

Technical brochure

# Pressure and temperature controls, Type CAS



The CAS Series consists of a series of pressure controlled switches and temperature controlled switches. In this series, special attention has been given to meeting demands for a high level of enclosure, robust and compact construction, and resistance to shock and vibration.

The CAS series is equipped with a microswitch with single pole changeover (SPDT) offering higher electrical loads (AC15: 4A, 440V), higher differential and adjustable differential compared to switches with contact system.

The series is suitable for use in alarm and regulation systems in factories, diesel plants, compressors, power stations and on board ships.

## Features

- A high level of enclosure
- Fixed differential
- Robust and compact construction
- Resistance to shock and vibration
- Available with all major marine approvals

**Approvals**

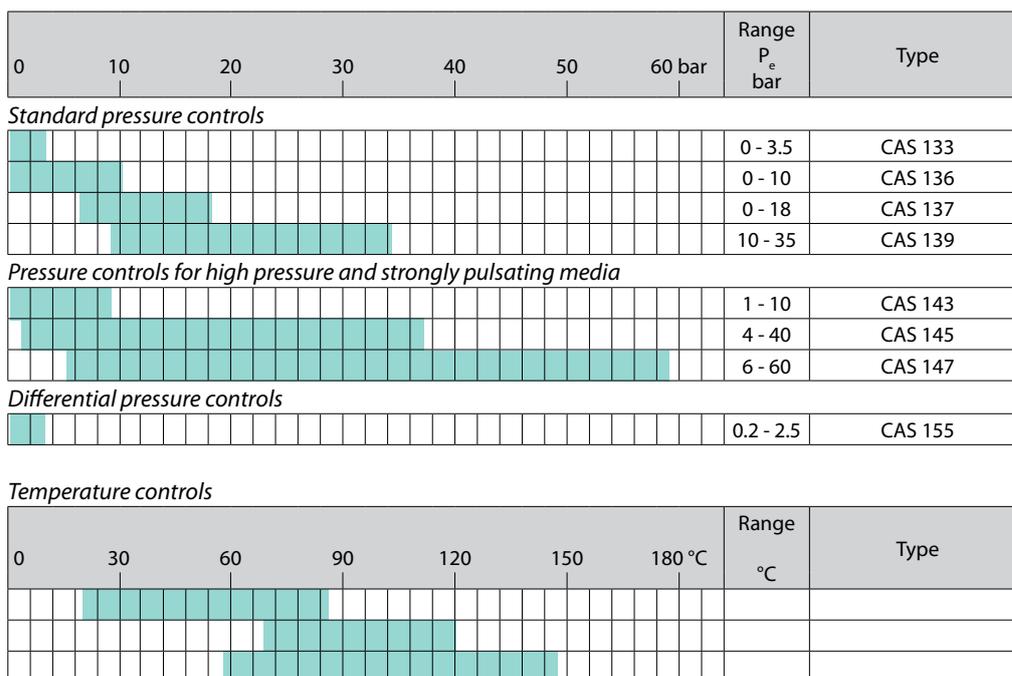
CE-marked acc. to EN 60947-5-1

**Ship approvals**

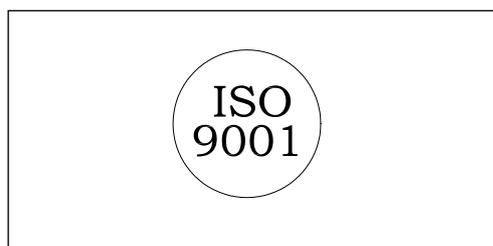
American Bureau of Shipping, ABS (excl. CAS 139)  
 Lloyds Register of Shipping, LR  
 Germanischer Lloyd, GL  
 Bureau Veritas, BV  
 Det Norske Veritas, DNV

Registro Italiano Navale, RINA  
 Maritime Register of Shipping, RMRS  
 Nippon Kaiji Kyokai, NKK

**Overview/Survey**



**ISO 9001 quality approval**



Danfoss A/S is certificated by BSI in accordance with international standard ISO 9001. This means that Danfoss fulfils the international standard in respect of product development, design, production and sale. BSI exercises continuous inspection to ensure that Danfoss observes the requirements of the standard and that Danfoss' own quality assurance system is maintained at the required level.

