HAZARDOUS LOCATIONS & EXPLOSIVE ATMOSPHERES

element

Guide to Equipment Certification Requirements

North America

Typical North American Marking

DIVISION SCHEME			
Class I	**Division 1**	**Groups A, B, C, D**	**T4**
Hazard Class	Area Classification	Gas Group	Temperature Class

ZONE SCHEME (GAS)						
Class I[1]	**Zone 0**	**AEx**	**ia**	**IIC**	**T4**	**Ga**
Hazard Class	Area Classification	Ex Protection Scheme	Protection Concept Code	Gas Group	Temperature Class	Equipment Protection Level (EPL)

ZONE EQUIVALENCY SCHEME			
Class I	**Zone 0**	**Groups IIA, IIB, IIC**	**T4**
Hazard Class	Area Classification	Gas Group	Temperature Class

ZONE SCHEME (DUST)					
Zone 20	**AEx**	**ta**	**IIIC**	**T90 C**	**Da**
Area Classification	Ex Protection Scheme	Protection Concept Code	Dust Group	Surface Temperature	Equipment Protection Level (EPL)

Note 1. Items in Green are US Only. For Canada any new installations must be classified using the Zone system, while existing installations may either use Division or be re-classified to Zone. US installations may use either Division or Zone. Element has the ability to issue combined Element NRTL certification for the US and Canada, offering efficiency and speed to market for global manufacturers entering North America. Contact Element for more information. Please note, Class I marking has now been removed in NEC 2020. However, product standards still reference this marking.

Protection Concepts [NEC & CEC][2]

ELECTRICAL EQUIPMENT - ZONE "Ex" SCHEME					
Type of Protection	Ex Code	EPL	Zone[3]	North American Standard ISA/UL/CSA	Basic Concept of Protection
General Requirements	-	Ga Da Gb Db Gc Dc	0, 1, 2, 20, 21, 22	60079-0	General requirements for all Ex equipment
Intrinsic Safety[4]	ia	Ga Da	0, 20	60079-11	Limit energy of sparks & surface temperature
	ib	Gb Db	1, 21		
	ic	Gc Dc	2, 22		
Increased Safety	eb	Gb	1	60079-7	No arcs, sparks or hot surfaces
	ec	Gc	2		
Non-Sparking	nA[5]	Gc	2	60079-15	
Flame-Proof	da	Ga	0	60079-1	Contain the explosion and extinguish the flame
	db	Gb	1		
	dc	Gc	2		
Powder-Filled	q	Gb	1	60079-5	
Pressurization	px	Gb	1, 21	60079-2	Prevent ingress of explosive atmosphere and limit surface temperature
	py	Gb	1, 21		
	pz	Gc	2, 22		
Pressurized room	pb	Gb	1	C60079-13 / UL 60079-13	
	pc	Gc	2		
	vc[6]	Gc	2		
Encapsulation	ma	Ga Da	0, 20	60079-18	
	mb	Gb Db	1, 21		
	mc	Gc Dc	2, 22		
Restricted Breathing	nR	Gc	2	60079-15	
Sealed Device	nC	Gc	2		
Liquid Immersion	ob	Gb	1	60079-6	
	oc	Gc	2		
Dust-Protected	ta	Da	20	60079-31	
	tb	Db	21		
	tc	Dc	22		
Optical Radiation	op pr	Gb Db	1, 21	60079-28	Protection against release of optical energy
	op is	Ga Da	0, 20		Limitation of optical energy
	op sh	Ga Da	0, 20		Optical system interlocking

