Nidec
All for dreams

solutions

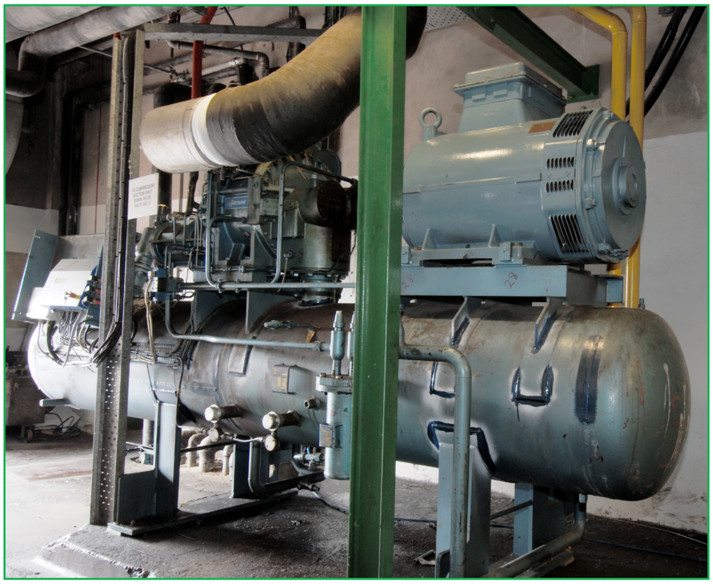
Compressors

Squeeze cost out of compression

Compressors are used to attain higher than normal pressures of gases such as standard air, refrigerants, natural gas, or specialty gases such as Ammonia, Oxygen and Nitrogen. They are used to increase storage capacity or to enable the gas to do work as it expands into a lower pressure environment. Unfortunately, compression is not an efficient process with much of the work going into the process wasted as heat. Compressed air is the most expensive form of energy transfer.

Compressors consume 18% of the power used by industry for motor driven equipment; second only to pumping. This energy intensity makes compressors and air distribution systems an excellent place to look for energy savings. After fixing leaks and optimizing water traps, one should consider compressor technologies and AC drives.

Compressors are available in many types but may be divided into either dynamic (centrifugal or axial) or positive displacement (reciprocating piston / diaphragm, rotary screw, lobe, vane, scroll, and others).



1. Dynamic Compressors

Horsepower: 50 to 4,200

Savings: 30-50%

(Depends on duty cycle.)

Dynamic compressors are used when high volumes of low pressure gas is required. They use centrifugal and axial forces to create pressure that moves the gas from inlet to discharge.

This application may be thought of as a multistage fan or blower where multiple levels of compression are used to achieve a useful final pressure of 10-20 psig. This doesn't sound impressive until we consider flows to 24,000 cfm. Applications include wastewater aeration, combustion air, landfill gas boosting, flotation air, & drying.

AC drives also known as variable frequency drives (VFD) have the same advantages here as they do with fans – with big cost savings - if capacity exceeds current air flow requirement.

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2. Positive Displacement Compressors

Horsepower: Up to 4,200

Savings: 10-25%

(Depends on duty cycle.)

Most compressors are positive displacement. They force a fixed volume of gas from inlet to discharge with each stroke or rotation. They operate as constant torque loads and are used to achieve relatively high pressures. Energy used is proportional to motor speed or flow at a given output pressure. Positive displacement types include:

Reciprocating

- Piston (high output pressure; to 4,200 HP)
- Diaphragm (diaphragm reduces contamination; to 5 HP)

Rotary Screw (10 to 4,200 HP)

- Fixed Displacement
- Variable Displacement (AC drive alternative)
- Vacuum

Lobe (fractional HP, high flows at low pressure)

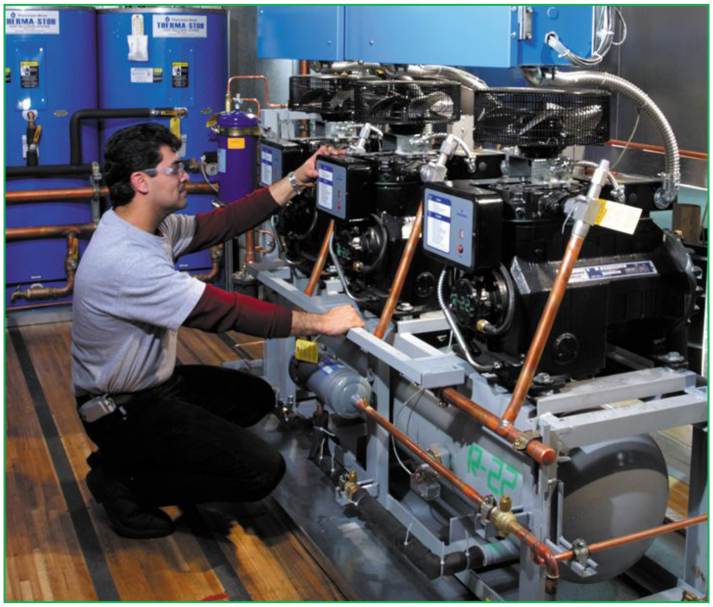
Vane (1-50 HP, even higher flows at low pressure)

Scroll (refrigeration, fractional to 15 HP)

The reciprocating piston compressor uses one or more (typically 2-6) pistons to create pressure - similar to a combustion engine. Multi-stage reciprocating compressors pass the compressed gas from one cylinder to the next to achieve ever higher pressures. Motors range from fractional to 4,200 HP. Starting torque is typically 160% but decreases below 150% with 3 or more cylinders and also fluctuates with the density of the gas. Refrigerants may require 200% starting torque with reciprocating piston compressors.

