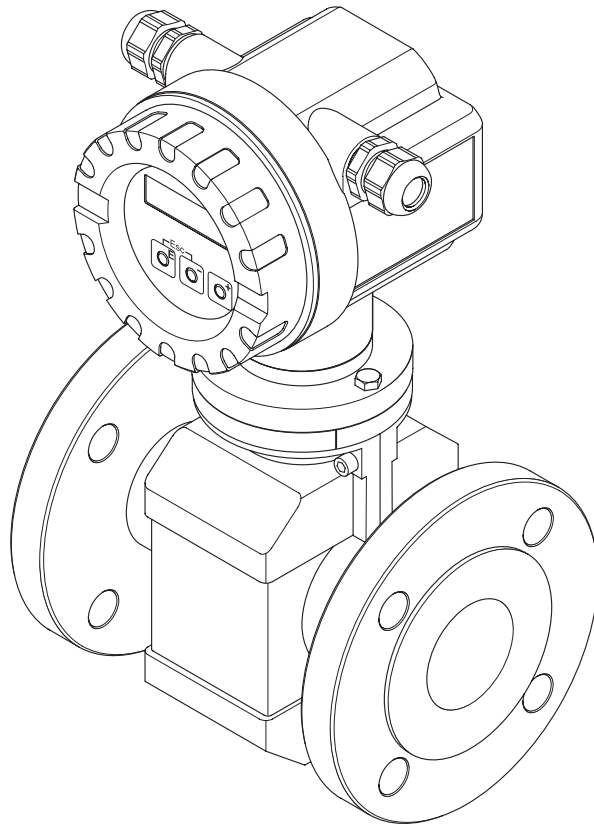|								
Level	Pressure	Flow	Temperature	Liquid Analysis	Registration	Systems Components	Services	Solutions

Operating Instructions

Proline Promag 10

Electromagnetic Flow Measuring System

HART®
FIELD COMMUNICATION PROTOCOL

Endress+Hauser

People for Process Automation

Brief operating instructions

The brief operating instructions are aimed at helping you commission your measuring device quickly and easily:

Safety instructions	Page 5 ff.

First familiarise yourself with the safety instructions to be able to carry out the following work steps quickly and easily. Here, you can find information on:

- The designated use of the measuring device
- Operational safety
- The safety symbols and conventions used in the document

▼

Installation	Page 10 ff.

The "Installation" section provides you with all necessary information from incoming acceptance and the installation conditions to be taken into consideration (orientation, mounting location, vibrations, etc.) to the actual installation of the device, including information on seals, earthing and the torques to be observed for the compact and remote versions.

▼

Wiring	Page 33 ff.

The electrical connection of the device and the process for connecting the connecting cable of the remote version are described in the "Wiring" section. This section also includes the following topics:

- The cable specifications of the coil and signal cable
- The terminal assignment
- The potential equalisation and the degree of protection

▼

Display and operating elements	Page 45 ff.

All the display and operating elements available for operating the device are described here.
Furthermore, this section provides you with a description of the procedure for configuring the measuring device via the function matrix and the HART protocol.

▼

Commissioning	Page 56 ff.

By means of the brief commissioning guide (→ Page 46), you can put your measuring device into operation quickly and easily. It enables you to configure important basic functions using the local display, for example the display language, measured variables, units of measure, type of signal, etc.
In addition, this section also describes the empty-pipe/full-pipe adjustment to be carried out for using empty pipe detection.

▼

Customer-specific configuration	Page 85 ff.

Complex measurement tasks require the configuration of additional functions which you can individually select, set and adapt to your process conditions using the function matrix.

✎   Note!
All functions are described in detail, as is the function matrix itself, in the Appendix to these Operating Instructions → Page 85 ff.

✎   Note!
Always start trouble-shooting with the checklist on Page 62 if faults occur after commissioning or during operation. This takes you directly (via various queries) to the cause of the problem and the appropriate remedial measures.

Table of contents

1   Safety instructions

1.1   Designated use

The measuring device described in these Operating Instructions is to be used only for measuring the flow of conductive liquids in closed pipes.

The majority of liquids can be measured as of a minimum conductivity of 50 µS/cm e.g.:
- Acids, alkalis,
- Drinking water, wastewater, sewage sludge,
- Milk, beer, wine, mineral water, etc.

Resulting from incorrect use or from use other than that designated the operational safety of the measuring devices can be suspended. The manufacturer accepts no liability for damages being produced from this.

1.2   Installation, commissioning, 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 authorised to perform such work by the facility's owner-operator. The specialist must have read and understood these Operating Instructions and must follow the instructions they contain.

- The device must be operated by persons authorised and trained by the facility's owner-operator. Strict compliance with the instructions in these Operating Instructions is mandatory.

- In the case of special fluids (incl. fluids for cleaning), Endress+Hauser will be happy to assist in clarifying the material resistance properties of wetted parts. However, the user is responsible for the choice of wetted materials as regards their in-process resistance to corrosion. The manufacturer refuses to accept liability.

- If welding work is performed on the piping system, do not ground the welding appliance through the measuring device.

- The installer must ensure that the measuring system is correctly wired in accordance with the wiring diagrams. The transmitter must be grounded, unless the power supply is galvanically isolated.

- 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 this Operating Manual. Strict compliance with the installation instructions and ratings as stated in this supplementary documentation is mandatory. The symbol on the front of this Ex documentation indicates the approval and the test center (⟨Ex⟩ Europe, ⟨FM⟩ USA, ⓒ Canada).

- The manufacturer reserves the right to modify technical data without prior notice. Your Endress+Hauser Sales Centre will supply you with current information and updates to these Operating Instructions.

- The measuring device complies with the general safety requirements in accordance with EN 61010 and the EMC requirements of EN 61326/A1 (IEC 1326) → Chap. 10.1.12 "Certificates and approvals", Page 83.

- In the case of the Promag H sensor, the process connection seals must be replaced periodically depending on the application.

1.4   Return

The following procedures must be carried out before a flowmeter requiring repair or calibration, for example, is returned to Endress+Hauser:

■ Always enclose a fully completed "Declaration of Contamination" form with the device. Only then can Endress+Hauser transport, examine and repair a returned device.

✎   Note!
A copy of the "Declaration of Contamination" can be found at the end of these Operating Instructions.

■ Enclose special handling instructions if necessary, for example a safety data sheet as per EN 91/155/EEC.

■ Remove all fluid residues. Pay special attention to the grooves for seals and crevices which could contain fluid residues. This is particularly important if the fluid is hazardous to health, e.g. flammable, toxic, caustic, carcinogenic, etc.

⚠ Warning!
■ 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 (caustic burns, etc.) due to inadequate cleaning will be charged to the owner-operator.

1.5   Notes on safety conventions and icons

The devices are designed to meet state-of-the-art safety requirements. They 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 "Protection Measures for Electrical Equipment for Measurement, Control, Regulation and Laboratory Procedures."
The devices can, however, be a source of danger if used incorrectly or for use other than that designated. Consequently, always pay particular attention to the safety instructions indicated in these Operating Instructions by the following symbols:

⚠ 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

2.1   Device designation

The flowmeter system consists of the following components:

- Promag 10 transmitter
- Promag W, Promag P or Promag H sensor

In the compact version, the transmitter and sensor form a mechanical unit; in the remote version they are mounted separate from one another.

2.1.1   Nameplate of the transmitter
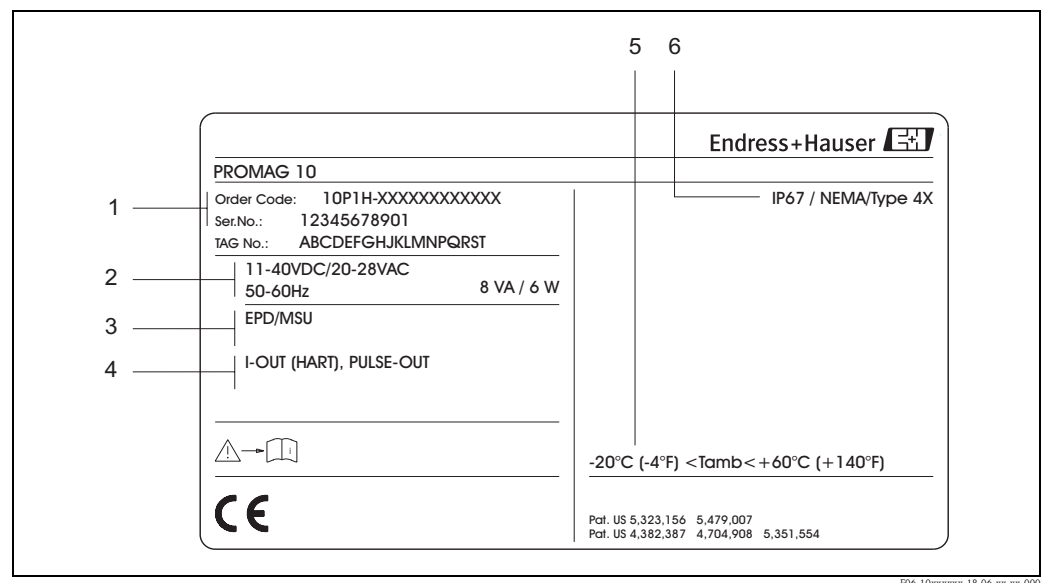
Fig. 1:   Nameplate specifications for the "Promag 10" transmitter (example)

1   Order code /serial number: see the specifications on the order confirmation for the meanings of the individual
*   letters and digits*
2   Power supply, frequency: 11...40 V DC / 20...28 V AC, 50...60 Hz
*   Power consumption: 8 VA / 6 W*
3   Additional information:
*   EPD/MSÜ: with empty pipe detection*
4   Outputs available:
*   I-OUT (HART): with current output (HART)*
*   PULSE-OUT: with pulse/status output*
5   Permitted ambient temperature range
6   Degree of protection

2.1.2   Nameplate of the sensor
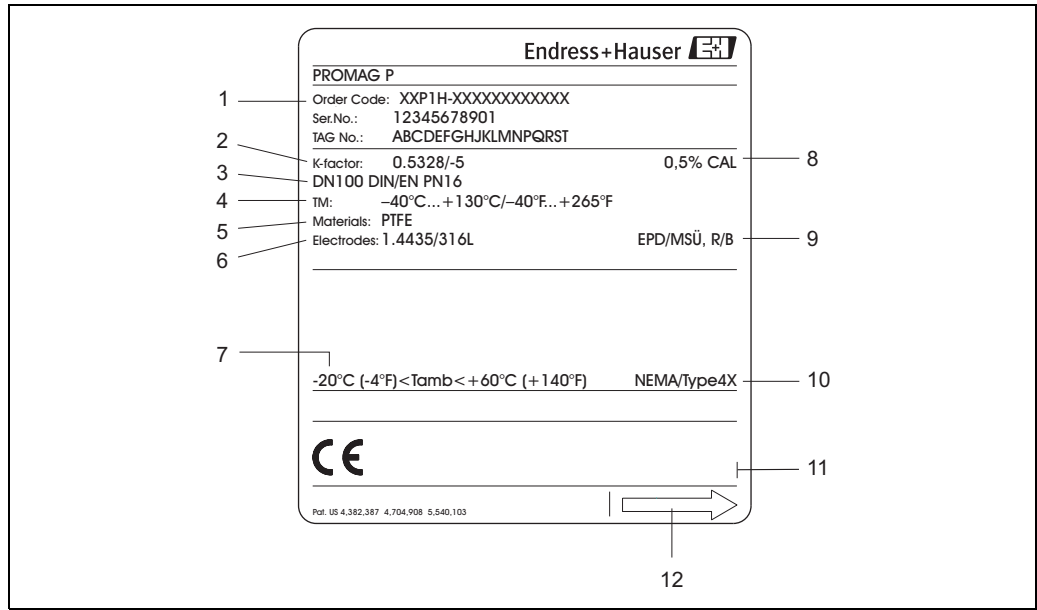
Fig. 2:   Nameplate specifications for the "Promag" sensor (example)

*1   Order code / serial number: see the specifications on the order confirmation for the meanings of the individual
         letters and digits*
2   Calibration factor: 0.5328 / zero point: –5
3   Nominal diameter: DN 100 / nominal pressure: EN (DIN) 16 bar
4   Medium temperature range
5   Lining material: PTFE
6   Measuring electrode material: stainless steel 1.4435/316L
7   Permitted ambient temperature range
8   See "Maximum measured error" → Page 74
9   Additional information (examples):
*   – EPD/MSÜ: with empty pipe detection electrode*
*   – R/B: with reference electrode*
10   Degree of protection
11   Reserved for additional information on device version (approvals, certificates)
12   Flow direction

2.1.3   Nameplate of the connections
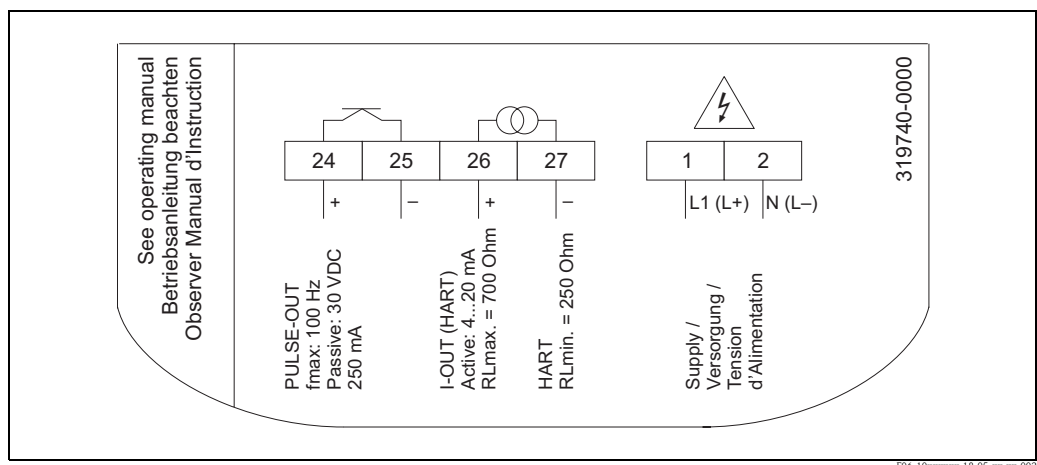
Fig. 3:   Nameplate specifications for the transmitter (example)

2.2   Certificates and approvals

The devices are designed according to 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 "Protection Measures for Electrical Equipment for Measurement, Control, Regulation and Laboratory Procedures" and with the EMC requirements of EN 61326/A1 (IEC 1326).

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.

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

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

ToF Tool – Fieldtool® Package, Fieldcheck®, Applicator®
Registered or registration-pending trademarks of Endress+Hauser Flowtec AG, Reinach, CH

3 Installation

3.1 Incoming acceptance, transport, storage

3.1.1 Incoming acceptance

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

3.1.2 Transport

Please note the following when unpacking or transporting to the measuring point:
- The devices must be transported in the container supplied.
- Do not remove the protective covers or caps on the process connections before installation. This is particularly important in the case of sensors with PTFE linings.

Points to note for flanged devices

Caution!
- The wooden covers mounted on the flanges before the device leaves the factory protect the linings on the flanges during storage and transportation. Do not remove these covers until immediately before the device is installed in the pipe.
- Flanged devices may not be lifted at the transmitter housing or at the connection housing of the remote version when transporting.

Transporting flanged devices (DN ≤ 300)

Use carrier slings when transporting and put the slings around both process connections .
Avoid chains as these could damage the housing.

Warning!
Risk of injury if the measuring device slips! The centre of gravity of the entire measuring device might be higher than the points around which the slings are slung.
Therefore, when transporting, make sure that the device does not unintentionally turn or slip.

F06-xxxxxxxx-22-00-00-xx-002
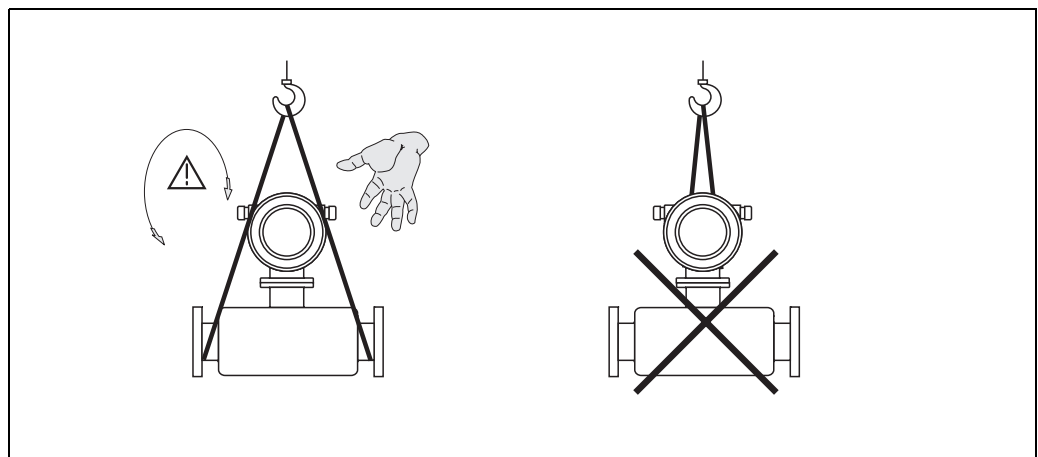
Fig. 4:   Transporting sensors with DN ≤ 300

Transporting flanged devices (DN > 300)

Use only the metal eyes on the flanges for transporting the device, lifting it and positioning the sensor in the piping.

Caution!
Do not attempt to lift the sensor with the tines of a fork–lift truck beneath the metal casing.
The casing would buckle and damage the internal magnetic coils.
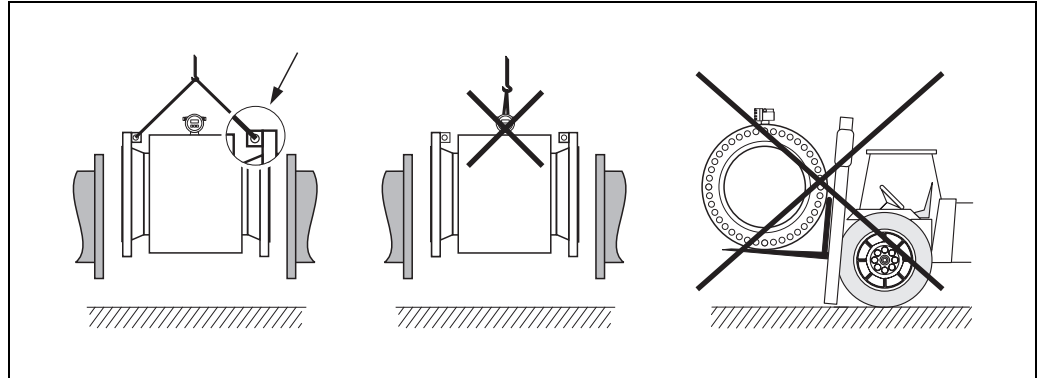
F06-10Fxxxxxx-22-xx-xx-001

Fig. 5:   Transporting sensors with DN > 300

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 storage temperature corresponds to the ambient temperature range of the transmitter and sensor → Page 75.

■ Do not remove the protective covers or caps on the process connections before installation. This is particularly important in the case of sensors with PTFE linings.

■ The measuring device must be protected against direct sunlight during storage in order to avoid unacceptably high surface temperatures.

■ Choose a storage location where moisture does not collect in the measuring device. This will help prevent fungus and bacteria infestation which can damage the liner.

3.2   Installation conditions

3.2.1   Dimensions

The dimensions and lengths of the sensor and transmitter can be found in the "Technical Information" document for 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 Section "Documentation" on Page 83.

3.2.2   Installation location

Entrained air or gas bubble formation in the measuring tube can result in an increase in measuring errors.
Avoid the following installation locations in the pipe:
- Highest point of a pipeline. Risk of air accumulating!
- Directly upstream from a free pipe outlet in a vertical pipeline.
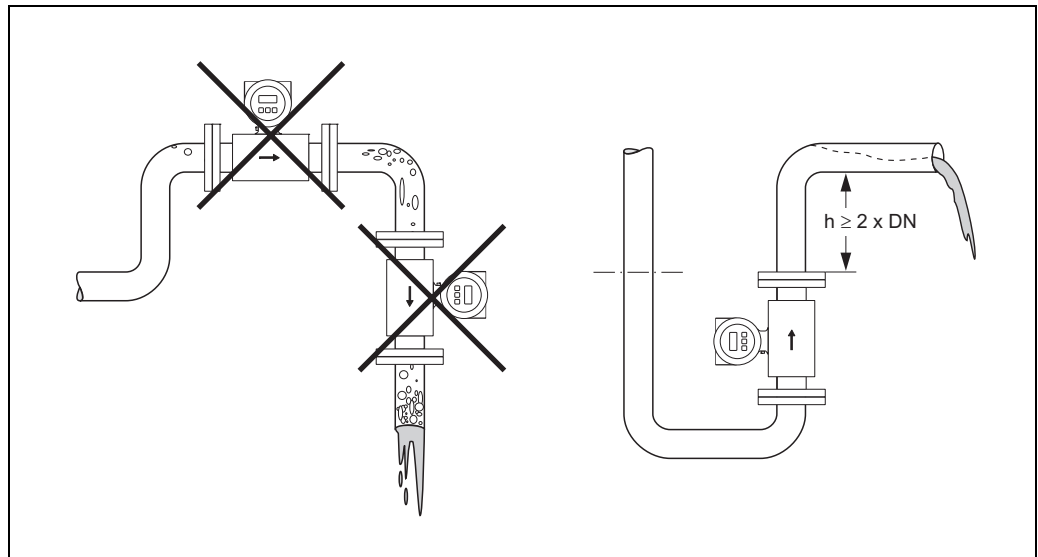
Fig. 6:   Installation location

Installation of pumps

Sensors may not be installed on the pump suction side. This precaution is to avoid low pressure and the consequent risk of damage to the lining of the measuring tube. Information on the pressure tightness of the measuring tube lining is provided on Page 78.
Pulsation dampers may be needed when using piston pumps, piston diaphragm pumps or hose pumps. Information on the vibration and shock resistance of the measuring system is provided on Page 75.
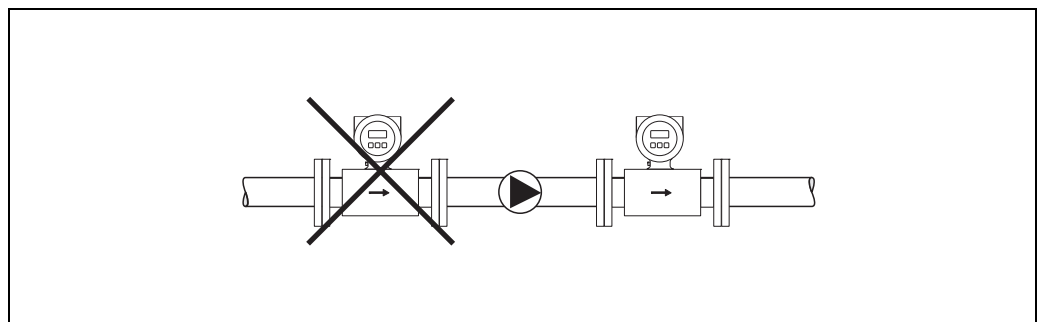
Fig. 7:   Installation of pumps

Partially filled pipes

Partially filled pipes with gradients necessitate a drain–type configuration.
The empty pipe detection function (EPD → Page 58) provides additional security in detecting empty or partially filled pipes.

