

HAZARDOUS LOCATIONS

EQUIPMENT CERTIFICATION REQUIREMENTS



NORTH AMERICA

Typical North American Marking

| Division Scheme | | | | Zone Scheme (Gas) | | | | | | |
|-------------------------|---------------------|----------------------|-------------------|---------------------|----------------------|-------------------------|-------------------------|---------------------|----------------------------------|----------------------------------|
| Class I | Division 1 | Groups A, B, C, D | T4 | Class I | Zone 0 | AEx | ja | IIC | T4 | Ga |
| | | | | | | | | | | |
| Hazard Class | Area Classification | Gas Group | Temperature Class | Hazard Class | Area Classification | Ex Protection Scheme | Protection Concept Code | Gas Group | Temperature Class | Equipment Protection Level (EPL) |
| Zone Equivalency Scheme | | | | Zone Scheme (Dust) | | | | | | |
| Class I | Zone 1 | Groups IIA, IIB, IIC | T4 | Zone 20 | AEx | ta | IIC | T90 C | Da | |
| | | | | | | | | | | |
| Hazard Class | Area Classification | Gas Group | Temperature Class | Area Classification | Ex Protection Scheme | Protection Concept Code | Dust Group | Surface Temperature | Equipment Protection Level (EPL) | |

Items in Red are US Only. For Canada any new installations must be classed 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.

NORTH AMERICA/ATEX/IECEx

Enclosure Type Ratings [NEC® & CEC®]

| 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 Fibers and Flyings | | Not Applicable | IIIA |
| Combustible Fibers and Flyings | | Not Applicable | IIIA |

Note 5: Group E is applicable to Class II Division 1 only
Note 6: Methane is a group IIA Gas for non-mining applications

Other Useful Standards

| Standard Types | IEC Standards | US & CAN 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 | IEC 60079-20-1 | NFPA 497 |
| Material Characteristics for Dust Classification | IEC 60079-20-2 | NFPA 499 |
| Application of Quality Systems for Equipment Manufacture | ISO/IEC 80079-34 | - |
| Quality Management Systems | ISO 9001 | ISO 9001 |

Other Useful Standards

| Hazard Level | Division Scheme | Zone Scheme Gas/Dust | Type of Explosive Atmosphere |
|----------------------------------|-----------------|----------------------|---|
| Continuous Hazard | Division 1 | IEC 60079-10-1 | Continually present |
| Intermittent Hazard | | IEC 60079-10-2 | Likely to occur during normal operations |
| Hazard Under Abnormal Conditions | Division 2 | IEC 60079-14 | Not likely to occur during normal operations, but may occur for short periods |

Temperature Classification⁷

| Max. Surface Temperature | NEC® 50 0 / 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 | T3 |
| 215° C (419°F) | T2D | |
| 200° C (392°F) | T3 | |
| 180° C (356°F) | T3A | |
| 165° C (329°F) | T3B | T4 |
| 160° C (320°F) | T3C | |
| 135° C (275°F) | T4 | T5 |
| 120° C (248°F) | T4A | |
| 100° C (212°F) | T5 | T6 |
| 85° C (185°F) | T6 | |

Note 7: For Group I applications (ATEX and IECEx 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 AND IECEx

Typical ATEX & IECEx Marking

| | | | | | | | | | | |
|-----------------------------------|--|--|------------------|---------------------|--------------|----------------------|-----------------|------------------|-------------------|----------------------------------|
| | 0359 | | II | 2 | G | Ex | db | IIC | T4 | Gb |
| | | | | | | | | | | |
| Complies with European Directive* | Notified Body Marking for Explosion Protection** | Specific Marking for Explosion Protection*** | Equipment Group† | Equipment Category† | Environment* | Explosion Protection | Protection Type | Atmosphere Group | Temperature Class | Equipment Protection Level (EPL) |

*ATEX only (ATEX 2014/34/EU)

Equipment Categories & Protection Levels¹⁰

| 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 |

ATEX Categories vs Zones of Use¹⁰

| Equipment Category ATEX 2014/34/EU | 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 |

Note 10: Unless the explosion protection risk assessment states otherwise

Functional Safety [IEC 61508 Safety Systems]¹¹

| 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 |

Note 11: 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 defined and assigned to the system. The standard is also the basis for ATEX-related safety devices, EN 50495.

Protection Concepts [ATEX and IECEx]

| Type of Protection | Ex Code | EPL | Zone(s) | IEC/EN Standard | Basic Concept of Protection |
|---|---------|----------------|--------------|-----------------|---|
| Purged and Pressurization ¹² | pX | Gb, Gc, Db, Dc | 1, 2, 21, 22 | 60079-13 | Keep the flammable gas / combustible dust out of room |
| | pY | Gb, Gc, Db, Dc | 1, 2, 21, 22 | | |
| | pZ | Gc, Dc | 2, 22 | | |

Note 12: a. The product should not have the number of a Notified Body affixed, if falling under Category 3 (other than Unit verification), as well as Category 2 Non-electrical equipment, and for any voluntary certification.
b. Refer "ATEX 2014/34/EU Guidelines, 1st Apr 2016, Page 235" for Hexagon Ex drawing details.
c. Refer "ANNEX II of Regulation (EC) No 765/2008" for "CE" Marking form.

