

Technical Datasheet



Magnetic Vertical Displacer Type Level Switches

For Critical Area Applications or General Purpose Control

Key Features

- Unique switching mechanism – totally reliable
- No springs in switch mechanism – positive snap action switching
- Vibration resistant – eliminates spurious trips
- Multiple switch point options – cost effective control
- Genuine hermetically-sealed switch option – totally safe and secure

Series Overview

Whether you require a switch for critical area applications or just general purpose control, the extensive range of Mobrey switches ensures that we will always have a solution to your particular problem.

A choice of displacer-type or float-type operated level switch is available to order for direct vertical mounting (no chamber included).

These level switches can be optionally supplied mounted vertically in chambers, in a sealed or removable form. A range of carbon steel chambers are available, and for more vigorous applications there are stainless steel chambers.

There are a variety of instrument and process connection options available to make installation simple and economic. This gives you the choice to meet your application in keeping with your budget.

Other products

Other products we can offer :

- Float type switches
- Chamber mount instruments



Product applications

- Unique hermetically-sealed switching mechanism option
- Unique treble-seal pressure tube and union
- Wide range of mounting options
- External chamber options
- Rugged, robust, and trusted all over the world
- Ideal for tough process control duties
- Operates in almost any liquid at high pressures and temperatures
- Multiple switch points
- Unique three-magnet, snap action, and latching switch mechanism

How can we help you?

Delta Mobrey offers fast, efficient and knowledgeable support when and where you need it. Please visit our website at www.delta-mobrey.com to find your local support centre or call us on: **+44 (0)1252 729140**

Magnetic Vertical Level Switches
For Critical Area Applications or General Purpose Control



Introduction

Whether you require a switch for critical area applications or just general purpose control, the extensive range of Mobrey switches ensures that we will always have a solution to your particular problem.

A choice of float-type or displacer-type operated level switch is available to order for direct vertical mounting (no chamber included).

These level switches can be optionally supplied mounted vertically in chambers, in a sealed or removable form. A range of carbon steel chambers are available, and for more vigorous applications there are stainless steel chambers.

There are a variety of instrument and process connection options available to make installation simple and economic. This gives you the choice to meet your application in keeping with your budget.

Quality and reliability

Mobrey vertical magnetic level switches for industrial and process control use have been available for over 20 years and have gained a reputation for quality and reliability.

Choice of switching mechanisms

There are two switching functions available: 2 x SPST (SPCO) or DPDT (DPCO) switching, and each comes in four variants:

- **General purpose** with silver cadmium oxide contacts for long life
- **Low power circuit** with gold-plated contacts for use in low current and voltage applications such as Intrinsically Safe (IS) circuits
- **High power circuits** giving up to 10 Amps switching capability
- **Hermetically-sealed** for the ultimate in reliability – *sealed for life*

Based on the industry-standard boiler water level controls, these controls use the same three-magnet switch mechanism for snap-action latching and switching. The design of this unique switch mechanism overcomes all the inherent problems of mercury tubes and micro switches. Even under severe vibration conditions, there are no springs to cause contact bounce, hover, or even failure. The snap-action magnets give a positive and stable latching, time after time.

Operation in extreme conditions

When controls are required to operate in extreme conditions, the unique Mobrey hermetically-sealed switch provides dependable life-long operation that you can rely on. With all its moving parts and contacts completely enclosed, this genuine hermetically-sealed switch is suitable for use in corrosive atmospheres and low temperature environments.

