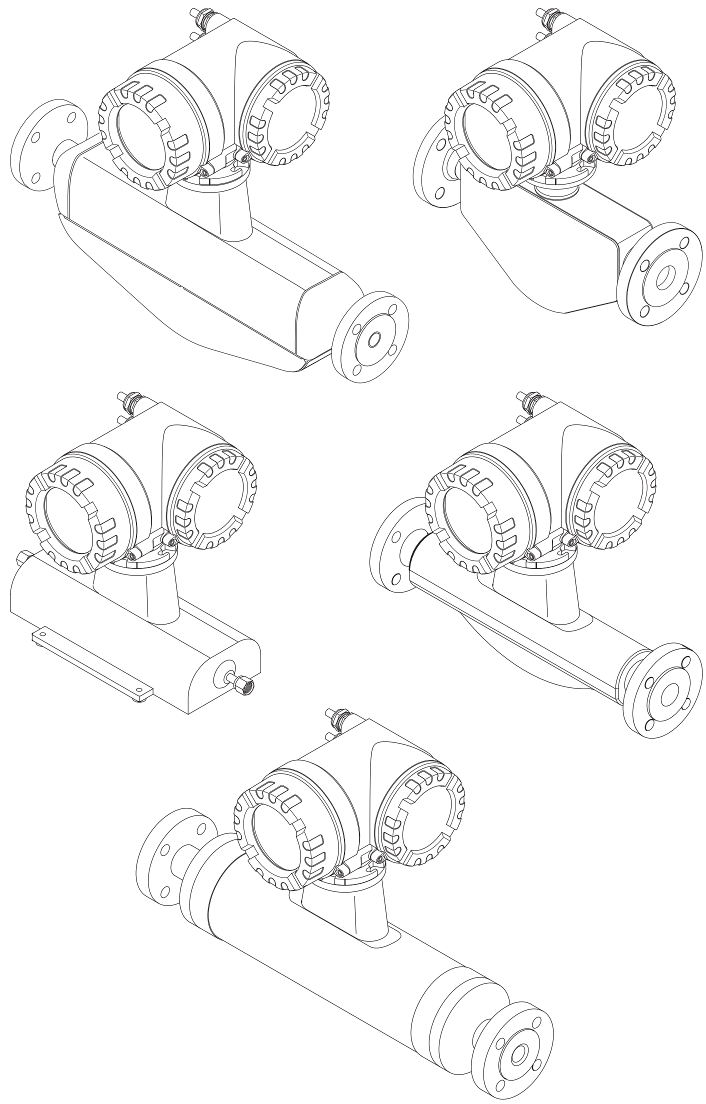
Level Pressure Flow Temperature Liquid Analysis Registration Systems Components Services Solutions

Operating Instructions

Proline Promass 80

Coriolis Mass Flow Measuring System

HART
FIELD COMMUNICATION PROTOCOL



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Valid as of version
V 3.01.XX (device software)

Endress+Hauser
People for Process Automation

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1 Safety instructions

1.1 Designated use

The measuring device described in these Operating Instructions is to be used only for measuring the mass flow rate of liquids and gases. At the same time, the system also measures fluid density and fluid temperature. These parameters are then used to calculate other variables such as volume flow. Fluids with widely differing properties can be measured.

Examples:
- Chocolate, condensed milk, liquid sugar
- Oils, fats
- Acids, alkalis, lacquers, paints, solvents and cleaning agents
- Pharmaceuticals, catalysts, inhibitors
- Suspensions
- Gases, liquefied gases etc.

The operational safety of the measuring devices cannot be guaranteed if the system is used incorrectly or used for purposes other than those intended. The manufacturer accepts no liability for damages being produced from this.

1.2 Installation, commissioning and operation

Note the following points:
- Installation, connection to the electricity supply, commissioning and maintenance of the device must be carried out by trained, qualified specialists authorized to perform such work by the facility's owner operator. Qualified personnel must have read and understood these Operating Instructions and must follow the instructions contained therein.
- The device may be operated only by persons authorized and trained by the facility's owner-operator. Strict compliance with the instructions in the Operating Instructions is mandatory.
- Endress+Hauser is willing to assist in clarifying the chemical resistance properties of parts wetted by special fluids, including fluids used for cleaning. However, small changes in temperature, concentration or the degree of contamination in the process can result in changes of the chemical resistance properties. Therefore, Endress+Hauser can not guarantee or accept liability for the chemical resistance properties of the fluid wetted materials in a specific application. The user is responsible for the choice of fluid wetted materials in regards to their in-process resistance to corrosion.
- If carrying out welding work on the piping, never ground the welding unit by means of the measuring device.
- The installer must ensure that the measuring system is correctly wired in accordance with the wiring diagrams. The transmitter must be earthed unless special protection measures have been taken e.g. galvanically isolated power supply SELV or PELV (SELV = Save Extra Low Voltage; PELV = Protective Extra Low Voltage).
- Invariably, local regulations governing the opening and repair of electrical devices apply.

1.3 Operational safety

Note the following points:

- Measuring systems for use in hazardous environments are accompanied by separate "Ex documentation", which is an integral part of these Operating Instructions. Strict compliance with the installation instructions and ratings as stated in this supplementary documentation is mandatory.
  The symbol on the front of this supplementary Ex documentation indicates the approval and the certification body i.e. Ⓔx Europe, FM USA, CSA Canada.
- The measuring device complies with the general safety requirements in accordance with EN 61010-1, the EMC requirements of IEC/EN 61326, the NAMUR recommendation NE 21, NE 43 and NE 53.
- External surface temperature of the transmitter can increase by 10 K due to power consumption of internal electronical components. Hot process fluids passing through the measuring device will further increase the surface temperature of the measuring device. Especially the surface of the sensor can reach temperatures which are close to process temperature. Additionally safety precautions are required when increased process temperatures are present.
- For measuring systems used in SIL 2 applications, the separate manual on functional safety must be observed.
- The manufacturer reserves the right to modify technical data without prior notice. Your Endress+Hauser distributor will supply you with current information and updates to these Operating Instructions.

1.4 Return

- Do not return a measuring device if you are not absolutely certain that all traces of hazardous substances have been removed, e.g. substances which have penetrated crevices or diffused through plastic.
- Costs incurred for waste disposal and injury (burns, etc.) due to inadequate cleaning will be charged to the owner-operator.
- Please note the measures on → 69

1.5 Notes on safety conventions and icons

The devices are designed to meet state-of-the-art safety requirements, have been tested, and left the factory in a condition in which they are safe to operate. The devices comply with the applicable standards and regulations in accordance with EN 61010-1 "Protection Measures for Electrical Equipment for Measurement, Control, Regulation and Laboratory Procedures". However, the devices can be a source of danger if used incorrectly or for other than the designated use. Consequently, always pay particular attention to the safety instructions indicated in these Operating Instructions by the following icons:

Warning!
"Warning" indicates an action or procedure which, if not performed correctly, can result in injury or a safety hazard. Comply strictly with the instructions and proceed with care.

Caution!
"Caution" indicates an action or procedure which, if not performed correctly, can result in incorrect operation or destruction of the device. Comply strictly with the instructions.

Note!
"Note" indicates an action or procedure which, if not performed correctly, can have an indirect effect on operation or trigger an unexpected response on the part of the device.

2 Identification

The following options are available for identification of the measuring device::
- Nameplate specifications
- Order code with breakdown of the device features on the delivery note
- Enter serial numbers from nameplates in *W@M Device Viewer* (www.endress.com/deviceviewer): All information about the measuring device is displayed.

For an overview of the scope of the Technical Documentation provided, refer to the following:
- The chapters "Documentation" → 🗎 109
- Der *W@M Device Viewer*: Enter the serial number from the nameplate (www.endress.com/deviceviewer)

Reorder
The measuring device is reordered using the order code.

Extended order code:
- The device type (product root) and basic specifications (mandatory features) are always listed.
- Of the optional specifications (optional features), only the safety and approval-related specifications are listed (e.g. LA). If other optional specifications are also ordered, these are indicated collectively using the # placeholder symbol (e.g. #LA#).
- If the ordered optional specifications do not include any safety and approval-related specifications, they are indicated by the + placeholder symbol (e.g. 8E2B50-ABCDE+).

2.1 Device designation

The "Promass 80" flow measuring system consists of the following components:
- Promass 80 transmitter
- Promass F, Promass E, Promass A, Promass H, Promass I, Promass S or Promass P sensor.

Two versions are available:
- Compact version: transmitter and sensor form a single mechanical unit.
- Remote version: transmitter and sensor are installed separately.

2.1.1 Nameplate of the transmitter

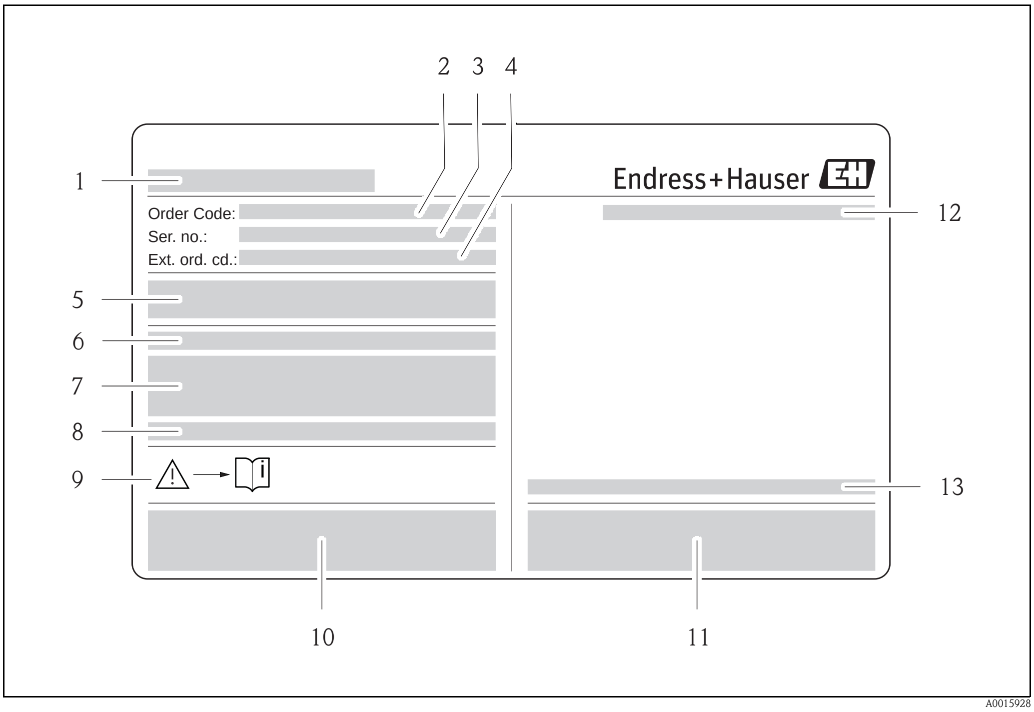


Fig. 1: Example of a transmitter nameplate

1 Name of the transmitter
2 Order code
3 Serial number (Ser. no.)
4 Extended order code (Ext. ord. cd.)
5 Power supply, frequency and power consumption
6 Additional function and software
7 Available inputs / outputs
8 Reserved for information on special products
9 Please refer to operating instructions / documentation
10 Reserved for certificates, approvals and for additional information on device version
11 Patents
12 Degree of protection
13 Ambient temperature range

2.1.2 Nameplate of the sensor

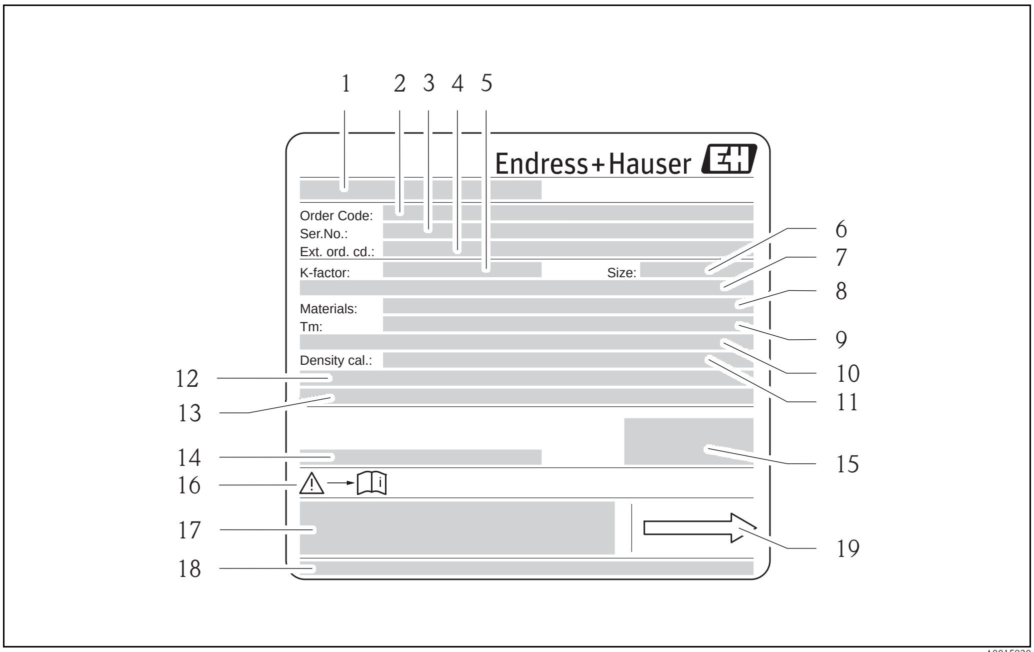


Fig. 2: Example of a sensor nameplate

1 Name of the sensor
2 Order code
3 Serial number (Ser. no.)
4 Extended order code (Ext. ord. cd.)
5 Calibration factor with zero point (K-factor)
6 Nominal diameter device (Size)
7 Flange nominal diameter/Nominal pressure
8 Material of measuring tubes (Materials)
9 Max. fluid temperature (Tm)
10 Pressure range of secondary containment
11 Accuracy of density measurement (Density cal.)
12 Additional information
13 Reserved for information on special products
14 Ambient temperature range
15 Degree of protection
16 Please refer to operating instructions / documentation
17 Reserved for additional information on device version (approvals, certificates)
18 Patents
19 Flow direction

2.1.3 Nameplate for connections

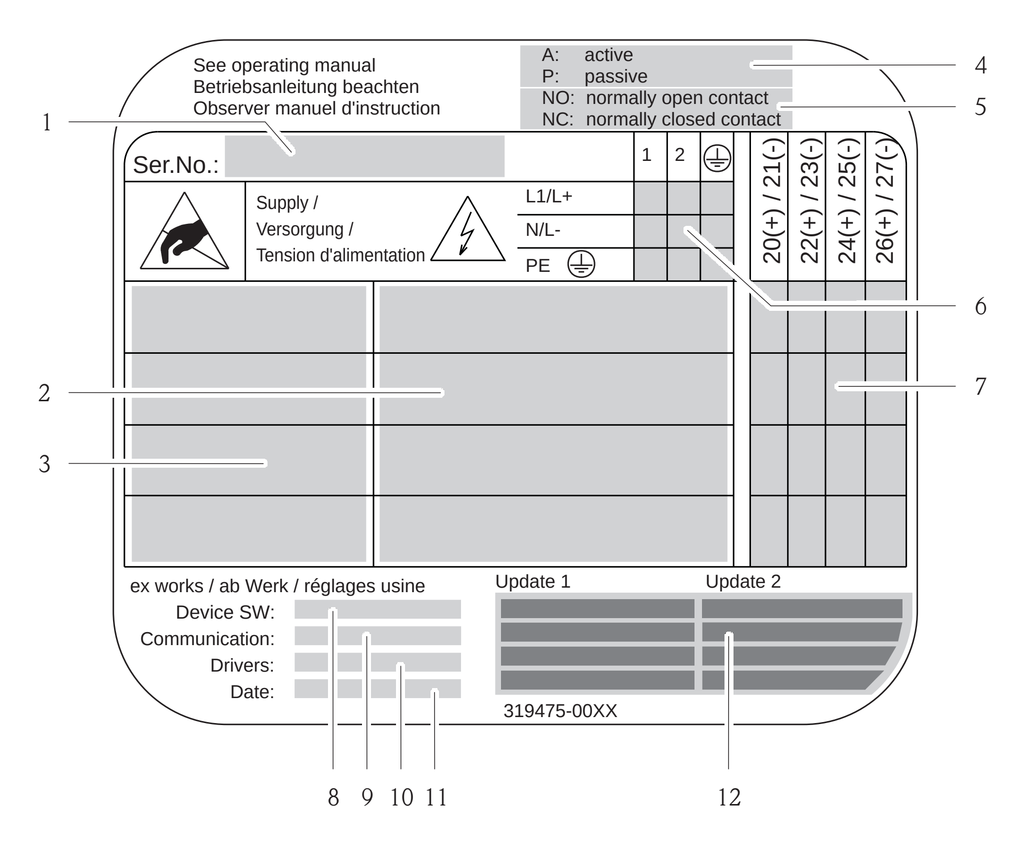


Fig. 3: Example of a connection nameplate

1 Serial number (Ser. no.)
2 Possible inputs and outputs
3 Signals present at inputs and outputs
4 Possible configuration of current output
5 Possible configuration of relay contacts
6 Terminal assignment, cable for power supply
7 Terminal assignment and configuration (see point 4 and 5) of inputs and outputs
8 Version of device software currently installed (Device SW)
9 Installed communication type (Communication)
10 Information on current communication software (Drivers: Device Revision and Device Description),
11 Date of installation (Date)
12 Current updates to data specified in points 8 to 11 (Update1, Update 2)

2.2 Certificates and approvals

The devices are designed in accordance with good engineering practice to meet state-of-the-art safety requirements, have been tested, and left the factory in a condition in which they are safe to operate. The devices comply with the applicable standards and regulations in accordance with EN 61010-1 "Protection Measures for Electrical Equipment for Measurement, Control, Regulation and Laboratory Procedures" and with the EMC requirements of IEC/EN 61326.

The measuring system described in these Operating Instructions thus complies with the statutory requirements of the EC Directives. Endress+Hauser confirms successful testing of the device by affixing to it the CE mark.

The measuring system is in conformity with the EMC requirements of the "Australian Communications and Media Authority (ACMA)".

2.3 Registered trademarks

KALREZ® and VITON®
Registered trademarks of E.I. Du Pont de Nemours & Co., Wilmington, USA

TRI–CLAMP®
Registered trademark of Ladish & Co., Inc., Kenosha, USA

SWAGELOK®
Registered trademark of Swagelok & Co., Solon, USA

HART®
Registered trademark of HART Communication Foundation, Austin, USA

HistoROM™, S-DAT®, FieldCare® Fieldcheck®, Field Xpert™, Applicator®
Registered or registration-pending trademarks of Endress+Hauser Flowtec AG, Reinach, CH

3 Installation

3.1 Incoming acceptance, transport and storage

3.1.1 Incoming acceptance

On receipt of the goods, check the following points:
- Check the packaging and the contents for damage.
- Check that nothing is missing from the shipment and that the scope of supply matches your order.

3.1.2 Transport

The following instructions apply to unpacking and to transporting the device to its final location:
- Transport the devices in the containers in which they are delivered.
- The covers or caps fitted to the process connections prevent mechanical damage to the sealing faces and the ingress of foreign matter to the measuring tube during transportation and storage. Consequently, do not remove these covers or caps until immediately before installation.
- Do not lift measuring devices of nominal diameters > DN 40 (1 ½ ") by the transmitter housing or the connection housing in the case of the remote version (→ 4). – Use webbing slings slung round the two process connections. Do not use chains, as they could damage the housing.

Warning!
Risk of injury if the measuring device slips.
The center of gravity of the assembled measuring device might be higher than the points around which the slings are slung. At all times, therefore, make sure that the device does not unexpectedly turn around its axis or slip.

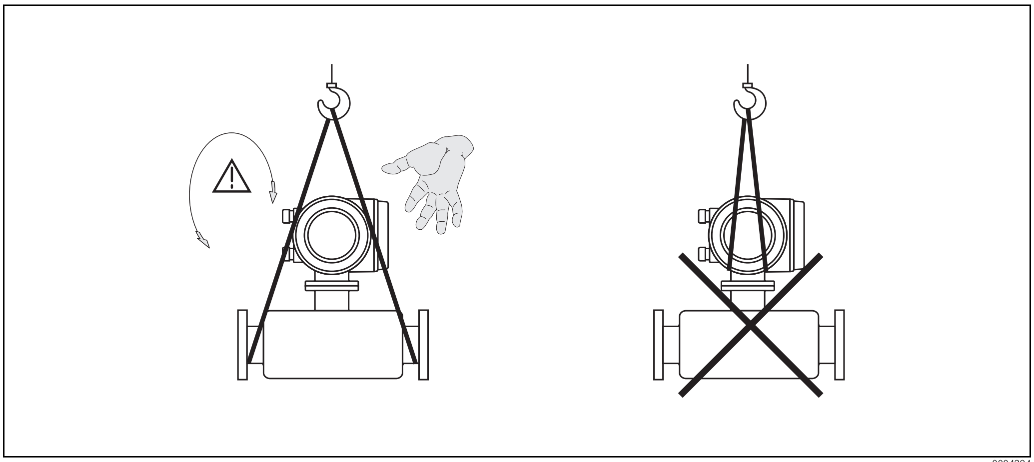


Fig. 4: Instructions for transporting sensors with > DN 40 (1 ½")

3.1.3 Storage

Note the following points:
- Pack the measuring device in such a way as to protect it reliably against impact for storage (and transportation). The original packaging provides optimum protection.
- The permissible storage temperature is –40 to +80 °C (–40 °F to +176 °F), preferably +20 °C (+68 °F).
- Do not remove the protective covers or caps on the process connections until you are ready to install the device.
- The measuring device must be protected against direct sunlight during storage in order to avoid unacceptably high surface temperatures.

3.2 Installation conditions

Note the following points:
- No special measures such as supports are necessary. External forces are absorbed by the construction of the instrument, for example the secondary containment.
- The high oscillation frequency of the measuring tubes ensures that the correct operation of the measuring system is not influenced by pipe vibrations.
- No special precautions need to be taken for fittings which create turbulence (valves, elbows, T-pieces etc.), as long as no cavitation occurs.
- For mechanical reasons and in order to protect the pipe, it is advisable to support heavy sensors.

3.2.1 Dimensions

All the dimensions and lengths of the sensor and transmitter are provided in the separate documentation entitled, "Technical Information".

3.2.2 Mounting location

Accumulated air or gas bubbles in the measuring tube can result in an increase in measuring errors. **Avoid** the following mounting locations in the pipe installation:
- Highest point of a pipeline. Risk of air accumulating.
- Directly upstream of a free pipe outlet in a vertical pipeline.

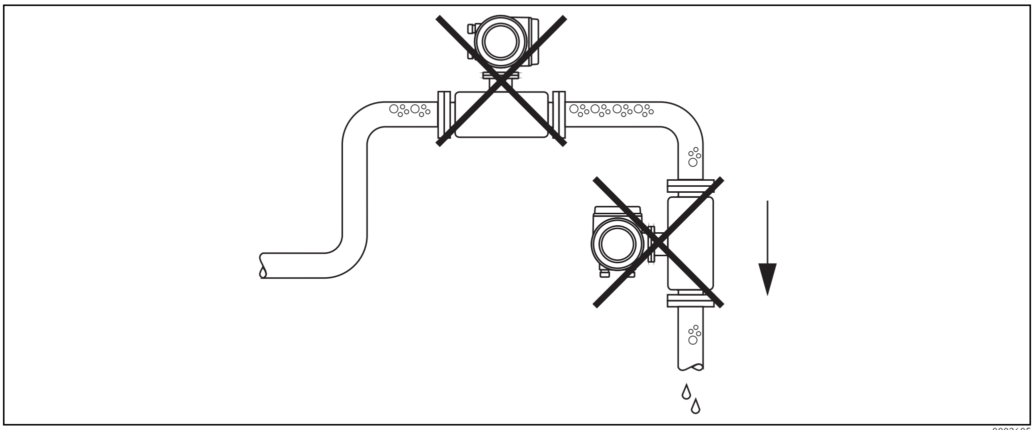


Fig. 5: Mounting location

Installation in a vertical pipe

The proposed configuration in the following diagram, however, permits installation in a vertical pipeline. Pipe restrictors or the use of an orifice plate with a smaller cross-section than the nominal diameter prevent the sensor from running empty during measurement.

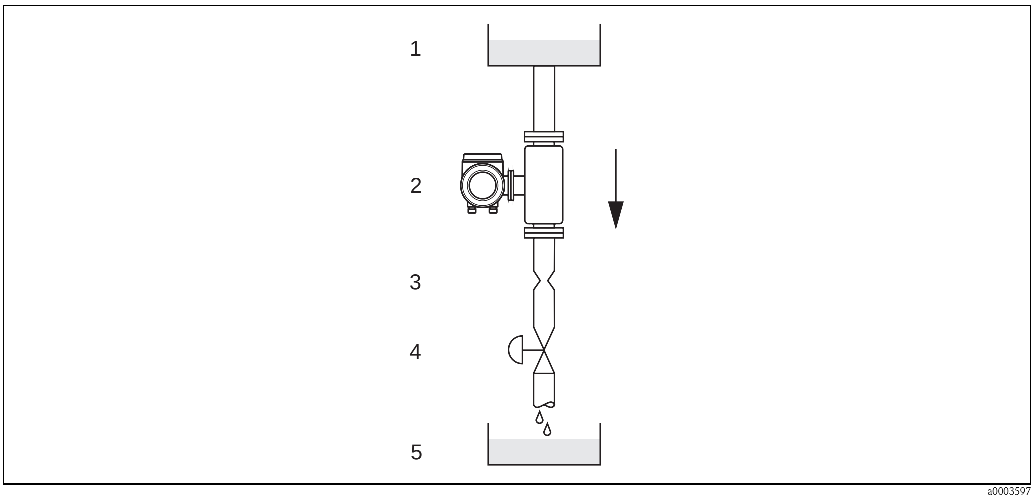


Fig. 6: Installation in a vertical pipe (e.g. for batching applications)

1 Supply tank
2 Sensor
3 Orifice plate, pipe restrictions (see Table)
4 Valve
5 Batching tank

DN		Ø Orifice plate, pipe restrictor mm	Ø Orifice plate, pipe restrictor inch
1	1/24"	0.8	0.03"
2	1/12"	1.5	0.06"
4	1/8"	3.0	0.12"
8	3/8"	6	0.24"
15	1/2"	10	0.40"
15 FB	1/2"	15	0.60"
25	1"	14	0.55"
25 FB	1"	24	0.95"
40	1 ½"	22	0.87"
40 FB	1 ½"	35	1.38"
50	2"	28	1.10"
50 FB	2"	54	2.00"
80	3"	50	2.00"
100	4"	65	2.60"
150	6"	90	3.54"
250	10"	150	5.91"

FB = Full bore versions of Promass I

System pressure

It is important to ensure that cavitation does not occur, because it would influence the oscillation of the measuring tube. No special measures need to be taken for fluids which have properties similar to water under normal conditions.
In the case of liquids with a low boiling point (hydrocarbons, solvents, liquefied gases) or in suction lines, it is important to ensure that pressure does not drop below the vapor pressure and that the liquid does not start to boil. It is also important to ensure that the gases that occur naturally in many liquids do not outgas. Such effects can be prevented when system pressure is sufficiently high.

Therefore, the following locations should be preferred for installation:
- Downstream from pumps (no danger of vacuum)
- At the lowest point in a vertical pipe

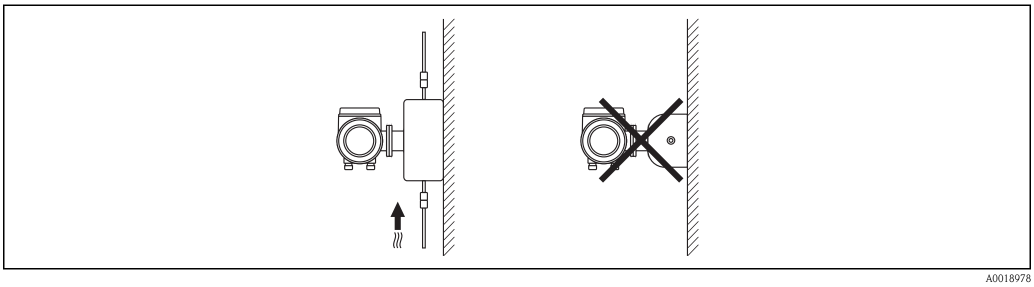
3.2.3 Orientation

Make sure that the direction of the arrow on the nameplate of the sensor matches the direction of flow direction in which the fluid flows through the pipe.

Orientation Promass A

Vertical
Recommended orientation with direction of flow upwards. When fluid is not flowing, entrained solids will sink down and gases will rise away from the measuring tube. The measuring tubes can be completely drained and protected against solids build-up.

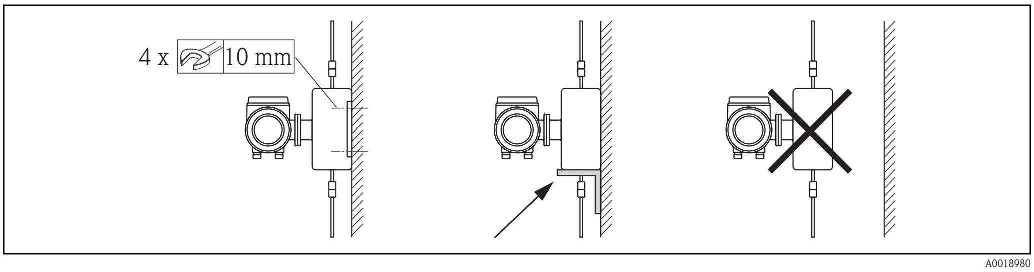
Horizontal
When installation is correct the transmitter housing is above or below the pipe. This means that no gas bubbles or solids deposits can form in the bent measuring tube (single-tube system).



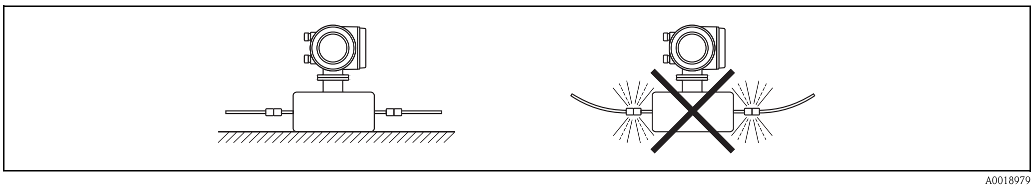
Special installation instructions for Promass A

Caution!
Risk of measuring pipe fracture if sensor installed incorrectly!
The sensor may not be installed in a pipe as a freely suspended sensor:
- Using the base plate, mount the sensor directly on the floor, the wall or the ceiling.
- Support the sensor on a firmly mounted support base (e.g. angle bracket).

Vertical
We recommend two installation versions when mounting vertically:
- Mounted directly on a wall using the base plate
- Measuring device supported on an angle bracket mounted on the wall



Horizontal
We recommend the following installation version when mounting horizontally:
- Measuring device standing on a firm support base



Orientation Promass F, E, H, I, S, P

Make sure that the direction of the arrow on the nameplate of the sensor matches the direction of flow (direction in which the fluid flows through the pipe).

Vertical:

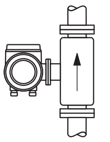
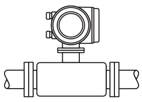
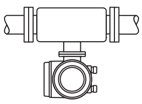
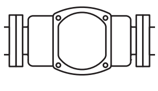
Recommended orientation with upward direction of flow (Fig. V). When fluid is not flowing, entrained solids will sink down and gases will rise away from the measuring tube. The measuring tubes can be completely drained and protected against solids buildup.

Horizontal (F, E):

The measuring tubes of Promass F and E must be horizontal and beside each other.
When installation is correct the transmitter housing is above or below the pipe (Fig. H1/H2).
Always avoid having the transmitter housing in the same horizontal plane as the pipe.

Horizontal (Promass H, I, S, P):

Promass H and Promass I can be installed in any orientation in a horizontal pipe run.

