MAICO
VENTILATOREN

Practical guide to explosion protection

Information, planning instructions, selection help

www.maico-ventilatoren.com

Preface

The tricky thing about risks of explosion is that people don't necessarily realise that they are present at first glance. This often means that risks are neglected or even trivialised. However, unfortunately the fact that explosions continue to occur means that this risk is still present in many areas of industry and everyday life. Serious injuries and damage to property are often the consequence of such harmful events. Preventing them is the primary objective of explosion protection, the application of which is prescribed through statutory rulings in most industrialised nations.

Sets of standards and rules are used in technology to meet the statutory requirements and to avoid risks of explosion. These standards and rules are an important instrument in implementing technical solutions for devices, which are to be used in areas with a potentially explosive atmosphere.

Since combustible and explosive materials are often used in production processes in the form of gases, vapours, mist or dusts, it is essential that the systems used in such processes and their components do not represent a risk of explosion.

Typical areas where explosive atmospheres may occur are

- the chemical and petrochemical industry,
- mining,
- the food industry,
- mills,
- biogas facilities.

Our guide provides an introduction into and an overview of explosion protection. It focuses primarily on our fans, which are suitable for use in areas at risk of explosion.
We hope that it will assist planners, fitters and operators of systems in their daily work. However, it cannot be a substitute for studying the relevant legislation and standards.

Extracts of laws and directives quoted in this guide are snapshots and are not legally binding. Legislation can change at any time. The current texts applicable to your specific circumstances should always be consulted.

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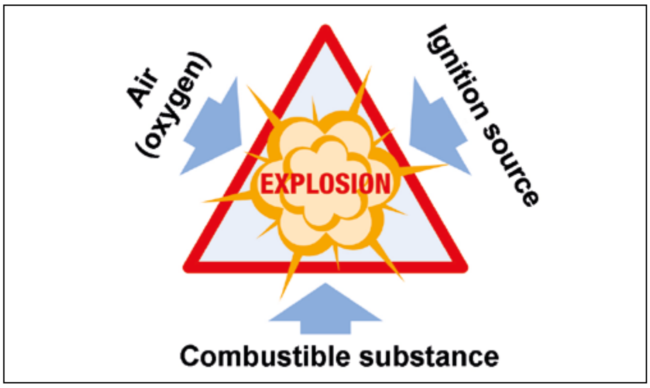
1 Physical principles of explosion hazards

1.1 What is an explosion?

An explosion is the chemical reaction that a combustible material has to a sudden increase in temperature, pressure or both at the same time. This results in a sudden increase in the volume of the material, and huge amounts of energy are released in a very small space.

1.2 Pre-requirements for an explosion

For an explosion to occur, three factors have to be present at the same time:



1.2.1 Combustible materials

The following may all be combustible:
gases, mist, vapours, dusts, solid materials

If used in workplaces and production processes, this means that a combustible substance may

- be used as a feed or auxiliary material,
- be produced as a residual, intermediate or end product or
- be produced in the event of a normal breakdown.

Combustible materials may also arise when they are not wanted, for example, when storing acids or alkalis in metal containers. Here gases may be formed which, when the container is opened, produce an explosive atmosphere in combination with the oxygen contained in the air.

Generally speaking, materials which are capable of an exothermic oxidisation reaction are considered to be combustible. This applies in particular to all materials, which are classified in accordance with EU Ordinance (EC) No. 1272/2008 as

- flammable,
- highly flammable or
- extremely flammable

and are labelled as such.

Combustible gases	Combustible liquids	Dusts of combustible solids
▸ Liquid gas (butane, butene, propane, propene) ▸ Natural gas ▸ Combustible gases (e.g. carbon monoxide or methane) ▸ Gaseous combustible chemicals (e.g. acetylene, ethylene oxide, vinyl chloride)	▸ Solvent ▸ Fuels ▸ Crude oil, heating oil, lubricating oil or used oil ▸ Paint ▸ Water-insoluble or water-soluble chemicals	▸ Coal ▸ Wood ▸ Foodstuffs and feeds (e.g. sugar, flour or grain) ▸ Plastics ▸ Metals ▸ Chemicals

1.2.2 Explosive atmosphere

An explosive atmosphere is a mixture of air or oxygen with

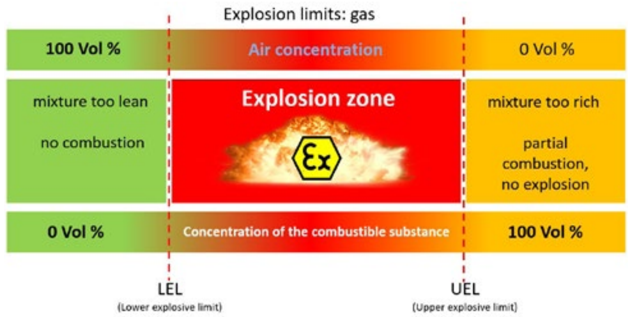
- combustible gases,
- vapours,
- mist or
- dusts,

the concentration of which is within the limits of explosion.

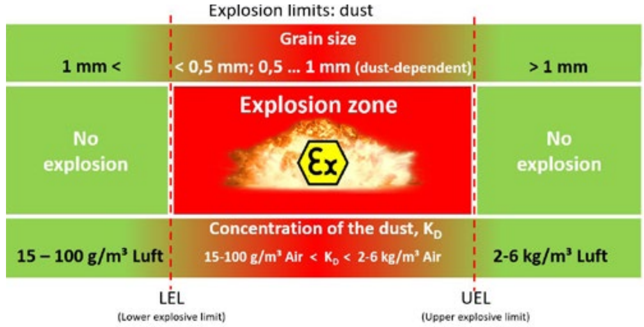
An explosion will not result from too low a concentration (lean mixture) or too high a concentration (rich mixture). In such cases, there is no combustion reaction or at the most partial stationary combustion.

The range in which an explosion can take place in the event of ignition is defined by an upper and lower limit of explosion. This depends greatly on the combustible material in question. When ignition takes place, the combustion process is transferred to the entire homogeneous mixture.

Limits of explosion of combustible materials



Limits of explosion of dusts



1.2.2.1 Potentially explosive area

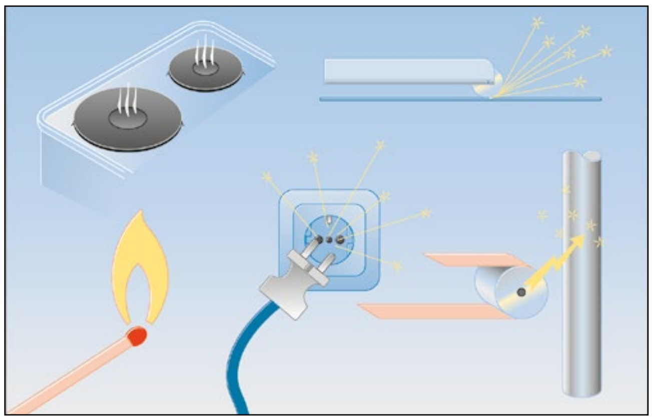
A potentially explosive area is a place where a potentially explosive atmosphere may occur.

1.2.2.2 Sources of ignition

For an explosive atmosphere to explode, an effective source of ignition is needed. The question of whether a source of ignition is effective and whether it is able to ignite an explosive atmosphere depends mainly on the energy of the source of ignition and the composition of the explosive atmosphere.

In applications in workplaces and production processes, the following sources of ignition may be present, for example:

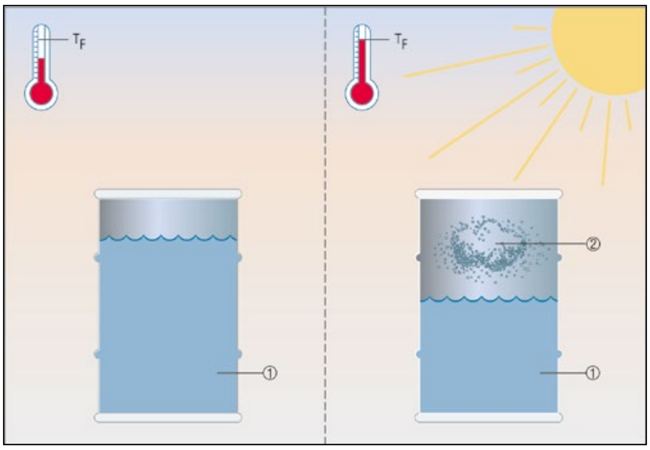
- hot surfaces
- naked flames
- mechanically generated sparks
- electrical systems
- static electricity
- self-ignition
- lightning
- electromagnetic waves
- ionising radiation
- ultrasound
- adiabatic compression
- exothermic reactions



1.2.2.3 Flash point

In the case of flammable liquids, an explosive atmosphere may result from the liquid evaporating.

At its flash point, a material reaches a vapour pressure or there is a corresponding concentration of saturated vapour above the material which is high enough to allow the gas/air mix with a source of ignition to catch fire for a least a short time. If the maximum room temperature is above the flash point of a combustible liquid, an explosive atmosphere may occur.[1)]



T_F Flammpunkt ① Brennbare Flüssigkeit ② Explosionsfähige Atmosphäre

[1)] See also https://www.chemie.de/lexikon/Flammpunkt.html

1.2.2.4 Formation of an explosive atmosphere

During application, an explosive atmosphere may occur during the production, storage, processing and transport of combustible materials.

Here are a few examples:

Gases

- Leakages from gas bottles or gas lines
- Outlet openings (taps, burners)
- Chemical reactions
- Heating liquids
- Electro-chemical processes

Liquids

- Evaporation
- Spraying, splashing or interrupting a jet of fluid
- Leakages on pipes carrying fluids

Dusts

- Milling or sifting
- Transporting, filling or emptying
- Drying
- Swirling up dust
- Dust processes

Application example:

Wall-mounted fans for air extraction

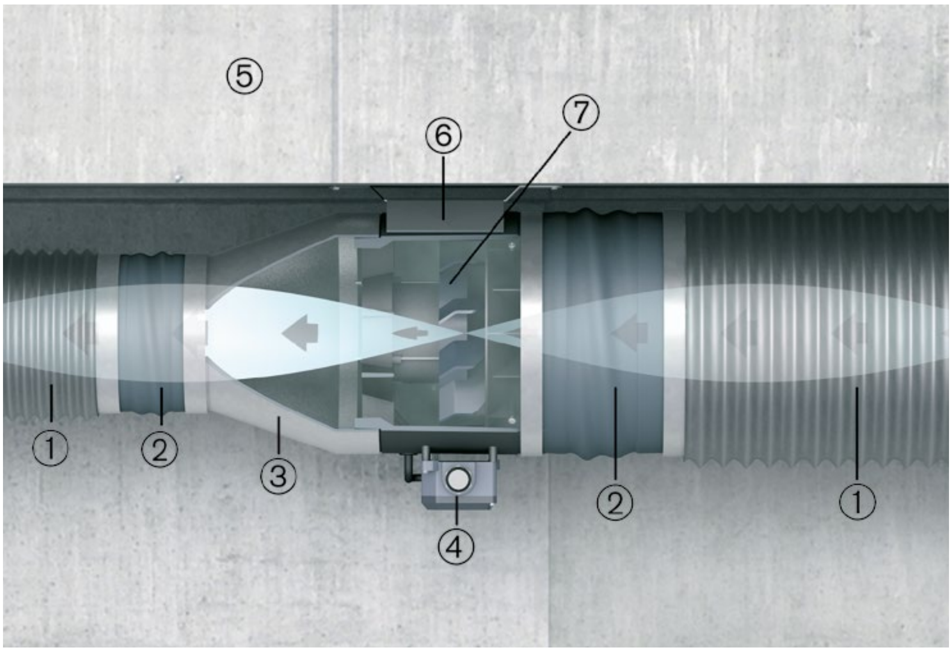
Air extraction can prevent the formation of a potentially explosive atmosphere from combustible fluids. To achieve this, the gas/air mix is extracted from the point at which it is produced using DZQ...Ex e wall-mounted fans.

① MLA or MLZ external grille
② Explosive atmosphere
③ EZQ ... E Ex e or DZQ ... Ex e fan

Application example:

Airstreams of the ERM 22 Ex e

The ERM 22 Ex e fan is approved for the T1-T3 temperature classes and gases of the IIB+H_2 explosion group. It can therefore convey an explosive atmosphere with an ignition temperature above 200 °C. Examples include vapours of petrol, diesel or heating oil.



① Ventilation duct, provided by custom-er ②
ELM Ex flexible cuffs
③ REM Ex reducer
④ Terminal box
⑤ Ceiling, girder
⑥ FUM mounting foot
⑦ ERM 22 Ex e fan

2 Legal Bases of Explosion Protection

2.1 Where do the requirements come from?

In the Treaty on the Functioning of the European Community of June 2016, Article 153 deals, among other things, with improving the working environment.

The objectives are

1. protection of the health of workers

2. increasing safety

3. improvement of working conditions.

This ultimately led to the implementation of the respective national occupational health and safety laws in the member states of the European Union.

Likewise, Article 114 led to the establishment of a harmonisation procedure for the approximation of the laws, regulations and administrative provisions of the Member States. This led to the adoption of the relevant EC/EU directives known today and thus to their implementation in the respective national laws. The objectives included the free movement of goods in the European internal market and the health and safety of consumers and workers.

Relevant directives that have been transposed into national law in this context are, for example:

- Directive 2001/95/EC, general product safety
- Directive 2014/34/EU, equipment and protective systems intended for use in potentially explosive atmospheres
- Directive 1999/92/EC, minimum requirements for improving the safety and health protection of workers potentially at risk from explosive atmospheres
- Directive 2014/30/EU, electromagnetic compatibility
- Directive 2006/42/EC, machinery

2.2 EU Directives for explosion protection

Within the EU, explosion protection is specified by two directives:

- Directive 2014/34/EU: equipment and protective systems intended for use in potentially explosive atmospheres.
- Directive 1999/92/EC: minimum requirements for improving the safety and health protection of workers potentially at risk from explosive atmospheres.

Directive 2014/34/EU describes

- the obligations of the manufacturers of the products,
- sets requirements and
- lays down rules for placing on the market with the aim of free movement of goods within the EU.

The directive is known as the ATEX directive (French abbreviation for ATmosphère EXplosible").
The ATEX directive contains the following specifications:

- Conformity assessment procedure
- Clustering
- Classification into categories
- Design and construction of the products
- Essential health and safety requirements

Directive 1999/92/EC is aimed at employers or operators of installations in areas with explosive atmospheres.