Features

- Unique switching mechanism – *totally reliable*
- No springs in switch mechanism – *positive snap action switching*
- Vibration resistant – *eliminates spurious trips*
- Multiple switch point options – *cost effective control*
- Genuine hermetically-sealed switch option – *totally safe and secure*
- Extensive range of chambers – *suitable for most applications*
- Relevant chambers are supplied CE marked and fully compliant with the Pressure Equipment Directive (97/23/EC)
- Designed to ASME B31.3
- Weld procedures approved to EN ISO 15614-1 and ASME IX
- Welders approved to EN 287-1
- Material certification to EN 10204, 3.1
- Materials to ASTM and British Standards (BS)

Approvals

- CSA approval:
Explosion-proof for Class I, Div 1, Groups B, C, and D
- Factory Mutual (FM) approval:
Explosion-proof for Class I, Div 1, Groups B, C, and D
Class II, Div 1, Groups E, F, and G
General Area, Weatherproof type NEMA 4
- Flameproof ATEX II 1/2G Ex d IIC T6 Ga/Gb (-50 °C ≤ Ta ≤ 60 °C)
- Flameproof IECEx Ex d IIC T6 Ga/Gb (-50 °C ≤ Ta ≤ 60 °C)
- Technical Regulation Customs Union (EAC) Flameproof 1Exd IIC T6X
(see certificate RU C-GB.1506.B.00078 for Ta range) and Ordinary Location Mark

Intrinsically Safe Use

For intrinsically safe circuits, gold-plated switch contacts are recommended. Users are reminded that it is their responsibility to obtain the necessary system approval and licences for such circuits.

BS EN ISO 9001: 2008

Delta Mobrey has been assessed and approved by Lloyds Register Quality Assurance against BS EN ISO 9001: 2008 for the design, development, assembly and re-calibration of precision instruments and systems for the measurement and indication of electrical signals, gas and liquid density, viscosity, pressure, level, flow and water/steam systems.

Quality assurance

With over 20 years worldwide experience in the major power, nuclear and petro-chemical industries, we are able to accommodate testing, surveying and documentation requirements as specified at the time of order. Inspection by customers or nominated inspection agencies can be arranged.

Table 1. Ordering Information: direct mounting vertical displacer-type level switch

★The Standard offering represents the most common options. The starred options (★) should be selected for best delivery.
The Expanded offering is subject to additional delivery lead time

Product Description				
D ⁽¹⁾	Direct mounting vertical level control (no chamber)			
Mounting Flange Material			Temperature Range	
Standard				Standard
C	Carbon steel		– 10 to +300 °C	★
S	316L stainless steel		– 50 to +300 °C	★
Function and Specification ⁽²⁾		Maximum Pressure at 20 °C	Temperature Range	
Standard				Standard
11D ⁽³⁾	Displacer, 3-in. NB, one switch, narrow differential		– 50 to +300 °C (See also Switch Mechanism Type for further limits)	★
12D ⁽³⁾	Displacer, 3-in. NB, one switch, wide differential			★
13D ⁽³⁾	Displacer, 3-in. NB, two switches, two wide differentials			★
18D ⁽³⁾	Displacer, 3-in. NB, two switches, two narrow differentials			★
Expanded				
20D ⁽⁴⁾	Floating roof detection			
21D ⁽⁴⁾	Floating roof and overflow detection			
Switch Enclosure ⁽⁵⁾				
Standard				Standard
S	150 mm (can fit one or two switch mechanisms)			★
Product Certifications			Enclosure Material	
Standard				Standard
E5	FM explosion-proof		A or I	★
E6	CSA explosion-proof		A or I	★
EM ⁽⁶⁾	Technical Regulation Customs Union (EAC) Flameproof		(6)	★
G5	FM ordinary location (unclassified, safe area)		N	★
G6	CSA ordinary location (unclassified, safe area)		N	★
GM ⁽⁶⁾	Technical Regulation Customs Union (EAC) Ordinary Locations Mark		(6)	★
KN	ATEX / IECEx flameproof		A or I	★
NA	No hazardous location certificates		N	★
Switch Enclosure Housing Material				
Standard				Standard
N	Aluminium alloy base, drawn steel cover			★
A	Aluminium alloy			★
I	Cast iron			★
Conduit Entry				
Standard				Standard
A	1-in NPT			★
B	20 mm thread			★

★The Standard offering represents the most common options. The starred options (★) should be selected for best delivery.
The Expanded offering is subject to additional delivery lead time

