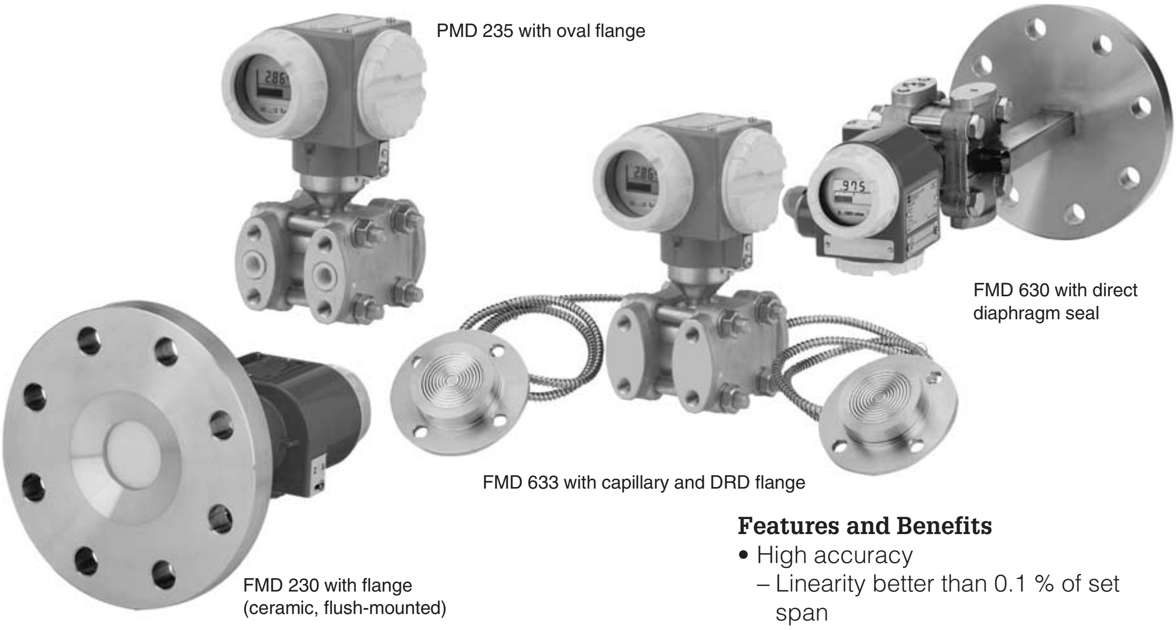
Technical
Information
TI 256P/00/en

Differential Pressure Transmitter
deltabar S PMD 230/235
deltabar S FMD 230/630/633

Deltabar S with ceramic and silicon sensors overload resistant with function monitoring Communication using HART, PROFIBUS-PA or Foundation Fieldbus



PMD 235 with oval flange

FMD 630 with direct diaphragm seal

FMD 633 with capillary and DRD flange

FMD 230 with flange (ceramic, flush-mounted)

Application
The Deltabar S transmitter is used for the following differential pressure measurement tasks:
- Flowrate (volumetric or mass flow) in connection with primary devices in gases, vapours and liquids
- Level, volume or mass flow measurement in liquids
- Differential pressure monitoring of filters and pumps

Features and Benefits
- High accuracy
  - Linearity better than 0.1 % of set span
  - With "platinum" version, linearity better than 0.05 % of set span
  - Long-term drift better than 0.1 % per year or 0.25 % per 5 years
- Process temperatures up to 120 °C as standard
- Universal modularity for differential pressure and process pressure (Deltabar S – Cerabar S), e.g.
  - Replaceable display
  - Sensor modules
  - Universal electronics for process pressure and differential pressure
- Simple and easy operation via 4…20 mA, HART protocol or connection to PROFIBUS-PA or Foundation Fieldbus
- Zero and span freely adjustable with or without referential pressure
- Self-monitoring from sensor to electronics
- Wide variety of software functions such as characteristic curves, diagnostic codes, totalizer etc.

Endress+Hauser
The Power of Know How

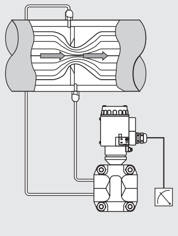
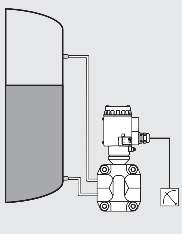
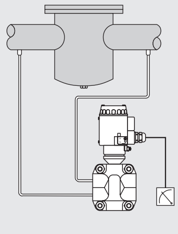
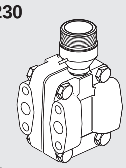
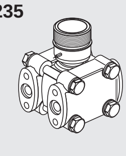
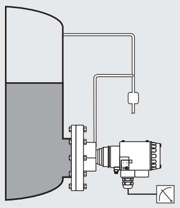
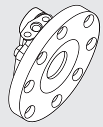
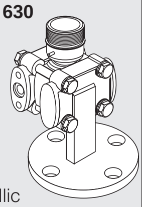
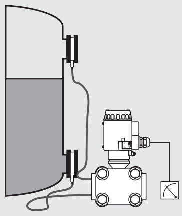
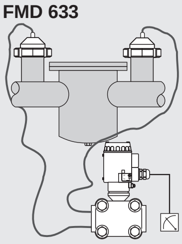
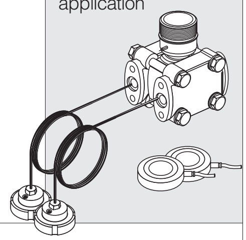
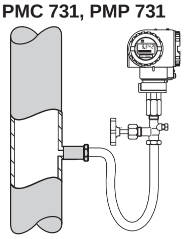
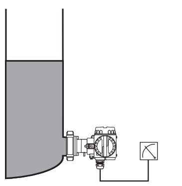
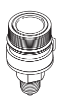
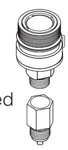
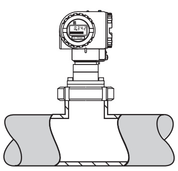
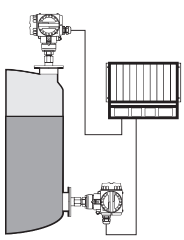
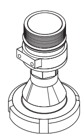
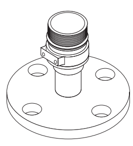
Selecting the Instrument

The Deltabar S is designed with replaceable modules and is based on the same construction principle as its "twin brother", the Cerabar S.
This has the following advantages:

- one electronics unit for all process pressure and differential pressure transmitters.
- Sensor modules and electronics can be replaced on site (autom. up-load).

The table below gives a complete summary of the Cerabar S/Deltabar S product family. Further information on instruments:

- in the grey fields is found in this Technical Information
- in the white fields is found in Technical Information TI 216P and TI 217P.

	Application				**Sensors**	
	Gauge and absolute pressure	**Flow (see also TI 297P "Deltatop/Deltaset")**	**Level**	**Differential pressure**	**Ceramic sensor** Differential pressure – 25 mbar: PN 10 – to 3 bar: PN 100	**Metallic sensor** Differential pressure – from 10 mbar: PN 160/PN 420 – to 40 bar: PN 420
Deltabar S **Oval flange**		**PMD 230, PMD 235** 	**PMD 230, PMD 235** 	**PMD 230, PMD 235** 	**PMD 230**  metal-free connection also available	**PMD 235**  Alloy diaphragm at no additional cost
Flange			**FMD 230, FMD 630** 		**FMD 230**  flush-mounted ceramic sensor, also metal-free connection available	**FMD 630**  metallic diaphragm with optional extension
Diaphragm seal with capillary extension			**FMD 633** 	**FMD 633** 		**FMD 633** including hygienic application 
					Gauge pressure – 5 mbar to 40 bar Absolute pressure – from 20 mbar to 40 bar	Gauge and absolute pressure – from 125 mbar to 400 bar
Cerabar S **threaded and flush-mounted process connection** **TI 216P**	**PMC 731, PMP 731** 		**PMC 731, PMP 731** 		**PMC 731**  including flush-mounted process connections	**PMP 731**  optional flush-mounted diaphragm or with internal diaphragm with adapter, also welded
Diaphragm seal **TI 217P**	**PMC 631, PMP 635** 		**PMC 631, PMP 635** 		**PMC 631** 	**PMP 635** 

Mechanical Construction

Modularity

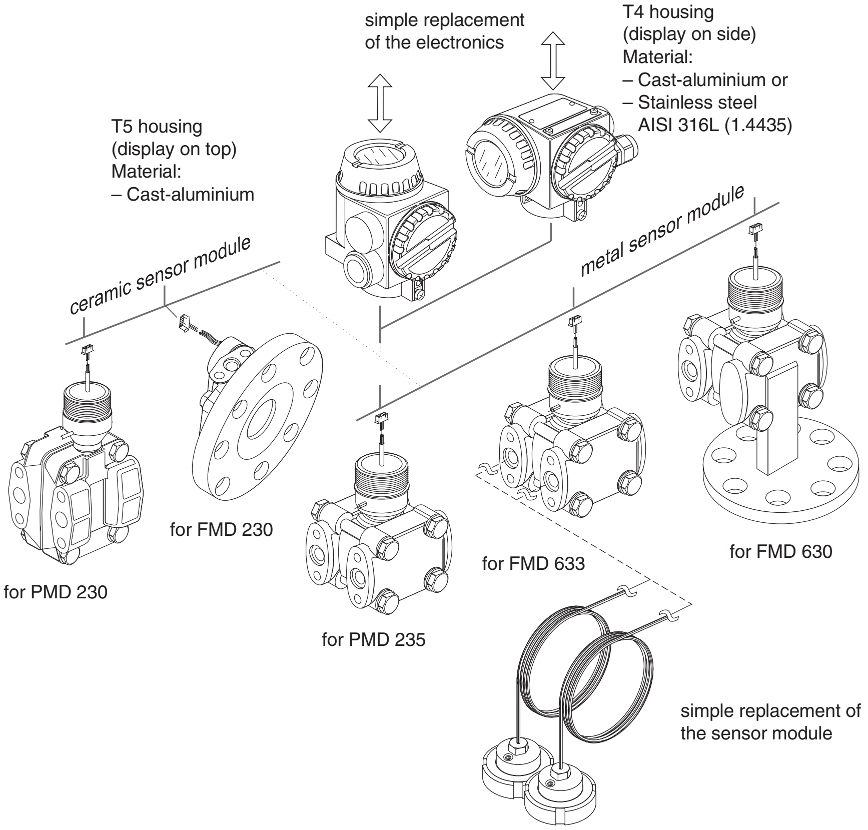
Both intelligent pressure transmitters from Endress+Hauser

- Deltabar S: differential pressure, level and flow measurement
- Cerabar S (TI 216P, TI 217P): gauge/absolute pressure measurement

offer optimum modularity for future product development.

Features include:

- interchangeable sensor module and process connections
- universal electronics for process pressure and differential pressure
- simple and uniform operation.



Interchangeable Sensor Modules

The sensor modules are fully calibrated for pressure and temperature in the factory. These data are stored in the sensor module. After replacing the module, the electronics automatically loaded into the electronics from the calibrated sensor module. The transmitter is then ready to measure without having to be recalibrated.

Display Module

A display module with the following features can be used for showing measured values and for simplifying local operation:

- Large four-character pressure display with bar graph showing current. For 4…20 mA instruments, the bar graph shows the actual current value and for fieldbus instruments, it displays the relationship between the current measured value and the set measuring range.
- The housing has both an isolated electronics compartment and an isolated connection compartment.

Housings

The following housings are available for the Deltabar S differential pressure transmitter:

- T5 for horizontal mounting and
- T4 for vertical mounting.

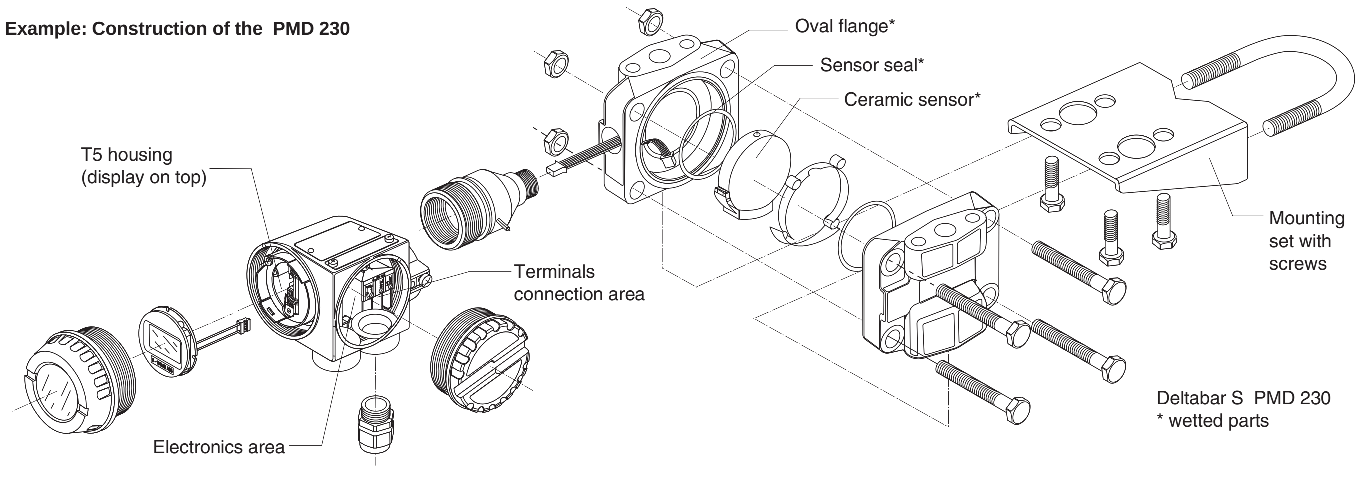
Both housings comply with the following requirements:

- protection IP 65/NEMA 4X
- separate electronics and terminal connection compartments
- easily accessible operating elements on the outside of the instrument
- optional M 20x1.5, ½ NPT or G ½
- PROFIBUS-PA M12-, FF 7/8"- or Harting Han7D plug
- Housing can be rotated by up to 330°.

Replaceable Process Connections

- The sensor seal and process connection of the Deltabar S can easily be replaced in just a few simple steps.
- Chemical resistance can be guaranteed by selecting suitable materials for the process connection.

Example: Construction of the PMD 230



Measuring System

System Components

The complete measuring system consists of:

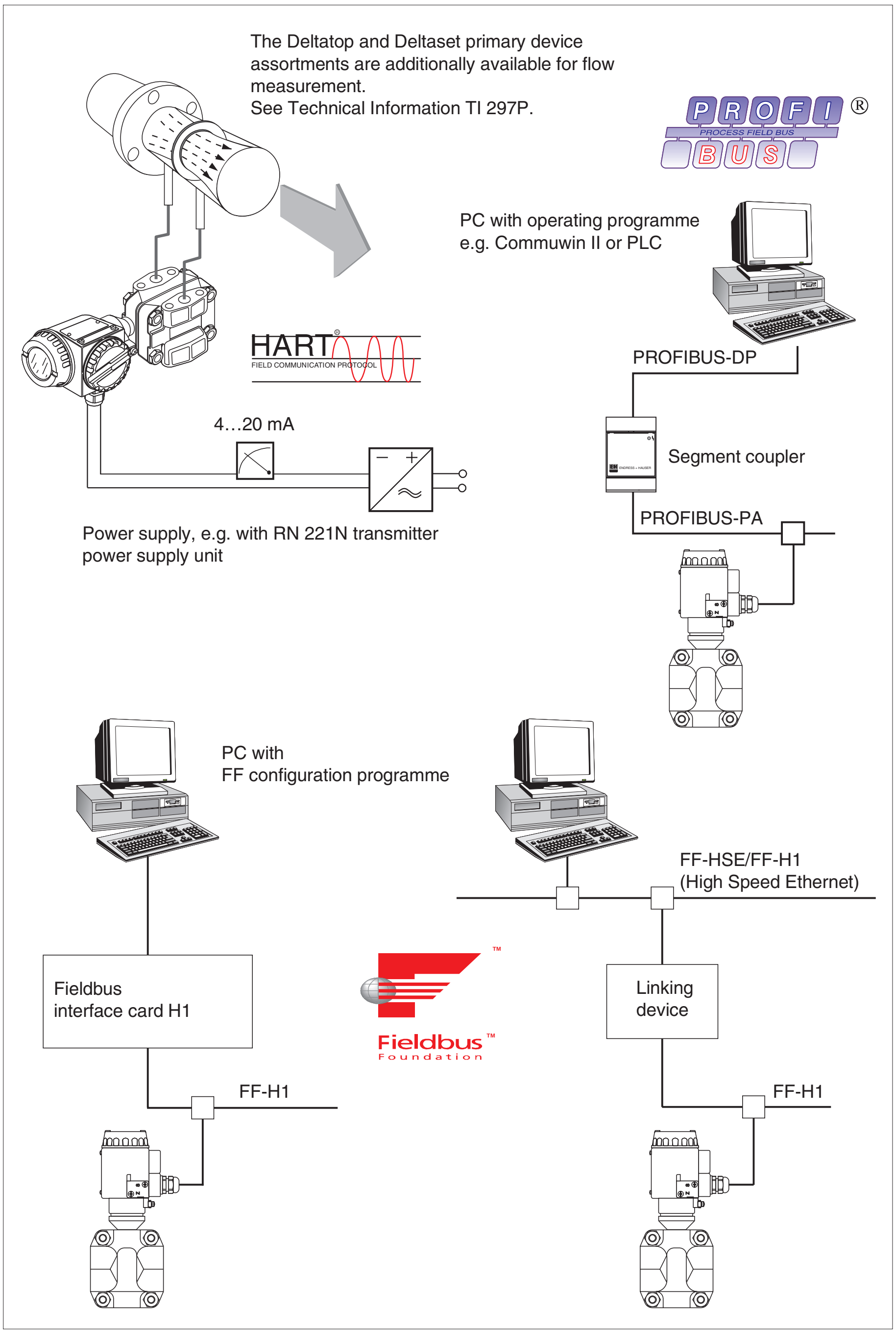
- Deltabar S differential pressure transmitter with
  - 4…20 mA signal output and **HART** communication protocol and
  - power supply e.g. with the RN 221N transmitter power supply unit from Endress+Hauser

or

- Deltabar S differential pressure transmitter with
  - **PROFIBUS-PA** digital communications signal and
  - PLC or PC with PROFIBUS interface card and operating programme, e.g. Endress+Hauser Commuwin II
  - segment coupler (DP/PA signal converter and bus power supply unit) and
  - PROFIBUS-PA termination-resistor

or

- Deltabar S differential pressure transmitter with
  - **Foundation Fieldbus** digital communications signal and
  - a PC with an FF configuration programme and interface card H1 or a PC with an FF configuration programme and a linking device FF-HSE/FF-H1.



Complete measuring system Deltabar S
- *left above:* Current output 4…20 mA with HART communication signal
- *right above:* PROFIBUS-PA see also Operation Page 7
- *below:* Foundation Fieldbus see also Operation Page 8

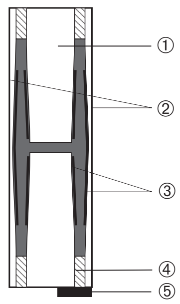
Operating Principle

Ceramic Sensor

The system pressure acts on the diaphragm of the sensor causing a displacement. This change in distance between the very finely drawn gold electrodes causes a change in capacitance on both sides.

Advantages:
- self-monitoring for diaphragm breakage or loss of fill fluid (continuous comparison of the measured temperature with that calculated from capacitance values)
- extremely high chemical resistance
- for use with vacuums down to 1 $mbar_{abs}$ (0.0145 psi_{abs})
- metal-free versions available

Ceramic sensor
25 mbar, 100 mbar, 500 mbar, 3bar
Deltabar S PMD 230, FMD 230



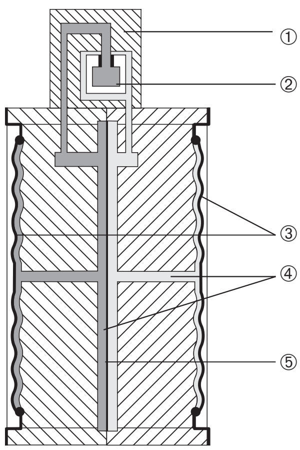
Ceramic sensor
① Basic body
② Diaphragm
③ Electrodes
④ Fritted glass
⑤ Temperature sensor

Metal Sensor

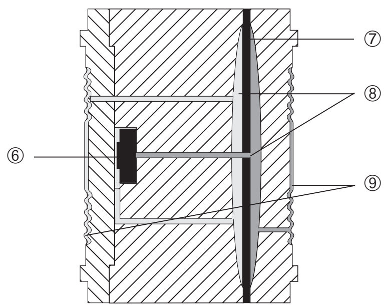
The separating diaphragm is deflected on both sides by the acting pressure with a fill fluid transmitting the pressure to a resistance bridge (semiconductor technology). The bridge output voltage, which is proportional to differential pressure, is then measured.

Advantages:
- standard system pressures: 160 bar (2320 psi) and 420 bar (6090 psi)
- excellent long-term stability
- guaranteed resistance to single-sided overload
- Alloy C diaphragm as standard at no extra cost
- welded stainless steel versions also available

Metal sensor 10 mbar, 40 mbar
Deltabar S PMD 235



Metal sensor 100 mbar, 500 mbar,
3 bar, 16 bar, 40 bar
Deltabar S PMD 235, FMD 630, FMD 633



Metal sensor
10 mbar, 40 mbar
① Measuring element
② Silicon diaphragm
③ Separating diaphragm as nap diaphragm extended
④ fill fluid
⑤ Integrated overload protection

Metal sensor
100 mbar, 500 mbar,
3 bar, 16 bar, 40 bar
⑥ Measuring element
⑦ Overload diaphragm
⑧ Fill fluid
⑨ Separating diaphragm as nap diaphragm extended

Operation

The Deltabar S can be operated in the following ways:
- Using the four keys on the instrument directly for calibrating zero point and span at the touch of a button.

or
- Operating remotely using intelligent HART data protocol
  - – e.g. via Commubox FXA 191 and a PC with the Endress+Hauser Commuwin II operating programme or
  - – via the handheld terminal HART Universal Communicator DXR 275

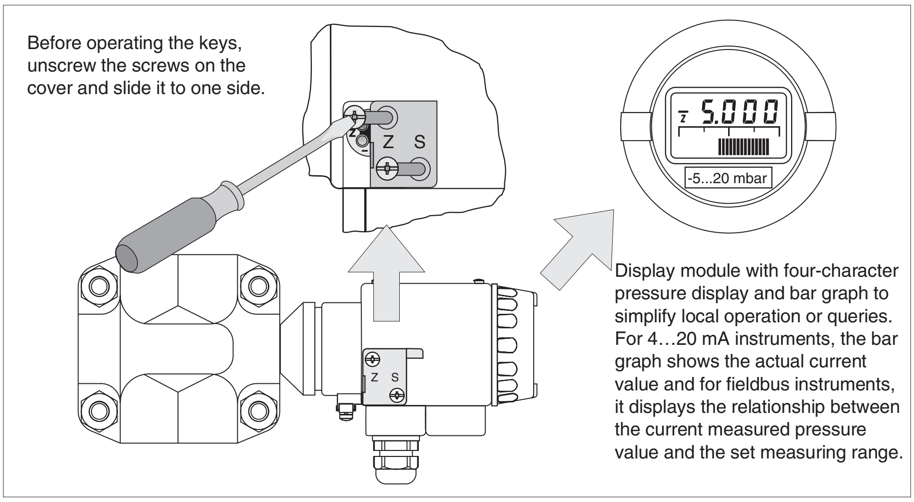
or
- Using segment couplers to connect the intrinsically-safe PROFIBUS-PA and PROFIBUS-DP fieldbus and operating the instrument via PC and Commuwin II operating programme

or
- Foundation Fieldbus H1: PC operation with configuration programme by means of interface card H1
- Foundation Fieldbus HSE: PC operation with configuration programme by means of linking device FF-HSE/FF-H1.

