

WATER-COOLED, OIL-FREE AIR COMPRESSOR

Frame 0, 1, 2, 3 50 – 500 HP

0123_WaterCooled

Effective: 01-01-21

Supersedes: 10-01-17

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1. SPECIFICATIONS SCOPE

- 1.1 This specification covers the requirement for supply of a packaged oil-free rotary screw air compressor, Rogers KNW Series® model _____.
- 1.2 Any and all exceptions to the specifications shall be clearly identified in the proposal under a section entitled, "Exceptions to Specifications."

2. GENERAL REQUIREMENTS

- 2.1 The manufacturer shall supply a positive displacement, two-stage rotary screw air compressor capable of delivering 100% oil-free air. There shall be no lubricants in the compression chamber. The assembly shall be fully packaged, including air compressor, main drive motor, oil cooler, intercooler and aftercooler, separate motor driven lubrication system, regulation and control systems, all mounted on a common base frame and fully enclosed by a steel sound dampening enclosure. A solid-state reduced voltage motor starter shall be standard.
- 2.2 The compressor shall be the manufacturer's standard oil-free, two-stage rotary screw air compressor package. The compressor shall consist of two compressor stages connected to an integral speed increaser. Each stage is to be driven from a common bull gear to ensure optimum speed and high efficiency. There shall be a water-cooled intercooler between the first and second compression stages and a water-cooled aftercooler installed after the final stage. Each stage shall incorporate a condensate separator with fail safe automatic drain.
- 2.3 The capacity shall be expressed in terms of free-air delivery at cubic feet per minute measured at the discharge pressure and related back to inlet conditions. The capacity and specific power shall be guaranteed per modified ASME PTC9. The free-air delivery and specific power quoted shall be within the following tolerances:

Air Delivery $\pm 4\%$

Power Consumption ... $\pm 5\%$

The compressor shall be rated at _____ SCFM at _____ PSIG discharge pressure and be suitable for use on ___ volts, ___ phase, ___ Hz.

3. **COMPRESSOR UNIT**

3.1 **Casing**

The compressor air end shall be an ASTM A48 Class 40 housing with precision manufactured, helical screw type rotors. The housing shall have cooling jackets. Male and female rotors and rotor casing shall have a PTFE coating for corrosion resistance.

3.2 **Rotors**

Rotors and shafts shall be one-piece ASTM 1144 steel construction with corrosion resistant PTFE coating. Internal rotor cooling shall not be required. Rotors shall have an asymmetric profile to ensure high efficiency. Rotors shall be dynamically balanced to guarantee vibration-free operation. Thrust compensation shall be incorporated on the male rotor of each stage to increase bearing life. Rotary tooth or water injected type compressors shall not be acceptable.

3.3 **Timing Gears**

Precision timing gears shall be manufactured of chromium molybdenum steel and be fitted to the rotor shafts and shall maintain precise rotor-to-rotor clearance. Gears shall be designed to assist in thrust canceling and absorb no more than 10% of input power under full load.

3.4 **Bearings**

Vacuum degassed, anti-friction bearings shall be incorporated on each rotor. Radial loads shall be carried by roller bearings. Axial loads shall be carried by ball bearings. Thrust bearings include a thrust balancing arrangement on each male rotor for maximum bearing life. Radial and thrust bearings shall be installed on each end of each rotor. Eight bearings total per air end.

3.5 **Speed Increaser**

A speed increaser shall be an integral part of the compressor unit and include the main drive shaft bull gear. The main drive shaft shall be supported through anti-friction bearings on both sides of the bull gear to eliminate overhung loads. The gear train shall be so designed to be thrust canceling. Main drive shaft shall be fitted with a stainless-steel labyrinth oil seal.

3.6 Seals

The seals shall be restrictive ring type, self-adjusting and centering and constructed of stainless steel. The oil and air seal chambers shall be vented to atmosphere to prevent any possible contamination of the compressed air stream. All air and oil seals shall be free floating non-wearing type. Carbon seals shall not be acceptable.

3.7 Gaskets

All gaskets shall be asbestos free.

