Technical Information
Deltabar S
PMD75, FMD77, FMD78

Differential pressure measurement and pressure measurement

Differential pressure transmitter with metal sensors

Applications

The device is used for the following measuring tasks:
- Flow measurement (volume flow or mass flow) in conjunction with differential pressure sensors in gases, vapors and liquids
- Level, volume or mass measurements in liquids
- High process temperatures up to 400 °C (752 °F) possible with diaphragm seal mount
- Differential pressure monitoring, e.g. of filters and pumps

Your benefits

- Very good reproducibility and long-term stability
- High reference accuracy up to 0.035 %
- Turn down up to 100:1, higher on request
- Used for flow and differential pressure monitoring up to SIL3, certified to IEC 61508 by TÜV SÜD
- High level of safety during operation thanks to function monitoring from the measuring cell to the electronics
- The patented TempC membrane for the diaphragm seal reduces measured errors caused by environmental and process temperature influences to a minimum
- Easy electronic replacement guaranteed with HistoROM®/M-DAT
- Uniform platform for differential pressure, hydrostatics and pressure (Deltabar S – Deltapilot S – Cerabar S)
- Practical user navigation for quick and easy commissioning
- Extensive diagnostic functions
- Cost-effective installation with Deltabar S FMD77, capillary on low-pressure side

Endress+Hauser
People for Process Automation

Table of contents

Document information

Document function

The document contains all the technical data on the device and provides an overview of the accessories and other products that can be ordered for the device.

Symbols used

Safety symbols

Symbol	Meaning
DANGER	**DANGER!** This symbol alerts you to a dangerous situation. Failure to avoid this situation will result in serious or fatal injury.
WARNING	**WARNING!** This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in serious or fatal injury.
CAUTION	**CAUTION!** This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in minor or medium injury.
NOTICE	**NOTE!** This symbol contains information on procedures and other facts which do not result in personal injury.

Electrical symbols

Symbol	Meaning	Symbol	Meaning
	**Protective ground connection** A terminal which must be connected to ground prior to establishing any other connections.		**Ground connection** A grounded terminal which, as far as the operator is concerned, is grounded via a grounding system.

Symbols for certain types of information

Symbol	Meaning
	**Permitted** Procedures, processes or actions that are permitted.
	**Preferred** Procedures, processes or actions that are preferred.
	**Forbidden** Procedures, processes or actions that are forbidden.
	**Tip** Indicates additional information.
	Reference to documentation
	Reference to page
	Reference to graphic
	Visual inspection

Symbols in graphics

Symbol	Meaning
1, 2, 3 ...	Item numbers
1. , 2. , 3. ...	Series of steps
A, B, C, ...	Views
A-A, B-B, C-C, ...	Sections

Documentation

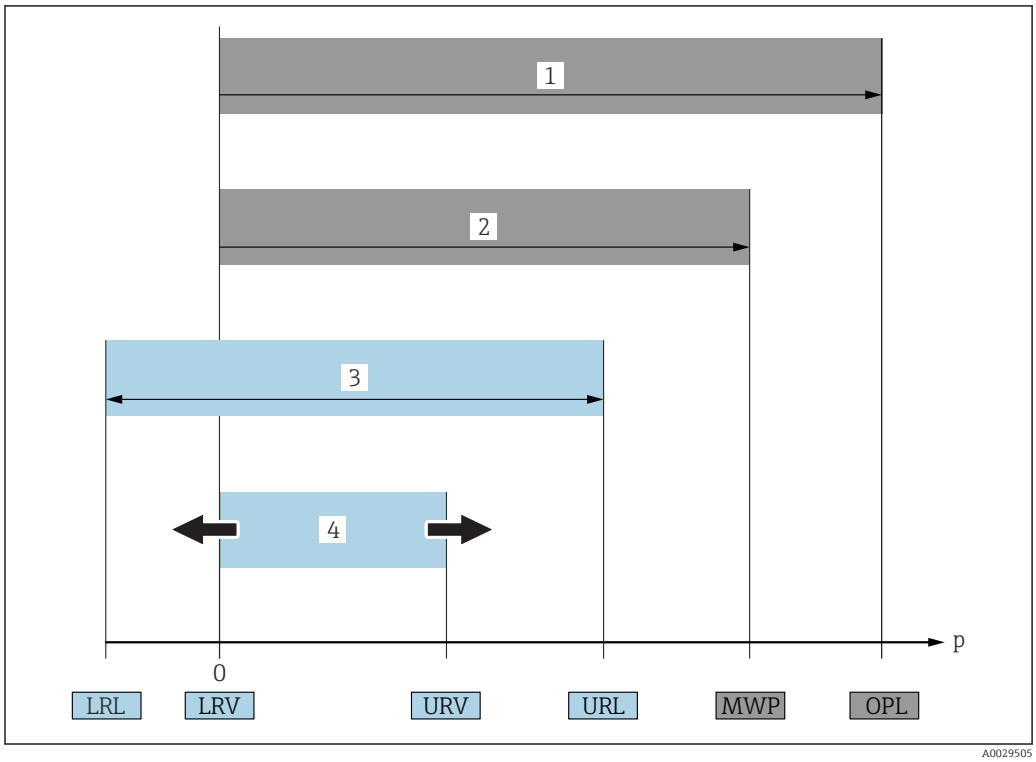
See chapter "Additional documentation" → 113

The document types listed are available:
In the Download Area of the Endress+Hauser Internet site: www.endress.com → Download

Safety Instructions (XA)

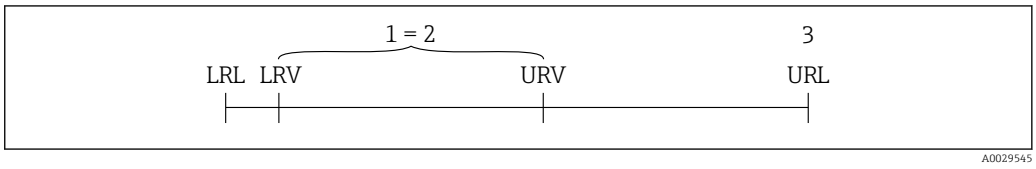
See the "Safety instructions" section → 113

Terms and abbreviations



Item	Term/abbreviation	Explanation
1	OPL	The OPL (over pressure limit = sensor overload limit) for the measuring device depends on the lowest-rated element, with regard to pressure, of the selected components, i.e. the process connection has to be taken into consideration in addition to the measuring cell. Also observe pressure-temperature dependency. For the relevant standards and additional information, see the "Pressure specifications"→ 🖹 47 section. The OPL may only be applied for a limited period of time.
2	MWP	The MWP (maximum working pressure) for the sensors depends on the lowest-rated element, with regard to pressure, of the selected components, i.e. the process connection has to be taken into consideration in addition to the measuring cell. Also observe pressure-temperature dependency. For the relevant standards and additional information, see the "Pressure specifications"→ 🖹 47 section. The MWP may be applied at the device for an unlimited period. The MWP can also be found on the nameplate.
3	Maximum sensor measuring range	Span between LRL and URL This sensor measuring range is equivalent to the maximum calibratable/adjustable span.
4	Calibrated/adjusted span	Span between LRV and URV Factory setting: 0 to URL Other calibrated spans can be ordered as customized spans.
p	-	Pressure
-	LRL	Lower range limit
-	URL	Upper range limit
-	LRV	Lower range value
-	URV	Upper range value
-	TD (turn down)	Turn down Example - see the following section.

Turn down calculation



1 Calibrated/adjusted span
2 Zero point-based span
3 URL sensor

Example

- Sensor:10 bar (150 psi)
- Upper range value (URL) = 10 bar (150 psi)
- Calibrated/adjusted span: 0 to 5 bar (0 to 75 psi)
- Lower range value (LRV) = 0 bar (0 psi)
- Upper range value (URV) = 5 bar (75 psi)

Turn down (TD):

$$TD = \frac{URL}{|URV - LRV|}$$

$$TD = \frac{10\ \text{bar (150 psi)}}{|5\ \text{bar (75 psi)} - 0\ \text{bar (0 psi)}|} = 2$$

In this example, the TD is 2:1.
This span is based on the zero point.

Registered trademarks

HART®

Registered trademark of the FieldComm Group, Austin, USA

PROFIBUS®

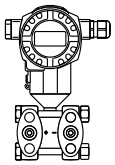
Registered trademark of the PROFIBUS User Organization, Karlsruhe, Germany

FOUNDATION™Fieldbus

Registered trademark of the FieldComm Group, Austin, Texas, USA

Function and system design

Device selection



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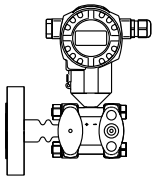
PMD75



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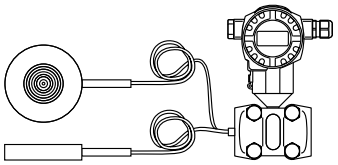
FMD77 with mounted diaphragm seal



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FMD78 with capillary diaphragm seals

Field of application

PMD75:
- Flow
- Level
- Differential pressure
- Pressure

FMD77:
- Level
- Differential pressure

FMD78:
- Level
- Differential pressure

Process connections

PMD75:
- 1/4 – 18 NPT
- RC 1/4

FMD77 low-pressure side (–):
- 1/4 – 18 NPT
- RC 1/4
- Alternatively available with capillary and diaphragm seal

FMD77 high-pressure side (+):
- DN 50 – DN 100
- ASME NPS 2" – 4"
- JIS 80A – 100A

FMD78:
Wide range of diaphragm seals

Measuring ranges

- PMD75: from −10 to +10 mbar (-0.15 to +0.15 psi) to −40 to +40 bar (-600 to +600 psi)
  As gauge or absolute pressure sensor: up to 250 bar (3750 psi)
- FMD77: from −100 to +100 mbar (-1.5 to +1.5 psi) to −16 bar to +16 bar (-240 to +240 psi)
- FMD78: from −100 to +100 mbar (-1.5 to +1.5 psi) to −40 to +40 bar (-600 to +600 psi)

OPL

PMD75:
on one side: up to 420 bar (6 300 psi)
on both sides: up to 630 bar (9 450 psi)
As gauge or absolute pressure sensor: up to 375 bar (5625 psi)

FMD77:
on one side: up to 160 bar (2 400 psi)
on both sides: up to 240 bar (3 600 psi)

FMD78:
on one side: up to 160 bar (2 400 psi)
on both sides: up to 240 bar (3 600 psi)

Process temperature range(temperature at process connection)

PMD75:
−40 to +85 °C (−40 to +185 °F)

FMD77:
−70 to +400 °C (−94 to +752 °F)
(depending on the filling oil)

FMD78:
−70 to +400 °C (−94 to +752 °F)
(depending on the filling oil)

Ambient temperature range

- Without LCD display: −50 to +85 °C (−58 to +185 °F)
- With LCD display: −20 to +70 °C (−4 to +158 °F)
  (extended temperature application range−50 to +85 °C (−58 to +185 °F) with limitations in optical properties, such as display speed and contrast)
- Separate housing −20 to +60 °C (−4 to +140 °F):
- Diaphragm seal systems depending on the version

Reference accuracy

- PMD75: up to ±0.035 % of the set span
- FMD77: up to ±0.075 % of the set span
- FMD78: up to ±0.075 % of the set span

Supply voltage

Supply voltage non-Ex
- 4 to 20 mA HART: 10.5 to 45 V DC
- PROFIBUS PA and FOUNDATION Fieldbus: 9 to 32 V DC

Supply voltage Ex ia
10.5 to 30 V DC

Output

4 to 20 mA with superimposed HART protocol, PROFIBUS PA or FOUNDATION Fieldbus

Options

- HistoROM®/M-DAT memory chip
- PMD75: with blind flange on LP side for gauge and absolute pressure measurement

Specialties

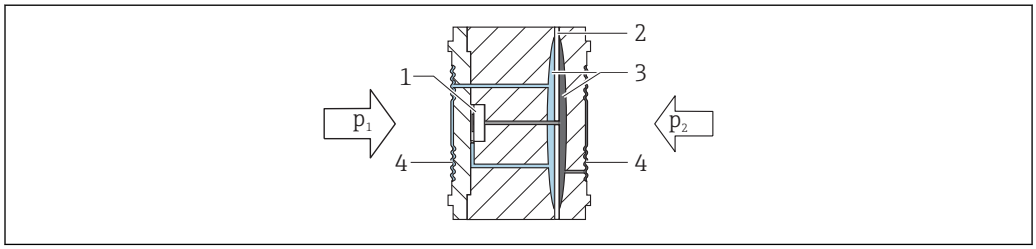
PMD75:
- p_{stat} up to 420 bar (6 300 psi)
- Process isolating diaphragm: tantalum

FMD77:
For extreme medium temperatures

FMD78:
Wide range of diaphragm seals

Measuring principle

Metal process isolating diaphragm



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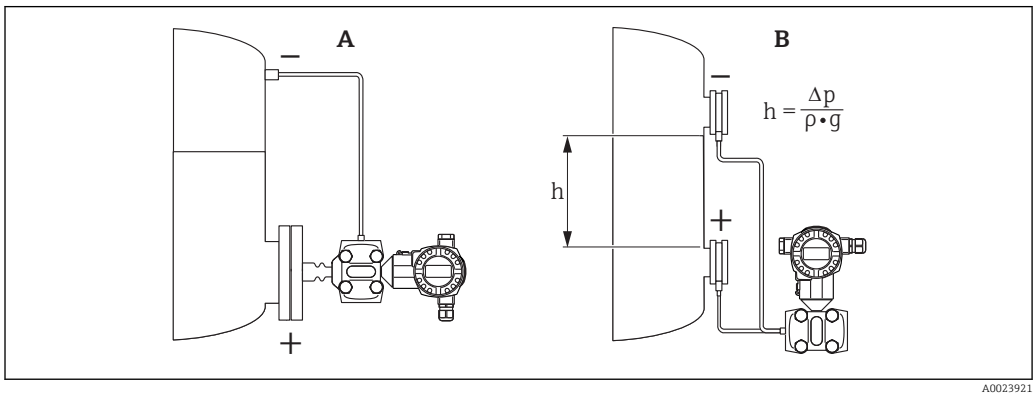
1 Measuring element
2 Middle diaphragm
3 Filling oil
4 Process isolating diaphragm

The process isolating diaphragms are deflected on both sides by the acting pressures. A filling oil transfers the pressure to a resistance bridge (semiconductor technology). The change in the bridge output voltage, which depends on the differential pressure, is measured and processed

Advantages:
- Standard system pressures: 160 bar (2 400 psi) up to 420 bar (6 300 psi)
- High long-term stability
- Very high single-sided overload resistance

Product design

Level measurement (level, volume and mass):



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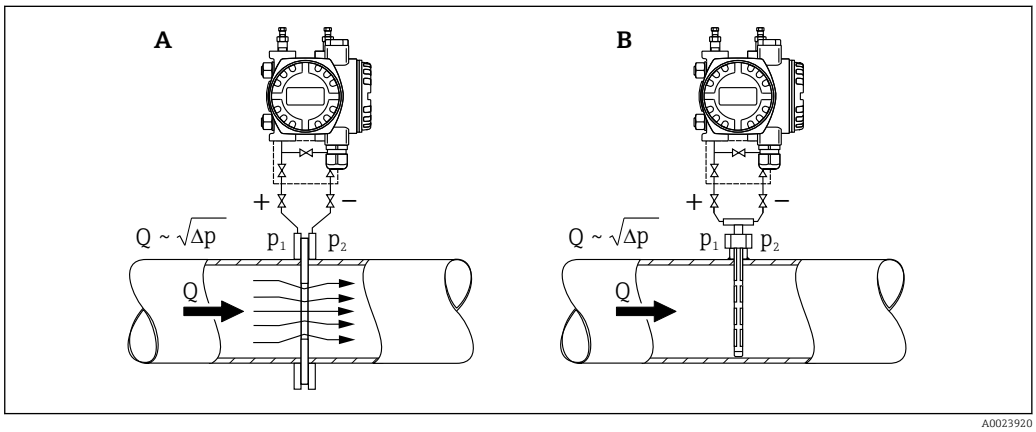
A Level measurement with FMD77
B Level measurement with FMD78
h Height (level)
Δp Differential pressure
ρ Density of the medium
g Gravitational constant

Your benefits

- Selection of the level operating mode which is optimum for your application in the device software
- Volume and mass measurements in any container shapes by means of a freely programmable characteristic curve
- Choice of diverse level units with automatic unit conversion
- A customized unit can be specified.
- Has a wide range of uses, e.g.
  - for level measurement in vessels with pressure overlay
  - in the event of foam formation
  - in containers with agitators or screen fittings
  - in the event of liquid gases
  - for standard level measurement

Flow measurement

Flow measurement with Deltabar S and primary device:



A Orifice plate
B Pitot tube
Q Flow
Δp Differential pressure, $\Delta p = p_1 - p_2$

Your benefits

- Choice of four flow modes of operation: volume flow, corrected volume flow (European norm conditions), standard volume flow (American standard conditions) and mass flow
- Choice of diverse flow units with automatic unit conversion
- A customized unit can be specified.
- Low flow cut off: when activated, this function suppresses small flows which can lead to large fluctuations in the measured value.
- Contains two totalizers as standard. One totalizer can be reset to zero.
- The totalizing mode and unit can be individually set for each totalizer. This allows independent daily and annual quantity totalizing.

Communication protocol

- 4 to 20 mA with HART communication protocol
- PROFIBUS PA
  - The Endress+Hauser devices meet the requirements of the FISCO model.
  - Due to a low current consumption of 13 mA ± 1 mA, the following number of devices can be operated on one bus segment if installing as per FISCO: up to 7 devices for Ex ia, CSA IS and FM IS applications or up to 27 devices for all other applications e.g. in non-hazardous areas, Ex nA etc. Further information on PROFIBUS PA can be found in Operating Instructions BA00034S "PROFIBUS DP/PA: Guidelines for planning and commissioning" and in the PNO Guideline.
- FOUNDATION Fieldbus
  - The Endress+Hauser devices meet the requirements of the FISCO model.
  - Due to a low current consumption of 15.5 mA ± 1 mA, the following number of devices can be operated on one bus segment if installing as per FISCO: up to 6 devices for Ex ia, CSA IS and FM IS applications or up to 24 devices for all other applications e.g. in non-hazardous areas, Ex nA etc. Further information on FOUNDATION Fieldbus, such as requirements for bus system components, can be found in Operating Instructions BA00013S "FOUNDATION Fieldbus Overview".

Input

Measured variable

Measured process variables

Differential pressure, pressure

Calculated process variables

- Flow rate (volume flow or mass flow)
- Absolute pressure, gauge pressure
- Level (level, volume or mass)

Measuring range

Sensor	Maximum sensor measuring range		Smallest calibratable span [1]	MWP	OPL		remains stable for a minimum of operating pressure [2]	Option [3]
	lower (LRL)	upper (URL)			on one side	on both sides		PN 160
[mbar (psi)]	[mbar (psi)]	[mbar (psi)]	[mbar (psi)]	[bar (psi)]	[bar (psi)]	[bar (psi)]	[$mbar_{abs}$ (psi_{abs})]	
FMD77, FMD78, PMD75: Option PN 160 / 16 MPa / 2400 psi								
10 (0.15) (PMD75 only)	−10 (-0.15)	+10 (+0.15)	0.25 (0.00375)	160 (2400)	160 (2400)	240 (3600)	0.1 (0.0015)	7B
30 (0.45) (PMD75 only)	−30 (-0.45)	+30 (+0.45)	0.3 (0.0045)					7C
100 (1.5)	−100 (-1.5)	+100 (+1.5)	1/5 (0.015/0.075) [4]	160 (2400) [5]				7D
500 (7.5)	−500 (-7.5)	+500 (+7.5)	5 (0.075)					7F
3000 (45)	−3000 (-45)	+3000 (+45)	30 (0.45)					7H
16000 (240)	−16000 (-240)	+16000 (+240)	160 (2.4)					7L
40000 (600)	−40000 (-600)	+40000 (+600)	400 (6)		"+" side [6]: 160 (2400)			7M
PMD75: Option PN 420 / 42 MPa / 6300 psi								
100 (1.5)	−100 (-1.5)	+100 (+1.5)	1/5 (0.015/0.075) [4]	420 (6300) [5]	420 (6300)	630 (9450)	0.1 (0.0015)	8D
500 (7.5)	−500 (-7.5)	+500 (+7.5)	5 (0.075)					8F
3000 (45)	−3000 (-45)	+3000 (+45)	30 (0.45)					8H
16000 (240)	−16000 (-240)	+16000 (+240)	160 (2.4)					8L
40000 (600)	−40000 (-600)	+40000 (+600)	400 (6)		"+" side [6]: 420 (6300)			8M

1) Turn down > 100:1 on request
2) The minimum operating pressure indicated in the table applies to silicone oil under reference operating conditions. Min. operating pressure at 85 °C (185 °F) for silicone oil: up to 10 $mbar_{abs}$ (0.15 psi_{abs}). FMD77 and FMD78: Min. operating pressure: 50 $mbar_{abs}$ (0.75 psi_{abs}); observe also the pressure and temperature application limits of the selected filling oil → 🖹 97. For vacuum applications, follow the installation instructions→ 🖹 102.
3) Product Configurator, order code for "Nominal range; PN"
4) Smallest calibratable span for the PMD75: 1 mbar (0.015 psi); Smallest calibratable span for the FMD77 and FMD78: 5 mbar (0.075 psi)
5) All PMD75 process connections are CRN-approved. If O-rings are used, the MWP is 315 bar (4 725 psi); if PTFE and CU seals are used, the MWP is 120 bar (1 800 psi).
6) "–" side: 100 bar (1 500 psi)

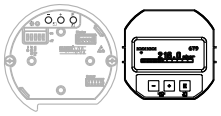
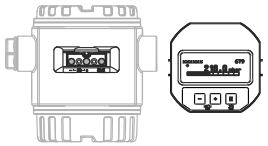
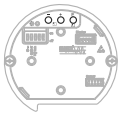
Sensor	Maximum sensor measuring range		Smallest calibratable span	MWP	OPL		remains stable for a minimum of operating pressure [1]	Option [2]
	lower (LRL)	upper (URL)			on one side	on both sides		
bar (psi)	bar (psi)	bar (psi)	bar (psi)	bar (psi)	bar (psi)		$mbar_{abs}$ (psi_{abs})	
PMD75: optionally available as a gauge or absolute pressure sensor								
160 (2400) rel	-1 (-15)	160 (2400)	40 (600)	160 (2400)	240 (3600)	- [3]	10	7Q
160 (2400) abs	0	160 (2400)	4 (60)	160 (2400)	240 (3600)	- [3]	10	7V
250 (3750) rel	-1 (-15)	250 (3750)	40 (600)	250 (3750)	375 (5625)	- [3]	10	7R
250 (3750) abs	0	250 (3750)	4 (60)	250 (3750)	375 (5625)	- [3]	10	7W

1) The minimum operating pressure indicated in the table applies to silicone oil under reference operating conditions. Min. operating pressure at 85 °C (185 °F) for silicone oil: up to 10 $mbar_{abs}$ (0.15 psi_{abs}).
2) Product Configurator, order code for "Nominal range; PN"
3) Available only with blind flange on LP side.

Output

Output Signal

- 4 to 20 mA with superimposed digital communication protocol HART, 2-wire
- Digital communication signal PROFIBUS PA (Profile 3.0), 2-wire
  - Signal coding: Manchester Bus Powered (MBP): Manchester II
  - Transmission rate: 31.25 KBit/s voltage mode
- Digital communication signal FOUNDATION Fieldbus, 2-wire
  - Signal coding: Manchester Bus Powered (MBP): Manchester II
  - Transmission rate: 31.25 KBit/s voltage mode

Output	Internal + LCD	External + LCD	Internal
	   A0021280		
	Option [1]		
4 to 20mA HART	B	A	C
4 to 20mA HART, Li=0	E	D	F
PROFIBUS PA	N	M	O
FOUNDATION Fieldbus	Q	P	R

1) Product Configurator, order code for "Display, operation: "

Signal range

4 to 20 mA

3.8 mA to 20.5 mA

Signal on alarm

4 to 20 mA HART

As per NAMUR NE43.

- Max. alarm: can be set from 21 to 23 mA (factory setting: 22 mA)
- Hold measured value: last measured value is held
- Min. alarm: 3.6 mA

PROFIBUS PA

As per NAMUR NE43.

Can be set in the Analog Input Block.

Options:
- Last Valid Out Value (factory setting)
- Fail Safe Value
- Status bad

FOUNDATION Fieldbus

As per NAMUR NE43.

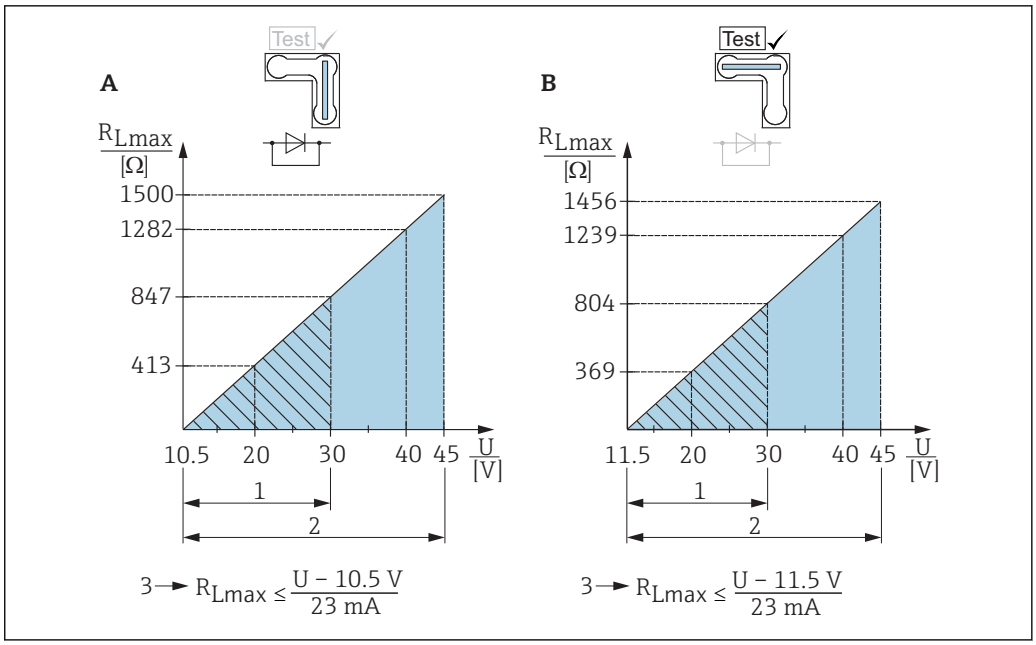
Can be set in the Analog Input Block.

Options:
- Last Good Value
- Fail Safe Value (factory setting)
- Wrong Value

Load

4 to 20 mA HART

In order to guarantee sufficient terminal voltage in two-wire devices, a maximum load resistance R (including line resistance) must not be exceeded depending on the supply voltage U_0 of the supply unit. In the following load diagrams, observe the position of the jumper and the explosion protection:



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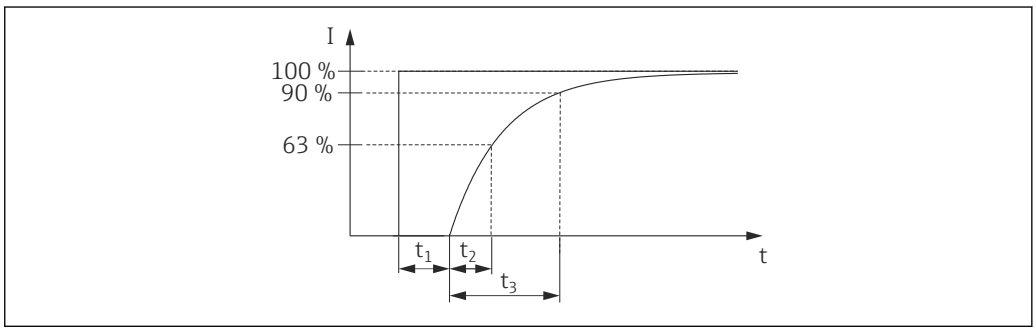
A Jumper for 4 to 20 mA test signal set to "Non-test" position
B Jumper for 4 to 20 mA test signal set to "Test" position
1 Power supply 10.5 (11.5) to 30 V DC for 1/2 G Ex ia, 1GD Ex ia, 1/2 GD Ex ia, FM IS, CSA IS, IECEx ia, NEPSI Ex ia
2 Power supply 10.5 (11.5) to 45 V DC for devices for non-hazardous areas, 1/2 D, 1/3 D, 2 G Ex d, 3 G Ex nA, FM XP, FM DIP, FM NI, CSA XP, CSA dust ignition-proof, NEPSI Ex d
3 R_{Lmax} maximum load resistance
U Supply voltage

When operating via a handheld terminal or via a PC with an operating program, a minimum communication resistance of 250 Ω must be taken into account.

Dead time, time constant

Presentation of the dead time and the time constant:



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Dynamic behavior, current output

Type		Measuring cell	Dead time (t_1) [ms]	Time constant T63 (t_2) [ms]	Time constant T90 (t_3) [ms]
PMD75	max.	▪ 10 mbar (0.15 psi) ▪ 30 mbar (0.45 psi) ▪ 100 mbar (1.5 psi) ▪ 500 mbar (7.5 psi) ▪ 3 bar (45 psi) ▪ 16 bar (240 psi) ▪ 40 bar (600 psi)	45	▪ 450 ▪ 450 ▪ 60 ▪ 45 ▪ 40 ▪ 60 ▪ 60	▪ 1040 ▪ 1040 ▪ 138 ▪ 104 ▪ 92 ▪ 138 ▪ 138
		▪ 160 bar (2 400 psi) ▪ 250 bar (3 750 psi)	50	40	90
FMD77, FMD78	max.	Dependent on the diaphragm seal			

Dynamic behavior Digital output (HART electronics)

A typical burst rate of 300 ms results in the following behavior:

Type		Measuring cell	Dead time (t_1) [ms]	Dead time (t_1) [ms] + Time constant T63 (t_2) [ms]	Dead time (t_1) [ms] + Time constant T90 (t_3) [ms]
PMD75	min.	▪ 10 mbar (0.15 psi) ▪ 30 mbar (0.45 psi) ▪ 100 mbar (1.5 psi) ▪ 500 mbar (7.5 psi) ▪ 3 bar (45 psi) ▪ 16 bar (240 psi) ▪ 40 bar (600 psi) ▪ 160 bar (2 400 psi) ▪ 250 bar (3 750 psi)	205	▪ 655 ▪ 655 ▪ 265 ▪ 250 ▪ 245 ▪ 265 ▪ 265 ▪ 295 ▪ 295	▪ 1200 ▪ 1200 ▪ 298 ▪ 264 ▪ 252 ▪ 298 ▪ 298 ▪ 300 ▪ 300
	max.	▪ 10 mbar (0.15 psi) ▪ 30 mbar (0.45 psi) ▪ 100 mbar (1.5 psi) ▪ 500 mbar (7.5 psi) ▪ 3 bar (45 psi) ▪ 16 bar (240 psi) ▪ 40 bar (600 psi) ▪ 160 bar (2 400 psi) ▪ 250 bar (3 750 psi)	1005	▪ 1455 ▪ 1455 ▪ 1065 ▪ 1050 ▪ 1045 ▪ 1065 ▪ 1065 ▪ 1095 ▪ 1095	▪ 2000 ▪ 2000 ▪ 1098 ▪ 1064 ▪ 1052 ▪ 1098 ▪ 1098 ▪ 1100 ▪ 1100
FMD77, FMD78	max.	Dependent on the diaphragm seal			

Reading cycle

- Acyclic: max. 3/s, typically 1/s (depending on command # and number of preambles)
- Cyclic (burst): max. 3/s, typically 2/s

The device commands the BURST MODE functionality for cyclical value transmission via the HART communication protocol.

Cycle time (update time)

Cyclic (burst): min. 300 ms

Response time

- Acyclic: min. 330 ms, typically 590 ms (depending on command # and number of preambles)
- Cyclic (burst): min. 160 ms, typically 350 ms (depending on command # and number of preambles)

Dynamic behavior PROFIBUS PA

A typical PLC cycle time of 1 s results in the following behavior:

Type		Measuring cell	Dead time (t_1) [ms]	Dead time (t_1) [ms] + Time constant T63 (t_2) [ms]	Dead time (t_1) [ms] + Time constant T90 (t_3) [ms]
PMD75	min.	▪ 10 mbar (0.15 psi) ▪ 30 mbar (0.45 psi) ▪ 100 mbar (1.5 psi) ▪ 500 mbar (7.5 psi) ▪ 3 bar (45 psi) ▪ 16 bar (240 psi) ▪ 40 bar (600 psi)	80	▪ 530 ▪ 530 ▪ 140 ▪ 125 ▪ 120 ▪ 140 ▪ 140	▪ 1075 ▪ 1075 ▪ 173 ▪ 139 ▪ 127 ▪ 173 ▪ 173
	max.	▪ 10 mbar (0.15 psi) ▪ 30 mbar (0.45 psi) ▪ 100 mbar (1.5 psi) ▪ 500 mbar (7.5 psi) ▪ 3 bar (45 psi) ▪ 16 bar (240 psi) ▪ 40 bar (600 psi)	1280	▪ 1730 ▪ 1730 ▪ 1340 ▪ 1325 ▪ 1320 ▪ 1340 ▪ 1340	▪ 2275 ▪ 2275 ▪ 1373 ▪ 1339 ▪ 1327 ▪ 1373 ▪ 1373
FMD77, FMD78	max.	Dependent on the diaphragm seal			

Reading cycle (PLC)

- Acyclic: Typically 25/s
- Cyclic: Typically 30/s (depending on the number and type of the function blocks used in the closed-control loop)

Cycle time (update time)

min. 200 ms

The cycle time in a bus segment in cyclic data communication depends on the number of devices, on the segment coupler used and on the internal PLC cycle time. A new measured value can be determined up to five times a second.

Response time

- Acyclic: Approx. 60 ms to 70 ms (depending on Min. Slave Interval)
- Cyclic: Approx. 10 ms to 13 ms (depending on Min. Slave Interval)

Dynamic behavior FOUNDATION Fieldbus

A typical configuration for the macro cycle time (host system) of 1 s results in the following behavior:

Type		Measuring cell	Dead time (t_1) [ms]	Dead time (t_1) [ms] + Time constant T63 (t_2) [ms]	Dead time (t_1) [ms] + Time constant T90 (t_3) [ms]
PMD75	min.	▪ 10 mbar (0.15 psi) ▪ 30 mbar (0.45 psi) ▪ 100 mbar (1.5 psi) ▪ 500 mbar (7.5 psi) ▪ 3 bar (45 psi) ▪ 16 bar (240 psi) ▪ 40 bar (600 psi)	90	▪ 540 ▪ 540 ▪ 150 ▪ 135 ▪ 130 ▪ 150 ▪ 150	▪ 1085 ▪ 1085 ▪ 183 ▪ 149 ▪ 137 ▪ 183 ▪ 183
	max.	▪ 10 mbar (0.15 psi) ▪ 30 mbar (0.45 psi) ▪ 100 mbar (1.5 psi) ▪ 500 mbar (7.5 psi) ▪ 3 bar (45 psi) ▪ 16 bar (240 psi) ▪ 40 bar (600 psi)	1090	▪ 1540 ▪ 1540 ▪ 1150 ▪ 1135 ▪ 1130 ▪ 1150 ▪ 1150	▪ 2085 ▪ 2085 ▪ 1183 ▪ 1149 ▪ 1137 ▪ 1183 ▪ 1183
FMD77, FMD78	max.	Dependent on the diaphragm seal			

Reading cycle

- Acyclic: Typically 10/s
- Cyclic: max. 10/s (dependent on the number and type of function blocks used in a closed-control loop)

Cycle time (update time)

Cyclic: Min. 100 ms

Response time

- Acyclic: Typically 100 ms (for standard bus parameter settings)
- Cyclic: max. 20 ms (for standard bus parameter settings)

Damping

A damping affects all outputs (output signal, display):
- via local display, handheld terminal or PC with operating program, continuous from 0 to 999 s
- Also for HART and PROFIBUS PA: Via DIP switch on the electronic insert, switch position "on" = set value and "off"
- Factory setting: 2 s

Alarm current

Designation	Option [1]
Min alarm current	J
HART burst mode PV	J
Min alarm current + HART burst mode PV	J

1) Product Configurator, "Additional options 1" and "Additional options 2" ordering feature

Firmware version

Designation	Option [1]
02.20.zz, HART 7, DevRev22	72
02.11.zz, HART 5, DevRev21	73
04.00.zz, FF, DevRev07	74
04.01.zz, PROFIBUS PA, DevRev03	75
02.10.zz, HART 5, DevRev21	76
03.00.zz, FF, DevRev06	77
04.00.zz, PROFIBUS PA	78
02.30.zz, HART 7	In preparation

1) Product Configurator, order code for "Firmware version"

HART protocol-specific data

Manufacturer ID	17 (11 hex)
Device type code	23 (17 hex)
Device revision	▪ 21 (15 hex) - SW version 02.1y.zz - HART specification 5 ▪ 22 (16 hex) - SW version 02.2y.zz - HART specification 7
HART specification	▪ 5 ▪ 7
DD revision	▪ 4 (Russian in language selection) for device revision 21 ▪ 3 (Dutch in language selection) for device revision 21 ▪ 1 for device revision 22
Device description files (DTM, DD)	Information and files at: ▪ www.endress.com ▪ www.fieldcommgroup.org
HART load	Min. 250 Ω

HART device variables	The measured values are assigned to the device variables as follows: **Measured values for PV (primary variable)** ▪ Pressure ▪ Flow ▪ Level ▪ Tank content **Measured values for SV, TV (second and third variable)** ▪ Pressure ▪ Totalizer **Measured values for QV (fourth variable)** Temperature
Supported functions	▪ Burst mode ▪ Additional transmitter status ▪ Device locking ▪ Alternative operating modes

PROFIBUS PA protocol-specific data

Manufacturer ID	17 (11 hex)
Identification number	1542 hex
Profile version	3.0 ▪ SW version 03.00.zz ▪ SW version 04.00.zz 3.02 SW version 04.01.zz (device revision 3) Compatibility with SW version 03.00.zz and higher.
GSD revision	▪ 4 (SW version 3.00.zz and 4.00.zz) ▪ 5 (device revision 3)
DD revision	▪ 1 (SW version 3.00.zz and 4.00.zz) ▪ 1 (device revision 3)
GSD file DD files	Information and files at: ▪ www.endress.com ▪ www.profibus.org
Output values	**Measured value for PV (via Analog Input Function Block)** ▪ Pressure ▪ Level ▪ Flow ▪ Tank content **Measured value for SV** ▪ Pressure ▪ Temperature **Measured value for QV** Totalizer
Input values	Input value sent from PLC, can be shown on display
Supported functions	▪ Identification & maintenance Simplest device identifier on the control system and nameplate ▪ Condensed status (only with Profile Version 3.02) ▪ Automatic ID number adjustment and switchable to the following ID numbers (only with Profile Version 3.02): – 9700: Profile-specific transmitter identification number with the "Classic" or "Condensed" status". – 1504: Compatibility mode for the old Deltabar S generation (FMD230, FMD630, FMD633, PMD230, PMD235). – 1542: Identification number of the new Deltabar S generation (FMD77, FMD78, PMD75). ▪ Device locking: The device can be locked by hardware or software.