Operation Using Keys on the Instrument

The differential pressure for lower range-value (4 mA) and upper range-value (20 mA) output can either be taken directly from the system pressure or else calibrated without reference pressure.
- ZERO: +Z and –Z
- SPAN: +S and –S

A zero point shift due to the orientation of the instrument (bias pressure) can also be corrected using these keys as well as for locking and unlocking the measuring point.

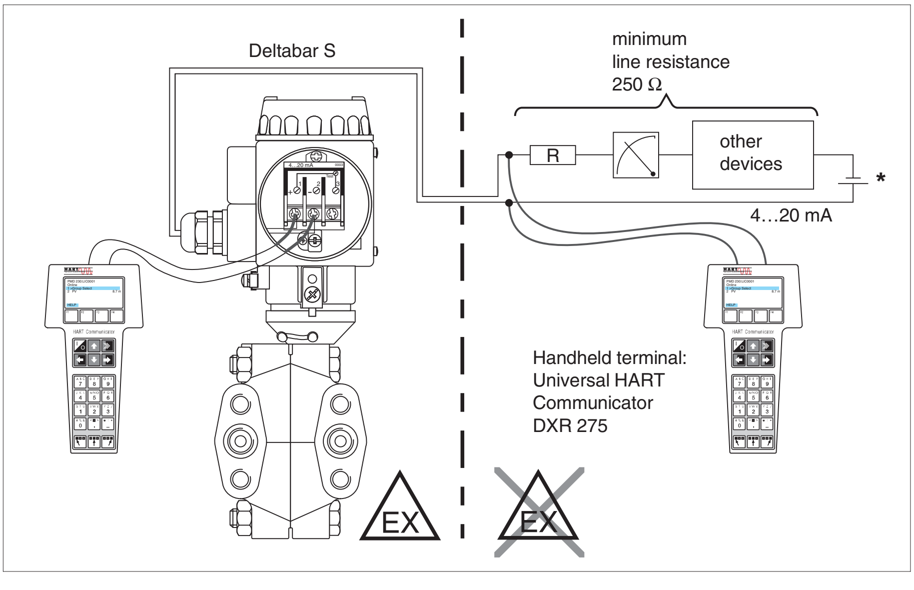


Operating using keys

When operating with keys, screw the cover securely with both screws after operation.

Operation Using Handheld Terminal

The Universal HART Communicator DXR 275 can be connected at any point along the 4…20 mA line to check, configure and read additional information (operating matrix, see Page 7).



The HART Communicator DXR 275 can be connected anywhere along the 4…20 mA line.

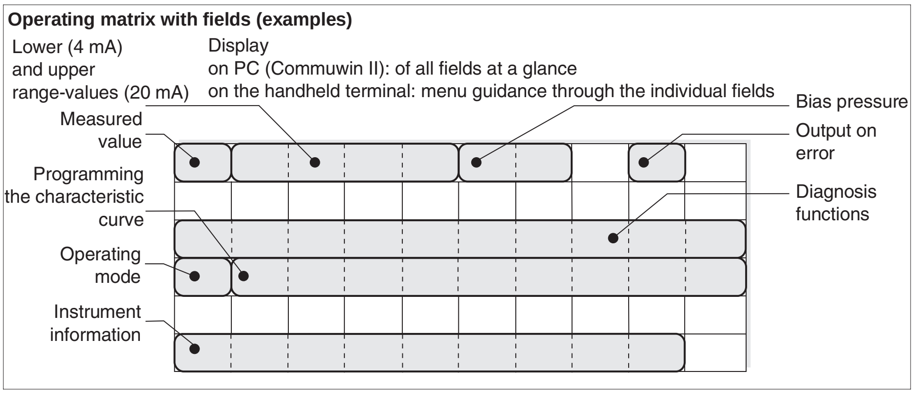
* Use an intrinsically safe power supply for Ex i.

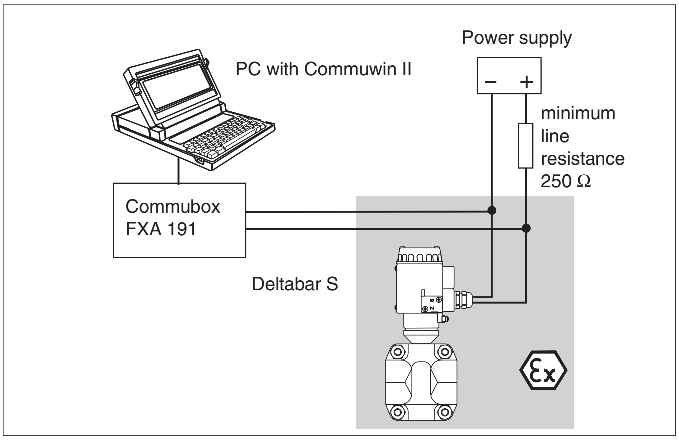
Operation (Continuation)

Operation Using the Matrix

All operations and functions are identical whether the Deltabar S is calibrated using a process bus and PC or a handheld terminal.

All information can easily be accessed using the operating matrix. Calibration is just as easy.





The Commubox can be connected anywhere along the 4…20 mA line.

Operation Using the Commubox FXA 191

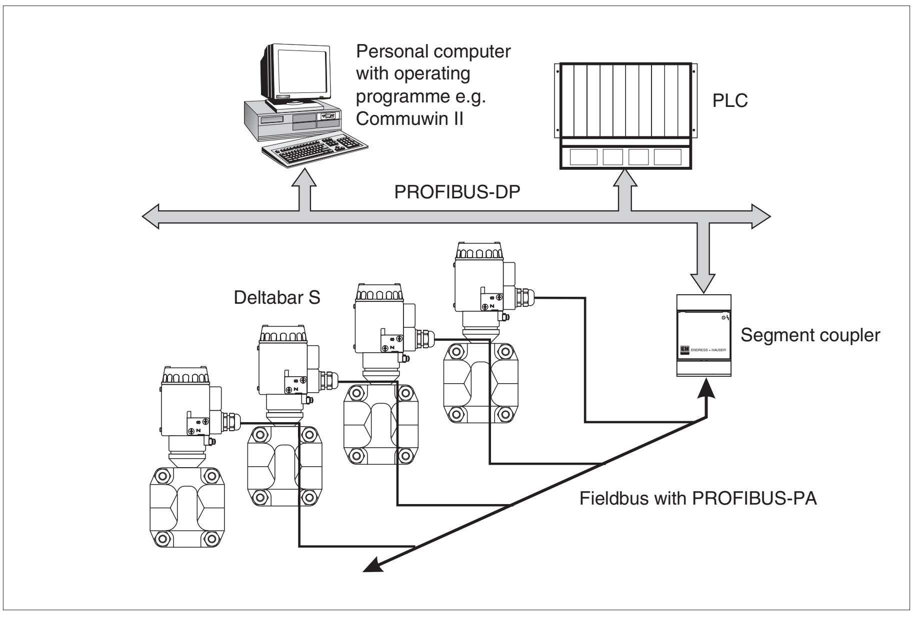
The Commubox FXA 191 connects 4…20 mA Smart transmitter that has a HART protocol to the RS 232 C serial interface of a personal computer. This enables the transmitter to be remotely operated with the Endress+Hauser Commuwin II operating programme. Commuwin II shows, for example, the operating matrix above for easy programming of the transmitter.
The Commubox FXA 191 is used for intrinsically safe signal circuits.

Connecting to PROFIBUS-PA

PROFIBUS-PA is an open fieldbus standard to enable several sensors and actuators, including those in explosion-hazardous areas, to be connected to a bus line. With PROFIBUS-PA, two-wire looped instruments can be supplied by the sensor with power and digital process information.

The number of instruments operated by one bus segment is:

- up to 10 instruments installed in accordance with FISCO for EEx ia, FM IS or CSA IS applications
- up to 32 instruments for all other applications (e.g. non-hazardous area, EEx nA).



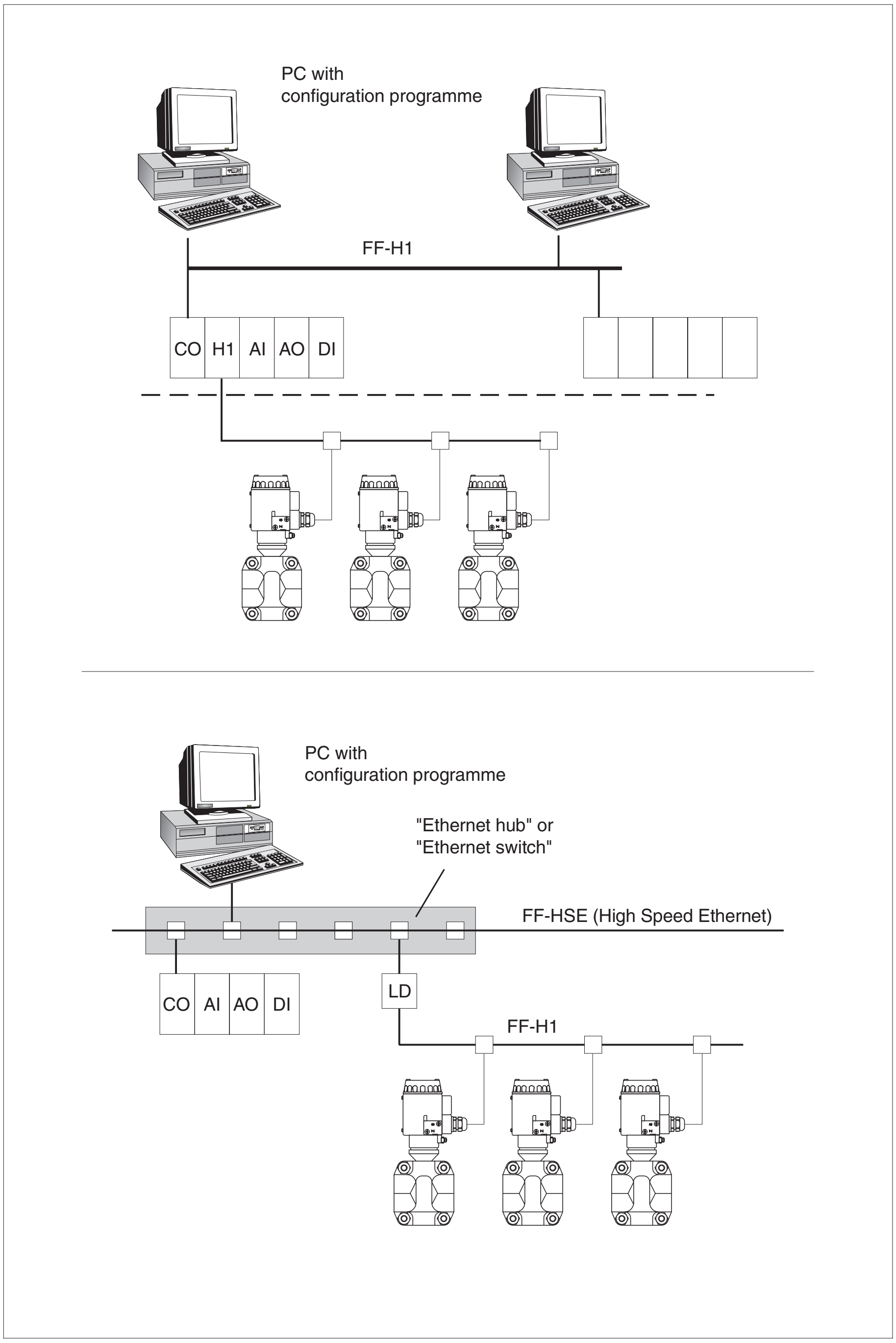
Deltabar S with PROFIBUS-PA

Operation (Continuation)

Connecting to Foundation Fieldbus

Foundation Fieldbus is an open fieldbus standard to enable several sensors and actuators, including those in explosion-hazardous areas, to be connected to a bus line. With Foundation Fieldbus, two-wire looped instruments can be supplied by the sensor with power and digital process information.

The following instruments can be operated via an interface card or via Link and an interface card:
- up to 9 instruments for EEx ia, FM IS or CSA IS applications
- up to 32 instruments for all other applications (e.g. non-hazardous area, EEx nA).



Deltabar S with Foundation Fieldbus

Above:
Connection via FF-H1 interface card
Below:
Connection via HSE (High Speed Ethernet)

AI: Analogue input
AO: Analogue output
CO: Controller
DI: Digital input
I/O: Input/Output
FC: Frequency converter
H1: H1 interface card
LD: Linking device

Installation for Flow Measurement

Flow Measurement

For flow measurement with primary elements, bluff bodies such as pitot tubes or orifice plates are installed in the piping. The primary elements create a differential pressure that is proportional to the volumetric or mass flow. The Deltabar S differential pressure transmitter measures the differential pressure and can display the volumetric or mass flow.

This measuring principle can be used anywhere:
- in gases, vapours and liquids
- for any nominal diameters (DN 4 … DN 12000)
- for circular and square pipe cross-sectional areas
- or flow rates with a dynamic range of 6:1 under constant conditions (p, T); (Dynamic range = ratio of maximum flow rate to minimum flow rate).

The "Totalizer" function, which adds up the volume or the mass, comes as standard in the Deltabar S software.

For further information about flow measurement with orifice plates or pitot tubes and Deltabar S differential pressure transmitters, see Technical Information TI 297P Deltatop and Deltaset.

Primary Elements

The following primary elements are standardised according to DIN ISO 5167 and DIN 1952:
- orifice plates
- nozzles
- venturi nozzles
- venturi pipes and others.

For standard nominal widths these sensor elements are used in applications on a case to case basis. Because dimensions are standard, no calibration of the entire flow measurement section is required. Calibrated measurement sections are used for nominal diameters outside the standard range.
The following conditions apply:
- static pressures up to 400 bar (5801 psi)
- product temperatures up to 1000°C (1832°F).

Pitot Tube Sensors

Very small pressure losses can be measured using pitot tube sensors (max. DN 12000).
Because of standards used for orifice plates, again no calibration is required.

Measuring Systems with Flow Computers

When high accuracy is required with varying temperatures and static pressures, the use of a flow computer is recommended, e.g. the Compart DXF (see also Technical Information TI 032D/06/en).This processes the input variables of differential pressure, process pressure and temperature and supplies the following output variables:
- volumetric flowrate
- mass flowrate
- heat quantity
- calorific value

Installation for Level Measurement

Level, Volumetric and Mass Measurement

Hydrostatics is the most widely used principle for continuous level measurement of liquids. A hydrostatic pressure is created due to the weight of a column of liquid. At constant density ρ the hydrostatic pressure is determined only by the height h of the column of liquid.

$$\Delta p = \rho \times g \times h$$

Where:
ρ: density of the medium
g: gravity constant (9.81 m/s^2)
h: level

If the liquid is under pressure, then this pressure acts on both sides of the Deltabar S and is thus cancelled out.

The measurement principle can be used especially for measuring
- liquids with foam,
- in vessels with agitators or filters
- and also in any shape of vessel.
- Using the freely programmable characteristic curve (linearisation), the level value can be converted into a volumetric or mass variable.

Instructions for Diaphragm Seals with FMD 630, FMD 633

Applications
Diaphragm seal systems should be used if the process media and the device should be separated.
Diaphragm seal systems offer clear advantages in the following instances:
- In the case of high process temperatures
- In the case of process media that crystallise
- 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 good and rapid measuring point cleaning is necessary
- The measuring point is exposed to vibration (e.g. better view of display).

Design and Operation Mode
Diaphragm seals are separating equipment between the measuring system and the process medium.

A diaphragm seal system consists of:
- A diaphragm seal in a one-sided system, e.g. FMD 630 or two diaphragm seals, in a two-sided system, e.g. FMD 633
- Capillary tube
- Fill fluid and
- A differential pressure transmitter.

The process pressure acts via the diaphragm seal membrane 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.

Note!
The correlations between the individual diaphragm seal components are presented in the following section.
For further information and comprehensive diaphragm seal system designs, please see your local Endress+Hauser Sales Center.

Diaphragm Seal
The diaphragm seal determines the application range of the system by
- the diaphragm diameter
- the diaphragms: stiffness and material
- the design (oil volume).

Diaphragm diameter
The larger the diaphragm diameter (less stiffness), the smaller the temperature effect on the measurement result.
Note: To keep the temperature effect in practice-oriented limits, you should select diaphragm seals with a nominal diameter of ≥ DN 80, in as far as the process connection allows for it.

Diaphragm stiffness
The stiffness is dependent on the diaphragm diameter, the material, any available coating and on the diaphragm thickness and shape. The diaphragm thickness and the shape are defined constructively. The stiffness of a diaphragm seal membrane influences the temperature operating range and the measuring error caused by temperature effects.

Capillary
Diaphragm seals are used with the following capillary internal diameters as standard:
- ≤ DN 50: 1 mm
- > DN 50: 2 mm

The capillary tube influences the T_K zero point, the ambient temperature operating range and the response time of a diaphragm seal system as a result of its length and internal diameter.
→ See also Page 12 ff, sections "Influence of the temperature on the zero point for diaphragm seal systems", "Ambient temperature range" and "Response time".
→ Observe the installation instructions regarding capillary tubes.
See Page 16 ff, section "Installation instructions".

Instructions for Diaphragm Seals with FMD 630, FMD 633 (Continuation)

Filling Oil

When selecting the filling oil, fluid 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 medium. For this reason, only filling oils that are harmless to health are used in the food industry, such as vegetable oil or silicone oil.
→ See also the following section "Diaphragm seal filling oils".
The filling oil used influences the T_K zero point and the temperature operating range of a diaphragm seal system and the response time. → See also Page 12 ff, sections "Influence of the temperature on the zero point for diaphragm seal systems" and "Response time".

Differential Pressure Transmitter

The differential pressure transmitter influences the temperature operating range, the T_K 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 optimised with regard to minimum volume change and side flange.

Diaphragm Seal Filling Oils

Filling oil	Permissible temperature range at 0.05 bar $p_{abs} \le 1$ bar	Permissible temperature range at $p_{abs} \ge 1$ bar	Density [g/cm³]	Viscosity [cSt at 25 °C]	Coefficient of thermal expansion [1/K]	T_K corrrection factor	Notes
Silicone oil	–40...+180°C (–40…+356°F)	–40...+250°C (–40…+482°F)	0.96	100	0.00096	1	suitable for foods
High-temperature oil	–10...+200°C (+14…+392°F)	–10...+350°C (+14…+662°F)	1.07	30	0.0007	0.72	high temperatures
Inert oil	–40...+80°C (–40…+176°F)	–40...+175°C (–40…+347°F)	1.87	27	0.000876	0.91	oil for ultra pure gas and oxygen applications
Vegetable oil, FDA 21 CFR 172.856	–10...+120°C (+14…+248°F)	–10...+200°C (+14…+392°F)	0.94	9.5	0.00101	1.05	suitable for foods

Instructions for Diaphragm Seals with FMD 630, FMD 633 (Continuation)

Influence of the Temperature on the Zero Point for Diaphragm Seal Systems

A temperature change results in a volume change of the filling oil. The volume change is dependent on the coefficient of thermal expansion of the filling oil and on the volume of the filling oil at calibration temperature (+25°C/ +77°F , range: +21...+33°C/ +69.8...91.4°F). → See also Page 11, section "Diaphragm seal filling oils".
For example, the filling oil expands in the event of a temperature increase. The additional volume presses against the diaphragm seal membrane. The stiffer a 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. For the "T_K Process", see Page 44 ff, section "Process connections FMD 633".

The following diagrams display the temperature coefficient "T_K Ambient" dependent on the capillary length. The following application is displayed: capillary temperature and transmitter temperature (ambient temperature) change, the process temperature corresponds to the calibration temperature.
The temperature coefficients obtained from the diagrams apply to silicone oil and the membrane material AISI 316L. For other filling oils, these temperature coefficients must be multiplied by the T_K correction factor of the corresponding filling oil. For the T_K correction factors, see Page 11, section "Diaphragm seal filling oils".

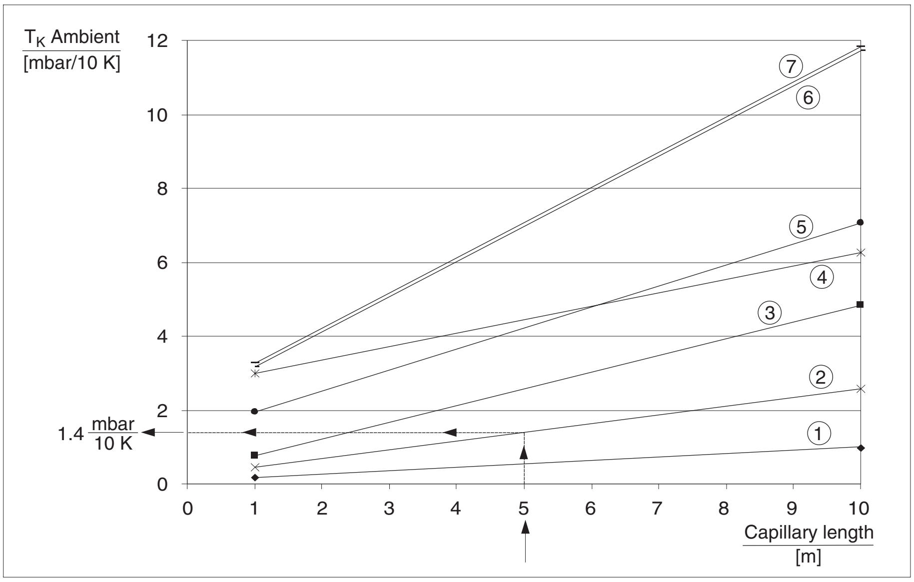


Diagram $T_{K\ Ambient}$ dependent on the capillary length for FMD 633

Example for:
- Diaphragm seal versions "BK, EN/DIN Flange DN 80 PN 10-40 B1, AISI 316L"
- Capillary length: 5 m
- Ambient temperature, capillary/transmitter: 45°C
- Filling oil: silicone oil

1. Select characteristic curve type for the diaphragm seal versions "BK" in accordance with the following table.
   Result: characteristic curve type 2

2. Obtain value for T_K Ambient from the diagram.
   Result: 1.4 mbar/10 K

3. $T_{ambient} - T_{calibration}$ =
   45°C – 25°C = 20°C
   ⇒ 1.4 mbar/10 K • 20 K
   = 2.8 mbar

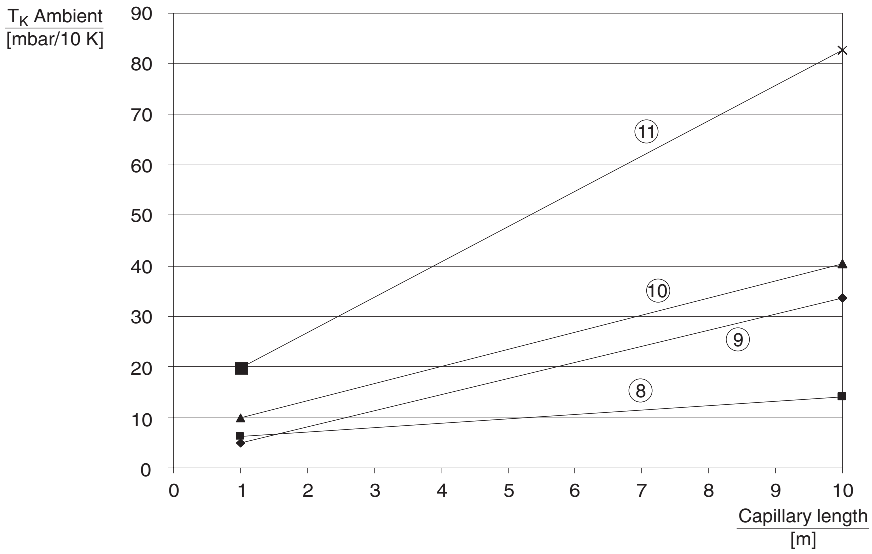
Result: In this application, the zero point is shifted by 2.8 mbar.

