
SECTION 226700 – LABORATORY COMPRESSED AIR AND VACUUM EQUIPMENT

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(Engineer shall edit specifications and blue text in header to meet project requirements. This includes but is not limited to updating Equipment and/or Material Model Numbers indicated in the specifications and adding any additional specifications that may be required by the project. Also turn off all “Underlines”.)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section and all other sections of Division 22.

1.2 SUMMARY

- A. This section includes the requirements for compressed air and vacuum equipment and all necessary components and including the following: **<Edit For particular Project>**
 - 1. Oil free reciprocating air compressors.
 - 2. Oil less reciprocating air compressors.
 - 3. Rotary screw air compressors.
 - 4. Scroll air compressors.
 - 5. Inlet air filters.
 - 6. Refrigerant compressed air dryers.
 - 7. Air cooled compressed air aftercoolers.
 - 8. Water cooled compressed air aftercoolers.
 - 9. Vacuum pumps.

1.3 DEFINITIONS

- A. Actual Air: Air delivered at air outlet and vacuum inlet. Flow rate is measured in acfm.
- B. Laboratory Air and Vacuum Equipment: Compressed air and vacuum equipment and accessories used for non medical laboratory facilities.
- C. Medical Air and/or Vacuum Equipment: Medical air and/or vacuum equipment and accessories used for medical/healthcare facilities.
- D. Standard Air: Free air at 68°F and one (1) atmosphere before compression or expansion and measured in scfm.

1.4 ACTION SUBMITTALS

- A. Product Data: For each specified product, include manufacturers cut sheets, dimensional data, performance data, installation instructions, wirings diagrams, power requirements, specified options, and warranty information.

B. Shop Drawings: For air all equipment in this specification.

1. Include plans, elevations, sections, and mounting details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
4. Include diagrams for power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For air compressors, accessories, and components from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculations.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Field reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: Include a copy of each approved submittal along with any applicable maintenance data in the project operation and maintenance manual.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

- a. Air Compressor and vacuum pumps, Inlet Air Filter Elements: Equal to 10 % of quantity installed, but no fewer than one (1) unit.
- b. Belts: One (1) for each belt driven compressor.

1.8 QUALITY ASSURANCE

A. Installer Qualifications:

1. Laboratory Air Equipment for Nonmedical Laboratory Facilities: An employer of workers trained and approved by manufacturer.

- B. Testing Agency Qualifications: An independent testing agency, with the experience and capability to conduct the compressed air and vacuum equipment testing indicated, that is an NRTL and that is acceptable to authorities having jurisdiction.
 - 1. Qualify testing personnel according to ASSE 6020 for inspectors and ASSE 6030 for verifiers.

1.9 WARRANTY AND GUARENTEE

- A. See Division 22, Specification Section “Basic Mechanical Requirements – Plumbing” for warranty and guarantee requirements.

PART 2 - PRODUCTS

2.1 GENERAL PRODUCT REQUIREMENTS

- A. Equipment Design and Selection: Compressed air and vacuum, equipment and specialties shall be designed and selected, for the intended use, in accordance with the scheduled capacities on the drawings and the requirements of this specification.
- B. Basis of Design: The basis of design for compressed air and vacuum, equipment shall be as follows: <Edit required for project>
 - 1. Air Compressors, Air Filters, Air Dryers and Accessories – Ingersoll Rand Inc.
 - 2. Vacuum Pumps and Accessories – Allied Healthcare Inc.
- C. Other Acceptable Manufacturers: Subject to compliance with requirements, provide compressed air and vacuum equipment by one (1) of the following: <Edit required for project>
 - 1. Air Compressors, Air Filters, Air Dryers and Accessories – Quincy Compressor, Kaeser Compressors Inc., Gardner Denver Products. Substitutions are not permitted.
 - 2. Vacuum Pumps and Accessories – Beacon Medaes, Bush USA, Ohio Medical Corporation. Substitutions are not permitted.

