GENERAL INDUSTRY SEGMENT

ATEX

BE › THINK › INNOVATE ›

GRUNDFOS

ATEX

What is ATEX

ATEX (ATmosphère EXplosible) refers to two new EU directives about danger of explosion within different areas. The first ATEX directive (94/9/EC) deals with requirements put on equipment for use in areas with danger of explosion. And is the norm that Grundfos is producing there products in accordance with. The manufacturer has to fulfil the requirements and mark his products with categories. The second ATEX directive (99/92/EC) deals with the minimum safety and health requirements that the owner of the equipment has to fulfil, when working in areas with danger of explosion.

On of the points mentioned in the ATEX directive telling what equipment the directive deals with says the following.

- Electrical, mechanical, hydraulic and pneumatic equipment including pumps and electric motors.

Zones and explosive atmosphere

An explosive atmosphere is an atmosphere that develops explosively because an uncontrollable combustion. Explosive atmosphere consists of air and some sort of combustible material such as gas, vapours, mists or dust in which the explosion spreads after ignition. So the liquid being pumped has nothing to do with ATEX. Typical examples of productions where combustible dust is of major concern, is the handling of cereals, animal feed, paper, wood, chemicals, plastics and coal.

How an explosive atmosphere is divided into zones

The ATEX directive 99/92/EC distinguishes between two types of explosive atmospheres: gas and dust. Areas subjected to these two kinds of explosive atmospheres are each divided into three zones. The zone's characteristics are identical for gas and dust, but their numbering is different. Zones 0, 1, 2 refer to gas and zones 20, 21, 22 refer to dust.

Zone 0 / 20: Constant danger
Permanent presence of explosive gasses or combustible dust. Minimum category 1 equipment. **Grundfos dos not have any category 1 equipment.**

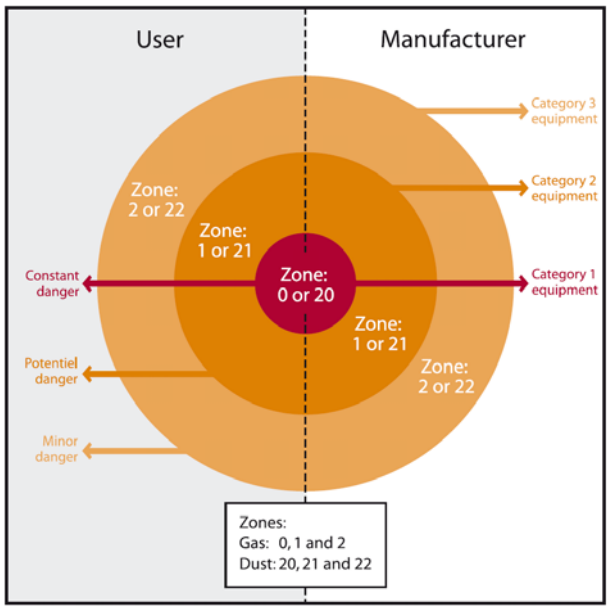
Zone 1 / 21: Potential danger
Occasional presence of explosive gasses or combustible dust during normal duty. Minimum category 2 equipment.

Zone 2 / 22: Minor danger
Presence of explosive gasses or combustible dust not likely to occur or only for a shorter period of time. Minimum category 3 equipment.

Grundfos manufactures pumps, with motors in both category 2 and category 3. The illustration on your right shows the division of an area into zones with different levels of danger of explosion. For each of the three zones it is only a certain category of equipment – in this case motors – that can be used due to danger of explosion.

The owner of the equipment is responsible for defining whether an area is to be considered hazardous within the regulations stated in the ATEX directive. However, if the user has any doubts about the definition of hazardous areas, he has to contact the proper authorities for advice.

In Denmark the proper authority is the local Emergency Management Agency.
The link between zones and equipment categories, is a minimum requirement. If the national rules are more strict, they are the ones to follow



The link between zones and equipment categories, is a minimum requirement. If the national rules are more strict, they are the ones to follow

Who is responsible of what?

Depending on whether you are the equipment manufacturer, owner or service engineer there are certain safety requirements that you have to fulfil.

The manufacturer

As manufacturer Grundfos is exclusively responsible for producing equipment that meets the requirements stated in the EU directive (ATEX directive (94/9/EC)).

The user

The equipment owner has to inform Grundfos of what kind of equipment he needs, as to:

- Category, e.g. 2G
- Temperature, e.g. 125°C
- Type of motor protection, e.g. EExe II T3

In addition, the equipment owner has to use the product according to the defined zones and there by take any possible risks into account. Likewise, the equipment owner is responsible for ensuring that the equipment runs safely through continuous maintenance. As per 1 July 2003, new installations must meet the requirements stated in the ATEX directive. If the equipment owner is also the manufacturer, the owner has to fulfil the requirements for both. Already existing installations have to comply with the requirements in the ATEX directive 99/92/EC by the latest on the 30rd june 2006.

Pumps.

In Grundfos the following products has been approved to use in ATEX areas.

- CR-CRI-CRN-CRT
- NB-NBG/NK-NKG
- TP
- MTR
- Some off the wastewater pumps.

The right motor for areas with non-conductive dust.

