

The ATEX & IECEx Pocket Guide

Essential Reference for Hazardous Area Engineers



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Based on IEC 60079, ATEX 2014/34/EU, and IECEx standards

Not a substitute for official standards or professional advice

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1. What Are Explosive Atmospheres?

An explosive atmosphere is a mixture of flammable substances (gas, vapour, mist, or dust) with air that can ignite and propagate an explosion. For ignition to occur, three elements must be present simultaneously - the 'fire triangle':

- Fuel - flammable gas, vapour, mist, or combustible dust
- Oxygen - normally present in air (~21%)
- Ignition source - spark, hot surface, static discharge, etc.

Explosion protection works by eliminating at least one element of this triangle. Zone classification identifies WHERE explosive atmospheres may occur. Equipment certification ensures devices do not become ignition sources.

Key Concepts

- LEL (Lower Explosive Limit) - minimum concentration for ignition
- UEL (Upper Explosive Limit) - maximum concentration for ignition
- Flash Point - lowest temperature at which vapour can ignite
- Auto-Ignition Temperature (AIT) - temperature at which a substance ignites without an external spark
- MIE (Minimum Ignition Energy) - smallest spark energy that can ignite the mixture

2. Zone Classification

Hazardous areas are classified into zones based on the frequency and duration of explosive atmospheres. This determines the level of equipment protection required.

Gas & Vapour Zones (IEC 60079-10-1)

Zone	Description
Zone 0	Explosive atmosphere present continuously or for long periods (>1000 h/yr)
Zone 1	Explosive atmosphere likely during normal operation (10-1000 h/yr)
Zone 2	Explosive atmosphere not likely, only briefly in abnormal conditions (<10 h/yr)

Dust Zones (IEC 60079-10-2)

Zone	Description
Zone 20	Combustible dust cloud present continuously or frequently
Zone 21	Combustible dust cloud likely during normal operation
Zone 22	Combustible dust cloud not likely, only briefly in abnormal conditions

Zone to Equipment Mapping

Zone	Min. Category	Min. EPL	Protection
0 / 20	Cat 1	Ga / Da	Very high
1 / 21	Cat 2	Gb / Db	High
2 / 22	Cat 3	Gc / Dc	Normal

3. Gas Groups

Gases and vapours are classified into groups based on their ignition energy and flame propagation characteristics. Equipment must be certified for the gas group present in the hazardous area.

Group	Typical Gases	MESG (mm)	MIC Ratio
I	Methane (mining)	1.14	1.0
IIA	Propane, Butane, Petrol	>0.90	>0.80
IIB	Ethylene, H ₂ S, DEE	0.50-0.90	0.45-0.80
IIC	Hydrogen, Acetylene, CS ₂	<0.50	<0.45

Key Rules

- IIC equipment can be used in IIA and IIB atmospheres (IIC is the most stringent)
- IIB equipment can be used in IIA atmospheres, but NOT in IIC
- Group I is exclusively for mining (firedamp)
- Always check the specific gas - some gases within a group have special requirements

4. Temperature Classes

The temperature class (T-class) indicates the maximum surface temperature of the equipment. This must be lower than the auto-ignition temperature (AIT) of the gas or vapour present.

T-Class	Max. Surface	Example Gases
T1	450 C	Hydrogen (560C), Methane (595C)
T2	300 C	Ethanol (425C), Butane (365C)
T3	200 C	Petrol/Gasoline (280C), H2S (260C)
T4	135 C	Diethyl ether (170C), Acetaldehyde (140C)
T5	100 C	Carbon disulphide (95C) - rare
T6	85 C	Carbon disulphide (95C) - strictest

Key Rules

- T6 equipment can be used in any T-class (T6 is the most restrictive)
- For dust: max surface temp = $\frac{2}{3}$ of dust cloud AIT or dust layer AIT - 75C
- Ambient temperature range is typically -20C to +40C unless marked otherwise

5. Protection Methods

Protection methods prevent equipment from becoming ignition sources. Each method addresses the fire triangle differently.

Code	Method	Principle
Ex d	Flameproof	Contains explosion inside enclosure; cools escaping gases
Ex e	Increased safety	Prevents sparks/arcs by enhanced design margins
Ex i	Intrinsic safety	Limits energy below ignition threshold (ia/ib/ic)
Ex p	Pressurisation	Maintains positive pressure to exclude explosive atmosphere
Ex n	Non-sparking	Normal operation produces no ignition-capable sparks
Ex o	Oil immersion	Submerges components in protective oil
Ex q	Powder/sand fill	Surrounds components in quartz powder
Ex m	Encapsulation	Encases components in compound (resin)
Ex t	Dust protection	Enclosure prevents dust ingress (IP6X)

Zone Suitability

- Zone 0: Ex ia, Ex ma (special cases only)
- Zone 1: Ex d, Ex e, Ex ib, Ex p, Ex o, Ex q, Ex mb
- Zone 2: Ex n, Ex ic, Ex ec, plus all Zone 0/1 methods

6. Equipment Categories & EPL

ATEX uses Equipment Categories (Cat 1, 2, 3). IECEx uses Equipment Protection Levels (EPL: Ga/Gb/Gc for gas, Da/Db/Dc for dust). They map directly to each other.

