

Non-Incendive Fieldbus for Simplified Maintenance

1 INTRODUCTION

Many plants using FOUNDATION Fieldbus™ are installed in Class I Division 2 (Zone 2) hazardous area. Designers must choose a protection method that best suits the application. Some trade-offs involve cost, ease of maintenance, and product availability. One very useful protection method is “Non-incendive”.

“Non-incendive” is a method that allows the system to be maintained while it is powered without needing a hot work permit. This is possible by limiting the power on the segment to a level that will not cause an explosion, and is accomplished in one of two ways. Either the entire segment is non-incendive, or a portion of the segment is non-incendive. Of course there are pros and cons with each of these two methods.

This paper will cover the requirements to design non-incendive Fieldbus segments (or portions of segments). Examples will be given of the types of Fieldbus devices that may and may not be used for a non-incendive installation and why this is the case. Methods will also be shown for documenting that the installation is safe. Issues when using a mix of devices that are and are not non-incendive rated will also be addressed.

2 NON-INCENDIVE DEFINITION

Unfortunately, the term “Non-incendive” means different things to different people which can lead to confusion. The thing that is common among the two definitions is that the non-incendive device (system) will not cause an ignition under normal operating conditions. The difference is in the definition of “normal operating conditions”. In one case, it means that the system should not be disturbed (maintained) as it contains incendive levels of power that will not cause an arc, spark, or hot spot as long as it is left to operate as designed and installed. This is more correctly called a “non-Arcing” system. In the other case, the system is “energy limited” and does not have enough energy to cause an ignition from an arc, spark or hot spot. Where allowed by local electrical codes (not in Canada), energy limited systems may be worked (maintained) while energized.

In the U.S., the National Electrical Code (NEC) defines the term “Non-incendive Field Wiring” which is the equivalent of “energy limited” – i.e. it can be maintained while energized.

In Canada and Europe, the markings for non-Arcing and energy limited are “Ex nA” and “Ex nL” respectively. These will be used for clarity in the remainder of this paper.

3 FNICO

FNICO stands for “Fieldbus Non-Incendive CONcept” and is based on FISCO which is “Fieldbus Intrinsically Safe CONcept”. Both of these are covered in the IEC standard 60079-27:2005. FISCO is based on work that was done by PTB in Germany that showed that the IS (Intrinsic Safety) requirements for Fieldbus systems could be relaxed without compromising safety. This allows more current and voltage (energy) to be on the Fieldbus cables as long as the Fieldbus Segment complies with some benign requirements such as having 2 terminators and certain segment and spur length limitations. Please see the standard and references at the end of this paper for more information.

A fieldbus segment using a FNICO fieldbus power supply would be energy limited in its entire length (trunk and spurs). The entire segment would be able to be maintained while it is powered without risking an ignition.

FNICO (and FISCO) also benefit from reduced design and documentation requirements as compared to an Entity based design. Again, see references for more information.

4 LIVE WORKING

“Live Working” is a term that is used to indicate that the system is worked on (maintained) while it is still energized. This also presumes that no gas sniffing was done and no “hot work permit” was completed. Live Working is only attempted on systems that are energy limited and only where permitted by local electrical codes (the Canadian Electrical Code does not allow Live Working).

Even where Live Working is allowed, it must be done with care. Most disasters occur during maintenance operations. In addition, for Class I Division 2 (or Zone 2) equipment, FM only evaluates one cable at a time. Multiple cable faults have not necessarily been considered during the certification process. For improved safety Live Working should be performed carefully and in a limited fashion (no major maintenance).

5 ENERGY LIMITED FIELDBUS TOPOLOGIES

There are two topologies that are used for Energy Limited Fieldbus segments. The first is to use a FNICO Fieldbus Power Supply to power the entire segment. In this case, the entire segment is energy limited and may be live worked if needed. This is the most convenient and straightforward, but has some limitations compared to the second approach that we will cover later.