Caution!
Risk of solids accumulating! Do not install the sensor at the lowest point in the drain. It is advisable to install a cleaning valve.
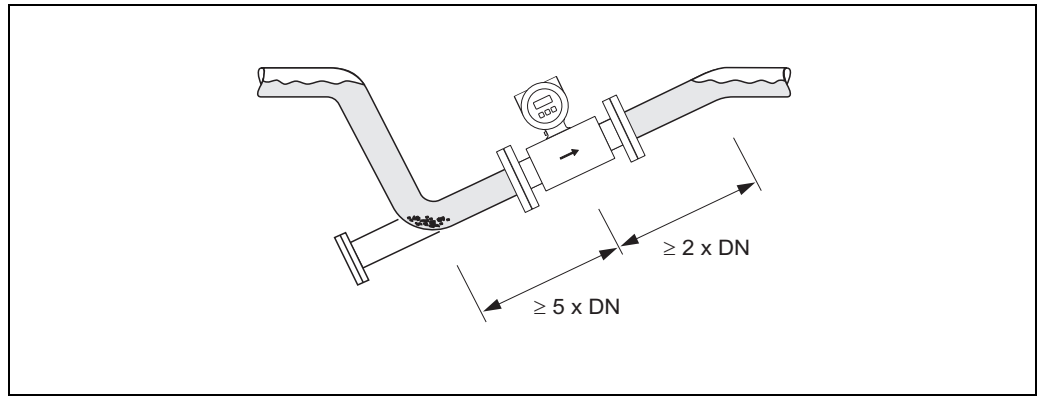
Fig. 8:   Installation in partially filled pipes

Down pipes

Install a siphon or a vent valve downstream of the sensor in down pipes longer than 5 meters. This precaution is to avoid low pressure and the consequent risk of damage to the lining of the measuring tube. This measure also prevents the liquid current stopping in the pipe which could cause air locks. Information on the pressure tightness of the measuring tube lining is provided on Page 78.
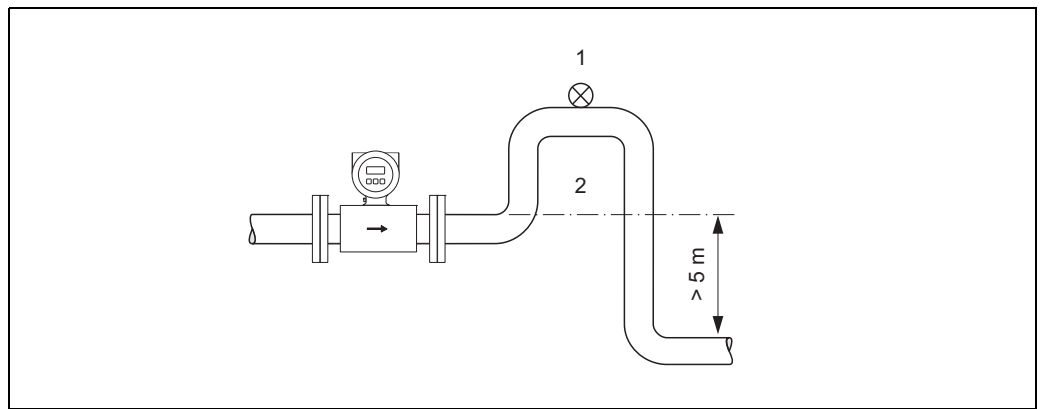
Fig. 9:   Installation measures for vertical pipes

1   Vent valve
2   Pipe siphon

3.2.3   Orientation

An optimum orientation helps avoid gas and air accumulations and deposits in the measuring tube. However, Promag also offers the additional function of empty pipe detection for detecting partially filled measuring tubes or if outgassing fluids or fluctuating operating pressures are present.

Vertical orientation

This is the ideal orientation for self-emptying piping systems and for use in conjunction with empty pipe detection.
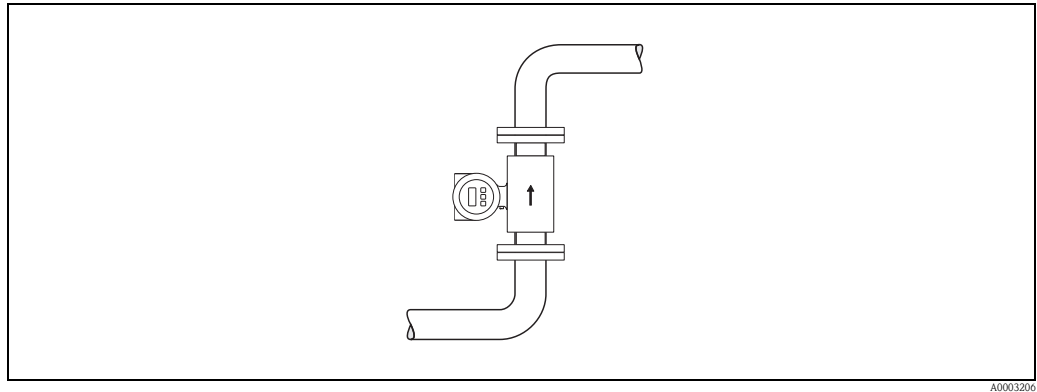
Fig. 10:   Vertical orientation

Horizontal orientation

The measuring electrode axis should be horizontal. This prevents brief insulation of the two measuring electrodes by entrained air bubbles.

Caution!
Empty pipe detection only works correctly with horizontal orientation if the transmitter housing is facing upwards ($\rightarrow$ Fig. 10). Otherwise there is no guarantee that empty pipe detection will respond if the measuring tube is only partially filled or empty.
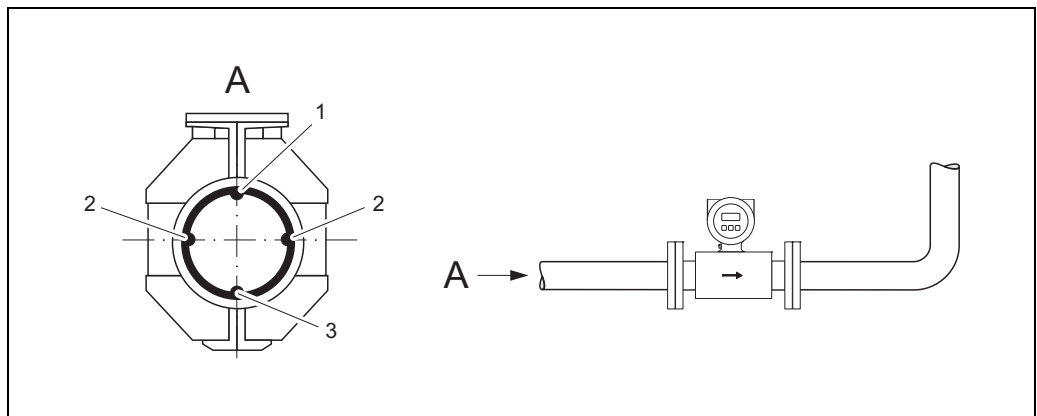
Fig. 11:   Horizontal orientation

1   EPD electrode for empty pipe detection (not for Promag H, DN 2...4)
2   Measuring electrodes for signal detection
3   Reference electrode for potential equalisation (not for Promag H)

Inlet and outlet run

If possible, install the sensor well clear of assemblies such as valves, T-pieces, elbows, etc.

Note the following inlet and outlet runs to comply with measuring accuracy specifications:
- Inlet run: ≥ 5 x DN
- Outlet run: ≥ 2 x DN
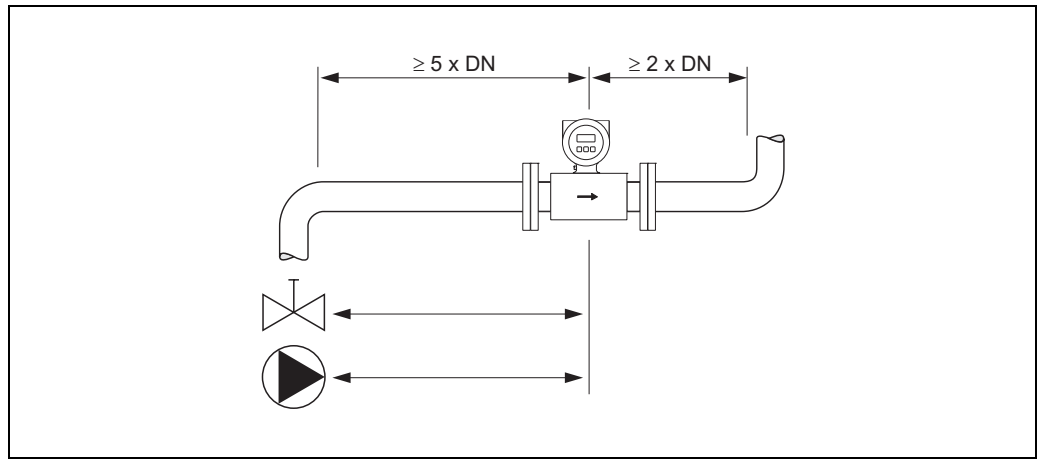
Fig. 12:   Inlet and outlet run

3.2.4   Vibrations

Secure the piping and the sensor if vibration is severe.

Caution!
If vibrations are too severe, we recommend the sensor and transmitter be mounted separately.
Information on the permitted vibration and shock resistance is provided on Page 75.
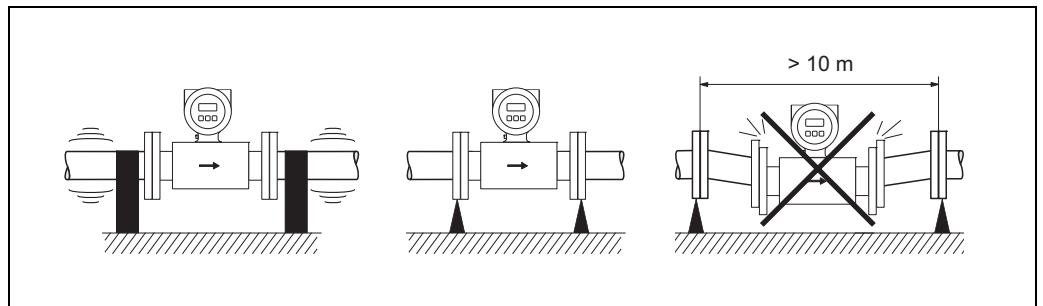
Fig. 13:   Measures to prevent vibration of the measuring device

3.2.5   Foundations, supports

For nominal diameters DN ≥ 350, mount the sensor on a foundation of adequate load-bearing strength.

Caution!
Risk of damage!
Do not support the weight of the sensor at the metal casing. The casing would buckle and damage the internal magnetic coils.

A0003209
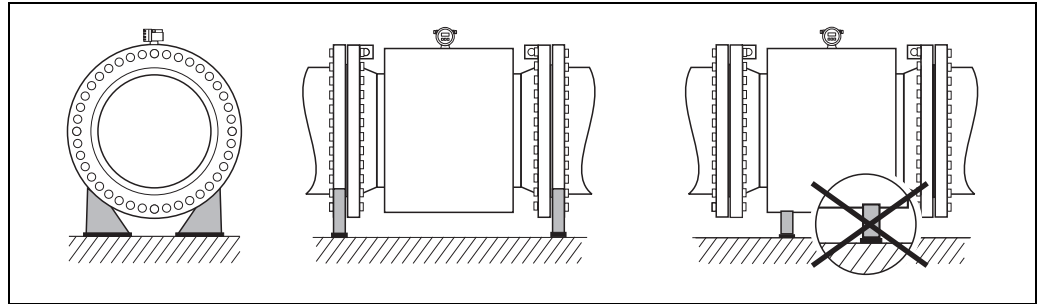
Fig. 14:   Correct support for large nominal diameters (DN ≥ 350)

3.2.6   Adapters

Suitable adapters to DIN EN 545 (double-flange reducers) can be used to install the sensor in larger-diameter pipes.
The resultant increase in the rate of flow improves measuring accuracy with very slow-moving fluids. The nomogram shown here can be used to calculate the pressure loss caused by reducers and expanders.

Note!
The nomogram only applies to liquids of viscosity similar to water.

1.   Calculate the ratio of the diameters d/D.

2.   From the nomogram read off the pressure loss as a function of flow velocity (downstream from the reduction) and the d/D ratio.

A0003213
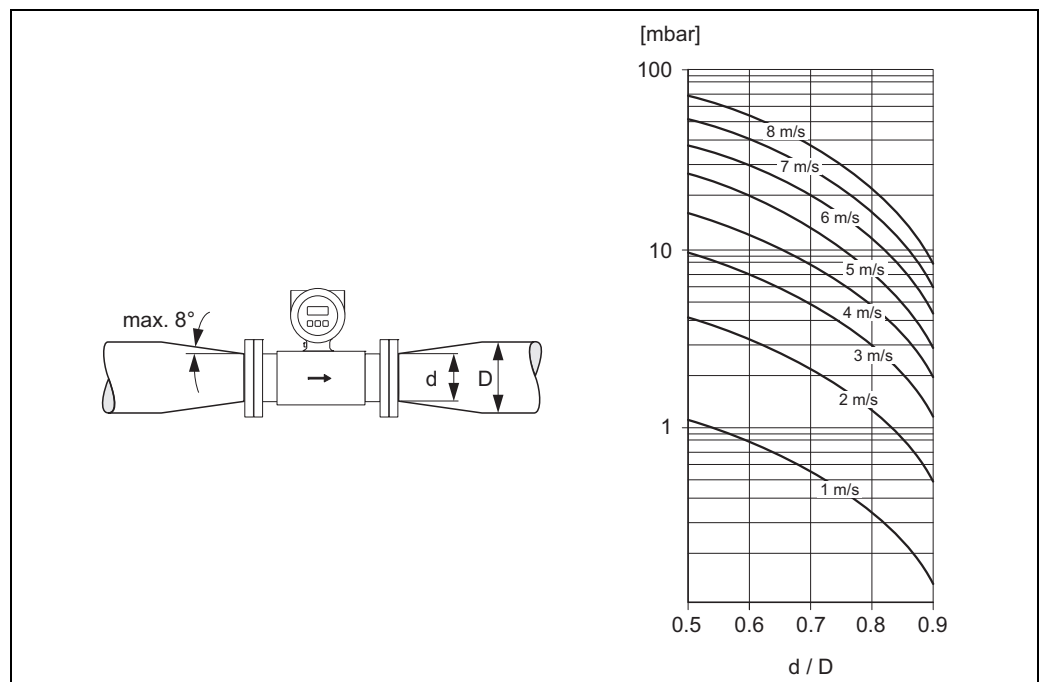
Fig. 15:   Pressure loss due to adapters

3.2.7   Nominal diameter and flow rate

The diameter of the pipe and the flow rate determine the nominal diameter of the sensor. The optimum flow velocity is between 2 and 3 m/s.
The velocity of flow (v), moreover, has to be matched to the physical properties of the fluid:

- v < 2 m/s: for abrasive fluids
- v > 2 m/s: for fluids producing build-up

Note!
Flow velocity can be increased, if necessary, by reducing the nominal diameter of the sensor → Page 16.

SI units	Recommended flow rate		
Diameter	Promag W	Promag P	Promag H
[mm]	Min./max. full scale value (v ≈ 0.3 or 10 m/s)	Min./max. full scale value (v ≈ 0.3 or 10 m/s)	Min./max. full scale value (v ≈ 0.3 or 10 m/s)
2	–	–	0.06 ...1.8 dm³/min
4	–	–	0.25 ...7 dm³/min
8	–	–	1 ...30 dm³/min
15	–	–	4 ...100 dm³/min
25	9...300 dm³/min	9...300 dm³/min	9...300 dm³/min
32	15...500 dm³/min	15...500 dm³/min	25...700 dm³/min
40	25...700 dm³/min	25...700 dm³/min	35...1100 dm³/min
50	35...1100 dm³/min	35...1100 dm³/min	60...2000 dm³/min
65	60...2000 dm³/min	60...2000 dm³/min	90...3000 dm³/min
80	90...3000 dm³/min	90...3000 dm³/min	145...4700 dm³/min
100	145...4700 dm³/min	145...4700 dm³/min	0.06 ...1.8 dm³/min
125	220...7500 dm³/min	220...7500 dm³/min	–
150	20...600 m³/h	20...600 m³/h	–
200	35...1100 m³/h	35...1100 m³/h	–
250	55...1700 m³/h	55...1700 m³/h	–
300	80...2400 m³/h	80...2400 m³/h	–
350	110…3300 m³/h	110…3300 m³/h	–
400	140…4200 m³/h	140…4200 m³/h	–
450	180…5400 m³/h	180…5400 m³/h	–
500	220…6600 m³/h	220…6600 m³/h	–
600	310…9600 m³/h	310…9600 m³/h	–
700	420...13500 m³/h	–	–
–	480...15000 m³/h	–	–
800	550...18000 m³/h	–	–
900	690...22500 m³/h	–	–
1000	850...28000 m³/h	–	–
-	950...30000 m³/h	–	–
1200	1250...40000 m³/h	–	–
–	1550...50000 m³/h	–	–
1400	1700...55000 m³/h	–	–
-	1950...60000 m³/h	–	–
1600	2200...70000 m³/h	–	–
-	2500…80000 m³/h	–	–
1800	2800…90000 m³/h	–	–
-	3300…100000 m³/h	–	–
2000	3400…110000 m³/h		–

US units Diameter [inch]	Recommended flow rate		
	Promag W Min./max. full scale value (v ≈ 0.3 or 10 m/s)	Promag P Min./max. full scale value (v ≈ 0.3 or 10 m/s)	Promag H Min./max. full scale value (v ≈ 0.3 or 10 m/s)
$1\,^{1}/_{12}$"	–	–	0.015 ...0.5 gal/min
$^{5}/_{32}$"	–	–	0.07...2 gal/min
$^{5}/_{16}$"	–	–	0.25...8 gal/min
$^{1}/_{2}$"	–	–	1.0...27 gal/min
1"	2.5...80 gal/min	2.5...80 gal/min	2.5...65 gal/min
$1\,^{1}/_{4}$"	4...130 gal/min	4...130 gal/min	7...190 gal/min
$1\,^{1}/_{2}$"	7...190 gal/min	7...190 gal/min	10...300 gal/min
2"	10...300 gal/min	10...300 gal/min	16...500 gal/min
$2\,^{1}/_{2}$"	16...500 gal/min	16...500 gal/min	24...800 gal/min
3"	24...800 gal/min	24...800 gal/min	40...1250 gal/min
4"	40...1250 gal/min	40...1250 gal/min	0.015 ...0.5 gal/min
5"	60...1950 gal/min	60...1950 gal/min	–
6"	90...2650 gal/min	90...2650 gal/min	–
8"	155...4850 gal/min	155...4850 gal/min	–
10"	250...7500 gal/min	250...7500 gal/min	–
12"	350...10600 gal/min	350...10600 gal/min	–
14"	500...15000 gal/min	500...15000 gal/min	–
16"	600...19000 gal/min	600...19000 gal/min	–
18"	800...24000 gal/min	800...24000 gal/min	–
20"	1000...30000 gal/min	1000...30000 gal/min	–
24"	1400...44000 gal/min	1400...44000 gal/min	–
28"	1900...60000 gal/min	–	–
30"	2150...67000 gal/min	–	–
32"	2450...80000 gal/min	–	–
36"	3100...100000 gal/min	–	–
40"	3800...125000 gal/min	–	–
42"	4200...135000 gal/min	–	–
48"	5500...175000 gal/min	–	–
54"	9...300 Mgal/d	–	–
–	10...340 Mgal/d	–	–
60"	12...380 Mgal/d	–	–
–	13...450 Mgal/d	–	–
66"	14...500 Mgal/d	–	–
72"	16...570 Mgal/d	–	–
78"	18...650 Mgal/d	–	–
–	20...700 Mgal/d	–	–

3.2.8   Length of connecting cable

When mounting the remote version, please note the following to achieve correct measuring results:

- Fix cable run or lay in armoured conduit. Cable movements can falsify the measuring signal especially in the case of low fluid conductivities.

- Route the cable well clear of electrical machines and switching elements.

- If necessary, ensure potential equalisation between sensor and transmitter.

- The permitted length of connecting cable L_{max} is determined by the fluid conductivity ($\rightarrow$ Fig. 16). A minimum conductivity of 50 µS/cm is needed for all fluids.

- When the empty pipe detection function is switched on (EPD $\rightarrow$ Page 58), the maximum connecting cable length is 10 m.
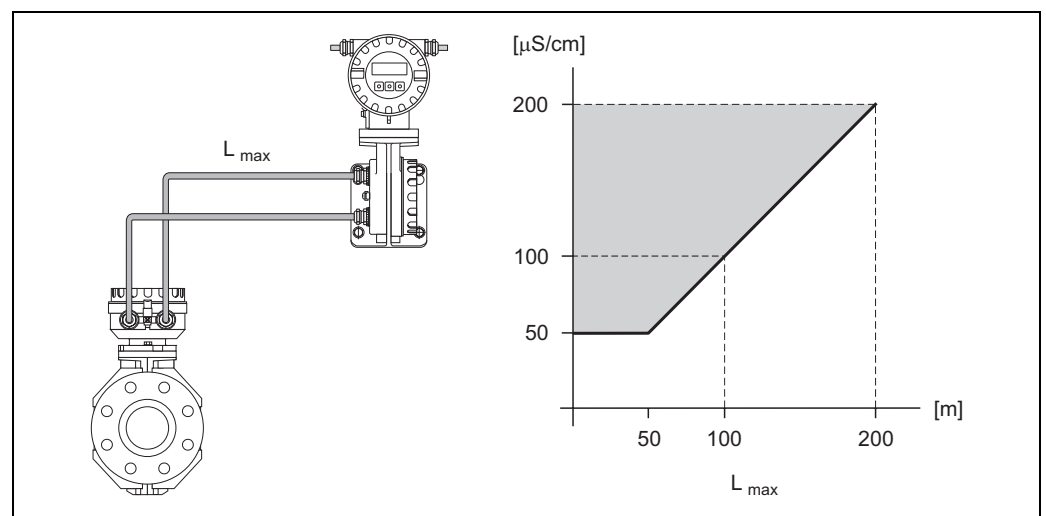
Fig. 16:   Permitted lengths of connecting cable for remote version

Area marked grey = permitted range
Lmax = length of connecting cable in [m]
Fluid conductivity in [µS/cm]

3.3   Installation

3.3.1   Installing Promag W sensor

✎ Note!
Bolts, nuts, seals, etc. are not included in the scope of supply and must be supplied by the customer.