	Promass F, E Standard, compact	**Promass F, E Standard, remote**	**Promass F High-temperature, compact**	**Promass F High-temperature, remote**	**Promass H, I, S, P Standard, compact**	**Promass H, I, S, P Standard, compact**
Fig. V: Vertical orientation  a0004572	✔✔	✔✔	✔✔	✔✔	✔✔	✔✔
Fig. H1: Horizontal orientation Transmitter head up  a0004576	✔✔	✔✔	✘ TM > 200 °C (392 °F)	✔ TM > 200 °C (392 °F)	✔✔	✔✔
Fig. H2: Horizontal orientation Transmitter head down  a0004580	✔✔	✔✔	✔✔	✔✔	✔✔	✔✔
Fig. H3: Horizontal orientation Transmitter head to the side  a0007558	✘	✘	✘	✘	✔✔	✔✔

✔✔ = Recommended orientation
✔ = Orientation recommended in certain situations
✘ = Impermissible orientation

In order to ensure that the permissible ambient temperature range for the transmitter (→ 🗎 93) is not exceeded, we recommend the following orientations:

- For fluids with very high temperatures we recommend the horizontal orientation with the transmitter head pointing downwards (Fig. H2) or the vertical orientation (Fig. V).
- For fluids with very low temperatures, we recommend the horizontal orientation with the transmitter head pointing upwards (Fig. H1) or the vertical orientation (Fig. V).

3.2.4 Special installation instructions

Promass F, E, H, S and P

Caution!
If the measuring tube is curved and the unit is installed horizontally, adapt the sensor position to the fluid properties.

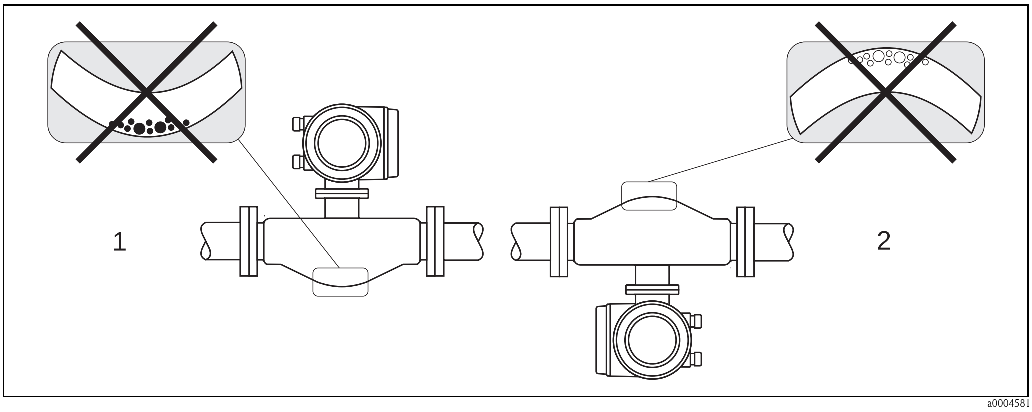


Fig. 7: Horizontal installation of sensors with curved measuring tube.

1 *Not suitable for fluids with entrained solids. Risk of solids accumulating.*
2 *Not suitable for outgassing fluids. Risk of air accumulating.*

Promass I and P with Eccentric Tri-clamps

Eccentric Tri-Clamps can be used to ensure complete drainability when the sensor is installed in a horizontal line. When lines are pitched in a specific direction and at a specific slope, gravity can be used to achieve complete drainability. The sensor must be installed in the correct position with the tube bend facing to the side, to ensure full drainability in the horizontal position. Markings on the sensor show the correct mounting position to optimize drainability.

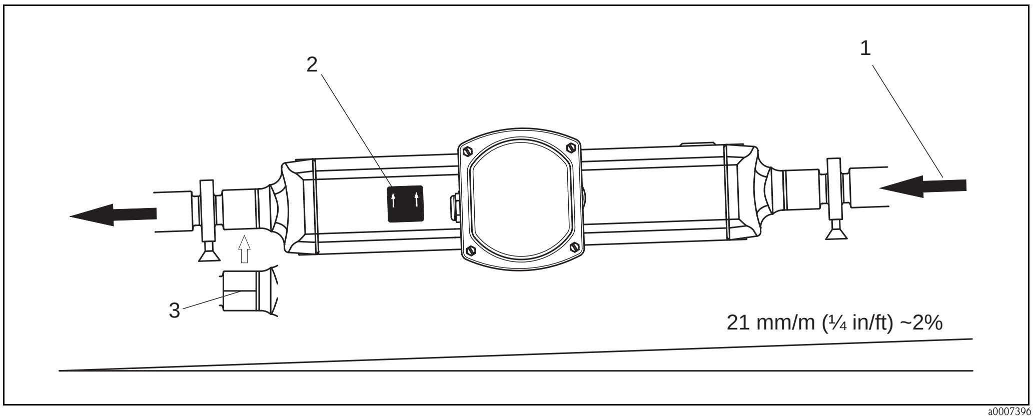


Fig. 8: Promass P: When lines are pitched in a specific direction and at a specific slope: as per hygienic guidelines (21 mm/m or approximatley 2%). Gravity can be used to achieve complete drainability.

1 *The arrow indicates the direction of flow (direction of fluid flow through the pipe).*
2 *The label shows the installation orientation for horizontal drainability.*
3 *The underside of the process connection is indicated by a scribed line. This line indicates the lowest point of the eccentric process connection.*

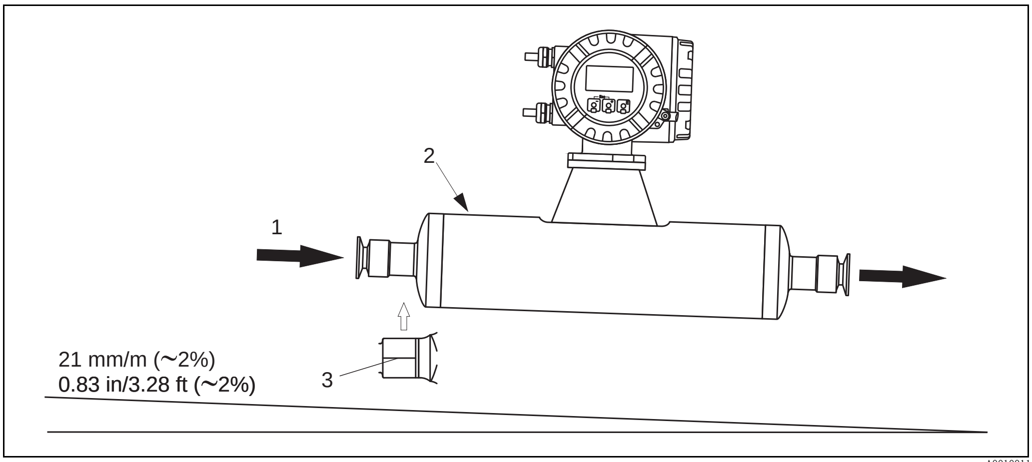


Fig. 9: Promass I: When lines are pitched in a specific direction and at a specific slope: as per hygienic guidelines (21 mm/m or approximatley 2%). Gravity can be used to achieve complete drainability.

1 The arrow indicates the direction of flow (direction of fluid flow through the pipe).
2 The label shows the installation orientation for horizontal drainability.
3 The underside of the process connection is indicated by a scribed line. This line indicates the lowest point of the eccentric process connection.

Promass I and P with hygienic connections (mounting clamp with lining between clamp and instrument)

It is not necessary to support the sensor under any circumstances for operational performance. If the requirement exists to support the sensor the following recommendation should be followed.

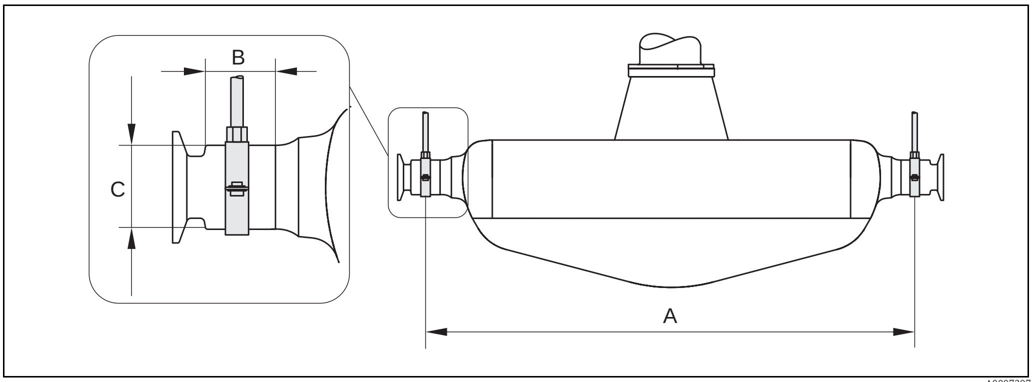


Fig. 10: Promass P, mounted with mounting clamp

DN	8	15	25	40	50
A	298	402	542	750	1019
B	33	33	33	36.5	44.1
C	28	28	38	56	75

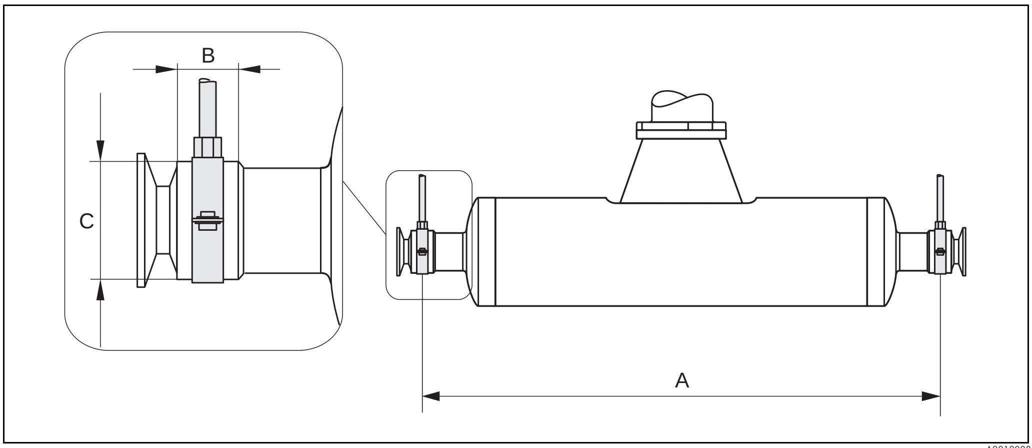


Fig. 11: Promass I, mounted with mounting clamp

DN	8	15	15FB	25	25FB	40	40FB	50	50FB	50FB	80	80
Tri-Clamp	**½"**	**3/4"**	**1"**	**1"**	**1 ½"**	**1 ½"**	**2"**	**2"**	**2 ½"**	**3"**	**2 ½"**	**3"**
A	373	409	539	539	668	668	780	780	1152	1152	1152	1152
B	20	20	30	30	28	28	35	35	57	57	57	57
C	40	40	44.5	44.5	60	60	80	80	90	90	90	90

3.2.5 Heating

Some fluids require suitable measures to avoid loss of heat at the sensor. Heating can be electric, e.g. with heated elements, or by means of hot water or steam pipes made of copper or heating jackets.

Caution!
- Risk of electronics overheating! Make sure that the maximum permissible ambient temperature for the transmitter is not exceeded. Consequently, make sure that the adapter between the sensor and transmitter and the connection housing of the remote version always remain free of insulating material. Note that a certain orientation might be required, depending on the fluid temperature → 15.
- With a fluid temperature between 200 °C to 350 °C (392 to 662 °F) the remote version of the high-temperature version is preferable.
- When using electrical heat tracing whose heat is regulated using phase control or by pulse packs, it cannot be ruled out that the measured values are influenced by magnetic fields which may occur, (i.e. at values greater than those permitted by the EC standard (Sinus 30 A/m)). In such cases, the sensor must be magnetically shielded.
  The secondary containment can be shielded with tin plates or electric sheets without privileged direction (e.g. V330-35A) with the following properties:
  – Relative magnetic permeability $\mu_r \geq 300$
  – Plate thickness $d \geq 0.35$ mm (0.014")
- Information on permissible temperature ranges → 94

Special heating jackets which can be ordered as accessories from Endress+Hauser are available for the sensors.

3.2.6 Thermal insulation

Some fluids require suitable measures to avoid loss of heat at the sensor. A wide range of materials can be used to provide the required thermal insulation.

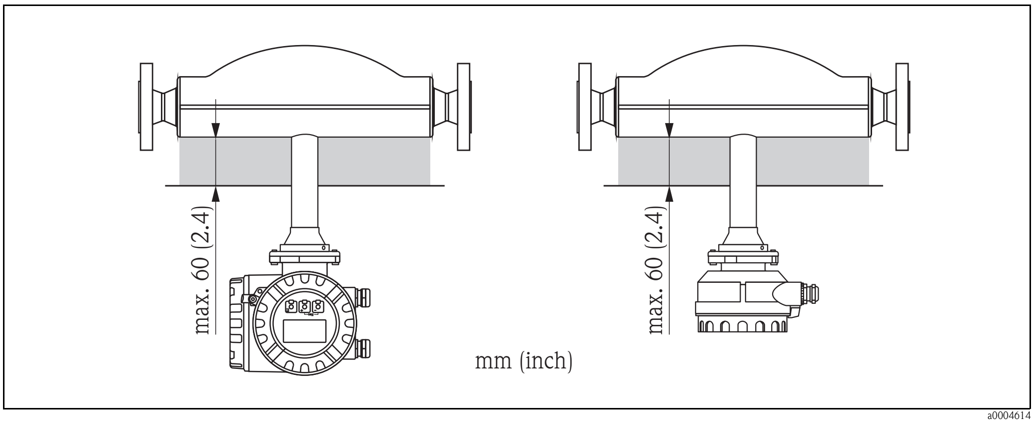


Fig. 12: In the case of the Promass F high-temperature version, a maximum insulation thickness of 60 mm (2.4") must be observed in the area of the electronics/neck.

If the Promass F high-temperature version is installed horizontally (with transmitter head pointing upwards), an insulation thickness of min. 10 mm (0.4") is recommended to reduce convection. The maximum insulation thickness of 60 mm (2.4") must be observed.

3.2.7 Inlet and outlet runs

There are no installation requirements regarding inlet and outlet runs. If possible, install the sensor well clear of fittings such as valves, T-pieces, elbows, etc.

3.2.8 Vibrations

The high oscillation frequency of the measuring tubes ensures that the correct operation of the measuring system is not influenced by pipe vibrations. Consequently, the sensors require no special measures for attachment.

3.2.9 Limiting flow

Relevant information can be found in the "Technical Data" section under Measuring range → 🗎 71 or Limiting Flow → 🗎 95.

3.3 Installation

3.3.1 Turning the transmitter housing

Turning the aluminum field housing

⚠ Warning!
The turning mechanism in devices with EEx d/de or FM/CSA Cl. I Div. 1 classification is not the same as that described here. The procedure for turning these housings is described in the Ex-specific documentation.

1. Loosen the two securing screws.
2. Turn the bayonet catch as far as it will go.
3. Carefully lift the transmitter housing as far as it will go.
4. Turn the transmitter housing to the desired position (max. 2 × 90° in either direction).
5. Lower the housing into position and reengage the bayonet catch.
6. Retighten the two securing screws.

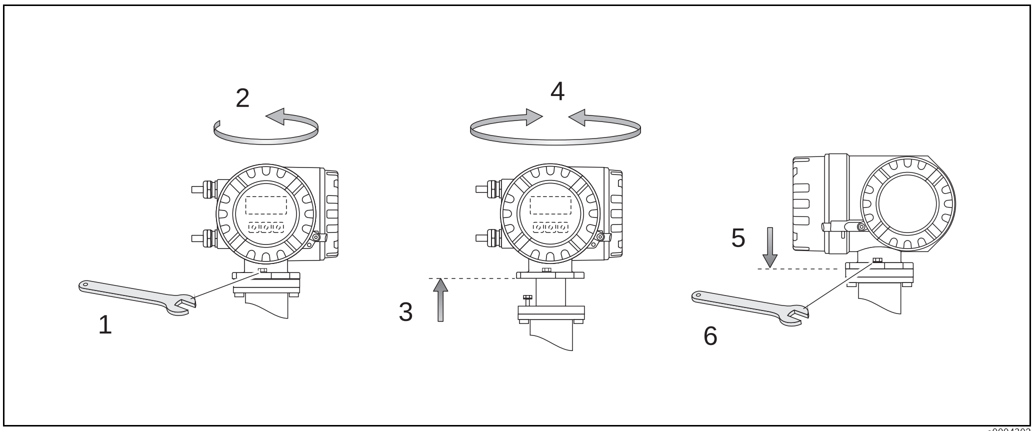


Fig. 13: Turning the transmitter housing (aluminum field housing)

Turning the stainless steel field housing

1. Loosen the two securing screws.
2. Carefully lift the transmitter housing as far as it will go.
3. Turn the transmitter housing to the desired position (max. 2 × 90° in either direction).
4. Lower the housing into position.
5. Retighten the two securing screws.

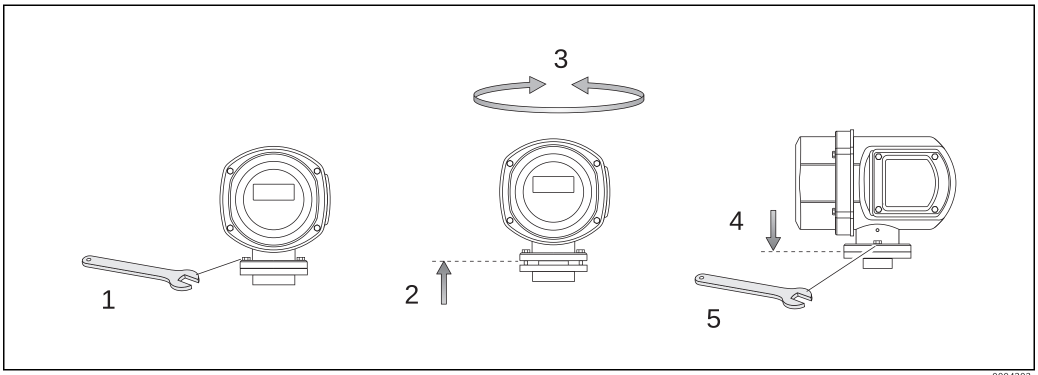


Fig. 14: Turning the transmitter housing (stainless steel field housing)

3.3.2 Installing the wall-mount housing

There are various ways of installing the wall-mount housing:

- Mounted directly on the wall
- Installation in control panel (separate mounting set, accessories) → 🗎 23
- Pipe mounting (separate mounting set, accessories) → 🗎 23

Caution!
- Make sure that ambient temperature does not go beyond the permissible range → 🗎 93. Install the device in a shady location. Avoid direct sunlight.
- Always install the wall-mount housing in such a way that the cable entries are pointing down.

Mounted directly on the wall

1. Drill the holes as illustrated in the diagram.
2. Remove the cover of the connection compartment (a).
3. Push the two securing screws (b) through the appropriate bores (c) in the housing.
   – Securing screws (M6): max. Ø 6.5 mm (0.26")
   – Screw head: max. Ø 10.5 mm (0.41")
4. Secure the transmitter housing to the wall as indicated.
5. Screw the cover of the connection compartment (a) firmly onto the housing.

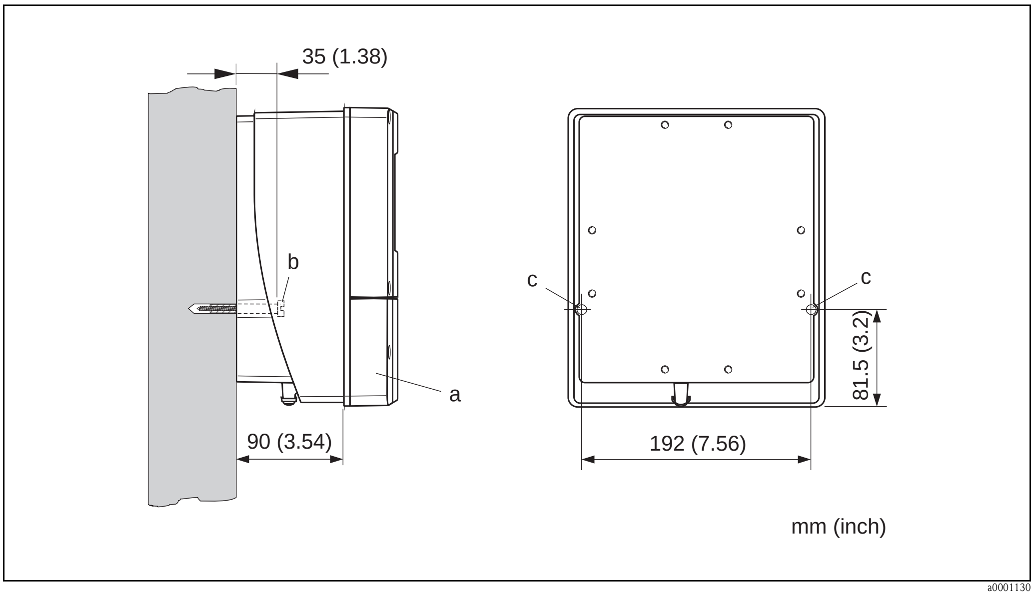


Fig. 15: Mounted directly on the wall

Installation in control panel

1. Prepare the opening in the panel as illustrated in the diagram.
2. Slide the housing into the opening in the panel from the front.
3. Screw the fasteners onto the wall-mount housing.
4. Screw threaded rods into holders and tighten until the housing is solidly seated on the panel wall. Afterwards, tighten the locking nuts.
   Additional support is not necessary.

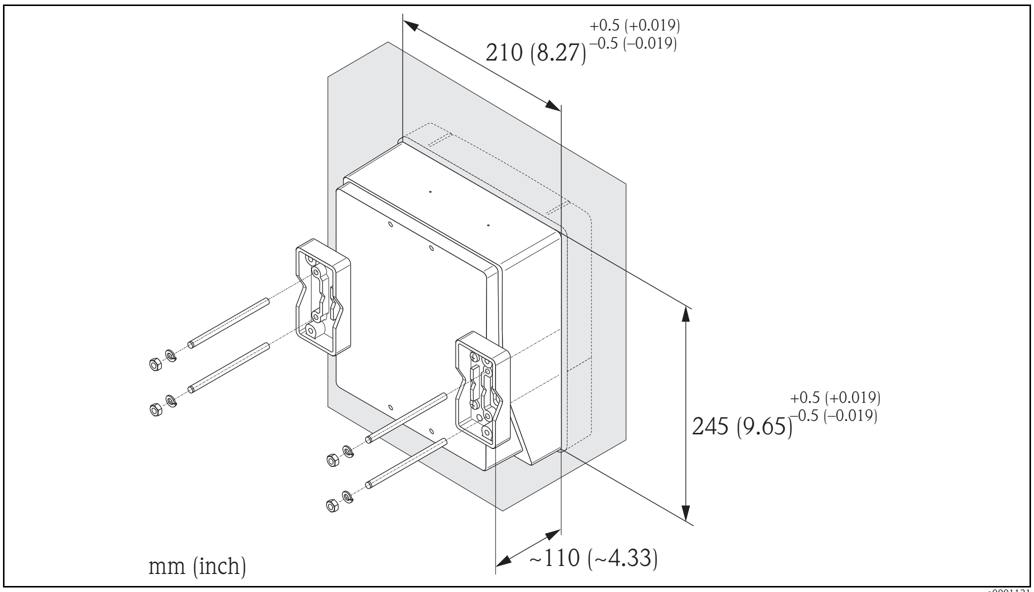


Fig. 16: Panel installation (wall-mount housing)

Pipe mounting

The assembly should be performed by following the instructions in the diagram.

Caution!
If a warm pipe is used for installation, make sure that
the housing temperature does not exceed the max. permitted value of +60 °C (+140 °F).

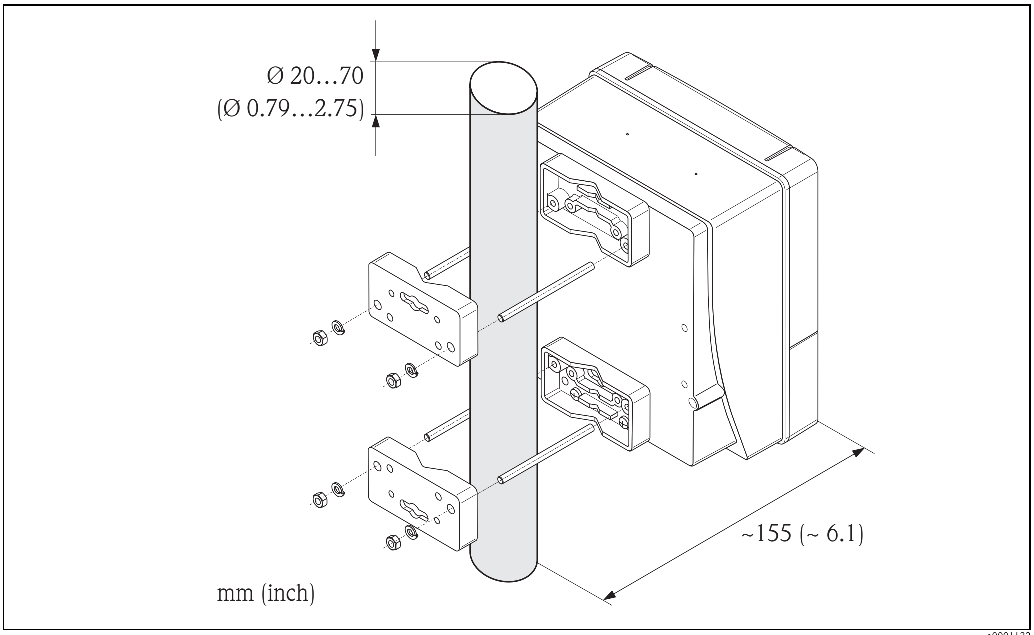


Fig. 17: Pipe mounting (wall-mount housing)

3.3.3 Turning the local display

1. Unscrew cover of the electronics compartment from the transmitter housing.
2. Press the side latches on the display module and remove the module from the electronics compartment cover plate.
3. Rotate the display to the desired position (max. 4 × 45 ° in both directions), and reset it onto the electronics compartment cover plate.
4. Screw the cover of the electronics compartment firmly back onto the transmitter housing.

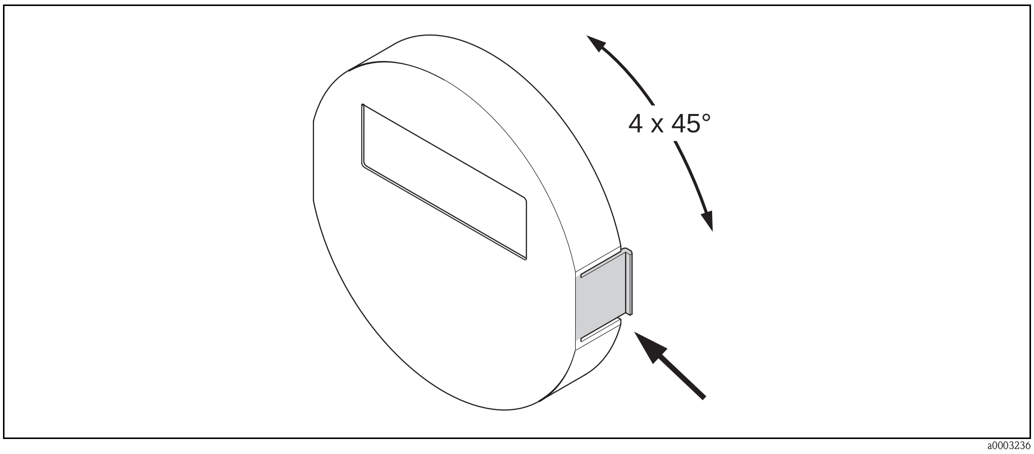


Fig. 18: Turning the local display (field housing)

3.4 Post installation check

Perform the following checks after installing the measuring device in the pipe:

Device condition and specifications	Notes
Is the device damaged (visual inspection)?	-
Does the device correspond to specifications at the measuring point, including process temperature and pressure, ambient temperature, measuring range etc.?	→ 🗎 5
Installation	Notes
Does the arrow on the sensor nameplate match the direction of flow through the pipe?	-
Are the measuring point number and labeling correct (visual inspection)?	-
Has the correct orientation been chosen for the sensor, in other words is it suitable for sensor type, fluid properties (outgassing, with entrained solids) and fluid temperature?	→ 🗎 13
Process environment / process conditions	Notes
Is the measuring device protected against moisture and direct sunlight?	-

4 Wiring

Warning!
When connecting Ex-certified devices, see the notes and diagrams in the Ex-specific supplement to these Operating Instructions. Please do not hesitate to contact your Endress+Hauser sales office if you have any questions.

Hinweis!
The device does not have an internal power switch. For this reason, assign the device a switch or power-circuit breaker which can be used to disconnect the power supply line from the power grid.

4.1 Connecting the remote version

4.1.1 Connecting the sensor/transmitter

Warning!
- Risk of electric shock. Switch off the power supply before opening the device.
  Do not install or wire the device while it is connected to the power supply.
  Failure to comply with this precaution can result in irreparable damage to the electronics.
- Risk of electric shock. Connect the protective earth to the ground terminal on the housing before the power supply is applied.
- You may only connect the sensor to the transmitter with the same serial number. Communication errors can occur if this is not observed when connecting the devices.

1. Remove the connection compartment cover (d) of the transmitter and sensor housing.
2. Feed the connecting cable (e) through the appropriate cable runs.
3. Establish the connections between sensor and transmitter in accordance with the wiring diagram (see → 19 or wiring diagram in screw cap).
4. Screw the connection compartment cover (d) back onto the sensor and transmitter housing.

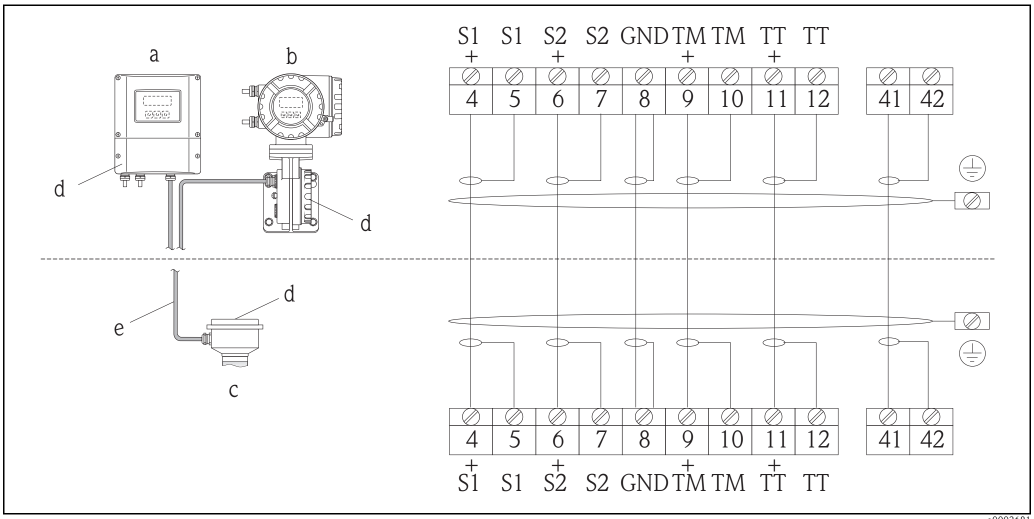


Fig. 19: Connecting the remote version

a Wall-mount housing: non-hazardous area and ATEX II3G / zone 2 → see separate "Ex documentation"
b Wall-mount housing: ATEX II2G / Zone 1 /FM/CSA → see separate "Ex documentation"
c Remote version, flanged version
d Cover of the connection compartment or connection housing
e Connecting cable

Terminal No.: 4/5 = gray; 6/7 = green; 8 = yellow; 9/10 = pink; 11/12 = white; 41/42 = brown

4.1.2 Cable specification, connecting cable

The specifications of the cable connecting the transmitter and the sensor of the remote version are as follows:

- 6 × 0.38 mm² PVC cable with common shield and individually shielded cores
- Conductor resistance: ≤ 50 Ω/km
- Capacitance core/shield: ≤ 420 pF/m
- Cable length: max. 20 m (65 ft)
- Permanent operating temperature: max. +105 °C (+221 °F)

Note!
The cable must be installed securely, to prevents movement.

4.2 Connecting the measuring unit

4.2.1 Transmitter connection

Warning!
- Risk of electric shock. Switch off the power supply before opening the device. Do not install or wire the device while it is connected to the power supply. Failure to comply with this precaution can result in irreparable damage to the electronics.
- Risk of electric shock. Connect the protective earth to the ground terminal on the housing before the power supply is applied (not required for galvanically isolated power supply).
- Compare the specifications on the nameplate with the local supply voltage and frequency. The national regulations governing the installation of electrical equipment also apply.

