

Electrodeless Conductivity, Toroidal Magnets, and the Procedure of Degaussing

Electrodeless conductivity sensors (also known as the sensor which looks like a donut on a stick) can be made by encapsulating two or three toroids* (windings of wire over a donut-shaped core material) that are insulated from each other.



An electrodeless conductivity (EC) sensor resembles a transformer in operation. When the sensor is immersed in a conductive solution, the encapsulated toroids form a conductive loop of solution. One toroid induces a current into the solution, and the second and third toroids detect the small induced current. The drive toroid is energized by a low energy source. The receiver toroid measures the current in the solution. Conductivity is then proportional to current. See Figure 1.

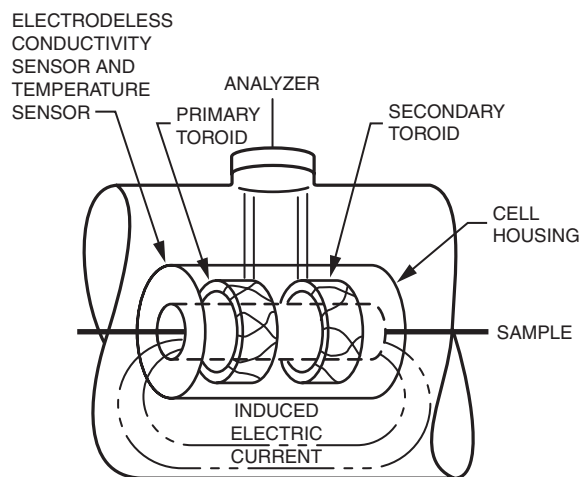
All EC sensors leave Invensys Foxboro in a nonmagnetized state. Magnetic induction (the process of being magnetized because of contact with other materials) is a reaction that has occurred to EC sensors. Many materials (including an atom) have, produce, or conduct magnetic lines of force. Common materials such as speakers, doorbells, relays, transformers, and tapeheads contain magnets or

magnetic materials. A sensor may contact a magnetic source during shipping, storage, or in preparation for installation. The negative result is that the sensor can become a toroidal magnet.

A toroidal magnet (no air gap) is a more efficient magnet (compared to bar or U-shaped ones); it stores magnetic force for longer lengths of time. See Figure 2. It is shaped like a donut with the field contained inside the core. An EC sensor that has become a magnet may become unstable as a conductivity sensor. The detector toroid is no longer able to hold and control current in the circuit to zero. This may be observed most readily with large bore sensors (871EC-LB or 871EC-UT), in low conductivity full-scale ranges where more resolution of signal is visible. The sensor signal no longer tracks conductivity but produces a lower conductivity reading.

As an aside, the flux, or concentration of lines in a magnetic field per given area, is called flux density. Flux density is measured in units of the gauss (1 gauss = 1 line/cm²).

Flux density is more concentrated in a coil as lines from one turn join with lines from another to form a magnetic field of high flux density. Since an EC sensor has current carrying conductors wound in this form, it too can have high flux density.



*Three toroid design is protected by Invensys Foxboro patent 5157332

Figure 1.

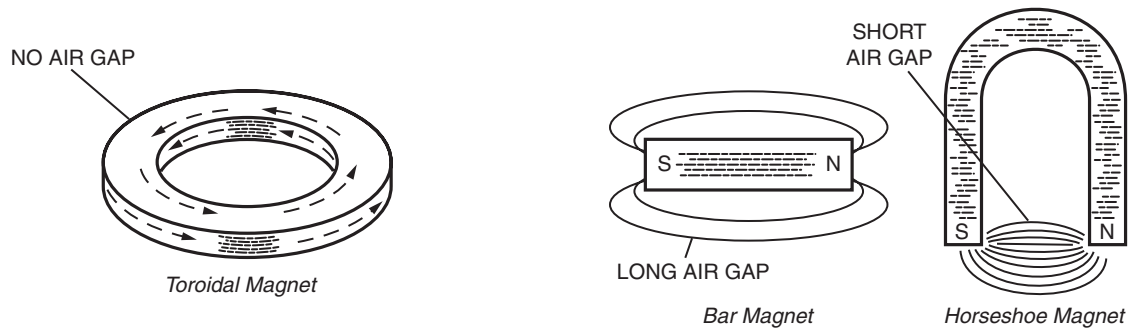


Figure 2.