The Expanded Switching is subject to additional delivery lead time

Number of Switch Mechanisms			
Standard			Standard
1	One switch		★
2	Two switches		★
Switch Mechanism Type ⁽⁷⁾			Maximum Wetside Temperature ⁽⁸⁾
Standard			Standard
D4	4 Contact: 2 × SPST (SPCO), general purpose	300 °C	★
P4	4 Contact: 2 × SPST (SPCO), low power circuits		★
X4	4 Contact: 2 × SPST (SPCO), high power circuits	250 °C	★
H4	4 Contact: 2 × SPST (SPCO), hermetically sealed		★
D8	8 Contact: DPDT (DPCO), general purpose	300 °C	★
P8	8 Contact: DPDT (DPCO), low power circuits		★
X8	8 Contact: DPDT (DPCO), high power circuits	250 °C	★
H8	8 Contact: DPDT (DPCO), hermetically sealed		★
Process Connection Size ⁽⁹⁾			
Standard			Standard
1	1 in. / 25 mm		★
3	3 in. / 80 mm		★
4	4 in. / 100 mm		★
Process Connection Rating ⁽⁹⁾			Connection Size
Standard			Standard
AA	ASME B16.5 Class 150		3 or 4
AB	ASME B16.5 Class 300		3 or 4
AC	ASME B16.5 Class 600		3 or 4
NN	NPT thread, 316 stainless steel		1
Process Connection Type			Connection Rating
Standard			Standard
R	Raised Face (RF) flange		AA, AB, or AC
N	NPT thread, 316 stainless steel		NN
Typical Model Number: D C 13D S N A N A 2 D4 3 A A R			

- (1) Supplied with 3 m of 316 stainless steel displacer cable as standard. Other lengths are available on request.
 (2) The switching-point is adjusted by moving the displacer elements on the cable. See "Displacer-type dimensions" on page 16 for information about this.
 (3) For minimum specific gravity requirements, see the section "Displacer-type dimensions" on page 16.
 (4) This switch is designed specifically for use on floating roof tanks to signal an alarm if the roof rises too high. See Product Data Sheet IP107/FR for full details.
 (5) See "Mobrey switch enclosures" on page 13 for information about these options.
 (6) Contact an Delta Mobrey Limited representative for additional information.
 (7) See "Mobrey switch mechanisms and ratings" on page 12 for information about these options.
 (8) The maximum wetside temperatures shown here override the maximum wetside temperatures shown in Table 6 on page 12.
 (9) Other flange sizes and ratings are available on request.

Technical Specifications

Material selection

Delta Mobrey provides a variety of Mobrey products with various product options and configurations including materials of construction that can be expected to perform well in a wide range of applications. The Mobrey product information presented is intended as a guide for the purchaser to make an appropriate selection for the application.

