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Encoders Go Barrier-less in Hazardous Locations

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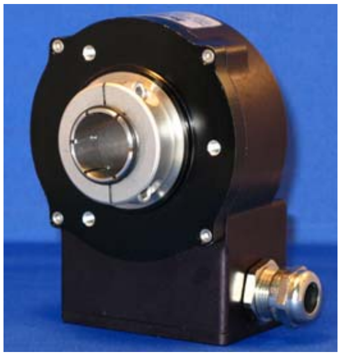

Encapsulated hollowshaft encoder from Dynapar

With today's widespread demand for energy, oil exploration and production are critical to the global economy. Drilling companies and equipment manufacturers are continually looking for ways to improve efficiency and save cost while improving production. In most drilling applications encoders are used to provide position and speed feedback for proper control of equipment like top drives, draw works, and pipe racking systems. However, encoders are electronic devices so they require special attention when used in hazardous environments such as a drilling platform. The energy contained within a typical industrial encoder circuit must not be allowed to ignite vapors and gases present in the drilling process, and there are several methods used to accomplish this. In this paper we will discuss some of the current options, their drawbacks, and a potential solution.

Regulation

Before investigating the different ways to make encoders suitable for hazardous duty, we must first take a quick look at how they're classified. ATEX, an acronym for ATmospehere Explosible (French for "explosive atmosphere"), is a commonly recognized European Union directive that establishes a detailed code for products used in hazardous locations. Encoders we'll discuss in this paper generally fall into Zone 0, where flammable materials are continuously present, or Zone 1 where flammable materials are intermittently present. Further clarification is required for the ignition energy of flammable material, commonly referenced by typical gases such as acetylene, ethylene, or propane, for example. These are classified as *groups*, IIC, IIB, and IIA, respectively.

Special Enclosures

One method used to make an encoder suitable for hazardous duty is to provide a special housing for the electronics. This special housing can take on several configurations, each with a specific ATEX code. The first method is to immerse the energized circuit in an oil bath. In this case the surrounding oil prevents contact with the hazardous atmosphere (ATEX protection code EEx o). Another method used is filling the housing with powder. In this example the circuit is surrounded by a powdered material, preventing arcing (ATEX code EEx q). A third method commonly employed is the use of a pressurized housing. In this case the encoder electronics are sealed inside a tough vessel. If an ignition does take place here, the ignition and possible subsequent explosion is contained within the housing (ATEX code EEx d). While each of these methods makes for a viable solution, the housing required usually turns a small encoder into an unwieldy device that takes up more space and places more loads on coupled components due to increased weight. There is also the consideration of the extra cost involved with the special housings and/or fillings.

Intrinsically Safe Designs
Another common type of protection class for encoders is Intrinsic Safety. Encoders classified in this area can be approved for use in either Zone 0 or 1. Again, the ATEX protection code makes the distinction here: Zone 0 (EEx ia) or Zone 1 (EEx ib). As the name implies, intrinsically safe designs are inherently "safe" through limitation of the energy allowed in the circuit, preventing unwanted effects of arcing. Intrinsically safe designs are commonly used with electrical barriers, external devices that effectively isolate the electrical connection between the encoder, controls, and power supply.

This design however, does have its drawbacks. Most obvious is the added cost of the barrier itself. Typically two barriers are needed for each encoder; one to isolate power, the other to isolate the encoder signal. At a rough "street" price of $200 per barrier, this can quickly add cost to the system, especially when multiple encoders are used. Another drawback is in the complexity of wiring. The encoder must be wired through the barrier, and not directly wired to the power or controls. Additionally, there is a voltage limitation within the circuit. The output voltage from the encoder is relatively low, commonly 5VDC. This decreased signal-to-noise ratio can be a problem when used in electrically noisy environments. This also limits allowable cable length, as a low power signal can degrade quickly over long distances.

A Better Idea
A different design, therefore, is needed to address the issues explained above: Housings that increase cost and size, external barriers, and voltage limitations. Enter the encapsulated protection method (code EEx m). With the encapsulated design, the encoder electronics are sealed within a conformal material, preventing ignition. Encapsulation, sometimes called non-barrier, can be suitable for use in Zone 1 environments. When designed properly, this increased safety design can allow elimination of external barriers.

The advantages of the encapsulated solution become readily apparent. The first is the elimination of barriers and associated cost and wiring. Although many existing installations in the field currently use barriers, the immediate benefits could persuade those applications to upgrade to a non-barrier solution. Second, since the electronics are encapsulated, the requirement to limit the energy within the circuit is reduced. Therefore, a higher power output is possible, allowing for longer cable runs and better signal-to-noise ratio. Finally, the encapsulated solution makes no requirement for a larger-than-necessary housing, reducing size and associated cost and complexity.

The Bottom Line
In summary, a multitude of options exist for applying encoders successfully in hazardous locations. Each has its own pros and cons, and ultimately the end user or design engineer must factor several things into account, such as total cost of ownership, Zone classification, electrical requirements, and physical size. With today's engineers and designers continually looking for that "better mousetrap", an encapsulated encoder that decreases total cost of ownership just may be the answer.

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