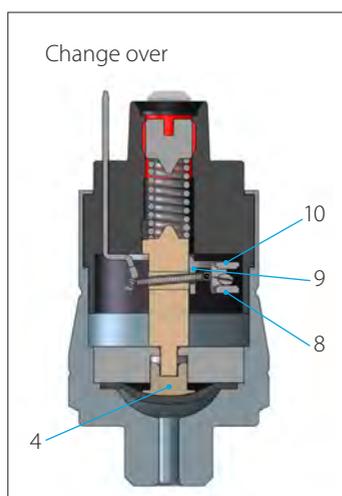
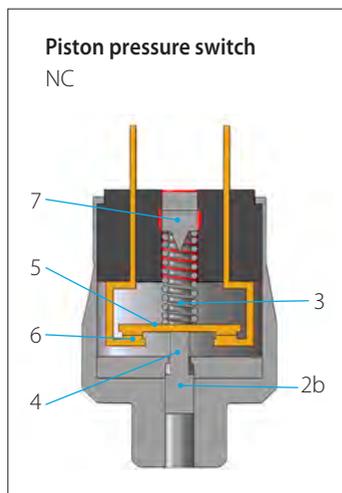
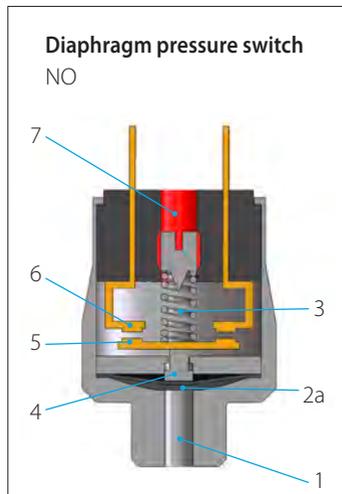


# Technical explanations for mechanical pressure switches



## What is a mechanical pressure switch?

Mechanical pressure switches from SUCO monitor the pressure of liquid or gaseous media, and close or open an electrical circuit on reaching a set threshold.

## Diaphragm pressure switches

SUCO diaphragm pressure switches are used in pressure ranges from 0.1 bar to 100 bar, meaning over pressure safety of 35, 100, 300 and 600 bar, depending on the used diaphragm type.

## Piston pressure switches

Pressure ranges from 10 bar to 400 bar can be monitored with SUCO piston pressure switches (dependent on size); an over pressure safety of up to 600 bar can be attained.

## Sizes of pressure switches

Mechanical pressure switches from SUCO can be divided into sizes hex 24, hex 27 and 30 A/F. Each particular size has specific hydraulic, pneumatic and electric properties (specified on the relevant catalogue page in the technical details).

## How does a pressure switch work?

### Function description for normally open (NO):

Pressure is applied to the diaphragm (2a) / pistons (2b) through the pressure connector (1).

If the generated pressure force is greater than the pre-tensioned force of the pressure spring (3), the plunger (4) moves towards the counter-contact (6), carrying along the contact disc (5), and closes the circuit. The switch opens again when the pressure is reduced by the hysteresis value.

### Function description for normally closed (NC):

Engaging happens in the reverse order.

The adjustment screw (7) enables the switching point to be changed within the adjustment range.

The micro switch of a **change-over contact system (snap-action)** offers both, a NC and a NO contact.

The swivel contact (9) is activated by the plunger (4). The circuit is closed by the NC (8) as long as no pressure is applied. When the applied pressure exceeds the set switching point, the swivel contact changes over and closes the circuit via the NO (10).

## Utilisation category

The utilisation category specifies for example voltages and currents, and the type of load, our pressure switches are designed for (to DIN EN 60947-5-1).

## AC voltage

**AC12:** Control of ohmic loads and semiconductor loads in input circuits of optocouplers (such as PLC inputs).

**AC14:** Control of electromagnetic loads, 72 VA.

## DC voltage

**DC12:** Control of ohmic loads and semiconductor loads in input circuits of optocouplers (such as PLC inputs).

**DC13:** Control of electromagnets.

## Classification of electrical switch functions

			Contact form DIN- EN-60947-5-1	Symbol IEC 60617
NO	NO, normally open	SPST single pole, single throw	X	
NC	NC, normally closed	SPST single pole, single throw	Y	
Change-over contacts	CO, change over (snap action)	SPDT Single pole, double throw	C	

### B10d value

The B10d value specifies the anticipated service life (with a 10% probability of failure). The B10d value is therefore directly dependent on the respective application of the pressure switch. For ohmic loads and currents < 1 A, we specify the B10d value as 1 million cycles of electrical life.

