PNEUMATICS 101

Definitions of Pneumatics Terms

http://www.rosscontrols.com/terms.htm#FLUID

FLUID

A fluid is any material capable of flowing. Specific examples include hydraulic oil and compressed air. In the pneumatics industry, we use compressed air.

FLUID POWER SYSTEMS

Fluid power systems generate, transmit, and control applications of power by using pressurized and moving fluids within an enclosed circuit. There are two types of fluid power systems:

Pneumatic Systems - These systems have two main features:
a) Pneumatic systems use compressed gas such as air or nitrogen to perform work processes.
b) Pneumatic systems are open systems, exhausting the compressed air to atmosphere after use.

Hydraulic Systems - These systems also have two main features:
a) Hydraulic systems use liquids such as oil and water to perform work processes.
b) Hydraulic systems are closed systems, recirculating the oil or water after use.

One of the main differences between the two systems is that in pneumatics, air is compressible. In hydraulics, liquids are not. ROSS Controls works entirely within the world of pneumatics. Why? What are the advantages of pneumatics? In pneumatics, a system needs only one power source. The work process creates a lower noise level than hydraulic systems, and pneumatic systems are relatively clean and operate at high speed. And of course of major concern to the customer, pneumatic systems feature lower component costs.

FORCE and PRESSURE

The relationship between force and pressure is important because in industrial applications pressure must be created to apply force. In fact:

PRESSURE is the force per unit area, and it is typically measured in pounds per square inch.
Or,
PRESSURE = FORCE/AREA

FORCE is created by pressure exerted on an area. Or,
FORCE = PRESSURE x AREA

Types of Pressure

1) Atmospheric Pressure - This is the pressure produced on the earth's surface by the weight of the air surrounding the earth. Tests show that atmospheric pressure equals around 14.7 psi (pounds per square inch).

2) Gauge Pressure - Because atmospheric pressure always exists all around us without significant change, we do not notice it. Therefore, we consider atmospheric pressure to be "zero" pressure. Gauge pressure is a pressure that does not take into account the additional pressure resulting from atmospheric pressure.

3) Absolute Pressure - When dealing with the effects of pressure on gases, we must consider the total pressure on the gas. We cannot ignore the effect of atmospheric pressure as we do when measuring gauge pressure. The total pressure acting on a gas is called absolute pressure, or Absolute Pressure = Gauge Pressure + 14.7. The "14.7" is the figure that represents atmospheric pressure. Absolute pressure is measured in psi absolute.

PASCAL'S LAW

Pascal's Law states that if pressure is applied to a non-flowing fluid in a container, then that pressure is transmitted equally in all directions within the container.

PERFECT GAS LAWS

Because pneumatics involves gases, the laws that govern gases are very important. The "Perfect Gas Laws" express the relationships between pressure, volume, and temperature. When applying these laws, remember that only absolute values of pressure and temperature can be used.

1) Boyle's Law - This law expresses the relationship between pressure and volume when temperature is held constant. According to Boyle's Law, the volume of gas in a container is inversely proportional to the absolute pressure on the gas. Or,

$P1V1 = P2V2$

The equation above is correct only after the compressed gas has been allowed to cool to the temperature it was before the compression took place. Remember, Boyle's Law applies when temperature is held constant.

2) Charles' Law - This law expresses the relationship between volume and temperature when pressure is held constant. According to Charles' Law, the volume of gas in an expendable container is directly proportional to the absolute temperature. Or,

$V1T2 = V2T1$

3) Gay-Lussac's Law - This law states that if the volume of a gas is held constant (i.e., confined in a rigid container), the absolute pressure of the gas is directly proportional to its absolute temperature. Or,