Electrical Equipment

| General Requirements | - | All ¹³ | 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 | | |
| Intrinsic Safety | eb | Gb Db Mb | 1 | 60079-7 | No arcs, sparks or hot surfaces |
| | ec | Gc Dc | 2, 22 | | |
| Non-Arcing | nA | Gc | 2 | 60079-15 | No arcs, sparks or hot surfaces |
| | da | Ga | 0 | | |
| Flame-Proof | db | Gb Mb | 1 | 60079-1 | Contain the explosion and extinguish the flame |
| | dc | Gc | 2 | | |
| | q | Gb Mb | 1 | | |
| Powder-Filled | q | Gb Mb | 1 | 60079-5 | |
| Enclosed Break | nC | Gc | 2 | 60079-15 | |
| Sealed Device | nC | Gc | 2 | 60079-15 | |
| Purge and Pressurization | pXb | Gb Mb | 1, 21 | 60079-2 | Prevent ingress of explosive atmosphere and limit surface temperature |
| | pYc | Gc | 1, 21 | | |
| | pZc | Gc | 2, 22 | | |
| Encapsulation | ma | Ga Da Ma | 0, 20 | 60079-18 | Prevent ingress of explosive atmosphere and limit surface temperature |
| | mb | Gb Db Mb | 1, 21 | | |
| | mc | Gc Dc | 2, 22 | | |
| 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 | Protection against release of optical energy |
| | tb | Dd | 21 | | |
| | tc | Dc | 22 | | |
| Optical Radiation ¹⁴ | op pr | Gb Db | 1, 21 | 60079-28 | Limitation of optical energy |
| | op is | Ga Da | 0, 20 | | |
| | op sh | Ga Da | 0, 20 | | |

Electrical Equipment

| Type of Protection | IECEx Code/ATEX Code | EPL | Zone(s) | ISO/IEC Standard (IECEx) | EN Standard (ATEX) | Basic Concept of Protection |
|------------------------------------|----------------------|-------------------|----------------|--------------------------|--------------------|---|
| General Requirements | h - | All ¹³ | 0,1,2,20,21,22 | 60079-13 | 13463-1 | Basic methods & All requirements |
| Flow-Restricted Enclosure | - fr | Gc Dc | 2, 22 | - | 13463-2 | Relies on tight seals, closely machined joints, and tough enclosures to restrict the breathing of the enclosure |
| Flame-Proof Enclosure | - d | All ¹³ | 1, 21 | - | 13463-3 | Ignition hazards mitigated by good engineering methods |
| Constructional Safety | ch - | All | 0,1,2,20,21,22 | 80079-37 | 13463-5 | Control equipment fitted to detect malfunctions |
| Control of Ignition Sources | bh b | All | 0,1,2,20,21,22 | 80079-37 | 13463-6 | Enclosure uses liquid to prevent contact with explosive atmospheres |
| Liquid Immersion | kh k | All | 0,1,2,20,21,22 | 80079-37 | 13463-8 | Prevent ingress of explosive atmosphere & limit surface temp |
| Purge & Pressurization | p | Gb, Gc, Db, Dc | 1,2,21,22 | 60079-2 | 60079-2 | Prevent ingress of explosive atmosphere & limit surface temp |
| Ignition Hazards & Risk Assessment | - | All | 0,1,2,20,21,22 | 80079-36 | 1027-1 | Basic concepts and methodology, & ignition hazard assessment |

Note 13: Evaluation per EN 50303 is additionally required for ATEX, Category M1

Ingress Protection Codes [IEC 60529]¹⁴

| 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 |

Atmosphere Groups [ATEX & IECEx]

| Group | Environment | Location | Typical Substance |
|-------|-------------------------|-----------------------------|---------------------------|
| I | Gases, Vapors and Mists | Surface and Other Locations | Methane (Fireclamp) |
| | | | Methane, Propane, etc. |
| | | | Ethylene |
| II | Combustible Dusts | Surface and Other Locations | Hydrogen, Acetylene, etc. |
| | | | Combustible Flyings |
| | | | Non-Conductive |
| | | | Conductive |

Note 14: Refer to IEC 60334-5 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 |
| 5 | Indoor | Protection against angled dripping water, dust, fibers, flyings |
| 6 | Indoor / Outdoor | Protection against temporary submersion |
| 6P | Indoor / Outdoor | Protection against temporary submersion |
| 12, 12K | Indoor | Protection against circulating dust, fibers, flyings |
| 13 | Indoor | Protection against circulating dust, fibers, flyings, seepage |

Other Useful Standards

| 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 |
| I (Mines with Firedamp) | 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 faults |
| II (All Other Areas) | 3G, 3D | Gas, Vapor, Mist, Dust | Low | Normal operation |