Most industrial air compressors are rotary screw type with 30-200 HP motors. These compressors use 1 to 3 helical rotors which force the gas into a chamber which decreases in size to increase the pressure. Valves open when stopped to unload the internal pressure and allow for easier starting.

Variable displacement rotary screw compressors reduce energy consumption when less than full output is required. Valves open during the early part of the compression stage. This reduces the energy being used to compress the smaller flow of gas.



Look for 20 HP or greater piston and rotary screw (not variable displacement) compressors which serve as stand-alone or as primary in a multi-compressor installation.

Compressed air is routed to a drying system (heat exchanger or air conditioner) which cools the air and removes water before going to a receiver (storage tank) typically sized at 5-10 gallons per system cfm. This allows the system to react to large air demands with reduced pressure fluctuations.

A compressor is most efficient when running across-the-line at 100% output. The purpose of adding an AC drive is to provide soft starting and match speed to process requirements rather than turning the motor on and off. Compressor cycling reduces machine life and system efficiency.

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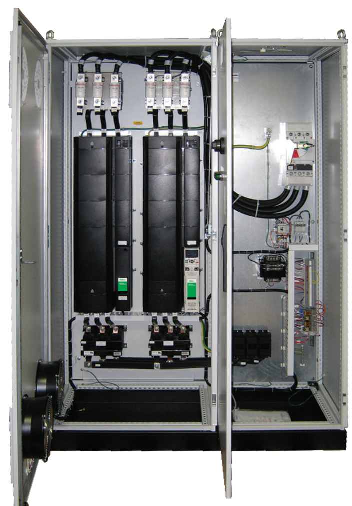
For multiple compressor installations, significant savings can be achieved by replacing simple cascade controls to reduce or eliminate the pressure range over which compressors are turned off and restarted. Since systems must supply a minimum pressure for specific machinery, any range must be added to the minimum pressure required by the system. Typical cascade control of multiple compressors uses a 10 psi differential between each compressor's set-point to help avoid frequent starts. If 90 psi is required on a three compressor system, compressors may be set to turn on & off at 90-100, 100-110, and 110-120 psi with the last being the primary compressor. Cascade control develops pressures far higher than your facility needs; with every 2 psi of developed pressure typically increasing energy costs by 10%.

A variable speed compressor can act as a trim compressor by adjusting to fluctuating demand to maintain pressure 1-2 psi above the desired minimum pressure. The AC Drive's PLC functionality, machine control module or separate control can then bring the other constant speed compressors online to meet demands beyond it's capacity. When the additional compressor comes online, the trim compressor would reduce speed to meet the reduced demand. This speed reduction and the reduction in system pressure combine to deliver large energy savings.

Adding a soft starter to each constant speed compressor greatly reduces mechanical stress while keeping maximum operational efficiency.

Please contact the compressor manufacturer for recommended speed range with AC drives. Speed range is typically limited to 2:1 or less due to compressor and lubrication concerns.

Control Techniques has been very successful in retrofitting compressors with AC drives to achieve improved pressure or temperature control for refrigeration. Consider upgrading the motor to a high efficiency inverter duty design such as the U.S. motors ACCU-Torq AC motors for even greater energy savings.



Look for industrial air & refrigeration compressors with standard NEMA industrial motors. Verify the motor can operate on inverter power or that the customer is prepared to replace the motor with an inverter duty motor.

Control Techniques AC drives adjust compressor speed to directly control flow and pressure. They include PLC functionality, PID control, and optional advanced machine control modules to make advanced control easy.

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Compressor wear is primarily caused by the number of starts, operational cycles and the output pressure. AC drives reduce all three. Soft starting greatly reduces stress on belts and the compressor. The compressor slows as demand drops off so fewer cycles take place and finally, output pressure is kept at a minimum set-point pressure rather than operating over a bandwidth dictated by cascade control set-points.

AC drives improve power factor (>0.95) and reduce motor starting current by a factor of 8:1 to further reduce power demand from your utility.

Control Techniques helps you document energy savings by including a kWh energy, run-time, and running cost meters in the drive. Standard communication options enable remote monitoring and proactive preventive maintenance.

Contact Control Techniques for assistance in identifying energy savings opportunities in your facility.

Drives plus...

World Class Products & Support

- Assistance estimating energy savings
- Worldwide Application & Field Service Network
- 24/7 support line +1 800 893-2321
- Custom software and panel configurations

AC Drives fractional to 4,200 HP