## Conversion table

	Pascal (= Newton per square metre) N/m <sup>2</sup> PA	Pascal per square mm N/mm <sup>2</sup>	bar	Kilopound per square metre (mm H <sub>2</sub> O) kp/m <sup>2</sup>	Meter water gauge m H <sub>2</sub> O	Technical atmosphere (kp/cm <sup>2</sup> ) atm	Physical atmosphere atm	Torr (0°C) mm Hg	Inches Hg (0°C)	Poundforce per square inch (lbf/in <sup>2</sup> ) psi
1 Pa	1	10 <sup>-6</sup>	10 <sup>-5</sup>	0.1020	1.020 × 10 <sup>-4</sup>	1.020 × 10 <sup>-5</sup>	9.869 × 10 <sup>-5</sup>	7.500 × 10 <sup>-3</sup>	2.953 × 10 <sup>-4</sup>	1.450 × 10 <sup>-4</sup>
1 N/mm <sup>2</sup>	10 <sup>6</sup>	1	10	1.020 × 10 <sup>5</sup>	102.0	10.20	9.869	7.5 × 10 <sup>3</sup>	295.3	145.0
1 bar	10 <sup>5</sup>	0.1	1	10.197 × 10 <sup>3</sup>	10.20	1.020	0.9869	750	29.53	14.50
1 kp/m <sup>2</sup>	9.80665	9.807 × 10 <sup>-6</sup>	9.807 × 10 <sup>-5</sup>	1	10 <sup>-3</sup>	10 <sup>-4</sup>	0.9678 × 10 <sup>-4</sup>	0.07355	2.896 × 10 <sup>-3</sup>	1.422 × 10 <sup>-3</sup>
1 m H <sub>2</sub> O	9806.7	9.807 × 10 <sup>3</sup>	0.09807	1000	1	0.1	0.09678	73.55	2.896	1.422
1 at	98.066 × 10 <sup>3</sup>	0.09807	0.9807	10 <sup>4</sup>	10	1	0.9678	735.5	28.96	14.22
1 atm	101.325 × 10 <sup>3</sup>	0.1013	1.013	10.333 × 10 <sup>3</sup>	10.33	1.033	1	760	29.92	14.70
1 mm Hg	133.32	1.333 × 10 <sup>-4</sup>	1.333 × 10 <sup>-3</sup>	13.60	0.01360	1.360 × 10 <sup>-3</sup>	1.315 × 10 <sup>-3</sup>	1	0.03937	1.934 × 10 <sup>-2</sup>
1 in Hg	3387	3.387 × 10 <sup>-3</sup>	0.03387	345.3	0.3453	0.03453	0.03342	25.4	1	0.4912
1 psi	6895	6.895 × 10 <sup>-3</sup>	0.06895	703.1	0.7031	0.07031	0.96804	51.71	2.036	1

## Pressure controls

### Technical data

*Switch*

Microswitch with single pole changeover (SPDT)

*Contact load*

Alternating current: 220 V, 0.1 A, AC-14 and AC-15 (inductive load)

Direct current: 125 V, 12 W DC-13 (inductive load)

*Materials in contact with the medium*

CAS 133	Bellows:	Stainless steel, material no. 1.4306 (DIN 17440)
CAS 136	Pressure connection:	Brass material no. 2.0401 (DIN 17660)
CAS 143	Diaphragm connection:	Nickel plated brass CuZn 40 Ob3 ISO R 426 (DIN 17569)
CAS 145	Diaphragm:	Nitrile-butadien rubber
CAS 147		
CAS 155		

*Ambient temperature*

CAS 133-139: -40 to +70°C

CAS 143-155: -25 to +70°C

*Temperature of medium*

CAS 133-139: -40 to + 100°C

CAS 143-155: -25 to + 100°C

For water and seawater, max. 80 °C

*Vibration resistance*

Vibration-stable in the range 2-30 Hz amplitude 1.1 mm and 30-100 Hz, 4 G.

*Enclosure*

IP 67 acc. to IEC 529 and DIN 40050.

The pressure control housing is enamelled pressure die cast aluminium (GD-AISI 12).

The cover is fastened by four screws which are anchored to prevent loss.

The enclosure can be sealed with fuse wire.