It is specified in this directive:

- obligations of employers to prevent and protect against explosions,
- the assessment of explosion risks,
- organisational measures (duty of coordination)
- the mandatory creation of the explosion protection document

The explosion protection document states in particular

- that the explosion risks have been identified and evaluated.
- that appropriate measures are taken to achieve the objectives of this Directive.
- which areas have been classified into zones in accordance with Annex I to the Directive.
- which areas are subject to the minimum requirements laid down in Annex II to the Directive.
- that the workplace and work equipment, including warning devices, are designed, operated and maintained safely.
- that arrangements have been made for the safe use of work equipment in accordance with Directive 2009/104/EC (formerly 89/655/EEC).

2.3 National laws

The EU/EC Directives require transposition into the respective national laws of the member states for the purpose of harmonising legislation.

In essence, they comply with Directive 2014/34/EU. They transpose the safety level described there into national law. All necessary specifications regarding the requirements for the condition and placing on the market of devices and protective systems, components as well as safety, monitoring and control equipment for hazardous areas are contained in these laws.

The transposition of Directive 1999/92/EC into national law contains the material requirements for explosion protection. These are essentially documentation obligations, such as the

- creation of a risk assessment and an explosion protection document,
- the prescribed protective measures against explosion hazards,
- the zone classification, and
- the use of equipment categories in zones.

If work equipment is used in areas with a dangerous explosive atmosphere or if its use leads to the formation of a dangerous explosive atmosphere, the necessary protective measures must be taken in compliance with these laws.

In particular, the equipment and protective systems suitable for the respective zone in accordance with Directive 2014/34/EU must be used. These protective measures must be documented in the explosion protection document before the work equipment is used for the first time. The requirements for tests in potentially explosive atmospheres are regulated in the respective law. Accordingly, the operator is obliged to check systems used in potentially explosive atmospheres and measures for explosion protection.

Systems in hazardous areas are the entirety of the work equipment relevant to explosion protection, including the connecting elements and the parts of the building relevant to explosion protection. The test must be performed both before initial commissioning and recommissioning after changes requiring testing. The tests must be carried out with the aim of ensuring protection against hazards due to explosions and fires at least until the next test. The tests must also determine the suitability and function of the technical protective measures that have been taken. The persons qualified to carry out the tests are also described. They must have the qualifications, skills and knowledge mentioned in the above

2.4 Standards

TIn the context of the implementation of legal requirements, international and European standards are advantageous as aids in addition to the nationally applicable technical regulations. If they have been published in the European Official Journal, they have the presumption of conformity with the requirements of the respective EU directive.

Although the standards are not legally binding, their presumption of conformity creates a legal certainty for manufacturers and operators. The lists of standards harmonized under the respective directive can be viewed and downloaded free of charge from the European Union.

As a manufacturer of fans for use in potentially explosive atmospheres, Maico uses the following standards:

Type of protection	Concept	System	Standard	Title
General requirements	Basis for ignition protection types	ATEX	EN 60079-0	Explosive atmospheres – Part 0: Equipment – General requirements
		IECEx	IEC 60079-0	
Increased Safety (electrical)	Design measures through spacing and dimensioning	ATEX	EN 60079-7	Explosive atmospheres – Part 7: Equipment protection by increased safety "e".
		IECEx	IEC 60079-7	
General requirements (non electrical)	Requirements for the design, construction, testing and marking of non-electrical equipment	ATEX	EN 80079-36	Explosive atmospheres – Part 36: Non-electrical equipment for explosive atmospheres – Basic method and requirements
		IECEx	ISO 80079-36	
Constructional safety (non electrical)	Requirements for the design and construction of non-electrical equipment	ATEX	EN 80079-37	Explosive atmospheres – Part 37: Non-electrical equipment for explosive atmospheres – Non electrical type of protection constructional safety “c”, control of ignition source “b”, liquid immersion “k”
		IECEx	ISO 80079-37	
Protection by enclosure	Protection through housing construction	ATEX	EN 60079-31	Explosive atmospheres - Part 31: Equipment dust ignition protection by enclosure "t"
		IECEx	IEC 60079-31	
Basic concepts and methodology		ATEX	EN 1127-1	Explosive atmospheres - Explosion prevention and protection - Part 1: Basic concepts and methodology

Only the EN standards have the presumption of conformity with the ATEX directive. Since Maico also certifies its devices in accordance with IECEx, the international IEC standards that are bindingly applicable for this certificate are also considered. Since the EN standards of the same name represent a transfer from the IEC standards and the differences are not too great, this is very useful and good to handle.

The following standards can be used by the operator to obtain the presumption of conformity:

EN Standard	IEC Standard	Title
EN 60079-10-1	IEC 60079-10-1	Explosive atmospheres - Part 10-1: Classification of areas. Explosive gas atmospheres
EN 60079-10-2	IEC 60079-10-2	Explosive atmospheres - Part 10-2: Classification of areas - Explosive dust atmospheres
EN 60079-14	IEC 60079-14	Explosive atmospheres - Part 14: Electrical installations design, selection and erection
EN 60079-17	IEC 60079-17	Explosive atmospheres - Part 17: Electrical installations inspection and maintenance
EN 60079-19	IEC 60079-19	Explosive atmospheres -- Part 19: Equipment repair, overhaul and reclamation

According to the EU Directive 1999/92/EC, an explosion protection document is a precondition for setting up and operating a potentially explosive facility.

The explosion protection document must contain all necessary information regarding

- the classification of zones,
- the temperature classes or
- the ignition temperatures characteristic of the flammable substances and
- record the classification of gases and dusts into the appropriate groups.

Based on this information, he is able to select devices that are suitable for the application at hand. The data, which can be taken from the technical documentation and the type plate, must be checked for conformity by the operator. In addition, the required conformity markings must be affixed to the product and legible in accordance with the directive. An EU Declaration of Conformity must be enclosed, on which the manufacturer of the product declares conformity with the ATEX Directive and other applicable directives. Further documents are the operating instructions and safety information of the manufacturers whose information must be included in the risk assessment.

The equipment categories and equipment protection levels must therefore be adapted to the respective zone. Similarly, when used in gas atmospheres, the temperature classes of the equipment must match those of the explosive medium. When used in dust atmospheres, the glow and ignition temperature of the medium must be determined, and if there is a risk of a dust cloud forming, the ignition temperature of the dust cloud must be determined. Likewise, if there is a risk of dust layers forming, the maximum layer thickness that can occur must be checked. EN 60079-14 should be used to determine the safety factors.

The operator must also include ambient conditions in his considerations and check the resistance to chemical, thermal, mechanical influences or humidity of the devices planned for use. Any special operating conditions must be taken from the technical documentation of the product or clarified with the manufacturer of the product.

The operating temperature range for devices usually specified by the manufacturer is -20 °C to + 40 °C. The normative scope of application of the EN or IEC 60079-0 assumes normal atmospheric conditions and is defined as a maximum range of -20°C to 60°C. Deviating operating conditions must be tested by a notified body.

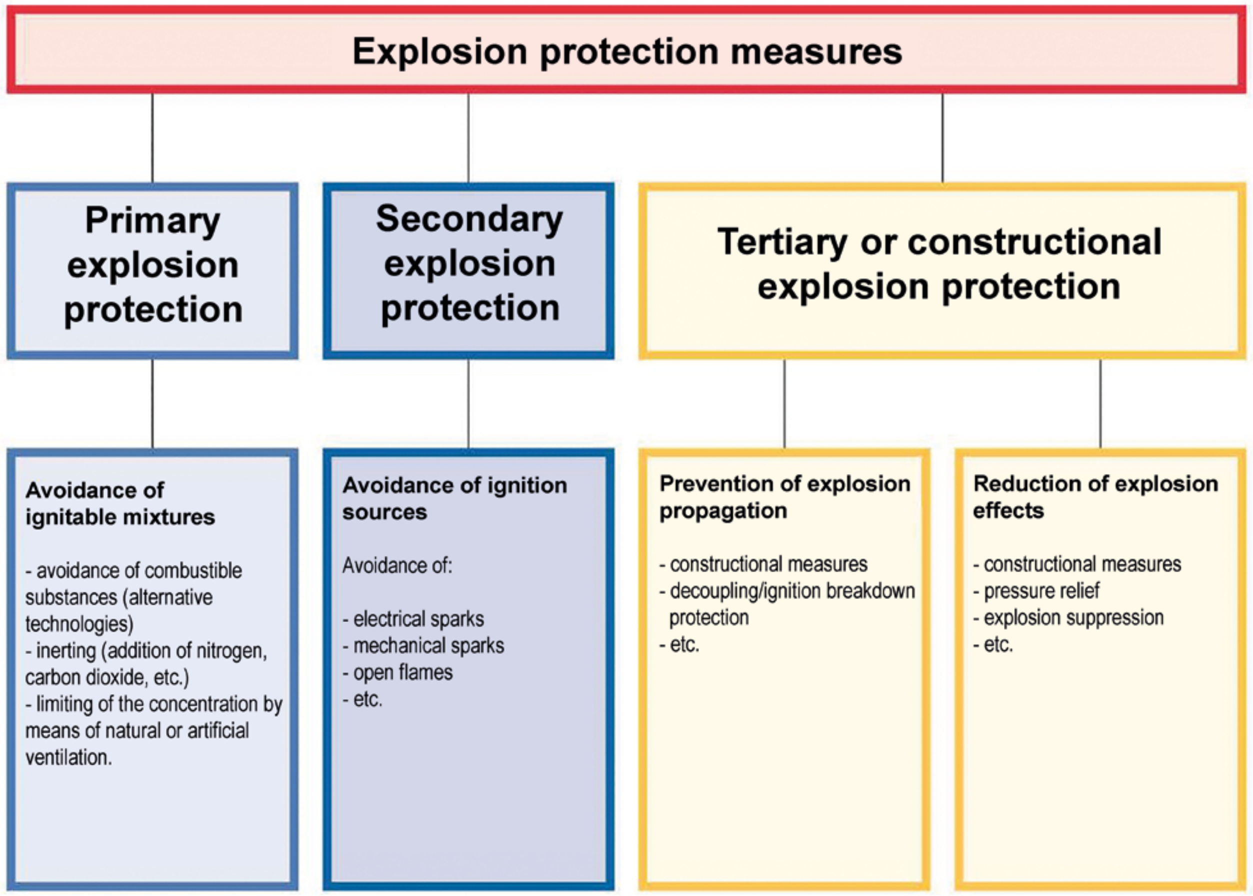
3 Technical principles of explosion protection

3.1 Explosion protection

The risk of an explosion can be prevented or at least reduced by means of technical measures. Three types of explosion protection apply here:

- primary
- secondary
- tertiary

explosion protection.



3.1.1 Primary explosion protection

The aim of primary explosion protection is to prevent an explosive atmosphere from coming about in the first place.

The following explosion protection measures should be implemented first:

- Avoidance of combustible materials
  – Use of non-combustible substitutions
- Reduction in oxygen content through inertisation:
  – Addition of an inert gas (e.g. nitrogen) or an inert dust (e.g. rock salt)
- Reduction in the concentration of the hazardous substance in the mix and therefore reduction below the lower limit of explosion by means of
  – natural or technical ventilation
  – thinning.

3.1.2 Secondary explosion protection

If the formation of an explosive atmosphere cannot be prevented, measures should be taken to prevent this explosive atmosphere from igniting. This involves assessing all potential sources of ignition and taking relevant protective measures to render them ineffective. This chapter of our guide provides a detailed description of possible protective measures and the procedure for applying secondary explosion protection.

3.1.3 Tertiary explosion protection

If an explosion cannot be prevented through primary and secondary explosion protection measures, a design solution should be found and used.

This may be, for example

- decoupling the system components,
- a solution to release pressure or
- a system to suppress the explosion.

3.2 Explosion groups

One of the key pre-requirements for an explosion occurring is the combustible material. There are a number of materials, which under normal circumstances will only catch fire with great difficulty, but are explosive if mixed with air and present in a particularly small particle size or with a sufficiently high ignition energy (e.g. metal dusts, aerosols).

The ignitability of an explosive atmosphere is a characteristic dependent on material. To distinguish between different risk levels, gases and vapours are divided into four explosion groups: I, IIA, IIB, IIC.

The ignitability increases from explosion group I to IIC, while the ignition energy required falls. The explosion group I classification is only used in mining.

Explosion group	Typical combustible material
I	Methane
IIA	Acetone, petrol, heating oil
IIB	Town gas, ethylene
IIC	Hydrogen, acetylene

Dusts are categorised by type and electric conductivity in the form of specific electric resistance.

Explosion group	Combustible material
IIIA	Flammable fluffs
IIIB	Non-conductive flammable dust, specific electric resistance $>10^3\ \Omega$
IIIC	Conductive flammable dust, specific electric resistance $\leq 10^3\ \Omega$

3.3 Zone classification

Areas subject to explosion hazards are split into zones. The aim of this zone classification is to make possible explosion protection which meets requirements from both a safety technology and economic standpoint. Different zone classifications are used for gas and dust atmospheres. Depending on zone, only certain categories of devices may be used. The same applies to the equipment protection level (EPL).

The figure below shows an example of zone classification for an explosive atmosphere containing gas:

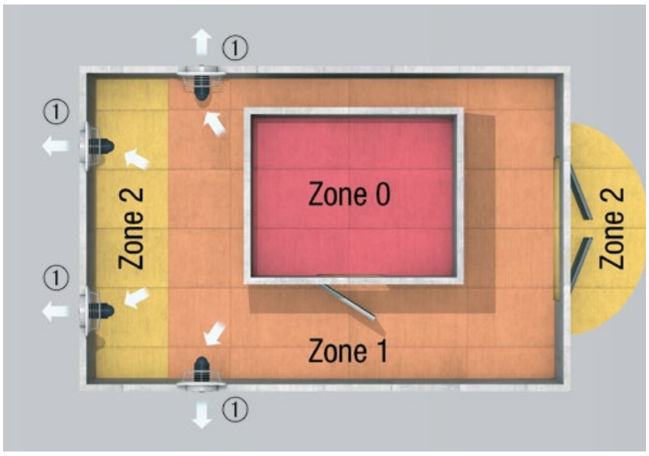
Application example:

MAICO fans in zone 1 and zone 2

The operating company has split the production and storage sites shown into zone 0, zone 1 and zone 2.

The concentration of combustible materials in the room air is reduced through permanent cross-ventilation. This reduces the risk of explosion.

MAICO EZQ/S 20/4 E Ex e or DZQ ... Ex e wall-mounted fans are therefore fitted in zones 1 and 2.



