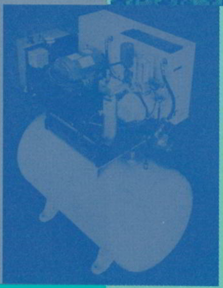
Rotary Air Compressor Selection Guide



CAGI

Compressed Air & Gas Institute
Rotary Positive Compressor Section

SECTION MEMBER COMPANIES

Atlas Copco Compressors Inc.

CompAir LeROI

Gardner Denver Machinery Inc.

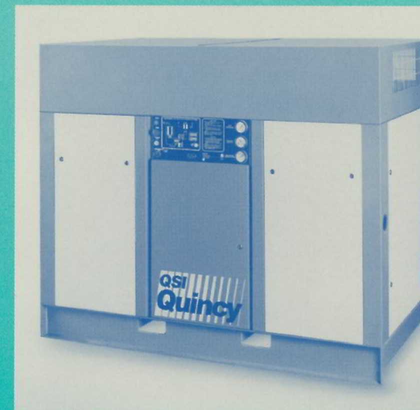
GHH - Rand

GrimmerSchmidt Corporation

Ingersoll - Rand Company

Quincy Compressor Division, Coltec Industries Inc.

Sullair Corporation



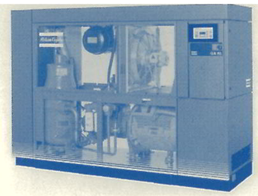
SCOPE

The scope of the Rotary Positive Compressor Section shall include: Rotary Positive Displacement Compressors and Vacuum Pumps. Such compressors may be oil free, forced feed lubricated or liquid injected, including but not limited to: sliding vane, lobe type, scroll, and helical screw.

These compressors shall include bare air ends, regardless of final package configuration, as well as packaged units. Packaged units will be stationary type or transportable (as distinct from engine driven portable compressors).

Member companies in this section manufacture compressors and vacuum pumps which operate on several different principles, although all employ positive displacement and rotary motion. Included among these products are rotary sliding vane compressors, both oil injected and forced feed lubricated; oil injected, water injected and dry type rotary helical lobe screw compressors; dry lobe type compressors; and liquid ring (or liquid piston) type compressors.

These are packaged in single and multi-stage configurations and have become the dominant types in industrial compressed air supply in a wide variety of applications.



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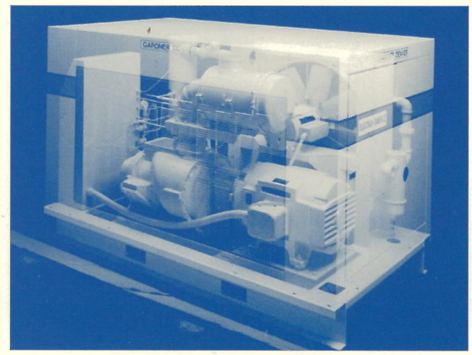
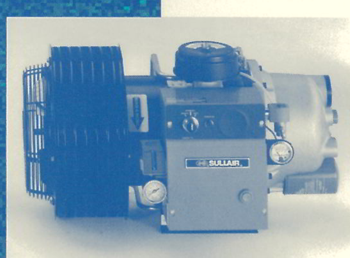
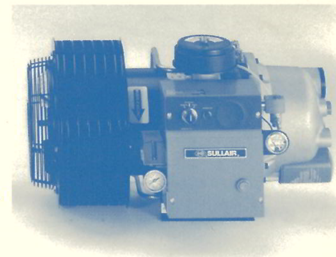




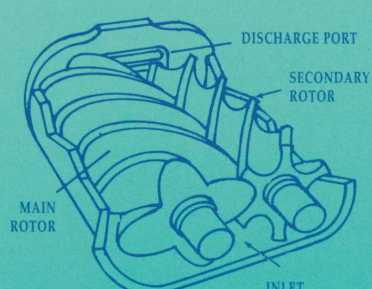
Oil Injected Rotary Screw Compressors



The Oil Injected Rotary Screw Compressor is a positive displacement type, which means that a given quantity of air or gas is trapped in a compression chamber and the space which it occupies is mechanically reduced, causing a corresponding rise in pressure prior to discharge.

The Oil Injected Rotary Screw Compressor consists of two intermeshing rotors in a stator housing having an inlet port at one end and a discharge port at the other. The **male** rotor has lobes formed helically along its length while the **female** rotor has corresponding helical grooves or flutes.

Air flowing in through the **inlet port** fills the spaces between the lobes on each rotor. Rotation then causes the air to be trapped between the lobes and the stator as the inter-lobe spaces pass beyond the inlet port. As rotation continues, a lobe on one rotor rolls into a groove on the other rotor and the point of intermeshing moves progressively along the axial length of the rotors, reducing the space occupied by the air, resulting in increased pressure. Compression continues until the inter-lobe spaces are exposed to the **discharge port** when the compressed air is discharged. This cycle is illustrated below.



Oil is injected into the compression chamber during compression and serves three basic functions:

1) It **lubricates** the intermeshing rotors and associated bearings.

2) It **takes away** most of the **heat** caused by compression.

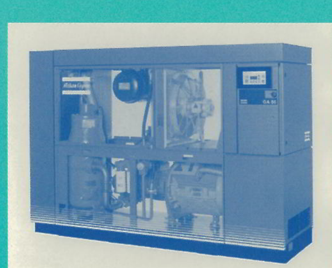
3) It **acts as a seal** in the clearances between the meshing rotors and between rotors and stator.

The generic term oil has been used. Generally this is understood to be a hydrocarbon product but most compressors now use cleaner and longer life synthetic lubricants, including diesters; polyglycols; polyalphaolefins and silicon based fluids. These newer products are suitable for a wider range of temperatures and have higher flash points.

