordance with Tables 1 and 2.
5. Preliminary ASME PTC-10 Test. Submit results of past performance testing to certify that the proposed model and size has been previously tested in accordance with ASME PTC-10. Failure to meet this requirement will result in immediate rejection.
6. Provide performance curves indicating speed, capacity, horsepower, input KW, and efficiency, over the range of operation.

7. Wiring Diagrams: For power, signal, and control wiring diagrams, including terminals and numbers.
8. Complete motor nameplate data, as defined by NEMA, motor manufacturer, and in accordance with the motor specification section.
9. Equipment weights and lifting points.
10. Warranties and service agreements.

C. Operation and Maintenance Data: Provide in accordance with Division 1 Section 01300 "Project Documentation."

D. Information Submittals:
1. Manufacturer's Certification of Compliance.
2. Special shipping, storage and protection, and handling instructions.
3. Manufacturer's instructions for installation.
4. Manufacturer's Certificate of Proper Installation.
5. Qualification Data: For manufacturer and manufacturer's representative, if applicable.
6. Location of nearest stocking distributor of spare parts.
7. Suggested spare parts list to maintain the equipment in service for a period of five years. Include a list of special tools required for checking, testing, parts replacement, and maintenance with current pricing information.
8. Factory Test Reports: Based on evaluation of comprehensive tests performed by manufacture and witness by manufacturer's quality control person.
9. Source quality-control reports.
10. Field quality-control reports.
11. Warranty: Sample of special warranty.

E. Software and Firmware Operational Documentation:
1. Software operating and upgrade manuals.
2. Program Software Backup: On magnetic media or compact disk, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications:
1. All equipment shall be the product of a manufacturer having at least twenty (20) U.S. installations of the type being proposed, with a minimum of five (5) years of satisfactory service.
2. Testing and manufacturing facility located in North America.
3. A list of similar installations shall be furnished with the shop drawing submittal, including names and telephone numbers of contacts.
4. Certified to ISO 9001 by an accredited certification agency.

B. Manufacturer's Representative: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

C. Source Limitations: Equipment units of each type specified in this section shall be supplied by a single manufacturer. This does not require that all equipment be manufactured by a single manufacturer, but does require that the manufacturer of the system shall be responsible for the complete system.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver, handle and store equipment components in accordance with shop drawings, manufacturer's written instructions, and the requirements within Division 1 Section 01300 "Project Documentation."

B. The motor space heaters shall be connected and energized by the Contractor upon receipt of the blower assembly at the jobsite.

1.8 PROJECT CONDITIONS

A. System Arrangement:
   1. The equipment, sizes, materials, and arrangements described in this Specification section are typically based on recommendations by equipment manufacturers and shall be considered minimum limits of acceptability. The equipment MANUFACTURER shall be responsible for design, arrangement, and performance of all equipment supplied under this section.
   2. Modifications to structural design due to a manufacturer's varying space requirements, foundation requirements, floor slope requirements, or dimension changes to fit manufacturer specific requirements shall be coordinated by CONTRACTOR and included in the Bid.
   3. The CONTRACTOR shall be responsible for any modifications to the piping, electrical, structural, and mechanical layouts to accommodate, as well reimbursement to OWNER for additional charges by ENGINEER for additional work required accomplishing changes.

B. Environmental Conditions:
   1. When installed in wastewater treatment areas, the environment could be moist, and corrosive, exhibiting hydrogen sulfide and other corrosive gases encountered in municipal wastewater treatment plants.
   2. Designed and capable of operation at the operating conditions listed in Tables 1 and 2.
   3. If specific blower manufacturer requires a maximum operating temperature lower than that specified, then that blower manufacturer shall provide additional HVAC improvements to be included in their blower package to maintain their required maximum operating temperature.
   4. Furnish heat tracing and insulation as required, if required for exterior installation. Insulation alone shall not be sufficient to fulfill freeze protection provisions of this section.

C. Field Measurements, Existing Facility Installation: Verify actual dimensions of openings, adjacent facilities and equipment, utilities and related items by field measurements before fabrication as applicable.

1.9 WARRANTY

A. Special Equipment Warranty: Refer to Specification 01500 "Contract Warranties", Part 1.6, C, for Special Equipment Warranty requirements as modified below.

B. Warranty Period for Special Equipment Warranty:
   1. The warranty period shall be interpreted as the 5-year (60 months) period following the final acceptance of the installed equipment by the OWNER and shall be exclusive of the time of use of the equipment in installation, testing, adjusting, etc., during the construction period, or of the time in storage, after delivery and prior to installation. Provisional acceptance of the equipment shall not affect the determination of the period of service. All equipment shall be operated for a minimum continuous successful 30-day start-up period before final acceptance and before the start of the 24-month warranty period.
   2. For the first 10 years following final acceptance, all parts shall be available for shipment within 24 hours or the parts are free of charge from the manufacturer.