The sensor is designed for installation between the pipe flanges:
■ Please pay particular attention to the torques required on Page 21 ff.
■ You can find a description of how to install additional ground disks on Page 21.

F06-10Fxxxxx-17-05-xx-xx-000
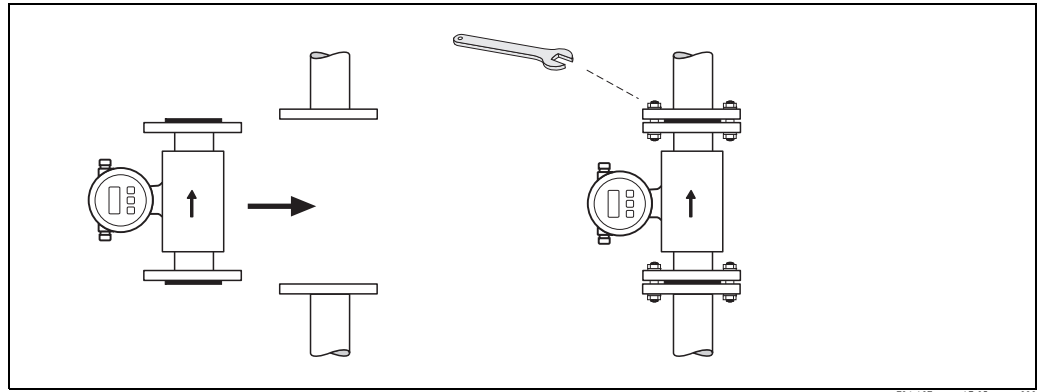
Fig. 17:   Mounting Promag W sensor

Seals

Comply with the following instructions when mounting seals:
■ Hard rubber lining → Additional seals are **always** required!
■ Polyurethane lining → Additional seals are recommended.
■ For DIN flanges, use only seals acc. to EN 1514-1.
■ Make sure that the seals do not protrude into the piping cross-section.

🖐 Caution!
Risk of short-circuit! Do not use electrically conductive sealing compound such as graphite. An electrically conductive layer can build up inside the measuring tube and short-circuit the measuring signal.

Ground cable (25...2000)

■ If necessary, special ground cables can be ordered as accessories for potential equalisation
  → Page 60.
■ Information on potential equalisation and detailed mounting instructions for using ground cables can be found on Page 40 ff.

Mounting ground disks (DN 25...300)

Ground disks must also be mounted between the sensor and the pipe flange for potential equalisation under certain application conditions, e.g. in the case of lined or ungrounded piping (→ Page 40). Ground disks can be ordered as separate accessories from Endress+Hauser (→ Page 60).

Caution!
- The length increases when ground disks (incl. seals) are used!
  Information on the dimensions are provided in the related Technical Information on Promag 10 W (TI093D/06/en).
- Hard rubber lining: additional seals must be mounted between the sensor and ground disk as well as between the ground disk and the pipe flange.
- Polyurethane lining → Additional seals must be mounted between the ground disk and the pipe flange.

1.   Locate the ground disk and the additional seal(s) between the device flange and pipe flange (→ Fig. 18).

2.   Push the screws through the flange bores. Then tighten the nuts so that they sit loosely.

3.   Now turn the ground disk as shown in the graphic until the grip is in contact with the screws. This automatically centres the ground disk correctly.

4.   Tighten the screws with the necessary torques → Page 21.

5.   Now connect the ground disk to the ground potential → Page 42.

F06-10Fxxxxx-17-05-xx-xx-001
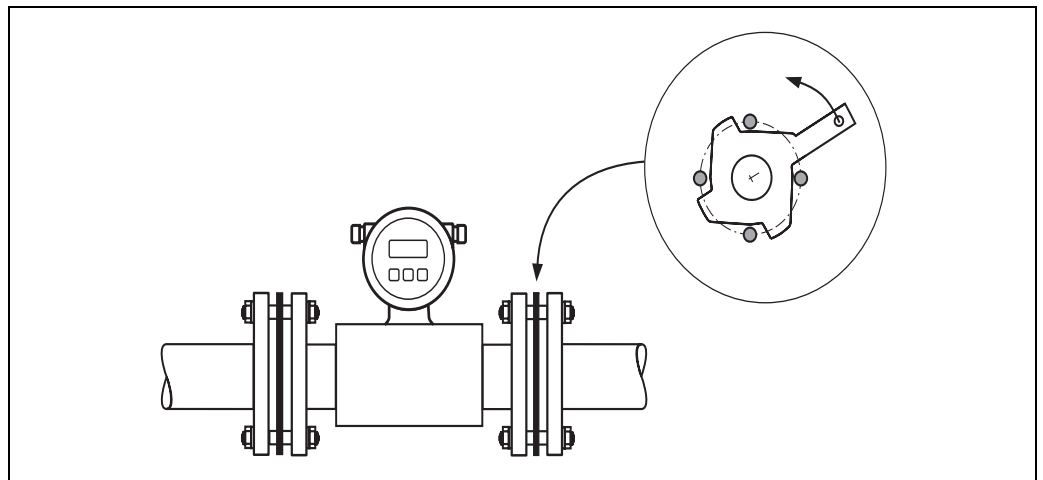
Fig. 18:   Mounting ground disks (Promag W, DN 25...300)

Torques (Promag W)

Note the following points:
- The torques listed below are for lubricated threads only.
- Always tighten screws uniformly and in diagonally opposite sequence.
- Overtightening the screws will deform the sealing faces or damage the seals.
- The tightening torques listed below apply only to pipes not subjected to tensile stress.

Tightening torques for:
- EN (DIN) → Page 22
- ANSI → Page 23
- JIS → Page 23
- AWWA → Page 24
- AS 2129 → Page 24
- AS 4087 → Page 25

Tightening torques for Promag W for EN (DIN)

Diameter [mm]	EN (DIN) Pressure rating [bar]	Screws	Max. tightening torque [Nm]	
			Hard rubber	Polyurethane
25	PN 40	4 x M 12	–	15
32	PN 40	4 x M 16	–	24
40	PN 40	4 x M 16	–	31
50	PN 40	4 x M 16	–	40
65 *	PN 16	8 x M 16	32	27
65	PN 40	8 x M 16	32	27
80	PN 16	8 x M 16	40	34
80	PN 40	8 x M 16	40	34
100	PN 16	8 x M 16	43	36
100	PN 40	8 x M 20	59	50
125	PN 16	8 x M 16	56	48
125	PN 40	8 x M 24	83	71
150	PN 16	8 x M 20	74	63
150	PN 40	8 x M 24	104	88
200	PN 10	8 x M 20	106	91
200	PN 16	12 x M 20	70	61
200	PN 25	12 x M 24	104	92
250	PN 10	12 x M 20	82	71
250	PN 16	12 x M 24	98	85
250	PN 25	12 x M 27	150	134
300	PN 10	12 x M 20	94	81
300	PN 16	12 x M 24	134	118
300	PN 25	16 x M 27	153	138
350	PN 10	16 x M 20	112	118
350	PN 16	16 x M 24	152	165
350	PN 25	16 x M 30	227	252
400	PN 10	16 x M 24	151	167
400	PN 16	16 x M 27	193	215
400	PN 25	16 x M 33	289	326
450	PN 10	20 x M 24	153	133
450	PN 16	20 x M 27	198	196
450	PN 25	20 x M 33	256	253
500	PN 10	20 x M 24	155	171
500	PN 16	20 x M 30	275	300
500	PN 25	20 x M 33	317	360
600	PN 10	20 x M 27	206	219
600 *	PN 16	20 x M 33	415	443
600	PN 25	20 x M 36	431	516
700	PN 10	24 x M 27	246	246
700	PN 16	24 x M 33	278	318
700	PN 25	24 x M 39	449	507
800	PN 10	24 x M 30	331	316
800	PN 16	24 x M 36	369	385
800	PN 25	24 x M 45	664	721
900	PN 10	28 x M 30	316	307
900	PN 16	28 x M 36	353	398
900	PN 25	28 x M 45	690	716
1000	PN 10	28 x M 33	402	405
1000	PN 16	28 x M 39	502	518
1000	PN 25	28 x M 52	970	971
1200	PN 6	32 x M 30	319	299
1200	PN 10	32 x M 36	564	568

Diameter	EN (DIN)		Max. tightening torque [Nm]	
[mm]	Pressure rating [bar]	Screws	Hard rubber	Polyurethane
1200	PN 16	32 x M 45	701	753
1400	PN 6	36 x M 33	430	398
1400	PN 10	36 x M 39	654	618
1400	PN 16	36 x M 45	729	762
1600	PN 6	40 x M 33	440	417
1600	PN 10	40 x M 45	946	893
1600	PN 16	40 x M 52	1007	1100
1800	PN 6	44 x M 36	547	521
1800	PN 10	44 x M 45	961	895
1800	PN 16	44 x M 52	1108	1003
2000	PN 6	48 x M 39	629	605
2000	PN 10	48 x M 45	1047	1092
2000	PN 16	48 x M 56	1324	1261
* Designed acc. to EN 1092-1 (not to DIN 2501)				

Tightening torques for Promag W for ANSI

Diameter		ANSI		Max. tightening torque [Nm]	
[mm]	[inch]	Pressure rating [lbs]	Screws	Hard rubber	Polyurethane
25	1"	Class 150	4 x 1/2"	–	7
25	1"	Class 300	4 x 5/8"	–	8
40	1 1/2"	Class 150	4 x 1/2"	–	10
40	1 1/2"	Class 300	4 x 3/4"	–	15
50	2"	Class 150	4 x 5/8"	–	22
50	2"	Class 300	8 x 5/8"	–	11
80	3"	Class 150	4 x 5/8"	60	43
80	3"	Class 300	8 x 3/4"	38	26
100	4"	Class 150	8 x 5/8"	42	31
100	4"	Class 300	8 x 3/4"	58	40
150	6"	Class 150	8 x 3/4"	79	59
150	6"	Class 300	12 x 3/4"	70	51
200	8"	Class 150	8 x 3/4"	107	80
250	10"	Class 150	12 x 7/8"	101	75
300	12"	Class 150	12 x 7/8"	133	103
350	14"	Class 150	12 x 1"	135	158
400	16"	Class 150	16 x 1"	128	150
450	18"	Class 150	16 x 1 1/8"	204	234
500	20"	Class 150	20 x 1 1/8"	183	217
600	24"	Class 150	20 x 1 1/4"	268	307

Tightening torques for Promag W for JIS

Diameter	JIS		Max. tightening torque [Nm]	
[mm]	Pressure rating	Screws	Hard rubber	Polyurethane
25	10K	4 x M 16	–	19
25	20K	4 x M 16	–	19
32	10K	4 x M 16	–	22
32	20K	4 x M 16	–	22
40	10K	4 x M 16	–	24
40	20K	4 x M 16	–	24
50	10K	4 x M 16	–	33
50	20K	8 x M 16	–	17
65	10K	4 x M 16	55	45

Diameter	JIS		Max. tightening torque [Nm]	
[mm]	Pressure rating	Screws	Hard rubber	Polyurethane
65	20K	8 x M 16	28	23
80	10K	8 x M 16	29	23
80	20K	8 x M 20	42	35
100	10K	8 x M 16	35	29
100	20K	8 x M 20	56	48
125	10K	8 x M 20	60	51
125	20K	8 x M 22	91	79
150	10K	8 x M 20	75	63
150	20K	12 x M 22	81	72
200	10K	12 x M 20	61	52
200	20K	12 x M 22	91	80
250	10K	12 x M 22	100	87
250	20K	12 x M 24	159	144
300	10K	16 x M 22	74	63
300	20K	16 x M 24	138	124

Tightening torques for Promag W for AWWA

Diameter		AWWA		Max. tightening torque [Nm]	
[mm]	[inch]	Pressure rating	Screws	Hard rubber	Polyurethane
700	28"	Class D	28 x 1 1/4"	247	292
750	30"	Class D	28 x 1 1/4	287	302
800	32"	Class D	28 x 1 1/2"	394	422
900	36"	Class D	32 x 1 1/2"	419	430
1000	40"	Class D	36 x 1 1/2"	420	477
1050	42"	Class D	36 x 1 1/2"	528	518
1200	48"	Class D	44 x 1 1/2"	552	531
1350	54"	Class D	44 x 1 3/4"	730	633
1500	60"	Class D	52 x 1 3/4"	758	832
1650	66"	Class D	52 x 1 3/4"	946	955
1800	72"	Class D	60 x 1 3/4"	975	1087
2000	78"	Class D	64 x 2"	853	786

Tightening torques for Promag W for AS 2129

Diameter [mm]	AS 2129 Pressure rating	Screws	Max. tightening torque [Nm] Hard rubber
80	Table E	4 x M 16	49
100	Table E	8 x M 16	38
150	Table E	8 x M 20	64
200	Table E	8 x M 20	96
250	Table E	12 x M 20	98
300	Table E	12 x M 24	123
350	Table E	12 x M 24	203
400	Table E	12 x M 24	226
500	Table E	16 x M 24	271
600	Table E	16 x M 30	439

Tightening torques for Promag W for AS 4087

Diameter [mm]	AS 4087 Pressure rating	Screws	Max. tightening torque [Nm] Hard rubber
80	Cl.14	4 x M 16	49
100 *	Cl.14	8 x M 16	38
150	Cl.14	8 x M 20	52
200	Cl.14	8 x M 20	77
250	Cl.14	8 x M 20	147
300	Cl.14	12 x M 24	103
350	Cl.14	12 x M 24	203
400	Cl.14	12 x M 24	226
500	Cl.14	16 x M 24	271
600	Cl.14	16 x M 27	393
* Designed acc. to AS 2129 (not to AS 4087)			

3.3.2   Installing Promag P sensor

Caution!
- The protective covers mounted on the two sensor flanges guard the PTFE lining which is turned over the flanges. Consequently, do not remove these covers until immediately before the sensor is installed in the pipe.
- The protective covers must always be mounted during storage.
- Ensure that the lining on the flange is not damaged or removed.

Note!
Bolts, nuts, seals, etc. are not included in the scope of supply and must be supplied by the customer.

The sensor is designed for installation between the pipe flanges:
- Please pay particular attention to the torques required on Page 26 ff.
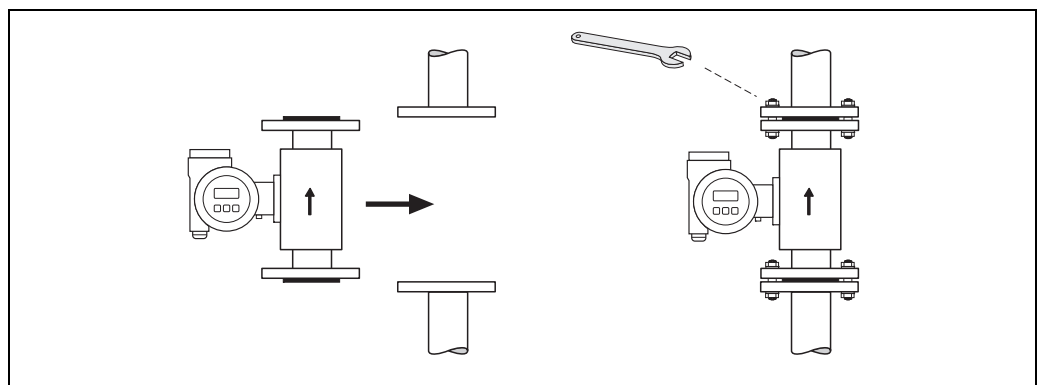- You can find a description of how to install additional ground disks on Page 26.

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Fig. 19:   Mounting Promag P sensor

Seals

Comply with the following instructions when mounting seals:
- PTFE lining → **No** seals are required!
- For DIN flanges, use only seals acc. to EN 1514–1.
- Make sure that the seals do not protrude into the piping cross-section.

Caution!
Risk of short–circuit! Do not use electrically conductive sealing compound such as graphite. An electrically conductive layer can build up inside the measuring tube and short–circuit the measuring signal.

Ground cable (DN 25...600)

- If necessary, special ground cables can be ordered as accessories for potential equalisation → Page 60.
- Information on potential equalisation and detailed mounting instructions for using ground cables can be found on Page 40 ff.
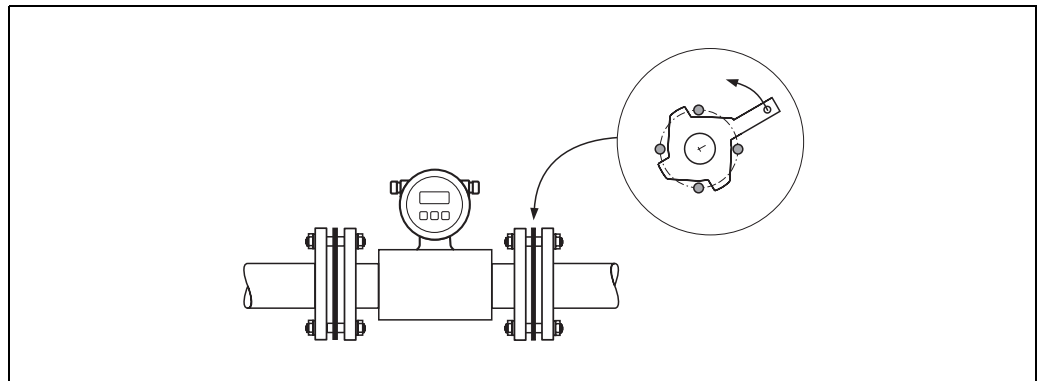
Mounting ground disks (DN 25...300)

Ground disks must also be mounted between the sensor and the pipe flange for potential equalisation under certain application conditions, e.g. in the case of lined or ungrounded piping (→ Page 40). Ground disks can be ordered as separate accessories from Endress+Hauser (→ Page 60).

Caution!
- The length increases when ground disks (incl. seals) are used! Information on the dimensions are provided in the related Technical Information on Promag 10 P (TI094D/06/en).
- PTFE and PFA lining → Only install additional seals between the ground disk and pipe flange.

1. Locate the ground disk and the additional seal(s) between the device flange and pipe flange (→ Fig. 19).

2. Push the screws through the flange bores. Then tighten the nuts so that they sit loosely.

3. Now turn the ground disk as shown in the graphic until the grip is in contact with the screws. This automatically centres the ground disk correctly.

4. Tighten the screws with the necessary torques → Page 26.

5. Now connect the ground disk to the ground potential → Page 42.

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Fig. 20:   Mounting ground disks (Promag P, DN 25...300)

Torques (Promag P)

Note the following points:
- The torques listed below are for lubricated threads only.
- Always tighten screws uniformly and in diagonally opposite sequence.
- Overtightening the screws will deform the sealing faces or damage the seals.
- The tightening torques listed below apply only to pipes not subjected to tensile stress.

Tightening torques for:
- EN (DIN) → Page 27
- AS 2129 → Page 27
- AS 4087 → Page 27 ff.
- ANSI → Page 28 ff.
- JIS → Page 28

Tightening torques for Promag P for EN (DIN)

Diameter [mm]	EN (DIN) Nominal pressure [bar]	Screws	Max. tightening torque [Nm] PTFE
25	PN 40	4 x M 12	26
32	PN 40	4 x M 16	41
40	PN 40	4 x M 16	52
50	PN 40	4 x M 16	65
65 *	PN 16	8 x M 16	43
65	PN 40	8 x M 16	43
80	PN 16	8 x M 16	53
80	PN 40	8 x M 16	53
100	PN 16	8 x M 16	57
100	PN 40	8 x M 20	78
125	PN 16	8 x M 16	75
125	PN 40	8 x M 24	111
150	PN 16	8 x M 20	99
150	PN 40	8 x M 24	136
200	PN 10	8 x M 20	141
200	PN 16	12 x M 20	94
200	PN 25	12 x M 24	138
250	PN 10	12 x M 20	110
250	PN 16	12 x M 24	131
250	PN 25	12 x M 27	200
300	PN 10	12 x M 20	125
300	PN 16	12 x M 24	179
300	PN 25	16 x M 27	204
350	PN 10	16 x M 20	188
350	PN 16	16 x M 24	254
350	PN 25	16 x M 30	380
400	PN 10	16 x M 24	260
400	PN 16	16 x M 27	330
400	PN 25	16 x M 33	488
450	PN 10	20 x M 24	235
450	PN 16	20 x M 27	300
450	PN 25	20 x M 33	385
500	PN 10	20 x M 24	265
500	PN 16	20 x M 30	448
500	PN 25	20 x M 33	533
600	PN 10	20 x M 27	345
600 *	PN 16	20 x M 33	658
600	PN 25	20 x M 36	731
* Designed acc. to EN 1092-1 (not to DIN 2501)			

Tightening torques for Promag P for AS 2129

Diameter [mm]	AS 2129 Pressure rating	Screws	Max. tightening torque [Nm] PTFE
25	Table E	4 x M 12	21
50	Table E	4 x M 16	42

Tightening torques for Promag P for AS 4087

Diameter [mm]	AS 4087 Pressure rating	Screws	Max. tightening torque [Nm] PTFE
50	Cl.14	4 x M 16	42

Tightening torques for Promag P for ANSI

Diameter		ANSI Pressure rating	Screws	Max. tightening torque [Nm]
[mm]	[inch]	[lbs]		PTFE
25	1"	Class 150	4 x 1/2"	11
25	1"	Class 300	4 x 5/8"	14
40	1 1/2"	Class 150	4 x 1/2"	24
40	1 1/2"	Class 300	4 x 3/4"	34
50	2"	Class 150	4 x 5/8"	47
50	2"	Class 300	8 x 5/8"	23
80	3"	Class 150	4 x 5/8"	79
80	3"	Class 300	8 x 3/4"	47
100	4"	Class 150	8 x 5/8"	56
100	4"	Class 300	8 x 3/4"	67
150	6"	Class 150	8 x 3/4"	106
150	6"	Class 300	12 x 3/4"	73
200	8"	Class 150	8 x 3/4"	143
250	10"	Class 150	12 x 7/8"	135
300	12"	Class 150	12 x 7/8"	178
350	14"	Class 150	12 x 1"	260
400	16"	Class 150	16 x 1"	246
450	18"	Class 150	16 x 1 1/8"	371
500	20"	Class 150	20 x 1 1/8"	341
600	24"	Class 150	20 x 1 1/4"	477

Tightening torques for Promag P for JIS

Diameter [mm]	JIS Pressure rating	Screws	Max. tightening torque [Nm] PTFE
25	10K	4 x M 16	32
25	20K	4 x M 16	32
32	10K	4 x M 16	38
32	20K	4 x M 16	38
40	10K	4 x M 16	41
40	20K	4 x M 16	41
50	10K	4 x M 16	54
50	20K	8 x M 16	27
65	10K	4 x M 16	74
65	20K	8 x M 16	37
80	10K	8 x M 16	38
80	20K	8 x M 20	57
100	10K	8 x M 16	47
100	20K	8 x M 20	75
125	10K	8 x M 20	80
125	20K	8 x M 22	121
150	10K	8 x M 20	99
150	20K	12 x M 22	108
200	10K	12 x M 20	82
200	20K	12 x M 22	121
250	10K	12 x M 22	133
250	20K	12 x M 24	212
300	10K	16 x M 22	99
300	20K	16 x M 24	183

3.3.3   Installing Promag H sensor

Depending on the order specifications, the sensor is supplied with or without mounted process connections. Mounted process connections are fixed to the sensor with 4 hexagonal-headed bolts.

