Subject: Pump Overview	Product: Z1000 and P1000 Drive	Doc#: AO.AFD.66
Title: Pump		

Pump Applications

Application Overview

A pump is a machine or device for raising, transferring or compressing fluids. Pumps represent the largest single use of power in industry (31%) by motor driven equipment. Process variables, including pressure and flow of gases and liquids, have long been regulated using mechanical clutches, throttles, and adjustable inlet guide vanes. Pumps often operate as a variable torque load, a load that increases as the speed increases. These mechanisms waste energy, require frequent maintenance, and provide inaccurate control.

Pumps have two main categories:

1. Positive displacement pumps:
   Force a fixed volume of fluid from inlet to discharge with each stroke or rotation.
   E.g., reciprocating, rotary or screw type pumps.

2. **C**entrifugal pumps:
   The biggest class of pumps which use the fluids own momentum to build up pressure or head. Centrifugal pumps use centrifugal and hydrodynamic forces to create pressure that moves the fluid from inlet to discharge.

Pumps can also be classified by principle of operation and drive requirements.

- Principle of Operation Application Served
- Materials of Construction
- Liquid Being Pumped
- Shaft Orientation (Vertical, Horizontal)
- Number of Stages
- Suction Port Arrangement

Application Challenges:

- Reduce energy costs - Motors use less energy as speed is reduced.
- Reduce demand charges - Drives reduce motor starting current 8-10 times.
- Variable and constant torque load characteristics, depending on pump type.
- The motor may spin backwards due to pump backpressure when stopped.
- Control of pressure and flow is desired.
- High reliability.
- Wide horsepower range for different pumps sizes.
- Environmentally friendly (harmonic standards).
- Network communications.
- Prevention of water hammer, pipe stress, valve and pump seals and cavitation prevention.

Yaskawa Products:

Product	Feature	Benefit
Z1000 Drive Family or P1000 Drives	Bi-directional start	Start a pump spinning in either direction
	Energy Saving Mode	Optimizing motor voltage based on the load requirements can save energy.
	Drive cooling fan control	Maintenance requirements can be reduced and component life increased by the drive controlling it's cooling fan.
	Built-in PID controller	An AC drive with a built-in PID controller makes external PID controls unnecessary.
	Speed Search	The AC drive can automatically restart a spinning motor with Speed Estimation- Speed Search following a momentary power loss or fault condition.
	Harmonic Suppression	A DC link choke is built into Yaskawa AC drives larger than 2018 and 4018. A built-in 12-pulse rectifier makes handling harmonic countermeasures simple (12-pulse transformer required).
	LonWorks, Apogee, EtherNet/IP and MODBUS TCP/IP, etc.	Yaskawa drives are compatible with a wide variety of popular networks.
	Undertorque detection	Use Undertorque Signal can indicate abnormal torque in the system. The signal can indicate when motor torque production falls below the regulated value due to a clog or a broken belt.

Subject: Pump Overview	Product: Z1000 and P1000 Drive	Doc#: AO.AFD.66
Title: Pump		

Application Details:

Yaskawa AC drives provide an efficient, more maintenance-free, accurately controlled power source for pump systems. Yaskawa AC drives adjust impeller speeds to modify the pump curve. Use of an AC drive is preferred to valve control due to the benefits of efficiency. Yaskawa drives provide many benefits over traditional mechanically controlled methods. The benefits are both cost and performance related. Yaskawa AC drives reduce peak energy demands by capturing the speed of a pump that is running backwards due to backpressure. Using Yaskawa's Bi-directional Start function, causes a free wheeling pump to reverse and restart under controlled conditions unlike a line started pump motor. Energy Saving Mode reduces motor voltage during low demand conditions to save power. A PID controller built-in to the AC drive eliminates the initial cost of external PID controllers. Speed Search is used to reduce stress on pump belts, pipes and valve seals as well as reducing maintenance and replacement costs for the pump system. Yaskawa AC drives have integral communication options that help reduce the initial cost of separate network gateways. Torque detection can warn the user of pump cavitation or a clogged pump system before serious damage occurs.

Classification of Pumps by Operating Principle:

- **Kinetic (Dynamic) Pumps**
- **Centrifugal Pumps**
    Radial Flow
    Axial Flow
    Mixed Flow
- **Regenerative Turbine**
    Peripheral
- **Jet Pumps**

- **Positive Displacement Pumps**
    Reciprocating Pumps
    •Piston
    •Diaphragm
    Rotary Pumps
    •Circumferential
    •Screw