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Defining Pressure:
What is Pressure and Why is it Critical to Process?

White Paper - W1002

In its most basic form, pressure is defined as the amount of force being applied to an area. As this force is distributed over a specific area, a change in movement of the defined area is occurring. It is important to remember that a force is just an occurrence that is causing an object to move, either accelerating or decelerating. The amount of movement from that object is based upon the amount of force.

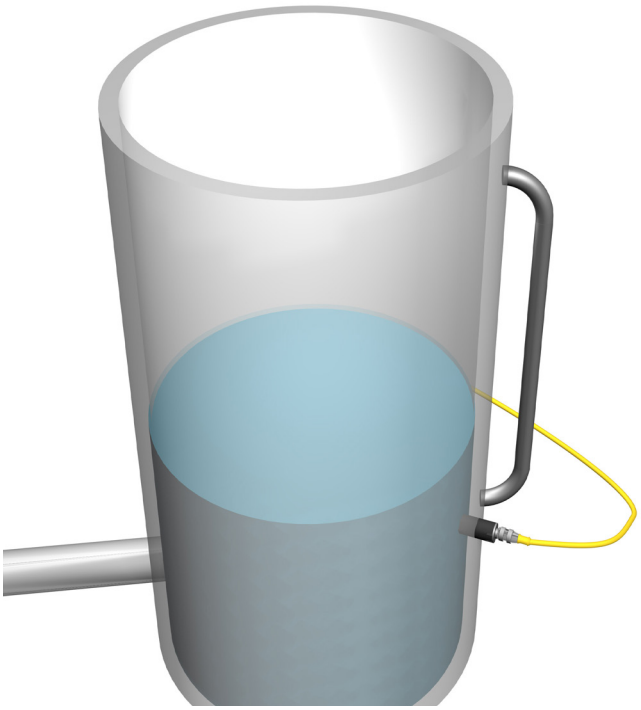
Pressure is very unique in that it is not subjected to a direction, but by the force acting on an area in a perpendicular motion.

Because of this action, movement by the area is created (this is sometimes referred to as a deflection). The amount of this deflection can then be measured to provide a representation of the amount of pressure being applied. As the need for this information grew, manufacturers created a device that is designed to deliver this measurement: the pressure sensor.

This white paper will define pressure, identifying how it is applied and measured. The white paper will also highlight how pressure sensors affect process environments and how they are applied in specific applications.

APPLYING PRESSURE

At all times there is pressure being applied in all directions around us. For example, as we are standing, there is pressure being applied to the area beneath our feet, which is caused my multiple forces. The weight of our body, combined with gravity, creates a perpendicular force to the area directly below. This force then creates the area below to move more than it did before the force was applied. An individual may not notice the movement because of the composition of the area, but it is occurring.



This same theory can be applied in a level application. If a tank is filled with liquid, the same downward force is being applied to the bottom of the tank. The amount of liquid weight, along with gravity, is creating a deflection to the bottom of the tank. With some quick calculations, the amount of liquid in the tank can be determined simply by measuring the pressure at the bottom of the tank. This can be a very critical piece of information for the application.

Typically, pressure measurements are taken to identify the amount of pressure being applied. While doing the same measurement, the loss of pressure can also be recorded. Since the pressure

measurement is primarily concerned with the amount of force on an area, the deflection of the area can vary in both a positive and negative direction. A different application that has a critical constant pressure applied can instantly indicate the pressure loss because the deflection of the measured area is now less than it was previously. Applied pressure does not always have to be analyzed from a zero point. The way that pressure is interpreted and manipulated is solely dependent on the person who is measuring it, but the concept of pressure on the area will not change.

PRESSURE AND PROCESS

So why is pressure important? In everyday activities, pressure may not be a concern whatsoever, however, in a process environment, pressure is a key component to keeping a system functional.

The level application discussed previously can be a critical one when considered in a different way. For example, if the tank represents a water tower that stores a city's supply of water and the level of water inside the tower drops below a certain point, the city could be without a water supply. Since this is a crucial component to the city, a pressure sensor may be used to measure the level inside of the tower and a process is put in place to regulate the level based upon the requirements and usage by the city.

Pressure is not just subjected to the type of media either. While the level application was measuring water, any form of media can be measured if the correct tools are used. Typical applications that

require a pressure measurement include the air (or other gases) inside of a system, fluids inside of a hydraulic line, liquids inside of a pipe and many more. While the media and applications may vary, the key component is the pressure sensor used to measure the amount of force being applied to the area.

When discussing pressure from a sensor standpoint, the area that is being measured is part of the sensor. While there is pressure being applied in all directions, the sensor is only measuring the force that is being applied directly to it. Since pressure does not have to be uniform in all directions, the pressure measured will be similar throughout the system, but does not represent the system as a whole. There are exclusions to this, however, this principle holds true in most cases.

Processes, whether in daily life or the industrial world, act as a way to control an outcome. These processes depend on information and actions (inputs and outputs). Pressure measurement is an input that can help guide which actions are needed in order to produce the desired outcome. For example, tools in a manufacturing facility require a certain amount of air pressure to operate successfully; without sufficient

air pressure, operation halts. To ensure this requirement is consistently met, a pressure sensor resides on the air line to the production floor. If the air pressure drops below the pre-determined level, a process has been developed to start the air compressor to increase the pressure back to the recommended level. This process keeps the manufacturing operation moving and avoids costly down time by continuously monitoring the pressure.

CONCLUSION

Processes can happen frequently, or infrequently, as defined by the user for each application. Pressure measurement is one form of information needed to develop a process in order to reach a desired outcome.

Although pressure is not limited to a specific media, location or application, it is a constant occurrence that can be measured and processed accordingly. This information is not only critical for maintaining a process, but also to ensure the longevity of a system.

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