Caution!
Depending on the application and piping length, the sensor may have to be supported or additionally secured. The measured value sensor has to be secured if using plastic process connections. An appropriate wall mounting kit can be ordered separately as an accessory from Endress+Hauser (→ Page 60).

F06-xxHxxxxx-17-05-xx-xx-000
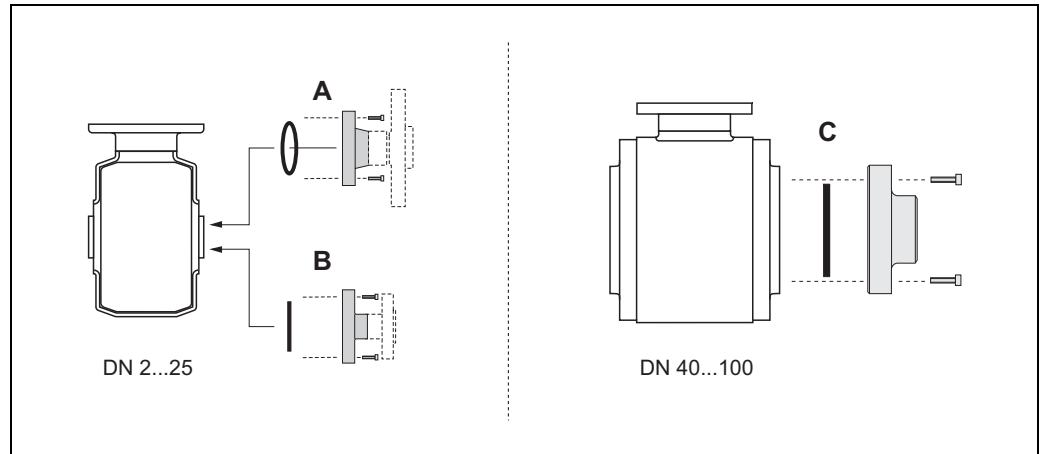
Fig. 21:   Promag H process connections (DN 2...25 / DN 40...100)

A = DN 2...25 / process connections with O-ring
– Flanges (EN (DIN), ANSI, JIS),
– External thread

B = DN 2...25 / process connections with aseptic moulded seal
– Weld sockets (DIN 11850, ODT/SMS)
– Tri-Clamp L14AM7
– Threaded joint (DIN 11851, DIN 11864-1, SMS 1145 (only DN 25)
– Flange DIN 11864-2

C = DN 40...100 / process connections with aseptic moulded seal
– Weld sockets (DIN 11850, ODT/SMS)
– Tri-Clamp L14AM7
– Threaded joint (DIN 11851, DIN 11864-1, SMS 1145)
– Flange DIN 11864-2

Seals

When mounting the process connections, make sure that the seals in question are clean and correctly centred.

Caution!
- Tighten the screws firmly. The process connection forms a metallic connection with the sensor which ensures a defined compression of the seal.
- Depending on the application, the seals should be replaced periodically, especially if moulded seals are used (aseptic version)!
  The period between changes depends on the frequency of cleaning cycles, the cleaning temperature and the fluid temperature.
  Replacement seals can be ordered as accessories → Page 60.

Cleaning with pigs

If pigs are used for cleaning, it is essential to take the internal diameters of the measuring tube and process connection into account. All the dimensions and lengths of the sensor and transmitter are provided in the separate "Technical Information" documentation → Page 83.

Welding the transmitter into the piping (weld sockets)

Caution!
Danger of destroying the meter electronics! Make sure that the welding system is not grounded through the sensor or transmitter.

1. Secure the sensor in the piping with a few weld points. A suitable welding aid can be ordered separately as an accessory → Page 60.

2. Loosen the screws at the process connection flange and remove the sensor incl. the seal from the piping.

3. Weld the process connection into the piping.

4. Remount the sensor in the piping. When doing so, ensure the seal is clean and in the right position.

Note!
- If thin-walled food pipes are welded correctly, the heat does not damage the seal when mounted. However, we recommend you disassemble the sensor and seal.
- It must be possible to open the pipe approximately 8 mm to permit disassembly.

3.3.4 Rotating the transmitter housing

1. Loosen the two securing screws.

2. Turn the bayonet lock 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. 280° clockwise or max. 20° counter-clockwise).

5. Put the housing back in position and engage the bayonet lock again.

6. Tighten the two fixing screws again.
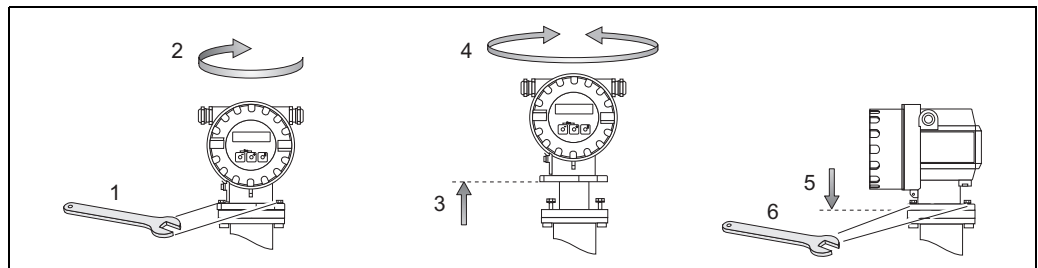
F06-10xxxxxx-17-06-xx-xx-000

Fig. 22:   Rotating the transmitter housing

3.3.5 Affixing the local display to the blind version

A local display can be temporarily affixed to devices which do not have a local display.

1. Switch off power supply.

2. Remove the cover of the electronics compartment.

3. Affix local display.

4. Switch on power supply.

3.3.6 Rotating the local display

1. Unscrew cover of the electronics compartment from the transmitter housing.

2. Remove the display module from the transmitter retainer rails.

3. Turn the display to the desired position (max. 4 x 45° in each direction).

4. Place the display back on the retaining rails.

5. Screw the cover of the electronics compartment firmly back onto the transmitter housing.
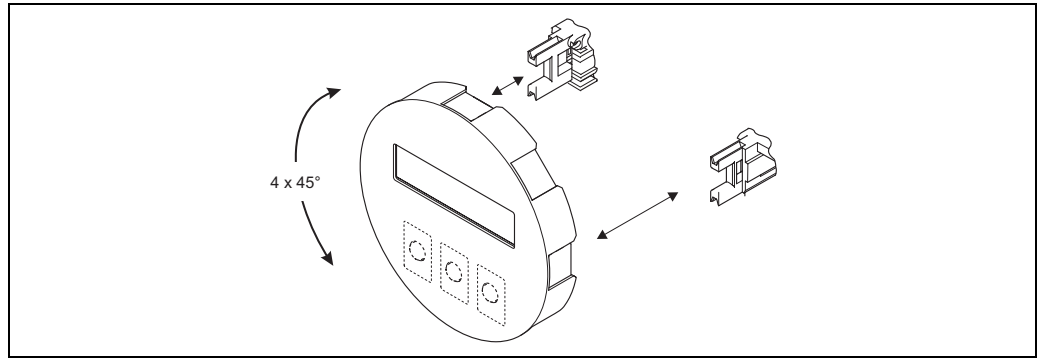

A0001892

Fig. 23:   Rotating the local display

3.3.7 Mounting the transmitter (remote version)

The transmitter can be mounted in the following ways:
- Wall mounting
- Pipe mounting (with separate mounting kit, accessories → Page 60)

The transmitter and the sensor must be mounted separate in the following circumstances:
- Poor accessibility
- Lack of space
- Extreme fluid/ambient temperatures (temperature ranges → Page 76)
- Severe vibration (> 2 g/2 h per day; 10...100 Hz)

Caution!
- The ambient temperature range (–20...+60°C) may not be exceeded at the mounting location. Avoid direct sunlight.
- If the device is mounted to a warm pipe, make certain that the housing temperature does not exceed +60 °C, which is the maximum permissible temperature.

Mount the transmitter as illustrated in Fig. 24.

A0003216
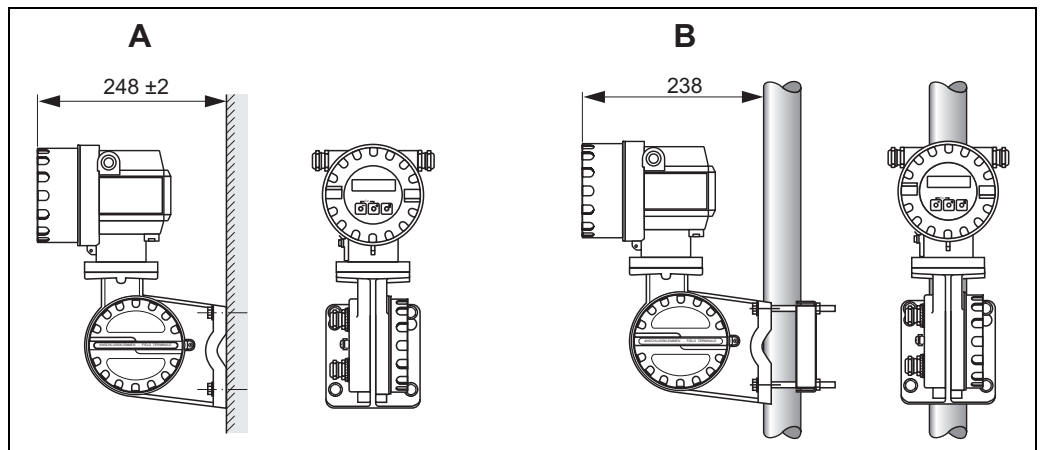
Fig. 24:   Mounting the transmitter (remote version)

A   Direct wall mounting
B   Pipe mounting

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, min. fluid conductivity, measuring range, etc.?	→ Page 76 ff.
Installation	**Notes**
Does the arrow on the sensor nameplate match the direction of flow through the pipe?	–
Is the position of the measuring electrode axis correct?	Horizontal
Is the position of the empty pipe detection electrode correct?	→ Page 14
Were all screws tightened to the specified torques when the sensor was installed?	Promag W → Page 21 Promag P → Page 26
Were the correct seals installed (type, material, installation)?	Promag W → Page 20 Promag P → Page 25 Promag H → Page 29
Are the measuring point number and labelling correct (visual inspection)?	–
Process environment / process conditions	**Notes**
Are the inlet and outlet runs respected?	Inlet run ≥ 5 x DN Outlet run ≥ 2 x DN
Is the measuring device protected against moisture and direct sunlight?	–
Is the sensor adequately protected against vibration (fixture, support)?	Acceleration up to 2 g following IEC 600 68-2-8

4   Wiring

⚠ Warning!
When using remote versions, only sensors and transmitters with the same serial number can be connected up. Measuring errors can occur if the devices are not connected in this way.

4.1   Connecting the remote version

4.1.1   Connecting Promag W/P/H

⚠ 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 connection on the housing before the power supply is applied.

Procedure (see Fig. 25 or Fig. 26):

1. Transmitter:
    Loosen the securing clamp and remove the cover from the connection compartment (a).

2. Sensor:
    Remove the cover from the connection housing (b).

3. Feed the signal cable (c) and the coil current cable (d) through the appropriate cable entries.

    ☝ Caution!
    – Lay the connecting cables securely (see "Length of connecting cable" → Page 19).
    – Danger of destroying the coil control!
      Only connect or detach the coil cable when the power supply is switched off.

4. Terminate the signal cable and coil current cable:
    Promag W, P → Refer to the "Cable termination" table → Page 35
    Promag H → Refer to the "Cable termination" table → Page 36

5. Establish the wiring between the sensor and transmitter as per the electric wiring diagram:
    – Promag W and P → Fig. 25
    – Promag H → Fig. 26

    ✎ Note!
    The cable shields of the Promag H sensor is grounded via the strain-relief terminals (see also the "Cable termination" table → Page 36)

    – wiring diagram inside the cover

    ☝ Caution!
    Insulate the shields of cables that are not connected to eliminate the risk of short-circuits with neighbouring cable shields inside the connection housing.

6. Transmitter:
    Secure the cover to the connection compartment (a) and tighten the socket head cap screw of the securing clamp.

7. Sensor:
    Mount the cover on the connection housing (b).
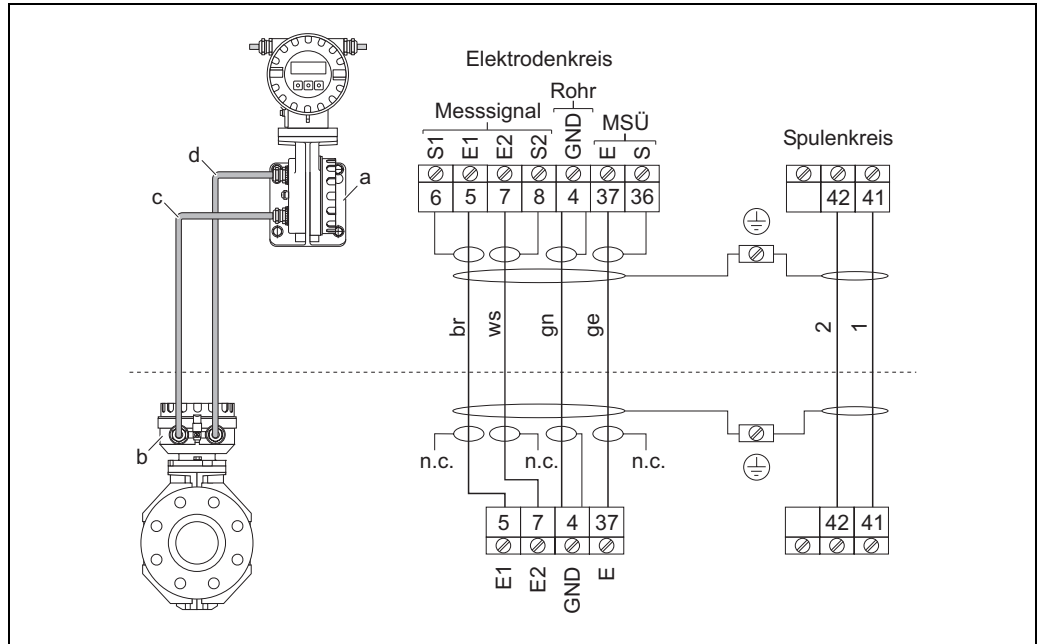
Fig. 25:   Connecting the remote version Promag W/P

a   Wall-mount housing connection compartment
b   Sensor connection housing cover
c   Signal cable
d   Coil current cable
n.c.   Not connected, insulated cable shields
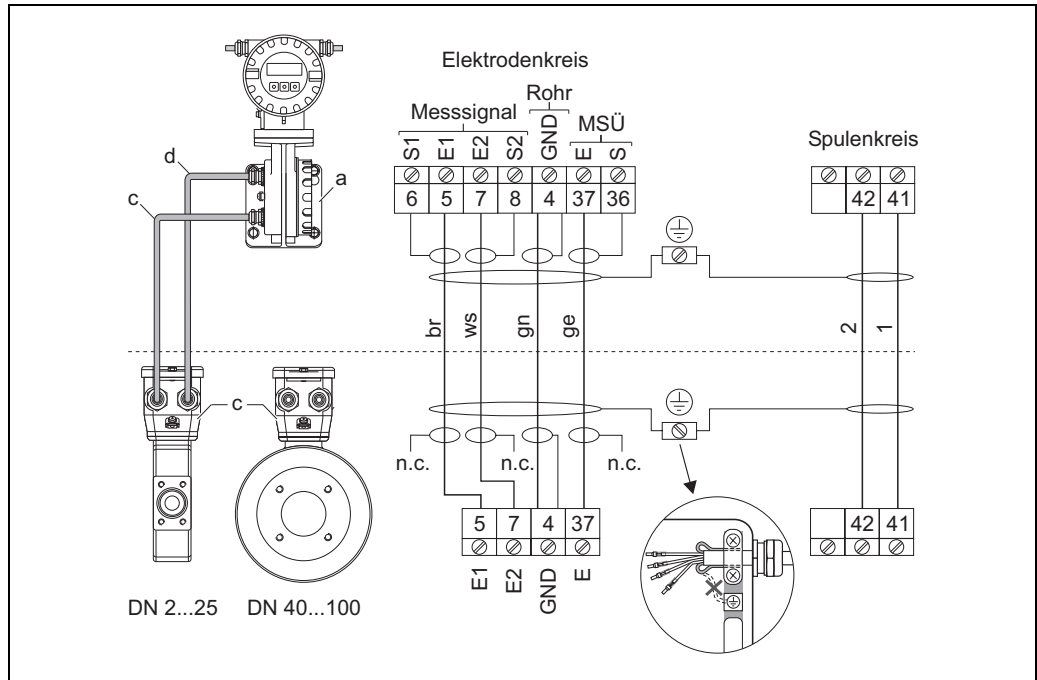
Fig. 26:   Connecting the remote version Promag H

a   Wall-mount housing connection compartment
b   Sensor connection housing cover
c   Signal cable
d   Coil current cable
n.c.   Not connected, insulated cable shields

Cable termination for remote version
Promag W / Promag P

Terminate the signal and coil current cables as shown in the illustrations below (Detail A).
Provide the fine-wire cores with wire end ferrules (Detail B: ① = red wire end ferrules, ∅ 1.0 mm; ② = white wire end ferrules, ∅ 0.5 mm).

☞   Caution!
Comply with the following instructions when terminating:
- Signal cable → Make sure that the wire end ferrules do not touch the core shields on the sensor side!
  Minimum distance = 1 mm (except "GND" = green cable)
- Coil current cable → Isolate one core of the three-core cable at the level of the core reinforcement; you only require two cores for the connection.
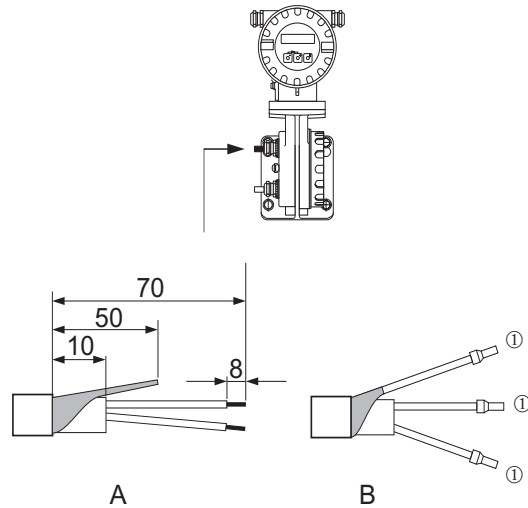
TRANSMITTER

Signal cable	Coil current cable
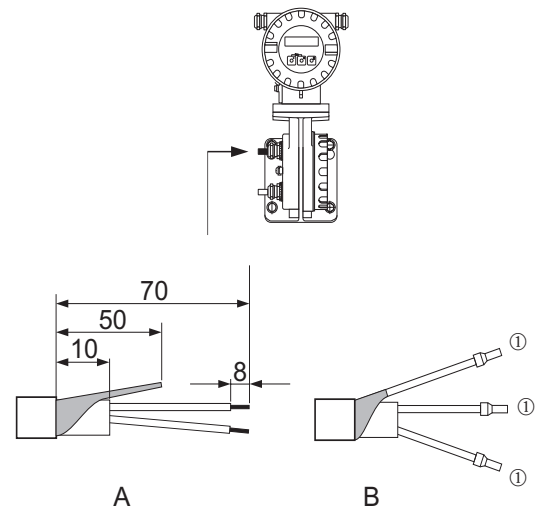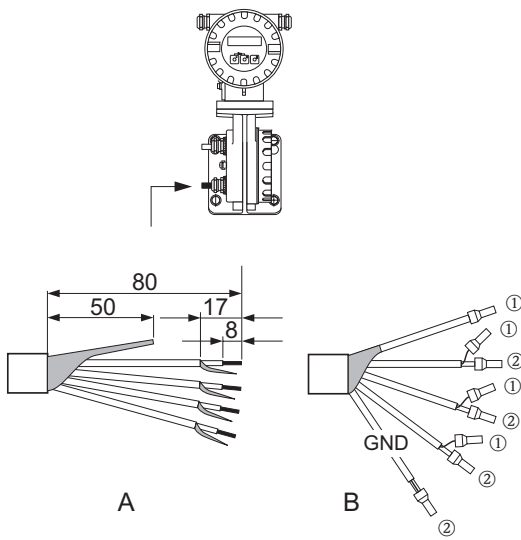
F06-10xxxxxx-04-11-08-de-000   F06-10xxxxxx-04-11-08-xx-000

SENSOR

Signal cable	Coil current cable
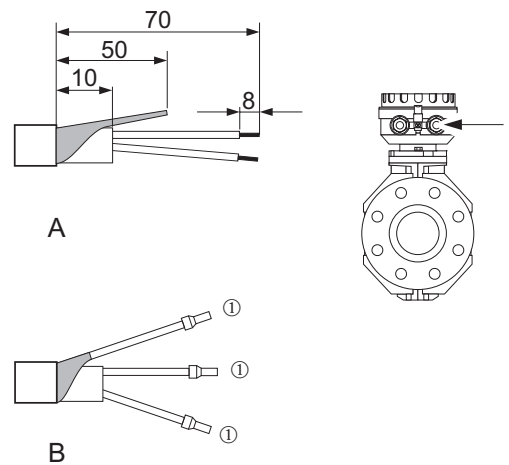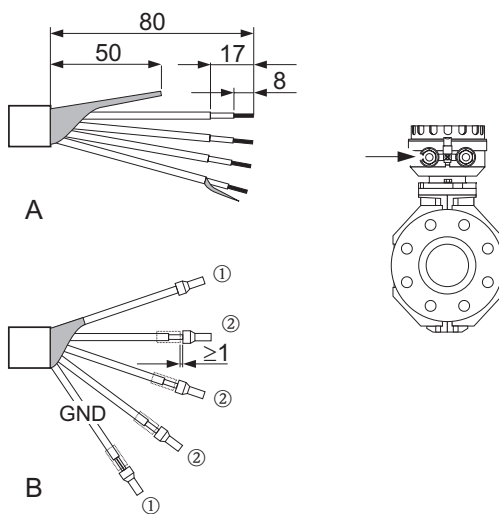
A0003241   A0003240

Cable termination for remote version
Promag H

Terminate the signal and coil current cables as shown in the illustrations below (Detail A).
Provide the fine-wire cores with wire end ferrules (Detail B: ① = red wire end ferrules, ∅ 1.0 mm; ② = white wire end ferrules, ∅ 0.5 mm).