① EZQ/S 20/4 E Ex e or DZQ ... Ex e wall-mounted fans
Zone 0 – MAICO fans **not** appropriate
Zone 1 – MAICO fans appropriate
Zone 2 – MAICO fans appropriate

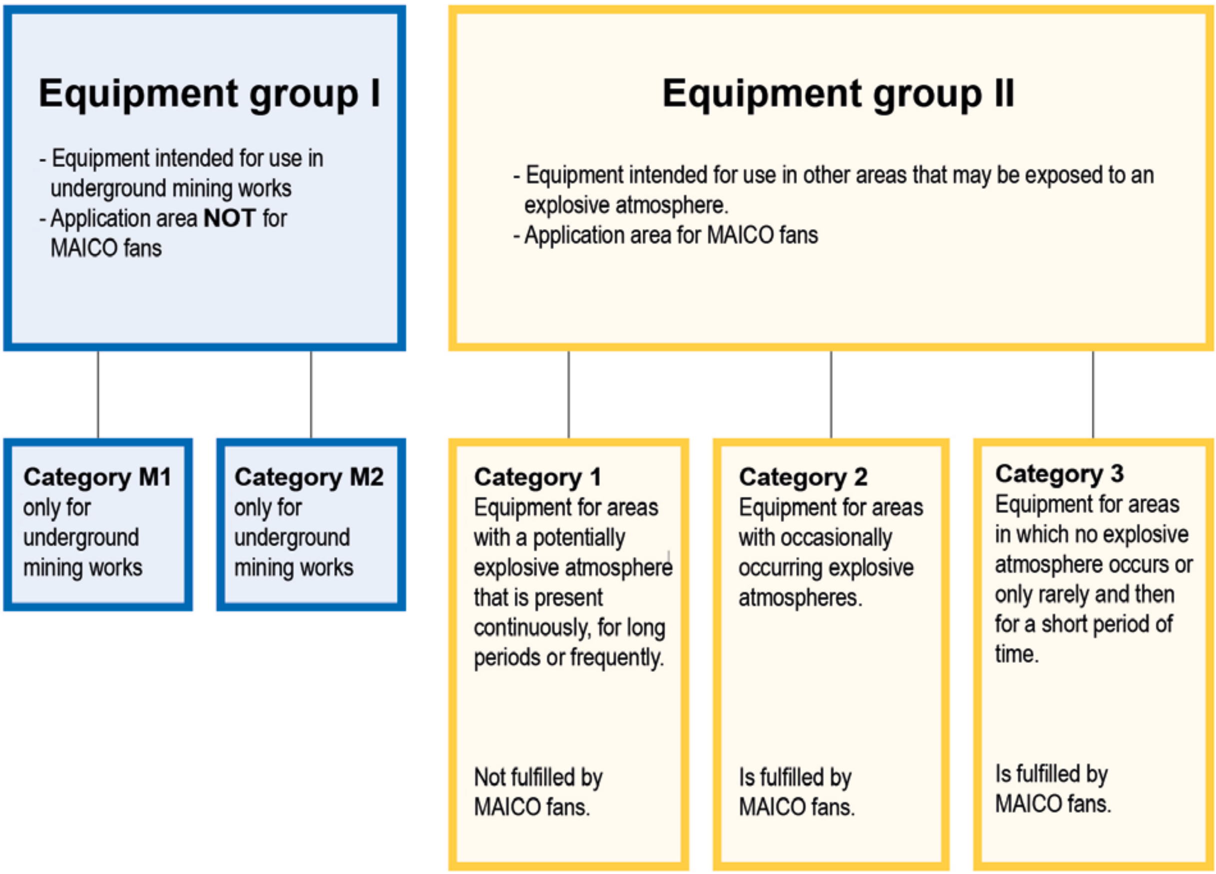
Zone classification depends on the frequency with which an explosive atmosphere occurs and the various potential risks this brings with it. Depending on the aggregation state of the combustible material, a distinction is also made between

- gas,
- vapour,
- mist and
- dust

3.4 Device groups and device categories

According to Directive 2014/34/EU, electrical equipment for use in areas at risk of explosion is split into two device groups and these are in turn split into categories:

- Device group I: Electrical equipment intended for use underground in areas at risk of mine gas (not included in MAICO's product range)
- Device group II: Electrical equipment in all other potentially explosive areas. Depending on risk potential, these are split into three categories. Maico produces category 2 devices.



Devices in device group II also feature a letter to identify the type of combustible material:

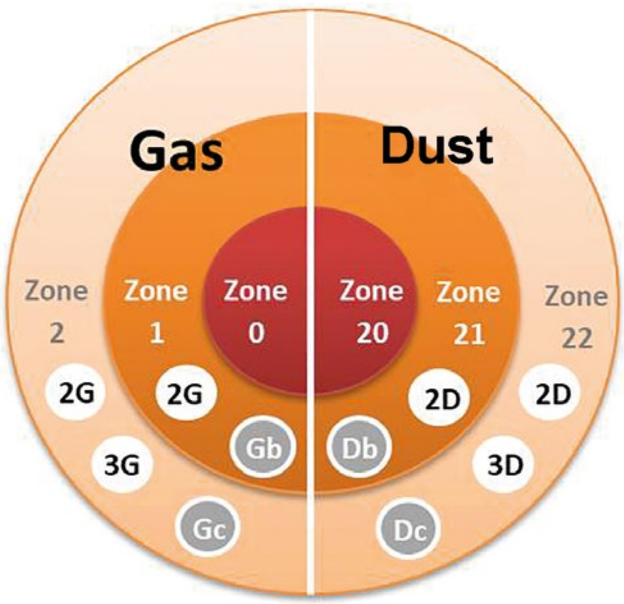
- G – for areas where there are explosive gas, vapour, mist, air mixes.
- D – for areas where dust may produce an explosive atmosphere.

Zones and categories

Com-bustible materials	Presence of combustible material in the potentially explosive area	Classifi-cation of potentially explosive areas	Level of Protec-tion	Device is safe...	Labelling of equipment used required in accordance with		
					ATEX 2014/34/EU		IEC/CENELEC
					Device group	Category	Equipment protection level (EPL)
Gas, mist, liquid	Permanent	Zone 0	Very high	... during normal operations, in the event of foreseeable errors and in the events of rare incidents	II	1G, (1)G	Ga
	Occasional	Zone 1	High	… during normal operations and in the event of foreseeable errors	II	2G, (2)G	Gb
	Rare, only briefly	Zone 2	Normal	... during normal operations	II	3G, (3)G	Gc
Dust	Permanent	Zone 20	Very high	... during normal operations, in the event of foreseeable errors and in the events of rare incidents	II	1D, (1)D	Da
	Occasional	Zone 21	High	… during normal operations and in the event of foreseeable errors	II	2D, (2)D	Db
	Rare, only briefly	Zone 22	Normal	... during normal operations	II	3D, (3)D	Dc
Methane, coal dust	Permanent	Coal mining	Very high	... during normal operations, in the event of foreseeable errors and in the events of rare incidents	I	M1	Ma
Methane, coal dust	Common	Coal mining	High	… until the unit is switched off	I	M2	Mb

Link between zone, device category and EPL for device group II:

The equipment protection level (EPL) is a level of protection, which is defined for the device. It is based on the probability of ignition. The differences between explosive gas atmospheres, explosive dust atmospheres and explosive atmospheres in mine workings sensitive to firedamp are taken into account.



3.5 Ignition temperature

An explosive atmosphere catches fire when it comes into contact with e.g. a contact surface heated to the respective ignition temperature of the medium.

The ignition temperature is different for different materials and in many cases is dependent on pressure. An exothermic oxidisation reaction then occurs. This means that the rate at which heat is being produced exceeds the rate at which heat is being dissipated through thermal conduction.

3.6 Temperature classes for gases and vapours

Combustible gases and vapours can be split into temperature classes in accordance with EN 60079-14 (non-exhaustive list) on the basis of their ignition temperatures and energies.

Danger increases → Requirements increase

Danger increases → Requirements increase

Ex Group	Minimum ignition energy	T1 (<450°C)	T2 (<300°C)	T3 (<200°C)	T4 (<135°C)	T5 (<100°C)	T6 (<85°C)
IIA	<160 µ J	Acetone Ammonia Methane Ethane Propane	Ethyl alcohol n-Butane Cyclohexane 1,2-dichloroethane Acetic anhydride	Petrols Diesel fuels Jet fuels Heating oil n-Hexane	Acetaldehyde	-	-
IIB	<80 µ J	Town gas Acrylonitrile	Ethylene Ethyloxide	Ethylene glycol Hydrogen sulphide	Ethyl ether	-	-
IIC	<20 µ J	Hydrogen	Acethylene	-	-		Carbon disulphide

The maximum surface temperature of equipment (for fans: the motor) must always be lower than the ignition temperature of the explosive atmosphere in which the equipment is used.

What's more, the ignition energy of any sparks produced must not exceed the minimum ignition energy of the hazardous material.

Equipment in a higher temperature class (e.g. T4) are allowed in applications where a lower temperature class is needed (e.g. T2).

For example, an electric motor with a surface temperature of 175 °C may be used in an explosive atmosphere with temperature classes T1, T2 and T3.

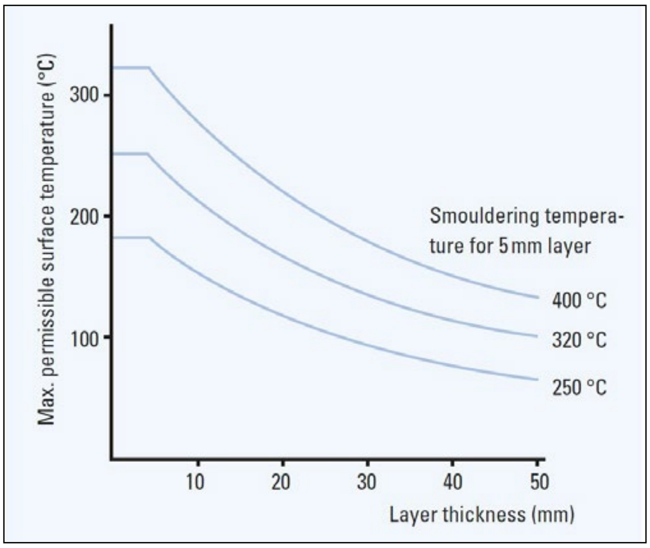
3.7 Ignition temperatures of dusts

There is no classification into temperature classes for combustible dusts. The ignition temperature differs depending on whether the dust is swirled up (as a cloud) or is deposited (as a layer).

In the case of a dust cloud, the equipment's maximum surface temperature may only be 2/3 of the ignition temperature. The ignition temperature of the dust layer should also be noted for dust deposits. This ignition temperature of the dust layer is defined as the smouldering temperature and is the lowest temperature of a hot surface, at which a dust layer of 5 mm can catch fire.

It is adjusted to the maximum surface temperature of the device using a safety factor of 75 K.

Because thermal insulation is greater with a higher layer thickness of dust, the maximum permitted surface temperature of the device should be reduced yet further. The diagram on the right is used for calculation purposes and is based on EN 60079-14.



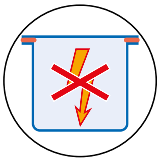
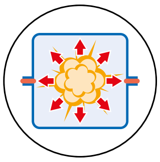
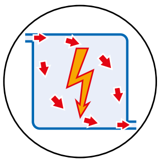
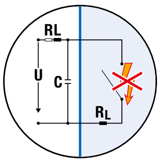
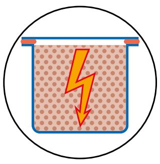
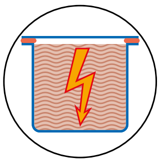
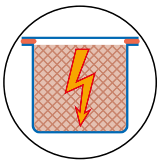
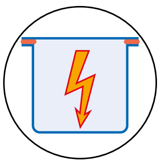
Example for calculating the max. surface temperature with dust layers of between 5 mm and 50 mm.

If the layer is thicker than 50 mm, the smouldering temperature should be calculated in the lab. The same is true for a layer thickness of more than 5 mm, if the smouldering temperature for a 5 mm layer thickness is less than 250 °C.

Lab testing is also needed if the device is filled entirely with combustible dust. At no critical point may the device be hotter than the lower of the two permissible surface temperatures calculated for dust clouds and dust layers.

3.8 Types of protection

A key aspect of secondary explosion protection is the categorisation of types of protection. These are used as protective measures against explosion for electrical equipment to prevent an explosive atmosphere from igniting. Various types of protection are displayed in the table below along with their principle of function and several application examples.

	Type of protection	Principle of function	Application examples
	Increased safety "e"	Additional measures are taken on the equipment to prevent impermissibly high temperatures as well as sparks on the inside or on outer parts.	Motors, terminals and terminal boxes, lights
	Constructional safety "c"	Tried and tested technical principles are applied to types of devices which do not have a source of ignition during normal operation. This is done such that the risk of mechanical errors, which may result in ignitable temperatures and sparks, is reduced to a very low level.	Motors switching devices, terminal boxes, lights
	Pressure-proof enclosure "d"	Parts, which may ignite an explosive atmosphere, are enclosed in a housing. This housing withstands the pressure of an explosion in its interior and prevents the explosion from passing to the surrounding explosive atmosphere.	Switching devices, motors, transformers, heaters
	Pressurisation "p"	The formation of an explosive atmosphere inside housings is prevented through use of a protective gas. This protective gas ensures excess pressure over the surrounding atmosphere.	Switch and control cabinets, analysis equipment, large motors
	Intrinsic safety "i"	The equipment only has intrinsically safe circuits. These ensure that no sparks or thermal effects can result in ignition of an explosive atmosphere.	Measurement and control technology, communication technology, sensors
	Powder filling "q"	Electrical equipment or parts of electrical equipment, which may represent a source of ignition, are secured into position and completely surrounded by a fine-grain filler. This prevents an external explosive atmosphere from igniting.	Capacitors
	Oil immersion "o"	Electrical equipment or parts of electrical equipment, which may represent a source of ignition, are completely surrounded by a protective liquid (e.g. oil). This prevents an external explosive atmosphere from igniting.	Starting resistances, transformers
	Encapsulation "m"	Electrical equipment or parts of electrical equipment, which may represent a source of ignition, are completely surrounded by a casting compound. This prevents an external explosive atmosphere from igniting.	Sensors, switching devices
	Protection by enclosure "t"	The seal integrity of the housing prevents dust from entering or limits it to a safe level. Ignitable equipment can therefore be installed in the housing. The temperature of the housing must not cause the surrounding atmosphere to catch fire.	Switching devices and systems, control, connection and terminal boxes, motors, lights

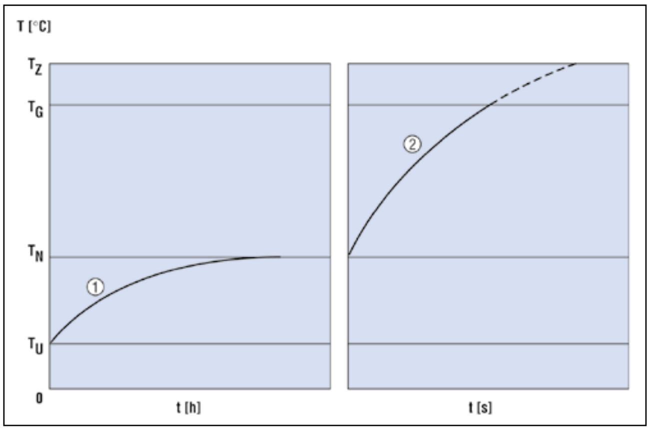
3.9 Protection concept for Maico fans

One potential source of ignition on Maico fans is their hot surface, which is produced by the motor's power loss.