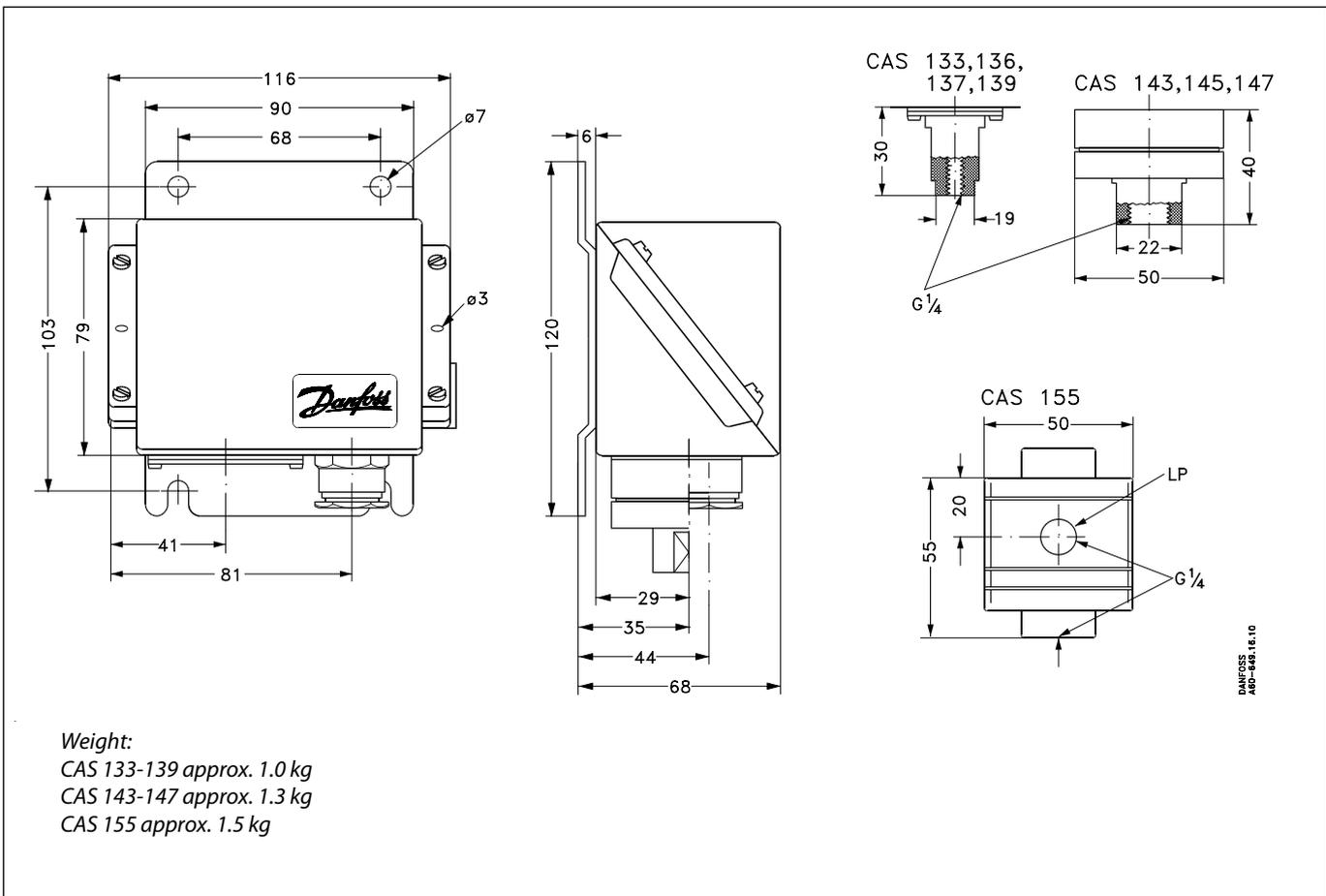
*Cable entry*

Pg 13.5 for cable diameters from 5 to 14 mm.

*Identification*

The type designation and code no. of the unit is stamped in the side of the housing.

### Dimensions



## Ordering

Preferred version



CAS 133, 135, 139

## Standard pressure controls

Setting range p <sup>e</sup> (bar)	Mechanical differential (bar)	Permissible operating pressure (bar)	Max test pressure (bar)	Min. burst pressure (bar)	Pressure connection	Code no.	Type
0 → 3.5	0.1	10	10	40	G ¼	<b>060-315066</b>	CAS 133
0 → 10	0.2	22	22	40		<b>060-315166</b>	CAS 136
6 → 18	0.3	27	27	72		<b>060-315266</b>	CAS 137
10 → 35	0.6	53	53	100		<b>060-315366</b>	CAS 139



CAS 143, 145, 147

## Pressure controls for high pressure and strongly pulsating media

Setting range p <sup>e</sup> (bar)	Mechanical differential (bar)	Permissible operating pressure (bar)	Max test pressure (bar)	Min. burst pressure (bar)	Pressure connection	Code no.	Type
1 → 10	0.2 → 0.6	120	180	240	G ¼	<b>060-316066</b>	CAS 143
4 → 40	0.8 → 2.4	120	180	240		<b>060-316166</b>	CAS 145
6 → 60	1 → 3	120	180	240		<b>060-316266</b>	CAS 147



CAS 155

CAS 155

## Differential pressure controls

Setting range p <sup>e</sup> (bar)	Mechanical differential (bar)	Permissible operating pressure for low pressure (bar)	Max test pressure (bar)	Min. burst pressure (bar)	Pressure connection	Code no.	Type
0.2 → 2.5	0.1	0 → 8	22	42	2 x G ¼	<b>060-313066</b>	CAS 155

## Terminology

## Range setting

The pressure range within which the unit will give a signal (contact changeover).

## Differential

The difference between make pressure and break pressure (see also page 6).

## Permissible burst pressure

The highest permanent or recurring pressure the unit can be loaded with.

## Max. test pressure

The highest pressure the unit may be subjected to when, for example, testing the system for leakage. Therefore, this pressure must not occur as a recurring system pressure.

## Min. burst pressure

The pressure which the pressure-sensitive element will withstand without leaking.