Zone	Cat	EPL	Protection	Faults tolerated
0	1G	Ga	Very high	2 independent faults
1	2G	Gb	High	1 fault
2	3G	Gc	Normal	Normal operation only
20	1D	Da	Very high	2 independent faults
21	2D	Db	High	1 fault
22	3D	Dc	Normal	Normal operation only

ATEX Group & Category Marking

- Group I - Mining equipment (M1 = Cat 1, M2 = Cat 2)
- Group II - Surface industries (1G, 2G, 3G for gas; 1D, 2D, 3D for dust)
- Higher category equipment can always be used in lower-risk zones

7. How to Read Ex Markings

Every certified Ex device carries a standardised marking. Here is how to decode it:

IECEx / IEC Marking Example

Ex db IIC T6 Gb

Ex	Explosion protected equipment
db	Flameproof (Ex d), protection level 'b' (EPL Gb)
IIC	Gas group IIC (hydrogen/acetylene - most stringent)
T6	Max surface temp 85C (most restrictive T-class)
Gb	Equipment Protection Level - suitable for Zone 1

ATEX Marking Example

II 2G Ex db IIC T6 Gb

II	Equipment Group II (surface industries, not mining)
2G	Category 2, Gas - suitable for Zone 1 and 2
Ex db	Same as IEC marking above
IIC T6 Gb	Gas group, T-class, EPL - same as IEC

8. ATEX vs IECEx

ATEX is a European directive (law). IECEx is an international certification scheme (voluntary). Both address the same goal - safe equipment for explosive atmospheres - but differ in scope and legal status.

Aspect	ATEX	IECEx
Type	EU Directive (law)	International scheme
Scope	EU/EEA/UK only	35+ countries worldwide
Legal status	Mandatory in EU	Voluntary (but often required)
Standards	EN 60079 series	IEC 60079 series
Marking	CE + Ex hexagon	IECEx logo
Categories	Cat 1, 2, 3	EPL Ga/Gb/Gc, Da/Db/Dc
Cert body	EU Notified Body	IECEx ExCB
Self-cert?	Cat 3 only	No

Also Worth Knowing

- NEC (US) uses Class/Division system alongside Zone system (NEC 505)
- DSEAR (UK) implements the ATEX workplace directive post-Brexit
- Dual-certified equipment (ATEX + IECEx) is common and simplifies global deployment

9. Equipment Selection Checklist

Use this checklist when specifying Ex equipment for a hazardous area:

1. Identify the zone classification (0/1/2 or 20/21/22)
2. Determine the gas group (IIA/IIB/IIC) or dust group (IIIA/IIIB/IIIC)
3. Find the auto-ignition temperature of the substance(s) present
4. Select the required temperature class (T1-T6)
5. Choose an appropriate protection method for the zone
6. Verify the equipment EPL matches or exceeds the zone requirement
7. Check the ambient temperature range matches the installation conditions
8. Confirm the IP rating is sufficient (especially for dust: IP6X minimum)
9. Verify the certification covers the intended gas group and T-class
10. Check the certificate is from a recognised Notified Body or ExCB
11. Review any special conditions ('X' suffix on certificate number)
12. Ensure installation complies with IEC 60079-14

10. Quick Reference Card

Zone > Category > EPL

Zone	Cat	EPL	Methods
0	1G	Ga	Ex ia, Ex ma
1	2G	Gb	Ex d, Ex e, Ex ib, Ex p, Ex o, Ex q, Ex mb
2	3G	Gc	Ex n, Ex ic, Ex ec + all above
20	1D	Da	Ex ia, Ex ma, Ex ta (IP6X)
21	2D	Db	Ex ib, Ex mb, Ex tb (IP6X)
22	3D	Dc	Ex ic, Ex tc (IP5X) + all above

Gas Group Hierarchy

IIC > IIB > IIA (IIC equipment works everywhere)

T-Class Hierarchy

T6 > T5 > T4 > T3 > T2 > T1 (T6 = strictest, 85C max)

Common Mistakes to Avoid

- Using Zone 2 (Cat 3) equipment in Zone 1
- Ignoring the ambient temperature range on the certificate
- Selecting T-class based on the substance name, not its actual AIT
- Forgetting special conditions (X-marked certificates)
- Mixing ATEX and IECEx markings when only one is legally required

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