2.2 GENERAL EQUIPMENT REQUIREMENTS FOR AIR COMPRESSORS, AND VACUUMPUMPS

- A. Assembly: Air and vacuum equipment shall be factory assembled, wired, piped, and tested assembly to perform as specified.
- B. Air and Vacuum Tanks: Air and vacuum tanks shall be constructed of galvanized steel in accordance with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1; bearing appropriate code symbols and comply with the following:

1. Pressure Rating: At least as high as highest discharge pressure of connected air compressors and bearing appropriate code symbols.
 2. Pipe Connections: Provide flanged pipe connections for system main pipe. Also provide taps for a low point drain, pressure gauge and pressure relief valve.
 3. Inspection Portal: Provide a means for inspecting the tank interior utilizing one (1) of the following:
 - a. Tanks up to thirty six (36) inches in diameter: four (4) inch by six (6) inch manhole.
 - b. Tanks forty two (42) inches in diameter and larger: twelve (12) inch by sixteen (16) inch manhole.
 4. Interior Finish: Corrosion resistant coating.
 5. Accessories: Include safety valve, pressure gauge, automatic drain, and pressure regulator.
- C. Mounting Skid: The mounting skid shall be fabricated of welded 2 inch tubular steel frame with grating to support the equipment and accessories and include reinforcement strong enough to resist movement during normal operation when the base mounting frame is anchored to the building structure. Grind welds smooth and sandblast entire unit to white metal finish. Wash in phosphoric acid. Finish shall be two (2) coats of polyurethane enamel.
- 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.
- E. Motors: Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section "Common Motor Requirements for Plumbing Equipment."
- F. Comply with NFPA 99, "Health Care Facilities," for compressed air and/or vacuum equipment and accessories intended for medical systems.
- G. Control Panels: Control panels for compressed air and vacuum systems shall include automatic control station with load control and protection functions. Comply with NEMA ICS 2 and UL 508 and the following:
1. Enclosure: NEMA ICS 6, Type 12 control panel.
 2. Motor Controllers: Full voltage, combination magnetic type with under voltage release feature and motor circuit protector type disconnecting means and short circuit protective device.
 3. Control Voltage: 120-V ac or less, using integral control power transformer.
 4. Motor Overload Protection: Overload relay in each phase.
 5. Starting Devices: Hand off automatic selector switch in cover of control panel, plus pilot device for automatic control.

6. Automatic control switches to [alternate lead/lag air compressors and/or vacuum pumps for duplex assemblies] and [sequence lead/lag air compressors and/or vacuum pumps for multiplex assemblies]. < Edit For Project >
7. Instrumentation: Include discharge air and receiver pressure gages, air filter maintenance indicator, hour meter, air compressor discharge air and coolant temperature gages, and control transformer.
8. Alarm Signal Device: For connection to alarm system to indicate when backup air compressor is operating.
9. Auxiliary Contacts: Provide auxiliary contacts for alarm connections to the BAS, using BAC Net IP Protocol as follows:
 - a. Air Compressor Alarms: Include the following:
 - 1) General Alarm.
 - 2) Low Air Pressure Alarm.
 - b. Vacuum System: Include the following:
 - 1) High/Low Temperature Alarm.
 - 2) Low Vacuum Pressure Alarm.

2.3 COMPRESSED AIR SYSTEM – AIR COMPRESSORS

A. Oil Free, Reciprocating Air Compressors:

1. Description: Packaged unit.
2. Air Compressor(s): Oil free, reciprocating-piston type with nonlubricated compression chamber and lubricated crankcase, and of construction that prohibits oil from entering compression chamber.
 - a. Submerged gear type oil pump, and oil filter.
 - b. Intercooler between stages of two stage units.
 - c. Combined high discharge air temperature and low lubrication oil pressure switch.
 - d. Belt guard totally enclosing pulleys and belts.
3. Compressors shall be cast iron construction with multi finned cylinders for maximum cooling, gasket free integral cylinder/head, ductile iron crankshaft, aluminum or cast iron pistons and connecting rods, Swedish steel disc type valves, balanced flywheel with fan cooling blades, large diameter, finned inter coolers, positive acting centrifugal unloader, tapered roller bearings, inter stage pressure relief valves, heavy duty five (5) micron inlet filter/mufflers, oil sight gauge and drain, low oil shutdown switch, enclosed OSHA belt guard, EPACT '92 energy efficient open drip proof motor.
4. Air compressors shall be as follows:

<Edit for Project>

- a. Base Mounted: Base mounted compressors shall be supplied with fabricated steel base for mounting to concrete housekeeping pad.
- b. Tank Mounted: Tank mounted compressors shall include, ASME Code <horizontal or vertical> <gallon> air receiver. Air receiver shall include 0-300 PSIG pressure gauge with snubber and needle valve, bucket high drain valve, ASME code pressure relief valve, hand operated discharge ball valve, factory set pressure switch(s). Receiver shall have base ring or support legs for mounted to concrete housekeeping pad. Receiver shall include one (1) of the following: <Edit for Project>
 - 1) Pneumatic Drain: Pneumatic automatic drain shall be a float type drain and does not require any external power.
 - 2) Timed Drain: Timed automatic drain shall include a solenoid valve with an adjustable drain frequency and duration time, and a 20 amp, 120 volt single phase power connection.

B. Oilless, Reciprocating Air Compressors:

1. Description: Packaged unit.
2. Provide factory assembled and tested, packaged 100% continuous duty rated, multi belt driven, [single (1) stage or two (2) stage*] reciprocating piston type centrifugal air compressors as indicated, of capacities and electrical characteristics indicated.
3. Each compressor shall be totally oil less dry crankcase with:
 - a. Internal surfaces sealed with oxide primer,
 - b. Finned crankcase for heat dissipation
 - c. Etc., removable crankcase for internal inspection,
 - d. Cantilevered crankshaft for rod bearing service without removing crankshaft,
 - e. Permanently sealed main and journal bearings,
 - f. Two (2) piece connecting rods for ease of service,
 - g. Iso temp heat barrier on top of pistons,
 - h. PFTE/carbon piston rings with 10,000 hour service life,
 - i. Nickel plated and hardened cylinders.
4. Compressors shall be cast iron construction with multi-finned cylinders for maximum cooling, gasket free integral cylinder/head, ductile iron crankshaft, aluminum or cast iron pistons and connecting rods, Swedish steel disc type valves, balanced flywheel with fan cooling blades, large diameter, finned inter coolers, positive acting centrifugal unloader, inter stage pressure relief valves, heavy duty five (5) micron inlet filter/mufflers, enclosed OSHA belt guard, EPACT '92 energy efficient open drip proof motor.

5. Air compressors shall be as follows:
- a. Base Mounted: Base mounted compressors shall be supplied with spring isolated, fabricated steel base for mounting to concrete housekeeping pad.
 - b. Tank Mounted: Tank mounted compressors shall include, ASME Code [horizontal or vertical] [gallon] air receiver. Air receiver shall include 0-300 PSIG pressure gauge with snubber and needle valve, bucket high drain valve, ASME code pressure relief valve, hand operated discharge ball valve, factory set pressure switch(s). Receiver shall have base ring to support legs for mounted to concrete housekeeping pad. Spring isolators to be installed between compressor/motor and receiver. Receiver shall include one (1) of the following: drain.
 - 1) Pneumatic Drain: Pneumatic automatic drain shall be a float type drain and does not require any external power.
 - 2) Timed Drain: Timed automatic drain shall include a solenoid valve with an adjustable drain frequency and duration time, and a 20 amp, 120 volt single phase power connection.

<*Note: Standard tank is steel with no lining. Optional vinyl tank lining or galvanized receiver is available as option.>

6. Air System Controls: Air system controls shall be one (1) of the following: <Edit for Project Requirements>
- a. Start/Stop: Automatic start/stop control shall be provided for systems with light and/or intermittent loads. Air compressor(s) shall be supplied with pressure switch(s) to control each compressor. Each pressure switch shall have adjustable differential control. Duplex compressed air packages shall have two pressure switches and include alternator to equalize wear.
 - b. Dual Control: Automatic dual control shall be provided for systems requiring continuous operation and steady air demand. Air compressor(s) shall be supplied to run continuously. Compressor(s) shall be supplied with head unloader solenoid valves.