FOUNDATION Fieldbus protocol-specific data

Manufacturer ID	452B48 hex
Device type	1009 hex
Device revision	▪ 6 - SW version 03.00.zz ▪ 7 - SW version 04.00.zz (FF-912)

DD revision	▪ 3 (device revision 6) ▪ 2 (device revision 7)
CFF revision	▪ 4 (device revision 6) ▪ 1 (device revision 7)
DD files	Information and files at: ▪ www.endress.com ▪ www.fieldcommgroup.org
CFF files	
Device tester version (ITK version)	▪ 5.0 (device revision 6) ▪ 6.01 (device revision 7)
Number of ITK test campaign	▪ IT054700 (Device Revision 6) ▪ IT085400 (Device Revision 7)
Link Master (LAS) capable	Yes
Choice of "Link Master" and "Basic Device"	Yes, factory setting is Basic Device
Node address	Factory setting: 247 (F7 hex)
Supported functions	Field diagnostics profile (only with FF912) The following methods are supported: ▪ Restart ▪ Configure error as warning or alarm ▪ HistoROM ▪ Peakhold ▪ Alarm info ▪ Sensor trim
Number of VCRs	▪ 44 (device revision 6) ▪ 24 (device revision 7)
Number of link objects in VFD	50

Virtual communication references (VCRs)

	Device revision 6	Device revision 7
Permanent entries	44	1
Client VCRs	0	0
Server VCRs	5	10
Source VCRs	8	43
Sink VCRs	0	0
Subscriber VCRs	12	43
Publisher VCRs	19	43

Link settings

	Device revision 6	Device revision 7
Slot time	4	4
Min. Inter PDU delay	12	10
Max. response delay	10	10

Transducer Blocks

Block	Content	Output values
TRD1 Block	Contains all parameters related to the measurement	▪ Pressure, flow or level (channel 1) ▪ Process temperature (channel 2)
Service Block	Contains service information	▪ Pressure after damping (channel 3) ▪ Pressure peakhold indicator (channel 4) ▪ Counter for max. pressure transgressions (channel 5)
Dp Flow Block	Contains flow and totalizer parameter	Totalizer 1 (channel 6)
Diagnostic Block	Contains diagnostic information	Error code via DI channels (channel 0 to 16)
Display Block	Contains parameters to configure the onsite display	No output values

Function blocks

Block	Content	Number blocks	Execution time		Functionality	
			Device Revision 6	Device Revision 7	Device Revision 6	Device Revision 7
Resource Block	This block contains all the data that uniquely identifies the device; it is an electronic version of a nameplate for the device.	1			enhanced	enhanced
Analog Input Block 1 Analog Input Block 2 Analog Input Block 3	The AI Block receives the measuring data from the Sensor Block, (selectable via a channel number) and makes the data available to other function blocks at its output. Enhancement: Digital outputs for process alarms, fail safe mode	3	45 ms	45 ms (without trend and alarm reports)	enhanced	enhanced
Digital Input Block	This block contains the discrete data of the Diagnose Block (selectable via a channel number 0 to 16) and provides them for other blocks at the output.	1	40 ms	30 ms	standard	enhanced
Digital Output Block	This block converts the discrete input and thus initiates an action (selectable via a channel number) in the DP Flow Block or in the Service Block. Channel 1 resets the counter for max. pressure transgressions.	1	60 ms	40 ms	standard	enhanced
PID Block	This block is used as a proportional-integral-derivative controller and can be used universally for closed-loop-control in the field. It enables cascade mode and feedforward control. Input IN can be indicated on the display. The selection is performed in the Display Block (DISPLAY_MAIN_LINE_CONTENT).	1	120 ms	70 ms	standard	enhanced
Arithmetic Block	This block is designed to permit simple use of popular measurement math functions. The user does not have to know how to write equations. The math algorithm is selected by name, chosen by the user for the function to be performed.	1	50 ms	40 ms	standard	enhanced
Input Selector Block	The Input Selector Block facilitates the selection of up to four inputs and generates an output based on the configured action. This block normally receives its inputs from AI Blocks. The block performs maximum, minimum, average and 'first good' signal selection. Inputs IN1 to IN4 can be indicated on the display. The selection is performed in the Display Block (DISPLAY_MAIN_LINE_CONTENT).	1	35 ms	35 ms	standard	enhanced
Signal Characterizer Block	The Signal Characterizer Block has two sections, each with an output that is a non-linear function of the respective input. The non-linear function is generated by a single look-up table with 21 arbitrary x-y pairs.	1	30 ms	40 ms	standard	enhanced

Block	Content	Number blocks	Execution time		Functionality	
			Device Revision 6	Device Revision 7	Device Revision 6	Device Revision 7
Integrator Block	The Integrator Block integrates a variable as a function of the time or accumulates the counts from a Pulse Input Block. The block can be used as a totalizer that counts up until a reset, or as a batch totalizer whereby the integrated value is compared against a target value generated before or during the control routine and generates a binary signal when the target value is reached.	1	35 ms	40 ms	standard	enhanced
Analog Alarm Block	This block contains all process alarm conditions (working like a comparator) and represents them at the output.	1	35 ms	35 ms	standard	enhanced

Additional function block information:

Instantiatable function blocks	YES	YES
Number of additional instantiatable function blocks	9	4

Power supply

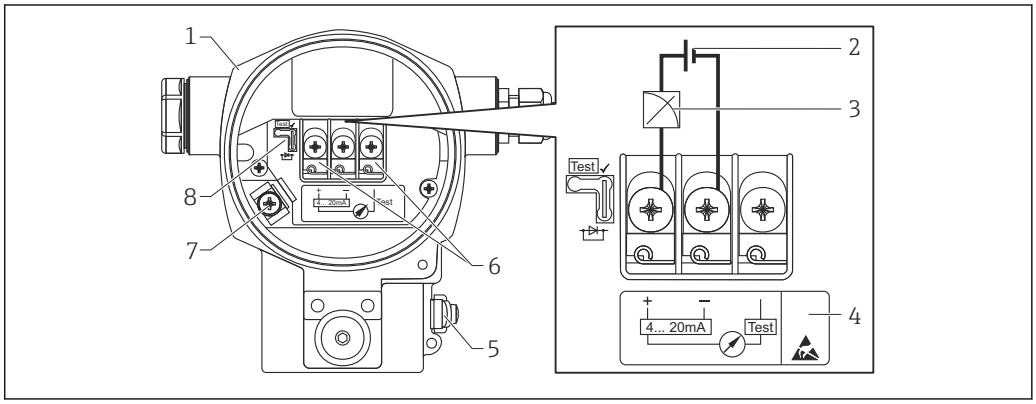
⚠ WARNING

Electrical safety is compromised by an incorrect connection!

- When using the measuring device in hazardous areas, the relevant national standards and regulations as well as the Safety Instructions or Installation or Control Drawings must also be observed.→ 113.
- All explosion protection data are given in separate documentation which is available upon request. The Ex documentation is supplied as standard with all Ex devices→ 113.
- Devices with integrated overvoltage protection must be grounded→ 26.
- Protective circuits against reverse polarity, HF influences and overvoltage peaks are integrated.

Terminal assignment

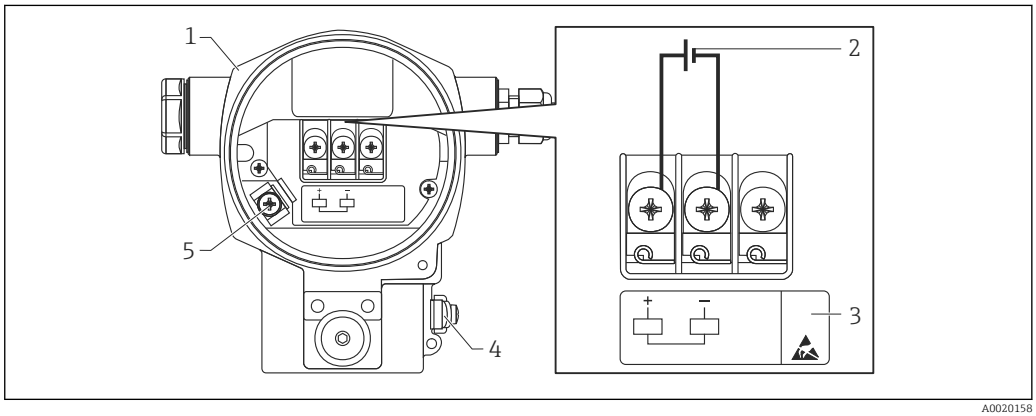
4 to 20 mA HART



A0019989

1 *Housing*
2 *Supply voltage*
3 *4 to 20 mA*
4 *Devices with integrated overvoltage protection are labeled "OVP" (overvoltage protection) here.*
5 *External ground terminal*
6 *4 to 20 mA test signal between positive and test terminal*
7 *Internal ground terminal*
8 *Jumper for 4 to 20 mA test signal*

PROFIBUS PA and FOUNDATION Fieldbus



A0020158

1 *Housing*
2 *Supply voltage*
3 *Devices with integrated overvoltage protection are labeled "OVP" (overvoltage protection) here.*
4 *External ground terminal*
5 *Internal ground terminal*

Supply voltage

4 to 20 mA HART

Electronic version	Jumper for 4 to 20 mA test signal in "Test" position (delivery status)	Jumper for 4 to 20 mA test signal in "Non-test" position
Version for non-hazardous area	11.5 to 45 V DC	10.5 to 45 V DC
Intrinsically safe	11.5 to 30 V DC	10.5 to 30 V DC
▪ Other types of protection ▪ Devices without certificate	11.5 to 45 V DC (versions with 35 V DC plug-in connection)	10.5 to 45 V DC (versions with 35 V DC plug-in connection)

Measuring a 4 to 20 mA test signal

Jumper position for test signal	Description
 A0019992	▪ Measurement of 4 to 20 mA test signal via the positive and test terminal: Possible. (Thus, the output current can be measured without interruption via the diode.) ▪ Delivery status ▪ Minimum supply voltage: 11.5 V DC
 A0019993	▪ Measurement of 4 to 20 mA test signal via positive and test terminal: Not possible. ▪ Minimum supply voltage: 10.5 V DC

PROFIBUS PA

- Version for non-hazardous areas: 9 to 32 V DC
- Ex ia: 10.5 to 30 V DC

FOUNDATION Fieldbus

- Version for non-hazardous areas: 9 to 32 V DC
- Ex ia: 10.5 to 30 V DC

Current consumption

- PROFIBUS PA: 13 mA ±1 mA, switch-on current corresponds to IEC 61158-2, Clause 21
- FOUNDATION Fieldbus: 15.5 mA ±1 mA, switch-on current corresponds to IEC 61158-2, Clause 21

Electrical connection

PROFIBUS PA

The digital communication signal is transmitted to the bus via a two-wire connection. The bus also provides the power supply. For further information on the network structure and grounding, and for further bus system components such as bus cables, see the relevant documentation, e.g. Operating Instructions BA00034S "PROFIBUS DP/PA: Guidelines for planning and commissioning" and the PNO Guideline.

FOUNDATION Fieldbus

The digital communication signal is transmitted to the bus via a two-wire connection. The bus also provides the power supply. For further information on the network structure and grounding and for further bus system components such as bus cables, see the relevant documentation, e.g. Operating Instructions BA00013S "FOUNDATION Fieldbus Overview" and the FOUNDATION Fieldbus Guideline.

Terminals

- Supply voltage and internal ground terminal: 0.5 to 2.5 mm^2 (20 to 14 AWG)
- External ground terminal: 0.5 to 4 mm^2 (20 to 12 AWG)

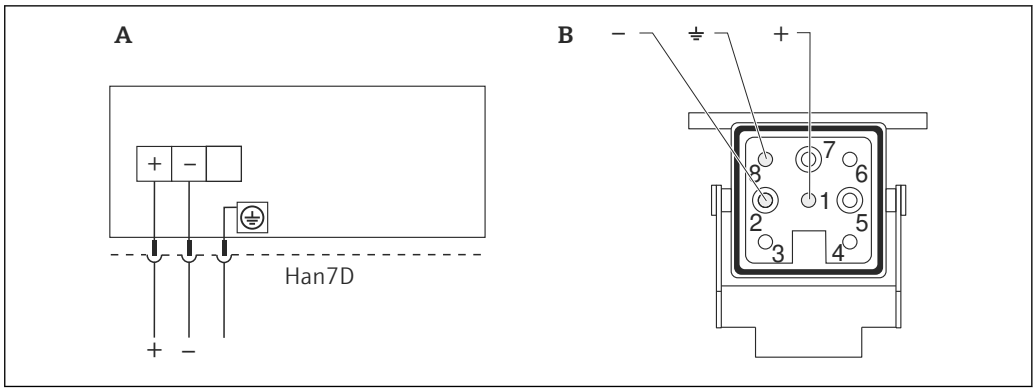
Cable entries

Approval	Cable gland	Clamping area
Standard, II 1/2 G Ex ia, IS	Plastic M20x1.5	5 to 10 mm (0.2 to 0.39 in)
ATEX II 1/2 D, II 1/3 D, II 1/2 GD Ex ia, II 1 GD Ex ia, II 3 G Ex nA	Metal M20x1.5 (Ex e)	7 to 10.5 mm (0.28 to 0.41 in)

For additional technical data, see section on housing → 🖹 49

Device plug

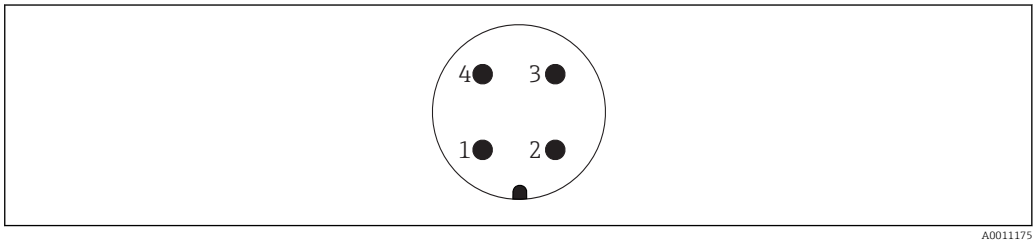
Devices with Harting plug Han7D



A Electrical connection for devices with Harting plug Han7D
B View of the plug-in connection on the device

Material: CuZn, gold-plated plug-in jack and plug

Devices with M12 plug



1 Signal +
2 Not assigned
3 Signal –
4 Ground

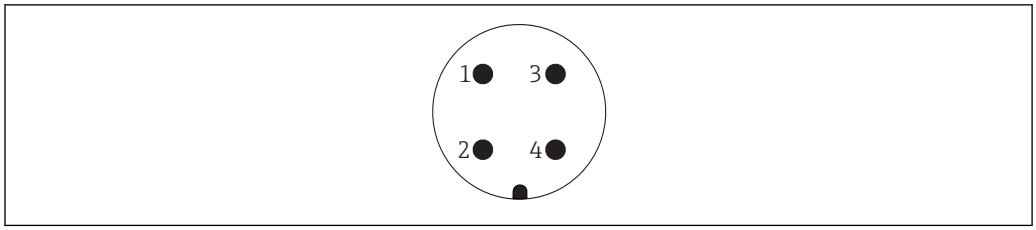
Endress+Hauser offers the following accessories for devices with an M12 plug:

Plug-in jack M 12x1, straight
- Material: Body PA; coupling nut CuZn, nickel-plated
- Degree of protection (fully locked): IP67
- Order number: 52006263

Plug-in jack M 12x1, elbowed
- Material: Body PBT/PA; coupling nut GD-Zn, nickel-plated
- Degree of protection (fully locked): IP67
- Order number: 71114212

Cable 4x0.34 mm^2 (20 AWG) with M12 socket, elbowed, screw plug, length 5 m (16 ft)
- Material: Body PUR; coupling nut CuSn/Ni; cable PVC
- Degree of protection (fully locked): IP67
- Order number: 52010285

Devices with 7/8" plug



A0011176

1 Signal –
2 Signal +
3 Not assigned
4 Shielding

External thread: 7/8 - 16 UNC
- Material: 316L (1.4401)
- Degree of protection: IP68

Cable specification

HART

- Endress+Hauser recommends using shielded, twisted-pair two-wire cables.
- Cable outer diameter: 5 to 9 mm (0.2 to 0.35 in) depending on the cable entry used → 📄 25

PROFIBUS PA

Use a twisted, shielded twin-core cable, preferably cable type A.

For further information regarding cable specifications, see the Operating Instructions BA00034S "PROFIBUS DP/PA: Guidelines for planning and commissioning", the PNO guideline 2.092 "PROFIBUS PA User and Installation Guideline" and IEC 61158-2 (MBP).

FOUNDATION Fieldbus

Use a twisted, shielded twin-core cable, preferably cable type A.

For further information on the cable specifications, see Operating Instructions BA00013S "FOUNDATION Fieldbus Overview", FOUNDATION Fieldbus Guideline and IEC 61158-2 (MBP).

Start-up current

12 mA

Residual ripple

Without influence on 4 to 20 mA signal up to ±5% residual ripple within the permitted voltage range [according to HART hardware specification HCF_SPEC-54 (DIN IEC 60381-1)].

Overvoltage protection (optionally for HART, PROFIBUS PA and FOUNDATION Fieldbus)

- Overvoltage protection:
  - Nominal functioning DC voltage: 600 V
  - Nominal discharge current: 10 kA
- Surge current check î = 20 kA satisfied as per DIN EN 60079-14: 8/20 µs
- Arrester AC current check I = 10 A satisfied

Ordering information: Product Configurator, order code for "Additional options 1" or Additional options 2", option "M"

NOTICE

Device could be destroyed!

► Devices with integrated overvoltage protection must be grounded.

Influence of power supply

≤0.0006 % of URL/1 V

Performance characteristics of differential pressure / pressure transmitter (sensor module + electronics module)

Preamble

The performance characteristic of the dP transmitter refers to "Accuracy of the transmitter". The factors influencing accuracy can be divided into two groups
- Total performance of transmitter → 🖹 28
- Installation dependent influencing factors → 🖹 36

Total performance of transmitter

Transmitter→ 🖹 28 total performance comprises the reference accuracy, the ambient temperature effect and the static pressure and is calculated using the following formula:

Total performance	=	$\pm \sqrt{ (E1)^2 + (E2)^2 + (E3)^2 }$
E1	=	Reference accuracy → 🖹 27
E2	=	Ambient temperature effect per ±28 °C (50 °F) (corresponds to the range of −3 to +53 °C (+27 to +127 °F)) → 🖹 30
E3	=	Static pressure effect → 🖹 31

Reference accuracy [E1]

PMD75: Reference accuracy E1 as % [1] The specifications refer to the calibrated span/Upper Range Value (URV).		
Measuring cell	**Standard**	**Platinum**
10 mbar (0.15 psi)	▪ TD 1:1 = ±0.075 ▪ TD > 1:1 = ±0.075 · TD	▪ TD 1:1 = ±0.05 ▪ TD > 1:1 = ±0.075 · TD
30 mbar (0.45 psi)	▪ TD ≤ 3:1 = ±0.075 ▪ TD > 3:1 = ±0.025 · TD	▪ TD 1:1 = ±0.05 ▪ TD > 1:1 to TD ≤ 3:1 = ±0.075 ▪ TD > 3:1 ±0.025 · TD
100 mbar (1.5 psi)	▪ TD ≤ 5:1 = ±0.05 ▪ TD > 5:1 = ±|0.009 · TD + 0.005|	TD ≥ 1:1 = ±0.04
500 mbar (7.5 psi), 3 bar (45 psi) 16 bar (240 psi), 40 bar (600 psi)	▪ TD ≤ 15:1 = ±0.05 ▪ TD > 15:1 = ±|0.0015 · TD + 0.0275|	TD ≥ 1:1 = ±0.035
160 bar (2 400 psi) rel/abs , 250 bar (3 750 psi) rel/abs	▪ TD ≤ 5:1 = ±0.10 ▪ TD > 5:1 = ±0.02 · TD	-

1) Reference accuracy comprises the non-linearity [DIN EN 61298-2] including the hysteresis [DIN EN 61298-2] and the non-repeatability [DIN EN 61298-2] in accordance with the limit point method as per [DIN EN 60770]. Reference accuracy for standard up to TD 100:1, for platinum up to TD 5:1. Valid for all membrane materials.

FMD77/FMD78: Reference accuracy as % [1] The specifications refer to the calibrated span / upper range value (URV) [2].		
Measuring cell	**FMD77**	**FMD77 with capillary on low-pressure side and FMD78**
100 mbar (1.5 psi)	▪ TD ≤ 5:1 = ±0.10 ▪ TD > 5:1 = ±0.02 · TD	▪ TD ≤ 5:1 = ±0.15 ▪ TD > 5:1 = ±0.03 · TD
500 mbar (7.5 psi)	▪ TD ≤ 15:1 = ±0.075 ▪ TD > 15:1 = ±[0.0015 · TD + 0.053]	▪ TD ≤ 5:1 = ±0.15 ▪ TD > 5:1 = ±0.03 · TD
3 bar (45 psi), 16 bar (240 psi)	▪ TD ≤ 15:1 = ±0.075 ▪ TD > 15:1 = ±[0.0015 · TD + 0.053]	▪ TD ≤ 15:1 = ±0.1 ▪ TD > 15:1 = ±[0.006 · TD + 0.01]
40 bar (600 psi)	-	▪ TD ≤ 15:1 = ±0.1 ▪ TD > 15:1 = ±[0.006 · TD + 0.01]

1) Reference accuracy comprises the non-linearity [DIN EN 61298-2] including the hysteresis [DIN EN 61298-2] and the non-repeatability [DIN EN 61298-2] in accordance with the limit point method as per [DIN EN 60770]. Reference accuracy for standard up to TD 100:1. The specifications refer to the calibrated span / upper range value (URV).
2) FMD77/FMD78: No diaphragm seal errors are taken into account. Diaphragm seal errors can be calculated separately in the Applicator diaphragm seal calculation module. Link to online tool Applicator: www.endress.com/applicator → Sizing Diaphragm Seal

Please refer to the next chapter “Detailed performance explanation and calculation” for further explanations on "Ambient temperature effect" as well as "Static pressure effect" .

Total performance – Specification values

PMD75: total performance as % The specifications refer to the calibrated span/Upper Range Value (URV).										
Measuring cell	**Standard [1]**					**Platinum [1]**				
	TD 1:1	**TD 2:1**	**TD 3:1**	**TD 4:1**	**TD 5:1**	**TD 1:1**	**TD 2:1**	**TD 3:1**	**TD 4:1**	**TD 5:1**
10 mbar (0.15 psi)	±0.30	±0.52	±0.74	±0.96	±1.18	±0.26	±0.44	±0.61	±0.78	±0.96
30 mbar (0.45 psi)	±0.26	±0.41	±0.56	±0.72	±0.88	±0.24	±0.38	±0.52	±0.67	±0.81
100 mbar (1.5 psi)	±0.20	±0.27	±0.34	±0.41	±0.49	±0.20	±0.26	±0.33	±0.40	±0.47
500 mbar (7.5 psi)	±0.11	±0.14	±0.17	±0.20	±0.23	±0.10	±0.13	±0.16	±0.19	±0.22
3 bar (45 psi)	±0.14	±0.18	±0.23	±0.28	±0.33	±0.11	±0.13	±0.16	±0.18	±0.20
16 bar (240 psi)	±0.12	±0.16	±0.20	±0.25	±0.30	±0.10	±0.12	±0.14	±0.16	±0.18
40 bar (600 psi)	±0.12	±0.16	±0.20	±0.25	±0.30	±0.10	±0.12	±0.14	±0.16	±0.18
160 bar (2 400 psi) rel/abs 250 bar (3 750 psi) rel/abs	±0.17	±0.20	±0.24	±0.28	±0.32	-				

1) The specification values apply to the temperature range per ±28 °C (50 °F) (corresponds to the range of −3 to +53 °C (+27 to +127 °F)) for all measuring cells. The specifications apply to a static pressure of 7 bar (105 psi) for measuring cells of 10 mbar (0.15 psi) to 500 mbar (7.5 psi), for larger measuring cells of 70 bar (1 050 psi). The specification values apply to the analog output (i.e. including electronics errors). The specification values apply to membrane material AISI 316L (1.4435), Alloy C .

Long-term stability

PMD75/FMD77/FMD78: long-term stability as % The specifications refer to the upper range limit (URL) [1].			
Measuring cell	**Standard & platinum**		
	1 year	**5 years**	**10 years**
10 mbar (0.15 psi)	± 0.200	± 0.280	± 0.310
30 mbar (0.45 psi)	± 0.200	± 0.280	± 0.310
100 mbar (1.5 psi)	± 0.080	± 0.140	± 0.270
500 mbar (7.5 psi)	± 0.025	± 0.050	± 0.075
3 bar (45 psi)	± 0.038	± 0.075	± 0.150
16 bar (240 psi)	± 0.025	± 0.110	± 0.210
40 bar (600 psi)	± 0.050	± 0.070	± 0.100
160 bar (2 400 psi) rel/abs 250 bar (3 750 psi) rel/abs	± 0.050	± 0.070	± 0.100

1) FMD77FMD78: No diaphragm seal errors are taken into account. Diaphragm seal errors can be calculated separately in the Applicator diaphragm seal calculation module. Link to online tool Applicator: www.endress.com/applicator → Sizing Diaphragm Seal

Detailed Performance Explanation and Calculation

To calculate the total performance outside the temperature range of −3 to +53 °C (+27 to +127 °F) or for a membrane material other than 1.4435/316L or Alloy C 276, please refer to the following sections: "Ambient temperature effect", "Static pressure effect" and "Calculating the total performance" [1].

Ambient temperature effect [E2]

- $E2 = (E2_M \cdot CF_1 \cdot CF_2) + E2_E + E2_{LT}$
- $E2_M$ = Main temperature error
- CF_1 = Temperature range correction factor
- CF_2 = Membrane material correction factor (thermal)
- $E2_E$ = Electronics error for analog output
- $E2_{LT}$ = low temperature error

$E2_M$ - Main temperature error

The output changes due to the effect of ambient temperature [IEC 61298-3] with respect to reference temperature [DIN 16086]. The values specify the maximum error due to min./max. ambient or process temperature conditions.

PMD75/FMD77/FMD78: main temperature error $E2_M$ as % per ±28 °C (50 °F) (corresponds to the range of −3 to +53 °C (+27 to +127 °F)) The specifications refer to the calibrated span/Upper Range Value (URV).		
Measuring cell	**Standard**	**Platinum**
10 mbar (0.15 psi), 30 mbar (0.45 psi)	± (0.14 · TD + 0.04)	± (0.14 · TD + 0.04)
100 mbar (1.5 psi)	± (0.07 · TD + 0.07)	± (0.07 · TD + 0.07)
500 mbar (7.5 psi)	± (0.03 · TD + 0.017)	± (0.03 · TD + 0.017)
3 bar (45 psi), 16 bar (240 psi), 40 bar (600 psi)	± (0.012 · TD + 0.017)	± (0.012 · TD + 0.017)
160 bar (2 400 psi) rel/abs	± (0.042 · TD + 0.04)	-
250 bar (3 750 psi) rel/abs	± (0.022 · TD + 0.04)	-

CF_1 - Temperature range correction factor

PMD75/FMD77/FMD78: correction factor CF_1		
Measuring cell	**Temperature range**	**Factor, CF_1**
For all measuring cells	25 °C ± 28 °C (−3 to +53 °C (+27 to +127 °F))	1
	−32 to −4 °C (−26 to +25 °F) and +54 to +85 °C (+129 to +185 °F)	2
	−50 to −33 °C (−58 to −27 °F)	2.3

CF_2 - Membrane material correction factor (thermal) (only for PMD75)

PMD75: correction factor CF_2					
Measuring cell	**AISI 316L**	**Alloy C**	**Gold-Rhodium**	**Monel**	**Tantalum**
10 mbar (0.15 psi)	1.0	1.0	2.5	2.8	2.3
30 mbar (0.45 psi)	1.0	1.0	2.5	2.8	2.3
100 mbar (1.5 psi)	1.0	1.0	1.1	1.1	1.1
500 mbar (7.5 psi)	1.0	1.0	1.8	1.8	1.8

1) FMD77FMD78: No diaphragm seal errors are taken into account. Diaphragm seal errors can be calculated separately in the Applicator diaphragm seal calculation module. Link to online tool Applicator: www.endress.com/applicator → Sizing Diaphragm Seal

PMD75: correction factor CF_2					
Measuring cell	**AISI 316L**	**Alloy C**	**Gold-Rhodium**	**Monel**	**Tantalum**
3 bar (45 psi)	1.0	1.0	3.1	3.1	3.1
16 bar (240 psi)	1.0	1.0	4.7	4.7	4.7
40 bar (600 psi)	1.0	1.0	3.1	3.1	3.1
160 bar (2 400 psi) rel/abs 250 bar (3 750 psi) rel/abs	1.0	1.0	-	-	-

$E2_E$ - Electronics error

PMD75/FMD77/FMD78: electronics error $E2_E$ as % The specifications refer to the calibrated span/Upper Range Value (URV).			
Measuring cell	**Electronics**	**Temperature range**	**Error** [1]
For all measuring cells	Analog output (4 to 20 mA)	−50 to +85 °C (−58 to +185 °F)	0.05
	Digital output (HART)	−50 to +85 °C (−58 to +185 °F)	0
	Digital output (PA/FF)	−40 to +85 °C (−40 to +185 °F)	0

1) The additional electronics error that occurs in the temperature range −50 to −41 °C (−58 to −42 °F) is covered by $E2_{LT}$.

$E2_{LT}$ - low temperature error

PMD75/FMD77/FMD78: low temperature error $E2_{LT}$ as % The specifications refer to the calibrated span/Upper Range Value (URV).		
Measuring cell	**Temperature range**	**Problem**
For all measuring cells	−40 to +85 °C (−40 to +185 °F)	0
	−50 to −41 °C (−58 to −42 °F)	1.5

Static pressure effect [E3]

- $E3 = E3_M \cdot CF_3$
- $E3_M$ = main static pressure error ($E3_M$ = zero point error + span error)
- CF_3 = Membrane material correction factor (static pressure)

$E3_M$ - Main static pressure error

Static pressure effect refers to the effect on the output due to changes in process static pressure. It is the difference between the output at each static pressure and the output at atmospheric pressure [IEC 61298-3]. It is the combination of influence of the operating pressure on the zero point and span.

PMD75/FMD77/FMD78: main static pressure error $E3_M$ as % The specifications refer to the calibrated span/Upper Range Value (URV).				
Measuring cell	**Standard**		**Platinum**	
	on the zero point [1]	**on the span**	**on the zero point** [1]	**on the span**
10 mbar (0.15 psi)	± 0.15 · TD per 7 bar (105 psi)	± 0.035 per 7 bar (105 psi)	± 0.07 · TD per 7 bar (105 psi)	± 0.035 per 7 bar (105 psi)
30 mbar (0.45 psi)	± 0.70 · TD per 70 bar (1 050 psi)	± 0.14 per 70 bar (1 050 psi)	± 0.25 · TD per 70 bar (1 050 psi)	± 0.14 per 70 bar (1 050 psi)
100 mbar (1.5 psi)	± 0.203 · TD per 70 bar (1 050 psi)	± 0.15 per 70 bar (1 050 psi)	± 0.077 · TD per 70 bar (1 050 psi)	± 0.15 per 70 bar (1 050 psi)
500 mbar (7.5 psi)	± 0.07 · TD per 70 bar (1 050 psi)	± 0.10 per 70 bar (1 050 psi)	± 0.028 · TD per 70 bar (1 050 psi)	± 0.10 per 70 bar (1 050 psi)

PMD75/FMD77/FMD78: main static pressure error $E3_M$ as % The specifications refer to the calibrated span/Upper Range Value (URV).				
Measuring cell	Standard		Platinum	
	on the zero point [1]	on the span	on the zero point [1]	on the span
3 bar (45 psi)	± 0.049 · TD per 70 bar (1 050 psi)	± 0.05 per 70 bar (1 050 psi)	± 0.021 · TD per 70 bar (1 050 psi)	± 0.05 per 70 bar (1 050 psi)
16 bar (240 psi), 40 bar (600 psi)	± 0.049 · TD per 70 bar (1 050 psi)	± 0.02 per 70 bar (1 050 psi)	± 0.021 · TD per 70 bar (1 050 psi)	± 0.02 per 70 bar (1 050 psi)
160 bar (2 400 psi) rel/abs 250 bar (3 750 psi) rel/abs	-	-	-	-

1) The influence of the operating pressure on the zero point can be corrected. Please refer to operating instructions and chapter Commissioning → Position adjustment.

CF_3 – Membrane material correction factor (static pressure) (applicable only to PMD75)

PMD75: membrane material correction factor $CF3_3$					
Measuring cell	AISI 316L	Alloy C	Gold-Rhodium	Monel	Tantalum
10 mbar (0.15 psi)	1.0	1.0	1.0	1.4	2.1
30 mbar (0.45 psi)	1.0	1.0	1.5	2.0	3.1
100 mbar (1.5 psi)	1.0	1.0	2.5	2.5	2.5
500 mbar (7.5 psi)	1.0	1.0	1.2	1.2	1.8
3 bar (45 psi)	1.0	1.0	2.1	2.1	2.8
16 bar (240 psi)	1.0	1.0	3.0	3.0	4.0
40 bar (600 psi)	1.0	1.0	3.0	3.0	4.0
160 bar (2 400 psi) rel/abs 250 bar (3 750 psi) rel/abs	-	-	-	-	-

Total error

Total error = total performance + long-term stability

Total performance as % of the set span with TD 1:1 → 🖹 28

Long-term stability as % of the upper range limit (URL) → 🖹 29

PMD75: total error as % The specifications refer to the upper range limit (URL).						
Measuring cell	Standard [1]			Platinum [1]		
	1 year	5 years	10 years	1 year	5 years	10 years
10 mbar (0.15 psi)	± 0.50	± 0.58	± 0.61	± 0.46	± 0.54	± 0.57
30 mbar (0.45 psi)	± 0.46	± 0.54	± 0.57	± 0.44	± 0.52	± 0,55
100 mbar (1.5 psi)	± 0.28	± 0.34	± 0,47	± 0.28	± 0.34	± 0,47
500 mbar (7.5 psi)	± 0.14	± 0.16	± 0.19	± 0,13	± 0.15	± 0.18
3 bar (45 psi)	± 0.17	± 0.21	± 0.29	± 0.15	± 0.19	± 0.26
16 bar (240 psi)	± 0.14	± 0.23	± 0.33	± 0.12	± 0.21	± 0.31
40 bar (600 psi)	± 0.17	± 0.19	± 0.22	± 0.15	± 0.17	± 0.20
160 bar (2 400 psi) rel/abs 250 bar (3 750 psi) rel/abs	± 0.22	± 0.24	± 0,27	-		

1) The specification values apply to the temperature range per ±28 °C (50 °F) (corresponds to the range of −3 to +53 °C (+27 to +127 °F)) for all measuring cells. The specifications apply to a static pressure of 7 bar (105 psi) for measuring cells of 10 mbar (0.15 psi) to 500 mbar (7.5 psi), for larger measuring cells of 70 bar (1 050 psi). The specification values apply to the analog output (i.e. including electronics errors). The specification values apply to membrane material AISI 316L (1.4435), Alloy C .

