Temposonics®

Magnetostrictive, Absolute, Non-contact
Linear-Position Sensors

MTS SENSORS

Designing with Magnetostrictive Sensors

Technical Article

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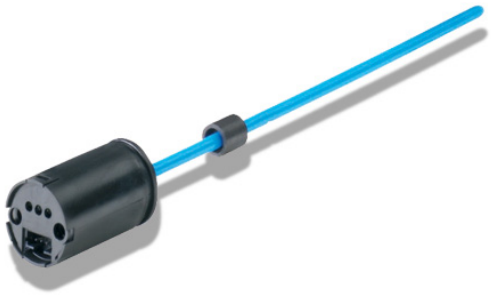
Core sensor with M-Style Housing & Core with H2 Housing



C-Series Core linear position sensor

By Mike Wardle, Product Manager MTS Systems Corporation

Designing with Magnetostrictive Sensors opens creative options. This article explores the different installation design possibilities and key configurable features of sensors in suspension dampers.

EMBEDDING MAGNETOSTRICTIVE SENSORS IN SUSPENSION DAMPERS

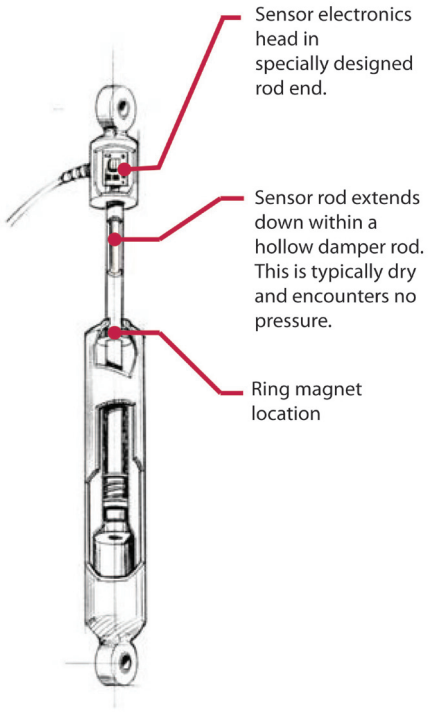
An advantage of the magnetostrictive sensor, over other types of linear position sensors, is the ability to read the position magnet even when there is a barrier between the position magnet and the sensing rod. For example: the barrier can be the cylinder wall when the position magnet is part of a piston. This is possible whenever the material directly between the position magnet and the rod can be a non-magnetic material. Common materials for this duty include plastics, ceramics, aluminum and non-ferrous metals, and some stainless steels.

Because most dampers have some of these materials, or can employ them in some fashion, these are the most common internal installation methods.

DRY, ROD-END INSTALLATION

In this style (Fig. 1), the sensor is placed within a hollow, non-ferrous damper rod from the conventional top, threaded end. A specially designed clevis or ball end is typically attached to the rod end to connect to the chassis. Inside the special rod end is a cavity that houses the sensor's electronics. Because this end typically is stationary with respect to the chassis, it's a good place for the wires to exit the damper while experiencing minimal flexing during operation.

The ring-shaped magnet in this style is located where the rod exits the damper tube. The magnet can be external, but is typically housed within a non-ferrous cap on the tube outboard of the seals.

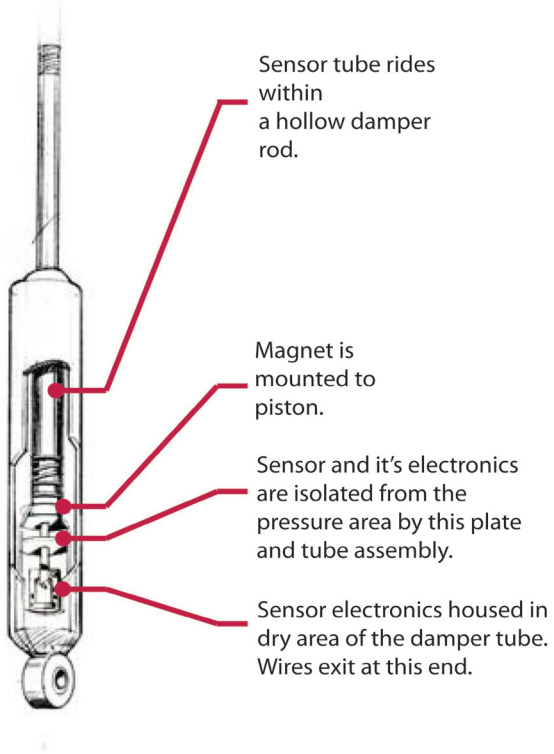


(Fig. 1, Example of a Dry, Rod-End Installation)

WET, TUBE-END INSTALLATION

This style (Fig. 2) of installation typically is used when the wires for some reason cannot exit the rod tip. In this case, the sensor is inverted from the previous rod end installation. The electronics is housed within a dry cavity in the tube's closed end and the wires exit there.

Because the sensor's tube extends into the wet area of the damper, the sensor tube must be a non-ferrous, pressure bearing material of sufficient diameter to clear a hollow cavity in the damper rod and the piston. This assembly can be as simple as a plate with a small diameter stainless, closed end tube welled to it. The plate is then fixed within the damper tube to provide the cavity for the electronics end of the sensor.