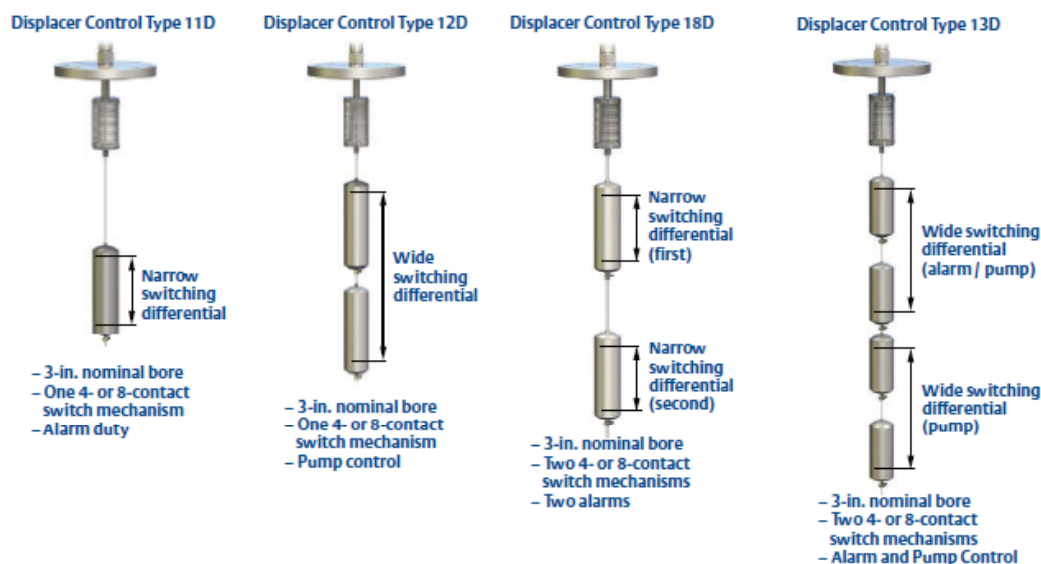
Direct mount displacer controls

Mobrey displacer-operated controls are ideal for sump applications and other top-mounting duties such as a low level alarm warning in deep tanks.

The operation principles also make them suitable, in a modified form, for very high pressure or low specific gravity applications.

The four most popular displacer arrangements are shown in Figure 3, which covers most of the likely applications. However, if you have a different requirement, we would be pleased to quote a model for your particular application.

Figure 3. Popular displacer arrangements



Operation principles

The displacer element, made of 316 stainless steel, is suspended on a stainless steel cable from a Nimonic 90 spring. The element is always heavier than its equivalent volume of the liquid in which it is to operate, and so will extend the tension spring at all times. In free air, the spring will be extended to a known length, controlled by a mechanical stop to prevent overstressing. Fixed to the spring is the rod and magnet assembly, free to move up and down as the spring extends or contracts.

As liquid rises to cover the displacer element, a buoyancy force is created equal to the weight of the liquid displaced. This force, in effect, is seen by the spring as a reduction in weight, causing the spring to contract. The spring contraction moves the magnet upwards and actuates the switch mechanism.

On a falling liquid level, the displacer element is uncovered and the spring sees an increasing effective weight, causing the spring to extend and move the magnet downwards to re-set the switch mechanism.

This simple principle can be refined to operate a single switch over a very wide differential (12D arrangement) by providing the buoyancy force from two elements instead of just one.

Two-switch-mechanism models are available for either two-alarms duty with two narrow differentials (18D arrangement) or for pump control/alarm duty with appropriate differentials (13D arrangement).

In all cases, because the elements are suspended on a cable, switching or control levels can be several metres below the mounting flange, and are fully field adjustable by re-setting the elements on the cable. The standard cable length is 3 m but can be cut to a shorter length (see "Dimensional Drawings" on page 16 for minimum lengths).

Mobrey switch mechanisms and ratings

Each Mobrey switch mechanism has flying leads which are factory-wired to the ceramic terminal blocks (in the enclosure) for SPST (SPCO) relay operation, as shown in Figure 4. For DPDT (DPCO) relay operation, the installer must common any one pair of A and B wires in the terminal block for each of the two sets of mechanisms.

Table 6. Mobrey switch mechanisms

Type	Purpose ⁽¹⁾
D4 or D8	General purpose switch mechanism.
X4 or X8	High current switch mechanism.
P4 or P8	Switch mechanism with gold-plated contacts for use in low-power or intrinsically safe circuits.
H4 or H8	Hermetically-sealed mechanism with gold-plated contacts. All moving parts and contacts are enclosed in an inert gas-filled stainless steel enclosure. Suitable for use in low temperatures, contaminated atmospheres, and intrinsically safe circuits.

(1) Switches must not be used for the direct starting of motors.