A mixture of compressed air and injected oil leaves the air end and is passed to a sump/separator where the oil is removed from the compressed air. Directional and velocity changes are used to separate most of the liquid. The remaining aerosols in the compressed air then are separated by means of a coalescing filter, resulting in only a few parts per million of oil carry-over. Most Oil Injected Rotary Screw Compressor Packages use the air pressure in the oil sump/separator, after the discharge of the air end, to circulate the oil through a filter and cooler prior to re-injection to the compression chamber. Some designs may use an oil pump.

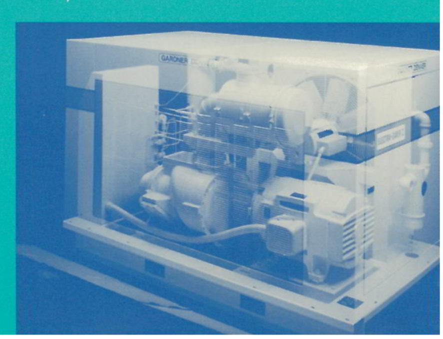
Single Stage Oil Injected Rotary Screw Compressor Packages are available from 3 - 900 hp, or 8 - 5000 cubic feet per minute, with discharge pressures from 50 - 200 psig. Two stage versions can improve specific power up to 15% and some can achieve higher discharge pressures. Oil Injected Rotary Screw Vacuum Pumps also are available from 120 - 3000 inlet cfm and vacuum to 29.9 in. Hg.

rotary

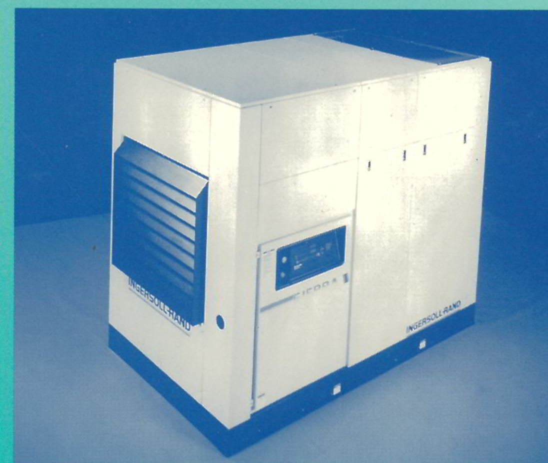


air

compressors



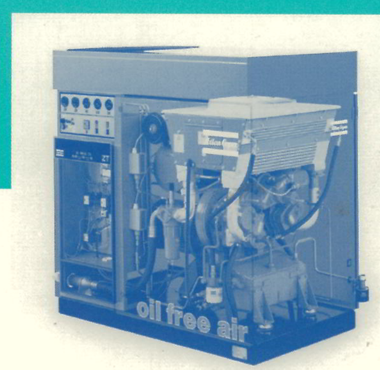
Oil Free
Rotary Screw Compressors



The Oil Free Rotary Screw Compressor also is a positive displacement type of compressor. The principle of compression is similar to that of the oil injected rotary screw compressor but without oil being introduced into the compression chamber. Two distinct types are available - the **dry type** and the **water injected type.**

In the **Dry Type**, the intermeshing rotors are not allowed to touch and their relative positions are maintained by means of lubricated timing gears external to the compression chamber. Since there is no injected fluid to remove the heat of compression, most designs use two stages of compression with an intercooler between the stages and an aftercooler after the second stage.The lack of a sealing fluid also requires higher rotative speeds than for the oil injected type.

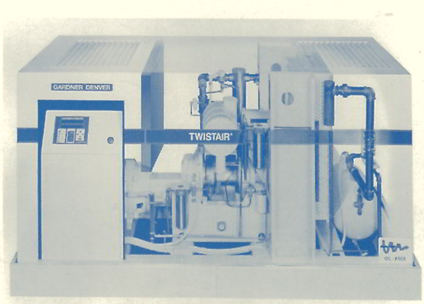
Dry Type oil free rotary screw compressors have a range from 50 - 4000 hp or 200 - 20,000 cubic feet per minute. Single stage units can operate up to 50 psig while two-stage generally can achieve 150 psig.



In the **Water Injected Type**, similar timing gear construction is used but water is injected into the compression chamber to act as a seal in internal clearances and to remove the heat of compression. This allows pressures in the 100 - 150 psig range to be accomplished with only one stage. The injected water, together with condensed moisture from the atmosphere, is removed from the discharged compressed air by a conventional moisture separation device.

Similar to the Oil Injected Type, Oil Free Rotary Screw Compressors generally are packaged with all necessary accessories.

Methods of capacity control are discussed later.



rotary

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compressors

Oil Injected Rotary Single Screw Compressors

The Rotary Screw Compressor normally refers to a compressor having two intermeshing rotors having parallel axes as described below. The Single Screw Compressor, as its name implies, has only one helically grooved rotor, normally arranged with a horizontal axis. Two meshing gate, or star, rotors are arranged one on each side of the helical rotor and with their axes at right angles to it.

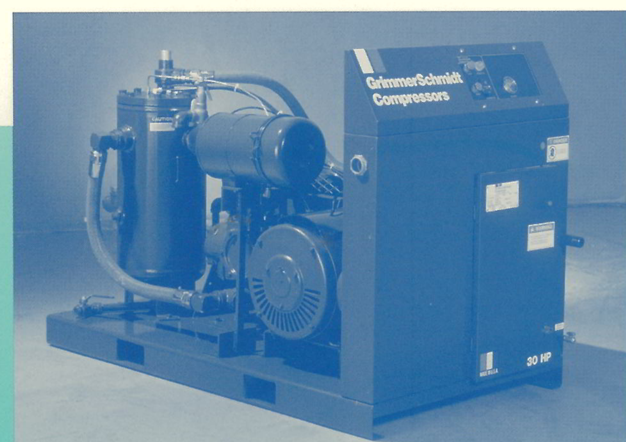
As for the standard Rotary Screw Compressor, the Single Screw Compressor is a displacement type, which means that a given quantity of air or gas is trapped in a compression chamber and the space is mechanically reduced, causing a corresponding rise in pressure prior to discharge.