When the area has been divided into zones, it is time to move a step further and decide which pump or motor to install in that specific area. Depending on the zone classification, certain rules have to be respected:

If an area is classified as zone 20, (area with constant
danger of explosion) it excludes any use of pumps or motors. If the area is classified as zone 21, (area with potential danger of explosion) the motor has to be approved by a notified body before it is installed. The motor manufacturer is responsible for having his prototype approved by the notified body for use in specific areas. If the area is classified as a zone 22 area, (area with minor danger of explosion) any motor that is dust ignition proofed by the manufacturer, can be use unless conductive dust is present.

When deciding which motor to use in an explosion risk area, it is important to take dust's ignition temperature into account in order to avoid explosion.
• The ignition temperature for a **cloud of dust** has to be at least **1/3 higher** than the **motor's marking temperature**.
• The ignition temperature of a **5 mm layer** of dust has to be **minimum 75°C higher** than the motor's **marking temperature** (see previous page).

It is exclusively the user's responsibility to see to it that the layer of dust does not exceed the 5 mm, through regular maintenance.
Ignition temperatures for different types of dust are available in reference tables like the one shown on your right.

$X^\circ = Y^\circ + 75^\circ C$

X °C = Ignition temperature for a 5 mm dust layer

Y °C = Motor surface temperature, e.g. 125° C

In areas with dusty air, dust is likely to be found on the pump and the motor

$Z^\circ = Z^\circ + Y^\circ/3$

Z °C = Ignition temperature for dust cloud

Y °C= Motor surface temperature, e.g. 125°C

Ignition temperatures		
Material	Cloud	5 mm layer
Wheat	420°C	200°C
Corn	400°C	250°C
Sugar	350°C	420°C
Lignite	450°C	200°C
Sulphur	40°C	250°C

Source: BIA-report 13/97
Combustion and explosion characteristics of dust

The difference between category 2 and 3 motors for use in areas with combustible dust

Category 2
In order to avoid static electricity to cause ignition, the cooling fan on a category 2 dust ignition-proof motor for use in zone 21 (area with potential danger of explosion) is made of metal or other anti-static materials. Likewise, to minimise the risk of ignition, the external ground terminal is subject to more severe demands of construction. The temperature, which is indicated on the motor's nameplate, corresponds to the running performance during the worst conditions allowed for the motor. Motors for use in zone 21 (areas with potential danger of explosion) has to be IP6X protected, that is completely protected against dust.

	Zone 20	
Dust	Conducting	Non-conducting
Index protection	IP6X	IP6X
Product marking	II 1 D	II 1 D

Motors may not operate in zone 20.

	Zone 21	
Dust	Conducting	Non-conducting
Index protection	IP6X	IP6X
Product marking	II 2 D	II 2 D

Category 3
The temperature indicated on a category 3 dust ignition - proof motor for use in zone 22 (areas with minor danger of explosion) corresponds to the running performance under the worst conditions allowed for that specific motor. A motor for use in zone 22 has to be IP5X protected, that is protected against dust and have an external grounding terminal.

	Zone 22	
Dust	Conducting	Non-conducting
Index protection	IP6X	IP5X
Product marking	II 2D	II 3 D

How to choose the right motor or pump

You are on the lookout for a motor that can be integrated in your sugar production plant. Waste of sugar, in the shape of dust, is a natural consequence of your production. In order to create a safe working environment with no danger of explosion, you have to consider several factors when choosing motors for your pumps.

Sugar dust is a non-conducting kind of dust.

The self-inflammation temperature for sugar depends on its concentration:
- For sugar in a layer, the self-inflammation temperature is 420°C
- For sugar in a cloud, the self-inflammation temperature is 350°C

Selection of equipment

The motor's Index Protection classification, (IP) determines in what zone the motor is allowed to operate.
IP6X motors can be used in zone 21
and,
IP5X motors can be used in zone 22

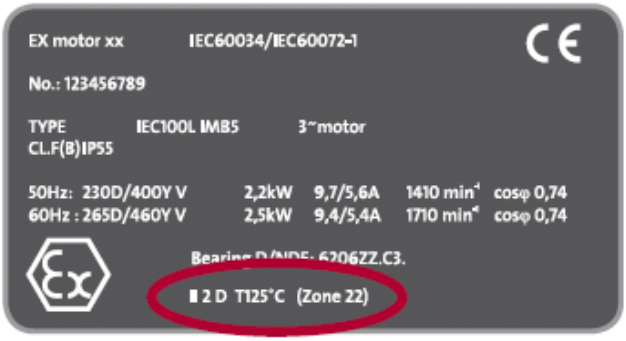
Temperature classes

When you determine the motor's temperature class, you have to take the ignition temperature for different concentrations of sugar dust into account.

- Sugar dust in a layer

The ignition temperature for a 5 mm layer of sugar dust is 420°C and as mentioned previously, its minimum ignition temperature must be 75°C higher than the motor's rated temperature. So, the maximum temperature that a layer of sugar dust can attain before it ignites is calculated in the following way:
420°C – 75°C = 345°C

The maximum product temperature is indicated on the motor's nameplate**: II 2D T125°C maximum.**



Normally, standard DIP motors are marked with 125 °C as the maximum product temperature. And as you can tell from the example above, 125°C is thus lower than the 345°C.

