

SPECIAL SPECIFICATION
SECTION 15213S
CLEAN COMPRESSED AIR SYSTEM

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Rotary screw drive compressors.
- B. After-coolers
- C. Receiver
- D. Regenerative air dryer
- E. Refrigerated dryer.
- F. Pipes, valves and fittings.
- G. Receiver.**
- H. Accessories.

1.02 RELATED SECTIONS

- A. Section 13085-S - Seismic Protection.
- B. Section 15060 - Hangers and Supports.
- C. Section 15070 - Vibration **Limits and Controls**.
- D. Section 15K-S – Compressed Gas Piping - Interior.
- E. Section 15950 - Testing, Adjusting and Balancing.
- F. Section 16269 – Variable Frequency Controllers (VFC)
- G. Section 16001-S – Electrical Work.

1.03 REFERENCES

- A. ASME P T C 10 - Compressors and Exhausters.
- B. ASME Code for Unfired Pressure Vessels.

1.04 SUBMITTALS

- A.** Include certified data for each unit and accessory system indicating following:
 - 1. Air compressor performance curves at summer design condition.
 - 2. Intercooler performance curves at summer design condition
 - 3. Regenerative air dryer performance at minus 40 degrees F dew point at 150 psig
 - 4. Refrigerated air dryer performance at 40 degrees F dew point at 150 psig
- B.** Indicate components, assembly, dimension, weights and loading, required clearances, location and size of field connections, intake air filter outline, main motor drive data, aftercoolers, VFC, control panel and electrical and pneumatic schematics
- C.** Factory test: Submit certified test report for the completely assembled air compressor package including the motor, intercooler, lube oil system and control panel. Indicate performance at maximum rated flow, rated point and surge conditions. Including performance of all accessories including aftercooler, intercooler, lubrication and control systems.
- D.** Provide operation and maintenance manual.

1.05 QUALITY ASSURANCE

- A.** Regulatory Requirements:
 - 1. Conform to ASME PTC10 for certificate of performance
 - 2. Conform to ASME Boiler and Pressure Vessel Code, Section B, pressure vessel
 - 3. Wastewater discharge Limitation Permit No. 2069G-2
- B.** Manufacturer Qualifications: Company specializing in manufacture of the products specified with a minimum three years's experience and minimum two year's experience with air compressors of the same design, construction, frame and of equal or larger capacity than those proposed for installation.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A.** Variable Speed Oil Free Rotary Screw Air Compressor: Atlas Copco
- B.** Regenerative Air Dryer: Hankinson
- C.** Refrigerated Air Dryer: Hankinson

2.02 MANUFACTURED UNITS:

- A. Provide factory assembled and tested, packaged, oil free rotary screw drive air compressors
- B. Include variable speed drives, gear assembly staged compressors, intercooler, and moisture separator, aftercooler and separator, condensate drain system, instrumentats, controls, pressure lubrication system with pre-lube system and shaft drive main oil pump, steel or iron base and accessories.
- C. Provide oil free rotary screw drive air compressors each having the capacity indicated on the drawings.
- D. Provide inlet air filtration efficiency of 98 percent of 4 micron size, maximum air leakages through seals and compressor interconnections of two percent, maximum average overall sound pressure level of 85 dBA measured one meter horizontal from compressor and 1.5 meters above floor with a maximum of 90 dBA for any one octave "and and maximum cooling water pressure drop through system of 21 pounds per square inch-gage at full cooling water flow rate.
- E. Design the compressor to unload prior to surge limit and to provide full capacity over the entire range of winter and summer design conditions.
- F. Critical Speeds: Provide unit such that start-up and shutdown of rotating equipment does not cause damage as critical speeds are passed and critical speed does not encroach on operating speed at specified load range. Measure amplitude of vibration during factory test and assure that maxmum double amplitude of vibration in any place measured on the shaft adjacent and relative to the radial bearing does not exceed two mils.
- G. Individually dynamically balance major parts of rotating elements such as impellers, balancing drums, etc.

2.03 COMPRESSOR

- A. Integrally geared centrifugal with a minimum of two rotary screw compression stages with low compression ratio, temperature and ekernal noise level.
- B. Provide accessibilitv, to shaft seals and bearings for inspection and replacement with a minimum of disassembly.
- C. Casing: Cast iron, ductile iron or cast steel pith casing, supports and base plates designed to preclude excessive and injurious distortion from temperatures, pressures and forces encountered in service conditions including surge. Provide Jackscrews, lifting lugs, eye bolts, guide dowels and casing alignment dowels to facilitate disassembly and reassembly.
- D. Shafts: Forged or rolled alloy steel machine finished throughout entire length.
- E. Rotors: presision-mashined with coating.
- F. Gears: AGMA 390.03 Quality Number 11 or better alloy steel for bull and pinpion gears, hardened to 275 Brinnell for bull gear and 320 Brinell for pinion gear. Grind gears to required contours so that break-in period in the feld is not required for proper operation.

