SECTION 11XXX

COMPRESSED GAS MIXING SYSTEM

PART 1 - GENERAL

1.01 SCOPE. This section covers the furnishing of a compressed gas mixing system for the ***(Note to Specifier:*** (Insert Treatment Process) including compressors, control panels, header piping, nozzles, auxiliary equipment and accessories as specified herein.

1.02 DESCRIPTION. The system shall intermittently and sequentially inject compressed air through fixed nozzles located on the basin floor to create large bubbles which effectively mix the basin contents with negligible oxygen transfer from the mixing system to the bulk liquid.

1.03 REFERENCES.

A. ASTM International (ASTM)

1. A240/A240M, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and General Applications.

2. A276, Standard Specification for Stainless Steel Bars and Shapes.

3. A312, Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipe

4. A380, Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems

1.04 DEFINITIONS.

A. Basin: The structure within which mixing occurs; i.e., Anoxic/Swing Zones.

B. Header Supply Pipe: Piping between a valve panel and respective nozzle headers.

C. Nozzle Header: Continuous (i.e., not branched) horizontal piping with nozzle offsets, with single inlet connection to header supply pipe and outlet offset connections to nozzles.

D. Nozzle Offset: Piping branching off nozzle header trunk piping and which connects to nozzles.

E. Nozzle: Floor-anchored, large bubble-emitting device.

F. Standard Cubic Feet per Minute (scfm): Air at 68° F, 14.7 psia, and 0 percent relative humidity as defined by the Compressed Air & Gas Institute.

G. Actual Cubic Feet per Minute (acfm): Terminology to quantify volume of air at the standardized reference condition (ISO 1217) delivered to the terminal point of the compressor package.

H. Valve Panel (VP): Control panel that controls the firing of integral solenoid valves, which intermittently emit compressed air bursts to the respective header supply pipes.

I. Master Control Panel (MCP): Single control panel that controls the firing of solenoids valves in one or more remote VPs.

1.05 SUBMITTALS.

A. The following items shall be submitted with the Shop Drawings:

1. Catalog data or illustrations showing principal parts and materials.

2. Detailed layout drawings.

3. Electrical schematics.

4. Test or performance data that the system does not contribute measureable oxygen into the process stream.

5. Operating and maintenance instructions and parts list

6. Compressor support locations and loads transmitted to bases and foundations.

7. Compressor electrical schematics and field termination wiring.

8. List of recommended spare parts other than those specified.

9. Field inspection reports.

10. Qualifications of field service engineer.

11. Recommendations for short and long-term storage.

12. Testing procedures.

13. Special tool requirements.

14. Full scale test results from a minimum of four (4) U.S. installations demonstrating that the Compressed Gas Mixing System achieved homogeneous mixing as substantiated through statistical analysis of Total Suspended Solids (TSS) samples yielding a Coefficient of Variation (Cv) of 10% or less.

15. Installation reference list including a minimum of five (5) Compressed Gas Mixing Installations for which the Supplier furnished and integrated the complete Compressed Gas Mixing System, including at a minimum Nozzles, In-Basin Piping, Valve Panels and Compressor. Provide Facility Name/Location, Design Average Daily Flow, Contact Name/Telephone Number and Start-Up Date for each installation.

1.06 WARRANTY.

A. The Compressed Gas Mixing Manufacturer shall guarantee the equipment against defects in materials and workmanship under normal use and service, to the original

purchaser, for a period of twelve (12) months from date of equipment startup by an authorized technician or eighteen (18) months from date of equipment shipment, whichever is the lesser.

B. ***(Specifier Note: Optional Text)*** The airend of the compressor packages will be specially warranted for a period of thirty-six (36) months from date of compressor startup or forty-two (42) months from date of shipment, whichever is the lesser.

C. Requirements to maintain the compressor warranty are:
   1. Factory Authorized start-up by a representative of the Compressor Manufacturer distributor/factory store.
   2. OEM filters and oil used at the intervals described in the compressor O&M manual.
   3. Oil samples are to be taken and analyzed every 2,000 hours of run-time as defined in compressor O&M manual.
   4. Maintenance in accordance with compressor manufacturer's operating and maintenance instruction.