Note!
The influence of temperature on the zero point can be corrected with position calibration.

Instructions for Diaphragm Seals with FMD 630, FMD 633 (Continuation)

Type	Diaphragm seal version	
1	HK	Clamp, ISO 2852 DN 76.1 (3"), AISI 316L
2	TR	Thread ISO 228 G 1/2 B, PN 40, AISI 316L, Separator, PTFE seal
	VR	Thread ANSI 1/2 FNPT, PN 40, AISI 316L, Separator, PTFE seal
	AK	Cell DN 80 PN 16-400, AISI 316L
	AR	Cell DN 100 PN 16-400, AISI 316L
	CK	Cell 3" 150-2500 lbs, AISI 316L
	CR	Cell 4" 150-2500 lbs, AISI 316L
	BK	EN/DIN flange DN 80 PN 10-40 B1, AISI 316L
	EH	EN/DIN flange DN 100 PN 10/16 A, AISI 316L
	BR	EN/DIN flange DN 100 PN 25/40 B1, AISI 316L
	DK	ANSI flange 3" 150 lbs RF, AISI 316/316L
	IK	ANSI flange 3" 300 lbs RF, AISI 316/316L
	DH	ANSI flange 4" 150 lbs RF, AISI 316/316L
	1H	ANSI flange 4" 150 lbs RF, AISI 316/316L, Extension: 2"
	2H	ANSI flange 4" 150 lbs RF, AISI 316/316L, Extension: 4"
	3H	ANSI flange 4" 150 lbs RF, AISI 316/316L, Extension: 6"
	IH	ANSI flange 4" 300 lbs RF, AISI 316/316L
	FA	DIN 11851 DN 50 PN 25, AISI 316L
	GA	DIN 11851 DN 50 PN 25 socket, AISI 316L
	FK	DIN 11851 DN 80 PN 25, AISI 316L
	GK	DIN 11851 DN 80 PN 25 socket, AISI 316L
3	FE	DIN 11851 DN 65 PN 25, AISI 316L
	GE	DIN 11851 DN 65 PN 25 socket, AISI 316L
	1K	ANSI flange 3" 150 lbs RF, AISI 316L, Extension: 2"
	2K	ANSI flange 3" 150 lbs RF, AISI 316L, Extension: 4"
	3K	ANSI flange 3" 150 lbs RF, AISI 316L, Extension: 6"
4	P1	RDM Clamp, ISO 2852 DN 38 (1 1/2"), AISI 316L
	PA	RDM Clamp, ISO 2852 DN 51 (2"), AISI 316L
5	AA	Cell DN 50 PN 16-400, AISI 316L
	CA	Cell 2" 150-2500 lbs, AISI 316L
	BA	EN/DIN flange DN 50 PN 10-40 B1, AISI 316L
	DA	ANSI flange 2" 150 lbs RF, AISI 316/316L
	IA	ANSI flange 2" 300 lbs RF, AISI 316/316L
6	HA	Clamp, ISO 2852 DN 51 (2")/DN 50, AISI 316L
7	KE	DRD 65 mm, PN 25, AISI 316L
	LE	Varivent Type N for tubes DN 40 – DN 162, PN 40, AISI 316L

Diagram $T_{K\ Ambient}$ dependent on the capillary length for FMD 633



Type	Diaphragm seal version	
8	PR	RDM Clamp, ISO 2852 DN 25 (1"), AISI 316L
9	WH	Sanitary tank spud, AISI 316L, Extension 2"
10	H1	Clamp, ISO 2852 DN 38 (1 – 1 1/2"), AISI 316L
11	H2	Clamp, ISO 2852 DN 25 (1"), AISI 316L

Instructions for Diaphragm Seals with FMD 630, FMD 633 (Continuation)

Minimise temperature effect by	Comments
Smaller capillary internal diameter	The response time increases with decreasing diameter.
Shorter capillary	—
Diaphragm seal with larger diaphragm diameter	—
Filling oil with a smaller coefficient of thermal expansion	– Observe compatibility of the filling oil with the fluid. – Observe the filling oil operating limits.

Ambient Temperature Range

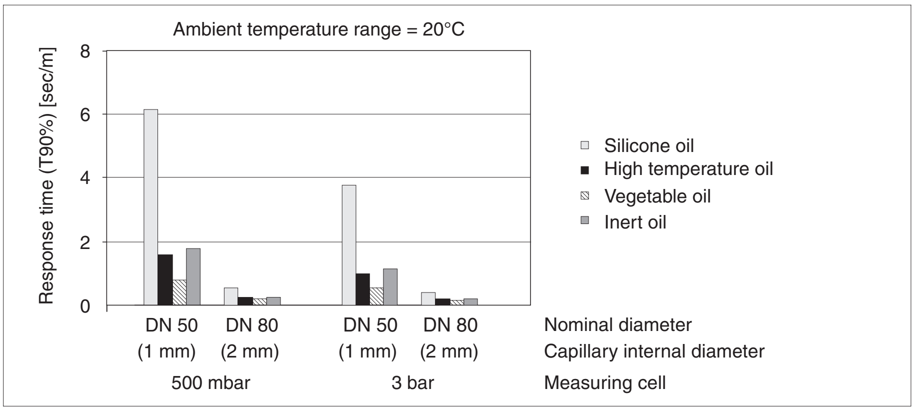
The filling oil, capillary length, capillary internal diameter and the diaphragm diameter of the diaphragm seal have an influence on the ambient temperature operating range of a diaphragm seal system.

Optimise ambient temperature operating range	Comments
Shorter capillaries	—
Smaller capillary internal diameter	The response time increases. Diaphragm seals are used with the following capillary internal diameter as standard: – ≤ DN 50: 1 mm – > DN 50: 2 mm
Filling oil with smaller coefficient of thermal expansion	– Observe compatibility of the filling oil with the fluid. – Observe the filling oil operating limits.
Diaphragm seal with larger diaphragm diameter	—

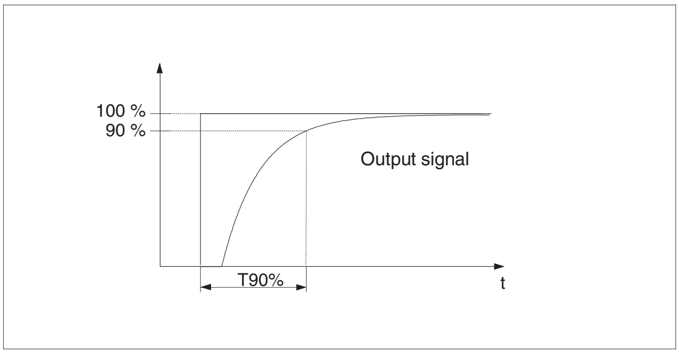
Response Time

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 is, the less filling oil has to be shifted in the diaphragm seal system.

The following diagram shows typical response times (T90%) for the various filling oils dependent on the measuring cell and the capillary internal diameter. The values given are in seconds per metre of capillary length and must be multiplied by the actual length of the capillary. The rise time of the transmitter must also be taken into consideration.



Instructions for Diaphragm Seals with FMD 630, FMD 633 (Continuation)



Presentation of the response time (T90%)

Minimise response time by	**Comments**
Larger capillary internal diameter	The temperature effect increases with increasing diameter.
Shorter capillaries	—
Filling oil with lower viscosity	– Observe compatibility of the filling oil with the fluid. – Observe the filling oil operating limits.

Installation Instructions

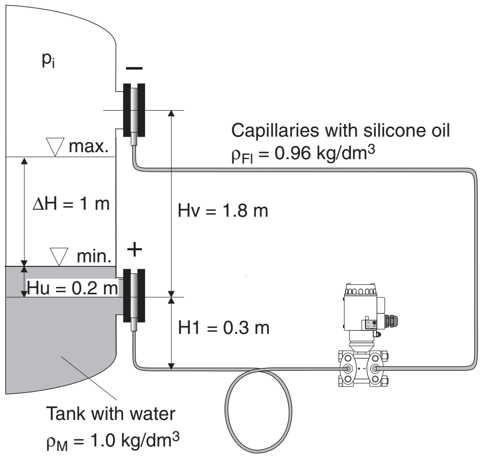
Instructions for Diaphragm Seal Systems

- 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.
- When selecting the measuring cell, observe the zero shift resulting from the hydrostatic pressure of the filling fluid columns in the capillaries. (→ See the following illustration).
- When using a mounting bracket, sufficient strain relief must be allowed for in order to prevent the capillary bending down (bending radius ≥ 100mm).
- The temperature and length of both capillaries should be the same when using two-sided diaphragm seal systems.

Conversion factors

- 1 mm = 0.039 in
  1 in = 25.4 mm
- 1 kg = 2.2 lbs
  1 lbs = 0.45 kg
- 1 bar = 14.5 psi
  1 psi = 0.069 bar

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



Pressure on the negative side of the differential pressure transmitter (p–) when the tank is empty (min. level)

$$p_{-} = p_{Hv} + p_{H1} = Hv \bullet \rho_{Fl} \bullet g + H1 \bullet \rho_{Fl} \bullet g + p_i$$

$$= 1.8\text{ m} \bullet 0.96 \frac{kg}{dm^3} \bullet 9.81 \frac{m}{s} + 0.3\text{ m} \bullet 0.96 \frac{kg}{dm^3} \bullet 9.81 \frac{m}{s} + p_i$$

$$= 197.77\text{ mbar} + p_i$$

Pressure on the positive side of the differential pressure transmitter (P+) when the tank is empty (min. level)

$$p_{+} = p_{Hu} + p_{H1} = Hu \bullet \rho_M \bullet g + H1 \bullet \rho_{Fl} \bullet g + p_i$$

$$= 0.2\text{ m} \bullet 1 \frac{kg}{dm^3} \bullet 9.81 \frac{m}{s} + 0.3\text{ m} \bullet 0.96 \frac{kg}{dm^3} \bullet 9.81 \frac{m}{s} + p_i$$

$$= 47.87\text{ mbar} + p_i$$

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

$$\Delta p_{Transmitter} = p_{+} - p_{-}$$

$$= 47.87\text{ mbar} - 197.77\text{ mbar}$$

$$= -149.90\text{ mbar}$$

Result:
If the tank were full, a differential pressure of –51.80 mbar would be present at the differential pressure transmitter. When the tank is empty, a differential pressure of –149.90 mbar is present. Therefore, a 500 mbar measuring cell is required for this application.

Installation Instructions (Continuation)

Installation Instructions

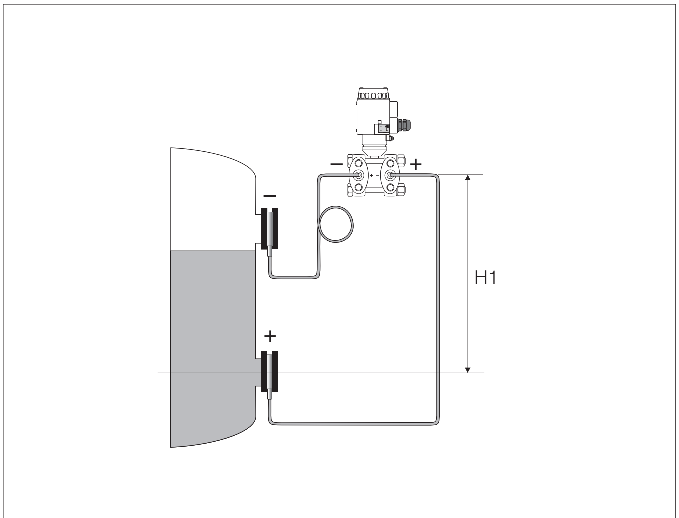
In order to obtain more precise measurement results and to avoid a defect in the device, mount the capillaries as follows:

- vibration-free (in order to avoid additional pressure fluctuations)
- not in the vicinity of heating or cooling lines
- insulate at colder or warmer ambient temperatures
- with a bending radius of ≥ 100 mm.

Vacuum Applications

For applications under vacuum, Endress+Hauser recommends mounting the pressure transmitter underneath the lower diaphragm seal. A vacuum load of the diaphragm seal caused by the presence of filling oil in the capillaries is hereby prevented.

When the pressure transmitter is mounted above the lower diaphragm seal, the maximum height difference H1 in accordance with the following illustration on the left must not be exceeded. The maximum height difference is dependent on the density of the filling oil and the smallest ever pressure that is permitted to occur at the diaphragm seal on the positive side (empty tank), see the illustration, on the right.



Installation above the lower diaphragm seal

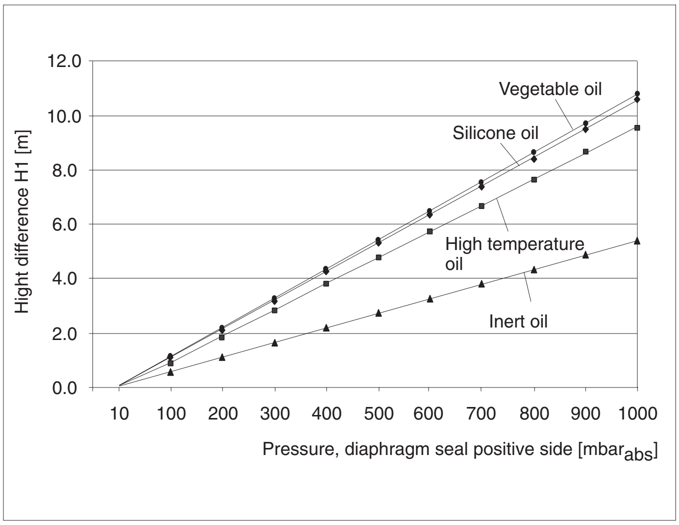


Diagram of maximum installation height above the lower diaphragm seal for vacuum applications dependent on the pressure at the diaphragm seal on the positive side.

Installation Instructions (Continuation)

Mounting Instructions

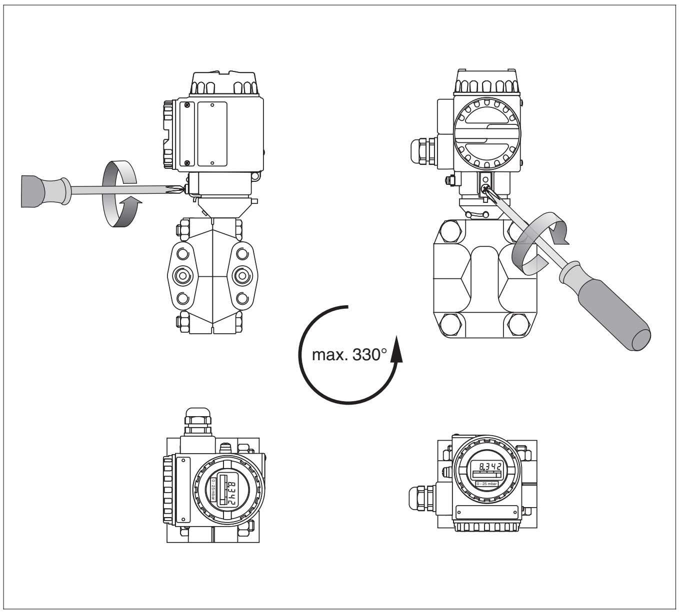
- The instrument can be easily commissioned without interrupting the process by using a three or five way manifold.
- For measurement in media with a solids content (e.g. contaminated liquids) separators and drain valves should be used in order to trap and remove any build-up that may occur.
- By simply loosening the locking screw, the housing of the Deltabar S can be rotated by up to 330°.
- A mounting bracket for wall or pipe mounting is also available for the Deltabar S, see diagram below on the right.
  - 1.4301 (AISI 304) incl. stainless steel screws
  - Order No.: 52024403

Instructions for Mounting with Pressure Piping

- General recommendation for installing pressure pipes are found in DIN 19210 "Process lines for flow measurement systems" or else in the appropriate national or international standards.
- Pressure piping must have a constant gradient of at least 10:1.
- There must be suitable frost protection when installing pressure piping in the open (e.g. electrical or steam tracing).

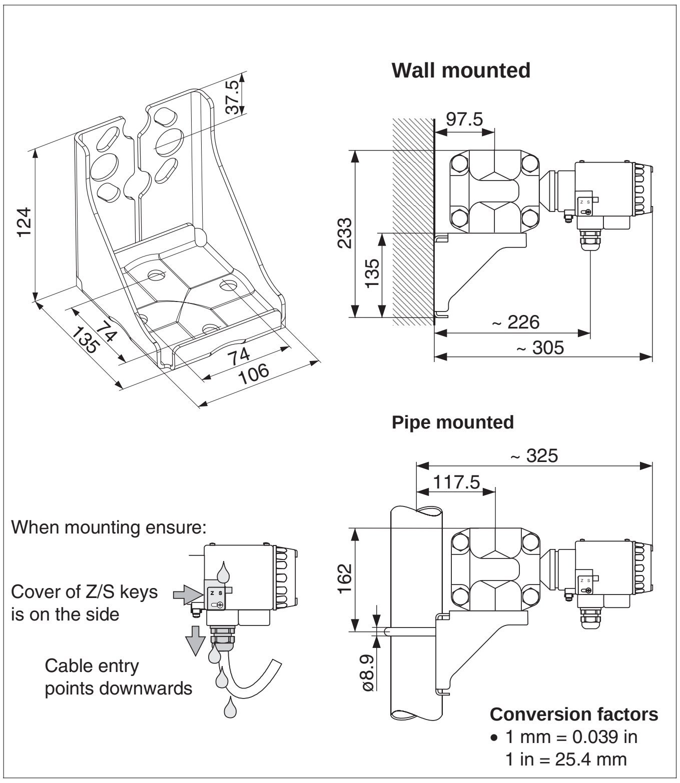
Shifting of the Zero Point due to Position

The Deltabar S is calibrated based on the limit point method according to IEC 60770.
Due to the hydrostatic column of fluid in the sensor, the zero point of the instrument depends on it being positioned between the vertical and horizontal planes and may vary up to 2 mbar (0.029 psi). Diaphragm seals also shift the zero point depending on the orientation of the instrument, see Page 16. This shift due to position can also be corrected by zero point calibration in the Ex-area directly on the instrument using the keys.



Positioning the housing

After mounting the Deltabar S, position the housing so that:
- the terminal connection compartment is easily accessible,
- the display can be seen most easily (display can be rotated in steps of 90°),
- the cable entry and the cover of the Z/S keys are protected from water (best position: cable entry points downwards).

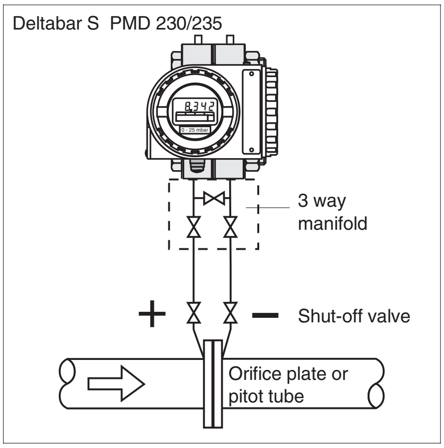


Wall and pipe mounting with bracket

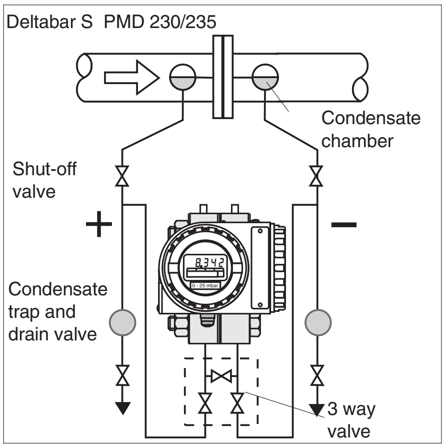
Mount the housing so that:
- The cable entry always points downwards thus any moisture on the connecting cable can run off and not enter the housing.
- The cover for the Z/S keys is on the side of the housing thus condensation and moisture can run off and not enter the housing.

Examples of Measuring Systems

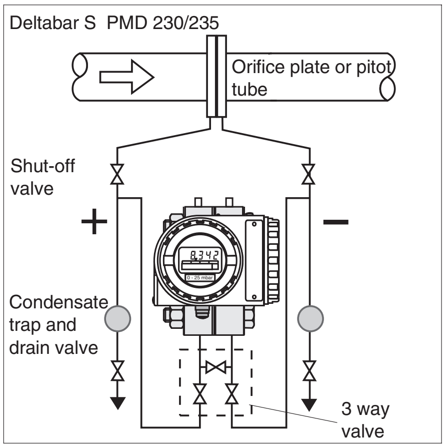
Flow Measurement



Gas:
- Mount the Deltabar S above the measuring point so that any condensate in the process line runs out.

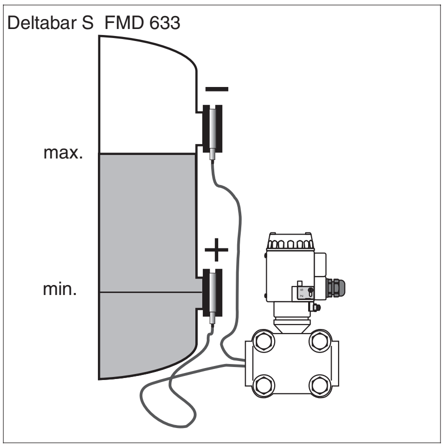


Vapours:
- Mount the Deltabar S below the measuring point.
- Mount and fill the condensate chambers at the same height as the bleeder connection.

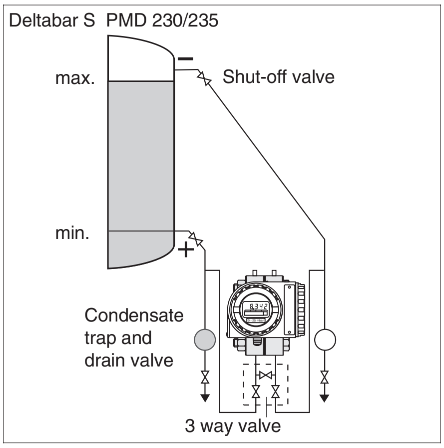


Liquids:
- Mount the Deltabar S below the measuring point so that the pressure piping is always filled with liquid.

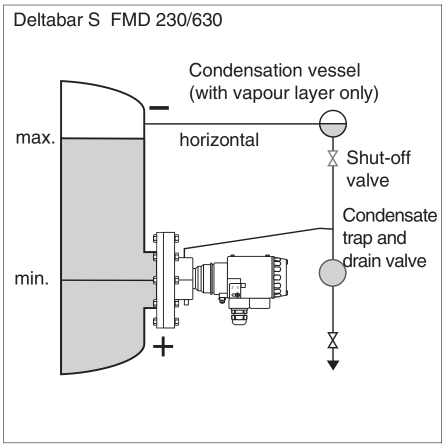
Level Measurement



Capillary diaphragm seal:
- Mount the Deltabar S below the lower connection. Exceptions: see Page 17
- Mount the diaphragm seal with capillary tube on the vessel.

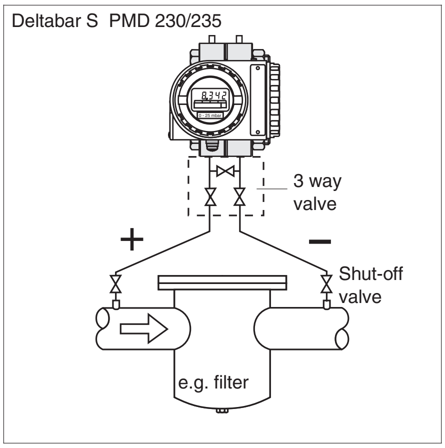


Closed vessels:
- Mount the Deltabar S below the lower connection so that the pressure piping is always filled with liquid.
- The negative side must be connected above the maximum level.