ELECTRICAL EQUIPMENT - DIVISION SCHEME AND ZONE EQUIVALENCY					
Type of Protection	Class	Division & Zone	Type	North American Standard	Basic Concept of Protection
Non-Arcing / Non-Incendive	I, II III I -	Division 2 Division 1, 2 Zone 2 Zone 22	-	UL121201, CSA C22.2 No. 213	Energy Limitation, Non-arcing/sparking, Sealing, and Ingress Protection
Explosion-Proof	I I	Division 1 Zone 1	-	UL 1203, CSA C22.2 No. 30	Contain the explosion and extinguish the flame
Purge and Pressurization	I, II I	Division 1 Zone 1	X	NFPA 496	Prevent ingress of explosive atmosphere and limit surface temperature
	I, II I	Division 1 Zone 1	Y		
	I, II I	Division 2 Zone 2	Z		
Dust-Tight	II -	Division 1, 2 Zone 22	-	UL121201, CSA C22.2 No. 213	
	III -	Division 1 Zone 20, 21			
Dust Ignition-Proof	II -	Division 1 Zone 20, 21	-	UL 1203, CSA C22.2 No. 25	
Intrinsic Safety	I II, III I -	Division 1 Division 1 Zone 0 Zone 20	-	ISA/UL/CSA C22.2 No. 60079-11 UL 913, CSA C22.2 No. 157	Limit energy of sparks and surface temperature

Note 2. In the United States, suitability for equipment in mining applications is per approval by the Mine Safety and Health Administration (MSHA).
Note 3. For US Zone Ex Scheme: Zone 0, 1 and 2 "Ex" markings are preceded by "Class I," and "Ex" is preceded by "A."
Note 4. For associated intrinsically safe apparatus suitable for installation in a hazardous location, the symbol for the type of protection ("ia" or "ib") is enclosed within square brackets on the marking, e.g., "AEx d [ia] IIC T4." For 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, "ia" or "ib," are enclosed within the same square brackets on the marking, e.g., [AEx ia] IIC; in this case, a temperature class is not included.
Note 5. Product standard has removed this type of protection; however, equipment already approved for this protection method is still recognised by the NEC & CEC.
Note 6. Protection type "vc" is not recognized by the NEC.

Enclosure Type Ratings [NEC & CEC]

Type	Area	Brief Definition
1	Indoor	General purpose
2	Indoor	Protection against angled dripping water
3, 3S	Indoor / Outdoor	Protection against rain, sleet, dirt, snow and windblown dust
3R	Indoor / Outdoor	Protection against rain, sleet, dirt and snow
4, 4X	Indoor / Outdoor	Protection against rain, snow, hose directed water and corrosion
5	Indoor	Protection against angled dripping water, dust, fibers, flyings
6	Indoor / Outdoor	Protection against temporary submersion
6P	Indoor / Outdoor	Protection against prolonged submersion
12, 12K	Indoor	Protection against circulating dust, fibers, flyings
13	Indoor	Protection against circulating dust, fibers, flyings, seepage

Making tomorrow safer than today.

North America/ATEX/IECEx/UKEX

Atmosphere Groups

Substance	Hazard Class	Division Groups	Division Groups
Acetylene	Class I Flammable Gases	Group A	IIC
Hydrogen		Group B	IIB + H2
Ethylene		Group C	IIB
Propane		Group D	IIA
Methane		Group D	IIA[7]
Combustible Metal Dusts	Class II Combustible Dusts	Group E[8]	IIIC
Combustible Carbonaceous Dusts		Group F	IIIB
Combustible Dust not in Group E or F (Flour, Grain, Wood, Plastics, Chemicals)		Group G	IIIB
Combustible Fibers and Flyings	Class III Fibers and Flyings	Not Applicable	IIIA

Note 7. Group E is applicable to Class II Division 1 only.
Note 8. Methane is a group IIA Gas for non-mining applications.