1.07 QUALITY ASSURANCE.

A. The compressed gas mixing system shall be furnished by a single manufacturer who is fully experienced, reputable and qualified in the manufacture of the equipment to be furnished. The equipment shall be designed, constructed, and installed in accordance with the best practices and methods and shall be as manufactured by EnviroMix, Inc. of Charleston, SC, no exceptions. The Contractor shall obtain the nozzles, nozzle headers, header supply piping, panels, compressors and appurtenances from the mixing system manufacturer, as a complete and integrated package to insure proper coordination and compatibility and operation of the system.

B. Alternate Manufacturer's wishing to offer their equipment must submit the following information to the Engineer in a Pre-Qualification Package within fourteen (14) days prior to the published date of Bid Closing. Engineer will evaluate information and if in the Engineer's sole discretion, the Alternate Manufacturer's proposed compressed gas mixing system meets the specification, performance and offers equal quality and experience to the basis of design, the Alternate Manufacturer will be added to the compressed gas mixing specification via addendum.

   1. A complete set of drawings, specifications, catalogue cut sheets, and detailed descriptive material of proposed major equipment items. This information shall identify all technical and performance requirements stipulated on each drawing and in each specification section.

   2. Full scale test results from a minimum of two (2) U.S. installations demonstrating that the Compressed Gas Mixing System achieved homogeneous mixing as substantiated through statistical analysis of Total Suspended Solids (TSS) samples yielding a Coefficient of Variation (Cv) of 10% or less.

   3. Test or performance data that the Compressed Gas Mixing System does not contribute measureable oxygen into the process stream.

4. Full scale test results from a minimum of two (2) U.S. installations demonstrating that the Compressed Gas Mixing System does not negatively impact biological nitrogen and/or phosphorus removal.

5. Written confirmation from Authorized Officer of the Company that the proposed compressed gas mixing system includes complete Unit Responsibility with all components specified in Section 11XXX – Compressed Gas Mixing System as well as the specified Field Performance Testing and Guarantee.

6. Installation reference list including a minimum of five (5) Compressed Gas Mixing Installations for which the Supplier furnished and integrated the complete compressed gas mixing system, including at a minimum nozzles, in-basin piping, valve panels and compressor. Provide Facility Name/Location, Design Average Daily Flow, Contact Name/Telephone Number and Start-Up Date for each installation.

7. List of recommended spare parts.

8. Information on equipment field installation requirements.

9. A maintenance schedule with projected labor hours showing the required maintenance, frequency of maintenance, lubricants and other items required at each regular preventative maintenance period.

10. Reviewed specification with each paragraph marked noting full compliance and detailed written documentation with discussion of all deviations from the specification.

PART 2 - PRODUCTS

2.01 PERFORMANCE AND DESIGN REQUIREMENTS. Performance and design requirements shall be as follows:

Basin Mixing shall be uniform throughout the basin with effective mixing confirmed through a Field Performance Test as specified.

Air Distribution and balancing shall be sufficient to maintain suspended solids in a state of suspension over entire depth of basins. The operator interface shall allow control of firing parameters (sequence, duration, and frequency) to achieve basin mixing.

Firing flow rate shall be manually adjustable via the throttling valve.

Air mixing system equipment and piping shall be sized to thoroughly mix the contents of the basins for which the systems are designed.

A. Treatment Process:

Basin	Zone 1	Zone 2
Basin Geometry		
Basin Dimensions		
Side Water Depth (SWD)		
Number of Basins		
Number of VPs per Basin		

Number of ACVs per VP		
Number of Nozzle Headers		
Number of Nozzles per Nozzle Header		
Minimum Number of Nozzles, Total per Basin		
Header Supply Pipe Dia. (in.)		

2.02 MATERIALS.

A. Header Supply Piping

1. Provide threaded connections only where required.

2. Sch 5S, stainless steel Press technology system (Victaulic, Viega, or equal), comprised of stainless steel Press technology fittings, couplings, and pipe, unless specified otherwise.

3. Maximum working pressure of 200 psi.

4. Couplings and fittings: Press technology products formed of Type 304/304L stainless steel tubing including a self-contained o-ring seal(s) molded of synthetic FKM rubber.

