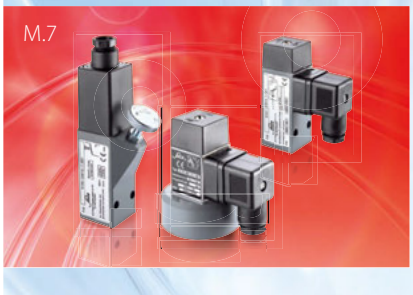
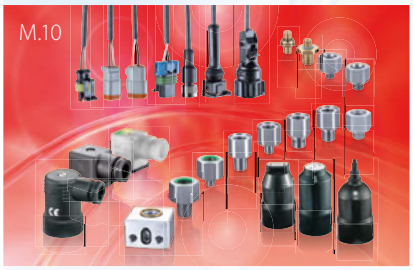
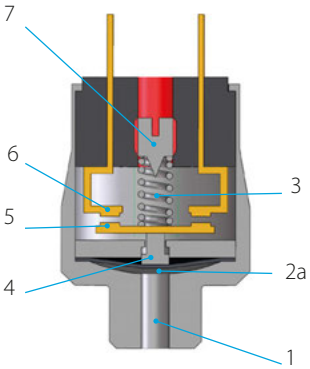
M. Overview of mechanical pressure switches



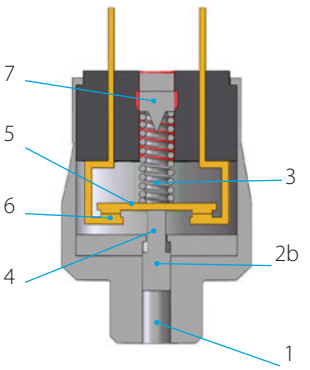


Technical explanations for mechanical pressure switches

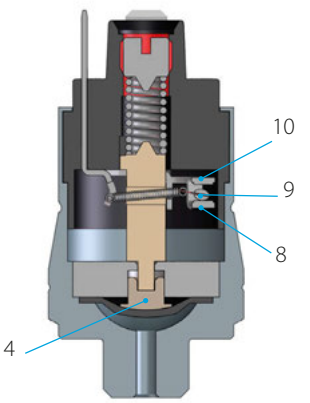
Diaphragm pressure switch
NO



Piston pressure switch
NC



Change-over



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 overpressure safety of 35, 100, 300 / 400 and 600 / 700 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); overpressure safety of up to 600 / 700 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 force of the pre-tensioned 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 (according 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.

B10d value
According to DIN EN ISO 13849-1, 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.

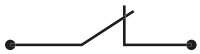
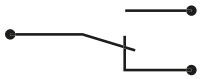
The specification of a MTTF time (mean time to failure) is not possible without knowing the specific conditions in the application. However, the MTTF time can be determined easily from the B10d value:

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

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.

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	

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.

If no switching point is specified on order, the pressure switches are adjusted by approximately half the adjustment range at factory.

The setting ranges specified for the respective device series apply to increasing pressure.
For switching points that are specified for falling pressure and are within the maximum value of the setting range minus the hysteresis, the next higher setting range must be selected (see also section „Hysteresis").

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.

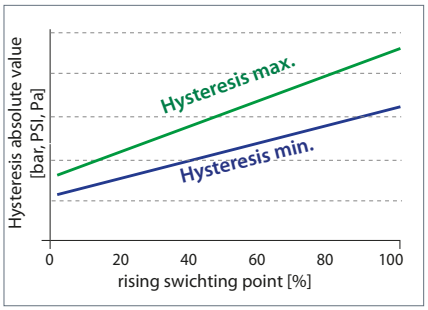
The switching point (for rising pressure) and hysteresis increase, whilst the switch-back point (for falling pressure) sinks.

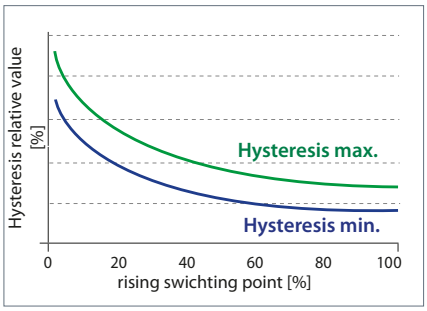
Also, the effect of the maximum (system) pressure on the switchback point (for falling pressure ramp) must be factored in for tolerance-critical applications. The higher the (system) pressure, the lower the resulting switch-back value.