- Sugar dust in a cloud

The ignition temperature for sugar in a cloud of dust is 350°C, and as mentioned previously, its minimum ignition temperature must be 1/3 higher than the motor's rated temperature. So, the maximum temperature that sugar dust in a cloud can attain before it ignites, is calculated in the following way:
2/3 of 350°C = 233°C

The maximum product temperature is indicated on the motor's nameplate: **II 2D T125°C maximum.**

Normally, standard DIP motors are marked with 125°C as the maximum product temperature. And as you can tell from the example above, 125°C is thus lower than the 233°C.

If both sugar in a layer and sugar dust in a cloud is present at the same time, the temperature indication on the equipment has to correspond to the maximum surface temperature of both pump and motor. And as mentioned before, 125°C is the standard rating most motor manufactures indicates on the nameplate for DIP motors.

How to choose the right pump or motor for areas with explosive gases

When the area has been divided into zones, it is time to move a step further, and decide which motor to install in that specific area. There are certain factors to take into consideration when determining which motor to use in an explosive atmosphere.

Typical gas hazard	Gas group
Acetylene	IIC
Hydrogen	IIC
Ethylene	IIB
Propane	IIA
Methane	I (firedamp) mining IIA industrial

The content of this table only applies to EExd motors

Grouping of gases

Gases are divided into the following two explosion groups depending on which kind of industry the equipment is to operate in: Explosion group I an II.

- Explosion group I: Mines and other underground industries
- Explosion group II: Off-shore industries and industries above ground

Explosion group II is divided into 3 subgroups, II A, II B and II C. **The group only applies for EExd motors,** which corresponds to the type of gas the motor is made to withstand if an internal explosion occurs.

A gas which is classified as a group IIC gas, designates that it is the most explosive gas possible. The table at your right shows examples of different kinds of gases and their explosion group classification.

The danger of gas explosion increases from group IIA to group IIC; Depending on which group the specific gas belongs to, the requirements for pumps and motors increase accordingly. The higher the dangers of explosion, the stricter are the requirements to the equipment. Therefore, it is a requirement that electrical equipment carries a clear marking of what explosion group it belongs to. An electric motor that is approved as IIC equipment may also be used for other explosion groups – since IIC is considered the most dangerous explosion group.

Temperature classification

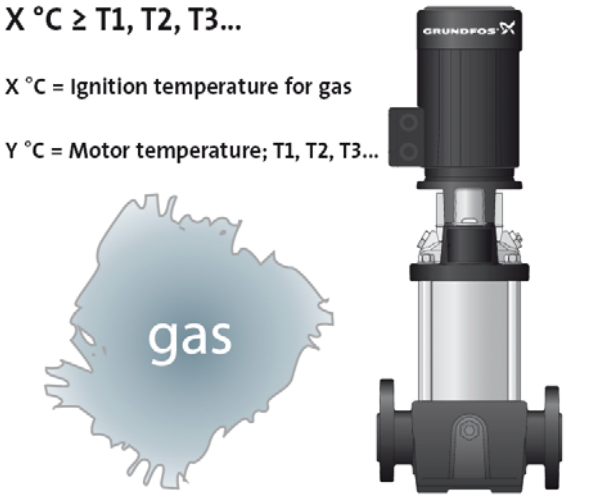
Auto-ignition temperature is the temperature at which a gas will ignite spontaneously without any other source of ignition. When hot surfaces are in contact with an explosive atmosphere, autoignition is likely to occur. The table below shows the classification, which is used to indicate the maximum surface temperature that a given piece of electrical equipment can reach when it is running normally.
Generally, the maximum surface temperature is based on a surrounding temperature of 40°C. Equipment's T-classification can be compared with the auto-ignition temperature for gases. Once the T-classification is determined, decisions concerning the equipment's use in areas with explosive atmosphere are made.

The table below shows the temperature classification for different types of gases classified according to explosion group IIA, IIB or IIC.

Regarding EExd motors the temperature classification is an expression of the maximum external temperature of the motor.

In connection with EExe and ExnA motors, the temperature classification is an expression of the temperature inside and outside the motor.

As far as dust is concerned, the most common external temperature designation is the precise temperature of the motor.



Pump and motor in areas exposed to explosive gases

Temp. class.	Maximum surface temperature C	Categorisation of gases and vapours		
		IIA	IIB	IIC
T1	450°C	Methane Ammonia		Hydrogen
T2	300°C	Butane	Ethylene	Acetylene
T3	200°C	Kerosene Cyclohexane		
T4	135°C	Acetalde-hyde	Diethyl Ether	
T5	100°C			
T6	85°C			Carbon Disulphide

Temperature classification for gases
The categories only apply to EEx d motors

Standards and methods of protection EExd, EExe and ExnA

Different techniques are used to prevent electrical equipment from becoming a source of ignition. The following table shows the concepts and standards for electrical appliances for gases, vapours and mists. In the case of electric motors, protection type d (flameproof), e (increased safety) and n (nonsparking) are applied. On the following pages, we will present the three protection types in detail.