5. Pipe: Type 304/304L ASTM A312 stainless steel.

B. Nozzle Headers

1. Sch 10S, 304/304L stainless steel with 1” Sch 40S, stainless steel nozzle offsets

2. Nozzle couplings: 1” NPT, 150 lb, 304/304L stainless steel

3. Delivered from the Manufacturer pre-assembled to the extent practicable to minimize field assembly error and installation time.

4. Pipe: Type 304/304L ASTM A312 stainless steel.

C. Nozzles

1. Top plate fabricated from 1/8” stainless steel plate, ASTM A240/A240M, Type 304/304L with a 2D finish.

2. Bottom plate fabricated from HDPE and gasketed to prevent air from leaking between the top plate and the bottom plate.

3. Top and bottom nozzle plates shall be joined together using Type 304/304L stainless steel hardware. Nozzles shall come pre-assembled.

4. Adequate strength to withstand vertical thrust of mixing air.

5. Threaded Rod Anchors: Use Hilti HIT-RE 500 adhesive or equal. A minimum of two threaded rods shall be installed per nozzle, one each on opposite diagonal corners.

6. Nozzles shall be installed in the locations as shown on the Drawings.

D. Appurtenances

1. Miscellaneous: Nuts, bolts, washers, threaded rod, and other non-welded parts shall be stainless steel, ASTM A240/A240M, Type 304. Threaded assemblies shall be chemically treated or lubricated prior to assembling to prevent galling.

E. Fabrication

1. The piping used for the air mixing system shall be Type 304/304L stainless steel unless otherwise noted.

2. Shop fabricate welded metal parts and assemblies from stainless steel, ASTM A240/A240M, Type 304/304L with a 2D finish.

3. Shop fabricate non-welded parts and pieces from sheets and plates of stainless steel, ASTM A240/A240M, Type 304 or from bars of stainless steel ASTM A276, Type 304, unless specified otherwise.

4. Welds and Welding Procedure

a. Shop weld with filler wire using MIG, TIG or shield-arc, or plasma-arc welding inert gas processes. Provide a cross-section equal to or greater than parent metal.

b. Provide full penetration welds to interior surface with gas shielding to interior and exterior of joint.

c. Provide smooth, evenly distributed interior weld beads with an interior projection not exceeding 1/16 inch beyond inner diameter of nozzle header or fittings.

d. Field welding is not permitted.

e. Clean all welded stainless steel surfaces and welds after fabrication to remove weld splatter and finish clean all exterior welds, carbon deposits and contaminants per ASTM A380 Section 6.2.11

2.03 CONTROL PANELS.

A. ***(Specifier Note: Choose MCP and NEMA 4X SS vs NEMA 12)*** Master Control Panel (MCP) Enclosure. MCP shall have UL-rated NEMA 12 painted steel enclosure. Control panels shall be sized to provide heat dissipation such that, at a 110 degree F ambient temperature, the operating temperature rating of the lowest-rated component in the panel is not exceeded.

B. Valve Panel (VP) Enclosures. VPs shall have UL-rated NEMA 4X 304 stainless steel enclosures. Control panels shall be sized to provide heat dissipation such that, at a 110 degree F ambient temperature, the operating temperature rating of the lowest-rated component in the panel is not exceeded.

C. ***Specifier Note: Delete if MCP and no remote HMI or indoor)*** VP Hinged Lockable Cover. The VP shall be provided with a hinged lockable cover for the Operator

Interface to protect against sun damage and intrusion damage.

D. Power Connection. All panels shall accept a single source 120 VAC power connection. Lightning and surge protection shall be provided on the incoming line power. Lighting and surge protection shall be Phoenix Contact Mains Plugtrab or equal.

E. ***(Specifier Note: Choose MCP OIT)*** MCP Operator Interface Terminal (OIT). The MCP shall have an OIT to make operating parameter changes and acknowledge alarms. The OIT shall be a Schneider Electric 12.1" color touchscreen. The OIT shall have flash memory capacity, USB port, and Ethernet communication.

