ATEX

Safety switches for potentially explosive atmospheres

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ATEX products from EUCHNER

General information

The ATEX directive
The ATEX Directive 2014/34/EU sets the standards that are currently applicable for the preventive explosion protection design of equipment and protective systems intended for use in potentially explosive atmospheres. In April 2016, it replaced the earlier ATEX Directive 94/9/EC.

All technical equipment that is a potential ignition source can trigger an explosion under certain circumstances. In order to reduce the risk of this happening, this equipment must comply with the ATEX Directive.

Prerequisites for an explosion
The following prerequisites must be met for an explosion to occur:

- A potentially explosive mixture of
  - combustible material (gas, vapor, mist or dust)
  - oxidizing agents (oxygen)
- An ignition source (sparks, hot surfaces, etc.)

Combustible material

Air (oxygen)

Ignition source

Prevention of explosions
The most effective way of preventing an explosion is to prevent the formation of an explosive atmosphere. This type of explosion protection is called **primary explosion protection**. Primary explosion protection is not always possible. For this reason, ignition of the explosive atmosphere must be prevented. This measure is termed **secondary explosion protection**. In practice, this form of protection is achieved by using explosion protected equipment. This equipment ensures that no ignition source can be produced due to its operation in an explosive atmosphere.

Marking of equipment
Equipment intended for potentially explosive atmospheres must be marked with the Ex symbol.
The equipment must be marked accordingly on the type label.

Explosion-protection equipment is marked according to:

- Application
- Equipment properties

Marking according to application

Marking according to ATEX

Directive
Corresponds to 2014/34/EU

Equipment groups
I: Mining
II: All areas except mining

Categories

Material groups

Equipment categories
(includes category and material group)

	Category 1 Very high safety level		Category 2 High safety level		Category 3 Normal safety level	
Material groups **G: gases, D: dusts**	**G**	**D**	**G**	**D**	**G**	**D**
Equipment categories	**1G**	**1D**	**2G**	**2D**	**3G**	**3D**
Hazardous zones	**Zone 0**	**Zone 20**	**Zone 1**	**Zone 21**	**Zone 2**	**Zone 22**

Equipment groups
Depending on the place of use, equipment is classified into the following groups according to the ATEX directive:

- **Group I:** Equipment for use in underground mining
- **Group II:** Equipment for all other potentially explosive atmospheres.

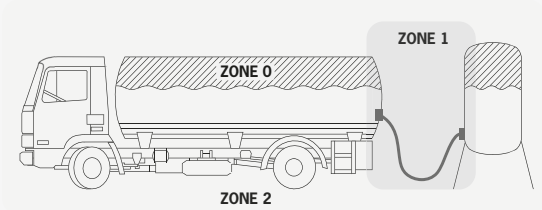
Equipment categories
The category describes the permissible application and the achieved safety level of equipment according to the ATEX directive. Equipment with equipment-related ignition sources must undergo an ignition hazard assessment to avoid potential ignition sources. This must form the basis for taking measures in accordance with the basic safety requirements to rule out the risk of ignition from this equipment.
The equipment category defines the hazardous zone in which a device (equipment) can be used.
Table 1 shows the classification and assignment of equipment categories and individual hazardous zones.

Material groups
The ATEX directive divides combustible materials into so-called material groups. A distinction is made between the following material groups:

- G (**g**ases, vapors and mists)
- D (**d**usts)

Hazardous zones
In accordance with EN IEC 60079-10-1/2, the potentially explosive applications of electrical equipment are classified into hazardous zones.

The hazardous zone defines the probability of the occurrence of an explosive atmosphere. A distinction is made between zones for combustible gases (zones 0, 1 and 2) and combustible dusts (zones 20, 21 and 22). The related zone must be defined by the machine or plant manufacturer.
The EN IEC 60079-14 standard must be taken into account for selecting the equipment and for its subsequent assembly and setup.



Example zone classification for a tank system.

EUCHNER ATEX equipment

- ATEX equipment manufactured by EUCHNER is suitable for use in zone 2 and zone 22.
- If cable glands are used on equipment for zone 2/22, they must possess special ATEX suitability. An appropriate cable gland is included with EUCHNER ATEX products.
- Equipment for zone 2/22 does not require a test certificate from a notified body. ATEX equipment is tested by the manufacturer under the manufacturer's responsibility.