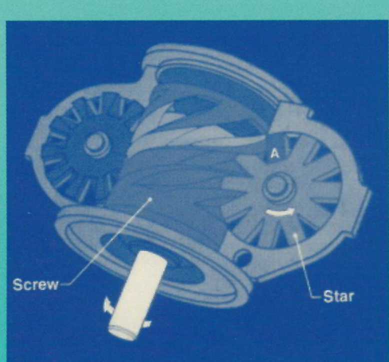
Air enters the compression chamber through an inlet port and compression begins when a tooth of a star rotor enters and seals the groove in the helical rotor. As rotation continues, the tooth follows along the path of the groove, reducing the space occupied by the air with a corresponding rise in pressure. When the discharge port is reached the compressed air is discharged. The two gate, or star, rotors allow compression to take place simultaneously on both sides of the helical rotor and maintain axial balance of the helical rotor but axial force is exerted on each gate rotor.

As with the conventional Rotary Screw Compressor, oil is injected into the compression chamber to lubricate, seal and take away the heat of compression.

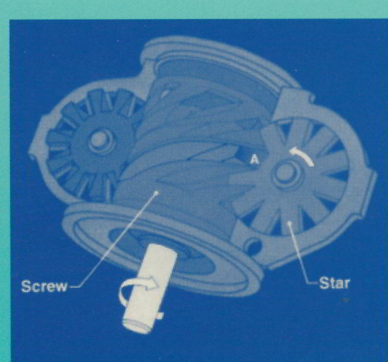
A mixture of compressed air and injected oil leaves the air end and is passed to a sump/separator where the oil is removed from the compressed air. Directional and velocity changes are used to separate most of the liquid. The remaining aerosols in the compressed air then are separated by means of a coalescing filter, resulting in only a few parts per million of oil carry-over. Most oil injected Rotary Screw Compressor Packages use the air pressure in the oil sump/separator, after the discharge of the air end, to circulate the oil through a filter and cooler prior to re-injection to the compression chamber. Some designs may use an oil pump.

Oil Injected Rotary Single Screw Compressor Packages are available from 20 - 150 hp and capacities from 62–700 acfm and pressures to 150 psig.

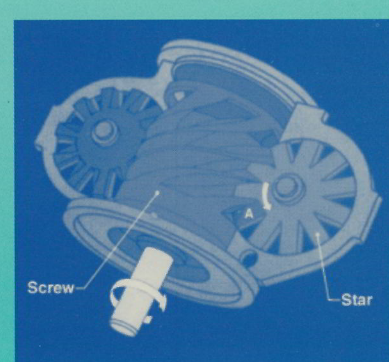




Compression starts when one tooth of the star enters the screw. A volume of air is trapped in the chamber formed by the groove, tooth, and casing.



As the screw rotates, the tooth follows along the groove's path, constantly reducing the volume available for the trapped air. Compression increases.



As the screw rotates, compression increases until the tooth reaches the discharge port in the casing. Here the fully compressed air discharges to the separator where lubricant is removed from the air and the compressor cycle is complete.

Oil Injected Rotary Sliding Vane Compressors

The Oil Injected Rotary Sliding Vane Compressor is a positive displacement type, which means that a given quantity of air or gas is trapped in a compression chamber and the space which it occupies is mechanically reduced, causing a corresponding pressure rise prior to discharge.

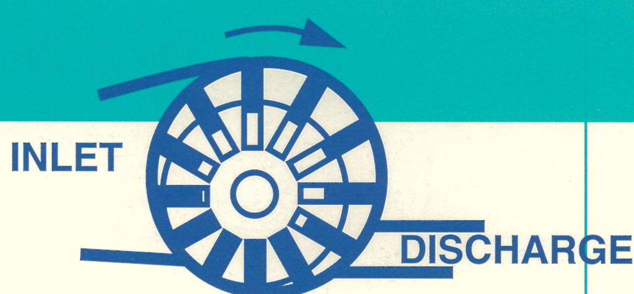
The basic design consists of a circular stator in which is housed a cylindrical rotor, smaller than the stator bore and supported eccentrically in it. The rotor has radial(sometimes off-set) slots in which vanes, or blades, slide. Rotation of the rotor exerts centrifugal force on the vanes, causing them to slide out to contact the bore of the stator, forming "cells" bounded by the rotor, adjacent vanes and the stator bore. Some designs have means of restraining the vanes so that a minimal clearance is maintained between the vanes and the stator bore.

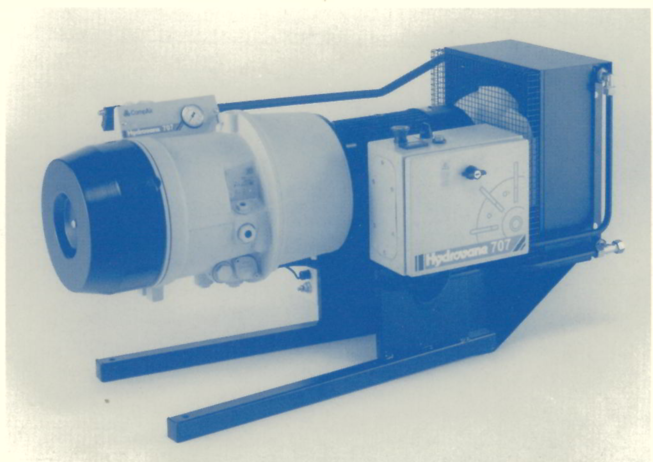
An Inlet Port is positioned to allow air to flow into each cell exposed to the port, filling each cell by the time it reaches its maximum volume. After passing the Inlet Port, the size of the cell is reduced as rotation continues, as each vane is pushed back into its slot in the rotor. Compression continues until the Discharge Port is reached, when the compressed air is discharged.