1. Unscrew the connection compartment cover (f) from the transmitter housing.
2. Feed the power supply cable (a) and the signal cable (b) through the appropriate cable entries.
3. Perform wiring:
   – Wiring diagram (aluminum housing) → 20
   – Wiring diagram (stainless steel housing → 21
   – Wiring diagram (wall-mount housing) → 22
   – Terminal assignment → 28
4. Screw the cover of the connection compartment (f) back onto the transmitter housing.

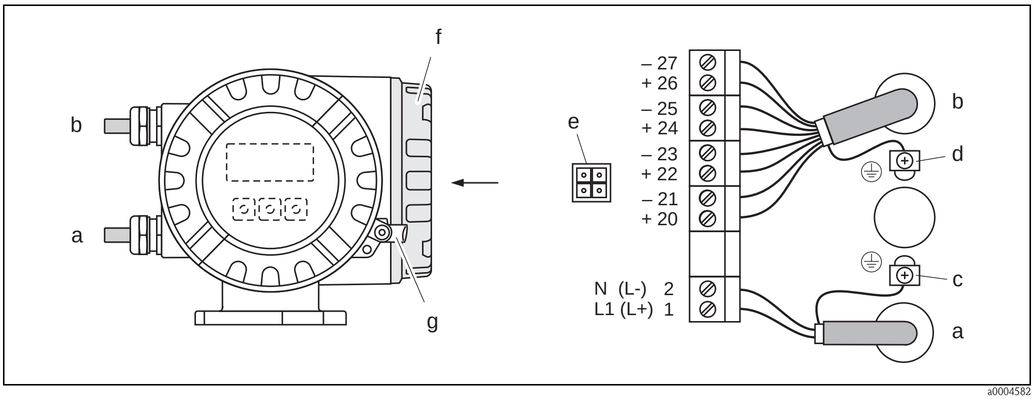


Fig. 20: Connecting the transmitter (aluminum field housing); cable cross-section: max. 2.5 mm²

a Cable for power supply: 85 to 260 V AC, 20 to 55 V AC, 16 to 62 V DC
*Terminal **No. 1:** L1 for AC, L+ for DC*
*Terminal **No. 2:** N for AC, L- for DC*
*b Signal cable: Terminals **Nos. 20–27** →* *28*
c Ground terminal for protective ground
d Ground terminal for signal cable shield
e Service adapter for connecting service interface FXA 193 (Fieldcheck, FieldCare)
f Cover of the connection compartment
g Securing clamp

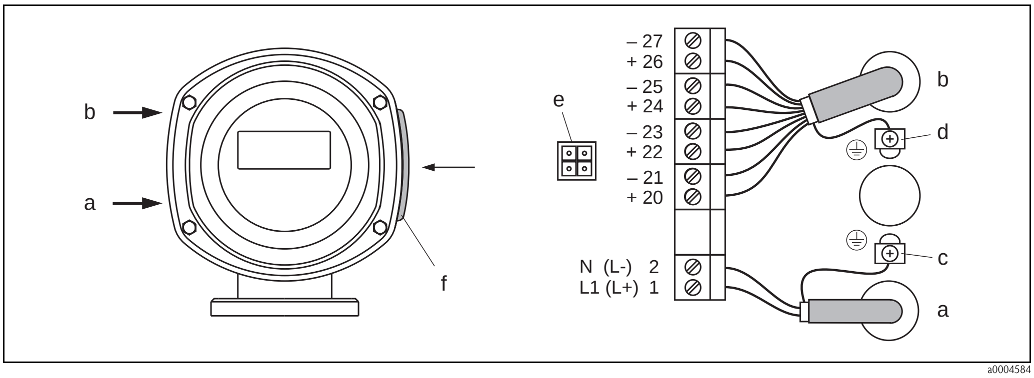


Fig. 21: Connecting the transmitter (stainless steel field housing); cable cross-section: max. 2.5 mm²

a Cable for power supply: 85 to 260 V AC, 20 to 55 V AC, 16 to 62 V DC
*Terminal **No. 1:** L1 for AC, L+ for DC*
*Terminal **No. 2:** N for AC, L- for DC*
*b Signal cable: Terminals **Nos. 20–27** →* *28*
c Ground terminal for protective ground
d Ground terminal for signal cable shield
e Service adapter for connecting service interface FXA193 (Fieldcheck, FieldCare)
f Cover of the connection compartment

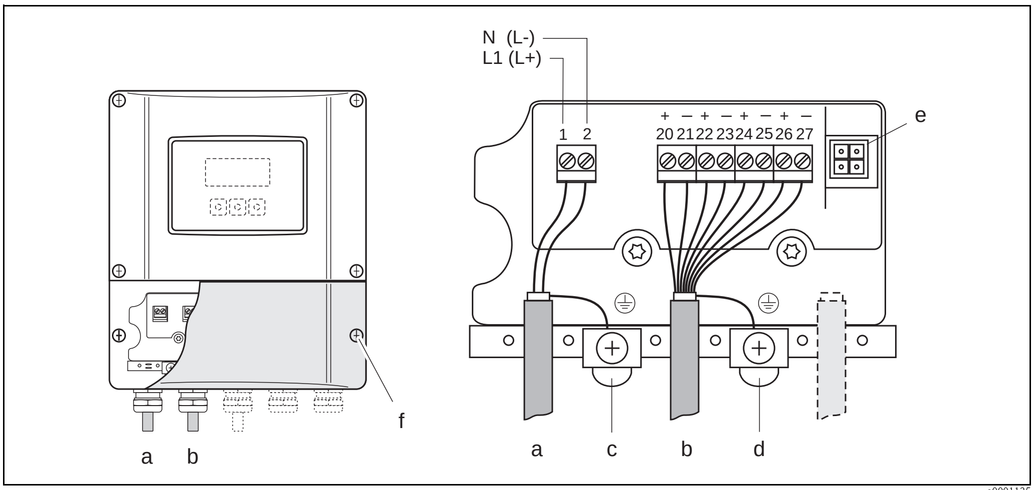


Fig. 22: Connecting the transmitter (wall-mount housing); cable cross-section: max. 2.5 mm²

a Cable for power supply: 85 to 260 V AC, 20 to 55 V AC, 16 to 62 V DC
*Terminal**No. 1:** L1 for AC, L+ for DC*
*Terminal**No. 2:** N for AC, L- for DC*
*b Signal cable: Terminals **Nos. 20–27** → 28*
c Ground terminal for protective ground
d Ground terminal for signal cable shield
e Service adapter for connecting service interface FXA193 (Fieldcheck, FieldCare)
f Cover of the connection compartment

4.2.2 Terminal assignment

Electrical values for:
- Inputs → 74
- Outputs → 74

	Terminal No. (inputs/outputs)			
Order version	**20 (+) / 21 (–)**	**22 (+) / 23 (–)**	**24 (+) / 25 (–)**	**26 (+) / 27 (–)**
80***-***********A	-	-	Frequency output	Current output HART
80***-***********D	Status input	Status output	Frequency output	Current output HART
80***-***********S	-	-	Frequency output Ex i, passive	Current output Ex i active, HART
80***-***********T	-	-	Frequency output Ex i, passive	Current output Ex i passive, HART
80***-***********8	Status input	Frequency output	Current output 2	Current output 1 HART

4.2.3 HART connection

Users have the following connection options at their disposal:
- Direct connection to transmitter by means of terminals 26(+) / 27(–)
- Connection by means of the 4 to 20 mA circuit

Note!
- The measuring circuit's minimum load must be at least 250 Ω.
- The CURRENT SPAN function must be set to "4–20 mA" (individual options see device function).
- See also the documentation issued by the HART Communication Foundation, and in particular HCF LIT 20: "HART, a technical summary".

Connection of the HART handheld communicator

See also the documentation issued by the HART Communication Foundation, and in particular HCF LIT 20: "HART, a technical summary".

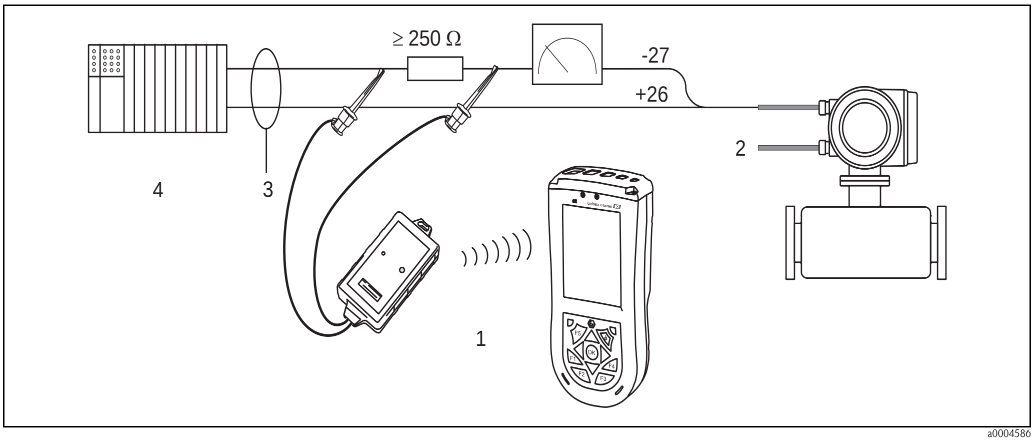


Fig. 23: Electrical connection of HART handheld terminal

1 HART handheld terminal
2 Auxiliary energy
3 Shielding
4 Other switching units or PLC with passive input

Connection of a PC with an operating software

In order to connect a PC with operating software (e.g. FieldCare), a HART modem (e.g. Commubox FXA195) is needed.

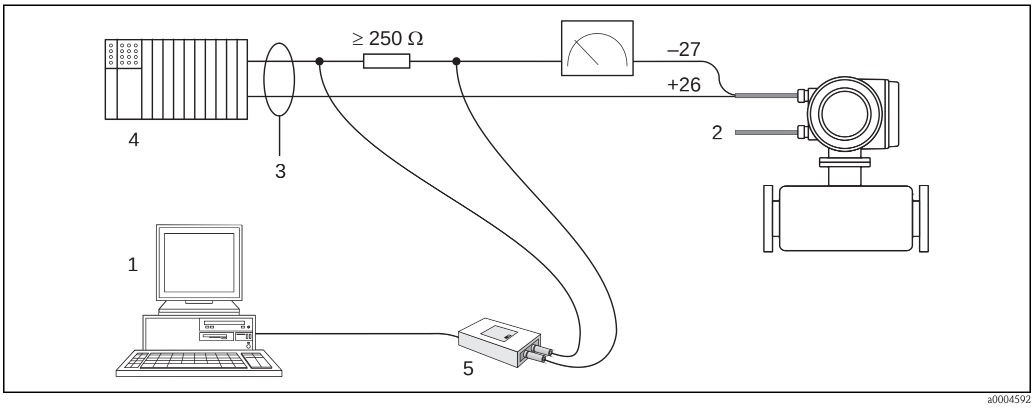


Fig. 24: Electrical connection of a PC with operating software

1 PC with operating software
2 Auxiliary energy
3 Shielding
4 Other switching units or PLC with passive input
5 HART modem, e.g. Commubox FXA195

4.3 Degree of protection

The measuring device fulfill all the requirements for IP 67.

Compliance with the following points is mandatory following installation in the field or servicing, in order to ensure that IP 67 protection is maintained:

- The housing seals must be clean and undamaged when inserted into their grooves. The seals must be dried, cleaned or replaced if necessary.
- The threaded fasteners and screw covers must be firmly tightened.
- The cables used for connection must be of the specified outside diameter → 75, cable entries.
- The cable entries must be firmly tighten (point **a** → 25).
- The cable must loop down in front of the cable entry ("water trap") (point **b** → 25). This arrangement prevents moisture penetrating the entry.

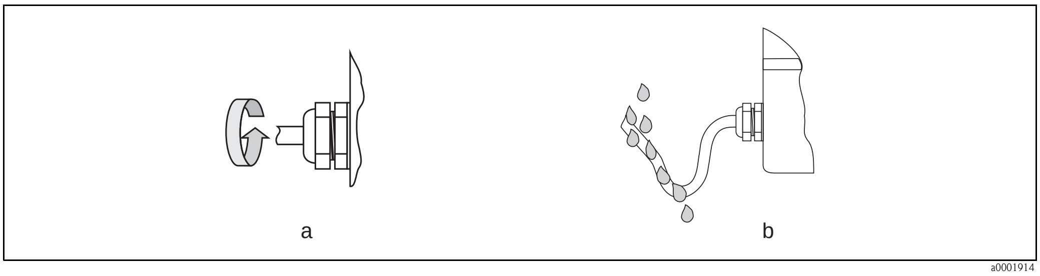


Fig. 25: Installation instructions, cable entries

- Do not remove the grommet from the cable entry.
- Remove all unused cable entries and insert plugs instead.

Caution!
Do not loosen the screws of the sensor housing, as otherwise the degree of protection guaranteed by Endress+Hauser no longer applies.

4.4 Post connection check

Perform the following checks after completing electrical installation of the measuring device:

Device condition and specifications	**Notes**
Are cables or the device damaged (visual inspection)?	–
Electrical connection	**Notes**
Does the supply voltage match the specifications on the nameplate?	85 to 260 V AC (45 to 65 Hz) 20 to 55 V AC (45 to 65 Hz) 16 to 62 V DC
Do the cables comply with the specifications?	→ 26
Do the cables have adequate strain relief?	–
Cables correctly segregated by type? Without loops and crossovers?	–
Are the power supply and signal cables correctly connected?	See the wiring diagram inside the cover of the terminal compartment
Are all screw terminals firmly tightened?	–
Are all cable entries installed, firmly tightened and correctly sealed? Cables looped as "water traps"?	→ 30
Are all housing covers installed and firmly tightened?	–

5 Operation

5.1 Display and operating elements

The local display enables you to read all important variables of the simulation directly at the measuring point and configure the device using the function matrix.
The display consists of two lines; this is where measured values and/or status variables (direction of flow, empty pipe, bar graph etc.) are displayed. You can change the assignment of display lines to different variables to suit your needs and preferences (→ "Description of Device Functions" manual).

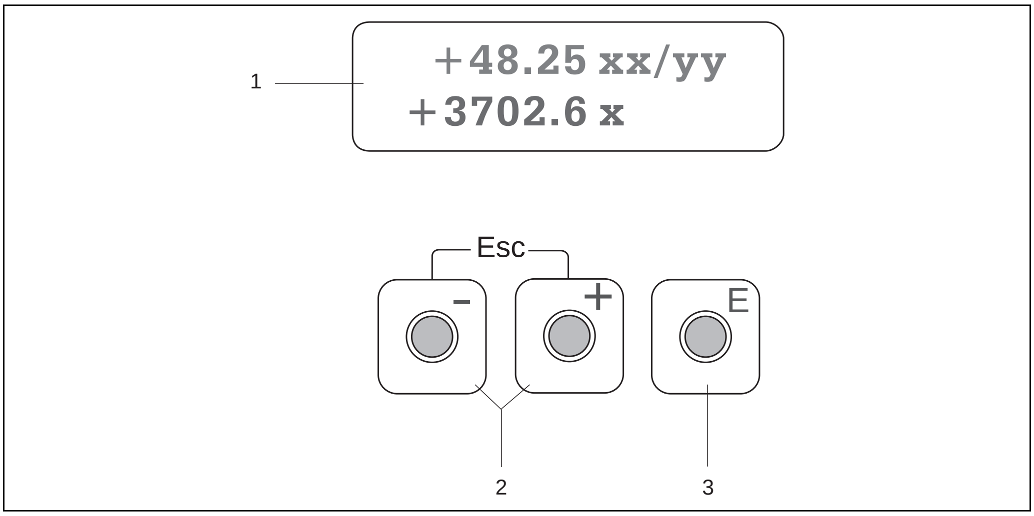


Fig. 26: Display and operating elements

1 Liquid crystal display
The backlit, two-line liquid crystal display shows measured values, dialog texts, fault messages and notice messages. The display as it appears when normal measuring is in progress is known as the HOME position (operating mode).
– Upper display line: shows primary measured values, e.g. mass flow in [kg/h] or in [%].
– Lower display line: shows additional measured variables and status variables, e.g. totalizer reading in [t], bar graph, measuring point designation.

2 Plus/minus keys
– Enter numerical values, select parameters
– Select different function groups within the function matrix
Press the +/– keys simultaneously to trigger the following functions:
– Exit the function matrix step by step → HOME position
– Press and hold down +/– keys for longer than 3 seconds → Return directly to HOME position
– Cancel data entry

3 Enter key
– HOME position → Entry into the function matrix
– Save the numerical values you input or settings you change

5.2 Brief operating instructions to the function matrix

Note!
- See the general notes → 33
- Function descriptions → see the "Description of Device Functions" manual

1. HOME position → E → Entry into the function matrix
2. Select a function group (e.g. CURRENT OUTPUT 1)
3. Select a function (e.g. TIME CONSTANT)
   Change parameter / enter numerical values:
   +/- → Select or enter enable code, parameters, numerical values
   E → Save your entries
4. Exit the function matrix:
   – Press and hold down Esc key (-/+) for longer than 3 seconds → HOME position
   – Repeatedly press Esc key (-/+) → Return step-by-step to HOME position

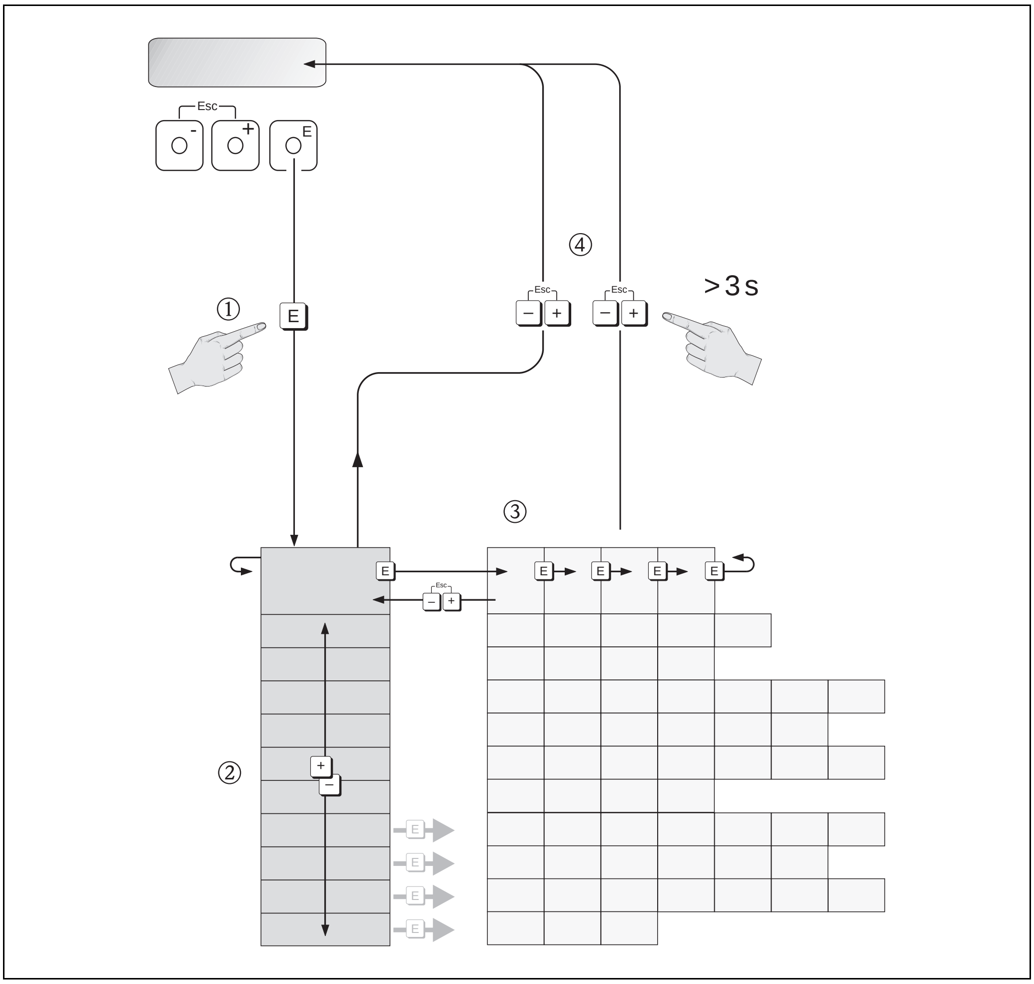


Fig. 27: Selecting functions and configuring parameters (function matrix)

5.2.1 General notes

The Quick Setup menu contains the default settings that are adequate for commissioning. Complex measuring operations on the other hand necessitate additional functions that you can configure as necessary and customize to suit your process parameters. The function matrix, therefore, comprises a multiplicity of additional functions which, for the sake of clarity, are arranged in a number of function groups.

Comply with the following instructions when configuring functions:
- You select functions as described already → 32.
- You can switch off certain functions (OFF). If you do so, related functions in other function groups will no longer be displayed.
- Certain functions prompt you to confirm your data entries. Press ± to select SURE [YES] and press E to confirm. This saves your setting or starts a function, as applicable.
- Return to the HOME position is automatic if no key is pressed for 5 minutes.
- Programming mode is disabled automatically if you do not press a key within 60 seconds following automatic return to the HOME position.

Caution!
All functions are described in detail, as is the function matrix itself, in the "Description of Device Functions" manual which is a separate part of these Operating Instructions.

Note!
- The transmitter continues to measure while data entry is in progress, i.e. the current measured values are output via the signal outputs in normal manner.
- If the power supply fails all preset and configured values remain safely stored in the EEPROM.

5.2.2 Enabling the programming mode

The function matrix can be disabled. Disabling the function matrix rules out the possibility of inadvertent changes to device functions, numerical values or factory settings. A numerical code (factory setting = 80) has to be entered before settings can be changed.
If you use a code number of your choice, you exclude the possibility of unauthorized persons accessing data (→ see the "Description of Device Functions" manual).

Comply with the following instructions when entering codes:
- If programming is disabled and the ± operating elements are pressed in any function, a prompt for the code automatically appears on the display.
- If "0" is entered as the customer's code, programming is always enabled!
- The Endress+Hauser service organization can be of assistance if you mislay your personal code.

Caution!
Changing certain parameters such as all sensor characteristics, for example, influences numerous functions of the entire measuring system, particularly measuring accuracy.
There is no need to change these parameters under normal circumstances and consequently, they are protected by a special code known only to the Endress+Hauser service organization. Please contact Endress+Hauser if you have any questions.

5.2.3 Disabling the programming mode

Programming mode is disabled if you do not press an operating element within 60 seconds following automatic return to the HOME position.
You can also disable programming in the ACCESS CODE function by entering any number (other than the customer's code).

5.3 Error messages

5.3.1 Type of error

Errors that occur during commissioning or measuring are displayed immediately. If two or more system or process errors occur, the error with the highest priority is the one shown on the display.

The measuring system distinguishes between two types of error:
- *System error:*
  This group includes all device errors, e.g. communication errors, hardware errors etc. → 57
- *Process error:*
  This group includes all application errors, e.g. fluid not homogeneous, etc. → 60

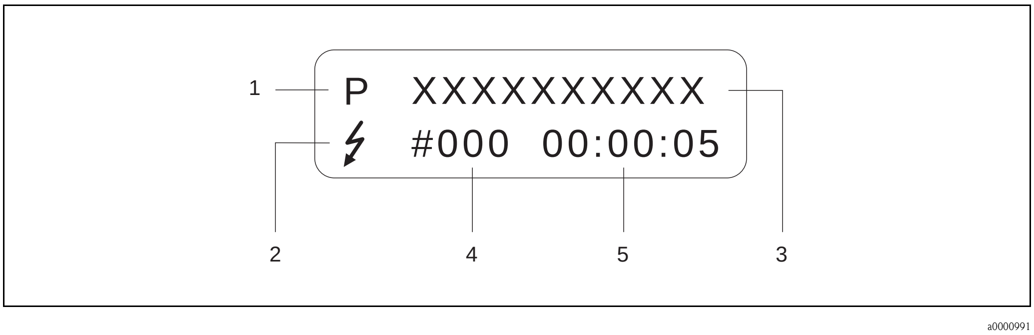


Fig. 28: Error messages on the display (example)

1 *Error type: P = process error, S = system error*
2 *Error message type: ϟ = fault message, ! = notice message*
3 *Error designation: e.g. MEDIUM INHOM. = fluid is not homogeneous*
4 *Error number: e.g. #702*
5 *Duration of most recent error occurrence (in hours, minutes and seconds)*

5.3.2 Error message type

Users have the option of weighting system and process errors differently, by defining them as **Fault messages** or **Notice messages**. You can define messages in this way with the aid of the function matrix (see the "Description of Device Functions" manual).
Serious system errors, e.g. module defects, are always identified and classified as "fault messages" by the measuring device.

Notice message (!)
- The error in question has no effect on the current operation and the outputs of the measuring device.
- Displayed as → Exclamation mark (!), error type (S: system error, P: process error).

Fault message (ϟ)
- The error in question interrupts or stops the current operation and has an immediate effect on the outputs. The response of the outputs (failsafe mode) can be defined by means of functions in the function matrix → 62
- Displayed as → Lightning flash (ϟ), error type (S: system error, P: process error)

Note!
For security reasons, error messages should be output via the status output.

5.4 Communication

In addition to local operation, the measuring device can be configured and measured values can be obtained by means of the HART protocol. Digital communication takes place using the 4–20 mA current output HART → 29.
The HART protocol allows the transfer of measuring and device data between the HART master and the field devices for configuration and diagnostics purposes. The HART master, e.g. a handheld terminal or PC-based operating programs (such as FieldCare), require device description (DD) files which are used to access all the information in a HART device. Information is exclusively transferred using "commands". There are three different command groups:

- *Universal Commands*
  Universal commands are supported and used by all HART devices. The following are examples of functions connected with them:
  – Recognizing HART devices
  – Reading digital measured values (volume flow, totalizer etc.)
- *Common practice commands*
  Common practice commands offer functions which are supported and can be executed by most but not all field devices.
- *Device-specific commands*
  These commands allow access to device-specific functions which are not HART standard. Such commands access individual field device information, among other things, such as empty/full pipe calibration values, low flow cut off settings, etc.

✎ Note!
The measuring device has access to all three command classes.
List of all "Universal Commands" and "Common Practice Commands" → 37.

5.4.1 Operating options

For the complete operation of the measuring device, including device-specific commands, there are DD files available to the user to provide the following operating aids and programs:

✎ Note!
The HART protocol requires the "4 to 20 mA HART" setting (individual options see device function) in the CURRENT SPAN function (current output 1).

HART handheld terminal Field Xpert

Selecting device functions with a HART Communicator is a process involving a number of menu levels and a special HART function matrix.
The HART manual in the carrying case of the HART Communicator contains more detailed information on the device.

Operating program "FieldCare"

FieldCare is Endress+Hauser's FDT-based plant asset management tool and allows the configuration and diagnosis of intelligent field devices. By using status information, you also have a simple but effective tool for monitoring devices. The Proline flowmeters are accessed via a HART interface FXA195 or via the service interface FXA193.

Operating program "SIMATIC PDM" (Siemens)

SIMATIC PDM is a standardized, manufacturer-independent tool for the operation, configuration, maintenance and diagnosis of intelligent field devices.

Operating program "AMS" (Emerson Process Management)

AMS (Asset Management Solutions): program for operating and configuring devices

5.4.2 Current device description files

The following table illustrates the suitable device description file for the operating tool in question and then indicates where these can be obtained.

HART protocol:

Valid for software:	3.01.00	→ Function DEVICE SOFTWARE
Device data HART Manufacturer ID: Device ID:	 11_{hex} (ENDRESS+HAUSER) 50_{hex}	 → Function MANUFACTURER ID → Function DEVICE ID
HART version data:	Device Revision 9 / DD Revision 1	
Software release:	01.2010	

Operating program:	Sources for obtaining device descriptions:
Field Xpert handheld terminal	▪ Use update function of handheld terminal
FieldCare / DTM	▪ www.endress.com → Download-Area ▪ CD–ROM (Endress+Hauser order number 56004088) ▪ DVD (Endress+Hauser order number 70100690)
AMS	▪ www.endress.com → Download-Area
SIMATIC PDM	▪ www.endress.com → Download-Area

Tester/simulator:	Sources for obtaining device descriptions:
Fieldcheck	▪ Update by means of FieldCare via flow device FXA 193/291 DTM in Fieldflash Module

5.4.3 Device and process variables

Device variables:
The following device variables are available using the HART protocol:

Code (decimal)	Device variable
0	OFF (unassigned)
2	Mass flow
5	Volume flow
6	Corrected volume flow
7	Density
8	Reference density
9	Temperature
250	Totalizer 1
251	Totalizer 2

Process variables:

At the factory, the process variables are assigned to the following device variables:
- Primary process variable (PV) → Mass flow
- Secondary process variable (SV) → Totalizer 1
- Third process variable (TV) → Density
- Fourth process variable (FV) → Temperature

Note!
You can set or change the assignment of device variables to process variables using Command 51 → 40.

5.4.4 Universal / Common practice HART commands

The following table contains all the universal practice commands supported by the device.

Command No. HART command / Access type		Command data (numeric data in decimal form)	Response data (numeric data in decimal form)
Universal Commands			
0	Read unique device identifier Access type = read	none	Device identification delivers information on the device and the manufacturer. It cannot be changed. The response consists of a 12-byte device ID: – Byte 0: fixed value 254 – Byte 1: Manufacturer ID, 17 = E+H – Byte 2: Device type ID, e.g. 81 = Promass 83 or 80 = Promass 80 – Byte 3: Number of preambles – Byte 4: Universal commands rev. no. – Byte 5: Device-specific commands rev. no. – Byte 6: Software revision – Byte 7: Hardware revision – Byte 8: Additional device information – Bytes 9-11: Device identification
1	Read primary process variable Access type = read	none	– Byte 0: HART unit code of the primary process variable – Bytes 1-4: Primary process variable *Factory setting:* Primary process variable = Mass flow Note! ▪ You can set the assignment of device variables to process variables using Command 51. ▪ Manufacturer-specific units are represented using the HART unit code "240".
2	Read the primary process variable as current in mA and percentage of the set measuring range Access type = read	none	– Bytes 0-3: Current current of the primary process variable in mA – Bytes 4-7: Percentage of the set measuring range *Factory setting:* Primary process variable = Mass flow Note! You can set the assignment of device variables to process variables using Command 51.
3	Read the primary process variable as current in mA and four (preset using Command 51) dynamic process variables Access type = read	none	24 bytes are sent as a response: – Bytes 0-3: Primary process variable current in mA – Byte 4: HART unit code of the primary process variable – Bytes 5-8: Primary process variable – Byte 9: HART unit code of the secondary process variable – Bytes 10-13: Secondary process variable – Byte 14: HART unit code of the third process variable – Bytes 15-18: Third process variable – Byte 19: HART unit code of the fourth process variable – Bytes 20-23: Fourth process variable *Factory setting:* ▪ Primary process variable = Mass flow ▪ Secondary process variable = Totalizer 1 ▪ Third process variable = Density ▪ Fourth process variable = Temperature Note! ▪ You can set the assignment of device variables to process variables using Command 51. ▪ Manufacturer-specific units are represented using the HART unit code "240".

Command No. HART command / Access type		Command data (numeric data in decimal form)	Response data (numeric data in decimal form)
6	Set HART shortform address Access type = write	Byte 0: desired address (0 to 15) *Factory setting:* 0 ✎ Note! With an address >0 (multidrop mode), the current output of the primary process variable is set to 4 mA.	Byte 0: active address
11	Read unique device identification using the TAG (measuring point designation) Access type = read	Bytes 0-5: TAG	Device identification delivers information on the device and the manufacturer. It cannot be changed. The response consists of a 12-byte device ID if the specified TAG agrees with the one saved in the device: – Byte 0: fixed value 254 – Byte 1: Manufacturer ID, 17 = E+H – Byte 2: Device type ID, 81 = Promass 83 or 80 = Promass 80 – Byte 3: Number of preambles – Byte 4: Universal commands rev. no. – Byte 5: Device-specific commands rev. no. – Byte 6: Software revision – Byte 7: Hardware revision – Byte 8: Additional device information – Bytes 9-11: Device identification
12	Read user message Access type = read	none	Bytes 0-24: User message ✎ Note! You can write the user message using Command 17.
13	Read TAG, descriptor and date Access type = read	none	– Bytes 0-5: TAG – Bytes 6-17: Descriptor – Bytes 18-20: Date ✎ Note! You can write the TAG, descriptor and date using Command 18.
14	Read sensor information on primary process variable	none	– Bytes 0-2: Sensor serial number – Byte 3: HART unit code of sensor limits and measuring range of the primary process variable – Bytes 4-7: Upper sensor limit – Bytes 8-11: Lower sensor limit – Bytes 12-15: Minimum span ✎ Note! ▪ The data relate to the primary process variable (= Mass flow). ▪ Manufacturer-specific units are represented using the HART unit code "240".
15	Read output information of primary process variable Access type = read	none	– Byte 0: Alarm selection ID – Byte 1: Transfer function ID – Byte 2: HART unit code for the set measuring range of the primary process variable – Bytes 3-6: Upper range, value for 20 mA – Bytes 7-10: Start of measuring range, value for 4 mA – Bytes 11-14: Attenuation constant in [s] – Byte 15: Write protection ID – Byte 16: OEM dealer ID, 17 = E+H *Factory setting:* Primary process variable = Mass flow ✎ Note! ▪ You can set the assignment of device variables to process variables using Command 51. ▪ Manufacturer-specific units are represented using the HART unit code "240".