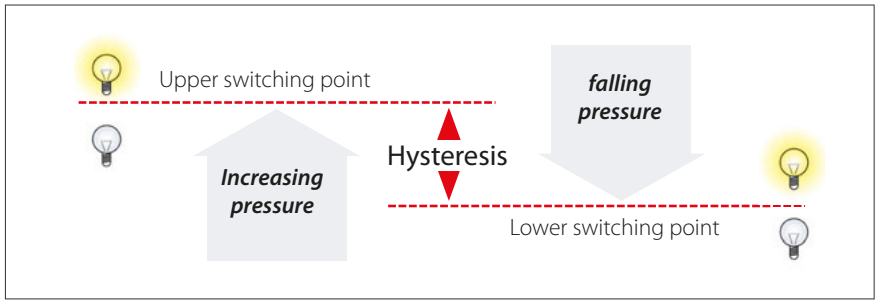
Hysteresis
Rising / falling switching point
The pressure difference between the rising (upper) and falling (lower) switching points (refer to the figure, e.g. NO) is known as hysteresis (switch-back difference).

Hysteresis has no constant value due to the structural layout of a mechanical pressure switch. In absolute values, the hysteresis is also the smallest with the smallest adjustment range. The hysteresis increases with increasing adjustment range.

Hysteresis over rising switching point







Technical explanations for mechanical pressure switches

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.

Due to their design, pressure switches with an overpressure resistance of 100 bar have smaller hystereses than the series with 300 bar or 400 bar overpressure resistance. Piston pressure switches have a slightly larger hysteresis than diaphragm 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/min specified by us is a guideline value. Higher switching frequencies 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 order 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 order number.

EPDM-TW with drinking water approval
This EPDM material is intended for drinking water applications (up to max. 35 bar overpressure safety) according to Elastomer Guideline, WRAS (Water Regulation Advisory Scheme), ACS (Attestation de Conformité Sanitaire) and NSF 61 (National Sanitation Foundation) and for use in medical and pharmaceutical applications.

EPDM-TW may not come into contact with oil because this would entail swelling and softening of the material, and so failure of the pressure switch. Sealing is only available upon request, so please consult us before ordering.
EPDM-TW is denoted by number „5“ in our order 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 order number.

FFKM
This diaphragm material is suitable for temperature exposure up to 120°C and can withstand very aggressive conditions such as chemical species including organic or inorganic acids, diluted alkalis, ketones, esters, alcohols, fuels and hot water.
FFKM is denoted by number „6“ in our order number.

TPE (Thermoplastic elastomers)
This sealing material is available only for our electronical products of the Performance Series.
TPE offers similar media compatibility like NBR, e.g suitable for mineral oil and hydraulic fluids.
Additionally the material can be used with diluted acids and bases and cold water, too.
TPE is denoted by number „7“ in our order 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 order 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 order 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 order 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/m²	bar	Torr	lbf/in², PSI
1 Pa = N/m²	Pascal	1	0.00001	0.0075	0.00014
1 bar	Bar	100 000	1	750.062	14.5
1 Torr = 1 mmHg	Millimetres, mercury column	133.322	0.00133	1	0.01934
1 lbf/in² = 1 PSI	Pound-force per square inch	6 894	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

Water applications
Standard piston switches are not suitable for water applications.
Pressure switches in stainless steel with EPDM seal have a special sealing system and can therefore also be used for water with corrosion protection, water mixtures or emulsions. The use of other fluid mixtures should be clarified with SUCO (e.g. swelling of EPDM sealing could happen by water – oil mixture).

Pressure switches with stainless steel housings with EPDM-TW diaphragm, SUCO type „5" are designed for the use of drinking water.

Gas applications
Our pressure switches are suitable for liquid and gaseous media. Gaseous media place particular demands on leak-tightness how ever. 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).

For gaseous applications below 10 bar (145 PSI) in combination with pressure switches with high IP class, i.e. IP 67 and IP6K9K, in general we recommend to use ventilation. Please consult us; we are able to offer suitable solutions.

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

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

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

Please consult us about gas, water and oxygen applications.

Subject to technical changes.

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 on the download area of our homepage: *https://www.suco.de/en/downloads*

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.