During normal operation, after a while the surface temperature reaches a stable, uncritical value.

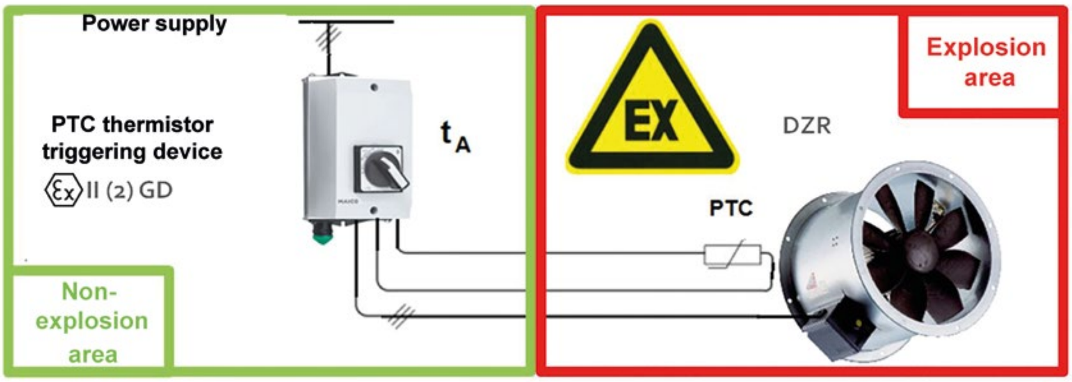
Should faults arise, if the impeller is blocked for example, this temperature will however shoot up very quickly.

Without protective measures, the ignition temperature of an explosive atmosphere could therefore be reached and an explosion triggered. The motors of the DZ... Ex e fans are therefore fitted with a PTC thermistor embedded in the motor winding in order to monitor the temperature. Once connected to the thermistor triggering device MVS 6 or the TMS machine protection relay thermistor, the protection concept is therefore in place. If a particular limit temperature is exceeded, the MVS 6 or TMS shuts down the fan. This reliably prevents the critical temperature from being reached. Further design protective measures are achieved through the choice of material and geometry of the mechanical fan parts. These include an air gap to prevent rotating parts from scraping, use of anti-static, temperature- and flame-resistant materials and material pairings in compliance with the relevant standards.

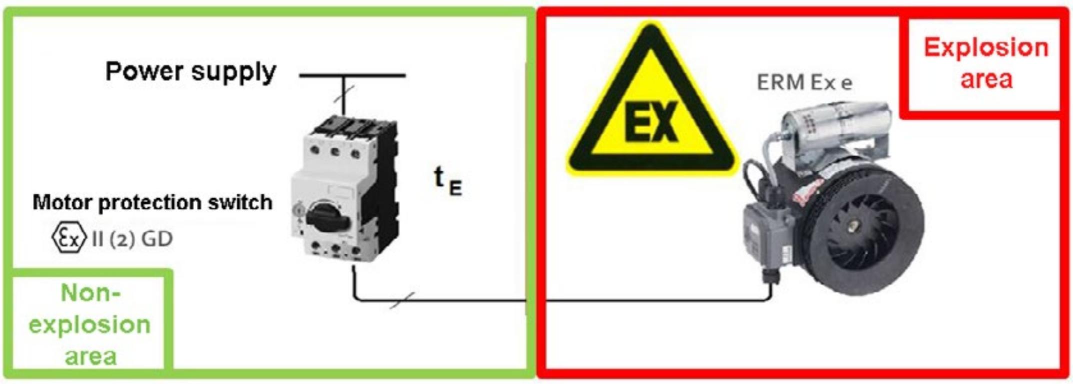


① Normal operation ② Fault (blocked impeller)
T_U – Maximum ambient temperature
T_G – Temperature limit
T_N – Surface temperature during normal operation
T_Z – Ignition temperature

The thermistor triggering device must not be located in the ex area. But it does have an effect in the ex area which explains why it is subject to the ATEX directive. When labelling devices in line with this directive, category 2 is therefore placed in brackets to indicate that the device has an effect in zone 1 and/or 2.



A PTC thermistor is not fitted in the single-phase devices of the ERM Ex e and EZ Ex e-series. A motor protection switch, such as the MVEx, should be used here to deliver the protection concept. This monitors the motor current, which rises should a fault occur, resulting in a hot surface. Like the thermistor triggering device, the motor protection switch should also be installed in the non-potentially explosive area.



4 Practical section / Application examples

4.1 Applications for ventilation systems in areas at risk of explosion

Typical applications for ventilation systems in areas at risk of explosion are:

- Store rooms
- Process technical applications
- Workshops
- Petrochemical industry
- Battery rooms
- Labs

A ventilation system is basically always needed in these areas to transport the combustible gases, vapours or mist in the explosive atmosphere out of the building.

Depending on application, an extra ventilation system may be needed. Failing this, an independent fresh air supply via the air grilles or shutters will suffice.

Air extraction

Air extraction at the exit point (e.g. edge extraction on open containers) prevents explosive substances from being distributed throughout the room.

Application example:

ERM Ex e for air extraction from storage rooms with explosive atmospheres

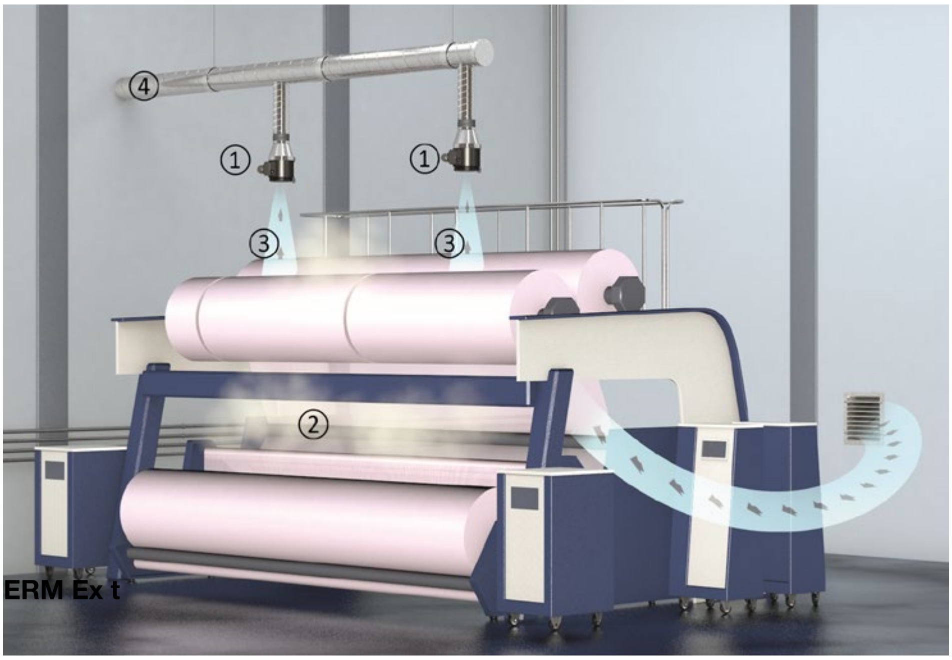
MAICO fans can be used to bring the concentration of combustible gases below the limit of explosion. This reliably prevents the build-up of an explosive atmosphere. In the example shown, an ERM Ex e fan is extracting gases which are heavier than air. It is therefore positioned close to the ground.

① Ventilation duct, provided by customer
② ELM … Ex fixing cuff
③ ERM Ex e fan
④ SGM … Ex protective grille
⑤ Explosive atmosphere

Application example:

ERM Ex t ventilation solution in the production of textiles with explosive dust atmospheres

Duct fans are used to directly and efficiently extract the fine textile dust, made up of many different materials, such as plastic and natural yarns. The production area remains free of a flammable air mix. The system operators breathe clean air, free from fine dust, while working on the machine.

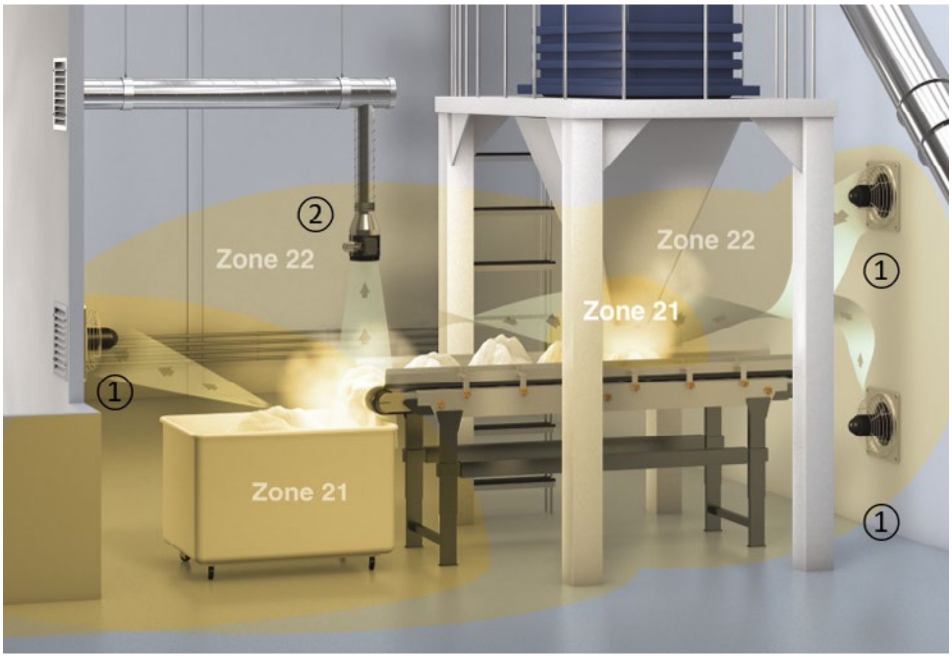


① ERM Ex t for air extraction
② Mix of textile dust and air
③ Exhaust air
④ Folded spiral-seams duct

Application example:

Milling system with explosive dust atmosphere

Different zone classifications are used for dust atmospheres. Depending on the zone, only certain device categories may be used.



① EZQ/S ... E Ex t or DZQ … Ex t wall-mounted fans
② ERM … Ex t duct fan

Zone 21 – MAICO fans appropriate.

Zone 22 – MAICO fans appropriate..

Dilution ventilation

By distributing in the air, the concentration of combustible material is reduced such that it falls below the lower limit of explosion. The lower limit of explosion is the lower value limit for the concentration of a combustible material in a mix of gases, vapours, mist or dusts, below which a flame can no longer transmit itself independently of the source of ignition once ignited (EN 1127-1).

① MLA or MLZ external grille
② Explosive atmosphere
③ EZQ … E Ex e or DZQ … Ex e wall-mounted fan

4.2 Technical implementation of ventilation systems in areas at risk of explosion

Experience shows that air exchange rates of at least 5/h should be aimed for in areas at risk of explosion. The values applicable in each specific case are stipulated by employers' liability insurance association requirements or corresponding rulings.

The air limit values (e.g. workplace exposure limit) or rather maximum allowable concentration values of all gases, vapours and mist present must be observed.

We would often recommend installing a fan system for active ventilation of the rooms in question in addition to air extraction and/or an exhaust air system. Controlling the air flows for outside and outgoing air can produce a slight excess pressure or partial vacuum as required. There should always be a partial vacuum in rooms with a potentially explosive area. This requires the mass flow in the supply air pipes to be lower than that in the exhaust duct.

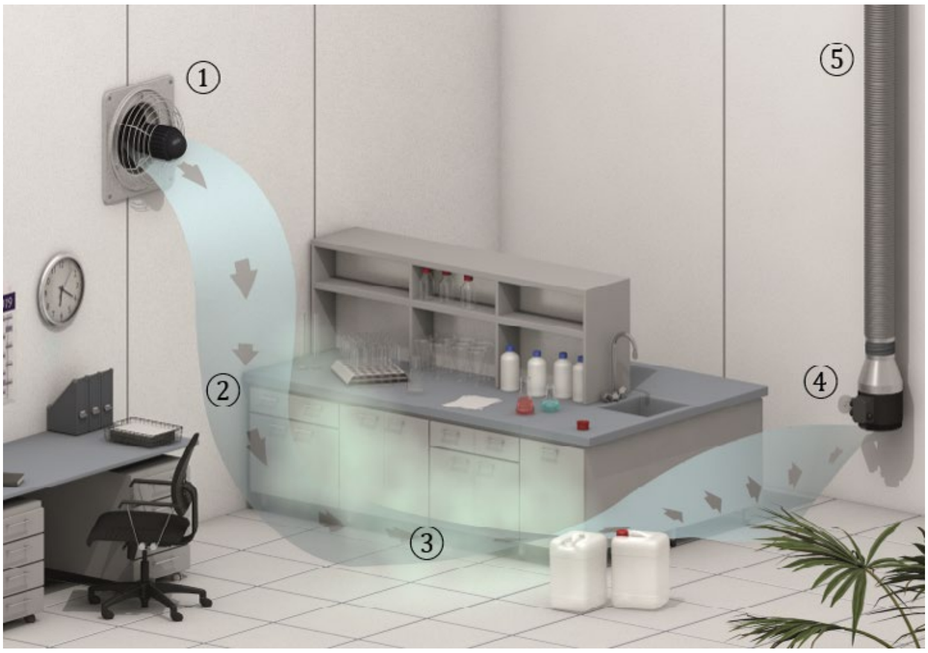
Depending on the specific application, there are numerous ways in which the supply and exhaust air fans, ventilation ducts, supply and exhaust air openings, etc. can be arranged.