C. Rotary Screw Air Compressors:

1. Description: Packaged unit.
2. Air Compressor(s): Single stage, oil free, rotary screw type with nonlubricated helical screws and lubricated gearbox, and of construction that prohibits oil from entering compression chamber.

- a. Cooling/Lubrication System: Unit mounted, air cooled exchanger package prepped to unit; with air pressure circulation system with coolant stop valve, full flow coolant filter, and thermal bypass valve.
 - b. Air Filter: Dry type, with maintenance indicator and cleanable replaceable filter element.
 - c. Air/Coolant Receiver and Separation System: 150 psig rated steel tank with ASME safety valve, coolant level gage, multistage air coolant separator element, minimum pressure valve, blowdown valve, discharge check valve, coolant stop valve, full flow coolant filter, and thermal-bypass valve.
 - d. Capacity Control: Capacity modulation between zero and 100 percent air delivery, with operating pressures between 50 and 100 psig. Include necessary control to hold constant pressure. When air demand is zero, unload compressor by using pressure switch and blowdown valve.
 - e. Mounting: Freestanding.
3. Sound attenuation enclosure. <Edit For Particular Project>

D. Scroll Air Compressors:

1. Description: Packaged unit.
2. Air Compressor(s): Single stage, oil free, rotary, oscillating volute type of construction that prohibits oil from entering compression chamber.
 - a. Mounting: Freestanding.

2.4 COMPRESSED AIR SYSTEM - ACCESSORIES

A. Air Filters:

1. Compressed Air Inlet Air Filters shall be as follows: <Choose and Edit for Project>
 - a. 3-Micron Particulate Filter: Filter unit shall have corrosion resistant cast aluminum alloy head and aluminum alloy bowl. Bowl assembly shall have threaded connections with "O" ring seal for easy access for cartridge replacement. Unit shall have durable enamel finish. Filter shall have pressure drop indicator to indicate filter replacement and installed internal automatic drain. Unit shall have 3-micron absolute removal. Unit shall be Zeks "PT" series or equal.

<Note: Particulate filter is recommended in all compressed air systems. It should always precede compressed air dryers of any type. It is recommended as a pre-filter before oil-removing coalescing filters in all systems. Particulate filter will provide instrument quality air.>

- b. 0.7-Micron Coalescing Filter: Filter unit shall have corrosion resistant cast aluminum alloy head and aluminum alloy bowl. Bowl assembly shall have threaded connections with "O" ring seal for easy access for cartridge replacement. Unit shall have durable enamel finish. Filter shall have pressure drop indicator to indicate filter replacement and installed internal automatic drain. Unit shall have 0.7-micron absolute removal. Unit shall be Zeks "RT" series or equal.

<Note: Coalescing filter is recommended in all compressed air systems with oil lubricated air compressors. It should always precede compressed air dryers of any type. It is recommended as a oil-removing coalescing filters in all systems where some oil is present and optical clarity is required. It should be preceded by a particulate filter.>

- c. 0.3-Micron Coalescing Filter: Filter unit shall have corrosion resistant cast aluminum alloy head and aluminum alloy bowl. Bowl assembly shall have threaded connections with "O" ring seal for easy access for cartridge replacement. Unit shall have durable enamel finish. Filter shall have pressure drop indicator to indicate filter replacement and installed internal automatic drain. Unit shall have 0.3-micron absolute removal. Unit shall be Zeks "LT" series or equal.

<Note: Coalescing filter is recommended in all compressed air systems with oil lubricated air compressors. It should always precede compressed air dryers of any type. It is recommended as an oil-removing coalescing filters in all system where "oil-free" air is required. It should be preceded by a particulate filter.>

- d. 0.5-2 PPM Absorbing Filter: Filter unit shall have corrosion resistant cast aluminum alloy head and aluminum alloy bowl. Bowl assembly shall have threaded connections with "O" ring seal for easy access for cartridge replacement. Unit shall have durable enamel finish. Filter shall have pressure drop indicator to indicate filter replacement and installed internal automatic drain. Unit shall have 0.5-2 PPM absolute removal. Unit shall be Zeks "AT" series or equal.

