Requirements For Fuses Used In Class 1 Division 2 Applications

There is a lot of confusion concerning the requirements for fusing in Class 1 Division 2 hazardous locations. What type of fuse holder is required and what type of fuse is acceptable are two common questions. This whitepaper addresses these issues and uses CSA standard C22.2 No. 213-17 as a reference. This is a harmonized standard prepared by CSA and UL. The US version is ANSI/UL 121201.

First, let's look at fuse holders. Is a DIN rail mounted fuse terminal block a fuse holder?
Most are not.

Products certified for use in C1D2 applications must be tested for maximum surface temperature. This is to ensure that any surface exposed to an explosive gas cannot ignite that gas. The test produces a "T code" rating. For example, rating T4 means a surface temperature of ≤ 135°C (ambient temperature plus the temperature rise caused by power dissipation).[1]

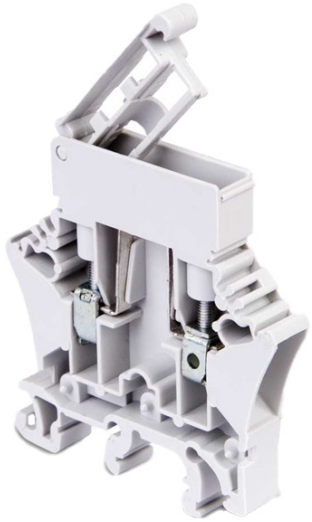

Figure 1 - Weidmuller's BC5F 5x20mm C1D2 fuse holder

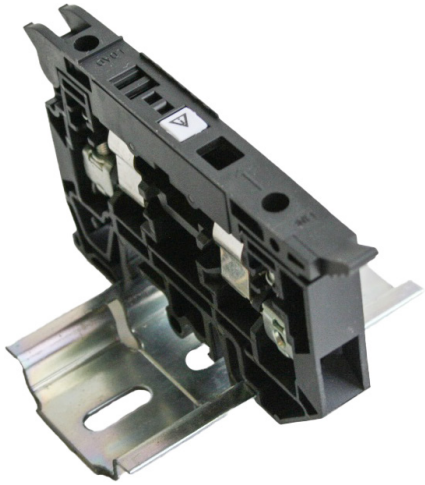

Figure 2 - Weidmuller's WSI4/2 1¼" x ¼" C1D2 fuse holder

Fuse terminals are tested by CSA and UL with a metal slug in place of the fuse so the power dissipation can be quite different when an actual fuse is installed. This is because the impedance of a fuse can be much higher than the impedance of a relatively large piece of copper or brass. A C1D2 certified fuse holder has been tested with a fuse installed, not a metal slug. It is entirely possible that a safe area certified fuse terminal block rated 10A would not meet the requirements for a 10A hazardous locations rating.

As you can see in Figures 1 and 2, a C1D2 rated fuse holder looks like a safe area fuse terminal block but that doesn't mean all fuse terminal blocks can be certified for C1D2 applications. They not only have to pass the temperature requirements but they also must pass a pull test.is test applies 15N (3.3 pounds-force) to the fuse or fuse lever. The intent is to determine susceptibility to accidental opening of a circuit and producing an arc that could ignite a flammable gas.

Figure 3 - So what's going on here?

Figure 3 shows a fuse terminal that failed the pull test but has a tie wrap holding the lever closed. Does this meet the requirements of the standard? Actually it does as long as documentation for the product specifically says the tie wrap must be installed in order for the fuse terminal to be used in a C1D2 application. Such documentation is called the Conditions of Acceptability and users of C1D2 fuse holders should request this document from the manufacturer before specifying a product.

Fgure 3 also leads us to something called "normal operating conditions". This is defined in the standard as:

"Conditions under which equipment conforms electrically and mechanically with its design specification and is used within the conditions specified by the manufacturer." [3]

In the case of the pull test, if the product fails, the manufacturer may specify the normal operating conditions as "installed in a cabinet where the door is closed under normal operating conditions and is not opened unless the area is known to be free of explosive gases". Or the manufacturer may specify "place a tie wrap around the unit to hold the lever closed" and warn against removing the tie wrap unless the area is known to be free of explosive gases. Either way conditions of acceptability must be known by the user.

Next let's look at what purpose the fuse serves. Sometimes a user will state the fuse is intended to protect the load. This might be the case, but probably isn't. If the fuse blows it is most likely because the load failed in a short circuit condition or the wiring was short circuited. Fusing generally protects the wiring from being damaged (or catching fire) in the event of an extreme overcurrent condition usually caused by a short circuit.

Another use for the fuse is to protect against overloads. If a motor normally draws 2A
but could be overloaded and draw a current sufficient to damage the control circuitry or wiring
then a fuse could be the solution.

Now let's look at the definition of class 1 division 2: "an area where ignitable concentrations of flammable gases, vapors or liquids are not likely to exist under normal operating conditions. In this area the gas, vapor or liquids would only be present under abnormal conditions". For a product to be approved for use in C1D2 applications it must withstand the explosive gas being present. That is the only fault it must withstand. A short circuit that causes a fuse to blow while an explosive gas is present represents two faults and does not apply to C1D2 applications. But in the case of the fuse being used to prevent issues caused by an overload, this is not a second fault simply because an overload is considered a normal operating condition. The standard clearly distinguishes between short circuit protection (a fault) and an overload (normal operating condition and thus not a fault). As per the standard, an example of an overload "in normal use includes a motor circuit where a possibility of a stalled motor opening the fuse exists, or where there is the possibility of an overload not caused by a fault in the circuit".[4]

So far we have described two actions users should take - check the conditions of acceptability for the fuse holder they've chosen and decide if the circuit is subject to overloads in normal operating conditions. Now let's decide on the type of fuse required.