A series of technical measures have proved to deliver effective ventilation:

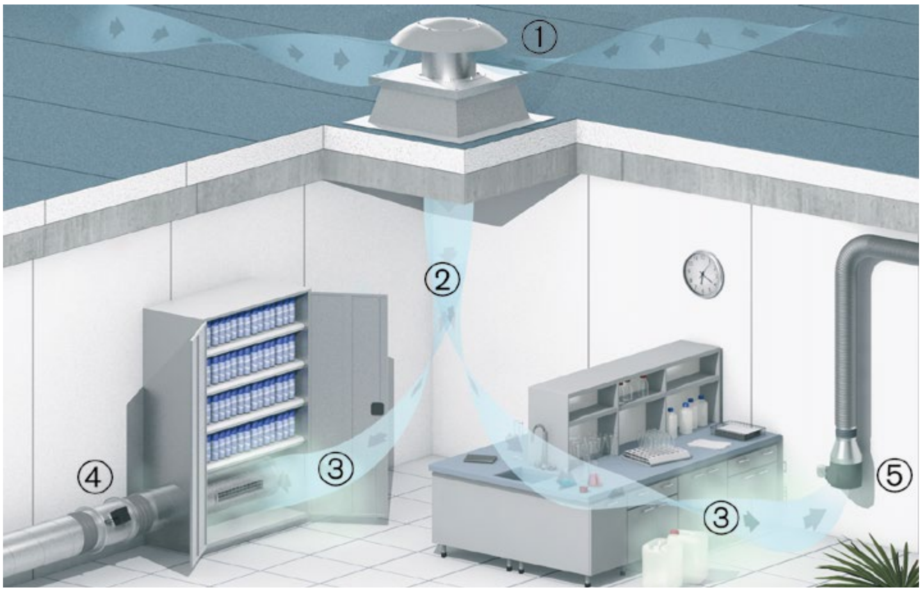
Cross-ventilation

With cross-ventilation, the supply air flows through the entire room before being extracted. The supply air should be blown in near the ceiling and in parallel with it. The induction effect distributes the supply air throughout the room.

The exhaust air is extracted near the floor because most combustible gases and vapours are heavier than air. One exception is hydrogen, which collects under the ceiling, for example (see "Cross-ventilation in battery rooms application example").



① EZQ … E Ex e or DZQ … Ex e wall-mounted fan
② Air flow during cross-ventilation
③ Explosive atmosphere
④ ERM … Ex e duct fan
⑤ Exhaust Air



① DZD … Ex e roof fan
② Supply air during cross-ventilation
③ Explosive atmosphere
④ DZR … Ex e duct fan
⑤ ERM … Ex e duct fan

In the applications shown above, the supply air is blown into the room in parallel to the ceiling. As the supply air crosses the room, it mixes well with the air already present in the room. It is then extracted either directly at the workplace, in a dangerous material cabinet with ventilation connected up directly or generally using exhaust air fans near the floor.

Supply and exhaust air openings
Supply air is brought in by means of what is known as cross-ventilation to cause as little turbulence as possible.

To keep the pressure losses at the supply air opening as low as possible, the free cross-section for the supply air opening should be at least 3 to 4 times the fan diameter. This can be achieved using a large opening of an appropriate size or using several smaller ones.

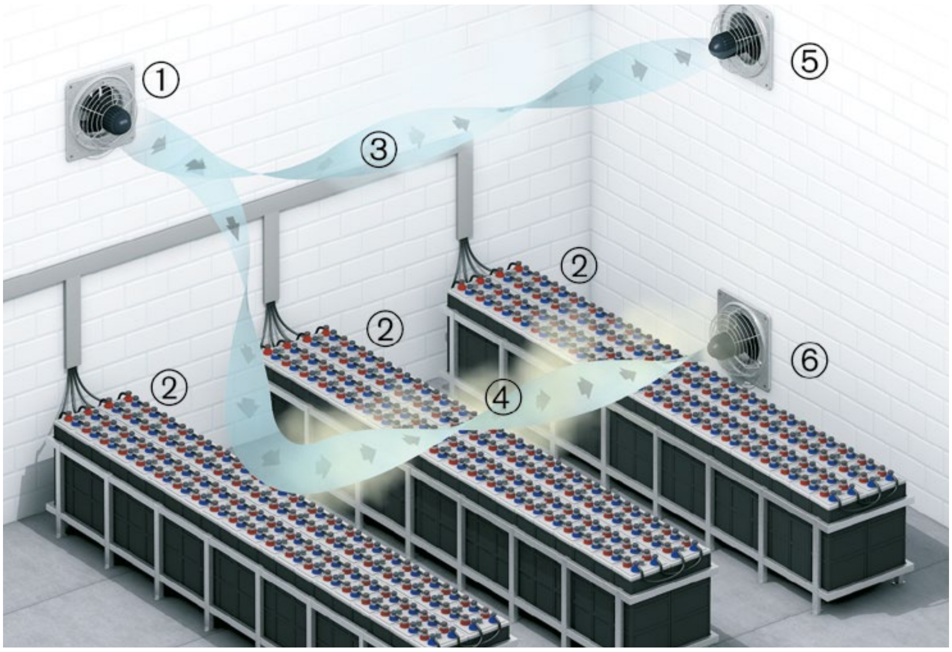
By way of external grille, we would recommend the MAICO MLA and MLZ external grilles, available in sizes 20 to 50. And for the shutters, MAICO recommends the airstream-operated
AS shutter, available in sizes 20 to 60. The RS shutter may only be used if the associated MS 2 servomotor is fitted outside the potentially explosive area.

MAICO also supplies an extensive range of system components and accessories for ventilation systems in areas at risk of explosion.

Application example:

Cross-ventilation in battery rooms

As the cells are charged, hydrogen is produced in the battery rooms and collects under the ceiling. With lead batteries, sulphuric acid mist forms close to the ground at the same time. Both need extracting.
To do this, equip the air extraction system with exhaust air openings at floor and ceiling height for this purpose or extract the exhaust air directly with EZQ ... E Ex e or DZQ ... Ex e wall-mounted fans. Supply air is fed in at the opposite end of the battery room using a separate ventilation system. If they can be used, EZQ ... E Ex e or DZQ ... Ex e wall-mounted fans again provide the simplest solution here for blowing in outside air.



① EZQ 20 E Ex e / DZQ … Ex e supply air fan
② Batteries on charging station
③ Explosive atmosphere (hydrogen)
④ Sulphuric acid mist
⑤ EZQ 20 E Ex e / DZQ … Ex e exhaust air fan for extracting the hydrogen
⑥ EZQ 20 E Ex e / DZQ … Ex e exhaust air fan for extracting the sulphuric acid mist

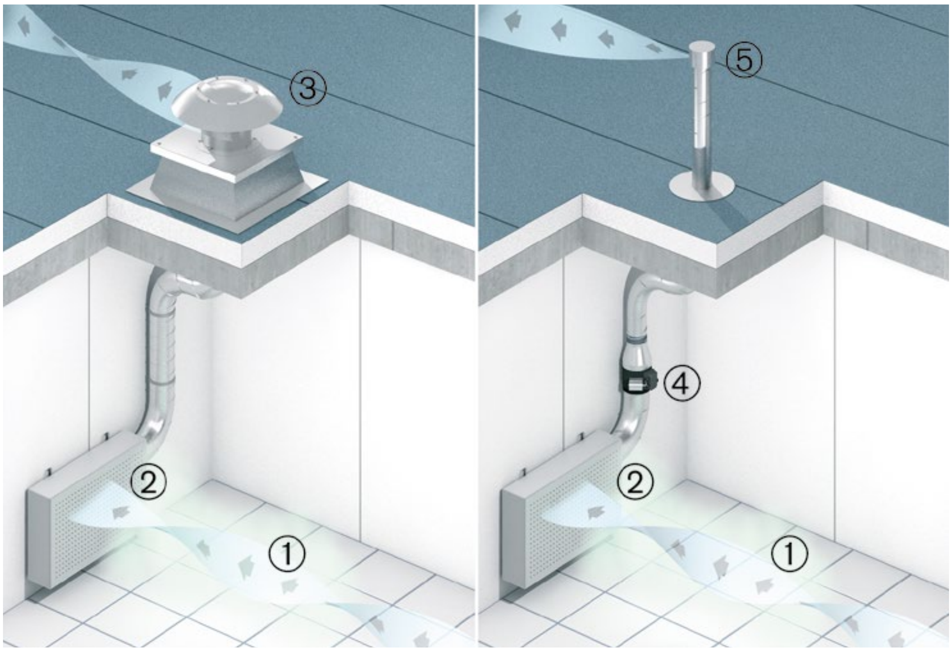
Exhaust air / air extraction system

Depending on the industry in question, the removal of exhaust air from the building has to meet different requirements. For example, the following applies to exhaust air exiting painting systems:

- The exhaust duct opening must be at least 2 m above the ridge of a pitched roof or 5 m above flat roofs.
- The exhaust duct opening must be at least 10 m above the ground.
- The exit speed of the exhaust air must be at least 7 m/s.
- In the case of air extraction systems, an appropriate overrun time must be used to ensure that an explosive atmosphere cannot form even once the actual activity is complete.

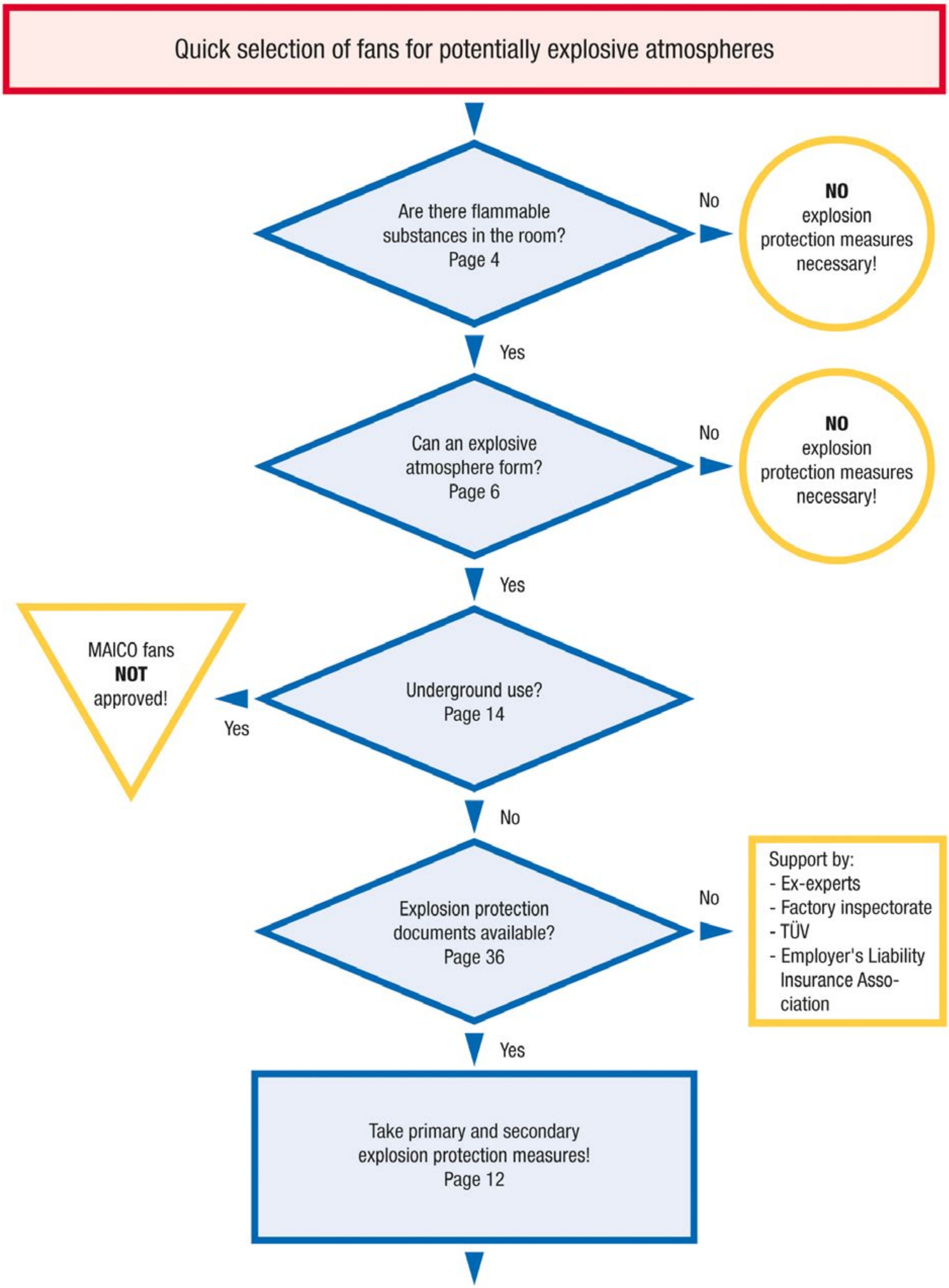
Folded spiral-seams ducts are used in the ventilation ducts here.