Command No. HART command / Access type		Command data (numeric data in decimal form)	Response data (numeric data in decimal form)
16	Read the device production number Access type = read	none	Bytes 0-2: Production number
17	Write user message Access = write	You can save any 32-character long text in the device under this parameter: Bytes 0-23: Desired user message	Displays the current user message in the device: Bytes 0-23: Current user message in the device
18	Write TAG, descriptor and date Access = write	With this parameter, you can store an 8 character TAG, a 16 character descriptor and a date: – Bytes 0-5: TAG – Bytes 6-17: Descriptor – Bytes 18-20: Date	Displays the current information in the device: – Bytes 0-5: TAG – Bytes 6-17: Descriptor – Bytes 18-20: Date

The following table contains all the common practice commands supported by the device.

Command No. HART command / Access type		Command data (numeric data in decimal form)	Response data (numeric data in decimal form)
Common Practice Commands			
34	Write damping value for primary process variable Access = write	Bytes 0-3: Attenuation constant of the primary process variable in seconds *Factory setting:* Primary process variable = Mass flow	Displays the current damping value in the device: Bytes 0-3: Damping value in seconds
35	Write measuring range of primary process variable Access = write	Write the desired measuring range: – Byte 0: HART unit code of the primary process variable – Bytes 1-4: Upper range, value for 20 mA – Bytes 5-8: Start of measuring range, value for 4 mA *Factory setting:* Primary process variable = Mass flow Note! ▪ You can set the assignment of device variables to process variables using Command 51. ▪ If the HART unit code is not the correct one for the process variable, the device will continue with the last valid unit.	The currently set measuring range is displayed as a response: – Byte 0: HART unit code for the set measuring range of the primary process variable – Bytes 1-4: Upper range, value for 20 mA – Bytes 5-8: Start of measuring range, value for 4 mA Note! Manufacturer-specific units are represented using the HART unit code "240".
38	Device status reset (Configuration changed) Access = write	none	none
40	Simulate output current of primary process variable Access = write	Simulation of the desired output current of the primary process variable. An entry value of 0 exits the simulation mode: Byte 0-3: Output current in mA *Factory setting:* Primary process variable = Mass flow Note! You can set the assignment of device variables to process variables with Command 51.	The momentary output current of the primary process variable is displayed as a response: Byte 0-3: Output current in mA
42	Perform master reset Access = write	none	none

Command No. HART command / Access type		Command data (numeric data in decimal form)	Response data (numeric data in decimal form)
44	Write unit of primary process variable Access = write	Set unit of primary process variable. Only unit which are suitable for the process variable are transferred to the device: Byte 0: HART unit code *Factory setting:* Primary process variable = Mass flow Note! ▪ If the written HART unit code is not the correct one for the process variable, the device will continue with the last valid unit. ▪ If you change the unit of the primary process variable, this has no impact on the system units.	The current unit code of the primary process variable is displayed as a response: Byte 0: HART unit code Note! Manufacturer-specific units are represented using the HART unit code "240".
48	Read additional device status Access = read	none	The device status is displayed in extended form as the response: Coding: see table → 42
50	Read assignment of the device variables to the four process variables Access = read	none	Display of the current variable assignment of the process variables: – Byte 0: Device variable code to the primary process variable – Byte 1: Device variable code to the secondary process variable – Byte 2: Device variable code to the third process variable – Byte 3: Device variable code to the fourth process variable *Factory setting:* ▪ Primary process variable: Code 1 for mass flow ▪ Secondary process variable: Code 250 for totalizer 1 ▪ Third process variable: Code 7 for density ▪ Fourth process variable: Code 9 for temperature Note! You can set the assignment of device variables to process variables with Command 51.
51	Write assignments of the device variables to the four process variables Access = write	Setting of the device variables to the four process variables: – Byte 0: Device variable code to the primary process variable – Byte 1: Device variable code to the secondary process variable – Byte 2: Device variable code to the third process variable – Byte 3: Device variable code to the fourth process variable *Code of the supported device variables:* See data → 36 *Factory setting:* ▪ Primary process variable = Mass flow ▪ Secondary process variable = Totalizer 1 ▪ Third process variable = Density ▪ Fourth process variable = Temperature	The variable assignment of the process variables is displayed as a response: – Byte 0: Device variable code to the primary process variable – Byte 1: Device variable code to the secondary process variable – Byte 2: Device variable code to the third process variable – Byte 3: Device variable code to the fourth process variable

<table>
<tr><th colspan="2">Command No.
HART command / Access type</th><th>Command data
(numeric data in decimal form)</th><th>Response data
(numeric data in decimal form)</th></tr>
<tr><td>53</td><td>Write device variable unit
Access = write</td><td>This command sets the unit of the given device variables. Only those units which suit the device variable are transferred:
– Byte 0: Device variable code
– Byte 1: HART unit code

Code of the supported device variables:
See data → 36

Note!
▪ If the written unit is not the correct one for the device variable, the device will continue with the last valid unit.
▪ If you change the unit of the device variable, this has no impact on the system units.</td><td>The current unit of the device variables is displayed in the device as a response:
– Byte 0: Device variable code
– Byte 1: HART unit code

Note!
Manufacturer-specific units are represented using the HART unit code "240".</td></tr>
<tr><td>59</td><td>Write number of preambles in response message
Access = write</td><td>This parameter sets the number of preambles which are inserted in the response messages:
Byte 0: Number of preambles (2 to 20)</td><td>As a response, the current number of the preambles is displayed in the response message:
Byte 0: Number of preambles</td></tr>
</table>

5.4.5 Device status / Error messages

You can read the extended device status, in this case, current error messages, via Command "48". The command delivers information which are partly coded in bits (see table below).

Note!
You can find a detailed explanation of the device status and error messages and their elimination in the "System error messages" section → 57

Byte–bit	Error No.	Short error description → 56
0-0	001	Serious device error
0-1	011	Measuring amplifier has faulty EEPROM
0-2	012	Error when accessing data of the measuring amplifier EEPROM
1-1	031	S-DAT: defective or missing
1-2	032	S-DAT: Error accessing saved values
1-5	051	I/O board and the amplifier board are not compatible.
3-3	111	Totalizer checksum error
3-4	121	I/O board and the amplifier board (software versions) are not compatible.
4-3	251	Internal communication fault on the amplifier board.
4-4	261	No data reception between amplifier and I/O board
7-3	351	Current output: Flow is out of range.
7-4	352	
7-5	353	
7-6	354	
7-7	355	Frequency output: Flow is out of range.
8-0	356	
8-1	357	
8-2	358	
8-3	359	Pulse output: Pulse output frequency is out of range.
8-4	360	
8-5	361	
8-6	362	
9-0	379	The measuring tube oscillation frequency is outside the permitted range.
9-1	380	
9-2	381	The temperature sensor on the measuring tube is likely defective.
9-3	382	
9-4	383	The temperature sensor on the carrier tube is likely defective.
9-5	384	
9-6	385	One of the measuring tube sensor coils (inlet or outlet) is likely defective.
9-7	386	
10-0	387	One of the measuring tube sensor coils (inlet or outlet) is likely defective.
10-1	388	
10-2	389	Amplifier error
10-3	390	
12-1	474	Maximum flow value entered is exceeded.
12-7	501	New amplifier software version is loaded. Currently no other commands are possible.
13-0	502	Upload and download of device files. Currently no other commands are possible.

Byte–bit	Error No.	Short error description → 🗎 56
13-5	586	The fluid properties do not allow normal measuring operation.
13-6	587	Extreme process conditions exist. The measuring system can therefore not be started.
13-7	588	Overdriving of the internal analog to digital converter. A continuation of the measurement is no longer possible!
14-3	601	Positive zero return active
14-7	611	Simulation current output 1 active
15-0	612	Simulation current output 2 active
15-3	621	Simulation frequency output active
15-7	631	Simulation pulse output active
16-3	641	Simulation status output active
17-7	671	Simulation status input active
18-3	691	Simulation of response to error (outputs) active
18-4	692	Simulation of measured variable active
19-0	700	The process fluid density is outside the upper or lower limit values
19-1	701	The maximum current value for the measuring tube exciter coils has been reached, since certain process fluid characteristics are extreme.
19-2	702	Frequency control is not stable, due to inhomogeneous fluid.
19-3	703	Overdriving of the internal analog to digital converter. A continuation of the measurement is still possible!
19-4	704	
19-5	705	The electronics' measuring range will be exceeded. The mass flow is too high.
20-5	731	The zero point adjustment is not possible or has been canceled.

6 Commissioning

6.1 Function check

Make sure that the following function checks have been performed successfully before switching on the supply voltage for the measuring device:
- Checklist for "Post installation check" → 🗎 24
- Checklist for "Post connection check" → 🗎 30

6.2 Switching on the measuring device

Once the function check has been performed successfully, the device is operational and can be switched on via the supply voltage. The device then performs internal test functions and the following messages are shown on the local display:

PROMASS 80 **START-UP...**	Startup message
▼	
DEVICE SOFTWARE **V XX.XX.XX**	Current software version
▼	
SYSTEM OK **→ OPERATION**	Beginning of normal measuring mode

Normal measuring mode commences as soon as startup completes.
Various measured value and/or status variables appear on the display (HOME position).g

Note!
If startup fails, an error message indicating the cause is displayed.

6.3 Quick Setup

In the case of measuring devices without a local display, the individual parameters and functions must be configured via the configuration program, e.g. FieldCare.
If the measuring device is equipped with a local display, all the important device parameters for standard operation, as well as additional functions, can be configured quickly and easily by means of the following Quick Setup menus.

6.3.1 "Commissioning" Quick Setup

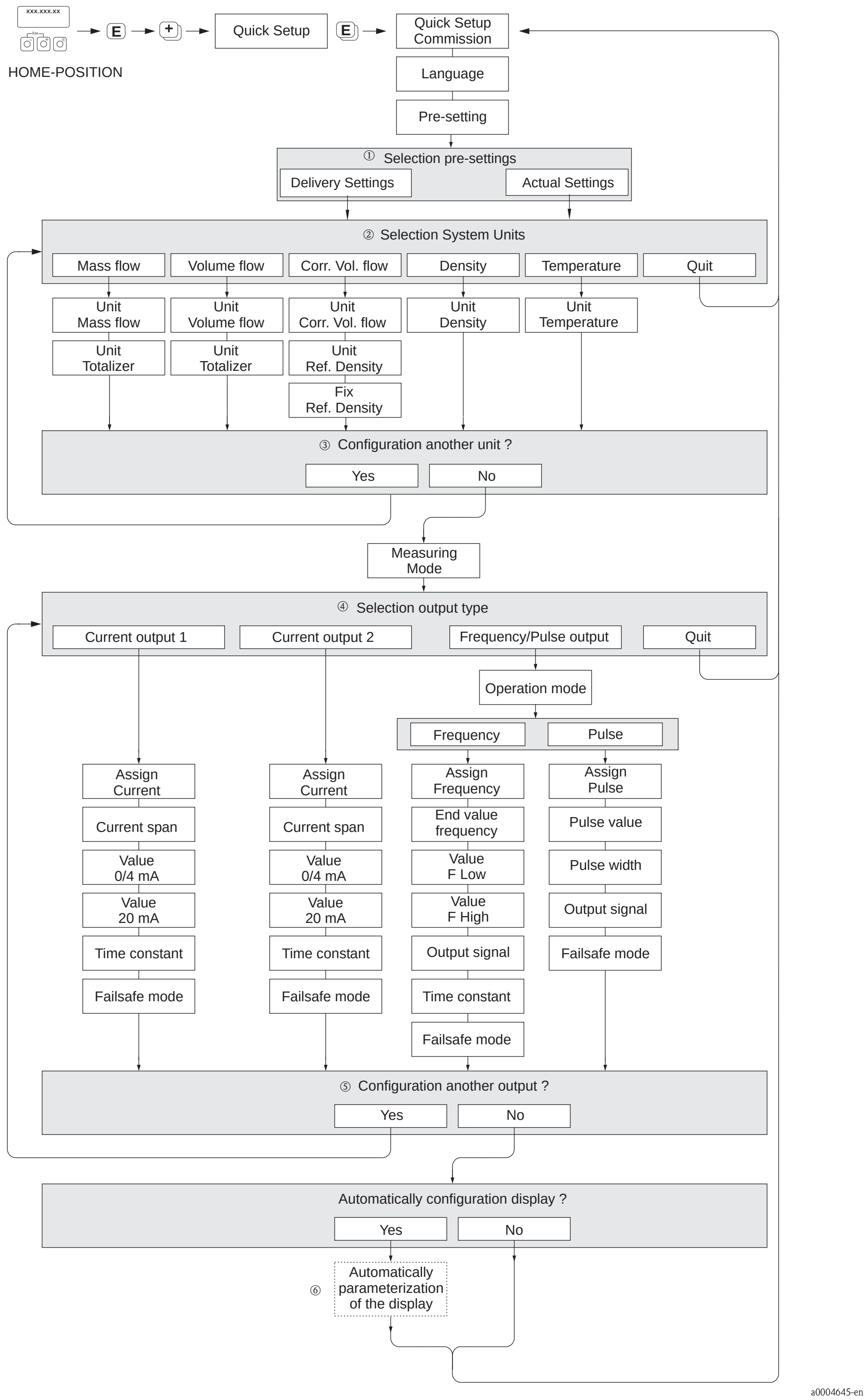


Fig. 29: "Commissioning" Quick Setup

✎ Note!

- The display returns to the cell SETUP COMMISSIONING (1002) if you press the key combination during parameter interrogation The stored parameters remain valid.
- The "Commissioning" Quick Setup must be carried out before one of the Quick Setups explained below is run.

① Selecting DELIVERY SETTINGS returns each selected unit to the factory setting.
Selecting ACTUAL SETTINGS applies the units you have set previously.

② Only units not yet configured in the current Setup are offered for selection in each cycle. The unit for mass, volume and corrected volume is derived from the corresponding flow unit.

③ The YES option remains visible until all the units have been configured. NO is the only option displayed when no further units are available.

④ Only the outputs not yet configured in the current Setup are offered for selection in each cycle.

⑤ The YES option remains visible until all the outputs have been configured. NO is the only option displayed when no further outputs are available.

⑥ The "automatic parameterization of the display" option contains the following basic settings/factory settings:
YES: line 1= mass flow; line 2 = totalizer 1;
information line = operating/system conditions
NO: The existing (selected) settings remain.

6.4 Configuration

6.4.1 One current output: active/passive

The current output is configured as "active" or "passive" by means of various jumpers on the I/O board.

Caution!
Configuring the current outputs as "active" or "passive" is possible for non-Ex i I/O boards only. Ex i I/O boards are permanently wired as "active" or "passive". Also refer to table → 28

Warning!
Risk of electric shock. Exposed components carry dangerous voltages. Make sure that the power supply is switched off before you remove the cover of the electronics compartment.

1. Switch off power supply.
2. Remove the I/O board → 63
3. Set the jumpers in accordance with → → 30

Caution!
Risk of destroying the measuring device. Set the jumpers exactly as shown in the diagram. Incorrectly set jumpers can cause overcurrents that would destroy either the measuring device or external devices connected to it.

4. Installation of the I/O board is the reverse of the removal procedure.

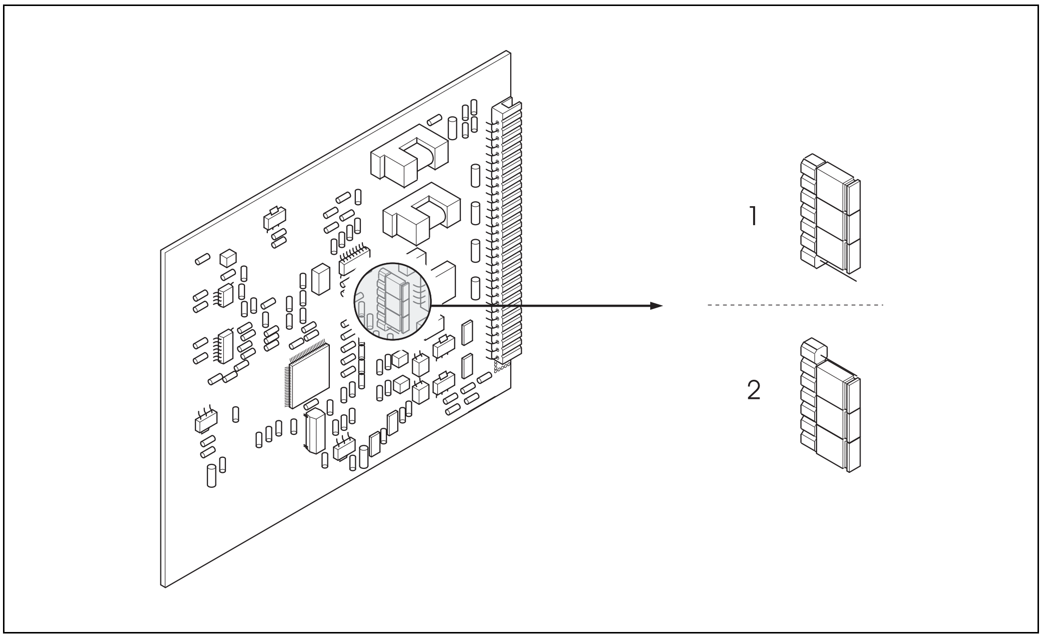


Fig. 30: Configuring the current output (I/O board)

1 Active current output (default)
2 Passive current output

6.4.2 Two current outputs: active/passive

The current outputs are configured as "active" or "passive" by means of various jumpers on the current input submodule.

Warning!
Risk of electric shock. Exposed components carry dangerous voltages. Make sure that the power supply is switched off before you remove the cover of the electronics compartment.

1. Switch off power supply
2. Remove the I/O board → 63
3. Set the jumpers → 31

Caution!
Risk of destroying the measuring device. Set the jumpers exactly as shown in the diagram. Incorrectly set jumpers can cause overcurrents that would destroy either the measuring device or external devices connected to it.

4. Installation of the I/O board is the reverse of the removal procedure.

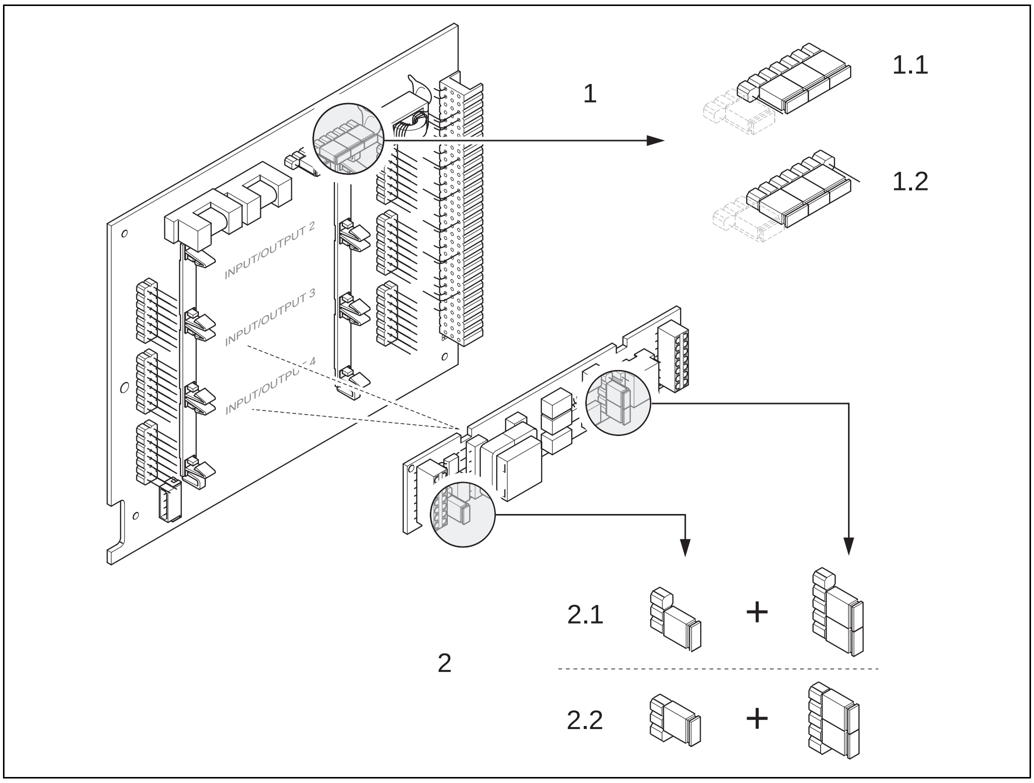


Fig. 31: Configuring current outputs with the aid of jumpers (I/O board)

1 Current output 1 with HART
1.1 Active current output (default)
1.2 Passive current output
2 Current output 2 (optional, plug-in module)
2.1 Active current output (default)
2.2 Passive current output

6.5 Adjust

6.5.1 Zero point adjustment

All measuring devices are calibrated with state-of-the-art technology. The zero point obtained in this way is printed on the nameplate.
Calibration takes place under reference operating conditions → 76.
Consequently, the zero point adjustment is generally **not** necessary!

Experience shows that the zero point adjustment is advisable only in special cases:
- To achieve highest measuring accuracy at very low flow rates
- Under extreme process or operating conditions (e.g. very high process temperatures or very high-viscosity fluids.

Preconditions for a zero point adjustment

Note the following before you perform a zero point adjustment:
- A zero point adjustment can be performed only with fluids with no gas or solid contents.
- A Zero point adjustment is performed with the measuring tubes completely filled and at zero flow (v = 0 m/s). This can be achieved, for example, with shutoff valves upstream and/or downstream of the sensor or by using existing valves and gates.
  - Normal operation → valves 1 and 2 open
  - Zero point adjustment *with* pump pressure → Valve 1 open / valve 2 closed
  - Zero point adjustment *without* pump pressure → Valve 1 closed / valve 2 open

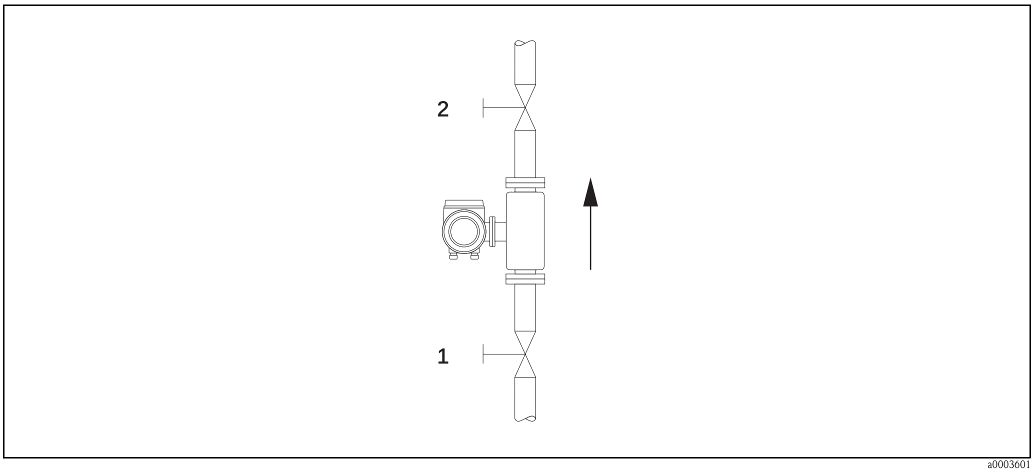


Fig. 32: Zero point adjustment and shutoff valves

Caution!
- If the fluid is very difficult to measure (e.g. containing entrained solids or gas) it may prove impossible to obtain a stable zero point despite repeated zero point adjustments. In instances of this nature, please contact your Endress+Hauser service center.
- You can view the currently valid zero point value using the ZERO POINT function (see the "Description of Device Functions" manual).

Performing a zero point adjustment

1. Let the system run until operating conditions have been reached.
2. Stop the flow (v = 0 m/s).
3. Check the shutoff valves for leaks.
4. Check that operating pressure is correct.
5. Perform a zero point adjustment as follows:

Key	Procedure	Display text
E	HOME position → Enter the function matrix	> GROUP SELECTION< MEASURED VARIABLES
+/-	Select the PROCESS PARAMETER function group	> GROUP SELECTION< PROCESS PARAMETER
E	Select the ZERO ADJUST. function	ZERO ADJUST. CANCEL
+/-	After you press +/-, you are automatically prompted to enter the code if the function matrix is still disabled.	CODE ENTRY ***
+/-	Enter the code (80 = default)	CODE ENTRY 80
E	Confirm the code as entered. The ZERO ADJUST function reappears on the display.	PROGRAMMING ENABLED ZERO ADJUST. CANCEL
+/-	Select START	ZERO ADJUST. START
E	Confirm the entry by pressing the Enter key. The confirmation prompt appears on the display.	SURE? NO
+/-	Select YES.	SURE? YES
E	Confirm the entry by pressing the Enter key. Zero point adjustment now starts. While zero point adjustment is in progress, the display shown here is visible for 30 to 60 seconds. If the flow of fluid in the pipe exceeds 0.1 m/s, an error message appears on the display: ZERO ADJUST NOT POSSIBLE. When the zero point adjustment completes, the ZERO ADJUST. function reappears on the display.	ZERO ADJUST. RUNNING ZERO ADJUST. CANCEL
E	After actuating the Enter key, the new zero point value is displayed.	ZERO POINT
Esc	Simultaneously pressing +/- → HOME position	

6.5.2 Density adjustment

Measuring accuracy in determining fluid density has a direct effect on calculating volume flow. Density adjustment, therefore, is necessary under the following circumstances:

- The sensor does not measure exactly the density value that the user expects, based on laboratory analyses.
- The fluid properties are outside the measuring points set at the factory, or the reference operating conditions used to calibrate the measuring device.
- The system is used exclusively to measure a fluid's density which must be registered to a high degree of accuracy under constant conditions.

Performing a 1-point or 2-point density adjustment

Caution!
- Onsite density adjustment can be performed only if the user has detailed knowledge of the fluid density, obtained for example from detailed laboratory analyses.
- The target density value specified in this way must not deviate from the measured fluid density by more than ±10%.
- An error in defining the target density affects all calculated density and volume functions.
- Density adjustment changes the factory density calibration values or the calibration values set by the service technician.
- The functions outlined in the following instructions are described in detail in the "Description of Device Functions" manual.

1. Fill the sensor with fluid. Make sure that the measuring tubes are completely filled and that liquids are free of gas bubbles.
2. Wait until the temperature difference between fluid and measuring tube has equalized. The time you have to wait for equalization depends on the fluid and the temperature level.
3. Select the density adjustment function:
   HOME → E → +/- → PROCESS PARAMETERS → E → DENSITY SET POINT
   – When you press +/- you are automatically prompted to enter the access code if the function matrix is still disabled. Enter the code.
   – Use +/- to enter the fluid's target density and press E to save this value (input range = actual density value ±10%).
4. Press E to select the MEASURE FLUID function.
   Use +/- to select the setting START and press E. The message DENSITY ADJUST RUNNING then appears on the display for 10 seconds. During this time Promass measures the current density of the fluid (measured density value).
5. Press F and select the DENSITY ADJUST function.
   Now use +/- to select the setting DENSITY ADJUST and press E. Promass compares the measured density value with the specified value and calculates the new density coefficient.

   Caution!
   If a density adjustment does not complete correctly, you can select the RESTORE ORIGINAL function to reactivate the default density coefficient.
6. Use Use Q to return to the HOME position (press +/- simultaneously).

6.6 Rupture disk

Sensor housings with integrated rupture disks are optionally available.

Warning!
- Make sure that the function and operation of the rupture disk is not impeded through the installation. Triggering overpressure in the housing as stated on the indication label.
  Take adequate precautions to ensure that no damage occurs, and risk to human life is ruled out, if the rupture disk is triggered. Rupture disk: Burst pressure 10 to 15 bar (145 to 217 psi).
- Please note that the housing can no longer assume a secondary containment function if a rupture disk is used.
- It is not permitted to open the connections or remove the rupture disk.

Caution!
- Rupture disks can not be combined with separately available heating jacket (except Promass A).
- The existing connection nozzles are not designed for a rinse or pressure monitoring function.

Note!
- Before commissioning, please remove the transport protection of the rupture disk.
- Please note the indication labels.

6.7 Purge and pressure monitoring connections

The sensor housing protects the inner electronics and mechanics and is filled with dry nitrogen. Beyond that, up to a specified measuring pressure it additionally serves as secondary containment.

Warning!
For a process pressure above the specified containment pressure, the housing does not serve as an additional secondary containment. In case a danger of measuring tube failure exists due to process characteristics, e.g. with corrosive process fluids, we recommend the use of sensors whose housing is equipped with special pressure monitoring connections (ordering option). With the help of these connections, fluid collected in the housing in the event of tube failure can be drained off. This diminishes the danger of mechanical overload of the housing, which could lead to a housing failure and accordingly is connected with an increased danger potential. These connections can also be used for gas purging (gas detection).

The following instructions apply to handling sensors with purge or pressure monitoring connections:
- Do not open the purge connections unless the containment can be filled immediately with a dry inert gas.
- Use only low gauge pressure to purge. Maximum pressure 5 bar.

6.8 Data storage device (HistoROM)

At Endress+Hauser, the term HistoROM refers to various types of data storage modules on which process and measuring device data are stored. By plugging and unplugging such modules, device configurations can be duplicated onto other measuring devices to cite just one example.

6.8.1 HistoROM/S–DAT (sensor–DAT)

The S-DAT is an exchangeable data storage device in which all sensor relevant parameters are stored, i.e., diameter, serial number, calibration factor, zero point.

7 Maintenance

No special maintenance work is required.

7.1 Exterior cleaning

When cleaning the exterior of measuring devices, always use cleaning agents that do not attack the surface of the housing and the seals.

7.2 Cleaning with pigs (Promass H, I, S, P)

If pigs are used for cleaning, it is essential to take the inside diameters of measuring tube and process connection into account. See also Technical Information → 🖹 109.

7.3 Replacing seals

Under normal circumstances, fluid wetted seals of the Promass A sensors do not require replacement. Replacement is necessary only in special circumstances, for example if aggressive or corrosive fluids are incompatible with the seal material.

✎ Note!
- The period between changes depends on the fluid properties and on the frequency of cleaning cycles in the case of CIP/SIP cleaning.
- Replacement seals (accessories)

8 Accessories

Various accessories, which can be ordered separately from Endress+Hauser, are available for the transmitter and the sensor. The Endress+Hauser service organization can provide detailed information on the order code of your choice.