The specification of a MTTF time (mean time to failure) is not possible without knowing the specific conditions in the application. However, the MTTF time can be determined easily from the B10d value:

$$MTTF_d = \frac{B_{10d}}{0,1 n_{op}}$$

$n_{op}$ : number of cycles per year

$B_{10d}$ : number of cycles until  
10% of components have failed.

### Minimum current / minimum working voltage

The minimum working current and minimum working voltage depend greatly on operating and ambient conditions.

Physically, the build-up of impurity layers on the contact rivets must be countered with mechanical friction and/or electrical erosion. It has proven useful in many applications to deploy our pressure switches with silver contact rivets ensuring that they are fail safe to 10 mA and 10 V. Variants with gold contacts are available in our catalogue for even lower currents and voltages.

### Potential-free – galvanically isolated

Mechanical pressure switches from SUCO are potential-free, i.e. no auxiliary energy is required. Also, there is no electrical contact between the individual, live parts and the housing.

### Adjustment range of switching point

The pressure range, within which the switching point of a pressure switch can be set, is called adjustment range. The switching point corresponds to the pressure value at which the electric circuit is opened or closed by the pressure applied.

### Switching point tolerances

The switching point tolerances specified by us pertain to room temperature (RT) and condition as new. The values can change as a result of temperature, ageing and deployment conditions.

It is not possible to specify generally applicable value for switching point tolerances over temperature as the medium has a significant influence on the sealing materials in the pressure switch. Double the tolerance stated

for RT and condition as new can be assumed as a typical magnitude for the tolerance over the entire temperature range.

Based on their design, piston switches may exhibit an increase in switching points due to storage (dry run, stick-slip effect). Following a short start phase, the switching points return to the value set at the factory.

Pressure change rates of >1bar/s may have an effect on the switching point for diaphragm pressure switches. The switching point (for rising pressure) and hysteresis increase, whilst the switch-back point (for falling pressure) sinks. Also, the effect of the maximum (system) pressure on the switch-back point (for falling pressure ramp) must be factored in for tolerance-critical applications. The higher the (system) pressure, the lower the resulting switch-back value.

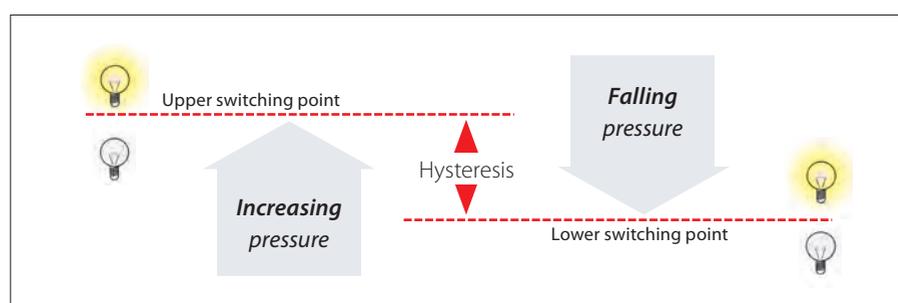
### Hysteresis

#### Rising / falling switching point

The pressure difference between the rising (upper) and falling (lower) switching points (refer to the figure) is known as hysteresis (switch-back difference).

Hysteresis is derived from the structural layout of a mechanical pressure switch. It has no constant value within the adjustment range, and is lowest for the lowest adjustment value. It is greatest at the end of the adjustment range.

Hysteresis can be set at SUCO in range from approx. 10% (at end of adjustment range) to 30% or higher (at start of adjustment range), related to the respective switching point for hex 27 and 30 A/F pressure switches with adjustable hysteresis.



# Technical explanations for mechanical pressure switches

The specifications in the catalogue only represent typical average values.

Please ask about the possible setting ranges you may require. Our electronic pressure switches are excellently suited to extremely low or high hysteresis.

The lowest possible hysteresis is set if nothing is specified in the order.

## Switching frequency

The switching frequency provides information on the possible number of cycles in one minute. The value of 200/minute specified by us is a guideline value. Higher cycle values can be attained depending on switch type and conditions of use.

