# Cutting Costs of Magnetic Flow Measurement

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*Insertion mounting and microprocessor electronics reduce the cost of magnetic flow measurement technology.*

Magnetic flow measurement technology works well in wastewater effluent applications – but the cost of full-line magnetic sensors can be high. Engineers should know about a lower-cost alternative: insertion-style magnetic flow sensors.

Magnetic flow sensors give "set-it-and-forget-it" reliability in wastewater applications. They have high tolerance for particulates and debris, they have no moving parts to wear and no ports to clog. High reliability makes magnetic flow measurement a good choice for alarm applications too. If you're protecting a pump or monitoring coolant flow to bearings or transmissions, sensor failure could lead to equipment damage.

## *Magnetic flow measurement principle*

Magnetic flow measurement works by sensing the voltage induced when a conductive fluid flows through a magnetic field. (See Figure 1.) The induced voltage – which is proportional to the flow velocity – is fed to a measuring amplifier by a pair of electrodes.

Historically, magnetic flow measurement has used relatively costly "full-bore" devices where 100 percent of the flow has to pass through the sensor. The disadvantages are:

1. Every pipe size requires a different instrument. That raises inventory costs if you're keeping spares on hand.
2. To install full-bore flow sensors in existing pipe you must cut the pipe and add flanges or fittings, which further raises costs – especially in large pipe sizes.
3. In larger sizes, the full bore instruments themselves are very expensive.

## *Insertion mounting can cut magnetic measurement costs*

Insertion-style magnetic sensors put a slender probe into the fluid flow. (See Figure 2.) The combination of insertion mounting and microprocessor-based electronics can reduce the cost of magnetic flow measurement technology by up to 40 percent, compared to full-bore instruments.

Lower costs means you can have the reliability benefits of magnetic flow measurement in wastewater applications that couldn't justify full-bore instruments.

An example of the insertion-style magnetic sensor is the +GF+ SIGNET 2560 Flowmag. This device measures flows from 0.3 to 15 fps in fluids with a conductivity of 20µS or higher. It handles fluid flows at up to 180 psi @ 68°F. Power requirements are less than 20mA at 20 VDC to 30 VDC. The 316 stainless steel and PVDF nosepiece is designed for maximum chemical resistance, and tailored for plastic piping systems. The round probe sticking into the pipe is non-clogging with typical wastewater contaminants: fibers, particles, congealed clumps and precipitates. Construction of polyvinyldine fluoride (PVDF) makes the sensor probe highly resistant to chemicals. The probe is also highly resistant to abrasion from particulates. Even is small amounts of coating do occur, it doesn't affect accuracy.

### *Insertion mounting simplifies installation and maintenance*

A single insertion-type sensor works with pipe sizes from 1/2 in. to 4 in. This universal fit simplifies instrumentation design if your piping sizes are still in flux. It also cuts your inventory costs if you stock spares for multiple installations.

Insertion installation is simple. Glue or heat-weld a compatible tee-fitting in the line and insert the sensor. The operation is especially easy with plastic piping such as the polypropylene or polyvinyldine fluoride (PVDF) systems made by the George Fischer company.

With compatible manufacturer's products, you can directly replace insertion-type paddlewheel or turbine sensors with magnetic units to get improved accuracy and reduced maintenance.

If a full-bore instrument requires maintenance, you have to replace it with an exact length of flanged pipe. With this insertion instrument, retrofitting is simple, allowing for an instant upgrade to advanced flow sensing technology. The insertion mounting adapter controls sensor depth, so if the instrument is removed and replaced, accuracy remains consistent without critical measurements and adjustments.

### *Horizontal and vertical mounting*

Insertion sensors operate by immersion in flowing liquid, so they're good in vertical piping installations. Flow should be upward, to make sure the pipe is full.

In a horizontal pipe, mount insertion sensors about 45° below the horizontal center line of the

pipe. That keeps the probe clear of possible air pockets at the top of the pipe and sediment at the bottom. To make sure the sensor is seeing uniform flow, you'll need to allow adequate straight runs of pipe upstream of the instrument. Distances vary from about 10 inside pipe diameters from a flange joint to 50 diameters from a gate valve. You'll also need about 5 diameters of clear pipe downstream of the sensor.

### *Shop for these magnetic sensor features*

For flexible control system compatibility, look for sensor output options. The +GF+ SIGNET unit for instance, provides a 4 - 20 mA current loop output where 4 mA is zero flow and 20 mA is your selected full-flow point. An alarm relay can be set to energize at any point on the current output curve. Microprocessor-based electronics deliver a stable 4 mA output with an empty pipe. Both the relay control and the current loop output respond identically to flow in both directions.

Microprocessor-based instruments can also perform comprehensive self-testing. In the +GF+ SIGNET instrument, a failure will deactivate relays, light an LED, and set loop current to 2 mA as an alarm indication.

Simple calibration procedures will help hold down maintenance costs. The +GF+ SIGNET unit's microprocessor logic delivers simple, single-point calibration. Put in a known flow rate and adjust the calibration potentiometer to your desired mA value. Full scale values are infinitely adjustable from .3 to 15 fps.