Other Useful Standards[9]

Standard Types	IEC Standards	US & CA standards
Area Classification - Gases, Vapors and Mists	IEC 60079-10-1	NFPA 497
Area Classification - Combustible Dusts, Fibers, Flyings	IEC 60079-10-2	NFPA 499
Electrical Equipment Installation	IEC 60079-14	NFPA 70 [NEC] / CSA C22.1 [CEC]
Electrical Equipment Inspection and Maintenance	IEC 60079-17	NFPA 70B
Electrical Equipment Repair and Overhaul	IEC 60079-19	-
Material Characteristics for Gas and Vapor Classification	ISO/IEC 80079-20-1	NFPA 497
Material Characteristics for Dust Classification	ISO/IEC 80079-20-2	NFPA 499
Application of Quality Systems for Equipment Manufacture	ISO/IEC 80079-34	-
Quality Management Systems	ISO 9001	ISO 9001
Intrinsically safe electrical systems	IEC 60079-25	UL 60079-25
Equipment with Separation Elements or combined Levels of Protection	IEC 60079-26	UL 60079-26
Gas detectors	IEC 60079-29-0 IEC 60079-29-1 IEC 60079-29-2 IEC 60079-29-3 IEC 60079-29-4	FM 6310/6320 CSA C22.2 No. 152

Note 9. Several other useful standards are omitted for convenience, like: IEC 60079-32-1 and 32-2, IEC 60079-35-1 and 35-2, IEC 60079-39, IEC 60079-40, IEC TS 60079-42, IEC TS 60079-44, IEC 60079-45, IEC 60079-47, IEC 60079-48. Please, contact Element, for more information.

Classification of Divisions and Zones

Hazard Level	Division Scheme	Zone Scheme Gas/Dust	Type of Explosive Atmosphere
Continuous Hazard	Division 1	Zone 0 / Zone 20	Continually present
Intermittent Hazard		Zone 1 / Zone 21[10]	Likely to occur during normal operations
Hazard Under Abnormal Conditions	Division 2	Zone 2 / Zone 22	Not likely to occur during normal operations, but may occur for short periods

Note 10. Zone 1 and Zone 21 products are not suitable for use in Division 1 areas.

Temperature Classification[11]

Max. Surface Temperature	NEC 500 / CEC	NEC 505 / IEC - Group II
450° C (842°F)	T1	T1
300° C (572°F)	T2	T2
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
180° C (356°F)	T3A	
165° C (329°F)	T3B	
160° C (320°F)	T3C	
135° C (275°F)	T4	T4
120° C (248°F)	T4A	
100° C (212°F)	T5	T5
85° C (185°F)	T6	T6

Note 11. For Group I applications (ATEX, IECEx and UKEX only), electrical apparatus has fixed temperature limits of 150°C (where layers of coal dust can form) and 450°C (where coal dust is not expected to form a layer).

ATEX, IECEx and UKEX

Typical ATEX, IECEx and UKEX Marking

UKCA	CE	XXXX	Ex	II	2
Complies with UKCA Requirements	Complies with European Directive[12]	Notified Body Number	Specific Marking for Explosion Protection[13]	Equipment Group[13]	Equipment Category[13]
G	**Ex**	**db**	**IIC**	**T4**	**Gb**
Environment[13]	Explosion Protection	Protection Type	Atmosphere Group	Temperature Class	Equipment Protection Level (EPL)

Note 12. ATEX only (ATEX 2014/34/EU).
Note 13. ATEX and UKEX

ATEX Directive 2014/34/EU

Element has the ability to issue ATEX Notified Body certificates, offering efficiency and speed to market for global manufacturers entering Europe and beyond. Contact Element for more information.

IECEx Scheme

Manufacturers of Ex equipment can obtain certificates of conformity, accepted at a national level for all countries participating in the IECEx Scheme.
A certificate of conformity may be obtained from any certification body accepted into the Scheme. The certificate will attest (1) the equipment design conforms to relevant IEC Standards, and (2) the product is manufactured under a quality control program assessed and registered though a Quality Assessment Report (QAR) by an accredited IECEx Certification Body (ExCB).
Element has IECEx Testing Laboratories (ExTLs) across North America, Europe, and Asia, and is an IECEx Certification Body (ExCB). For more information visit www.IECEx.com.