Type of Protection	Code	Standards		Use in ATEX category/ zone	Principle	Application
		CENELEC EN	IEC 60079			
General requirements	-	50014	- 0	-	Basic electrical requirements	All equipment
Oil immersion	o	50015	- 6	Category 2 Zone 1	Electric components immersed in oil excluding explosive atmosphere from igniting	Transformers
Pressurised	p	50016	- 2	Category 2 Zone 1	Enclosure housing equipment is purged to remove explosive atmosphere and pressurised to prevent ingress of / from the surrounding atmosphere	Switching and control cabinets, large motors
Powder filled	q	50017	- 5	Category 2 Zone 1	Electric parts are surrounded with powder e.g. quartz to prevent contact with an explosive atmosphere	Electronic devices e.g. capacitors, fuses
Flameproof	d	50018	- 1	Category 2 Zone 1	Enclosure housing of electric equipment will not ignite surrounding atmosphere, if there is an internal explosion,	**AC motors**, Control Panels, light fittings
Increased safety	e	50019	-7	Category 2 Zone 1	Additional methods are used to eliminate arcs, sparks and hot surface capable of igniting flammable atmosphere	**AC motors**, terminal and connection boxes, light fittings, squirrel cage motors
Intrinsic safety	i_a i_b	50020 50020	- 11 - 11	Category 1 Zone 0 Category 2 Zone 1	Electric energy in equipment is limited so that circuits cannot ignite an atmosphere by sparking or heating	Measurement and control equipment e.g. sensors, instrumentation
Encapsulation	m	50028	- 18	Category 2 Zone 1	Electric components embedded in approved material to prevent contact with explosive atmosphere	Measurement and control devices, solenoid valves
Type of protection 'n'	nA	50021	- 15	Category 3 Zone 2	Non-arcing and non-sparking	**AC motors**, terminal boxes, light fittings
Note: Group II dust atmospheres are covered by CENELEC EN 50281-1-1 and EN50281-1-2 standards						

Flameproof motors – protection type EExd

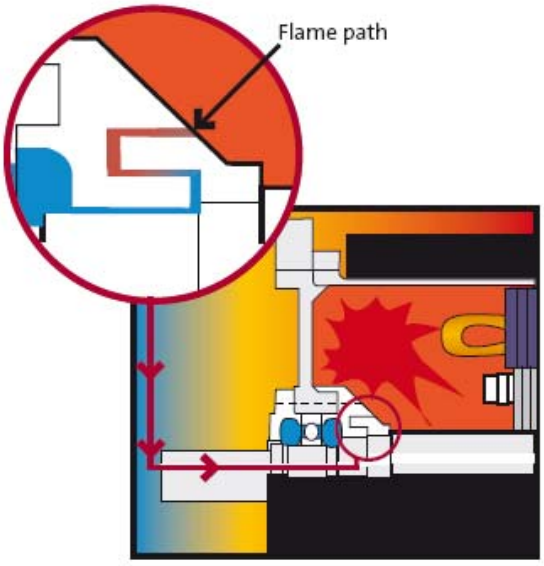
In this section, you can read about the onstruction and the characteristics of a flameproof motor. Likewise, you will find information about the kind of applications flameproof motors are installed in.

The explosion occurs inside the motor and is lead out of the motor through the flame paths. The temperature classification for flameproof EExd motors is valid for external surfaces

Construction of flameproof motors

First of all, flameproof EExd motors are category 2G equipment for use in zone 1. The stator housing and the flanges enclose the flameproof motor parts that can ignite a potentially explosive atmosphere.
Because of the enclosure, the motor can withstand the pressure resulting from an explosion of an explosive mixture inside the motor.
Propagation of the explosion to the atmosphere that surrounds the enclosure is hereby avoided because the explosion is cooled down by means of flame paths. The size of the flame paths is defined in the EN 50018 standard.

Furthermore, the temperature classification is valid for external surfaces.



Characteristics of flameproof motors

The following features are what characterize a flameproof motor.

- Flame paths
- Reinforced frame, terminal box and end shields
- Greater contact surface between motor components
- Reduced clearance between motor shaft and bearing cap to avoid transmission of sparks to the external environment
- Pressure test of all components (frames, end shields, terminal boxes, and terminal box covers)
- Compulsory third body certification by, e.g. DEMKO, PTB, KEMA or BASEEFA
- Ex approved cable entries

Typical applications for flameproof motors

The most frequent applications for flameproof motors include pumps, fans, blowers, crushers, conveyor systems, mills, cranes and other applications located in areas that require explosion proof motors.

In certain applications the motor may carry two protection types: One for the stator housing, “d” and one for the terminal box, “e”.

In this case, the motor is marked “de”. So, the only difference between a motor that is marked EExde and a motor that is marked EExd is the configuration of the terminals and the terminal box. The terminal box with increased safety terminal block prevents any source of ignition such as sparks and, excessive heating from taking place.

The main characteristics of EExde motors are:

- Terminal box components as well as connection cables must be firmly fastened (in order not to move)
- Special terminal block to avoid arcs and sparks. (increased safety terminal block)
- Double grounding must be provided (one on the stator housing and the other on the terminal box cover)

Increased safety motors - protection type EExe

In this section, you can read about the construction and the characteristics of an increased safety motor. Likewise, you will find information about what kind of applictions increased safety motors are installed in.

