Guide to Hazardous Locations

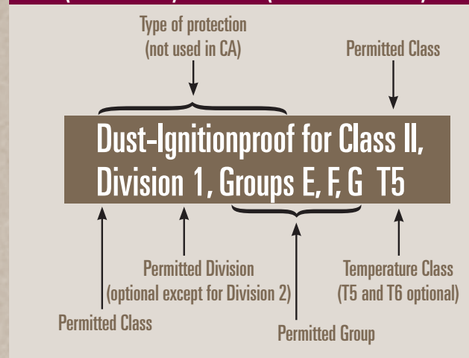
Explosive Dust Atmospheres

FM Approvals®

Member of the FM Global Group

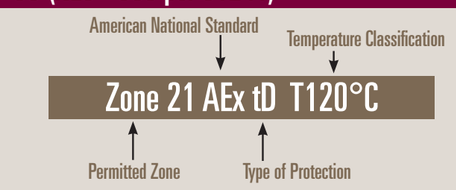
Ex Marking

US (NEC® 500) and CA (CEC Annex J18)



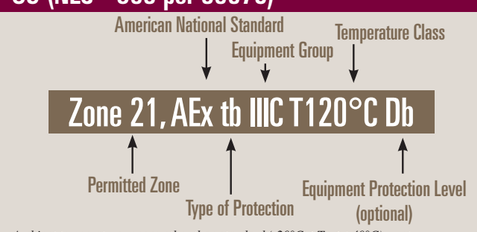
Ambient temperature ranges other than standard (-25°C ≤ Ta ≤ +40°C) must be marked.

US (NEC® 506 per 61241)



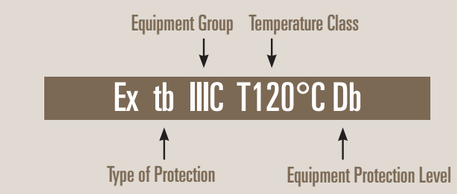
Ambient temperature ranges other than standard (-20°C ≤ Ta ≤ +40°C) must be marked.

US (NEC® 506 per 60079)



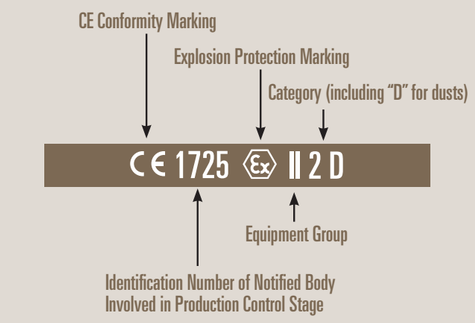
Ambient temperature ranges other than standard (-20°C ≤ Ta ≤ +40°C) must be marked.

CA (CEC Sect 18), EU and IEC



Ambient temperature ranges other than standard (-20°C ≤ Ta ≤ +40°C) must be marked.

Additional EU marking per 2014/34/EU(ATEX)



EPL/Category

Definition	IEC		EU (ATEX)		Typical Zone of Application
	EPL	Group	Category	Group	
Dust atmospheres, "very high" level of protection	Da	III	1D	II	20
Dust atmospheres, "high" level of protection	Db		2D		21
Dust atmospheres, "enhanced" level of protection	Dc		3D		22

Level of protection assigned to equipment based on its likelihood of becoming a source of ignition