F. ***(Specifier Note: or Choose VP OIT)*** VCP Operator Interface Terminal (OIT). The VCP shall have an OIT to make operating parameter changes and acknowledge alarms. The OIT shall be a Schneider Electric 5.7" color touchscreen. The OIT shall have flash memory capacity, USB port, and Ethernet communication.

G. Controller. Each control panel shall be equipped with a controller which controls the sequence, duration, and frequency of ACV openings via relay outputs. The controller shall also provide alarming functionality. The controller shall be equipped with the following features

Rated for Class I, Division 2 Hazardous Areas

10/100 BaseT Ethernet port with Modbus TCP/IP

H. Air Control Valves. The air control valves shall be poppet style valves, mounted to a common manifold. The valves shall have a life expectancy of 20,000,000 cycles. Valves shall vent to the outside of the panel.

I. Throttling Valve. Each VP shall be equipped with a throttling valve to adjust the volume of air released to the ACVs and corresponding header supply piping. The throttling valve shall be pre-plumbed into the VP.

J. ***(Specifier Note: Alternative Text)*** Proportional Pressure Controller. A proportional pressure controller shall be used to automatically adjust the pilot pressure to an air pressure regulator. The Proportional Pressure Controller shall accept a 4-20 mA signal and shall be controlled by the PLC in the control panel.

K. Control Air Filter. Each VP shall include a pre-plumbed 5-micron filter with an auto-drain to remove fine particles, water vapor, and oil from the air supply. The filter shall be Watts F603D or approved equal.

L. Heater. Each control panel located outdoors shall be provided with a 120 VAC heater designed to maintain 40° F in an ambient outside temperature of 20° F. The heater shall be equipped with a thermostat to turn the heater off at temperatures above 40° F.

M. Nameplate. A stainless steel nameplate shall be provided on the control panel. The nameplate shall be securely fastened in a conspicuous place and clearly inscribed with the manufacturer's name, year of manufacture, and serial number.

N. Asset Monitoring System. Each control panel shall have the ability to communicate asset-level detail including valve performance through alerts and notifications;

information including remaining life of the valve, panel faults, and running data.

2.04 CONTROL AND OPERATION.

A. All control features shall be adjustable from the Operator Interface Terminal (OIT) provided by the mixing system manufacturer. Control features shall be adjustable at any time during the operation of the system. Control features shall be initially set according to manufacturer recommendations.

B. Mixing Parameters. Minimum control features shall include the following:

1. Sequence – Menu of preprogrammed operator selectable air control valve firing sequences.

2. Duration – Selection of the length of time the ACV is open during a firing. This value shall be adjustable and have a minimum value of 100 milliseconds and a maximum value of 2,000 milliseconds.

3. Frequency – Selection of the frequency at which each ACV is firing. This value shall be adjustable and have a minimum value of 1,000 milliseconds and a maximum value of 30,000 milliseconds.

4. Valve Status – Enable / Disable functionality of individual valves shall be provided.

C. Startup Modes. The Controller shall enable startup modes that utilize the manufacturer default settings, firing parameters set during the preceding mixing system operation, as well as new settings entered through the OIT.

D. Pressure Alarms. Each VP shall come equipped with a pressure transducer plumbed to the valve manifold. The pressure transducer shall transmit pressure anomalies to the controller. The controller shall interpret the pressures transmitted to provide low system pressure and high system pressure alarms.

E. Valve Failure Alarms. The ACV shall come equipped with a position sensor. The controller shall provide Valve Fail to Open and Valve Fail to Close alarms based on the ACV position.

F. Alarm Annunciation. When either the low system pressure, high system pressure, Valve Fail to Open, Valve Fail to Close alarms occur within a VP a red general alarm light shall be illuminated on the top of the VP. The specific alarm shall be indicated on the Operator Interface Terminal on VP. Each VP shall come equipped with a general FAIL alarm dry contact for remote alarm annunciation. The FAIL alarm dry contact shall close under the same circumstances that the amber general alarm light is illuminated. The FAIL alarm dry contact shall remain closed until the fault is corrected or the system is turned off.