Figure 4. Mobrey switch mechanisms

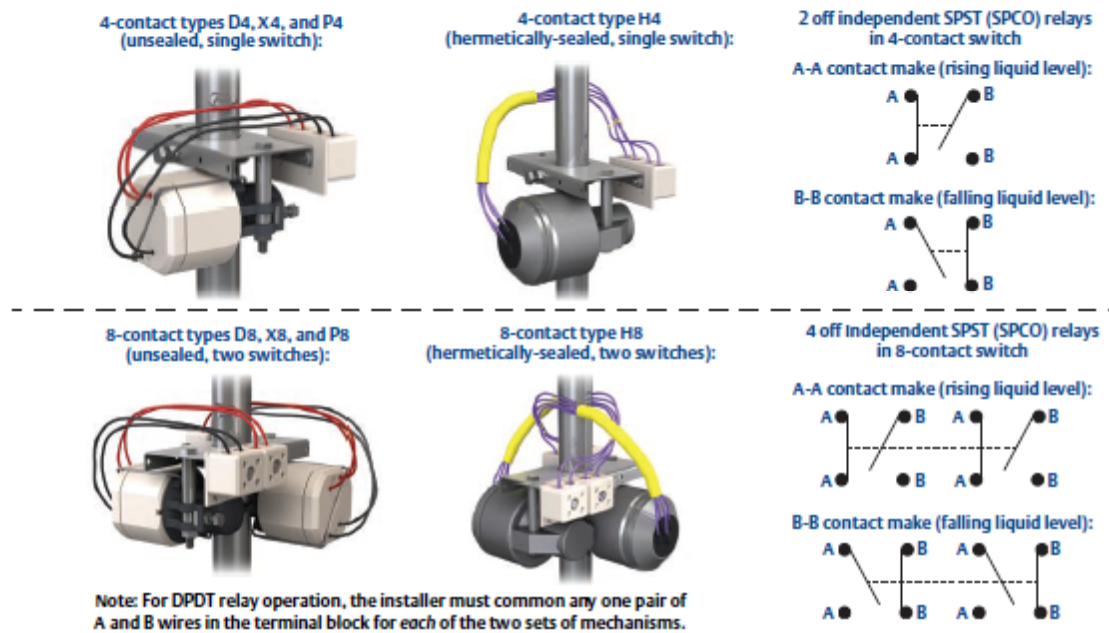


Table 7. Electrical ratings for Mobrey switch mechanisms

Type	Maximum wetside temperature ⁽¹⁾	Low temperature use	AC maximum values			DC maximum values			
			VA	Volts	Amps	Watts	Volts	Residual amps	Inductive amps
D4 or D8	400 °C	No	2000	440	5	50	250	5	0.5
X4 or X8	250 °C	No	2000	440	10	50	250	10	0.5
P4 or P8 ⁽²⁾	400 °C	No	6	250	0.25	3.6	250	0.25	0.1
H4 or H8 ⁽³⁾	250 °C	-50 °C	2000	440	5	50	250	5	0.5

(1) See also ordering information tables on pages 4, 6, and 8 for further operating temperature limits.

(2) The gold plating on the contacts of P4 and P8 switch mechanisms may be permanently damaged if the mechanisms are used to switch circuits with values greater than those shown above.

(3) The gold plating on the contacts of H4 and H8 switch mechanisms may be permanently damaged if the mechanisms are used to switch circuits with values greater than those shown for P4 and P8 above.

Mobrey switch enclosures

Figure 5. Mobrey switch enclosures



Weatherproof NEMA 4 / IP66 enclosures

- Aluminium alloy base and drawn steel cover (code "N")
- Type S**N: up to 94 mm switch point adjustment

Flameproof and explosion-proof enclosures

- Aluminium alloy base and cover (code "A")
- Cast iron base and cover (code "I")
- Type S**A or S**I: up to 94 mm switch point adjustment
- These enclosures also have a weatherproof rating to NEMA 4 / IP66

Conduit entries

- Enclosures supplied with 4-contact switch mechanisms have a single 1-in. NPT conduit entry
- Enclosures supplied with 8-contact switch mechanisms have two 1-in. NPT conduit entries.
- Weatherproof NEMA 4 / IP66 enclosures with 8-contact switches are supplied with a cast iron base instead of the aluminium alloy base, and have two 1-in. conduit entries.