- G.** Seals: Provide separate air and oil shaft seals to confine air in the casing and prevent contamination of the air stream by lubricating oil. Provide air space vented to atmosphere between the air and oil seals.
- H.** Thrust Bearings: Provide hydrodynamic (fluid film), tapered land type thrust bearings on the individual pinion gear or transferred to the bull gear shaft by tapered conical, rider ring thrust collars to absorb axial impeller thrusts.
- I.** Radial Bearings: Provide hydrodynamic (fluid film) bored sleeve or pad-type radial bearings.
- J.** Intercoolers and Aftercoolers: Provide intercoolers and aftercoolers constructed of copper tube sheets with plate fins and baffles for optimum cooling. Provide intercooler between stages of compression either integral with unit or factory assembled on unit base with piping connected. Aftercoolers may be mounted separately. Factory test intercooler and aftercooler at 1.5 times operating pressure. Construct in accordance with ASME Boiler and Pressure Vessel and ASME stamped for 175 pounds per square inch-gage working pressure. Provide with one-piece bundle removal design. Design coolers with approach temperature to meet required aftercooler output temperature with minimum 20 degrees F approach for intercooler and 15 degrees F approach for aftercooler. Design compressor to accept 55 degrees F cooling water.
- K.** Condensate: Provide a minimum of one condensate trap per stage with all required piping and bypass valves.
- L.** Lubrication System: Include reservoir, shaft driven positive displacement pump single oil cooler, single filter/strainer and parallel piping and valving provisions accommodate separately driven pre-lube system for start-up and standby. Construct coil cooler with copper tubes in carbon steel tube sheets with plate fins and baffles. Factory test assembly at 1.5 times operating pressure. Design oil cooler for a 15 degrees F approach and fouling factor of 0.001 on the tube and 0.0005 on the shell side.

2.04 PRE-LUBRICATION PUMP

- A.** Provide positive displacement gear pump separately mounted with motor on a common base. Construct with cast iron case, hardened steel gears and shaft, bronze bearings and mechanical seal. Provide NEMA Design A, Class B insulation, totally enclosed motor with motor starter mounted and wired.

2.05 LUBE OIL HEATER

- A.** Provide thermostatically controlled heater in lubrication oil sump of sufficient capacity to heat and maintain manufacturer's recommended oil temperature when unit is cold at 32 degrees F. Lube oil heater contactor to be mounted and wired.

2.06 MAIN ELECTRIC DRIVE MOTOR

- A. Provide induction motor of the horsepower indicated on the drawings with a minimum continuous service factor of 1.15. Provide **and install a variable frequency conforming to specification 16269 without a manual by-pass.** Design system, including motor and control systems to prevent motor overload over the entire range of operation condition. Adjust the motor rating for the altitude. Provide motor with full Class F insulation

2.07 CONTROL PANEL

- A. Provide factory assembled and mounted control panel package. complete with connections made to sensing points. Allow for terminal connections for remote monitoring of system on facilities management system console.
- B. Fabricate panel of formed sheet steel with gasketed doors meeting NEMA 12 requirements. Factory finish paint panel.
- C. Provide start and stop buttons, vibration monitor. discharge air pressure indication. control test switch, reset button, compressor running indication and control selector switch in panel along with pilot lights for alarm device.
- D. Provide lube heater contactor, pre-lube pump starter and control transformer. Provide microcontroller to read, alarm and trip oil pressure and temperature and interstage and discharge temperatures.

2.08 ELECTRICAL CONNECTION

- A. **Provide single point of electrical connection for each compressor.**

2.09 ACCESSORIES

- A. Pneumatically controlled valves on suction inlet of compressor for modulation control. Mount valves on unit with all control tubing connected.
- B. Weatherproof air intake filter silencer with two-stage filter.
- C. Stainless steel bellows type flexible connection with braided steel cover jacket and stainless steel inner sleeve. 18 inch nominal length bellows. flanged ends. Class 150.
- D. Check valve with stainless steel trim mounted on discharge line of the air compressor.
- E. High/low limit amp control.
- F. Provide remote intake adaptor for the compressor and connect to 8"x28" air duct

2.10 CLEAN DRY AIR DRYER

- A. Provide heatless type, regenerative desiccant air dryer for clean dry air capable of delivering the required air flow indicated on the drawings at dew point of minus 40 F. Provide packaged unit containing twin towers (pressure vessels) desiccant dryer, controls, and filters ahead of dryer and after dryer.