Similar to the Oil Flooded Rotary Screw Compressor, oil is injected into the compression chamber to act as a lubricant, as a seal and to remove the heat of compression. Single and two stage versions are available with either in-line or over-under arrangement of the stages.

The Sliding Vane Compressor normally is sold as a completely pre-engineered package in the range from 10 to 200 hp, with capacities from 40 to 800 acfm and discharge pressures from 80 to 125 psig.

This type of compressor is used in some portable air compressors but has largely been superseded by the Oil Injected Rotary Screw Compressor.





The Rotary Scroll Compressor

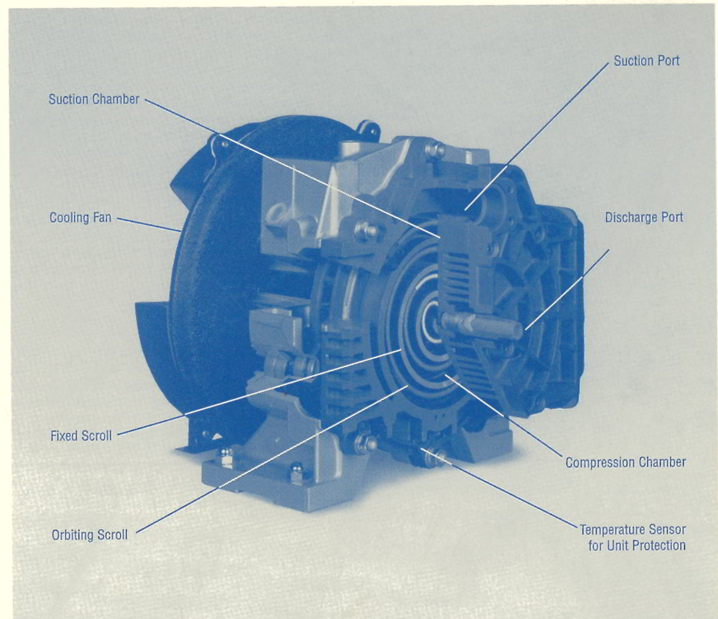
The rotary scroll compressor has become a popular compressor as a domestic air conditioning refrigerant compressor. More recently it has been introduced to the standard air compressor market in the lower end of the horsepower range of rotary air compressors.

The operating compression principle is accomplished by means of two intermeshing spirals or scrolls, one scroll being stationary and the other orbiting in relation to the stationary scroll. The stationary scroll is shown in black and the orbiting scroll in white. Air entering through the suction port in the stationary scroll, fills the suction chamber consisting of the outer labyrinth of the stationary scroll and on the outside edge of the orbiting scroll, as shown in the illustration at position 1. At this position, the portion of the compression chamber at an inter-mediate pressure is sealed by adjacent portions of the two scrolls.

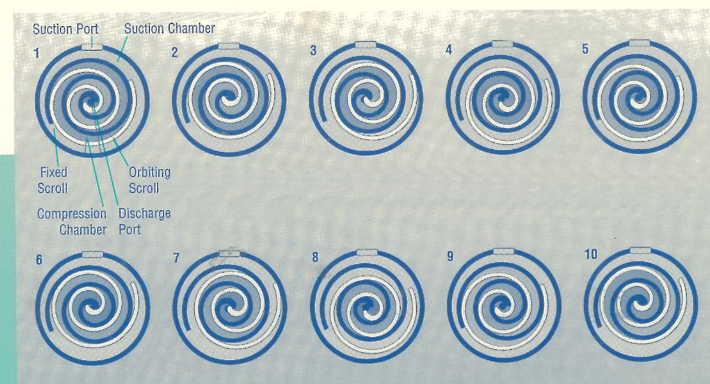
As orbiting continues, the space occupied by the air becomes progressively reduced as shown in steps 2 through 10 and moves progressively towards the discharge port in the center of the stationary scroll.

It should be noted that the flow through the Suction Port and through the Discharge Port is continuous, providing pulsation free delivery of compressed air to the system. There is no metal to metal contact between the scrolls, eliminating the need for lubrication in the compression chamber and ensuring oil free air delivery from the scroll compressor. However, without the removal of the heat of compression, the efficiency is less than comparable oil injected air compressors.

Current models are air cooled and range from approximate 6 to 14 acfm, 2 through 5 hp, with discharge pressures up to 145 psig. This size range



Rotary Scroll Compressor



Operating Compression Principle

is expected to steadily increase. Noise levels with a sound attenuating canopy are extremely low, in the range 52 - 59 dBA at 1 meter, in accordance with the CAGI/PNEUROP test code.

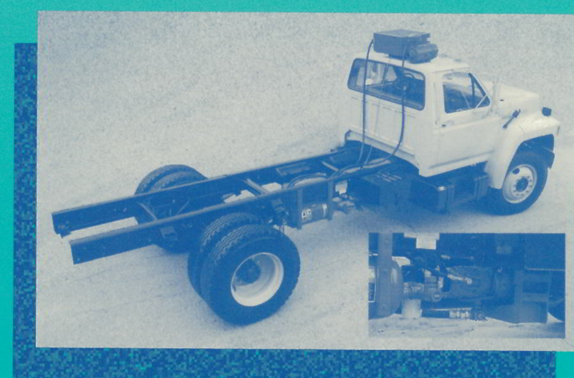
Capacity control generally is START/STOP as described under Capacity Control on page 9.