Tube and unions

- 316 stainless steel throughout
- Welded construction with additional swaging technique to ensure maximum integrity
- Individually pressure tested to 150 bar (operating pressure is limited by the float or flange specified)

Paint Finish:

- Black stovepaint
- Epoxy paint finishes available on request

Quality standards

Mobrey Vertical Level Controls are manufactured to the highest standards of quality with only certified materials: BS EN 10204: 2004-3.1. Design of Mobrey chambers is in accordance with ASME B31.3. Relevant chambers are supplied CE marked and fully compliant with the Pressure Equipment Directive (97/23/EC).

Weld procedures approved to EN ISO 15614-1 and ASME IX, welders approved to BS EN 287-1. Circumferential and set-on branch welds are full penetration welds, with visual inspection in accordance with ASME B31.3 "normal service" requirements and our company standard 417.

All pressure retaining assemblies are hydrostatically pressure tested to a minimum of $1.43 \times$ maximum working pressure or to flange standard requirements.

Radiography or other NDT techniques can be accommodated provided that they are specified at time of order entry.

Inspection

Whilst Delta Mobrey employ inspectors in house, unconnected with production, customers frequently ask for outside inspection. We are happy to accommodate nominated inspectors if agreed at order entry.

Some specifications require a quality control plan detailing inspection points and hold points. Delta Mobrey will produce these QC plans for customer approval if agreed at order entry.

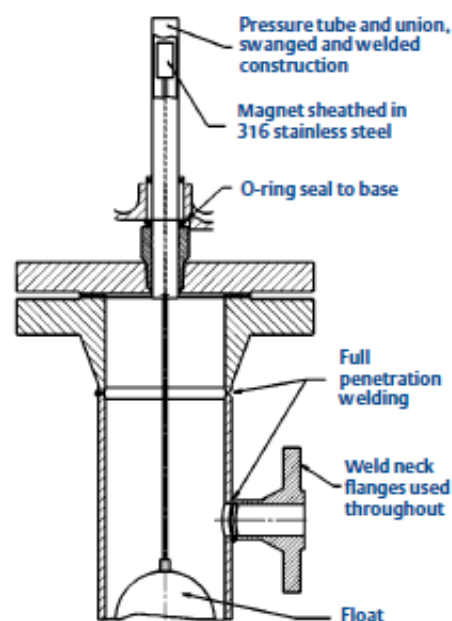


Table 10. Pressure ratings (bar)

Material	Carbon steel: A105			Stainless steel: 316L		
	20 °C	250 °C	400 °C	20 °C	250 °C	400 °C
ASME B16.5 Class 150	19.6	12.1	6.5	15.9	10.5	6.5
ASME B16.5 Class 300	51.1	41.9	34.7	41.4	27.5	24.3
ASME B16.5 Class 600	102.1	83.9	69.4	82.7	54.9	48.6

Table 11. Construction materials

	Carbon steel chamber	Stainless steel chamber
Chamber tube	ASTMA106 grade B	ASTMA312 TP316L
Top casting	ASTMA216	-
Top/bottom caps	ASTMA105	ASTMA182 F316L / A403 WP316L
Top cover	ASTMA105	ASTMA182 F316L
Flanges/fittings	ASTMA105	ASTMA182 F316
Studs	ASTMA193-B7	ASTMA320-L7
Nuts	ASTMA194-2H	ASTMA194 Grade 7+S3
Standard carbon steel chamber temperature range is -10 to +400 °C. Stainless steel chamber temperature range is -101 to +400 °C.		

Options

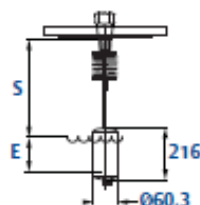
- Low temperature carbon steel
- Ratings up to ASME Class 2500
- N.A.C.E. requirements
- Process connections to specification
- Cr. mo. steels
- N.D.T. to your specifications
- Duplex UNS31803
- 3.1 identifiable certification
- Vent and drain connections

Dimensional Drawings

Displacer-type dimensions

Note that the minimum specific gravity requirement varies by displacer type and switching mechanism type.
Dimension S is the adjustable distance for the upper switching point level. Dimension E is the switching differential.