Performance characteristics - calculation example and additional information

Calculating the total performance in 5 steps

Data (Example)

Measuring Conditions / Device configuration	
dP range (URV)	8 bar (116 psi)
Min./ Max. temp. differential pressure transmitter (ambient/process)	Ambient temp.:0 to 45 °C (32 to 113 °F) Max. Process temp.:50 °C (122 °F)
Membrane material	AISI 316L
Reference accuracy (± 0.05%)	Standard
PMD75 - suitable measuring cell (upper range limit, URL)	16 bar (240 psi) with TD 2:1
Static pressure	35 bar (508 psi)
Output Signal	4 to 20 mA

Formula

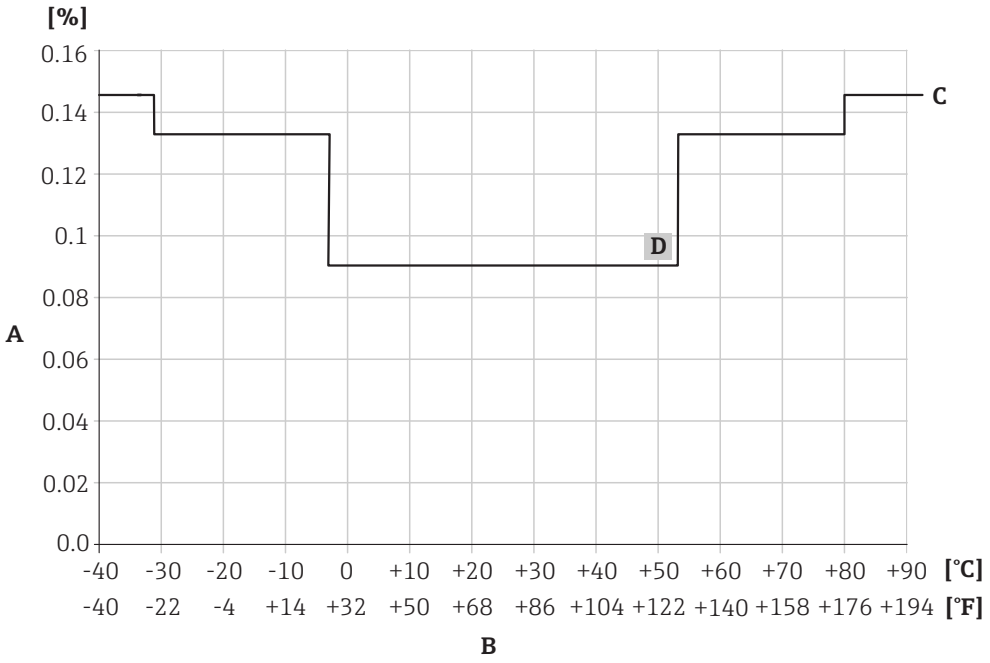
Total performance	=	$\pm \sqrt{ (E1)^2 + (E2)^2 + (E3)^2 }$
E1	=	Reference accuracy → 🖹 27
E2	=	Ambient temperature effect per ±28 °C (50 °F) (corresponds to the range of −3 to +53 °C (+27 to +127 °F)) → 🖹 30
E3	=	Static pressure effect → 🖹 31

Calculation

Step 1: Calculating the turn down → 🖹 7		
Turn down (TD) = URL/ | URV - LRV |	=	16 bar (240 psi)/8 bar (116 psi)
	=	TD = 2:1
Step 2: Calculating the reference accuracy (E1) → 🖹 27		
For the measuring conditions,		
Reference accuracy, E1	=	± 0.05 (% of the set span)
	=	± (0.05/100) · 8 bar (116 psi)
	=	±0.0040 bar (0.0580 psi)
	E1 =	± 0.05 (% of the set span)
	(or)	±0.0040 bar (0.0580 psi)

Step 3: Calculation of the ambient temperature effect [$E2 = (E2_M \cdot CF_1 \cdot CF_2) + E2_E + E2_{LT}$] → 🖹 30

For the measuring conditions, Main temperature error, $E2_M$	=	± (0.012 · TD + 0.017) % of the set span
Temperature correction factor, CF_1	=	1
Membrane material correction factor, CF_2	=	1
Electronics error , $E2_E$	=	0.05 %
Low temperature error $E2_{LT}$	=	0 %
Ambient temperature effect, E2	=	± [(0.012 · TD + 0.017) · 1 · 1] +0.05
	=	± [(0.012 · 2 + 0.017) · 1 · 1] + 0.05
	=	± 0.091 (% of the set span)
	=	± (0.091/100) · 8 bar (116 psi)
	=	±0.0073 bar (0.10585 psi)
E2	=	± 0.091 (% of the set span)
	(or)	±0.0073 bar (0.10585 psi)



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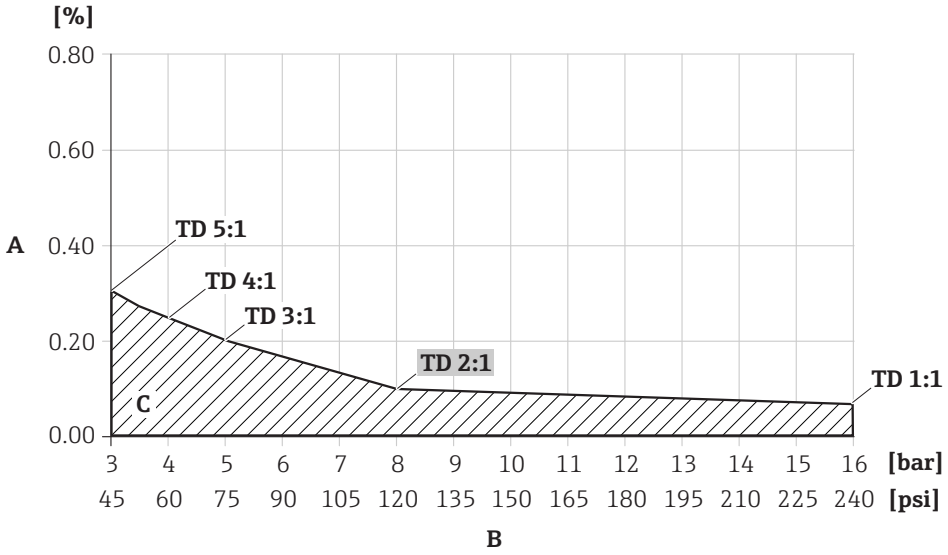
A Error (% of the set span)
B Temperature
C Measuring membrane made from 316L or Alloy C
D Ambient temperature effect: 0.091 (% of the set span) (E_2 at 50 °C (122 °F))

Step 4: Calculating the static pressure effect ($E3 = E3_M \cdot CF_3$) → 🖹 31

For the measuring conditions, Main static pressure error, $E3_M$	=	± (0.049 · TD) on the zero point and ± 0.02 on the span (% of the set span) per 70 bar (1015 psi)
	=	[± (0.049 · TD) on the zero point and ± 0.02 on the span] · (35/70) (% of the set span) per 35 bar (507.50 psi)
Error factor dependent on membrane material, CF_3	=	1
Static pressure effect, E3	=	± (0.049 · TD + 0.02) · (35/70) · CF_3 (% of the set span)
	=	± (0.049 · 2 + 0.02) · (0.5) · 1
	=	± 0.059 (% of the set span)
	=	± (0.059/100) · 8 bar (116 psi)
	=	±0.0047 bar (0.06815 psi)
	E3 =	± 0.059 (% of the set span)
	(or)	±0.0047 bar (0.06815 psi)

Step 5: Calculation of total performance

Total performance	=	$\pm \sqrt{((E1)^2 + (E2)^2 + (E3)^2)}$
		E1 = Reference accuracy E2 = Ambient temperature effect per ±28 °C (50 °F) (corresponds to the range of −3 to +53 °C (+27 to +127 °F)) E3 = Static Pressure Effect
Total performance, in mbar	=	$\pm \sqrt{((0.004)^2 + (0.0073)^2 + (0.0047)^2)}$
	=	± 0.0095 bar (0.13775 psi) or 9.5 mbar (0.13775 psi)
	~	0.119 % of 8 bar (116 psi)
	(or)	
Total performance, in % of the set span	=	$\pm \sqrt{((0.05)^2 + (0.091)^2 + (0.059)^2)}$
	=	± 0.119 (% of the set span)
Total performance	=	± 0.119 (% of the set span)
	(or)	±0.0095 bar (0.13775 psi)

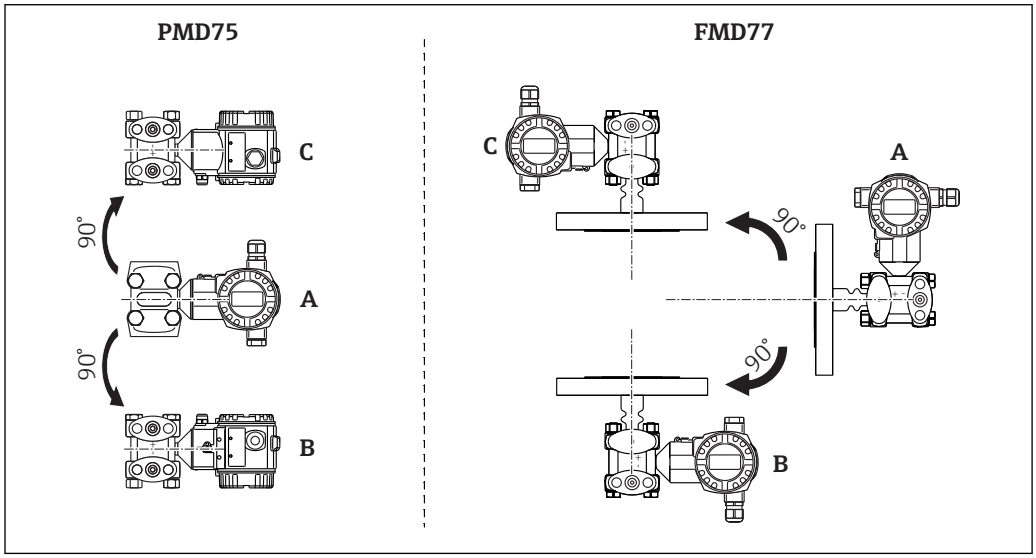


A Error (% of the set span)
B Set span [bar]
C Standard measuring cell

Installation factors

Some of the influencing factors are:
- Influence of installation position → 36
- Vibration effects → 36

Influence of installation position



Device	Calibration position (A)	Device rotated vertically downwards (B)	Device rotated vertically upwards (C)
PMD75 and silicone oil	No additional error	<+4 mbar (+0.06 psi) The value is doubled for inert oil.	<−4 mbar (−0.06 psi) The value is doubled for inert oil.
FMD77 and silicone oil	No additional error	<+32 mbar (+0.46 psi) The value is doubled for inert oil.	<−32 mbar (−0.46 psi) The value is doubled for inert oil.

A position-dependent zero point shift can be corrected. Please refer to operating instructions chapter Commissioning → Position adjustment.

Vibration effects

Device/accessory	Measuring cells	Housing	Test standard	Vibration resistance
PMD75	10 mbar (0.15 psi), 30 mbar (0.45 psi)	T14 stainless steel T15 aluminum T17 aluminum	IEC 61298-3	≤ 0.15% URL to 10 to 38 Hz: ±0.35 mm (0.0138 in); 38 to 2000 Hz: 2 g in all 3 planes
		T14 aluminum	IEC 61298-3	≤ 0.15% URL to 10 to 60 Hz: ±0.21 mm (0.0083 in); 60 to 2000 Hz: 3 g in all 3 planes
	≥100 mbar (1.5 psi)	T14 stainless steel T15 aluminum	IEC 61298-3	≤ 0.075 % URL to 10 to 38 Hz: ±0.35 mm (0.0138 in); 38 to 2000 Hz: 2 g in all 3 planes
		T14 aluminum	IEC 61298-3	≤ 0.075 % URL to 10 to 60 Hz: ±0.35 mm (0.0138 in); 60 to 2000 Hz: 5 g in all 3 planes

Performance Characteristics Conformance

All performance characteristics are in conformance to ≥ ± 3 sigma.

Resolution

Current output: 1 µA

Warm-up period

- 4 to 20 mA HART: < 10 s
- PROFIBUS PA: 6 s
- FOUNDATION Fieldbus: 50 s

Reference operating conditions

- As per IEC 60770
- Ambient temperature T_A = constant, in the range +21 to +33 °C (+70 to +91 °F)
- Humidity φ = constant, in the range: 5 to 80 % RH ± 5 %
- Ambient pressure p_A = constant, in range: 860 to 1060 mbar (12.47 to 15.37 psi)
- Position of measuring cell: horizontal ±1° (see also "Influence of installation position" section→ 36)
- Input of LOW SENSOR TRIM and HIGH SENSOR TRIM for lower range value and upper range value
- Zero based span
- Membrane material for PMD75: AISI 316L (1.4435), Alloy C276, gold/rhodium-coated, Monel
- Membrane material for FMD77, FMD78: AISI 316L (1.4435)
- Filling oil: silicone oil
- Supply voltage: 24 V DC ±3 V DC
- Load with HART: 250 Ω
- Turn down (TD) = URL/ | URV - LRV |

Installation

General installation instructions

- A position-dependent zero point shift can be corrected directly at the device via operating keys, and also in hazardous areas in the case of devices with external operation.
  Diaphragm seals also shift the zero point, depending on the installation position → 98.
- The device housing can be rotated up to 380° .
- Endress+Hauser offers a mounting bracket for installing the device on pipes or walls → 39.
- Use flushing rings for flange and cell diaphragm seals if buildup or clogging can be expected at the diaphragm seal connection. The flushing ring can be fitted between the process connection and diaphragm seal. Material buildup in front of the process isolating diaphragm can be flushed away, and the pressure chamber vented, via the two lateral flushing holes.
- When measuring in media containing solids, such as dirty liquids, installing separators and drain valves is useful for capturing and removing sediment.
- Using a valve manifold allows for easy commissioning, installation and maintenance without interrupting the process.
- General recommendations for the pressure piping can be found in DIN 19210 "Methods for measurement of fluid flow; differential piping for flow measurement devices" or the corresponding national or international standards.
- Install the pressure piping with a continuous gradient of at least 10%.
- When routing the pressure piping outdoors, ensure sufficient anti-freeze protection, e.g. by using pipe heat tracing.
- Point the cable and connector downwards where possible to prevent moisture from entering (e.g. rain or condensation water).

Measuring arrangement

Flow measurement

- The PMD75 is best suited to flow measurement.
- Measuring arrangement for gases: Mount device above the measuring point.
- Measuring arrangement for liquids and vapors: Mount device below the measuring point.
- For flow measurement in vapors, mount the condensate traps at the same level as the tapping point and at the same distance from the Deltabar S.

Level measurement

The PMD75 and FMD77 are best suited to level measurement in open containers. All Deltabar S devices are suitable for level measurement in closed vessels.

Measuring arrangement for level measurement in open containers
- PMD75: Mount device below the lower measuring connection. The negative side is open to atmospheric pressure.
- FMD77: Mount device directly on the vessel. The negative side is open to atmospheric pressure.

Measuring arrangement for level measurement in closed containers and closed containers with superimposed vapor
- PMD75: Mount device below the lower measuring connection. Always connect the negative side above the maximum level via pressure piping.
- FMD77: Mount device directly on the vessel. Always connect the negative side above the maximum level via pressure piping.
- In the case of level measurement in closed vessels with superimposed vapor, a condensate trap ensures the pressure remains constant on the minus side.

Pressure measurement

- The PMD75 and FMD78 are best suited to differential pressure measurement.
- Measuring arrangement for gases: Mount device above the measuring point.
- Measuring arrangement for liquids and vapors: Mount device below the measuring point.
- For differential pressure measurement in vapors, mount the condensate traps at the same level as the tapping point and at the same distance from the Deltabar S.

Measuring arrangement for devices with diaphragm seals – FMD77 and FMD78

→ 94

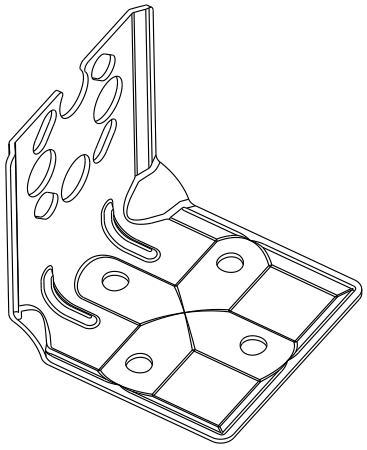
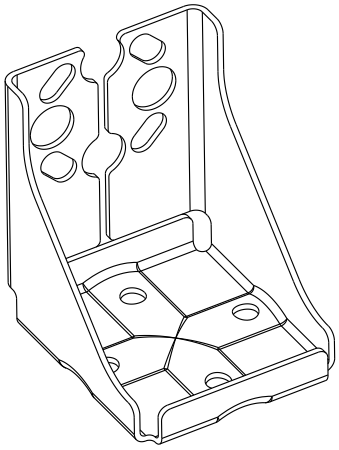
Orientation

The orientation may cause a zero point shift, see → 36.

This position-dependent zero point shift can be corrected directly at the device via the operating key, and also in hazardous areas in the case of devices with external operation (position adjustment).

Wall and pipe mounting, transmitter (optional)

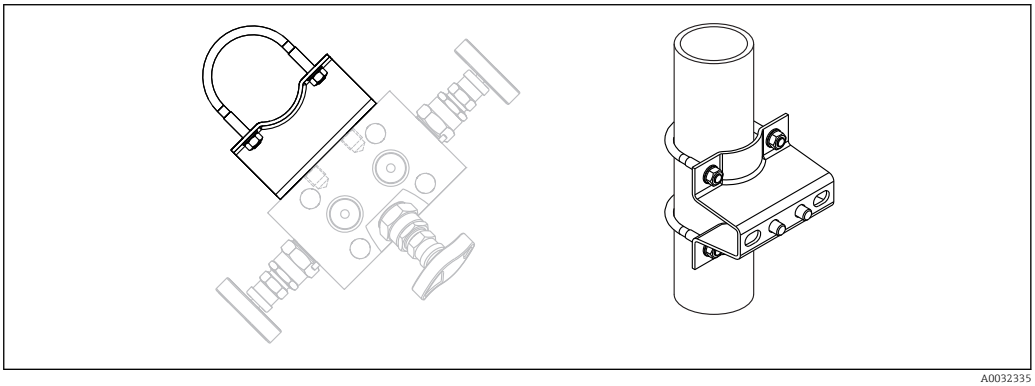
Endress+Hauser offers the following mounting bracket for installing the device on pipes or walls:

Standard version	Heavy-duty version
 A0031326	 A0031327

- The standard mounting bracket version is **not** suitable for use in an application subject to vibrations.
- The vibration resistance of the heavy-duty mounting bracket has been tested according to IEC 61298-3, see the "Vibration resistance" section → 44.
- If a valve manifold is used, its dimensions should also be taken into consideration.
- Bracket for wall and pipe mounting including retaining bracket for pipe mounting and two nuts.
- The material of the screws used to secure the device depend on the order code.
- For the technical data (such as the dimensions or order numbers for screws), see the document SD01553P/00/EN.

Ordering information:
- Standard version: Product Configurator, order code for "Additional options" option "Q" or
- Standard version: Product Configurator, order code for "Accessories enclosed" option "PD"
- Heavy-duty version: Product Configurator, order code for "Additional options" option "U" or
- Heavy-duty version: Product Configurator, order code for "Accessories enclosed" option "PB"

Wall and pipe mounting, valve manifold (optional)



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For the technical data (such as the dimensions or order numbers for screws), see the document SD01553P/00/EN.

Ordering information:

Product Configurator, order code for "Accessories enclosed", option "PJ"

"Separate housing" version

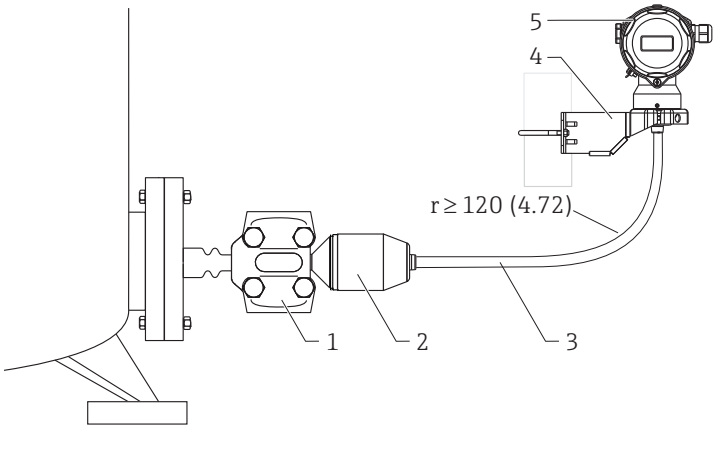
With the "separate housing" version, you are able to mount the housing with the electronics insert at a distance from the measuring point. This version facilitates trouble-free measurement
- Under particularly difficult measuring conditions (at installation locations that are cramped or difficult to access)
- If rapid cleaning of the measuring point is required and
- If the measuring point is exposed to vibrations.

You can choose between different cable versions:
- PE: 2 m (6.6 ft), 5 m (16 ft) and 10 m (33 ft)
- FEP: 5 m (16 ft).

Ordering information: Product Configurator, order code for "Additional options 2", version "G".

Dimensions → 🖹 78

In the case of the "separate housing" version, the sensor is delivered with the process connection and cable ready mounted. The housing and a mounting bracket are enclosed as separate units. The cable is provided with a socket at both ends. These sockets are simply connected to the housing and the sensor.



1 Process connection with sensor - For degrees of protection, see the following section
2 Process connection adapter (weight: 0.93 kg (2.05 lb))
3 Cable (weight: 0.05 kg/meter (0.11 lb)), both ends are fitted with a socket
4 Mounting bracket provided, suitable for pipe and wall mounting
5 Housing with electronic insert - degrees of protection → 🖹 49

Engineering unit mm (in)

Degree of protection for the process connection and sensor with the use of
- FEP cable:
  - IP 69 [2)]
  - IP 66 NEMA 4/6P
  - IP 68 (1.83 mH_2O for 24 h) NEMA 4/6P
- PE cable:
  - IP 66 NEMA 4/6P
  - IP 68 (1.83 mH_2O for 24 h) NEMA 4/6P

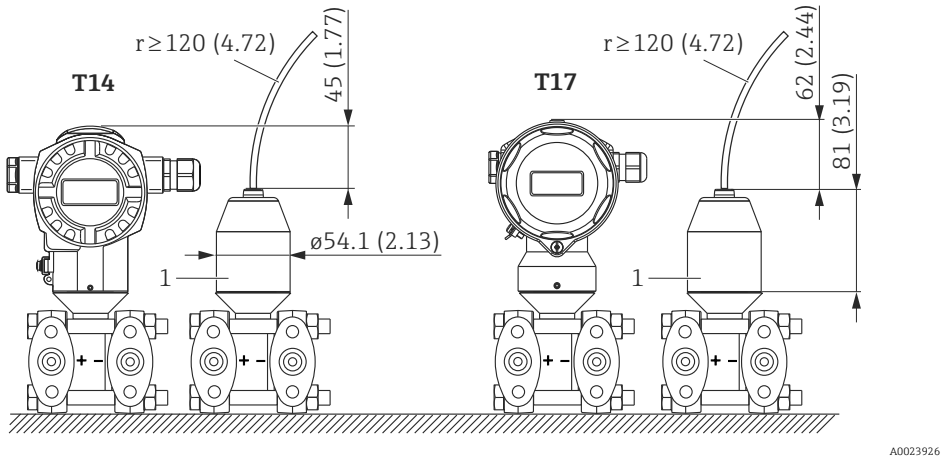
Technical data of the PE and FEP cable:
- Minimum bending radius: 120 mm (4.72 in)
- Cable extraction force: max. 450 N (101.16 lbf)
- Resistance to UV light

Use in hazardous area:
- Intrinsically safe installations (Ex ia/IS)
- FM/CSA IS: for Div. 1 installation only

2) Designation of the IP protection class according to DIN EN 60529. Previous designation "IP69K" according to DIN 40050 Part 9 is no longer valid (standard withdrawn on November 1, 2012). The tests required by both standards are identical.

Reduction of the installation height

If the separate housing is used, the installation height of the process connection is reduced compared to the dimensions of the standard version.



1 Process connection adapter

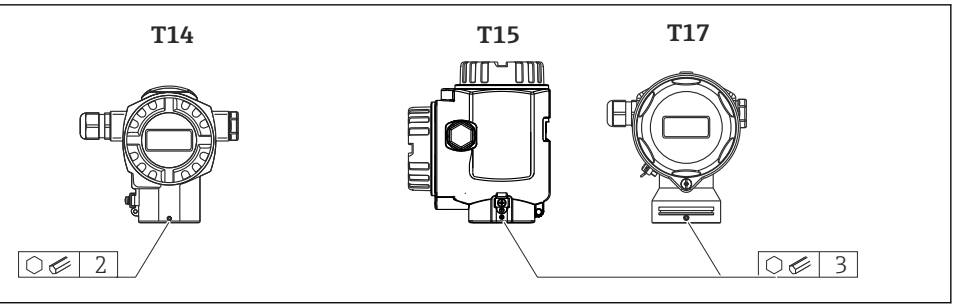
Engineering unit mm (in)

Turning the housing

The housing can be rotated up to 380° by loosening the Allen screw.

Your benefits

- Easy mounting due to optimum alignment of housing
- Good, accessible device operation
- Optimum readability of the onsite display (optional).



Oxygen applications

Oxygen and other gases can react explosively to oils, grease and plastics, such that, among other things, the following precautions must be taken:
- All components of the system, such as measuring devices, must be cleaned in accordance with the BAM (DIN 19247) requirements.
- Dependent on the materials used, a certain maximum temperature and a maximum pressure for oxygen applications must not be exceeded.

The devices suitable for gaseous oxygen applications are listed in the following table with the specification p_{max}.

HB = Cleaned for oxygen service

Order code for devices [1], cleaned for oxygen applications	p_{max} for oxygen applications	T_{max} for oxygen applications
PMD75 – * * * * * * * * K * * or PMD75 – * * * * * * * * H * * HB	160 bar (2 400 psi)	85 °C (185 °F)
PMD75 – * * * * * * * * 2 * * or PMD75 – * * * * * * * * A * * HB	160 bar (2 400 psi)	60 °C (140 °F)
PMD75 – * * * * * * * * 3 * * or PMD75 – * * * * * * * * C * * HB	160 bar (2 400 psi)	60 °C (140 °F)
FMD77 – * * * * * T * F * * or FMD77 – * * * * * D * F * * HB	PN of the flange	60 °C (140 °F)
FMD78 – * * * * * * * * 4 * * or FMD78 – * * * * * * * * 6 * * HB FMD78 – * * * * * * * * D * * or FMD78 – * * * * * * * * F * * HB	Depends on filling oil: max. 160 bar (2 400 psi)	85 °C (185 °F)

1) Devices only, not accessories or enclosed accessories.

Ultrapure gas applications

Endress+Hauser also offers devices for special applications, such as ultrapure gas, cleaned from oil and grease. No special restrictions regarding the process conditions apply to these devices.

Ordering information:
- PMD75: Product Configurator, order code for "Seal"
- FMD77: Product Configurator, order code for "Process connection low-pressure side; Material; Seal".

Applications with hydrogen

A **gold-plated** metal process isolating diaphragm offers universal protection against hydrogen diffusion, both in gas applications and in applications with aqueous solutions.

Applications with hydrogen in aqueous solutions

A **gold/rhodium-plated** metal process isolating diaphragm (AU/Rh) offers effective protection against hydrogen diffusion.

Environment

Ambient temperature range

Version	PMD75	FMD77	FMD78
Without LCD display	−50 to +85 °C (−58 to +185 °F) [1]		
With LCD display [2]	−20 to +70 °C (−4 to +158 °F)		
With separate housing	-	−20 to +60 °C (−4 to +140 °F)	
Diaphragm seal systems [3]	-	→ 94	

1) If the temperature is below −40 °C (−40 °F), chances of failure increases. Product Configurator, order code for "Test, certificate" option "JN".
2) Extended temperature application range (−50 to +85 °C (−58 to +185 °F)) with restrictions in optical properties, such as display speed and contrast
3) Ambient temperature range and process temperature range are mutually dependent - see "Heat insulation" section

Hazardous areas

- For devices for use in hazardous areas, see Safety Instructions, Installation or Control Drawing→ 113.
- Pressure measuring devices that have the usual explosion protection certificates (e.g. ATEX-/ CSA-/ FM-/ IEC Ex,...) can be used in hazardous areas at ambient temperatures down to −50 °C (−58 °F). The functionality of the explosion protection is also guaranteed for ambient temperatures down to −50 °C (−58 °F).

Storage temperature range

- −40 to +90 °C (−40 to +194 °F)
- Local display: −40 to +85 °C (−40 to +185 °F)
- Separate housing:−40 to +60 °C (−40 to +140 °F)
- Devices with PVC-sheathed capillary: −25 to +90 °C (−13 to +194 °F)

Degree of protection

Depends on the deployed
- Housing → 49
- Separate housing → 40

Climate class

Class 4K4H (air temperature: −20 to +55 °C (−4 to +131 °F), relative humidity: 4 to 100 %) fulfilled as per DIN EN 60721-3-4 (condensation possible.)

Electromagnetic compatibility

- Electromagnetic compatibility as per EN 61326 and NAMUR recommendation EMC (NE21).
- With enhanced immunity against electromagnetic fields as per EN 61000-4-3: 30 V/m with closed cover (for devices with T14 housing or T15 housing)
- Maximum deviation: < 0.5 % of span
- All EMC measurements were performed with a turn down (TD) = 2:1.

For further details refer to the Declaration of Conformity.

Vibration resistance

Device/accessory	Measuring cells	Housing	Test standard	Vibration resistance
PMD75	10 mbar (0.15 psi), 30 mbar (0.45 psi)	T14 stainless steel T15 aluminum T17 aluminum	IEC 61298-3	Guaranteed for 10 to 38 Hz: ±0.35 mm (0.0138 in); 38 to 2000 Hz: 2 g in all 3 planes
		T14 aluminum	IEC 61298-3	Guaranteed for 10 to 60 Hz: ±0.21 mm (0.0083 in); 60 to 2000 Hz: 3 g in all 3 planes
	≥100 mbar (1.5 psi)	T14 stainless steel T15 aluminum	IEC 61298-3	Guaranteed for 10 to 38 Hz: ±0.35 mm (0.0138 in); 38 to 2000 Hz: 2 g in all 3 planes
		T14 aluminum	IEC 61298-3	Guaranteed for 10 to 60 Hz: ±0.35 mm (0.0138 in); 60 to 2000 Hz: 5 g in all 3 planes
With mounting bracket (heavy duty design)	All	All	IEC 61298-3	Guaranteed for 10 to 60 Hz: ±0.15 mm (0.0059 in); 60 to 500 Hz: 2 g in all 3 planes
FMD77	All	All	IEC 61298-3:1998	Guaranteed for 10 to 60 Hz: ±0.075 mm (0.0030 in); 60 to 150 Hz: 1 g in all 3 planes

Process

Process temperature limits (temperature at transmitter)

PMD75

- Process connections made of 316L or Alloy C276: −50 to +85 °C (−58 to +185 °F) [3]
- Process connections made of C22.8: −10 to +85 °C (+14 to +185 °F)
- For oxygen applications, note → 🖹 42"Oxygen applications" section.
- Pay attention to the process temperature range of the seal. See also the following section "Process temperature range, seals".

FMD77

- Depends on the design (see the following table)
- Dependent on diaphragm seal and filling oil (→ 🖹 97): −70 to +400 °C (−94 to +752 °F)
- For oxygen applications, note → 🖹 42"Oxygen applications" section.
- Pay attention to the process temperature range of the seal. See also the following section "Process temperature range, seals".
- Please observe the temperature application limits of the diaphragm seal oil. → 🖹 97, "Diaphragm seal filling oils" section.
- Please observe the maximum gauge pressure and maximum temperature.

Design	Temperature isolator	Temperature	Option [1]
Transmitter horizontal	long	400 °C (752 °F)	MA
Transmitter vertical	long	300 °C (572 °F)	MB
Transmitter horizontal	short	200 °C (392 °F)	MC
Transmitter vertical	short	200 °C (392 °F)	MD
U-bracket, Transmitter horizontal (for devices which require a CRN approval)	-	400 °C (752 °F)	[2]

1) Product Configurator, "Process connection" ordering feature
2) In combination with CSA approval.

FMD78

- Dependent on diaphragm seal and filling oil:−70 to +400 °C (−94 to +752 °F)
- For oxygen applications, note → 🖹 42"Oxygen applications" section.
- Please observe the temperature application limits of the diaphragm seal oil. → 🖹 97, "Diaphragm seal filling oils" section.
- Please observe the maximum gauge pressure and maximum temperature.

FMD77 and FMD78: Devices with PTFE-coated process isolating diaphragm

The non-stick coating has excellent gliding properties and is used to protect the process isolating diaphragm against abrasive media.

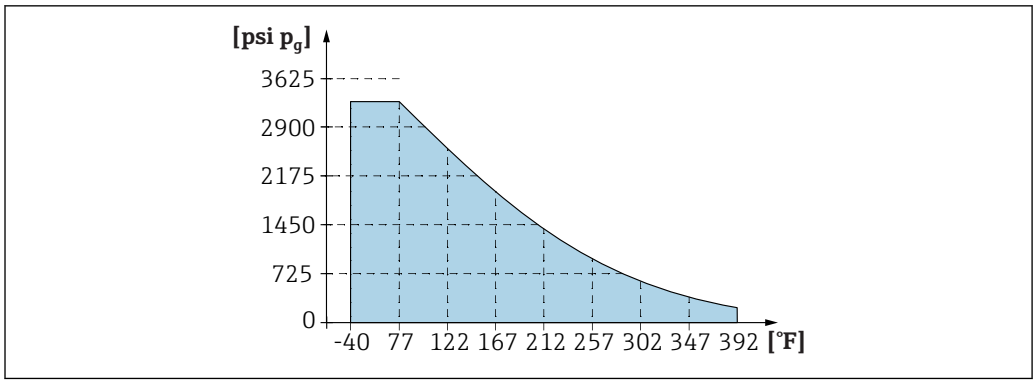
NOTICE

Incorrect use of the PTFE foil will destroy the device!

▶ The PTFE foil is designed to protect the unit against abrasion. It does not provide protection against corrosive media.

For the range of application of the 0.25 mm (0.01 in) PTFE foil on an AISI 316L (1.4404/1.4435) process isolating diaphragm, see the following diagram:

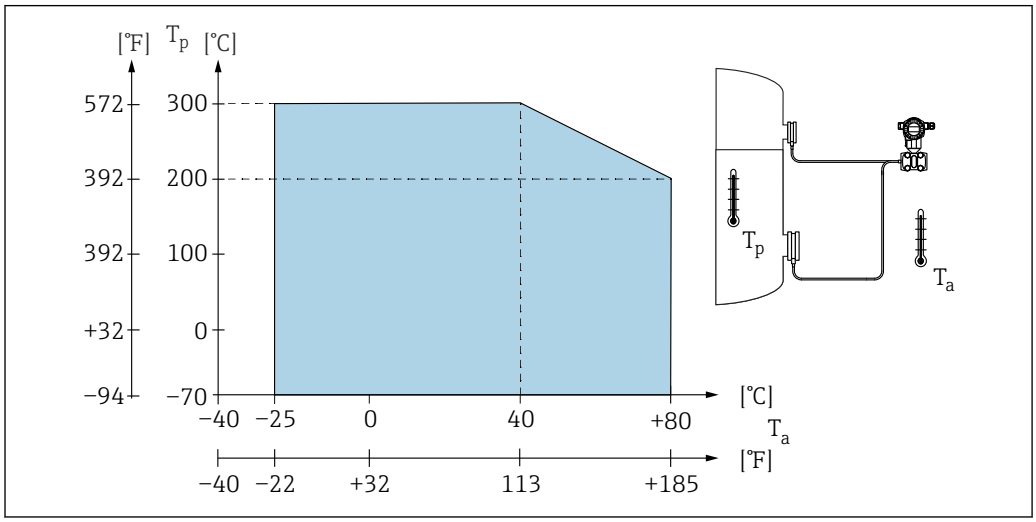
3) If the temperature is below −40 °C (−40 °F), increased failure rates are likely. Product Configurator, order code for "Test, certificate" option "JN".



For vacuum applications: p_{abs} ≤ 1 bar (14.5 psi)to 0.05 bar (0.725 psi)up to max. +150 °C (302 °F).

Process temperature limits of capillary armoring: FMD77 and FMD78

- 316L: No restrictions
- PTFE: No restrictions
- PVC: See the following diagram



Process temperature range, seals

PMD75

Seal	Process temperature range [1]	Option [2]
FKM Viton	−20 to +85 °C (−4 to +185 °F)	A
PTFE	−50 to +85 °C (−58 to +185 °F)	C
NBR	−20 to +85 °C (−4 to +185 °F)	F
Copper	−40 to +85 °C (−40 to +185 °F)	H
Copper, cleaned for oxygen service	−20 to +85 °C (−4 to +185 °F)	K or H [3]
FKM Viton, cleaned from oil and grease	−10 to +85 °C (+14 to +185 °F)	1
FKM Viton, cleaned for oxygen service	−10 to +60 °C (+14 to +140 °F)	2 or A [3]
PTFE, cleaned for oxygen applications	−20 to +60 °C (−4 to +140 °F)	3 or C [3]
EPDM [4]	−40 to +85 °C (−40 to +185 °F)	J

1) lower temperatures on request
2) Product Configurator, "Seal" ordering feature
3) with option "HB", see Product Configurator, order code for "Service"
4) Always for LP side with blind flange (see Product Configurator, order code for "Process connection").