PTO Compressors

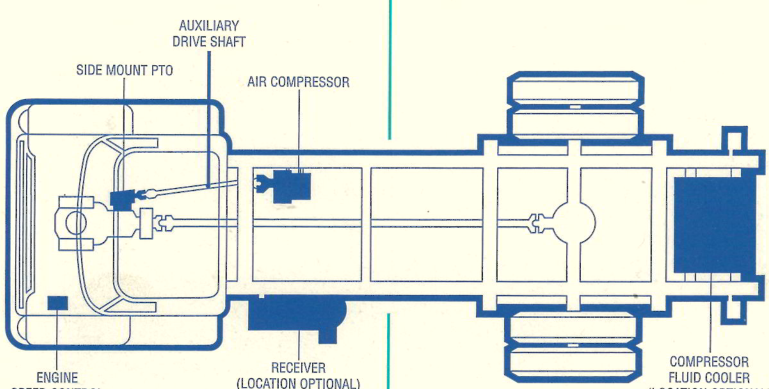
PTO means Power Take-Off. This refers to the means of driving from a source other than the conventional electric motor or an engine. Power may be transmitted from a gearbox mounted directly to the side of the engine transmission of the vehicle on which the compressor is mounted. Using the transmission counter-shaft (usually 2nd or 3rd gear), the desired speed and torque can be obtained through the PTO gear box to drive the compressor, either directly or through a pulley and belt drive arrangement.

The PTO compressor may also be driven by a hydraulic motor which receives its supply from a hydraulic pump driven by the truck engine.

Different configurations allow this type of compressor (Rotary Screw or Sliding Vane) to be accommodated either above or below the truck "deck", depending on truck design and available space. Coolers also may be mounted above the cab or below the rear deck. The fan drive may be through a hydraulic pump and motor using the same oil as for the compressor.



The most common application is on utility and telephone company trucks for independent operation and in remote locations. Capacities range from 85 to 250 acfm and pressures from 75 to 110 psig. Another application is pneumatic unloading of dry bulk materials from tanker trucks where capabilities range from 300-500 acfm and pressures from 22 to 36 psig.



rotary

air compressors

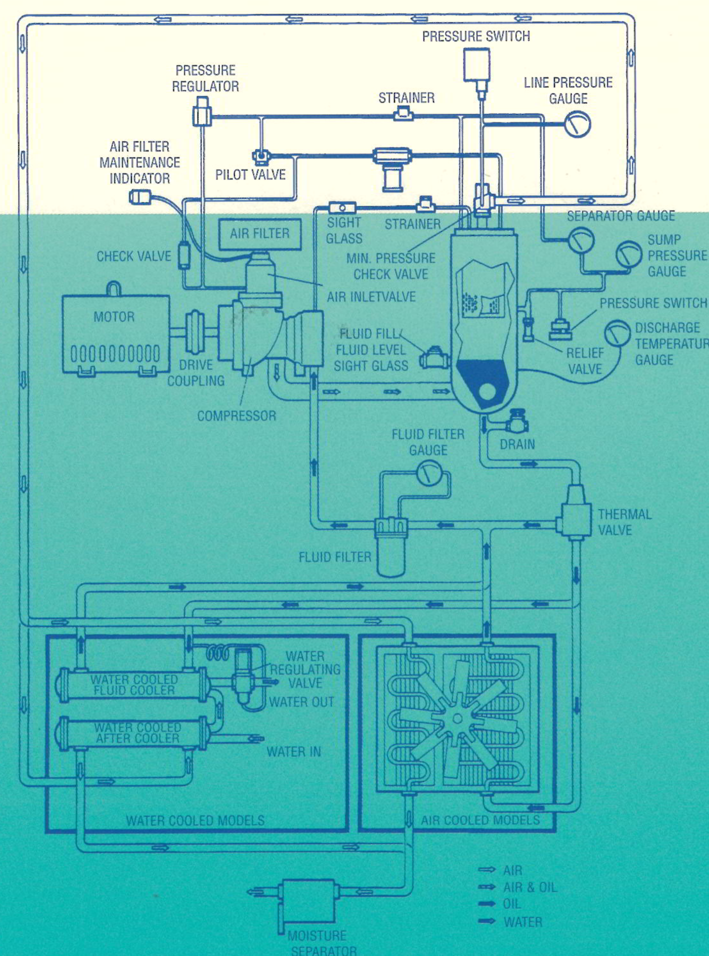
Capacity Controls for Rotary Displacement Type Air Compressors

Demand for compressed air seldom matches exactly the output from the compressor so some form of capacity control is essential. The type of capacity control is based on both the type and size of rotary air compressor, the application and the number of compressors in the system. Typical systems are as follows:

Start/Stop Control is the simplest form of control, in which a pressure switch sensing system pressure at the discharge of the compressor, sends a signal to the main motor starter to stop the compressor when a pre-set pressure is reached. When pressure falls to another pre-set pressure, the pressure switch sends a signal for the compressor to be restarted. The pressure switch will have an adjustable upper pressure setting and a fixed or adjustable differential between the upper and lower pressure settings. An air receiver is essential to prevent too frequent starting and stopping, which affects life of motor insulation due to high inrush current at each start. This type of control normally is limited to compressors in the 30 hp and under range. Its advantage is that power is used only while the compressor is running but this is off-set by having to compress to a higher receiver pressure to allow air to be drawn from the receiver while the compressor is stopped.