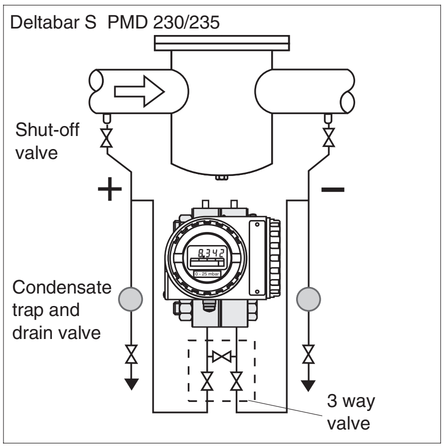


Closed vessels with flanged Deltabar S:
- Mount the Deltabar S directly onto the vessel.
- The negative side must be connected above the maximum level.
- The condensate chambers ensure a constant column of fluid with a layer of vapour.

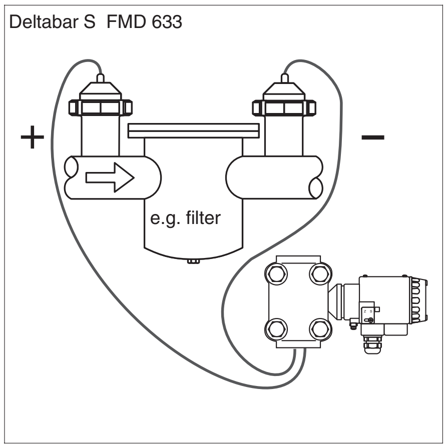
Differential Measurement



Gas and vapour:
- Mount the Deltabar S above the measuring point so that any condensate in the process line runs out.



Liquids:
- Deltabar S below the measuring point so that the pressure piping is always filled and gas bubbles can rise and return to the process piping.



Deltabar S FMD 633:
- Mount the diaphragm seal above the piping.
- Mount the transmitter below the measuring point.

Electrical Connection

Wiring 4…20 mA

The two-wire cable is connected to screw terminals in the connecting compartment.
(wire cross section 0.5…2.5 mm^2/ AWG 20…13).

- We recommend using twisted, screened two-cores cables for the connecting wire.
- Supply voltage (see Page 27):
  - Version for non-hazardous areas: 11.5…45 V DC
  - When using the measuring device in hazardous areas, installation must comply with the corresponding national standards and regulations and the Safety Instructions (XAs) or Installation or Control Drawings (ZDs).
- Internal protection circuits against reverse polarity, HF interference and overvoltage peaks (see Technical Information TI 241F "EMC Guidelines").
- Test signal:
  The output current can be measured between terminal 1 and 3 without interrupting the process measurement.

Wiring PROFIBUS-PA

The digital communication signal is transmitted to the bus using a two-wire connecting cable. The bus cable also carries the power supply.

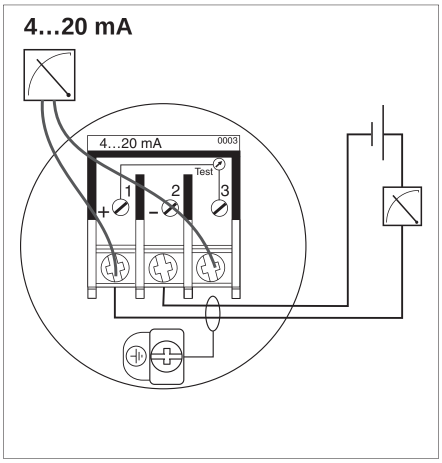
- Supply voltage:
  - Version for non-hazardous areas: 9…32 V DC
  - When using the measuring device in hazardous areas, installation must comply with the corresponding national standards and regulations and the Safety Instructions (XAs) or Installation or Control Drawings (ZDs).
- Bus cable:
  - Version for non-hazardous areas, EEx nA: It is preferable to use a twisted, screen two-wire cable.
  - EEx ia, FM IS and CSA IS:
    The instrument is suitable for connection to a Fieldbus system according to the FISCO model. Observe the installation instructions for the instruments and for the other bus system components, such as the bus cable. For this, see the corresponding literature, such as Operating Instructions BA 034S "PROFIBUS-DP/-PA: Guidelines for Planning and Commissioning" and the PNO guideline.

Instructions for assembling and grounding the network can be found in Operating Instructions BA 034S.

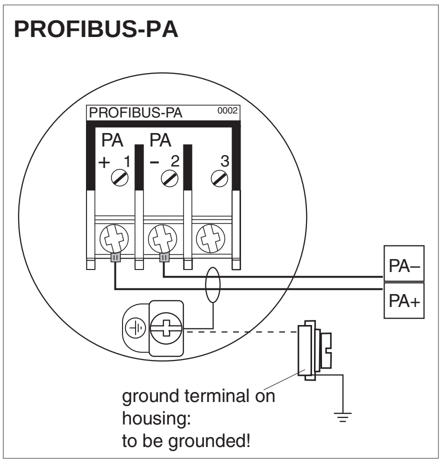
Wiring Foundation Fieldbus

The digital communication signal is transmitted to the bus using a two-wire connecting cable. The bus cable also carries the power supply.

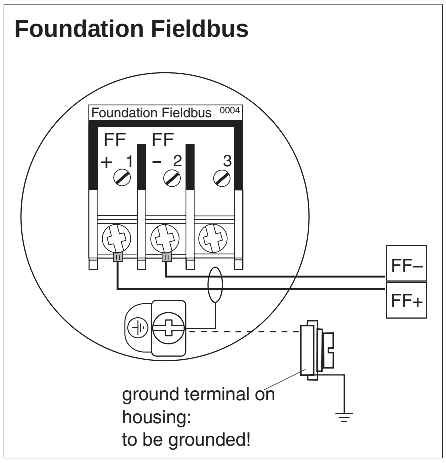
- Supply voltage:
  - Version for non-hazardous areas: 9…32 V DC
  - When using the measuring device in hazardous areas, installation must comply with the corresponding national standards and regulations and the Safety Instructions (XAs) or Installation or Control Drawings (ZDs).
- Bus cable:
  - Version for non-hazardous areas, EEx d, EEx nA: It is preferable to use a twisted, screen two-wire cable.
  - EEx ia, FM IS und CSA IS:
    The instrument is suitable for connection to a Fieldbus system according to the FISCO model. Observe the installation instructions for the instruments and for the other bus system components, such as the bus cable. For this, see the corresponding literature, such as Operating Instructions BA 013S "Foundation Fieldbus Overview". Here you will also find instructions for assembling and grounding the network.



Electrical connection:
Deltabar S for all versions with 4…20 mA



Electrical connection:
Deltabar S for all versions with PROFIBUS-PA
(Reversed polarity has no effect on function.)



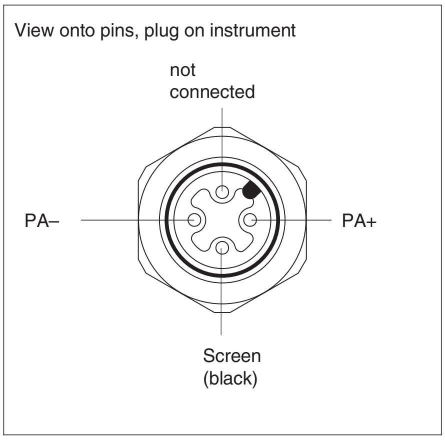
Electrical connection:
Deltabar S for all versions with Foundation Fieldbus
(Reversed polarity has no effect on function.)

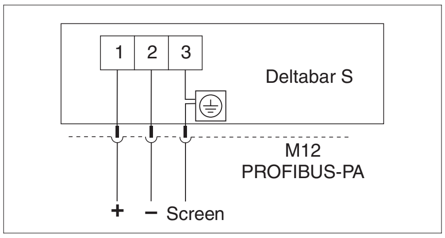
Connection M12 Plug (PROFIBUS-PA)

Endress+Hauser also provides a Deltabar S with M12 plug. This version can be easily connected to the PROFIBUS network using a preterminated cable.

Versions:

- PMD 23❑ – 3 ❑ ❑❑ ❑ ❑❑ ❑ ❑
- PMD 23❑ – I ❑ ❑❑ ❑ ❑❑ ❑ ❑
- FMD ❑3❑ – 3 ❑ ❑ ❑ ❑ ❑ ❑ ❑ ❑ (❑ ❑)
- FMD ❑3❑ – I ❑ ❑ ❑ ❑ ❑ ❑ ❑ ❑ (❑ ❑)



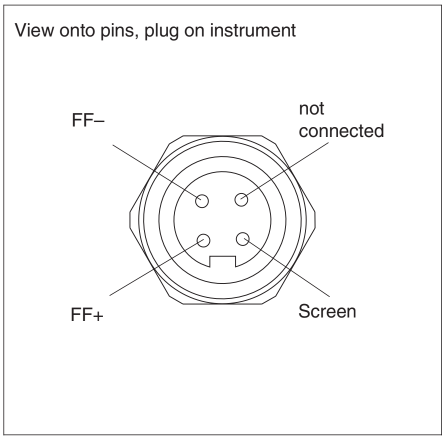


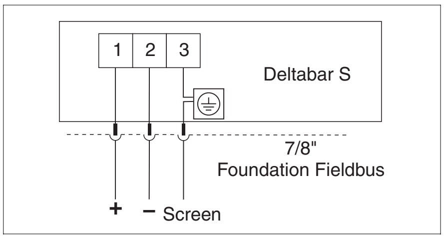
Connection 7/8" Foundation Fieldbus Plug

Endress+Hauser also provides a Deltabar S with 7/8" Foundation Fieldbus plug. This version can be easily connected to the Foundation Fieldbus network using a pretermined cable.

Versions:

- PMD 23❑ – 4 ❑ ❑❑ ❑ ❑❑ ❑ ❑
- PMD 23❑ – J ❑ ❑❑ ❑ ❑❑ ❑ ❑
- PMD 23❑ – V ❑ ❑❑ ❑ ❑❑ ❑ ❑
- FMD ❑3❑ – 4 ❑ ❑ ❑ ❑ ❑ ❑ ❑ ❑ (❑ ❑)
- FMD ❑3❑ – J ❑ ❑ ❑ ❑ ❑ ❑ ❑ ❑ (❑ ❑)
- FMD ❑3❑ – V ❑ ❑ ❑ ❑ ❑ ❑ ❑ ❑ (❑ ❑)



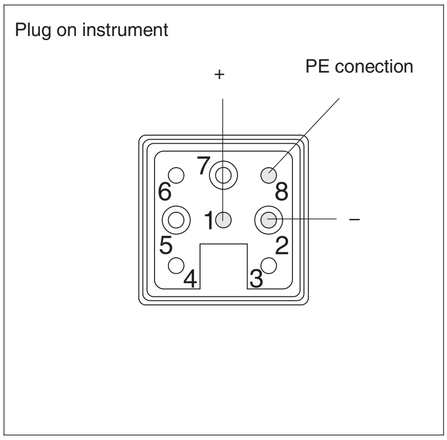


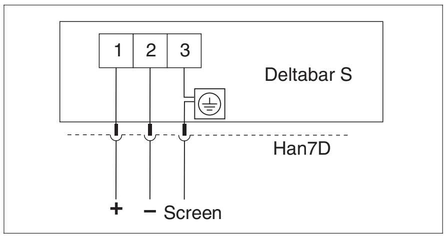
Connection Harting Plug

For applications in power stations, there is a Deltabar S with a Harting Han7D plug.

Versions:

- PMD 23❑ – F ❑ ❑❑ ❑ ❑❑ ❑ ❑
- FMD ❑3❑ – F ❑ ❑ ❑ ❑ ❑ ❑ ❑ ❑ (❑ ❑)





Special Applications

"Platinum"-Transmitters

Besides standard versions, instruments with higher accuracy are also available (linearity ±0.05% of set span, see also technical data. These are known as "Platinum" instruments and are special versions of the PMD 235.

Three versions are available (see also Page 30):

- PMD 235 – ❑❑❑❑ A ❑❑❑❑ (bar/mbar)
- PMD 235 – ❑❑❑❑ B ❑❑❑❑ (Pa/MPa)
- PMD 235 – ❑❑❑❑ C ❑❑❑❑ (psi)

Oxygen and Ultra Pure Gas 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 must not be exceeded.

The devices suitable for oxygen applications are listed in the following table with the specifications T_{max} and p_{max}.

Special Applications (Continuation)

Instruments for oxygen applications	$p_{max\ operation}$ when using oxygen	T_{max} when using oxygen
PMD 230 – ❏ ❏ ❏❏ ❏ ❏❏ 6 ❏ 500 mbar, 3000 mbar	30 bar (435 psi)	60°C (140°F)
PMD 230 – ❏ ❏ ❏❏ ❏ ❏❏ 6 ❏ 25 mbar, 100 mbar	PN of measuring cell	60°C (140°F)
PMD 235 – ❏ ❏ ❏❏ ❏ ❏❏ 6 ❏	70 bar (1015 psi) [1), 2)]	60°C (140°F)
FMD 230 – ❏ ❏ ❏❏ ❏ ❏❏ 6 ❏ ❏❏ 500 mbar, 3000 mbar	30 bar (435 psi)	60°C (140°F)
FMD 230 – ❏ ❏ ❏❏ ❏ ❏❏ 6 ❏ ❏❏ 25 mbar, 100 mbar	PN of measuring cell	60°C (140°F)
FMD 630 – ❏ ❏ ❏❏ ❏ ❏❏ 6 ❏ ❏ ❏	PN of flange	60°C (140°F)
FMD 633 – ❏ ❏ ❏❏ ❏ ❏❏ ❏❏ 4A	90 bar (1305 psi) [1), 2)]	60°C (140°F)

1) Instruments with Tantalum diaphragm p_{max} = 10 bar (145 psi)
2) Instruments with Alloy or Monel diaphragm p_{max} = 40 bar (580 psi)

Endress+Hauser also offers degreased devices for special applications, such as ultra pure gas.
No special restrictions regarding the process conditions apply to these devices.

- PMD 230 – ❏ ❏ ❏❏ ❏ ❏❏ 8 ❏
- PMD 235 – ❏ ❏ ❏❏ ❏ ❏❏ 8 ❏
- FMD 230 – ❏ ❏ ❏❏ ❏ ❏❏ 8 ❏ ❏❏
- FMD 630 – ❏ ❏ ❏❏ ❏ ❏❏ 8 ❏ ❏ ❏

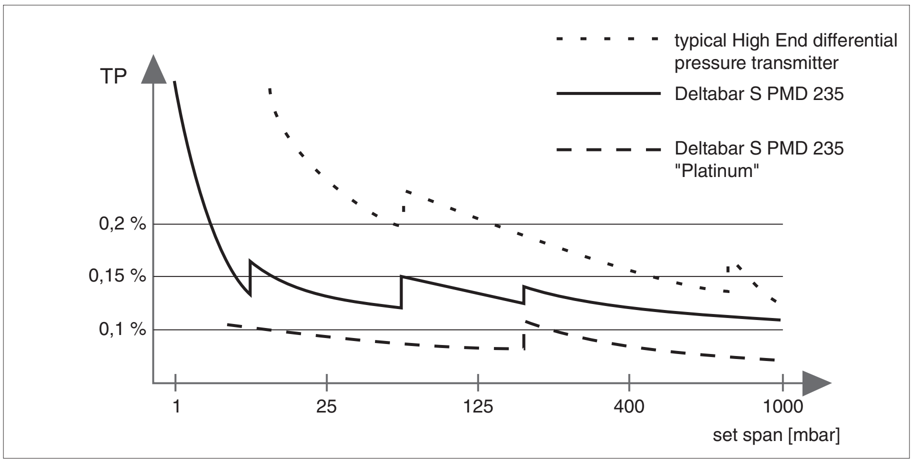
Total Performance

Total Performance
A detailed summary of the accuracy of measurement data under process conditions is known as the "Total Performance" (TP) and given as a % of the set span. This value is calculated as follows:

$$TP = \sqrt{(L^2 + S^2 + T^2)}$$

Where:
L: linearity including hysteresis and repeatability
S: static pressure effects on the span
T: temperature effects

The following graph shows the Total Performance of PMD 235 as well as "Platinum" instruments. The example given here is for a typical 30 K temperature variation and 10 bar static pressure.



Graph showing "Total Performance" (TP) as a function of the set span.

Technical Data

General Information

Manufacturer	Endress+Hauser
Designation	Deltabar S

Application

Deltabar S	The instrument is used for the measurement of flow in gases, vapours and liquids; for the measurement of level in liquids as well as for the measurement of differential pressure in gases, vapours and liquids

Operation and System Design

Measuring Principle	For PMD 230, FMD 230: capacitive with ceramic single-chamber sensor For PMD 235, FMD 630, FMD 633: piezoresistive with metallic sensor
with 4…20 mA current output and HART communication protocol	Deltabar S and power supply e.g. via transmitter power pack RN 221N and operation using – four keys on the instrument and a plug-in display module – Universal HART Communicator DXR 275 handheld terminal – PC with the Commuwin II operating programme via Commubox FXA 191
with PROFIBUS-PA	via segment coupler or PLC or PC with a PROFIBUS interface card and operating programme, e.g. Commuwin II
with Foundation Fieldbus	Foundation Fieldbus H1: – PC operation with configuration programme by means of interface card H1, Foundation Fieldbus HSE: – PC operation with configuration programme by means of linking device FF-HSE/FF-H1

Input

Measuring variables	Differential pressure for deriving flowrate (volumetric or mass flow), level, mass or volume
Adjustment range of the span (Turn down)	100:1

Measuring range

Nom. value ceramic sensor	Measurement limits		Span		PN	Overload		Sensor
PMD 230 FMD 230 [mbar]	Lower (LRL) [mbar]	Upper (URL) [mbar]	recom-mended TD 20:1 [mbar]	smallest [mbar]		One-sided [bar]	Two-sided [bar]	Fill fluid 3)
25	–25	25	2.5	0.5	10	10	10	Mineral oil
100	–100	100	10	2	16 1)	16 1)	16 1)	Mineral oil
500	–500	500	50	10	100 1), 2)	100 1), 2)	100 1), 2)	Silicone oil
3000	–3000	3000	300	60	100 1), 2)	100 1), 2)	140 1), 2), 4)	Silicone oil

1) p_{max} = 10 bar for PMD 230 with PVDF process connection.
2) FMD 230: the specified PN (pressure rating) or the specified overload applies to the measuring cell. Observe max. pressure of the flange, see product structure.
3) Voltalef 1A, for applications in very pure gases, observe operating limits for oxygen service for non-metallic materials.
4 100 bar for FM and CSA

Nom. value Silicon sensor (URL)	Measurement limits		Span		PN 3), 4)	Overload 3)		Sensor
PMD 235 FMD 630 FMD 633 [mbar]	Lower (LRL) [mbar]	Upper (URL) [mbar]	recom-mended TD 20:1 [mbar]	smallest [mbar]		One-sided	Two-sided 5)	Fill fluid 2)
10 1)	–10	10	1	0.2	160 6)	PN	1.5 x PN	Silicone oil
40 1)	–40	40	4	0.8	160 6)	PN	1.5 x PN	Silicone oil
100	–100	100	10	2	160 6)	PN	1.5 x PN	Silicone oil
500	–500	500	50	10	160 420	PN	1.5 x PN	Silicone oil
3000	–3000	3000	300	60	160 420	PN	1.5 x PN	Silicone oil
16000	–16000	16000	1600	320	160 420	PN	1.5 x PN	Silicone oil
40000 1)	–40000	40000	4000	800	160 420	100 bar	1.5 x PN	Silicone oil

1) PMD 235 only
2) Inert oil for applications in very pure gases.
3) The specified PN (pressure rating) or the specified overload applies to the measuring cell. Observe the maximum pressure of the flange, see product structure.
4) 160 bar version with stainless steel bolts, 420 bar version with chromized steel bolts.
5) Type tested for burst pressure (FM) upt to 1120 bar on both sides with PN 420 bar version.
6) High pressure 420 bar version on request.

Input (Continuation)

Min. system pressure	PMD 230, PMD 235, FMD 230: p_{abs} > 1 mbar for all sensores and measuring ranges FMD 630, FMD 633: dependent on the diaphragm seal fill fluid, see Page 12, "Instructions for Diaphragm Seals with FMD 630, FMD 633"

Output

PROFIBUS-PA

Output signal	digital communication signal, PROFIBUS-PA protocol
PA function	Slave
Transmission rate	31.25 kBits/s
Response time	Slave: approx. 20 ms PLC: approx. 600 ms (depending on system coupler) for approx. 30 transmitters
Signal on alarm	Signal: status bit set, last valid measured value will be held, Display module: error code
Communication resistance	PROFIBUS-PA termination resistor

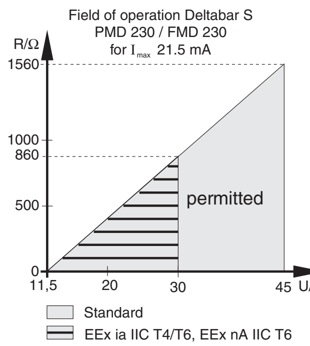
Foundation Fieldbus

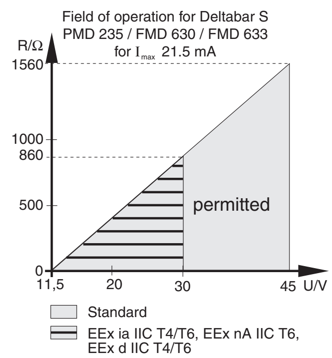
Output signal	digital communication signal, Foundation Fieldbus protocol
FF function	Publisher–Subscriber
Transmission rate	31.25 kBits/s
Signal on alarm	Signal: status bit set, last valid measured value will be held, Display module: error code
Communication resistance	Foundation Fieldbus termination resistor

4…20 mA with HART protocol

Output signal	4 to 20 mA with superimposed HART communication signal, under-run 3.8 mA (4 mA adjustable), over-run 20.5 mA
Load	see diagrams below

Load

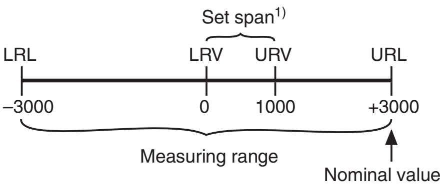




Signal on alarm	Options: – Max. Alarm: can be set from 21…22.5 mA – Value hold: last measured value is kept – Min. Alarm: 3.6
Resolution	better than 5 µA
Integration time	– can be set steplessly from 0…40 s with handheld terminal or PC with operating program or – can be set in steps from 0…16 s via rotary switch on the device
Communication resistance	min. 250 Ω
Adjusting range	Freely adjustable within the limits of the lower and upper range values

Explanation of terms:

Turn down (TD)
= Measuring range / set span[1)]



Example: Measuringe range = 6000 mbar
Set span[1)] = 1000 mbar
TD = 6:1

Accuracy

Reference conditons	according to DIN IEC 60770 T_U= +25°C (+77°F) Accuracy data adopted after entering "Low Sensor Trim" and "High Sensor Trim" for lower range value and upper range value [2)]
Non-Linearity including hysteresis and non-repeatability based on the limit point method to IEC 60770	to TD 10:1: ±0.1% (* ±0.05%) of the set span[1)] for TD 10:1 to 20:1: ±0,1% (* ±0.05%) of set span[1)] x TD/10)
Long-term drift	±0.1% of nominal value/year ±0.25% of nominal value/5 years

Effects of system pressure on the zero point (on the span)

Values in percent of nominal value

Metal sensor		Ceramic sensor	
Nom. value	Diviation	Nom. value	Diviation
10 mbar	1.5 (0.5) %/100 bar	25 mbar	0.5 (0.2) %/10 bar
40 mbar	0.5 (0.2) %/100 bar	100 mbar	0.2 (0.2) %/16 bar
100 mbar	0.3 (0.2) %/100 bar	500 mbar	0.2 (0.2) %/100 bar
500 mbar, 3 bar, 16 bar, 40 bar	0.2 (0.2) %/100 bar	3 bar	0.2 (0.2) %/100 bar

***** "**Platinum**"
Values for instruments with higher accuracy ("Platinum", for sensors with a nominal value ≥ 100 mbar) are shown with an asterisk *
(PMD 235 – ****A****
PMD 235 – ****B****
PMD 235 – ****C****) see also Page 22

Root values
For root characteristic curves:
The accuracy specifications of the Deltabar S are reduced by a factor of ½ when calculating fow rates.