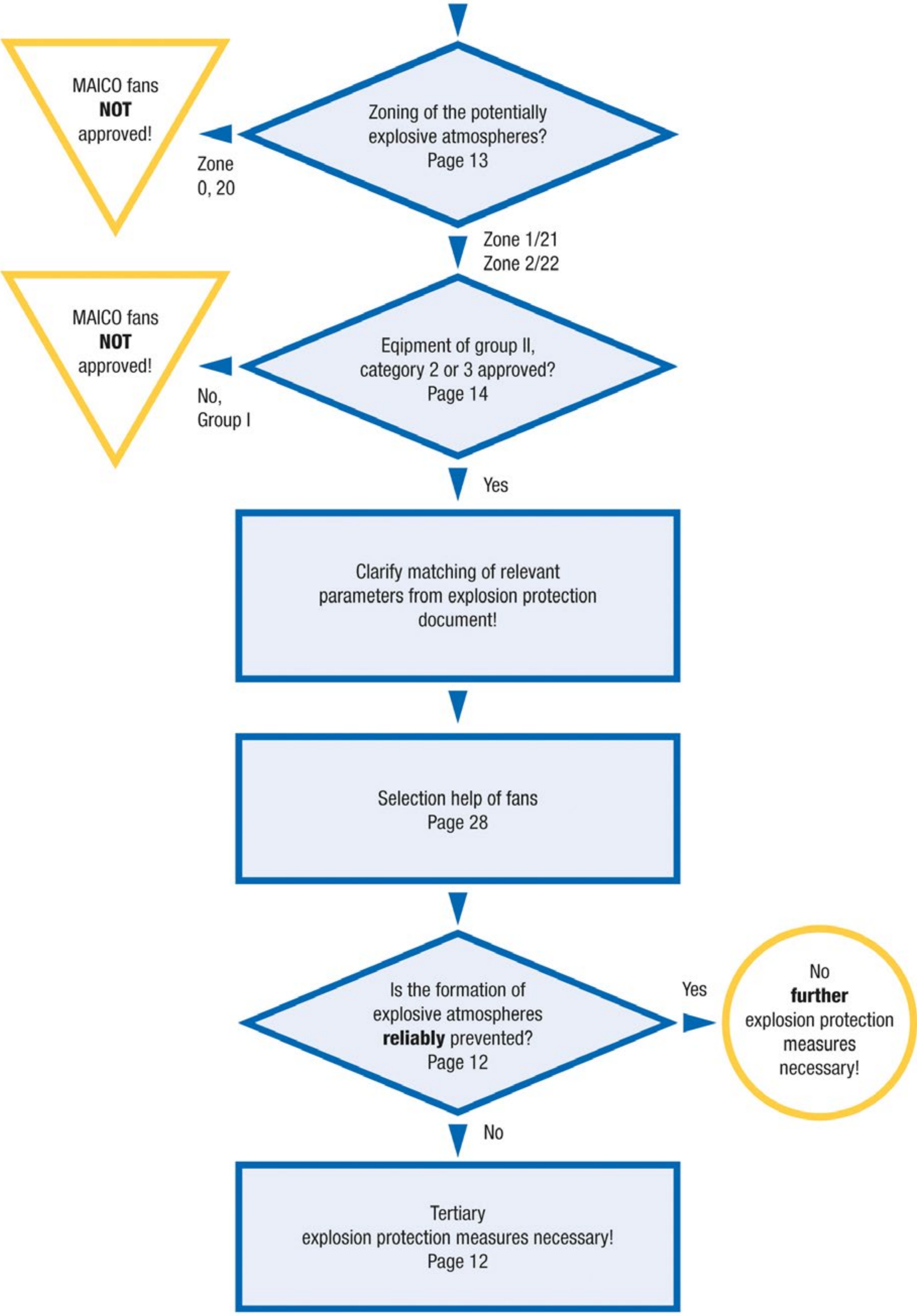
Standard plastic ducts may not be used due to the risk of electrostatic charges. Special electrically conductive plastic ducts may however be used.



① Explosive atmosphere
② Exhaust opening for exhaust air
③ DZD … Ex e roof fan
④ ERM … Ex e duct fan
⑤ Outgoing air

5 Checklist


Quick selection of fans for potentially explosive atmospheres
Are there flammable substances in the room? Page 4
No
NO explosion protection measures necessary!
Yes
Can an explosive atmosphere form? Page 6
No
NO explosion protection measures necessary!
Yes
Underground use? Page 14
Yes
MAICO fans NOT approved!
No
Explosion protection documents available? Page 36
No
Support by:
- Ex-experts
- Factory inspectorate
- TÜV
- Employer's Liability Insurance Association
Yes
Take primary and secondary explosion protection measures! Page 12


Zoning of the potentially explosive atmospheres? Page 13
Zone 0, 20
MAICO fans **NOT** approved!
Zone 1/21
Zone 2/22
Eqipment of group II, category 2 or 3 approved? Page 14
No, Group I
MAICO fans **NOT** approved!
Yes
Clarify matching of relevant parameters from explosion protection document!
Selection help of fans Page 28
Is the formation of explosive atmospheres **reliably** prevented? Page 12
Yes
No **further** explosion protection measures necessary!
No
Tertiary explosion protection measures necessary! Page 12

Selection help for MAICO fans

MAICO fans for use in areas subject to explosion hazards

In order to select the right fan, you need to know the following:

	MAICO provides:	**Applicable for:**
Device group, category	Device group II, category 2 G, in other words, suitable for explosive atmospheres with gases, vapours and mists other than mines.	All product groups of the ex fans
Zone	**Approved for zone 1/21 and zone 2 /22.** (Zones 0, 20 **not** approved!)	All product groups of the ex fans
Type of protection	**Product group for gas ex** Device protection thanks to increased safety “e” (for the motor and electrics, standard: EN 60079-7, labelling: eb) Constructional safety “c” (for the mechanical part, i.e. the fan but not electrics, standard: EN 80079-37, labelling: h).	Product groups of the gas ex fans
	Product group for dust ex Protection for devices from dust explosions by enclosure “t” (for the motor and electrics, labelling: tb) Constructional safety “c” (for the mechanical part, i.e. the fan but not electrics, labelling: h).	Product groups of the ust ex fans
Installation location	Fans for roof, wall and duct installation.	Respective product group
Operating point	Roof fans: 800 m³/h to 6510 m³/h Wall fans: 440 m³/h to 9450 m³/h Duct fans: 980 m³/h to 9370 m³/h (DZR ... B Ex e) Duct fans: 310 m³/h to 870 m³/h (ERM ... Ex e)	Respective product group
Temperature class	For gas Depending on product type, T3 or T4 can be used up to T1.	gas ex fans
Ignition temperature	For dust Depending on product type, T200°C or T135°C.	dust ex fans

The following factors also come into play when selecting the right fan:

	MAICO provides:	Applicable for:
Air medium	For all neutral and slightly acidic/alkaline vapours and gases of groups IIA, IIB and hydrogen.	All product groups of the gas ex fans
	IIIA Flammable fluffs IIIB Non-conductive flammable dust, specific electric resistance >10³ Ω **Not for use with abrasive media.**	All product groups of the dust ex fans
Airstream temperature	-20 °C ≤ T_a ≤ +50 °C -20 °C ≤ T_a ≤ +40 °C	ERM... Ex DZS ... B Ex e, DZQ ... B Ex e, DZR ... B Ex e, DZD … B Ex e
Rated voltage	400 V 50/60 Hz (Special 125-500 V devices possible)	DZS / DZQ / DZR / DZD … B Ex e
	230 V 50/60 Hz (Special 100-250 V devices possible)	ERM... Ex, EZQ/EZS... Ex
With adjustable speed (no control)	Yes, with the exception that DZ... 35/2 B Ex e, ERM... Ex and EZQ... E Ex e does not offer speed adjustment	DZS /DZQ /DZR /DZD … B Ex e

Application example

The customer is looking for a fan for the following potentially explosive area:

- Zone 1
- Medium: acetaldehyde, ignition temperature 155°C, temperature class T4, gas from group IIA
- Installation location: duct system

All MAICO fans for areas subject to explosion hazards may be used in zone 1.

Example for ERM ex fans

Fan	Temperature class	Can be used?
ERM 18 Ex e	T1 to T4	x
ERM 22 Ex e	T1 to T3	
ERM 25 Ex e	T1 to T3	

Fans for areas subject to explosion hazards (medium: gas

MAICO-Fans for areas subject to explosion hazards

Article	Article	Nominal size		Article number	Article number	Installation site	Temperature class medium: gas
Gas	Dust			Gas	Dust	Fans for roof, wall and duct installation	Depending on product type T3 / T T4 / T (Temperature class)
Axial wall fans EZQ Ex, DZQ Ex, DZS Ex							
EZQ 20/4-E Ex e	**EZQ 20/4-E Ex t**	**DN 200**		0083.0850	0083.0217	Wall / Ceiling	T3 / T 200°C
DZQ 20/4-B Ex e	**DZQ 20/4 B Ex t**	**DN 200**		0083.0170	0083.0200		T4 / T 135°C
DZQ 20/2-B Ex e	**DZQ 20/2 B Ex t**	**DN 200**		0083.0171	0083.0201		T4 / T 135°C
DZQ 25/4-B Ex e	**DZQ 25/4 B Ex t**	**DN 250**		0083.0172	0083.0202		T3 / T 200°C
DZQ 25/2-B Ex e	**DZQ 25/2 B Ex t**	**DN 250**		0083.0173	0083.0203		T4 / T 135°C
DZQ 30/6-B Ex e	**DZQ 30/6 B Ex t**	**DN 300**		0083.0174	0083.0204		T4 / T 135°C
DZQ 30/4-B Ex e	**DZQ 30/4 B Ex t**	**DN 300**		0083.0175	0083.0205		T3 / T 200°C
DZQ 30/2-B Ex e	**DZQ 30/2 B Ex t**	**DN 300**		0083.0176	0083.0206		T3 / T 200°C
DZQ 35/6-B Ex e	**DZQ 35/6 B Ex t**	**DN 350**		0083.0177	0083.0207		T4 / T 135°C
DZQ 35/4-B Ex e	**DZQ 35/4 B Ex t**	**DN 350**		0083.0178	0083.0208		T3 / T 200°C
DZQ 35/2-B Ex e	**DZQ 35/2 B Ex t**	**DN 350**		0083.0179	0083.0209		T3 / T 200°C
DZQ 40/6-B Ex e	**DZQ 40/6 B Ex t**	**DN 400**		0083.0180	0083.0210		T4 / T 135°C
DZQ 40/4-B Ex e	**DZQ 40/4 B Ex t**	**DN 400**		0083.0181	0083.0211		T4 / T 135°C
DZQ 45/6-B Ex e	**DZQ 45/6 B Ex t**	**DN 450**		0083.0182	0083.0212		T4 / T 135°C
DZQ 45/4-B Ex e	**DZQ 45/4 B Ex t**	**DN 450**		0083.0183	0083.0213		T4 / T 135°C
DZQ 50/6-B Ex e	**DZQ 50/6 B Ex t**	**DN 500**		0083.0184	0083.0214		T4 / T 135°C
DZQ 50/4-B Ex e	**DZQ 50/4 B Ex t**	**DN 500**		0083.0185	0083.0215		T3 / T 200°C
DZQ 60/6-B Ex e	**DZQ 60/6 B Ex t**	**DN 600**		0083.0186	0083.0216		T3 / T 200°C
Axial duct fans DZR Ex							
DZR 20/2-B Ex e	**DZR 20/2 B Ex t**	**DN 200**		0086.0700	0086.0720	Duct	T4 / T 135°C
DZR 25/4-B Ex e	**DZR 25/4 B Ex t**	**DN 250**		0086.0701	0086.0721		T3 / T 200°C
DZR 25/2-B Ex e	**DZR 25/2 B Ex t**	**DN 250**		0086.0702	0086.0722		T4 / T 135°C
DZR 30/6-B Ex e	**DZR 30/6 B Ex t**	**DN 300**		0086.0703	0086.0723		T4 / T 135°C
DZR 30/4-B Ex e	**DZR 30/4 B Ex t**	**DN 300**		0086.0704	0086.0724		T3 / T 200°C
DZR 30/2-B Ex e	**DZR 30/2 B Ex t**	**DN 300**		0086.0705	0086.0725		T3 / T 200°C
DZR 35/6-B Ex e	**DZR 35/6 B Ex t**	**DN 350**		0086.0706	0086.0726		T4 / T 135°C
DZR 35/4-B Ex e	**DZR 35/4 B Ex t**	**DN 350**		0086.0707	0086.0727		T3 / T 200°C
DZR 35/2-B Ex e	**DZR 35/2 B Ex t**	**DN 350**		0086.0708	0086.0728		T3 / T 200°C
DZR 40/6-B Ex e	**DZR 40/6 B Ex t**	**DN 400**		0086.0709	0086.0729		T4 / T 135°C
DZR 40/4-B Ex e	**DZR 40/4 B Ex t**	**DN 400**		0086.0710	0086.0730		T4 / T 135°C
DZR 45/6-B Ex e	**DZR 45/6 B Ex t**	**DN 450**		0086.0711	0086.0731		T4 / T 135°C
DZR 45/4-B Ex e	**DZR 45/4 B Ex t**	**DN 450**		0086.0712	0086.0732		T4 / T 135°C
DZR 50/6-B Ex e	**DZR 50/6 B Ex t**	**DN 500**		0086.0713	0086.0733		T4 / T 135°C
DZR 50/4-B Ex e	**DZR 50/4 B Ex t**	**DN 500**		0086.0714	0086.0734		T3 / T 200°C
DZR 60/6-B Ex e	**DZR 60/6 B Ex t**	**DN 600**		0086.0715	0086.0735		T3 / T 200°C
Semi-centrifugal duct fan ERM Ex							
ERM 18 Ex e	**ERM 18 Ex t**	**DN 180**		0080.0290	0080.0466	Duct	T4 / T 135°C
ERM 22 Ex e	**ERM 22 Ex t**	**DN 220**		0080.0288	0080.0467		T3 / T 200°C
ERM 25 Ex e	**ERM 25 Ex t**	**DN 250**		0080.0249	0080.0468		T3 / T 200°C
Axial roof fans DZD Ex							
DZD 25/4-B Ex e	**DZD 25/4 B Ex t**	**DN 250**		0087.0796	0087.0810	Roof	T3 / T 200°C
DZD 25/2-B Ex e	**DZD 25/2 B Ex t**	**DN 250**		0087.0797	0087.0811		T4 / T 135°C
DZD 30/6-B Ex e	**DZD 30/6 B Ex t**	**DN 300**		0087.0798	0087.0812		T4 / T 135°C
DZD 30/4-B Ex e	**DZD 30/4 B Ex t**	**DN 300**		0087.0799	0087.0813		T3 / T 200°C
DZD 30/2-B Ex e	**DZD 30/2 B Ex t**	**DN 300**		0087.0800	0087.0814		T3 / T 200°C
DZD 35/6-B Ex e	**DZD 35/6 B Ex t**	**DN 350**		0087.0801	0087.0815		T4 / T 135°C
DZD 35/4-B Ex e	**DZD 35/4 B Ex t**	**DN 350**		0087.0802	0087.0816		T3 / T 200°C
DZD 35/2-B Ex e	**DZD 35/2 B Ex t**	**DN 350**		0087.0803	0087.0817		T3 / T 200°C
DZD 40/6-B Ex e	**DZD 40/6 B Ex t**	**DN 400**		0087.0804	0087.0818		T4 / T 135°C
DZD 40/4-B Ex e	**DZD 40/4 B Ex t**	**DN 400**		0087.0805	0087.0819		T4 / T 135°C
DZD 50/6-B Ex e	**DZD 50/6 B Ex t**	**DN 500**		0087.0806	0087.0820		T4 / T 135°C
DZD 50/4-B Ex e	**DZD 50/4 B Ex t**	**DN 500**		0087.0807	0087.0821		T3 / T 200°C
DZD 60/6-B Ex e	**DZD 60/6 B Ex t**	**DN 600**		0087.0808	0087.0822		T3 / T 200°C

and dust)

Temperature class medium: dust	Air flow volume	Rated voltage 400 V	Rated voltage 230 V	Speed controllable yes	Speed controllable no
200°C			•		•
135°C			•		•
135°C		•		•	
200°C		•		•	
135°C		•		•	
135°C		•		•	
200°C		•		•	
200°C		•		•	
135°C		•		•	
200°C	440 – 9.450 m³/h	•		•	
200°C		•			•
135°C		•		•	
135°C		•		•	
135°C		•		•	
135°C		•		•	
135°C		•		•	
200°C		•		•	
200°C		•		•	
135°C		•		•	
200°C		•		•	
135°C		•		•	
135°C		•		•	
200°C		•		•	
200°C		•		•	
135°C		•		•	
200°C		•		•	
200°C	980 – 9.370 m³/h	•			•
135°C		•		•	
135°C		•		•	
135°C		•		•	
135°C		•		•	
135°C		•		•	
200°C		•		•	
200°C		•		•	
135°C			•		•
200°C	310 – 870 m³/h		•		•
200°C			•		•
200°C		•		•	
135°C		•		•	
135°C		•		•	
200°C		•		•	
200°C		•		•	
135°C		•		•	
200°C	800 – 6.510 m³/h	•		•	
200°C		•			•
135°C		•		•	
135°C		•		•	
135°C		•		•	
200°C		•		•	
200°C		•		•	

Features of fans for areas subject to explosion hazards (medium: gas)

- Approved for Zone 1 and 2
- Device category 2 G
- Pumped medium (gas): for neutral and slightly acidic/alkaline vapours and gases of group IIA, IIB and hydrogen
- Usage temperatures: DZ-/EZ: of –20°C ≥ Ta ≥ +40°C. ERM: of –20°C ≥ Ta ≥ +50°C.