## Sealing materials

The priority in sealing material selection is the chemical resistance. The temperature range only becomes a selection criterion when different sealing materials are suitable for the medium.

## NBR (Buna-N)

This is the standard material most commonly used. It is a special SUCO material mix with high level of cold flexibility so that the sealing properties of the pressure switch are also retained at low temperatures.

NBR is denoted by number "1" in our item number.

## EPDM

This material is the solution of choice for applications with brake fluids.

It is particularly suitable for applications with (process) water. Approval from the BAM (Federal Institute for Material Testing) is in place for oxygen applications. The safety regulations from country-specific authorities must be observed for oxygen applications.

EPDM may not come into contact with oil because this would entail swelling and softening of the material, and so failure of the pressure switch.

EPDM is denoted by number "2" in our item number.

## EPDM with drinking water approval W270

This EPDM material is intended for drinking water applications and for use in medical and pharmaceutical applications. Approval as per code "DVGW Technical Codes, Worksheet W270" is in place for this.

EPDM may not come into contact with oil because this would entail swelling and softening of the material, and so failure of the pressure switch.

EPDM W270 is denoted by number "5" in our item number.

## FKM / FPM (Viton®)

This is a diaphragm material suitable for high temperature exposure and exhibits special chemical resistance. It has been tested in the hydraulic sector and has been proven to work successfully with critical oils.

FKM/FPM is denoted by number "3" in our item number.

## ECO (epichlorhydrin)

ECO is only used in our vacuum switches. This material has similar properties to NBR in terms of chemical resistance, and can be used in gas applications as well as oil and fuel applications.

ECO is denoted by number "4" in our item number.

## Silicone

Silicone is suitable for use within a wide temperature range. The SUCO silicone diaphragm is FDA-approved (Food & Drug Administration) for the food sector.

Silicone is a soft material reserved for sensitive applications in the low pressure range (below 10 bar) with maximum overpressure safety to 35 bar. Piston switches are therefore not offered with silicone seals. Silicone is also not suitable for oil applications.

Silicone is denoted by number "8" in our item number.

## H-NBR

This is a special SUCO material mixture optimised for ester-based bio-oils. The multitude of bio-oils on the market means suitability of the material for the respective oil must be determined. This diaphragm material can also be used for a number of mineral and synthetic oils.

H-NBR is denoted by number "9" in our item number.

## Medium compatibility

The specifications on medium compatibility in this catalogue cannot be generalised as they pertain to the sealing materials used in our pressure switches.

## Saturated and superheated steam applications

The sealing materials mentioned are not suitable for saturated or superheated steam applications.

## Conversion table for pressure units

Unit symbol	Unit name	Pa= N/m <sup>2</sup>	bar	rising	lbf/in <sup>2</sup> , PSI
1 Pa = N/m <sup>2</sup>	Pascal	1	0.00001	0.0075	0.00014
1 bar	Bar	100 000	1	750.062	14.5
1 Torr = 1 mm Hg	Millimetres, mercury column	133.322	0.00133	1	0.01934
1 lbf/in <sup>2</sup> = 1 PSI	Pound-force per square inch	6894	0.06894	51.71	1

## Conversion table for temperature units

	K	°C	F
K	1	K-273.15	9/5 K-459.67
°C	°C + 273.15	1	9/5 °C + 32
F	5/9 (F+459.67)	5/9 (F-32)	1

**Please consult us about gas, water and oxygen applications.**

### Water applications

Standard piston switches are not suitable for water applications.

This also applies for stainless steel switches with EPDM seals. The use of water with corrosion protection, water mixtures and emulsions needs to be clarified with SUCO.

### Gas applications

Our pressure switches are suitable for liquid and gaseous media. Gaseous media place particular demands on leak-tightness however. The leakage rate is dependent on the respective gaseous medium, the working pressure and the permeability of the seal material used in the pressure switch.

Their lower leakage rates mean diaphragm pressure switches are better suited for gas pressures than piston pressure switches. The latter can also be used however if certain measures are taken (such as venting of the housing).

### Oxygen applications

Our mechanical pressure switches are suitable for use with oxygen. We recommend the use of our EPDM diaphragm. The resistance to internal burnout of the diaphragm has been tested by the BAM (Federal Institute for Material Testing).