Classification and assignment of the equipment categories									
Combustible materials	**Temporary behavior** of combustible materials in the explosion area. Explosive medium:	**Hazardous zones**	**Equipment** marking				**Equipment protection level** (EPL)		
			Equipment group	**Equipment category**					
Gases/ vapors /mists	present continuously, for long periods or frequently	**Zone 0**	**II**	**1G**	**2G**	**3G**	**Ga**	**Gb**	**Gc**
	present occasionally	**Zone 1**	**II**						
	probably not present. If present, only rarely or briefly	**Zone 2**	**II**						
Dusts	present continuously, for long periods or frequently	**Zone 20**	**II**	**1D**	**2D**	**3D**	**Da**	**Db**	**Dc**
	present occasionally	**Zone 21**	**II**						
	probably not present due to disturbed dust. If present, only rarely/briefly	**Zone 22**	**II**						

Table 1

Hazardous zones

- **Zone 0**
  Area in which an explosive atmosphere comprising a mixture of air and combustible gases, vapors or mists is **present continuously, for long periods or frequently**.
- **Zone 20**
  Area in which an explosive atmosphere comprising a cloud of combustible dust in the air is **present continuously, for long periods or frequently**.

- **Zone 1**
  Area in which an explosive atmosphere comprising a mixture of air and combustible gases, vapors or mists can **occasionally form during normal operation**.
- **Zone 21**
  Area in which an explosive atmosphere comprising a cloud of combustible dust in the air can **occasionally form during normal operation**.

- **Zone 2**
  Area in which an explosive atmosphere comprising a mixture of air and combustible gases, vapors or mists **usually does not form or forms only briefly during normal operation**.
- **Zone 22**
  Area in which an explosive atmosphere comprising a cloud of combustible dust in the air **usually does not form or forms only briefly during normal operation**.

Equipment categories

- **Category 1G/1D**
  Equipment in this category is intended for use in areas in which an explosive atmosphere comprising gases (G) or dusts (D) is present continuously, for long periods or frequently.
  - **Requirements for the equipment**
    Very high level of safety. The equipment remains protected against providing a source of ignition even in case of malfunctions to be expected only rarely. The equipment also remains safe if two independent failures occur. Safety is achieved using two independent means of protection against providing a source of ignition.

- **Category 2G/2D**
  Equipment in this category is intended for use in areas in which it is to be expected that an explosive atmosphere comprising gases (G) or dusts (D) may occur occasionally.
  - **Requirements for the equipment**
    High level of safety. The equipment remains protected against providing a source of ignition even in the case of malfunctions or fault conditions to be expected frequently. Safety is achieved using one means of protection against providing a source of ignition.

- **Category 3G/3D**
  Equipment in this category is intended for use in areas in which it is not to be expected that an explosive atmosphere may occur due to gases (G) or dusts (D). If an explosive atmosphere nevertheless occurs, then in all probability it will occur only rarely and for a short period.
  - **Requirements for the equipment**
    Equipment offers a normal level of safety. The equipments remains protected against providing a source of ignition in normal operation. ATEX equipment manufactured by EUCHNER is category 3 equipment.

Marking according to equipment characteristics

Marking according to standard

Gases

Marking for use in atmospheres with combustible gases (zones 0, 1, 2) according to EN IEC 60079-0

Ex	ec	IIB	T5	Gc	X
Explosion-protected equipment	**Types of protection:** i: Intrinsic safety m: Encapsulation o: Oil immersion e: Increased safety ec: for equipment protection level Gc q: Powder filling p: Pressurization d: Flameproof enclosure n: Type of protection nR: Restricted breathing enclosure	**Explosion groups:** IIA/IIB/IIC	**Temperature class:** T1 to T6 Permissible surface temperature	**Equipment protection level:** Ga/Gb/Gc	**X:** Special conditions must be met (e.g. properly tightened cover screws)

Dusts

Marking for use in atmospheres with combustible dusts (zones 20, 21, 22) according to EN IEC 60079-0

Ex	tc	IIIC	T90°C	Dc	X
Explosion-protected equipment	**Types of protection:** i: Intrinsic safety m: Encapsulation t: Protection by enclosure tc: for equipment protection level Gc p: Pressurization	**Explosion groups:** IIIA/IIIB/IIIC	**Maximum surface temperature:** $T=T_a+T_i$ T: Maximum surface temperature T_a: Max. ambient temperature T_i: Intrinsic heating of the equipment	**Equipment protection level:** Da/Db/Dc	**X:** Special conditions must be met (e.g. properly tightened cover screws)

Types of protection

The general requirements for electrical equipment are listed in the EN IEC 60079-0 standard. Classification occurs into various types of protection: The type of protection the manufacturer uses for a device (equipment) essentially depends on the device type and function, and it is included in the ATEX marking on the type label of the respective device. EUCHNER uses the following types of protection (Table 2):