At-a-glance overview of mechanical pressure switches

	[illegible]																	■	■	■	■	■
	max. 24 V / 50 mA																					
Adjustment range	100 – 950 mbar																					
	200 – 950 mbar																					
	0,1 – 1 bar	■		■		■		■		■		■		■		■						
	0,2 – 2 bar																					
	0,3 – 1,5 bar																	■		■		■
	0,5 – 1 bar																					
	0,5 – 3 bar	■		■		■		■		■		■		■		■						
	0,5 – 5 bar																					
	1,0 – 6 bar																					
	1,0 – 10 bar	■		■		■		■		■		■		■		■		■		■		■
	2,0 – 20 bar																					
	5,0 – 50 bar																					
	10 – 20 bar	■		■		■		■		■		■		■		■						
	10 – 50 bar																	■		■		■
	10 – 100 bar																	■		■		■
	20 – 50 bar	■		■		■		■		■		■		■		■						
	20 – 100 bar																					
	25 – 250 bar																					
	40 – 400 bar																					
	50 – 100 bar																					
	50 – 150 bar		■		■		■		■		■		■		■		■					
	50 – 200 bar																		■		■	
	100 – 300 bar																					
	100 (200) – 400 bar																					
Overpressure savety up to	35 bar																					
	100 bar																					
	200 bar																					
	300 bar	■		■		■		■		■		■		■		■		■		■		■
	600 bar		■		■		■		■		■		■		■		■		■		■	
Size	hex 24	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■					
	hex 27																	■	■	■	■	■
	30 A/F																					
Housing material	Zinc-platted steel	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
	stainless steel																					
	Brass																					
	Aluminium																					
Custom variant	ATEX																					
	Configurable																					
	additional functions																					
	cCSAus approval	■	■	■	■	■	■	■	■	■	■	■	■	■	■			■	■	■	■	■

		M.1 **hex 24** **with integrated connector**																M.2 **hex 27** **with integrated connector**				
		0110	0111	0112	0113	0114	0115	0116	0117	0118	0119	0120	0121	0122	0123	0124	0125	0132	0133	0134	0135	0136
	Page	26	27	26	27	26	27	26	27	26	27	28	29	26	27	26	27	34	34	34	34	34
Function	Overpressure	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
	Vacuum																					
	NO / NC	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■					
	Changeover contacts																	■	■	■	■	■
Voltage	max. 42 V	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■					
	max. 48 V																	■	■	■	■	■
	max. 250 V																					
	max. 24 V / 50 mA																					
Adjustment range	100 – 950 mbar																					
	200 – 950 mbar																					
	0,1 – 1 bar	■		■		■		■		■		■		■		■						
	0,2 – 2 bar																					
	0,3 – 1,5 bar																	■		■		■
	0,5 – 1 bar																					
	0,5 – 3 bar	■		■		■		■		■		■		■		■						
	0,5 – 5 bar																					
	1,0 – 6 bar																					
	1,0 – 10 bar	■		■		■		■		■		■		■		■		■		■		■
	2,0 – 20 bar																					
	5,0 – 50 bar																					
	10 – 20 bar	■		■		■		■		■		■		■		■						
	10 – 50 bar																	■		■		■
	10 – 100 bar																	■		■		■
	20 – 50 bar	■		■		■		■		■		■		■		■						
	20 – 100 bar																					
	25 – 250 bar																					
	40 – 400 bar																					
	50 – 100 bar																					
	50 – 150 bar		■		■		■		■		■		■		■		■					
	50 – 200 bar																		■		■	
	100 – 200 (300) bar		■		■		■		■		■		■		■		■					
	100 (200) – 400 bar																					
Overpressure savety up to	35 bar																					
	100 bar																					
	200 bar																					
	300 (400) bar	■		■		■		■		■		■		■		■		■		■		■
	600 (700) bar		■		■		■		■		■		■		■		■		■		■	
Size	hex 24	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■					
	hex 27																	■	■	■	■	■
	30 A/F																					
Housing material	Zinc-platted steel	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
	stainless steel																					
	Brass																					
	Aluminium																					
Custom variant	ATEX																					
	Configurable																					
	additional functions																					
	cCSAus approval	■	■	■	■	■	■	■	■	■	■	■	■	■	■			■	■	■	■	■