1.10 EXTRA MATERIALS

A. Furnish spare parts, packed in sturdy containers with clear, indelible identification markings, which shall be stored in a dry, warm location until transferred to the OWNER at the conclusion of the project.

B. Provide the following spare parts:
   1. Spare parts shall include, but not be limited to:
      a. Four (4) air filters per blower size.
   2. Special tools necessary to maintain the equipment.
   3. Other parts recommended by the manufacturer as typically needed in the first two (2) years of operation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers and products.
   ~~1. ABS, Inc. HST Series Turbo Blower~~
   ~~2. Neuros, Inc. NX/VX Series Turbo Blower~~
   ~~3. Aerzen USA Corporation, TB Series Turbo Blower~~
   1. APG Neuros, Inc. NX/VX Series Turbo Blower
   2. Aerzen USA Corporation, TB Series Turbo Blower
   3. Lone Star Blower, TurboMax Blower

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2.2 BLOWER

A. General Description: Blower shall be either air-foil or magnetic bearing type turbo blower; not requiring oils or lubricants for operation; and capable of variable speed and output selection.

B. Components:
   1. Casing Design:
      a. Maximum continuous duty design temperature of 400^0 F.
      b. Design pressure of 50 psig.
   2. Impellers:
      a. Type: Backswept three dimensional high efficiency configuration.
      b. Material: Forged or cast aluminum alloy.
      c. First Lateral Critical Speed: At least 120 percent of maximum operating speed.
      d. Mounting: Directly to motor shaft and statically and dynamically balanced. Axial gap between impeller and casing shall be adjusted by shims.
   3. Bearings: Designed for a minimum of 20,000 on/off cycles.

2.3 MOTORS

A. Each blower shall be equipped with a 460 volt, 60 Hz, 3 phase, induction type synchronous motor or permanent magnet.

B. Refer to Tables 1 and 2 for minimum motor horsepower.

C. The blower manufacturer shall be responsible for the coordination of the starting torque requirement of the blower and the motor.

D. The motor shall be capable of operation at the rated voltage with a variance of +/- 5 percent of the nameplate frequency.

E. The motor shall be capable of continuous operation at full load and rated frequency with a voltage variance of +/- 10 percent of the nameplate voltage.

F. Motor Accessories:
   1. The cabinet shall have internal 120 volt, single phase, suitably sized space heaters (if required) connected to a motor mounted terminal box.
   2. The winding shall be provided with one embedded RTD in the motor core for remote temperature sensing and alarm. RTDs shall be 100 ohm, platinum, of the 3-wire type with transmitters for interfacing with the PLC.

3. Motor shall be rated for VFD operation.

2.4 INSTRUMENTATION AND CONTROL

A. General: Refer to Division 11 Section 11009 "Common Control Panel Requirements for Equipment" for general instrumentation and control requirements. All instrumentation, control and electrical components provided under this section shall comply with the requirements on the Drawings and Division 11, 16 and 17 Sections.

B. Panels:

Panel	Material	NEMA Rating	Name	Power Supply
300-MCP-11	316 SST	4X	Master Blower Control Panel	Notes 1,2

Note 1: Power Supply: ~~460 V, 3-Phase, 60 Hz or~~ 120 V, Single-Phase, 60 Hz when the manufacturer provides a control power transformer.
Note 2: Refer to Division 17 Section 11610 "Aeration Basin Air Flow Control System" for Master Control Panel requirements.

C. Controls: Provide control system for equipment system, but not limited to, for monitoring the following instruments and controls. This list is not intended to completely depict all of the functional requirements of the control system provided under this Section. The system supplier shall provide all additional instrumentation and controls necessary to produce a safe and operable system. 4

1. Controls mounted on panel face.
2. ~~Controls shall be mounted in a NEMA 4X stainless steel cabinet, coated with a white powder coating.~~
2. Controls shall be mounted in a NEMA 4X 316 stainless steel cabinet, or NEMA 4X 304 stainless steel coated with a white powder coating.
3. UL/ULC/TUV certified, with certification label shown on nameplate, at point of manufacturing.

