# EXPLOSION PROTECTION

## QUICK REFERENCE

## AREA CLASSIFICATION

| CLASSIFICATION OF DIVISIONS AND ZONES | | | |
|---|---|---|---|
| **HAZARD LEVEL** | **DIVISION SCHEME** | **ZONE SCHEME** | **TYPE OF EXPLOSIVE ATMOSPHERE** |
| **Continuous Hazard** | Division 1 | Zone 0 (Gas, Vapours & Mist)<br>Zone **20** (Dust) | Continually present |
| **Intermittent Hazard** | | Zone 1 (Gas, Vapours, & Mist)<br>Zone 21 (Dust) | Likely to occur during normal operations |
| **Hazard Under Abnormal Conditions** | Division 2 | Zone 2 (Gas, Vapours, & Mist)<br>Zone 22 (Dust) | Not likely to occur during normal operations, but may occur for short periods |


## GROUPS & TEMPERATURE CLASS

| ATMOSPHERE GROUPS [ATEX & IECEx] | | | |
|---|---|---|---|
| **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, Fibres and Flyings | | Combustible Flyings |
| IIIB | | | Non-Conductive |
| IIIC | | | Conductive |

| ATMOSPHERE GROUPS | | | |
|---|---|---|---|
| **SUBSTANCE** | **HAZARD CLASS** | **DIVISION GROUPS** | **ZONE 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** |
| Combustible Metal Dusts | Class II Combustible Dusts | Group E* | IIIC |
| Combustible Carbonaceous Dusts | | Group F | IIIB |
| Combustible Dusts not in Group E or F (Flour, Grain, Wood, Plastics, Chemicals) | | Group G | IIIB |
| Combustible Fibres and Flyings | Class III Fibres and Flyings | Not Applicable | IIIA |

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

| TEMPERATURE CLASSIFICATION* | | |
|---|---|---|
| **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 |

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

## STANDARDS & DIRECTIVES

| FUNCTIONAL SAFETY [IEC 61508 SAFETY SYSTEMS]* | |
|---|---|
| **STANDARD** | **TITLE/SCOPE** |
| IEC/EN 61508-1 | Functional Safety of electrical/electronic/programmable electronic safety-related systems - Part 1: General Requirements |
| IEC/EN 61508-2 | Functional Safety of electrical/electronic/programmable electronic safety-related systems - Part 2: Requirements for electrical/electronic/ programmable electronic safety-related items |
| IEC/EN 61508-3 | Functional Safety of electrical/electronic/programmable electronic safety-related systems - Part 3: Software Requirements |
| IEC/EN 61508-4 | Functional Safety of electrical/electronic/programmable electronic safety-related systems - Part 4: Definitions and Abbreviations |
| IEC/EN 61508-5 | Functional Safety of electrical/electronic/programmable electronic |
| | safety-related systems - Part 5: Examples of methods for the determination of safety integrity levels |
| IEC/EN 61508-6 | Functional Safety of electrical/electronic/programmable electronic |
| | safety-related systems - Part 6: Guidelines on the application of IEC 61508-2 and IEC 61508-3 |
| IEC/EN 61508-7 | Functional Safety of electrical/electronic/programmable electronic safety-related systems - Part 7: Overview of techniques and measures |

** The IEC/EN 61508 series of standards sets out the requirements for electrical, electronic, and programmable safety-related systems, covering the design, implementation, operation, and maintenance as necessary for the assigned Safety Integrity Level (SIL).*
*According to the system application, four SILs are dened and assigned to the system. The standard is also the basis for ATEX-related safety devices, EN 50495.*

| OTHER USEFUL STANDARDS | | |
|---|---|---|
| **STANDARD TYPES** | **IEC STANDARDS** | **US & CAN STANDARDS** |
| Area Classification - Gases, Vapours 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 | IEC 60079-20-1 | NFPA 497 |
| Application of Quality Systems for Equipment Manufacture | ISO/IEC 80079-34 | - |
| Quality Management Systems | ISO 9001 | ISO 9001 |

| OTHER CE DIRECTIVES THAT MAY APPLY | |
|---|---|
| Electromagnetic Compatibility (EMC) | 2014/30/EU |
| Low Voltage* | 2014/35/EU |
| Machinery Directive | 2006/42/EC |
| Industrial Trucks | EN1755:2015 |
| Pressure Equipment Directive (PED) | 97/23/EC |
| Reciprocating internal combustion engines | EN1834-1:2000 |
| Restriction of Hazardous Substances (RoHS) | 2002/95/EC |

