

EXPLOSION-PROTECTED ELECTRIC MOTORS

MECHATRIC | Hazardous Area Classification, ATEX / IECEx Selection and Engineering Replacement

Technical landing-page content for industrial Ex motors, with emphasis on Innomotics, Siemens SIMOTICS XP and ABB. Selection must always follow the actual certificate, site hazardous-area dossier and project specification.

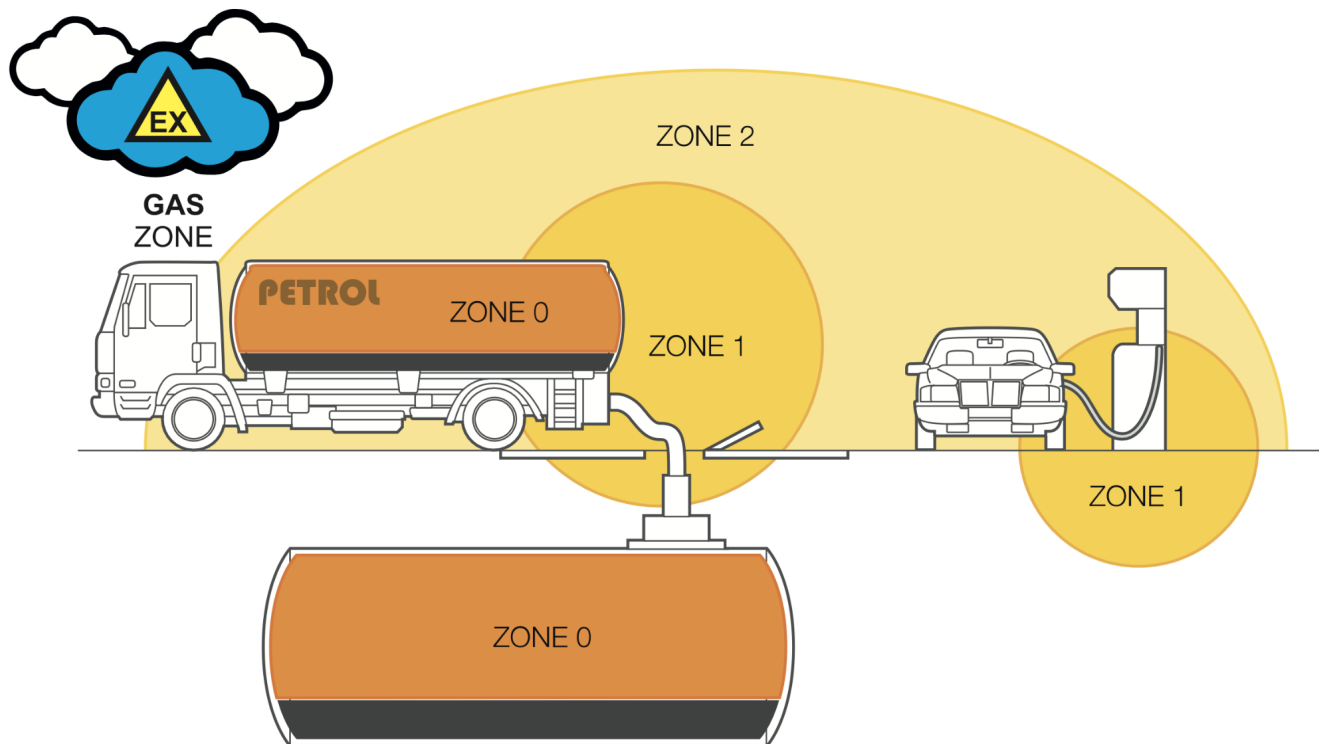


Illustration supplied by the client: typical gas zones around a fuel storage and dispensing installation. Actual zone extents require a documented classification study.

1 | What is a hazardous (Ex) area?

An explosive atmosphere may form when flammable gas, vapor, mist or combustible dust mixes with air and an ignition source is present. Ex-rated motors control ignition hazards through certified construction, thermal limits, wiring arrangements and operating restrictions. A motor with a high ingress-protection (IP) rating alone is **not** necessarily explosion protected.

2 | Gas and dust hazardous-area zones

Atmosphere / zone	Presence during operation	Typical equipment requirement
Gas Zone 0	Continuous, long periods or frequent	EPL Ga / ATEX 1G; conventional industrial rotating motors are generally not used.
Gas Zone 1	Occasional in normal operation	EPL Gb / 2G; e.g., certified Ex db, Ex db eb, Ex eb.
Gas Zone 2	Unlikely in normal operation; short duration if it occurs	EPL Gc / 3G; e.g., Ex ec; higher EPL equipment may also qualify.
Dust Zone 20	Continuous, long periods or frequent	EPL Da / 1D; conventional industrial motors generally not installed.
Dust Zone 21	Occasional in normal operation	EPL Db / 2D; e.g., Ex tb.