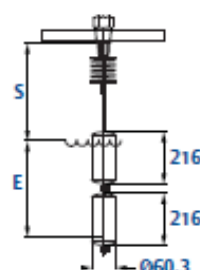
Table 12. Displacer-type dimensions



Type 11D (one 4- or 8-contact switch mechanism and narrow switching differential)

- Specify for alarm duty
- Switching point level can be changed by simply moving the displacer up or down the cable

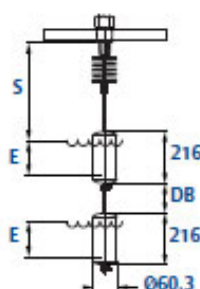
	4-contact switches (D4, P4, X4, and H4)				8-contact switches (D8, P8, X8, H8)		
S.G.	0.6	0.75	1.0	1.2	0.75	1.0	1.2
S (minimum)	315 mm	335 mm	365 mm	380 mm	275 mm	320 mm	340 mm
E	90 mm	70 mm	60 mm	55 mm	135 mm	105 mm	90 mm



Type 12D (one 4- or 8-contact switch mechanism and wide switching differential)

- The two displacer elements are positioned at any point on the cable to correspond to the switching point level required. Should the liquid level drop to the **lower displacer element**, the switch mechanism is actuated and starts (or stops) a pump. When the liquid rises to the **upper displacer element**, the switch mechanism is again actuated to stop (or start) the pump.

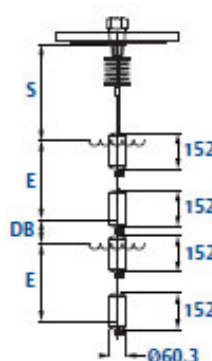
	4-contact switches (D4, P4, X4, and H4)				8-contact switches (D8, P8, X8, H8)		
S.G.	0.5	0.8	1.0	1.2	0.75	0.8	1.0
S (minimum)	415 mm	430 mm	430 mm	425 mm	390 mm	390 mm	400 mm
E	165 mm	110 mm	95 mm	80 mm	205 mm	200 mm	165 mm



Type 18D (two 4- or 8-contact switch mechanisms and two narrow switching differentials)

- The two displacer elements are positioned **apart** to form two separate switching (alarm) point levels. This arrangement is typical for a sump application.

	4-contact switches (D4, P4, X4, and H4)				8-contact switches (D8, P8, X8, H8)		
S.G.	0.6	0.8	1.0	1.2	0.8	1.0	1.2
S (minimum)	390 mm	385 mm	375 mm	365 mm	355 mm	350 mm	345 mm
E	90 mm	70 mm	60 mm	55 mm	135 mm	105 mm	90 mm
Dead band	200 mm	230 mm	255 mm	310 mm	165 mm	215 mm	250 mm



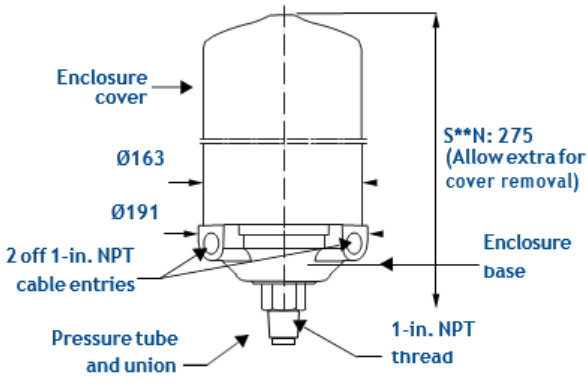
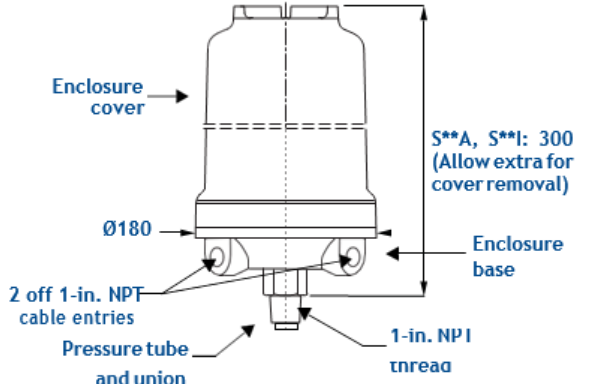
Type 13D (two 4- or 8-contact switch mechanisms and wide switching differential)

- A pump is controlled between the **middle** and the **lower** displacer elements positioned on the cable at the required levels. Should the level rise to the **upper** displacer element, this actuates the upper alarm switch which remains actuated until the level drops to the middle displacer element. Alternatively, the upper switch could control a second pump.