⚠ Caution!
Comply with the following instructions when terminating:
- Signal cable → Make sure that the wire end ferrules do not touch the core shields on the sensor side!
  Minimum distance = 1 mm (except "GND" = green cable).
- Coil current cable → Isolate one core of the three-core cable at the level of the core reinforcement; you only require two cores for the connection.
- On the sensor side, reverse both cable shields approx. 15 mm over the outer jacket. The strain relief ensures an electrical connection with the connection housing.

TRANSMITTER

Signal cable	Coil current cable
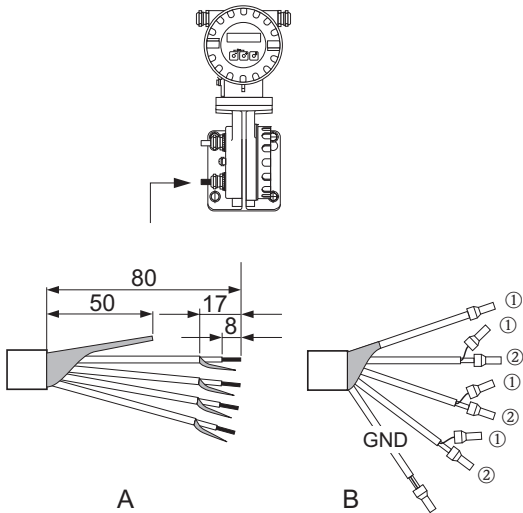
F06-10xxxxxx-04-11-08-de-000

F06-10xxxxxx-04-11-08-xx-000

SENSOR

Signal cable	Coil current cable
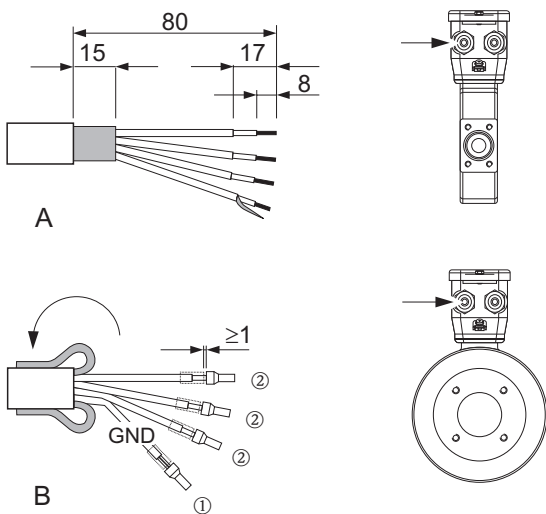
A0002647
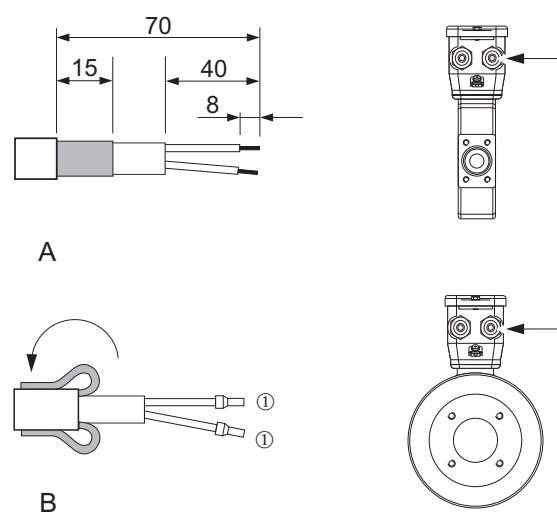
A0002647

4.1.2   Cable specifications

Coil cable
- 2 x 0.75 mm^2 PVC cable with common, braided copper shield ($\varnothing \sim 7$ mm)
- Conductor resistance: ≤ 37 Ω/km
- Capacitance core/core, shield grounded: ≤ 120 pF/m
- Operating temperature: $-20...+80$ °C
- Cable cross-section: max. 2.5 mm^2

Signal cable:
- 3 x 0.38 mm^2 PVC cable with common, braided copper shield ($\varnothing \sim 7$ mm) and individual shielded cores
- With empty pipe detection (EPD): 4 x 0.38 mm^2 PVC cable with common, braided copper shield ($\varnothing \sim 7$ mm) and individual shielded cores
- Conductor resistance: ≤ 50 Ω/km
- Capacitance core/shield: ≤ 420 pF/m
- Operating temperature: $-20...+80$ °C
- Cable cross-section: max. 2.5 mm^2

F06-5xWxxxxx-04-11-08-xx-003
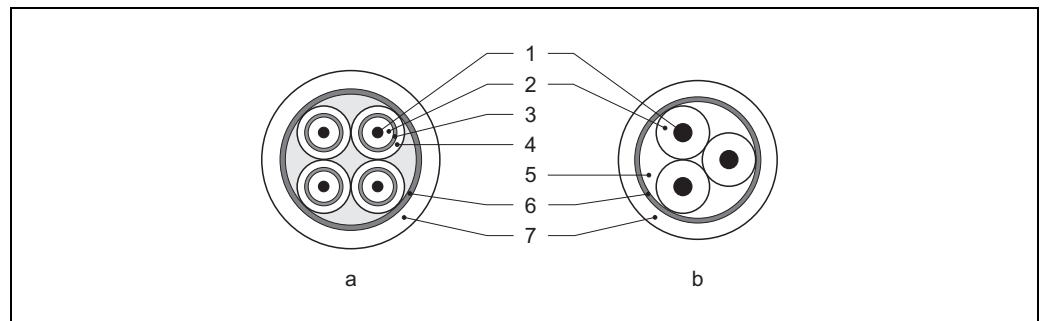
Fig. 27:   Cable cross-section

a   Signal cable
b   Coil current cable

1   Core
2   Core insulation
3   Core shield
4   Core jacket
5   Core reinforcement
6   Cable shield
7   Outer jacket

Operation in zones of severe electrical interference:
The measuring device complies with the general safety requirements in accordance with EN 61010 and the EMC requirements of EN 61326/A1 (IEC 1326).

Caution!
Grounding is by means of the ground terminals provided for the purpose inside the connection housing. Ensure that the stripped and twisted lengths of cable shield to the ground terminal are as short as possible.

4.2   Connecting the measuring unit

4.2.1   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 connection on the housing before the power supply is applied.
- Compare the specifications on the nameplate with the local supply voltage and frequency.
  The national regulations governing the installation of electrical equipment also apply.
- The transmitter must be included in the building fuse system.

1. Unscrew cover of the electronics compartment from the transmitter housing.

2. Press the side latches and flip down the cover of the connection compartment.

3. Feed the cable for the power supply and the signal cable through the appropriate cable entries.

4. Remove the terminal connectors from the transmitter housing and connect the cable for the power supply and the signal cable:
    – Wiring diagram → Fig. 28
    – Terminal assignment → Page 39

5. Plug the terminal connectors back into the transmitter housing.

    ✎ Note!
    The connectors are coded so you cannot mix them up.

6. Secure the ground cable to the ground terminal.

7. Flip up the cover of the connection compartment.

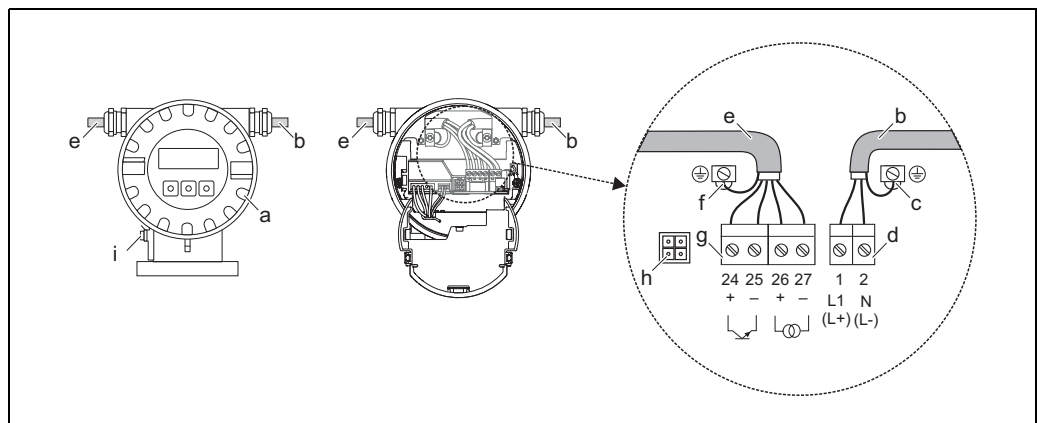8. Screw the cover of the electronics compartment firmly onto the transmitter housing.

A0003192

Fig. 28:   Connecting the transmitter (aluminium field housing).
Cable cross-section: max. 2.5 mm^2

a   Electronics compartment cover
b   Cable for power supply: 85...250 V AC, 11...40 V DC, 20...28 V AC
c   Ground terminal for power supply cable
*d   Terminal connector for power supply: **No. 1–2** → Page 39 (terminal assignment)*
e   Signal cable
f   Ground terminal for signal cable
*g   Terminal connector for signal cable: **No. 24–27** → Page 39 (terminal assignment)*
h   Service connector
i   Ground terminal for potential equalisation

4.2.2 Terminal assignment

Terminal No. (wiring diagram → Page 38)					
24 (+)	25 (−)	26 (+)	27 (−)	1 (L1/L+)	2 (N/L−)
Pulse output		HART current output		Power supply	
■ Galvanically isolated ■ Open collector ■ Passive: 30 V DC / 250 mA ■ Can be configured as pulse output or status output		■ Galvanically isolated ■ Full scale value adjustable ■ Active: 4...20 mA, $R_L < 700\ \Omega$ (for HART: RL ≥ 250 Ω)		■ 85...250 V AC / 45...65 Hz ■ 20...28 V AC / 45...65 Hz, 11...40 V DC	

4.2.3 HART connection

Users have the following connection options at their disposal:
- Direct connection to transmitter by means of terminals 26 (+) and 27 (−).
- Connection by means of the 4...20 mA circuit.
- The measuring circuit's minimum load must be at least 250 Ω.
- On completion of commissioning, make the following settings:
  – CURRENT RANGE function → "4–20 mA HART"
  – Switch HART write protection on or off → Page 50

Connecting the HART handheld terminal

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

F06-xxxxxxxx-04-xx-xx-xx-012
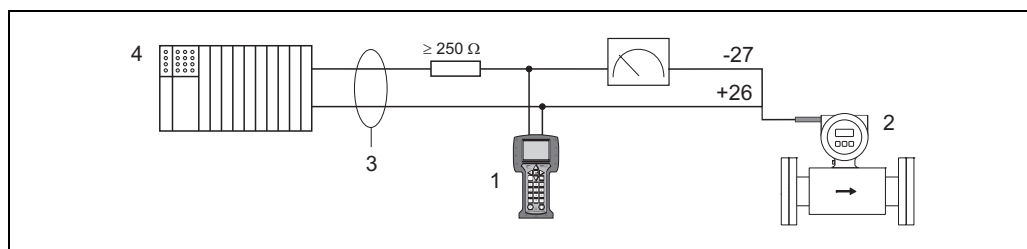
Fig. 29:   Electrical connection of the HART handheld terminal

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

Connecting a PC with operating software

In order to connect a PC with an operating software (e.g. "ToF Tool – Fieldtool Package"), a HART modem (e.g. "Commubox FXA 191") is needed.
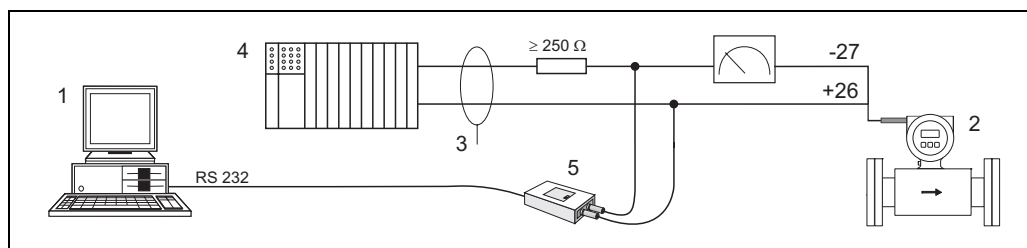

F06-xxxxxxxx-04-xx-xx-xx-013

Fig. 30:   Electrical connection of a PC with operating software

1   PC with operating software
2   Power supply
3   Shielding
4   Other switching units or PLC with passive input
5   HART modem, e.g. Commubox FXA 191

4.3   Potential equalisation

⚠ Warning!
The measuring system must be included in the potential equalisation.

4.3.1   Standard

Perfect measurement can only be guaranteed if the fluid and sensor are on the same electric potential. Most sensors have a built-in reference electrode as standard which guarantees the necessary connection. As a result, the use of ground disks or other measures is generally not required.

- Promag W → Reference electrode present as standard
- Promag P → Reference electrode present as standard
- Promag H → No reference electrode present. There is always an electrical connection to the fluid via the metallic process connection.

✎ Note!
When installing in metallic pipes, we recommend you connect the ground terminal of the transmitter housing with the piping. Also, observe company-internal grounding guidelines.
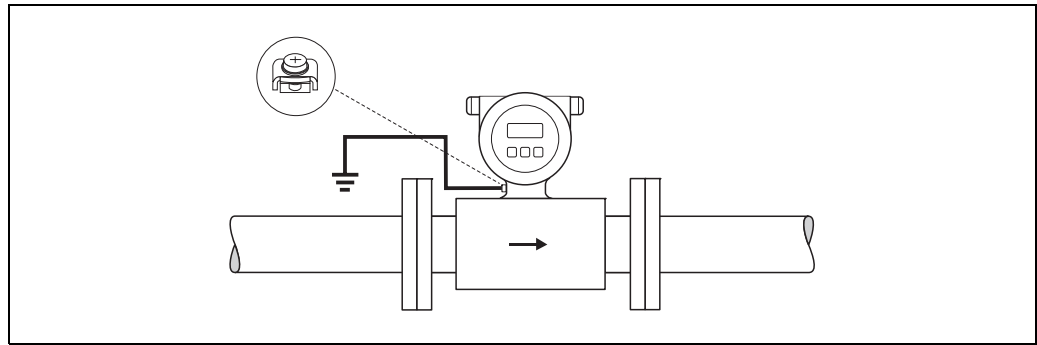
A0003195

Fig. 31:   Potential equalisation via the ground terminal of the transmitter

☞ Caution!
For sensors without reference electrodes or without metallic process connections, potential equalisation must be carried out as described in the following special cases.
These special measures apply especially where normal grounding cannot be guaranteed or excessively strong equalising currents are expected.

4.3.2 Special cases

Metallic, not grounded piping

To prevent disturbing influences on the measurement, we recommend both sensor flanges be connected to the pipe flange via a ground cable and grounded.
The transmitter or sensor terminal compartment must be set to ground potential via the ground terminal provided (see the diagram below).

Note!
The ground cable required for the flange-to-flange connection can be ordered separately from Endress+Hauser as an accessory → Page 60:
- DN ≤ 300: the ground cable is mounted directly on the conductive flange coating with the flange screws.
- DN ≥ 350: the ground cable is mounted directly on the transportation metal support.
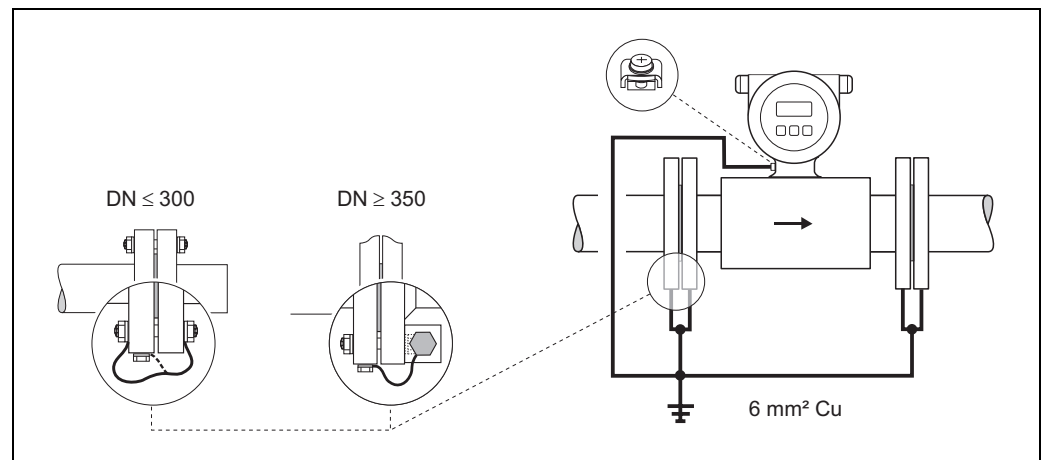
Fig. 32:   Potential equalisation in the case of equalisation currents in metallic, not grounded piping

Plastic pipelines or pipelines with insulating lining

Normally, potential equalisation takes place via the reference electrodes in the measuring tube. However, in exceptional circumstances, large equalising currents can flow via the reference electrodes due to the grounding concept of a plant. This can destroy the sensor due to the electrochemical reduction of the electrodes, for example. In such instances, e.g. in the case of fibreglass or PVC pipelines, we recommend the additional use of ground disks for potential equalisation.

Note!
Mounting ground disks → Page 21 (Promag W), → Page 26 (Promag P)

Caution!
- Risk of damage by electrochemical corrosion. Please note the electrochemical series if ground disks and measuring electrodes are made of different material.
- Also, observe company-internal grounding guidelines.
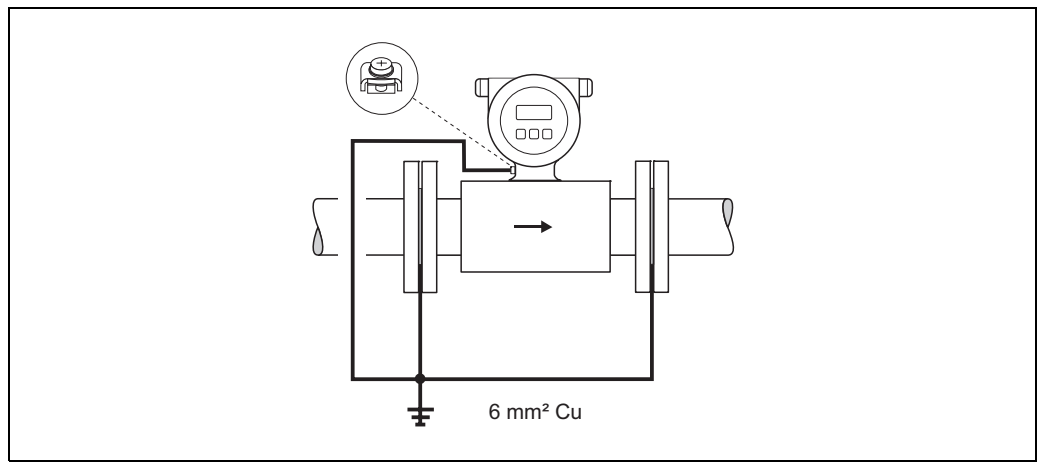
Fig. 33:   Potential equalisation/ground disks for plastic or lined pipes

Pipe with cathodic protective units

In such instances, the device is to be installed potential-free in the piping:
- During installation, ensure that the sections of the piping are electrically connected with one another (copper wire, 6 mm²).
- Make sure that no conductive connection to the device originates from the mounting material used and that the mounting material withstands the torques used during installation.
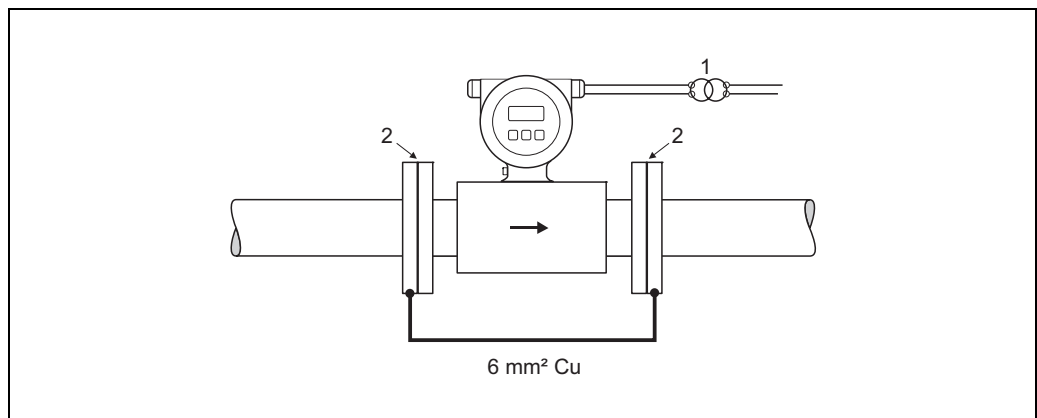- Please also note the applicable regulations regarding potential-free installation.

Fig. 34:   Potential equalisation and cathodic protection

1   Power supply isolation transformer
2   Electrically isolated

4.4 Degree of protection

The devices 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.
- All threaded fasteners and screw covers must be firmly tightened.
- The cables used for connection must be of the specified outside diameter → Page 37.
- Firmly tighten the cable entry.
- The cables must loop down before they enter the cable entries ("water trap"). This arrangement prevents moisture penetrating the entry. Always install the measuring device in such a way that the cable entries do not point up.
- Remove all unused cable entries and insert dummy plugs instead.
- Do not remove the grommet from the cable entry.

a0001914
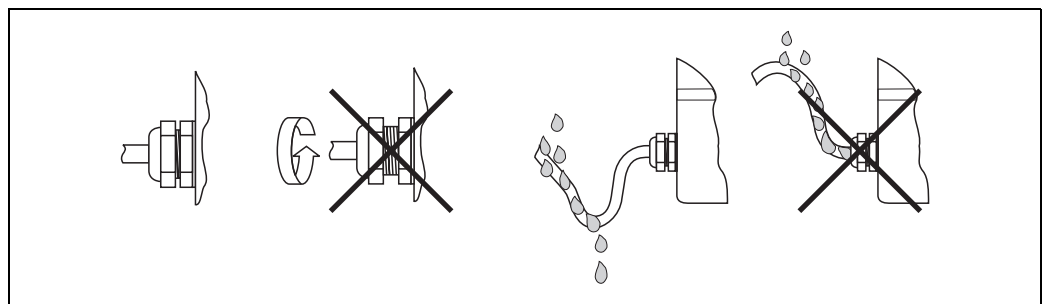
Fig. 35: Installation instructions for cable entries

Caution!
The screws on the sensor housing may not be loosened as otherwise the degree of protection guaranteed by Endress+Hauser cannot be ensured.

Note!
The Promag W and Promag P sensors are also optionally available in IP 68 degree of protection (constantly under water to 3 m depth). In this case the transmitter must be installed remote from the sensor.