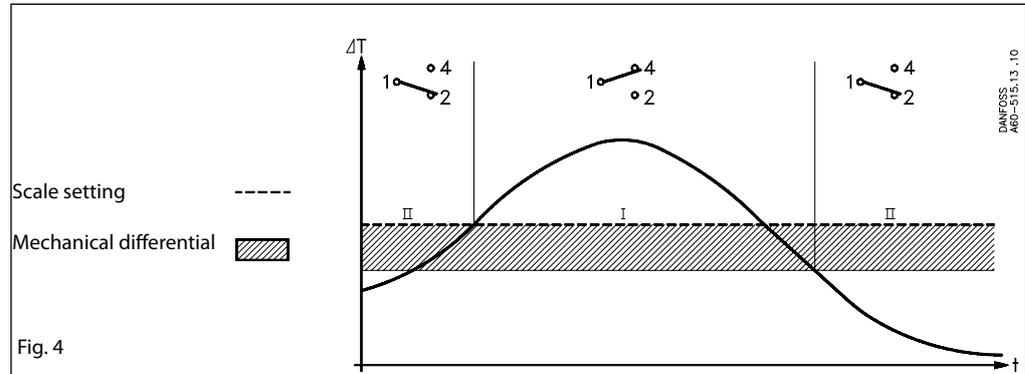
**Function**

a. CAS 155

Contacts 1-4 make and contacts 1-2 break when the differential pressure rises above the set range value. The contacts changeover to their initial position when the differential pressure again falls to the range value minus the differential (see fig. 4).

I. Alarm for rising differential pressure given at the set range value.

II. Alarm for falling differential pressure given at the set range value minus the differential.

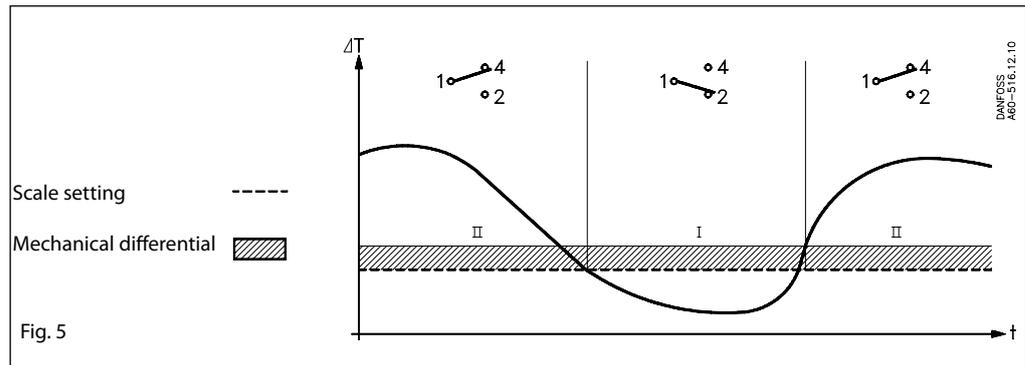


b. All other CAS pressure controls

Contacts 1-2 make and contacts 1-4 break when the pressure falls under the set range value. The contacts changeover to their initial position when the pressure again rises to the set range value plus the differential (see fig. 5).

I. Alarm for falling pressure given at the set range value.

II. Alarm for rising pressure given at the set range value plus the differential.



**Example 1:**

An alarm must be given when the lubrication oil pressure in a motor falls below 0.8 bar. Select CAS 133 (range 0 to 3.5 bar).

The minimum permissible lubricating oils pressure of 0.8 bar must be set using the range spindle. The differential is fixed at 0.1 bar, i.e. the alarm will not cut out before the pressure rises to 0.9 bar.

The switch break function is normally used for alarm purposes, i.e. the alarm must be connected to terminals 1 and 4.

**Example 2:**

When the differential pressure exceeds 1.3 bar a filter must be cleaned.

The maximum static pressure (LP) for the CAS 155 of 8 bar must not be exceeded.

The pressure control range spindle must be set at 1.3 bar.

The alarm must be connected to terminals 1 and 2 (alarm for broken circuit).

## Accessories

Part		Description	Qty.	Code no.
Connector with nipple		Pipe thread ISO 228/1, G 3/8 connector, nipple and AL washer (10 mm ext. 8 mm int. diam) for solering onto steel or copper tubing, steel span of jaws 22	5	<b>017-436866</b>
Connector with nipple		G 3/8 connector, nipple and washer (10 mm ext./ 6.5 mm int. diam.) for welding, steel span of jaws 22	1	<b>017-422966</b>
Reducer		Pipe thread ISO 228/1, G 3/8 x 7/16 - 20 UNF reducer, washer, brass span of jaws 22	5	<b>017-420566</b>
Adaptor		Pipe thread ISO 228/1, G 3/8 x 1/8 - 27 NPT with copper washer brass span of jaws 22	1	<b>060-333466</b>
Adaptor		Pipe thread ISO 228/1, G 3/8 A x 1/4 - 18 NPT with copper washer brass span of jaws 22	1	<b>060-333566</b>
Adaptor		Pipe thread ISO 228/1, G 3/8 x 1/4 - 18 NPT with copper washer brass span of jaws 22	1	<b>060-333666</b>
Adaptor		7/16 - 20UNF x R 3/8 (ISO 7/1) brass, span of jaws 19	1	<b>060-324066</b>
Nipple		G 1/4 A x G 3/8 A		<b>060-333266</b>
		G 1/4 A x ext. M10 x 1 with washer		<b>060-333866</b>
Damping coil		Pipe thread ISO 228/1, damping coil with G 3/8 connector and 1.5 m copper capillary tube. Standard washers are supplied.	1	<b>060-104766</b>
Armoured damping coil		Pipe thread ISO 228/1, damping coil with G 3/8 connector and 1 m copper capillary tube. Standard washers are supplied.	1	<b>060-333366</b>