Construction of increased safety motors

Increased safety motors (type e) are not flameproof and not built to withstand an internal explosion.
The construction of such a motor is based on increased security against the risk of excessive temperatures and occurence of sparks and arcs during normal operation, and when one predictable error occurs. The temperature classification for increased safety motors is valid for both internal and external surfaces. Therefore it is important to observe the stator winding’s temperature.

For increased safety motors EExe, no sparks may occur. The temperature classification covers both internal and external surfaces

Characteristics of increased safety motors

The following features are what characterize an increased safety motor:

- Reduced power output versus frame size.
- Special attention to air gap concentricity and clearance of all rotating parts.
- Components subject to impact tests.
- The temperature rise has to be 10K lower than the permitted maximum for that class of insulation e.g.: ΔT = 70°C for Class B temperature rise.
- PTC (Positive Temperature Coefficient) thermistors 110°C (normal 155°C).
- Maximum surface temperature T1, T2 or T3.
- Compliance with tE characteristic (the time taken at maximum ambient temperature for stator windings to be heated up when carrying the stator current or the locked rotor current.)
- Special terminal board that ensures the specified creepage and clearance, with non-twist terminations.
- Terminal box with IP55 enclosure.
- External grounding on the frame is mandatory.
- Frame grounding must be connected with terminal box grounding.
- Drip cover must be applied on vertical applications.
- Compulsory third body certification by, e.g. DEMKO, PTB, KEMA or BASEEFA.

Time tE

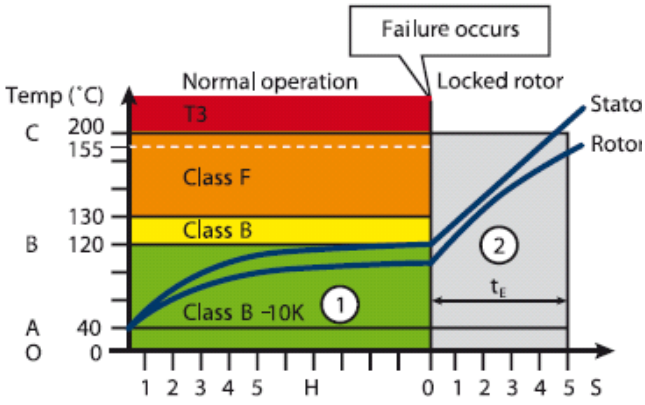
Time tE is the time it takes for the motor winding, when starting current or locked rotor current runs through it, to reach the temperature limit. The calculation of Time tE is based on the achieved temperature under normal duty and it takes the maximum ambient temperature into consideration as well.

When the rotor is locked, the motor is switched off by protection device, before time tE gets to the end.

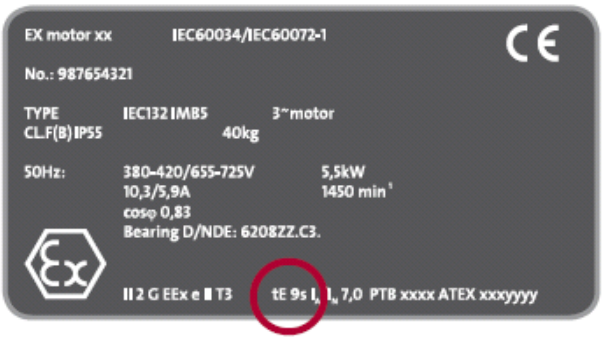
The supplier is responsible for indicating time tE on the motor's rating plate and in the data booklet.

The interval OA in the illustration represents the maximum ambient temperature, and the interval OB represents the maximum temperature the stator windings reach under normal operation. If for example the rotor locks and the temperature consequently increases, the protective device turns off the motor. This scenario is illustrated in interval 2 of the chart.

In interval 2, the motor temperature increases quickly and it has to be lower than its maximum surface temperature classification. In order to avoid an explosion, it is therefore important that the motor is put to a stop before it reaches its maximum surface temperature. If you need to know the value tE of an EEx e motor you can find it in the manufacturer's data booklet or on the motor nameplate.



Time t_E is the time it takes the motor winding to reach the maximum temperature. Time t_E is the equivalent to safe stall time or locked rotor time for standard motors



Typical applications for increased safetymotors EEx e

In areas, where a certain amount of explosive atmosphere is present, explosions can occur even when the equipment is running normally. The areas are classified as zone 1 and 2, and the equipment as explosion group II. The most common gases that can cause an explosion in these areas include: Ammonia, butane, methane, ether and hydrogen.

Non-sparking motors - protection type ExnA

In this section, you can read about the construction and the characteristics of non-sparking motors. Likewise, you will find information about what kind of applications non-sparking motors are installed in.

With non-sparking motors, no ignition is likely to occur

Construction of non-sparking motors

Non-sparking motors type nA cannot by any means ignite a potentially explosive atmosphere, under normal operation. As the name non-sparking implies, the motor is not likely to cause an ignition.
Non-sparking motors type ExnA, are category 3G equipment for use in zone 2. The construction of the ExnA motor is more or less similar to the standard IP55 motor.

