Temposonics®

Magnetostrictive, Absolute, Non-contact Linear-Position Sensors

MTS SENSORS

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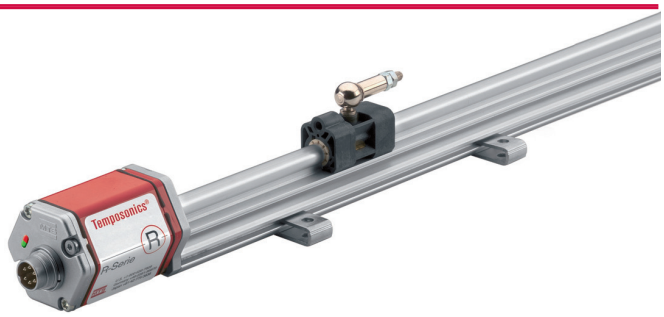
Improving Reliability in Manufacturing using Magnetostrictive Linear Position Sensors

Technical Article

R-Series Model RH rod-style position sensor



R-Series Model RP profile-style position sensor

By Matt Hankinson, Ph.D, Technical Marketing Manager of MTS Sensors

In high speed manufacturing facilities, it isn't enough to install sensors that provide accurate measurements and results. Those results have to be consistent every time the machine is used. Variability between runs can produce goods and materials that potentially flawed and, possibly, useless. That inconsistency costs the operator money and time by forcing them to run machines longer with less output.

HOW THE INDUSTRY MEASURES SUCCESS

Before discussing the different technologies, it is important to understand how the industry measures reliability and consistency. There are many different standards – varying greatly based on the industry served. The margin for error in and industry such as bottling can be more lax than that in medical equipment or precision testing equipment. This makes it harder to properly compare different linear positioning technologies in a way that is meaningful to the machine designer and manufacturer. Even where standards do exist, they primarily refer to efficacy of the measurement itself rather than its repeatability.

For the sake of this discussion, we will be basing performance on two factors - – *Relative Error,* which refers to the percentage of the reading and *Fixed Error*, which refers to the actual measurement error itself. By tracking these two figures across multiple high speed runs, equipment specifiers can more easily determine the impact accurate linear measurement is having on their business's bottom line.

These figures are important for manufacturers because they allow companies to select the equipment that meets the exact parameters of their applications, as well as industry expectations and standards, while still considering other factors such as operating cost, ease of installation and environmental conditions.

MEASUREMENT TECHNOLOGIES

One of the most common methods used to measure linear displacement today is through the use of a linear variable displacement transformer (LVDT). LVDTs work by measuring an electric current along a cylindrical ferromagnetic core. A metallic object travels along the core and generates a signal, which is in turn measured by three coils placed along a tube. This technology offers several benefits, including compatibility with most industrial equipment, easy installation and fast start up (no recalibration required).

A second technology, magnetostriction, works by inducing a sonic strain pulse in a specially designed magnetostrictive waveguide by the momentary interaction of two magnetic fields. One field comes from a movable permanent magnet which passes along the outside of the sensor tube; the other field comes from a current pulse or interrogation pulse applied along the waveguide. This interaction produces a strain pulse, which travels at sonic speed along the waveguide until the pulse is detected at the head of the sensor.

The magnet's position is determined with high precision by measuring the elapsed time between the application of the interrogation pulse and the arrival of the resulting strain pulse. Consequently, accurate, non-contact position feedback is achieved with absolutely no wear to the sensing components. Magnetostriction also requires no recalibration and can be easily installed in most industrial settings.

FACTORS AFFECTING ACCURACY

In perfect laboratory settings (controlled temperature, electrical/magnetic interference, shock, vibration, etc.), most sensors will provide fairly consistent results. The true indicator is how the product behaves in real world environments.

LVDTs, particularly, are susceptible to environmental influences. By design, LVDTs are variable AC transformers, making them prone to errors from cable capacitance, impedance, demodulator phase variations, and minor variability in the physical winding of the transformer and its matched core. Additionally, since the core and the transformer remain in concentric and angular alignment, the element can degrade over time, especially when combined with grit or other contamination.

HOW THEY MEASURE UP - ADVANTAGES OF MAGNETOSTRICTION

While LVDTs still have a strong market position in the market, when they are compared directly, the advantages of magnetostriction are obvious. Where LVDTs struggle to achieve a Relative Error of ± 2.0% of Reading and a Fixed Error ± 0.005 Inch over the physical range at the >25cm lengths using typical linearization algorithms, most magnetostrictive linear positioning sensors easily attain a Relative Error as low as ± 0.5% of Reading with a Fixed Error below ± 0.001 Inch, especially when measured in actual field conditions. This advantage becomes even more prevalent in applications where very long stroke lengths or high speed readings are required.

Magnetostrictive sensors are also less susceptible to environmental factors, such as EM inference, temperature, shock and vibration, when compared to LVDTs. Additionally, since magnetostrictive sensors utilize no moving parts, wear and tear due to continual use is not an issue. These sensors can operate indefinitely with little or no maintenance required. They can be mounted in virtually any space without impeding performance.

Magnetostrictive sensors are compatible with many different electronic protocols, including EtherNet/IP™, EtherCAT®, Profibus, DeviceNet, CANbus, SSI, Analog and general Ethernet. MTS Systems Corp., Sensor Division, recently introduced a model incorporating detached electronics. By detaching the electronics, manufacturers can further remove sensitive equipment from harsh environments where they may be damaged by temperature, shock, vibration or other conditions, without impacting the performance of the sensor.

CONCLUSIONS

While LVDTs still offer value in lower end performance applications, magnetostriction provide tangible benefits in equipment where long term, reliable data is essential. In almost any manufacturing application, magnetostrictive linear positioning sensors will provide more consistent results with less wear and tear, enabling manufacturers to better meet application needs, customer expectations and industry regulations.

ABOUT MTS SENSORS:

MTS Sensors, a division of MTS Systems Corp., is the global leader in the development and production of magnetostrictive linear-position and liquid-level sensors.

MTS Sensors Division is continually developing new ways to apply Temposonics® magnetostrictive sensing technology to solve critical applications in a variety of markets worldwide. With facilities in the U.S., Germany, Japan, and China, MTS Sensors Division is an ISO 9001 certified supplier committed to providing customers with innovative sensing products that deliver reliable position sensing solutions.

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MTS®
SENSORS

MTS Systems Corporation
Sensors Division

3001 Sheldon Drive
Cary, North Carolina
27513, USA
Tel.: +1-800-633-7609
Fax: +1-919-677-2343
+1-800-498-4442
e-mail: sensorsinfo@mts.com
http://www.mtssensors.com

MTS Sensor Technologie
GmbH & Co. KG

Auf dem Schüffel 9
D - 58513 Lüdenscheid, Germany
Tel.: +49-2351-9587-0
Fax: +49-2351-56491
e-mail: info@mtssensor.de
http://www.mtssensor.de

MTS Sensors Technology
Corporation

737 Aihara-cho, Machida-shi
Tokyo 194-0211, Japan
Tel.: +81-42-775-3838
Fax: +81-42-775-5516
e-mail: info@mtssensor.co.jp
http://www.mtssensor.co.jp