PROCESS AUTOMATION

INTRINSIC SAFETY IN A NUTSHELL

TECHNICAL WHITE PAPER

Intrinsic safety is the safest, least expensive, and easiest-to-install method of protection available. These safety systems offer significant labor savings over traditional protection methods because there are no heavy conduits or bolted enclosures. Material costs are less because a standard enclosure is the only major expense for mounting the barriers.
So, how does it work?

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INTRODUCTION

Despite the simplicity and increased popularity of intrinsic safety, many people believe the technology is about as easy as finding an engineer who still remembers how to solve differential equations. In part, that's due to tradition. For years European manufacturers have implemented intrinsic safety for their low-power operations, while in North America, large motors, alternating current, and high power dominate industry. So we assume if something is not familiar to us, it must be difficult.

WHAT IS INTRINSIC SAFETY?

As its name implies, intrinsic safety refers to equipment and wiring that's inherently safe. In other words, an intrinsically safe system is one with energy levels so low they cannot cause an explosion.

This is typically achieved through the use of barriers—either zener diode barriers or isolated barriers—that limit energy to a hazardous (potentially flammable) area.

The term hazardous area can be confusing. Hazardous area refers to any location with combustible material such as gases, dusts, or fibers that might produce an ignitable mixture. A hazardous area can be a sealed room filled with a volatile Material or an area that is open to normal foot traffic, such as the area around a gasoline pump.

In North America, hazardous areas are usually designated by classes, divisions, and groups, although the international system of zones and groups is becoming increasingly popular.

INTRINSICALLY SAFE SYSTEM

Although a thorough explanation of installation practices is beyond the scope of this article, you must follow certain principles in every application, regardless of the type of barrier used.

For instance, separate intrinsically safe wiring from nonintrinsically safe wires by an air space, a conduit, or a partition. Label wires to distinguish hazardous area wiring from safe area wiring. Seal or vent conduit and raceways inside hazardous areas so they do not transfer the hazardous atmosphere to the safe area.

Naturally, intrinsic safety practices must comply with local, state, and federal regulations.

APPROVALS

One of two methods can certify intrinsic safety equipment: systems or parameters. With a systems approval, approvers specify every component and evaluate the entire system. A variance to any of those components voids the approval.

By contrast, a parametric approval is one in which approvers evaluate each device separately and assign it a set of safety or entity parameters. With entity approval, you can connect a field device to any barrier with compatible safety parameters. See more information on ISA and Factory Mutual standards on the next page. For more information about regulations or approvals, contact ISA or an approval agency such as the National Fire Protection Agency, Factory Mutual, Underwriters Laboratories, or the Canadian Standards Association.

SELECTING COMPONENTS

Barriers are a key component because they limit the energy to the hazardous area.Zener diode barriers provide a simple method for implementing intrinsic safety. Their primary drawback is they must be connected to a dedicated intrinsic safety earth ground, which may introduce problems such as electrical noise on the control signal.

If a proper ground system is not in place, the cost of installing and properly maintaining it might outweigh the savings of this traditionally inexpensive intrinsic safety solution.

By contrast, isolated barriers provide galvanic isolation for anything connected to them, so there is no need for a dedicated ground. A potential downside is that isolated barriers usually require a separate power supply, although a single supply typically provides power to all barriers inside an enclosure.

Galvanically isolated barriers provide protection for specific applications such as transmitters, solenoids, and thermocouples, enabling easy system design.

ADVANTAGES OF INTRINSIC SAFETY

Quite simply, intrinsic safety is the safest, least expensive, and easiest-to-install method of protection available. With intrinsic safety, system integrity is not a concern because explosions cannot occur.

Intrinsic safety systems offer significant labor savings over traditional protection methods because there are no heavy conduits or bolted enclosures. Material costs are less because a standard enclosure is the only major expense for mounting the barriers.

With intrinsic safety, low energy requirements eliminate shock hazards and safety "hot" permits so field instruments can be calibrated and maintained while power is on.

And unlike most explosion protection methods, intrinsic safety systems operate seamlessly with retrofit applications and with modern technologies such as fieldbus.

The affinity to newer technology is one reason intrinsic safety is becoming the dominant protection method.

MORE ON ENTITY EVALUATIONS

According to ISA's intrinsic safety standard (ISA-12.02.01-2002),"The control drawing for the apparatus investigated under the entity evaluation concept shall provide the following information: Either the ISA marking, the IEC marking, or both, as shown in Table 12.3 of the standard, may be used to designate circuit parameters on the apparatus and in the installation documents and control drawing."