<Note: Accrasorb filters are used where oil vapor and hydrocarbon contaminants are to be removed for odor and "polishing" the air stream. A 0.3 Micron Coalescing Filter must precede this filter.>

2. Compressed Air Filter Assemblies: Filter assemblies shall be suitable for compressed air, in parallel duplex arrangement. Size each assembly for maximum capacity of connected equipment and operating pressure of compressed air system. Include automatic ejection of condensate from airstream, inlet and outlet pressure gages, and shutoff valves.

B. Air Dryers:

1. Compressed Air Dryers: Compressed air dryers shall be electric motor driven, fan operation, finned tube unit; rated at 250 psig and leak tested at 350 psig minimum air pressure; in capacities indicated. Size units to cool compressed air in compressor rated capacities to 10°F above summertime maximum ambient temperature. Include moisture separator and automatic drain.
2. Refrigerant Compressed Air Dryers: Refrigerant compressed air dryers shall be non cycling, air cooled, electric motor driven unit with steel enclosure and capability to deliver 35°F, 100 psig air at dew point. Include automatic ejection of condensate from airstream, step down transformers, disconnect switches, inlet and outlet pressure gages, thermometers, automatic controls, and filters.

C. Compressed Air Purification System: Compressed air purification system shall be sized for maximum connected equipment capacity with coalescing, particulate, and activated charcoal filters; compressed air dryer; catalytic converter; gages and thermometers; and controls.

1. Include the following capabilities:
 - a. Removal of excessive moisture, solid particulates, oil and oil mist, carbon monoxide, and hydrocarbon vapors.
 - b. Automatic ejection of condensate from airstream.
 - c. Production of air complying with USP - NF for medical air.
 - d. Capacity and dew point indicated, but not higher than 35°F 100 psig.
2. Filters: Parallel duplex filters, each sized for maximum system demand, with valved bypass for filter servicing.
 - a. Inlet Filters: 5 micrometers.
 - b. Outlet Filters: 1 micrometer(s).
3. Accessories: Inlet and outlet pressure gages, thermometers, safety valves, and shutoff valves; and automatic ejection of condensate from airstream.
4. Differential Pressure Switch: Adjustable, diaphragm type, with electrical connections for alarm system, to indicate when air-pressure drop through filters rises to more than 2 psig greater than when new and clean.
 - a. Inlet Connection: From inlet to particulate filter.
 - b. Outlet Connection: To outlet from final activated charcoal filter.
5. Compressed Air Dryer: Air dryer shall be one (1) of the following:
 - a. Desiccant Dryer: Twin-tower desiccant type with automatic controls, purge system, and mufflers.

- b. Refrigerant Dryer: Noncycling refrigerant type
- D. Water Cooled, Compressed Air Aftercoolers: Water cooled compressed air aftercoolers shall be a shell and tube unit, rated at 250 psig and leak tested at 350 psig minimum air pressure, in capacities indicated. Include moisture separator and automatic drain.
- 2.5 VACUUM SYSTEM – VACUUM PUMPS <Chemical Grade>
- A. Provide Rietschle Industrial Vacuum System, Model <Edit for project>
1. The Duplex Base Mounted System includes two rotary vane vacuum pumps, vacuum and exhaust filtration, automated valves, application specific controls, all necessary instrumentation, interconnecting piping and wiring.
 2. Total System Capacity: - <CFM>
 3. Area Classification: Non Hazardous
 4. Utilities:
 - a. - 480 V, 3 phase, 60Hz (to control panel)
 - b. - 80- 120 psig instrument air (for automated valves)
 5. The System Package shall contain:
 - a. Model <Insert Note Here> Mechanical Vacuum Pump Two (2) each
 - 1) Type: Two (2) stage; rotary vane
 - 2) Performance and Dimensions: Refer to Document No. DU 117 (Attached)
 - 3) Capacity: <> CFM
 - 4) Ultimate Vacuum: .4 mmHg
 - 5) Lubrication: Once-through oil lubrication for aggressive gas applications.
 - 6) Cooling: Air/closed loop radiator
 - 7) Drive Mechanism: Direct Drive
 - 8) Includes Integral Oil Reservoir, Low Oil Level Switch and Sight Glass for
 - 9) Oil Reservoirs, High Coolant Temperature Switch, and cooling motor control temperature switch.
 - 10) Drive Motor, <> HP Two (2) each
 - 11) Cooling Motor, <> HP Two (2) each
 - 12) Electrical: 460 V, 3 Ph, 60 Hz, 1800 RPM
 - 13) Enclosure: TEFC
 - b. VWZ Chemical Duty Vacuum Pumps
 - 1) The design of the VWZ series vacuum pump results from an exhaustive survey of the applications and preferences of the process chemical industry. In terms of low noise, thermal stability