3.8 Coolers

The compressor cooling package shall have single point connections for cooling water supply and discharge. Tube bundles shall be removable for cleaning and inspection. The cooling water supply and discharge shall be manifolded to the following coolers:

3.8.1 Water-cooled oil cooler.

3.8.2 Water-cooled intercooler complete with automatic temperature regulating valve, moisture separator and fail-safe automatic drain.

3.8.3 Water-cooled aftercooler complete with moisture separator and fail-safe automatic drain.

3.8.4 The cooling fan shall be driven by a separate motor, starting and stopping, with the oil pump for maximum cooling during start-up and shutdown.

3.8.5 All coolers shall be parallel-flow heavy duty construction to achieve maximum cooling efficiency and shall be rated for 150 PSIG at 450 degrees F. operating conditions.

3.9 Drive Motors

The motor shall be horizontal ball bearing of standard manufacturer NEMA design B with class B temperature rise and class F. insulation. Premium efficiency motor shall be standard. Motors shall be inverter duty as standard.

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- 3.9.1** The main drive motor and oil pump motor shall be C flange connected through a non-lubricated coupling for permanent shaft alignment.
- 3.9.2** The cooling fan motor shall be total enclosed fan-cooled (TEFC) for maximum service life.

3.10 Lubricating System

- 3.10.1** Lubrication oil for the compressor shall be contained in an integral sump. Sump breather element shall be located inside compressor enclosure.
- 3.10.2** A separate oil pump driven by its own motor shall be provided to ensure positive lubrication at start-up when gear and bearing loads are at their peak. Oil pump driven by main motor or compressor shaft is not acceptable.
- 3.10.3** The drive gear, all bearings and timing gears in each stage shall be spray lubricated. Main oil circuit hoses shall be stainless steel construction with SAE fittings.
- 3.10.4** All bearings and timing gears shall be pre-lubricated for 20 seconds prior to start-up and continue to be lubricated for 30 seconds after shutdown. This time period for lubrication shall be monitored and controlled by the unit's internal control system.

3.11 Pressure Regulating System

The regulating system shall be a full load/no load or VFD type for maximum efficiency.

3.12 Control System

- 3.12.1** The control system shall be integral with the compressor package and shall consist of an electro-pneumatic regulator, designed to provide manual and automatic running. The capacity control valve shall be a positive closing disc type with fixed orifices for trouble-free, operation. Unloaded bhp shall not exceed 18% of full load power consumption. The control system voltage shall be maximum of 115 volts, 60 Hz. The control system shall provide automatic

shutdown of the compressor during periods of excessive idling. Intake air for compressor shall be drawn from outside the enclosure.

3.12.2 The control system shall be controlled and monitored by an Allen Bradley Programmable Logic Controller (PLC). This controller will initiate and sequence the events during start-up, operation, and shutdown. The PLC will monitor system functions, safety devices, and instrumentation. The PLC will incorporate an SD Card program storage. This device shall enable control sequences to be changed on site or in the manufacturer's factory to meet future plant needs. Compressor temperatures and pressures shall be monitored using Smart Sensor technology and I/O-Link communication. The control system shall provide for the following:

- a) Start oil pump to ensure positive lubrication prior to compressor start-up.
- b) Start cooling fan when oil pressure is established.
- c) The compressor shall start unloaded and shall shut down unloaded, ensuring maximum component life.
- d) The oil pump shall continue to run after the compressor stops.
- e) Stop cooling fan motors after oil pump is stopped to exhaust latent heat.
- f) Dry contacts are provided for remote indication of power failure or fault conditions and run indication.
- g) The control system shall provide automatic shut-off of the compressor if it remains unloaded for 15 minutes to conserve energy and shall automatically restart compressor on demand.
- h) Service indication shall be provided when it is time to perform routine maintenance.
- i) Shutdown indication shall occur with "first out" (first failure) feature when abnormal operating parameters are reached. Pre-alarms shall be required for all temperature shutdowns.
- j) Shall be adaptable to accept optional automatic or manual lead/lag control, sequencer control, automatic restart following

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power failure, remote start/stop control, or other controls as may be required for future plant needs.

- k) Shall be expandable to automatically start dryers, pumps, cooling tower, or other remote devices.
- l) Shall be capable of recording time and day of last alarms/events.