FMD77 (with diaphragm seal)

Seal on the LP side (–)	Process temperature range [1]	OPL bar (psi)	PN bar (psi)	Option [2]
FKM Viton	–20 to +85 °C (–4 to +185 °F)	See the "Measuring range" section "FMD77, FMD78, PMD75: Option PN 160 / 16 MPa / 2400 psi" → 12.		B, D, F, U
PTFE	–50 to +85 °C (–58 to +185 °F)			H, J
EPDM	–40 to +85 °C (–40 to +185 °F)			K, L
FKM Viton, cleaned from oil and grease	–10 to +85 °C (+14 to +185 °F)			S
FKM Viton, cleaned for oxygen service	–10 to +60 °C (+14 to +140 °F)			T or D [3]
Kalrez, Compound 6375	0 to +5 °C (+32 to +41 °F)	44…49 (660…735)	29…33 (435…495)	M, N
	+5 to +10 °C (+41 to +50 °F)	49…160 (735…2400)	33…107 (495…1605)	
	+10 to +85 °C (+50 to +185 °F)	160 (2400)	107 (1605)	
Chemraz, Compound 505	–10 to +25 °C (+14 to +77 °F)	130…160 (1950…2400)	87…107 (1305…1605)	P, Q
	+25 to +85 °C (+77 to +185 °F)	160 (2400)	107 (1605)	
Diaphragm seal and capillary, welded	Please observe the temperature application limits of the diaphragm seal oil. → 97, "Diaphragm seal filling oils" section.			

1) lower temperatures on request
2) Product Configurator, order code for "Process connection, LP side; seal:"
3) with option "HB", see Product Configurator, order code for "Service"

Pressure specifications

WARNING

The maximum pressure for the measuring device depends on the lowest-rated element with regard to pressure.

- For pressure specifications, see the "Measuring range" section and the "Mechanical construction" section.
- The measuring device must be operated only within the specified limits!
- MWP (maximum working pressure): The MWP (maximum working pressure) is specified on the nameplate. This value refers to a reference temperature of +20 °C (+68°F) and may be applied to the device for an unlimited time. Observe temperature dependency of the MWP. The pressure values permitted at higher temperatures can be found in the standards EN 1092-1: 2001 Tab. 18 (With regard to their stability-temperature property, the materials 1.4435 and 1.4404 are grouped together under 13EO in EN 1092-1 Tab. 18. The chemical composition of the two materials can be identical.), ASME B 16.5a – 1998 Tab. 2-2.2 F316, ASME B 16.5a – 1998 Tab. 2.3.8 N10276, JIS B 2220.
- The test pressure corresponds to the over pressure limit of the individual sensors (OPL = 1.5 x MWP) and may be applied only for a limited period of time to prevent any lasting damage.
- The Pressure Equipment Directive (2014/68/EU) uses the abbreviation "PS". The abbreviation "PS" corresponds to the MWP (maximum working pressure) of the measuring device.
- In the case of sensor range and process connections where the over pressure limit (OPL) of the process connection is smaller than the nominal value of the sensor, the device is set at the factory, at the very maximum, to the OPL value of the process connection. If you want to use the entire sensor range, select a process connection with a higher OPL value (1.5 x PN; MWP = PN)
- In oxygen applications, the values for "p_{max} and T_{max} for oxygen applications must not be exceeded→ 42.
- For the PMD75, the MWP applies to the temperature ranges specified in the "Ambient temperature range" → 43 and "Process temperature limits" → 45 sections.

Mechanical construction

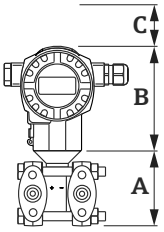
Device height

The device height is calculated from

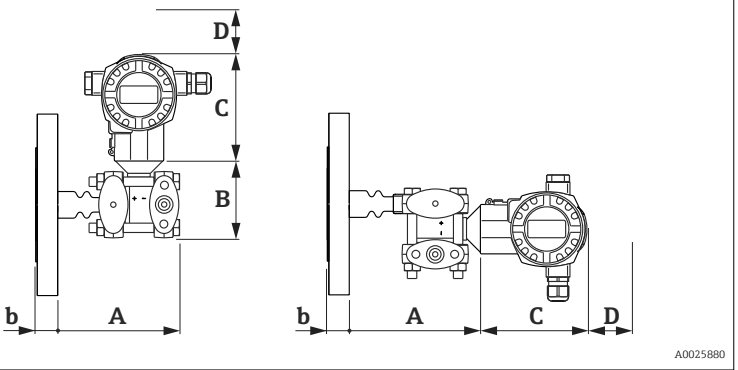
- the height of the housing
- the height of optional mounted parts such as temperature isolators or capillaries
- the height of the relevant process connection.

The individual heights of the components can be found in the following sections. To calculate the device height, simply add up the individual heights of the components. If necessary, the installation space (the space used to install the device) must also be taken into account. You can use the following table for this:

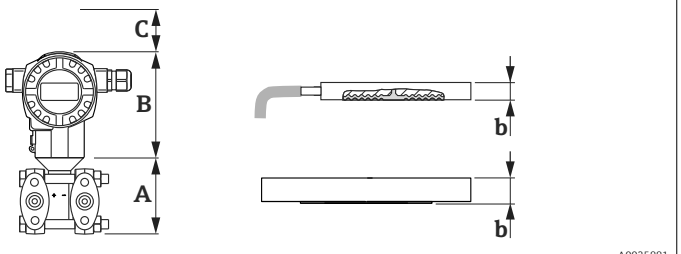
PMD75

Designation	Position	Dimension	Example
Side flanges	(A)	85 mm (3.35 in)	
Height of housing	(B)	→ 🖹 49 ff.	
Installation space	(C)	-	
Device height			

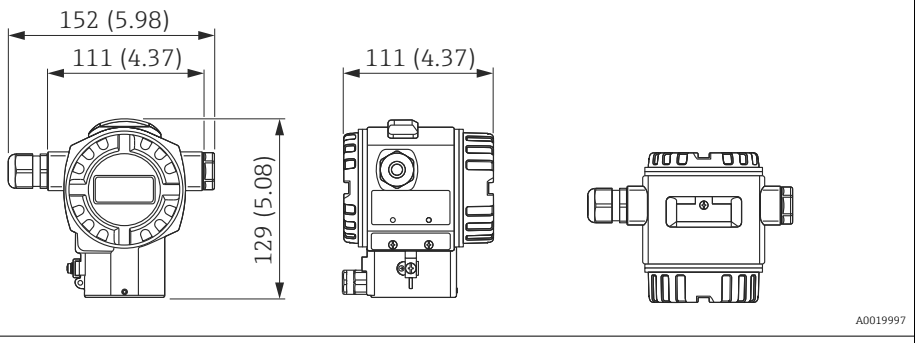
FMD77

Designation	Position	Dimension	Example
Mounted parts	(A)	→ 🖹 57	
Side flanges	(B)	85 mm (3.35 in)	
Height of housing	(C)	→ 🖹 49 ff.	
Installation space	(D)	-	
Process connections	(b)	→ 🖹 51	
Device height			

FMD78

Designation	Position	Dimension	Example
Side flanges	(A)	85 mm (3.35 in)	
Height of housing	(B)	→ 🖹 49 ff.	
Installation space	(C)	-	
Process connections	(b)	→ 🖹 51	
Device height			

T14 housing, optional display on the side

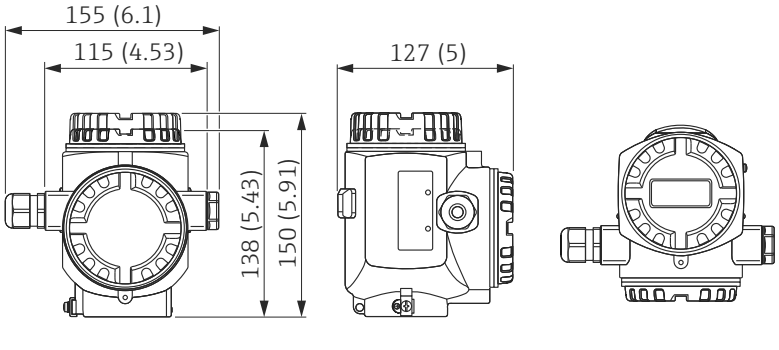


Engineering unit mm (in). Front view, left-hand side view, top view

Material		Degree of protection	Cable entry	Weight in kg (lb)		Option [1]
Housing	Cover seal			with display	without display	
Aluminum	EPDM	IP66/67 NEMA 6P	M20 gland	1.2 (2.65)	1.1 (2.43)	A
		IP66/67 NEMA 6P	G ½" thread			B
		IP66/67 NEMA 6P	NPT ½" thread			C
		IP66/67 NEMA 6P	M12 plug			D
		IP66/67 NEMA 6P	7/8" plug			E
		IP65 NEMA 4	HAN7D plug 90 degrees			F
316L	EPDM	IP66/67 NEMA 6P	M20 gland	2.1 (4.63)	2.0 (4.41)	1
		IP66/67 NEMA 6P	G ½" thread			2
		IP66/67 NEMA 6P	NPT ½" thread			3
		IP66/67 NEMA 6P	M12 plug			4
		IP66/67 NEMA 6P	7/8" plug			5
		IP65 NEMA 4	HAN7D plug 90 degrees			6
	FVMQ	IP66/67 NEMA 6P	M20 gland			7
	FVMQ	IP66/67 NEMA 6P	NPT ½" thread			8

1) Product Configurator, order code for "Housing, cover seal, cable entry, degree of protection"

T15 housing, optional display on the top

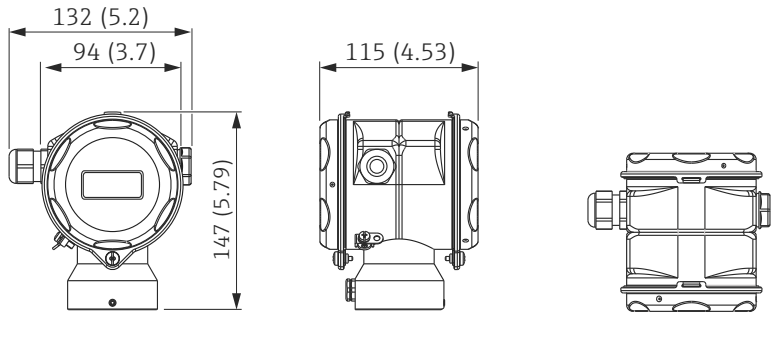


Engineering unit mm (in). Front view, left-hand side view, top view

Material		Degree of protection	Cable entry	Weight in kg (lb)		Option [1]
Housing	Cover seal			with display	without display	
Aluminum	EPDM	IP66/67 NEMA 6P	M20 gland	1.8 (3.97)	1.7 (3.75)	J
		IP66/67 NEMA 6P	G ½" thread			K
		IP66/67 NEMA 6P	NPT ½" thread			L
		IP66/67 NEMA 6P	M12 plug			M
		IP66/67 NEMA 6P	7/8" plug			N
		IP65 NEMA 4	HAN7D plug 90 degrees			P

1) Product Configurator, order code for "Housing, cover seal, cable entry, degree of protection"

T17 housing (hygienic), optional display on the side

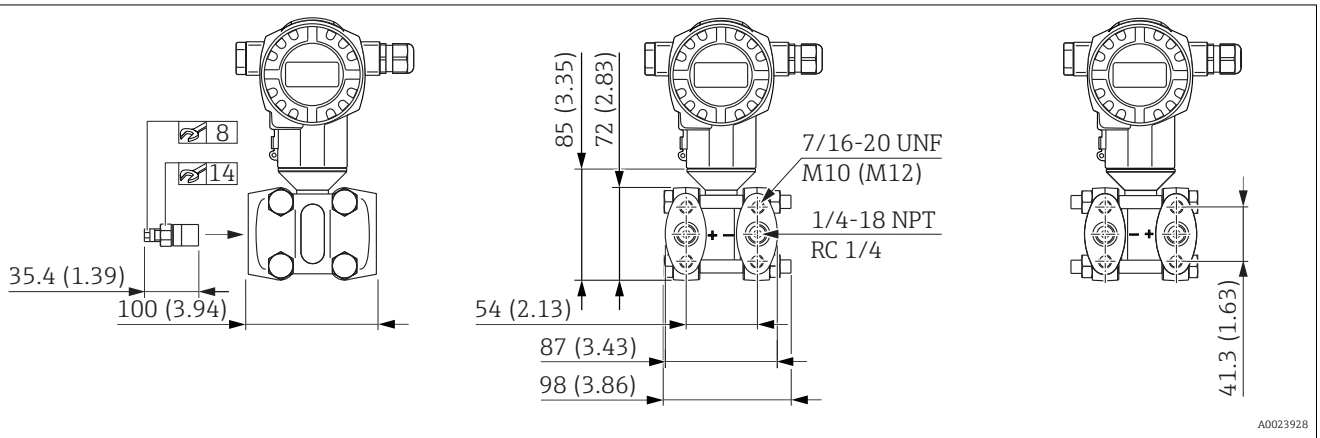


Engineering unit mm (in). Front view, left-hand side view, top view

Material		Degree of protection [1]	Cable entry	Weight in kg (lb)		Option [2]
Housing	Cover seal			with display	without display	
316L	EPDM	IP66/68 NEMA 6P	M20 gland	1.2 (2.65)	1.1 (2.43)	R
		IP66/68 NEMA 6P	G ½" thread			S
		IP66/68 NEMA 6P	NPT ½" thread			T
		IP66/68 NEMA 6P	M12 plug			U
		IP66/68 NEMA 6P	7/8" plug			V

1) Degree of protection IP 68: 1.83 mH_2O for 24 h
2) Product Configurator, order code for "Housing, cover seal, cable entry, degree of protection"

Process connections PMD75 Oval flange, connection 1/4-18 NPT or RC 1/4

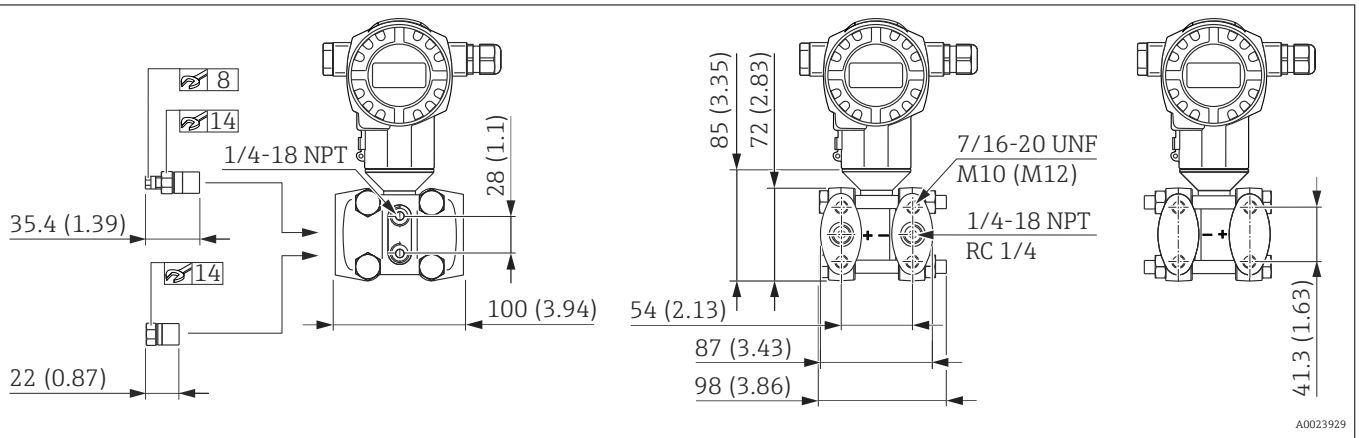


Engineering unit mm (in). Front view, left-hand side view, right-hand side view. Nuts are always located on the minus side.

Connection	Mounting	Material	Accessories	Weight [1]	Option [2]
				kg (lbs)	
1/4-18 NPT IEC 61518	7/16-20 UNF	Steel C 22.8 (1.0460/Zn5) [3]	incl. 2 vent valves AISI 316L (1.4404)	4.2 (9.26)	B
1/4-18 NPT IEC 61518	7/16-20 UNF	1.4408 / CF3M [4] / AISI 316L			D
		AISI 316L (1.4404) [5]			
1/4-18 NPT IEC 61518	7/16-20 UNF	Alloy C276 (2.4819)	Vent valves Alloy C276 (2.4819) [6]	4.5 (9.92)	F
RC 1/4	7/16-20 UNF	1.4408 / CF3M [4] / AISI 316L	incl. 2 vent valves AISI 316L (1.4404)	4.2 (9.26)	U
		AISI 316L (1.4404) [5]			
1/4-18 NPT IEC 61518	▪ PN 160: M10 ▪ PN 420: M12	Steel C 22.8 (1.0460/Zn5) [3]			1
1/4-18 NPT IEC 61518	▪ PN 160: M10 ▪ PN 420: M12	AISI 316L (1.4404)			2
1/4-18 NPT IEC 61518	▪ PN 160: M10 ▪ PN 420: M12	Alloy C276 (2.4819)	Vent valves Alloy C276 (2.4819) [6]	4.5 (9.92)	3
HP: 1/4-18 NPT IEC 61518 LP: blind flange	7/16-20 UNF	AISI 316L (1.4404)	incl. vent valve AISI 316L (1.4404)	4.2 (9.26)	Q
HP: 1/4-18 NPT IEC 61518 LP: blind flange	7/16-20 UNF	Alloy C276 (2.4819)	without vent valve [6].	4.5 (9.92)	S

1) Weight of process connections without vent valves with 10 mbar (0.15 psi)or 30 mbar (0.45 psi)measuring cell, process connections without vent valves with measuring cells ≥ 100 mbar (1.5 psi) weigh approx. 800 g (28.22 oz) less.
2) Product Configurator, order code for "Process connection"
3) The C22.8 side flanges are coated with anti-corrosion protection (zinc, chrome). To prevent the formation of hydrogen and thereby diffusion through the membrane, Endress+Hauser recommends the use of 316L side flanges for applications involving water. Hydrogen diffusion through the diaphragm leads to measurement errors, or in extreme cases to a device failure.
4) Cast equivalent to material AISI 316L
5) For devices with CSA approval: Product Configurator, order code for "Approval", options D, E, F, U, V, W and X
6) Product Configurator, order code for "Additional options 2"

Process connections PMD75 Oval flange, connection 1/4-18 NPT or RC 1/4, with side vent

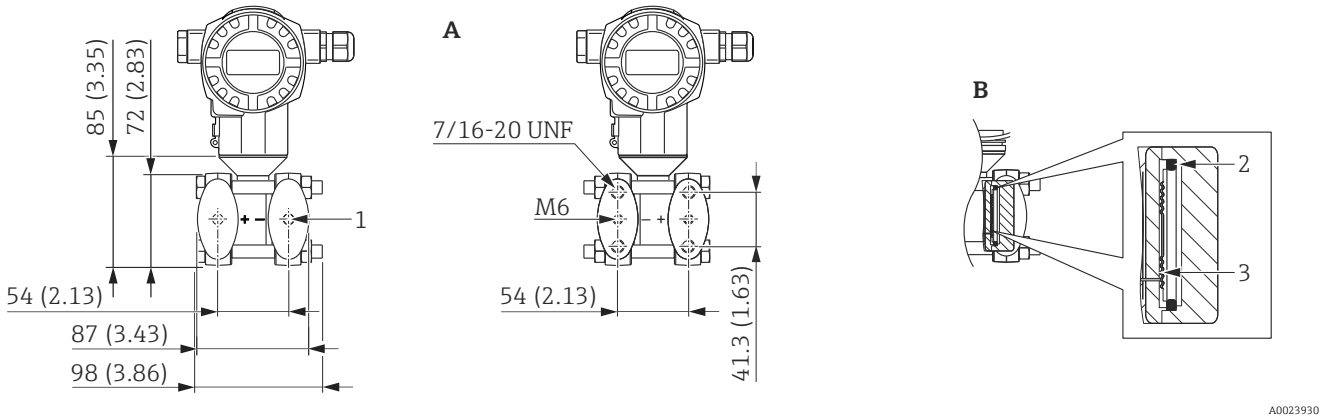


Engineering unit mm (in). Front view, left-hand side view, right-hand side view. Nuts are always located on the minus side.

Connection	Mounting	Material	Accessories	Weight [1]	Option [2]
				kg (lbs)	
1/4-18 NPT IEC 61518	7/16-20 UNF	Steel C 22.8 (1.0460/Zn5) [3]	4 locking screws and 2 vent valves AISI 316L (1.4404)	4.2 (9.26)	C
1/4-18 NPT IEC 61518	7/16-20 UNF	1.4408 / CF3M [4] / AISI 316L			E
		AISI 316L (1.4404) [5]			
1/4-18 NPT IEC 61518	7/16-20 UNF	Alloy C276 (2.4819)	Vent valves Alloy C276 (2.4819) [6]	4.5 (9.92)	H
RC 1/4	7/16-20 UNF	1.4408 / CF3M [4] / AISI 316L	4 locking screws and 2 vent valves AISI 316L (1.4404)	4.2 (9.26)	V
		AISI 316L (1.4404) [5]			
HP: 1/4-18 NPT IEC 61518 LP: blind flange	7/16-20 UNF	AISI 316L (1.4404)	incl. locking screws and vent valve AISI 316L (1.4404)	4.2 (9.26)	R
HP: 1/4-18 NPT IEC 61518 LP: blind flange	7/16-20 UNF	Alloy C276 (2.4819)	Vent valve Alloy C276 (2.4819) [6]	4.5 (9.92)	T

1) Weight of process connections without vent valves with 10 mbar (0.15 psi)or 30 mbar (0.45 psi)measuring cell, process connections without vent valves with measuring cells ≥ 100 mbar (1.5 psi) weigh approx. 800 g (28.22 oz) less.
2) Product Configurator, order code for "Process connection"
3) The C22.8 side flanges are coated with anti-corrosion protection (zinc, chrome). To prevent the formation of hydrogen and thereby diffusion through the membrane, Endress+Hauser recommends the use of 316L side flanges for applications involving water. Hydrogen diffusion through the diaphragm leads to measurement errors, or in extreme cases to a device failure.
4) Cast equivalent to material AISI 316L
5) For devices with CSA approval: Product Configurator, order code for "Approval", options D, E, F, U, V, W and X
6) Product Configurator, order code for "Additional options 2"

Process connections PMD75 Oval flange, prepared for diaphragm seal mount



A Prepared for diaphragm seal mount
B Position of copper seal
1 Diaphragm seal mount
2 Copper ring seal
3 Process isolating diaphragm

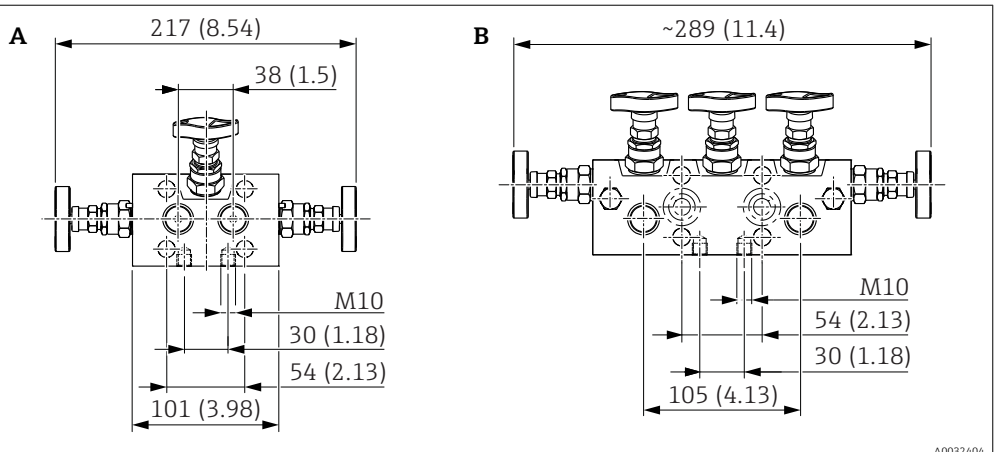
Engineering unit mm (in). Left-hand side view, right-hand side view. Nuts are always located on the minus side.

Material	Option [1]
1.4408 / CF3M [2] / AISI 316L	W
AISI 316L (1.4404) [3]	

1) Product Configurator, order code for "Process connection"
2) Cast equivalent to material AISI 316L
3) For devices with CSA approval: Product Configurator, order code for "Approval", options D, E, F, U, V, W and X

Valve manifold DA63M- (optional)

Endress+Hauser supplies milled valve manifolds via the transmitter's product structure in the following versions:



A 3-way valve manifold
B 5-way valve manifold

Engineering unit mm (in)

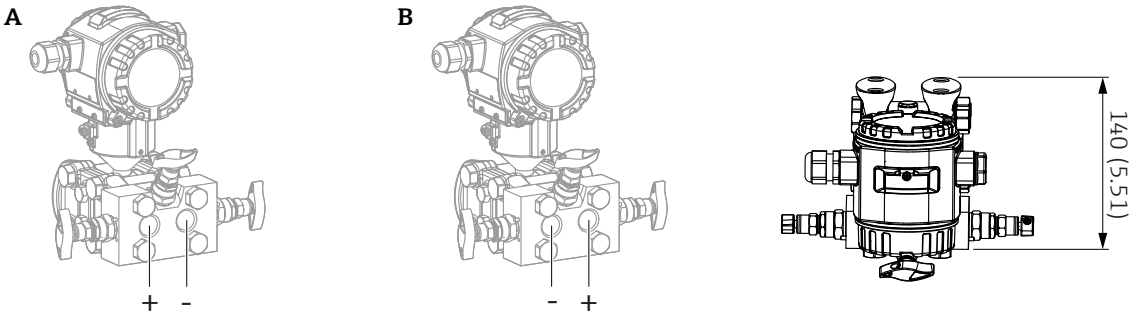
3-way or 5-way valve manifolds in 316L or AlloyC can be
- ordered as an **enclosed** accessory (screws and seals for mounting are enclosed)
- ordered as a **mounted** accessory (mounted valve manifolds are supplied with a documented leakage test).

Certificates ordered with the equipment (e.g. 3.1 material certificate and NACE) and tests (e.g. PMI and pressure test) apply to the transmitter and the valve manifold.

For other details (order option, dimension, weight, materials), see SD01553P/00/EN "Mechanical accessories for pressure measuring devices".

During the operating life of the valves, it may be necessary to re-tighten the packing.

Mounting on valve manifold



Engineering unit mm (in)

Position	Designation	Option [1]
A	Mounting from above on valve manifold	NV
B	Mounting from below on valve manifold	NW

1) Product Configurator, order code for "Accessories mounted"

FMD77: Selecting the process connection and capillary line

The device can be fitted with different process connections on the high-pressure side (HP) and on the low-pressure side (LP).

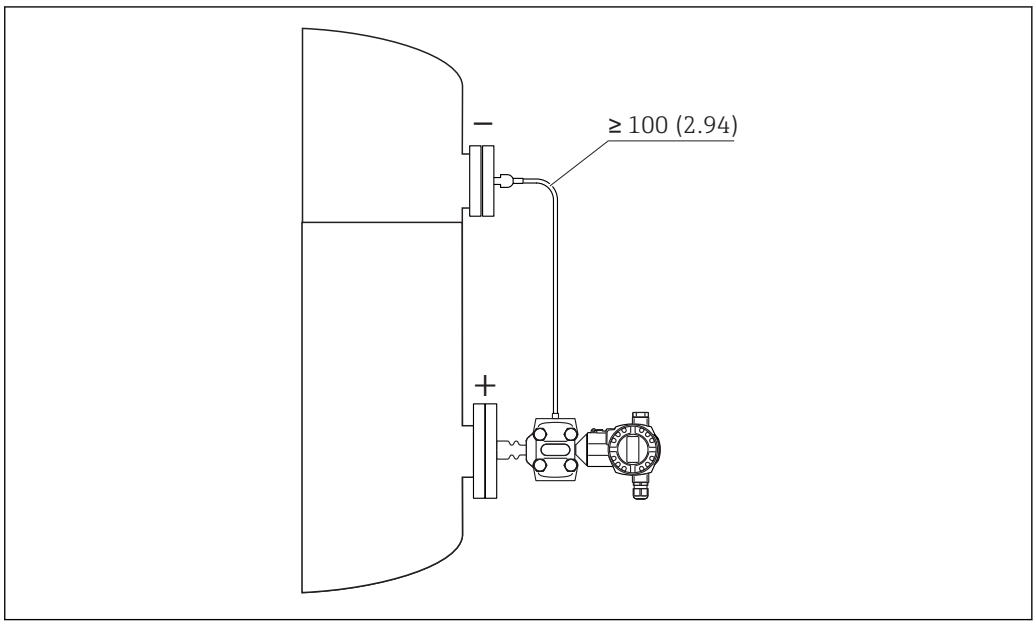
The FMD77 can also be fitted with capillary lines on the low-pressure side (LP).

When using diaphragm seal systems with a capillary, sufficient strain relief must be provided to prevent the capillary from bending (capillary bending radius ≥ 100 mm (3.94 in)).

Example:
- Process connection on high-pressure side = DN80 flange
- Process connection on low-pressure side = DN50 flange

Your benefits:
- Thanks to the variety of order options, the devices can be optimally adapted to the given installation situation
- Reduced costs due to optimum system design
- Easier installation due to adjusted length of capillary line
- Easier adaptation to existing installation situations

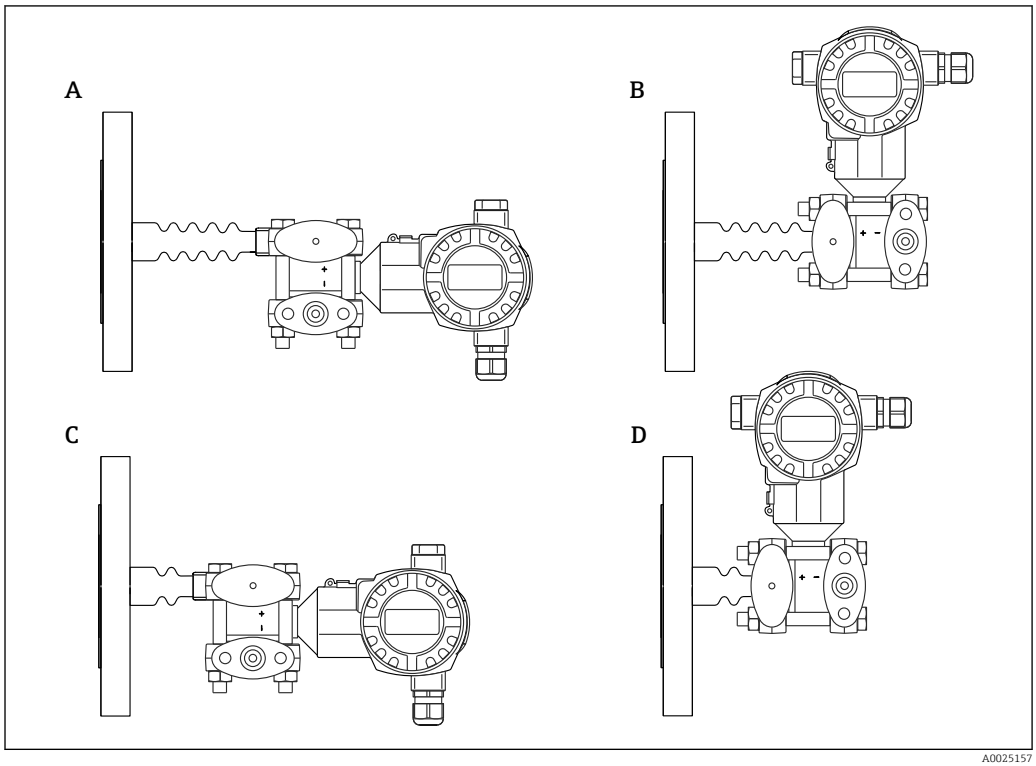
Ordering information:
- Process connections are indicated in the relevant section by HP (high-pressure side) and LP (low-pressure side)
- Order details for capillary lengths → 86



A0027889

Due to the use of different process connections and capillary lines, it is essential that the device be designed/ordered using the "Applicator Sizing Diaphragm Seal" selection tool, which is available free of charge. Additional information can be found in the "Planning instructions, diaphragm seal systems" section → 94

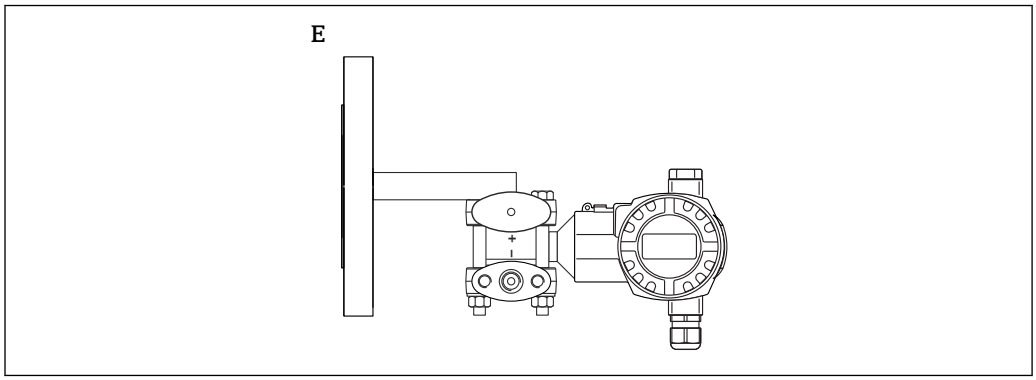
FMD77 - Overview



A0025157

Item	Design	Temperature isolator	Page	Option [1]
A	Transmitter horizontal	long	→ 57	MA [2]
B	Transmitter vertical	long	→ 57	MB
C	Transmitter horizontal	short	→ 57	MC
D	Transmitter vertical	short	→ 57	MD

1) Product Configurator, order code for "Design; temperature isolator"
2) Standard



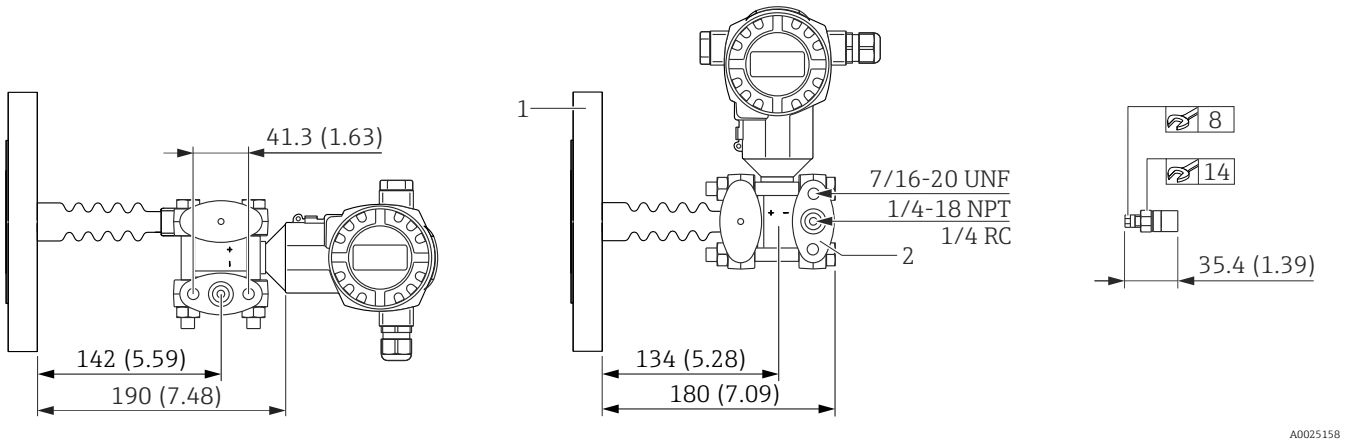
A0025252

Item	Design	Page	Option [1]
E	U-bracket, Transmitter horizontal (for devices which require a CRN approval)	→ 58	In combination with CSA approval.

1) Product Configurator, order code for "Process connection"

Process connections FMD77 with diaphragm seal, high-pressure side

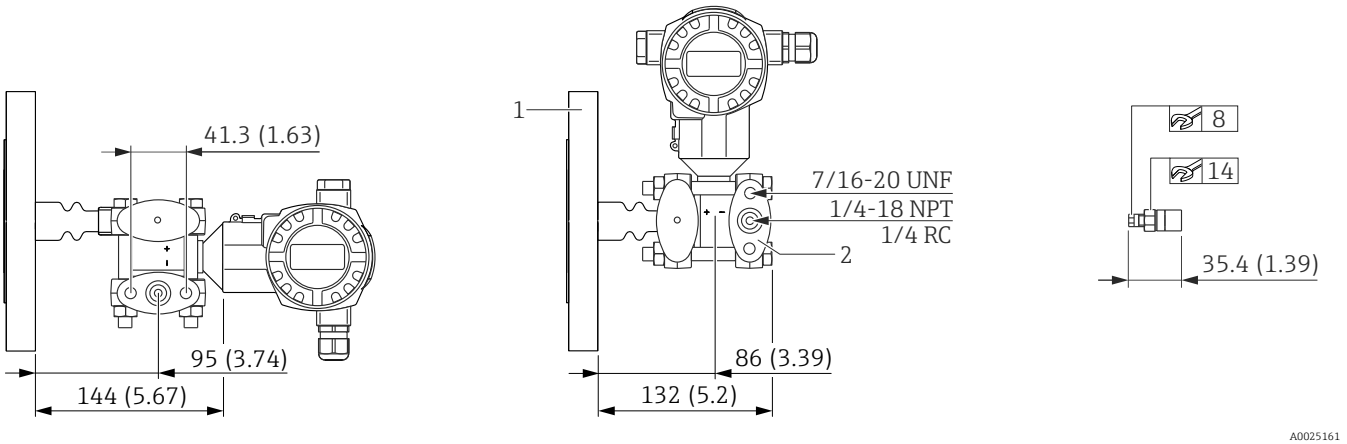
Device with long temperature isolator



1 High-pressure side: see "Process connections FMD77 with diaphragm seal, high-pressure side" section → 59
2 Low-pressure side: see "Process connections FMD77 with diaphragm seal, low-pressure side" section → 63

Engineering unit mm (in).