Basic standard	Marking	Type of protection	Standard corresponding to the type of protection
Gases EN IEC 60079-0	Ex nR (zone 2)	Type of protection "nR" Restricted breathing enclosure Enclosure designed to restrict the penetration of gas, vapors and mists	EN IEC 60079-15
	Ex ic (zone 2)	Type of protection "i" Intrinsic safety	EN IEC 60079-11
	Ex ec (zone 2)	Increased safety for type of protection "ec"	EN IEC 60079-7
Dusts EN IEC 60079-0	Ex tc (zone 22)	Type of protection "t" Protection by enclosure	EN IEC 60079-31
	Ex ic (zone 22)	Type of protection "i" Intrinsic safety	EN IEC60079-11

Table 2

Explosion groups

Explosion groups and temperature classes determine the media for which equipment may be used within the hazardous zones.

- **Equipment for areas with combustible gases**
  The ignitability of an explosive atmosphere depends on the material.
  Gases and vapors are classified into explosion groups IIA, IIB and IIC depending on the energy required for ignition (see Table 4 in the chapter on temperature classes).

  The danger posed by the gases (ignitability) increases from explosion group IIA to IIC. The requirements on the equipment increase correspondingly. Electrical equipment approved for IIB, for example, may also be used for explosion group IIA.

  Explosion group IIC includes explosion groups IIB and IIA. ATEX equipment manufactured by EUCHNER belongs to explosion group IIB.

- **Equipment for atmospheres with flammable lint and dusts**
  Material group D is classified into explosion groups IIIA, IIIB and IIIC depending on the size and conductivity of the dust particles (see Table 3).
  The danger posed by dusts (ignitability) increases from explosion group IIIA to IIIC. ATEX equipment manufactured by EUCHNER belongs to explosion group IIIC.

Explosion group	Dust types
IIIA	**Combustible fibers and lint** (example: textiles)
IIIB	**Non-conductive dust** (example: sawdust, flour)
IIIC	**Conductive dust** (example: metal dust, dust containing carbon)

Table 3

Temperature classes

Electrical equipment is classified into temperature classes T1 to T6. The temperature class relates directly to the

- ignition temperature of gases and dusts (temperature above which an explosive atmosphere ignites) and
- smoldering temperature of dusts (temperature above which a deposited dust layer begins to smolder)

and thereby specifies the maximum permissible surface temperature of the equipment.

The maximum surface temperature must always be less than the ignition/smoldering temperature of the explosive atmosphere in which the equipment is used.

A safety clearance (maximum surface temperature to ignition/smoldering temperature) might also have to be taken into account.

On equipment intended for use in zones 0, 1, 2 (gases), the related temperature class must be given in the equipment marking.

On equipment intended for use in zones 20, 21, 22 (dusts), the maximum surface temperature must be given in the equipment marking.

Classification of explosive gases according to explosion groups and temperature classes									
Explosion group	IIA			▶ Ammonia ▶ Methane ▶ Ethane ▶ Propane	▶ Ethyl alcohol ▶ Cyclohexane ▶ n-butane	▶ Gasoline ▶ Diesel ▶ Fuel oil ▶ n-hexane	▶ Acetaldehyde		
		IIB		▶ Town gas ▶ Acrylonitrile	▶ Ethylene ▶ Ethylene oxide	▶ Ethylene glycol ▶ Hydrogen sulfide	▶ Ethyl ether		
			IIC	▶ Hydrogen	▶ Acetylene		▶ Trichlorosilane		▶ Carbon disulfide
Temperature class				T1 < 450 °C					
				T2 < 300 °C					
				T3 < 200 °C					
				T4 < 135 °C					
				T5 < 100 °C					
				T6 < 85 °C					
Note: The list contains only some of the explosive materials.									

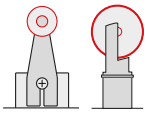
Table 4

Equipment protection level

Devices (equipment) for potentially explosive atmospheres are classified into protection levels (EPL: Equipment Protection Level). The marking consists of two letters.

The first letter indicates the type of explosive atmosphere: G for gas and D for dust. The second letter indicates the corresponding protection level (see Table 1).

