



**Explosion-Proof Drives
in Accordance with EU Directive 94/9/EC**

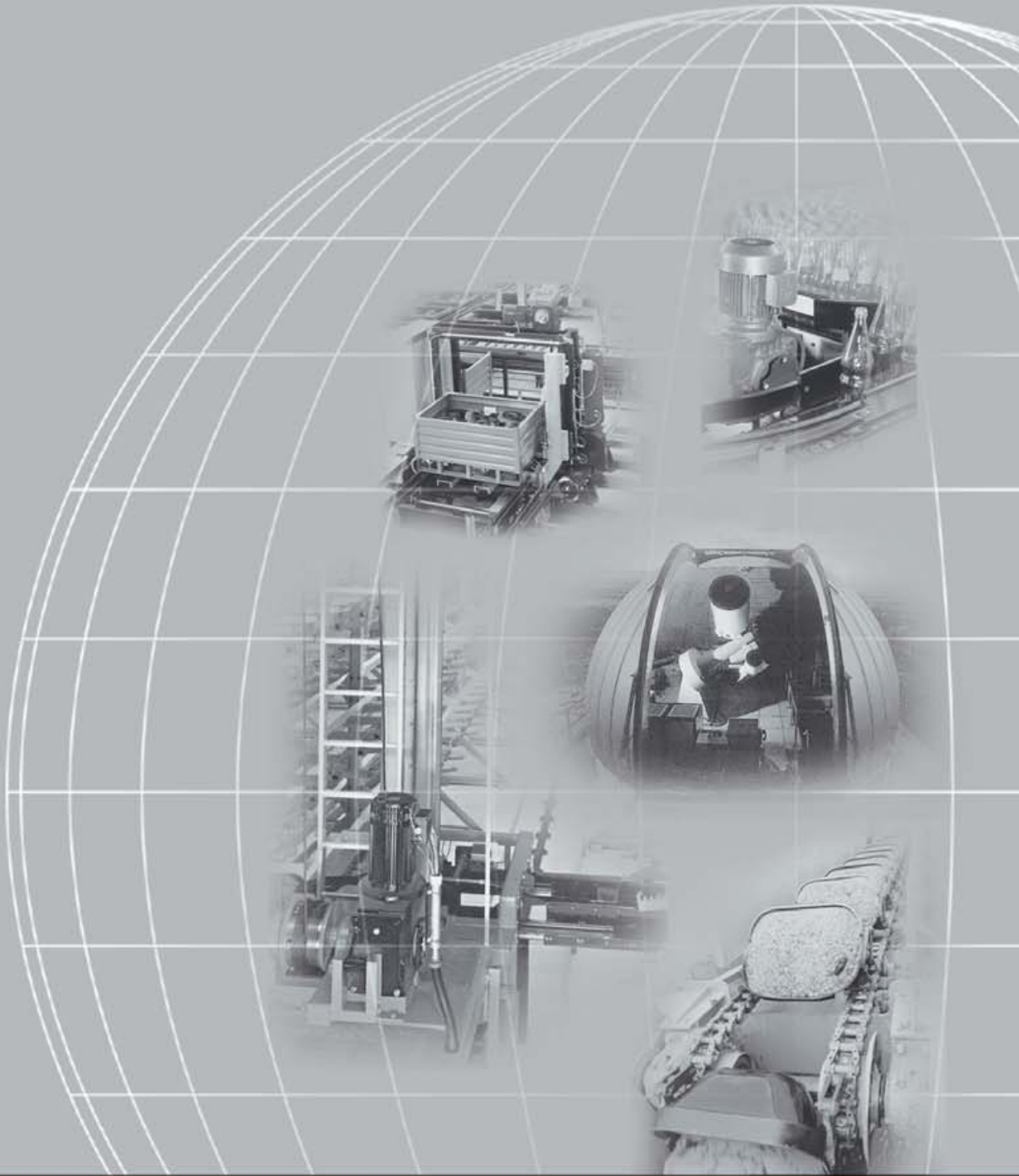
Edition

02/2003



System Description

1056 0416 / EN



SEW-EURODRIVE





1 Introduction

Why Explosion Protection?