VERIFYING IF AN ELECTRODELESS SENSOR HAS BECOME MAGNETIZED

A 1 M Ω resistance decade box is required for this procedure. The sensor has been calibrated using the Electronic Bench Calibration Procedure.

1. Loop a wire through the sensor and connect to a resistance decade box. See Figure 3.
2. Starting with resistance set to 1 M Ω slowly start decreasing resistance through the sensor in small increments.

If the sensor is not magnetized, the reading slowly increases

If the sensor has become magnetized, the reading first decreases (or may become negative) before increasing as the resistance is decreased.

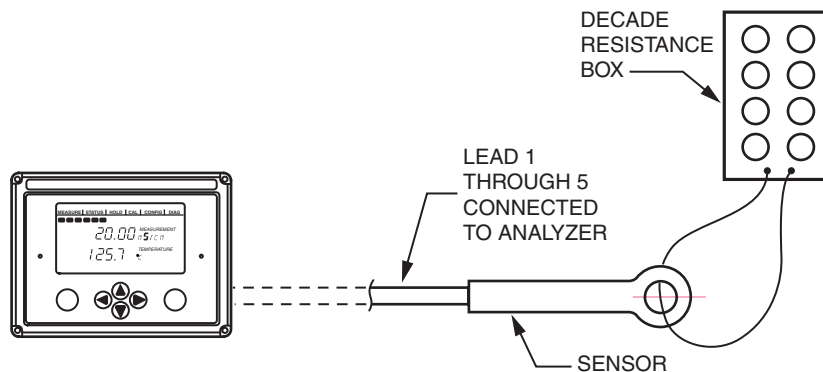


Figure 3.

REMOVING THE MAGNETIC PROPERTIES FROM AN EC SENSOR

The easiest and most efficient way to demagnetize an EC sensor is with a tool known as a “degausser.” This tool is readily available from your local stereo, video, or electronics store as a “magnetic or bulk tape eraser.” The tool in this environment is used to remove the magnetic imprint left on the tape from a previous recording. In the process chemical environment, this tool can quickly restore an EC sensor to its nonmagnetic state.

1. Power the degaussing tool and bring it close to sensor.
2. Move the tool slowly around sensor donut in close proximity to it for about one minute. See Figure 4.
3. With power to the tool still on, slowly withdraw it from the sensor. Move the tool at least two feet from the sensor. See Figure 5.
4. Remove power from the degaussing tool.

This procedure may be carried out on sensors still wired to a powered analyzer or transmitter, or to sensors ready for installation.

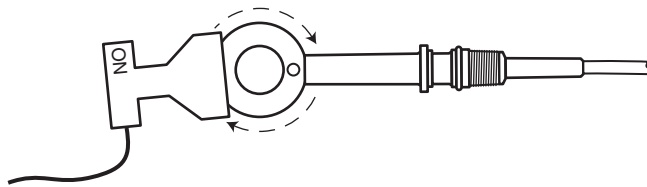


Figure 4.

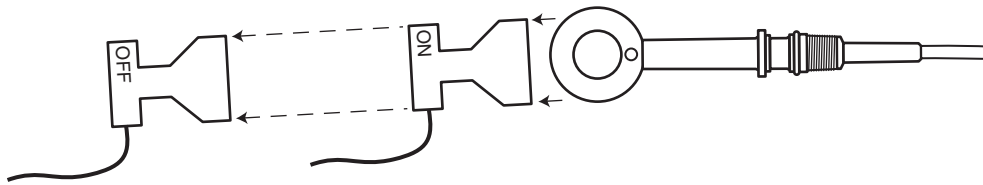


Figure 5.

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