and overall reliability, they are "the vacuum pumps" for chemical applications.

- 2) VWZ vacuum pumps have the following important features:
 - a) Once through oil lubrication small quantities of oil are continuously metered through the compression stages to entrain and eliminate corrosives and condensed residues.
 - b) Modular configuration for ease of maintenance and service. Stages can be serviced or replaced without disconnecting process piping and instrumentation.
 - c) Proven rotary vane principle of operation.
 - d) Interstage bypass valve configuration provides full range of operation from atmosphere to ultimate vacuum.
 - e) Exact control of operating temperature by cooling water bath. Allows compression stages to be operated at high temperatures, to avoid condensation, without fear of overheating.
 - f) Deeper ultimate vacuum with greater capacity.
 - g) No minimum flow. Can be operated indefinitely while at no load.
 - h) Tolerant of vapor loading.
 - i) Continuous decline gradient from inlet to exhaust prevents accumulation of liquids or solids in the compression stages.
 - j) Compact skid design will support vacuum pump and most accessory packages;

c. Waste Oil Receiver/Oil Mist Eliminator Two (2) each.

- 1) Function: Capture oil, oil mist and condensate from vacuum pump exhaust.
- 2) Construction: 304 stainless steel
- 3) Elements Media: Borosilicate glass
- 4) Drainage: Automatic:
 - a) Includes High Liquid Level Switch, back pressure gauge and sight glass.

d. Inlet Separator - One (1) each:

- 1) Function: Protects vacuum pump from liquid or particles from the inlet piping.
- 2) Construction: 304 stainless steel
- 3) Element Media: Polypropylene, 10 micron
- 4) Drainage: Manual ball valve

- 5) Includes: Sight glass, level switch
- e. Isolation Valve - Two (2) each:
- 1) Function: Non return valve: isolates vacuum pump during warm up, purge and while not operating.
 - 2) Type: Electro pneumatic butterfly valve with rack & pinion actuator and pilot solenoid.
 - 3) Construction: Stainless steel and PTFE for wetted surfaces.
- f. Purge Valve - Two (2) each:
- 1) Function: Provides metered air flow for warm-up and purge of vacuum pump.
 - 2) Type: Solenoid.
 - 3) Construction: Stainless steel and Teflon for wetted surfaces.
- g. Duplex Control Panel, with one (1) point power connection. One (1) each:
- 1) Enclosure: NEMA 12
 - 2) Location: Skid mount
 - 3) Includes PLC, motor starters, control voltage transformer, hour meters with panel face controls, status and diagnostic indicators.
 - 4) The duplex control panel provides completely automated operation. For energy efficiency, each pump is started only when additional capacity is required. The pumps are sequenced and alternated evenly so that one (1) maintenance schedule can be maintained for all.
 - 5) Panels automates the following functions:
 - a) Automated lead/lag operation and alternation of vacuum pumps.
 - b) Timed purge of vacuum pump(s).
 - c) Shutdown of vacuum pump(s) for low oil level with timed grace period for replenishment.
 - d) Shutdown of vacuum pump(s) for high exhaust liquid level with timed grace period for drainage.
 - e) Isolation and shutdown of vacuum pump(s) for high inlet liquid level, with timed grace period for drainage.
 - f) Shutdown of vacuum pump(s) for high operating temperature.
 - g) Shutdown for motor overload.
 - h) Contacts for common trouble alarm.
 - i) Reset/lamp test feature.