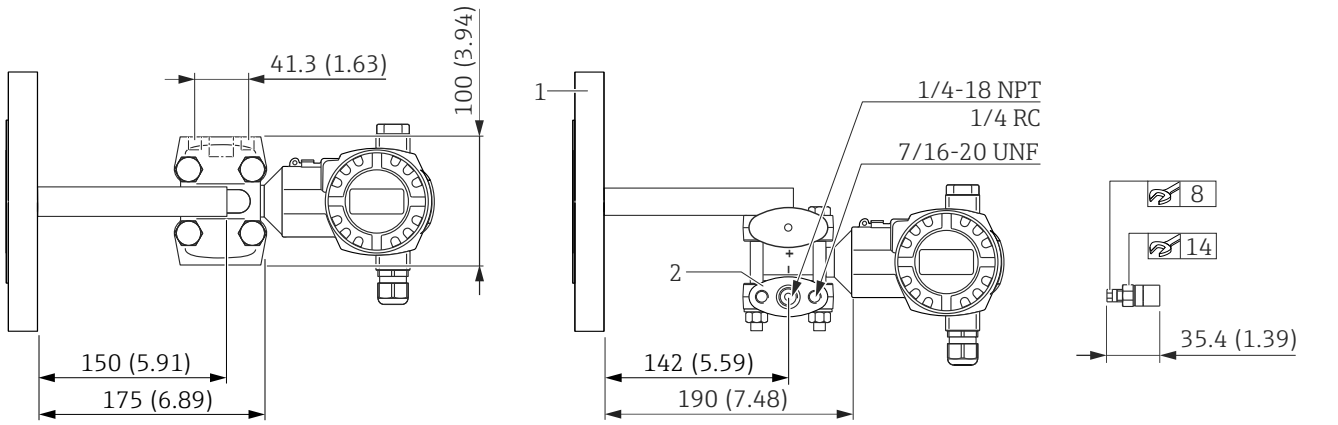
Device with short temperature isolator



1 High-pressure side: see "Process connections FMD77 with diaphragm seal, high-pressure side" section → 59
2 Low-pressure side: see "Process connections FMD77 with diaphragm seal, low-pressure side" section → 63

Engineering unit mm (in).

Process connections FMD77 with diaphragm seal, high-pressure side **U-bracket with CRN approval**



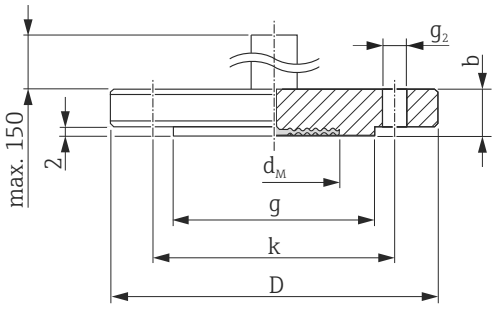
1 High-pressure side: see "Process connections FMD77 with diaphragm seal, high-pressure side" section → 59
2 Low-pressure side: see "Process connections FMD77 with diaphragm seal, low-pressure side" section → 63

Engineering unit mm (in).

Process connections FMD77 with diaphragm seal

- The following drawings are drawings that illustrate how the system works in principle. In other words, the dimensions of a diaphragm seal supplied can deviate from the dimensions given in this document.
- Note "Planning instructions, diaphragm seal systems" section→ 94
- For further information please contact your local Endress+Hauser Sales Center.

EN/DIN flanges, connection dimensions in accordance with EN 1092-1/DIN 2527



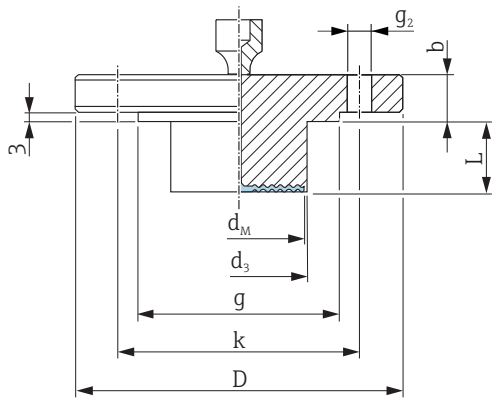
D *Diameter of flange*
b *Thickness*
g *Raised face*
k *Hole circle*
g_2 *Diameter of hole*
d_M *Max. diameter of the process isolating diaphragm*

Engineering unit mm

Material [1) 2) 3)]						Boltholes			Diaphragm seal		Option	
Nominal diameter	Nominal pressure	Shape [4)]	D	b	g	Number	g_2	k	d_M	Weight		
	PN		[mm]	[mm]	[mm]		[mm]	[mm]	[mm]	[kg (lb)]	HP [5)]	LP [6)]
DN 50	10-40	B1 (D)	165	20	102	4	18	125	59	3.0 (6.62)	A [7)]	TA [7)]
DN 80	10-40	B1 (D)	200	24	138	8	18	160	89	5.2 (11.47)	B [7)]	TB [7)]
DN 100	10-16	B1 (C)	220	20	–	8	18	180	89	4.8 (10.58)	F	TC
DN 100	25-40	B1 (D)	235	24	162	8	22	190	89	6.7 (14.77)	G	TD

1) Material: AISI 316L
2) The roughness of the surface in contact with the media, including the raised face of the flanges (all standards) made of Alloy C276, Monel, Tantalum, Rhodium>Gold or PTFE is Ra R_a< 0.8 µm (31.5 µin). Lower surface roughness on request.
3) The flange raised face is made of the same material as the process isolating diaphragm.
4) Description as per DIN 2527 provided in brackets
5) Product Configurator, order code for "Process connection, HP/ HP+LP:"
6) Product Configurator, order code for "Alternative process connection LP side:"
7) Alternatively available with TempC membrane.

EN/DIN flanges with barrel (extended diaphragm seal), connection dimensions in accordance with EN 1092-1/DIN 2527



D *Diameter of flange*
b *Thickness*
d_3 *Barrel (extended diaphragm seal) diameter*
L *Barrel (extended diaphragm seal) length*
g *Raised face*
k *Hole circle*
g_2 *Diameter of hole*
d_M *Max. diameter of the process isolating diaphragm*

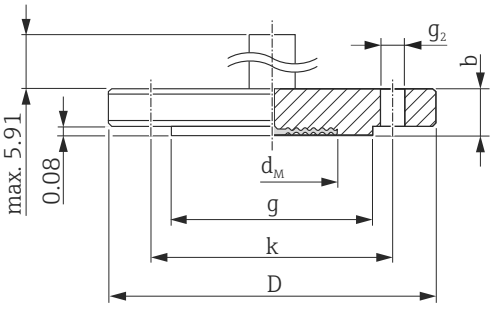
Engineering unit mm

Flange [1) 2)]								Boltholes			Diaphragm seal		Option [3)] (HP + LP)
Nominal diameter	Nominal pressure	Shape [4)]	D	b	g	L	d_3	Number	g_2	k	d_M	Weight	
	PN		[mm]	[mm]	[mm]	[mm]	[mm]		[mm]	[mm]	[mm]	[kg (lb)]	
DN 80	10-40	B1 (D)	200	24	138	50	76	8	18	160	72	6.2 (13.67)	C
						100						6.7 (14.77)	
						200						7.8 (17.20)	

1) material: AISI 316L
2) In the case of process isolating diaphragms made of Alloy C276, Monel oder tantalum, the raised face of the flange and the barrel pipe are made of 316L.
3) Product Configurator, order code for "Process connection, HP/ HP+LP:"
4) Description as per DIN 2527 provided in brackets

Process connections FMD77 with diaphragm seal

ASME flanges, connection dimensions in accordance with B 16.5, raised face RF



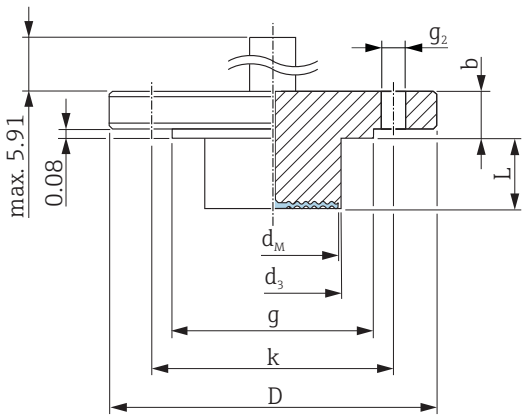
D *Diameter of flange*
b *Thickness*
g *Raised face*
k *Hole circle*
g_2 *Diameter of hole*
d_M *Max. diameter of the process isolating diaphragm*

Engineering unit in

Flange [1) 2) 3)]					Boltholes			Diaphragm seal	Weight	Approval [4)]	Option	
Nominal diameter	Class	D	b	g	Number	g_2	k	d_M				
[in]	[lb./sq.in]	[in]	[in]	[in]		[in]	[in]	[in]	[kg (lb)]		HP [5)]	LP [6)]
2	150	6	0.75	3.62	4	0.75	4.75	2.32	2.6 (5.73)	CRN	N [7)]	TE [7)]
2	300	6.5	0.88	3.62	8	0.75	5	2.32	3.4 (7.5)	CRN	O [7)]	TF [7)]
2	400/600	6.5	1	3.62	8	0.75	5	2.32	4.3 (9.48)	-	J	-
3	150	7.5	0.94	5	4	0.75	6	3.5	5.1 (11.25)	CRN	P [7)]	TG [7)]
3	300	8.25	1.12	5	8	0.75	6	3.5	7.0 (15.44)	CRN	R [7)]	TH [7)]
4	150	9	0.94	6.19	8	0.75	7.5	3.5	7.2 (15.88)	CRN	T	TI
4	300	10	1.25	6.19	8	0.88	7.88	3.5	11.7 (25.8)	CRN	W	TJ

1) Material: AISI 316/316L. Combination of AISI 316 for required pressure resistance and AISI 316L for required chemical resistance (dual rated)
2) The roughness of the surface in contact with the medium including the raised face of the flanges (all standards) made of Alloy C276, Monel, tantalum, rhodium-gold or PTFE is R_a< 0.8 µm (31.5 µin). Lower surface roughness on request.
3) The flange raised face is made of the same material as the process isolating diaphragm.
4) CSA approval: Product Configurator, order code for "Approval"
5) Product Configurator, order code for "Process connection, HP/ HP+LP:"
6) Product Configurator, order code for "Alternative process connection LP side:"
7) Alternatively available with TempC membrane.

ASME flanges with barrel (extended diaphragm seal), connection dimensions in accordance with ASME B 16.5, raised face RF



D *Diameter of flange*
b *Thickness*
d_3 *Barrel (extended diaphragm seal) diameter*
L *Barrel (extended diaphragm seal) length*
g *Raised face*
k *Hole circle*
g_2 *Diameter of hole*
d_M *Max. diameter of the process isolating diaphragm*

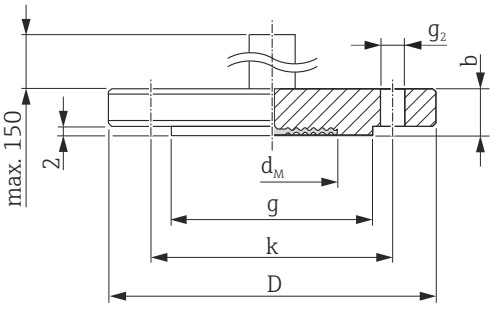
Engineering unit in

Flange [1) 2)]							Boltholes			Diaphragm seal	Weight	Option [3)] (HP + LP)
Nominal diameter	Class	D	b	g	L	d_3	Number	g_2	k	d_M		
[in]	[lb./sq.in]	[in]	[in]	[in]	[in]	[in]		[in]	[in]		[kg (lb)]	
3	150	7.5	0.94	5	2	2.99	4	0.75	6	2.83	6 (13.23)	Q
					4						6.6 (14.55)	
					6						7.1 (15.66)	
					8						7.7 (16.98)	

1) material: AISI 316/316L
2) In the case of process isolating diaphragms made of Alloy C276, Monel oder tantalum, the raised face of the flange and the barrel pipe are made of 316L.
3) Product Configurator, order code for "Process connection, HP/ HP+LP:"

Process connections FMD77 with diaphragm seal

JIS flanges, connection dimensions in accordance with JIS B 2220 BL, raised face RF



D *Diameter of flange*
b *Thickness*
g *Raised face*
k *Hole circle*
g_2 *Diameter of hole*
d_M *Max. diameter of the process isolating diaphragm*

Engineering unit mm

Flange [1) 2) 3)]					Boltholes			Diaphragm seal	Weight	Option	
Nominal diameter	Nominal pressure	D	b	g	Number	g_2	k	d_M			
		[mm]	[mm]	[mm]		[mm]	[mm]	[mm]	[kg (lb)]	HP [4)]	LP [5)]
50 A	10 K	155	16	96	4	19	120	59	2.3 (5.07)	X	TK
80 A	10 K	185	18	126	8	19	150	89	3.5 (7.72)	1	TL
100 A	10 K	210	18	151	8	19	175	89	4.7 (10.36)	4	TM

1) material: AISI 316
2) The roughness of the surface in contact with the medium including the raised face of the flanges (all standards) made of Alloy C276, Monel, tantalum, rhodium-gold or PTFE is R_a< 0.8 µm (31.5 µin). Lower surface roughness on request.
3) The flange raised face is made of the same material as the process isolating diaphragm.
4) Product Configurator, order code for "Process connection, HP/ HP+LP:"
5) Product Configurator, order code for "Alternative process connection LP side:"

Process connections FMD77 with diaphragm seal, low-pressure side

Process connection low-pressure side	Material	Seal	Option [1)]
Mounting: 7/16 – 20 UNF, Process isolating diaphragm low-pressure side AISI 316L			
1/4 – 18 NPT IEC 61518	C22.8	FKM Viton	B
1/4 – 18 NPT IEC 61518,	AISI 316L	FKM Viton	D
1/4 – 18 NPT IEC 61518	Alloy C276	FKM Viton	F
1/4 – 18 NPT IEC 61518	AISI 316L	PTFE+C4-ring	H
1/4 – 18 NPT IEC 61518	Alloy C276	PTFE+C4-ring	J
1/4 – 18 NPT IEC 61518	AISI 316L	EPDM	K
1/4 – 18 NPT IEC 61518	Alloy C276	EPDM	L
1/4 – 18 NPT IEC 61518	AISI 316L	Kalrez	M
1/4 – 18 NPT IEC 61518	Alloy C276	Kalrez	N
1/4 – 18 NPT IEC 61518	AISI 316L	Chemraz	P
1/4 – 18 NPT IEC 61518	Alloy C276	Chemraz	Q
1/4 – 18 NPT IEC 61518	AISI 316L	FKM Viton, cleaned from oil and grease	S
1/4 – 18 NPT IEC 61518	AISI 316L	FKM Viton, cleaned for oxygen service	T

Process connection low-pressure side	Material	Seal	Option [1]
RC 1/4	AISI 316L	FKM Viton	U
LP diaphragm seal and capillary	AISI 316L	welded	1

1) Product Configurator, order code for "Process connection, LP side; seal:"

FMD78: Selecting the process connection and capillary line

The device can be fitted with different process connections on the high-pressure side (HP) and on the low-pressure side (LP).

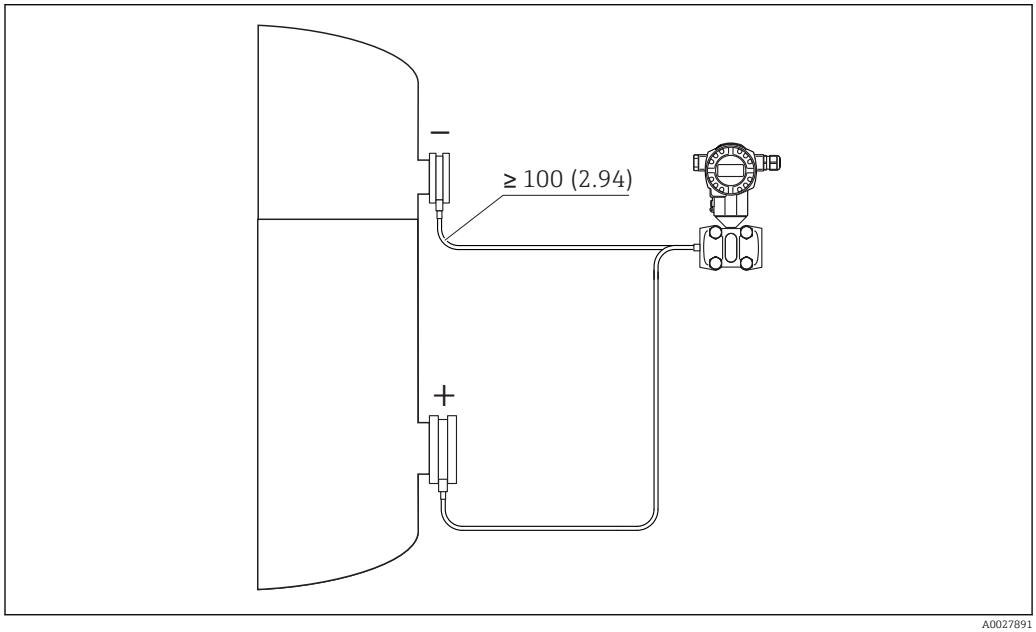
The FMD78 can also be fitted with different capillary lengths on the high-pressure side (HP) and on the low-pressure side (LP).

When using diaphragm seal systems with a capillary, sufficient strain relief must be provided to prevent the capillary from bending (capillary bending radius ≥ 100 mm (3.94 in)).

Example:
- Process connection on high-pressure side = DN80 flange
- Process connection on low-pressure side = DN50 flange
- Capillary length on high-pressure side = 2 m (6.6 ft)
- Capillary length on low-pressure side = 5 m (16 ft)

Your benefits:
- Thanks to the variety of order options, the devices can be optimally adapted to the given installation situation
- Reduced costs due to optimum system design
- Easier installation due to adjusted length of capillary on low-pressure side and high-pressure side
- Easier adaptation to existing installation situations

Ordering information:
- Process connections are indicated in the relevant section by HP (high-pressure side) and LP (low-pressure side)
- Order details for capillary lengths → 86



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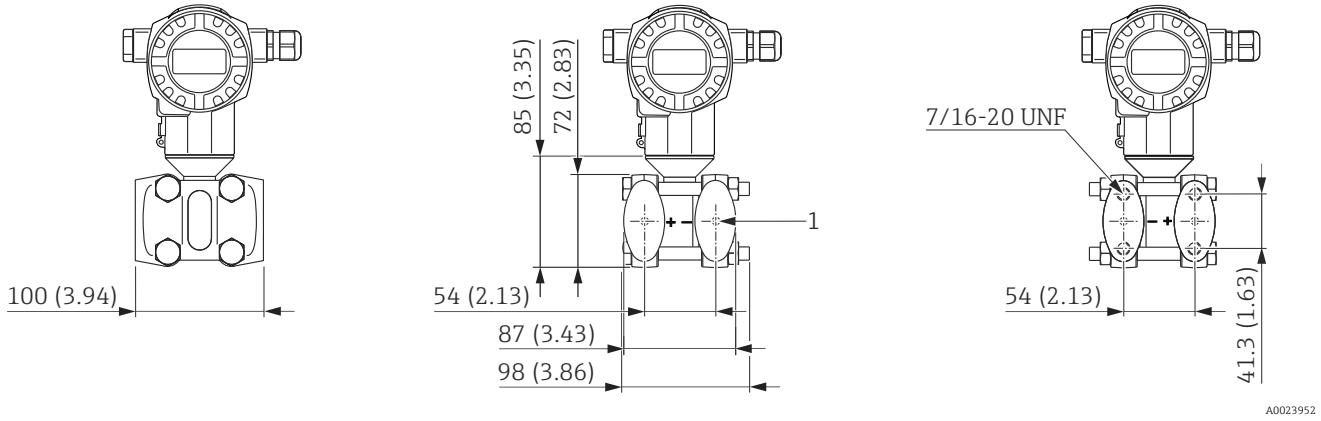
Due to the use of different process connections and capillary lines, it is essential that the device be designed/ordered using the "Applicator Sizing Diaphragm Seal" selection tool, which is available free of charge. Additional information can be found in the "Planning instructions, diaphragm seal systems" section → 94

FMD78 basic device



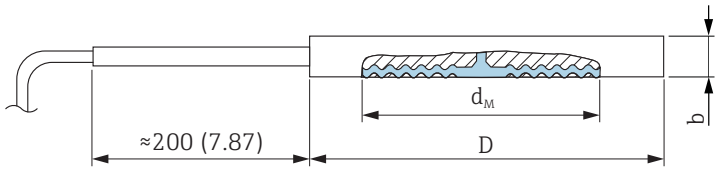
1 Diaphragm seal mount

Engineering unit mm (in). Front view, left-hand side view, right-hand side view. Nuts are always located on the minus side.

Process connections FMD78 with diaphragm seal

- The following drawings are drawings that illustrate how the system works in principle. In other words, the dimensions of a diaphragm seal supplied can deviate from the dimensions given in this document.
- Note "Planning instructions, diaphragm seal systems" section→ 🖹 94
- For further information please contact your local Endress+Hauser Sales Center.

Diaphragm seal cell structure



D *Diameter*
d_M *Max. diameter of the process isolating diaphragm*
b *Thickness*

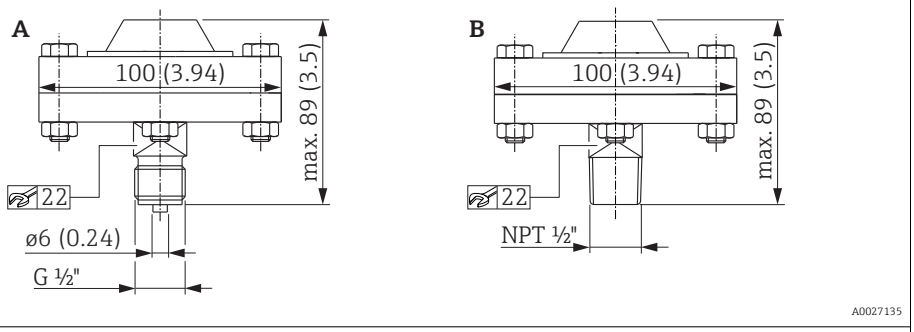
Engineering unit mm (in)

Flange					Diaphragm seal		Approval [1]	Option	
Material	Nominal diameter	Nominal pressure [2]	D	b	d_M	Weight of two diaphragm seals			
						[kg (lb)]		HP [3]	LP [4]
			[mm]	[mm]	[mm]				
AISI 316L	DN 50	PN 16-400	102	20	59	2.6 (5.73)	-	UF	UL
	DN 80	PN 16-400	138	20	89	4.6 (10.14)	-	UH	UM
	DN 100	PN 16-400	162	20	89	6.2 (13.67)	-	UJ	UN
	[in]	[lb/sq.in]	[in (mm)]	[in (mm)]	[in (mm)]				
	2	150-2500	3.9 (99)	0.79 (20)	2.32 (59)	2.6 (5.73)	CRN	VF	UP
	3	150-2500	5 (127)	0.79 (20)	3.50 (89)	4.6 (10.14)	CRN	VH	UR
	4	150-2500	6.22 (158)	0.79 (20)	3.50 (89)	6.2 (13.67)	CRN	VJ	US

1) CSA approval: Product Configurator, order code for "Approval"
2) The specified nominal pressure applies to the diaphragm seal. The maximum pressure for the measuring device is dependent on the lowest-rated element, with regard to pressure, of the selected components→ 🖹 47.
3) Product Configurator, order code for "Process connection, HP/ HP+LP:"
4) Product Configurator, order code for "Alternative process connection LP side:"

Process connections FMD78 with diaphragm seal

Threaded separators

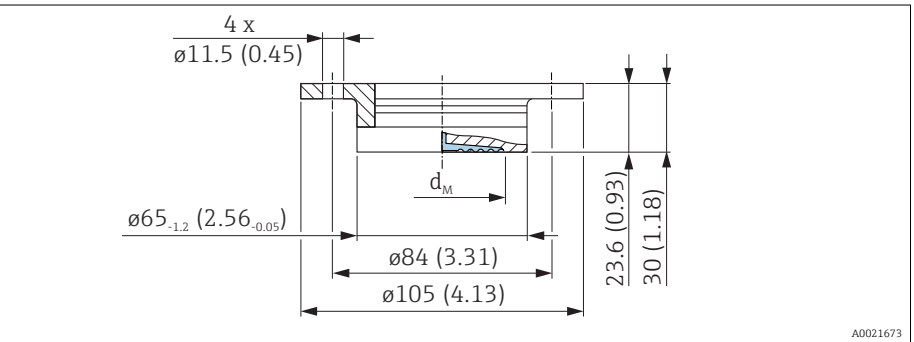


Engineering unit mm (in)

Position	Designation	Material	Measuring range [bar (psi)]	Nominal pressure	Weight [kg (lb)]	Option [1]
A	Threaded, ISO 228 G ½ A EN837 with PTFE seal −40 to +260 °C (−40 to +500 °F)	AISI 316L, screws made of A4	≤ 40 (580)	PN 40	1.43 (3.15)	GA
B	Threaded, ANSI ½ MNPT with PTFE seal −40 to +260 °C (−40 to +500 °F)					RL

1) Product Configurator, order code for "Process connection, HP/ HP+LP:"

DRD DN50 (65 mm)



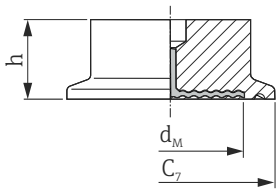
d_M *Max. diameter of the process isolating diaphragm*

Engineering unit mm (in)

Material [1]	Nominal pressure	d_M		Weight	Option	
		Standard	with TempC membrane			
		[mm]	[mm]	[kg (lb)]	HP [2]	LP [3]
AISI 316L	PN 25	50	48	0.75 (1.65)	TK [4]	UH [4]

1) Surface roughness of the wetted surfaces R_a < 0.76 µm (29.9 µin) as standard.
2) Product Configurator, order code for "Process connection, HP/ HP+LP:"
3) Product Configurator, order code for "Alternative process connection LP side:"
4) Alternatively available with TempC membrane.

Tri-Clamp ISO 2852



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C7 Diameter of flange
h Height
d_M Max. diameter of the process isolating diaphragm

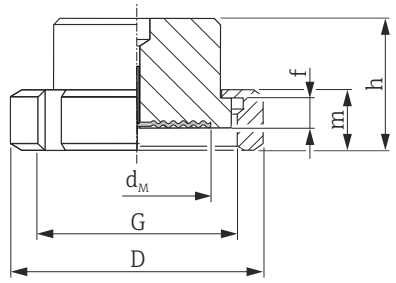
Engineering unit mm (in)

Material [1]	Nominal diameter ISO 2852	Nominal diameter DIN 32676	Nominal diameter	C_7	d_M		h	Weight	Approval [2]	Option	
					Standard	with TempC membrane					
			[in]	[mm]	[mm]	[mm]	[mm]	[kg (lb)]		HP [3]	LP [4]
AISI 316L	ND 25 / 33.7	DN 25	1	50.5	24	-	37	0.32 (0.71)	EHEDG, 3A, CRN	TB	UA
	ND 38	DN 40	1 ½	50.5	36	36	30	1 (2.21)	EHEDG, 3A, CRN	TC [5] [6]	UB [5] [6]
	ND 51 / 40	DN 50	2	64	48	41	30	1.1 (2.43)	EHEDG, 3A, CRN	TD [5] [6]	UC [5] [6]
	ND 63.5	DN 50	2 ½	77.5	61	61	30	0.7 (1.54)	EHEDG, 3A	TE [7]	UD [7]
	ND 76.1	–	3	91	73	61	30	1.2 (2.65)	EHEDG, 3A, CRN	TF [6]	UE [6]

1) Surface roughness of the wetted surfaces R_a < 0.76 µm (29.9 µin) as standard. Lower surface roughness available on request.
2) CSA approval: Product Configurator, order code for "Approval"
3) Product Configurator, order code for "Process connection, HP/ HP+LP:"
4) Product Configurator, order code for "Alternative process connection LP side:"
5) Optionally available as ASME-BPE-compliant diaphragm seal version for use in biochemical processes, surfaces in contact with medium R_a < 0.38 µm (15 µin)), electropolished; order using the order code for "Additional options 1" or "Additional options 2", option "O".
6) Alternatively available with TempC membrane.
7) With TempC membrane

Process connections FMD78 with diaphragm seal

SMS nozzles with coupling nut



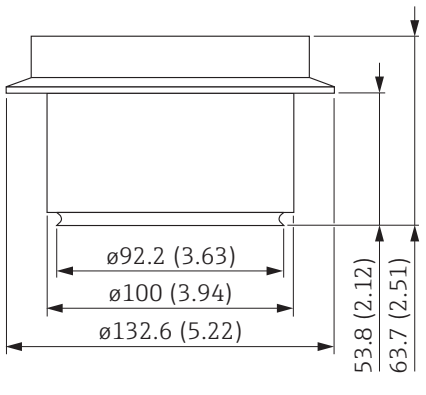
D *Diameter*
f *Nozzle height*
G *Thread*
h *Height*
m *Height*
d_M *Max. diameter of the process isolating diaphragm*

Engineering unit mm (in)

Material [1]	Nominal diameter	Nominal pressure	D	f	G	m	h	d_M	Weight	Approval	Option	
			[mm]	[mm]		[mm]	[mm]	[mm]	[kg (lb)]		HP [2]	LP [3]
AISI 316L	1 ½	PN 25	74	4	Rd 60 – 1/6	25	57	36	0.65 (1.43)	3A, EHEDG	TH [4]	UF [4]
	2	PN 25	84	4	Rd 70 – 1/6	26	62	48	1.05 (2.32)	3A, EHEDG	TI [4]	UG [4]

1) Surface roughness of the wetted surfaces R_a < 0.76 µm (29.9 µin) as standard.
2) Product Configurator, order code for "Process connection, HP/ HP+LP:"
3) Product Configurator, order code for "Alternative process connection LP side:"
4) With TempC membrane

Hygienic connection, sanitary tank spud, barrel (extended diaphragm seal) 2"

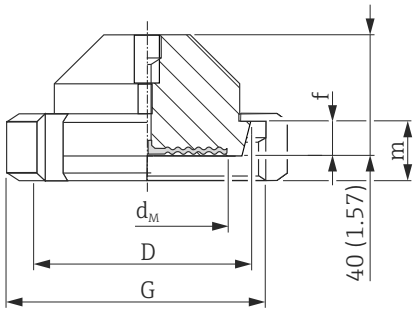


Engineering unit mm (in)

Material [1]	Weight kg (lbs)	Approval	Option [2]
AISI 316L	2.5 (5.51)	3A	WH [3]

1) Roughness of wetted surfaces R_a < 0.76 µm (29.9 µin) as standard. Lower surface roughness on request.
2) Product Configurator, order code for "Process connection, HP/ HP+LP:"
3) With TempC membrane

Taper adapter with coupling nut, DIN 11851



D *Diameter*
f *Nozzle height*
G *Thread*
m *Height*
d_M *Max. diameter of the process isolating diaphragm*

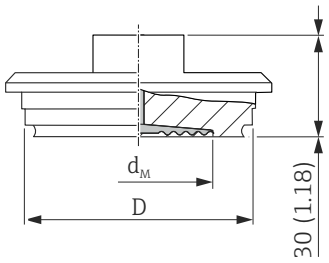
Engineering unit mm (in)

Material [1]	Taper adapter				Slotted nut		Diaphragm seal			Approval	Option	
							d_M		Weight			
	Nominal diameter	Nominal pressure	D	f	G	m	Standard	with TempC membrane				
		[bar]	[mm]	[mm]		[mm]	[mm]	[mm]	[kg (lb)]		HP [2]	LP [3]
AISI 316L	DN 32	PN 40	50	10	Rd 58 x 1/6"	21	32	28	0.45 (0.99)	3A, EHEDG	MI [4]	TP [4]
	DN 40	PN 40	56	10	Rd 65 x 1/6"	21	38	36	0.45 (0.99)	3A, EHEDG	MZ [4]	TU [4]
	DN 50	PN 25	68.5	11	Rd 78 x 1/6"	19	52	48	1.1 (2.43)	3A, EHEDG	MR [5]	TR [5]
	DN 65	PN 25	86	12	Rd 95 x 1/6"	21	66	61	2.0 (4.41)	3A, EHEDG	MS [5]	TS [5]
	DN 80	PN 25	100	12	Rd 110 x 1/4"	26	81	61	2.55 (5.62)	3A, EHEDG	MT [5]	TT [5]

1) Surface roughness of the wetted surfaces R_a < 0.76 µm (29.9 µin) as standard.
2) Product Configurator, order code for "Process connection, HP/ HP+LP:"
3) Product Configurator, order code for "Alternative process connection LP side:"
4) with TempC membrane
5) Alternatively available with TempC membrane.

Process connections FMD78 with diaphragm seal

Varivent for pipes



D *Diameter*
d_M *Max. diameter of the process isolating diaphragm*

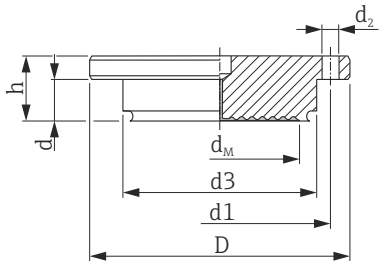
Engineering unit mm (in)

Material [1]	Designation	Nominal pressure	D	d_M		Weight	Approval	Option	
				Standard	with TempC membrane				
			[mm]	[mm]	[mm]	[kg (lb)]		HP [2]	LP [3]
AISI 316L	Type F for pipes DN 25 - DN 32	PN 40	50	34	36	0.4 (0.88)	EHEDG, 3A	TU [4]	UK [4]
AISI 316L	Type N for pipes DN 40 - DN 162	PN 40	68	58	61	0.8 (1.76)	EHEDG, 3A	TR [5]	-

1) Surface roughness of the wetted surfaces R_a < 0.76 µm (29.9 µin) as standard.
2) Product Configurator, order code for "Process connection, HP/ HP+LP:"
3) Product Configurator, order code for "Alternative process connection LP side:"
4) With TempC membrane
5) Alternatively available with TempC membrane.

Process connections FMD78 with diaphragm seal

NEUMO BioControl



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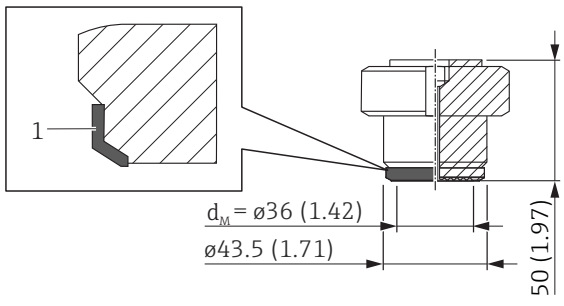
D Diameter
h/d Height
d1/ d3 diameter
d_2 Diameter of hole
d_M Max. diameter of the process isolating diaphragm

Engineering unit mm (in)

Material [1]	NEUMO BioControl (Process temperature range: −10 to +200 °C (+14 to +392 °F))							Diaphragm seal			Approval	Option	
								d_M		Weight			
	Nominal diameter	Nominal pressure	D	d_2	d_3	d_1	h	Standard	with TempC membrane				
		[bar]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[kg (lb)]		HP [2]	LP [3]
AISI 316L	DN 50	PN 16	90	4 x Ø 9	50	70	27	40	36	1.1 (2.43)	3A	S4 [4]	TV
	DN 80	PN 16	140	4 x Ø 11	87.4	115	37	61	61	2.6 (5.73)	3A	S6 [4]	TW

1) Surface roughness of the wetted surfaces R_a < 0.76 µm (29.9 µin) as standard.
2) Product Configurator, order code for "Process connection, HP/ HP+LP:"
3) Product Configurator, order code for "Alternative process connection LP side:"
4) With TempC membrane

Universal process adapter



1 Silicone molded seal

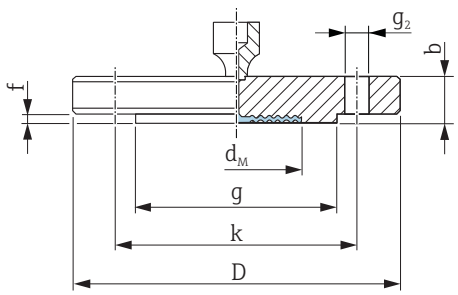
Engineering unit mm (in)

Designation	Nominal pressure	Material [1]	Weight	Approval	Option	
			[kg (lb)]		HP [2]	LP [3]
Universal adapter with silicone molded seal (spare part no.: 52023572) FDA 21CFR177.2600/USP Class VI	PN 10	AISI 316L (1.4435)	0.8 (1.76)	3A, EHEDG	00 [4] [5]	UT [4] [5]

1) Surface roughness of the wetted surfaces R_a< 0.76 µm (29.9 µin) as standard.
2) Product Configurator, order code for "Process connection, HP/ HP+LP:"
3) Product Configurator, order code for "Alternative process connection LP side:"
4) Endress+Hauser supplies these slotted nuts in stainless steel AISI 304 (DIN/EN material number 1.4301) or in AISI 304L (DIN/EN material number 1.4307).
5) With TempC membrane.