D. Local Control Panel:

1. PLC Based Control System: All controls, alarms, monitoring, and related blower control functions shall be accomplished by a touch screen PLC based control system integrated into the blower controller. Provide the following minimum controls for each blower.
   a. HAND/OFF/AUTOMATIC.
      1) AUTO allows the unit to be started, stopped, or speed adjusted from the SCADA or remote control system.
      2) HAND and AUTO settings will utilize the speed signal (4-20 mA) from the VFD.
   b. RUN, ALARM, and OFF indicating lights.
   c. ALARM reset.
   d. Inlet air temperature sensor.
   e. Inlet air temperature transmitter 4-20 mA.
   f. Inlet air filter differential pressure switches:
   g. Measure differential pressure across the air filter.
   h. Set switch at 10.0 in of water column (alarm)
   i. Inlet Pressure transmitter 4-20 mA
   j. Discharge Temperature transmitter 4-20 mA
   k. Bearing temperature sensor
   l. Vibration sensor
   m. Discharge air pressure gauge.
   n. Discharge air pressure transmitter.

o. Differential pressure (inlet/discharge) transmitter 4-20 mA.

2. RTD Monitoring System:
   a. A high temperature (as determined by the blower manufacturer) shuts down the blower and gives an alarm. The PLC shall receive the alarm and the operator interface shall graphically display the RTO signals.
   b. The alarm/shutdown shall be displayed until reset.
   c. Provide necessary hardware for direct communication between RTD's, PLC, and Operator Interface.
3. Local Control Panel interface with Master Control Panel and SCADA system:
   a. Port shall be configured and tested at the factory prior to shipment to the site, with a memory map of the blower PLC data provided.
   b. Manufacturer shall assist in the coordination and field testing of the data link between the Local Control Panels, Master Control Panel and the plant SCADA system.
4. Provide the following discrete outputs:
   a. Operation status of equipment.
   b. Pressure, temperature, flow, and other parameters.
5. Provide the following discrete inputs:
   a. Operation control of equipment.

E. Local Control Panel shall also include all required transformers, controls, starters, breakers, variable frequency drives or inverters, and related electrical components required for electric motors and blower controls.

F. Variable Frequency Drive:
1. Comply with the requirements of Division 16 Section 16269 "Variable Frequency Drives."
2. Manufacturer:
   a. As listed in the above section.
   b. In addition, a drive that is integral to the blower package. This drive shall meet the requirements of harmonics, temperature and ratings as specified in Division 6 Section 16269 "Variable Frequency Drives."
3. Demonstrated full factory support for US market and have been established in market for 10 years.
4. Shall be selected and sized for proper operation with blower motor.
5. All adjustments and settings shall be performed by the manufacturer.

G. Master Control Panel:
1. Provide programmable logic control based control logic, input/output (I/O) devices, and data communications capability.
2. Provide data communications, control logic integration, and coordination for all blower local control panels.
3. Provide local control and alarming for shared system parameters.
4. Contain controls to send flow signal to local control panels to adjust the speed of the motors and modulate the air control valves based on readings from instrument to control the air flow.
5. Provide touch screen PLC based control system and Ethernet communication between the control panels.
6. Refer to Specification Section 11009 for Control Panel requirements.

2.5 SOUND ATTENUATION ENCLOSURE

A. Design Requirements:
1. UL/ULC certified standard sound attenuation enclosure covering the entire blower package.
2. Joint Construction: A bolted UL approved enclosure.
   a. Painted steel, 16-gauge sheet metal.

b. Enclosure skid shall be heavy duty steel I-beam construction with fork lift access ports.
c. Panel Insulation:
   1) Acoustical/thermal insulating material that is noncombustible, inert, mildew-resistant, and vermin-proof. Insulation shall not settle within the enclosure panel.
   2) Fire Rating: Flame spread greater than 25 or a smoke developed greater than 50 in accordance with ASTM E-85, Class 1; per ASTM E-162 and ASTM E-662.
d. Sound level shall be less than 85 dBa at 3 feet from the blower enclosure.

2.6 FINISHES

A. Select the finish coating for the equipment based on location, substrate, and environment. Refer to Division 9 Section 09910 "Painting and Protective Coatings" and Coating System Schedule for information.
   1. Provide polyurethane, pigmented over epoxy zinc rich primer and high build epoxy.

B. Clean all stainless steel surfaces and provide glass bead blast or chemically treat all external non-wetted stainless steel to a uniform finish.