Explosion protection for electrical and mechanical machinery is an important precaution to safeguard people and all kinds of production, storage, and distribution equipment whenever potentially explosive mixtures of combustible gases and dust and air may occur.

What does explosion protection achieve?

Explosion protection can mean preventing an explosive mixture from ever occurring at all. Explosion protection can also be achieved by precluding possible sources of combustion in advance, e.g. high temperatures and sparking, through designing components accordingly and by having constant monitoring in operation. Alternatively, the source of combustion can be made flameproof in order to protect the surrounding area against the possible effects of an internal explosion.

The pressurized enclosure method involving a permanent supply of fresh air or inert gas from areas outside the potentially explosive atmosphere is common, particularly in large drives.

The drives in question should continue to operate even if dangerous mixtures occur, and should not be switched off.

Harmonized European design provisions

The EU directive 94/9/EC (ATEX¹⁾ 100a) lays down minimum requirements for explosion-proof equipment within the European Union. In relation to drives, it deals with motors as well as other electrical and mechanical components such as gear units, mechanical variable speed gear units, brakes, forced cooling fans, integrated frequency inverters, sensors, actuators, etc.

The 94/9/EC directive defines the minimum requirements for units and divides the units into categories.

The requirements for production facilities, division into zones and the assignment of equipment categories to zones are dealt with in the EU directive 1999/92/EC (ATEX 137).

Explosion-Proof drives by SEW-EURODRIVE

Drives by SEW-EURODRIVE for operation in potentially explosive atmospheres are characterized by:

- Inclusion of all product areas from mains-operated AC geared motors and MOVIMOT[®] geared motors with integrated frequency inverters through to controlled drives for particularly exacting applications.
- All components can be combined with one another in accordance with the rules of the modular concept of SEW-EURODRIVE.
- All drives satisfy typical market requirements in terms of their power range and functions.

1) Atmosphères Explosibles



2 Concept of Protection

2.1 Explosion protection in accordance with the EU directive 94/9/EC

The EU directive 94/9/EC defines the minimum requirements for equipment and protective systems for use in potentially explosive atmospheres. According to 94/9/EC, equipment is divided into equipment groups, categories and types of protection.

Equipment group I Group I equipment is intended for use in mining applications and is divided into categories M1 and M2.

Equipment group II Group II equipment is intended for use in potentially explosive atmospheres other than mines and is designed in categories 1, 2, and 3. The category indicates the degree of protection of the equipment as well as permitted operating temperatures. In addition, equipment must be identified for use in areas

- with explosive gas-air mixtures with the letter **G** (gas)
- with explosive dust-air mixtures with the letter **D** (dust).

Category 1 – Particularly high safety

Category 1 equipment must continue to operate in the event of rare unit malfunctions. If one protective measure fails, there must be at least a second protective measure to prevent a possible source of ignition.

This means the equipment must still be safe with two independent faults.

Electrical drives cannot be designed in category 1. They cannot be used in zones 0 and 20.

Category 2 – High safety

Protective measures against explosions for category 2 equipment ensure the necessary degree of safety even in case of frequent unit malfunctions or frequently anticipated malfunctions.

This safety is ensured in areas with

- explosive dust-air mixtures by preventing dust from getting into contact with excessively hot surfaces (unit designation 2D)
- explosive gas-air mixtures through protection types (unit designation 2G).

Category 2 equipment is predominantly designed for zone 1 or 21. Of course, it can also be used for zone 2 / 22.

Motors

Typical electrical drives of the II2G type for zone 1 are motors with the following protection types.