Constant Speed Control allows the compressor to continue to run, even when there is reduced or no demand for compressed air. This term may be used with **Load/Unload Control** and/or with **Inlet Valve Modulation.**

Load/Unload Control. In this type of control when the upper pressure setting is reached, the pressure switch sends a signal to open a blow-down valve installed in a line coming from the compressor discharge but prior to a discharge check valve. When the blow-down valve is opened, the compressor discharge pressure is lowered and the discharge check valve prevents back flow from the system or receiver. The lower discharge pressure reduces energy requirements. At the same time, the signal from the pressure switch also is arranged to close a valve at the inlet of the compressor, reducing the mass flow of air entering the compressor, further reducing power requirements although the pressure ratio across the compressor does increase. In the case of oil injected rotary compressors, the rate of blow-down must be limited to prevent foaming of the lubricant in the sump/separator.In oil free rotary compressors this is the most common type of control and requires an adequate receiver or system volume to prevent too frequent operation.



rotary air compres

Inlet Valve Modulation allows compressor capacity to be adjusted to match demand. A regulating valve senses system or discharge pressure over a prescribed range (usually about 10 psi) and sends a proportional pressure to operate the inlet valve. Closing (or throttling) the inlet valve causes a pressure drop across it, reducing the inlet pressure at the compressor and, hence, the mass flow of air. Since the pressure at the compressor inlet is reduced while discharge pressure is rising slightly, the compression ratios are increased so that energy savings are somewhat limited. Inlet valve modulation normally is limited to the range from 100% to about 40% of rated capacity, at which point the discharge pressure will have reached full load pressure plus 10 psi and it is assumed that demand is insufficient to require continued air discharge to the system. At this point the compressor will be unloaded as previously described.

Dual Control is a term used to describe a small rotary air compressor with a selector switch to enable selection of either Start/Stop or Load/Unload capacity control. This arrangement is suitable for locations where different shifts have substantially different compressed air requirements.

Slide Valve; Spiral Valve or Turn Valve is a device built in to the compressor casing to control output to match demand. Rising discharge pressure causes the valve to be repositioned progressively. This reduces the effective length of the rotors by allowing some bypass at inlet and delaying the start of compression. The inlet pressure and compression ratio remain constant so part load power requirements are less than for inlet valve modulation. The normal capacity range is from 100% to 40%, below which the compressor is unloaded.

Step Control Valves or Poppet Valves may be used to have a similar effect to Slide, Spiral or Turn Valves but with discreet steps of % capacity rather than infinitely variable positioning.

Automatic Dual Control is a further refinement to each of the above systems. When a compressor is unloaded a timer is started. If compressed air demand does not lower system pressure to the point where the compressor is required to be re-loaded before the pre-set time has expired, the compressor is stopped. The compressor will re-start automatically when system pressure falls to the predetermined setting.

Variable Speed Control is gaining acceptance as the cost for these drives decreases. In a positive displacement rotary compressor the displacement is directly proportional to the rotational speed of the input shaft of the air end. However, it is important to note that with constant discharge pressure, if efficiency remained constant over the speed range, the input torque requirement would remain constant, unlike the requirement of dynamic compressors, fans or pumps. The actual efficiency also may fall at lower speeds, requiring an increase in torque. Electric motors and controllers currently are available to satisfy these needs but their efficiency and power factor at reduced speeds must be taken into consideration. Steam turbines and engines also are variable speed drivers.

Multiple Compressor Sequencing is desirable in larger installations so that only a sufficient number of compressors will be in operation to meet current demand. Compressors are started and stopped, loaded and unloaded, as required to maintain current system requirements. It is desirable to have only one compressor in the system at any given time to be in a reduced capacity mode of operation. This optimizes energy requirements. Sequencing can be arranged to equalize running hours of each compressor or to operate the compressors in a specified sequence, particularly where there is a mix of larger and smaller compressors. The sequence can be changed manually or automatically. Most modern compressors have microprocessor controls which facilitate appropriate programming.

Instrumentation & Accessories for Rotary Displacement Type Compressors

Most rotary displacement type air compressors are sold as packages complete with driver and starter, air inlet filter, oil cooler, aftercooler (and intercooler where required), instrumentation and controls. An aesthetic enclosure also is common, providing sound attenuation.

Air inlet Filter normally is a dry type with pleated paper as the element. Coarse particle separation prior to the element may be achieved by a centrifugal action and two-stage elements may be employed for a higher degree of filtration or for dirty environments.

Coolers (Heat Exchangers) are required to take away the heat generated by compression. In an oil injected compressor, most of the heat is transferred to the lubricant/coolant fluid and is then removed in a heat exchanger prior to re-injection. The remaining heat is transferred from the compressed air after the oil separator and prior to discharge from the package. The aftercooler also condenses moisture in the compressed air so it should be followed by a moisture separator and condensate trap. Most oil injected rotary compressors have air cooled radiator heat exchangers which means that compressed air leaving the aftercooler will be about 15 deg. F (8 deg. C) above ambient temperature and most design for a maximum ambient temperature of 104 deg. F (40 deg. C), which also corresponds with standard electric motor ambient ratings. Higher ambient packages are optional or standard, depending on the manufacturer.

Automatic Water Valves. On water cooled packages, the water cooled heat exchangers may have a solenoid type water valve to shut off water supply when the compressor is not running. A water regulating valve sensing temperature may be added to use only the amount of water required to achieve the desired cooling.

Instrumentation. Discharge pressure and temperature indicators are essential to monitor operating conditions but additional indicators and safety feature also are required, including a pressure relief valve prior to any shut-off valve or the discharge check valve. Normally this is part of the sump/separator design. A high temperature shutdown device also is required at the discharge from the compressor air end. Maintenance indicators also are desirable for the air inlet filter, air/oil separator and oil filter. Except on the smallest compressors, conventional pressure and temperature gauges and electro-mechanical devices have been superseded by solid state or microprocessor controls which offer several additional features and benefits. Generally they have a schematic diagram on the panel so that components and status are readily identified and an LCD or LED display with appropriate messages. A communication port (RS232 or RS485) allows two way communication with other compressor panels or computer system.