G. Heartbeat Function. The controller shall have a register with a bit that toggles at a regular interval to act as a heartbeat for confirmation of continued controller operation and network communication

H. The controller shall communicate the following through Ethernet:

1. System pressure

2. Firing sequence

3. Firing frequency

4. Firing duration

5. System running

6. General alarm

I. The controller shall accept the following parameters through Ethernet:

1. Enable/Disable Mixing

2. Firing sequence

3. Firing frequency

4. Firing duration

2.05 AIR COMPRESSORS.

A. Low Pressure Air Compressors

1. ***(Specifier Note: Indicate Quantity)*** Quantity air compressor modules shall be as noted in the Design Table below. Each shall include an inlet air filter, compressor with an AC motor, air/oil separator reservoir, air cooled oil cooler, cooling fan, separator pressure relief valve, discharge check valve, filters, controls, control panel, base, and unloading system.

2. Each compressor module shall be completely factory assembled requiring only field connection of electrical power, and air and condensate drain piping.

3. Each compressor shall be of the single stage, positive displacement, oil-flooded, rotary screw type. The compressor shall be provided with an integral skid or lifting lugs for unloading and placement.

4. Motor Driving Arrangement for Low HP Compressors (≤ 15 Hp)

a. The airend shall have a 4-6 lobe combination with both male and female rotors being identical in diameter. The discharge end of the rotors shall be supported by back-to-back mounted duplex tapered roller bearings. The suction end of the rotors shall be supported by a single row of cylindrical roller bearings. Bearing life shall be in excess of 300,000 hours

b. The airend shall be driven by a multiple belt, “V” groove belt-drive arrangement. The unit must be belt-driven with no step-up or reduction gears. Proper belt tension shall be maintained by an automatic spring-loaded belt tensioner located on the motor base with an indicator pin to note when the belts need to be changed. The tensioning device should not have to require any adjustments for the life of the belts. Using motor weight as an automatic tensioning device is not acceptable.

5. Motor Driving Arrangement for Low HP Compressors (≥ 15 Hp)

a. The airend shall have a 4-6 lobe combination with both male and female rotors being identical in diameter. The discharge end of the rotors shall be supported by a triplex bearing arrangement on the male rotor and a duplex bearing arrangement on the female rotor. The suction end of the rotors shall be supported by a single row of cylindrical roller bearings.

b. The motor and airend shall be rigidly mounted to a welded base and driven through a direct drive coupling to eliminate the need for shaft alignment. The unit must be direct-driven with no step-up or reduction gears.

1. The compressor sealing/cooling fluid shall be air-cool and shall have a fan cooled, fin-type fluid cooler. Configuration shall include a thermal mixing valve and by-pass line to ensure proper air/fluid discharge temperature to the compressor. The cooling system shall be capable of maintaining proper compressor temperatures in the ambient conditions up to 110 degrees F.

2. Fluid circulation shall be maintained by the pressure differential between the reservoir pressure and the vacuum level on the suction side of the airend. There shall not be a separate motor driven fluid pump.

3. An air/oil separator reservoir shall be provided for each compressor. The reservoir shall be designed and constructed in accordance with the ASME Code for Unfired Pressure Vessels and shall bear the code stamp. The reservoir shall include two-stage filtration to remove oil from air stream. Oil carry-over downstream of compressor modules shall not exceed 3 mg/m^3.

4. Each air compressor module shall have automatic controls integral to the unit which open (loaded condition) and close (unloaded condition) the inlet valve to the air end to deliver appropriate volume to meet demand and maintain system target pressure. On sensing a low demand, the motor will keep running but the air end inlet valve will close, resulting in a decreased “idling” power draw on the motor. The valve shall reopen when system pressure drops below the set point.

5. Each baseplate shall be constructed of one-piece folded mild-steel with structural members and shall be designed for no measurable deflection with the equipment mounted thereon and the baseplate supported around its perimeter. Each base shall be designed so that all equipment bolted to it can be removed without access to the underside of the plate and with a flat top surface for ease of cleaning. Structural stiffeners shall be located under the compressors at the compressor anchor points.

6. Valves and piping within the enclosure shall be the compressor manufacturer's standard. Relief valves shall be provided for equipment protection on the air and coolant systems as required.

7. Each compressor shall be provided with an integral, dry-type intake filter. Intake filters shall have replaceable filter element(s). Particle arrestance shall be not less than 99.9% efficient at 10 microns and above.