**Installation**

*Installation*

CAS pressure controls are fitted with a 3 mm steel mounting plate. The units should not be allowed to hang from the pressure connection.

*Pressure connection*

When fitting or removing pressure lines, the spanner flats on the pressure connection should be used to apply counter-torque.

*Steam plant*

To protect the pressure element from excessive heat, the insertion of a water-filled loop is recommended. The loop can, for example, be made of 10 mm copper tube as shown in fig. 1.

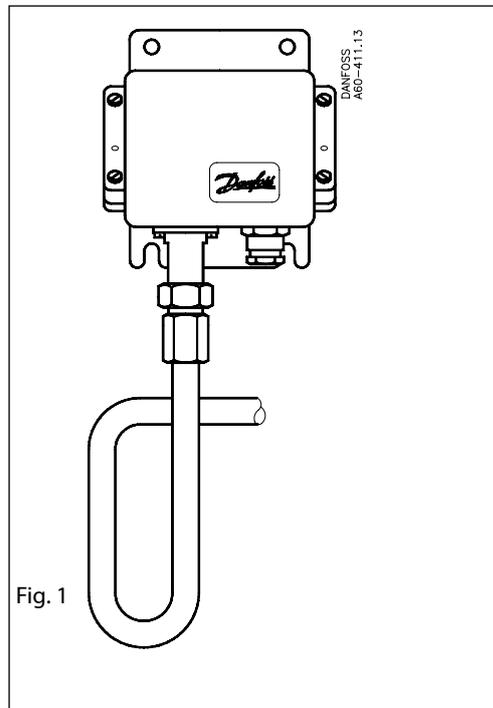


Fig. 1

*Water systems*

Water in the pressure element is not harmful, but in case of frost a water-filled pressure element may burst. To prevent this happening, the pressure control can be allowed to operate on an air cushion.

*Media resistance*

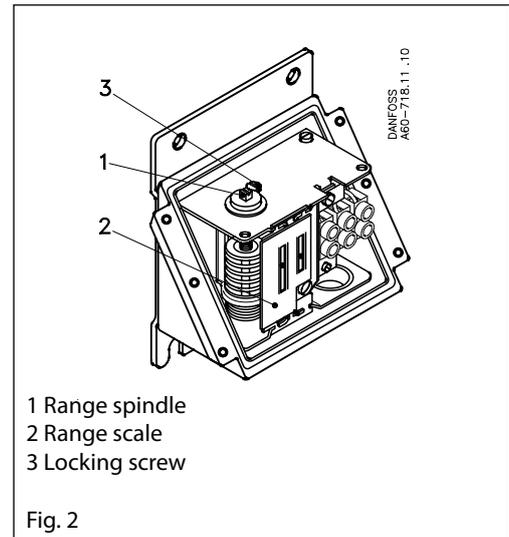
See table of materials in contact with the medium, page 4. If seawater is involved, types CAS 143, 145, 147 are recommended.

*Pulsations*

If the pressure medium is superimposed with severe pulsations, which occur in automatic sprinkler systems (fire protection), fuel systems for diesel motors (priming lines), and hydraulic systems (e.g. propeller systems), etc, types case 143, 145, 147 are recommended. The maximum permissible pulsation level for these types is 120 bar.

*Setting*

When the pressure control cover is removed, and the locking screw (3) is loosened, the range can be set with the spindle (1) while at the same time the scale (2) is being read.



- 1 Range spindle
- 2 Range scale
- 3 Locking screw

Fig. 2

*Electrical connection*

CAS pressure controls are fitted with a PG 13.5 screwed cable entry that is suitable for cable diameters from 5 to 13 mm.

Contact function is shown in fig. 3.

