

CLASS I, DIV. 2 FUSE APPLICATIONS

Protecting process signals with hazardous location fuse terminals

Technical note

3465A

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The **CLIPLINE Complete** approach to terminal block design created by Phoenix Contact is revolutionary. By combining five connection technologies (screw, push-in, spring cage, insulation displacement and ring lug) into one easily interchangeable family that shares marking, bridging, testing and other functional accessories, connection applications are more flexible and easier to implement than ever before. As part of this approach, Phoenix Contact has developed industry-based family subsets that perfectly extend this flexibility into the most demanding applications. The following document details the application of the **CLIPLINE Complete** process series of terminal blocks specifically designed for process industry applications.

1 What is a hazardous (classified) location?

Hazardous locations are strictly defined by the various global standards organizations, but in general the Zone or Division declaration simply establishes a probability measure to the exposure to an explosive atmosphere. According to the ATEX Directive (94/9/EC):

An explosive atmosphere is a mixture with air, under atmospheric conditions, of flammable gases, vapors, mists or dusts in which, after ignition has occurred, combustion spreads to the entire unburned mixture. A potentially explosive atmosphere is an atmosphere which could become explosive due to local and operational conditions.

Along with ATEX (European Union) one may typically find any of the following international agencies contributing to these standards: International Electrotechnical Commission Explosive Scheme (IECEX), Underwriters Laboratory (UL), National Electric Code (NEC), and Canadian Electric Code (CEC). Managing hazardous locations starts with assessing the potential risk of an area and assigning a Zone or Division classification. The areas are classified based on the frequency of the occurrence of

potentially explosive atmospheres under normal operating conditions. For gases, Zones are defined as areas where potentially explosive atmospheres are:

Zone 0	Continuously present or frequently present for long periods during normal conditions.
Zone 1	Occasionally present during normal conditions.
Zone 2	Not usually present or present only for a very short period during normal conditions.

The same classification system is used for atmospheres that contain explosive dust, and they are marked Zone 20, Zone 21, and Zone 22, respectively. The following image from Sira Certification helps to summarize these classifications along with the protection concepts required for each zone.

For the Division system, used primarily in North America, the occurrence of potentially explosive atmospheres is spelled out as follows:

Division 1	May be present constantly or temporarily under normal conditions.
Division 2	Do not usually occur under normal conditions.

In 1996 the IEC Zone-based system was incorporated into the National Electric Code as article 505, setting up a parallel certification standard in the U.S. As a result, the IEC standards from Technical Committee (TC) 31, Equipment for explosive atmospheres, have been harmonized within the U.S. and are now fully referenced within the NEC.

Classification of Divisions and Zones			
Type of Area	NEC and CEC*	ATEX and IEC	Definitions
Continuous hazard	Division 1	Zone 0 / Zone 20 Cat 1	A place in which an explosive atmosphere is continually present
Intermittent hazard	Division 1	Zone 1 / Zone 21 Cat 2	A place in which an explosive atmosphere is likely to occur in normal operation
Hazard under abnormal conditions	Division 2	Zone 2 / Zone 22 Cat 3	A place in which an explosive atmosphere is not likely to occur in normal operation, but may occur for short periods

* On occasion the ATEX and IEC Zones may be used in the corresponding NEC and CEC system

Figure 1. Classifications

2 How are Phoenix Contact fuse blocks marked?



Figure 2. Typical classification marking

Hazardous location fuse blocks from Phoenix Contact are listed as Class I, Zone 2, AEx nA IIC Gc, and can alternately be listed as Class I, Division 2, Group A, B.

Typical North American Marking (CSA)					
Class I, Division 1, Groups A&B T4					
I	I	I	I	I	I
Hazard Class	Area Classification	Gas Group	Temperature Class		
Class I, Zone 0, AEx ia IIC T4					
I	I	I	I	I	I
Hazard Class	Area Classification	Approved to US Standards	Protection Concept Code	Gas Group	Temperature Class

Figure 3. Marking

Figure 4 shows the actual UL Certification Directory listing for our UT 4 and UT 6 fuse blocks – file number XCIB2. E192998.

Class I, Zone 2, AEx nA IIC Gc.										
Cat. No.	Wire Range (AWG)	Wire Range (mm ²)	Wire Type	FW	TQ (Lb In.)	TQ (Nm)	V	A	CA	
UT 4-MT-EX	26-10(1)	—	Cu	2	5-7	—	500	16	2 (105),4	—
UT 4-MT-P/P-EX	26-10(1)	—	Cu	2	5-7	—	250	16	2 (105),4	—
UT 4-TG(-P/P)-EX	26-10	—	Cu	2	5-7	—	250	6.3	2 (105),4	—
UT 6-TG-EX	24-8(2)	—	Cu	2	13-15	—	250	6.3	2 (105),4	—
UT 4-L/HESI w/wo LED 24, LED 60, LED 250 f/b (5x20)	(upper) 26-10	—	Cu	2	5-7	—	300	16	—	—
	(middle) 26-10	—	Cu	2	5-7	—	300	20	—	—
	(lower) 26-10	—	Cu	2	5-7	—	N/A Gnd	N/A Gnd	—	—
Note: (1) Additional multiple wire combination rating of two No. 16-26 AWG Cu. stranded wires (same size only) for field and factory wiring. Note: (2) Additional multiple wire combination rating of two No. 12-24 AWG Cu. stranded wires (same size only) for field and factory wiring.										