Process connections FMD78 with diaphragm seal

EN/DIN flanges, connection dimensions in accordance with EN 1092-1/DIN 2527, JIS flanges, connection dimensions in accordance with JIS B 2220 BL



D *Diameter of flange*
b *Thickness*
g *Raised face*
f *Thickness of raised face*
k *Hole circle*
g_2 *Diameter of hole*

Engineering unit mm

Material 1) 2) 3)							Boltholes			Diaphragm seal		Option	
Nominal diameter	Nominal pressure	Shape 4)	D	b	g	f	Number	g_2	k	d_M [mm]	Weight		
			[mm]	[mm]	[mm]	[mm]		[mm]	[mm]		[kg (lb)]	HP 5)	LP 6)
DN 50	PN 10-40	B1 (D)	165	20	102	3	4	18	125	59	3.0 (6.62)	B3 7)	TA 7)
DN 80	PN 10-40	B1 (D)	200	24	138	3.5	8	18	160	89	5.3 (11.69)	B5 7)	TB 7)
DN 100	PN 10-16	B1 (C)	220	20	–	4	8	18	180	89	4.5 (9.92)	BT	TC
DN 100	PN 25-40	B1 (D)	235	24	162	5	8	22	190	89	7 (15.44)	B6	TD

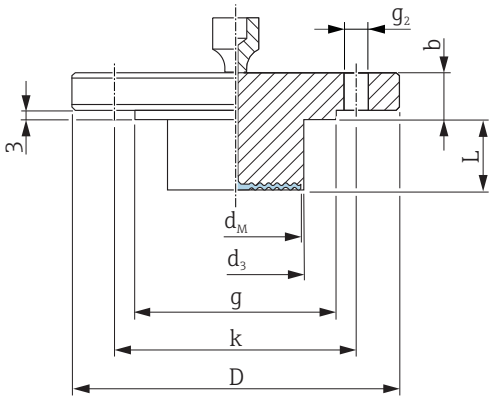
1) Material: AISI 316L
2) The roughness of the surface in contact with the media, including the raised face of the flanges (all standards) made of Alloy C276, Monel, Tantalum, Rhodium>Gold or PTFE is Ra R_a< 0.8 µm (31.5 µin). Lower surface roughness on request.
3) The flange raised face is made of the same material as the process isolating diaphragm.
4) Description as per DIN 2527 provided in brackets
5) Product Configurator, order code for "Process connection, HP/ HP+LP:"
6) Product Configurator, order code for "Alternative process connection LP side:"
7) Alternatively available with TempC membrane.

Material 1) 2) 3)						Boltholes			Diaphragm seal		Option	
Nominal diameter	Nominal pressure	D	b	g	f	Number	g_2	k	d_M [mm]	Weight		
		[mm]	[mm]	[mm]	[mm]		[mm]	[mm]		[kg (lb)]	HP 4)	LP 5)
50 A	10 K	155	16	96	2	4	19	120	59	2.3 (5.07)	CF	TK
80 A	10 K	185	18	127	2	8	19	150	89	3.3 (7.28)	KL	TL
100 A	10 K	210	18	151	2	8	19	175	89	4.4 (9.7)	KH	TM

1) Material: AISI 316L
2) The roughness of the surface in contact with the media, including the raised face of the flanges (all standards) made of Alloy C276, Monel, Tantalum, Rhodium>Gold or PTFE is Ra R_a< 0.8 µm (31.5 µin). Lower surface roughness on request.
3) The flange raised face is made of the same material as the process isolating diaphragm.
4) Product Configurator, order code for "Process connection, HP/ HP+LP:"
5) Product Configurator, order code for "Alternative process connection LP side:"

Process connections FMD78 with diaphragm seal

EN/DIN flanges with barrel (extended diaphragm seal), connection dimensions in accordance with EN 1092-1/DIN 2527 and DIN 2501-1



D *Diameter of flange*
b *Thickness*
g *Raised face*
k *Hole circle*
g_2 *Diameter of hole*
d_M *Max. diameter of the process isolating diaphragm*
d_3 *Barrel (extended diaphragm seal) diameter*
L *Barrel (extended diaphragm seal) length*

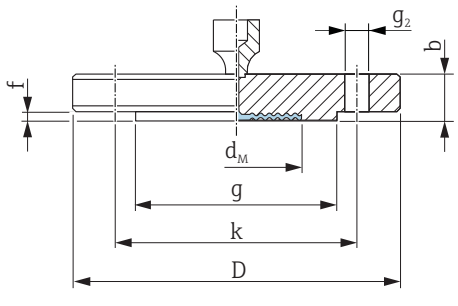
Engineering unit mm

Flange [1) 2)]								Boltholes			Diaphragm seal		Option [3)] (HP + LP)
Nominal diameter	Nominal pressure	Shape [4)]	D	b	g	L	d_3	Number	g_2	k	d_M [mm]	Weight	
			[mm]	[mm]	[mm]	[mm]	[mm]		[mm]	[mm]		[kg (lb)]	
DN 80	PN 10-40	B1 (D)	200	24	138	50	76	8	18	160	72	6.2 (13.67)	D4
						100						6.7 (14.77)	
						200						7.8 (17.20)	

1) material: AISI 316L
2) In the case of process isolating diaphragms made of Alloy C276, Monel oder tantalum, the raised face of the flange and the barrel pipe are made of 316L.
3) Product Configurator, order code for "Process connection, HP/ HP+LP:"
4) Description as per DIN 2527 provided in brackets

Process connections FMD78 with diaphragm seal

ASME flanges, in accordance with connection dimensions ASME B 16.5, raised face RF



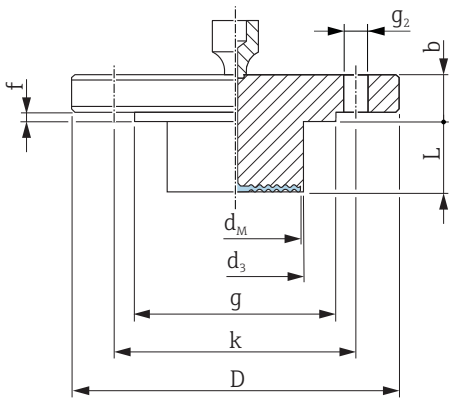
D *Diameter of flange*
b *Thickness*
g *Raised face*
f *Thickness of raised face*
k *Hole circle*
g_2 *Diameter of hole*

Engineering unit in

Material [1) 2) 3)]						Boltholes			Diaphragm seal		Approval [4)]	Option	
Nominal diameter	Class	D	b	g	f	Number	g_2	k	d_M	Weight			
[in]	[lb./sq.in]	[in]	[in]	[in]	[in]		[in]	[in]	[in]	[kg (lb)]		HP [5)]	LP [6)]
2	150	6	0.75	3.62	0.06	4	0.75	4.75	2.32	2.2 (4.85)	CRN	AF [7)]	TE [7)]
2	300	6.5	0.88	3.62	0.06	8	0.75	5	2.32	3.4 (7.5)	CRN	AR [7)]	TF [7)]
2	400/600	6.5	1	3.62	0.25	8	0.75	5	2.32	4.3 (9.48)	-	AJ	-
3	150	7.5	0.94	5	0.06	4	0.75	6	3.5	5.1 (11.25)	CRN	AG [7)]	TG [7)]
3	300	8.25	1.12	5	0.06	8	0.88	6	3.5	7.0 (15.44)	CRN	AS [7)]	TH [7)]
4	150	9	0.94	6.19	0.06	8	0.75	7.5	3.5	7.2 (15.88)	CRN	AH	TI
4	300	10	1.25	6.19	0.06	8	0.88	7.88	3.5	11.7 (25.8)	CRN	AT	TJ

1) Material AISI 316/316L: Combination of AISI 316 for required pressure resistance and AISI 316L for required chemical resistance (dual rated)
2) The roughness of the surface in contact with the media, including the raised face of the flanges (all standards) made of Alloy C276, Monel, Tantalum, Rhodium>Gold or PTFE is R_a< 0.8 µm (31.5 µin). Lower surface roughness on request.
3) The flange raised face is made of the same material as the process isolating diaphragm.
4) CSA approval: Product Configurator, order code for "Approval"
5) Product Configurator, order code for "Process connection, HP/ HP+LP:"
6) Product Configurator, order code for "Alternative process connection LP side:"
7) Alternatively available with TempC membrane.

ASME flanges with barrel (extended diaphragm seal), connection dimensions in accordance with ASME B 16.5, raised face RF



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D *Diameter of flange*
b *Thickness*
g *Raised face*
k *Hole circle*
g_2 *Diameter of hole*
d_M *Max. diameter of the process isolating diaphragm*
d_3 *Barrel (extended diaphragm seal) diameter*
L *Barrel (extended diaphragm seal) length*

Engineering unit in

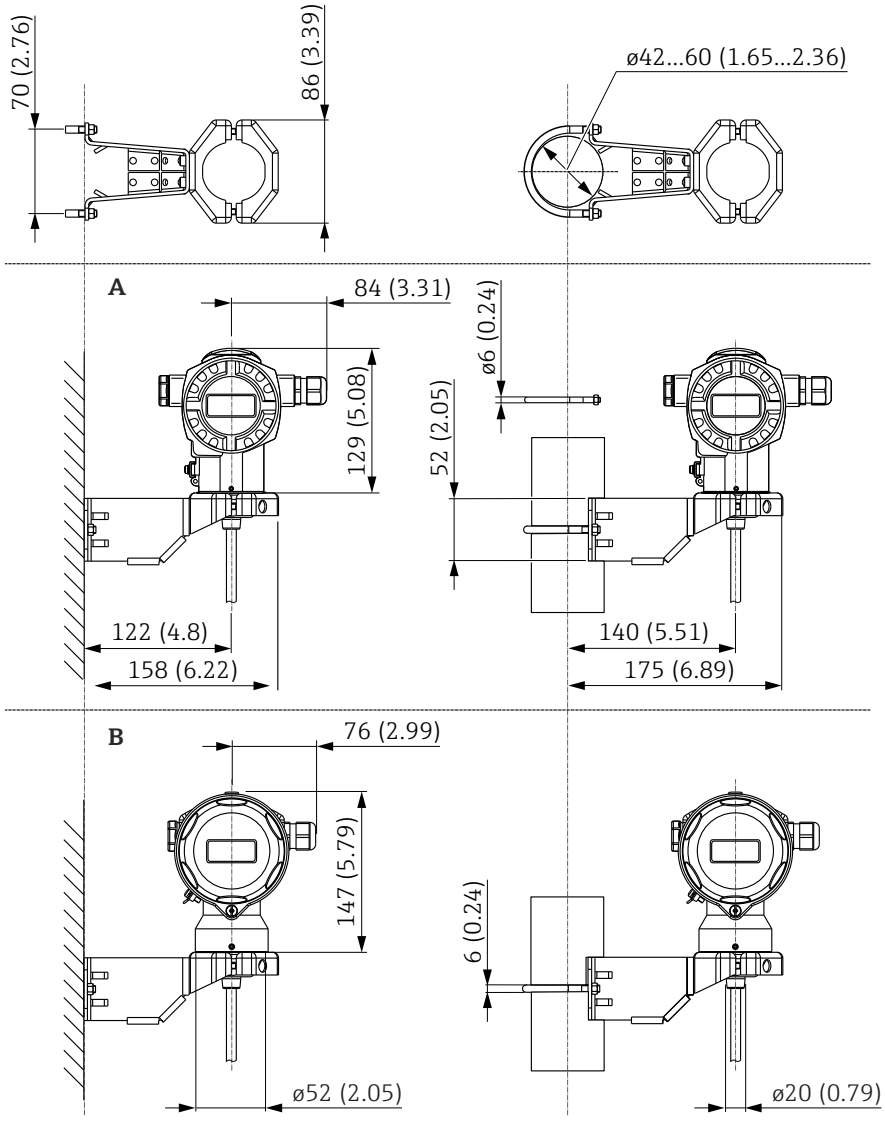
Flange [1) 2)]						Boltholes			Diaphragm seal		Approval [3)]	Option [4)] (HP + LP)
Nominal diameter	Class	D	b	g	f	Number	g_2	k	d_M	Weight		
[in]	[lb./sq.in]	[in]	[in]	[in]	[in]		[in]	[in]	[in]	[kg (lb)]		
3	150	7.5	0.94	5	0.06	4	0.75	6	2.83	[5)]	CRN	J4 [5)]
4	150	9	0.94	6.19	0.06	8	0.75	7.5	3.5	[5)]	CRN	J5 [5)]

1) Material: AISI 316/316L. Combination of AISI 316 for required pressure resistance and AISI 316L for required chemical resistance (dual rated)
2) In the case of process isolating diaphragms made of Alloy C276, Monel or tantalum, the raised face of the flange and the barrel pipe are made of 316L.
3) CSA approval: Product Configurator, order code for "Approval"
4) Product Configurator, order code for "Process connection, HP/ HP+LP:"
5) Choice of 2", 4", 6" or 8" barrel (extended diaphragm seal), for diameter and weight of barrel (extended diaphragm seal) see the following table

Option [1)]	Nominal diameter	Class	(L)	d_3	Weight
	[in]	[lb./sq.in]	in (mm)	in (mm)	[kg (lb)]
J4	3	150	2 (50.8) / 4 (101.6) / 6 (152.4) / 8 (203.2)	2.99 (76)	6.0 (13.2) / 6.6 (14.5) / 7.1 (15.7) / 7.8 (17.2)
J5	4	150	2 (50.8) / 4 (101.6) / 6 (152.4) / 8 (203.2)	3.7 (94)	8.6 (19) / 9.9 (21.8) / 11.2 (24.7) / 12.4 (27.3)

1) Product Configurator, order code for "Process connection"

Separate housing: Wall and pipe mounting with mounting bracket



Engineering unit mm (in)

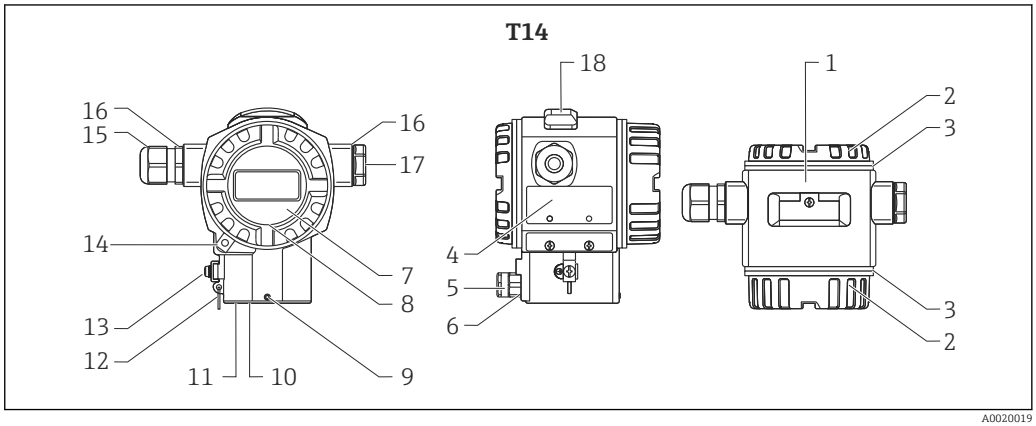
Position	Designation	Weight in kg (lb)		Option [1]
		Housing (T14 or T17)	Mounting bracket	
A	Dimensions with T14 housing, optional side display	→ 🖹 49	0.5 (1.10)	U
B	Dimensions with T17 housing, optional side display			

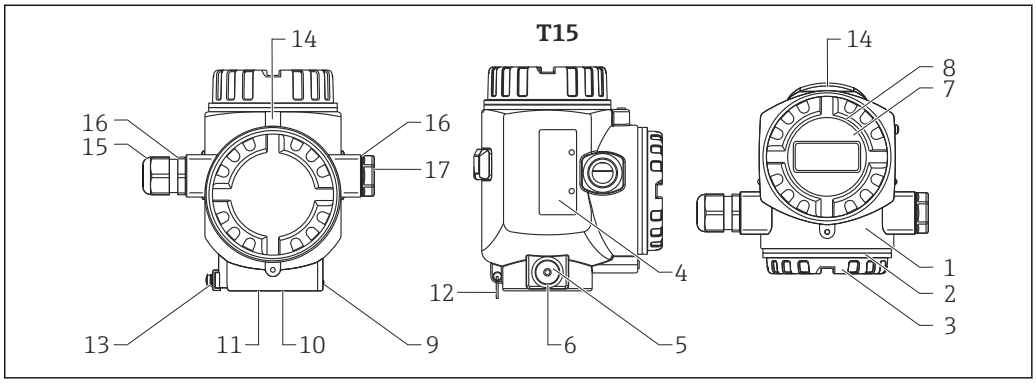
1) Product Configurator, order code for "Additional options 2", version "G"

Also available for order as a separate accessory: Part number 71102216

Materials not in contact with process

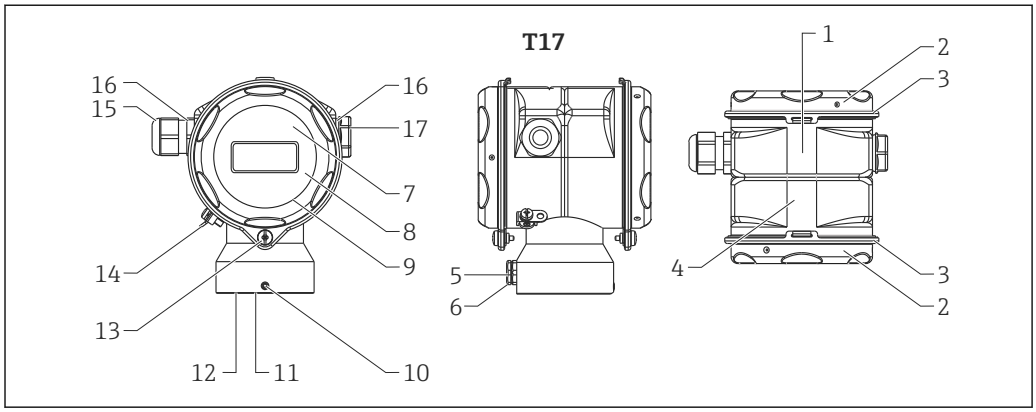
Transmitter housing





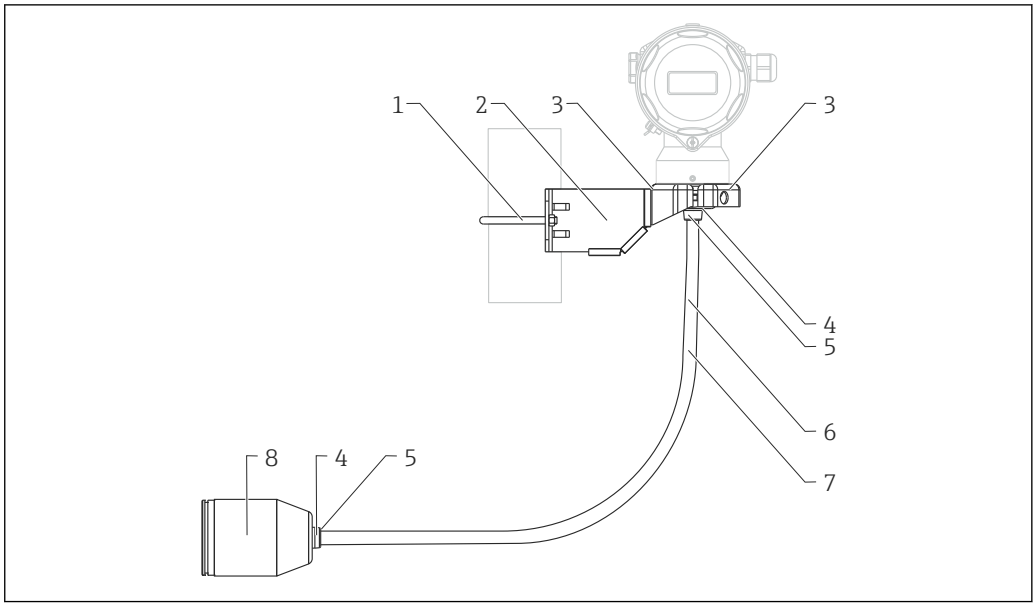
Item number	Component part	Material
1	T14 and T15 housing, RAL 5012 (blue)	▪ Die-cast aluminum with protective powder-coating on polyester base ▪ Thread coating: Heat-curing lubricant varnish
2	Cover, RAL 7035 (gray)	Die-cast aluminum with protective powder-coating on polyester base
3	Cover seal	EPDM
4	Nameplates	▪ AISI 316L (1.4404), if T14 housing is precision-cast ▪ Anodized aluminum, if housing T14/T15 of die-cast aluminum
5	Pressure compensation filter	AISI 316L (1.4404) and PBT-FR
6	Pressure compensation filter, O-ring	VMQ or EPDM
7	Sight glass	Mineral glass
8	Sight glass seal	Silicone (VMQ)
9	Screw	A4
10	Sealing ring	EPDM
11	Snap ring	PA66-GF25
12	Snap ring for nameplates	AISI 304 (1.4301)/AISI 316 (1.4401)
13	External ground terminal	AISI 304 (1.4301)
14	Cover clamp	Clamp AISI 316L (1.4435), screw A4
15	Cable entry	Polyamide (PA) or CuZn nickel-plated
16	Seal of cable entry and plug	Silicone (VMQ)

Item number	Component part	Material
17	Blind plug	PBT-GF30 FR, for dust ignition-proof: AISI 316L (1.4435)
18	External operation (keys and key cover), RAL 7035 (gray)	Polycarbonate PC-FR, screw A4



Item number	Component part	Material
1	T17 housing	AISI 316L (1.4404)
2	Cover	
3	Cover seal	EPDM
4	Nameplates	Lasered on
5	Pressure compensation filter	AISI 316L (1.4404) and PBT-FR
6	Pressure compensation filter, O-ring	VMQ or EPDM
7	Sight glass for non-hazardous area, ATEX Ex ia, NEPSI Zone 0/1 Ex ia, IECEx Zone 0/1 Ex ia, FM NI, FM IS, CSA IS	Polycarbonate (PC)
8	Sight glass for ATEX 1/2 D, ATEX 1/3 D, ATEX 1 GD, ATEX 1/2 GD, ATEX 3 G, FM DIP, CSA dust ignition-proof	Mineral glass
9	Sight glass seal	EPDM
10	Screw	A2-70
11	Sealing ring	EPDM
12	Snap ring	PA6
13	Screw	A4-50 Thread coating: Heat-curing lubricant varnish
14	External ground terminal	AISI 304 (1.4301)
15	Cable entry	Polyamide PA, for dust ignition-proof: CuZn nickel-plated
16	Seal of cable entry and plug	Silicone (VMQ)
17	Blind plug	PBT-GF30 FR, for dust ignition-proof: AISI 316L (1.4435)

Connecting parts



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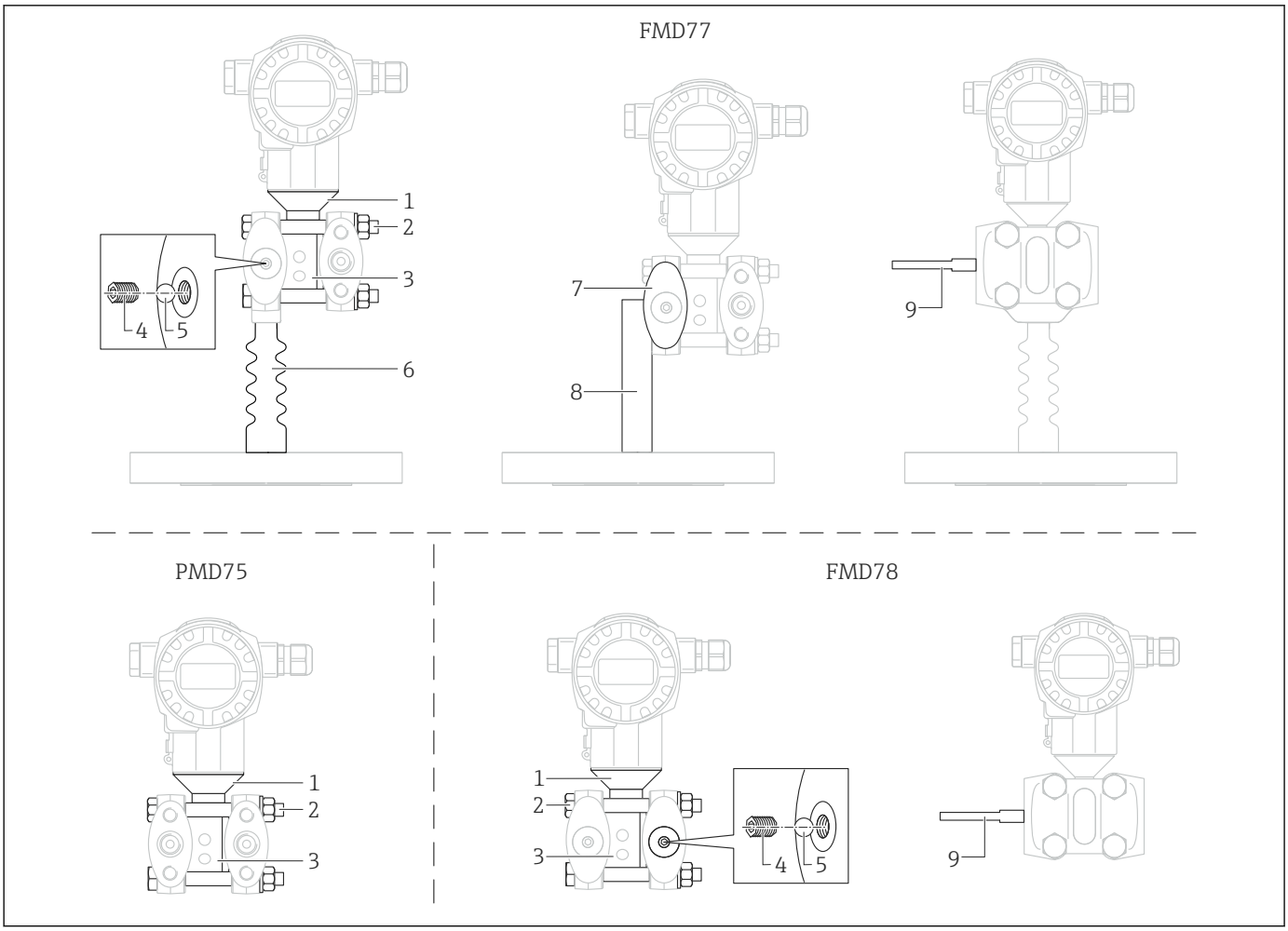
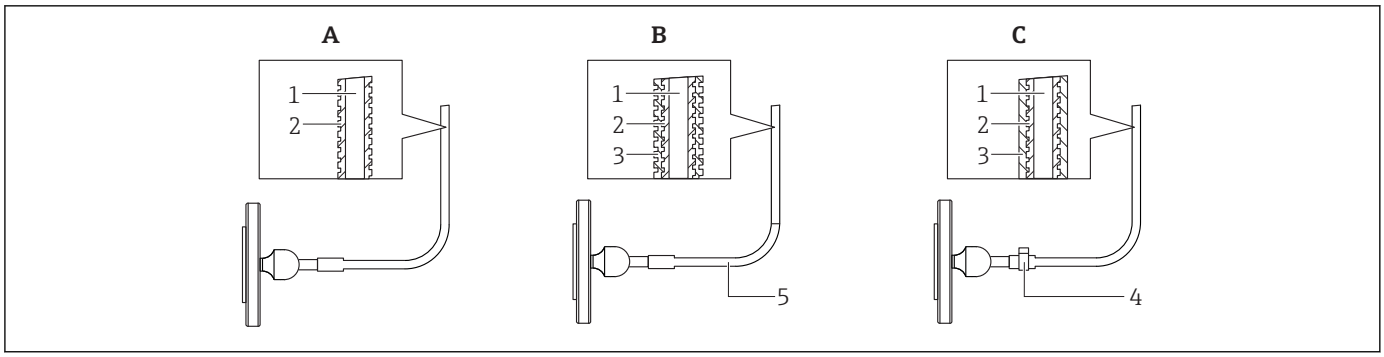
Item number	Component part	Material
1	Mounting bracket	Bracket AISI 316L (1.4404)
2		Screw and nuts A4-70
3		Half-shells: AISI 316L (1.4404)
4	Seal for cable from separate housing	EPDM
5	Gland for cable from separate housing	AISI 316L (1.4404)
6	PE cable for separate housing	abrasion-proof cable with strain-relief Dynema members; shielded using aluminum-coated foil; insulated with polyethylene (PE-LD), black; copper wires, twisted, UV-resistant
7	FEP cable for separate housing	Abrasion-proof cable; shielded using galvanized steel wire netting; insulated with fluorinated ethylene propylene (FEP), black; copper cores, twisted, UV-resistant
8	Process connection adapter for separate housing	AISI 316L (1.4404)



Item number	Component part	Material
1	Connection between the housing and process connection	AISI 316L (1.4404)
2	Screw and nuts	PMD75 PN 160, FMD77, FMD78: ▪ Hex.-headed bolt DIN 931-M12x90-A4-70 ▪ Hex.-headed nut DIN 934-M12-A4-70 PMD75 PN 420: ▪ Hex.-headed bolt ISO 4014-M12x90-A4 ▪ Hex.-headed nut ISO 4032-M12-A4-bs
3	Cell body	AISI 316L (1.4404)
4	Threaded pin	DIN 915 M 6x8 A2-70
5	Bearing	DIN 5401 (1.3505)
6	Temperature isolator	AISI 316L (1.4404)
7	Side flanges	1.4408 / CF3M [1] / AISI 316L
8	U-bracket	AISI 304 (1.4301)
9	Heat-shrink tube (available only if flexible armor for capillary has PVC coating or PTFE hose)	Polyolefin

1) Cast equivalent to material AISI 316L



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Position	Component part	A Standard [1] Armor for capillary	B PVC-coated Armor for capillary	C PTFE hose Armor for capillary
1	Capillary	AISI 316 Ti (1.4571)	AISI 316 Ti (1.4571)	AISI 316 Ti (1.4571)
2	Flexible armor for capillary	AISI 316L (1.4404) [2]	AISI 316L (1.4404)	AISI 316L (1.4404)
3	Coating/armor	-	PVC [3]	PTFE [4]
4	Single-ear clamp	-	-	1.4301
5	Shrink tubing at capillary junction	-	Polyolefin	-

1) If no option is specified when ordering, order option "SA" is supplied.
2) Product Configurator, order code for "Capillary armoring:" option "SA"
3) Product Configurator, order code for "Capillary armoring:" option "SB"
4) Product Configurator, order code for "Capillary armoring:" option "SC"

Weight

Component part	Weight
Housing	See "Housing" section
Process connection	See "Process connections" section
Capillary with armoring made of AISI 316L (1.4404)	0.16 kg/m (0.35 lb/m) + 0.2 kg (0.44 lb) (weight per capillary line)
Capillary with armoring made of AISI 316L (PVC)	0.21 kg/m (0.46 lb/m) + 0.2 kg (0.44 lb) (weight per capillary line)
Capillary with armoring made of AISI 316L (PTFE)	0.29 kg/m (0.64 lb/m) + 0.2 kg (0.44 lb) (weight per capillary line)

Materials in contact with process

NOTICE

- The device components in contact with the process are specified in the "Mechanical construction" → 48 and "Ordering information" → 108 sections.

Delta-ferrite content

A delta-ferrite content of ≤ 3% can be guaranteed and certified for the wetted parts of the FMD78 if option "8" is selected in the "Additional options 1" or "Additional options 2" order code in the Product Configurator.

TSE Certificate of Suitability (Transmissible Spongiform Encephalopathy)

The following applies to all device components in contact with the process:

- They do not contain any materials derived from animals.
- No additives or operating materials derived from animals are used in production or processing.

Process connections

- "Clamp connections" and "Hygienic process connections": AISI 316L (DIN/EN material number 1.4435)
- Endress+Hauser supplies DIN/ EN process connections with threaded connections made of stainless steel as per AISI 316L (DIN/EN material number 1.4404 or 14435). With regard to their stability-temperature property, the materials 1.4404 and 1.4435 are grouped together under 13E0 in EN 1092-1: 2001 Tab. 18. The chemical composition of the two materials can be identical.
- Some process connections are also available in alloy C276 (DIN/EN material number 2.4819). For this purpose see the information in the "Mechanical construction" section.
- Side flanges: 316L, C 22.8 with zinc plating or alloy C 276. The C22.8 side flanges are coated with anti-corrosion protection (zinc, chrome). To prevent the formation of hydrogen and thereby diffusion through the membrane, Endress+Hauser recommends the use of 316L side flanges for applications involving water. Hydrogen diffusion through the membrane leads to measurement errors, or in extreme cases to a device failure.

Process isolating diaphragm

Sensor	Designation	Option [1]
FMD77	AISI 316L, high-pressure side (HP)	1
	Alloy C 276, high-pressure side (HP) [2]	2
	Monel (2.4360), high-pressure side (HP) [2]	3
	Tantalum (UNS R05200), high-pressure side (HP) [2]	5
	AISI 316L with gold-rhodium coating, high-pressure side (HP)	6
	AISI 316L with 0.25 mm (0.01 in)PTFE coating, high-pressure side (HP)	8
FMD77 with capillaries on low-pressure side (LP)	AISI 316L, high-pressure side (HP) + low-pressure side (LP)	H
	AISI C 276, high-pressure side (HP) + low-pressure side (LP)	J
	Monel (2.4360), high-pressure side (HP) + low-pressure side (LP)	K
	Tantalum (UNS R05200), high-pressure side (HP) + low-pressure side (LP)	L
	AISI 316L with gold-rhodium coating, high-pressure side (HP) + low-pressure side (LP)	M
	AISI 316L with 0.25 mm (0.01 in)PTFE coating, high-pressure side (HP) + low-pressure side (LP)	N
FMD78	AISI 316L, TempC	E
	AISI 316L	1
	Alloy C 276 [2]	2
	Monel (2.4360) [2]	3
	Tantalum (UNS R05200) [2]	5
	AISI 316L with gold-rhodium coating	6
	AISI 316L with 0.25 mm (0.01 in) PTFE foil (FDA 21 CFR 177.1550)	8
PMD75	AISI 316L	1
	Alloy C 276 (2.4819)	2
	Monel (2.4360)	3
	Tantalum (UNS R05200)	5
	Alloy C 276 with gold-rhodium coating	6

1) Product Configurator, order code for "Membrane material"
2) The material used in the raised face of the flange is the same as that used in the process isolating diaphragm. For devices with a barrel (extended diaphragm seal), the flange raised face and the barrel pipe are made of 316L.

Seals

Device	Designation	Option [1]
PMD75	FKM Viton	A
	PTFE (PN160bar/16MPa/2400psi)	C [2]
	PTFE (PN250bar/25MPa/3625psi)	D [2]
	NBR	F
	Copper seal ring	H
	Copper seal ring, oxygen service, note pressure and temperature application limits	K
	FKM Viton, cleaned from oil and grease	1
	FKM Viton, cleaned for oxygen service, note pressure and temperature application limits	2
	PTFE, cleaned for oxygen service, note pressure and temperature application limits	3
	EPDM	J [3]

1) Product Configurator, "Seal" ordering feature
2) Suitable for foodstuffs FDA21 CFR 177.1550
3) Suitable for drinking water NSF61.

Fill fluid

FMD77: Diaphragm seal fill fluid

Process connection	Designation	Option [1] [2]
High-pressure side (HP)	Silicone oil (food-safe FDA 21 CFR 175.105)	A
	Vegetable oil (food-safe FDA 21 CFR 172.856)	D
	Inert oil	F
	Low-temperature oil	L
	High-temperature oil	V
Low-pressure side (LP)	..... m capillary, silicone oil	M
	..... m capillary, vegetable oil	N
	..... m capillary, inert oil	O
	..... m capillary; low-temperature oil	P
	..... m capillary; high-temperature oil	Q
	.....ft capillary; silicone oil	R
	..... ft capillary; vegetable oil	S
	..... ft capillary, inert oil	T
	..... ft capillary; low-temperature oil	U
	..... ft capillary; high-temperature oil	W

1) Product Configurator, order code for "Fill fluid"
2) For diaphragm seal devices with 3-A and EHEDG certificates, only select filling oils with FDA approval!

FMD77: Pressure measuring cell fill fluid

FMD77	Designation	Option [1]
With capillary on low-pressure side (LP)	Silicone oil	Standard, if no option was selected.
	Inert oil, PWIS-free	HC
Without capillary on low-pressure side (LP)	Silicone oil	Standard, if no option was selected.