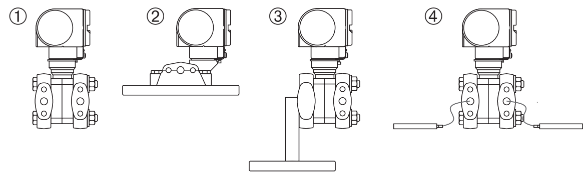
1) For instruments with PROFIBUS-PA and Foundation Fieldbus electronics: "calibrated span"
2) For instruments with PROFIBUS-PA and Foundation Fieldbus electronics: "Low Sensor Calibration" and "High "Sensor Calibration" for lower range value and upper range value

Accuracy (Continuation)

Temperature coefficient	–10…60°C (+14…+140°F): 0.04% (* 0.03%) of nominal value/30 K and –40…–10°C or +60…+85°C (–40…+14°F or +140…+185°F): 0.1% (* 0.08%) of nominal value/30 K
Temperature coefficient of diaphragm seal	See Pages 12…13 and Pages 44 to 48, tables.
Thermal effects	(0.2% x TD + 0.2%) of set span[1)]
Settling time	PMD 230/FMD 230: 300 ms PMD 235: 250 ms FMD 630/633: depending on diaphragm seal
Scanning time	min. 20 times per second
Rise time	1/3 of the settling time
Warm-up period	2 s
Vaccum resistance	PMD 230, PMD 235, FMD 230: up to 1 $mbar_{abs}$ FMD 630, FMD 633: dependent on the diaphragm seal fill fluid, see Page 11

Application conditions

Installation conditions

Position of calibration ① PMD 230, PMD 235 ② FMD 230 ③ FMD 630 ④ FMD 633	
Orientation	as required, orientation-dependent zero shift can be completely corrected within the measurement limits

Process conditions

Product temperature range in process	PMD 230/FMD 230: –40…+85°C (–40…+185°F) PMD 235: –40…+120°C (–40…+212°F) FMD 630/FMD 633: up to +350°C (+662°F) Oberserve temperature limits of the seals, see "Temperature application limits, seals" on this page. For FMD 630 and FMD 633: Observe temperature application limits of the diaphragm seal fill fluid, Page 11. Do not use diaphragm seals with 0.09 mm PTFE foil on AISI 316L (1.4435/1.4405) for vacuum applications, upper temperature limits +205°C (+401°F)
Temperature application limits, seals	see table below

Temperature application limits, seals:

*	Seals for PMD 230 and FMD 230	Temperature application limits
1	FKM Viton	–20°C** (–4°F)
4	EPDM	–40°C** (–40°F)
C	Chemraz	–10°C** (+14°F)
7	Kalrez	+5°C** (+41°F)
8	FKM, Viton, oil and grease free, Compound V70G3	–10°C** (+14°F)
6	FKM Viton cleaned for oxygen service, Compound V70G3	–10…+60°C (+14…+140°F)
	Seals for PMD 235 and FMD 630	Temperature application limits
1	FKM Viton	–20°C** (–4°F)
2	NBR	–20…+80°C (–4…+176°F)
3	PTFE, Compound TFM4105 FDA conform	–40°C** (–40°F)
8	FKM Viton, oil and grease free, Compound V70G3	–10°C** (+14°F)
6	FKM Viton, cleaned for oxygen service, Compound V70G3	–10…+60°C (+14…+140°F)
H	Copper	–40°C** (–40°F)

1) Version in order code, e.g. PMD 230 – ❑ ❑ ❑❑ ❑ ❑❑ _ ❑
2) For the upper temperature limit, see "Product temperature range" on this page.

1) For instruments with PROFIBUS-PA and Foundation Fieldbus electronics: "calibrated span"

Application conditions (Continuation)

Process specification	The rating pressure is specified on the nameplate. The value refers to a reference temperature of 20°C (68°F) or 100°F for ANSI flanges. – Test pressure = rating pressure nameplate x 1.5 – The pressure values permitted at higher temperatures can be found in the following standards: EN 1092-1: 2001 Tab. 18; ASME B 16.5 a – Tab. 2.3.8 N10276; JIS B2210/B2238 The maximum pressure for the measuring device is dependent on the lowest-rated element with respect to pressure, see following section for this: – permitted overload of the sensor Page 23, table "Measuring range" – for process connections "Product structure" and "Dimensions", Page 28 ff – "Oxygen and Ultra Pure Gas Application", Page 22

Ambient conditions

Ambient temperature	–40…+85°C (–40…+185°F) 3)
Storage temperature	–40…+100°C (–40…+212°F) 3), 4)
Climatic class	4K4H according to DIN EN 60721-3
Vibrational resistance	Ceramic sensor: ±0.1% of sensor span (to DIN IEC 68 Part 2-6) Metal sensor: ±0.1 % of sensor span (to DIN IEC 68 Part 2-6)
Protection	IP 65/NEMA 4X
Electromagnetic compatibitility	Interference emission to EN 61326 electrical equipment B, Interference immunity to EN 61326 Annex A (industrial) and NAMUR directive EMC (NE 21), Interference immunity to EN 61000-4-3: 30 V/m For cable specification see Page 20.

Mechanical Construction

Design

Housing	Housing T4 (display on side) or T5 (display on top), the housing can be rotated up to 330°, Seperated electronics and connection compartments, optional electrical connection via – M 20x1.5 cable gland – G ½, ½ NPT cable entry – PROFIBUS-PA M12-, Foundation Fieldbus 7/8"- and Harting Han7D plug Terminal connection for wire cross section 0.5…2.5 mm^2 (AWG 20…13).
Process connections	optional flange or diaphragm seal with capillary extension available, see also Product Structures

Materials

Housing	– Cast aluminium housing with protective polyester based powder coating RAL 5012 (blue), cover RAL 7035 (grey), saltwater spray test DIN 50021 (504 h) passed – AISI 316 L (1.4435)
Nameplates	AISI 304 (1.4301)
Process connection	optional: AISI 316 L (1.4435), Alloy C276 (2.4819), Stainless steel C 22.8, PMD 230: PVDF coated, FMD 230: ECTFE coated, see Product Structure
Process diaphragm	– PMD 230, FMD 230: Al_2O_3 Aluminium oxide ceramic – PMD 235: AISI 316L (1.4404), Alloy C276, Tantalum, Monel – FMD 630: AISI 316L, Alloy C276, Tantalum – FMD 633: AISI 316L (1.4435), Alloy C276, Tantalum, AISI 316L with PTFE film 0.09 mm
Fill fluid in diaphragm seals	Silicone oil AK 100, High temperature oil (Paraffin), inert oil, Vegetable oil (Neobee), see also Pages 11 and 12.
Seals — Ceramic sensor	FKM Viton, EPDM, Chemraz, Kalrez, FKM Viton cleaned for oxygen services[5], for temperature limits see Table "Seals for PMD 230 and FMD 230", Page 25
Seals — Metal sensor	FKM Viton, NBR, PTFE, FKM Viton oil and grease free, FKM Viton cleaned for oxygen services[5], for temperature limits see Table "Seals for PMD 235, FMD 630 and FMD 633", Page 25
O-Ring for cover seal	NBR
Mounting accessories	Monting set with screws AISI 304 (1.4301)

3) For devices approved for use in hazardous areas, see Safety Instructions (XA…), Installation Drawing or Control Drawing (ZD…).
4) With display max. +85°C (+185°F)
5) Observe operating limits for oxygen service for non-metallic materials.

Display and Operating Interface

Display and operating module

Display (optional)	Plug-in display module with four-character pressure display and bar graph (For 4…20 mA instruments, the bar graph shows the actual current value and for fieldbus instruments, it displays the relationship between the current measured value and the set measuring range.)
Operation	via four keys on the instrument

Communication interface

Handheld terminal	HART protocol: Universal HART Communicator DXR 275 The HART Communicator can be connected anywhere along the 4…20 mA line. Minimum line resistance: 250 Ω
PC	Connection via Commubox FXA 191 to a serial interface of a PC with an operating programme, e.g. Commuwin II. The Commubox can be connected anywhere along the 4…20 mA line. Minimum line resistance: 250 Ω
PROFIBUS-PA	via segment coupler or PLC or PC with a PROFIBUS interface card and operating programme, e.g. Commuwin II
Foundation Fieldbus	Foundation Fieldbus H1: – Connection via H1 interface card to a PC with configuration programme Foundation Fieldbus HSE: – Connection via linking device FF-HSE/FF-H1 to a PC with configuration programme

Power supply

4…20 mA with and without HART protocol

Power voltage	Non hazardous area: 11.5…45 V DC, EEx ia: 11.5…30 V DC, EEx nA: 11.5…30 V DC, EEx d: 13…30 V DC 3)
Residual ripple	– no effect for 4…20 mA up to ±5% residual ripple within permissible voltage range – with communication, HART protocol: U_{PP} smaller 0.2 V (0.47 Hz to 125 Hz) and U_{eff} smaller 2.2 mV (500 Hz bis 10 kHz)

PROFIBUS-PA

Power voltage	Non hazardous area: 9…32 V DC, EEx ia: 9…24 V DC, EEx nA: 9…32 V DC 3)
Current consumption	10 mA ±1 mA 3)
Power up current	corresponds to Table 4, IEC 61158-2

Foundation Fieldbus

Power voltage	Non hazardous area: 9…32 V DC, EEx ia: 9…24 V DC, EEx d: 9…32 V DC, EEx nA: 9…32 V DC 3)
Current consumption	11 mA ±1 mA 3)
Power up current	corresponds to Table 4, IEC 61158-2

Certificates and Approvals

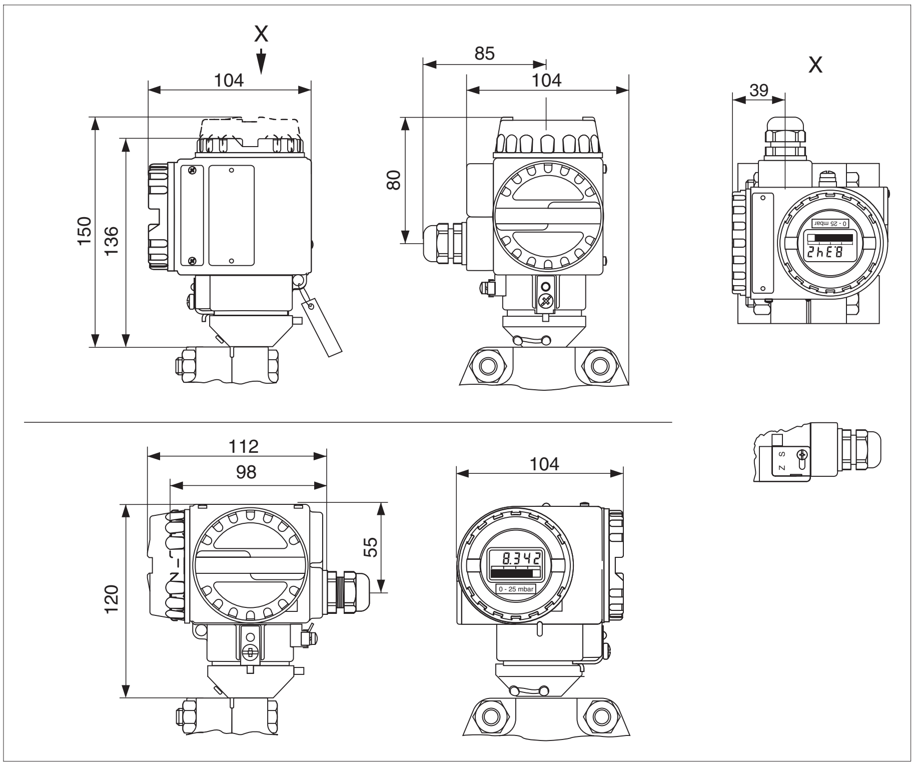
Pressure Equipment Directive	– This device conforms to Article 3(3) of the EC Directive 97/23/EG (Pressure Equipment Directive) and is developed and produced in sound engineering practice. – PMD 235, PN 420 bar: suitable for gases in fluid group 1 – FMD 633 with pipe diaphragm seals ≥ 1.5 inch/PN40: suitable for stable gases in fluid group 1
CE Mark	By attaching the CE Mark, Endress+Hauser confirms that the instrument fullfils all the requirements of the relevant EC directives.
Protection	see Product Structure on Page 29 onwards

Supplementary Documentation

System Information Cerabar S/Deltabar S: SI 020P/00/en
Special Documentation Accessories Deltabar: SD 069P/00/en
Technical Information Deltatop and Deltaset: TI 297P/00/en
Operating Instructions Deltabar S HART: BA 174P/00/en
Operating Instructions Deltabar S PROFIBUS-PA: BA 167P/00/en
Operating Instructions Deltabar S Foundation Fieldbus: BA 212P/00/en
PROFIBUS-DP/PA, Guidelines for Planning and Comissioning: BA 034S/04/en
Foundation Fieldbus Overview, Installation and Comissioning Guidelines: BA 013S/04/en
Safety Instructions ATEX EEx II 1/2 G, EEx ia IIC T4/T6, (4…20 mA, HART): XA 002P-B/00/a3
Safety Instructions ATEX EEx II 1/2 G or 2 G, EEx ia IIC T4/T6 (PROFIBUS-PA): XA 003P-B/00/a3
Safety Instructions ATEX EEx II 2 G, EEx d IIC T5/T6 (4…20 mA, HART, Foundation Fieldbus): XA 005P-B/00/a3
Safety Instructions ATEX EEx II 1/2 G, EEx ia IIC T4/T5 (Foundation Fieldbus) : XA 089P-B/00/a3
Safety Instructions ATEX EEx II 3 G, EEx nA II T6 (4…20 mA, HART, PROFIBUS-PA, Foundation Fieldbus): XA 151P-B/00/a3
Deltabar S PROFIBUS-PA CSA IS Class I, II, III, Division 1, Groups A-G: ZD 035P/00/en
Deltabar S PROFIBUS-PA FM IS Class I, II, III, Division 1, Groups A-G: ZD 020P/00/en
Deltabar S Foundation Fieldbus CSA IS Class I, II, III, Division 1, Groups A-G: ZD 050P/00/en
Deltabar S Foundation Fieldbus FM IS Class I, II, III, Division 1, Groups A-G: ZD 049P/00/en
SD 158P/00/en
Technical Information EMC Test procedures: TI 241F/00/en

3) For devices approved for use in hazardous areas, see Safety Instructions (XA…), Installation Drawing or control Drawing (ZD…).

Housing Deltabar S



Conversion factors

- 1 mm = 0.039 in
  1 in = 25.4 mm

Deltabar S housing versions
above: housing T5 (display on top)
below: housing T4 (display on side)

- Separate electronics and connection compartments
- Can be rotated by up to 330°
- Material:
  Housing T5 (display on top):
  – Cast aluminium with protective polyester-based powder coating
  Housing T4 (display on side)
  – Cast aluminium housing with protective polyester-based powder coating
  – AISI 316L (1.4435)
- Optional cable gland or cable entry, see Product Structure

Dimensions Deltabar S PMD 230

Process connections PMD 230

Oval flange with M10 mounting pin to DIN 19213 and ¼-18 NPT connection

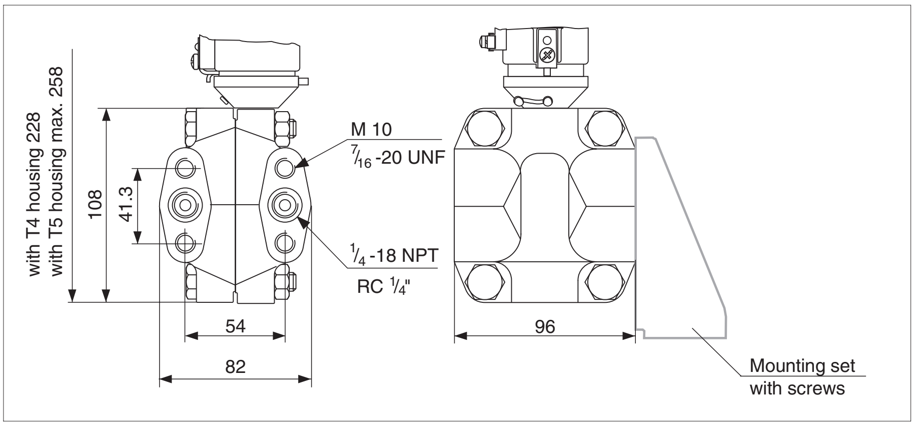
- Version A: C 22.8
- Version C: AISI 316L (1.4435)

Oval flange with $^7/_{16}$ - 20 UNF mounting pin and ¼-18 NPT connection

- Version B: C 22.8
- Version D: AISI 316L (1.4435)
- Version F: Alloy C276

Oval flange with $^7/_{16}$ - 20 UNF mounting pin and RC ¼" connection

- Version L: AISI 316L (1.4435)

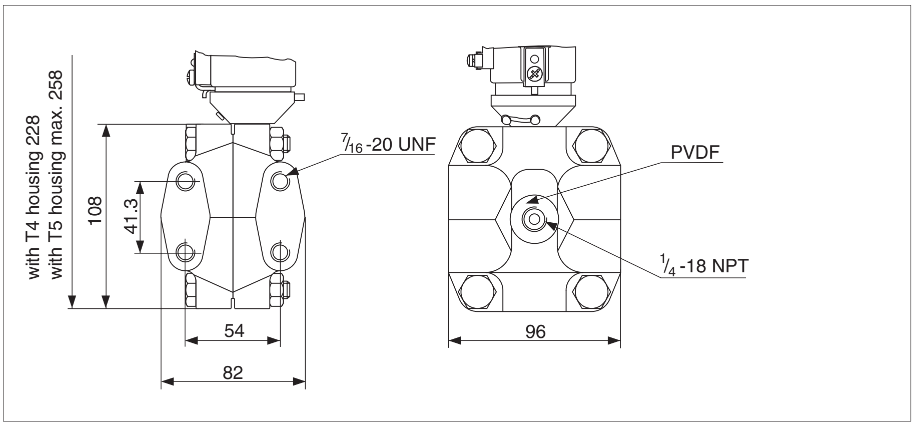


Conversion factors

- 1 mm = 0.039 in
  1 in = 25.4 mm
- 1 kg = 2.2 lbs
  1 lbs = 0.45 kg

Process connections PMD 230
Oval flange with $^7/_{16}$ - 20 UNF mounting pin and ¼-18 NPT connection (in centre of flange)

- Version G: PVDF-coated



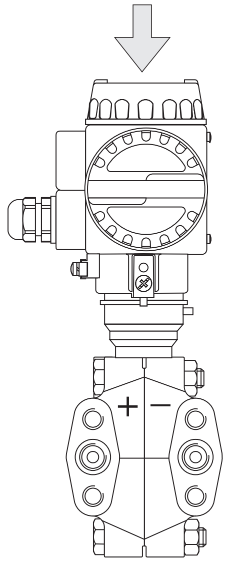
Weight PMD 230:

- Aluminium housing T5, AISI 316L flange: 4.7 kg
- Aluminium housing T4, AISI 316L flange: 4.6 kg
- Stainless steel housing T4, AISI 316L flange: 6.1 kg

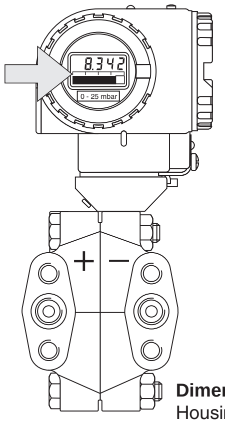
Product Structure Deltabar S PMD 230

PMD 230 Deltabar S with ceramic sensor. Differential pressure transmitter

Housing type T5
Display or cover on top,
Material: Cast aluminium with protective polyester-based powder coating



Housing type T4
Display or cover on side,
Material: Optional cast aluminium with protective polyester-based powder coating or AISI 316L



Dimensions
Housing: Page 28 above
Process connection: Page 28 below

Cable entry; Approval

K Standard, M 20x1.5
S Standard, ½ NPT
5 Standard, G ½
3 Standard, M12 PROFIBUS-PA plug
4 Standard, 7/8" FF-plug
F Standard, Harting plug Han7D, 90°
L EEx ia IIC T4/T6; ATEX II 1/2 G, M 20x1,5
6 EEx ia IIC T4/T6; ATEX II 1/2 G, ½ NPT
I EEx ia IIC T4/T6; ATEX II 1/2 G, M12 PROFIBUS-PA plug
J EEx ia IIC T4/T6; ATEX II 1/2 G, 7/8" FF plug
W FM IS, Class I,II, III, Div. 1, ½ NPT
V FM IS, Class I,II, III, Div. 1, 7/8" FF plug
2 CSA IS (non incendive), Class I, II, III, Div.1, Groups A–G, ½ NPT
B EEx nA II T6; ATEX II 3 G, M 20x1.5
N EEx nA II T6; ATEX II 3 G, ½ NPT
8 Overspill protection: WHG, M 20x1.5
Z see additional specification

Output; Housing

Code for housing without display in brackets

Aluminium housing T4, Display on top (without)	*Aluminium housing T5, Display on side (without)*	*Stainless steel housing T4, Display on side*
B 4…20 mA HART, SIL 2 (H)	U 4…20 mA HART, SIL 2 (M)	2 4…20 mA HART
C 4…20 mA (S)	W 4…20 mA (N)	
D PROFIBUS-PA (I)	P PROFIBUS-PA (X)	3 PROFIBUS-PA
F Foundation Fieldbus (G)	K Foundation Fieldbus (R)	4 Foundation Fieldbus
1 4…20 mA HART + Totalizer		

Ceramic sensor (wetted ceramic diaphragm):

	Nominal value	PN
1B	25 mbar	10 bar
2D	100 mbar	16 bar
3F	500 mbar	100 bar
3H	3 bar	100 bar
88	prepared for Deltatop/Deltaset	

Calibration and Units

1 Nominal range; mbar/bar
2 Nominal range; kPa/MPa
3 Nominal range; mm/mH_2O
4 Nominal range; inH_2O/ftH_2O
5 Nominal range; kgf/cm^2
6 Nominal range; psi
8 Adjusted for Deltatop/Deltaset
9 Adjusted; see additional spec. (adjusted from … to … unit, lin/sqrt with report)
E Customised; see additional spec. + protocol (calibrated from … to … unit, lin/sqrt with report)

Additional option

EA Basic version
ED 2x vent valve AISI 316L
EM Mounting bracket, wall/pipe
EH 2x vent valve AISI 316L + 1x mounting bracket
EQ Mounted top of manifold, pos …
ER Mounted bottom of manifold, …
FA EN10204-3.1 (wetted parts), Inspection certificate
FD EN10204-3.1, 2x vent valve, Inspection certificate
FM EN10204-3.1, mounting bracket, Inspection certificate
FH EN10204-3.1, 2x vent valve + mounting bracket, Inspection certificate
FQ EN10204-3.1, mounting bracket, Inspection certificate mounted top of manifold
FR EN10204-3.1, mounting bracket, Inspection certificate mounted bottom of manifold

Seal (wetted part)

1 FKM Viton
4 EPDM
C Chemraz
7 Kalrez
8 FKM Viton, oil- and grease-free
6 FKM Viton, cleaned for oxygen service

Process connection ¼ - 18 NPT (wetted part)
Mounting, Material

A Oval flange with M10, C 22.8
B Oval flange with $^7/_{16}$ - 20 UNF, C 22.8
C Oval flange with M10, AISI 316L
D Oval flange with $^7/_{16}$ - 20 UNF, AISI 316L
I Oval flange with M10, Alloy C276
F Oval flange with $^7/_{16}$ - 20 UNF, Alloy C276
G Oval flange with $^7/_{16}$ - 20 UNF, PVDF, p_{max} = 10 bar
L Oval flange with RC ¼, 7/16-20 UNF, AISI 316L

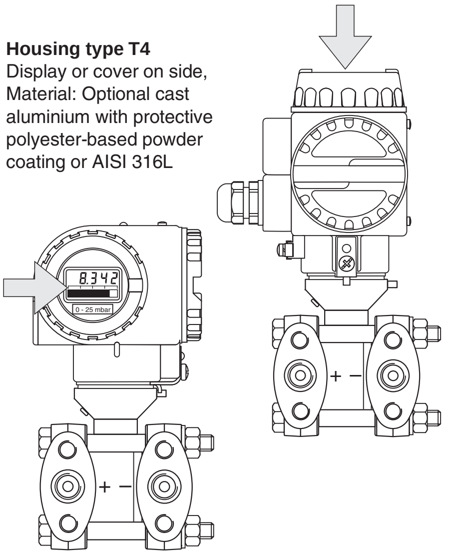
PMD 230 – | | | | | | | | Product designation

Note!
Special versions for e.g. sensor, seal etc. on request.