8.1 Device-specific accessories

Accessory	Description	Order code
Proline Promass 80 transmitter	Transmitter for replacement or for stock. Use the order code to define the following specifications: – Approvals – Degree of protection / version – Cable entries – Display / power supply / operation – Software – Outputs / inputs	80XXX – XXXXX * * * * * *

8.2 Measuring principle-specific accessories

Accessory	Description	Order code
Mounting set for transmitter	Mounting set for remote version. Suitable for: – Wall mounting – Pipe mounting – Installation in control panel Mounting set for aluminum field housing: Suitable for pipe mounting (3/4" to 3")	DK8WM – *
Post mounting set for the Promass A sensor	Post mounting set for the Promass A	DK8AS – * *
Mounting set for the Promass A sensor	Mounting set for Promass A, comprising: – 2 process connections – Seals	DK8MS – * * * * * *
Set of seals for sensor	For regular replacement of the seals of the Promass A sensors. Set consists of two seals.	DKS – * * *
Memograph M graphic display recorder	The Memograph M graphic display recorder provides information on all the relevant process variables. Measured values are recorded correctly, limit values are monitored and measuring points analyzed. The data are stored in the 256 MB internal memory and also on a DSD card or USB stick. Memograph M boasts a modular design, intuitive operation and a comprehensive security concept. The ReadWin® 2000 PC software is part of the standard package and is used for configuring, visualizing and archiving the data captured. The mathematics channels which are optionally available enable continuous monitoring of specific power consumption, boiler efficiency and other parameters which are important for efficient energy management.	RSG40 - ************

8.3 Communication-specific accessories

Accessory	Description	Order code
HART Communicator Field Xpert handheld terminal	Handheld terminal for remote parameterization and for obtaining measured values via the current output HART (4 to 20 mA). Contact your Endress +Hauser representative for more information.	SFX100 – *******
FXA195	The Commubox FXA195 connects intrinsically safe smart transmitters with the HART protocol with the USB port of a personal computer. This enables remote operation of the transmitter with operating software (e.g. FieldCare). Power is supplied to the Commubox via the USB port.	FXA195 – *

8.4 Service-specific accessories

Accessory	Description	Order code
Applicator	Software for selecting and configuring Endress+Hauser flowmeters: ▪ Calculating all necessary data to determine the optimal flowmeter: e.g. nominal diameter, pressure drop, performance characteristics or process connections ▪ Graphic display of calculation results Management, documentation and retrievability of all project-related data and parameters of the entire operating life of a project. Applicator is available: ▪ Via the Internet: https://wapps.endress.com/applicator ▪ On CD-ROM for installation on local computer	DXA80 – *
Fieldcheck	Tester/simulator for testing flowmeters in the field. When used in conjunction with the "FieldCare" software package, test results can be imported into a database, printed and used for official certification. Contact your Endress+Hauser representative for more information.	50098801
FieldCare	FieldCare is Endress+Hauser's FDT-based plant asset management tool and allows the configuration and diagnosis of intelligent field devices. By using status information, you also have a simple but effective tool for monitoring devices. The Proline flowmeters are accessed via a service interface or via the service interface FXA193.	→ Product page on the Endress+Hauser website: www.endress.com
FXA193	Service interface from the measuring device to the PC for operation via FieldCare.	FXA193 – *

9 Troubleshooting

9.1 Troubleshooting instructions

Always start troubleshooting with the following checklist if faults occur after commissioning or during operation. The routine takes you directly to the cause of the problem and the appropriate remedial measures.

Check the display	
No display visible and no output signals present.	1. Check the supply voltage → Terminals 1, 2 2. Check device fuse → 🗎 68 85 to 260 V AC: 0.8 A slow-blow / 250 V 20 to 55 V AC and 16 to 62 V DC: 2 A slow-blow / 250 V 3. Measuring electronics defective → order spare parts → 🗎 63
No display visible, but output signals are present.	1. Check whether the ribbon-cable connector of the display module is correctly plugged into the amplifier board → 🗎 63 2. Display module defective → order spare parts → 🗎 63 3. Measuring electronics defective → order spare parts → 🗎 63
Display texts are in a foreign language.	Switch off power supply. Press and hold down both the keys and switch on the measuring device. The display text will appear in English (default) and is displayed at maximum contrast.
Measured value indicated, but no signal at the current or pulse output	Measuring electronics defective → order spare parts → 🗎 63
▼	
Error messages on display	
Errors that occur during commissioning or measuring are displayed immediately. Error messages consist of a variety of icons. The meanings of these icons are as follows (example): – Error type: **S** = system error, **P** = process error – Error message type: ϟ = fault message, **!** = notice message – **MEDIUM INHOM.** = error designation (e.g. fluid is not homogeneous) – **03:00:05** = duration of error occurrence (in hours, minutes and seconds) – **#702** = error number Caution! See the information → 🗎 34	
▼	
Other error (without error message)	
Some other error has occurred.	Diagnosis and rectification → 🗎 61

9.2 System error messages

Serious system errors are **always** recognized by the instrument as a "Fault message" and are shown as a lightning flash (ϟ) on the display! Fault messages immediately affect the inputs and outputs.

Caution!
In the event of a serious fault, a flowmeter might have to be returned to the manufacturer for repair. Important procedures must be carried out before you return a flowmeter to Endress+Hauser → 🗎 69.
Always enclose a duly completed "Declaration of contamination" form.
You will find a preprinted blank of this form at the back of this manual.

Note!
- The error types listed in the following correspond to the factory settings.
- See the information on → 🗎 34

No.	Error message / Type	Cause	Remedy (spare part → 🗎 63)
S = System error ϟ = Fault message (with an effect on the outputs) ! = Notice message (without an effect on the outputs)			
No. # 0xx → Hardware error			
001	S: CRITICAL FAILURE ϟ: # 001	Serious device error	Replace the amplifier board.
011	S: AMP HW EEPROM ϟ: # 011	Amplifier: Defective EEPROM	Replace the amplifier board.
012	S: AMP SW EEPROM ϟ: # 012	Measuring amplifier: Error when accessing data of the EEPROM	The EEPROM data blocks in which an error has occurred are displayed in the TROUBLESHOOTING function. Press Enter to acknowledge the errors in question; default values are automatically inserted instead of the erroneous parameter values. Note! The measuring device has to be restarted if an error has occurred in a totalizer block (see error No. 111/CHECKSUM TOTAL.).
031	S: SENSOR HW DAT ϟ: # 031	1. S-DAT is not plugged into the amplifier board correctly (or is missing). 2. S-DAT is defective.	1. Check whether the S-DAT is correctly plugged into the amplifier board. 2. Replace the S-DAT if it is defective. Check that the new, replacement DAT is compatible with the measuring electronics. Check the: - Spare part set number - Hardware revision code 3. Replace measuring electronics boards if necessary. 4. Plug the S-DAT into the amplifier board.
032	S: SENSOR SW DAT ϟ: # 032		
No. # 1xx → Software error			
121	A / C COMPATIB. !: # 121	Due to different software versions, I/O board and amplifier board are only partially compatible (possibly restricted functionality). Note! – This message is only listed in the error history. – Nothing is displayed on the display.	Module with lower software version has either to be actualized by FieldCare with the required software version or the module has to be replaced.
No. # 2xx → Error in DAT / no communication			
251	COMMUNICATION I/O ϟ: # 251	Internal communication fault on the amplifier board.	Remove the amplifier board.
261	COMMUNICATION I/O ϟ: # 261	No data reception between amplifier and I/O board or faulty internal data transfer.	Check the BUS contacts

No.	Error message / Type	Cause	Remedy (spare part → 🗎 63)
No. # 3xx → System limits exceeded			
351 to 354	CURRENT RANGE n !: # 351 to 354	Current output: Flow is out of range.	1. Change the upper or lower limit setting, as applicable. 2. Increase or reduce flow, as applicable.
355 to 358	FREQUENCY RANGE n !: # 355 to 358	Frequency output: Flow is out of range.	1. Change the upper or lower limit setting, as applicable. 2. Increase or reduce flow, as applicable.
359 to 362	PULSE RANGE !: # 359 to 362	Pulse output: Pulse output frequency is out of range.	1. Increase the setting for pulse weighting 2. When selecting the pulse width, choose a value that can still be processed by a connected counter (e.g. mechanical counter, PLC etc.). *Determine the pulse width:* – Version 1: Enter the minimum duration that a pulse must be present at the connected counter to ensure its registration. – Version 2: Enter the maximum (pulse) frequency as the half "reciprocal value" that a pulse must be present at the connected counter to ensure its registration. Example: The maximum input frequency of the connected counter is 10 Hz. The pulse width to be entered is: $\frac{1}{2 \cdot 10\ \text{Hz}} = 50\ \text{ms}$ a0004437 3. Reduce flow.
379 to 380	S: FREQ. LIM ϟ: # 379 to 380	The measuring tube oscillation frequency is outside the permitted range. Causes: – Measuring tube damaged – Sensor defective or damaged	Contact your Endress+Hauser service organization.
381	S: FLUIDTEMP.MIN. ϟ: # 381	The temperature sensor on the measuring tube is likely defective.	Check the following electrical connections before you contact your Endress+Hauser service organization: – Verify that the sensor signal cable connector is correctly plugged into the amplifier board. – Remote version: Check sensor and transmitter terminal connections No. 9 and 10 → 🗎 25.
382	S: FLUIDTEMP.MAX. ϟ: # 382		
383	S: CARR.TEMP.MIN ϟ: # 383	The temperature sensor on the carrier tube is likely defective.	Check the following electrical connections before you contact your Endress+Hauser service organization: – Verify that the sensor signal cable connector is correctly plugged into the amplifier board. – Remote version: Check sensor and transmitter terminal connections No. 11 and 12 → 🗎 25.
384	S: CARR.TEMP.MAX ϟ: # 384		
385	S: INL.SENS.DEF. ϟ: # 385	One of the measuring tube sensor coils (inlet) is likely defective.	Check the following electrical connections before you contact your Endress+Hauser service organization: – Verify that the sensor signal cable connector is correctly plugged into the amplifier board. – Remote version: Check sensor and transmitter terminal connections No. 4, 5, 6 and 7 → 🗎 25.
386	S: OUTL.SENS.DEF. ϟ: # 386	One of the measuring tube sensor coils (outlet) is likely defective.	
387	S: SEN.ASY.EXCEED ϟ: # 387	Measuring tube sensor coil is probably faulty.	
388 to 390	S: AMP. FAULT ϟ: # 388 to 390	Amplifier error.	Contact your Endress+Hauser service organization.

No.	Error message / Type	Cause	Remedy (spare part → 🗎 63)
No. # 5xx → Application error			
501	S: SW.–UPDATE ACT. !: # 501	New amplifier or communication (I/O module) software version is loaded. Currently no other functions are possible.	Wait until process is finished. The device will restart automatically.
502	S: UP-/DOWNLOAD ACT. !: # 502	Up- or downloading the device data via configuration program. Currently no other functions are possible.	Wait until process is finished.
No. # 6xx → Simulation mode active			
601	S: POSITIVE ZERO RETURN !: # 601	Positive zero return active. Caution! This message has the highest display priority.	Switch off positive zero return
611 to 614	S: SIM. CURR. OUT. n !: # 611 to 614	Simulation current output active.	
621 to 624	S: SIM. FREQ. OUT. n !: # 621 to 624	Simulation frequency output active.	Switch off simulation.
631 to 634	S: SIM. PULSE n !: # 631 to 634	Simulation pulse output active.	Switch off simulation.
641 to 644	S: SIM. STATUS OUT n !: # 641 to 644	Simulation status output active.	Switch off simulation.
671 to 674	S: SIM. STATUS IN n !: # 671 to 674	Simulation status input active.	Switch off simulation.
691	S: SIM. FAILSAFE !: # 691	Simulation of response to error (outputs) active.	Switch off simulation.
692	S: SIM. MEASURAND !: # 692	Simulation of measuring variables (e.g. mass flow).	Switch off simulation.

9.3 Process error messages

Process errors can be defined as either "Fault" or "Notice" messages and can thereby be weighted differently. This is specified via the function matrix (→ "Description of Device Functions" manual).

Note!
- The listed error message types below correspond to the factory setting.
- See the information on → 34

No.	Error message / Type	Cause	Remedy (spare part → 63)
P = Process error ϟ = Fault message (with an effect on the inputs and outputs) ! = Notice message (without an effect on the inputs and outputs)			
586	P: OSC. AMP. LIM. ϟ: # 586	The fluid properties do not allow a continuation of the measurement. Causes: – Extremely high viscosity – Process fluid is very inhomogeneous (gas or solid content)	Change or improve process conditions.
587	P: TUBE NOT OSC ϟ: # 587	Extreme process conditions exist. The measuring system can therefore not be started.	Change or improve process conditions.
588	P: NOISE LIMIT ϟ: # 588	Overdriving of the internal analog to digital converter. Causes: – Cavitation – Extreme pressure pulses – High gas flow velocity A continuation of the measurement is no longer possible!	Change or improve process conditions, e.g. by reducing the flow velocity.
No. # 7xx → Other process errors)			
700	P: EMPTY PIPE !: # 700	The process fluid density is outside the upper or lower limit values set in the EPD function Causes: – Air in the measuring tube – Partly filled measuring tube	1. Ensure that there is no gas content in the process liquid. 2. Adapt the values in the EPD function to the current process conditions.
701	P: EXC. CURR. LIM. !: # 701	The maximum current value for the measuring tube exciter coils has been reached, since certain process fluid characteristics are extreme, e.g. high gas or solid content. The instrument continues to work correctly.	In particular with outgassing fluids and/or increased gas content, the following measures are recommended to increase system pressure: 1. Install the instrument at the outlet side of a pump. 2. Install the instrument at the lowest point of an ascending pipeline. 3. Install a flow restriction, e.g. reducer or orifice plate, downstream from the instrument.
702	P: FLUID INHOM. !: # 702	Frequency control is not stable, due to inhomogeneous process fluid, e.g. gas or solid content.	
703	P: NOISE LIMIT CH0 !: # 703	Overdriving of the internal analog to digital converter. Causes: – Cavitation – Extreme pressure pulses – High gas flow velocity A continuation of the measurement is still possible!	Change or improve process conditions, e.g. by reducing the flow velocity.
704	P: NOISE LIMIT CH1 !: # 704		
705	P: FLOW LIMIT ϟ: # 705	The mass flow is too high. The electronics' measuring range will be exceeded.	Reduce flow
731	P: ABJ. ZERO FAIL !: # 731	The zero point adjustment is not possible or has been canceled.	Make sure that zero point adjustment is carried out at "zero flow" only (v = 0 m/s) → 49.

9.4 Process errors without messages

Symptoms	Rectification
Note! You may have to change or correct certain settings of the function matrix in order to rectify faults. The functions outlined below, such as DISPLAY DAMPING, for example, are described in detail in the "Description of Device Functions" manual.	
Measured value reading fluctuates even though flow is steady.	1. Check the fluid for presence of gas bubbles. 2. TIME CONSTANT function → increase value (→ OUTPUTS / CURRENT OUTPUT / CONFIGURATION) 3. DISPLAY DAMPING function → increase value (→ USER INTERFACE / CONTROL / BASIC CONFIGURATION)
Measured value reading shown on display, even though the fluid is at a standstill and the measuring tube is full.	1. Check the fluid for presence of gas bubbles. 2. Activate the ON-VAL. LF-CUTOFF function, i.e. enter or increase the value for the low flow cut off (→ BASIC FUNCTION / PROCESS PARAMETER / CONFIGURATION).
The fault cannot be rectified or some other fault not described above has occurred. In these instances, please contact your Endress+Hauser service organization.	The following options are available for tackling problems of this nature: **Request the services of an Endress+Hauser service technician** If you contact our service organization to have a service technician sent out, please be ready with the following information: – Brief description of the fault – Nameplate specifications : Order code and serial number **Returning devices to Endress+Hauser** The procedures on must be carried out before you return a flowmeter requiring repair or calibration to Endress+Hauser → 🗎 69. Always enclose a duly completed "Declaration of contamination" form with the flowmeter. You will find a preprinted "Dangerous Goods Sheet" at the back of this manual. **Replace transmitter electronics** Components in the measuring electronics defective → order replacement → 🗎 63

9.5 Response of outputs to errors

Note!
The failsafe mode of totalizers, current, pulse and frequency outputs can be customized by means of various functions in the function matrix. You will find detailed information on these procedures in the "Description of Device Functions" manual.

You can use positive zero return to set the signals of the current, pulse and status outputs to their fallback value, for example when measuring has to be interrupted while a pipe is being cleaned. This function takes priority over all other device functions. Simulations, for example, are suppressed.

Failsafe mode of outputs and totalizers		
	Process/system error is present	Positive zero return is activated
Caution! System or process errors defined as "Notice messages" have no effect whatsoever on the inputs and outputs. See the information on → 34		
Current output 1, 2	MINIMUM CURRENT The current output will be set to the lower value of the signal on alarm level depending on the setting selected in the CURRENT SPAN (see the "Description of Device Functions" manual). MAXIMUM CURRENT The current output will be set to the higher value of the signal on alarm level depending on the setting selected in the CURRENT SPAN (see the "Description of Device Functions" manual). HOLD VALUE Measured value display on the basis of the last saved value preceding occurrence of the fault. ACTUAL VALUE Measured value display on the basis of the current flow measurement. The fault is ignored.	Output signal corresponds to "zero flow"
Pulse output	FALLBACK VALUE Signal output → no pulses HOLD VALUE Last valid value (preceding occurrence of the fault) is output. ACTUAL VALUE Fault is ignored, i.e. normal measured value output on the basis of ongoing flow measurement.	Output signal corresponds to "zero flow"
Frequency output	FALLBACK VALUE Signal output → 0 Hz FAILSAFE VALUE Output of the frequency specified in the FAILSAFE VALUE function. HOLD VALUE Last valid value (preceding occurrence of the fault) is output. ACTUAL VALUE Fault is ignored, i.e. normal measured value output on the basis of ongoing flow measurement.	Output signal corresponds to "zero flow"
Totalizer 1, 2	STOP The totalizers are paused until the error is rectified. ACTUAL VALUE The fault is ignored. The totalizer continues to count in accordance with the current flow value. HOLD VALUE The totalizers continue to count the flow in accordance with the last valid flow value (before the error occurred).	Totalizer stops
Status output	Status output → nonconductive in the event of fault or power supply failure	No effect on status output

9.6 Spare parts

The previous sections contain a detailed troubleshooting guide → 🗎 56
The measuring device, moreover, provides additional support in the form of continuous self-diagnosis and error messages.
Fault rectification can entail replacing defective components with tested spare parts.
The illustration below shows the available scope of spare parts.

Note!
You can order spare parts directly from your Endress+Hauser service organization by providing the serial number printed on the transmitter's nameplate → 🗎 7.

Spare parts are shipped as sets comprising the following parts:
- Spare part
- Additional parts, small items (threaded fasteners etc.)
- Mounting instructions
- Packaging

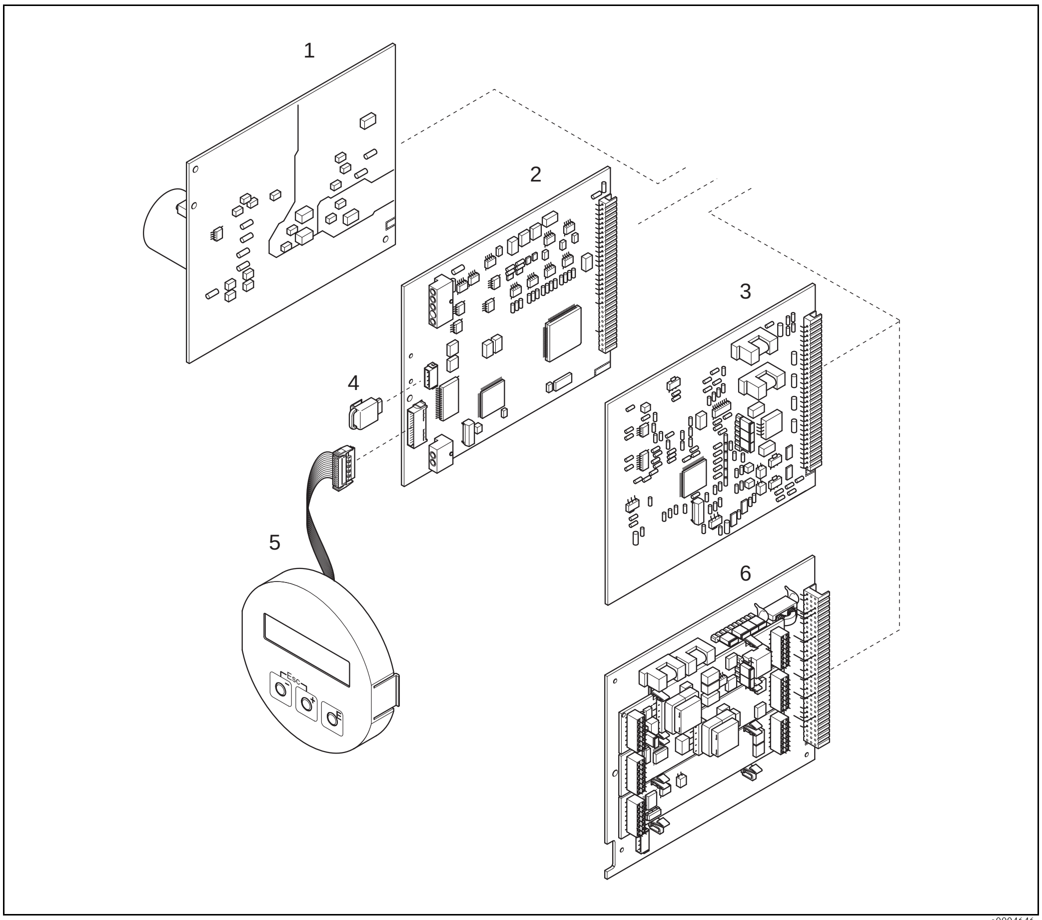


Fig. 33: Spare parts for transmitter Promass 80 (field and wall-mount housing)

1 Power unit board (85 to 260 V AC, 20 to 55 V AC, 16 to 62 V DC)
2 Amplifier board
3 I/O board (COM module)
4 HistoROM / S-DAT (sensor data storage device)
5 Display module
*6 I/O board (COM module); version 80***–***********8 only*

9.6.1 Removing and installing printed circuit boards

Field housing

Warning!
- Risk of electric shock. Exposed components carry dangerous voltages. Make sure that the power supply is switched off before you remove the cover of the electronics compartment.
- Risk of damaging electronic components (ESD protection). Static electricity can damage electronic components or impair their operability. Use a workplace with a grounded working surface purposely built for electrostatically sensitive devices!
- If you cannot guarantee that the dielectric strength of the device is maintained in the following steps, then an appropriate inspection must be carried out in accordance with the manufacturer's specifications.

Caution!
Use only original Endress+Hauser parts.

→ 34, installation and removal:

1. Unscrew cover of the electronics compartment from the transmitter housing.
2. Remove the local display (1) as follows:
   – Press in the latches (1.1) at the side and remove the display module.
   – Disconnect the ribbon cable (1.2) of the display module from the amplifier board.
3. Remove the screws and remove the cover (2) from the electronics compartment.
4. Remove power unit board (4) and I/O board (6, 7):
   Insert a thin pin into the hole (3) provided for the purpose and pull the board clear of its holder.
5. Remove amplifier board (5):
   – Disconnect the plug of the sensor signal cable (5.1) including S-DAT (5.3) from the board.
   – Gently disconnect the plug of the excitation current cable (5.2) from the board, i.e. without moving it back and forward.
   – Insert a thin pin into the hole (3) provided for the purpose and pull the board clear of its holder.
6. Installation is the reverse of the removal procedure.

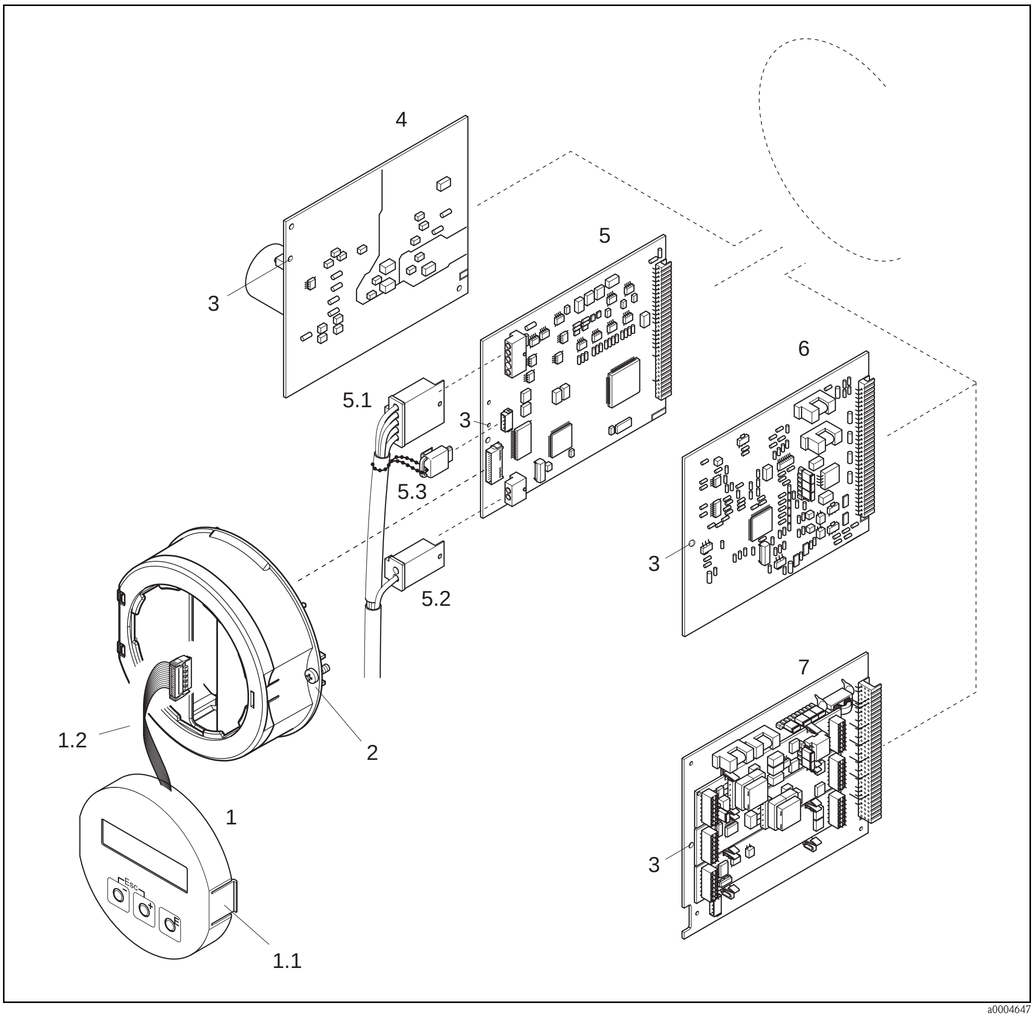


Fig. 34: Field housing: removing and installing printed circuit boards

1 Local display
1.1 Latch
1.2 Ribbon cable (display module)
2 Screws of electronics compartment cover
3 Aperture for installing/removing boards
4 Power unit board
5 Amplifier board
5.1 Signal cable (sensor)
5.2 Excitation current cable (sensor)
5.3 S-DAT (sensor data memory)
6 I/O board (flexible assignment)
7 I/O board (permanent assignment)

Wall-mount housing

Warning!

- Risk of electric shock. Exposed components carry dangerous voltages. Make sure that the power supply is switched off before you remove the cover of the electronics compartment.
- Risk of damaging electronic components (ESD protection). Static electricity can damage electronic components or impair their operability. Use a workplace with a grounded working surface purposely built for electrostatically sensitive devices!
- If you cannot guarantee that the dielectric strength of the device is maintained in the following steps, then an appropriate inspection must be carried out in accordance with the manufacturer's specifications.

Caution!
Use only original Endress+Hauser parts.

→ 35, installation and removal:

1. Loosen the screws and open the hinged cover (1) of the housing.
2. Loosen the screws securing the electronics module (2). Then push up electronics module and pull it as far as possible out of the wall-mount housing.
3. Disconnect the following cable plugs from amplifier board (7):
   – Sensor signal cable plug (7.1) including S-DAT (7.3)
   – Unplug excitation current cable (7.2). Gently disconnect the plug, i.e. without moving it back and forward.
   – Ribbon cable (3) of the display module
4. Remove the screws and remove the cover (4) from the electronics compartment.
5. Remove the boards (6, 7, 8, 9):
   Insert a thin pin into the hole (5) provided for the purpose and pull the board clear of its holder.
6. Installation is the reverse of the removal procedure.

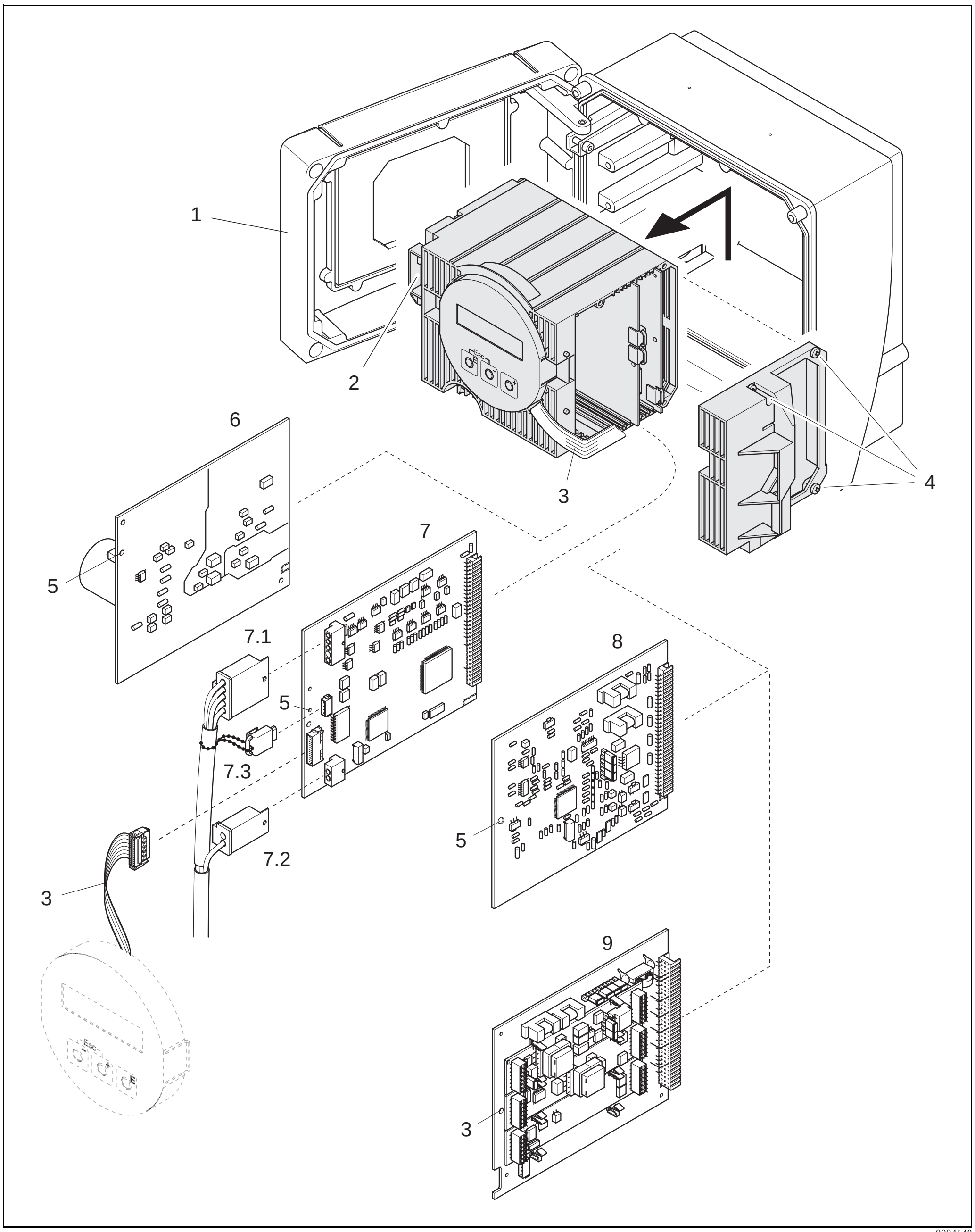


Fig. 35: Field housing: removing and installing printed circuit boards

1 Housing cover
2 Electronics module
3 Ribbon cable (display module)
4 Screws of electronics compartment cover
5 Aperture for installing/removing boards
6 Power unit board
7 Amplifier board
7.1 Signal cable (sensor)
7.2 Excitation current cable (sensor)
7.3 S-DAT (sensor data memory)
8 I/O board (flexible assignment)
9 I/O board (permanent assignment)

9.6.2 Replacing the device fuse

Warning!
Risk of electric shock. Exposed components carry dangerous voltages. Make sure that the power supply is switched off before you remove the cover of the electronics compartment.

The main fuse is on the power unit board → 34.
The procedure for replacing the fuse is as follows:

1. Switch off power supply.
2. Remove the power unit board → 64
3. Remove the protection cap (1) and replace the device fuse (2).
   Only use the following fuse type:
   – 20 to 55 V AC / 16 to 62 V DC → 2.0 A slow-blow / 250 V; 5.2 × 20 mm
   – Power supply 85 to 260 V AC → 0.8 A slow-blow / 250 V; 5.2 × 20 mm
   – Ex-rated devices → see the Ex documentation
4. Installation is the reverse of the removal procedure.