The diagram below (Figure 1) shows an example system using a FNICO power supply. Voltage and current are limited at the FNICO power supply to a safe level for Div 2 (Zone 2). Both the Trunk and the Spurs may be worked on while energized without risk of ignition. Depending on the FNICO power supply that you pick, current is limited to 320mA for gas group C (IIB) or 180mA for gas groups AB (IIC). Voltage is typically limited to less than 15VDC. So the trade-off for a completely energy limited segment is going to be the cable length and number of devices. Also, the FNICO power supply is a single point of failure. At this time, there is no redundancy available for completely energy limited segments.

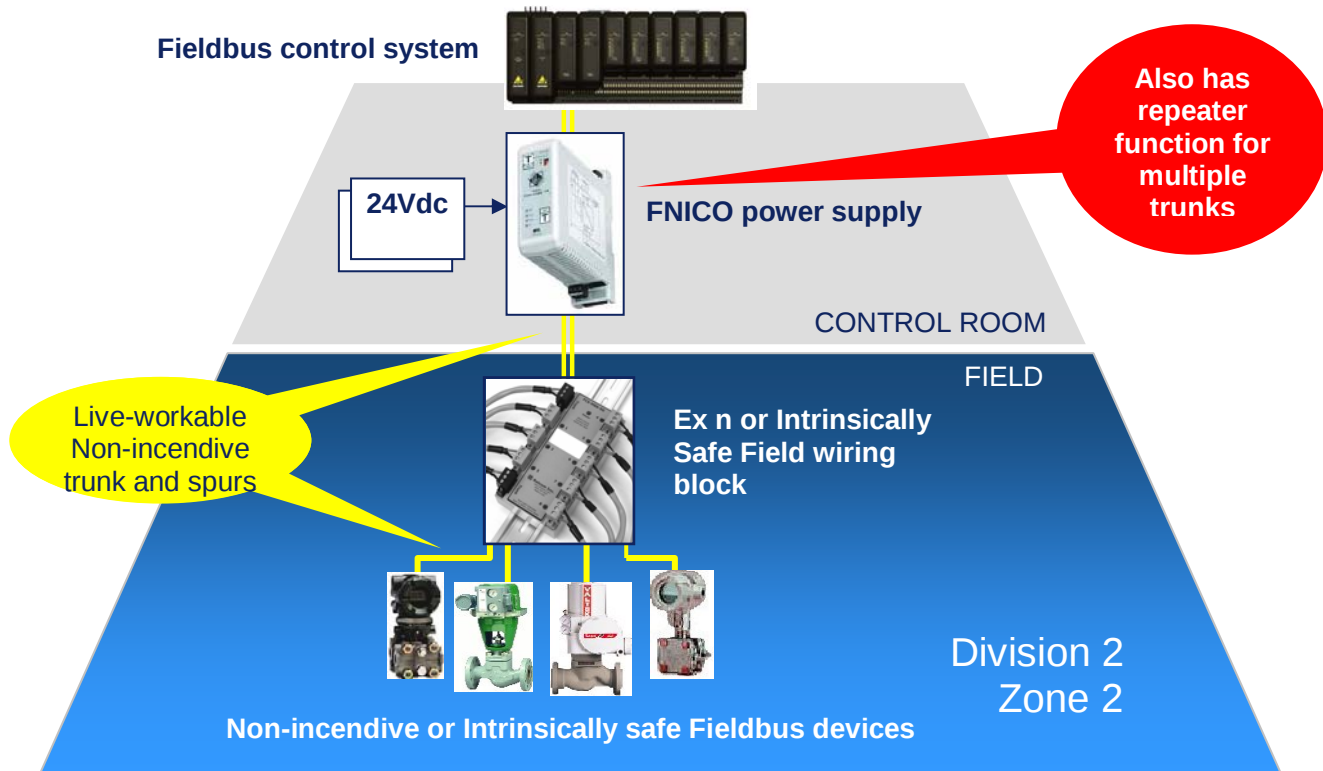


Figure 1

The second topology used to limit energy to fieldbus segments is called the High Powered Trunk method (see Figure 2). Here an Isolated Fieldbus Power Supply (FPS) which may also be redundant is used to feed the Trunk of the segment. The FPS limits the voltage and current, but not to a level that is safe for live working. The Field Wiring block contains current limiters (SG) on each of the spurs and typically limits the current to 60mA. At this point with the voltage being limited by the FPS and the current being limited by the SG, the energy on the Spurs is below a level that would cause an ignition if a short occurred. This makes the Spurs Live Workable. The Trunk, however, is rated non-Arcing and must not be worked without powering down, or getting a gas clearance. Since most work needs to go on at the device and most people would frown on working on a Trunk while energized since a mistake there could take all devices offline, this method is widely used. It provides the benefit of redundant power, long cable lengths (the FPS can supply voltages as high as 28VDC), and a maximum device count (the FPS can supply 350mA-500mA or more).