UKEX - UK Statutory Instrument 2016 No.1107

Element has the ability to issue UKEX and UKEXNI Approved Body certificates, for global manufacturers entering the UK. UKEX requirements are currently closely aligned to ATEX requirements. Contact Element for more information.

Other CE Directives that may apply

Electromagnetic Compatibility (EMC)	2014/30/EU
Low Voltage	2014/35/EU
Machinery Directive	2006/42/EC
Medical Device Regulation	2017/745/EU
Pressure Equipment Directive (PED)	2014/68/EU
Radio Equipment Directive (RED)	2014/53/EU
Restriction of Hazardous Substances (RoHS)	2002/95/EC

ATEX, UKEX Categories vs Zones[14]

Equipment Category	Zone of Use	
	Gas, Vapors, & Mist	Dust
Category 1	Zone 0 , 1 & 2	Zone 20, 21 & 22
Category 2	Zone 1 & 2	Zone 21 & 22
Category 3	Zone 2	Zone 22

Equipment Categories & Protection Levels[14]

ATEX, UKEX Category	Equipment Protection Level	Typical Equipment Zone Suitability
1G	Ga	Zones 0, 1 , 2
1D	Da	Zones 20, 21, 22
2G	Gb	Zones 1, 2
2D	Db	Zones 21, 22
3G	Gc	Zone 2
3D	Dc	Zone 22
M1	Ma	Very high level of protection for mines
M2	Mb	High level of protection for mines

Note 14. Unless the explosion protection risk assessment states otherwise.

Training Courses[15] — insightEx

Course		Description
iEx000	Ex Awareness	Gives an understanding of the Ex industry.
iEx001	Ex Supervisor	A deeper understanding of what the Ex industry is and how it is organised.
iEx002	New Ex Engineer	Designed for new starters to understand, interpret, and apply principles with confidence.
iEx003	Ex General Principles	Build essential knowledge and confidence in hazardous area safety.
iEx004	Ex Cable Gland Selection	Master the requirements of IEC 60079-14 for safe cable & gland selection.
iEx005	QAN QAR Awareness	Understand the requirements and expectations of QAN & QAR for Ex Manufacturers.
iEx006	Authorised Person	Understand the responsibilities of the Ex Authorised Person, including legal requirements.

Note 15. Training provided through Element's training partner, InsightEx Ltd.

Protection Concepts [ATEX, IECEx and UKEX]

ELECTRICAL EQUIPMENT					
Type of Protection	Ex Code	EPL	Zone	IEC/EN Standard	Basic Concept of Protection
General Requirements	-	All[16]	0, 1, 2, 20, 21, 22	60079-0	General requirements for all Ex equipment
Intrinsic Safety	ia	Ga Da Ma	0, 20	60079-11	Limit energy of sparks & surface temperature
	ib	Gb Db Mb	1, 21		
	ic	Gc Dc	2, 22		
Increased Safety	eb	Gb Mb	1	60079-7	No arcs, sparks or hot surfaces
	ec	Gc	2		
Flame-Proof	da	Ga	0	60079-1	Contain the explosion and extinguish the flame
	db	Gb Mb	1		
	dc	Gc	2		
Powder-Filled	q	Gb Mb	1	60079-5	
Sealed Device	nC	Gc	2	60079-15	Prevent ingress of explosive atmosphere and limit surface temperature
Pressurization	pxb	Gb Db Mb	1, 21	60079-2	
	pyb	Gb Db	1, 21		
	pzc	Gc Dc	2, 22		
Pressurized room	pb	Gb	1	60079-13[17]	
	pc	Gc	2		
	vc	Gc	2		
Encapsulation	ma	Ga Da Ma	0, 20	60079-18	
	mb	Gb Db Mb	1, 21		
	mc	Gc Dc	2, 22		
Restricted Breathing	nR	Gc	2	60079-15	
Liquid Immersion	ob	Gb Mb	1	60079-6	
	oc	Gc	2		
Dust-Protected	ta	Da	20	60079-31	
	tb	Db	21		
	tc	Dc	22		
Optical Radiation	op pr	Gb Db Mb	1, 21	60079-28	Protection against release of optical energy
	op is	Ga Da Ma	0, 20	60079-28	Limitation of optical energy
	op sh	Ga Da Ma	0, 20	60079-28	Optical system interlocking
Electrical resistance trace heating	60079-30-1	Gb Gc Db Dc	1, 2, 21, 22	60079-30-1	Based on increased standard, a specific set of requirements for trace heating products
Special Protection	sa sb sc	All	0, 1, 2, 20, 21, 22	60079-33	Special requirements where compliance with existing concepts not possible
Equipment assemblies	60079-46	All	0, 1, 2, 20, 21, 22	60079-46	Assessment of assemblies of Ex equipment