If the circuit is not subject to overloads, i.e. the fuse is protecting the wiring from short circuits, any fuse is acceptable. Glass 5x20mm fuses are acceptable. TR5 micro-fuses are acceptable. Midget fuses are acceptable.

If the circuit is subject to overloads section 5.3 of the standard applies. This states the fuse shall meet one of the following conditions: [5]

1: housed in a Division 1 enclosure
2: evaluated in accordance with section 5.1.2 (includes non-incendive devices and sealed devices) [6]
3: immersed in oil
4: non-indicating, filled, current-limiting type

Section 5.1.2 deals with a number of conditions including sealing the fuse so that any arc produced within the fuse when it blows cannot ignite the explosive gas. This same requirement applies to switching or "make/break" devices such as relays and switches. We will discuss this option later.

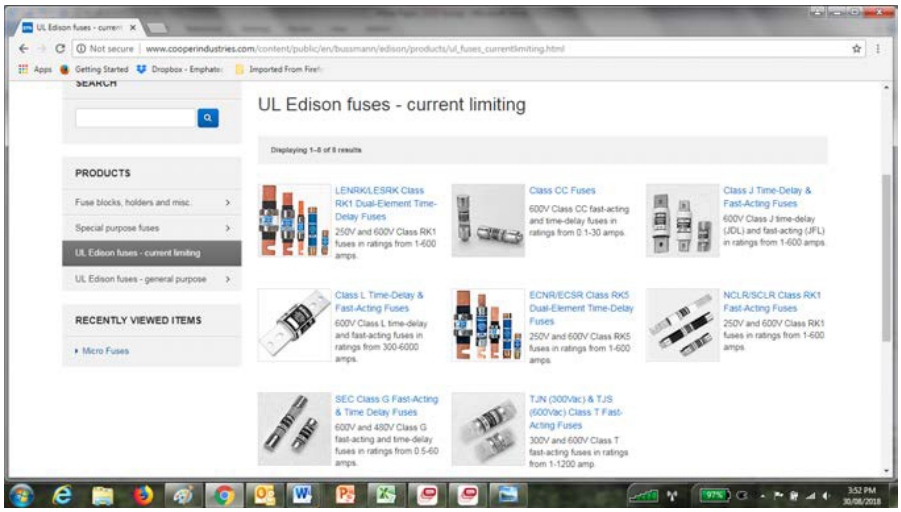

Figure 4 - Current Limiting Fuses

From the four options listed above the 4th (non-indicating, filled, current limiting type) seems to be the most practical. A web search for "current limiting fuse" leads to branch rated fuses such as CC and T-class fuses. Unfortunately it does not lead to a 5x20mm or a 1¼"x¼" fuse. As long as a C1D2 certified fuse holder is used a couple good solutions to fusing for overload circuits would be a CC fuse (readily available) or a T-class (physically smaller than the CC fuse but perhaps not as readily available).

Figure 5 - Weidmuller's C1D2 rated CC fuse module, Emphatec DePro® - FMC/CC

Figure 5 shows the Weidmuller C1D2 certified CC fuse module. It provides a socket for the fuse , a touch safe cover, status LED and terminations for the neutral. The maximum fuse rating is 25A.

What about a sealed fuse as per section 5.1.2 of the standard? Sealed fuses tend to be C1D1 or intrinsically safe rated devices. There is a compact hermetically sealed fuse available from Littelfuse and a C1D1 DIN rail mounted fuse from Stahl – not a lot to choose from!

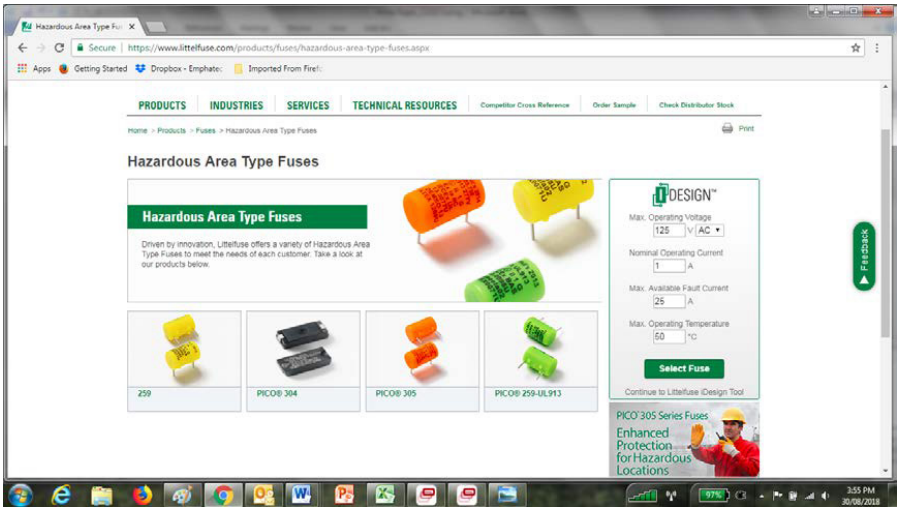

Figure 6 – Hazardous Area Fuses

Conclusion

Not all fuse holders are equal – check the Conditions of Acceptability.
The user must know if the circuit that includes the fuse is an overload circuit or if the fuse is only intended to provide short circuit protection.

For overload circuits the fuse must be sealed or a non-indicating, filled, current limiting type such as a CC or T-class.

For short circuit protection in Class 1 Division 2 applications any fuse is acceptable.

Notes:
1: CSA C22.2 No. 213-17, clause 9.2, Table 1
2: Clause 8.2
3: Clause 3.30
4: Clause 5.3.1, Note 1
5: Summarized, see clause 4.3 for full descriptions
6: Summarized, see clause 5.1.2 for full descriptions

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August 31, 2018

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