FMD77	Designation	Option [1]
	Inert oil, cleaned for oxygen service	HB
	Inert oil, PWIS-free	HC

1) Product Configurator, order code for "Service"

FMD78: Diaphragm seal fill fluid

Capillary length;	Designation	Option [1]
Symmetrical	..... ft capillary; silicone oil (food-safe FDA 21 CFR 175.105)	A [2]
	..... ft capillary; vegetable oil (food-safe FDA 21 CFR 172.856)	B [2]
	..... ft capillary; high-temperature oil	C [2]
	..... ft capillary; inert oil, oxygen service, observe pressure/temp. application limits	D [2]
	..... ft capillary; low-temperature oil	E [2]
	..... ft capillary, inert oil	F [2]
	..... m capillary; silicone oil (food-safe FDA 21 CFR 175.105)	1 [2]
	..... m capillary; vegetable oil (food-safe FDA 21 CFR 172.856)	2 [2]
	..... m capillary; high-temperature oil	3 [2]
	..... m capillary; inert oil, oxygen service, observe pressure/temp. application limits	4 [2]
	..... m capillary; low-temperature oil	5 [2]
	..... m capillary, inert oil	6 [2]
Asymmetrical Low-pressure side (LP) [3]	..... m capillary, silicone oil, LP side	M [2]
	..... m capillary, vegetable oil, LP side	N [2]
	..... m capillary, inert oil, LP side	O [2]
	..... m capillary, low-temperature oil, LP side	P [2]
	..... m capillary, high-temperature oil, LP side	Q [2]
	..... ft capillary, silicone oil, LP side	R [2]
	..... ft capillary, vegetable oil, LP side	S [2]
	..... ft capillary, inert oil, LP side	T [2]
	..... ft capillary, low-temperature oil, LP side	U [2]
	..... ft capillary, high-temperature oil, LP side	W [2]
Asymmetrical High-pressure side (LP) [4]	..... ft capillary, HP side	V [5]
	..... m capillary, HP side	W [5]

1) For diaphragm seal devices with 3-A and EHEDG certificates, only select filling oils with FDA approval!
2) Product Configurator, order code for "Fill fluid"
3) If the capillary length for asymmetrical LP or HP is identical, select a symmetrical capillary length when ordering.
4) If the capillary length for asymmetrical LP or HP is identical, select a symmetrical capillary length when ordering.
5) Product Configurator, order code for "Additional options 2"

FMD78: Pressure measuring cell fill fluid

Designation	Option [1]
Silicone oil	Standard, if no option was selected.
Inert oil, PWIS-free	HC

1) Product Configurator, order code for "Service"

PMD75: Pressure measuring cell fill fluid

Designation	Option
Silicone oil	Standard, if no option was selected.
Inert oil, FKM Viton, oxygen service	2 [1]
Inert oil, PTFE, oxygen service	3 [1]
Inert oil, copper seal ring, oxygen service	K [1]
Inert oil, PWIS-free	HC [2]
Inert oil, cleaned for oxygen service	HB [2]

1) Product Configurator, order code for "Seal"
2) Product Configurator, oder code for "Service"

Operability

Operating concept

Operator-oriented menu structure for user-specific tasks

- Commissioning
- Operation
- Diagnosis

Fast and safe commissioning

Guided menus for applications

Reliable operation

- Local operation possible in several languages
- Standardized operation at the device and in the operating tools
- Parameters relating to measured values can be locked/unlocked using the device's write protection switch, using the device software or via remote operation

Efficient diagnostics increase measurement availability

- Remedial measures are integrated in plain text
- Diverse simulation options

Local operation

Functions

Function	External operation (operating keys, optional, not T17 housing)	Internal operation (electronic insert)	Onsite display (optional)
Position adjustment (zero point correction)	✔	✔	✔
Setting lower-range value and upper-range value - reference pressure present at the device	✔ (HART only)	✔ (HART only)	✔
Device reset	✔	✔	✔
Locking and unlocking parameters relevant to the measured value	—	✔	✔
Value acceptance indicated by green LED	✔	✔	✔
Switching damping on and off	✔ (only if display is connected)	✔ (HART and PA only)	✔
Configuring the bus address of the device (PA)	—	✔	✔
Switching simulation mode on and off (FOUNDATION Fieldbus)	—	✔	✔

Operating the device using onsite display (optional)

A 4-line liquid crystal display (LCD) is used for display and operation. The onsite display shows measured values, dialog text as well as fault and notice messages in plain text, thereby supporting the user in every stage of operation.

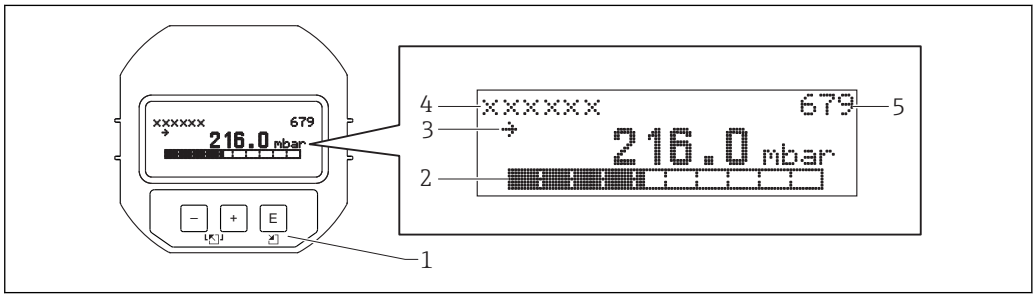
The display can be removed for easy operation.

The device display can be turned in 90° steps.

Depending on the installation position of the device, this makes it easy to operate the device and read the measured value.

Functions:
- 8-digit measured value display including sign and decimal point and bar graph for
  - 4 to 20 mA HART (bar graph from 4 to 20 mA)
  - PROFIBUS PA (bar graph as graphic display of standardized value of AI block)
  - FOUNDATION Fieldbus (bar graph as graphic display of transducer output).
-
- Simple and complete menu guidance due to breakdown of parameters into several levels and groups
- Menu guidance in up to 8 languages
- Each parameter is given a 3-digit ID number for easy navigation.
- Option for configuring the display according to individual requirements and preferences, such as language, alternating display, display of other measured values such as sensor temperature, contrast setting.
- Comprehensive diagnostic functions (fault and warning message, peak-hold indicators, etc.).
- Rapid and safe commissioning with the Quick Setup menus

Overview



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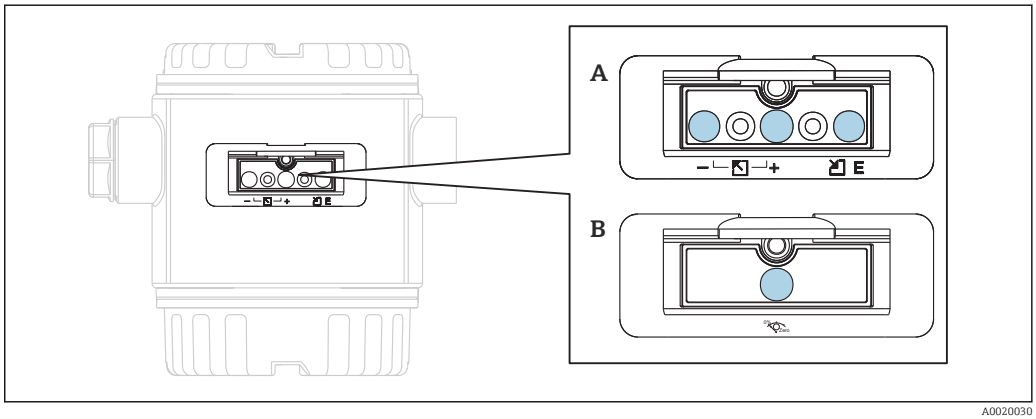
1 Operating keys
2 Bargraph
3 Symbol
4 Header
5 Parameter ID number

Operating keys on the exterior of the device

With the aluminum housing (T14), the operating keys are located either outside on the housing, under the protection cap or inside on the electronic insert. With the stainless steel housing (T17), the operating keys are always located inside the housing on the electronic insert.



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A 4 to 20 mA HART
B PROFIBUS PA and FOUNDATION Fieldbus

The operating keys located externally on the device work on the Hall sensor principle. As a result, no additional openings are required in the device. This guarantees:

- Complete protection against environmental influences such as moisture and contamination.
- Simple operation without any tools.
- No wear.

Ordering information:

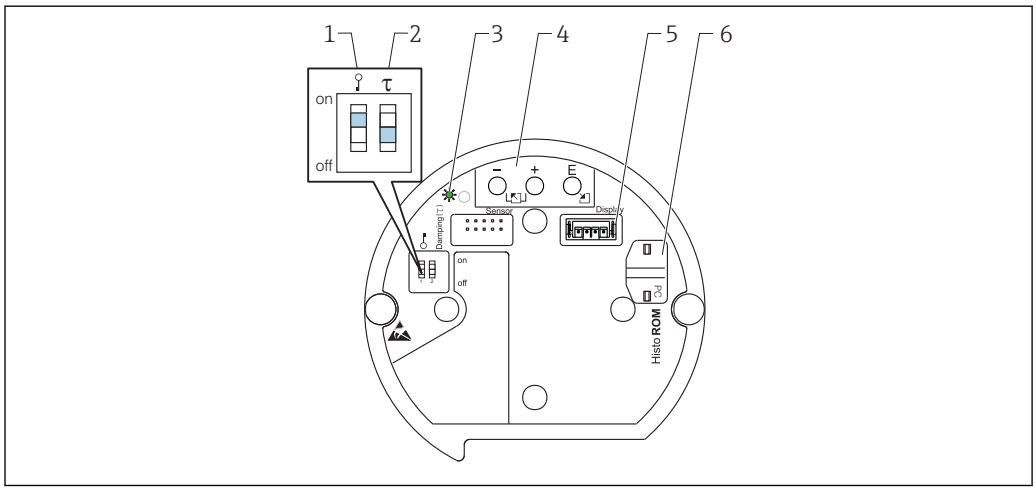
Product Configurator, order code for "Output, operation"

Operating keys and elements located internally on the electronic insert

Ordering information:

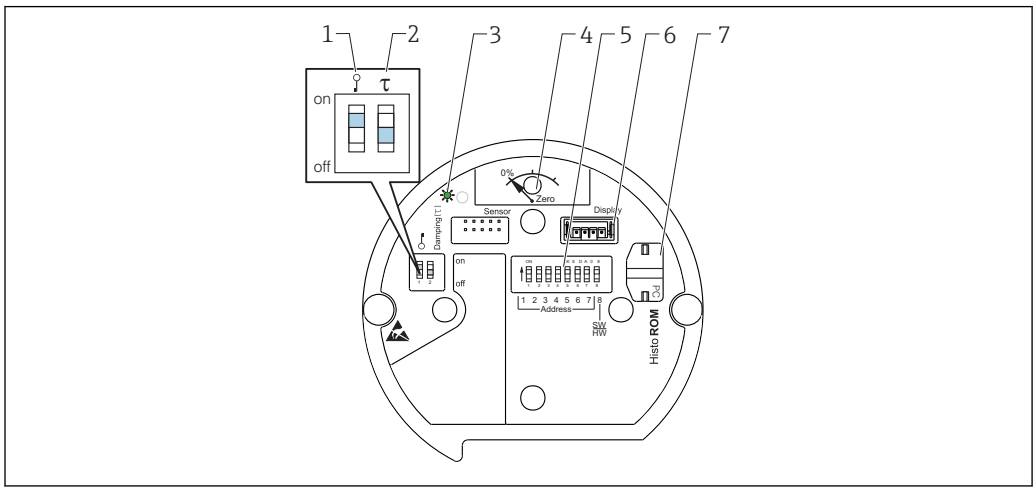
Product Configurator, order code for "Output, operation"

HART



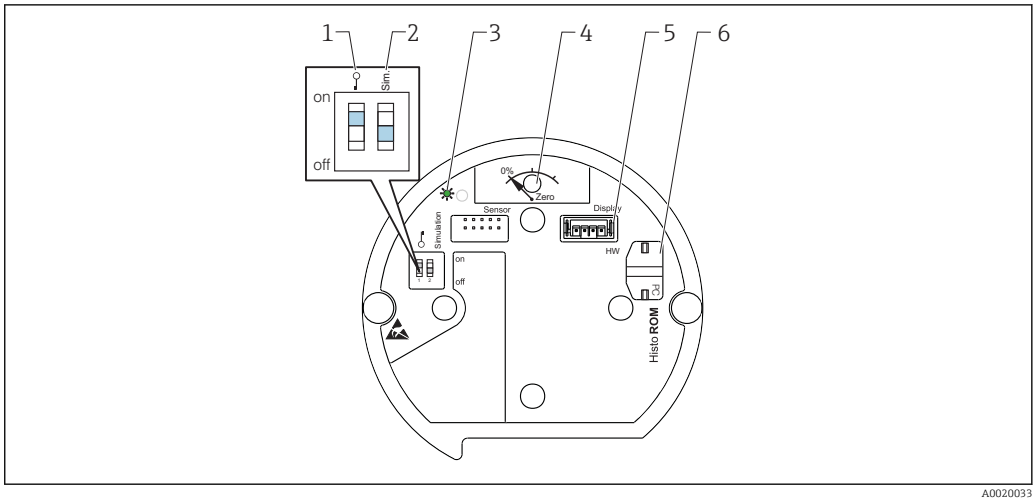
1 DIP switch for locking/unlocking parameters relevant to the measured value
2 DIP switch for switching damping on/off
3 Green LED to indicate value being accepted
4 Operating keys
5 Slot for optional display
6 Slot for optional HistoROM®/M-DAT

PROFIBUS PA



1 DIP switch for locking/unlocking parameters relevant to the measured value
2 DIP switch for switching damping on/off
3 Green LED to indicate value being accepted
4 Key for position adjustment and device reset
5 DIP switch for bus address
6 Slot for optional display
7 Slot for optional HistoROM®/M-DAT

FOUNDATION Fieldbus



1 *DIP switch for locking/unlocking parameters relevant to the measured value*
2 *DIP switch for simulation mode on/off*
3 *Green LED to indicate value being accepted*
4 *Key for position adjustment and device reset*
5 *Slot for optional display*
6 *Slot for optional HistoROM®/M-DAT*

Remote operation

All software parameters are accessible depending on the position of the write protection switch on the device.

Hardware and software for remote operation	HART	PROFIBUS PA	FOUNDATION Fieldbus
FieldCare	✔	✔	✔
FieldXpert SFX100	✔	–	✔
NI-FBUS Configurator	–	–	✔
HistoROM®/M-DAT	✔	✔	✔

FieldCare

FieldCare is an Endress+Hauser asset management tool based on FDT technology. With FieldCare, you can configure all Endress+Hauser devices as well as devices from other manufacturers that support the FDT standard.

FieldCare supports the following functions:
- Configuration of transmitters in offline and online mode
- Device data upload/download
- HistoROM®/M-DAT analysis
- Documentation of the measuring point

Connection options:
- HART via Commubox FXA195 and the USB interface of a computer
- PROFIBUS PA via segment coupler and PROFIBUS interface card
- Service interface with Commubox FXA291 and ToF adapter FXA291 (USB).

For further information please contact your local Endress+Hauser Sales Center.

Field Xpert SFX100

Field Xpert is an industrial PDA with integrated 3.5" touchscreen from Endress+Hauser based on Windows Mobile. It offers wireless communication via the optional VIATOR Bluetooth modem from Endress+Hauser. Field Xpert also works as a stand-alone device for asset management applications. For details, refer to BA00060S/04/EN.

Commubox FXA195

For intrinsically safe HART communication with FieldCare via the USB interface. For details refer to TI00404F/00/EN.

Commubox FXA291

The Commubox FXA291 connects Endress+Hauser field devices with a CDI interface (=Endress +Hauser Common Data Interface) to the USB interface of a personal computer or a notebook. For details refer to TI00405C/07/EN.

For the following Endress+Hauser devices you need the "ToF adapter FXA291" as an additional accessory:
- Cerabar S PMC71, PMP7x
- Deltabar S PMD7x, FMD7x
- Deltapilot S FMB70

ToF adapter FXA291

The ToF adapter FXA291 connects the Commubox FXA291 with devices of the ToF platform, pressure equipment and Gammapilot via the USB interface of a personal computer or a notebook. For details refer to KA00271F.

Profiboard

For connecting a PC to PROFIBUS.

Proficard

For connecting a laptop to PROFIBUS.

FF configuration program

FF configuration program, such as NI-FBUS Configurator, to
- connect devices with "FOUNDATION Fieldbus signal" into an FF network
- set FF-specific parameters

Remote operation via the NI-FBUS Configurator:

The NI-FBUS Configurator is an easy-to-use graphical environment for creating linkages, field-based control loops and schedules based on the FOUNDATION Fieldbus concept.

You can use the NI-FBUS Configurator to configure a fieldbus network as follows:
- Set block and device tags
- Set device addresses
- Create and edit function block control strategies (function block applications)
- Configure vendor-defined function and transducer blocks
- Create and edit schedules
- Read and write to function block control strategies (function block applications)
- Invoke Device Description (DD) methods
- Display DD menus
- Download a configuration
- Verify a configuration and compare it to a saved configuration
- Monitor a downloaded configuration
- Replace a virtual device by a real device
- Save and print a configuration

HistoROM®/M-DAT (optional)

The HistoROM®/M-DAT is a memory module that can be attached to any electronic insert. HistoROM®/M-DAT can be retrofitted at any stage (order number: 52027785).

Your benefits
- Quick and safe commissioning of the same measuring points by copying the configuration data of one transmitter to another transmitter
- Reliable process monitoring thanks to cyclical recording of pressure and sensor temperature measured values
- Simple diagnosis by recording diverse events such as alarms, configuration changes, counters for measuring range undershoot and overshoot for pressure and temperature as well as user limit overshoot and undershoot for pressure and temperature etc.
- Analysis and graphic evaluation of the events and process parameters via software (contained in scope of supply).

A CD with an Endress+Hauser operating program is also included in the scope of delivery. You can copy data from one transmitter to another transmitter when operating a FOUNDATION Fieldbus device via an FF configuration program. You need the Endress+Hauser FieldCare operating program, the Commubox FXA291 service interface and the ToF adapter FXA291 to be able to access the data and events saved in the HistoROM®/M-DAT.

Ordering information:

Product Configurator, order code for "Additional options:", version "N" or

Product Configurator, order code for "Application package:", option "EN" or

as a separate accessory (part no.: 52027785).

For further information please contact your local Endress+Hauser Sales Center.

System integration

The device can be given a tag name (max. 8 alphanumeric characters).

Designation	Option [1]
Measuring point (TAG), see additional spec.	Z1
Bus address, see additional spec.	Z2

1) Product Configurator, order code for "Identification"

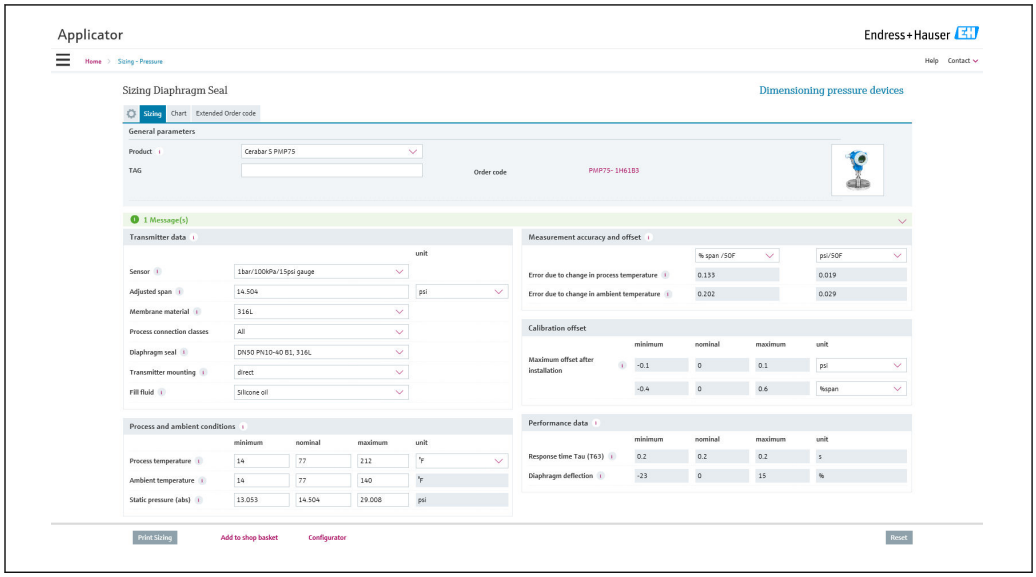
Planning instructions, diaphragm seal systems

NOTICE

Incorrect sizing/ordering of diaphragm seal systems

The performance and the permitted range of application of a diaphragm seal system depend on the process isolating diaphragm used, the filling oil, the coupling, the unit design and on the process and ambient conditions present in the individual application.

- ▶ To help you select the right diaphragm seal systems for your particular applications, Endress +Hauser provides its customers with the "Applicator Sizing Diaphragm Seal" selection tool, which is available free of charge at "www.endress.com/applicator" or as a download.



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For more detailed information or the layout of the optimum diaphragm seal solution for your application, please contact your local Endress+Hauser Sales Center.

Applications

Diaphragm seal systems should be used if the process and the device should be separated. Diaphragm seal systems offer clear advantages in the following instances:

- In the case of extreme process temperatures
- For aggressive media
- In the case of process media that crystallize
- In the case of corrosive or highly various process media or process media with solids content
- In the case of heterogeneous and fibrous process media
- If extreme measuring point cleaning is necessary, or for very humid mounting locations
- If the measuring point is exposed to severe vibrations
- For mounting locations that are difficult to access

Design and operation mode

Diaphragm seals are separating equipment between the measuring system and the process.

A diaphragm seal system consists of:
- A diaphragm seal in a one-sided system, e.g. FMD77 or two diaphragm seals in a two-sided system, e.g. FMD78
- One capillary tube or two capillary tubes
- Fill fluid
- A differential pressure transmitter

The process pressure acts via the process isolating diaphragm of the diaphragm seal on the liquid-filled system, which transfers the process pressure via the capillary tube onto the sensor of the differential pressure transmitter.

Endress+Hauser delivers all diaphragm seal systems as welded versions. The system is hermetically sealed, which ensures the highest reliability.

The diaphragm seal determines the application range of the system by:
- The diameter of the process isolating diaphragm
- The stiffness and material of the process isolating diaphragm
- The design (oil volume)

Diameter of the process isolating diaphragm

The greater the diameter of the process isolating diaphragm (less stiff), the smaller the temperature effect on the measurement result.

Stiffness of the process isolating diaphragm

The stiffness depends on the diameter of the process isolating diaphragm, the material, any existing coating and the thickness and shape of the process isolating diaphragm. The thickness of the process isolating diaphragm and the shape are determined by the design. The stiffness of a process isolating diaphragm of a diaphragm seal influences the temperature operating range and the measuring error caused by temperature effects.

The Endress+Hauser TempC membrane: Highest accuracy and process safety when measuring pressure and differential pressure using diaphragm seals

To measure even more precisely in such applications and to increase process safety, Endress+Hauser has developed the TempC membrane based on a completely revolutionary technology. This membrane guarantees the highest level of accuracy and process safety in diaphragm seal applications.
- The very low temperature effect minimizes the influence of fluctuations of both process and ambient temperatures, thus guaranteeing accurate and stable measurements. Measurement inaccuracies caused by temperature are reduced to a minimum.
- The TempC membrane can be used at temperatures between −70 °C (−94 °F) and +400 °C (+752 °F). This guarantees maximum process safety even for very long sterilization and cleaning cycles (SIP/CIP) in tanks and pipes at high temperatures.
- Thanks to the TempC membrane, smaller dimension process connections are possible. With a smaller process connection, the new membrane measures at least as accurately as a conventional membrane with a larger diameter.
- Due to the geometry of the membrane, an overshoot occurs initially immediately following a temperature shock. This results in a transient response, the duration and deviation of which are significantly less compared to traditional membrane types. In the case of batch processes, these shorter recovery times mean a far higher level of availability of the production facilities. For TempC membranes, the effect of the overshoot on the output signal can be reduced by adjusting the damping.

Ordering information:

See the Product Configurator for the individual process connection and the choice of process isolating diaphragm.

Selection in the Applicator:

Under "Transmitter data" in the "Membrane material" field.

Capillary

Diaphragm seals are used with the following capillary internal diameters as standard:
- ≤ DN 50: 1 mm (0.04 in)
- > DN 50: 2 mm (0.08 in)

The capillary tube influences the thermal change, the ambient temperature operating range and the response time of a diaphragm seal system as a result of its length and internal diameter.

Filling oil

When selecting the filling oil, the media and ambient temperature as well as the operating pressure are of crucial importance. Observe the temperatures and pressures during commissioning and cleaning. A further selection criterion is the compatibility of the filling oil with the requirements of the process media. For this reason, only filling oils that are harmless to health may be used in the food industry, such as vegetable oil or silicone oil (see also the following section on "diaphragm seal filling oils").

The filling oil used influences the thermal change, the temperature operating range of a diaphragm seal system and the response time. A temperature change results in a volume change of the filling oil. The volume change is dependent on the expansion coefficient and on the volume of the filling oil at calibration temperature (constant in range: +21 to +33 °C (+70 to +91 °F)). The application range can be extended by a filling oil with a lower expansion coefficient and a shorter capillary.

For example, the filling oil expands in the event of a temperature increase. The additional volume presses against the process isolating diaphragm of a diaphragm seal. The stiffer a process isolating diaphragm is, the greater its return force, which counteracts a volume change and acts on the measuring cell together with the operating pressure, thus shifting the zero point.

Differential pressure transmitter

The differential pressure transmitter influences the temperature operating range, the TK zero point and the response time as a result of the volume of its side flange and as a result of its volume change. The volume change is the volume that has to be shifted to pass through the complete measuring range.

Differential pressure transmitters from Endress+Hauser are optimized with regard to the minimum volume change and side flange.

Diaphragm seal filling oils

Filling oil	Permissible temperature range [1] at 0.05 bar (0.725 psi) ≤ p_{abs} ≤ 1 bar (14.5 psi)	Permitted temperature range [1] at p_{abs} ≥1 bar (14.5 psi)	Option [2]
Silicone oil	−40 to +180 °C (−40 to +356 °F)	−40 to +250 °C (−40 to +482 °F)	FMD77: A FMD78: A, 1
High-temperature oil	−10 to +200 °C (+14 to +392 °F)	−10 to +400 °C (+14 to +752 °F) [3) 4) 5)]	FMD77: V FMD78: C, 3
Inert oil	−40 to +80 °C (−40 to +176 °F)	−40 to +175 °C (−40 to +347 °F)	FMD77: F FMD78: D, 4
Vegetable oil	−10 to +120 °C (+14 to +248 °F)	−10 to +200 °C (+14 to +392 °F)	FMD77: D FMD78: B, 2
Low-temperature oil	−70 to +80 °C (−94 to +176 °F)	−70 to +180 °C (−94 to +356 °F)	FMD77: L FMD78: E, 5

1) Observe temperature limits of the device and of the system
2) Product Configurator, “Fill fluid” ordering feature
3) 325 °C (617 °F) at ≥1 bar (14.5 psi)absolute pressure.
4) 350 °C (662 °F) at ≥1 bar (14.5 psi) absolute pressure (max. 200 hours).
5) 400 °C (752 °F) at ≥1 bar (14.5 psi) absolute pressure (max. 10 hours).

Additional data:

Filling oil	Density [g/cm3] / [SGU]	Viscosity [mm²/s] / [cSt] at 25 °C (77 °F)	Expansion coefficient [1] [1/K]	Notes [2]	Option [3]
Silicone oil	0.96	100	0.00096	suitable for foods FDA 21 CFR 175.105	FMD77: A FMD78: A, 1
High-temperature oil	1.00	150	0.00096	High temperatures	FMD77: V FMD78: C, 3
Inert oil	1.87	27	0.000876	For ultrapure gas and oxygen applications	FMD77: F FMD78: D, 4
Vegetable oil	0.94	9.5	0.00101	suitable for foods FDA 21 CFR 172.856	FMD77: D FMD78: B, 2
Low-temperature oil	0.92	4.4	0.00108	Low temperatures	FMD77: L FMD78: E, 5

1) The thermal change in the diaphragm seal and other important technical features can be found in the "Applicator Sizing Diaphragm Seal" selection tool.
2) Only select FDA-approved filling oils for diaphragm seal devices with 3-A and EHEDG certification!
3) Product Configurator, “Fill fluid” ordering feature

Operating temperature range

The operating temperature range of a diaphragm seal system depends on the fill fluid, capillary length and internal diameter, process temperature and oil volume of the diaphragm seal.

The application range can be extended by using a filling oil with a smaller expansion coefficient and a shorter capillary.

Response time

The viscosity of the filling oil, the capillary length and the capillary internal diameter influence the frictional resistance. The greater the frictional resistance, the longer the response time. Furthermore, the volume change of the measuring cell influences the response time. The lower the volume change of the measuring cell, the less filling oil has to be shifted in the diaphragm seal system.

To help you select the right diaphragm seal systems for your particular applications, Endress+Hauser provides its customers with the "Applicator Sizing Diaphragm Seal" selection tool, which is available free of charge at "www.endress.com/applicator" or can be ordered on a DVD.

Information on cleaning

Endress+Hauser provides flushing rings as an accessory to enable cleaning of the process isolating diaphragm without removing the transmitter from the process.

For further information please contact your local Endress+Hauser Sales Center.

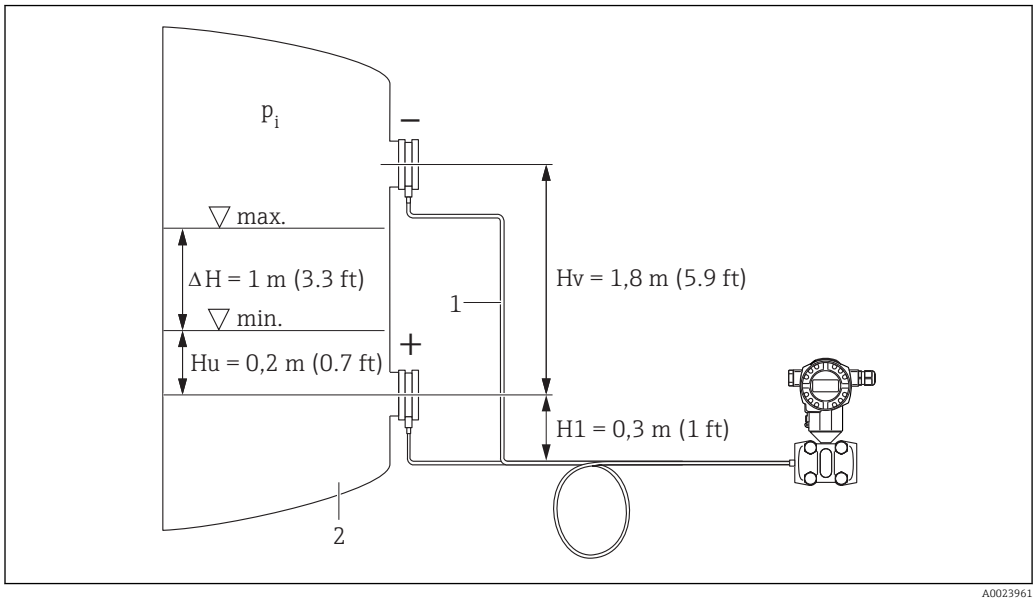
We recommend you perform CIP (cleaning in place (hot water)) before SIP (sterilization in place (steam)) for pipe diaphragm seals. A frequent use of sterilization in place (SIP) will increase the stress on the process isolating diaphragm. Under unfavorable circumstances in the long term view we cannot exclude that a frequent temperature change could lead to a material fatigue of the process isolating diaphragm and possibly to a leakage.

Installation instructions

Diaphragm seal systems

- The diaphragm seal together with the transmitter form a closed, calibrated system, which is filled through ports in the diaphragm seal and in the measuring system of the transmitter. These ports are sealed and must not be opened.
- In the case of devices with diaphragm seals and capillaries, the zero point shift caused by the hydrostatic pressure of the filling liquid column in the capillaries must be taken into account when selecting the measuring cell. If a measuring cell with a small measuring range is selected, the sensor nominal range can be overdriven as a result of position adjustment (see the figure and the example below).
- For devices with a capillary a suitable fastening device (mounting bracket) is recommended.
- When mounting, sufficient strain relief must be provided for the capillary line to prevent the capillary from bending (capillary bending radius ≥ 100 mm (3.94 in)
- For more detailed installation instructions, Endress+Hauser provides its customers with the free "Applicator Sizing Diaphragm Seal" selection tool, which is available online at "www.endress.com/applicator" or as a download.

Selecting the measuring cell (observe the hydrostatic pressure of the filling liquid column in the capillaries!)



1 *Capillary with silicone oil: ρ_{FI} = 0.96 kg (2.12 lb) dm³*

2 *Vessel with water: ρ_M = 1.0 kg (2.21 lb) dm³*

Pressure on the negative side of the differential pressure transmitter (p−) when the container is empty (minimum level):

$$p_{-} = p_{HV} + p_{H1} = Hv \cdot \rho_{FI} \cdot g + H1 \cdot \rho_{FI} \cdot g + p_i$$
$$= 1{,}8\ \text{m} \cdot 0{,}96 \frac{\text{kg}}{\text{dm}^3} \cdot 9{,}81 \frac{\text{m}}{\text{s}^2} + 0{,}3\ \text{m} \cdot 0{,}96 \frac{\text{kg}}{\text{dm}^3} \cdot 9{,}81 \frac{\text{m}}{\text{s}^2} + p_i$$
$$= 197{,}77\ \text{mbar} + p_i$$

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Pressure on the positive side of the differential pressure transmitter (p+) when the container is empty (minimum level):

$$p_{+} = p_{HU} + p_{H1} = Hu \cdot \rho_{M} \cdot g + H1 \cdot \rho_{FI} \cdot g + p_i$$
$$= 0{,}2\ \text{m} \cdot 1 \frac{\text{kg}}{\text{dm}^3} \cdot 9{,}81 \frac{\text{m}}{\text{s}^2} + 0{,}3\ \text{m} \cdot 0{,}96 \frac{\text{kg}}{\text{dm}^3} \cdot 9{,}81 \frac{\text{m}}{\text{s}^2} + p_i$$
$$= 47{,}87\ \text{mbar} + p_i$$

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Differential pressure at the transmitter ($\Delta p_{transmitter}$) when the container is empty:

$$\Delta p_{Transmitter} = p_{+} - p_{-}$$
$$= 47{,}87\ \text{mbar} - 197{,}77\ \text{mbar}$$
$$= -149{,}9\ \text{mbar}$$

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Result:

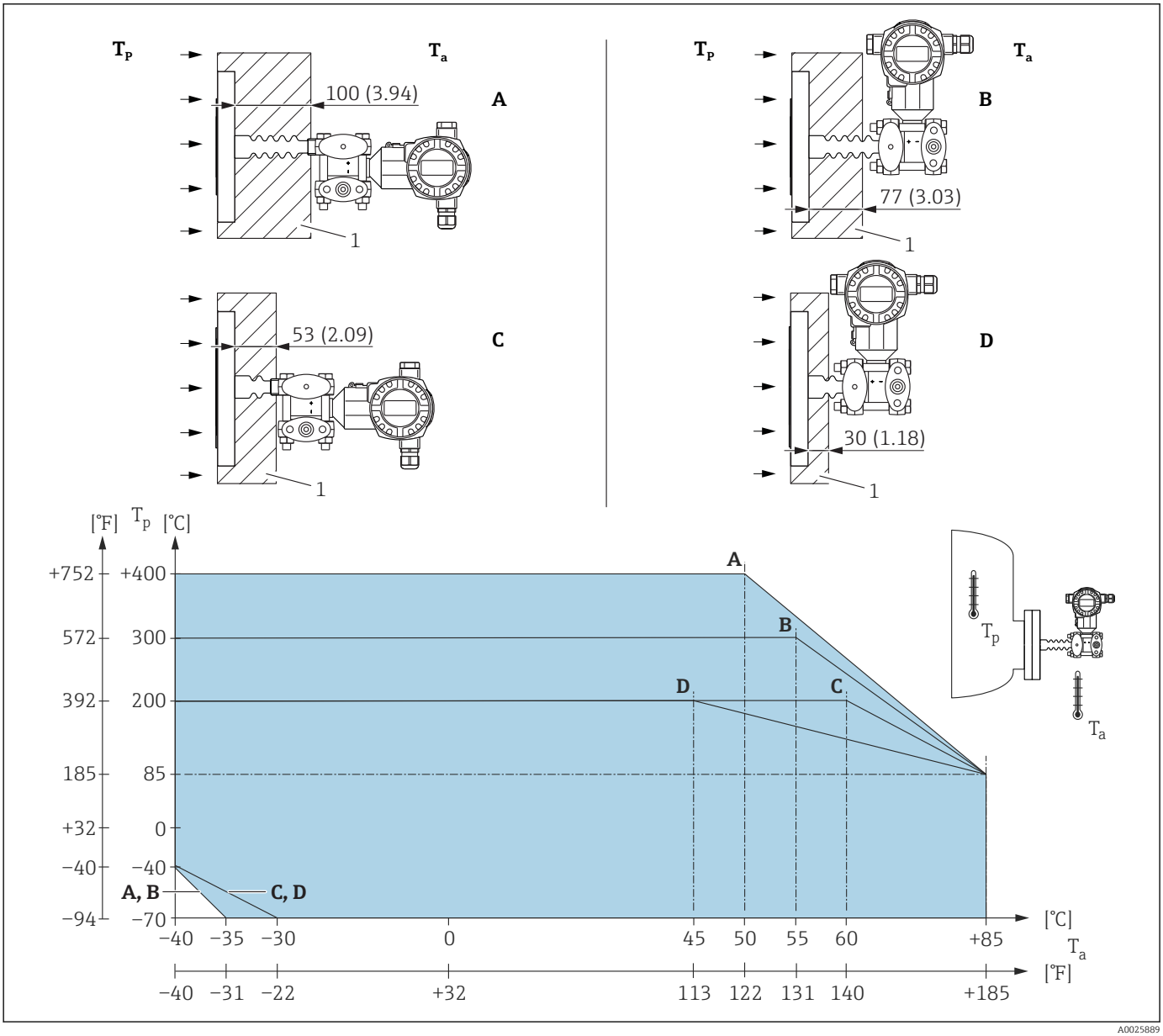
When the vessel is full, a differential pressure of −51.80 mbar (−0.762 psi) is present at the differential pressure transmitter. When the vessel is empty, a differential pressure of −149.90 mbar (−2.2485 psi) is present. A 500 mbar (7.5 psi)measuring cell is therefore necessary for this application.