Product Structure Deltabar S PMD 235

Housing type T5
Display or cover on top,
Material: Cast aluminium with protective polyester-based powder coating

Housing type T4
Display or cover on side,
Material: Optional cast aluminium with protective polyester-based powder coating or AISI 316L



Dimensions
Housing: Page 28 above
Process connection: Page 32

Note!
Special versions for e.g. sensor, seal etc. on request.

PMD 235 Deltabar S with metallic sensor. Differential pressure transmitter

Cable entry; Approval

K Standard, M 20 x 1.5
S Standard, ½ NPT
5 Standard, G ½
3 Standard, M12 PROFIBUS-PA plug
4 Standard, 7/8" FF-plug
F Standard, Harting plug Han7D, 90°
L EEx ia IIC T4/T6; ATEX II 1/2 G, M 20x1.5
6 EEx ia IIC T4/T6; ATEX II 1/2 G, ½ NPT
I EEx ia IIC T4/T6; ATEX II 1/2 G, M12 PROFIBUS-PA plug
J EEx ia IIC T4/T6; ATEX II 1/2 G, 7/8" FF-plug
W FM IS, Class I,II, III, Div. 1, ½ NPT
V FM IS, Class I,II, III, Div. 1, 7/8" FF-plug
2 CSA IS (non incendive), Class I, II, III, Div.1, Groups A–G, ½ NPT
M EEx d IIC T5/T6 und ATEX II 2 G, M 20x1.5
T EEx d IIC T5/T6 und ATEX II 2 G, ½ NPT
U FM Explosion proof, Class I,II, III, Div. 1, Groups A–G, ½ NPT
1 CSA Explosion proof, Class I,II, III, Div.1, Groups B–G, ½ NPT
P TIIS Ex d IIC T6, G ½ with Ex d cable gland G ½
B EEx nA II T6; ATEX II 3 G, M 20x1.5
N EEx nA II T6; ATEX II 3 G, ½ NPT
Z see additional specification

Output; Housing
Code for housing without display in brackets

Aluminium housing T4, Display on top (without)	*Aluminium housing T5, Display on side (without)*	*Stainless steel housing T4, Display on side*
B 4…20 mA HART, SIL 2 (H)	U 4…20 mA HART, SIL 2 (M)	2 4…20 mA HART, SIL 2
C 4…20 mA (S)	W 4…20 mA (N)	
D PROFIBUS-PA (I)	P PROFIBUS-PA (X)	3 PROFIBUS-PA
F Foundation Fieldbus (G)	K Foundation Fieldbus (R)	4 Foundation Fieldbus
1 4…20 mA HART + Totalizer		

Metallic sensor (wetted metallic diaphragm)
Example: BD = Diaphragm Alloy C276, 160 bar, 100 mbar

	Material of diaphragm	**PN**		**Nominal value**
B	Diaphragm Alloy C276	160 bar	A	10 mbar
H	Diaphragm Alloy C276	420 bar	C	40 mbar
4	Diaphragm AISI 316 L (1.4404)	160 bar	D	100 mbar
5	Diaphragm AISI 316 L (1.4404)	420 bar	F	500 mbar
D	Diaphragm Monel	160 bar	H	3 bar
L	Diaphragm Monel	420 bar	L	16 bar
F	Diaphragm Tantal	160 bar	M	40 bar
N	Diaphragm Tantal	420 bar	8	Deltatop/Deltaset

Calibration; Unit

1 Nominal range; mbar/bar
2 Nominal range; kPa/MPa
3 Nominal range; mm/mH_2O
4 Nominal range; inH_2O/ftH_2O
5 Nominal range; kgf/cm^2
6 Nominal range; psi
8 Adjusted for Deltatop/Deltaset
9 Adjusted; see additional spec. (adjusted from … to … unit, lin/sqrt with report)
E Customised; see additional spec. + protocol (calibrated from … to … unit, lin/sqrt with report)
A 0.05% Platinum nominal range; mbar/bar
B 0.05% Platinum nominal range; kPa/MPa
C 0.05% Platinum nominal range; psi

Code for Additional option, see Page 31

Code for Seal (wetted part), see Page 31

Code for Process connection ¼ - 18 NPT (wetted part), Mounting, Material, see Page 31

PMD 235 – | | | | | | | | Product designation

Product Structure Deltabar S PMD 235 (Continuation)

PMD 235 Deltabar S with metallic sensor. Differential pressure transmitter

Additional options

EA Basic version
ED 2x vent valve AISI 316L
EM Mounting bracket wall/pipe
EH 2x vent valve AISI 316L + 1x mounting bracket
EQ Mounted top of manifold, pos …
ER Mounted bottom of manifold, pos …
FA EN10204-3.1 (wetted parts), Inspection certificate
FD EN10204-3.1, 2x vent valve, Inspection certificate
FM EN10204-3.1, mounting bracket, Inspection certificate
FH EN10204-3.1, 2x vent valve + bracket, Inspection certificate
FQ EN10204-3.1, mounted top of manifold, Inspection certificate
FR EN10204-3.1, mounted bottom of manifold, Inspection certificate
NA EN10204-3.1, NACE MR0175, Inspection certificate (wetted parts)
ND EN10204-3.1, NACE MR0175 + 2x vent valve, Inspection certificate (wetted parts)
NH EN10204-3.1, NACE MR0175 + 2x vent valve + 1x mounting bracket, Inspection certificate (wetted parts)
NM EN10204-3.1, NACE MR0175 + 1x mounting bracket, Inspection certificate (wetted parts)
NQ EN10204-3.1, NACE MR0175, mounted top of manifold
NR EN10204-3.1, NACE MR0175, mounted bottom of manifold

Seal (wetted part)

1 FKM Viton
2 NBR
3 PTFE
8 FKM Viton, oil- and grease-free
6 FKM Viton, cleaned for oxygen service
H Copper ring seal (with process connection for diaphragm seal only, Version H)

Process connection ¼ - 18 NPT (wetted part)
Mounting, Material

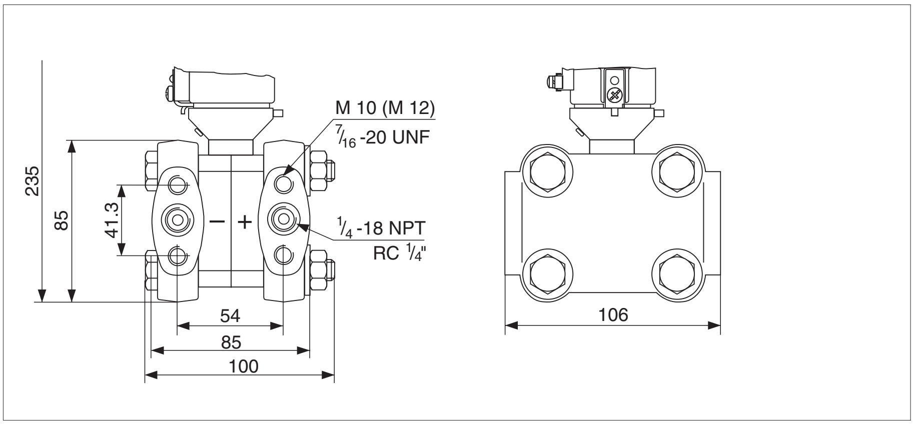
A Oval flange with M10 (M12 bei PN 420), C 22.8
B Oval flange with $^{7}/_{16}$ - 20 UNF, C 22.8
C Oval flange with M10 (M12 bei PN 420), AISI 316L
D Oval flange with $^{7}/_{16}$ - 20 UNF, AISI 316L
I Oval flange with M10 (M12 bei PN 420), Alloy C276
F Oval flange with $^{7}/_{16}$ - 20 UNF, Alloy C276
L Oval flange RC ¼", $^{7}/_{16}$ - 20 UNF, AISI 316L
H Oval flange for diaphragm seal, $^{7}/_{16}$ - 20 UNF, AISI 316L

PMD 235– ☐☐☐☐☐☐☐ Product designation

Dimensions Deltabar S PMD 235

Process connections PMD 235
for measuring ranges: 10 mbar and 40 mbar

- Oval flange with M10 mounting pin (M12 for PN 420) to DIN 19213 and ¼-18 NPT connection
- Flange with $^{7}/_{16}$ - 20 UNF mounting pin and ¼-18 NPT connection
- Oval flange with $^{7}/_{16}$ - 20 UNF mounting pin and RC ¼" connection

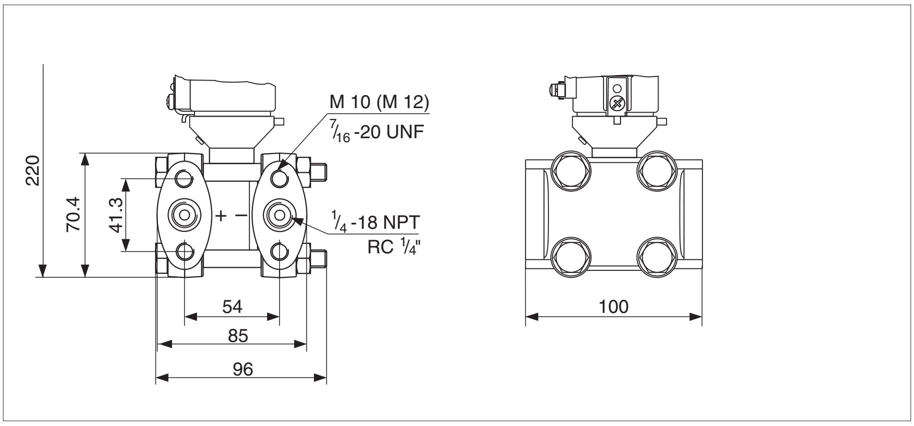


Conversion factors

- 1 mm = 0.039 in
  1 in = 25.4 mm
- 1 kg = 2.2 lbs
  1 lbs = 0.45 kg

Process connections PMD 235
for measuring ranges:
100 mbar, 500 mbar, 3 bar, 16 bar and 40 bar

- Oval flange with M10 mounting pin (M12 for PN 420) to DIN 19213 and ¼-18 NPT connection
- Flange with $^{7}/_{16}$ - 20 UNF mounting pin and ¼-18 NPT connection
- Oval flange with $^{7}/_{16}$ - 20 UNF mounting pin and RC ¼" connection

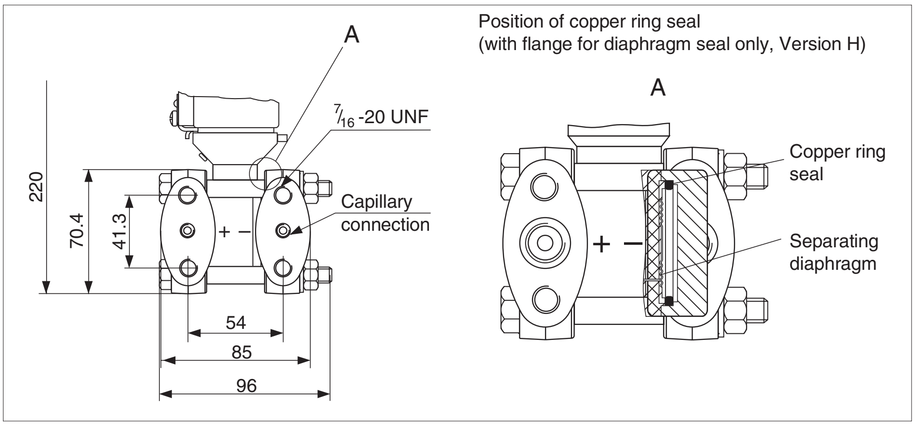


Process connections PMD 235
for standard measuring ranges:
100 mbar, 500 mbar, 3 bar, 16 bar and 40 bar

- Oval flange for diaphragm seal with $^{7}/_{16}$ - 20 UNF mounting pin

Weight PMD 235

- Aluminium housing T5 with flange: 3.9 kg
- Aluminium housing T4 with flange: 3.8 kg
- Stainless steel housing T4 with flange: 5.2 kg

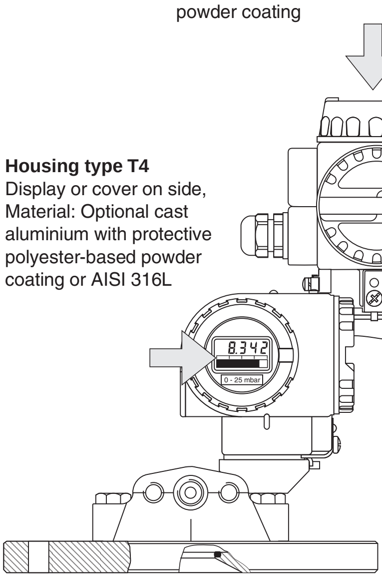


Product Structure Deltabar S FMD 230

Flush-Mounted Ceramic

Housing type T5
Display or cover on top,
Material: Cast aluminium with protective polyester-based powder coating

Housing type T4
Display or cover on side,
Material: Optional cast aluminium with protective polyester-based powder coating or AISI 316L



Dimensions
Housing: Page 28 above
Process connection: Pages 35 to 36

Note!
Special versions for e.g. sensor, seal etc. on request.

FMD 230 Deltabar S differential pressure transmitter with flush-mounted ceramic for level

Cable entry; Approval
K Standard, M 20x1.5
S Standard, ½ NPT
5 Standard, G ½
3 Standard, M12 PROFIBUS-PA plug
4 Standard, 7/8" FF-plug
F Standard, Harting plug Han7D, 90°
L EEx ia IIC T4/T6; ATEX II 1/2 G, M 20x1.5
6 EEx ia IIC T4/T6; ATEX II 1/2 G, ½ NPT
I EEx ia IIC T4/T6; ATEX II 1/2 G, M12 PROFIBUS-PA plug
J EEx ia IIC T4/T6; ATEX II 1/2 G, 7/8" FF-plug
W FM IS, Class I,II, III, Div. 1, ½ NPT
V FM IS, Class I,II, III, Div. 1, 7/8" FF-plug
2 CSA IS (non incendive), Class I, II, III, Div.1, Groups A–G, ½ NPT
B EEx nA II T6; ATEX II 3 G, M 20x1.5
N EEx nA II T6; ATEX II 3 G, ½ NPT
8 Overspill protection: WHG, M 20x1.5
Z see additional specification

Output; Housing
Code for housing without display in brackets

Aluminium housing T4, Display on top (without)	*Aluminium housing T5, Display on side (without)*	*Stainless steel housing T4, Display on side*
B 4…20 mA HART (H)	U 4…20 mA HART (M)	2 4…20 mA HART
C 4…20 mA (S)	W 4…20 mA (N)	
D PROFIBUS-PA (I)	P PROFIBUS-PA (X)	3 PROFIBUS-PA
F Foundation Fieldbus (G)	K Foundation Fieldbus (R)	4 Foundation Fieldbus

Ceramic sensor (wetted ceramic diaphragm):

	Nominal value	**PN**
2D	100 mbar	16 bar
3F	500 mbar	100 bar
3H	3 bar	100 bar

Calibration and Units
1 Nominal range; mbar/bar
2 Nominal range; kPa/MPa
3 Nominal range; mm/mH_2O
4 Nominal range; inH_2O/ftH_2O
5 Nominal range; kgf/cm^2
6 Nominal range; psi
9 Adjusted; see additional spec. (adjusted from … to … unit, lin/sqrt with report)
E Customised; see additional spec. + protocol (calibrated from … to … unit, lin/sqrt with report)

Additional option
EA Basic version
EC 1x vent valve
FA EN10204-3.1 (wetted parts), Inspection certificate
FC EN10204-3.1, 1x went valve, Inspection certificate

Seal (wetted part)
1 FKM Viton
4 EPDM
C Chemraz
7 Kalrez
8 FKM Viton, cleaned for oxygen service
6 FKM Viton, oil- and grease-free

Code for Process connection (wetted part), Mounting, Material, see Page 35

Code for Process connection Positive Side, Material, see Pages 35 to 36

FMD 230– [ ][ ][ ][ ][ ][ ][ ][ ] Product designation

Product Structure Deltabar S FMD 230 (Continuation)

Flush-Mounted Ceramic

FMD 230 Deltabar S differential pressure transmitter with flush-mounted ceramic for level

Process connection (wetted part)/Mounting, Material

A with ¼-18 NPT / flange with M 10, C22.8
B with ¼-18 NPT / flange with $^7/_{16}$ - 20 UNF, C22.8
C with ¼-18 NPT / flange with M 10, AISI 316L
D with ¼-18 NPT / flange with $^7/_{16}$ - 20 UNF, AISI 316L
F with ¼-18 NPT / flange with $^7/_{16}$ - 20 UNF, Alloy C276
I with ¼-18 NPT / flange with M 10, Alloy C276
L with RC ¼" / $^7/_{16}$ - 20 UNF, AISI 316L

Process connection, Positive side, Material

Flanges, connection dimensions according to EN 1092-1
BK DN 80 PN 10-40, AISI 316L
BN DN 80 PN 10-40, Alloy C276
BM DN 80 PN 10-40, ECTFE-coated
BU DN 100 PN 10-16, AISI 316L
BW DN 100 PN 10-16, Alloy C276
BV DN 100 PN 10-16, ECTFE-coated
BR DN 100 PN 25-40, AISI 316L
BT DN 100 PN 25-40, Alloy C276
BS DN 100 PN 25-40, ECTFE-coated

Flanges, connection dimensions according to ANSI B16.5
DK ANSI 3" 150 lbs, AISI 316L
DN ANSI 3" 150 lbs, Alloy C276
DM ANSI 3" 150 lbs, ECTFE-coated
DR ANSI 4" 150 lbs, AISI 316L
DT ANSI 4" 150 lbs, Alloy C276
DS ANSI 4" 150 lbs, ECTFE-coated

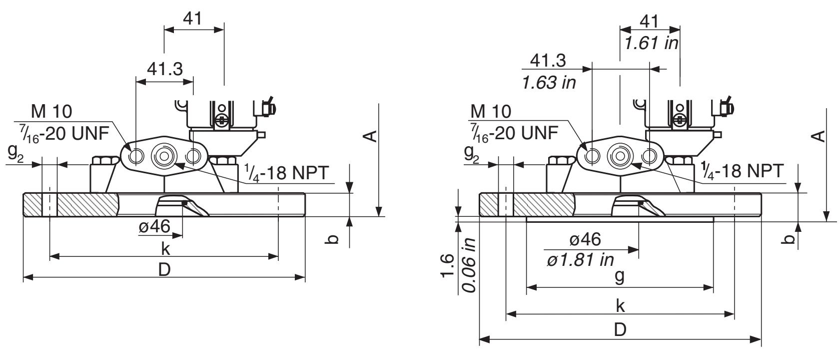
Flanges, connection dimensions according to JIS
NK Flange JIS 10K 80 A, AISI 316L
NN Flange JIS 10K 80 A, Alloy C276
NM Flange JIS 10K 80 A, ECTFE-coated

WH Sanitary tank spud with 2" extension, negative side ¼-18 NPT without mounting parts, AISI 316L

FMD 230- | | | | | | | | | | | Product designation

Dimensions Deltabar S FMD 230

Conversion factors
- 1 mm = 0.039 in
  1 in = 25.4 mm
- 1 kg = 2.2 lbs
  1 lbs = 0.45 kg
- 1 bar = 14.5 psi
  1 psi = 0.069 bar



EN flange, connection dimensions according to EN 1092-1, contact face type form A for AISI 316L (1.4435) and Alloy C276

Instrument	Code	Diaphragm material	Pipe: Nominal diameter DN (mm)	Flange: Nominal pressure PN (bar)	Flange: Diameter D (mm)	Flange: Thickness b (mm)	Bolt holes: Number	Bolt holes: Diameter g_2 (mm)	Bolt holes: Hole circle k (mm)	Installation height A (mm)	Weight (kg 1))
FMD 230	BK	AISI 316L									8.3
FMD 230	BN	Alloy C276	80	10–40	200	24	8	18	160	210	9.0
FMD 230	BM	ECTFE-coated									8.3
FMD 230	BU	AISI 316L									8.1
FMD 230	BW	Alloy C276	100	10–16	220	20	8	18	180	210	8.7
FMD 230	BV	ECTFE-coated									8.1
FMD 230	BR	AISI 316L									10.0
FMD 230	BT	Alloy C276	100	25–40	235	24	8	22	190	210	10.9
FMD 230	BS	ECTFE-coated									10.0

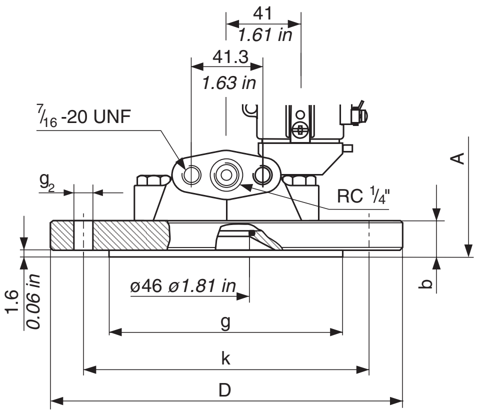
1) Weight for flange (material of the negative side AISI 316L) and aluminium housing type T5 (display on top)

ANSI flange, connection according to ANSI B 16.5, contact face type: raised face RF

