All industrial manufacturing, ranging from refining raw materials to plastic bottles to aerospace vehicles, is driven by a balance of economics and performance. Companies that can increase the performance of their operations and products without unrealistic costs can create a true value differentiation from their competitors and drive innovation in the industry.

One of the most reliable ways to improve operations in a manufacturing facility is implementing higher precision measurement and control of the machines throughout an operation. In a fast pace, competitive environment, every inch (or micron in some cases) matters. High speed precision manufacturing is the now the standard.

This simple need has driven the innovation and development of linear positioning sensors for almost half a century. Today, there are few production processes that do not rely on some type of positioning measurement methods, whether it is a simple encoder or a more advanced solution such as magnetostriction. Better equipment control and quality assurance means less waste and greater productivity and has been one of the primary drivers of advanced automation techniques.

There are still areas, however, where the installation and use of linear positioning sensors is problematic. Due to the mechanical and environmental sensitivity of many positioning technologies, many manufacturers struggle to find a good solution in applications where the sensor is proximal or exposed to corrosive materials, high temperatures, electromagnetic interference (EMI), continual shock and other factors that could damage the sensor or compromise the performance.

Compromise or failure of any of these components could result in a system failure. Since the controller is often housed away from the machine in a controlled environment such as a control center, the solutions defined in this article will focus on the design and protection of the sensing element and electronics.

Potential hazardous conditions exist in almost every manufacturing facility, but there are some that require special considerations. Gas and steam turbine valves, for example, require sensors that can withstand high temperatures and typically require hazardous area approvals. These industries are continually evolving and looking for new sensor technologies to improve reliability and accuracy.
In steel fabrication, rolling mills have requirements for high accuracy, but also experience high temperature, shock and vibration. These environments can also generate a lot of contamination that would affect sensor performance and reliability. Many steel applications today use a combination of technologies, but are beginning to transition machines to higher performance sensors to add redundancy, reliability and contamination tolerance.

High temperature is another important concern to consider. Many position sensor technologies require electronics that may fail at high temperatures. There may also be a performance impact if the measurement drifts with temperature variation. To survive high temperatures, some technologies may offer housing options to cool the electronics or remotely mount the electronics to a protected location where the temperatures are acceptable. Otherwise, electronic components must be selected to operate at the required temperature.

**PROTECTING THE SENSOR THROUGH PRODUCT AND CYLINDER DESIGN**

In the past 12-24 months, MTS Systems Corp., Sensors Division, has developed and introduced several new sensor products designed to directly address the issue of harsh environments. These solutions have centered around three areas – embeddable products, detachable electronics and redundant design for greater reliability in harsh environments.

**EMBEDDABLE PRODUCTS - WHERE DESIGN MATTERS**

The simplest, and often most effective, way to ensure the integrity of a sensor is to fully embed the electronics inside of a hydraulic or pneumatic cylinder. This has become the standard in mobile hydraulics, where moving equipment on construction and mining equipment is continually exposed to the elements and is also seen in some industrial applications.

In industrial manufacturing applications, it is often preferable to install the sensor electronics externally where it can be easily replaced if necessary. However, there are some machine designs that require an embedded solution either because of space constraints, or for the protection of the sensor in harsh environments such as high temperature.

To address this issue, MTS developed products that can be embedded directly into the cylinder.

The Temposonics® Model EE Sensor is a fully embeddable sensor, including the electronics, which is compact enough to be integrated directly into a hydraulic cylinder. It is also designed to withstand higher temperature ratings, making it ideal in applications such as steel mills or other harsh application such as rock crushers, presses or outdoor applications.
DETACHED ELECTRONICS - WHERE SPACE MATTERS

Embedded solutions do have another drawback, however. They have to enclose both the sensing element and the electronics to perform the measurements. This is not a concern in applications the Model EE was designed to address that use simple interfaces such as an analog signal. However, when more advanced controller interfaces are needed, such as Industrial Ethernet, a different approach is required to accommodate the electronics.

A solution developed by MTS Sensors involves remotely mounting the electronics away from the equipment to avoid the harsh environment. The Temposonics R-Series Model RD4 sensor incorporates a detached electronics design (the sensing element is connected to the interface electronics via a cable), allowing manufacturers and operators to place sensitive electronics in areas where interference or damage is less likely. This is useful for a variety of harsh environments such as high shock and vibration or high temperature.

HIGH TEMPERATURE PRODUCTS - WHERE HEAT MATTERS

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REDUNDANCY - WHERE RELIABILITY MATTERS

Even the best designs and protective housings can experience failures, however. Many machine designers address this by installing multiple redundant sensors across the equipment. While effective, it is also the bulkiest and most expensive solution possible.

To help address this issue, MTS developed the Temposonics® G-Series Model GTE embedded, redundant magnetostrictive sensor. Embedded into a hydraulic cylinder or other equipment like the Model EE sensor, the Model GTE features a dual channel output and two sensor elements in the same housing. This allows extremely compact design with the same redundancy offered in the multiple sensor scenario described above. This sensor is also designed to withstand temperatures up to 85 degrees C and features an IECEx Zone 2 approval for use in hazardous areas.

The redundant sensor design also makes integration within a cylinder a more attractive concept by addressing the reliability concern. Machine engineers, operators and maintenance crew can have greater confidence that the sensor will continue to perform even in the event of a failure. The improved reliability reduces the costly downtime associated with machine repair, especially when an embedded solution is used.

ABOUT MTS SENSORS:

MTS Sensors is continually working with customers to identify and determine the best possible solutions based around the performance and level of protection needed for each application. Together, we are designing solutions that require less maintenance and keep machines running at peak performance in even the harshest environments.

For more information on MTS Sensors, please visit www.mtssensors.com or contact a local MTS representative.