Protection type d – flameproof enclosure

Even if an explosion occurs inside the motor, the housing is able to withstand the pressure. Any gas which may possibly escape is sufficiently cooled so it will not ignite a potentially explosive atmosphere outside the motor.

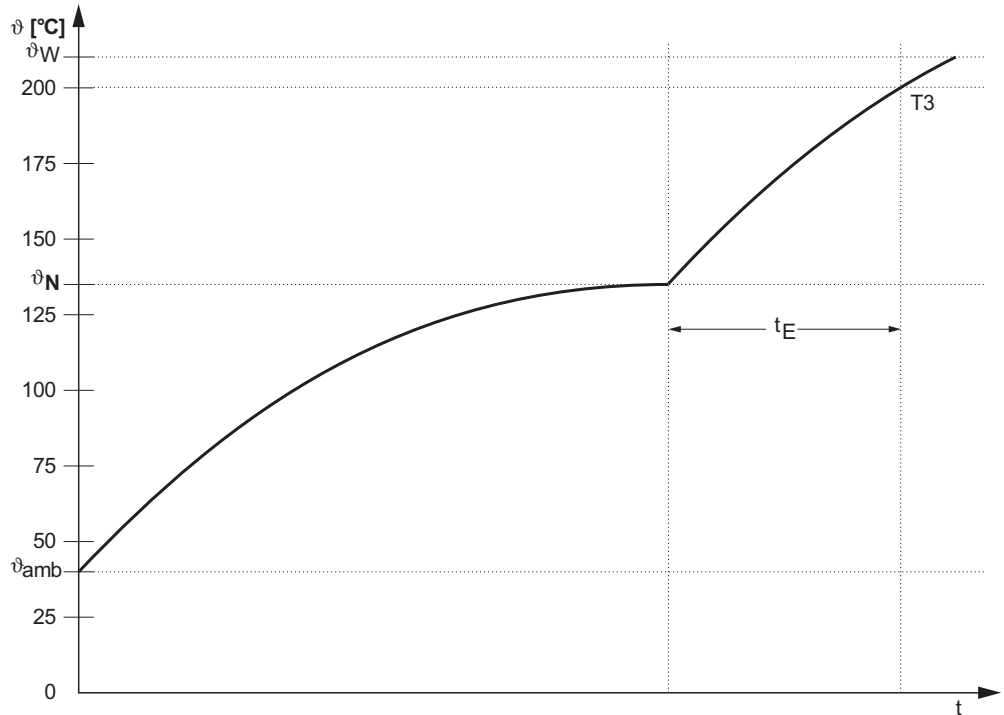
The units have ignition gaps in order to dissipate the pressure arising from an explosion. These ignition gaps must be designed in such a way that escaping hot gases are sufficiently cooled by the time they escape to prevent that a potentially explosive atmosphere can be ignited.



Protection type e – increased safety

There is no source of ignition in normal operation and given expected malfunctions. This is achieved by design measures such as higher quality insulation systems or larger clearances. Normal operation is referred to as operation with the usual unit malfunctions.

As an example, the following figure shows the temperature characteristic of a motor with blocked shaft. During the heating time t_E , the temperature rises from the nominal operating temperature ϑ_N to the maximum permissible surface temperature $T3 = 200\text{ °C}$.



- ϑ_W = maximum permissible winding temperature
- ϑ_N = steady-state temperature of the motor in operation without malfunctions
- ϑ_{amb} = ambient temperature

The special protective circuit breaker switches off the motor within the motor's heating time t_E if a malfunction occurs. This ensures that the critical temperature (here, temperature class T3) is not reached.

Gear units

The following protection types apply to gear units:

Protection type c – design safety

In the case of protection type c, a risk analysis should be performed to demonstrate that no source of ignition can arise due to gear unit fault which can be expected.

Protection type k – liquid immersion

In the case of protection type k, a procedure must be followed to ensure that the source of ignition is in a bath of fluid (e.g. oil) or is wet by liquid at all times.