Protection Concepts

Type of Protection	Code	Market	Application	Standard	Protection Principle
General Requirements		US	Class II, Division 1 & 2	FM 3600	
		CA	Class II, Division 1 & 2	CAN/CSA C22.2 No. 0	
		US	Class III, Division 1 & 2	FM 3600	
		CA	Class III, Division 1 & 2	CAN/CSA C22.2 No. 0	
	AEx	US	Zone 20, 21, & 22	ANSI/ISA 61241-0 or ANSI/UL 60079-0	
	Ex	CA	Zone 20, 21, & 22	CAN/CSA C22.2 No. 60079-0	
	Ex	EU	Category 1D, 2D, & 3D	EN 60079-0	
	Ex	IEC	EPL Da, Db, & Dc	IEC 60079-0	
Dust-Ignitionproof	(DIP)	US	Class II, Division 1	FM 3616	
		CA	Class II, Division 1	CAN/CSA C22.2 No. 25	
Dust-Protected	(NI)	US	Class II, Division 2	FM 3611	
		CA	Class II, Division 2	CAN/CSA C22.2 No. 213	
Protection by Enclosure	AEx tD	US	Zone 21	ANSI/ISA 61241-1	
	AEx ta	US	Zone 20	ANSI/UL 60079-31	
	Ex ta	CA	Zone 20	CAN/CSA C22.2 No. 60079-31	
	Ex ta	EU	Category 1D	EN 60079-31	
	Ex ta	IEC	EPL Da	IEC 60079-31	
	AEx tb	US	Zone 21	ANSI/UL 60079-31	
	Ex tb	CA	Zone 21	CAN/CSA C22.2 No. 60079-31	
	Ex tb	EU	Category 2D	EN 60079-31	
	Ex tb	IEC	EPL Db	IEC 60079-31	
	AEx tc	US	Zone 22	ANSI/UL 60079-31	
	Ex tc	CA	Zone 22	CAN/CSA C22.2 No. 60079-31	
	Ex tc	EU	Category 3D	EN 60079-31	
	Ex tc	IEC	EPL Dc	IEC 60079-31	
Fiber + Flying Protection	(DIP)	US	Class III, Division 1 & 2	FM 3611	
		CA	Class III, Division 1 & 2	CAN/CSA C22.2 No. 213	
Encapsulation	AEx ma	US	Zone 20	ANSI/ISA 61241-18	Keep combustible dust out
	Ex ma	CA	Zone 20	CAN/CSA C22.2 No. 60079-18	
	Ex ma	EU	Category 1D	EN 60079-18	
	Ex ma	IEC	EPL Da	IEC 60079-18	
	AEx maD	US	Zone 20	ANSI/ISA 61241-18	
	AEx mb	US	Zone 21	ANSI/UL 60079-18	
	Ex mb	CA	Zone 21	CAN/CSA C22.2 No. 60079-18	
	Ex mb	EU	Category 2D	EN 60079-18	
	Ex mb	IEC	EPL Db	IEC 60079-18	
	AEx mbD	US	Zone 21	ANSI/ISA 61241-18	
	AEx mc	US	Zone 21	ANSI/UL 60079-18	
	Ex mc	CA	Zone 22	CAN/CSA C22.2 No. 60079-18	
	Ex mc	EU	Category 2D	EN 60079-18	
	Ex mc	IEC	EPL Dc	IEC 60079-18	
Pressurization	(PX)	US	Class II, Division 1	FM 3620 (NFPA 496)	
	(PX)	CA	Class II, Division 1	NFPA 496	
	(PY)	US	Class II, Division 1	FM 3620 (NFPA 496)	
	(PY)	CA	Class II, Division 1	NFPA 496	
	(PZ)	US	Class II, Division 2	FM 3620 (NFPA 496)	
	(PZ)	CA	Class II, Division 2	NFPA 496	
	AEx pD	US	Zone 21	ANSI/ISA 61241-2	
	Ex pxb	EU	Category 2D	EN 60079-2	
	Ex pxb	IEC	EPL Db	IEC 60079-2	
	AEx pxb	US	Zone 21	ANSI/UL 60079-2	
	EX pxb	CA	Zone 21	CAN/CSA C22.2 No. 60079-2	
	Ex pyb	EU	Category 2D	EN 60079-2	
	Ex pyb	IEC	EPL Db	IEC 60079-2	
	AEx pyb	US	Zone 21	ANSI/UL 60079-2	
	Ex pyb	CA	Zone 21	CAN/CSA C22.2 No. 60079-2	
	Ex pzc	EU	Category 3D	EN 60079-2	
	Ex pzc	IEC	EPL Dc	IEC 60079-2	
	AEx pzc	US	Zone 22	ANSI/UL 60079-2	
	Ex pzc	CA	Zone 22	CAN/CSA C22.2 No. 60079-2	
Intrinsic Safety	(I.S.)	US	Class II, Division 1	FM 3610	Limit energy of sparks and surface temperature
	(I.S.)	CA	Class II, Division 1	CAN/CSA C22.2 No. 157	
	AEx ia	US	Zone 20	ANSI/UL 60079-11	
	Ex ia	CA	Zone 20	CAN/CSA C22.2 No. 60079-11	
	Ex ia	EU	Category 1D	EN 60079-11	
	Ex ia	IEC	EPL Da	IEC 60079-11	
	AEx iaD	US	Zone 20	ANSI/ISA 61241-11	
	AEx ib	US	Zone 21	ANSI/UL 60079-11	
	Ex ib	CA	Zone 21	CAN/CSA C22.2 No. 60079-11	
	Ex ib	EU	Category 2D	EN 60079-11	
	Ex ib	IEC	EPL Db	IEC 60079-11	
	AEx ibD	US	Zone 21	ANSI/ISA 61241-11	
	AEx ic	US	Zone 22	ANSI/UL 60079-11	
	Ex ic	CA	Zone 22	CAN/CSA C22.2 No. 60079-11	
	Ex ic	EU	Category 3D	EN 60079-11	
	Ex ic	IEC	EPL Dc	IEC 60079-11	
	(I.S.)	US	Class III, Division 1	FM 3610	
	(I.S.)	CA	Class III, Division 1	CAN/CSA C22.2 No. 157	

Note 1: For associated intrinsically safe apparatus suitable for installation in a hazardous location, the symbol for the type of protection "iaD", "ibD", "ia", or "ib" are enclosed within square brackets, e.g. Zone 21 AEx tb [ia] IIIC T135°C or Zone 21 AEx tD [iaD] T135°C.

