Fundamentals of Magnetostrictive Technology

Basic overview of magnetostrictive technology as applied to linear measurement sensors

What is it?

Magnetostriction

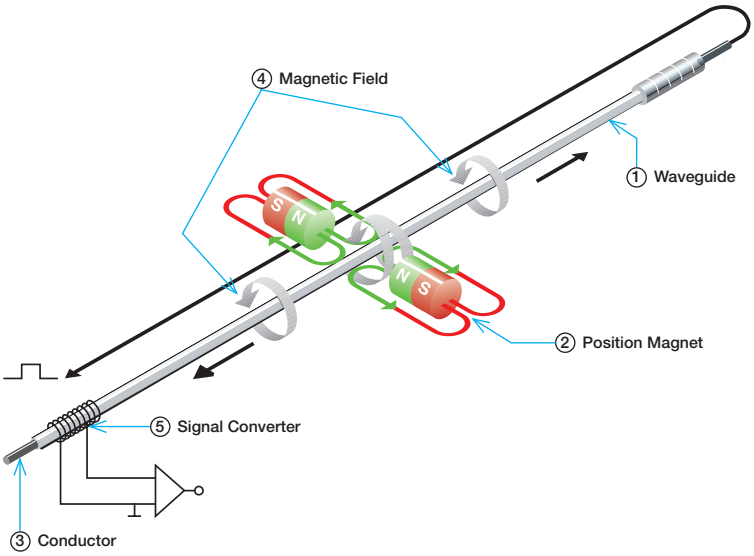
Magnetostriction is a property of ferromagnetic (iron-based, magnetizeable) materials that causes them to change their shape or dimensions in the presence of a magnetic field. In addition to numerous other practical uses, this magnetostrictive effect is ideally suited for use in industrial linear position measurement sensors.

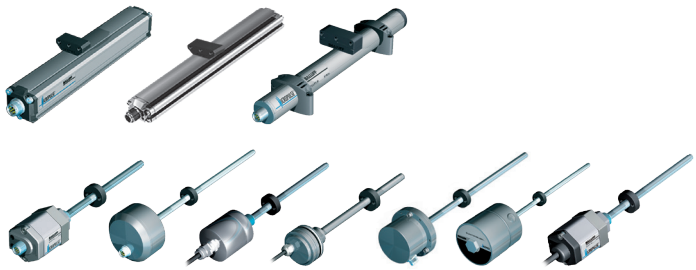
How is it used in linear position measurement sensors?

Magnetostrictive linear position sensors use an iron-alloy sensing element, typically referred to as a waveguide. The waveguide ① is usually encased inside a stainless steel pressure tube or in an aluminum extrusion. The position magnet ② is attached to the moving part of the machine, or the piston of a hydraulic or pneumatic cylinder.

Measurements are initiated by applying a short-duration (1 to 3 microsecond) electrical pulse to a conductor ③ attached to the waveguide, which creates a magnetic field ④ along the waveguide. The magnetic field from the position magnet interacts with the generated magnetic field to cause a mechanical pulse to be generated on the waveguide. This mechanical pulse travels at a constant speed, and is detected at the signal converter ⑤.

The time between the initial electrical pulse and the received mechanical pulse accurately represents the absolute position of the position magnet and, ultimately the machine or hydraulic cylinder.





Benefits and information

Rugged and Wear-free

- No mechanical contact between magnet and sensing element
- Immune to dirt, dust, and other potential contaminants
- Available in many different form factors for many different applications

Absolute

- Resulting time measurement represents absolute position of machine
- Available in many analog and digital interface types
- No need to re-home after power interruption

Accurate

- Can detect position changes as small as 1 micrometer (1/1000th of a millimeter
- Absolute positional accuracy to ±30 micrometers

Gotchas

Strong External Magnetic Fields

Since magnetostriction relies on interaction of magnetic fields, very strong external magnetic fields that are very close to the sensing element can cause problems.

Electromagnetic Interference

The most common output signals specified for magnetostrictive linear position sensors are analog (0-10Vdc or 4-20 mA). It is important that proper shielding be used to protect these signals from electrical interference.