8. ***(Specifier Note: Optional Text)*** Each compressor shall be supplied in a sound attenuated enclosure. The enclosure shall reduce the measured sound to a maximum of 85 decibels, as measured by ISO 8571, while the compressor is operating and the sound level is measured a distance of three feet from the

enclosure.

9. ***(Specifier Note: Optional Text)*** Each compressor electrical enclosure shall be NEMA 4 rated.

10. A pressure relief valve shall be provided on the reservoir. This valve shall be sized to handle the full capacity of the compressor.

11. A high air/fluid temperature shutdown system shall be provided. The unit must have safety devices mounted and wired. Safety devices shall include motor thermal overload and high compressor discharge temperature shut-down. These systems must be designed to prevent the compressor from running in an over temperature situation or motor from running in an overload condition.

12. ***(Specifier Note: Optional Text)*** The two compressors shall each feature controls capable of operating at two pressure settings, selected by a panel mounted switch on the compressor's control panel. The controller shall allow one of two different pressure control settings to be chosen for each compressor. If the demand is greater than one unit's capacity (the lead compressor), the second compressor (the lag compressor) will automatically turn itself on until the excess demand has been satisfied. The lag compressor's motor will shut down after a set period of time in which it is not loaded as described in paragraph above. The lead/lag circuits shall be fully incorporated inside the compressor's control panel. No additional separate control sequence panels shall be required.

13. The compressors shall be as manufactured by Quincy, Model QSLP ***(Specifier Note: Specify Model)***, or equal.

B. ***(Specifier Note: Optional Text)***Coalescing Filter

1. A coalescing filter shall be provided for each compressor. The coalescing filter shall be designed to remove liquid aerosols from the compressed air supply. The filter shall be effective to 1 micron for particles and liquid aerosols to 0.1 mg/m^3 at 21°C.

2. The coalescing filter shall have an aluminum housing, NPT connections, and automatic condensate drain.

3. The coalescing filter shall be rated for the maximum capacity of the air stream it is treating.

C. ***(Specifier Note: Optional Text)***Free Standing Aftercooler

1. One (1) common aftercooler shall be provided. The aftercooler shall be designed to reduce compressed air temperature and remove moisture.

2. The aftercooler shall have a steel cabinet with baked enamel finish, aluminum core, painted steel shroud, and 460 V, 60 Hz, 3 Ph TEFC fan motor.

3. The aftercooler shall be rated for the maximum discharge capacity of two air compressors in operation.

D. ***(Specifier Note: Optional Text)***Oil/Water Separator

1. One (1) common oil water separator shall be provided. The oil water separator shall be designed to separate and retain oil from condensate removed from the compressed air system.

2. It shall be rated for the maximum capacity of the compressed air it is treating with a media life greater than 4000 hour at normal oil carry-over concentrations <20 ppm.

E. ***(Specifier Note: Optional Text)*** Refrigerated Dryer

1. An air dryer shall be provided of cycling refrigerated air type. The dryer shall produce an ISO Class 5, 7^0C dew point at the dryer exit when operating continuously at the rating conditions of 2^0C and RH of 60%.

2. The dryer shall be capable of continuously drying the maximum discharge capacity of the air compressor.

3. The dryer shall be mounted separately from the compressor package.

F. ***(Specifier Note: Select Free Standing)*** Free Standing Air Receiver

1. (Specifier Note: Select Quantity) Number air receivers shall be provided. The receivers shall be designed and constructed in accordance with the ASME Code of Unfired Pressure Vessels and shall bear the code stamp.

2. Receivers shall be factory powder coated. One quart touch-up paint shall be provided.

3. Each receiver shall be provided with mounting feet, safety relief valve and pressure gauge.

4. Each receiver shall be provided with a self-contained NEMA 4X automatic, gear-motor-operated ball drain valve with a 115V 60 Hz grounded power cord. Autodrain shall include a programmable solid state timer. The ball valve shall be provided with glass reinforced seals and stainless steel ball and stem.

G. ***(Specifier Note: Select Free Standing Optional Text)*** Condensate Level Sensor

1. Each receiver shall be provided with a capacitive proximity sensor to detect condensate level which shall alarm on the OIT and generate a general FAIL alarm.

