Mechanical EX-pressure switches

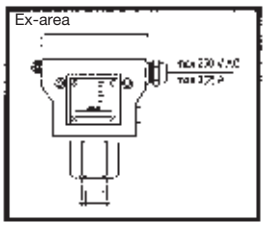
	Type	Medium	Pressure range	Temperature range	Directive for CE	Testing basis	Comments
Pressure proof encapsulation Ex-d	**EX-DCM** **EX-DNM**	non aggressive liquids and gases	1…25 mbar. 1…10 bar, 16...63 bar	-20…+60°C	ATEX 94/9/EC IECEx	DIN EN60730 DIN EN60079	Mechanical Ex-d pressure switch
	EX-DNS **EX-VNS**	aggressive liquids and gases	-1…16 bar	-20…+60°C	ATEX 94/9/EC IECEx	DIN EN60730 DIN EN60079	Mechanical Ex-d pressure/vacuum switch with stainless steel sensor 1.4571
	EX-DDCM	liquids and gases	4 mbar…16 bar	-20…+60°C	ATEX 94/9/EC IECEx	DIN EN60730 DIN EN60079	Mechanical Ex-d differential pressure monitor
	EX-VCM **EX-VNM**	liquids and gases	-1…0,5 bar	-20…+60°C	ATEX 94/9/EC IECEx	DIN EN60730 DIN EN60079	Mechanical Ex-d vacuum switch
	EX-DGM	fuel gases	15…250 mbar	-20…+60°C	ATEX 94/9/EC IECEx EU/2009/142/EC	DIN EN 1854 DIN EN60730 DIN EN60079	Mechanical Ex-d pressure monitor for gases in accordance with DVGW work sheet G260
	EX-DWR	Steam, hot water, fuel gases and liquied fuels	0,1…40 bar	-20…+60°C	ATEX 94/9/EC IECEx DGR 97/23/EC EU/2009/142/EC	VdTÜV Druck 100 DIN EN 1854 DIN EN12952-11 DIN EN12953-9 DIN EN 764-7 DIN EN60079	Mechanical Ex-d pressure switch, Sensor of special construction by testing with 2 milion operating cycles
Intrinsically safe	**DCMx-5xx**	non aggressive liquids and gases	1 mbar…63 bar	-25…+60°C*	ATEX 94/9/EC IECEx	DIN EN60730	Mechanical Ex-i pressure switch
	VCMx-5xx **VNMx-5xx**	liquids and gases	-1…0,5 bar	-25…+60°C*	ATEX 94/9/EC IECEx	DIN EN60730	Mechanical Ex-i vacuum switch
	VNSx-5xx **DNSx-5xx**	aggressive liquids and gases	-1…16 bar	-25…+60°C	ATEX 94/9/EC IECEx	DIN EN60730	Mechanical Ex-i pressure/ vacuum switch with stainless steel sensor 1.4571
	DDCMx-5xx	liquids and gases	4 mbar…16 bar	-25…+60°C	ATEX 94/9/EC IECEx	DIN EN60730 DIN EN 60079	Mechanical Ex-i differential pressure monitor
	DWAMx-5xx	Steam and hot water	0,1…32 bar	-20…+60°C	ATEX 94/9/EC IECEx DGR97/23/EC	VdTÜV Druck 100 DIN EN 12952-11 DIN EN 12953-9	Mechanical Ex-i Pressure monitor and Pressure limiter
	DGMx-5xx	fuel gases	15…1,6 bar	-25…+60°C	ATEX 94/9/EC IECEx EU/2009/142/EC	DIN EN 1854	Mechanical Ex-i pressure monitor for gases in accordance with DVGW work sheet G260
	DWRx-5xx	Steam, hot water, fuel gases and liquied fuels	0,1…40 bar	-25…+60°C	ATEX 94/9/EC IECEx EU/2009/142/EC DGR97/23/EC	VdTÜV Druck 100 DIN EN 1854 DIN EN12952-11 DIN EN12953-9 DIN EN 764-7 DIN EN60079	Mechanical Ex-i pressure switch, Sensor of special construction by testing with 2 milion operating cycles
	FD16-326 **FD16-327**	liquid gas	3…16 bar	-25…+60°C	ATEX 94/9/EC IECEx DGR97/23/EC	VdTÜV Druck 100 DIN EN 764-7	Mechanical Ex-i maximum pressure limiter for liquid gas installations