C. Machined, polished, and non-ferrous surfaces shall be coated with a corrosion prevention compound.

2.7 ACCESSORIES

Each blower shall be provided with the following accessories:

A. Process Inlet Filter:
   1. Filter silencer housings shall be single-stage, cartridge-style w/ removable weather hoods, suitable for indoor or outdoor service.
   2. Filter silencer outlet shall fit directly to the blower inlet piping or connection without the requirement of reducers or transitions to eliminate dirt by pass of filter due to cabinet framing and seam failure.
   3. Filter silencer housing metal parts shall be polyester powder coated interior and exterior (no liquid or oil-based paint).
   4. Filter silencers total head loss, filter housing + filter element, shall not exceed 2" WG max initial @ specification rated air flow when measured at the filter silencer outlet
   5. Filter silencer pressure loss rating shall include total restriction, including losses induced by filter housing and filter elements
   6. Filter elements shall be a single-stage, cartridge-style, and disposable
   7. Filter element face velocity shall not exceed 75 fpm at rated flow
   8. Filter medium shall be synthetic, and not less than 98% efficient @ 10-micron (nominal
   9. Filter element final differential pressure/resistance shall be rated not less than 10" WG
   10. Filter element changes shall not require hand tools
   11. Filter element and Filter Hoods combined weight shall not exceed 50 lbs
   12. Filter silencer shall be Endustra Tri-Vent® Series P09 or equal

B. Flexible Connector:
   1. Provide EPDM discharge expansion joint capable of withstanding the vacuum, pressure, and temperature under all operating conditions.
   2. Provide control rods and carbon steel flanges drilled for ASME / ANSI B16.5, Class 150 bolt pattern.

C. Blow-Off Valve:
   1. Provide self powered, either electric actuated or pneumatic actuated blow off valve to allow unloaded start-up and stop.

2. Powered by the single point electrical supply or powered pneumatically by the discharge pressure of the compressor. No external power shall be required for the operation of the valve.
3. Blow off valve shall be integral to the packaged compressor as a self contained unit.

D. Discharge Cone (if required by Turbo Blower Manufacturer's Equipment Design):
1. Provide a flanged discharge cone, constructed from carbon steel and having a minimum outlet size as the connecting air pipe shown in the Drawing. The discharge cone shall have a flanged side-out for direct bolting to the blow-off valve.

E. Discharge Butterfly Valve:
1. Provide a flanged, resilient seated butterfly valve, with a chain-wheel operated gear actuator for each blower, having cast iron body and 316 stainless steel disc, Type 416 stainless steel shaft, wing-thru seat design, graphite bronze bearing, graphite Teflon packing, and designed for temperatures up to 300°F. Alternatively, a split disc thpe check valve with EPDM seat may be supplied, provided that the EPDM is rate for 400 degrees Fahrenheit.
2. Chain-wheel operator assembly consists of ductile iron gear-box, alloy steel worm gear and ductile iron quadrant gear, with adjustable stops and chain.
3. Acceptable manufacturers are DeZurik, M&H and Valmatic.

F. Check Valve:
1. Provide a wafer type discharge check valve of the dual, flat plate type with center hinge, spring closure, cast iron body, Viton B seals, and Type 316 stainless steel plates, stainless steel springs and trims.
2. Rated for temperatures up to 400 degrees Fahrenheit.
3. Provide flat surfaces with resilient seat facing on the body.
4. Suitable for installation in the horizontal or vertical position as indicated on the drawings.
5. Acceptable manufacturers are DeZurik, M&H and Valmatic.

G. Blow-Off Valve Silencer:
1. Provide a carbon steel blow off silencer as an integral unit, fitted with a flange for direct bolting to the blow-off valve.
2. Silencer sound attenuation shall not be less than 20 dB.

H. Miscellaneous:
1. Equipment Identification Plates: A 16-gauge stainless steel identification plate shall be securely mounted on the equipment in a readily visible location. The plate shall bear 1/4-inch die-stamped equipment identification number indicated in this Section and/or on the Drawings.
2. Lifting Lugs: Individual equipment and/or each field disassemble part weighing over 100 pounds shall be provided with lifting lugs.
3. Anchor Bolts: Provide template and Type 316 stainless steel anchors.

2.8 SOURCE QUALITY CONTROL

A. Testing and inspection of the factory assembled equipment shall be accomplished by manufacturer prior to shipment. The entire blower system and control panel shall be tested as an operation system for a minimum of four (4) hours at the factory.

B. Blower assembly performance test shall be in accordance with ASME PTC-10, modified to permit zero tolerance for power.
1. Test equipment shall be calibrated and certified by an independent test agency no more than 12 months prior to the test date. Certificates shall show the stability of calibration over a period of at least one year per ISO 9001.
2. The capacity of the blower shall be defined as per ASME PTC 10. Air flow shall be measured on the discharge side of the compressor at 4 percent tolerance.