Pressure switches in steel housings with zinc-nickel coating are, in conjunction with oxygen, only approved to a maximum working pressure of 10 bar.

Pressure switches in brass housings are, in conjunction with oxygen, only approved to a maximum working pressure of 35 bar.

Pressure switches in stainless steel housings are, in conjunction with oxygen, only approved to a maximum working pressure of 50 bar.

DGUV accident prevention regulations (such as DGUV 500, Section 2.32 and BGI 617) must be observed for first operation.

Please specify when ordering "oil and grease-free, for use with oxygen".

### Underpressure safety of pressure switches

Our pressure switches are underpressure safe down to 300 mbar (relative).

### Overpressure safety of vacuum switches

Our vacuum switches are overpressure safe up to 20 or 35 bar depending on type.

### cCSAus approval

Almost all of our mechanical pressure switches (sizes hex 24 and hex 27), and vacuum switch 0151, have cCSAus approval. The CSA mark together with "c" and "us" combines the control stamps for introduction onto the Canadian and American markets. The cCSAus certificate also includes the test of the relevant UL standard.

Checked by an official institution and verified with regular company visits by CSA inspectors, this approval guarantees the highest levels of quality and operational reliability for our products.

You can download the current cCSAus certificate from the download area on the homepage:

<http://www.suco.de/Downloads.htm>

### Product information

The technical information in this catalogue is based upon fundamental testing during product development, as well as upon empirical values. The information cannot be used for all application scenarios.

Testing of the suitability of our products for a specific application (e.g. also the checking of material compatibilities) rests under the responsibility of the user. It may be the case that suitability can only be guaranteed with appropriate field testing.

### Subject to technical changes.

# General technical explanations

## User information

Our pressure monitoring products may only be installed and started up by authorised specialists. The safety regulations of country-specific authorities must be observed, especially when working with mains voltages and oxygen, and in potentially explosive areas.

## Product information

The technical information in this catalogue is based upon fundamental testing during product development and empirical values. The information cannot be used for all application scenarios.

Testing of the suitability of our products for a specific application (such as the checking of material compatibilities) remains the responsibility of the user. It may be the case that suitability can only be verified by appropriate field testing.

## IP protection class

The IP protection class is a defined protection level code (sealing) of electrical equipment housings in line with IEC 60529 (formerly DIN 40050 - Part 2). Protection of a housing against the following is tested here:

- The penetration of solid extraneous particles, such as dust
- Access of hazardous parts
- Penetration of water

IP protection tests are performed as type tests. The IP protection type code, made up of two digits, specifies the protection of a housing against the penetration of solid extraneous particles and water. The numeric code therefore provides conclusions to be drawn on the level of personal safety as well as the functional protection / mid to long-term functional reliability of electrical equipment.

## Protection types IP00, IP65, IP67 and IP6K9K

### IP00:

No protection against penetration of solid particles or water, no protection against contact.

### IP6X:

Protection against penetration of dust (dust proof). Full contact protection.

### IPX5:

A jet of water from a nozzle, aimed at equipment (such as a pressure switch) from all directions, must not have any harmful effect.

### IPX7:

Protection from water, when equipment (such as a pressure switch) is immersed in water under defined pressure and time conditions. Water must not penetrate into the equipment in harmful quantities.

### IP6K9K:

Devices satisfying these requirements must be dust-proof and be able to withstand loads during the use of high-pressure cleaners and steam jets. The standard stipulates a water pressure from 80 to 100 bar at a temperature of 80°C for testing.

### IP6KX:

Dust must not penetrate. Letter K: Specific to the electrical equipment of road vehicles.

### IPX9K:

Protection against penetration of water at high pressure / for steam jet cleaning. Water aimed at the housing from every direction at greatly increased pressure may not have any damaging effects.

**We are able to offer IP67 / IP6K9K for many of our mechanical and electronic pressure switches (pre-wired or with integrated connector) and for our transmitters.**

## Cylindrical threads

Cylindrical threads are either sealed on the front by underlaying an appropriate sealing ring (such as a copper sealing ring) or by already having integrated O-rings or gaskets.