4.5   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...250 V AC (50...60 Hz) ■ 20...28 V AC (50...60 Hz), 11...40 V DC
Do the cables used comply with the specifications?	→ Page 37
Do the cables have adequate strain relief?	–
Is the cable type route completely isolated? 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?	–
Have the measures for grounding/potential equalisation been correctly implemented?	→ Page 40 ff.
Are all cable entries installed, firmly tightened and correctly sealed? Cable run with "water trap"?	→ Page 43
Are all the housing covers installed and tightened?	–

5   Operation

5.1   Display and operating elements

The local display enables you to read important parameters directly at the measuring point and also configure the device via the function matrix.

The display consists of two lines; this is where measured values and/or status variables (partially filled pipe, etc.) are displayed. The assignment of the display lines in operating mode is specified.
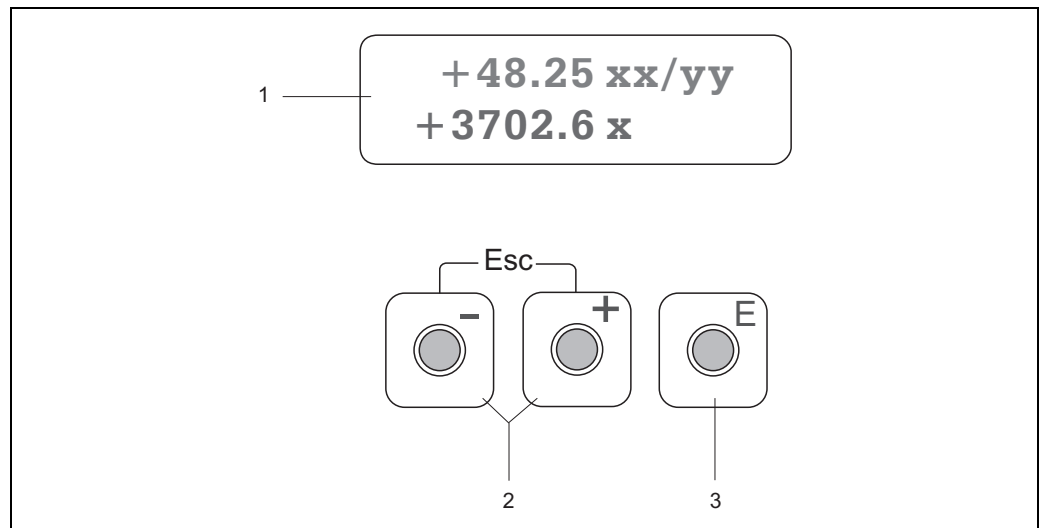
The top line displays the volume flow and the bottom line displays the totalizer status.

Fig. 36:   Display and operating elements

1   Liquid crystal display
The two-line liquid-crystal display shows measured values, dialog text, fault messages and notice messages. The display as it appears during standard measuring mode is known as the HOME position (operating mode).
– Top line: shows main measured values, e.g. volume flow, [e.g. in ml/min]
– Bottom line: shows the totalizer status, [e.g. in m³]
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 the +/– keys for more than 3 seconds → Return directly to HOME position
– Cancel data entry
3   Enter key
– HOME position → Enter the function matrix
– Save the numerical values you input or settings you changed

5.2   Brief guide to the function matrix

✎ Note!
- Please refer to the general notes on → Page 47.
- Function matrix overview → Page 85
- Detailed description of all functions → Page 86 ff.

The function matrix is a two-level construct: the function groups form one level and the groups' functions the other.
The groups are the highest-level grouping of the control options for the measuring device. A number of functions is assigned to each group. You select a group in order to access the individual functions for operating and configuring the measuring device.

1.   HOME position → Ⓔ → Enter the function matrix

2.   Select a function group (e.g. OPERATION)

3.   Select a function (e.g. LANGUAGE)
      Change parameter / enter numerical values:
      ⊞ → Select or enter enable code, parameters, numerical values
      Ⓔ → Save your entries

4.   Exit the function matrix:
      – Press and hold down the Esc key (⊟⊞) for more than 3 seconds → HOME position
      – Repeatedly press Esc key (⊟⊞) → Return step by step to HOME position

F06-x0xxxxxx-19-xx-xx-xx-000
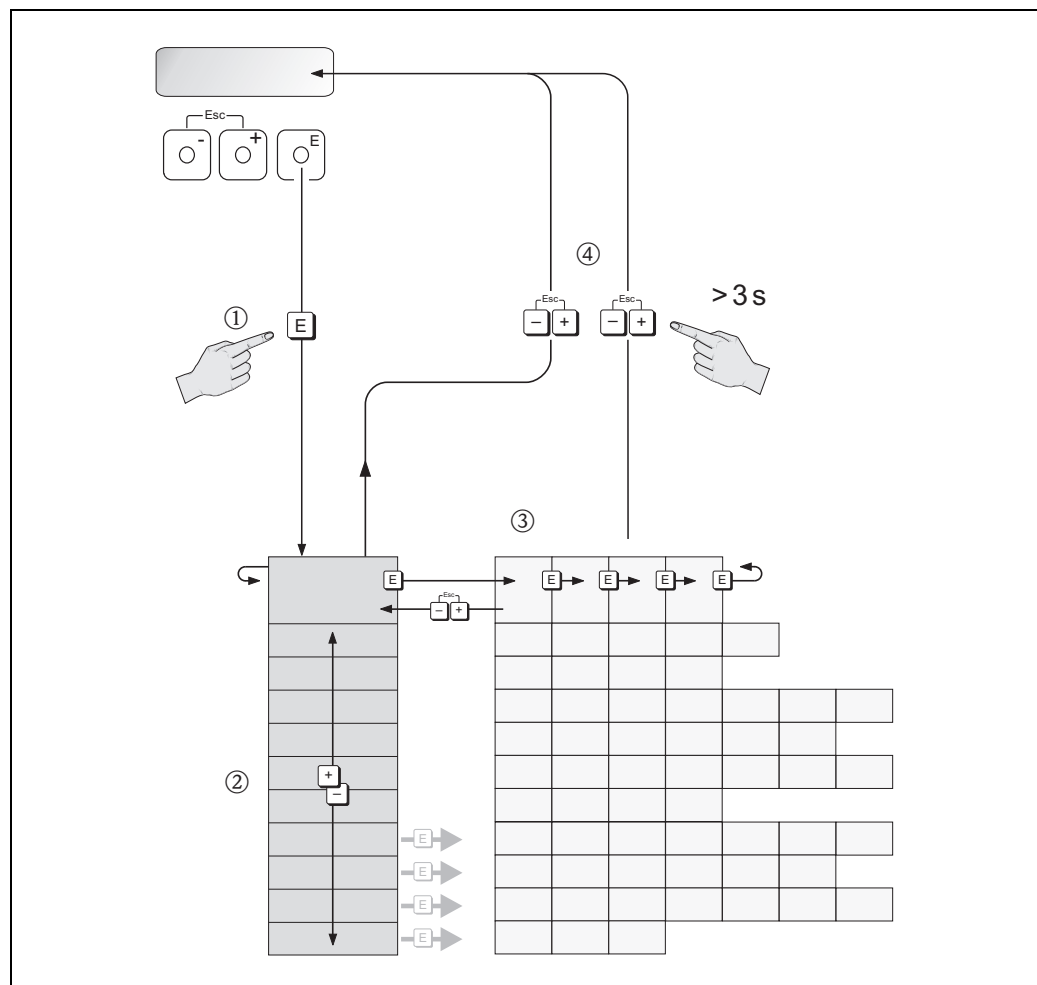
Fig. 37:   Selecting and configuring functions (function matrix)

5.2.1   General notes

The brief commissioning guide (→ Page 56) is adequate for commissioning with the necessary standard settings. 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 on Page 46.
- 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 ⏍ again 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.

✎   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 the normal way.
- 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 = 10) has to be entered before settings can be changed.
If you use a code of your choice, you exclude the possibility of unauthorised persons accessing data, see ACCESS CODE function → Page 87.

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 specified as the private code, programming is always enabled.
- The Endress+Hauser service organisation 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 device, particularly measuring accuracy.
Normally, such parameters may not be changed! Please contact Endress+Hauser if you have any questions.

5.2.3   Disabling the programming mode

Programming is disabled if you do not press the operating elements within 60 seconds following a return to the HOME position.
You can also disable programming in the "ACCESS CODE" function by entering any number (other than the private code).

5.3 Error message display

5.3.1 Type of error

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

The measuring system distinguishes between two types of error:
- System error → Page 63:
  This group comprises all device errors, e.g. communication errors, hardware faults, etc.
- Process error → Page 65:
  This group comprises all application errors, e.g. empty pipe,etc.
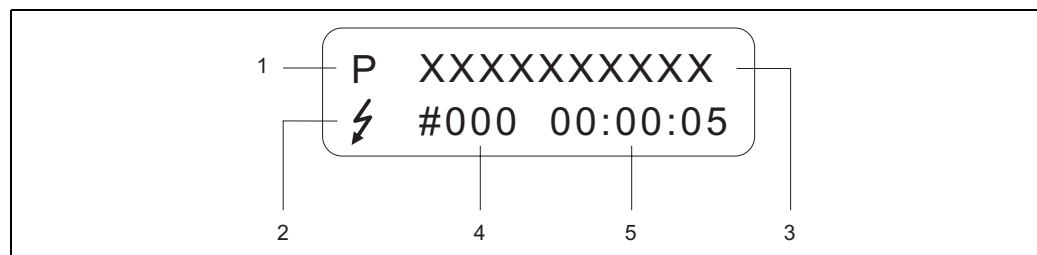
Fig. 38:   Error messages on the display (example)

1   Type of error:
*   – P = Process error*
*   – S = System error*
2   Error message type:
*   – ⚡ = Fault message*
*   – ! = Notice message*
3   Error designation: e.g. EMPTY PIPE = partially filled or empty measuring tube
4   Error number: e.g. #401
5   Duration of last error occurrence (in hours/minutes/seconds)

5.3.2 Error message types

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

Fault message (⚡)
- Displayed as → Lightning flash (⚡), error designation (S: system error, P: process error)
- The error in question has a direct effect on the outputs.
  The response of the individual outputs (failsafe mode) can be defined by means of the "FAILSAFE MODE" function in the function matrix → Page 104.

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

5.4 Communication

In addition to local operation, the measuring device can also be configured and measured values obtained by means of the HART protocol. Digital communication takes place using the 4–20 mA current output HART → Page 39.

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 masters, e.g. a handheld terminal or PC-based operating programs (such as ToF Tool – Fieldtool Package), require device description (DD) files which are used to access all the information in a HART device. Information is exclusively transferred using so-called "Commands". There are three different command classes:

There are three different command classes:
- Universal commands:
  All HART devices support and use universal commands.
  The following functionalities are linked to them:
  – Recognising HART devices
  – Reading off 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-pipe/full-pipe adjustment values, low flow cut off settings etc.

✎ Note!
The measuring device has access to all three command classes. A list of all the "Universal commands" and "Common Practice Commands" can be found on Page 51.

5.4.1 Operating options

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

HART handheld terminal DXR 375

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

"ToF Tool – Fieldtool Package" operating program

Modular software package consisting of the service program "ToF Tool" for configuration and diagnosis of ToF level measuring devices (time-of-flight measurement) and evolution of pressure measuring instruments as well as the "Fieldtool" service program for the configuration and diagnosis of Proline flowmeters. The Proline flowmeters are accessed via a service interface or via the FXA 193 service interface or the HART protocol.

Contents of the "ToF Tool – Fieldtool Package":
- Commissioning, maintenance analysis
- Measuring device configuration
- Service functions
- Visualisation of process data
- Trouble-shooting
- Controlling the "Fieldcheck" tester/simulator

"SIMATIC PDM" operating program (Siemens)

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

"AMS" operating program (Emerson Process Management)

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

Note!
In the "CURRENT RANGE" function (current output → Page 90), the HART protocol demands the selection "4...20 mA HART".

5.4.2   Device variables

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

ID (decimal)	Device variable
0	OFF (unassigned)
1	Volume flow
250	Totalizer

Process variables:

At the factory, the process variables are assigned to the following device variables:
- Primary process variable (PV) → Volume flow
- Second process variable (SV) → Totalizer
- Third process variable (TV) → Not assigned
- Fourth process variable (FV) → Not assigned

5.4.3   Switching HART write protection on/off

HART write protection can be switched on or off via the HART WRITE PROTECTION device function → Page 97.

5.4.4 Universal / common practice HART commands

The following table contains all the universal 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	The device identifier provides information on the device and manufacturer; it cannot be altered. 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, 69 = Promag 10 – 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 ID of the primary process variable – Bytes 1–4: primary process variable Factory setting: primary process variable = Volume flow ✎ Note! Manufacturer-specific units are represented using the HART unit ID "240".
2 Read the primary process variable as current in mA and percentage of the set measuring range Access type = Read	none	– Byte 0-3: current current of the primary process variable in mA – Byte 4-7: %- value of the set measuring range Factory setting: primary process variable = Volume flow
3 Read the primary process variable as current in mA and four 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 ID of the primary process variable – Bytes 5-8: primary process variable – Byte 9: HART unit ID of the second process variable – Bytes 10-13: second process variable – Byte 14: HART unit ID of the third process variable – Bytes 15-18: third process variable – Byte 19: HART unit ID of the fourth process variable – Bytes 20-23: fourth process variable Factory setting: ■ Primary process variable = Volume flow ■ Second process variable = Totalizer ■ Third process variable = OFF (not assigned) ■ Fourth process variable = OFF (not assigned) The assignment of the process variables is fixed and cannot be changed. ✎ Note! Manufacturer-specific units are represented using the HART unit ID "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...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 the unique device identifier using the TAG Access type = Read	Bytes 0-5: TAG	The device identifier provides information on the device and manufacturer; it cannot be altered. The response consists of a 12-byte device ID if the given TAG matches the one saved in the device: – Byte 0: fixed value 254 – Byte 1: manufacturer ID, 17 = E+H – Byte 2: device type ID, 69 = Promag 10 – 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, TAG description and date Access type = Read	none	– Bytes 0-5: TAG – Byte 6-17: TAG description – Bytes 18-20: date ✎ Note! You can write the TAG, TAG description and date using command 18.
14	Read sensor information on primary process variable	none	– Bytes 0-2: sensor serial number – Byte 3: HART unit ID 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 (= volume flow). ■ Manufacturer-specific units are represented using the HART unit ID "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 ID for the set measuring range of the primary process variable – Bytes 3-6: end of measuring 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 = Volume flow ✎ Note! Manufacturer-specific units are represented using the HART unit ID "240".
16	Read the device production number Access type = Read	none	Bytes 0-2: production number

Command No. HART command / Access type	Command data (numeric data in decimal form)	Response data (numeric data in decimal form)
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, TAG description and date Access = Write	You can save an 8-character TAG, a 16-character TAG description and a date with this parameter: – Bytes 0–5: TAG – Byte 6-17: TAG description – Bytes 18–20: date	Displays the current information in the device: – Bytes 0–5: TAG – Byte 6-17: TAG description – Bytes 18–20: date
19	Write the device production number Access = Write	Bytes 0-2: production number	Bytes 0-2: production number

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 attenuation constants for primary process variable Access = Write	Byte 0-3: attenuation constant of the primary process variable "volume flow" in seconds Factory setting: Primary process variable = Current output attenuation	Displays the current attenuation constant in the device: Bytes 0-3: attenuation constant in seconds
35	Write measuring range of the primary process variable Access = Write	Write the desired measuring range: – Byte 0: HART unit ID for the primary process variable – Byte 1-4: end of measuring range, value for 20 mA – Bytes 5-8: start of measuring range, value for 4 mA Factory setting: Primary process variable = Volume flow ✎ Note! ■ The start of measuring range (4 mA) must correspond to zero flow. ■ If the HART unit ID does not suit the process variable, the device will continue with the last valid unit.	The measuring range currently set is shown as the response: – Byte 0: HART unit ID for the set measuring range of the primary process variable – Byte 1-4: end of measuring 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 ID "240".
38	Device status reset "configuration changed" Access = Write	none ✎ Note! This HART command can also be executed if the write protection is switched on (= ON)!	none
42	Perform device 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 the primary process variable Access = Write	Specify the unit of the primary process variable. Only units which are suitable for the process variable are accepted by the device: Byte 0: HART unit ID Factory setting: Primary process variable = Volume flow ✎ Note! ■ If the written HART unit ID does not suit the process variable, the device will continue with the last valid unit. ■ If you change the unit of the primary process variable, this has a direct impact on the system units.	The current unit ID of the primary process variable is displayed as a response: Byte 0: HART unit ID ✎ Note! Manufacturer-specific units are represented using the HART unit ID "240".
48 Read extended device status Access = Read	none	The current device status is displayed in extended form as the response: Encoding: see Table → Page 55.
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 ID to the primary process variable – Byte 1: device variable ID to the second process variable – Byte 2: device variable ID to the third process variable – Byte 3: device variable ID to the fourth process variable Factory setting: ■ Primary process variable: ID 1 for volume flow ■ Second process variable: ID 250 for totalizer ■ Third process variable: ID 0 for OFF (not assigned) ■ Fourth process variable: ID 0 for OFF (not assigned)
53 Write device variable unit Access = Write	This command sets the unit of the given device variables. Only those units which suit the device variable are transferred: – Byte 0: device variable ID – Byte 1: HART unit ID ID of the supported device variables: See data → Page 50 ✎ Note! ■ If the written unit does not suit the device variable, the device will continue with the last valid unit. ■ If you change the unit of the device variable, this has a direct impact on the system units.	The current unit of the device variables is displayed in the device as a response: – Byte 0: device variable ID – Byte 1: HART unit ID ✎ Note! Manufacturer-specific units are represented using the HART unit ID "240".
59 Specify number of preambles in message responses Access = Write	This parameter specifies the number of preambles which are inserted in the message responses: Byte 0: number of preambles (4...20)	As a response, the current number of the preambles is displayed in the response message: Byte 0: number of preambles

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 bit-encoded information (see table below).

✎ Note!
- For detailed information on the device status messages and error messages, and how they are rectified → Page 55.
- Bits and bytes not listed are not assigned.

Byte	Bit	Error No.	Short error description
0	0	001	Serious device error.
	1	011	Faulty amplifier EEPROM.
	2	012	Error when accessing data of the amplifier EEPROM.
3	3	111	Totalizer checksum error
5	0	321	Coil current of sensor is outside tolerance.
7	3	351	Current output: The current flow is outside the set range.
8	3	359	Pulse output: The pulse output frequency is outside the set range.
10	7	401	Measuring tube partially filled or empty
11	2	461	EPD adjustment is not possible as the fluid conductivity is too low or too high.
	4	463	The EPD adjustment values for empty pipe or full pipe are identical, i.e. faulty.
12	7	501	Loading new measuring amplifier software version. No other commands possible at this point.
14	3	601	Positive zero return active.
18	3	691	Simulation of failsafe mode (outputs) active.
	4	692	Simulation of volume flow active

6 Commissioning

6.1 Function check

Make sure that all final checks have been completed before you commission your measuring point:
- "Post-installation check" checklist → Page 32
- "Post-connection check" checklist → Page 44

6.2 Switching on the measuring device

Once the post-connection checks have been successfully completed, it is time to switch on the supply voltage. The device is ready for operation! The measuring device performs a number of internal test functions after power-up. As this procedure progresses the following sequence of messages appears on the local display:

PROMAG 10 **V 1.XX.XX**	→	Start-up message

Normal measuring mode commences as soon as start-up completes. The volume flow and the totalizer status appear on the display (HOME position).

✎ Note!
If start-up fails, an appropriate error message is displayed, depending on the cause.

6.3 Brief commissioning guide

HOME position → E → +

Configure display	
UI language	→ Page 87
Display contrast	→ Page 88
Number of decimal places	→ Page 88

Select engineering units	
Volume flow	→ Page 86
Totalizer	→ Page 86

Configure outputs			
Current output		Pulse/status output	
Current range	→ Page 90	Operating mode	→ Page 92
Full scale value	→ Page 91	Pulse value	→ Page 92
		Pulse width	→ Page 92
		or	
		Assign status output	→ Page 93
		Switch-on point	→ Page 93

Complex applications The quickest way to find information on configuring additional functions is via the following pages:	
Operating matrix	→ Page 85
Index	→ Page 111

For optimum measurement results	
Low flow cut off	→ Page 98
Empty pipe detection	→ Page 98

6.4 Commissioning after installing a new electronics board

After start–up, the device checks whether a serial number is available. If this is not the case, the following setup is started. Installing a new electronics board → Page 68.

6.4.1 Setup "Commissioning"

✎ Note!
- The setup can no longer be called up once a serial number has been entered and stored. If a parameter is entered incorrectly during the setup, this must be corrected in the relevant function via the function matrix.
- The appropriate information is documented on the nameplate of the sensor and on the inside of the housing cover, see Fig. 2 → Page 8.
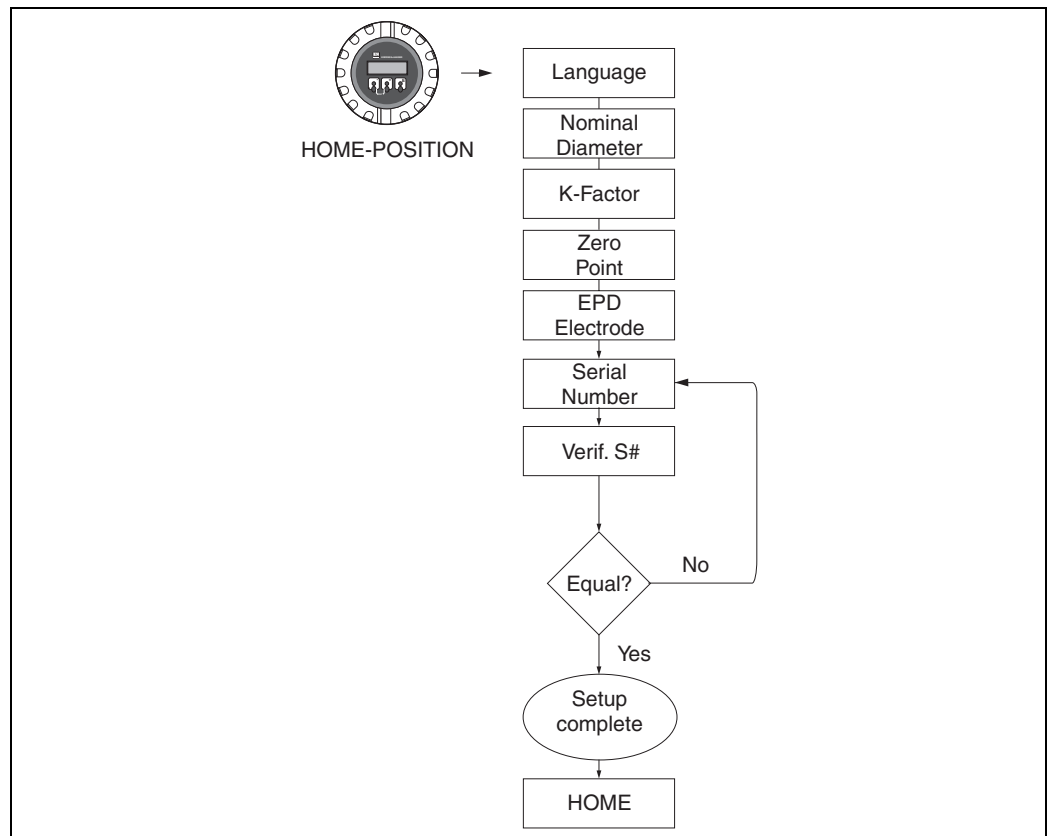
F06-10xxxxxx-19-xx-xx-en-000

Fig. 39:   The "Commissioning" setup starts after installation of a new electronics board if no serial number is present.