Characteristics of the non-sparking motor

The following features are what characterize a non-sparking motor:

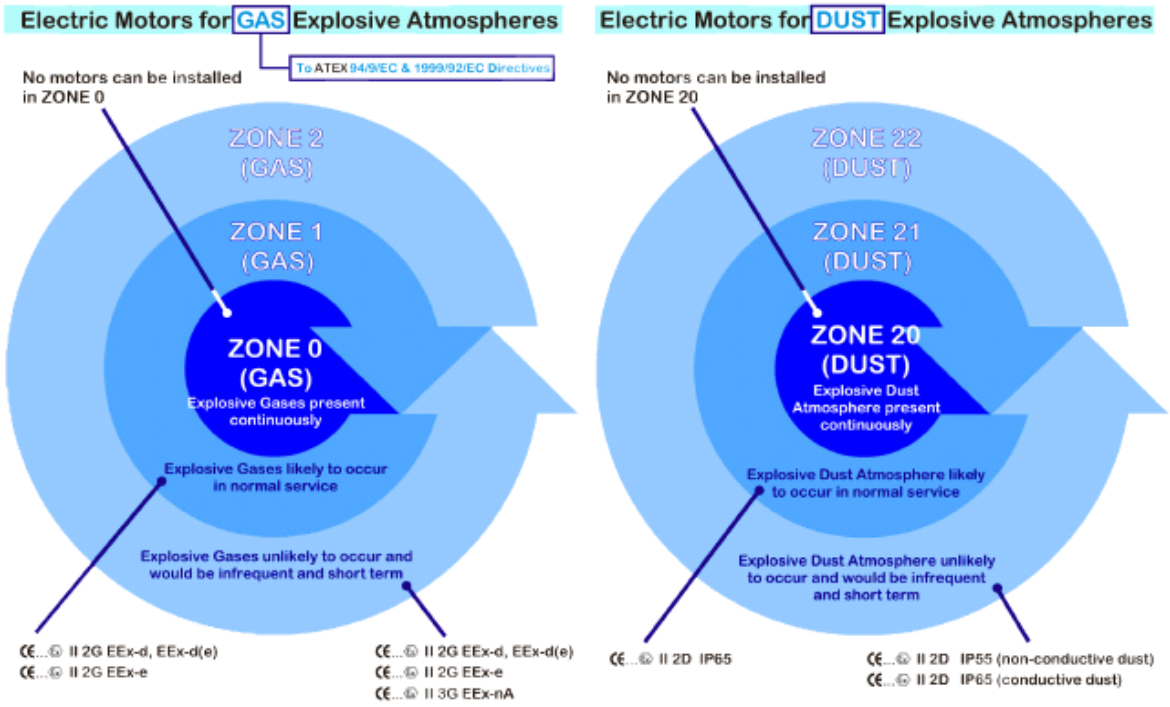
- Special attention to air gap concentricity and clearance of all rotating parts
- Components subject to impact test
- Permissible internal or external surface temperature classification, T3,T2, T1
- Minimum IP54
- Manufactures can without consulting any authorities declare their motors as ExnA protected motors

Some of the above features are similar to the increased safety motor, type e, except that the standard output is obtained from the motor without any derating and any tE monotoring. Because these motors are used in areas classified as zone 2, internal and external surfaces are always limited to temperature classification T3,T2, T1, except during start-up.

Typical applications for non-sparking motors

The areas are classified as Zone 2, Non-sparking motors are typically used in environments where an explosive atmosphere will probably not be present under normal operation. The most common gases that can cause an explosion in this area are: Ammonia, butane, methane, ether and hydrogen.

Overview of motor selection



Hazardous Area Motor Markings

Equipment Category			
G - gas symbol		D - dust symbol	
Category 1	Zone 0	Category 1	Zone 20
Category 2	Zone 1	Category 2	Zone 21
Category 3	Zone 2	Category 3	Zone 22

CE 123 Ex II 2G EEx de IIC T1 *to* T4

- CE
- 123 — Notified Body (Testing Authority) Identification number
- Ex — Specific marking of explosive protection
- II — Equipment Group: I - Mining Application; II - Non-mining Application
- 2G — Equipment Category
- EEx — E - European Certification; Ex - Explosion protection
- de — d - Flameproof to EN 50018; e - Increased safety to EN 50019; nA - Non-sparking to EN 50021; de - Flameproof motor with Increased safety Terminal box EN 50018&19
- IIC — Flameproof Symbol / Gas/ Vapour

Flameproof Symbol	Gas/ Vapour
A	Propane,etc
B	Ethylene,etc
C	Hydrogen,etc

- T1 *to* T4 — Temp Class / Max Surface Temp

Temp Class	Max Surface Temp
T1	450°C
T2	300°C
T3	200°C
T4	135°C
T5	100°C
T6	85°C

CE Marking			
LVD	Low Voltage Directive	73/23/EEC 93/68/EEC	Electrical Equipment 50 - 1000 V AC
EMC	Electromagnetic Compatibility	93/68/EEC 89/336/EEC 92/31/EEC	EN 55081 Parts 1&2 Emissions EN 55082 Parts 1&2 Immunity
MD	Machinery Directive	various	Not applicable to electric motors as they are components
ATEX	ATEX Directive	94/9/EC	Hazardous area equipment