	M.2 **hex 27 with int. connector**					M.3 **hex 24 NO / NC**						M.4 **hex 27 CO**											M.5 **hex 27 Configured**			
	0137	0184	0185	0194	0195	0163	0164	0166	0167	0168	0169	0140	0141	0170	0171	0180	0181	0183	0186	0187	0190	0191	0196	0197	0240	0241
Page	34	36	37	38	39	42	48	44	50	46	47	55	55	56	56	57	57	58	59	59	60	60	61	61	65	65
Overpressure	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Vacuum																										
NO / NC						■	■	■	■	■	■															
Changeover contacts	■	■	■	■	■							■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
max. 42 V						■	■	■	■	■	■			■	■											
max. 48 V	■																									
max. 250 V		■	■									■	■			■	■	■	■	■					■	■
max. 24 V / 50 mA				■	■																■	■	■	■		
100 – 950 mbar																										
200 – 950 mbar																										
0,1 – 1 bar						■	■	■	■	■																
0,2 – 2 bar																										
0,3 – 1,5 bar		■		■								■		■		■			■		■		■		■	
0,5 – 1 bar																										
0,5 – 3 bar						■	■	■	■	■																
0,5 – 5 bar																			■				■			
1,0 – 6 bar																										
1,0 – 10 bar		■		■		■	■	■	■	■		■		■		■			■		■		■		■	
2,0 – 20 bar																										
5,0 – 50 bar																										
10 – 20 bar						■	■	■	■	■		■													■	
10 – 50 bar		■		■										■		■			■		■		■			
10 – 100 bar		■		■										■		■			■		■		■			
20 – 50 bar						■	■	■		■		■													■	
20 – 100 bar																										
25 – 250 bar																										
40 – 400 bar																										
50 – 100 bar																										
50 – 150 bar											■															■
50 – 200 bar	■		■		■										■					■		■		■		
100 – 200 (300) bar											■							■								
100 (200) – 400 bar																		■								
35 bar									■																	
100 bar		■		■										■		■					■					
200 bar																										
300 (400) bar		■		■				■		■		■		■		■			■		■		■		■	
600 (700) bar	■		■		■	■	■				■		■		■		■	■		■		■		■		■
hex 24						■	■	■	■	■	■															
hex 27	■	■	■	■	■							■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
30 A/F																										
Zinc-platted steel	■	■	■	■	■	■		■		■	■	■	■	■	■	■	■	■			■	■				
stainless steel							■												■	■			■	■		
Brass									■																	
Aluminium																										
ATEX																										
Configurable						■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
additional functions																										
cCSAus approval	■	■	■	■	■	■	■	■	■	■	■			■	■	■	■		■	■	■	■	■	■		

M.6 Pressure Switches *PLUS* hex 24 with intelligent electronic functions															M.7 hex 30 CO				M.8 ATEX Variant					M.9 Vacuum Switch			
0410	0411	0412	0413	0414	0415	0416	0417	0418	0419	0422	0423	0424	0425		0159	0161	0162	0175	0165	0340	0341	0342	0343	0150	0151		
70	72	70	72	70	72	70	72	70	72	70	72	70	72		76	77	77	78	83	84	84	85	85	88	89	Page	
■	■	■	■	■	■	■	■	■	■	■	■	■	■		■	■	■	■	■	■	■	■	■			Overpressure	**Function**
																								■	■	Vacuum	
■	■	■	■	■	■	■	■	■	■	■	■	■	■												■	NO / NC	
															■	■	■	■	■	■	■	■	■	■		Changeover contacts	
■	■	■	■	■	■	■	■	■	■	■	■	■	■												■	max. 42 V	**Voltage**
																										max. 48 V	
															■	■	■	■	■	■	■	■	■	■		max. 250 V	
																										max. 24 V / 50 mA	
																								■		100 – 950 mbar	**Adjustment range**
																									■	200 – 950 mbar	
■		■		■		■		■		■		■						■		■		■				0,1 – 1 bar	
															■											0,2 – 2 bar	
																										0,3 – 1,5 bar	
																■	■									0,5 – 1 bar	
																										0,5 – 3 bar	
															■	■	■									0,5 – 5 bar	
																			■							1,0 – 6 bar	
■		■		■		■		■		■		■			■	■	■			■		■				1,0 – 10 bar	
															■											2,0 – 20 bar	
															■				■							5,0 – 50 bar	
■		■		■		■		■		■		■								■		■				10 – 20 bar	
																■	■									10 – 50 bar	
															■											10 – 100 bar	
■		■		■		■		■		■		■								■		■				20 – 50 bar	
																										20 – 100 bar	
															■				■							25 – 250 bar	
															■											40 – 400 bar	
																■	■									50 – 100 bar	
	■		■		■		■		■		■		■								■		■			50 – 150 bar	
																										50 – 200 bar	
																										100 – 200 (300) bar	
																■	■		■							100 (200) – 400 bar	
																		■						(■)	■	35 bar	**Overpressure savety up to**
																										100 bar	
															■	■	■		■							200 bar	
■		■		■		■		■		■		■								■		■				300 (400) bar	
	■		■		■		■		■		■		■		■	■	■		■		■		■			600 (700) bar	
■	■	■	■	■	■	■	■	■	■	■	■	■	■												■	hex 24	**Size**
																				■	■	■	■			hex 27	
															■	■	■	■	■					■		30 A/F	
■	■	■	■	■	■	■	■	■	■	■	■	■	■							■	■	■	■			Zinc-platted steel	**Housing material**
																										stainless steel	
																									■	Brass	
															■	■	■	■	■					■		Aluminium	
																			■	■	■	■	■			ATEX	**Custom variant**
																				■	■	■	■		■	Configurable	
■	■	■	■	■	■	■	■	■	■	■	■	■	■													additional functions	
																									■	cCSAus approval	