Caution!
Use only original Endress+Hauser parts.

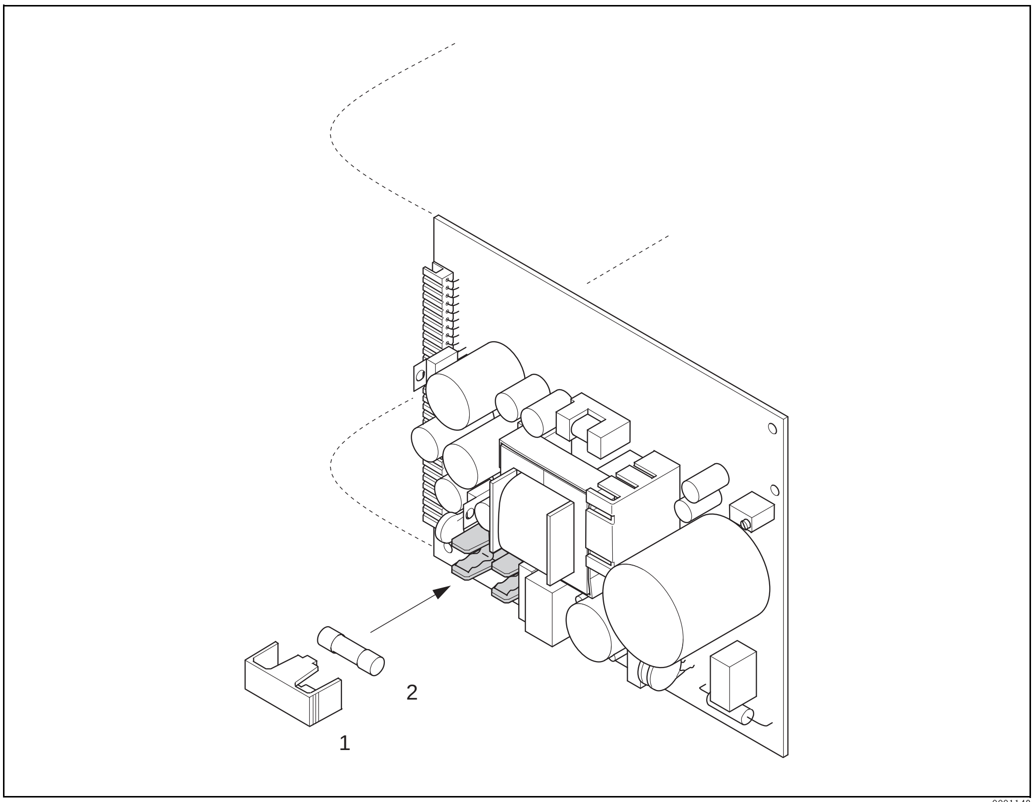


Fig. 36: Replacing the device fuse on the power unit board

1 Protective cap
2 Device fuse

9.7 Return

Caution!
Do not return a measuring device if you are not absolutely certain that all traces of hazardous substances have been removed, e.g. substances which have penetrated crevices or diffused through plastic.
Costs incurred for waste disposal and injury (burns, etc.) due to inadequate cleaning will be charged to the owner-operator.

The following steps must be taken before returning a flow measuring device to Endress+Hauser, e.g. for repair or calibration:
- Always enclose a duly completed "Declaration of contamination" form. Only then can Endress+Hauser transport, examine and repair a returned device.
- Enclose special handling instructions if necessary, for example a safety data sheet as per EC REACH Regulation No. 1907/2006.
- Remove all residues. Pay special attention to the grooves for seals and crevices which could contain residues. This is particularly important if the substance is hazardous to health, e.g. flammable, toxic, caustic, carcinogenic, etc.

Note!
You will find a preprinted "Declaration of contamination" form at the back of these Operating Instructions.

9.8 Disposal

Observe the regulations applicable in your country!

9.9 Software history

Note!
Up or downloading a software version normally requires a special service software.

Date	Software version	Changes to software	Documentation
10.2012	3.01.XX	–	71197479/13.12
01.2010	3.01.XX	New functionalities: – Calibration history – Life zero	71111267/03.10
07.2008	3.00.XX	– New amplifier hardware – Enhancement gas measuring range – New SIL evaluation	71079069/09.08
12.2006	2.02.00	New Sensor: Promass S, Promass P	71036073/12.06
11.2005	2.01.XX	Software expansion: – Promass I DN80, DN50FB – General instrument functions	71008475/12.05
11.2004	2.00.XX	Software expansion: – New sensor DN 250 – Chinese language package (English and Chinese contents) New functions: – Empty pipe detection via exciting current (EPD EXC.CURR.MAX (6426)) – DEVICE SOFTWARE (8100) → Display of the device software (NAMUR recommendation 53)	50098468/11.04

Date	Software version	Changes to software	Documentation
10.2003	Amplifier: 1.06.xx Communication module: 1.03.xx	Software expansion: – Language groups – Corrected volume flow measurement – Adjustments to Fieldcheck and Simubox – Reset error history – SIL 2 New functions: – Operation hours counter – Intensity of background illumination adjustable – Simulation pulse output – Counter for access code – Up-/Download with ToF Tool-Fieldtool Package – 2nd totalizer Compatible with: – ToF Tool-Fieldtool Package (the latest SW version can be downloaded under: www.tof-fieldtool.endress.com) – HART Communicator DXR 375 with Device Rev. 5, DD Rev. 1	50098468/10.03
03.2003	Amplifier: 1.05.xx Communication module: 1.02.01	Software adaptation: – 2nd current output	50098468/03.03
09.2002	Amplifier: 1.04.00	Software adaptation: – Promass E New functions: – Function CURRENT SPAN – Function FAILSAFE MODE	50098468/09.02
04.2002	Amplifier: 1.02.02	Software expansion: – Promass H – Ex i current output, frequency output	50098468/04.02
11.2001	Amplifier: 1.02.01	Software adjustment	50098468/11.01
06.2001	Amplifier: 1.02.00 Communication module: 1.02.00	Software expansion: – General instrument functions – "Pulse width" software function New functions: – HART operating via Universal Commands and Common Practice Commands	
05.2001 03.2001	Amplifier: 1.01.01 Amplifier: 1.01.00	Software adjustment	
11.2000	Amplifier: 1.00.xx Communication module: 1.01.xx	Original software Compatible with: – Fieldtool – HART Communicator DXR 275 (OS 4.6 or higher) with Rev. 1, DD 1.	50098468/11.00

10 Technical data

10.1 Technical data at a glance

10.1.1 Applications

→ 📄 5

10.1.2 Function and system design

Measuring principle

Mass flow measurement by the Coriolis principle

Measuring system

→ 📄 7

10.1.3 Input

Measured variable

- Mass flow (proportional to the phase difference between two sensors mounted on the measuring tube to register a phase shift in the oscillation)
- Fluid density (proportional to resonance frequency of the measuring tube)
- Fluid temperature (measured with temperature sensors)

Measuring range

Measuring ranges for liquids (Promass F):

DN		Range for full scale values (liquids) $\dot{m}_{min(F)}$ to $\dot{m}_{max(F)}$	
[mm]	[inch]		
8	3/8"	0 to 2000 kg/h	0 to 73.5 lb/min
15	1/2"	0 to 6500 kg/h	0 to 238 lb/min
25	1"	0 to 18000 kg/h	0 to 660 lb/min
40	1 ½"	0 to 45000 kg/h	0 to 1650 lb/min
50	2"	0 to 70000 kg/h	0 to 2570 lb/min
80	3"	0 to 180000 kg/h	0 to 6600 lb/min
100*	4"*	0 to 350000 kg/h	0 to 12860 lb/min
150*	6"*	0 to 800000 kg/h	0 to 29400 lb/min
250*	10"*	0 to 2200000 kg/h	0 to 80860 lb/min
* only Promass F			

Measuring ranges for liquids (Promass E, H, S, P):

DN		Range for full scale values (liquids) $\dot{m}_{min(F)}$ to $\dot{m}_{max(F)}$	
[mm]	[inch]		
8	3/8"	0 to 2000 kg/h	0 to 73.5 lb/min
15	1/2"	0 to 6500 kg/h	0 to 238 lb/min
25	1"	0 to 18000 kg/h	0 to 660 lb/min
40	1 ½"	0 to 45000 kg/h	0 to 1650 lb/min
50	2"	0 to 70000 kg/h	0 to 2570 lb/min
80*	3"*	0 to 180000 kg/h	0 to 6600 lb/min
* only Promass E			

Measuring ranges for liquids (Promass A):

DN		Range for full scale values (liquids) $\dot{m}_{min(F)}$ to $\dot{m}_{max(F)}$	
[mm]	[inch]		
1	1/24"	0 to 20 kg/h	0 to 0.7 lb/min
2	1/12"	0 to 100 kg/h	0 to 3.7 lb/min
4	1/8"	0 to 450 kg/h	0 to 16.5 lb/min

Measuring ranges for liquids (Promass I):

DN		Range for full scale values (liquids) $\dot{m}_{min(F)}$ to $\dot{m}_{max(F)}$	
[mm]	[inch]		
8	3/8"	0 to 2000 kg/h	0 to 73.5 lb/min
15	1/2"	0 to 6500 kg/h	0 to 238 lb/min
15 FB	1/2" FB	0 to 18000 kg/h	0 to 660 lb/min
25	1"	0 to 18000 kg/h	0 to 660 lb/min
25 FB	1" FB	0 to 45000 kg/h	0 to 1650 lb/min
40	1 ½"	0 to 45000 kg/h	0 to 1650 lb/min
40 FB	1 ½" FB	0 to 70000 kg/h	0 to 2570 lb/min
50	2"	0 to 70000 kg/h	0 to 2570 lb/min
50 FB	2" FB	0 to 180000 kg/h	0 to 6600 lb/min
80	3"	0 to 180000 kg/h	0 to 6600 lb/min
FB = Full bore			

Measuring ranges for gases, generell, (except Promass H)

The full scale values depend on the density of the gas. Use the formula below to calculate the full scale values:

$\dot{m}_{max(G)} = \dot{m}_{max(F)} \cdot \rho_{(G)} : x$ [kg/m³ (lb/ft³)]

$\dot{m}_{max(G)}$ = Max. full scale value for gas [kg/h (lb/min)]
$\dot{m}_{max(F)}$ = Max. full scale value for liquid [kg/h (lb/min)]
$\rho_{(G)}$ = Gas density in [kg/m³ (lb/ft³)] for process conditions

Here, $\dot{m}_{max(G)}$ can never be greater than $\dot{m}_{max(F)}$

Measuring ranges for gases (Promass F):

DN		x
[mm]	[inch]	
8	3/8"	60
15	½"	80
25	1"	90
40	1 ½"	90
50	2"	90
80	3"	110
100	4"	130
150	6"	200
250	10"	200

Measuring ranges for gases (Promass E)

DN		x
[mm]	[inch]	
8	3/8"	85
15	½"	110
25	1"	125
40	1 ½"	125
50	2"	125
80	3"	155

Measuring ranges for gases (Promass P, S)

DN		x
[mm]	[inch]	
8	3/8"	60
15	½"	80
25	1"	90
40	1 ½"	90
50	2"	90

Measuring ranges for gases (Promass A)

DN		x
[mm]	[inch]	
1	1/24"	32
2	1/12"	32
4	1/8"	32

Measuring ranges for gases (Promass I)

DN		x
[mm]	[inch]	
8	3/8"	60
15	1/2"	80
15 FB	1/2" FB	90
25	1"	90
25 FB	1" FB	90
40	1 ½"	90
40 FB	1 ½" FB	90
50	2"	90
50 FB	2" FB	110
80	3"	110
FB = Full bore versions of Promass I		

Calculation example for gas:

- Sensor type: Promass F, DN 50
- Gas: air with a density of 60.3 kg/m³ (at 20 °C and 50 bar)
- Measuring range (liquid): 70000 kg/h
- x = 90 (for Promass F DN 50)

Max. possible full scale value:
$\dot{m}_{max(G)} = \dot{m}_{max(F)} \cdot \rho_{(G)} \div x\ [kg/m^3] = 70000\ kg/h \cdot 60.3\ kg/m^3 \div 90\ kg/m^3 = 46900\ kg/h$

Recommended full scale values

→ 95 ("Limiting flow")

Operable flow range	Greater than 1000 : 1. Flows above the preset full scale value do not overload the amplifier, i.e. totalizer values are registered correctly.
Input signal	*Status input (auxiliary input):* U = 3 to 30 V DC, R_i = 5 kΩ, galvanically isolated. Configurable for: totalizer reset, positive zero return, error message reset, zero point adjustment start, batching start/stop (optional)

10.1.4 Output

Output signal	*Current output:* Active/passive selectable, galvanically isolated, time constant selectable (0.05 to 100 s), full scale value selectable, temperature coefficient: typically 0.005% of full scale value/C, resolution: 0.5 μ A ▪ Active: 0/4 to 20 mA, R_L < 700 Ω (for HART: $R_L \geq$ 250 Ω) ▪ Passive: 4 to 20 mA; supply voltage U_S 18 to 30 V DC; $R_i \geq$ 150 Ω *Pulse / frequency output:* Passive, open collector, 30 V DC, 250 mA, galvanically isolated. ▪ Frequency output: full scale frequency 2 to 1000 Hz (f_{max} = 1250 Hz), on/off ratio 1:1, pulse width max. 2 sec. ▪ Pulse output: pulse value and pulse polarity selectable, pulse width adjustable (0.5 to 2000 ms)
Signal on alarm	*Current output:* Failsafe mode selectable (for example, according to NAMUR recommendation NE 43) *Pulse / frequency output:* Failsafe mode selectable *Status output:* "Nonconductive" in the event of fault or power supply failure
Load	See "Output signal"
Switching output	*Status output:* Open collector, max. 30 V DC / 250 mA, galvanically isolated. Configurable for: error messages, Empty Pipe Detection (EPD), flow direction, limit values.

Low flow cut off	Switch points for low flow cut off are selectable.
Galvanic isolation	All circuits for inputs, outputs, and power supply are galvanically isolated from each other.

10.1.5 Power supply

Electrical connections	→ 🗎 25
Supply voltage	85 to 260 V AC, 45 to 65 Hz 20 to 55 V AC, 45 to 65 Hz 16 to 62 V DC
Cable entry	*Power supply and signal cables (inputs/outputs):* ▪ Cable entry M20 × 1.5 (8 to 12 mm) ▪ Threads for cable entries, 1/2" NPT, G 1/2" *Connecting cable for remote version:* ▪ Cable entry M20 × 1.5 (8 to 12 mm) ▪ Threads for cable entries, 1/2" NPT, G 1/2"
Cable specifications (remote version)	→ 🗎 26
Power consumption	AC: <15 VA (including sensor) DC: <15 W (including sensor) *Switch-on current*: ▪ max. 13.5 A (< 50 ms) at 24 V DC ▪ max. 3 A (< 5 ms) at 260 V AC
Power supply failure	*Lasting min. 1 power cycle:* ▪ EEPROM saves measuring system data if power supply fails. ▪ S-DAT is an exchangeable data storage chip with sensor specific data: (nominal diameter, serial number, calibration factor, zero point etc.).
Potential equalization	No measures necessary.

10.1.6 Performance characteristics

Reference operating conditions

- Error limits following ISO/DIN 11631
- Water, typically +20 to +30 °C (+68 to +86 °F); 2 to 4 bar (30 to 60 psi)
- Data according to calibration protocol ±5 °C (±9 °F) and ±2 bar (±30 psi)
- Accuracy based on accredited calibration rigs according to ISO 17025

Performance characteristic Promass A

Maximum measured error

The following values refer to the pulse/frequency output.
The additional measured error at the current output is typically ±5 µA.
Design fundamentals → 77.

o.r. = of reading; 1 g/cc = 1 kg/l; T = medium temperature

- Mass flow and volume flow (liquid): ±0.15% o.r.
- Mass flow (gas): ±0.50% o.r.
- Density (liquid)
  ±0.0005 g/cc (under reference conditions)
  ±0.0005 g/cc (after field density calibration under process conditions)
  ±0.002 g/cc (after special density calibration)
  ±0.02 g/cc (over the entire measuring range of the sensor)
- Special density calibration (optional):
  – Calibration range: 0.0 to 1.8 g/cc, +5 to +80 °C (+41 to +176 °F)
  – Operation range: 0.0 to 5.0 g/cc, –50 to +200 °C (–58 to +392 °F)
- Temperature: ±0.5 °C ± 0.005 · T °C; (±1 °F ± 0.003 · (T - 32) °F)

Zero point stability

DN		Max. full scale value		Zero point stability	
[mm]	[inch]	[kg/h] or [l/h]	[lb/min]	[kg/h] or [l/h]	[lb/min]
1	1/24"	20	0.73	0.0010	0.000036
2	1/12"	100	3.70	0.0050	0.00018
4	1/8"	450	16.5	0.0225	0.0008

Example for max. measured error

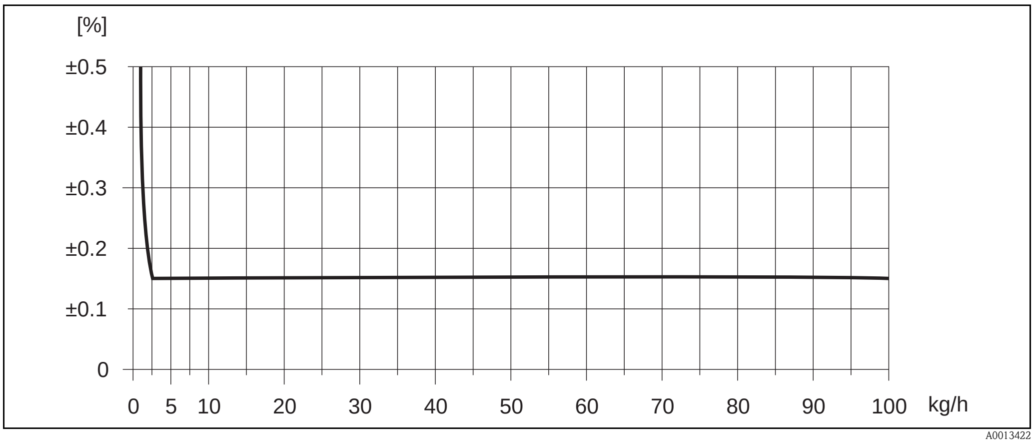


Fig. 37: Max. measured error in % o.r. (example: Promass A, DN 2)

Flow values (example)

Turn down	Flow		Max. measured error
	[kg/h]	[lb/min.]	[% o.r.]
250:1	0.4	0.0147	1.250
100:1	1.0	0.0368	0.500
25:1	4,0	0.1470	0.125
10:1	10	0.3675	0.100
2:1	50	1.8375	0.100

o.r. = of reading; Design fundamentals → 🗎 77

Repeatability

Design fundamentals → 🗎 77
o.r. = of reading; 1 g/cc = 1 kg/l; T = medium temperature

- Mass flow and volume flow (liquid): ±0.05% o.r.
- Mass flow (gas): ±0.25% o.r.
- Density (liquid): ±0.00025 g/cc
- Temperature: ±0.25 °C ± 0.0025 · T °C; (±0.5 °F ± 0.0015 · (T–32) °F)

Influence of medium temperature

When there is a difference between the temperature for zero point adjustment and the process temperature, the typical measured error of the sensor is ±0.0002% of the full scale value / °C (±0.0001% of the full scale value/°F).

Influence of medium pressure

A difference in pressure between the calibration pressure and the process pressure does not have any effect on the accuracy.

Design fundamentals

Dependent on the flow:

- Flow ≥ Zero point stability ÷ (Base accuracy ÷ 100)
  – Max. measured error: ±Base accuracy in % o.r.
  – Repeatability: ± ½ · Base accuracy in % o.r.
- Flow < Zero point stability ÷ (Base accuracy ÷ 100)
  – Max. measured error: ± (Zero point stability ÷ measured value) · 100% o.r.
  – Repeatability: ± ½ · (Zero point stability ÷ measured value) · 100% o.r.

o.r. = of reading

Base accuracy for	
Mass flow liquids	0.15
Volume flow liquids	0.15
Mass flow gases	0.50

Performance characteristic Promass E

Maximum measured error

The following values refer to the pulse/frequency output.
The additional measured error at the current output is typically ±5 µA.
Design fundamentals → 80.

o.r. = of reading; 1 g/cc = 1 kg/l; T = medium temperature

- Mass flow and volume flow (liquid): ±0.30% o.r.
- Mass flow (gas): ±0.75% o.r.
- Density (liquid)
  ±0.0005 g/cc (under reference conditions)
  ±0.0005 g/cc (after field density calibration under process conditions)
  ±0.02 g/cc (over the entire measuring range of the sensor)
- Temperature: ±0.5 °C ± 0.005 · T °C; (±1 °F ± 0.003 · (T - 32) °F)

Zero point stability

DN		Zero point stability	
[mm]	**[inch]**	**[kg/h] or [l/h]**	**[lb/min]**
8	3/8"	0.20	0.0074
15	½"	0.65	0.0239
25	1"	1.80	0.0662
40	1 ½"	4,50	0.1654
50	2"	7.00	0.2573
80	3"	18.00	0.6615

Example for max. measured error

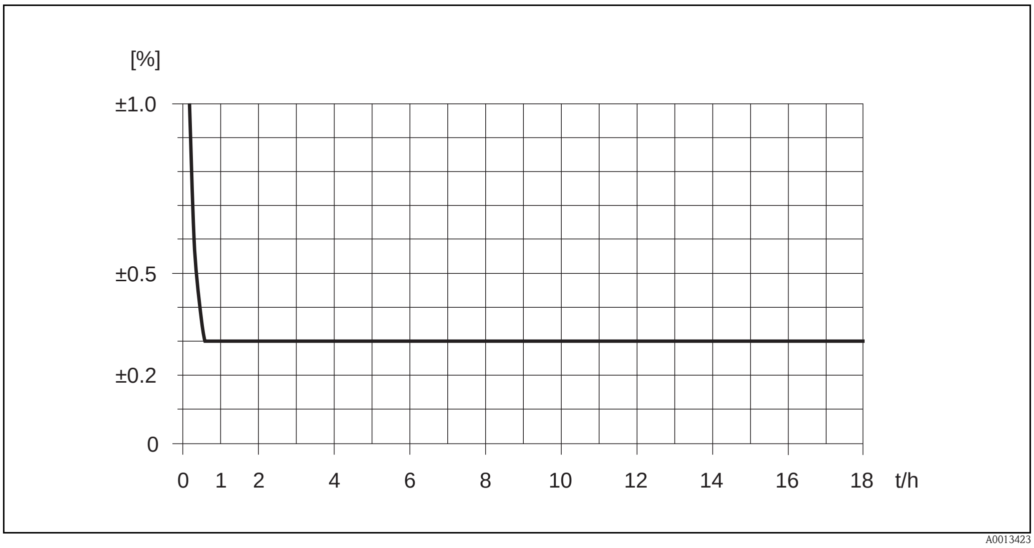


Fig. 38: Max. measured error in % o.r. (example: Promass E, DN 25)

Flow values (example)

Turn down	Flow		Maximum measured error
	[kg/h] or [l/h]	[lb/min]	[% o.r.]
250 : 1	72	2.646	2.50
100 : 1	180	6.615	1.00
25 : 1	720	26.46	0.25
10 : 1	1800	66.15	0.25
2 : 1	9000	330.75	0.25

o.r. = of reading; Design fundamentals → 80

Repeatability

Design fundamentals → 80
o.r. = of reading; 1 g/cc = 1 kg/l; T = medium temperature

- Mass flow and volume flow (liquid): ±0.10% o.r.
- Mass flow (gas): ±0.35% o.r.
- Density (liquid): ±0.00025 g/cc
- Temperature: ±0.25 °C ± 0.0025 · T °C; (±0.5 °F ± 0.0015 · (T–32) °F)

Influence of medium temperature

When there is a difference between the temperature for zero point adjustment and the process temperature, the typical measured error of the sensor is ±0.0002% of the full scale value / °C (±0.0001% of the full scale value/°F).

Influence of medium pressure

The table below shows the effect on accuracy of mass flow due to a difference between calibration pressure and process pressure.

DN		
[mm]	[inch]	[% o.r./bar]
8	3/8"	no influence
15	½"	no influence
25	1"	no influence
40	1 ½"	no influence
50	2"	–0.009
80	3"	–0.020

o.r. = of reading

Design fundamentals

Dependent on the flow:

- Flow ≥ Zero point stability ÷ (Base accuracy ÷ 100)
  - Max. measured error: ±Base accuracy in % o.r.
  - Repeatability: ± ½ · Base accuracy in % o.r.
- Flow < Zero point stability ÷ (Base accuracy ÷ 100)
  - Max. measured error: ± (Zero point stability ÷ measured value) · 100% o.r.
  - Repeatability: ± ½ · (Zero point stability ÷ measured value) · 100% o.r.

o.r. = of reading

Base accuracy for	
Mass flow liquids	0.30
Volume flow liquids	0.30
Mass flow gases	0.75

Performance characteristic Promass F

Maximum measured error

The following values refer to the pulse/frequency output.
The additional measured error at the current output is typically ±5 μA.
Design fundamentals → 82.

o.r. = of reading; 1 g/cc = 1 kg/l; T = medium temperature

- Mass flow and volume flow (liquid):
  ±0.10% o.r. (optional)
  ±0.15% o.r.
- Mass flow (gas): ±0.35% o.r.
- Density (liquid)
  ±0.0005 g/cc (under reference conditions)
  ±0.0005 g/cc (after field density calibration under process conditions)
  ±0.001 g/cc (after special density calibration)
  ±0.01 g/cc (over the entire measuring range of the sensor)
- Special density calibration (optional):
  - Calibration range: 0.0 to 1.8 g/cc, +5 to +80 °C (+41 to +176 °F)
  - Operation range: 0.0 to 5.0 g/cc, –50 to +200 °C (–58 to +392 °F)
- Temperature: ±0.5 °C ± 0.005 · T °C; (±1 °F ± 0.003 · (T – 32) °F)

Zero point stability Promass F (standard)

DN		Zero point stability Promass F (Standard)	
[mm]	[inch]	[kg/h] or [l/h]	[lb/min]
8	3/8"	0.030	0.001
15	½"	0.200	0.007
25	1"	0.540	0.019
40	1 ½"	2.25	0.083
50	2"	3.50	0.129
80	3"	9.00	0.330
100	4"	14,00	0.514
150	6"	32.00	1.17
250	10"	88.00	3.23

Zero point stability Promass F (high-temperature version)

DN		Zero point stability Promass F (high-temperature version)	
[mm]	[inch]	[kg/h] or [l/h]	[lb/min]
25	1"	1.80	0.0661
50	2"	7.00	0.2572
80	3"	18.0	0.6610

Example for max. measured error

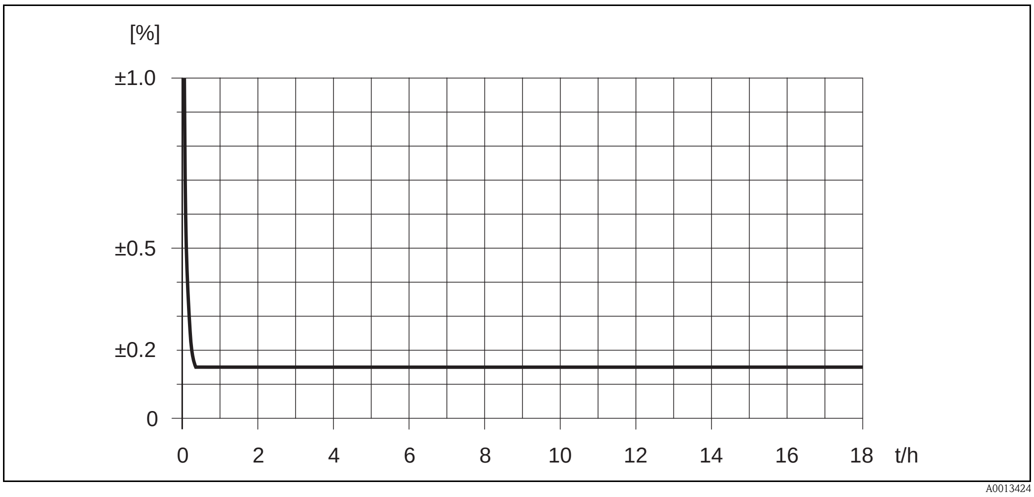


Fig. 39: Max. measured error in % o.r. (example: Promass F, DN 25)

Flow values (example)

Turn down	Flow		Maximum measured error
	[kg/h] or [l/h]	[lb/min]	[% o.r.]
500 : 1	36	1.323	1.5
100 : 1	180	6.615	0.3
25 : 1	720	26.46	0.1
10 : 1	1800	66.15	0.1
2 : 1	9000	330.75	0.1

o.r. = of reading; Design fundamentals → 82

Repeatability

Design fundamentals → 82.
o.r. = of reading; 1 g/cc = 1 kg/l; T = medium temperature

- Mass flow and volume flow (liquid): ±0.05% o.r.
- Mass flow (gas): ±0.25% o.r.
- Density (liquid): ±0.00025 g/cc
- Temperature: ±0.25 °C ± 0.0025 · T °C; (±0.5 °F ± 0.0015 · (T–32) °F)

Influence of medium temperature

When there is a difference between the temperature for zero point adjustment and the process temperature, the typical measured error of the sensor is ±0.0002% of the full scale value / °C (±0.0001% of the full scale value/°F).

Influence of medium pressure

The table below shows the effect on accuracy of mass flow due to a difference between calibration pressure and process pressure.