What Grundfos can offer

1. CR-CRI-CRN-CRT

5. Scope of ATEX categories for CR pumps

Directive	ATEX-approved CR pumps							
94/9/EC	Group I		Group II					
	Category M		Category 1		Category 2		Category 3	
	1	2	G	D	G	D	G	D
1999/92/EC [2]			Zone 0	Zone 20	Zone 1	Zone 21	Zone 2	Zone 22
CR pumps	None	CR CRI CRN	None	None	CR CRI CRN CRT [1]	CR CRI CRN CRT	CR CRI CRN CRT	CR CRI CRN CRT
Motors	None	None	None	None	2G EEx e T3 2G EEx d T4	2D 125 °C	2G EEx e T3 2G EEx d T4	3D 125 °C

1) For II 2 G, the pump must be protected against dry running. Use one of the following methods:

- An ATEX-approved dry-running protection. Always use this protection on pumps with MAGdrive or pumps with a single mechanical shaft seal.
- Pumps with double-seal system (back-to-back or tandem). The system for pressurising or flushing the double-seal system must be ATEX-approved.

Make sure that the combination of "CR pump" and "dry-running protection" is described in the Explosion Protection Document according to the 1999/92/EC Directive.

The responsibility for checking the functions of the dry-running protection, such as correct flow, correct sealing pressure and temperature of the flushing liquid rests with the installer/owner.

2) **Important:** The link between groups, categories and zones is explained in the 1999/92/EC directive. Please note that this is a minimum directive. Some EEC countries may therefore have stricter local rules. The user or installer is always responsible for checking that the group and category of the pump correspond to the zone classification of the installation site.

2. NB-NBG / TP

3. Scope of ATEX categories for NB, NBG, TP, TPD pumps

Directive	ATEX-approved NB, NBG, TP, TPD pumps							
94/9/EC	Group I		Group II					
	Category M		Category 1		Category 2		Category 3	
	1	2	G	D	G[2]	D	G	D
1999/92/EC [1]			Zone 0	Zone 20	Zone 1	Zone 21	Zone 2	Zone 22
NB, NBG, TP, TPD pumps	None	None	None	None	NB, NBG, TP, TPD pumps	None	NB, NBG, TP, TPD pumps	NB, NBG, TP, TPD pumps

1) **Important:** The link between groups, categories and zones is explained in 1999/92/EC. Please note that this is a minimum directive. Some EU countries might therefore have stricter local rules. The user or installer is always responsible for checking that the group and category of the pump correspond to the zone classification of the installation site.

2) **Note:** The risk assessment done by Grundfos on the NB, NBG, TP, TPD pumps for category 3 G shows that the pump can be upgraded to category 2 G by installing an ATEX-approved dry-running protection.The dry-running protection must stop the pump if the minimum flow rate cannot be maintained. Always check that the motor is marked for category 2 G. Make sure that the combination of "NB, NBG, TP, TPD" and "dry-running protection" is described in the Explosion Protection Document according to the directive 1999/92/EC.
The responsibility rests with the installer/owner.
In case of doubt, please contact the local authorities.

3. NK-NKG

3. Scope of ATEX categories for NK, NKG pumps

Directive	ATEX-approved NK, NKG pumps							
94/9/EC	Group I		Group II					
	Category M		Category 1		Category 2		Category 3	
	1	2	G	D	G	D	G[2)]	D
1999/92/EC [1)]			Zone 0	Zone 20	Zone 1	Zone 21	Zone 2	Zone 22
NK, NKG pumps	None	None	None	None	None	None	NK, NKG pumps	NK, NKG pumps
Motors	None	None	None	None	None	None	VEM EExnA 3G T3	VEM EEx 3D 125°C

1) **Important:** The link between groups, categories and zones is explained in 1999/92/EC. Please note that this is a minimum directive. Some EU countries might therefore have stricter local rules. The user or installer is always responsible for checking that the group and category of the pump correspond to the zone classification of the installation site.

2) **Note:** The risk assessment done by Grundfos on the NK, NKG pump for category 3 G shows that the pump can be upgraded to category 2 G by installing an ATEX-approved dry-running protection.The dry-running protection must stop the pump if the minimum flow rate cannot be maintained. Always check that the motor is marked for category 2 G. Make sure that the combination of “NK, NKG” and “dry-running protection” is described in the Explosion Protection Document according to the directive 1999/92/EC.
The responsibility rests with the installer/owner.
In case of doubt, please contact the local authorities.

4. MTR

3. Scope of ATEX categories for MTR pumps

Directive	ATEX-approved MTR pumps							
94/9/EC	Group I		Group II					
	Category M		Category 1		Category 2		Category 3	
	1	2	G	D	G	D	G[2)]	D
1999/92/EC [1)]			Zone 0	Zone 20	Zone 1	Zone 21	Zone 2	Zone 22
MTR pumps	None	None	None	None	None	MTR	MTR	MTR
Motors	None	None	None	None	None	VEM 2D 125°C	VEM 2G EEx e T3 ATB 2G EEx d T4	VEM 3D 125°C

1. **Important:** The link between groups, categories and zones is explained in 1999/92/EC. Please note that this is a minimum directive. Some EU countries might therefore have stricter local rules. The user or installer is always responsible for checking that the group and category of the pump correspond to the zone classification of the installation site.