Category 3 – Normal safety

Units in category 3 are only intended for zone 2 or 22 where there is a low probability of potentially explosive mixtures occurring.

The units must be designed in such a way that there is no source of ignition in normal operation.

**Motors**

nA is a typical protection type for motors:

Protection type nA

Typical electrical drives of the II3G type for zone 2 (gas) are motors with protection type nA – non-sparking. The requirements of protection type nA largely correspond to the requirements of protection type e for operation without malfunctions.

Gear units

Compliance with EN 13463-1 must be ensured for gear units.

In this category, there is no requirement for gear units to be of a particular protection type.

2.2 Explosion protection according to the EU directive 1999/92/EC

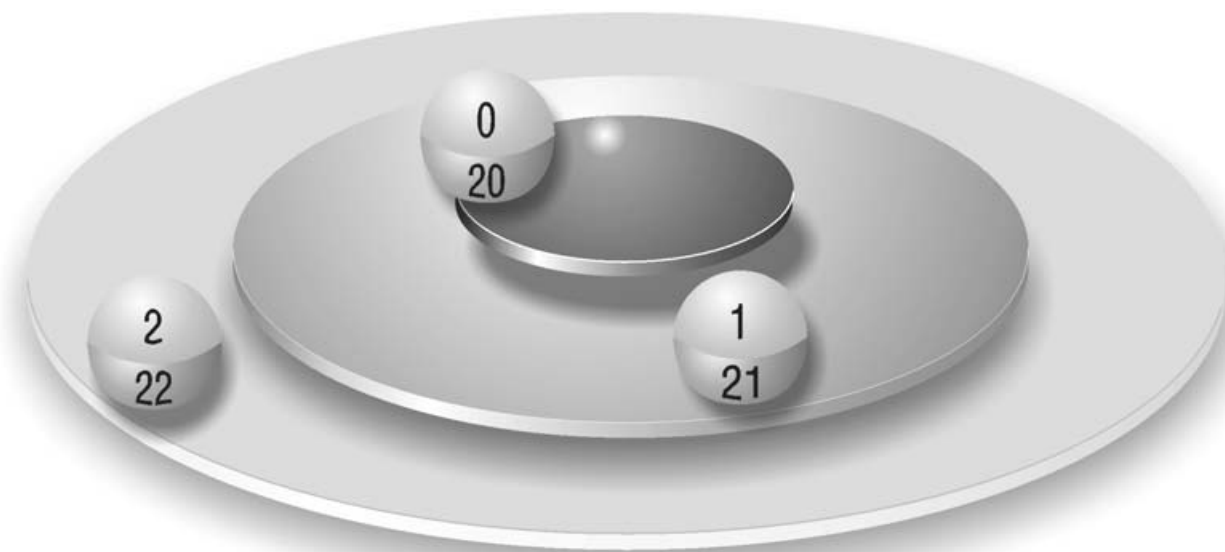
In contrast to the EU directive 94/9/EC, which defines the equipment characteristics for the manufacturer, the EU directive 1999/92/EC is directed at system operators. Besides various requirements for the installation and operation of systems, it also defines the assignment of the equipment category to the different hazardous areas (zones).

Zones

Potentially explosive atmospheres are further divided into zones. These zones relate to the predicted occurrence of when an explosive atmosphere may be present in the area.

*Zones in an
Ex-atmosphere*

Zone		Probability of a potentially explosive atmosphere occurring
Gas	Dust	
0	20	Continuous, long-term, frequent (predominant in time)
1	21	Occasional, in normal operation
2	22	Seldom, short-term



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Assignment of category - zone

The following overview shows the use of equipment of certain categories in the respective zones. Category 1G, 2G, and 3G equipment may only be used in areas with explosive gas atmospheres, category 1D, 2D, and 3D equipment may only be used in areas with explosive dust atmospheres.

The degree of hazard in the individual zones is reflected in the levels of protection of the respective category. This allows to select an adequately designed unit for each specific hazardous area protecting the user from safety inadequacies and unnecessary high costs.