- B. Provide pressure vessels containing desiccant beds which are capable of delivering air across the desiccant bed at a velocity not great than 60 feet per minute at 100 pounds per square inch-gauge. Size bed with sufficient desiccant so that the effect of desiccant aging are negated and the pressure drop through the dryer is less than 3 pounds per square inch-gauge at rated conditions
- C. Provide each tower with fill and drain ports so that desiccant can be replaced without disconnecting piping, pressure relief valve and pressure gauge. Mount cleanable stainless steel air diffusers on the inlet and outlet of each tower to prevent air channeling. Construct pressure vessels in accordance with ASME for a maximum working pressure of 150 pounds per square inch-gauge.
- D. Provide front mounted NEMA 4 enclosure which contains ON/OFF switch, power on light and solid state timer. Include jumper switch on timer to set cycle time at four or ten minutes and an economizer switch to reduce purge time when operated at less than maximum flow capacity. (Install timer to sequence operation of inlet and purge/repressurization valves and check valves so that one tower is drying the main air stream while the other tower is being regenerated. Control valves are non-lubricated. Check valves are soft seated.
- E. Regulate purge air by a manual valve and pressure reducing orifice. Indicate purge rate by a purge flow indicator. Exhaust purge air through mufflers to reduce noise level. Include silencing muffler with unit.
- F. Provide normally open air inlet valves and normally closed purge and repressurization valves to maintain a supply of dry air downstream until desiccant bed is saturated in the event of a power failure and to isolate the desiccant bed from ambient air when the unit is de-energized.
- G. Provide light to indicate power is ON to the unit and a moisture indicator to indicate elevated dew point.
- H. Provide NEMA 4 active tworer indicator lights, NEMA 4 switching failure alarm.

2.11 REFRIGERATED AIR DRYER

- A. Provide refrigerated air dryer of self-contained mechanical refrigeration type complete with heat exchanger, refrigeration compressor, automatic controls, moisture removal trap, internal wiring and piping, and full refrigerant charge.
- B. Provide air inlet and outlet connections at same level and factory insulated.
- C. Heat exchangers to consist of air-to-air and refrigerant-to-air coils. Provide centrifugal type moisture separator located at discharge of heat exchanger. Provide heat exchangers with utomatic control system to bypass refrigeration system on low or no load condition.
- D. Refrigeration unit of hermetically sealed type to operate continuously to maintain specificc 40 degrees F dew point. House unit in steel cabinet provided with access door and panel for maintenance and inspection.
- E. Provide dryer with air inlet temperature gauge, air inlet pressure gauge, ON/OFF switch, high temperature light, power on light and refrigerant gauge.

- F. Provide bypass piping at the refrigerated dryer and automatic drains.

2.12 ACCESSORIES FOR DRYERS

- A. Provide dryers with two 0.1 micron coalescence filters ahead of the dryers and automatic condensate drain valve. Provide the desiccant dryers with two one micron filters and two 0.1 micron final filters after the desiccant dryers. Provide the refrigerated dryer with two 0.1 micron final filters after the refrigerated dryer.
- B. Complete wire assembly and test unit at factory before shipment.
- C. Mount dryers at location suitable for servicing and replacing the desiccant.
- D. Do not use pipe smaller than 1/2-inch at dryer outlet. Provide pipe increasers as required.
- E. Provide pipe connections free of joint compound, metal chips or foreign material
- F. Assemble pipe connections with teflon tape.
- G. Provide rigid structural support to concrete pad and support dryers independently of the piping system.

2.13 AIR RECEIVER

- A. Provide horizontal receiver stamped ASME rated for working pressure of 167 pounds per square inch. Flange or screw inlet connections, welded steel construction.
- B. Fitting to include safety relief valve, pressure gauge, drain cock and electrical operated automatic drain valve with bypass.
- C. Tank Finish: Factory finish to match compressor
- D. Interior surface finishing: epoxy coated
- E. Complete wire assembly and test unit at factory before shipment.
- F. **Provide integral welded saddle and seat support to install tank suspended in horizontal position.**

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's recommendations.
- B. Install on 4-inch housekeeping pad.
- C. Provide for connection to electrical service.
- D. Align air compressor and dryers on concrete foundations. Level, grout and bolt in place.
- E. Provide vibration isolation between unit and structural support.

- F. Provide connection to compressed air piping and air drier system.
- G. Install receiver suspended in horizontal position with threaded rods and beam clamps.**
- H. Provide training in the operation and maintenance of the compressor, associated equipment and all control and safety devices.

END OF SECTION