Atmosphere / zone	Presence during operation	Typical equipment requirement
Dust Zone 22	Unlikely in normal operation; short duration	EPL Dc / 3D; e.g., Ex tc, subject to dust subgroup and enclosure requirements.

Zone classification is based on the frequency and duration of explosive atmosphere, not a fixed universal radius or a guaranteed hours-per-year threshold. Reference: IEC 60079-10-1 (gas) and IEC 60079-10-2 (dust).

3 | Ex motor protection concepts

Marking	Principle	Typical motor application
Ex db	Flameproof enclosure contains an internal explosion and prevents flame transmission.	Zone 1 gas; Gb.
Ex db eb	Flameproof motor enclosure plus increased-safety terminal box.	Zone 1 gas; Gb.
Ex eb	Increased safety: measures to avoid excessive temperatures, arcs and sparks.	Zone 1 gas; Gb; starting and thermal protection need careful review.
Ex ec	Increased safety level ec for normal-operation ignition control.	Zone 2 gas; Gc. Older Ex nA markings require certificate review.
Ex pxb / pyb / pzc	Pressurization keeps explosive gas from entering protected enclosure.	Selected larger MV/HV motors; specific EPL depends on design.
Ex tb / Ex tc	Dust ignition protection by enclosure and temperature limitation.	Zone 21 (tb, Db) / Zone 22 (tc, Dc), subject to certificate.

4 | EPL, ATEX categories and gas/dust groups

Gas	Dust	ATEX category	Equipment protection level
Zone 0: Ga	Zone 20: Da	1G / 1D	Very high
Zone 1: Gb	Zone 21: Db	2G / 2D	High
Zone 2: Gc	Zone 22: Dc	3G / 3D	Enhanced

Gas groups: IIA (e.g., propane), IIB (e.g., ethylene), IIC (e.g., hydrogen/acetylene). **Dust groups:** IIIA (combustible flyings), IIIB (nonconductive dust), IIIC (conductive dust). The certificate must cover the actual material group. IIC gas certification generally encompasses IIB and IIA; IIIC dust certification generally encompasses IIIB and IIIA, subject to all other conditions.

5 | Temperature class and surface-temperature limits

Gas class	T1	T2	T3	T4	T5	T6
Maximum surface temperature	450 C	300 C	200 C	135 C	100 C	85 C

The permitted motor surface temperature must be below the gas autoignition temperature. For dust, markings normally give a maximum surface temperature in degrees Celsius (e.g., T125 C), and the engineering assessment must consider both dust-cloud ignition and dust-layer ignition, layer thickness, ambient temperature and dust accumulation. A gas T-class is not a substitute for dust thermal evaluation.

6 | How to read an Ex motor nameplate

Example A: CE [Ex symbol] II 3G Ex ec IIC T3 Gc

II = surface industries; 3G = gas Category 3; Ex ec = increased-safety protection level ec; IIC = gas subgroup; T3 = 200 C maximum surface temperature; Gc = equipment protection level for Zone 2. CE and the ATEX Ex hexagon are distinct symbols. A four-digit notified-body number appears only when required by the applicable conformity-assessment route; its presence is not universal.

Example B: II 2G Ex db eb IIC T4 Gb

Category 2 gas motor; flameproof housing and increased-safety terminal box; gas group IIC; T4 = 135 C; EPL Gb, typically for Zone 1. The legacy marking Ex d IIC T4 should be reconciled with its certificate and applicable standard edition.

Important correction: II 2G Ex ec IIC T3 is not a coherent standard example: Ex ec is normally EPL Gc / Zone 2 and Category 3G, not Zone 1 / 2G.

7 | Manufacturers and product-family positioning

Manufacturer	Representative portfolio	Engineering notes
Innomotics	Industrial explosion-protected LV and MV/HV motors; SIMOGEAR geared motors with Ex ec / Ex tc configurations.	Check current Innomotics catalogue, product transition, frame range, Ex certificates and converter duty.
Siemens	SIMOTICS XP explosion-protected LV motors; historical Siemens SIMOTICS HV / LOHER references.	Examples include Ex db, Ex db eb, Ex eb, Ex ec, Ex tb and Ex tc depending on series. Verify current legal manufacturer and series availability.
ABB	IEC LV flameproof and increased-safety motors; MV/HV flameproof induction motors.	Options include Ex db / Ex db eb, Ex eb / Ex ec and dust variants; MV/HV specifications depend on cooling, voltage and certification.