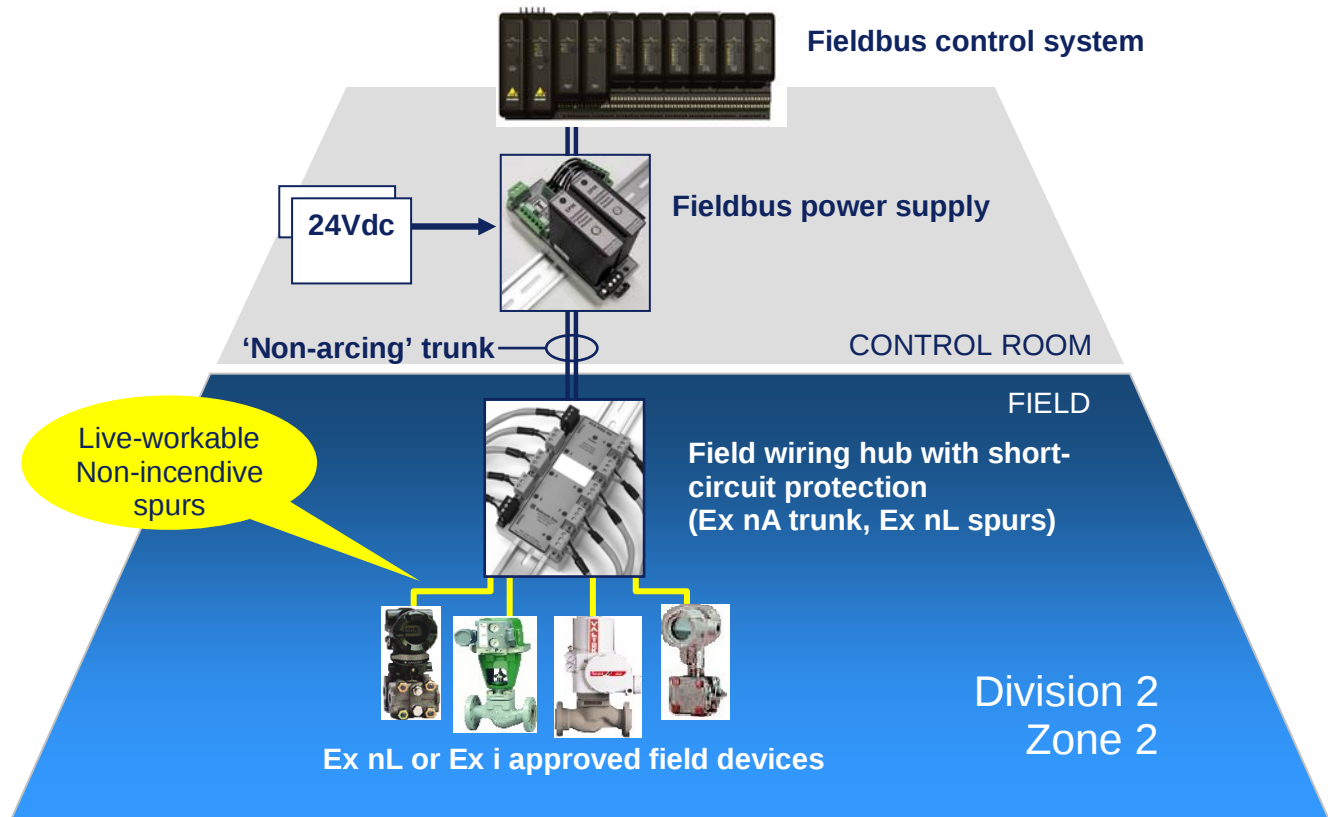


Figure 2

6 DESIGN REQUIREMENTS

As stated earlier, one of the benefits of FNICO is simplified design. Design proceeds based on the basic requirements for a Fieldbus segment. This includes a Host, Power Supply (in this case FNICO rated), Cable, Two Terminators (usually built into the supply and a wiring block), Wiring Blocks, and Fieldbus Devices. The following list shows the specific requirements:

- FNICO rated Fieldbus Power Supply
- Cable
 - o Loop resistance 15-150 ohms/km
 - o Loop inductance 0.4-1.0 mH/km
 - o Capacitance 45-200 nF/km
 - o Maximum spur length 60m
 - o Maximum total cable length 1km (IIC), 5km (IIB)
- Wiring Blocks
 - o Must be certified Ex nL (energy limited) or IS (FISCO)
- Fieldbus Devices
 - o Must be certified Ex nL (energy limited) or IS (Entity or FISCO)

Although several parameters were listed for the cable, they are not restrictive. Most any Fieldbus cable will be sufficient. So, setting up a FNICO segment comes down to picking the right components.

The design requirements for a High Powered Trunk (HPT) Fieldbus segment are a little more involved. However, most people feel that the benefits outweigh the extra complication. Below is a list of the requirements:

- Isolated Fieldbus Power Supply
 - o May be redundant
 - o Current only limited by the trunk cable and wiring block ratings
 - o Division 2 or Zone 2 rated maximum output voltage
- Trunk
 - o Design for non-Arcing method of protection
 - o Any Fieldbus compatible cable will work
- Wiring Blocks
 - o Must be certified and rated for Energy Limited Spurs (entity parameters)