DN		Promass F (standard)	Promass F (high-temperature version)
[mm]	[inch]	[% o.r./bar]	[% o.r./bar]
8	3/8"	no influence	–
15	½"	no influence	–
25	1"	no influence	no influence
40	1 ½"	–0.003	–
50	2"	–0.008	–0.008
80	3"	–0.009	–0.009
100	4"	–0.007	–
150	6"	–0.009	–
250	10"	–0.009	–

o.r. = of reading

Design fundamentals

Dependent on the flow:

- Flow ≥ Zero point stability ÷ (Base accuracy ÷ 100)
  - Max. measured error: ±Base accuracy in % o.r.
  - Repeatability: ± ½ · Base accuracy in % o.r.
- Flow < Zero point stability ÷ (Base accuracy ÷ 100)
  - Max. measured error: ± (Zero point stability ÷ measured value) · 100% o.r.
  - Repeatability: ± ½ · (Zero point stability ÷ measured value) · 100% o.r.

o.r. = of reading

Base accuracy for	
Mass flow liquids	0.15
Mass flow liquids, optional	0.10
Volume flow liquids	0.15
Mass flow gases	0.35

Performance characteristic Promass H

Maximum measured error

The following values refer to the pulse/frequency output.
The additional measured error at the current output is typically ±5 µA.
Design fundamentals → 85.

o.r. = of reading; 1 g/cc = 1 kg/l; T = medium temperature

Material measuring tube: Zirconium 702/R 60702

- Mass flow and volume flow (liquid): ±0.15% o.r.
- Density (liquid)
  ±0.0005 g/cc (under reference conditions)
  ±0.0005 g/cc (after field density calibration under process conditions)
  ±0.002 g/cc (after special density calibration)
  ±0.02 g/cc (over the entire measuring range of the sensor)

  Special density calibration (optional):
  – Calibration range: 0.8 to 1.8 g/cc, +10 to +80 °C (+50 to +176 °F)
  – Operation range: 0.0 to 5.0 g/cc, –50 to +200 °C (–58 to +392 °F)
- Temperature: ±0.5 °C ± 0.005 · T °C; (±1 °F ± 0.003 · (T - 32) °F)

Material measuring tube: Tantalum 2.5W

- Mass flow and volume flow (liquid): ±0.15% o.r.
- Mass flow (gas): ±0.50% o.r.
- Density (liquid)
  ±0.0005 g/cc (under reference conditions)
  ±0.0005 g/cc (after field density calibration under process conditions)
  ±0.002 g/cc (after special density calibration)
  ±0.02 g/cc (over the entire measuring range of the sensor)

  Special density calibration (optional)
  – Calibration range: 0.0 to 1.8 g/cc, +10 to +80 °C (+50 to +176 °F)
  – Operation range: 0.0 to 5.0 g/cc, –50 to +150 °C (–58 to +302 °F)
- Temperature: ±0.5 °C ± 0.005 · T °C; (±1 °F ± 0.003 · (T - 32) °F)

Zero point stability

DN		Zero point stability	
[mm]	[inch]	[kg/h] or [l/h]	[lb/min]
8	3/8"	0.20	0.007
15	½"	0.65	0.024
25	1"	1.80	0.066
40	1 ½"	4,50	0.165
50	2"	7.00	0.257

Example for max. measured error

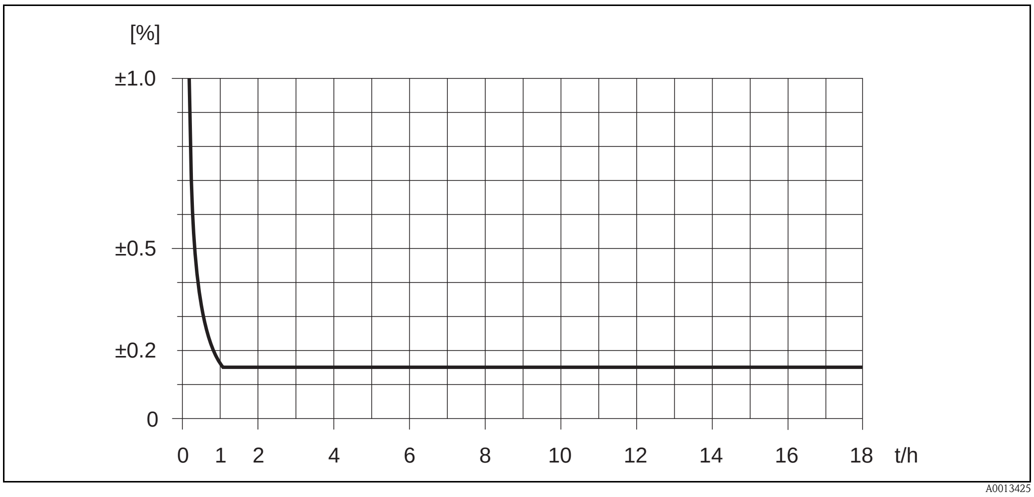


Fig. 40: Max. measured error in % o.r. (example: Promass H, DN 25)

Flow values (example)

Turn down	Flow		Maximum measured error
	[kg/h] or [l/h]	[lb/min]	[% o.r.]
250 : 1	72	2.646	2.50
100 : 1	180	6.615	1.00
25 : 1	720	26.46	0.25
10 : 1	1800	66.15	0.10
2 : 1	9000	330.75	0.10

o.r. = of reading; Design fundamentals → 🗎 85

Repeatability

Design fundamentals → 🗎 85.
o.r. = of reading; 1 g/cc = 1 kg/l; T = medium temperature

Material measuring tube: Zirconium 702/R 60702

- Mass flow and volume flow (liquid): ±0.05% o.r.
- Density (liquid): ±0.00025 g/cc
- Temperature: ±0.25 °C ± 0.0025 · T °C; (±0.5 °F ± 0.0015 · (T–32) °F)

Material measuring tube: Tantalum 2.5W

- Mass flow and volume flow (liquid): ±0.05% o.r.
- Mass flow (gas): ±0.25% o.r.
- Density (liquid): ±0.00025 g/cc
- Temperature: ±0.25 °C ± 0.0025 · T °C; (±0.5 °F ± 0.0015 · (T–32) °F)

Influence of medium temperature

When there is a difference between the temperature for zero point adjustment and the process temperature, the typical measured error of the sensor is ±0.0002% of the full scale value / °C (±0.0001% of the full scale value/°F).

Influence of medium pressure

The table below shows the effect on accuracy of mass flow due to a difference between calibration pressure and process pressure.

DN		Promass H Zirconium 702/R 60702	Promass H Tantalum 2.5W
[mm]	[inch]	[% o.r./bar]	[% o.r./bar]
8	3/8"	–0.017	–0.005
15	½"	–0.021	–0.005
25	1"	–0.013	–0.050
40	1 ½"	–0.018	–
50	2"	–0.020	–

o.r. = of reading

Design fundamentals

Dependent on the flow:

- Flow ≥ Zero point stability ÷ (Base accuracy ÷ 100)
  – Max. measured error: ±Base accuracy in % o.r.
  – Repeatability: ± ½ · Base accuracy in % o.r.
- Flow < Zero point stability ÷ (Base accuracy ÷ 100)
  – Max. measured error: ± (Zero point stability ÷ measured value) · 100% o.r.
  – Repeatability: ± ½ · (Zero point stability ÷ measured value) · 100% o.r.

o.r. = of reading

Base accuracy for	
Mass flow liquids	0.15
Volume flow liquids	0.15
Mass flow gases (only Tantalum 2.5W)	0.50

Performance characteristic Promass I

Maximum measured error

The following values refer to the pulse/frequency output.
The additional measured error at the current output is typically ±5 µA.
Design fundamentals → 87.

o.r. = of reading; 1 g/cc = 1 kg/l; T = medium temperature

- Mass flow and volume flow (liquid): ±0.15% o.r.
- Mass flow (gas): ±0.50% o.r.
- Density (liquid)
  ±0.0005 g/cc (under reference conditions)
  ±0.0005 g/cc (after field density calibration under process conditions)
  ±0.004 g/cc (after special density calibration)
  ±0.02 g/cc (over the entire measuring range of the sensor)
  Special density calibration (optional):
  – Calibration range: 0.0 to 1.8 g/cc, +10 to +80 °C (+50 to +176 °F)
  – Operation range: 0.0 to 5.0 g/cc, –50 to +150 °C (–58 to +302 °F)
- Temperature: ±0.5 °C ± 0.005 · T °C; (±1 °F ± 0.003 · (T - 32) °F)

Zero point stability

DN		Zero point stability	
[mm]	[inch]	[kg/h] or [l/h]	[lb/min]
8	3/8"	0.150	0.0055
15	½"	0.488	0.0179
15 FB	½" FB	1.350	0.0496
25	1"	1.350	0.0496
25 FB	1" FB	3.375	0.124
40	1 ½"	3.375	0.124
40 FB	1 ½" FB	5.250	0.193
50	2"	5.250	0.193
50 FB	2" FB	13.50	0.496
80	3"	13.50	0.496

FB = Full bore (voller Nennweitenquerschnitt)

Example for max. measured error

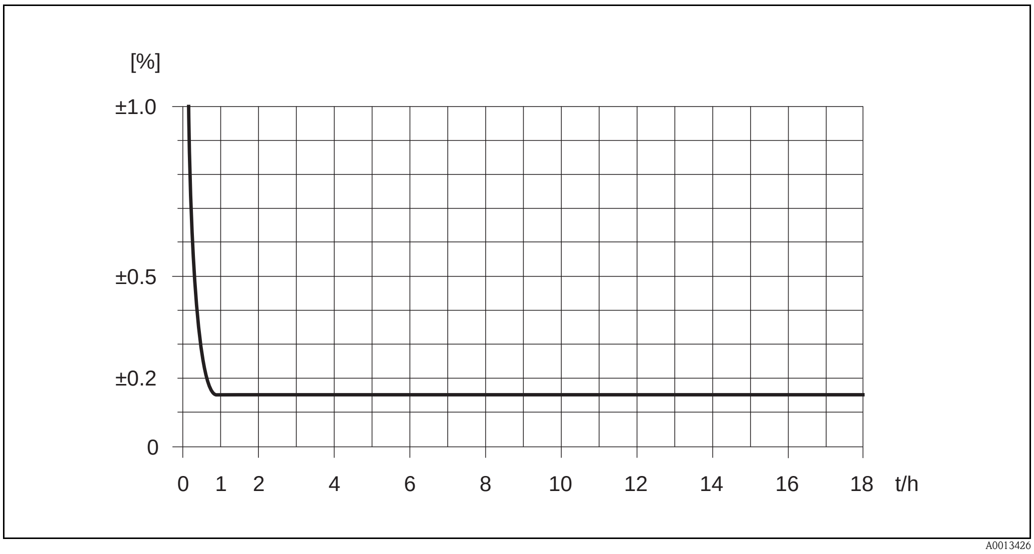


Abb. 41: Max. measured error in % o.r. (example: Promass I, DN 25)

Flow values (example)

Turn down	Flow		Maximum measured error
	[kg/h] or [l/h]	[lb/min]	[% o.r.]
250 : 1	72	2.646	1.875
100 : 1	180	6.615	0.750
25 : 1	720	26.46	0.188
10 : 1	1800	66.15	0.100
2 : 1	9000	330.75	0.100

o.r. = of reading; Design fundamentals → 87

Repeatability

Design fundamentals → 87
o.r. = of reading; 1 g/cc = 1 kg/l; T = medium temperature

- Mass flow and volume flow (liquid): ±0.05% o.r.
- Mass flow (gas): ±0.25% o.r.
- Density (liquid): ±0.00025 g/cc
- Temperature: ±0.25 °C ± 0.0025 · T °C; (±0.5 °F ± 0.0015 · (T–32) °F)

Influence of medium temperature

When there is a difference between the temperature for zero point adjustment and the process temperature, the typical measured error of the sensor is ±0.0002% of the full scale value / °C (±0.0001% of the full scale value/°F).

Influence of medium pressure

The table below shows the effect on accuracy of mass flow due to a difference between calibration pressure and process pressure.

DN		
[mm]	[inch]	[% o.r./bar]
8	3/8"	no influence
15	½"	no influence
15 FB	½" FB	0.003
25	1"	0.003
25 FB	1" FB	no influence
40	1 ½"	no influence
40 FB	1 ½" FB	no influence
50	2"	no influence
50 FB	2" FB	0.003
80	3"	0.003

o.r. = of reading; FB = Full bore (voller Nennweitenquerschnitt)

Design fundamentals

Dependent on the flow:

- Flow ≥ Zero point stability ÷ (Base accuracy ÷ 100)
  - Max. measured error: ±Base accuracy in % o.r.
  - Repeatability: ± ½ · Base accuracy in % o.r.
- Flow < Zero point stability ÷ (Base accuracy ÷ 100)
  - Max. measured error: ± (Zero point stability ÷ measured value) · 100% o.r.
  - Repeatability: ± ½ · (Zero point stability ÷ measured value) · 100% o.r.

o.r. = of reading

Base accuracy for	
Mass flow liquids	0.15
Volume flow liquids	0.15
Mass flow gases	0.50

Performance characteristic Promass P

Maximum measured error

The following values refer to the pulse/frequency output.
The additional measured error at the current output is typically ±5 μA.
Design fundamentals → 📄 90.

o.r. = of reading; 1 g/cc = 1 kg/l; T = medium temperature

- Mass flow and volume flow (liquid): ±0.15% o.r.
- Mass flow (gas): ±0.50% o.r.
- Density (liquid)
  ±0.0005 g/cc (under reference conditions)
  ±0.0005 g/cc (after field density calibration under process conditions)
  ±0.002 g/cc (after special density calibration)
  ±0.01 g/cc (over the entire measuring range of the sensor)

  Special density calibration (optional):
  – Calibration range: 0.0 to 1.8 g/cc, +10 to +80 °C (+50 to +176 °F)
  – Operation range: 0.0 to 5.0 g/cc, –50 to +200 °C (–58 to +392 °F)
- Temperature: ±0.5 °C ± 0.005 · T °C; (±1 °F ± 0.003 · (T - 32) °F)

Zero point stability

DN		Zero point stability	
[mm]	[inch]	[kg/h] or [l/h]	[lb/min]
8	3/8"	0.20	0.007
15	½"	0.65	0.024
25	1"	1.80	0.066
40	1 ½"	4,50	0.165
50	2"	7.00	0.257

Example for max. measured error

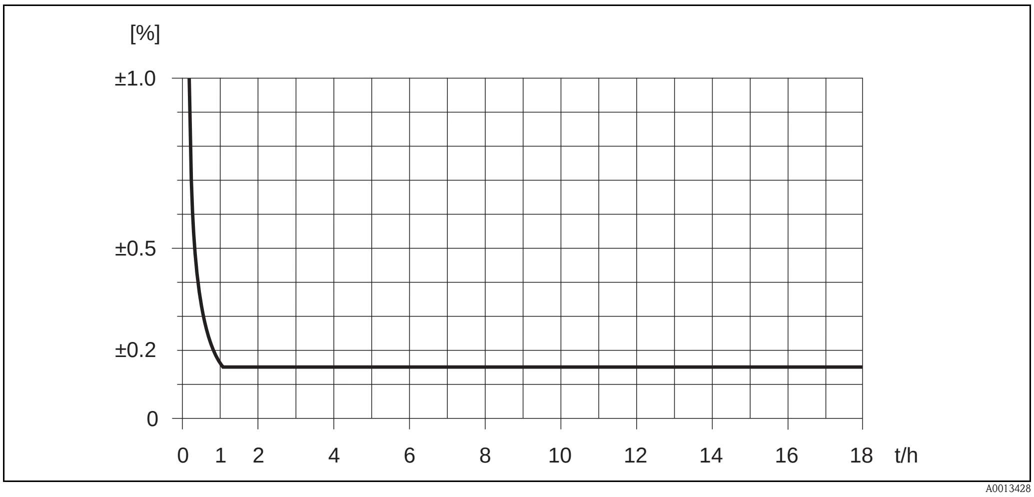


Fig. 42: Max. measured error in % o.r. (example: Promass P, DN 25)

Flow values (example)

Turn down	Flow		Maximum measured error
	[kg/h] or [l/h]	[lb/min]	[% o.r.]
250 : 1	72	2.646	2.50
100 : 1	180	6.615	1.00
25 : 1	720	26.46	0.25
10 : 1	1800	66.15	0.10
2 : 1	9000	330.75	0.10

o.r. = of reading; Design fundamentals → 🗎 90

Repeatability

Design fundamentals → 🗎 90.
o.r. = of reading; 1 g/cc = 1 kg/l; T = medium temperature

- Mass flow and volume flow (liquid): ±0.05% o.r.
- Mass flow (gas): ±0.25% o.r.
- Density (liquid): ±0.00025 g/cc
- Temperature: ±0.25 °C ± 0.0025 · T °C; (±0.5 °F ± 0.0015 · (T–32) °F)

Influence of medium temperature

When there is a difference between the temperature for zero point adjustment and the process temperature, the typical measured error of the sensor is ±0.0002% of the full scale value / °C (±0.0001% of the full scale value/°F).

Influence of medium pressure

The table below shows the effect on accuracy of mass flow due to a difference between calibration pressure and process pressure.

DN		
[mm]	[inch]	[% o.r./bar]
8	3/8"	–0.002
15	½"	–0.006
25	1"	–0.005
40	1 ½"	–0.005
50	2"	–0.005

o.r. = of reading

Design fundamentals

Dependent on the flow:

- Flow ≥ Zero point stability ÷ (Base accuracy ÷ 100)
  - Max. measured error: ±Base accuracy in % o.r.
  - Repeatability: ± ½ · Base accuracy in % o.r.
- Flow < Zero point stability ÷ (Base accuracy ÷ 100)
  - Max. measured error: ± (Zero point stability ÷ measured value) · 100% o.r.
  - Repeatability: ± ½ · (Zero point stability ÷ measured value) · 100% o.r.

o.r. = of reading

Base accuracy for	
Mass flow liquids	0.15
Volume flow liquids	0.15
Mass flow gases	0.50

Performance characteristic Promass S

Maximum measured error

The following values refer to the pulse/frequency output.
The additional measured error at the current output is typically ±5 µA.
Design fundamentals → 📄 92.

o.r. = of reading; 1 g/cc = 1 kg/l; T = medium temperature

- Mass flow and volume flow (liquid): ±0.15% o.r.
- Mass flow (gas): ±0.50% o.r.
- Density (liquid)
  ±0.0005 g/cc (under reference conditions)
  ±0.0005 g/cc (after field density calibration under process conditions)
  ±0.002 g/cc (after special density calibration)
  ±0.01 g/cc (over the entire measuring range of the sensor)

  Special density calibration (optional):
  - Calibration range: 0.0 to 1.8 g/cc, +10 to +80 °C (+50 to +176 °F)
  - Operation range: 0.0 to 5.0 g/cc, –50 to +150 °C (–58 to +302 °F)
- Temperature: ±0.5 °C ± 0.005 · T °C; (±1 °F ± 0.003 · (T - 32) °F)

Zero point stability

DN		Zero point stability	
[mm]	[inch]	[kg/h] or [l/h]	[lb/min]
8	3/8"	0.20	0.007
15	½"	0.65	0.024
25	1"	1.80	0.066
40	1 ½"	4,50	0.165
50	2"	7.00	0.257

Example for max. measured error

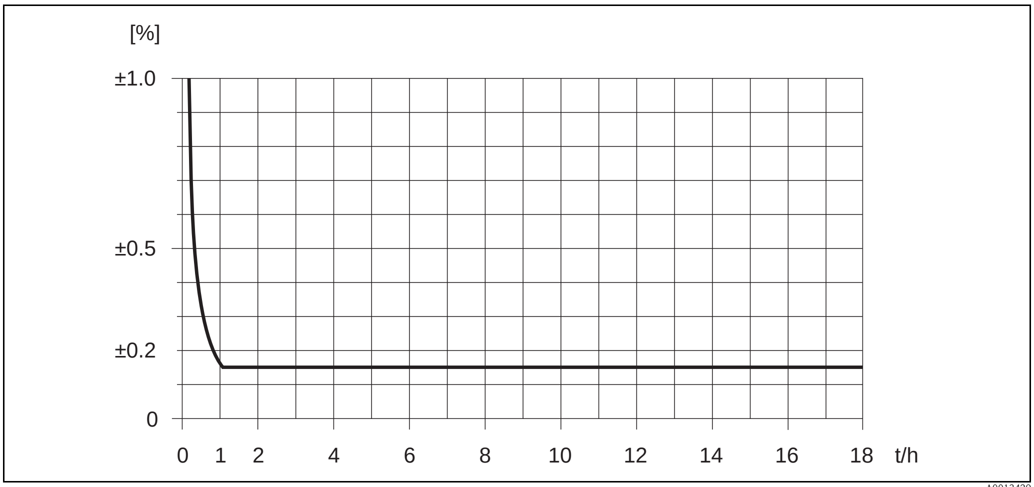


Fig. 43: Max. measured error in % o.r. (example: Promass S, DN 25)

Flow values (example)

Turn down	Flow		Maximum measured error
	[kg/h] or [l/h]	[lb/min]	[% o.r.]
250 : 1	72	2.646	2.50
100 : 1	180	6.615	1.00
25 : 1	720	26.46	0.25
10 : 1	1800	66.15	0.10
2 : 1	9000	330.75	0.10

o.r. = of reading; Design fundamentals → 92

Repeatability

Design fundamentals → 92.
o.r. = of reading; 1 g/cc = 1 kg/l; T = medium temperature

- Mass flow and volume flow (liquid): ±0.05% o.r.
- Mass flow (gas): ±0.25% o.r.
- Density (liquid): ±0.00025 g/cc
- Temperature: ±0.25 °C ± 0.0025 · T °C; (±0.5 °F ± 0.0015 · (T–32) °F)

Influence of medium temperature

When there is a difference between the temperature for zero point adjustment and the process temperature, the typical measured error of the sensor is ±0.0002% of the full scale value / °C (±0.0001% of the full scale value/°F).

Influence of medium pressure

The table below shows the effect on accuracy of mass flow due to a difference between calibration pressure and process pressure.

DN		
[mm]	[inch]	[% o.r./bar]
8	3/8"	–0.002
15	½"	–0.006
25	1"	–0.005
40	1 ½"	–0.005
50	2"	–0.005

o.r. = of reading

Design fundamentals

Dependent on the flow:

- Flow ≥ Zero point stability ÷ (Base accuracy ÷ 100)
  - Max. measured error: ±Base accuracy in % o.r.
  - Repeatability: ± ½ · Base accuracy in % o.r.
- Flow < Zero point stability ÷ (Base accuracy ÷ 100)
  - Max. measured error: ± (Zero point stability ÷ measured value) · 100% o.r.
  - Repeatability: ± ½ · (Zero point stability ÷ measured value) · 100% o.r.

o.r. = of reading

Base accuracy for	
Mass flow liquids	0.15
Volume flow liquids	0.15
Mass flow gases	0.50

10.1.7 Operating conditions: Installation

Installation instructions	→ 13
Inlet and outlet runs	There are no installation requirements regarding inlet and outlet runs.
Length of connecting cable remote version	max. 20 m (65 ft)
System pressure	→ 14

10.1.8 Operating conditions: Environment

Ambient temperature	Sensor, transmitter ■ Standard: –20 to +60 °C (-4 to +140°F) ■ Optional: –40 to +60 °C (-40 to +140°F) Note! ■ Install the device at a shady location. Avoid direct sunlight, particularly in warm climatic regions. ■ At ambient temperatures below –20 °C (–4 °F) the readability of the display may be impaired.
Storage temperature	–40 to +80 °C (–40 to +175 °F), preferably +20 °C (+68 °F)
Degree of protection	Standard: IP 67 (NEMA 4X) for transmitter and sensor
Shock resistance	According to IEC 68-2-31
Vibration resistance	Acceleration up to 1 g, 10 to 150 Hz, following IEC 68-2-6
CIP cleaning	yes
SIP cleaning	yes
Electromagnetic compatibility (EMC)	As per IEC/EN 61326 and NAMUR recommendation NE 21

10.1.9 Operating conditions: Process

Medium temperature range

Sensor:

Promass A, F, P:

–50 to +200 °C (–58 to +392 °F)

Promass E:

–40 to +140 °C (–40 to +284 °F)

Promass F (high-temperature version):

–50 to +350 °C (–58 to +662 °F)

Promass H:

- Zirconium 702/R 60702: –50 to +200 °C (–58 to +392 °F)
- Tantalum 2.5W: –50 to +150 °C (–58 to +302 °F)

Promass I, S:

–50 to +150 °C (–58 to +302 °F)

Seals:

Promass F, E, H, I, S, P:

No internal seals

Promass A

No seals inlying.
Only for mounting sets with threaded connections:
Viton: –15 to +200 °C (–5 to +392 °F)
EPDM: –40 to +160 °C (–40 to +320 °F)
Silicon :–60 to +200 °C (–76 to +392 °F)
Kalrez: –20 to +275 °C (–4 to +527 °F)

Limiting medium pressure range (rated pressure)	The material load diagrams (pressure-temperature diagrams) for the process connections are provided in the separate "Technical Information" document on the device in question. This can be downloaded as a PDF file from www.endress.com. A list of the "Technical Information" documents available is provided in the "Documentation" section → 🗎 109. *Pressure ranges of secondary containment:* Promass A: ▪ 25 bar (362 psi) Promass E: ▪ No secondary containment Promass F: ▪ DN 8 to 50 (3/8 to 2"): 40 bar (580 psi) ▪ DN 80 (3"): 25 bar (362 psi) ▪ DN 100 to 150 (4 to 6"): 16 bar (232 psi) ▪ DN 250 (10"): 10 bar (145 psi) Promass H: ▪ Zirconium 702/R 60702 – DN 8 to 15 (3/8 to ½"): 25 bar (362 psi) – DN 25 to 50 (1 to 2"): 16 bar (232 psi) ▪ Tantalum 2.5W – DN 8 to 25 (3/8 to 1"): 25 bar (362 psi) – DN 40 to 50 (1 ½ to 2"): 16 bar (232 psi) Promass I: ▪ 40 bar (580 psi) Promass P: ▪ DN 8 to 25 (3/8 to 1"): 25 bar (362 psi) ▪ DN 40 (1 ½"): 16 bar (232 psi) ▪ DN 50 (2"): 10 bar (145 psi) Promass S: ▪ DN 8 to 40 (3/8 to 1 ½"): 16 bar (232 psi) ▪ DN 50 (2"): 10 bar (145 psi)
Limiting flow	See the "Measuring range" section → 🗎 71. Select nominal diameter by optimizing between required flow range and permissible pressure loss. See the "Measuring range" section for a list of max. possible full scale values. ▪ The minimum recommended full scale value is approx. 1/20 of the max. full scale value. ▪ In most applications, 20 to 50% of the maximum full scale value can be considered ideal. ▪ Select a lower full scale value for abrasive substances such as liquids with entrained solids (flow velocity < 1 m/s (3 ft/s)). ▪ For gas measurement the following rules apply: – Flow velocity in the measuring tubes should not be more than half the sonic velocity (0.5 Mach). – The maximum mass flow depends on the density of the gas: formula → 🗎 73

Pressure loss (SI units)

Pressure loss depends on the properties of the fluid and on its flow. The following formulas can be used to approximately calculate the pressure loss:

Pressure loss formulas for Promass F, E

Reynolds number	$Re = \frac{2 \cdot \dot{m}}{\pi \cdot d \cdot \nu \cdot \rho}$ a0004623
$Re \geq 2300$ 1)	$\Delta p = K \cdot \nu^{0.25} \cdot \dot{m}^{1.85} \cdot \rho^{-0.86}$ a0004626
	Promass F DN 250 $\Delta p = K \cdot \left\{1 - a + \frac{a}{e^{b \cdot (\nu - 10^{-6})}}\right\} \cdot \nu^{0.25} \cdot \dot{m}^{1.85} \cdot \rho^{-0.86}$ a0012135
$Re < 2300$	$\Delta p = K1 \cdot \nu \cdot \dot{m} + \frac{K2 \cdot \nu^{0.25} \cdot \dot{m}^2}{\rho}$ a0004628
Δp = pressure loss [mbar] ν = kinematic viscosity [m^2/s] $\dot{m}$ = mass flow [kg/s]	ρ = fluid density [kg/m^3] d = inside diameter of measuring tubes [m] K to K2 = constants (depending on nominal diameter)
1) To compute the pressure loss for gases, always use the formula for $Re \geq 2300$.	

Pressure loss formulas for Promass H, I, S, P

Reynolds number	$Re = \frac{4 \cdot \dot{m}}{\pi \cdot d \cdot \nu \cdot \rho}$ a0003381
$Re \geq 2300$ 1)	$\Delta p = K \cdot \nu^{0.25} \cdot \dot{m}^{1.75} \cdot \rho^{-0.75} + \frac{K3 \cdot \dot{m}^2}{\rho}$ a0004631
$Re < 2300$	$\Delta p = K1 \cdot \nu \cdot \dot{m} + \frac{K3 \cdot \dot{m}^2}{\rho}$ a0004633
Δp = pressure loss [mbar] ν = kinematic viscosity [m^2/s] $\dot{m}$ = mass flow [kg/s]	ρ = fluid density [kg/m^3] d = inside diameter of measuring tubes [m] K to K3 = constants (depending on nominal diameter)
1) To compute the pressure loss for gases, always use the formula for $Re \geq 2300$.	

Pressure loss formulas for Promass A

Reynolds number	$Re = \frac{4 \cdot \dot{m}}{\pi \cdot d \cdot \nu \cdot \rho}$ a0003381
$Re \geq 2300$ 1)	$\Delta p = K \cdot \nu^{0.25} \cdot \dot{m}^{1.75} \cdot \rho^{-0.75}$ a0003380
$Re < 2300$	$\Delta p = K1 \cdot \nu \cdot \dot{m}$ a0003379
Δp = pressure loss [mbar] ν = kinematic viscosity [m^2/s] $\dot{m}$ = mass flow [kg/s]	ρ = density [kg/m^3] d = inside diameter of measuring tubes [m] K to K1 = constants (depending on nominal diameter)
1) To compute the pressure loss for gases, always use the formula for $Re \geq 2300$.	

Pressure loss coefficient for Promass F

DN	d[m]	K	K1	K2
8	$5.35 \cdot 10^{-3}$	$5.70 \cdot 10^{7}$	$9.60 \cdot 10^{7}$	$1.90 \cdot 10^{7}$
15	$8.30 \cdot 10^{-3}$	$5.80 \cdot 10^{6}$	$1.90 \cdot 10^{7}$	$10.60 \cdot 10^{5}$
25	$12.00 \cdot 10^{-3}$	$1.90 \cdot 10^{6}$	$6.40 \cdot 10^{6}$	$4.50 \cdot 10^{5}$
40	$17.60 \cdot 10^{-3}$	$3.50 \cdot 10^{5}$	$1.30 \cdot 10^{6}$	$1.30 \cdot 10^{5}$
50	$26.00 \cdot 10^{-3}$	$7.00 \cdot 10^{4}$	$5.00 \cdot 10^{5}$	$1.40 \cdot 10^{4}$
80	$40.50 \cdot 10^{-3}$	$1.10 \cdot 10^{4}$	$7.71 \cdot 10^{4}$	$1.42 \cdot 10^{4}$
100	$51.20 \cdot 10^{-3}$	$3.54 \cdot 10^{3}$	$3.54 \cdot 10^{4}$	$5.40 \cdot 10^{3}$
150	$68.90 \cdot 10^{-3}$	$1.36 \cdot 10^{3}$	$2.04 \cdot 10^{4}$	$6.46 \cdot 10^{2}$
250	$102.26 \cdot 10^{-3}$	$3.00 \cdot 10^{2}$	$6.10 \cdot 10^{3}$	$1.33 \cdot 10^{2}$

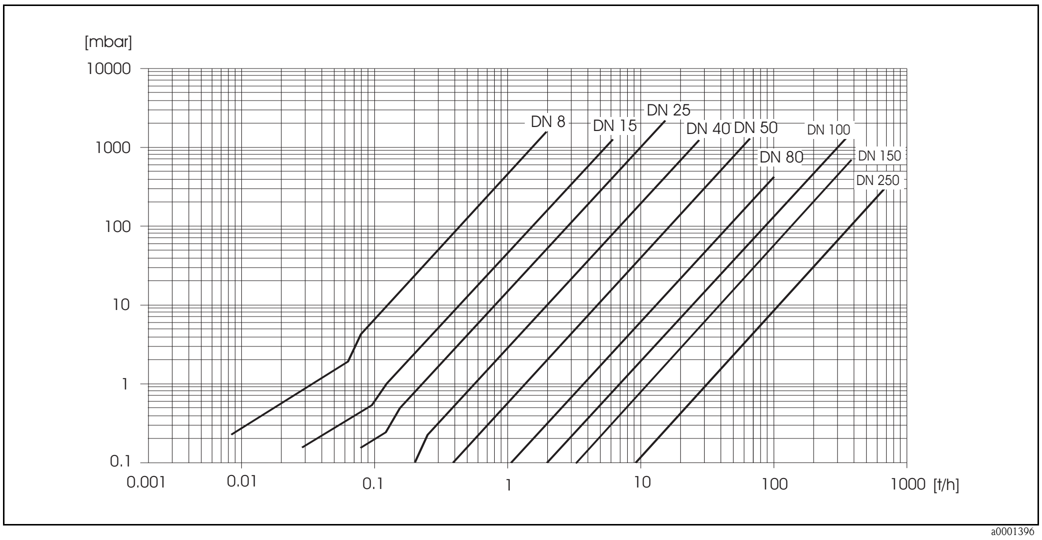


Fig. 44: Pressure loss diagram for water

Pressure loss coefficient for Promass E

DN	d[m]	K	K1	K2
8	$5.35 \cdot 10^{-3}$	$5.70 \cdot 10^{7}$	$7.91 \cdot 10^{7}$	$2.10 \cdot 10^{7}$
15	$8.30 \cdot 10^{-3}$	$7.62 \cdot 10^{6}$	$1.73 \cdot 10^{7}$	$2.13 \cdot 10^{6}$
25	$12.00 \cdot 10^{-3}$	$1.89 \cdot 10^{6}$	$4.66 \cdot 10^{6}$	$6.11 \cdot 10^{5}$
40	$17.60 \cdot 10^{-3}$	$4.42 \cdot 10^{5}$	$1.35 \cdot 10^{6}$	$1.38 \cdot 10^{5}$
50	$26.00 \cdot 10^{-3}$	$8.54 \cdot 10^{4}$	$4.02 \cdot 10^{5}$	$2.31 \cdot 10^{4}$
80	$40.50 \cdot 10^{-3}$	$1.44 \cdot 10^{4}$	$5.00 \cdot 10^{4}$	$2.30 \cdot 10^{4}$