6.5   Empty-pipe/full-pipe adjustment

Flow cannot be measured correctly unless the measuring tube is completely full.
This status can be permanently monitored using the Empty Pipe Detection:
EPD = Empty pipe detection (with the help of an EPD electrode).

Caution!
More detailed information on empty-pipe and full-pipe adjustment can be found in the description
of the functions:
- EPD ADJUSTMENT (carrying out the adjustment) → Page 98.
- EPD (switching empty pipe detection on and off) → Page 98

Note!
- The EPD function is not available unless the sensor is fitted with an EPD electrode.
- The devices are already calibrated at the factory with water (approx. 500 µS/cm).
  If the fluid conductivity differs from this reference, empty-pipe/full-pipe adjustment has to be
  performed again on site.
- The default setting for EPD when the devices are delivered is OFF; the function has to be activated
  if required.
- The EPD process error can be output via the configurable status output.

6.5.1   Performing empty-pipe and full-pipe adjustment (EPD)

1. Select the corresponding function in the function matrix:
    HOME → Ｅ → ⊞ → PROCESS PARAMETER → Ｅ → ⊞ → EPD ADJUSTMENT

2. Empty the piping. For EPD empty-pipe adjustment, the wall of the measuring tube should still
    be covered with fluid.

3. Start empty-pipe adjustment: Select "EMPTY PIPE ADJ." and press Ｅ to confirm.

4. After empty-pipe adjustment, fill the piping with fluid.

5. Start full-pipe adjustment: Select "FULL PIPE ADJUST" and press Ｅ to confirm.

6. Having completed the adjustment, select the setting "OFF" and exit the function by
    pressing Ｅ.

7. Now switch on empty pipe detection in the EPD function by selecting the option "ON".

    Caution!
    The adjustment coefficients must be valid before you can activate the EPD function. If
    adjustment is incorrect the following messages might appear on the display:
    – FULL = EMPTY
      The adjustment values for empty pipe and full pipe are identical. In cases of this nature you
      must repeat empty-pipe or full-pipe adjustment!
    – ADJUSTMENT NOT OK
      Adjustment is not possible because the fluid's conductivity is out of range.

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   Seals

The seals of the Promag H sensor should be replaced periodically, especially if moulded seals are used (aseptic version)!
The period between changes depends on the frequency of cleaning cycles, the cleaning temperature and the fluid temperature.

Replacement seals (accessory) → Page 60.

8   Accessories

Various accessories, which can be ordered separately from Endress+Hauser, are available for the transmitter and the sensor. Your Endress+Hauser service organisation can provide detailed information on the order code in question.

Accessory	Description	Order code
Promag 10 transmitter	Transmitter for replacement or for stock. Use the order code to define the following specifications: ■ Approvals ■ Degree of protection / version ■ Cable type for remote version ■ Cable entry ■ Display / power supply / operation ■ Software ■ Outputs / inputs	10XXX - XXXXX * * * * * * * *
Cable for remote version	Coil and signal cables in various lengths.	DK5CA - * *
Ground cable for Promag W, P	A set consists of two ground cables.	DK5GC - * * *
Ground disk for Promag W, P	Ground disk for potential equalisation	DK5GD – * * ***
Mounting kit for remote version, aluminium field housing	Mounting kit suitable for pipe and wall mounting.	DK5WM – B
Mounting kit for Promag H	Mounting kit for Promag H comprising: ■ 2 process connections ■ Screws ■ Seals	DKH * * – * * *
Adapter connection for Promag A, H	Adapter connections for installing Promag 10 H instead of a Promag 30/33 A or Promag 30/33 H DN 25.	DK5HA - * * * * *
Sealing kit for Promag H	For regular replacement of the seals of the Promag H sensor.	DK5HS - * * *
Promag H wall mounting kit	Wall mounting kit for Promag H sensor	DK5HM-**
Welding aid for Promag H	Weld socket as process connection: Welding jig for installation in the pipe	DK5HW - * * *
HART Communicator DXR 375 handheld terminal	Handheld terminal for remote configuration and for obtaining measured values via the current output HART (4...20 mA). Contact your Endress+Hauser representative for more information.	DXR375 - * * * *
Applicator	Software for selecting and configuring flowmeters. Applicator can be downloaded from the Internet or ordered on CD-ROM for installation on a local PC. Contact your Endress+Hauser representative for more information.	DKA80 - *

Accessory	Description	Order code
ToF Tool – Fieldtool Package	Modular software package consisting of the service program "ToF Tool" for configuration and diagnosis of ToF level measuring devices (time-of-flight measurement) and the "Fieldtool" service program for the configuration and diagnosis of Proline flowmeters. The Proline flowmeters are accessed via a service interface or the FXA 193 service interface. Contents of the "ToF Tool – Fieldtool Package": ■ Commissioning, maintenance analysis ■ Measuring device configuration ■ Service functions ■ Visualisation of process data ■ Trouble-shooting ■ Controlling the "Fieldcheck" tester/simulator Contact your Endress+Hauser representative for more information.	DXS10 – * * * * *
Fieldcheck	Tester/simulator for testing flowmeters in the field. When used in conjunction with the "ToF Tool – Fieldtool Package" 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

9   Trouble-shooting

9.1   Trouble-shooting instructions

Always start trouble-shooting with the checklist below, if faults occur after commissioning or during operation. This takes you directly (via various queries) to the cause of the problem and the appropriate remedial measures.

Check the display	

No display visible and no output signals present	1. Check supply voltage → Terminal 1, 2
	2. Check device fuse → Page 70
	   85...250 V AC: TR5 1 A slow-blow / 250 V
	   11...40 V DC / 20...28 V AC: TR5 1.6A slow-blow / 250 V
	3. Electronics defective → Order spare part → Page 60

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 → Page 68 ff. 2. Display module defective → Order spare part → Page 60 3. Electronics defective → Order spare part → Page 60
Display texts are in a foreign language.	Switch off power supply. Press and hold down the ⊞⊟ keys simultaneously and switch on the measuring device again. The display text will appear in English and is displayed at maximum contrast.
Measured value indicated, but no signal output at the current or pulse output.	Electronics board defective → Order spare part → Page 60

<center>↓</center>

Error messages on display
Errors which occur during commissioning or measuring operation are displayed immediately. Error messages consist of a variety of icons. The meanings of these icons are as follows (example): – Type of error: **S** = System error, **P** = Process error – Error message type: ⚡ = Fault message, **!** = Notice message – **EMPTY PIPE** = Error designation (e.g. partially filled measuring tube) – **03:00:05** = Duration of error occurrence (in hours / minutes /seconds) – **#401** = Error number ☞   Caution! ▪ Please refer also to the information on Page 48! ▪ The measuring system interprets simulations and positive zero return as system errors, but displays them as notice messages only.

Error number: No. 001 – 399 No. 501 – 699	System error (device error) has occurred → Page 63
Error number: No. 401 - 499	Process error (application error) has occurred → Page 65

<center>↓</center>

Other errors (without error message)
Some other error has occurred.	Diagnosis and remedial measures → Page 65

9.2   System error messages

Serious system errors are **always** recognised by the device as "Fault messages" and are indicated with a lightning flash (⚡) on the display! Fault messages have a direct effect on the outputs. Simulations and positive zero return, on the other hand, are only classed and displayed as notice messages.

Caution!
In the event of a serious fault, a flowmeter might have to be returned to the manufacturer for repair. Necessary procedures must be carried out before you return the measuring device to Endress+Hauser → Page 6.
Always enclose a fully completed "Declaration of Contamination" form with the device. A copy of the form can be found at the end of these Operating Instructions.

Note!
- The error types listed in the following correspond to the factory settings.
- Please refer also to the information on Page 48 ff.

Type	Error message / No.	Cause	Remedy / spare part
S = System error ⚡ = Fault message (with an effect on the inputs and outputs) ! = Notice message (without an effect on the inputs and outputs)			
No. # 0xx → Hardware error			
S ⚡	CRITICAL FAIL. **# 001**	Serious device error.	Replace electronics board. Spare part → Page 60
S ⚡	AMP HW EEPROM **# 011**	Electronics board: Faulty EEPROM	Replace electronics board. Spare part → Page 60
S ⚡	AMP SW EEPROM **# 012**	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 errored parameter values. ✎ Note! The measuring device has to be restarted if an error has occurred in the totalizer block (see also Error No. 111 / CHECKSUM TOTAL.).
No. # 1xx → Software error			
S ⚡	GAIN ERROR AMP **# 101**	Impermissible gain deviation compared to reference.	Replace electronics board. Spare part → Page 60
S ⚡	CHECKSUM TOTAL. **# 111**	Totalizer checksum error	1. Restart the measuring device 2. Replace electronics board if necessary. Spare part → Page 60
No. # 3xx → System limits exceeded			
S ⚡	TOL. COIL CURR. **# 321**	Sensor: The coil current is outside the tolerance.	1. Remote version: Switch off the power supply before connecting or disconnecting the cable of the coil (terminals 41/42). 2. Remote version: Switch off power supply and check wiring of terminals 41/42 Spare part → Page 33 3. Switch off power supply and check coil current cable connector → Page 68 4. Replace electronics board if necessary. Spare parts, spare part → Page 60

Type	Error message / No.	Cause	Remedy / spare part
S !	CURRENT RANGE # 351	Current output: The current flow is outside the set range.	– Change the upper or lower limit setting, as applicable. – Increase or reduce flow
S !	RANGE PULSE # 359	Pulse output: The pulse output frequency is outside the set range.	1. Increase the setting for pulse value 2. When entering the pulse width, select a value that can still be processed by an external totalizer (e.g. mechanical totalizer, PLC, etc.). Determine pulse width: – Method 1: enter the minimum time for which a pulse has to be present at a connected totalizer in order to be recorded. – Method 2: enter the maximum (pulse) frequency as a half "reciprocal value" for which a pulse has to be present at a connected totalizer in order to be recorded. Example: The maximum input frequency of the connected totalizer is 10 Hz. The pulse width to be entered is: $$\frac{1}{2 \cdot 10\ Hz} = 50\ ms$$ 3. Reduce flow
No. # 5xx → Application error			
S !	SW.-UPDATE ACT. # 501	Electronics board: New software version being loaded, no other commands are possible at present.	Wait until process is completed and restart device.
S !	UP-/DOWNL. ACT. # 502	Data are being uploaded or downloaded via the ToF Tool – Fieldtool Package. ✎ Note! Measuring device configuration is locked during the upload/download.	Wait until uploading/downloading process is finished.
No. # 6xx → Simulation mode active			
S !	POS. ZERO-RET. # 601	Positive zero return active.	Switch off positive zero return.
S ⚡	SIM. FAILSAFE # 691	Simulation of failsafe mode (outputs) active.	Switch off simulation.
S !	SIM. VOL. FLOW # 692	Simulation of volume flow active.	Switch off simulation.

9.3 Process error messages

Process errors are permanently defined as fault messages or notice messages.

Type	Error message / No.	Cause	Remedy / spare part
P = Process error ⚡ = Fault message (with an effect on the inputs and outputs) ! = Notice message (without an effect on the inputs and outputs)			
P ⚡	EMPTY PIPE # 401	Measuring tube partially filled or empty	1. Check system process conditions 2. Fill measuring tube
P !	ADJ. NOT OK # 461	EPD adjustment is not possible as the fluid conductivity is too low or too high.	The EPD function cannot be used for such fluids!
P ⚡	EPD FULL = EMPTY # 463	The EPD adjustment values for empty pipe or full pipe are identical, i.e. faulty.	Repeat adjustment and follow procedure carefully → Page 58.

9.4 Process errors without display messages

Symptoms	Remedial measures
N.B. You may have to change or correct settings in certain functions of the function matrix in order to rectify faults.	

Flow values are negative, even though the fluid is flowing forwards through the pipe.	1. If remote version:
	  – Switch off power supply and check wiring → Page 33
	  – If necessary, reverse the connections at terminals 41 and 42
	2. Change the setting in the "INSTALLATION DIRECTION SENSOR" function accordingly

Measured value reading fluctuates even though flow is steady.	1. Check grounding and potential equalisation → Page 40 2. Check the fluid for presence of gas bubbles. 3. In the "SYSTEM DAMPING" function → Increase the value
Measured value reading shown on display, even though the fluid is at a standstill and the measuring tube is full.	1. Check grounding and potential equalisation → Page 40 2. Check the fluid for presence of gas bubbles. 3. Activate the "LOW FLOW CUT OFF" function, i.e. enter or increase the value for the switching point.
Measured value shown on display even though measuring tube empty?	1. Perform empty or full-pipe adjustment and then switch on empty pipe detection → Page 58 2. Remote version: check the terminal connections of the EPD cable → Page 33 3. Fill the measuring tube.
The current output signal is always 4 mA, irrespective of the flow signal at any given time.	1. Set the "BUS ADDRESS" function to "0". 2. Low flow cut off too high. Reduce value in the "LOW FLOW CUT OFF" function.
The fault cannot be rectified or some other fault not described above has occurred. In these instances, please contact your Endress+Hauser service organisation.	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 organisation to have a service technician sent out, please be ready with the following information: – Brief description of the fault – Nameplate specifications (Page 7): order code and serial number **Return devices to Endress+Hauser** The necessary procedures must be carried out before you return a flowmeter requiring repair or calibration to Endress+Hauser (Page 6). Always enclose a fully completed "Declaration of Contamination" form with the flowmeter. A copy of the "Dangerous Goods Sheet" can be found at the end of these Operating Instructions. **Replace transmitter electronics** Components in the electronics defective → Order spare part → Page 60.

9.5   Response of outputs to errors

✎ Note!
The response of the totalizer, current output, pulse output and status output is defined in the FAILSAFE MODE function (→ Page 104).

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

Response of outputs and totalizers to errors		
	Process/system error present	Positive zero return activated
☞ Caution! System or process errors defined as "Notice messages" have no effect whatsoever on the inputs and outputs. Please refer also to the information on → Page 48.		
Current output	MINIMUM VALUE 4–20 mA (25 mA) → 2 mA 4–20 mA NAMUR →3.5 mA 4–20 mA US → 3.75 mA 4–20 mA (25 mA) HART → 2 mA 4–20 mA HART NAMUR → 3.5 mA 4–20 mA HART US → 3.75 mA MAXIMUM VALUE 4–20 mA (25 mA) → 25mA 4–20 mA NAMUR → 22.6 mA 4–20 mA US → 22.6 mA 4–20 mA (25 mA) HART → 25 mA 4–20 mA HART NAMUR → 22.6 mA 4–20 mA HART US → 22.6 mA ACTUAL VALUE Fault is ignored, i.e. normal measured-value output on the basis of ongoing flow measurement.	Output signal corresponds to "zero flow"
Pulse output	MINIMUM/MAXIMUM VALUE → FALLBACK VALUE Signal output → No pulses 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	MINIMUM/MAXIMUM VALUE → STOP The totalizer is paused until the fault is rectified. ACTUAL VALUE The fault is ignored. The totalizer continues to count in accordance with the current flow value.	Totalizer stops
Status output	In the event of a fault or power supply failure: Status output → Non-conductive	No effect on status output

9.6   Spare parts

The previous sections contain a detailed trouble-shooting guide → Page 62 ff.
The measuring device, moreover, provides additional support in the form of continuous self-diagnosis and error messages.

Trouble-shooting 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 organisation by quoting the serial number printed on the transmitter nameplate → Page 7.

Spare parts are shipped as sets comprising the following parts:
- Spare part
- Additional parts, small items (screws, etc.)
- Installation instructions
- Packaging
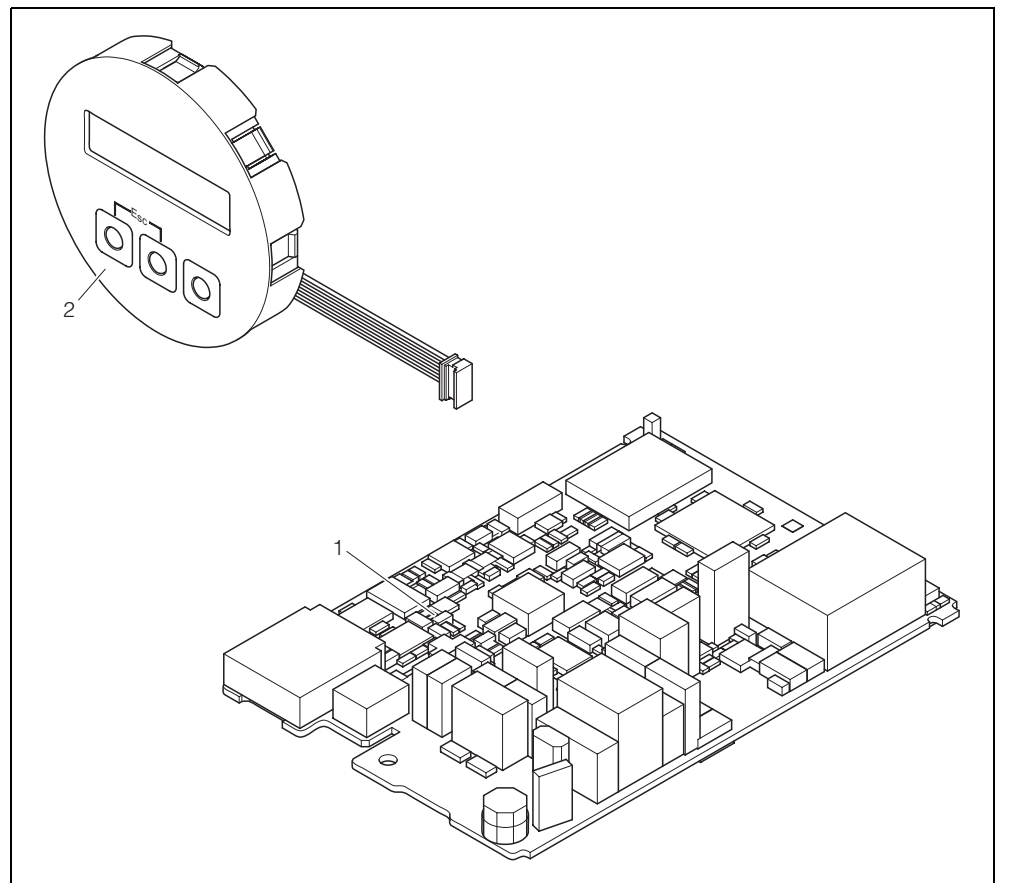
F06-10xxxxxx-03-06-xx-000

Fig. 40:   Spare parts for Promag 10 transmitter

1   Electronics board
2   Display module

9.7 Removing and installing electronics boards

9.7.1 Field housing: removing and installing electronics boards → Fig. 41

⚠ 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, purpose-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 genuine Endress+Hauser parts.

✎ Note!
Commissioning a new electronics board: → Page 57

1. Switch off power supply.

2. Unscrew cover of the electronics compartment from the transmitter housing.

3. Remove the local display (a) from the connection compartment cover.

4. Press the side latches (b) and flip down the cover of the connection compartment.

5. Disconnect the connector of the electrode signal cable (c) and the coil current cable (d).

6. Disconnect the connector for the power supply (e) and the outputs (f).

7. Disconnect the connector of the local display (g).

8. Remove the cover from the connection compartment (h) by loosening the screws.

9. Plug out the ground cable (i) of the electronics board.

10. Pull entire module (plastic retainer and electronics board) out of the housing.

11. Press the side latches (j) slightly outwards and partly push out the electronics board towards the rear from the front.