With an inexpensive, large-face analog current loop monitor such as the +GF+ SIGNET 5091, you can get flow rate readings visible from 30 to 40 feet away with no additional power source. The 5091 drops only about 2.2 V at 20 mA, so other devices can be in the loop also. The 2.2 V drop is about half that of comparable LED/LCD displays.

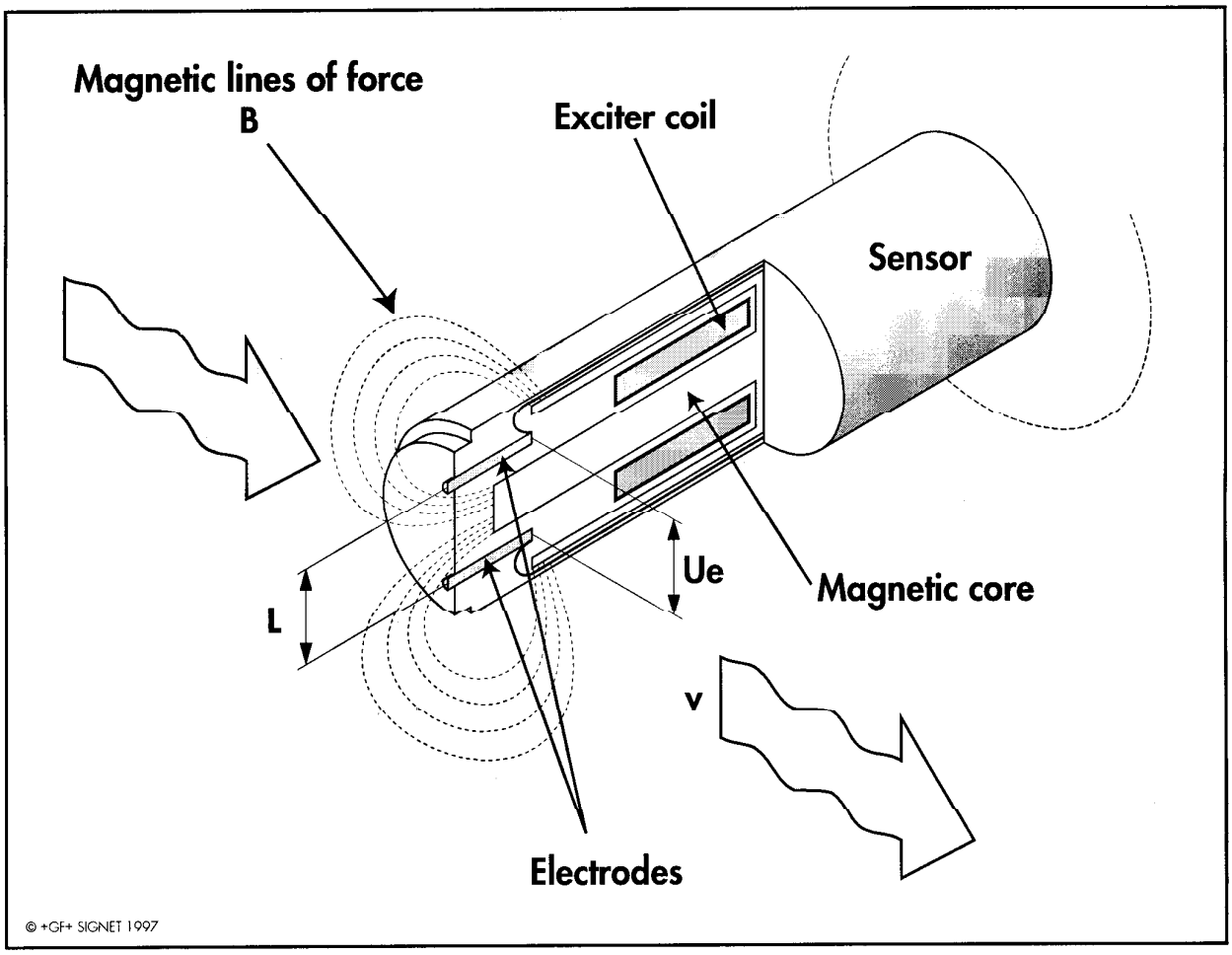
For design flexibility, be sure the instruments you're considering will stand up to environmental conditions. Look for housings that give NEMA 4X/IP65 protection.

### *Put insertion magnetic sensors in your tool kit*

For a wide range of wastewater environments, the cost and reliability of insertion-style magnetic sensors add up to a solution worth considering in your design. With low-conductivity fluids, such as ultra-pure water applications, you may have to go a different flow sensing technology – such as +GF+ SIGNET's vortex flow sensing instruments – but insertion-style magnetic flow sensing technology offers benefits engineers should know about.

***Fig. 1***

*Conducting fluid moving through a magnetic field generates an electrical potential proportional to flow rate. Magnetic sensors are rugged and reliable.*




**Ue** – B x L x v – induced voltage
**B** = magnetic induction (magnetic field)
**L** = distance between electrodes
**v** = flow velocity at the tip of the sensor

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***Fig. 2***

*Simple mounting hardware adapts a single magnetic flow sensor to many pipe sizes. Universal fit and simple installation hold down costs.*