Features of fans for areas subject to explosion hazards (medium: dust)

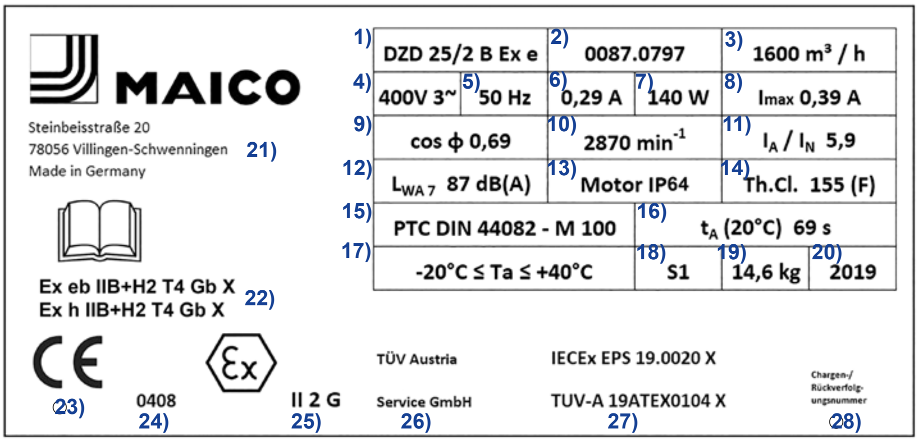
- Approved for Zone 21 and 22
- Device category 2 D
- Pumped medium (dust): for non-conductive and non-abrasive dusts of group IIIB or IIIA
- Usage temperatures: DZ-/EZ: of –20°C ≥ Ta ≥ +40°C. ERM: of –20°C ≥ Ta ≥ +50°C.

Fans for areas subject to explosion hazards (medium: dust) with ignition protection type "t"

Ingress of dust is prevented by the tightness of the enclosure. This means that ignitable equipment can be installed in the enclosure. The temperature at the enclosure must not ignite the surrounding atmosphere.

The wall fans EZQ / DZQ with square wall plate are also available in the version with steel wall ring.

7 Documentation section



1)	Product designation
2)	Article no.
3)	Air volume (free-blowing)
4)	Rated voltage
5)	Rated frequency of rated voltage
6)	Rated current
7)	Rated output
8)	Maximum current present
9)	Power factor
10)	Nominal speed
11)	IA / IN starting current ratio determines the current when blocked (e.g. 2.5 * IN = IA) and in accordance with EN 60079-7, may be no greater than 10.
12)	Sound power
13)	IP degree of protection of motor (seal integrity of motor housing)
14)	Thermal class of motor in accordance with EN 60085 (recommended maximum temperature during continuous use).
15)	PTC thermistor for motor and machine protection
16)	Time t_A describes the response time of the integrated temperature sensor should the motor block. The type of temperature sensor is stated and the trigger temperature is defined by the customer to satisfy the relevant explosion protection requirements. Time t_E describes the response time of the connected motor protection switch provided there is no PTC integrated.
17)	Operating temperature range of surroundings and air medium
18)	Operating mode of motor (continuous operation)
19)	Total weight
20)	Year of manufacture
21)	Complete manufacturer's address
22)	Designation as per relevant standard: Ex = Device for use in areas subject to explosion hazards eb = Electrical increased safety degree of protection, in accordance with EN 60079-7 (for the motor) tb = Degree of protection provided by enclosure, in accordance with EN 60079-31 h = Labelling in accordance with EN 80079-36, device with degree of protection "c" (constructional safety), in accordance with EN 80079-37 (for the fan – non-electrical) IIB + H_2 = Device group II for electrical devices with gaseous media above ground + hydrogen IIIB = Non-conductive combustible dust, specific electric resistance >10^3 Ω T4 = Maximum surface temperature present on device: 135 °C T135°C / T200°C = Maximum surface temperature present on device Gb = Equipment protection level (EPL) for a high degree of safety, use in zone 1 or 2 possible Db = Equipment protection level (EPL) for a high degree of safety, use in zone 21 or 22 possible X = Special operating conditions: thermistor triggering device (DZ series) or motor protection switch (ERM, EZ series) must be installed.
23)	CE marking, product conformity with the relevant guidelines.
24)	ID number of notified inspection authority, which has certified the production facilities in accordance with EN 80079-34
25)	Designation in accordance with 2014/34/EU directive: Explosion protection labelling II = Device group: Use in all areas apart from underground mining 2 = Device category, a high degree of safety: despite the occurrence of an error, the device can still be operated safely G = Gas air medium, D = Air medium for dust
26)	Name of notified inspection authority, which has certified the production site in accordance with EN 80079-34.
27)	EU type examination certificate number
28)	Batch tracking number

Alongside its ATEX certification prescribed by law, Maico also holds IECEx certification. This means that its products can also be supplied outside the European common market. The prerequisite is that the technical and statutory requirements of the destination country comply with those of the products.

How does IECEx work?

The IECEx system is part of the International Electrotechnical Commission, which is the world's leading organisation for the development of electrotechnical and similar standards.

The main job of the IEC is

- to develop and maintain international standards and
- to check the conformity of electrical products and also
- to check quality management in conjunction with the standards produced.

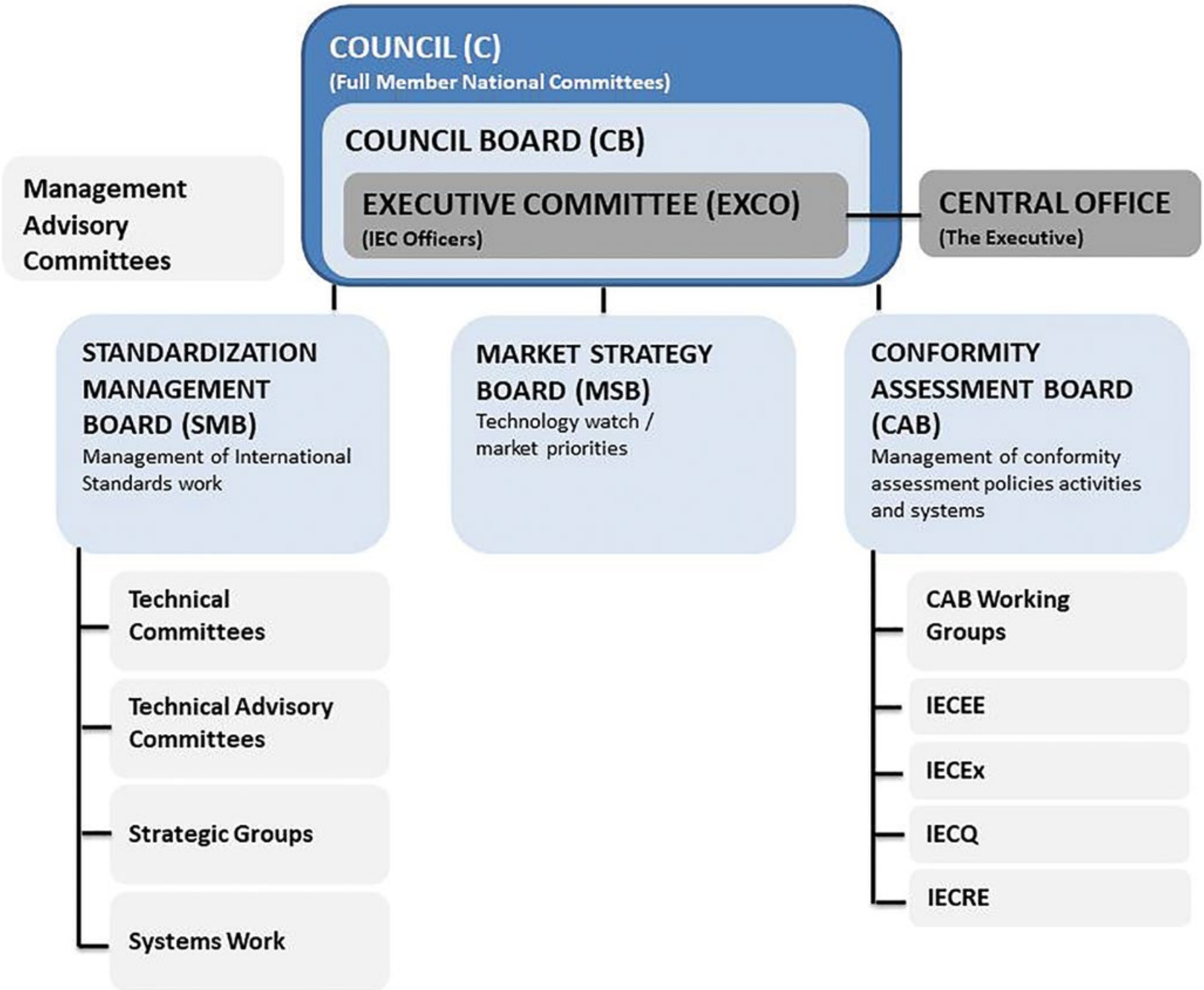


Figure 1: Structure of the IECEx system

Conformity with the respective standards is checked in terms of

- safety,
- efficiency,
- reliability,
- compatibility
- and competence

through the use of independent validation and testing of

- services,
- production processes,
- products,
- people,
- and management systems

through the application of the IEC's conformity assessment system.

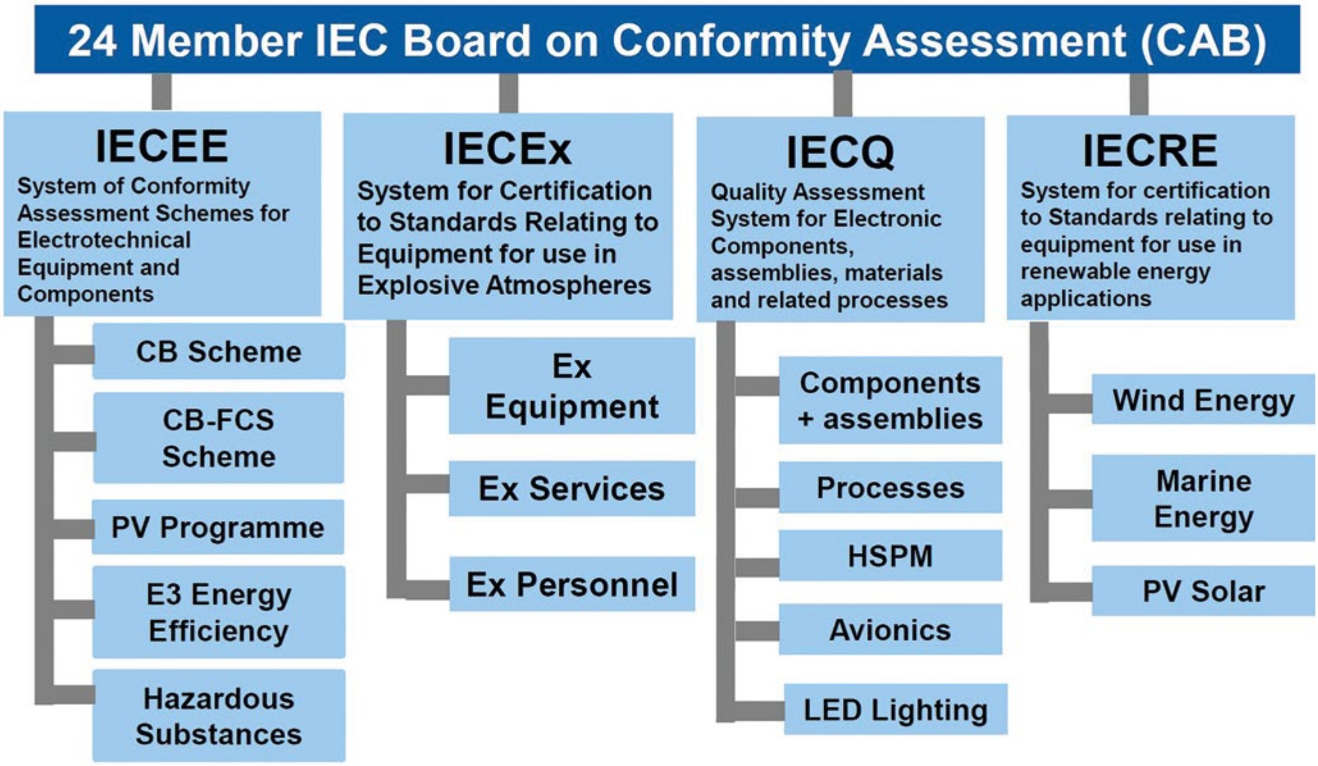


Figure 2: The IEC's conformity assessment system

The main concern of the IECEx system is to facilitate international trade in products for use in areas subject to explosion hazards while also retaining the necessary safety level.