3.13 Monitoring Equipment / Human Machine Interface (HMI)

3.13.1 Operator interface shall be ten-inch (10”) touch screen type with graphics, sunlight readable, and in color to read compressor data easily. Three configurable graphs for historical trending shall be standard. Compressor temperatures and pressures are monitored using Smart Sensor technology and I/O link communication.

3.13.2 Minimum Monitoring Equipment:

- a. First-stage discharge air pressure display.
- b. Second-stage discharge air pressure display.
- c. Oil pressure display.
- d. Air inlet filter condition indicator.
- e. Digital first-stage discharge air temperature display.
- f. Digital second-stage air inlet temperature display.
- g. Digital second-stage discharge temperature display.
- h. Digital oil temperature display.
- i. Low oil pressure indicator.
- j. Hour meter displaying running time.
- k. Hour meter displaying loaded time.
- l. Standby light.
- m. Power-on light.

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- n. Motor overload indication.
- o. Compressor run light.
- p. Oil pump run light.
- q. Fan run light.
- r. Load light.
- s. Manual unload button.
- t. Oil level gauge.
- u. Oil filter condition indicator.
- v. Alarm bell.
- w. Lamp test switch.
- x. Bell cancel switch.
- y. Service air and oil filter notification.
- z. Aftercooler outlet temperature display.

3.14 Safety Devices

Compressor shall have automatic shut-off devices for the following conditions:

- 3.14.1** Low oil pressure display.
- 3.14.2** High first-stage discharge air temperature.
- 3.14.3** High second-stage inlet air temperature.
- 3.14.4** High second-stage discharge air temperature.
- 3.14.5** High oil temperature.
- 3.14.6** Motor overload.
- 3.14.7** High cabinet temperature.

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- 3.14.8** Reset switch.
- 3.14.9** High after cooler temperature.
- 3.14.10** Pete's plugs shall be provided for all pressure transmitter locations.

The unit shall automatically stop, annunciate by alarm bell, and indicate the appropriate failure by alarm and text display. Alarm bell must remain on until manually reset.

3.15 Filter System

- 3.15.1** Air intake filters are to be enclosed in package and easily accessible for service. Air entering the filter shall be drawn from outside the compressor enclosure.
- 3.15.2** Filters shall be paper cartridge type with pre filter.
5 micron - 99% or greater efficiency.

3.16 Compressor Enclosure

- 3.16.1** The compressor unit, including motor, shall be enclosed in a sectionalized steel sound insulating canopy with doors to provide ready access for normal maintenance.
- 3.16.2** The doors shall be removable. Enclosure and base frame to be powder coated for long life and durable powder coated finish.
- 3.16.3** Sound insulating material shall be nominal 2 pounds per cubic foot polyether foam with UL94HP-1 flame resistance. Sound insulating material shall be 2 inches thick.
- 3.16.4** Enclosure shall be ventilated using a separate motor driven fan starting when oil pressure is established and stopping 5 seconds after the oil pump stops.

3.17 Noise Levels

The compressor package noise level shall not exceed 85 dBA at three (3) feet.

3.18 Installation Requirements

The compressor shall be designed so that the installation is simplified. No special foundations are required other than those necessary to fully support the weight of the unit on a level surface. The unit shall be delivered with all internal compressed air, water piping, and wiring complete. There shall be a 4-source hook-up for utilities, one for air discharge and one for incoming electrical service, one each for cooling water supply and cooling water discharge. All automatic drain lines shall be brought out of the cabinet for ease in connecting to floor drain. A wet control air receiver is required between the compressor and dryer.

4. OPTIONAL EQUIPMENT

The following optional equipment shall be included in the assembly provided. Check options required.

- 4.1** Lead/lag control for 2-machine operation. (Indicate: manual or automatic)
- 4.2** TEFC motor.
- 4.3** Circuit Breaker or Disconnect Switch.
- 4.4** ASME stamped, stainless-steel heat exchanger shells.
- 4.5** Sequencer for Multi-Machine Operation. (Specify quantity: 3, 4, 5, or 6 machines)
- 4.6** Weather Protection for Outdoor Operation.
- 4.7** Freeze Protection.
- 4.8** VFD (indicate preference of manufacturer)
- 4.9** Remote Communication Module (specify desired protocol).

END OF SECTION