2. The sensor shall be suitable for installation in an unclassified environment, have a M18 barrel and an M12 IP-66 rated connection.

3. Each sensor shall be provided with a ¾" tank well for mounting directly to each receiver.

4. IP-66 rated field cable with M12 adaptors shall be provided for powering from and signaling to the controller.

H. Compressor System Electrical

1. All electrical and control equipment for the air compressor module shall be

furnished as required for a complete installation, requiring only field connection of 480 VAC, three phase power supply

2. The compressor electric motor shall be rated 480 volts, 60 Hz, three phase.

I. Compressor System Control Panel – An enclosure-integrated control panel mounted on the compressor module shall include:

1. Full voltage, non-reversing, circuit breaker type combination motor starters sized as required by the manufacturer

a. Starters shall include auxiliary contacts as required. One normally open auxiliary contact shall be provided for RUN status

b. Magnetic motor circuit protectors shall be 3 phase, 480 volts, molded-case circuit breakers with instantaneous trip elements. The breakers shall be manually operated with quick-make, quick-break, trip-free toggle mechanism.

c. One thermal overload relay shall be provided in each phase lead. Each starter shall be provided with an external manual reset push button for reset of the thermal overload relays. Overloads shall be bimetallic ambient compensated type, matched to motor current, and shall be provided with a manual reset pushbutton.

d. The complete starter shall have an interrupting rating of at least 10,000 amperes at 480 volts.

2. Control power transformers shall have both primary leads fused, one secondary lead fused, and one secondary lead grounded.

3. Terminal blocks for all system wiring. Internal panel wiring shall be neatly bundled and tied and shall be identified with suitable wire markers

4. Gauges and indicators shall be provided to indicate the following conditions; Differential pressure across fluid filter, discharge pressure, compressor discharge temperature, power on, hours of operation, operating mode, differential separator, percent capacity, air filter.

5. A contact which closes under alarm conditions shall be provided for the compressor for remote "FAIL" alarm. The contact shall close when any alarm occurs for the compressor.

J. Compressor Shop Painting

1. All components of the compressed air equipment system shall be shop primed and finish painted with the manufacturer's standard paint system prior to shipment to the site.

K. Compressor Shop Test

1. Prior to shipment each compressor module shall be operated to check alignment; faulty equipment and controls; proper wiring; leaks in piping, seals, or wells; and proper operation of the safety and operating controls. Compressor pressure controls shall be adjusted to the specified pressures. Defective equipment and

controls disclosed by such tests shall be replaced and the package placed in satisfactory operating condition before shipping.

L. Compressor System Performance and Design Requirements

1. Design Requirements:

Service	***(Specifier Note: Specify Zone)***
Capacity @ 38 psig (acfm)	Specify

2. The compressed air equipment shall be designed for the following operating conditions:

Ambient Conditions		
	Max Air temperature, F	110
	Min Air temperature, F	35
	Relative humidity, percent	80
	Barometric pressure, psia	14.6
Compressors		
	Number required	Specify
	Maximum discharge pressure, psig Operating Target Pressure, psig	40 35
	Capacity at operating target pressure, acfm	Specify
	Motor size, hp	Specify
	Max motor shaft speed, rpm	1600
	Max free field noise level measured as rated by ISO 2151 test standards, dBA (with enclosure)	70
Receivers		
	Number required	Specify
	Design pressure, psig	200
	Nominal volume, gal	Specify 60, 120, 240
Coalescing Filters ***(Specifier Note: Select if Req'd)***		
	Type	Particulate and Oil Removal
	Number required	1 each/compressor

Refrigerated Air Dryer ***(Specifier Note: Select if Req'd)***		
	Type	Cycling
	Number required	Specify
	Target Pressure Dew Point (^{0}C)	2 – 3

2.06 SPARE PARTS.

A. Provide spare parts that are identical to and interchangeable with similar parts installed.

1. One (1) Air Control Valves (ACVs) rebuild kit
2. One (1) pressure regulator rebuild kit
3. One (1) pilot air filter assembly
4. One (1) solenoid
5. One (1) valve plug and cable assembly
6. One (1) relay and circuit breaker
7. One (1) 5-micron pilot air filter
8. Two (2) compressor intake air filter elements
9. Two (2) compressor air-oil separator filter elements
10. Two (2) each compressor primary/secondary elements
11. Any other standard parts recommended by the Manufacturer.