Figure 4. UL 192998

2.1 Division markings

As per the global harmonization effort, there are directions in the UL file on applying the new Zone classification to any existing Division classifications. As a result, the UL file Section General stipulates that, while approved as Class I, Zone 2, Group IIC, they may also be labeled Class I, Division 2, Group A and B.

- I. Any Products Suitable for Class I, Zone 0, Zone 1, or Zone 2 Locations:

The following marking(s) may be applied in addition to the class, zone and gas group markings required by each individual section within this volume under the following conditions:

- D. Product or products that may be marked Class I, Zone 0, Zone 1, or Zone 2, Group IIC may additionally be marked Class I, Div. 2, Group A and B.

Additionally:

- Note 3: Equipment that can be marked Group A and B may alternatively be marked Group A, B, C, and D or any combination of these groups.

3 Applying a Class I, Division 2 fuse block

Fuse blocks listed for use in Zone 2/Division 2 are subject to very specific usage criteria primarily dictated by the NEC. In short, the NEC states that fuses may only be used for non-current limiting applications and, when used in such applications, there is no restriction on the type of fuse that must be used in the fuse block. According to the NEC, instrumentation applications are not considered to be subject to overload current during normal operation. On the other hand, power applications (such as motors) are designed to experience overload current during normal operating conditions and require a current limiting fuse.

From our UL file, these are the only additional conditions of acceptability that must be met for application: Marking

1. Meet all Conditions noted in the Applicant's File E60425, issue date: 2004-01-23.
2. The terminal blocks were evaluated for use in an enclosure certified for the area with a minimum rating of IP54 which shall bear the following or equivalent warning:

WARNING – DO NOT REMOVE OR REPLACE THE FUSE WHEN ENERGIZED! or

WARNING – DO NOT ACTUATE THE DISCONNECTOR KNIFE WHEN ENERGIZED!

3. The end use product shall provide provision for the correct type and value for replacement fuses to be marked in the installation instructions.

With respect to fuses, the UL file makes the following statement:

Fuses – All fuses are cartridge type. They are not subject to overloading.

3.1 *What does the National Electric Code say?*

The 2014 NEC separates the applications into Power (NEC 501.115) and Instrumentation (NEC 501.105). Power applications have very rigid requirements for the usage of interrupting devices, such as circuit breakers and fuses. For a fuse block to apply to these applications, it would have to be fitted with a special “filled” fuse. These applications are typically satisfied using a CC-style fuse. NEC 501.105(B)(5) and NEC 500.8(B)(3) state that, for instrumentation applications where circuits are “not subject to overloading in normal use”, “general-purpose equipment or equipment in general-purpose enclosures shall be permitted.” This is interpreted to mean that, for instrumentation applications, no special approvals are required on these fuse holders and no special fuse is required.

3.2 *2014 National Electric Code verbiage*

Following are the sections from the NEC that directly apply to our product offerings.

NEC 501.105(B)(5) – Meters, Instruments, and Relays for Class I, Division 2 locations

Where general-purpose enclosures are permitted in 501.105(B)(1) through (B)(4), fuses for overcurrent protection of instrument circuits not subject to overloading in normal use shall be permitted to be mounted in general-purpose enclosures if each such fuse is preceded by a switch complying with 501.105(B)(1).

NEC 501.105(B)(1) – Meters, Instruments, and Relays for Class I, Division 2 locations

Switches, circuit breakers, and make-and-break contacts of push buttons, relays, alarm bells, and horns shall have enclosures identified for Class I, Division 1 locations in accordance with 501.105(A).

Exception: General-purpose enclosures shall be permitted if current-interrupting contacts comply with one of the following:

1. Are immersed in oil
2. Are enclosed within a chamber that is hermetically sealed against the entrance of gases or vapors
3. Are in nonincendive circuits
4. Are listed for Division 2

NEC 500.8(B)(3) – Meters, Instruments, and Relays for Class I, Division 2 locations

Where specifically permitted in Articles 501 through 503, general-purpose equipment or equipment in general-purpose enclosures shall be permitted to be installed in Division 2 locations if the equipment does not constitute a source of ignition under normal operating conditions.

