



Hazardous Location Electrical Markings – Temperature Class

Introduction

This edition of the *Drill Down* on Hazardous Location (HazLoc) electrical equipment markings will focus on the temperature class designations used in National Fire Protection Association (NFPA) 70 (National Electric Code (NEC)) and the International Electrotechnical Commission (IEC) 60079-series. Temperature class is the maximum safe operating temperature of the equipment installed in HazLocs and corresponds to the ignition temperature of the substance(s) (i.e., gases) present or likely to be present in a classified location.

NFPA 70, Article 500

Manufacturer's Identification (Name or Trademark & Address)		Product Model/Type Product Serial No.	
II 2 G D	1234	LISTED	$-20^{\circ}\text{C} \leq \text{Ta} \leq +50^{\circ}\text{C}$ IP66
Ex d IIC T4 Gb	Class I Zone 1	AEx d IIC T4 Gb	
Ex tb IIIC T135°C Db	Zone 21	AEx tb IIIC T135°C Db	
NBOD 23 ATEX 0620X	Class I, Div 1	Groups B, C, D T4	
IECEx NBOD 23.0620X	Class II, Div 1	Groups E, F, G T4	

Figure 1: Equipment label with NFPA 70, Article 500 temperature class and ambient temperature range indicated

In accordance with NFPA 70 (2017), Article 500.8(C)(4)), “equipment markings shall specify the temperature class or operating temperature at a 40°C [104°F] ambient temperature, or at the higher ambient temperature if the equipment is rated and marked for an ambient temperature of greater than 40°C”. More than one temperature class (T code) or operating temperature may be marked for gases and vapors, dusts and different ambient temperatures. Figure 1 shows the temperature class to be “T4” that equates to a 135°C maximum surface temperature (see table 1).

Non-heat-producing equipment (e.g. junction boxes, conduit, fittings) and heat-producing equipment having a maximum temperature of no more than 100°C are **not** required to have a marked operating temperature or temperature class.

“Electrical equipment designed for use in the ambient temperature range between -25°C to +40°C shall require no ambient temperature marking. For equipment rated for a temperature range other than -25°C to +40°C, the marking shall specify the special range of ambient temperatures in degrees Celsius. The marking shall include either the symbol “Ta” or “Tamb” (NFPA 70 (2017), Article

500.8(C)(5)). The example label in figure 1 shows the ambient temperature range to be $-20^{\circ}\text{C} \leq \text{Ta} \leq +50^{\circ}\text{C}$ and applies to all three marking systems.

There is no consistent relationship between explosion properties and ignition temperature, so they are **two independent requirements** (NFPA 70 (2017), Article 500.8 information note 1). As such, a temperature rating may disqualify equipment from installation within a location that it would otherwise be qualified to be installed. For example, if the label in figure 1 did not have an ambient temperature marking, the equipment would be safe within the range of -25°C to 40°C but would not be safe in a classified location with a 48°C ambient temperature. The same would be true for the varied ambient temperatures that follow for the Article 505 and IEC marking systems.

Table 1 lists the temperature classes for Article 500.

Maximum Surface Temperature		Temperature Class (T Code)
C°	F°	
450	842	T1
300	572	T2
280	536	T2A
260	500	T2B
230	446	T2C
215	419	T2D
200	392	T3
180	356	T3A
165	329	T3B
160	320	T3C
135	275	T4
120	248	T4A
100	212	T5
85	185	T6

Table 1: NFPA 70, Article 500 Temperature Classes

NFPA 70, Article 505

Manufacturer's Identification (Name or Trademark & Address)		Product Model/Type Product Serial No.	
II 2 G D	1234	LISTED	$-20^{\circ}\text{C} \leq \text{Ta} \leq +50^{\circ}\text{C}$ IP66
Ex d IIC T4 Gb	Class I Zone 1	AEx d IIC T4 Gb	
Ex tb IIIC T135°C Db	Zone 21	AEx tb IIIC T135°C Db	
NBOD 23 ATEX 0620X	Class I, Div 1	Groups B, C, D T4	
IECEx NBOD 23.0620X	Class II, Div 1	Groups E, F, G T4	

Figure 2: Equipment label with NFPA 70, Article 505 temperature class and ambient temperature range indicated

Class I (see [Drill Down #24](#)) “equipment shall be marked to show the operating temperature or temperature class referenced to a 40°C [104°F] ambient, or at the higher ambient temperature if the equipment is rated and marked for an ambient temperature of greater than 40°C” (NFPA 70 (2017), 505.9(D)(1)). The temperature marking “shall not exceed the autoignition temperature of the specific gas or vapor to be encountered” (NFPA 70 (2017), Article 505.9(D)). Figure 2 shows the temperature class to be “T4”, equating to a maximum surface temperature of 135°C (table 2).

Ambient temperature marking requirements for Article 505 are similar to Article 500, but with a varied temperature range. “Electrical equipment designed for use in the ambient temperature range between -20°C to +40°C shall require no ambient temperature marking. Electrical equipment designed for use in a temperature range other than -20°C to +40°C is considered to be special; and the ambient temperature range shall then be marked on the equipment, including either the symbol “Ta” or “Tamb” together with the special range of ambient temperatures, in degrees Celsius” (NFPA 70 (2017), Article 505.9(D)(1)).

Table 2 summarizes Article 505 temperature classes.