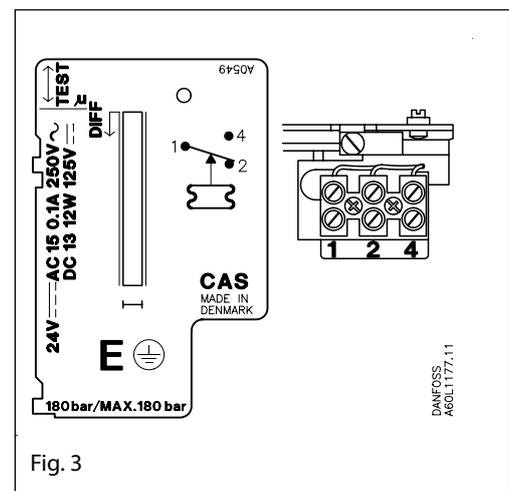


Fig. 3

## Temperature controls

### Technical data and ordering

Preferred version



CAS with remote sensor, armored capillary tube

Setting range °C	Mechanical differential adjustable / fixed °C	Max. sensor temperature °C	Suitable sensor length (see also "Accessories") mm				Capillary tube length m	Code no.	Type
			65	75	110	160			
20 → 80	2.0	130	65	75	110	160	2	<b>060L315166</b>	CAS 178
70 → 120	2.0	220	65	75	110	160	2	<b>060L315366</b>	CAS 180
60 → 150	2.0	250	65	75	110	160	2	<b>060L315566</b>	CAS 181

#### Switch

Microswitch with single pole changeover (SPDT)

#### Contact load

Alternating current:

220 V, ~0,1 A, AC-14 and AC-15 (inductive load)

#### Direct current

125 V, 12W DC-13 (inductive load)

#### Ambient temperature

CAS 178,180 and 181: -25°C → +70°C

#### Vibration resistance

Vibration-stable in the range 2-30 Hz, amplitude 1,1 mm and 30-100 Hz, 4 G.

#### Enclosure

IP 67 acc. to IEC 529 and DIN 40050.

The thermostat housing is enamelled pressure die cast aluminium (GD-AISI 12). The cover is fastened by four screws which are anchored to prevent loss.

The enclosure can be sealed with fuse wire.

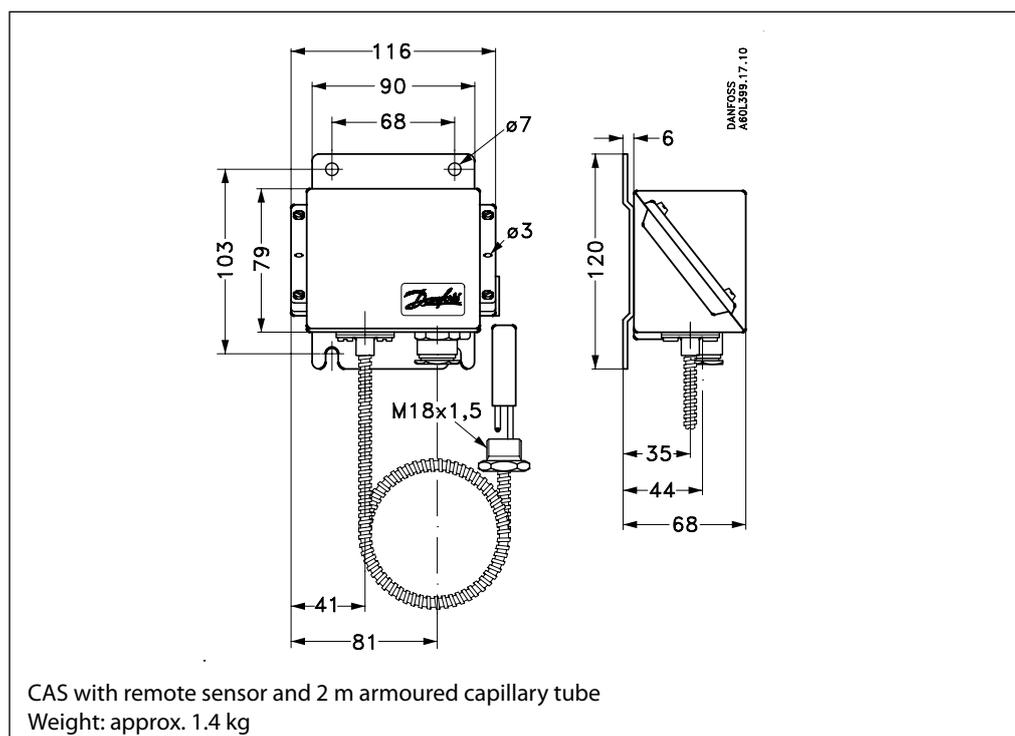
#### Cable entry

Pg 13.5 for cable diameters from 5 to 14 mm.

#### Identification

The type designation and code no. of the unit is stamped in the side of the housing.