Capillary

In order to obtain more precise measurement results and to avoid a defect in the device, mount the capillaries as follows:
- vibration-free (in order to avoid additional pressure fluctuations)
- not in the vicinity of heating or cooling lines
- insulate if the ambient temperature is below or above the reference temperature
- with a bending radius ≥ 100 mm (3.94 in)
- When using diaphragm seal systems with a capillary, sufficient strain relief must be provided to prevent the capillary from bending (capillary bending radius ≥ 100 mm (3.94 in)).
- In the case of devices with diaphragm seals and capillaries, the zero point shift caused by the hydrostatic pressure of the filling liquid column in the capillaries must be taken into account when selecting the measuring cell. If a measuring cell with a small measuring range is selected, a position adjustment can cause range violation.

Heat insulation – FMD77

The FMD77 must only be insulated up to a certain height. The maximum permitted insulation height applies to an insulation material with a heat conductivity ≤ 0.04 W/(m x K) and to the maximum permitted ambient and process temperature. The data were determined under the most critical application "quiescent air".

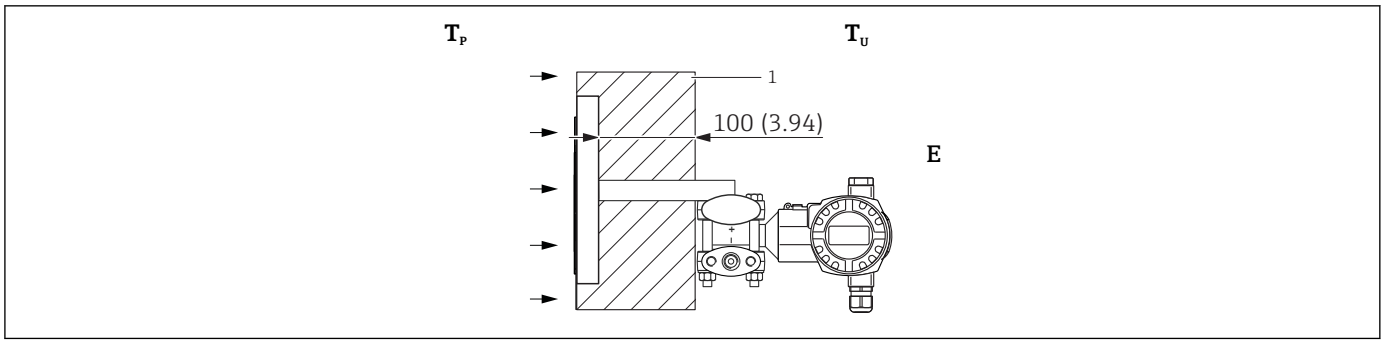


1 Insulation material

Without insulation, the ambient temperature decreases by 5 K.

Position	Design	Temperature isolator	Option [1]
A	Transmitter horizontal	long	MA [2]
B	Transmitter vertical	long	MB
C	Transmitter horizontal	short	MC
D	Transmitter vertical	short	MD

1) Product Configurator, order code for "Design; temperature isolator"
2) Standard



1 Insulation material

Position	Design	Ambient temperature T_U	Process temperature T_P	Option [1]
E	U-bracket, Transmitter horizontal (for devices which require a CRN approval)	≤ 70 °C (158 °F)	max. 350 °C (662 °F)depending on diaphragm seal filling oil used	[2]

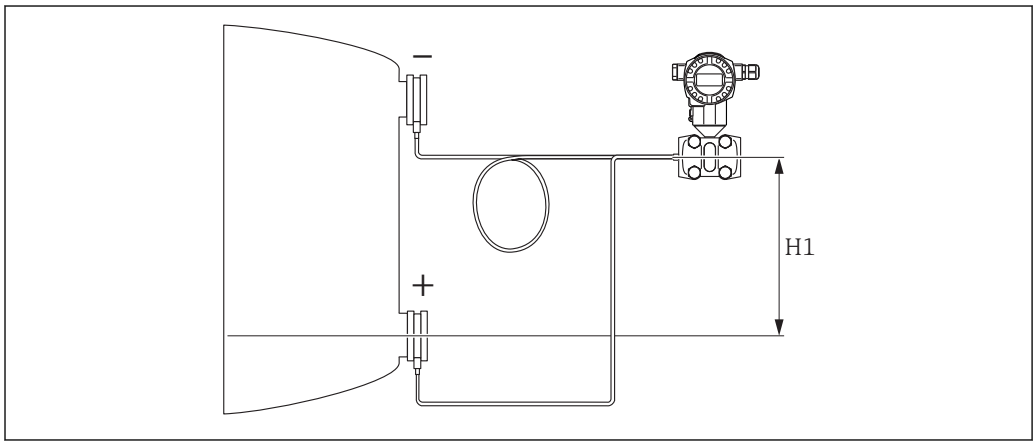
1) Product Configurator, "Process connection" ordering feature
2) In combination with CSA approval.

Vacuum applications

Installation instructions

For applications under vacuum, Endress+Hauser recommends mounting the pressure transmitter below the lower diaphragm seal. This prevents a vacuum load of the diaphragm seal caused by the presence of filling oil in the capillaries.

When the pressure transmitter is mounted above the lower diaphragm seal, the maximum height difference H1, in accordance with the following illustrations, must not be exceeded:



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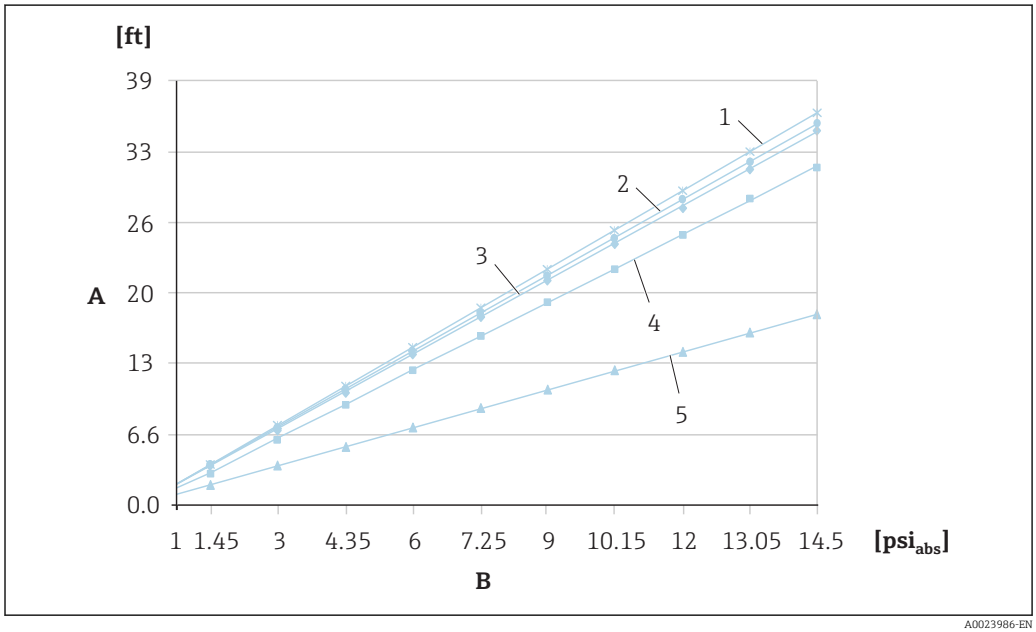
The maximum height difference is dependent on the density of the filling oil and the lowest pressure that is ever allowed to occur at the diaphragm seal on the positive side (empty container), see the following illustration:



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A Height difference H1
B Pressure at diaphragm seal
1 Low-temperature oil
2 Vegetable oil
3 Silicone oil
4 High-temperature oil
5 Inert oil

Certificates and approvals

CE mark

The device meets the legal requirements of the relevant EC directives. Endress+Hauser confirms that the device has been successfully tested by applying the CE mark.

RCM-Tick marking

The supplied product or measuring system meets the ACMA (Australian Communications and Media Authority) requirements for network integrity, interoperability, performance characteristics as well as health and safety regulations. Here, especially the regulatory arrangements for electromagnetic compatibility are met. The products are labelled with the RCM- Tick marking on the name plate.

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Ex approvals

- ATEX
- FM
- CSA
- NEPSI
- IECEx
- GOST on request
- Also combinations of different approvals

All explosion protection data are given in separate documentation which is available upon request. The Ex documentation is supplied as standard with all Ex devices→ 113.

EAC conformity

The measuring system meets the legal requirements of the applicable EAC guidelines. These are listed in the corresponding EAC Declaration of Conformity together with the standards applied.

Endress+Hauser confirms successful testing of the device by affixing to it the EAC mark.

Suitable for hygiene applications

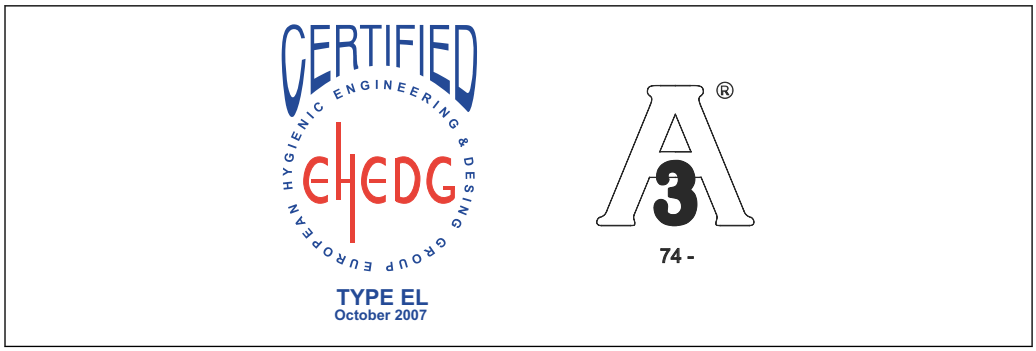
The device is available with hygienic process connections (overview: see order code). The materials of the hygienic process connections in contact with foodstuffs comply with framework Regulation (EC) 1935/2004.

⚠ CAUTION

Contamination in the process!

Risk of contamination if incorrect seals and parts are used!

- ▶ To avoid the risk of contamination, when installing the device comply with the design principles of EHEDG, Guideline 37 "Hygienic Design and Application of Sensors" and Guideline 16 "Hygienic Pipe Couplings".
- ▶ Suitable assemblies and seals must be used to ensure hygienic design in accordance with 3-A SSI and EHEDG specifications.
- ▶ The leak-proof connections can be cleaned with the cleaning methods typical of this industry (CIP and SIP). Attention must be paid to the pressure and temperature specifications of the sensor and process connections for CIP and SIP processes (clean in place/sterilize in place).
- ▶ For diaphragm seal devices with 3-A and EHEDG certificates, only select filling oils with FDA approval!



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The gap-free connections can be cleaned of all residue using the usual cleaning methods within this industry.

Functional safety SIL/ IEC 61508 Declaration of Conformity (optional)

The Deltabar S with 4 to 20 mA output signal has been developed in accordance with the IEC 61508 standard. The device can be used for flow, level and differential pressure monitoring up to SIL 3. For a detailed description of the safety functions with the Deltabar S, settings and functional safety data, see the "Functional safety manual - Deltabar S" SD00189P.

For devices up to SIL 3 / IEC 61508 Declarations of Conformity see:

Ordering information:

Product Configurator, order code for "Additional options 1", version "E"

Overfill protection

WHG (see document ZE00259P/00/EN)

Ordering information:

Product Configurator, order code for "Approval", option "6".

CRN approval

Some device versions have CRN approval. A CRN-approved process connection with a CSA approval must be ordered for a CRN-approved device. These devices are fitted with a separate nameplate with the registration number CRN 0F10524.5C .

Ordering information:

Product Configurator, order code for "Process connection; material" and

Product Configurator, order code for "Approval" (only in conjunction with an approved process connection)

Other standards and guidelines

The applicable European guidelines and standards can be found in the relevant EU Declarations of Conformity. The following were also applied:

DIN EN 60770 (IEC 60770):

Transmitters for use in industrial-process control systems. Part 1: Methods for operating performance evaluation

DIN 16086:

Electrical pressure measuring instruments, pressure sensors, pressure transmitters, pressure measuring instruments, concepts, specifications on data sheets

EN 61326-X:

EMC product family standard for electrical equipment for measurement, control and laboratory use.

EN 60529:

Degrees of protection provided by enclosures (IP code)

Pressure Equipment Directive 2014/68/EU (PED)

Pressure equipment with allowable pressure ≤ 200 bar (2 900 psi)

Pressure equipment (having a maximum allowable pressure PS ≤ 200 bar (2 900 psi)) can be classified as pressurized equipment in accordance with Pressure Equipment Directive 2014/68/EU. If the maximum allowable pressure is ≤ 200 bar (2 900 psi) and the pressurized volume of the pressure

equipment is ≤ 0.1 l, the pressure equipment is subject to the Pressure Equipment Directive (cf. Pressure Equipment Directive 2014/68/EU, Article 4, point 3). The Pressure Equipment Directive only requires that the pressure equipment shall be designed and manufactured in accordance with the "sound engineering practice of a Member State".

Reasons:

- Pressure Equipment Directive (PED) 2014/68/EU Article 4, point 3
- Pressure equipment directive 2014/68/EU, Commission's Working Group "Pressure", Guideline A-05 + A-06

Note:

A partial examination shall be performed for pressure instruments that are part of safety equipment for the protection of a pipe or vessel from exceeding allowable limits (equipment with safety function in accordance with Pressure Equipment Directive 2014/68/EU, Article 2, point 4).

Pressure equipment with allowable pressure > 200 bar (2 900 psi)

Pressure equipment designated for application in every process fluid having a pressurized volume of <0.1 l and a max. allowable pressure PS > 200 bar (2 900 psi) shall satisfy the essential safety requirements set out in Annex I of the Pressure Equipment Directive 2014/68/EU. According to Article 13 pressure equipment shall be classified by category in accordance with Annex II. The conformity assessment of the pressure equipment shall be determined by the category I under consideration of the above-mentioned low pressurized volume. These devices shall be provided with CE marking.

Reasons:

- Pressure Equipment Directive 2014/68/EU, Article 13, Annex II
- Pressure equipment directive 2014/68/EU, Commission's Working Group "Pressure", Guideline A-05

Note:

A partial examination shall be performed for pressure instruments that are part of safety equipment for the protection of a pipe or vessel from exceeding allowable limits (equipment with safety function in accordance with Pressure Equipment Directive 2014/68/EU, Article 2, point 4).

The following also applies:

- FMD78 with pipe diaphragm seal ≥ 1.5"/PN40:
  Suitable for stable gases in group 1, category II, module A2
- PMD75, PN 420
  Suitable for stable gases in group 1, category I, module A

Manufacturer declarations

Depending on the desired configuration, the following documents can be ordered additionally with the device:

- FDA conformity
- TSE-free: materials free from animal origin
- Regulation (EC) No. 2023/2006 (GMP)
- Regulation (EC) No. 1935/2004 on materials and articles intended to come into contact with food

Downloading the Declaration of Conformity

http://www.endress.com/en/download

1. Select "Approvals & Certificates"
2. Select "Manufact. Declaration"
3. Enter the required product code
4. Click "Search"

The available downloads are displayed.

Marine approval

- GL: FMD78, PMD75
- ABS: FMD78, PMD75

Ordering information:

Product Configurator, order code for "Additional options 1" or "Additional options 2", version "S".

Classification of process sealing between electrical systems and (flammable or combustible) process fluids in accordance with ANSI/ISA 12.27.01

Endress+Hauser devices are designed in accordance with ANSI/ISA 12.27.01. allowing the user to waive the use and save the cost of installing external secondary process seals in the conduit as required by the process sealing sections of ANSI/NFPA 70 (NEC) and CSA 22.1 (CEC). These instruments comply with the North American installation practice and provide a very safe and cost-saving installation for pressurized applications with hazardous fluids. Please refer to the following table for the seal class assigned (single seal or dual seal):

Device	Approval	Single seal MWP
PMD75	CSA C/US IS, XP	420 bar (6 300 psi)
FMD77	CSA C/US IS, XP	160 bar (2 400 psi)
FMD78	CSA C/US IS, XP	160 bar (2 400 psi)

Further information can be found in the control drawings of the relevant devices.

Inspection certificate

Designation	FMD77	FMD78	PMD75	Option
3.1 Material documentation, wetted metal parts, EN10204-3.1 inspection certificate	✔	✔	✔	B [1) 4)]
Declaration of Conformity NACE MR0175, wetted metal parts	✔	✔	✔	C [1) 4)]
EN10204-3.1 material, NACE MR0175, wetted metal parts, inspection certificate	✔	✔	✔	D [1) 4)]
Individual test, test report	✔	✔	✔	3 [1) 2)]
Pressure test, internal procedure, test report	✔	✔	✔	4 [1) 2)]
EN10204-3.1 material wetted parts +Ra, Ra= surface roughness, dimensional check, inspection certificate	–	✔	–	6 [1) 2)]
Delta-Ferrit measurement, internal procedure, wetted metallic parts, inspection certificate	–	✔	–	8 [1) 2)]
3.1 Material documentation, wetted metal parts, EN10204-3.1 inspection certificate	✔	✔	✔	JA [3) 4)]
Declaration of Conformity NACE MR0175, wetted metal parts	✔	✔	✔	JB [3) 4)]

Designation	FMD77	FMD78	PMD75	Option
Declaration of Conformity NACE MR0103, wetted metal parts	✔	✔	✔	JE [3) 4)]
Helium leak test, internal procedure, inspection certificate	✔	✔	✔	KD [3)]
Pressure test, internal procedure, inspection certificate	✔	✔	✔	KE [3)]
PMI test (XRF), internal procedure, metal parts in contact with the medium	✔	✔	✔	KG [3)]
Welding documentation, wetted/pressurized seams	—	✔	—	KS

1) Product Configurator, order code for "Additional options 1"
2) Product Configurator, order code for "Additional options 2"
3) Product Configurator, order code for "Test, Certificate"
4) The choice of this feature for coated process isolating diaphragms/process connections refers to the metal base material.

Calibration

Designation	FMD77	FMD78	PMD75	Option [1)]
Nominal range; mbar/bar	✔	✔	✔	1
Nominal range; kPa/MPa	✔	✔	✔	2
Nominal range; mmH2O/mH2O	✔	✔	✔	3
Nominal range; inH2O/ftH2O	✔	✔	✔	4
Nominal range; psi	✔	✔	✔	6
Factory calibration certificate, 5-point; see additional specification	✔	✔	✔	C
DKD/DAkkS certificate; see additional specification	✔	✔	✔	D
Customized pressure; see additional specification	✔	✔	✔	E
Customized level; see additional specification	✔	✔	✔	F
Customized flow; see additional specification	–	–	✔	G
Customized pressure + 5-point factory calibration certificate; see additional specification	✔	✔	✔	H
Customized level + 5-point factory calibration certificate; see additional specification	✔	✔	✔	I
Customized flow + 5-point factory calibration certificate; see additional specification	✔	✔	✔	J
Platinum; see additional specification	–	–	✔	K
Platinum + factory calibration certificate 5-point; see additional specification	–	–	✔	L
Platinum + DKD/DAkkS certificate; see additional specification	–	–	✔	M

1) Product Configurator, order code for "Calibration; unit"

Service

Designation	Option [1)]
Cleaned of oil+grease [2)]	HA
Cleaned for oxygen service [2)]	HB
Cleaned of PWIS (paint-wetting impairment substances) [2)]	HC

1) Product Configurator, order code for "Service"
2) Device only, not accessories or enclosed accessories.

Ordering information

Detailed ordering information is available from the following sources:
- In the Product Configurator on the Endress+Hauser website: www.endress.com -> Click "Corporate" -> Select your country -> Click "Products" -> Select the product using the filters and search field -> Open product page -> The "Configure" button to the right of the product image opens the Product Configurator.
- From your Endress+Hauser Sales Center: www.addresses.endress.com

Product Configurator - the tool for individual product configuration
- Up-to-the-minute configuration data
- Depending on the device: Direct input of measuring point-specific information such as measuring range or operating language
- Automatic verification of exclusion criteria
- Automatic creation of the order code and its breakdown in PDF or Excel output format
- Ability to order directly from the Endress+Hauser Online Shop

Scope of delivery

- Measuring device
- Optional accessories
- Brief Operating Instructions
- Certificates of calibration
- Optional certificates

Measuring point (TAG)

Ordering feature	895: Marking
Option	Z1: Tagging (TAG), see additional spec.
Position of the measuring point marking	To be selected in the additional specifications: ▪ Tag plate Stainless Steel ▪ Self-adhesive paper label ▪ Supplied label/plate ▪ RFID TAG ▪ RFID TAG + Tag plate Stainless Steel ▪ RFID TAG + Self-adhesive paper label ▪ RFID TAG + Supplied label/plate
Definition of the measuring point designation	To be defined in the additional specifications: 3 lines containing up to 18 characters each The measuring point designation appears on the selected label and/or the RFID TAG.
Identification on electronic nameplate (ENP)	32 characters

Configuration data sheet

Pressure

The following configuration data sheet must be completed and included with the order if the option "E" or "H" has been selected in the Product Configurator, order code for "Calibration; Unit".

Pressure unit

❑ mbar	❑ mmH_2O [1]	❑ mmHg [2]	❑ Pascal	❑ torr
❑ bar	❑ mH_2O [1]	❑ inHg [2]	❑ hPa	❑ g/cm^2
❑ psi	❑ ftH_2O [1]	❑ gf/cm^2	❑ kPa	❑ kg/cm^2
	❑ inH_2O [1]	❑ kgf/cm^2	❑ MPa	❑ lb/ft^2
				❑ atm

1) The conversion factor for the pressure unit is based on a reference temperature of 4 °C (39.2 °F).
2) The conversion factor of the pressure unit refers to a reference temperature of 0 °C (32 °F).

Calibration range / Output

Lower range value (LRV): _____ [pressure unit]
Upper range value (URV): _____ [pressure unit]

Display

Display of the content of the main line (option depends on sensor and communication variant)

- ❑ Primary value [PV] (default)
- ❑ Primary value [%]
- ❑ Pressure
- ❑ Current [mA] (HART only)
- ❑ Temperature
- ❑ Error number
- ❑ Alternating display

Damping

Damping: _____ sec (Default 2 sec)

Smallest span (factory calibration) → 🖹 12

Level

The following configuration data sheet must be completed and included with the order if the option "F" or "T" has been selected in the Product Configurator, order code for "Calibration; Unit".

Pressure unit

- ❑ mbar
- ❑ bar
- ❑ psi
- ❑ mmH_2O [1]
- ❑ mH_2O [1]
- ❑ ftH_2O [1]
- ❑ inH_2O [1]
- ❑ mmHg [2]
- ❑ inHg [2]
- ❑ gf/cm^2
- ❑ kgf/cm^2
- ❑ Pascal
- ❑ hPa
- ❑ kPa
- ❑ MPa
- ❑ torr
- ❑ g/cm^2
- ❑ kg/cm^2
- ❑ lb/ft^2
- ❑ atm

Output unit (scaled unit)

Mass	Lengths	Volume	Volume	Percent
❑ kg	❑ m	❑ l	❑ USgal	❑ %
❑ t	❑ dm	❑ hl	❑ impgal	
❑ lb	❑ cm	❑ m^3	❑ USbblPE TR	
	❑ mm	❑ ft^3		
	❑ ft			
	❑ inch			

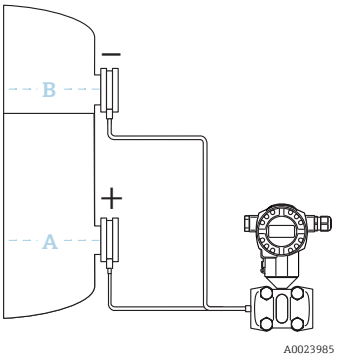
Empty calibration [a]: Low pressure value (empty) _____ [pressure unit]

Empty calibration [a]: Low measured value (empty) _____ [Scaled unit]

Full calibration [b]: High pressure value (full) _____ [pressure unit]

Full calibration [b]: High level value (full) _____ [Scaled unit]

Example



A *500 mbar (7.25 psi) / 100 m^3*
B *50 mbar (1 psi) / 3 m^3*

1) The conversion factor for the pressure unit is based on a reference temperature of 4 °C (39.2 °F).
2) The conversion factor of the pressure unit refers to a reference temperature of 0 °C (32 °F).

Display

Display of the content of the main line (option depends on sensor and communication variant)

- ❑ Primary value [PV] (default)
- ❑ Primary value [%]
- ❑ Pressure
- ❑ Current [mA] (HART only)
- ❑ Temperature
- ❑ Level before lin.
- ❑ Tank content
- ❑ Error number
- ❑ Alternating display

Damping

Damping: _____ sec (Default 2 sec)

Flow

The following configuration data sheet must be completed and included with the order if the option "G" or the option "J" has been selected in the Product Configurator for the "Calibration; Unit" order code.

Pressure unit

- ❑ mbar
- ❑ bar
- ❑ psi
- ❑ mmH_2O [1]
- ❑ mH_2O
- ❑ ftH_2O
- ❑ inH_2O
- ❑ mmHg [2]
- ❑ inHg
- ❑ gf/cm^2
- ❑ kgf/cm^2
- ❑ Pascal
- ❑ hPa
- ❑ kPa
- ❑ MPa
- ❑ torr
- ❑ g/cm^2
- ❑ kg/cm^2
- ❑ lb/ft^2
- ❑ atm

Flow Unit / Measured Value (PV)

Mass	Volume Operating conditions	Volume Standard conditions	Volume Standard Condition
❑ kg/s	❑ m^3/s	❑ Nm^3/s	❑ Sm^3/s
❑ kg/min	❑ m^3/min	❑ Nm^3/m	❑ Sm^3/min
❑ kg/h	❑ m^3/h	❑ in	❑ Sm^3/h
❑ t/s	❑ l/s	❑ Nm^3/h	❑ Sm^3/d
❑ t/min	❑ l/min	❑ Nm^3/d	❑ Scf/s
❑ t/h	❑ l/h		❑ Scf/min
❑ oz/s	❑ US Gal/s		❑ Scf/h
❑ oz/min	❑ US Gal/min		❑ Scf/d
❑ lb/s	❑ US Gal/h		
❑ lb/min	❑ ACFS		
❑ lb/h	❑ ACFM		
	❑ ACFH		

1) The conversion factor for the pressure unit is based on a reference temperature of 4 °C (39.2 °F).
2) The conversion factor of the pressure unit refers to a reference temperature of 0 °C (32 °F).

Output Characteristic

❑ linear (HART only)
Operating point

Maximum pressure	_____	[pressure unit]
Maximum flow rate	_____	[flow unit]
LRV	_____	[pressure unit]

(Lower Range Value (HART only))

❑ quadratic (HART only)
Operating point

Maximum pressure	_____	[pressure unit]
Maximum flow rate	_____	[flow unit]
LRV	_____	[pressure unit]

(Lower Range Value (HART only))

Low flow cut off

Value: _____ [%] (default = 5%)

Display

Display of the content of the main line (option depends on sensor and communication variant)

- ❑ Primary value [PV] (default)
- ❑ Primary value [%]
- ❑ Pressure
- ❑ Current [mA] (HART only)
- ❑ Temperature
- ❑ Flow
- ❑ Totalizer 1
- ❑ Totalizer 2
- ❑ Error number
- ❑ Alternating display

Damping

Damping: _____ sec (Default 2 sec)

Accessories

HistoROM®/M-DAT	The HistoROM®/M-DAT is a memory module that can be attached to any electronic insert. Ordering information: Product Configurator, order code for "Additional options 1" or Additional options 2", version "N" or as a separate accessory (part no.: 52027785).
Welding flanges and welding neck	For details, refer to TI00426F/00/EN "Weld-in adapters, process adapters and flanges".
Manifolds	See → 🖹 54. For further details, see SD01553P/00/EN "Mechanical accessories for pressure measuring devices".
Additional mechanical accessories	Oval flange adapters, pressure gauge valves, shutoff valves, siphons, condensate pots, cable shortening kits, adapter test, flushing rings, block&bleed valves, protective roofs. For details see SD01553P/00/EN "Mechanical accessories for pressure measuring devices".

Supplementary documentation

Field of Activities

Pressure measurement, powerful instruments for process pressure, differential pressure, level and flow:

FA00004P/00/EN

Technical Information

- Cerabar S: TI00383P/00/EN
- Deltapilot S: TI00416P/00/EN
- EMC test procedures: TI00241F/00/EN
- Weld-in adapters, process adapters and flanges: TI00426F/00/EN

Special Documentation

Mechanical accessories for pressure measuring devices: SD01553P/00/EN

Operating Instructions

4 to 20 mA HART:
- Deltabar S: BA00270P/00/EN
- Description of device functions Cerabar S/Deltabar S/Deltapilot S: BA00274P/00/EN

PROFIBUS PA:
- Deltabar S: BA00294P/00/EN
- Description of device functions Cerabar S/Deltabar S/Deltapilot S: BA00296P/00/EN

FOUNDATION Fieldbus:
- Deltabar S: BA00301P/00/EN
- Description of device functions Cerabar S/Deltabar S/Deltapilot S: BA00303P/00/EN

Brief Operating Instructions

- 4 to 20 mA HART, Deltabar S: KA01018P/00/EN
- PROFIBUS PA, Deltabar S: KA01021P/00/EN
- FOUNDATION Fieldbus, Deltabar S: KA01024P/00/EN

Functional safety manual (SIL)

Deltabar S (4 to 20 mA): SD00189P/00/EN

Overfill protection

WHG: ZE00259P/00/DE

Safety Instructions (XA)

Depending on the approval, the following Safety Instructions (XA) are supplied with the device. They are an integral part of the Operating Instructions.

Directive	Electronic insert	Documentation	Option [1]
ATEX II 1/2G Ex ia IIC T6 Ga/Gb (WHG)	4 to 20 mA HART, PROFIBUS PA, FOUNDATION Fieldbus	XA00235P	1 (6)
ATEX II 1/2D Ex ta/tb IIIC Da/Db	4 to 20 mA HART	XA00237P	2
	PROFIBUS PA, FOUNDATION Fieldbus	XA00280P	
ATEX II 1/3D Ex ta IIIC Da/Dc	4 to 20 mA HART	XA00239P	4
	PROFIBUS PA, FOUNDATION Fieldbus	XA00282P	
ATEX II 2 G Ex d IIC T6 Gb	4 to 20 mA HART, PROFIBUS PA, FOUNDATION Fieldbus	XA00240P	5
ATEX II 3 G Ex nA II T6	4 to 20 mA HART, PROFIBUS PA, FOUNDATION Fieldbus	XA00241P	7
ATEX II 1/2G Ex ia IIC T6 Ga/Gb + ATEX II 1/2D Ex ia IIIC Da/Db	4 to 20 mA HART, PROFIBUS PA, FOUNDATION Fieldbus	XA00243P	3
ATEX II 1G Ex ia + II 1D Ex iaD	4 to 20 mA HART, PROFIBUS PA, FOUNDATION Fieldbus	XA00275P	8
ATEX II 1/2G Ex ia IIC T6+II 2G Ex d IIC T6	4 to 20 mA HART, PROFIBUS PA, FOUNDATION Fieldbus	XA00242P	B
ATEX II Ex ia/Ex d + FM/CSA IS + XP ATEX II 1/2G Ex ia IIC T6+ ATEX II 2G Ex d IIC T6+FM/CSA IS + XP Cl.I.II Div.1 Gr.A-G/B-GFM/CSA: Zone 1,2	4 to 20 mA HART	XA00242P ZD00153P XA01196P	F

Directive	Electronic insert	Documentation	Option [1]
	PROFIBUS PA, FOUNDATION Fieldbus	XA00242P XA01198P ZD00191P	
IECEx Ex ia IIC T6 Ga/Gb	4 to 20 mA HART, PROFIBUS PA, FOUNDATION Fieldbus	XB00004P	I
IEC Ex d IIC T6 Gb	4 to 20 mA HART, PROFIBUS PA, FOUNDATION Fieldbus	XA00512P	M
NEPSI Ex ia IIC T6	4 to 20 mA HART, PROFIBUS PA, FOUNDATION Fieldbus	XA00550P	H
NEPSI Ex d IIC T6	4 to 20 mA HART, PROFIBUS PA, FOUNDATION Fieldbus	XA00552P	G

1) Product Configurator, order code for "Approval"

Directive	Electronic insert	Documentation	Option [1]
TIIS Ex do IIC T6	4 to 20 mA HART	TC18007 TC18008	L

1) Product Configurator, order code for "Approval"

Directive	Electronic insert	Documentation	Option [1]
INMETRO Ex ia IIC T6 Ga/Gb	4 to 20 mA HART, PROFIBUS PA, FOUNDATION Fieldbus	XA01318P	J
INMETRO Ex d IIC T6 Gb	4 to 20 mA HART, PROFIBUS PA, FOUNDATION Fieldbus	XA01281P	O
INMETRO Ex ta IIIC Da/Db	4 to 20 mA HART, PROFIBUS PA, FOUNDATION Fieldbus	XA01316P	Z

1) Product Configurator, order code for "Approval"

Installation/Control Drawings

Directive	Electronic insert	Documentation	Option [1]
FM IS Cl.I,II,III Div.1 Gr.A-G, NI Cl.I Div.2 Gr.A-D, AEx ia, Zone 0,1,2,20,21,22	4 to 20 mA HART	XA01058P	S
	PROFIBUS PA, FOUNDATION Fieldbus	XA01060P	
FM/CSA IS + XP Cl.I Div.1 Gr.A-D, FM/CSA: Zone 1,2	4 to 20 mA HART	XA00591P XA01196P	Q
	PROFIBUS PA, FOUNDATION Fieldbus	XA00590P XA01198P	
FM DIP Cl.II,III Div.1 Gr.E-G, Zone 21,22	4 to 20 mA HART, PROFIBUS PA, FOUNDATION Fieldbus	FM3017778	Q
CSA C/US IS Cl.I,II,III Div.1 Gr.A-G, Cl.I Div.2 Gr.A-D, Ex ia, C: Zone 0,1,2/ US: Zone 0,1,2,20,21,22	4 to 20 mA HART	ZD00142P	U
	PROFIBUS PA, FOUNDATION Fieldbus	ZD00189P	
FM IS + XP Cl.I Div.1 Gr.A-D, Zone 1,2	4 to 20 mA HART	XA01196P	C
	PROFIBUS PA, FOUNDATION Fieldbus	XA01198P	
FM NI Cl.I Div.2 Gr.A-D, Zone 2	4 to 20 mA HART, PROFIBUS PA, FOUNDATION Fieldbus	XA01064P	R
FM XP Cl.I Div.1 Gr.A-D, AEx d, Zone 1,2	4 to 20 mA HART, PROFIBUS PA, FOUNDATION Fieldbus	XA01071P	T
CSA C/US IS + XP Cl.I Div.1 Gr.A-D, Zone 1,2	4 to 20 mA HART	ZD00153P	D
	PROFIBUS PA, FOUNDATION Fieldbus	ZD00191P	
ATEX II Ex ia/Ex d + FM/CSA IS + XP ATEX II 1/2G Ex ia IIC T6+ ATEX II 2G Ex d IIC T6+FM/CSA IS + XP Cl.I.II Div.1 Gr.A-G/B-GFM/CSA: Zone 1,2	4 to 20 mA HART	XA00242P ZD00153P XA01196P	F

Directive	Electronic insert	Documentation	Option [1]
	PROFIBUS PA, FOUNDATION Fieldbus	XA00242P XA01198P ZD00191P	
CSA C/US XP Cl.I Div.1 Gr.B-D, Ex d, Zone 1,2	4 to 20 mA HART, PROFIBUS PA, FOUNDATION Fieldbus	ZD00229P	V
CSA C/US Cl.II, III Div.1 Gr.E-G	4 to 20 mA HART, PROFIBUS PA, FOUNDATION Fieldbus	CSA1509834	W
CSA C/US General Purpose	4 to 20 mA HART, PROFIBUS PA, FOUNDATION Fieldbus	-	Z

1) Product Configurator, order code for "Approval"

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