NON-ELECTRICAL EQUIPMENT[18]					
Type of Protection	Ex Code	EPL	Zone	ISO/IEC and EN Standard	Basic Concept of Protection
General Requirements	h	All[16]	0, 1, 2, 20, 21, 22	80079-36	Basic methods & all requirements
Constructional Safety	h	All	0, 1, 2, 20, 21, 22	80079-37	Ignition hazards mitigated by good engineering methods
Control of Ignition Sources	h	All	0, 1, 2, 20, 21, 22	80079-37	Control equipment fitted to detect malfunctions
Liquid Immersion	h	All	0, 1, 2, 20, 21, 22	80079-37	Enclosure uses liquid to prevent contact with explosive atmospheres

Note 16. Evaluation per EN 50303 is additionally required for ATEX, Category M1.
Note 17. EN 60079-13 is not part of the ATEX Official Journal or a UK Designated Standard as of September 2021.
Note 18. Ex d, Ex p, and Ex t may also be used for non-electrical equipment using 60079 series standards.

Ingress Protection Codes[19] [IEC 60529]

First Number (protect from solid bodies)		Second Number (protect from water)	
0	No Protection	0	No Protection
1	Objects > 50mm	1	Vertical drip
2	Objects > 12.5mm	2	Angled drip
3	Objects > 2.5mm	3	Spraying
4	Objects > 1.0mm	4	Splashing
5	Dust-Protected	5	Jetting
6	Dust-Tight	6	Powerful jetting
		7	Temporary immersion
		8	Continuous immersion
		9	High pressure and temperature water jet

Note 19. Refer to IEC 60034-5 for Ingress Protection of rotating electrical machines.

Atmosphere Groups [ATEX, IECEx and UKEX]

Group	Environment	Location	Typical Substance
I	Gases, Vapors and Mists	Coal Mining	Methane (Firedamp)
IIA		Surface and other locations	Methane, Propane, etc.
IIB			Ethylene
IIC			Hydrogen, Acetylene, etc.
IIIA	Combustible Dusts		Combustible Flyings
IIIB			Non-conductive
IIIC			Conductive

Equipment Groups [ATEX and UKEX]

Equipment Group	ATEX Equipment Category	Atmosphere	Equipment Protection Level (EPL)	Required Protection Performance & Operation
I (Mines with Firedamp)	M1	Methane & Dust	Very High Ma	Two faults, Remain energized and functioning
	M2		High Mb	Severe normal operation, De-energize in exp. atm.
II (All Other Areas)	1G, 1D	Gas, Vapor, Mist, Dust	Very High	Two faults
	2G, 2D		High	One fault
	3G, 3D		Low	Normal operation

ABOUT

Element Materials Technology is a leading lab-based testing partner to companies operating in the world's most highly-regulated industries. We provide certainty where failure in service is simply not an option, making us a key player in the testing, inspection and certification industry. From early R&D, through complex regulatory approvals and into production and maintenance, we support every step from our global network of over 270 laboratories.

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