(Fig. 2, Example of a Wet, Tube-End Installation)

The ring magnet in this case is mounted to the damper piston.

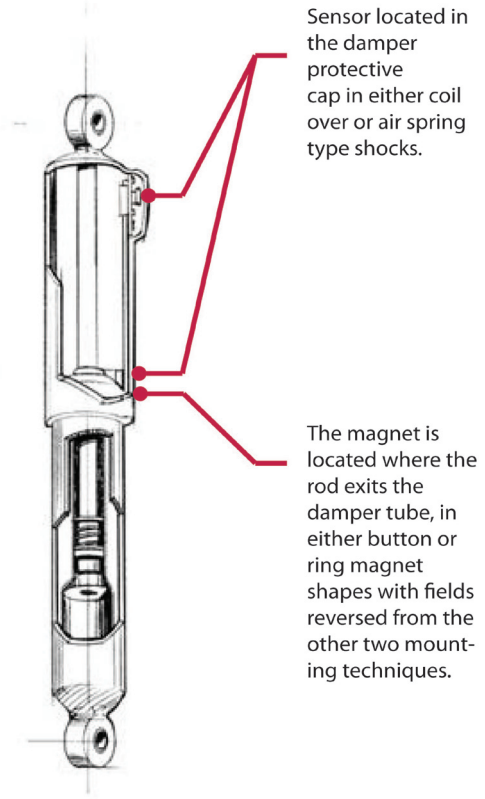
This is a variation of the conventional hydraulic cylinder installation used for 30 years in the industrial sensor market and is well proven to be reliable.

NON-COAXIAL PROTECTIVE CAP MOUNTING

This method (Fig. 3) is attractive when little room exists within the rod or damper to house the sensor. It's also a method whereby dampers that have either wire wound springs (coil overs) or internal air bag springs can easily mount a sensor.

In this case, the sensor is mounted on a protective cap that slides along the damper tube. This cap is typically used to house either a coil spring or more commonly, an air spring bag. Air bags roll over the damper tube body which acts like piston. Air shocks as they are commonly known, can easily use this method as an alternative to the co-axially mounted sensor.

A feature can be molded, cast or welded to the protective cap to house the sensor tube and it's electronics, providing ample protection and an easy managed wire exit. The cap, or at least the area of the cap adjacent to the sensor, should be non-ferrous.



(Fig. 3, Example of a Non-Coaxial Protective Cap Installation)

The magnet in this concept is placed similarly to the first example (where the damper rod exits the damper tube), except that the fields are reversed. A ring magnet can be used, or to make an easy, less expensive installation, a button magnet can be used. Typically, since there are only two possible alignments of the mounting eyes, 0 and 180 degrees, two button magnets placed 180 degrees from one another, ensure proper installation. When a threaded rod is provided to the user, a ring magnet may be the right choice.

KEY FEATURES OF MAGNETOSTRICTIVE SUSPENSION SENSORS

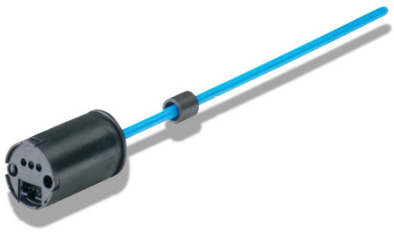
Due to a highly efficient automated manufacturing process, the magnetostrictive sensor implementation costs have become very competitive with other technologies normally associated with high volume applications but with some very significant advantages.

The totally automated manufacturing process allows production of fully-tested core sensors every 17 seconds. This hands-off process is designed to verify that each sensor conforms to the very high standards of quality and control required by automotive and other vehicular industries (Fig. 4).

- Complete integration is possible
- No additional wearing parts
- Well-proven, long term measurement principle
- High accuracy
- High temperature stability
- Easy matching of stroke length detected at the head of the sensor

(Fig. 4, C-Series Model CS/CM Sensors can be used in a variety of suspension systems, including RV suspensions)

The sensor is an absolute positioning device. Its electronics measures the interval of the sound wave's travel from the location of the magnet to the tip of the sensor using the known speed of sound in a waveguide material. In fact, the sensor's resolution is primarily a function of its electronics and can be as fine as 50 microns, at rates that allow excellent velocity derivatives.



(Fig. 5, C-Series Core Sensor)

Inherent features such as these can help a design get to production easily and more quickly:

- Factory programmable zero and full scale positions allow customized active zones to be specified, including forward or reverse analog output or truncated active zones anywhere along the sensor without losing any sensitivity. The standard sensor has 0 to 5 Vdc output, a serial digital output or other outputs on a custom basis, allowing a choice of interfacing.

- C-Series sensors are modular. This means that the fully complete, common denominator, C-Series Core sensor (Fig. 5) can be embedded within an OEM product to keep the size as small as possible and take advantage of environmental protection.

- The modular concept includes standardized IP67 or IP69K housings (Fig. 6) that can be added to the Core sensor to allow external mounting for prototyping or production to protect it from routine to harsh or unusual environmental considerations.

(Fig. 6, C-Series Core Sensor with CM and H2 housings)

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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