Overview of ATEX safety engineering

		Electromechanical safety switches			
		Safety switch NZ1-RS...EX NZ1-HS...EX	Safety switch NZ.VZ...EX	Safety switch SGA1...EX	Safety switch STA.A...EX
	Marking according to				
ATEX	- Application (gases/dusts)	Ex II 3 G D	Ex II 3 G D	Ex II 3 G D	Ex II 3 G D
ATEX	- Equipment characteristics (gases)	Ex nR IIB T5 Gc X	Ex nR IIB T5 Gc X	Ex nR IIB T5 Gc X	Ex nR IIB T4 Gc X
ATEX	- Equipment characteristics (dusts)	Ex tc IIIC T90° Dc (NZHS) Ex tc IIIC T100° Dc (NZRS)	Ex tc IIIC T90° Dc	Ex tc IIIC T90° Dc X	Ex tc IIIC T110° Dc X
	Approvals	c UL us	c UL us	c UL us	c UL us
	Features/specific advantages	- Basic housing according to EN 50041 - With impact resistant cover	- Basic housing according to EN 50041 - With impact resistant cover	- Identical mounting dimensions to safety switch STA - With impact resistant cover	- Metal actuating head - High locking force - With impact resistant cover
Inputs/outputs	Slow-action switching contacts				
Inputs/outputs	Positively driven contacts	1 2 2 3 4	1 2 2 3 4	1 2 2 3 4	1 1 2 2 2 4
Inputs/outputs	NO contacts	1 – 2 1 –	1 – 2 1 –	1 – 2 1 –	1 – – 2 1 –
Inputs/outputs	NC contacts	– – – – –	– – – – –	– – – – –	– 1 – – 1 –
Inputs/outputs	Conventional thermal current	4 A	4 A	4 A	4 A
Inputs/outputs	Switching current, min. (at 24 V)	1 mA	1 mA	1 mA	1 mA
Inputs/outputs	Mechanical life, min.	30×10^6	2×10^6	2×10^6	1×10^6
Environment	Housing material	Anodized die-cast alloy	Anodized die-cast alloy	Die-cast alloy	Die-cast alloy
Environment	Housing dimensions, min. (HxWxD)	128 x 44 x 43.5 mm	142 x 44 x 43.5 mm	123 x 45 x 52 mm	191 x 43 x 46 mm
Environment	Ambient temperature	-20 to +75 °C	-20 to +75 °C	-10 to +75 °C	-20 to +75 °C
Environment	Degree of protection, max., acc. to IEC 60529	IP67	IP67	IP67	IP67
Environment	LED indicators	–	–	–	–
Environment	Approach/actuating directions	Depending on actuator			
Environment	Approach speed, max.	20 m/min.	20 m/min.	20 m/min.	20 m/min.
Guard locking	Solenoid operating voltage	–	–	–	24 V
Guard locking	Power consumption	–	–	–	8 W
Guard locking	Locking force, max.	–	–	–	3000 N
Connection	Cable entry (ATEX cable gland included)	M 20 x 1.5	M 20 x 1.5	3 x M 20 x 1.5	3 x M 20 x 1.5
Accessories	Straight actuator/bent		●/–	●/●	●/●
Accessories	Hinged actuator		●	●	●
Accessories	Door radius, min.		165 mm	200 mm	200 mm
Accessories	Bolts for safety guards		–	●	●

● optionally available ○ available on request – not applicable

The specified data refer to the respective minimum and/or maximum values for the entire series.

Overview of ATEX safety engineering

		Transponder-coded safety switches		
		Without guard locking		With guard locking
		Safety switch CES-A-C5...EX	Safety switch CES-I-AP-.-C04-...-EX CES-I-AR-.-C04-...-EX	Safety switch CTP...EX
	Marking according to			
ATEX	- Application (gases/dusts)	Ex II 3 G D	Ex II 3 G D	Ex II 3 G D
ATEX	- Equipment characteristics (gases)	Ex ic ec IIB T5 Gc X	Ex ec IIB T6 Gc X	II3G Ex ec IIC T4 Gc X
ATEX	–Equipment characteristics (dusts)	Ex ic tc IIIC T90° Dc X	Ex tc IIIC T80° Dc X	Ex tc IIIC T110° Dc X
ATEX	Safety category PL acc. to EN ISO 13849-1	Cat. 4 / PL e	Cat. 4 / PL e	Cat. 4 / PL e
	Approvals	cULus	cULus	cULus
	Features/specific advantages	- With impact resistant cove - No own pulsing of the safety outputs - External pulsing (possible with safe PLC, for example)	- Switches may be used in potentially explosive atmospheres only when the supplied equipped with housing guard - separate pulsing on safety outputs to detect short circuits	- Metal actuating head - Attachment compatible with safety switch STA - With impact resistant cover - separate pulsing on safety outputs to detect short circuits
Inputs/outputs	Semiconductor safety outputs	2	2	2
Inputs/outputs	Monitoring outputs (semiconductor)	1	1	2
Inputs/outputs	Switching current per safety output (semiconductor)	100 mA	150 mA	150 mA
Inputs/outputs	Mechanical life, min.	–	–	$1x10^6$
Environment	Switch	Integrated evaluation unit/ read head	Integrated evaluation unit/ read head	Integrated evaluation unit/ read head
Environment	Dimensions, min. (HxWxD)	118 x 40 x 40 mm	75 x 30 x 20 mm	245 x 45 x 43 mm
Environment	Ambient temperature	-20 to +50 °C	-25 to +65 °C	-20 to +55 °C
Environment	Degree of protection, max., according to IEC 60529	IP67	IP67/IP69/IP69K	IP65/IP66
Environment	LED indicators	2	2	3
Environment	Approach directions			
Guard locking	Solenoid operating voltage	–	–	24 DC
Guard locking	Power consumption, max.	–	–	6 W
Guard locking	Locking force, max.	–	–	3900 N
Connection	Plug connector	Plug connector M 12	Plug connector M 8 / Connection cable with Plug connector M12	Plug connector M 12
Accessories	Rectangular actuator (transponder)	Typical operating distance: 22 mm	Typical operating distance: 14 mm	Straight actuator, hinged actuator
Accessories	Bolts for safety guards	–	–	●