	4-contact switches (D4, P4, X4, and H4)				8-contact switches (D8, P8, X8, H8)		
S.G.	0.6	0.8	1.0	1.2	0.8	1.0	1.2
S minimum	390 mm	385 mm	375 mm	365 mm	355 mm	350 mm	345 mm
E	135 mm	110 mm	95 mm	80 mm	200 mm	145 mm	140 mm
Dead band	220 mm	255 mm	285 mm	310 mm	165 mm	215 mm	250 mm

Dimensions of switch enclosures

Table 14. Dimensions of switch enclosures

Weatherproof enclosures S**N	Hazardous area enclosures S**A, S**I
 <p>Enclosure cover</p> <p>Ø163</p> <p>Ø191</p> <p>2 off 1-in. NPT cable entries</p> <p>Pressure tube and union</p> <p>1-in. NPT thread</p> <p>Enclosure base</p> <p>S**N: 275 (Allow extra for cover removal)</p> <p>Dimensions for bases with a single 1-in. NPT cable entry are the same.</p>	 <p>Enclosure cover</p> <p>Ø180</p> <p>2 off 1-in. NPT cable entries</p> <p>Pressure tube and union</p> <p>1-in. NPT thread</p> <p>Enclosure base</p> <p>S**A, S**I: 300 (Allow extra for cover removal)</p> <p>Enclosure type S**I has a different cover look but the dimensions shown here are the same.</p> <p>Dimensions for bases with a single 1-in. NPT cable entry are the same.</p>

Approvals

GLOBAL CERTIFICATION



IECEX

FLAMEPROOF Certificate No. IECEX SIR 09.0038X
Ex d IIC T6....T1 Ga/Gb (Ta = -50°C to +60°C)



Functional Safety Certified

Meets the requirements of IEC 61508-2:2010 for use in safety related systems.

Systematic capability: SC 2;

Random Capability: Type A element

SIL1, 2 capable with HFT 0 (1oo1); Route 2_H and 2_S

SIL Capability (Low Demand Mode) = SIL2 ; SIL Capability (High demand mode) = SIL1

Certificate No. CSA FSP 22002

Note: the associated full package of Safety Documentation must be listed on the order acknowledgement.



NORTH AMERICA

Canadian Standards Association

Class I Div. 1 , Group B,C and D

C22.2 NO 14

CSA Enc 4

EUROPEAN DIRECTIVES



Low voltage Directive (LVD) 2014/35/EU.

Compliant to LVD

Pressure Equipment Directive (PED) 2014/68/EU:

The product has been designed and manufactured according to Sound Engineering Practice (SEP)



ATEX Directive 2014/34/EU

Sira 03ATEX1189X

II 1/2 G Ex d IIC T6....T1 Ga/Gb (Ta = -50°C to +60°C)

UK REGULATION



Electrical Equipment (Safety) Regulations 2016 .

Conform to UK SI 2016 No 1101 as amended

Pressure Equipment (Safety) Regulations UK SI 2016 No 1105, as amended

The product has been designed and manufactured according to Sound Engineering Practice (SEP)



Equipment and protective system for use in Potentially Explosive Atmospheres Regulation 2016

Certificate no. CSAE 21UKEX1616X

Ex db IIC T6...T1 Ga/Gb (Ta = -50°C to +60°C)

In the interest of development and improvement Delta Mobrey Ltd, reserves the right to amend, without notice, details contained in this publication. No legal liability will be accepted by Delta Mobrey Ltd for any errors, omissions or amendments.

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