4 Understanding hazardous location certifications

Generally there are two independent classification systems for gases that will address the application of most Phoenix Contact products:

NEC Article 505 – General and special requirements for Zone 0, 1, and 2

- Divides locations into Zones and Gas Groups
- Class I, Zone 2, AEx nA IIC Gc

Zone 0	An area in which an explosive atmosphere consisting of a mixture with air and flammable substances in the form of gas, vapor or mist is present continuously or for long periods of time or frequently (>1000 hours/year).
Zone 1	An area in which an explosive atmosphere consisting of a mixture with air and flammable substances in the form of gas, vapor or mist is likely to occur occasionally in normal operation (10 hours to 1000 hours/year).
Zone 2	An area in which an explosive atmosphere consisting of a mixture with air and flammable substances in the form of gas, vapor or mist is not likely to occur in normal operation, but if it does occur, only for short periods of time (1 hour to 10 hours/year).

NEC Article 500 – General requirements for Divisions of Class I, II, and III

- Divides locations into Divisions and Groups
- Class I, Division 2, Groups A & B

Division 1	An area in which an explosive atmosphere: <ul style="list-style-type: none"> – exists during normal operation. – exists during repair/maintenance. – or exists because of leakage (>10 hours/year).
Division 2	An area in which an explosive atmosphere: <ul style="list-style-type: none"> – exists during abnormal operation. – or an area that is adjacent to a Division 1 location (1 hour to 10 hours/year).

To further differentiate the potential hazard an explosive atmosphere represents, locations are segmented into Groups based upon their explosion and ignition characteristics. These Groups are generally defined by three measurements:

- Explosion pressure in PSI
- Maximum Experimental Safe Gap in MM – MESG
- Minimum Ignition Current – MIC ratio

The measurements used and their value depends upon the standard being met – Zone or Division.

4.1 Defining gas measurements

Gases in hazardous locations are generally defined by four characteristics: maximum explosion pressure, maximum experimental safe gap (MESG), minimum igniting current (MIC) ratio, and autoignition temperature.

Gas	Maximum explosion pressure	MESG (mm)	MIC	Auto-ignition Temp (F)
Propane	160	0.97	146	842
Ethylene	200	0.65	108	914
Hydrogen	845	0.28	75	932
Acetylene	1140	0.25	60	581

Lower values for all of these except maximum explosion pressure indicate a more volatile atmosphere.

4.2 Zone 0, 1, 2 material groups

NEC 505.6(A), (B), and (C)

Material groups under the NEC 505-defined Zones are defined by the MESG and the MIC ratio values of the gases and divided into groups based upon the values described in the following table.

Group	Gas	MESG (mm)	MIC
IIC	Acetylene and hydrogen	≤0.50	≤0.45
IIB	Hydrogen	>0.50 ≤0.90	>0.45 ≤0.80
IIA	Ethylene	>0.90	>0.80

Group IIC contains the gases with the most explosion potential.

4.3 Class I group classifications

NEC 500.6(A)(1) through (A)(4)

Group classifications under the NEC 500 Divisions are also defined by the MESG and MIC ratio values of the gases, but maximum explosion pressure is also taken into account. Acetylene exhibits the highest explosion pressure and therefore resides by itself in Group A. The other groups are arranged in descending order of explosion pressure with propane exhibiting the lowest value.

Group	Gas	MESG (mm)	MIC
A	Acetylene		
B	Hydrogen	≤0.45	≤0.40
C	Ethylene	>0.45 ≤0.75	>0.45 ≤0.80
D	Propane	≥0.75	>0.80

A comparison of the two methods used to determine the grouping of gases reveals the rationale behind UL's statement of additional and alternative marking of Zone 2, Group IIC products as follows:

- D. Product or products that may be marked Class I, Zone 0, Zone 1, or Zone 2, Group IIC may additionally be marked Class I, Div. 2, Group A and B.

Additionally:

- Note 3: Equipment that can be marked Group A and B may alternatively be marked Group A, B, C, and D or any combination of these groups.

4.4 ANSI/ISA-12.12.01-2012

Finally, when applying a connector or plug-in component in an incandive circuit, there are some additional constraints spelled out in ANSI/ISA-12.12.01-2012.

8 Normally nonarcing components

Connectors and plug-in components used in incandive circuits and incorporated within equipment shall be considered normally nonarcing if disconnection is not required under operational conditions and either 1) each connection or group of connections is secured with a mechanical retaining device which may or may not be an integral part of the connector and does not rely on friction alone, or 2) disconnections require a separating force of at least 15 N. If accessible during normal operating conditions, connectors in an incandive circuit shall be provided with a warning marking in accordance with 9.2.

5 References

Directive 94/9/EC on equipment and protective systems intended for use in potentially explosive atmospheres (ATEX)

SIRA Certification, www.siracertification.com

NFPA 70: National Electrical Code

UL file number XCIB2.E192998

NFPA (National Fire Protection Association) - www.nfpa.org