* Excludes equipment for use in explosive atmospheres - see ATEX Annex II 1.2.7

## EQUIPMENT CATEGORIES & GROUPS

| EQUIPMENT GROUPS [ATEX] | | | | |
|---|---|---|---|---|
| **GROUP** | **ATEX CATEGORY** | **ATMOSPHERE** | **EQUIPMENT PROTECTION LEVEL (EPL)** | **REQUIRED PROTECTION PERFORMANCE & OPERATION** |
| I (Mines with Fire-damp) | M1 | Methane & Dust | Very High Ma | Two faults, Remain energized and functioning |
| I (Mines with Fire-damp) | M2 | Methane & Dust | High Mb | Severe normal operation, De-energize in exp. atm. |
| II (All Other Areas) | 1G, 1D | Gas, Vapor, Mist, Dust | Very High | Two faults |
| II (All Other areas) | 2G, 2D | Gas, Vapor, Mist, Dust | High | One fault |
| II (All Other Areas) | 3G, 3D | Gas, Vapor, Mist, Dust | Low | Normal operation |

| EQUIPMENT CATEGORIES & PROTECTION LEVELS* | | |
|---|---|---|
| **ATEX CATEGORY** | **EQUIPMENT PROTECTION LEVEL** | **TYPICAL EQUIPMENT ZONE SUITABILITY** |
| 1 G | Ga | Zones 0, 1, 2 |
| 1 D | Da | Zones 20, 21, 22 |
| 2 G | Gb | Zones 1, 2 |
| 2 D | Db | Zones 21, 22 |
| 3 G | Gc | Zone 2 |
| 3 D | Dc | Zone 22 |
| M1 | Ma | Very high level of protection for mines |
| M2 | Mb | High level of protection for mines |

** Unless the explosion protection risk assessment states otherwise*

## TYPES OF PROTECTION

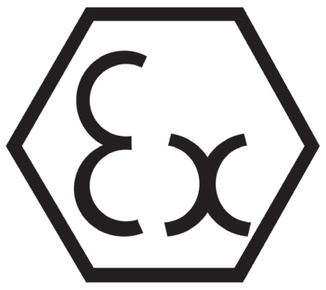
| PROTECTION CONCEPTS [ATEX AND IECEX] | | | | | |
|---|---|---|---|---|---|
| **TYPE OF PROTECTION** | **EX CODE** | **EPL** | **ZONE(S)** | **IEC/EN** | **BASIC CONCEPT OF PROTECTION** |
| **Electrical Equipment** | | | | | |
| General Requirements | - | All* | 0,1,2,20, 21,22 | 60079-0 | General requirements 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 Db Mb | 1, 21 | 60079-7 | No arcs, sparks or hot surfaces |
| | ec | Gc Dc | 2, 22 | | |
| Non-Arcing | nA | Gc | 2 | 60079-15 | |
| Flame-Proof | da | Ga | 0 | 60079-1 | Contain the explosion and extinquish the flame |
| | db | Gb Mb | 1 | | |
| | dc | Gc | 2 | | |
| Powder-Filled | q | Gb Mb | 1 | 60079-5 | |
| Enclosed Break | nC | Gc | 2 | 60079-15 | |
| Sealed Device | nC | Gc | 2 | 60079-15 | Prevent ingress of explosive atmosphere and limit surface temperature |
| Purge and Pressurization | pxb | Gb Db Mb | 1, 21 | 60079-2 | |
| | pyc | Gb Db | 1, 21 | | |
| | pzc | Gc Dc | 2, 22 | | |
| Encapsulation | ma | Ga Da Ma | 0, 20 | 60079-18 | |
| | mb | Gb Db Mb | 1, 21 | | |
| | mc | Gc | 2, 22 | | |
| | | Dc | | | |
| Restricted Breathing | nR | Gc | 2 | 60079-15 | |
| Liquid Immersion | ob | Gb | 1 | 60079-6 | |
| Liquid Immersion | oc | Gc | 2 | 60079-6 | |
| 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 | 0, 20 | | Limitation of optical energy |
| | | Da | | | |
| | op sh | Ga | 0, 20 | | Optical system interlocking |
| | | Da | | | |
| **Non-Electrical Equipment** | | | | | |
| **TYPE OF PROTECTION** | **IECEX CODE/ ATEX CODE** | **EPL** | **ZONE(S)** | **IEC/ENISO** | **BASIC CONCEPT OF PROTECTION** |
| General Requirements | h<br>- | All* | 0, 1, 2, 20, 21, 22 | 80079-36 | Basic methods & requirements |
| Flow-Restricted Enclosure | -<br>fr | Gc Dc | 2, 22 | | Relies on tight seals, closely machined joints, and tough enclosures to restrict the breathing of the enclosure |
| Flame-Proof Enclosure | -<br>d | All | 1, 21 | | |
| Constructional Safety | h<br>c | All | 0, 1, 2, 20, 21, 22 | 80079-37 | Ignition hazards mitigated by good engineering methods |
| Control of Ignition Sources | h<br>b | All | 0, 1, 2, 20, 21, 22 | 80079-37 | Control equipment fitted to detect malfunctions |
| Liquid Immersion | h<br>k | All | 0, 1, 2, 20, 21, 22 | 80079-37 | Enclosure uses liquid to prevent contact with explosive atmospheres |
| Purge & Pressurization | -<br>p | Gb Db Gc Dc | 1, 2, 21, 22 | 60079-2 | Prevent ingress of explosive atmosphere & limit surface temp. |
| Ignition Hazards & Risk Assessment | -<br>- | All | 0, 1, 2, 20, 21, 22 | 1127-1 80079-36 | Basic concepts and methodology, & ignition hazard assessment |