- h. Technical Support
 - 1) Rietschle Inc. shall provide on site review of installation and operating procedures and operator training at initial start up of system.
- i. Extended Oil Reservoir – Two (2) each.
 - 1) Function: Increase fresh oil reservoir capacity to extend time period between refills.
 - 2) Material: Steel
 - 3) Capacity: < Insert capacity > Gallon
- j. Exhaust Auto-Drainage: One (1) lot.
 - 1) Provides for automated drainage of Exhaust Separator assemblies without interruption of the pump operation.
 - 2) One (1) lot - Control Panel Expansion
 - 3) Four (4) each - Drainage Valve
 - 4) One (1) each - Drainage Pump
 - 5) One (1) lot - Skid and Interconnecting Tubing
- k. Process Pressure Control
 - 1) This provides the option to manually set operating pressure to a specific set point and control to that pressure. Panel face will include process pressure control unit with readout of process pressure level.
- l. Modulation Valve Assembly One (1) each
 - 1) Function: Modulates gas/vapor flow to regulate process pressure.
 - 2) Type: I/P, 4020 m Amp input
- m. Absolute Pressure Transmitter One (1) each
 - 1) Function: Provides vacuum level input to controller to provide for process pressure control.
 - 2) Range: 0- 760 mmHg
 - 3) Output: 4 - 20 m Amp
 - 4) Wetted Surfaces: 316 Stainless Steel
- n. Process Control Unit One (1) each

- 1) Function: Provides signal to modulation valve for control of process pressure.
 - 2) Input: 4-20 m Amp
 - 3) Output: 4-20 m Amp
 - 4) Features: Digital display showing vacuum level, set point or valve position, manual or automatic operation.
- o. System shall be tested and labeled in accordance with UL.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean compressed air and vacuum equipment, accessories, and components that have not been cleaned for oxygen service and sealed or that are furnished unsuitable for laboratory air applications, according to CGA G-4.1, "Cleaning Equipment for Oxygen Service."

3.2 INSTALLATION – GENERAL

- A. Install the work in accordance with manufacturer's instructions, reviewed submittals, referenced codes, and referenced Sections of the Specifications.
- B. Mount all equipment and skids on individual concrete pads.
- C. Connect, calibrate and adjust devices and instrumentation to perform functions shown or specified.

3.3 COMPRESSED AIR EQUIPMENT INSTALLATION

- A. General Requirements for Compressed Air Equipment Installation:
1. Install compressed air equipment to allow maximum headroom unless specific mounting heights are indicated.
 2. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces unless otherwise indicated.
 3. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
 4. Install equipment to allow right of way for piping installed at required slope.
 5. Install the following devices on compressed air equipment:
 - a. Thermometer, Pressure Gage, and Safety Valve: Install on each compressed air receiver.
 - b. Pressure Regulators: Install downstream from air compressors, dryers, purification units, and filter assemblies.

- c. Drain Valves: Install on after coolers, receivers, and dryers. Discharge condensate over nearest floor drain.

B. Nonmedical Laboratory Compressed Air Equipment Installation:

1. Install compressed-air equipment, except wall-mounted equipment, on cast in place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Architectural Specification Section "Miscellaneous Cast in Place Concrete."
2. Comply with requirements for vibration isolation and seismic control devices specified in Division 22 Specification Section "Vibration and Seismic Controls for Plumbing Piping Systems."
3. Comply with requirements for vibration isolation devices specified in Division 22 Specification Section "Vibration and Seismic Controls for Plumbing Piping Systems."

3.4 VACUUM EQUIPMENT INSTALLATION

- A. Install vacuum equipment for healthcare facilities according to ASSE 6010 and NFPA 99.