Only the gray boxes (categories 2 and 3) in the following overview are relevant to drives from SEW-EURODRIVE.

Ex-atmosphere gas (G)		Ex-atmosphere dust (D)	
Category	For operation in zone	Category	For operation in zone
1G	0, 1 and 2	1D	20, 21 and 22
2G	1 and 2	2D	21 and 22 22 + combustible dust
3G	2	3D	22

2.3 Standards

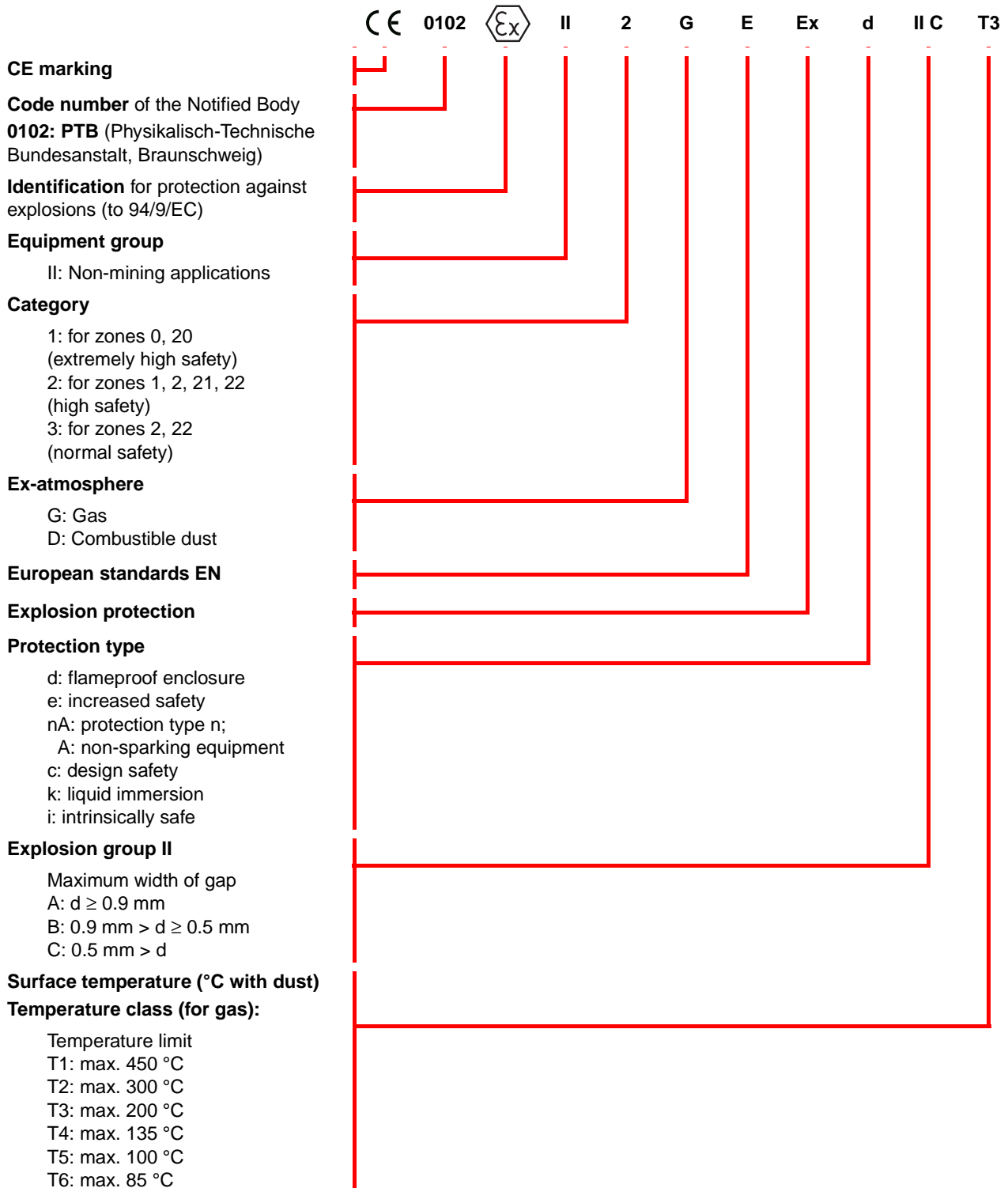
The list below contains some of the standards relating to explosion protection and concerning the design of explosion-proof drives within the field of application of CEN (Comité Européen de Normalisation) which covers all the member states of the European Union as well as Iceland and Switzerland:

Motors	Non-electrical equipment / gear units
<ul style="list-style-type: none"> EN 50014 General regulations 	<ul style="list-style-type: none"> EN 13463-1 Fundamental methods and requirements
<i>Gas atmosphere (protection types)</i> <ul style="list-style-type: none"> EN 50018 Flameproof enclosure "d" EN 50019 Increased safety "e" EN 50020 Intrinsically safe "i" EN 50021 Protection type "n" / non-sparking "nA" 	<i>Protection types for gas and dust atmospheres</i> <ul style="list-style-type: none"> EN 13463-5 Design safety "c" EN 13463-8 Liquid immersion "k"
<i>Dust atmosphere</i> <ul style="list-style-type: none"> EN 50281 	The standards for non-electrical equipment are in preparation and will become mandatory on July 1, 2003.



Identification key according to EU directive 94/9/EC

The EU directive 94/9/EC links protection types to equipment groups, categories, potentially explosive atmospheres as well as to minimum protection types and temperature classes (Example: equipment with protection type "flameproof enclosure" (d)).





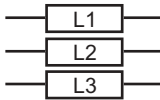
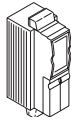
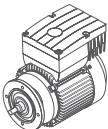
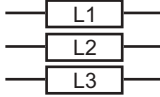
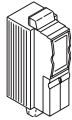
The designation IIA, IIB and IIC applies in connection with protection type "d". For all other protection types, only II is listed here.



3 Drives by SEW-EURODRIVE in Accordance with EU Directive 94/9/EC

Overview

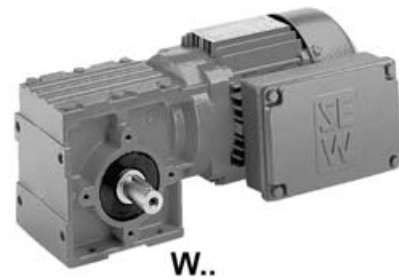
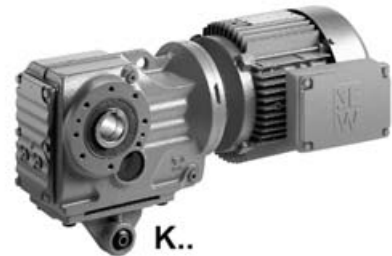
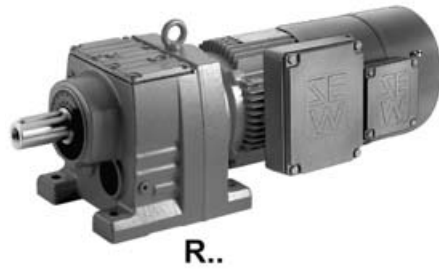
The following chart gives an overview of SEW-EURODRIVE electrical drives. Optional motor add-ons such as actual value encoders must be selected in accordance with the explosion regulations in each case.