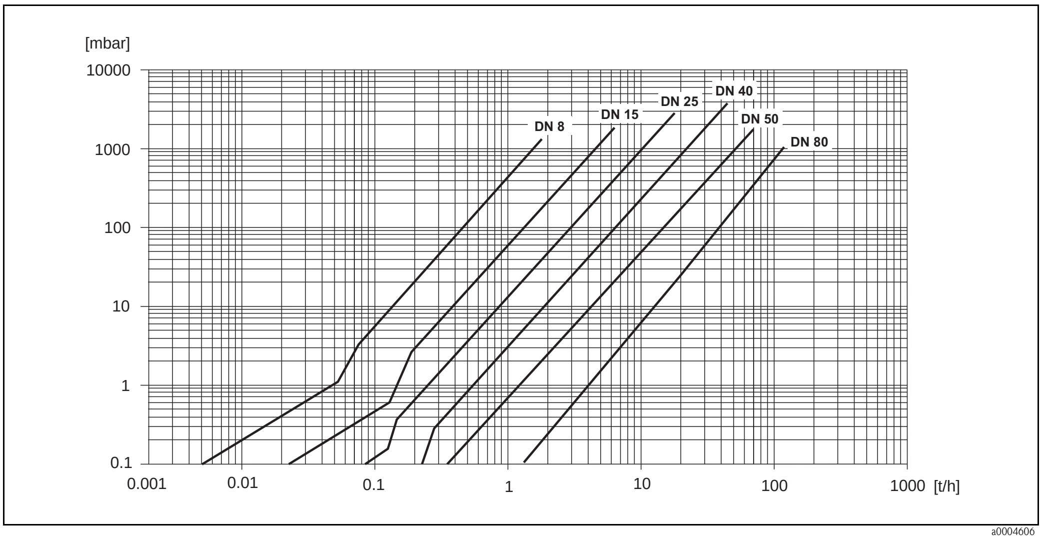


Fig. 45: Pressure loss diagram for water

Pressure loss coefficient for Promass A

DN	d[m]	K	K1
1	$1.1 \cdot 10^{-3}$	$1.2 \cdot 10^{11}$	$1.3 \cdot 10^{11}$
2	$1.8 \cdot 10^{-3}$	$1.6 \cdot 10^{10}$	$2.4 \cdot 10^{10}$
4	$3.5 \cdot 10^{-3}$	$9.4 \cdot 10^{8}$	$2.3 \cdot 10^{9}$
High pressure version			
2	$1.4 \cdot 10^{-3}$	$5.4 \cdot 10^{10}$	$6.6 \cdot 10^{10}$
4	$3.0 \cdot 10^{-3}$	$2.0 \cdot 10^{9}$	$4.3 \cdot 10^{9}$

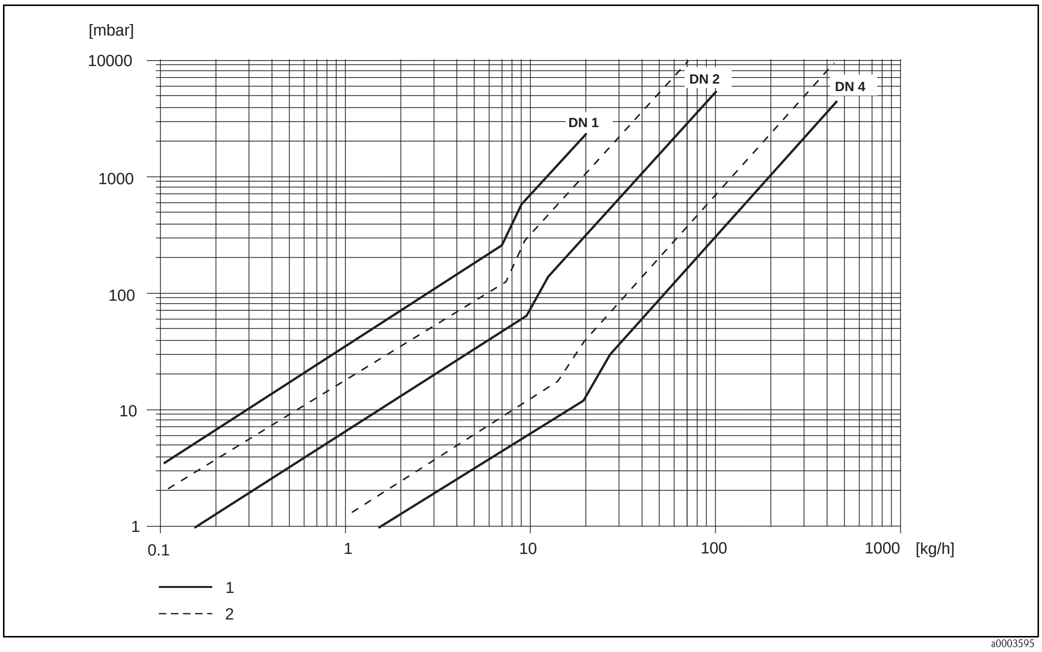


Fig. 46: Pressure loss diagram for water

1 *Standard version*
2 *High pressure version*

Pressure loss coefficient for Promass H

DN	d[m]	K	K1	K3
8	$8.51 \cdot 10^{-3}$	$8.04 \cdot 10^{6}$	$3.28 \cdot 10^{7}$	$1.15 \cdot 10^{6}$
15	$12.00 \cdot 10^{-3}$	$1.81 \cdot 10^{6}$	$9.99 \cdot 10^{6}$	$1.87 \cdot 10^{5}$
25	$17.60 \cdot 10^{-3}$	$3.67 \cdot 10^{5}$	$2.76 \cdot 10^{6}$	$4.99 \cdot 10^{4}$
40	$25.50 \cdot 10^{-3}$	$8.75 \cdot 10^{4}$	$8.67 \cdot 10^{5}$	$1.22 \cdot 10^{4}$
50	$40.5 \cdot 10^{-3}$	$1.35 \cdot 10^{4}$	$1.72 \cdot 10^{5}$	$1.20 \cdot 10^{3}$
Pressure loss data includes interface between measuring tube and piping				

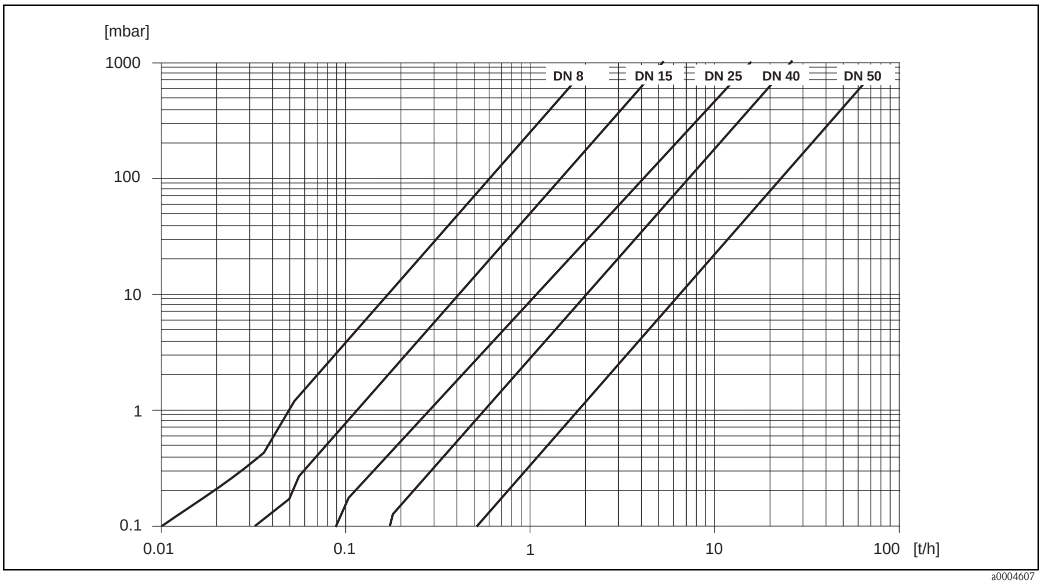


Fig. 47: Pressure loss diagram for water

Pressure loss coefficient for Promass I

DN	d[m]	K	K1	K3
8	$8.55 \cdot 10^{-3}$	$8.1 \cdot 10^{6}$	$3.9 \cdot 10^{7}$	$129.95 \cdot 10^{4}$
15	$11.38 \cdot 10^{-3}$	$2.3 \cdot 10^{6}$	$1.3 \cdot 10^{7}$	$23.33 \cdot 10^{4}$
15 1)	$17.07 \cdot 10^{-3}$	$4.1 \cdot 10^{5}$	$3.3 \cdot 10^{6}$	$0.01 \cdot 10^{4}$
25	$17.07 \cdot 10^{-3}$	$4.1 \cdot 10^{5}$	$3.3 \cdot 10^{6}$	$5.89 \cdot 10^{4}$
25 1)	$26.40 \cdot 10^{-3}$	$7.8 \cdot 10^{4}$	$8.5 \cdot 10^{5}$	$0.11 \cdot 10^{4}$
40	$26.40 \cdot 10^{-3}$	$7.8 \cdot 10^{4}$	$8.5 \cdot 10^{5}$	$1.19 \cdot 10^{4}$
40 1)	$35.62 \cdot 10^{-3}$	$1.3 \cdot 10^{4}$	$2.0 \cdot 10^{5}$	$0.08 \cdot 10^{4}$
50	$35.62 \cdot 10^{-3}$	$1.3 \cdot 10^{4}$	$2.0 \cdot 10^{5}$	$0.25 \cdot 10^{4}$
50 1)	$54.8 \cdot 10^{-3}$	$2.3 \cdot 10^{3}$	$5.5 \cdot 10^{4}$	$1.0 \cdot 10^{2}$
80	$54.8 \cdot 10^{-3}$	$2.3 \cdot 10^{3}$	$5.5 \cdot 10^{4}$	$3.5 \cdot 10^{2}$
Pressure loss data includes interface between measuring tube and piping 1) DN 15, 25, 40, 50 "FB" = Full bore versions of Promass I				

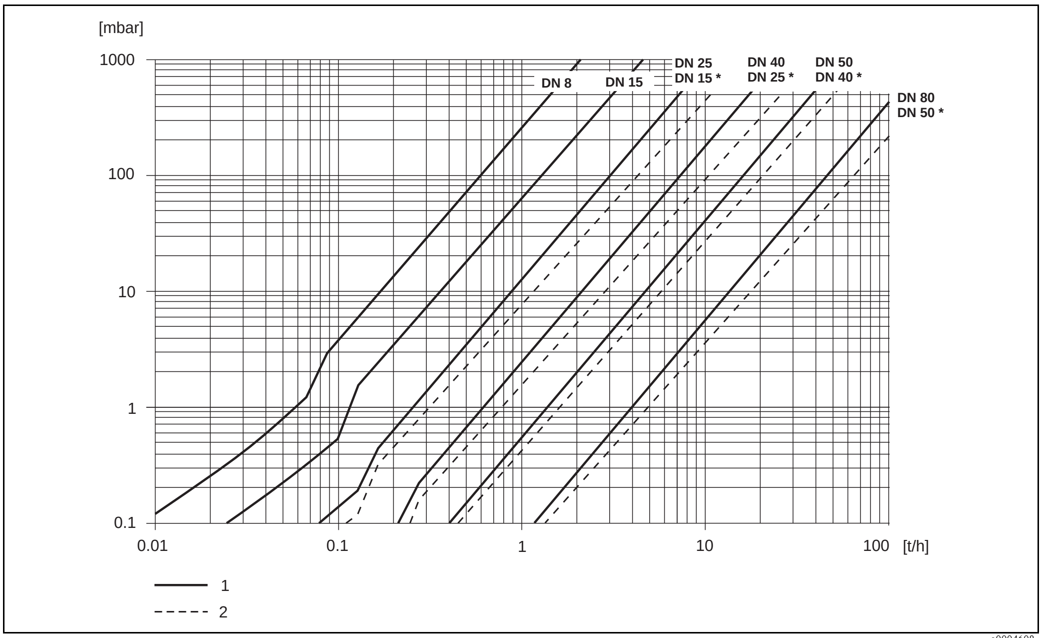


Fig. 48: Pressure loss diagram for water

1 Standard versions
2 Full bore versions (*)

Pressure loss coefficient for Promass S, P

DN	d[m]	K	K1	K3
8	$8.31 \cdot 10^{-3}$	$8.78 \cdot 10^{6}$	$3.53 \cdot 10^{7}$	$1.30 \cdot 10^{6}$
15	$12.00 \cdot 10^{-3}$	$1.81 \cdot 10^{6}$	$9.99 \cdot 10^{6}$	$1.87 \cdot 10^{5}$
25	$17.60 \cdot 10^{-3}$	$3.67 \cdot 10^{5}$	$2.76 \cdot 10^{6}$	$4.99 \cdot 10^{4}$
40	$26.00 \cdot 10^{-3}$	$8.00 \cdot 10^{4}$	$7.96 \cdot 10^{5}$	$1.09 \cdot 10^{4}$
50	$40.50 \cdot 10^{-3}$	$1.41 \cdot 10^{4}$	$1.85 \cdot 10^{5}$	$1.20 \cdot 10^{3}$
Pressure loss data includes interface between measuring tube and piping				

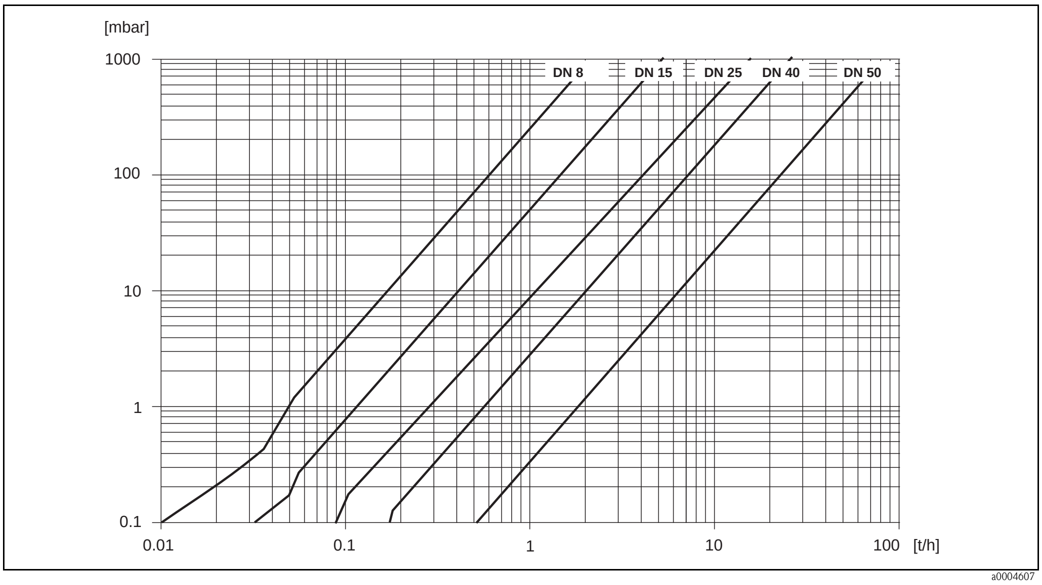


Abb. 49: Pressure loss diagram for water

Pressure loss (US units)

Pressure loss ist dependent on fluid properties nominal diameter. Consult Endress+Hauser for Applicator PC software to determine pressure loss in US units. All important instrument data is contained in the Applicator software programm in order to optimize the design of measuring system. The software is used for following calculations:

- Nominal diameter of the sensor with fluid characteristics such as viscosity, density, etc.
- Pressure loss downstream ot the measuring point.
- Converting mass flow to volume flow, etc.
- Simultaneous display of various meter size.
- Determining measuring ranges.

The Applicator runs on any IBM compatible PC with windows.

10.1.10 Mechanical construction

Design / dimensions

The dimensions and lengths of the sensor and transmitter are provided in the separate "Technical Information" document on the device in question. This can be downloaded as a PDF file from www.endress.com. A list of the "Technical Information" documents available is provided in the "Documentation" section → 109.

Weight

- Measuring device in compact and remote version: see tables below
- Wall-mount housing: 5 kg (11 lb)

Weight (SI units) in [kg]

All values (weight) refer to devices with EN/DIN PN 40 flanges.

Promass F / DN	8	15	25	40	50	80	100	150	250*
Compact version	11	12	14	19	30	55	96	154	400
Compact version, high-temperature	–	–	14.7	–	30.7	55.7	–	–	–
Remote version	9	10	12	17	28	53	94	152	398
Remote version, high-temperature	–	–	13.5	–	29.5	54.5	–	–	–
* With 10" according to ASME B16.5 Cl 300 flanges									

Promass E / DN	8	15	25	40	50	80
Compact version	8	8	10	15	22	31
Remote version	6	6	8	13	20	29

Promass A / DN	1	2	4
Compact version	10	11	15
Remote version	8	9	13

Promass H / DN	8	15	25	40	50
Compact version	12	13	19	36	69
Remote version	10	11	17	34	67

Promass I / DN	8	15	15FB	25	25FB	40	40FB	50	50FB	80
Compact version	13	15	21	22	41	42	67	69	120	124
Remote version	11	13	19	20	39	40	65	67	118	122
"FB" = Full bore versions of Promass I										

Promass S / DN	8	15	25	40	50
Compact version	13	15	21	43	80
Remote version	11	13	19	41	78

Promass P / DN	8	15	25	40	50
Compact version	13	15	21	43	80
Remote version	11	13	19	41	78

Weight (US units) in [lb]

All values (weight) refer to devices with flanges according to EN/DIN PN 40.

Promass F / DN	3/8"	1/2"	1"	1 ½"	2"	3"	4"	6"	10"*
Compact version	24	26	31	42	66	121	212	340	882
Compact version, high-temperature	–	–	32	–	68	123	–	–	–
Remote version	20	22	26	37	62	117	207	335	878
Remote version, high-temperature	–	–	30	–	65	120	–	–	–
* With 10" according to ASME B16.5 Cl 300 flanges									

Promass E / DN	3/8"	1/2"	1	1 ½"	2"	3"
Compact version	18	18	22	33	49	69
Remote version	13	13	18	29	44	64

Promass A / DN	1/24"	1/12"	1/8"
Compact version	22	24	33
Remote version	18	20	29

Promass H / DN	3/8"	1/2"	1	1 ½"	2"
Compact version	26	29	42	79	152
Remote version	22	24	37	75	148

Promass I / DN	3/8"	1/2"	1/2"FB	1 ½"	1 ½"FB	3/8"	3/8"FB	1	1FB	2"
Compact version	29	33	46	49	90	93	148	152	265	273
Remote version	24	29	42	44	86	88	143	148	260	269
"FB" = Full bore versions of Promass I										

Promass S / DN	3/8"	1/2"	1	1 ½"	2"
Compact version	29	33	46	95	176
Remote version	24	29	42	90	172

Promass P / DN	3/8"	1/2"	1	1 ½"	2"
Compact version	29	33	46	95	176
Remote version	24	29	42	90	172

Material

Transmitter housing:

Compact version
- Powder coated die-cast aluminium
- Stainless steel housing: stainless steel 1.4301/ASTM 304
- Window material: Glass or polycarbonate

Remote version
- Remote field housing: powder coated die-cast aluminium
- Wall-mount housing: powder coated die-cast aluminium
- Window material: Glass

Sensor housing / containment:

Promass F:

- Acid- and alkali-resistant outer surface
- Stainless steel 1.4301/1.4307/304L

Promass E, A, H, I, S, P:

- Acid- and alkali-resistant outer surface
- Stainless steel 1.4301/304

Connection housing, sensor (remote version):

- Stainless steel 1.4301/304 (standard)
- Powder coated die-cast aluminum
  (high-temperature version and version for heating)

Process connections

Promass F:

- Flanges according to EN 1092-1 (DIN 2501) / according to ASME B16.5 / JIS B2220
  → stainless steel 1.4404/316L
- Flanges according to EN 1092-1 (DIN 2501) / according to ASME B16.5 / JIS B2220
  → Alloy C-22 2.4602/N 06022
- DIN 11864-2 Form A (flat flange with groove) → stainless steel 1.4404/316L
- Threaded hygienic connections DIN 11851/ DIN 11864-1, Form A / ISO 2853 / SMS 1145
  → stainless steel 1.4404/316L
- Tri-Clamp (OD-tubes)→ stainless steel 1.4404/316L
- VCO connection → stainless steel 1.4404/316L

Promass F (high-temperature version):

- Flanges according to EN 1092-1 (DIN 2501) / according to ASME B16.5 / JIS B2220
  → stainless steel 1.4404/316L
- Flanges according to EN 1092-1 (DIN 2501) / according to ASME B16.5 / JIS B2220
  → Alloy C-22 2.4602 (N 06022)

Promass E:

- Flanges according to EN 1092-1 (DIN 2501) / according to ASME B16.5 / JIS B2220
  → stainless steel 1.4404/316L
- DIN 11864-2 Form A (flat flange with groove) → stainless steel 1.4404/316L
- VCO connection → stainless steel 1.4404/316L
- Threaded hygienic connections DIN 11851/ DIN 11864-1, Form A / ISO 2853 / SMS 1145
  → stainless steel 1.4404/316L
- Tri-Clamp (OD-tubes) → stainless steel 1.4404/316L

Promass A:

- Mounting set for flanges according to EN 1092-1 (DIN 2501) / according to ASME B16.5 / JIS B2220 → stainless steel 1.4539/904L, Alloy C-22 2.4602/N 06022.
  Loose flanges → stainless steel 1.4404/316L
- VCO connection → stainless steel 1.4539/904L, Alloy C-22 2.4602/N 06022
- Tri-Clamp (OD-tubes) (1/2") → stainless steel 1.4539/904L
- Mounting set for SWAGELOK (1/4", 1/8") → stainless steel 1.4401/316
- Mounting set for NPT-F (1/4") → stainless steel 1.4539/904L1.4539/904L, Alloy C-22 2.4602/N 06022

Promass H:

- Flanges according to EN 1092-1 (DIN 2501) / according to ASME B16.5 / JIS B2220 → stainless steel 1.4301/304, parts in contact with medium: zirconium 702

Promass I:

- Flanges according to EN 1092-1 (DIN 2501) / according to ASME B16.5 / JIS B2220 → stainless steel 1.4301/304
- DIN 11864-2 Form A (flat flange with groove) → titanium grade 2
- Threaded hygienic connections DIN 11851/ DIN 11864-1, Form A / ISO 2853 / SMS 1145 → titanium grade 2
- Tri-Clamp (OD-tubes) → titanium grade 2

Promass S

- Flanges according to EN 1092-1 (DIN 2501) / JIS B2220 → stainless steel 1.4404/316/316L
- Flanges according to ASME B16.5 → stainless steel 1.4404/316/316L
- DIN 11864-2 Form A (flat flange with groove) → stainless steel 1.4435/316L
- Threaded hygienic connections DIN 11851/ DIN 11864-1, Form A / ISO 2853 / SMS 1145 → stainless steel 1.4435/316L
- Tri-Clamp (OD-Tubes)→ stainless steel 1.4435/316L
- Clamp aseptic connection DIN 11864-3, Form A → stainless steel 1.4435/316L
- Clamp pipe connection DIN 32676 / ISO 2852 → stainless steel 1.4435/316L

Promass P

- Flanges according to EN 1092-1 (DIN 2501) / JIS B2220 → stainless steel 1.4404/316/316L
- Flanges according to ASME B16.5 → stainless steel 1.4404/316/316L
- DIN 11864-2 Form A (flat flange with groove), BioConnect® → stainless steel 1.4435/316L
- Threaded hygienic connections DIN 11851/ DIN 11864-1, Form A / ISO 2853 / SMS 1145 → stainless steel 1.4435/316L
- Tri-Clamp (OD-Tubes)→ stainless steel 1.4435/316L
- Clamp aseptic connection DIN 11864-3, Form A → stainless steel 1.4435/316L
- Clamp pipe connection DIN 32676/ISO 2852, BioConnect® → stainless steel 1.4435/316L

Measuring tube(s):

Promass F:

- DN 8 to 100 (3/8" to 4"): stainless steel 1.4539/904L
- DN 150 (6"): stainless steel 1.4404/316L
- DN 250 (10"): stainless steel 1.4404/316L; manifold: CF3M
- DN 8 to 150 (3/8" to 6"): Alloy C-22 2.4602/N 06022

Promass F (high-temperature version):

- DN 25, 50, 80 (1", 2", 3"): Alloy C-22 2.4602/N 06022

Promass E, S:

- Stainless steel 1.4539/904L

Promass A:

- Stainless steel 1.4539/904L, Alloy C-22 2.4602/N 06022

Promass H:

- Zirconium 702/R 60702
- Tantalum 2.5W

Promass I:

- Titanium grade 9
- Titanium grade 2 (flange disks)

Promass P

Stainless steel 1.4435/316L

Seals:

Promass F, E, H, I, S, P:

Welded process connections without internal seals

Promass A:

Welded process connections without internal seals.
Only for mounting sets with threaded connections: Viton, EPDM, Silikon, Kalrez

Material load diagram

The material load diagrams (pressure-temperature diagrams) for the process connections are provided in the separate "Technical Information" document on the device in question. This can be downloaded as a PDF file from www.endress.com.
A list of the "Technical Information" documents available is provided in the "Documentation" section → 🗎 109

Process connections

→ 🗎 105

10.1.11 Human interface

Display elements	▪ Liquid crystal display: illuminated, two lines with 16 characters per line ▪ Selectable display of different measured values and status variables ▪ At ambient temperatures below –20 °C (–4 °F) the readability of the display may be impaired.
Operating elements	▪ Local operation with push buttons (–, +, E) ▪ Quick Setup menus for straightforward commissioning
Language groups	Language groups available for operation in different countries: ▪ Western Europe and America (WEA): English, German, Spanish, Italian, French, Dutch and Portuguese ▪ Eastern Europe and Scandinavia (EES): English, Russian, Polish, Norwegian, Finnish, Swedish and Czech ▪ South and east Asia (SEA): English, Japanese, Indonesian ✎ Note! You can change the language group via the operating program "FieldCare".
Remote operation	Operation by means of HART protocol

10.1.12 Certificates and approvals

CE mark	The measuring system is in conformity with the statutory requirements of the EC Directives. Endress+Hauser confirms successful testing of the device by affixing to it the CE mark.
C-tick mark	The measuring system is in conformity with the EMC requirements of the "Australian Communications and Media Authority (ACMA)".
Ex approval	Information about currently available Ex versions (ATEX, FM, CSA, IECEx, NEPSI etc.) can be supplied by your Endress+Hauser Sales Center on request. All information relevant to explosion protection is available in separate Ex documents that you can order as necessary.
Sanitary compatibility	▪ 3A authorization (all measuring systems, except Promass H) ▪ EHEDG-tested (all measuring systems, except Promass E and H)
Pressure measuring device approval	The measuring devices can be ordered with or without PED (Pressure Equipment Directive). If a device with PED is required, this must be ordered explicitly. For devices with nominal diameters less than or equal to DN 25 (1"), this is neither possible nor necessary. ▪ With the identification PED/G1/III on the sensor nameplate, Endress+Hauser confirms conformity with the "Basic safety requirements" of Appendix I of the Pressure Equipment Directive 97/23/EC. ▪ Devices with this identification (with PED) are suitable for the following types of fluid: – Fluids of Group 1 and 2 with a steam pressure of greater or less than 0.5 bar (7.3 psi) – Unstable gases ▪ Devices without this identification (without PED) are designed and manufactured according to good engineering practice. They correspond to the requirements of Art. 3, Section 3 of the Pressure Equipment Directive 97/23/EC. Their application is illustrated in Diagrams 6 to 9 in Appendix II of the Pressure Equipment Directive 97/23/EC.
Functional safety	SIL -2: In accordance with IEC 61508/IEC 61511-1 (FDIS)

Other standards and guidelines

- EN 60529
  Degrees of protection by housing (IP code)
- EN 61010-1
  Safety requirements for electrical equipment for measurement, control and laboratory use
- IEC/EN 61326
  "Emission in accordance with requirements for Class A".
  Electromagnetic compatibility (EMC requirements)
- NAMUR NE 21
  Electromagnetic compatibility (EMC) of industrial process and laboratory control equipment.
- NAMUR NE 43
  Standardization of the signal level for the breakdown information of digital transmitters with analog output signal.
- NAMUR NE 53
  Software of field devices and signal-processing devices with digital electronics

10.1.13 Ordering information

The Endress +Hauser service organization can provide detailed ordering information and information on the order codes on request.

10.1.14 Accessories

Various accessories, which can be ordered separately from Endress+Hauser, are available for the transmitter and the sensor → 📄 54.

10.1.15 Documentation

- Flow measuring technology (FA00005D)
- Technical Information
  - Promass 80A, 83A (TI00054D)
  - Promass 80E, 83E (TI00061D)
  - Promass 80F, 83F (TI00101D)
  - Promass 80H, 83H (TI00074D)
  - Promass 80I, 83I (TI00075D)
  - Promass 80P, 83P (TI00078D)
  - Promass 80S, 83S (TI00076D)
- Description of Device Functions Promass 80 (BA00058D)
- Supplementary documentation on Ex-ratings: ATEX, FM, CSA, IECEx, NEPSI
- Functional Safety Manual Promass 80, 83 (SD00077D)

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Endress+Hauser

People for Process Automation

Declaration of Hazardous Material and De-Contamination

Erklärung zur Kontamination und Reinigung

RA No. ☐☐☐☐☐☐☐☐

Please reference the Return Authorization Number (RA#), obtained from Endress+Hauser, on all paperwork and mark the RA# clearly on the outside of the box. If this procedure is not followed, it may result in the refusal of the package at our facility.
Bitte geben Sie die von E+H mitgeteilte Rücklieferungsnummer (RA#) auf allen Lieferpapieren an und vermerken Sie diese auch außen auf der Verpackung. Nichtbeachtung dieser Anweisung führt zur Ablehnung ihrer Lieferung.

Because of legal regulations and for the safety of our employees and operating equipment, we need the "Declaration of Hazardous Material and De-Contamination", with your signature, before your order can be handled. Please make absolutely sure to attach it to the outside of the packaging.
Aufgrund der gesetzlichen Vorschriften und zum Schutz unserer Mitarbeiter und Betriebseinrichtungen, benötigen wir die unterschriebene "Erklärung zur Kontamination und Reinigung", bevor Ihr Auftrag bearbeitet werden kann. Bringen Sie diese unbedingt außen an der Verpackung an.

Type of instrument / sensor
Geräte-/Sensortyp ____

Serial number
Seriennummer ________________________

☐ **Used as SIL device in a Safety Instrumented System /** *Einsatz als SIL Gerät in Schutzeinrichtungen*

Process data/ *Prozessdaten*

Temperature / *Temperatur* _____ [°F] _____ [°C]
Pressure / *Druck* _____ [psi] _____ [Pa]
Conductivity / *Leitfähigkeit* ________ [µS/cm]
Viscosity / *Viskosität* _____ [cp] _____ [mm^2/s]

Medium and warnings
Warnhinweise zum Medium

	Medium /concentration *Medium /Konzentration*	Identification CAS No.	flammable *entzündlich*	toxic *giftig*	corrosive *ätzend*	harmful/ irritant *gesundheits-schädlich/ reizend*	other * *sonstiges**	harmless *unbedenklich*
Process medium *Medium im Prozess*								
Medium for process cleaning *Medium zur Prozessreinigung*								
Returned part cleaned with *Medium zur Endreinigung*								

* explosive; oxidizing; dangerous for the environment; biological risk; radioactive
* *explosiv; brandfördernd; umweltgefährlich; biogefährlich; radioaktiv*

Please tick should one of the above be applicable, include safety data sheet and, if necessary, special handling instructions.
Zutreffendes ankreuzen; trifft einer der Warnhinweise zu, Sicherheitsdatenblatt und ggf. spezielle Handhabungsvorschriften beilegen.

Description of failure / *Fehlerbeschreibung* ____

____

____

Company data / *Angaben zum Absender*

Company / *Firma* ________________________________

____

Address / *Adresse*

____

____

Phone number of contact person / *Telefon-Nr. Ansprechpartner:*

____

Fax / E-Mail ________________________________

Your order No. / *Ihre Auftragsnr.* ________________________

“We hereby certify that this declaration is filled out truthfully and completely to the best of our knowledge.We further certify that the returned parts have been carefully cleaned. To the best of our knowledge they are free of any residues in dangerous quantities.”
“Wir bestätigen, die vorliegende Erklärung nach unserem besten Wissen wahrheitsgetreu und vollständig ausgefüllt zu haben. Wir bestätigen weiter, dass die zurückgesandten Teile sorgfältig gereinigt wurden und nach unserem besten Wissen frei von Rückständen in gefahrbringender Menge sind.”

(place, date / *Ort, Datum*) ____________________

Name, dept./ *Abt.* (please print / *bitte Druckschrift*) ____________________

Signature / *Unterschrift* ____________________

www.endress.com/worldwide

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People for Process Automation

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