 - o Certified input voltage rating must not be exceeded by the FPS output rating
- Spurs
 - o Any Fieldbus compatible cable will work
- Fieldbus Devices
 - o FB terminals Must be Ex nL, IS (entity), or IS (FISCO) certified (have safety parameters)
 - o Certified Voltage Rating (Vmax) must not be exceeded by the FB Power Supply
- Safety Calculations
 - o Perform and document safety of each Spur. Includes parameters from Wiring Block, Spur Cable, and FB Device.

The Terminators were not explicitly included in this list. Most of the time one is included in the FPS and another can be included in the wiring block. Separate discrete Terminators can be used if desired.

7 DOCUMENTATION REQUIREMENTS

The documentation requirements that we are referring to here are the Hazardous Area documentation requirements. For FNICO, the documentation only needs to be a list of the components used. Figure 3 is an example from a real system.

For the HPT solution, a more traditional approach will be required using the Safety Calculations that were part of the design process.

System title: Typical Installation (refer to Figure 26)

Conclusion

This safety document demonstrates that the FNICO system described satisfies the requirements of a IIB non-incendive system in which the field devices mounted in the hazardous area all have a T4 temperature classification and can be used in the ambient temperature range of –30°C to +60°C.

The cable used for the non-incendive trunk and spurs is UNITRONIC BUS PA blue, type 2020234 T and has parameters compatible with the FISCO/FNICO requirements, and has a useable temperature range of –30°C to +60°C.