### Dimensions and weight



Accessories: Sensor pockets for thermostats	Sensor pocket	A mm	Thread B	Code no.	Sensor pocket	A mm	Thread B	Code no.
<p><b>Note: all sensor pockets are supplied without gland nut, gaskets and washes</b></p>	Brass	65	½ NPT	<b>060L326566</b>				
	Brass	75	½ NPT	<b>060L326466</b>	Steel 18/8	75	G ½ A	<b>060L326766</b>
		75	G ½ A	<b>060L326266</b>				
		75	G ¾ A	<b>060L326666</b>				
		75	G ½ A (ISO 228/1)	<b>060L328166</b>				
	Brass	110	½ NPT	<b>060L328066</b>	Steel 18/8	110	G ½ A	<b>060L326866</b>
		110	G ½ A	<b>060L327166</b>		110	½ NPT	<b>060L327066</b>
		110	G ½ A (ISO 228/1)	<b>060L340666</b>				
		110	G ¾ A (ISO 228/1)	<b>060L340366</b>				
	Brass	160	G ½ A	<b>060L326366</b>	Steel 18/8	160	G ½ A	<b>060L326966</b>
		160	G ¾ A (ISO 228/1)	<b>060L340566</b>				
	Brass	200	G ½ A	<b>060L320666</b>				
	200	G ½ A (ISO 228/1)	<b>060L340866</b>					
	200	G ¾ A (ISO 228/1)	<b>060L340266</b>					
Brass	250	G ½ A	<b>060L325466</b>	Steel 18/8	250	G ½ A	<b>060L329366</b>	
Brass	330	G ½ A	<b>060L325566</b>					
Brass	400	G ½ A	<b>060L325666</b>					

Other Accessories	Description	Qty./ unit	Code no.
Clamping band	<p>For CAS temperature controls with remote sensor (L = 392 mm)</p>	10	<b>017-420466</b>
Heat conductive compound (Tube with 4.5 cm <sup>3</sup> )	<p>For CAS with sensor fitted in a sensor pocket. For filling sensor pocket to improve heat transfer between pocket and sensor. Application range for compound: -20 to +150 °C, momentarily up to 220°C</p>	1	<b>041E0114</b>

**Installation**

Location of unit: CAS thermostats are designed to withstand the shocks that occur, for example, in ships on compressors and in large machine installations. CAS thermostats are fitted with a base of 3 mm steel plate for fixing to bulkheads, etc.

*Resistance to media*

Material specifications for sensor pockets.

*Sensor pocket brass*

The tube is made of Ms 72 to DIN 17660, the threaded portion of So Ms 58 Pb to DIN 17661.

*Sensor pocket, stainless steel 18/8*

Material designation 1.4305 to DIN 17440.

*Sensor position*

As far as possible the sensor should be positioned so that its longitudinal axis is at right angles to the direction flow. The active part of the sensor is Ø13 mm × 47.5 mm.

*The medium*

The fastest reaction is obtained from a medium having high specific heat and high thermal conductivity. It is therefore advantageous to use a medium that fulfils these conditions (provided there is a choice). The flow velocity of the medium is also of significance. (The optimum flow velocity for liquids is about 0.3 m/s). For permissible media pressure see fig. 1.

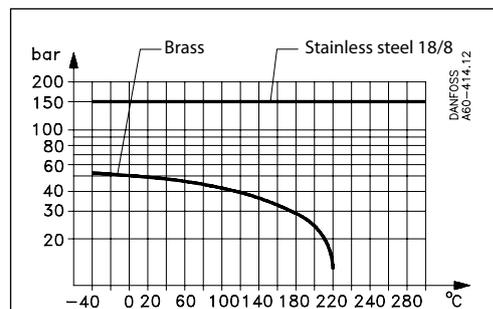


Fig. 1 Permissible media pressure on the sensor pocket as a function of temperature

*Setting*

When the thermostat cover is removed, and the locking screw (3) fig. 2 is loosened, the range can be set with the spindle (1) while at the same time the scale (2) is being read.

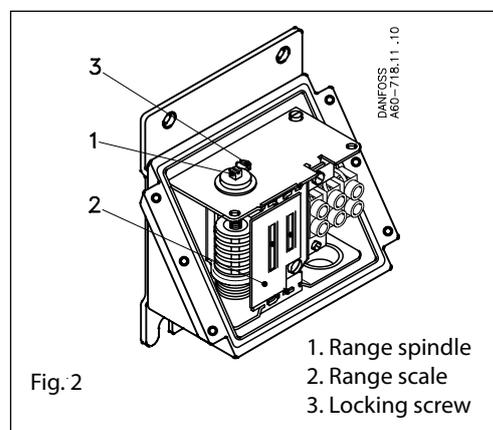


Fig. 2

*Scale correction*

The sensor on CAS temperature controls contains an adsorption charge. Therefore function is not affected whether the sensor is placed warmer or colder than the remaining part of the thermostatic element (bellows and capillary tube).

However, such a charge is to some extent sensitive to changes in the temperature of bellows and capillary tube. Under normal conditions this is of no importance, but if the thermostat is to be used in extreme ambient temperatures there will be a scale deviation. The deviation can be compensated for as follows:

Scale correction =  $Z \times a$

Z can be found from fig. 3, while a is the correction factor from the table below.

(See example, page 11).

