Subject: Compressor Overview	Product: G7 or A1000 Drives	Doc#: AO.AFD.67
Title: Compressor		

Compressor

Application Overview

A compressor is a mechanical device that takes in a medium and compresses it to a smaller volume. Compressors can either increase or decrease a given mass to a lower or higher pressure. A mechanical or electrical drive is typically connected to a pump that is used to compress the medium.

Compressors have many everyday uses, such as:

- Air conditioners, (car, home)
- Air pumps
- Home and industrial refrigeration
- High pressure car washes
- Hydraulic compressors for industrial machines
- Air compressors for industrial manufacturing

Compressors are used by many industries that depend on the power of compressed gas or fluid to power manufacturing processes of all kinds.

There are several different compressor types:

Rotary screw compressor - Two helical rotors force gas into a chamber that decreases in size, thereby increasing the pressure of the gas. The screws in the rotary screw compressor can be lubricated with oil or non-lubricated. Oil-free compressors are used for gas that must remain clean and uncontaminated. Rotary screw compressors are typically sized from 30-200 horsepower.

Reciprocating compressor – One or more pistons are moved inside a cylinder to increase the gas pressure. This is similar to a combustion engine without the ignition of fuel. Just like a car, the pistons generate much heat so the reciprocating compressor is typically cooled by air or water. Multi-stage reciprocating compressors pass the compressed gas from one cylinder to another, increasing the pressure in each stage. Most industrial compressors are multi-stage, ranging from one to 500 or more horsepower.

Centrifugal compressor - Centrifugal compressors speed up and compress gas via a rotor with blades. Centrifugal force is used to force the air or gas to an outer chamber under higher pressure. Centrifugal compressors are designed to operate above 75-80% speed. Surging can occur below these speeds. This makes the centrifugal compress ideal for continuous high duty operation.

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Application Challenges:

- Varied compressor I/O that must interface with the AC drive to control compressor functions.
- Reduce energy consumption
- Constant pressure regulation
- Constant torque load requirement
- Starting torque

Yaskawa Products:

Product	Feature	Benefit
G7 Drives or A1000 Drives	PID Control Mode	Automatically regulate speed based on load conditions. The drive employs a built-in PID Controller (an external PID device is not required).
	Cooling Fan On/Off Control	Controlling the number of times the drive fan is switched on and off increases the lifespan of the cooling fan and reduces the need for maintenance.
	Flux Vector Control	With vector control, the system can operate at a stable speed regardless of the load.
	Energy saving control	V/f pattern selection saves energy while operating with light load and low speeds.
	Restart after momentary power loss.	The motor continues running even after a (2 s) momentary power loss.
	Continue to run when external frequency reference is lost.	The drive enables different responses to momentary power losses.
	Avoid mechanical resonance	The drive skips over the frequency at which resonance occurs.
	Frequency Lower Limit	Continuous motor operation at low speed with a minimum speed reference
	Reverse Prohibit	The drive can be prohibited from running in reverse by using the Reverse Prohibit Function.

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Application Details:

AC drive requirements are different for the different types of compressors.

Inlet valve control of **rotary screw compressors** can be simplified thru use of AC drive control. Slowing down a positive displacement screw compressor allows the compressor to operate under partial load efficiently. This method can reduce compressor power proportional to output and allow for more efficient operation.

Compressors require a controller to handle varying loads by increasing the speed of the compressor during high demand conditions. Starting torque must be considered in selecting a compressor drive, as the density of the compressed medium may be different for each application. For example, refrigerant density is often much higher at start-up than at operating conditions.

It is typically necessary to oversize a standard drive by one horsepower size because 160% starting torque is often required to start **reciprocating compressors**.

Centrifugal, rotary screw, single-screw and **twin-screw compressors** have low starting torques accomplished by closing discharge valves, sideload valves and pre-rotation vanes at shutdown. Over sizing of the drives for these compressors is not necessary, due to the low torque demands at start-up.

Yaskawa drives have features that can be a benefit to compressor applications. A built-in PID controller can automatically regulate speed based on load conditions and eliminate the cost and complexity of a separate PID controller. Flux Vector Control allows the drive to maintain stable compressor speed regardless of load. Automatic Restart features provide quick restart in the event of power failures to keep production process downtime to a minimum. Compressor mechanical resonance points can be avoided by the AC drive by using Jump Frequency points. In summary overall compressor initial cost and efficiency is improved by applying Yaskawa drives on industrial compressor applications.