** Evaluation per EN 50303 is additionally required for ATEX, Category M1*

| INGRESS PROTECTION CODES* [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 |

** Refer to IEC 60034-5 for Ingress Protection of rotating electrical machines*

| 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 (X only) |
| 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 |

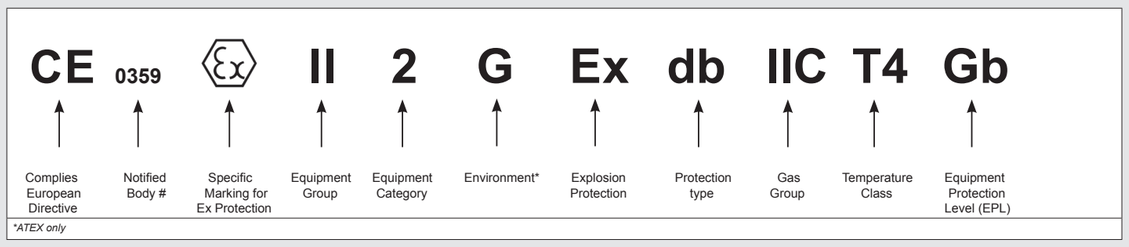


| PROTECTION CONCEPTS [NEC® & CEC®]* | | | | | |
|---|---|---|---|---|---|
| **TYPE OF PROTECTION** | **EX CODE** | **EPL** | **ZONE** | **US STANDARD** | **BASIC CONCEPT OF PROTECTION** |
| **Electrical Equipment - Zone "Ex" Scheme** | | | | | |
| General Requirements | - | Ga Da<br>Gb Db<br>Gc Dc | 0,1,2,20, 21,22 | UL 60079-0 | General requirements for all Ex equipment |
| Intrinsic Safety*** | ia | Ga Da | 0, 20 | UL 60079-11 | Limit energy of sparks & surface temperature |
| | ib | Gb Db | 1, 21 | | |
| | ic | Gc Dc | 2, 22 | | |
| Increased Safety (ec pending) | eb | Gb Db | 1, 21 | UL 60079-7 | No arcs, sparks or hot surfaces |
| Non-Arcing | nA | Gc | 2 | UL 60079-15 | |
| Flame-Proof | da | Ga | 0 | UL 60079-1 | Contain the explosion and extinquish the flame |
| | db | Gb | 1 | | |
| | dc | Gc | 2 | | |
| Powder-Filled | q | Gb | 1 | UL 60079-5 | |
| Enclosed Break | nC | Gc | 2 | UL 60079-15 | |
| Purge and Pressurization | px | Gb | 1 | UL 60079-2 | Prevent ingress of explosive atmosphere and limit surface temperature |
| | py | Gb | 1 | | |
| | pz | Gc | 2 | | |
| | pD | - | 21, 22 | ISA 61241-0 & ISA 61241-2 | |
| Encapsulation | ma | Ga Da | 0, 20 | UL 60079-18 | |
| | mb | Gb Db | 1, 21 | | |
| | mc | Gc Dc | 2, 22 | | |
| Restricted Breathing | nR | Gc | 2 | UL 60079-15 | |
| Sealed Device | nC | Gc | 2 | UL 60079-15 | |
| Oil Immersion | o | Gb | 1 | UL 60079-6 | |
| Dust-Protected | ta | Da | 20 | UL 60079-31 | |
| | tb | Db | 21 | | |
| | tc | Dc | 22 | | |
| | tD | - | 21,22 | ISA 61241-0 & ISA 61241-1 | |
| Optical Radiation **** | op pr | Gb Db | 1, 21 | ISA 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** | **TYPE** | **CLASS** | **DIVISION & ZONE** | **US STANDARD** | **BASIC CONCEPT OF PROTECTION** |