PART 3 – EXECUTION

3.01 INSTALLATION.

A. Install items in accordance with approved shop drawings, manufacturer's printed instructions and as indicated.

B. All nozzles on respective nozzle header shall be level within ½-inch of a common horizontal plane.

3.02 MANUFACTURER'S FIELD SERVICES.

A. The services of a qualified manufacturer's technical representative shall be provided for installation inspection, testing, startup and training. The mixing system manufacturer shall include the following site visits and days on site:

Service	Number of Trips	Number of Days/Trip
Installation Inspection and	1	2

Testing		
Compressor Installation Inspection and Testing	1	1
Startup and Training	1	2

3.03 FIELD PERFORMANCE TESTING AND GUARANTEE.

A. All mixer components shall be field tested with the respective basins full to the maximum water surface elevation.

B. Exposed air piping shall be tested by Contractor for leaks using soapy water on all joints and applying 100 psi test pressure. Buried air piping shall be tested using this method before the trench is filled. Air piping in the tanks may be tested by submersing the piping in non-potable water and pressurizing the piping to 100 psi, in lieu of using soapy water on all joints. Pressure testing requirement shall not apply to supply piping downstream from VP or pre-manufactured nozzle headers.

C. The Contractor shall operate each mixing system at the maximum water surface elevation in the basins for a continuous period of not less than 72 hours. The CONTRACTOR shall correct and resolve all operating problems, deficiencies, etc., determined as a result of the tests.

D. After the above testing is complete, field mixing performance testing of the installed Air Mixing System shall be performed by the manufacturer as described below.

1. Mixing performance testing shall be conducted in the following basin: ***(Specifier Note: Select Zone to Be Tested)***

2. All personnel and equipment necessary to conduct and supervise all testing shall be provided by the mixer manufacturer. Engineer/Owner shall be notified of the test to witness at their option and expense.

3. Prior to performing the tests, the basin which will be tested must have been in normal operating mode for at least two days with TSS in typical operating ranges of ***(Specifier Note: Select TSS Range) (EQ 250 – 500, Activated Sludge/Channels 1,500 – 3,000, Digester 10,000 – 20,000, Thickened Sludge 25,000 – 50,000)*** mg/L. No flow shall enter or exit the respective basin for two hours prior to and during the test.

4. The compressed gas mixing system manufacturer shall conduct total suspended solids (TSS) testing using a Cerlic TSS probe, or equal, suspended solids analyzer.

   a. ***(Specifier Note: Alternate Text:)*** The compressed gas mixing system manufacturer shall pay all costs for an independent laboratory to conduct total suspended solids (TSS) analysis for all samples.

   b. The analysis shall be performed in accordance with “Standard Methods for the Examination of Water and Wastewater”.

5. Testing Procedure:

   a. Four horizontal-plane sample sites for ***(Specifier Note: Select Zone to Be***

Tested) to be tested shall be selected by the Engineer. At each sample site, three vertical samples shall be collected as follows: 24-inches from the surface, tank sidewall mid-point and 24-inches above the tank sidewall bottom. Each sample site must be a minimum of 4 ft away from any structure within the tank. The samples for each location shall be analyzed as described above.

b. The Coefficient of Variation (Cv) shall be determined for the sample set, excluding the maximum and minimum samples. The Cv shall be calculated by taking the resultant set of ten (10) samples as follows: Cv = (100 x Standard Deviation of Ten Samples)/(Mean Value of Ten Samples)."

c. If the Cv is less than or equal to 10%, then the mixer performance shall be acceptable for that location.

d. If the Cv is greater than 10%, then the mixer performance shall be unacceptable for that location and the Contractor and/or Manufacturer shall make all necessary improvements (at no additional cost to the Owner) and repeat the testing procedure at no additional cost to the Owner until the Cv is less than or equal to 10% for that location.

END OF SECTION