Type	Regulation range °C	Correction factor a for thermostats
CAS 178	20 → 80	2.5
CAS 180	70 → 120	2.4
CAS 181	60 → 150	3.7

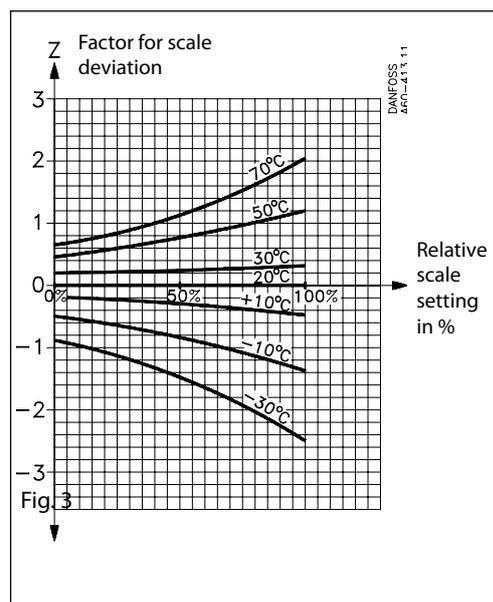
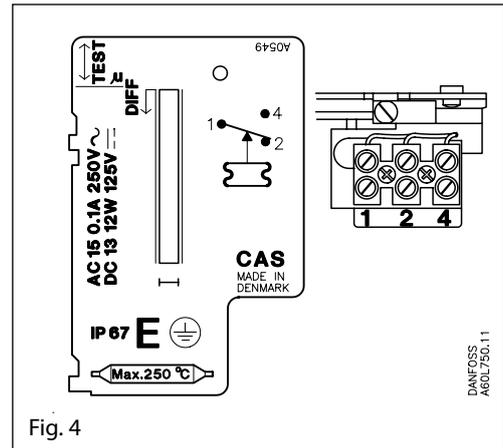


Fig. 3

*Electrical connection*

CAS thermostats are fitted with a Pg 13.5 screwed cable entry suitable for cables from 5 to 14 mm. Contact function, see fig. 4.



**Function**

*Differentials*

The mechanical differential is the differential determined by the design of the thermostat. The thermal differential (operating differential) is the differential the system operates on.

The thermal differential is always greater than the mechanical differential and depends on three factors:

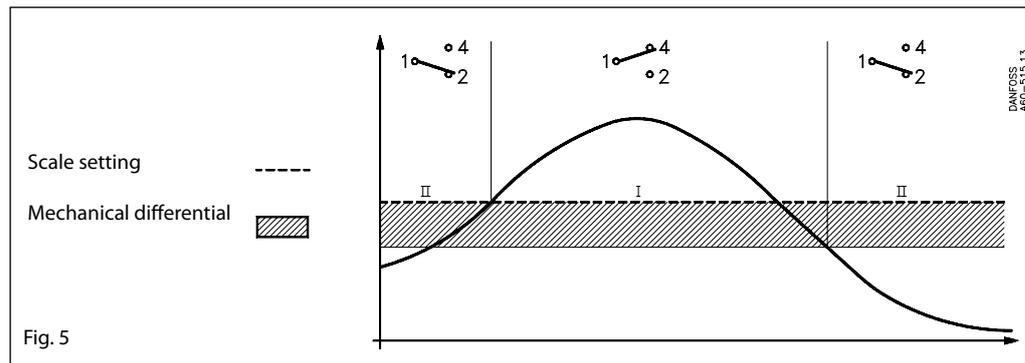
- 1) Medium flow velocity
- 2) Temperature change rate of the medium
- 3) Heat transmission to the sensor

*Thermostat function*

Contacts 1-4 make while contacts 1-2 break when the temperature rises above the scale setting.

The contacts changeover to their initial position when the temperature falls to the scale setting minus the differential. See fig. 5.

- I. Alarm for rising temperature given at range setting value.
- II. Alarm for falling temperature given at range setting value minus the differential



**Example 1**

Diesel engine with cooling water temperature of 85°C (normal). An alarm must be triggered if the cooling water temperature exceeds 95°C. Choose a CAS thermostat 180 (range +70 to 120°C). Main spindle setting: 95°C. The required alarm function is obtained by connecting to thermostat terminals 1-4.

**Example 2**

Find the necessary scale correction for a CAS 180. Set +95°C at +50°C ambient temperature.

The relative scale setting Z can be calculated from the following formula:

$$\frac{\text{Setting value} - \text{min. scale value}}{\text{max. scale value} - \text{min. scale value}} \times 100 = \%$$

$$\text{Relative scale setting: } \frac{95 - 70 \times 100}{120 - 70} = 50\%$$

Factor for scale deviation Z fig. 3, Z ≈ 0.7

Correction factor a, see table page 10,

fig. 3 = 2.4.

Scale correction = Z x a = 0.7 x 2.4 = 1.7°C

CAS must be set at 95 + 1.7 = 96.7°C

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