| General Requirements | - | I, II, III<br>I<br>- | Division 1, 2<br>Zone 0, 1, 2<br>Zone 20, 21, 22 | FM 3600 | Required for all equipment evaluated to FM Standards |
| Non-Incendive | NI | I, II<br>III<br>I<br>- | Division 2<br>Division 1, 2<br>Zone 2<br>Zone 22 | ISA 12.12.01, FM 3611 | Energy Limitation, Non-arcing/ sparking, Sealing, and Ingress Protection |
| Explosion Proof | XP | I<br>I | Division 1<br>Zone 1 | UL 1203, FM 3615 | Contain the explosion and extinguish the flame |
| Purge and Pressurization | X | I, II<br>I | Division 1<br>Zone 1 | NFPA 496, FM 3620 | Prevent ingress of explosive atmosphere and limit surface temperature |
| | Y | I, II<br>I | Division 1<br>Zone 1 | | |
| | Z | I, II<br>I | Division 2<br>Zone 2 | | |
| Dust-Tight | - | II<br>- | Division 2<br>Zone 22 | UL 1203, FM 3616 | |
| | | III<br>- | Division 1, 2<br>Zone 22 | | |
| Dust-Ignition Proof | DIP | II<br>- | Division 1<br>Zone 20, 21 | UL 1203, FM 3615 | |
| Intrinsic Safety | IS | I<br>II, III<br>I<br>- | Division 1<br>Division 1<br>Zone 0<br>Zone 20 | UL 913, FM 3610<br>UL 60079-11 | Limit energy of sparks and surface temperature |

** In the United States, suitability for equipment in mining applications is per approval by the Mine Safety and Health Administration (MSHA). Intertek can test and evaluate equipment to ACRI standards or equivalent, per US National Standards, providing test reports for your submittal to MSHA*
*** For US Zone Ex Scheme: Zone 0, 1 and 2 Ex markings are preceded by Class I, and Ex is preceded by A*
**** 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.*
***** Optical protection is not a recognized protection technique, nor is optical radiation addressed by the NEC® & CEC®.*

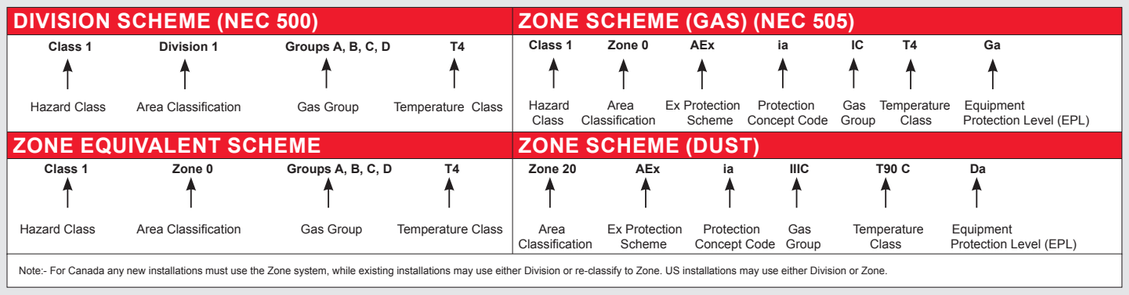
## EQUIPMENT MARKING

### TYPICAL ATEX & IECEx MARKING




**ATEX only*

### TYPICAL NORTH AMERICAN MARKING




Note:- For Canada any new installations must use the Zone system, while existing installations may use either Division or re-classify to Zone. US installations may use either Division or Zone.