3. Calibrated wattmeter shall measure the electrical shaft power to the blower system. Measured power shall include wire to air; all losses associated with electrical shaft power, including but not limited to the motor, inverter, job filter and cooling system.
4. Net delivered flow rate and discharge pressure shall be guaranteed with no negative tolerance.

C. Test Report:
1. Present computations in exact accordance with ASME PTC-10, with performance curves showing capacity, pressure, and horsepower inputs for each of the flow and pressure conditions guaranteed.
2. Test results of the motors and blowers shall be included in the Operation and Maintenance Manual.

D. Upon satisfactory completion of testing, the units will be disassembled into subcomponent assemblies for shipment and installation. At the manufacturer's option, the units may also be shipped to the site as complete units, providing said units can be installed as a complete assembly.

E. All control panels shall be factory tested under simulated operating conditions verifying all devices function.

F. Complete factory performance assurance testing shall be required prior to shipment.

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

A. Functional Tests: Prior to plant startup, the CONTRACTOR, with the assistance of the manufacturer's representative, shall inspect all equipment for proper assembly and alignment, quiet operation, and proper operation.

B. Performance Test: The manufacturer's representative shall conduct performance tests on the equipment to certify compliance with the performance requirements.
1. Place each piece of equipment in the system in operation until the entire system is functioning. All components shall continue to operate without alarms or shut downs, except as intended, for eight consecutive hours to be considered ready for facility startup.
2. Operate the equipment through the design performance range consistent with available flows. Adjust, balance, and calibrate and verify that the equipment, safety devices, controls, and process system operate within the design conditions. Each safety device shall be tested for proper setting and signal. Response shall be checked for each equipment item and alarm. Simulation signals may be used to check equipment and alarm responses.

C. Noise Test: Sound level measurement shall be made at a distance of five (5) feet from the equipment and shall not exceed specified limits.

D. A copy of all information from functional tests, including data, worksheets, and other materials shall be turned over to the OWNER at the completion of the testing program.

3.2 MANUFACTURERS' CERTIFICATES

A. Provide equipment manufacturer's Certificate of Installation stating that the equipment is installed per the manufacturer's recommendations and in accordance with the Drawings and Specifications.

B. Provide equipment manufacturer's Certificate of Performance stating that the equipment meets or exceeds the performance requirements as defined hereinbefore.

3.3 MANUFACTURER'S SERVICES

A. Manufacturer's Representative: Present at Project site or classroom designated by OWNER, for minimum person-days listed below, travel time excluded:

No. Person Days	Work Description
1	Installation assistance and inspection.
1	Functional and performance testing.
½	Pre-startup classroom or site training.
1	Facility startup.
1/2	Post-startup training of OWNER'S personnel.

B. Services Provided:
1. Furnish test forms and procedures for field testing.
2. Furnish startup services.
3. Furnish training of OWNER'S personnel at such times requested by OWNER.

C. Manufacturer's services and training shall comply with the requirements of Division 1 Section 01600 "Startup, Testing, Commissioning and Training."

3.4 FACILITY STARTUP

A. Startup of the facility shall be in accordance with Division 1 Section 01600 "Startup, Testing, Commissioning and Training." After initial startup under the supervision of a qualified representative of the manufacturer, a preliminary "running-in" period will be provided for the CONTRACTOR, per the Contract Documents, to make field tests and necessary adjustments.

B. Place each piece of equipment in the system in operation until the entire system is functioning. All components shall continue to operate without alarms or shut downs, except as intended, for thirty (30) consecutive days to be considered started up.

C. Operate the equipment through the design performance range consistent with available flows. Adjust, balance, and calibrate and verify that the equipment, safety devices, controls, and process system operate within the design conditions. Each safety device shall be tested for proper setting and signal. Response shall be checked for each equipment item and alarm. Simulation signals may be used to check equipment and alarm responses.

D. Prepare manufacturer's installation report and submit within 30 days after completion of field testing. Including the following information:
1. Field testing results.
2. Descriptions of installation deficiencies not resolved to the manufacturer's satisfaction.
3. Description of problems or potential problems.
4. Names of the OWNER'S personnel who attended operations and maintenance training sessions.
5. Record copy of materials used for training session including outlined summary of course.
6. Manufacturer's Certificate of Installation and Certificate of Performance.

E. At the end of the specified period of operation, the equipment system will be accepted if, in the opinion of the ENGINEER, the system has operated satisfactorily without excessive power input, wear, lubrication, or undue attention required for this operation, and if all rotating parts operate without excessive vibration or noise and the desired performance has been obtained.

END OF SECTION