● optionally available ○ available on request – not applicable

The specified data refer to the respective minimum and/or maximum values for the entire series.

Ordering table

Item	Order no.	Guard locking type	Monitoring of solenoid position[1)]	Monitoring of door position[1)]	Suitable for zone	Temperature class/ max. surface temperature
Electromechanical safety switches						
NZ1RS-3131-M-EX	094169	---	---	2 pos. dr. + 2 NO	2 / 22	T5/100 °C
NZ1HS-3131-M-EX	094167	---	---	2 pos. dr. + 2 NO	2 / 22	T5/90 °C
NZ1VZ-2131E-M-EX	093660	---	---	3 pos. dr. + 1 NO	2 / 22	T5/90 °C
SGA1A-2131A-M-EX	123460	---	---	3 pos. dr. + 1 NO	2 / 22	T5/90 °C
STA3A-2131A024MF-EX	115584	Closed-circuit current principle	2 pos. dr. + 1 NO	1 NC	2 / 22	T4/110 °C
STA4A-2131A024MF-EX	115585	Open-circuit current principle	2 pos. dr. + 1 NO	1 NC	2 / 22	T4/110 °C
STA3A-4121A024MF-EX	115586	Closed-circuit current principle	2 pos. dr.	1 NC + 1 NO	2 / 22	T4/110 °C
STA4A-4121A024MF-EX	123076	Open-circuit current principle	2 pos. dr.	1 NC + 1 NO	2 / 22	T4/110 °C
Transponder-coded safety switches						
Safety switches without guard locking						
CES-A-C5H-01-EX (Unicode)	097945	---	---	2 safety outputs (semiconductor)	2 / 22	T5/90 °C
CES-I-AP-U-C04-SK-EX (Unicode)	175321	---	---	2 safety outputs (semiconductor)	2 / 22	T6/80 °C
CES-I-AP-U-C04-USI-EX (Unicode)	174983	---	---	2 safety outputs (semiconductor)	2 / 22	T6/80 °C
CES-I-AR-U-C04-SG-EX (Unicode)	175319	---	---	2 safety outputs (semiconductor)	2 / 22	T6/80 °C
CES-I-AR-U-C04-USA-EX (Unicode)	174984	---	---	2 safety outputs (semiconductor)	2 / 22	T6/80 °C
Safety switches with guard locking						
CTP-L1-AP-U-HA-AZ-SA-EX (Unicode)	136675	Closed-circuit current principle	2 safety outputs (semiconductor) + monitoring output OL	1 monitoring output OD (semiconductor)	2 / 22	T4/110 °C
CTP-L1-AP-U-HA-AZ-SA-EX (Unicode)	129512	Closed-circuit current principle	2 safety outputs (semiconductor) + diagnostics output OI	1 monitoring output OD (semiconductor)	2 / 22	T4/110 °C
CTP-L1-AP-U-HA-AE-SA-EX (Unicode) with escape release	156240	Closed-circuit current principle	2 safety outputs (semiconductor) + monitoring output OL	1 monitoring output OD (semiconductor)	2 / 22	T4/110 °C
CTP-L2-AP-U-HA-AZ-SA-EX (Unicode)	175620	Open-circuit current principle	2 safety outputs (semiconductor) + diagnostics output OI	1 monitoring output OD (semiconductor)	2 / 22	T4/110 °C

1) pos. dr.: positively driven normally closed contact; NC: normally closed contact, NO: normally open contact

Further information

Details about the various ATEX safety switches and accessories can be found on our homepage at www.euchner.com

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