Item number	1	2	3	4	5	6	7
Description	Power supply	Wiring termination unit	Terminator	Field Enclosure	Temperature Transmitter	Pressure Transmitter	Flow Transmitter
Manufacturer	MTL	Relcom	MTL	Boxco	Tempex Industries	Force Instruments Co.	Surf
Model No.	9112-NI	FCS-MB8	FBT1-IS	JB-18	THC22	BAR-976	Wizwirl 323e
FISCO/FNICO	FNICO	-	FISCO	-	FISCO	-	-
Approval	EEx nA [L]	EEx nAL	EEx ia	Simple Apparatus	EEx ia	EEx ia	EEx nL
Gas Group	IIB	IIC	IIC		IIC	IIC	IIC
Temperature Classification	N/A *	T4	T4	-	T4	T4	T4
Certificate number	MTL03 ATEX9112X	REL02ATEX 500-047	Baseefa02 ATEX0042	-	XXX02ATEX 0001	YYY01ATEX 0002	ZZZ01ATEX 0003
Temperature range	–40°C to +60°C	–45°C to +70°C	–40°C to +70°C	–45°C to +85°C	–40°C to +85°C	–40°C to +80°C	–40°C to +80°C
Safety voltage (where applicable)	Uo=14.8V	-	-	-	-	Ui=24V	Ui=32V

* Normally T4 but, in this example, the unit is mounted in the safe area

Figure 3

8 PICK YOUR DEVICES CAREFULLY

Since FNICO Fieldbus Power Supplies have a fairly low maximum output voltage rating, picking Fieldbus devices is trivial. Most Fieldbus devices are certified to 24VDC with Entity IS parameters and 17.5VDC for FISCO. However, for a HPT system, care must be taken to ensure that the Fieldbus Device voltage rating is no lower than the maximum output rating of the FPS. This has been an issue since Fieldbus Device manufacturers were not aware of the HPT method which gains significant benefit by having a higher output FPS. More recently, Fieldbus Device manufacturers have begun raising their device certification from 24VDC to 28VDC or 30VDC. The reader is cautioned that from a safety (certification) standpoint, the Fieldbus Device MUST have an input voltage rating (with entity parameters) that is not exceeded by the FPS.

There are other cases where - in particular – 4 wire Fieldbus devices do not have a Division 2 or Zone 2 rating. These cannot be used in either the HPT or FNICO topologies. A different device must be chosen, or the manufacturer pressured to get the appropriate certification.

9 CONCLUSION

Non-incendive Fieldbus segments provide a good method to protect from ignitions in hazardous areas and provide for easier maintenance procedures. It is important to recognize that the term “non-incendive” has two meanings that are very different. It can mean “non-Arcing” or “energy limited” and segments (or portions of segments) need to be treated differently depending on which of these two protection methods are used. Make sure you understand which one is meant when the term “non-incendive” is used.

Most people understand what Live Working means, but they don’t understand that the certification agencies don’t evaluate major maintenance with circuits energized (Division 2 or Zone 2). Live Working should only be performed on one cable at a time. Multiple cable interactions may not have been considered in the certification process. Also, make sure that your local electrical code allows for live working.

We looked at two different topologies for providing energy limitation to a Fieldbus segment so that it can be live worked. One topology provides for the entire segment being energy limited (FNICO), and the other is a combination of non-Arcing and energy limited. Only the energy limited (Spurs) portion may be live worked.

For these two topologies we looked at the design and Hazardous Area documentation requirements.

Finally we paid particular attention to some areas that can invalidate an energy limited system. This included certified voltage ratings on the Fieldbus Devices.

A properly implemented Fieldbus segment will be safe in the hazardous area and also allow for simplified maintenance.

10 RESOURCES

MTL Application Note AN9027 (FNICO) – see www.mtl-fieldbus.com

Fieldbus Wiring Guide - see www.relcominc.com