The goals of this system are as follows:

- Reduced testing and certification costs for the manufacturer.
- Faster access to the respective national market
- Established confidence in the product validation process at an international level.
- One single database accessible internationally for listed manufacturers.
- Continuous assurance of trustworthiness in equipment and services through IECEx certification.

There are various services within the IECEx system:

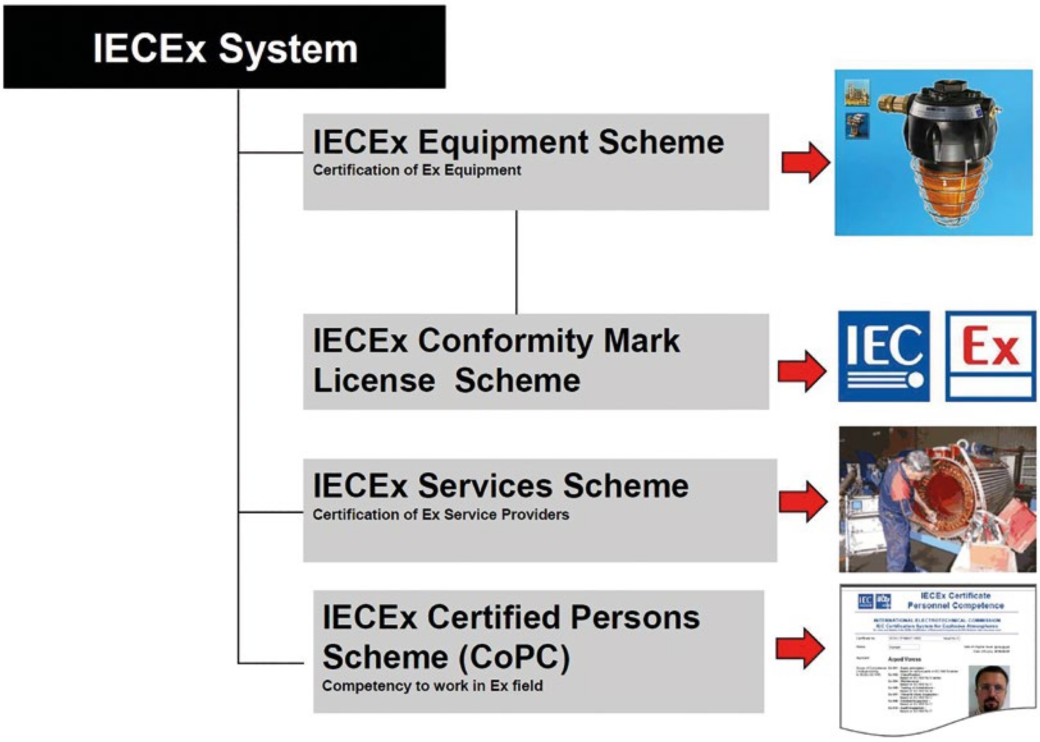


Figure 3: IECEx services

The IECEx equipment scheme involves the assessment of products for explosive areas. In order to receive this certificate, the manufacturer sends a test sample of his application to the IECEx Certification Body (ExCB), where the sample is tested in the lab. The manufacturer's production facilities are also audited by the ExCB. Repeat audits ensure that the strict normative requirements of the IEC standards which have to be applied are observed on a continual basis. The sample test results in the technical report (ExTR), which documents that the product has been tested and found to meet all relevant IEC or ISO standard requirements. This applies both to the requirements of electrical equipment, which are covered by IEC 60079 and the 61241 series of standards as well as non-electrical equipment, covered by the ISO/IEC 80079 series of standards.

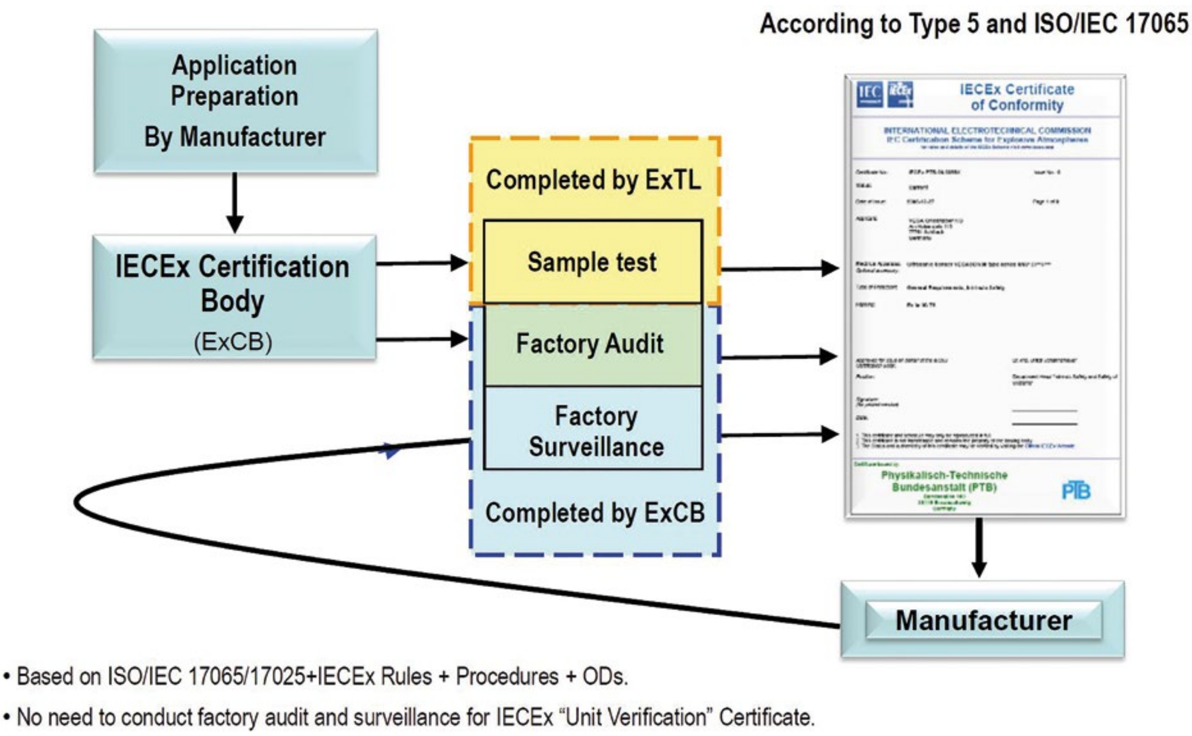


Figure 4: IECEx certification process for equipment for use in explosive environments

The audit of the production facilities results in the writing of the Quality Assessment Report (QAR), which testifies to the manufacturer's ability and competence in producing products for use in explosive environments. The QAR is valid for three years during which repeat audits are undertaken. The test cycles are linked to the respective certification status of ISO 9001 and ISO 80079-34 certification.

IECEx Certificate of Conformity

INTERNATIONAL ELECTROTECHNICAL COMMISSION
IEC Certification Scheme for Explosive Atmospheres
for rules and details of the IECEx Scheme visit www.iecex.com

Certificate No.: IECEx EPS 19.0018X — Issue No: 0 — Certificate history: Issue No. 0 (2019-09-13)

Status: Current — Page 1 of 4

Date of Issue: 2019-09-13

Applicant: Maico Elektroapparate-Fabrik GmbH
Steinbeisstraße 20
78056 Villingen-Schwenningen
Germany

Equipment: Fans with asynchronous motors DZQ and DZS series
Optional accessory:

Type of Protection: increased safety "e"; Protection by enclosures "t", non-electrical equipment "h"

Marking:
Ex eb IIB+H_2 T4/T3 Gb
Ex h IIB+H_2 T4/T3 Gb

Ex tb IIIB T135°C/T200°C Db IP64
Ex h IIIB T135°C/T200°C Db

Approved for issue on behalf of the IECEx Certification Body: Holger Schaffer

Position: Manager certification

Signature: (for printed version)

Date: 2019-09-13

1. This certificate and schedule may only be reproduced in full.
2. This certificate is not transferable and remains the property of the issuing body.
3. The Status and authenticity of this certificate may be verified by visiting the Official IECEx Website.

Certificate issued by:
Bureau Veritas Consumer Products Services Germany GmbH
Businesspark A96
86842 Türkheim
Germany

Figure 5: Example of an IECEx equipment certificate

DCompared with ATEX, the certificate number is made up as follows:

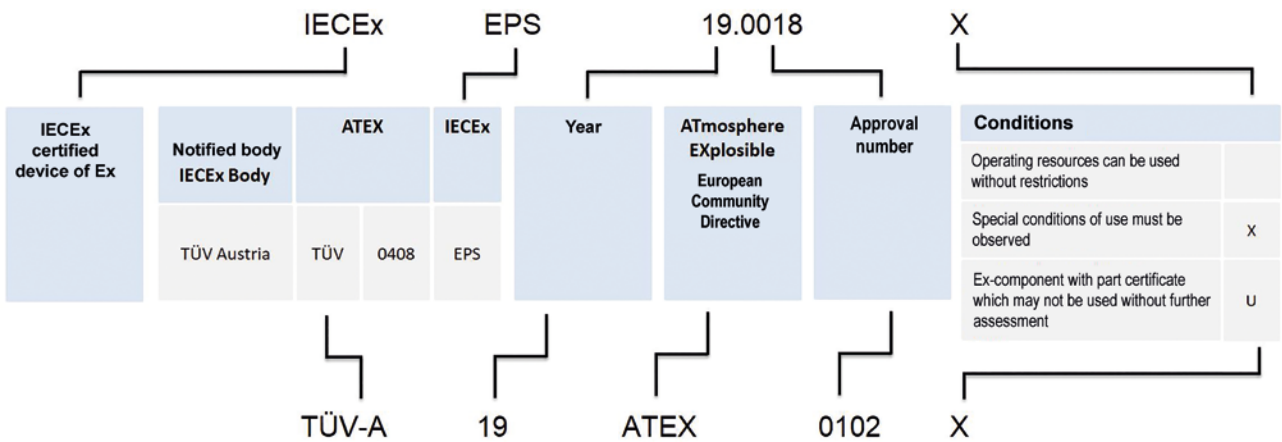


Figure 6: Example of Maico certificate number

All certificates can be viewed online at IECEx by going to www.iecex.com, from where they can also be downloaded. This can also be done via an app on Android or Apple devices.

8 Addendum / Important terms

Air extraction

Air extraction at the exit point (e.g. edge extraction on open containers) prevents explosive substances from being distributed throughout the room.

Combustible materials

Combustible materials are all substances, which are classified as flammable or highly flammable. These may be gases, liquids and dusts of combustible solids.

Detonation

Detonation is an explosion under optimum conditions. The resultant pressure wave propagates in the supersonic range.

Explosion

An explosion is a sudden oxidation reaction occurring with a sudden increase in temperature, pressure or both at the same time. An explosion produces pressure waves with high excess pressure.

Explosive atmosphere

A mixture of air or oxygen with combustible gases, vapours, mist or dusts under atmospheric conditions. Should this catch fire, the combustion spreads to the entire unburnt mix.

Potentially explosive area

A place where an explosive atmosphere may occur.

Explosion protection document

Whenever an explosive atmosphere is reasonably likely to occur, an explosion protection document must be produced. This should provide an overview of the results of the evaluation of the danger and the resulting technical and organisational protective measures for a system.

Flash point

Lowest temperature at which an immediately flammable gas or vapour/air mix forms above a liquid under prescribed normal conditions.

Device group

Electrical equipment for use in potentially explosive atmospheres are split into 2 groups:

- Group 1: Electrical equipment intended for use underground in areas at risk of mine gas (not included in MAICO's product range).
- Group II: Electrical equipment in all other potentially explosive areas.

Device category

Depending on risk, electrical equipment of device group II is split into three device categories.

For gases, these are

- Category 1G, (1)G offering adequate safety in the event of infrequent errors
- Category 2G, (2)G offering adequate safety in the event of foreseeable errors
- Category 3G, (3)G offering adequate safety in normal operation

For dusts, these are

- Category 1D, (1)D offering adequate safety in the event of infrequent errors
- Category 2D, (2)D offering adequate safety in the event of foreseeable errors
- Category 3D, (3)D offering adequate safety in normal operation

Limit of the explosion area

An explosion can only occur if the concentration of combustible material is between the upper and lower limit of the explosion area. So an explosive atmosphere may form inside a partially filled fuel tank, for example, while a full fuel tank is not hazardous.

Primary explosion protection measures

Prevent the formation and spread of an explosive atmosphere (e.g. ventilation, inertisation, concentration monitoring with shutdown).

Cross-ventilation

Supply and exhaust air openings are fitted at opposite ends of the ventilated room. The air then flows through the room before being extracted.

Secondary explosion protection measures

Prevent sources of ignition from having any effect: Explosion protection for electrical and non-electrical equipment with measures to protect against ignition.

Temperature classes

Explosive gases can be split into temperature classes on the basis of their ignition temperatures. The maximum surface temperature of equipment (for fans: the motor) must always be lower than the ignition temperature of the explosive atmosphere in which it is used.

Tertiary explosion protection measures

Restrict the impact of an explosion to a safe extent, e.g. using explosion-proof construction, release of pressure, suppression of explosion.

Dilution ventilation

By distributing in the air, the concentration of combustible material is reduced such that it falls below the lower limit of explosion. The lower limit of explosion (UEG) and the upper limit of explosion (OEG) are the lower and upper limits for the concentration of a combustible material in a mix of gases, vapours, mist or dusts, within which a flame can no longer transmit itself independently of the source of ignition once ignited (EN 1127-1).

9 Sources

- Heinz Olenik – Elektroinstallation und Betriebsmittel in explosionsgefährdeten Bereichen (Electrical installation and equipment in areas subject to explosion)
- R. Stahl – Grundlagen Explosionsschutz (Principles of explosion protection)
- https://www.iecex.com/
- https://www.iec.ch/dyn/www/f?p=103:63
- https://www.chemie.de/lexikon/Flammpunkt.html

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Miscellaneous

- © STAHL publication ESSENTIAL EXPLOSION PROTECTION p. 17
- https://www.iec.ch/dyn/www/f?p=103:63, p. 33
- https://www.iecex.com/information/about-iecex/, p. 33–36

Information relating to the practical guide to explosion protection

- Misprints, errors and technical changes are reserved.
-
- We reserve the right to make modifications in line with our policies of continuous improvement.

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