Note 2: For associated intrinsically safe apparatus not suitable for installation in a hazardous location, both the symbol "Ex" or "AEx" and the symbol for the type of protection "iaD" "ibD", "ia", or "ib" are enclosed within the same square brackets, e.g. [AEx iaD] or [AEx ia] IIIC; in this case, a temperature class is not included.

Area Classification

	Combustible Dust Present Continuously	Combustible Dust Present Intermittently	Combustible Dust Present Abnormally
IEC / EU	Zone 20	Zone 21	Zone 22
US (NEC® 506)	Zone 20	Zone 21	Zone 22
US (NEC® 500)	Division 1		Division 2
CA (CEC Section 18)	Zone 20	Zone 21	Zone 22
CA (CEC Annex J18)	Division 1		Division 2

US area classification per ANSI/NFPA 70 National Electrical Code® (NEC®) Article 500 or Article 506
CA area classification per CSA C22.1 Canadian Electrical Code (CEC) Section 18
EU area classification per EN 60079-10-2
IEC area classification per IEC 60079-10-2 or IEC 61241-10

Equipment Grouping

Typical material	EU (60079) IEC (60079) US (NEC 506) CA (CEC Section 18)	US (NEC 506) per 61241	US (NEC 500) CA (CEC Annex J18)
Metal dusts	IIIC	N/A	Class II, Group E
Carbonaceous dusts	IIIB	D	Class II, Group F
Non-conductive dusts	IIIB	D	Class II, Group G
Fibers and flyings	IIIA	D	Class III

61241 did not differentiate between different materials, but referred to all with a "D" suffix on the Type of Protection.

Temperature

Marking		US NEC 500/CA CEC Annex J18 Class II or III
T1	450°C	For Class II, the temperature class is determined with a maximum dust layer* on the equipment. For installation, that temperature class must not be greater than the dust layer or dust cloud ignition temperature. For organic dusts that may dehydrate or carbonize, temperature classes greater than "T3B" (165°C) are not permitted.
T2	300°C	
T2A	280°C	
T2B	260°C	
T2C	230°C	
T2D	215°C	
T3	200°C	
T3A	180°C	
T3B	165°C	
T3C	160°C	
T4	135°C	
T4A	120°C	
T5	100°C	
T6	85°C	
No temperture marking		For Class III, the temperature is determined with a maximum dust layer* on the equipment. The temperature must not be greater 120°C for equipment that can be overloaded and 165°C for equipment not subject to overloading.

Marking	US NEC 506/CA CEC Sect 18	EU/IEC
T___ °C Temperature class in degrees Celsius preceded by a "T" e.g. T120°C	Temperature is determined with a maximum dust layer* on the equipment. For installation, that temperature must not be greater than the dust layer or dust cloud ignition temperature.	Temperature is determined with no dust layer on the equipment. For installations with layers up to 5mm thick, that temperature must be at least 75K below the dust layer ignition temperature and no more 2/3 of the dust cloud ignition temperature. For installations with layers up to 50mm thick, IEC/EN 60079-14 provides information on reduction of temperature.
T_L ___ °C Temperature class in degrees Celsius preceded by a "T_L" with a dust layer of "$_L$" where "$_L$" is the layer depth in mm e.g. T_{150}120°C	Not recognized	Temperature is determined with specified layer depth, (> 50 mm) on all sides of the equipment. That temperature must be at least 75K below the dust layer ignition temperature and no more 2/3 of the dust cloud ignition temperature.

** A maximum dust layer is a layer or blanket of wheat flour, corn flour, or grain dust that results from the equipment being covered with dust until no more will stay on the equipment.*

Ingress Protection (IP) Codes

First characteristic Numeral		Second characteristic Numeral
Protection against solid bodies		**Protection against liquid**
0	No protection	No protection
1	Objects greater than 50mm	Vertical (90˚) dripping water
2	Objects greater than 12mm	75˚ to 90˚ dripping water
3	Objects greater than 2.5mm	Sprayed water
4	Objects greater than 1mm	Splashed water
5	Dust-protected	Water jets
6	Dust-tight	Heavy seas
7		Temporary immersion
8		Continuous immersion
9		High pressure/temperature water jet

Approximate U.S. enclosure type equivalent to IPXX

Type →	IP	Type →	IP	Type →	IP
1	10	3S	54	6 and 6P	67
2	11	4 and 4X	55	12 and 12K	52
3	54	5	52	13	54
3R	14				

Acronyms

ATEX	Atmosphère explosible	IEC	International Electrotechnical Commission
CA	Canada	I.S.	Intrinsic Safety
CEC	Canadian Electrical Code (CSA C22.1)	NFPA	National Fire Protection Association
EPL	Equipment Protection Level	NEC	National Electrical Code (NFPA 70)
EU	European Union	US	United States of America

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Canada	FM c APPROVED; FM c US APPROVED
EU (ATEX)	FM APPROVED; Ex; CE

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