External Accessories. Some desirable compressed air system accessories not included in standard compressor packages are as follows:

Air Receiver. This can provide storage of compressed air and isolate the compressor from widely fluctuating discharge pressures caused by intermittent demands and prevents too frequent operation of capacity control systems. It also may provide radiant cooling of the compressed air within it and condense some of the moisture remaining in the compressed air. The air receiver should meet ASME Code design, complete with pressure relief valve.

Compressed Air Dryer. Atmospheric air contains an amount of moisture which will vary with ambient temperature and relative humidity. The dew point (the temperature below which the moisture will condense) is higher after compression, so to avoid water in compressed air lines, it is desirable to pass the compressed air through a dryer to remove the moisture.

The most common type in industrial air plants is the **Refrigerant Type**, where a refrigerant loop is used to cool the air to 35 - 40 deg. F (2 - 5 deg. C) causing most of the moisture to be condensed and removed before the air is reheated and discharged to the system. This is equivalent to an atmospheric dew point of -7 to -12 deg. F.(-22 to -24 deg. C). Matching dryers of this type also have been designed to be incorporated into the compressor package.

For lower dew points the **Regenerative Desiccant Type** dryer is commonly used. The moisture is adsorbed by the desiccant medium in a tower while an adjacent tower is being regenerated by drying of the moisture which has been adsorbed. Standard dryers of this type normally are rated for a pressure dew point of -40 deg. F (-40 deg. C) but variations in design can accomplish down to -100 deg. F (-73 deg. C). This type of dryer requires an amount of the compressed air as purge air which can range from 5 to 15% of the total flow through the dryer. Compressor capacity must allow for this additional use.

Compressed Air Filters. Particulate filters are designed to remove solids from compressed air while coalescing filters are designed to remove liquids (oil or water). These can enhance the quality of compressed air to processes and tools but allowance must be made for the pressure drop across them.

ISO 8573-1, which the Compressed Air & Gas Institute helped formulate, divides air quality into different classes of content of particulate, moisture and oil.

This enables a user to determine the classes most suitable to his application and the type of accessories needed to obtain them.

Pressure Regulator. This allows a downstream pressure to be controlled within prescribed limits.

Air Line Lubricator. This is designed to inject oil mist into compressed air prior to a tool or cylinder requiring lubrication for efficient operation.

Filter/Regulator/Lubricator (FRL) is a combined assembly for installation close to the point of use.

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compressors

Glossary of Terms

Adiabatic compression. See Compression, adiabatic.

Aftercooler. Heat exchanger for cooling air or gas discharged from a compressor. Resulting condensate may be removed by a moisture separator following the aftercooler.

Air cooled compressor. A compressor having its compressed air and oil cooled by atmospheric air flowing across radiator type heat exchangers.

Air receiver. See Receiver.

Base plate. A metallic structure on which a compressor and its accessories are mounted.

Capacity. The actual volume flow rate of air or gas compressed and delivered from a compressor package but measured at prevailing conditions of pressure, temperature and composition prevailing at the inlet to the compressor.

Capacity, actual. The actual volume flow rate of air or gas compressed and delivered from a compressor running at its rated operating conditions of speed, pressures and temperatures. Actual capacity generally is expressed in actual cubic feet per minute (acfm) at conditions prevailing at the compressor inlet.

Capacity controls. The means of adjusting the actual volume flow rate from a compressor to match the demands from the compressed air system.

Casing. The pressure containing stationary element (stator) which encloses the rotors and associated internal components of a compressor and including the inlet and discharge connections or nozzles.

Check Valve. A valve permitting flow only in one direction.

Compression, adiabatic (isentropic). A compression process in which there is no heat transfer to or from the gas during compression. It is represented by the equation PV = a constant.

Compression, isothermal. A compression process in which the temperature of the gas remains constant. For perfect gases, it is represented by the equation PV = a constant.

Compression, polytropic. A compression process between adiabatic and isothermal, represented by the equation PV = a constant. Most compressors operate in this mode.

Compression Ratio. The ratio of absolute discharge pressure to the absolute inlet pressure.

Displacement. The displacement of a compressor is the swept volume per unit of time, usually expressed in cubic feet per minute (cfm). It may also be considered as the theoretical capacity if the volumetric efficiency is 100 per cent.

Efficiency, isothermal. The ratio of the work calculated on an isothermal basis to the actual work transferred to the gas during compression.

Efficiency, mechanical. The ratio of thermodynamic work requirement in the compressor to actual brake horsepower requirement.

Efficiency, polytropic. The ratio of polytropic compression energy transferred to the gas during compression to the actual energy transferred to the gas.

Efficiency, volumetric. The ratio of actual capacity to displacement, expressed as a percentage.

Filter. A device for removing particulate and/or liquid from the air stream. The liquid may be water or oil.

Flange connection(inlet or discharge). The means of connecting the compressor to the piping system.

Free air. Air at atmospheric conditions at any specified location and unaffected by the compressor.

Gas. Gas is one of the three basic phases of matter, thus air is a gas. However, in compressor practice, the term gas normally is applied to a gas other than air.

Horsepower, brake. Horsepower is a rate of doing work and brake horsepower is the horsepower input to the machine (compressor) drive shaft.

Horsepower, theoretical, or ideal. The horsepower required to compress isothermally the air or gas delivered by the compressor at specified conditions.

Humidity, relative. The relative humidity of a gas (or air) vapor mixture, is the ratio of the partial pressure of the vapor to the vapor saturation pressure at the dry bulb temperature of the mixture.

Humidity, specific. The weight of water vapor in an air vapor mixture per pound of dry air.

Intercooler. Heat exchanger for removing the heat of compression between stages of a multi stage compressor. Normally this also results in removal of a substantial amount of moisture.

Intercooling, perfect. When the temperature of the air or gas leaving the intercooler is equal to the temperature of the air or gas entering the compressor inlet.