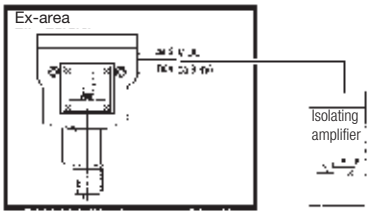
*: -15….+60°C for DCM4016-5..,DCM4025-5.., VCM4156-5..

Ex devices

Pressure monitoring in explosion risk areas, Zones 1, 2 and 20, 21, 22

Specially equipped pressure switches can also be used in explosion risk areas Zone 1, 2 and 20, 21, 22. The following alternatives are possible:





1. Type of ignition protection Ex-d, Ex-e and Ex-t:
The pressure switch with protection type "Flameproof Ex-d and Increased Safety Ex-e" can be used with the switch device in hazardous areas of zone 1 and 2 for flammable gas mixtures. For use in dust atmospheres, the protection is "protected by enclosure Ex-t".
The switching device may be used in hazardous areas of zones 21 and 22 for explosive dusts. In addition, for the dust explosion protection zone 20 on the sensor (device screwed into container walls, which may occur in the interior permanent dust atmosphere).
The permissible values for switching voltage, switching capacity and ambient temperature please refer to the detailed description of the Ex-equipment, and the installation and operating instructions. In addition, please note the general rules for the use and installation of equipment in hazardous atmosphere.
Special circuits, as well as versions with adjustable switching differential or internal interlock (reclosing lock) are not possible.

2. Ignition protection Ex-i
All pressure switches with features for intrinsically safe circuits can be used with the switching device in hazardous areas Zone 1 and 2 (Gas) and zones 21 and 22 (Dust). In addition, the sensor in hazardous areas Zone 0 (Gas) and 20 (Dust) may be screwed. (Inside tank = defined as zone 0 or zone 20). A circuit is considered to be "intrinsically safe" if the amount of energy conveyed therein is not capable of generating an ignitable sparks. This pressure switch can only be operated in combination with a suitable isolating switching amplifier, which is approved for the type Ex-i. Suitable variants must be selected for this pressure switch with resistor combination for line and short circuit monitoring. Because of the low voltages and currents in intrinsically safe circuits, micro switches with gold contacts are used for pressure monitors with automatic reset. For limiter (with internal interlock) micro switches with silver contacts are used. FEMA pressure switches for use in intrinsically safe circuits are marked by blue terminals and cable entries. In addition, the pressure switch has been tested by a "notified body". The units get a serial number and the nameplate inform about the ignition protection and registration number.

Ignition protection for pressure monitoring in Zones 0 (20), 1 (21) and 2 (22)

Pressure proof encapsulation Ex-d (EN 60079-0:2009) Enhanced safety Ex-e (EN 60079-7:2007) Protection via housing Ex-t (EN60079-31:2009) Ex-...	**Intrinsically safe Ex-i (EN 60079 - 11: 2012) D...513, ...-563 (gold-plated contact, monitor) D...575, ...-577 (silver-plated contact, limiter)**
Ignition protection type: CE 0035 Ex II 2G Ex d e IIC T6 Gb CE 0035 Ex II 1/2D Ex ta/tb IIIC T80°C Da/Db	Ignition protection type: CE 0035 Ex II 1/2G Ex ia T6 Ga/Gb CE 0035 Ex II 1/2D Ex ia IIIC T85ºC
ATEX approval for the complete switching device	ATEX approval for the complete switching device and for isolating amplifier
Pressure switches with a silver contact	Pressure switches with gold plated contacts (monitors) Pressure switches with silver plated contacts (limiter)
Switching capacity: max. 3 A, 250 VAC min. 2mA, 24 VDC	Rate value without resistor combination …-513 /…-563: Ui: 24VDC li: 100mA Ci: 1nF Li: 100µH Rate value with resistor combination …-574 / …-575 / …-576 / …-577: Ui: 14VDC Ri: 1500 Ohm Ci: 1nF Li: 100µH
The pressure switch can be installed within the Ex-Zone.	Pressure switch will be installed in Ex-Zone The isolating amplifier must be installed outside the Ex-Zone.