2. **Note:** The risk assessment done by Grundfos on the MTR pump for category 3 G shows that the pump can be upgraded to category 2 G by installing an ATEX-approved dry-running protection.
The dry-running protection **must** stop the pump if the liquid supply ceases.
Always check that the motor is marked for category 2 G.
Make sure that the combination of "MTR pump" and "dry-running protection" is described in the Explosion Protection Document according to the directive 1999/92/EC. The responsibility rests with the installer/owner.

Details on nameplate

On the nameplate on the pumps it is written if the pump is ATEX approved. Underneath here there is showed an example from an CR pump

The nameplate on the pump head gives the following details:

- data of standard pump
- data of ATEX marking
  - technical file number
  - serial number
  - Ex category.

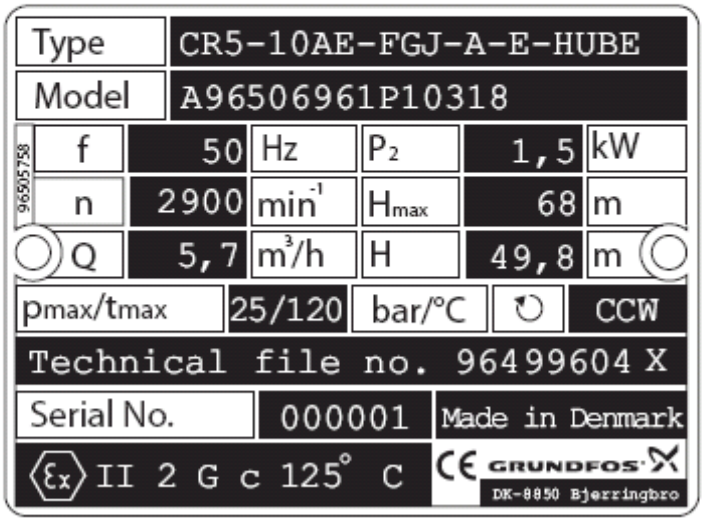


Fig. 1 Example of CR nameplate with ATEX approval

In the technical file no. the X in the end, indicates that the customer is responsible of making some documentation before the pump live up to the ATEX classification stamped on the nameplate. See point 1 underneath the CR table in what Grundfos can offer.

Service and maintenance.

To ensure that the electric motor always provides maximum protection and delivers a high performance, it is important to carry out regular service and maintenance. However, in most cases only authorised personnel is allowed to carry out service and maintenance. Regulations concerning service and maintenance vary according to the country in which the motor is to operate. Therefore, you have to follow the specific rules that apply for explosion proof motors in your country.

On the following page, we have listed some general Danish rules you need to be aware of when you carry out service and maintenance on explosion-proof motors. But again, we need to stress that rules concerning service and maintenance are placed under local legislation and that you need to consult them, to be sure that you take the necessary precautions when you deal with explosion-proof motors.

- Repair of explosion-proof motors has to be carried out by the manufacturer himself. Further, the motor manufacturer has the possibility to assign the repair work to other authorised companies, even across national borders.
- Control and test of repaired motors.
- It is only possible to replace motor parts if it does not affect the motor's protection type or the motor's maximum temperature. If motor parts are replaced, the motor has to be tested before it is put into operation again.
- If it is possible to disconnect the motor during repair, any qualified company can carry out the service as long as it does not affect the explosion protection of the motor.
- When the motor has undergone repair that may have an impact on the motor's protection type, the motor has to go through a new unit control and unit test.

Now that we have presented some general guidelines in connection with repair of explosion-proof motors, it is time to move a step further. What follows are some examples of repair work on original parts, which **does not** affect the motor protection type and thus can be carried out by any qualified company.

- Replacement of damaged cable entries
- Replacement of external fastening equipment such as bolts and screws
- Replacement of thermal relay
- Replacement of bearings and cooling fans
- Welding of cracked motor foot, (if it is not a part of the enclosure)
- Replacement of damaged gaskets

Now that we know what kind of repair work that does not affect the motor's protection type, let us have a look at the type of repair work that **does affect** the motor's protection type, and thus requires authorised personnel:

Whenever it is necessary to carry out repair work that might affect the motor's explosion

- Drilling of holes in EEx d motor enclosure, flanges, stator housing etc.
- Machining, grinding, painting etc. of flame paths on EEx d motors.
- Replacement of components in EEx d motors by unoriginal components, i.e. self-made flanges.
- Fitting of additional terminals in EEx e terminal box if the terminals are not mentioned in the certificate. Only applies for EEx d motors.
- Rewinding of EEx e motors.
- Replacement of factory-mounted connections between EEx d stator housing and EEx e terminal box by EEx de motors.

proofness, an expert has to approve the repair. However, if the expert cannot give his approval of the repair work, the motor must not be reconnected to the pump.

Having presented what kind of repair work authorised or qualified personnel may carry out on explosion-proof motors, let us have a look at the type of repair the user is allowed to carry out himself on EExe and EExd motors.

• Repair of external parts, which do not affect the motor's protection type

Should it be necessary to open the motor, you need to follow the local rules in your country. In connection with EExd motors this is especially important because the dismantling and the assembly of the motor might affect the flame paths.
We recommend keeping a log concerning the repair work that has been carried out and the components that have been replaced on each Ex motor.
If there is any doubt about whether the repair work will affect or might affect the protection type of the equipment, the repair always has to be carried out by qualified personnel.