Isentropic compression. See Compression, adiabatic (isentropic).

Isothermal compression. See Compression, isothermal.

Liquid Piston (or Liquid Ring) Compressor. A rotary compressor in which a fixed vane rotor revolves in an elliptical stator and carries with it a ring of liquid within the stator. The space between vanes varies with depth of penetration of the vanes into the liquid ring.

Load factor. The ratio of the average compressor load during a given period of time to the maximum rated load of the compressor. In the case of air tools it is the ratio of the time actually working to the total time available.

Multi-casing compressor. Two or more compressors, or stages, each having a separate stator but with a common driver.

Performance curve. A plot of expected, or tested, operating characteristics, e.g. discharge pressure and bhp plotted against capacity, or capacity and bhp plotted against rotative speed.

Polytropic compression. See Compression, polytropic.

Positive displacement compressor. A compressor in which successive volumes of air or gas are trapped in a confined space and the space reduced mechanically, resulting in compression.

Power, theoretical (polytropic). The mechanical power required to compress polytropically and to deliver, through the specified range of pressures, the air or gas delivered by the compressor.

Pressure, absolute. The total pressure measured from absolute zero (perfect vacuum).

Pressure, discharge. The total pressure at the specified discharge connection (of the compressor package). This may be expressed as an absolute or gauge pressure.

Pressure, inlet. The total pressure at the specified inlet point (of the compressor package).

Pressure ratio. See Compression ratio.

Pressure rise. The difference between discharge pressure and inlet pressure.

Pressure, static. The pressure measured in a flowing stream in such a way that the velocity of the stream has no effect on the measurement.

Pressure, total. The pressure which would be obtained by stopping a moving stream of gas or liquid. It is the pressure measured by an impact tube.

Pressure, velocity. The total pressure minus the static pressure in an air or gas stream.

Receiver. A vessel (or tank) used for the storage of air or gas discharged from a compressor. In a large compressed air system there may be primary and secondary storage locations.

Reynolds number. A dimensionless flow parameter, ($\vartheta v^{\rho} \mu$) in which ϑ is a significant dimension, often a diameter, v is the fluid velocity, $^{\rho}$ is mass density, and μ is dynamic viscosity, all in consistent units.

Rotor(s). The rotating element(s) of a machine such as a compressor, and may include shaft sleeves and a thrust balancing device.

Rotary displacement type compressor. A compressor in which successive volumes of air or gas are trapped in a confined space and the space reduced mechanically by rotation of the rotor(s), resulting in compression.

Rotative speed. The number of revolutions per unit of time of the compressor drive shaft, normally expressed in revolutions per minute (rpm).

Rotor tip speed. The distance traveled per unit of time of a point on the outside diameter of a rotor. For rotary screw compressors, this refers to the male rotor (drive rotor) and is expressed in meters per second.

Seal. A seal is a device used between a rotating and a stationary part of a compressor to separate them and minimize leakage between areas of unequal pressure.

Shaft. The part of the rotating element on which bearings and seals normally are located and through which energy is transmitted from the prime mover.

Single stage compressor. A compressor in which full compression is achieved in a single stator.

Sliding vane compressor. A compressor in which vanes slide in radial slots in a rotor mounted eccentrically in a stator.

Specific gravity. The ratio of the specific weight of air or gas to that of dry air at the same pressure and temperature.

Specific weight. The weight of air or gas per unit volume. Unless otherwise specified, in compressor practice it is the weight per unit volume at conditions of total pressure, total temperature and composition which prevail at the inlet to the compressor.

Stages. A series of steps in the compression process, normally requiring separate rotors and stators and with intercooling between them.

Standard air. The Compressed Air & Gas Institute and PNEUROP have adopted the definition used in ISO standards. This is air at 14.5 psia(1 bar); 68°F (+20 deg. C) and dry (0%RH.) Process gas industries normally use 60 deg. F(15.55 deg. C). Some process companies have their own standard and when Standard air or SCFM is specified it is best to confirm which standard is to be used.

Stator. The casing in which a rotor or rotors are housed and in which compression takes place.

Swept volume. The theoretical amount of air or gas displaced by the rotor(s) per unit of time assuming 100% volumetric efficiency. Normally expressed in cubic feet per minute (cfm).

Temperature, absolute. The temperature of the air or gas measured from absolute zero. It is the Fahrenheit temperature plus 459.6 and is known as the Rankine temperature. In the metric system, the absolute temperature is the Centigrade temperature plus 273 and is known as the Kelvin temperature.

Temperature, discharge. The total temperature at the discharge connection of the compressor.

Temperature, inlet. The absolute temperature at the inlet connection of the compressor.

Temperature rise ratio. The ratio of the computed isentropic temperature rise to the measured total temperature rise during compression. For a perfect gas, this is equal to the ratio of the isentropic enthalpy rise to the actual enthalpy rise.

Temperature, static. The actual temperature of a moving gas stream. It is the temperature indicated by a thermometer moving in the stream and at the same velocity.

Temperature, total. The temperature which would be measured at the stagnation point if a gas stream were stopped, with adiabatic compression from the flow condition to the stagnation pressure.

Thrust balancing device (balance piston). Part of a rotating element arranged to counteract any inherent thrust developed by the rotor(s) during compression.

Torque. A torsional moment or couple. Normally it refers to the driving couple of a machine or motor.

Vacuum pump. A compressor having an intake pressure below atmospheric and a discharge pressure at or above atmospheric.

Valve. A device with passages for directing or stopping flow.

Water cooled compressor. A compressor which uses water to remove the heat of compression by means of shell and tube heat exchanger(s). See also Water injected compressor.

Water injected compressor. A compressor where water is injected into the compression chamber to remove the heat of compression.

rotary
air
compressors

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