General information about explosion protection

Basic principle

The basic principle of explosion protection is that:

a) combustible materials (gas, steam, mist or dust) in dangerous quantities
b) air (or oxygen)
c) ignition sources

must not occur in the same place.

The permanent or temporary occurrence of explosive mixtures as per a) and b) is often unavoidable, therefore when operating electrical installations care must be taken to ensure that no ignition sources can occur.

In order to accomplish this, standards have been legislated in Europe serving as a basis for various different types of ignition protection. These standards have been recognized in all European countries. Equipment for the reliable prevention of the ignition of ambient explosive gas mixtures must be constructed according to these standards.

In addition to ISO9000ff applies to the production monitoring, the ISO/IEC 80079-34 for ex-protected areas.

These standards are based on European Directive 94/9/EC (ATEX). The goal of this regulation is the harmonization of statutory regulations EN60079 in the area of explosion protection as well as the elimination of trade barriers between Member States. This Directive provides for the harmonization of all standards relevant to the construction of equipment with ignition protection.

The most important types of ignition protection for FEMA products are as follows:

"Ex-d" pressure proof encapsulation	**EN 60079-1**
"Ex-e" enhanced safety	**EN 60079-7**
"Ex-t" protection via housing	**EN 60079-31**
"Ex-i" intrinsically safety	**EN 60079-11**

Pressure switches
Specially designed FEMA Ex-protected pressure switches are available for use in ex-protection areas. They conform to these standards and are type-tested (Ex-d, Ex-e, Ex-t) and / or have been technically prepared for these areas (Ex-i).

"Ex-d" Pressure-Proof Encapsulation
Switch components and other electrical functional units capable of igniting explosive gas mixtures are encapsulated in a housing which will survive the explosive pressure of an internal explosion and the special design of which prevents the transference of this explosion to the ambient atmosphere.

"Ex-e" Enhanced Safety
This type of ignition protection pertains to the special design of the terminal connection housing. The connection area is grouted and thus specially separated from the microswitch. A type tested terminal block, a type tested cable gland, and the IP65 protection degree all ensure an enhanced safety of "Ex-e" in the connection housing.

"Ex-t" Protection via Housing
This type of ignition protection pertains to dust explosion protection and is based upon the reliable protection of ignition sources against atmospheric dust. For FEMA pressure switches and thermostats for use in dust explosion protected areas, a protection degree of IP65 is required. Together with devices according to "Ex-d" and "Ex-e," devices with "Ex-t" protection are approved for use in gaseous and dust laden atmospheres.

"Ex-i" Intrinsically Safety
The equipment employed in explosion relevant areas are components of inherently safe electrical circuits. An electrical circuit is inherently safe if the amount of energy it contains is so small that no spark or other thermal effect can arise. This reliably prevents the ignition of explosive gas mixtures in the proximity of this equipment. In the context of this directive, pressure switches and thermostats containing no switching components with energy storage effects are referred to as "simple electrical equipment."

General information about explosion protection

Zone classification

Explosion risk areas are grouped into zones according to the likelihood of a dangerous explosive atmosphere **according to EN 1127-1** occurring.
When assessing the explosion hazard, i.e. when identifying explosion risk areas, the "Guidelines for the Avoidance of Danger due to Explosive Atmospheres with Examples (ExRL)" of the German Insurance Association for the Chemical Industry must be taken into account.
If the situation concerns a special case or if doubts exist as to the definition of explosion risk areas, the matter shall be decided by the supervisory authorities (Trade Supervisory Office, where applicable with the assistance of the Insurance Association or the Technical Control Boards.