Instrument	Code	Diaphragm material	Pipe: Nominal diameter d (*in* / mm)	Flange: Nominal pressure PN (*lb/sq. in*)	Flange: Diameter D (*in* / mm)	Flange: Thickness b (*in* / mm)	Flange: Contact face diameter g (*in* / mm)	Bolt holes: Number	Bolt holes: Diameter g_2 (*in* / mm)	Bolt holes: Hole circle k (*in* / mm)	Installation height A (*in* / mm)	Weight (*kg 1)*)
FMD 230	DK	AISI 316/316L	*3*	*150*	*7.5* 190.5	*0.94* 23.9	*5* 127	*4*	*0.75* 19.1	*6* 152.4	*8.35* 212	*7.5*
FMD 230	DN	Alloy C276	*3*	*150*	*7.5* 190.5	*0.94* 23.9	*5* 127	*4*	*0.75* 19.1	*6* 152.4	*8.35* 212	*7.8*
FMD 230	DM	ECTFE-coated	*3*	*150*	*7.5* 190.5	*0.94* 23.9	*5* 127	*4*	*0.75* 19.1	*6* 152.4	*8.35* 212	*7.5*
FMD 230	DR	AISI 316/316L	*4*	*150*	*9* 228.6	*0.94* 23.9	*6.19* 157.2	*8*	*0.75* 19.1	*7.5* 190.5	*8.35* 212	*9.4*
FMD 230	DT	Alloy C276	*4*	*150*	*9* 228.6	*0.94* 23.9	*6.19* 157.2	*8*	*0.75* 19.1	*7.5* 190.5	*8.35* 212	*10.2*
FMD 230	DS	ECTFE-coated	*4*	*150*	*9* 228.6	*0.94* 23.9	*6.19* 157.2	*8*	*0.75* 19.1	*7.5* 190.5	*8.35* 212	*9.4*

1) Weight for flange (material of the negative side AISI 316L) and aluminium housing type T5 (display on top)

Dimensions Deltabar S FMD 230

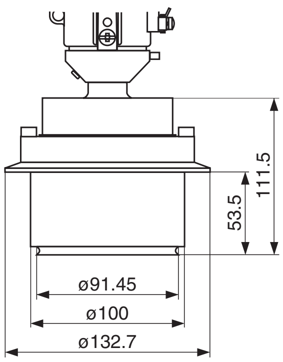


Conversion factors
- 1 mm = 0.039 in
  1 in = 25.4 mm
- 1 kg = 2.2 lbs
  1 lbs = 0.45 kg
- 1 bar = 14.5 psi
  1 psi = 0.069 bar

JIS flange 10 K 80 A, connection dimensions according to JIS B2210/B2238, contact face type: raised face RF

Instrument	Code		Pipe	Flange				Bolt holes				
		Diaphragm material	Nominal diameter	Nominal pressure	Diameter	Thickness	Contact face diameter	Number	Diameter	Hole circle	Installation height	Weight
			d	PN	D	b	g		g2	k	A	
			in		*in* mm	*in* mm	*in* mm		*in* mm	*in* mm	*in* mm	*kg* 1)
FMD 230	NK	AISI 316L	*3*	*10 K*	*7.32* 185	*0.71* 18	*5* 127	*8*	*0.75* 19	*5.9* 150	*8.12* 208	*5.6*
FMD 230	NN	Alloy C276	*3*	*10 K*	*7.32* 185	*0.71* 18	*5* 127	*8*	*0.75* 19	*5.9* 150	*8.12* 208	*5.9*
FMD 230	NM	ECTFE-coated	*3*	*10 K*	*7.32* 185	*0.71* 18	*5* 127	*8*	*0.75* 19	*5.9* 150	*8.12* 208	*5.6*

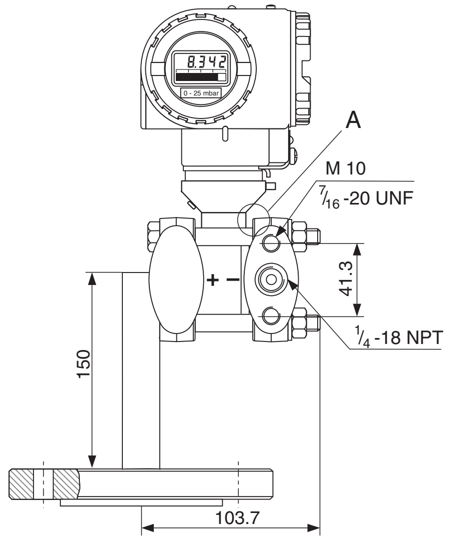
1) Weight for flange (material of the negative side AISI 316L) and aluminium housing type T5 (display on top)



Sanitary connection with 2" extension
negative side ¼ -18 NPT
- Version WH: AISI 316L (1.4435)

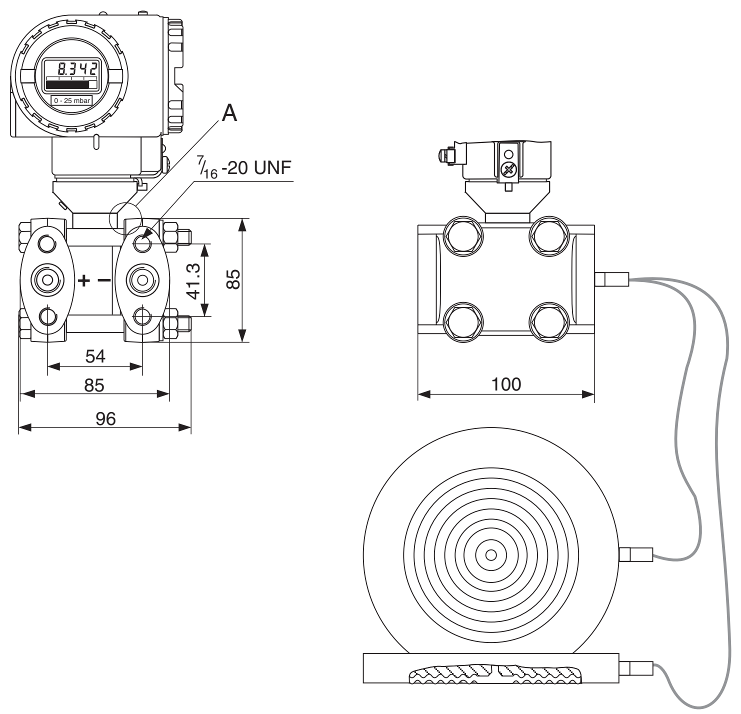
Mechanical Construction with Diaphragm Seal

Conversion factors
- 1 mm = 0.039 in
  1 in = 25.4 mm
- 1 kg = 2.2 lbs
  1 lbs = 0.45 kg

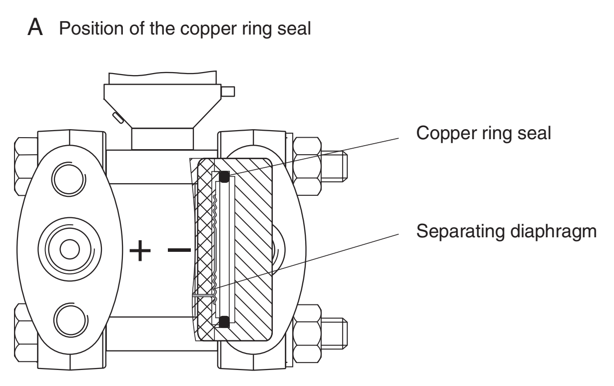


Deltabar S FMD 630 with direct diaphragm seal
Dimensions
- Housing: Page 29 above
- Process connections: Pages 40 to 41

Conversion factors
- 1 mm = 0.039 in
  1 in = 25.4 mm
- 1 kg = 2.2 lbs
  1 lbs = 0.45 kg



Deltabar S FMD 633 with capillary tubing
Dimensions
- Housing: Page 29 above
- Process connections: Pages 44 to 48



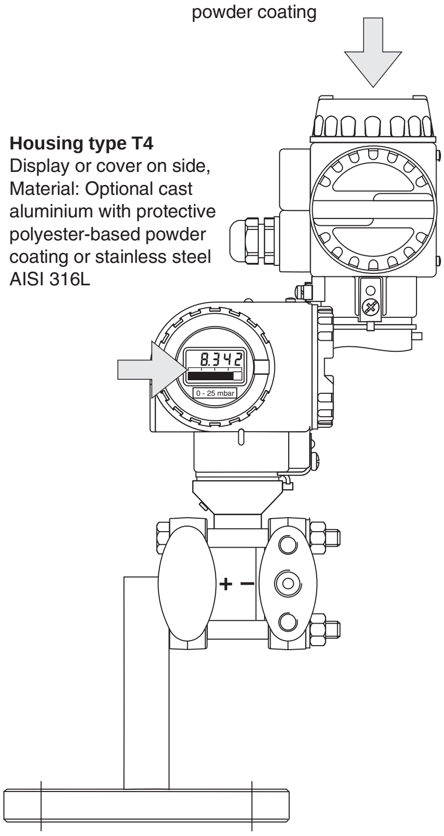
Copper ring seal
for Deltabar S FMD 630, FMD 633

Product Structure Deltabar S FMD 630

FMD 630 Deltabar S differential pressure transmitter with direct diaphragm seal for level

Housing type T5
Display or cover on top,
Material: Cast aluminium with protective polyester-based powder coating

Housing type T4
Display or cover on side,
Material: Optional cast aluminium with protective polyester-based powder coating or stainless steel AISI 316L



Dimensions
Housing : Page 28 above
Process connection:
Pages 40 to 41

Note!
Special versions for e.g. sensor, seal etc. on request.

Cable entry; Approval
- K Standard, M 20x1,5
- S Standard, ½ NPT
- 5 Standard, G ½
- 3 Standard, M12 PROFIBUS-PA plug
- 4 Standard, 7/8" FF-plug
- F Standard, Harting plug Han7D, 90°
- L EEx ia IIC T4/T6; ATEX II 1/2 G, M 20x1.5
- 6 EEx ia IIC T4/T6; ATEX II 1/2 G, ½ NPT
- I EEx ia IIC T4/T6; ATEX II 1/2 G, M12 PROFIBUS-PA plug
- J EEx ia IIC T4/T6; ATEX II 1/2 G, 7/8" FF-plug
- W FM IS, Class I,II, III, Div. 1 , ½ NPT
- V FM IS, Class I,II, III, Div. 1, 7/8" FF-plug
- 2 CSA IS (non incendive), Class I, II, III, Div.1, Groups A–G, ½ NPT
- M EEx d IIC T5/T6; ATEX II 2 G, M 20 x 1.5
- T EEx d IIC T5/T6; ATEX II 2 G, ½ NPT
- U FM Explosion proof Class I, II, III, Div. 1, Groups A–G, ½ NPT
- 1 CSA Explosion proof Class I,II, III, Div.1, Groups B–G, ½ NPT
- P TIIS Ex d IIC T6, G ½ with Ex d cable gland G ½
- B EEx nA II T6; ATEX II 3 G, M 20x1.5
- N EEx nA II T6; ATEX II 3 G, ½ NPT
- Z see additional specification

Output; Housing
Code for housing without display in brackets

Aluminium housing T4, Display on top (without)	*Aluminium housing T5, Display on side (without)*	*Stainless steel housing T4, Display on side*
B 4…20 mA HART, SIL 2 (H)	U 4…20 mA HART, SIL 2 (M)	2 4…20 mA HART, SIL 2
C 4…20 mA (S)	W 4…20 mA (N)	
D PROFIBUS-PA (I)	P PROFIBUS-PA (X)	3 PROFIBUS-PA
F Foundation Fieldbus (G)	K Foundation Fieldbus (R)	4 Foundation Fieldbus

Metallic sensor (wetted metallic diaphragm on negative side)

	Nominal value	**PN**
4D	100 mbar	160 bar
4F	500 mbar	160 bar
4H	3 bar	160 bar
4L	16 bar	160 bar

Calibration and Units
- 1 Nominal range; mbar/bar
- 2 Nominal range; kPa/MPa
- 3 Nominal range; mm/mH_2O
- 4 Nominal range; inH_2O/ftH_2O
- 5 Nominal range; kgf/cm^2
- 6 Nominal range; psi
- 9 Adjusted; see additional spec. (adjusted from … to … unit, lin/sqrt with report)
- E Customised; see additional spec. + protocol (calibrated from … to … unit, lin/sqrt with report)

Additional option
- EA Basic version
- EC 1x vent valve
- FA EN10204-3.1 (wetted parts), Inspection certificate
- FC EN10204-3.1, 1x vent valve, Inspection certificate
- NA EN10204-3.1, NACE MR0175, Inspection certificate (wetted parts)
- NC EN10204-3.1, NACE MR0175 + 1x vent valve, Inspection certificate (wetted parts)

Seal (wetted part)
see Page 39

Code for Process connection $^1/_4$ - 18 NPT, wetted material, see Page 39

Code for Process connection Positive Side (wetted part, AISI 316L), see Page 39
Dimensions, see Page 41

Diaphragm seal: Diaphragm material and Fill fluid (always with extension in AISI 316L), see Page 39

FMD 630 – | | | | | | | | | | Product designation

Product Structure Deltabar S FMD 630 (Continuation)

FMD 630 Deltabar S differential pressure transmitter with direct diaphragm seal for level

Seal (wetted part)
1 FKM Viton
2 NBR
3 PTFE
8 FKM Viton, oil and grease free
6 FKM Viton, cleaned for oxygen services

Process connection $^1/_4$ - 18 NPT, wetted material
A Flange with M 10, Steel C 22.8
B Flange with $^7/_{16}$ - 20 UNF, Steel C 22.8
C Flange with M 10, Stainless steel AISI 316L
D Flange with $^7/_{16}$ - 20 UNF, Stainless steel AISI 316L
H Flange for diaphragm seal, Stainless steel AISI 316L
L Flange RC ¼", $^7/_{16}$ - 20 UNF, Stainless steel AISI 316L

Process connection Positive Side (wetted part), Material AISI 316L, see Pages 40 and 41

Flanges, connection dimensions according to EN 1092-1/DIN 2527
A DN 50, PN 10–40 B1, AISI 316L
B DN 80, PN 10–40 B1, AISI 316L
C DN 80, PN 10–40 B1, AISI 316L, extension 50 mm
D DN 80, PN 10–40 B1, AISI 316L, extension 100 mm
E DN 80, PN 10–40 B1, AISI 316L, extension 200 mm
H DN 100, PN 10–16 A, AISI 316L
G DN 100, PN 25–40 B1, AISI 316L

Flanges, connection dimensions according to ANSI B16.5
P 2", 150 lbs RF, AISI 316/316L
R 3", 150 lbs RF, AISI 316/316L
S 3", 150 lbs RF, AISI 316/316L, extension 2"
T 3", 150 lbs RF, AISI 316/316L, extension 4"
U 3", 150 lbs RF, AISI 316/316L, extension 8"
W 4", 300 lbs RF, AISI 316/316L

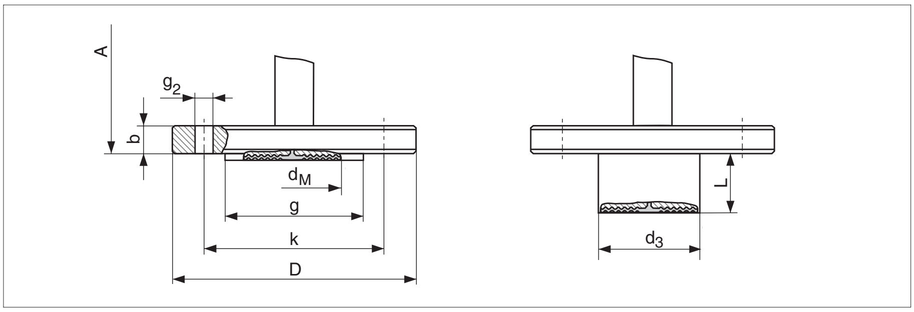
Flanges, connection dimensions according to JIS
1 JIS 10K 50A, AISI 316L
2 JIS 10K 80A, AISI 316L
3 JIS 10K 100A, AISI 316L

Diaphragm seal: Diaphragm material and Fill fluid (always with extension AISI 316L)
1 Diaphragm AISI 316L, Silicon oil
4 Diaphragm AISI 316L, high-temperature oil
5 Diaphragm AISI 316L, oil for oxygen application
2 Diaphragm AISI 316L, vegetable oil
A Diaphragm Alloy C276, Silicon oil
D Diaphragm Alloy C276, high-temperature oil
F Diaphragm Tantalum, Silicon oil
G Diaphragm Tantalum, high-temperature oil

FMD 630 – [ ][ ][ ][ ][ ][ ][ ][ ][ ][ ] Product designation

Dimensions Deltabar S FMD 630

Conversion factors
- 1 mm = 0.039 in
  1 in = 25.4 mm
- 1 kg = 2.2 lbs
  1 lbs = 0.45 kg
- 1 bar = 14.5 psi
  1 psi = 0.069 bar



Note!
Specifications for the "T_K Ambient" and "T_K Process" are listed in the following tables. These temperature coefficients apply to silicone oil and the membrane material AISI 316L.

For other filling oils, this temperature coefficient must be multiplied by the T_K correction factor of the corresponding filling oil. For the T_K correction factors, see also Page 11, section "Diaphragm seal filling oils".

Diaphragm seal flange, connection dimensions according to EN 1092-1/DIN 2527, Material: AISI 316L (1.4435)

Instrument	Code	Pipe	Flange						Bolt holes			Diaphragm seal				
		Nominal diameter	Nominal pressure	Diameter	Thickness	Raised face	Extension length	Extension diameter	Quantity	Diameter	Hole circle	max. diaphragm diameter	Ambient	Process	Installation height	Weight
		DN	PN	D	b	g	L	d_3		g_2	k	d_M	TK		A	3)
		mm	bar	mm	mm	mm	mm	mm		mm	mm	mm	mbar/10K		mm	kg
FMD 630	A	50	10–40[1)]	165	20	102	—	—	4	18	125	59	+3.02	+1.15	360	9
FMD 630	C	80	10–40[1)]	200	24	138	—	—	8	18	160	89	+0.23	+0.11	360	11
FMD 630	D	80	10–40[2)]	200	24	—	50	76	8	18	160	72	+0.23	+0.11	360	13
FMD 630	E	80	10–40[2)]	200	24	—	100	76	8	18	160	72	+0.23	+0.11	360	15
FMD 630	F	80	10–40[2)]	200	24	—	200	76	8	18	160	72	+0.23	+0.11	360	18
FMD 630	H	100	10–16	220	20	—	—	—	8	18	180	89	+0.23	+0.11	360	13
FMD 630	G	100	25–40[1)]	235	24	162	—	—	8	22	190	89	+0.23	+0.11	360	13

1) Form B1 according to EN 1092-1
2) Form B1 according to EN 1092-1, Form D according to 2527
4) Weight for FMD 630 with aluminium housing (display on top)

Dimensions Deltabar S FMD 630 (Continuation)

Diaphragm seal flange, dimensions according to ANSI B 16.5, Material: AISI 316/316L

Instrument	Code	Pipe	Flange						Bolt holes			Diaphragm seal				
		Nominal diameter	Nominal pressure	Diameter	Diameter	Raised face	Extension length	Extension diameter	Quantity	Diameter	Hole circle	max. diaphragm diameter	Ambient	Process	Installation height	Weight
		d	PN	D	b	g	L	d_3		g_2	k	d_M	TK		A	2)
		in	*lb/sq. in*	*in*	*in*	in	*in*	*in*		*in*	*in*	*in*			*in*	
				mm	mm	mm	mm	mm		mm	mm	mm	mbar/10 K		mm	kg
FMD 630	P	*2*	*150*	*6* 152.4	*0.75* 19.1	3.62 91.9	—	—	*4*	*0.75* 19.1	*4.75* 120.7	*2.32* 59	+3.02	+1.15	*14.2* 360	9
FMD 630	R	*3*	*150*	*7.5* 190.5	*0.94* 23.9	5 127	—	—	*4*	*0.75* 19.1	*6* 152.4	*3.50* 89	+0.23	+0.11	*14.2* 360	11
FMD 630	S	*3*	*150*	*7.5* 190.5	*0.94* 23.9	5 127	*2* 50.8	*2.99* 75.9	*4*	*0.75* 19.1	*6* 152.4	*2.83* 72	+0.23	+0.11	*14.2* 360	13
FMD 630	T	*3*	*150*	*7.5* 190.5	*0.94* 23.9	5 127	*4* 101.6	*2.99* 75.9	*4*	*0.75* 19.1	*6* 152.4	*2.83* 72	+0.23	+0.11	*14.2* 360	15
FMD 630	U	*3*	*150*	*7.5* 190.5	*0.94* 23.9	5 127	*8* 203.2	*2.99* 75.9	*4*	*0.75* 19.1	*6* 152.4	*2.83* 72	+0.23	+0.11	*14.2* 360	18
FMD 630	W	*4*	*300*	*10* 254	*1.25* 31.8	6.19 157.2	—	—	*8*	*0.88* 22.4	*7.88* 200.2	*3.50* 89	+0.23	+0.11	*14,2* 360	13

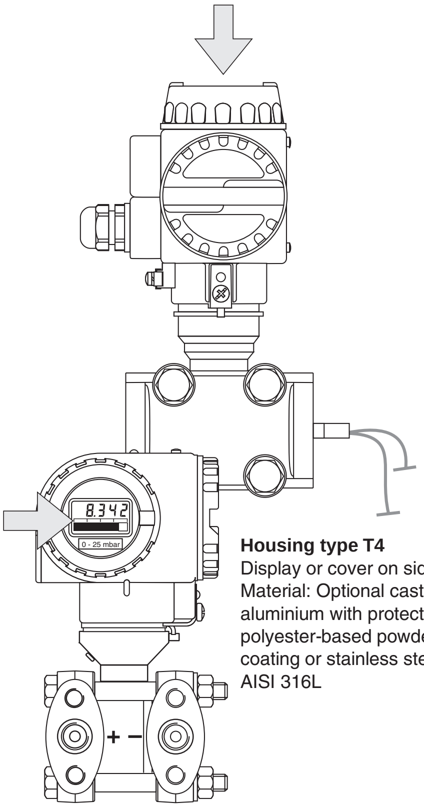
Diaphragm seal flange, dimensions according to JIS B2238, Material: AISI 316L (1.4435)

Instrument	Code	Pipe	Flange						Bolt holes			Diaphragm seal				
		Nominal diameter	Nominal pressure	Diameter	Diameter	Raised face	Extension length	Extension diameter	Quantity	Diameter	Hole circle	max. diaphragm diameter	Ambient	Process	Installation height	Weight
		DN	PN	D	b	g	L	d_3		g_2	k	d_M	TK		A	2)
		mm		mm	mm	mm	mm	mm		mm	mm	mm	mbar/10 K		mm	kg
FMD 630	1	50	10 K	155	16	96	—	—	4	19	120	59	+3.02	+1,15	356	9
FMD 630	2	80	10 K	185	18	126	—	—	8	19	150	89	+0.23	+0.11	358	11
FMD 630	3	100	10 K	210	18	151	—	—	8	19	175	89	+0.23	+0.11	358	13

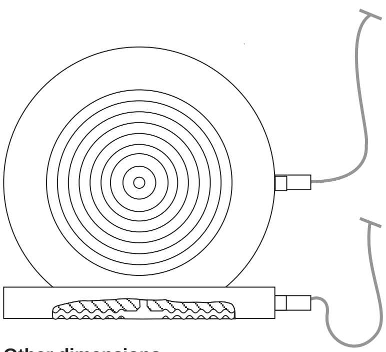
2) Weight for process connection and stainless steel housing type 5 (display on top).

Product Structure Deltabar S FMD 633

Housing type T5
Display or cover on top,
Material: Cast aluminium with protective polyester-based



Housing type T4
Display or cover on side,
Material: Optional cast aluminium with protective polyester-based powder coating or stainless steel AISI 316L



Other dimensions
Housing: Page 29 above
Process connection: Pages 44 to 48

Note!
Special versions for e.g. sensor, seal etc. on request.