Brand names and family descriptions are informative, not blanket claims of availability or approvals. Innomotics is a separate motor brand; legacy Siemens documentation may refer to product lines subsequently transferred. Only exact model certificates determine permissible zones, VFD configurations and conditions of use.

8 | Selection workflow for an Ex electric motor

1. Obtain area classification drawing and gas/dust material data. **2.** Identify Zone, EPL, ATEX category and gas/dust subgroup. **3.** Confirm ambient range, altitude, gas ignition temperature or dust cloud/layer temperatures. **4.** Select Ex protection method and approved maximum surface temperature. **5.** Determine rated power, speed, voltage, frequency, duty, efficiency, mounting and cooling. **6.** Review starting method, locked-rotor limits, protection relay and PTC/RTD requirements. **7.** If VFD-fed, verify certified motor-drive combination or certificate conditions, permissible speed range and thermal monitoring. **8.** Check terminal box, cable glands, earthing, installation and maintenance instructions. **9.** Validate certificates, special conditions (X), ambient limits and nameplate before purchase.

9 | Replacement and cross-brand equivalence

A Siemens, Innomotics or ABB motor must never be substituted on kW, rpm and frame size alone. Match or exceed the required EPL; verify the **exact** gas/dust subgroup, temperature rating, protection concept, certified ambient range, VFD permission, shaft/mounting dimensions, terminal entry, IP rating, insulation, bearing arrangement, duty cycle and applicable project approvals. Equivalent protection cannot be inferred from visual similarity.

10 | Typical industries and applications

Oil and gas: hydrocarbon pumps, compressors, blowers, fans and loading facilities. Petrochemical and chemical: agitators, extruders, mixers and process pumps. Grain, sugar, wood and bulk solids: conveyors, elevators, dust collectors and mixers. Paint and solvent processing: ventilation and pumping systems. Each area must be assessed for its own hazardous substances and ventilation conditions.

11 | Request for quotation (RFQ) checklist

Please provide: motor manufacturer/model/nameplate; rated kW, rpm, voltage and Hz; Zone / EPL / ATEX category; gas or dust subgroup; temperature class or max surface temperature; ambient and altitude; direct-on-line or VFD; mounting (IM), frame and shaft; enclosure IP, cooling and efficiency; applicable certificate and project standards; quantity, destination and required delivery.

13 | FAQ

Is an IP66 motor automatically explosion-proof? No. IP and Ex certification address different hazards.

Can a Zone 1 motor be used in Zone 2? Usually yes if its certificate, subgroup, temperature, installation and other conditions satisfy the site requirements.

Is Ex ec suitable for Zone 1? Normally no: Ex ec is Gc and intended for Zone 2.

Can an Ex motor run on a VFD? Only within the certified configuration and stated limits.

Are gas and dust certifications interchangeable? No. Dual-marked motors require separate appropriate markings for each atmosphere.

14 | Standards and manufacturer reference material

IEC 60079-0 (general), -1 (flameproof), -2 (pressurization), -7 (increased safety), -10-1 (gas classification), -10-2 (dust classification), -14 (installation), -17 (inspection), -31 (dust enclosure); ATEX Directive 2014/34/EU; IECEx scheme. Refer to the applicable editions and local regulatory requirements.

Siemens SIMOTICS XP product announcement

<https://press.siemens.com/global/en/pressrelease/high-safety-level-under-extreme-conditions-simotics-xp-chemstar>

Siemens LV motor catalogue D81.1

https://cache.industry.siemens.com/dl/files/197/109749197/att_1110720/v1/Motors-D81-1-complete-English-12-2021-Update_2022-07.pdf

Innomotics SIMOGEAR catalogue

https://cache.industry.siemens.com/dl/files/934/109746934/att_1231821/v1/Catalog_D50.1_EN_08.2022_Update_11.2023_SIMOGEAR_Gearedmotors.pdf

ABB increased safety motors

<https://www.abb.com/global/en/areas/motion/motors-generators/low-voltage-motors/iec-low-voltage-motors/motors-for-explosive-atmospheres/low-voltage-increased-safety-motors>

ABB flameproof motors

<https://www.abb.com/global/en/areas/motion/motors-generators/low-voltage-motors/iec-low-voltage-motors/motors-for-explosive-atmospheres/low-voltage-flameproof-motors>

ABB MV/HV flameproof motors

<https://www.abb.com/global/en/areas/motion/motors-generators/mv-hv-motors/induction-motors/flameproof-induction-motors>

MECHATRIC | Engineering support for hazardous-area motor selection, specification review and cross-brand replacement.