## Conical threads (cone-shaped threads)

Conical threads guarantee tolerance compensation of the two threaded parts. The sealing function is realised with thread flanks which deform permanently and enter into a metallic frictional fit. Conical threads are not screwed in down to the screw-in depth, but fixed with the tightening torque required for the leak tightness. Remember not to exceed the permitted tightening torque of the pressure switch or transmitter presented in the following table (to prevent damaging the threaded pin beforehand, causing it to become untight during operation or to snap off when tightened).

## Tightening torques of steel threads

The specifications below are to be understood upper material thresholds for the housing of pressure switches or transmitters. Remember during installation that the type and material of the seal, the condition of mating surfaces (e.g. dry or oily) and the material of the counter-piece all have a bearing on the tightening torque.

Thread	Tightening torque
NPT 1/8; M 10 x 1 conical	max. 18 Nm
M 10 x 1 cyl.; G 1/8	max. 20 Nm
M 12 x 1.5; 7/16 – 20 UNF	max. 30 Nm
G 1/4; 9/16 – 18 UNF	max. 40 Nm
NPT 1/4; M 14 x 1.5	max. 40 Nm

**Values 30% lower than in the table above must be used for brass housings.**

Using additional sealant to attain the required leak tightness may be necessary for gas applications.

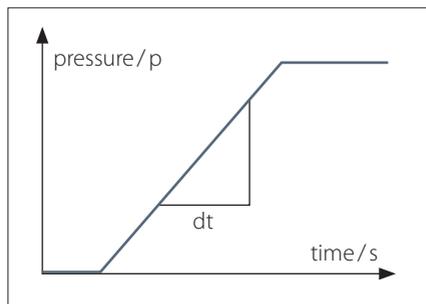
## Vacuum

The values given in the technical details for the vacuum range are specified in millibars (mbar) below atmospheric pressure.

## Pressure change rate (~rise / ~fall)

The pressure change rate denotes the pressure over time for the rising/falling pressure. The pressure change rate is specified in bar/s or bar/ms.

The maximum pressure change rate for SUCO mechanical pressure switches is 1 bar/ms (1,000 bar/s). For SUCO electronic pressure monitoring products the maximum pressure change rate can be up to 5 bar/ms (5,000 bar/s).



## Over pressure protection

The specified over pressure protection in the catalogue is based on a static pressure. The values refer to the hydraulic or pneumatic part of the switch.

It is best practice to use 30 - 50% lower values for dynamic pressure compared to static pressure. These empirical values are based on the knowledge that, in pressure systems, unexpected pressure peaks which are higher than the working pressure are generated as a result of activation of valves, sudden falling or rising load or simply the change of cross-sections in the pipes. With conventional measurement techniques (such as manometers), these pressure peaks are hardly measurable. Faster measurement systems must therefore be used for this data acquisition. Attempts are being made to take this into account by using empirical or corrective factors.

If the pressure ratios are known and the pressure change rates are  $\leq 0.1$  bar/ms, our pressure switches and transmitters can be used up to the permitted overpressure protection as per data sheet / catalogue. Only 50 % of the specified overpressure protection is permitted when operating at the maximum permitted pressure change rate of  $\leq 1$  bar/ms for mechanical pressure switches, and at  $\leq 5$  bar/ms for transmitters.

## RoHS-Compliance

**RoHS**  
= Restriction of Hazardous Substances  
(EC Directive 2011/65/EU (RoHS II))



## CE mark

European Parliament and Council directives must be observed when products are launched onto the market. If a directive exists for a product, it must be applied. Only products for which a directive exists may bear the CE mark.

Mechanical pressure switches with a supply voltage above 50 VAC or 75 VDC are covered by the 2014/35/EU Low Voltage Directive. Variants for potentially explosive areas are covered in addition by the 2014/34/EU ATEX Product Directive.

Our electronic products satisfy EMC (Electromagnetic Compatibility) Directive 2014/30/EC.

Mechanical pressure switches do not fall under the EMC Directive.

The Machinery Directive 2006/42/EC is not applicable, because our products are classed as components.

Our product designs are based upon "good engineering practise" in line with Article 4, Paragraph 3 of the Pressure Equipment Directive (2014/68/EU), meaning neither a declaration of conformity may be issued nor a CE mark affixed.

The current product-specific CE declaration is available for download from the download area on our homepage:  
[www.suco.de/Downloads.htm](http://www.suco.de/Downloads.htm)



Subject to technical changes.