FMD 633 Deltabar S differential pressure transmitter, with capillary tubing for level

Cable entry; Approval

- K Standard, M 20x1.5
- S Standard, ½ NPT
- 5 Standard, G ½
- 3 Standard, M12 PROFIBUS-PA plug
- 4 Standard, 7/8" FF-plug
- F Standard, Harting plug Han7D, 90°
- L EEx ia IIC T4/T6; ATEX II 1/2 G, M 20x1.5
- 6 EEx ia IIC T4/T6; ATEX II 1/2 G, ½ NPT
- I EEx ia IIC T4/T6; ATEX II 1/2 G, M12 PROFIBUS-PA plug
- J EEx ia IIC T4/T6; ATEX II 1/2 G, 7/8" FF-plug
- W FM IS, Class I,II, III, Div. 1, ½ NPT
- V FM IS, Class I,II, III, Div. 1, 7/8" FF-plug
- 2 CSA IS (non incendive), Class I, II, III, Div.1, Groups A–G, ½ NPT
- M EEx d IIC T5/T6; ATEX II 2 G, M 20x1.5
- T EEx d IIC T5/T6; ATEX II 2 G, ½ NPT
- U FM Explosion proof Class I, II, III, Div. 1, Groups A–G, ½ NPT
- 1 CSA Explosion proof Class I,II, III, Div.1, Groups B–G, ½ NPT
- P TIIS Ex d IIC T6, G ½ mit Ex d Kabelverschraubung G ½
- B EEx nA II T6; ATEX II 3 G, M 20x1.5
- N EEx nA II T6; ATEX II 3 G, ½ NPT
- Z see additional specification

Output; Housing
Code for housing without display in brackets

Aluminium housing T4, Display on top (without)	*Aluminium housing T5, Display on side (ohne)*	*Stainless steel housing T4, Display on side*
B 4…20 mA HART, SIL 2 (H)	U 4…20 mA HART, SIL 2 (M)	2 4…20 mA HART, SIL 2
C 4…20 mA (S)	W 4…20 mA (N)	
D PROFIBUS-PA (I)	P PROFIBUS-PA (X)	3 PROFIBUS-PA
F Foundation Fieldbus (G)	K Foundation Fieldbus (R)	4 Foundation Fieldbus

Metallic sensor (wetted ceramic diaphragm)

	Nominal value	PN
4D	100 mbar	160 bar
4F	500 mbar	160 bar
4H	3 bar	160 bar
4L	16 bar	160 bar

Calibration, Unit

- 1 Nominal range; mbar/bar
- 2 Nominal range; kPa/MPa
- 3 Nominal range; mm/mH_2O
- 4 Nominal range; inH_2O/ftH_2O
- 5 Nominal range; kgf/cm^2
- 6 Nominal range; psi
- 9 Adjusted; see additional spec. (adjusted from … to … unit, lin/sqrt with report)
- E Customised; see additional spec. + protocol (calibrated from … to … unit, lin/sqrt with report)

Additional option

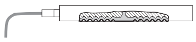
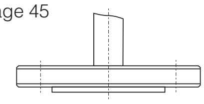
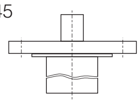
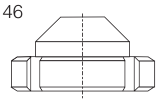
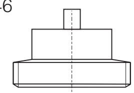
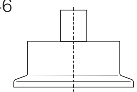
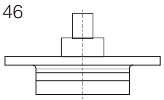
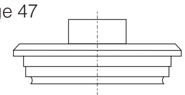
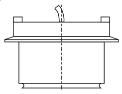
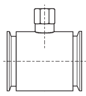
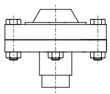
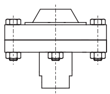
- EA Basic version
- EM Mounting bracket, wall/pipe
- EP 4x screw $^7/_{16}$ UNF, length: 1½"
- FA EN10204-3.1 (wetted parts), Inspection certificate
- FP EN10204-3.1, 4x screw $^7/_{16}$ UNF, Inspection certificate
- FM EN10204-3.1, mounting bracket, Inspection certificate
- NA EN10204-3.1, NACE MR0175, Inspection certificate (wetted parts)
- NM EN10204-3.1, NACE MR0175 + 1x mounting bracket, Inspection certificate (wetted parts)

Process connection (wetted part)
Structures are given in the tables on Pages 44 to 48 (Column "Code")

Capillary length and Fill fluid
Price per metre started

- 1A m capillary with Silicon oil
- 3A m capillary with high-temperature oil
- 2A m capillary with vegetable oil
- 4A m capillary with oil for oxygen applications

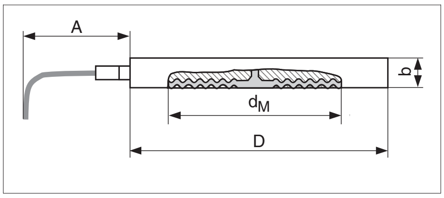
FMD 633 –									Product designation

Diaphragm seal Deltabar S FMD 633						
Design	**Diaphragm seal**	**Connection**	**Page/Version**	**Norm**	**Nominal width**	**Nominal pressure**
Pancake cell	Diaphragm seal	DIN cell	Page 44 	DIN 2501	DN 50 DN 80 DN 100	16/400 bar
		ANSI cell		ANSI B 16.5	2" 3" 4"	150/2500 lb/sq. in
Flange	Diaphragm seal	DIN flange	Page 45 	EN 1092-1/ DIN 2527	DN 50 DN 80 DN 100"	bis 40 bar
		ANSI flange		ANSI B. 16.5	2" 3" 4"	bis 300 lb/sq. in
Flange with extension	Diaphragm seal	ANSI flange with extension	Page 45 	ANSI B. 16.5	3" 4" (mit 2", 4", 6" Tubus)	150 lb/sq. in
Hygienic applications	Diaphragm seal	Conical sleeve	Page 46 	DIN 11851	DN 50 DN 65 DN 80	25 bar
		Thread sleeve	Page 46 	DIN 11851	DN 50 DN 65 DN 80	25 bar
		Clamp	Page 46 	ISO 2852	1 1/2" 2" 3"	40 bar
		DRD flange	Page 46 		D = 65 mm (DN 50)	25 bar
		Varivent	Page 47 		D = 68 mm	40 bar
		Sanitary tank spud with 2" extension	Page 47 		d = 100 mm	10 bar
	Pipe diaphragm seal	Clamp	Page 47 	ISO 2852	1 " 1 ½" 2 "	40 bar
Thread boss with separator	Diaphragm seal	G	Page 48 		G ½ A	40 bar
		NPT	Page 48 		½ NPT	40 bar

Conversion factors
- 1 mm = 0.039 in
  1 in = 25.4 mm
- 1 bar = 14.5 psi
  1 psi = 0.069 bar

Dimensions Deltabar S FMD 633

Note!
- Specifications for the "T_K Process" are listed in the following tables. These temperature coefficients apply to silicone oil and the membrane material AISI 316L. For other filling oils, this temperature coefficient must be multiplied by the T_K correction factor of the corresponding filling oil. For the T_K correction factors, see also Page 11, section "Diaphragm seal filling oils".
- The temperature coefficient "T_K Ambient" is listed in relation to the capillary length on Page 12 in the "Influence of the temperature on the zero point for diaphragm seal systems" section.



Wetted parts for all versions:
Body: AISI 316L
Diaphragm:
see tables

Conversion factors
- 1 mm = 0.039 in
  1 in = 25.4 mm
- 1 kg = 2.2 lbs
  1 lbs = 0.45 kg
- 1 bar = 14.5 psi
  1 psi = 0.069 bar

Diaphragm seal flange, pancake cell type, connection dimensions according to DIN 2527, contact face type form B for AISI 316L (1.4435), Alloy C276, Tantalum

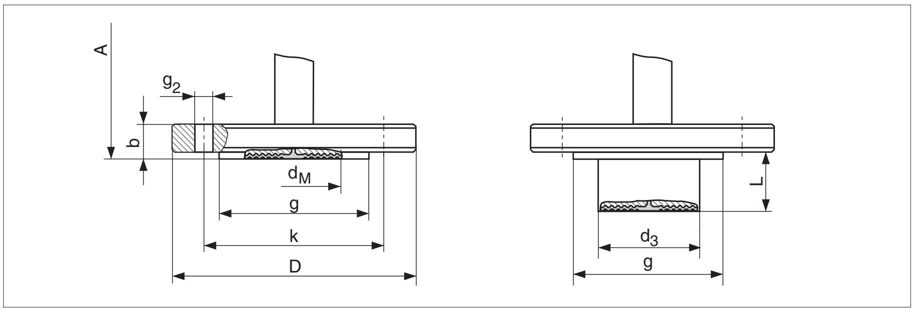
Instrument	Code		Pipe	Flange			Diaphragm seal			
		Diaphragm material	Nominal diameter	Nominal pressure	Diameter	Diameter	max. diaphragm diameter	Process	Minimal installation height	Weight for two diaphragm seals
			DN	PN	D	b	d_M	T_K	A	
			mm	bar	mm	mm	mm	mbar/10 K	mm	kg
FMD 633	AA	AISI 316L								
FMD 633	AB	Alloy C276[1)]	50	16/400	102	20	59	+1.21	145	2.6
FMD 633	AC	Tantal[2)]								
FMD 633	AK	AISI 316L								
FMD 633	AM	PTFE-foil 0.09 mm on AISI 316L	80	16/400	136	20	89	+0.19	145	4.6
FMD 633	AN	Alloy C276[1)]								
FMD 633	AP	Tantal [2)]								
FMD 633	AR	AISI 316L	100	16/400	158	20	89	+0.19	145	6.2

1) for oxygen service p_{max} = 40 bar (145 psi)
2) for oygen service p_{max} = 10 bar (580 psi)

Diaphragm seal flange, pancake cell type, connection dimensions according to ANSI B 16.5

Instrument	Code		Pipe	Flange			Diaphragm seal			
		Diaphragm material	Nominal diameter	Nominal pressure	Diameter	Diameter	max. diaphragm diameter	Process	Minimal installation height	Weight for two diaphragm seals
			d	PN	D	b	d_M	T_K	A	
			in	*lb/sq. in*	*in* mm	*in* mm	*in* mm	mbar/10 K	*in* mm	*kg*
FMD 633	CA	AISI 316L	*2*	150/2500	*3.90* 99	0.79 20	2.32 59	 +1.21	5.71 145	2.6
FMD 633	CK	AISI 316L	*3*	*150/2500*	*5.00* 127	0.79 20	3.50 89	 +0.19	5.71 145	*4.6*
FMD 633	CR	AISI 316L	*4*	*150/2500*	*6.22* 158	0.79 20	3.50 89	 +0.19	5.71 145	*6.2*

Dimensions Deltabar S FMD 633 (Continuation)



Umrechnung
- 1 mm = 0.039 in
  1 in = 25.4 mm
- 1 kg = 2.2 lbs
  1 lbs = 0.45 kg
- 1 bar = 14.5 psi
  1 psi = 0.069 bar

Diaphragm seal flange, connection dimensions according to EN 1092-1/DIN 2527, material: AISI 316L (1.4435)

Instrument	Code	Pipe	Flange						Bolt holes			Diaphragm seal			
		Nominal diameter	Nominal pressure	Diameter	Diameter	Raised face	Extension length	Extension diameter	Quantity	Diameter	Hole circle	max. diaphragm diameter	Process	Minimal installation height	Weight for two diaphragm seals
		DN	PN	D	b	g	L	d_3		g_2	k	d_M	TK	A	
		mm	bar	mm	mm	mm	mm	mm		mm	mm	mm	mbar/10 K	mm	kg
FMD 633	BA	50	10–40[1]	165	20	102	—	—	4	18	125	52	+1.21	145	6
FMD 633	BK	80	10–40[1]	200	24	138	—	—	8	18	160	80	+0.19	145	8.7
FMD 633	EH	100	10–16[2]	220	20	158	—	—	8	18	180	80	+0.19	145	9.5
FMD 633	BR	100	25–40[1]	235	24	162	—	—	8	22	190	80	+0.19	145	13.3

1) Form B1 according to EN 1092-1 and Form D according to DIN 2527
2) Form A

Diaphragm seal flange, connection dimensions according to ANSI B 16.5, material: AISI 316L (1.4435), raised face RF

Instrument	Code	Pipe	Flange						Bolt holes			Diaphragm seal			
		Nominal diameter	Nominal pressure	Diameter	Tickness	Raised face	Extension diameter	Extension length	Quantity	Diameter	Hole circle	max. diaphragm diameter	Process	Minimal installation height	Weight for two diaphragm seals
		d	PN	D	b	g	L	d_3		g_2	k	d_M	TK	A	
		in	*lb/sq.in*	*in*	*in*	*in*	*in*	*in*		*in*	*in*	*in*		*in*	*kg*
				mm	mm	mm	mm	mm		mm	mm	mm	mbar/10 K	mm	
FMD 633	DA	*2*	*150*	*6* 152.4	*0.75* 19.1	*3.62* 91.9	—	—	*4*	*0.75* 19.1	*4.75* 120.7	*2.32* 59	+1.21	*5.71* 145	*5.2*
FMD 633	DK	*3*	*150*	*7.5* 190.5	*0.94* 23.9	*5* 127	—	—	*4*	*0.75* 19.1	*6* 152.4	*3.50* 89	+0.19	*5.71* 145	*10.2*
FMD 633	1K	*3*	*150*	*7.5* 190.5	*0.94* 23.9	*5* 127	*2* 50.8	*3* 76	*4*	*0.75* 19.1	*6* 152.4	*2.83* 72	+0.29	*5.71* 145	*12*
FMD 633	2K	*3*	*150*	*7.5* 190.5	*0.94* 23.9	*5* 127	*4* 101.6	*3* 76	*4*	*0.75* 19.1	*6* 152.4	*2.83* 72	+0.29	*5.71* 145	*13.2*
FMD 633	3K	*3*	*150*	*7.5* 190.5	*0.94* 23.9	*5* 127	*6* 152.4	*3* 76	*4*	*0.75* 19.1	*6* 152.4	*2.83* 72	+0.29	*5.71* 145	*14.3*
FMD 633	DH	*4*	*150*	*9* 228.6	*0.94* 23.9	*6.19* 157.2	—	—	*8*	*0.75* 19.1	*7.5* 190.5	*3.50* 89	+0.19	*5.71* 145	*14.4*
FMD 633	1H	*4*	*150*	*9* 228.6	*0.94* 23.9	*6.19* 157.2	*2* 50	*3.7* 94	*8*	*0.75* 19.1	*7.5* 190.5	*3.50* 89	+0.19	*5.71* 145	*17.3*
FMD 633	2H	*4*	*150*	*9* 228,6	*0.94* 23.9	*6.19* 157.2	*4* 101.6	*3.7* 94	*8*	*0.75* 19.1	*7.5* 190.5	*3.50* 89	+0.19	*5.71* 145	*19.8*
FMD 633	3H	*4*	*150*	*9* 228.6	*0.94* 23.9	*6.19* 157.2	*6* 152.4	*3.7* 94	*8*	*0.75* 19.1	*7.5* 190.5	*3.50* 89	+0.19	*5.71* 145	*22.3*
FMD 633	IA	*2*	*300*	*6.5* 165.1	*0.88* 22.4	*3.62* 91.9	—	—	*8*	*0.75* 19.1	*5* 127	*2.32* 59	+1.21	*5.71* 145	*6.8*
FMD 633	IK	*3*	*300*	*8.3* 210	*1.12* 28,4	*5* 127	—	—	*8*	*0.88* 22,4	*6.62* 168.1	*3.50* 89	+0,19	*5.71* 145	*14*
FMD 633	IH	*4*	*300*	*10* 254	*1.25* 31.8	*6.19* 157.2	—	—	*8*	*0.88* 22.4	*7.88* 200.1	*3.50* 89	+0.19	*5.71* 145	*23.4*
	YY	Special version on request													

Dimensions Deltabar S FMD 633 (Continuation)

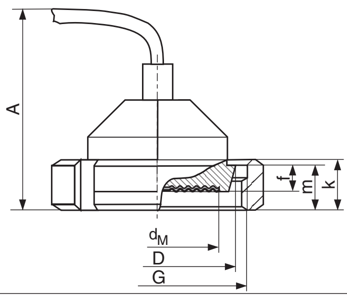
Conversion factors
- 1 mm = 0.039 in
  1 in = 25.4 mm
- 1 kg = 2.2 lbs
  1 lbs = 0.45 kg
- 1 bar = 14.5 psi
  1 psi = 0.069 bar

Code KE
DRD-Flansch

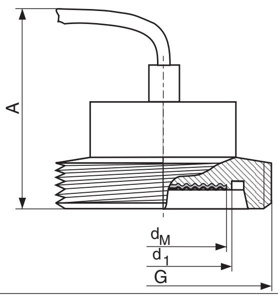
- T_K Process +2.01mbar/10 K
- Weight for two diaphragm seals: 1.5 kg

Standard surface roughness of parts in contact with the medium Ra ≤ 0.8 µm. Reduced surface roughness on request.

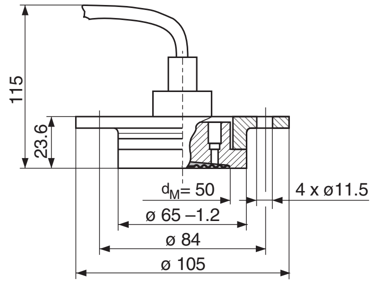
DIN 11851 Conical Sleeve



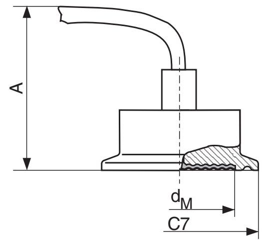
DIN 11851 Threaded Sleeve



DRD Flange PN 25



Clamp



Diaphragm seal conical sleeve with groove nut, DIN11851 (sanitary connection), material: AISI 316L (1.4435)

Instrument	Code	Pipe	Conical sleeve			Groove nut			Diaphragm seal			
		Nominal diameter	Nominal pressure	Diameter	Collar height	Thread	Height	Height	max. diaphragm diameter	Process	Minimal installation height	Weight for two diaphragm seals
		DN	PN	D	f	G	k	m	d_M	T_K	A	
		mm	bar	mm	mm		mm	mm	mm	mbar/10 K	mm	kg
FMD 633	FA	50	25	68.5	11	Rd 78 x 1/6"	22	19	52	+1.21	135	2.2
FMD 633	FE	65	25	86	12	Rd 95 x 1/6"	25	21	66	+0.29	135	4.0
FMD 633	FK	80	25	100	12	Rd 110 x 1/4"	30	26	81	+0.19	135	5.1

Diaphragm seal thread adapter, DIN 11851 (sanitary connection), material: AISI 316L (1.4435)

Instrument	Code	Pipe	Thread adapter			Diaphragm seal			
		Nominal diameter	Nominal pressure	Diameter	Thread	max. diaphragm diameter	Process	Minimal installation height	Weight for two diaphragm seals
		DN	PN	d_1	G	d_M	T_K	A	
		mm	bar	mm		mm	mbar/10 K	mm	kg
FMD 633	GA	50	25	54	Rd 78 x 1/6"	52	+1.21	125	1.8
FMD 633	GE	65	25	71	Rd 95 x 1/6"	66	+0.29	125	3.4
FMD 633	GK	80	25	85	Rd 110 x 1/4"	81	+0.19	125	4.0

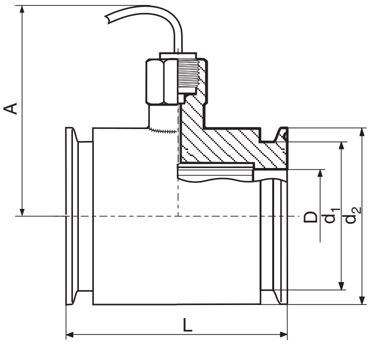
Diaphragm seal Clamp, ISO 2852

Instrument	Code	Pipe			Diaphram seal			
		Nominal diameter ISO 2852	Nominal diameter	Diameter	max. diaphragm diameter	Process	Minimal installation height	Weight for two diaphragm seals
			d	C7	d_M	T_K	A	
			inch	mm	mm	mbar/10 K	mm	kg
FMD 633	H2	DN 25	1	50.5	24	+10.45	115	0.6
FMD 633	H1	DN 38	1-1/2	50.5	36	+5.44	115	2.0
FMD 633	HA	DN 51	2	64	48	+1.91	115	2.2
FMD 633	HK	DN 76.1	3	91	73	+0.08	115	2.4

Dimensions Deltabar S FMD 633 (Continuation)

Standard surface roughness of parts in contact with the medium Ra ≤ 0.8 µm. Reduced surface roughness on request.

Pipe diaphragm seal, Clamp



Conversion factors
- 1 mm = 0.039 in
  1 in = 25.4 mm
- 1 kg = 2.2 lbs
  1 lbs = 0.45 kg
- 1 bar = 14.5 psi
  1 psi = 0.069 bar

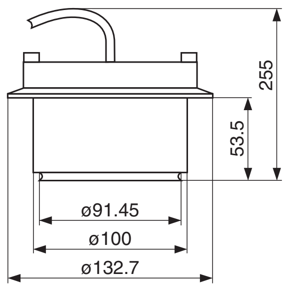
Pipe diaphragm seal Clamp, ISO 2852

Instrument	Code	Pipe		Clamp	Diaphragm seal					
		Nominal diameter ISO 2852	Nominal diameter	Diameter	Diameter	Diameter	Einbaulänge	Process	Minimal installation height	Weight for two diaphragm seals
			d	D	d1	d2	L	T_K	A	
			inch	mm	mm	mm	mm	mbar/10 K	mm	kg
FMD 633	PR	DN25	1	22.5	43.5	50.5	126	+5.10	145	3.4
FMD 633	P1	DN28	$1^1/_2$	35.5	43.5	50.5	126	+2.51	158	2
FMD 633	PA	DN51	2	48.6	56.5	64	100	+2.51	169	3.4

Sanitary tank spud with extension

Code WH,
Sanitary tank spud with 2" extension

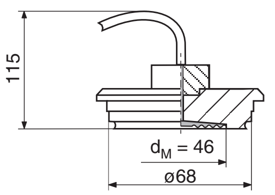
- Material: AISI 316L
- T_K process +1.64 mbar/10 K
- Weight for two diaphragm seals: 5 kg
- Standard surface roughness of parts in contact with the medium Ra ≤ 0.8 µm. Reduced surface roughness on request.



Varivent

Code LE,
Varivent

- d = 68 mm (DN 50), PN 40 bar
- Material: AISI 316L
- T_K process: +2.01 mbar/10 K
- Weight for two diaphragm seals: 2.6 kg
- Standard surface roughness of parts in contact with the medium Ra ≤ 0.8 µm. Reduced surface roughness on request.

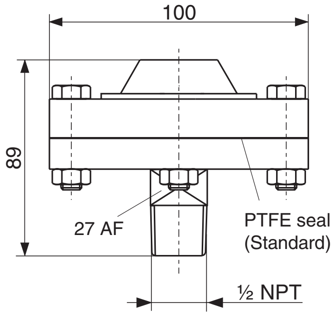


Dimensions Deltabar S FMD 633 (Continuation)

Code VR,
½ NPT thread boss

- Material: AISI 316L
- PN 40 bar
- T_K proces:
  +0.1 mbar/10 K
- Weight for two diaphragm seals:
  2.9 kg

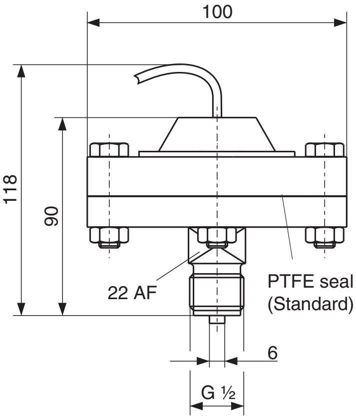
½ NPT thread boss



Code TR,
G ½ thread boss

- Material: AISI 316L
- PN 40 bar
- T_K process:
  +0.1 mbar/10 K
- Weight for two diaphragm seals:
  2.9 kg

G ½ thread boss



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