Factory Mutual Approvals also addresses entity evaluations in its October 1999 standard, 3610, which says,"Intrinsically safe apparatus shall be evaluated for the possibility of arc ignition or hot surface ignition based upon the values of maximum voltage (U_i or V_{max}), maximum current (I_i or I_{max}) and maximum input power (P_i) specified by the manufacturer." *(Source: FM Approvals 3610, Intrinsic Safety Apparatus & Associated Apparatus for use in Class I, II, & III, Division I, & Class I,Zone 0 & 1,Hazardous (Classified) Locations.)*

TABLE 12.3—ENTITY MARKINGS

ELECTRICAL PARAMETER ***For associated apparatus***	**ISA MARKING**	**IEC MARKING**
Maximum output voltage	V_{oc}	U_o
Maximum output voltage—multiple channel apparatus	V_t	U_o
Maximum output current	I_{sc}	I_o
Maximum output current—multiple channel apparatus	I_t	I_o
Maximum allowed capacitance	C_a	C_o
Maximum allowed inductance	L_a	L_o
Maximum output power	P_t	P_o
External inductance-to-resistance ratio	L_a/R_a	L_a/R_a
For intrinsically safe apparatus		
Maximum input voltage	V_{max}	U_i
Maximum input current	I_{max}	I_i
Maximum internal capacitance	C_i	C_i
Maximum internal inductance	L_i	L_i
Maximum input power	P_i	P_i
Internal inductance-to-resistance ratio	L_i/R_i	L_i/R_i

Source: ISA-12.02.01 2002 (IEC 60079-11Mod), Electrical Apparatus for Use in Class I, Zones 0, 1, & 2 Hazardous (Classified) Locations—Intrinsic Safety "i"

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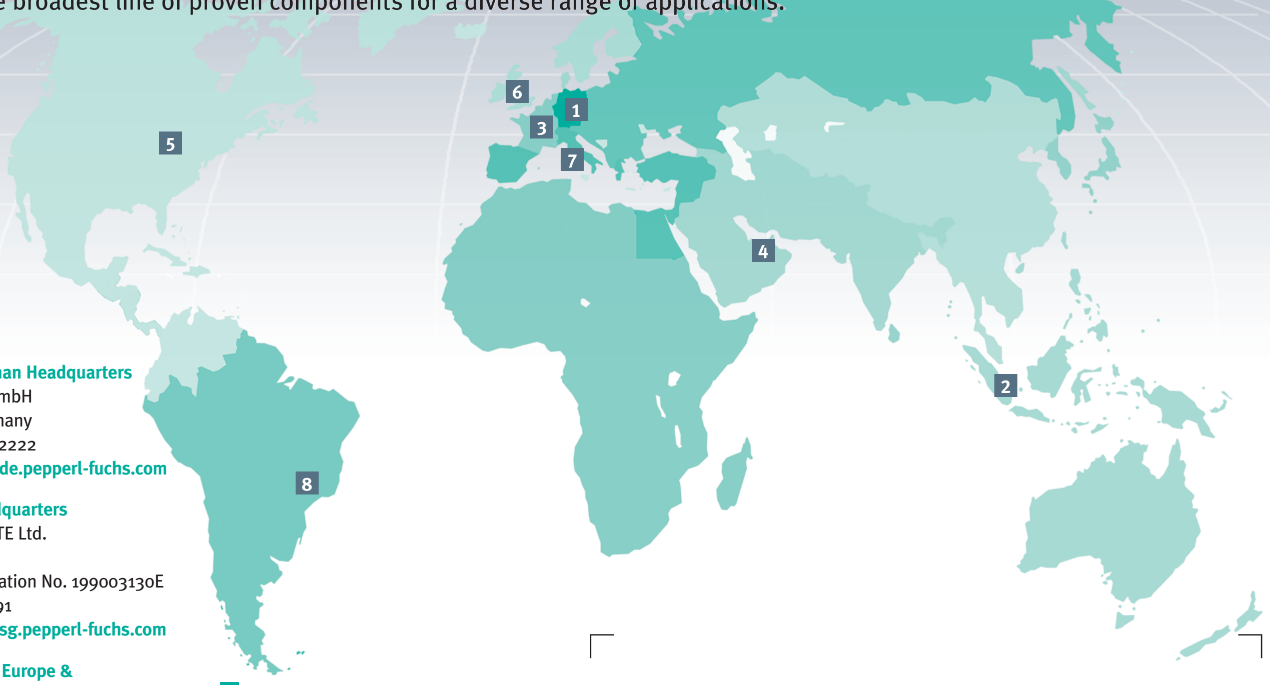

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