B. Equipment Mounting:

1. Install vacuum producers on cast in place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Architectural Specification Section "Miscellaneous Cast in Place Concrete."
2. Comply with requirements for vibration isolation and seismic control devices specified in Division 22 Specification Section "Vibration and Seismic Controls for Plumbing Systems."
3. Comply with requirements for vibration isolation devices specified in Division 22 Specification Section "Vibration and Seismic Controls for Plumbing Systems."

- C. Install vacuum equipment anchored to substrate.

- D. Orient equipment so controls and devices are accessible for servicing.

- E. Maintain manufacturer's recommended clearances for service and maintenance.

- F. Install the following devices on vacuum equipment:

1. Thermometer, Vacuum Gage, and Pressure Relief Valve: Install on each vacuum pump receiver.
2. Drain Valves: Install on receivers and separators. Discharge receiver condensate over nearest floor drain. Discharge separator oral evacuation fluids by direct connection into sanitary waste piping system.

3.5 CONNECTIONS

- A. Comply with requirements for water supply piping specified in Division 22 Specification Section "Domestic and Laboratory Water Piping Systems and Specialties." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Comply with requirements for drain piping specified in Division 22 Specification Section "Sanitary, Chemical and Vent Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- C. Comply with requirements for compressed air and vacuum piping specified in Division 22 Specification Section "Laboratory Piping Systems and Specialties." Drawings indicate general arrangement of piping, fittings, and specialties.
- D. Where installing piping adjacent to equipment, allow space for service and maintenance.
- E. Connect compressed air and vacuum piping to compressed air and vacuum equipment, accessories, and specialties with shutoff valve and union or flanged connection.
- F. Connect water supply to compressed air equipment that requires water. Include backflow preventer. Backflow preventers are specified in Division 22 Specification Section "Domestic and Laboratory Water Piping Systems and Specialties."

3.6 IDENTIFICATION

- A. Identify nonmedical laboratory compressed air equipment system components. Comply with requirements for identification specified in Division 22 Specification Section "Identification for Plumbing Piping and Equipment."

3.7 FIELD QUALITY CONTROL FOR HEALTHCARE FACILITY MEDICAL COMPRESSED AIR EQUIPMENT

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform the following tests and inspections [with the assistance of a factory-authorized service representative].
 - 1. Medical Compressed Air Equipment Testing Coordination: Perform tests, inspections, verifications, and certification of medical compressed air equipment concurrently with tests, inspections, and certification of [medical vacuum equipment] [medical vacuum piping] [medical compressed-air piping] [and] [medical gas piping] systems.
 - 2. Preparation: Perform medical compressed air equipment tests according to requirements in NFPA 99 for the following:

- a. Air quality purity test.
 - b. System operation test.
3. Equipment Verification: Comply with requirements in ASSE 6020, ASSE 6030, and NFPA 99 for verification of medical compressed air equipment.
 4. Replace damaged and malfunctioning controls and equipment.
 5. Testing Certification: Certify that specified tests, inspections, and procedures have been performed and certify report results. Include the following:
 - a. Inspections performed.
 - b. Procedures, materials, and gases used.
 - c. Test methods used.
 - d. Results of tests.
- D. Components will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.

3.8 STARTUP SERVICE

- A. Engage a factory authorized service representative to perform startup service.
1. Complete installation and startup checks according to manufacturer's written instructions.
 2. Check for lubricating oil in lubricated type equipment.
 3. Check belt drives for proper tension.
 4. Verify that air compressor inlet filters and piping are clear.
 5. Check for equipment vibration control supports and flexible pipe connectors and verify that equipment is properly attached to substrate.
 6. Check safety valves for correct settings. Ensure that settings are higher than air compressor discharge pressure, but not higher than rating of system components.
 7. Check for proper seismic restraints.
 8. Drain receiver tank(s).
 9. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 10. Test and adjust controls and safeties.
- B. Prepare written report documenting testing procedures and results.

3.9 DEMONSTRATION

- A. Engage a factory authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air compressors, vacuum pumps and deionizing equipment.

END OF SECTION 226700