Category	Application	Use in zone		
3	Mains operation 	2 Gas	<ul style="list-style-type: none"> Protection type "n" motors (II3GExnA) Types: DT/DV../II3G 	Gear units are always designed for use in II2G/II2D. They can also be used for applications in category II3G/II3D.
		22 Dust	<ul style="list-style-type: none"> Motors in II3D design Types: DT/DV../II3D 	
	Drive in potentially explosive atmosphere and inverter in the switch cabinet outside the potentially explosive atmosphere 	2 Gas	<ul style="list-style-type: none"> Protection type "n" motors (II3GExnA) Types: DT/DV../II3G with inverter: MOVITRAC® 31C MOVIDRIVE® MCF/MDF/MCV/MDV 	
		22 Dust	<ul style="list-style-type: none"> Motors in II3D design Types: DT/DV../II3D with inverter: MOVITRAC® MC07 MOVITRAC® 31C MOVIDRIVE® MCF/MDF/MCV/MDV 	
	Drive with integrated frequency inverter in potentially explosive atmosphere 	2 Gas		
		22 Dust	<ul style="list-style-type: none"> MOVIMOT® motors in II3D design Types: DT/DV../MM../II3D with inverter: MOVIMOT® MM03..MM30 	
2	Mains operation 	1 / 2 Gas	<ul style="list-style-type: none"> Motors in "increased safety" design (II2GExe) Types: eDT/eDV.. Motors in "flameproof enclosure" design (II2GExd) Types: CD/BD 	II2G deesign <ul style="list-style-type: none"> Gear units Variable-speed gear units
		21 / 22 Dust	<ul style="list-style-type: none"> Motors in II2D design Types: eDT/eDV../II2D 	II2D design <ul style="list-style-type: none"> Gear units Variable-speed gear units
	Drive in potentially explosive atmosphere and inverter in switch cabinet outside the potentially explosive atmosphere 	1 / 2 Gas	<ul style="list-style-type: none"> Motors in "flameproof enclosure" design (II2GExd) Types: CD/BD with inverter: MOVITRAC® MC07 MOVITRAC® MC31C MOVIDRIVE® MCF/MDF/MCV/MDV 	II2G design <ul style="list-style-type: none"> Gear units
		21 / 22 Dust		II2D design <ul style="list-style-type: none"> Gear unit



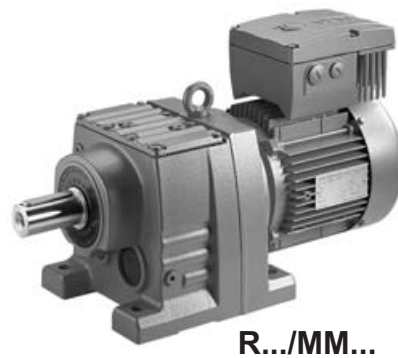
3.1 Products

Standard geared motors R / F / K / S / W



51306AXX

Drives for decentralized installation



51307AXX



AC (brake) motors



eDT/eDV...



eDT/eDV.../BC

51308AXX

3.2 Examination and certification of drives to EU directive 94/9/EC

Conformity evaluation

To assess the conformity, the manufacturer must first determine to which group and category his products belong.

This document deals exclusively with group II equipment for use in areas other than mining. As a further limitation, only categories 2 and 3 that are customary for drives are taken into account.

Category	Type	Conformity through
2	Electrical equipment (motors)	EC type examination and <ul style="list-style-type: none"> • conformity to type or • production quality assurance
	Non-electrical equipment (gear units)	Technical documentation to Notified Body and internal product verification
3	All	Internal product verification

EC type examination

Electrical equipment of category 2 which also includes motors, motors with frequency inverter and sensors of drive engineering must pass through an *EC type examination* at a *Notified Body*. If the submitted prototype meets the regulations, the Notified Body will issue an EC type examination certificate. The certificate contains the name and address of the manufacturer, result of the examination, and the information necessary to identify the approved prototype. The copy of the certificate is maintained by the Notified Body together with a list of the important technical documentation.

All Notified Bodies exchange the approved type examination certificates.

The manufacturer keeps a copy of the type examination certificates and their possible additions together with the technical documentation for at least 10 years following the production of the last unit.

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