Temperature Class	Maximum Surface Temperature °C(°F)
T1	≤ 450(842)
T2	≤ 300(572)
T3	≤ 200(392)
T4	≤ 135(275)
T5	≤ 100(212)
T6	≤ 85(185)

Table 2: NFPA 70, Article 505 Temperature Classes

IEC 60079-Series




Manufacturer's Identification (Name or Trademark & Address)	Product Model/Type Product Serial No.
 II 2 G D  1234 	Product Model/Type Product Serial No. -20°C ≤ Ta ≤ +50°C IP66
Ex d IIC T4 Gb	Class I Zone 1 AEx d IIC T4 Gb
Ex tb IIIC T135°C Db	Zone 21 AEx tb IIIC T135°C Db
NBOD 23 ATEX 0620X	Class I, Div 1 Groups B, C, D T4
IECEX NBOD 23.0620X	Class II, Div 1 Groups E, F, G T4

Figure 3: Equipment label with IEC temperature class and ambient temperature range indicated

Temperature class is defined by IEC 60079-0 (2017) as a “classification system of Ex Equipment, based on its maximum surface temperature, related to the specific explosive gas atmosphere for which it is intended to be used” (Clause 3.85). Group II (see [Drill Down #25](#)) electrical equipment must be marked with the symbol indicating the temperature class. The manufacturer may specify the maximum surface temperature between two temperature classes by marking the maximum surface temperature in °C alone, or by marking the maximum surface temperature in °C, with the next highest temperature class in parenthesis (e.g. T1 or 350°C or 350°C (T1)) (IEC 60079-0 (2017), Clause

29.4.d). Figure 3 shows “T4” as the temperature class for the IEC marking, also with a 135°C maximum surface temperature (table 3).

“Equipment designed for use in a normal ambient temperature range of -20°C to +40°C does not require marking of the ambient temperature range. However, equipment designed for use in other than this normal temperature range is considered to be special. The marking shall then include either the symbol Ta or Tamb together with both the upper and lower ambient temperatures or, if this is impractical, the symbol “X” shall be used to indicate specific conditions of use that include the upper and lower ambient temperatures” (IEC 60079-0 (2017), Clause 5.1.1).

Temperature marking requirements vary slightly with older editions of IEC 60079-0, so it is pertinent to match the edition of the standard to the age of the equipment when verifying compliance. Special symbols, such as the “X” mentioned above are to be discussed in [Drill Down #29](#).

IEC 60079-series temperature classes are listed in Table 3.

Temperature Class	Maximum Surface Temperature (°C)
T1	450
T2	300
T3	200
T4	135
T5	100
T6	85

Table 3: IEC 60079-series Temperature Classes

Conclusion

While there are variations between the temperature classes of the three HazLoc marking systems that we have examined, there are two major considerations:

- 1) Temperature class is relevant to any gases that may be present or expected in a protected location; **and**
- 2) All equipment in a HazLoc should be rated to the temperature class with the **lowest** ignition temperature of the atmosphere expected within the location.

A higher temperature class may be used in place of a lesser class than is required for a HazLoc. For example, if acetylene (305°C ignition temp) is the gas with the lowest ignition temperature present (or expected) in a classified location, T2 is the minimum required temperature class, but T2 through T6 would be satisfactory for that location.

As shown on the example labels, the ambient temperature marking must be included if not within the “normal range” of the respective standard, but may reside separately from the specified marking components.

See the appendix on page 3 for a reference sheet.

The next *Drill Down* in this series will address the equipment protection level (EPL), a marking component that has been mentioned previously in this *Drill Down* series on HazLoc markings.

Temperature Class Reference Chart

NFPA 70, Articles 500 and 505; IEC 60079-Series






Temperature Classification					
Maximum Surface Temperature	NFPA 70, Article 500	NFPA 70, Article 505	IEC 60079 Group II	Example Gas	Ignition Temperature
450°C (842°F)	T1	T1	T1	Methane (CH ₄) Hydrogen (H ₂) Propane (C ₃ H ₈)	600°C (1,112°F) 560°C (1,040°F) 450°C (842°F)
300°C (572°F)	T2	T2	T2	Ethylene (C ₂ H ₄) Acetylene (C ₂ H ₂)	440°C (824°F) 305°C (581°F)
280°C (536°F)	T2A				
260°C (500°F)	T2B				
230°C (446°F)	T2C				
215°C (419°F)	T2D				
200°C (392°F)	T3	T3	T3		
180°C (356°F)	T3A				
165°C (329°F)	T3B				
160°C (320°F)	T3C				
135°C (275°F)	T4	T4	T4		
120°C (248°F)	T4A				
100°C (212°F)	T5	T5	T5		
85°C (185°F)	T6	T6	T6	Carbon Disulfide (CS ₂)	90°C (194°F)

Ambient Temperature Range

Not required if in the “normal” range:

-20°C to +40°C for IEC and NFPA 70, Article 505, or
-25°C to +40°C for NFPA 70, Article 500

NFPA 70, Article 505 Temperature Class

Manufacturer's Identification (Name or Trademark & Address)		Product Model/Type Product Serial No.	
 II 2 G D  1234  LISTED	 T4 Gb  T135°C Db NBOD 23 ATEX 0620X IECEx NBOD 23.0620X	Class I Zone 1 Zone 21 Class I, Div 1 Class II, Div 1	-20°C ≤ Ta ≤ +50°C IP66 AEx d IIC T4 Gb AEx tb IIIC T135°C Db Groups B, C, D T4 Groups E, F, G T4

IEC 60079-Series
Temperature Class

NFPA 70, Article 500
Temperature Class