In Zones 0 (20) and 1 (21), only electrical equipment for which a type test certificate has been issued by a recognized testing agency may be used. In Zone 0 (20), however, only equipment expressly authorized for that zone may be used. Equipment approved for use in Zones 0 (20) and 1 (21) may also be used in Zone 2 (22). Under the new European Directive 94/9 EC (ATEX 100a), a distinction is made between **gas atmospheres** and **dust atmospheres**. This results in the following zone classifications:

Gas	**Zone 0**	**continuously or for long periods**	**Zone 0** (gas) is a place in which a dangerous explosive atmosphere is present continuously or for long periods. This normally includes only the interior of containers or the interior of apparatus (evaporators, reaction vessels etc.), if the conditions of Zone 0 are fulfilled. Continuous danger > 1000 hours / year.
	Zone 1	**occasionally**	**Zone 1** (gas) is a place in which a dangerous explosive atmosphere can be expected to occur occasionally in normal operation. This may include the immediate vicinity of Zone 0. Occasional danger = 10 to 1000 hours / year.
	Zone 2	**seldom and for short periods**	**Zone 2** (gas) is a place in which a dangerous explosive atmosphere can be expected to occur only rarely and then only for short periods. This may include areas surrounding Zones 0 and/or 1. Danger only under abnormal operating conditions < 10 hours / year.
Dust	**Zone 20**	**continuously or for long periods**	**Zone 20** (dust) is a place in which a dangerous explosive atmosphere in the form of a cloud of dust in air is present continuously or for long periods, and in which dust deposits of unknown or excessive thickness may be formed. Dust deposits on their own do not form a Zone 20. Continuous danger > 1000 hours / year.
	Zone 21	**occasionally**	**Zone 21** (dust) is a place in which a dangerous explosive atmosphere in the form of a cloud of dust in air may occasionally occur in normal operation, and in which deposits or layers of inflammable dust may generally be present. This may also include the immediate vicinity of Zone 20. Occasional danger = 10 to 1000 hours / year.
	Zone 22	**seldom and for short periods**	**Zone 22** (dust) is a place in which a dangerous explosive atmosphere may be expected to occur only rarely and then only for short periods. This may include areas in the vicinity of Zones 20 and 21. Danger only under abnormal operating conditions < 10 hours / year.

General information about explosion protection

Explosion group

The requirements for explosion protected equipment depend on the gases and / or steam present on the equipment and on the dusts lying on, adhering to and / or surrounding the equipment. This affects the gap dimensions required for pressure proof encapsulation and, in the case of intrinsically safe circuits, the maximum permitted current and voltage values. Gases, steam and dusts are therefore subdivided into various explosion groups.
The danger of the gases rises from explosion group IIA to IIC. The requirements for electrical equipment in these explosion groups increase accordingly. Electrical equipment approved for IIC may also be used for all other explosion groups.

Temperature class

The maximum surface temperature of an item of equipment must always be lower than the ignition temperature of the gas, steam or dust mixture. The temperature class is therefore a measure of the maximum surface temperature of an item of equipment.

Temperature class °C	Ignition temperature °C	Maximum surface temperature °C
T1	> 450	450
T2	> 300	300
T3	> 200	200
T4	> 135	135
T5	> 100	100
T6	> 85	85

Equipment Protection Level (EPL)

In addition to the afore mentioned types of ignition protection, the new norms IEC and EN60079ff have introduced the corresponding Equipment Protection Levels (EPL).

Zone (Gas-Ex)	EPL	Zone (Staub-Ex)	EPL	Protection Level
0	Ga	20	Da	highest
1	Gb	21	Db	high
2	Gc	22	Dc	standard

Example: Ex d e IIC T6 Gb:
Device is designed for Zone 1 for gas group IIC and gas equipment protection level "high level of protection".

Marking of Explosion-Protected Electrical Equipment

In addition to the usual data (manufacturer, model, serial number, electrical data), the explosion protection information is likewise to be included in the marking.
According to Directive 94/9/EC (ATEX), in compliance with the IEC recommendation and the currently valid standards, the following forms of identification are to be followed.

Example for FEMA Pressure Switch