12. Remove the electronics board from the plastic retainer from the rear.

13. Reverse the procedure to reassemble.
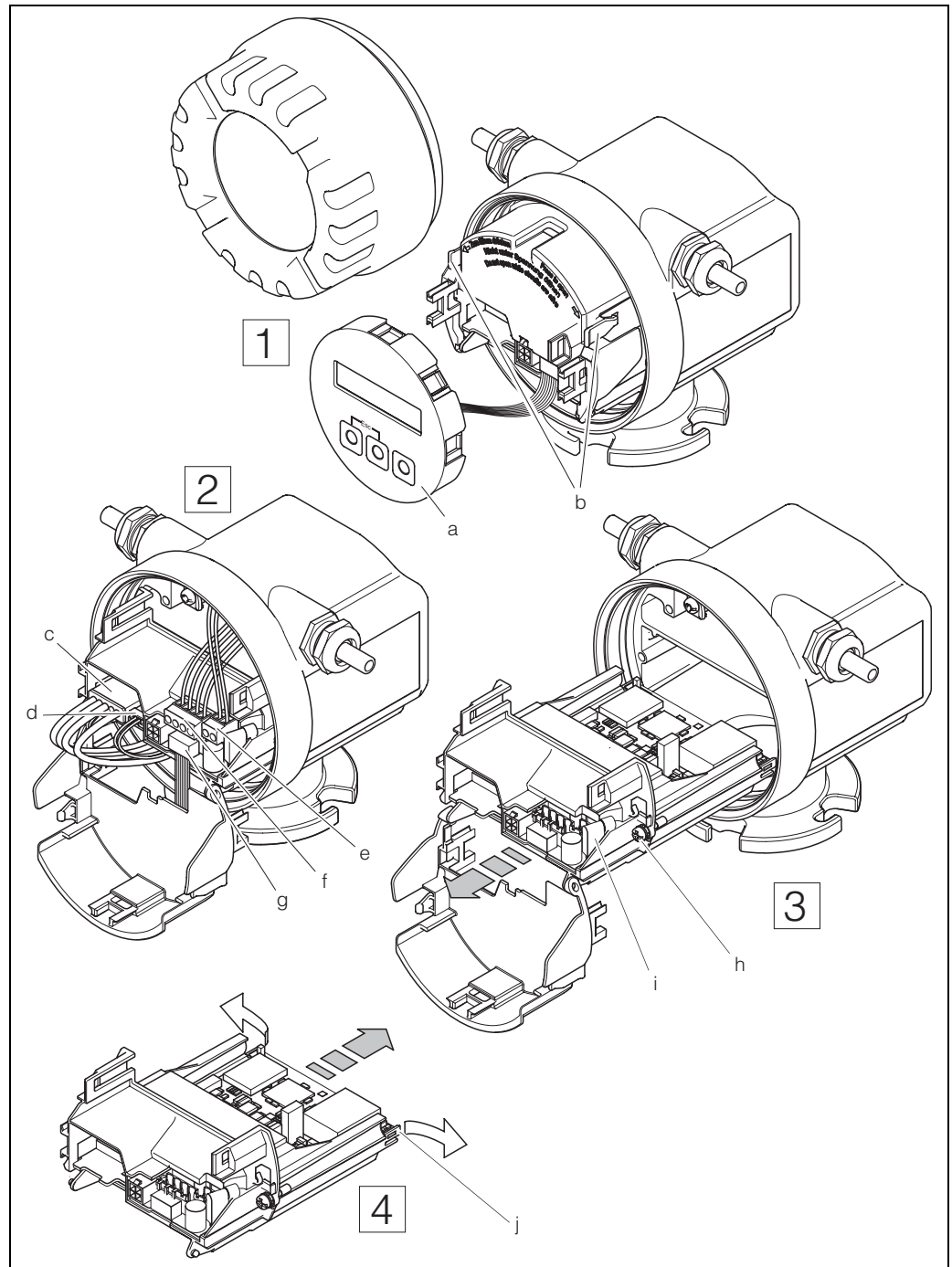
F06-10xxxxxx-03-06-06-xx-001

Fig. 41:   Field housing: removing and installing electronics boards

a   Local display
b   Latches
c   Connector of the electrode signal cable
d   Connector of the coil current cable
e   Connector for the power supply
f   Connector for current output and pulse/status output
g   Connector of local display
h   Screws of electronics compartment cover
i   Connector of the ground cable
j   Latches for the electronics board

9.8   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 device fuse is located on the electronics board ($\rightarrow$ Fig. 42).
The procedure for replacing the fuse is as follows:

1. Switch off power supply.

2. Unscrew cover of the electronics compartment from the transmitter housing.

3. Press the side latches and flip down the cover of the connection compartment.

4. Remove the connector for the power supply (a).

5. Replace device fuse (b). Only use the following fuse type.
    Use only fuses of the following type:
    – Power supply 11...40 V DC / 20...28 V AC $\rightarrow$ 1.6 A slow-blow / 250 V TR5
    – Power supply 85...250 V DC $\rightarrow$ 1 A slow-blow / 250 V TR5

6. Installation is the reverse of the removal procedure.

✋ Caution!
Use only genuine Endress+Hauser parts.
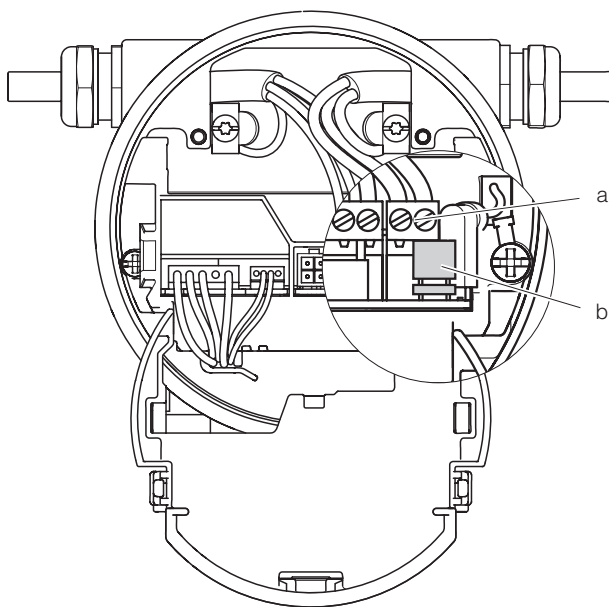
F06-10xxxxxx-03-xx-06-xx-000

Fig. 42:   Replacing the device fuse on the electronics board

a   Connector for power supply
b   Device fuse

9.9   Return

Information on returning the device: Page 6

9.10   Disposal

Observe the regulations applicable in your country!

9.11   Software history

Date	Software version	Software modification	Operating Instructions
10.2004	V 1.02.00	Software modification/extension Function: SELF CHECKING	50104787 / 05.05
09.2004	V 1.01.01	Software modification Extension of nominal diameter range	50104787 / 04.03
06.2004	V 1.01.00	Software extension Preparation for uploading/downloading via ToF Tool – Fieldtool Package	50104787 / 04.03
08.2003	V 1.00.02	Production-related software modification	50104787 / 04.03
01.2003	V 1.00.00	Original software. Compatible with: ToF Tool – Fieldtool Package, HART Communicator DXR 275 (OS 4.6 and higher) with Rev. 1, DD 1.	50104787 / 04.03

Note!
An upload or download between the individual software versions is only possible with a special service software.

10   Technical data

10.1   Technical data at a glance

10.1.1   Application

- Measuring the flow rate of fluids in closed piping systems.
- A minimum conductivity of $\geq 50\ \mu S/cm$ is required for measuring.
- Applications in measuring, control and regulation technology.

✎ Note!
Lining-specific applications, see also Section 10.1.2, "Measuring device"

10.1.2   Function and system design

Measuring principle	Electromagnetic flow measurement based on Faraday's law.
Measuring system	The measuring system consists of a transmitter and a sensor.

Two versions are available:
- Compact version: Transmitter and sensor form a mechanical unit.
- Remote version: Sensor is mounted separate from the transmitter.

Transmitter
- Promag 10

Sensor
- Promag W, DN 25...2000:
  - Polyurethane lining for fresh water and wastewater applications,
    applications with a constant temperature and applications with slight abrasion (e.g. mining industry).
  - Hard rubber lining for all applications with water (especially for drinking water).

- Promag P, DN 25...600:
  PTFE lining for all standard applications in chemical and process industries.

- Promag H, DN 2...100:
  PFA lining for all applications in chemical, process and food industries. Especially for applications with high temperatures and large temperature jumps (e.g. CIP and SIP).

10.1.3   Input

Measured variable	Flow velocity (proportional to induced voltage)
Measuring range	Typically $v = 0.01...10$ m/s with the specified accuracy
Operable flow range	Over 1000 : 1

10.1.4   Output

Output signal	**Current output**
	■ Galvanically isolated
	■ Full scale value adjustable
	■ Temperature coefficient: typ. 2 µA/°C, resolution: 1.5 µA
	■ Active: 4...20 mA, R_L < 700 Ω (for HART: RL ≥ 250 Ω)

Pulse/status output:

- Galvanically isolated
- Open collector
- 30 V DC / 250 mA
- Passive
- Can be configured as:
  - **Pulse output**: Pulse value and pulse polarity can be selected, max. pulse width adjustable (5...2000 ms), pulse frequency max. 100 Hz
  - **Status output**: for example, can be configured for error messages, empty pipe detection, flow recognition, limit value

Signal on alarm	■ Current output, pulse output → Failsafe mode can be selected → Page 104
	■ Status output → "Not conductive" in the event of fault or power supply failure

Load	See "output signal"

Low flow cut off	Low flow cut off → Switch-on point can be selected as required

Galvanic isolation	All circuits for inputs, outputs and power supply are galvanically isolated from each other.

10.1.5   Power supply

Electrical connections	See Page 33 ff.

Supply voltage (power supply)	■ 85...250 V AC, 45...65 Hz
	■ 20...28 V AC, 45...65 Hz, 11...40 V DC

Cable entry	Power supply and signal cables (inputs/outputs):
	■ Cable entry M20 x 1.5 (8...12 mm)
	■ Thread for cable entries 1/2" NPT, G 1/2"
	Connecting cable for remote version:
	■ Cable entry M20 x 1.5 (8...12 mm)
	■ Thread for cable entries 1/2" NPT, G 1/2"

Cable specifications	See Page 37 ff.

Power consumption	85...250 V AC: <12 VA (incl. sensor)
	20...28 V AC: <8 VA (incl. sensor)
	11...40 V DC: <6 W (incl. sensor)
	Switch-on current:
	■ At 24 V DC → Max. 3.3 A (< 5 ms)
	■ At 28 V AC → Max. 5.5 A (< 5 ms)
	■ At 250 V AC → Max. 16 A (< 5 ms)

Power supply failure	Lasting min. ½ cycle frequency: EEPROM saves measuring system data

Potential equalisation	See Page 40 ff.

10.1.6   Performance characteristics

Reference operating conditions	As per DIN EN 29104 and VDI/VDE 2641: ■ Fluid temperature: +28 C ± 2 K ■ Ambient temperature: +22 C ± 2 K ■ Warm-up period: 30 minutes Installation: ■ Inlet run >10 x DN ■ Outlet run > 5 x DN ■ Sensor and transmitter grounded. ■ The sensor is centered in the pipe.
Maximum measured error	■ Pulse output: ± 0.5% o.r. ± 2 mm/s (o.r. = of reading) ■ Current output: also typically ± 5 μA Fluctuations in the supply voltage do not have any effect within the specified range.
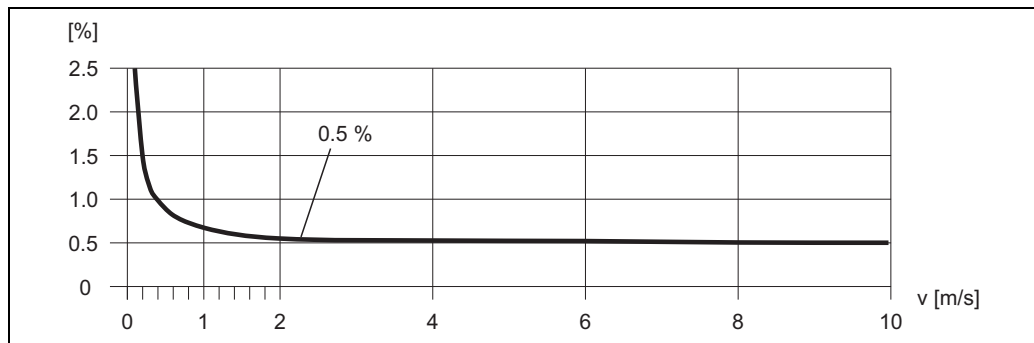
Fig. 43:   Max. measured error in % of reading

Repeatability	Max. ± 0.2% o.r. ± 2 mm/s (o.r. = of reading)

10.1.7   Operating conditions: Installation

Installation instructions	Any orientation (vertical, horizontal) Restrictions and additional installation instructions → Page 12 ff.
Inlet and outlet run	If possible, install the sensor well clear of assemblies such as valves, T-pieces, elbows, etc. Note the following inlet and outlet runs to comply with measuring accuracy specifications (→ Page 15, Fig. 12): ■ Inlet run: ≥ 5 x DN ■ Outlet run: ≥ 2 x DN
Length of connecting cable	■ The permitted length of connecting cable L_{max} is determined by the fluid conductivity (→ Page 19, Fig. 16). A minimum conductivity of 50 μS/cm is needed for all fluids. ■ When the empty pipe detection function is switched on (EPD → Page 58), the maximum connecting cable length is 10 m.

10.1.8 Operating conditions: Environment

Ambient temperature range	■ Transmitter: –20...+60 °C
	■ Sensor:
	  – For carbon steel flange material (Promag W, P): –10...+60 °C
	  – For stainless steel flange material (Promag H): –20...+60 °C
	
	Caution!
	The permitted temperature range of the measuring tube lining may not be undershot or overshot (→ "Medium temperature range").
	
	Please note the following points:
	■ Install the device in a shady location. Avoid direct sunlight, particularly in warm climatic regions.
	■ The transmitter must be mounted separate from the sensor if both the ambient and fluid temperatures are high (→ "Medium temperature range").

Storage temperature	The storage temperature corresponds to the ambient temperature range of the transmitter and sensor (→ "Ambient temperature range").
Degree of protection	■ Standard: IP 67 (NEMA 4X) for transmitter and sensor ■ Optional: IP 68 (NEMA 6P) for Promag W and P sensor in remote version
Shock and vibration resistance	Acceleration up to 2 g following IEC 600 68-2-6
CIP cleaning	Promag W → Not possible Promag P → Possible (observe max. temperature) Promag H → Possible (observe max. temperature)
SIP cleaning	Promag W, P→ Not possible Promag H → Possible (observe max. temperature)
Electromagnetic compatibility (EMC)	To: ■ EN 61326 ■ Emission: to limit value for industry EN 55011

10.1.9   Operating conditions: Process

Medium temperature range

The permitted temperature depends on the measuring tube lining

Promag W
- 0...+80 °C for hard rubber (DN 65...2000)
- 20...+50 °C for polyurethane (DN 25...1000)

Promag P
- −40...+130 °C for PTFE (DN 25...600), restrictions → See following diagrams
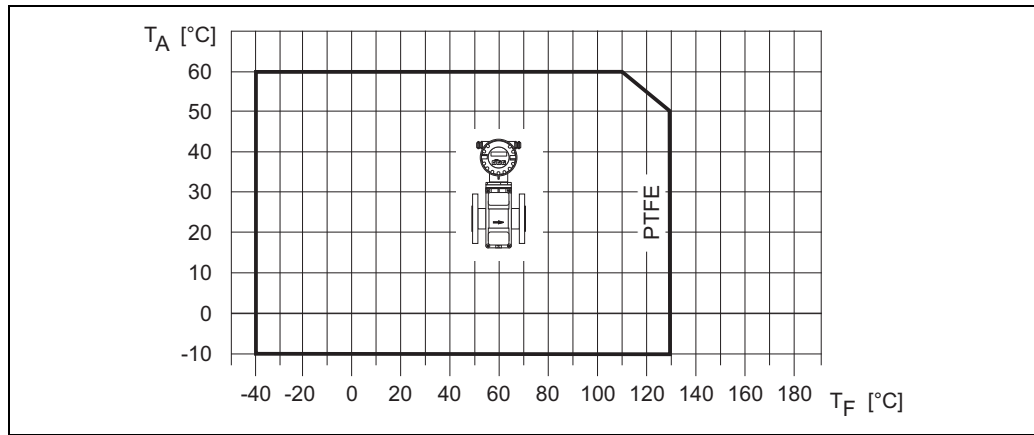
Fig. 44:   Compact version, Promag P (T_A = ambient temperature, T_F = fluid temperature)
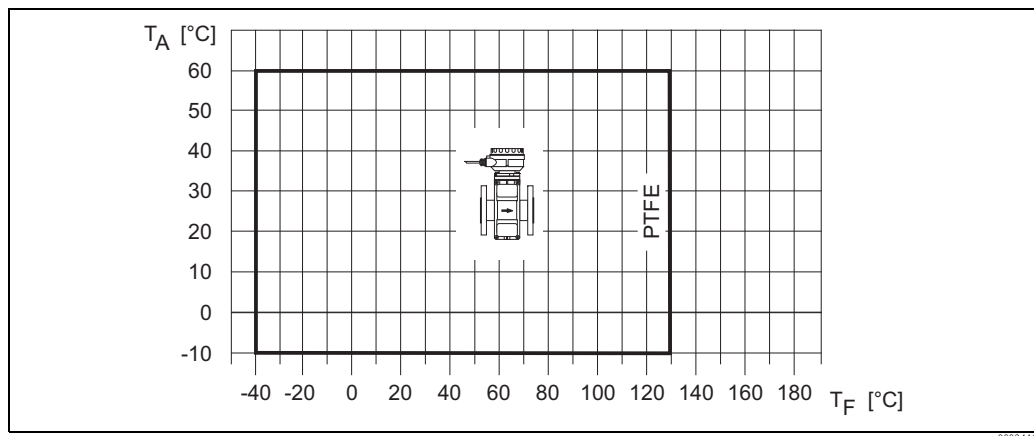
Fig. 45:   Remote version, Promag P (T_A = ambient temperature, T_F = fluid temperature)

Promag H
Sensor:
- DN 2...25: −20...+150 °C
- DN 40...100: −20...+150 °C

Seals:
- EPDM: −20...+130 °C
- Viton: −20...+150 °C
- Kalrez: −20...+150 °C

Fluid conductivity

Minimum conductivity: ≥ 50 µS/cm

Note!
In the remote version, the permitted length of connecting cable L_{max} is determined by the fluid conductivity → Page 19.

Medium pressure range	**Promag W**

Promag W
- EN 1092-1 (DIN 2501)
  - PN 6 (DN 1200...2000)
  - PN 10 (DN 200...2000)
  - PN 16 (DN 65...2000)
  - PN 25 (DN 200...1000)
  - PN 40 (DN 25...150)
- ANSI B 16.5
  - Class 150 (1"...24")
  - Class 300 (1"...6")
- AWWA
  - Class D (28"...78")
- JIS B2238
  - 10 K (DN 50...300)
  - 20 K (DN 25...300)
- AS 2129
  - Table E (DN 80, 100, 150...400, 500, 600)
- AS 4087
  - Cl. 14 (DN 80, 100, 150...400, 500, 600)

Promag P
- EN 1092-1 (DIN 2501)
  - PN 10 (DN 200...600)
  - PN 16 (DN 65...600)
  - PN 25 (DN 200...600)
  - PN 40 (DN 25...150)
- ANSI B 16.5
  - Class 150 (1"...24")
  - Class 300 (1"...6")
- JIS B2238
  - 10 K (DN 50...300)
  - 20 K (DN 25...300)
- AS 2129
  - Table E (DN 25, 50)
- AS 4087
  - Cl. 14 (DN 50)

Promag H
The permitted nominal pressure depends on the process connection and the seal:
- 40 bar → Flange, weld socket (with O-ring seal)
- 16 bar → All other process connections

Pressure tightness

Promag W nominal diameter		Measuring tube lining	Pressure tightness, measuring tube lining Limit values for abs. pressure [mbar] at various fluid temperatures						
[mm]	[inch]		25 °C	50 °C	80 °C	100 °C	130 °C	150 °C	180 °C
25...1000	1...40"	Polyurethane	0	0	-	-	-	-	-
65...2000	3...78"	Hard rubber	0	0	0	-	-	-	-

Promag P nominal diameter		Measuring tube lining	Pressure tightness, measuring tube lining Limit values for abs. pressure [mbar] at various fluid temperatures			
[mm]	[inch]		25 °C	80 °C	100 °C	130 °C
25	1"	PTFE	0	0	0	100
32	-	PTFE	0	0	0	100
40	1 1/2"	PTFE	0	0	0	100
50	2"	PTFE	0	0	0	100
65	-	PTFE	0	*	40	130
80	3"	PTFE	0	*	40	130
100	4"	PTFE	0	*	135	170
125	-	PTFE	135	*	240	385
150	6"	PTFE	135	*	240	385
200	8"	PTFE	200	*	290	410
250	10"	PTFE	330	*	400	530
300	12"	PTFE	400	*	500	630
350	14"	PTFE	470	*	600	730
400	16"	PTFE	540	*	670	800
450	18"	PTFE	Partial vacuum is impermissible			
500	20"	PTFE				
600	24"	PTFE				
* No value can be specified.						

Promag H nominal diameter		Measuring tube lining	Pressure tightness, measuring tube lining Limit values for abs. pressure [mbar] at various fluid temperatures						
[mm]	[inch]		25 °C	80 °C	100 °C	130 °C	150 °C	180 °C
2...100	1/12...4"	PFA	0	0	0	0	0	0

Limiting flow   See Page 17.

Pressure loss   ■ No pressure loss if the sensor is installed in a pipe with the same nominal diameter.
                          ■ Pressure losses for configurations incorporating adapters according to DIN EN 545, see "Adapters" → Page 16.

10.1.10 Mechanical construction

Design, dimensions   The dimensions and lengths of the sensor and transmitter can be found in the "Technical Information" document for 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 Section "Documentation" on Page 83.

Weight

Promag W weight data in kg

Diameter		Compact version					Remote version (without cable)						Trans-mitter
		EN (DIN)/ AS*		JIS		ANSI/ AWWA		Sensor					
								EN (DIN)/ AS*		JIS		ANSI/ AWWA	
[mm]	[inch]												
25	1"	PN 40	5.7	10K	5.7	Class 150	5.7	PN 40	5.3	10K	5.3	Class 150	5.3	3.1
32	1 1/4"		6.4		5.7		–		6.0		5.3		–	3.1
40	1 1/2"		7.8		6.7		7.8		7.4		6.3		7.4	3.1
50	2"		9.0		7.7		9.0		8.6		7.3		8.6	3.1
65	2 1/2"	PN 16	10.4		9.5		–	PN 16	10.0		9.1		–	3.1
80	3"		12.4		10.9		12.4		12.0		10.5		12.0	3.1
100	4"		14.4		13.1		14.4		14.0		12.7		14.0	3.1
125	5"		19.9		19.4		–		19.5		19.0		–	3.1
150	6"		23.9		22.9		23.9		23.5		22.5		23.5	3.1
200	8"	PN 10	43.4		40.3		43.4	PN 10	43		39.9		43	3.1
250	10"		63.4		67.8		73.4		63		67.4		73	3.1
300	12"		68.4		70.7		108.4		68		70.3		108	3.1
350	14"		113.4				172.4		113				173	3.1
400	16"		133.4				203.4		133				203	3.1
450	18"		173.4				253.4		173				253	3.1
500	20"		173.4				283.4		173				283	3.1
600	24"		233.4				403.4		233				403	3.1
700	28"		353.4				398.4		353				398	3.1
–	30"		–				458.4		–				458	3.1
800	32"		433.4				548.4		433				548	3.1
900	36"		573.4				798.4		573				798	3.1
1000	40"		698.4				898.4		698				898	3.1
–	42"	PN 6	–			Class D	1098.4	PN 6	–			Class D	1098	3.1
1200	48"		848.4				1398.4		848				1398	3.1
–	54"		–				2198.4		–				2198	3.1
1400	–		1298.4				–		1298				–	3.1
–	60"		–				2698.4		–				2698	3.1
1600	–		1698.4				–		1698				–	3.1
–	66"		–				3698.4		–				3698	3.1
1800	72"		2198.4				4098.4		2198				4098	3.1
–	78"		–				4598.4		–				4598	3.1
2000	–		2798.4				–		2798				–	3.1

Promag transmitter (compact version): 1.8 kg
(Weight data valid for standard pressure ratings and without packaging material)
*For flanges to AS, only DN 80, 100, 150...400, 500 and 600 are available)

Promag P weight data in kg								
Diameter		Compact version			Remote version (without cable)			
					Sensor			Trans-mitter
[mm]	[inch]	EN (DIN)/AS*	JIS	ANSI/AWWA	EN (DIN)/AS*	JIS	ANSI/AWWA	
25	1"	PN 40 — 5.7	10K — 5.7	Class 150 — 5.7	PN 40 — 5.3	10K — 5.3	Class 150 — 5.3	3.1
32	1 1/4"	6.4	5.7	–	6.0	5.3	–	3.1
40	1 1/2"	7.8	6.7	7.8	7.4	6.3	7.4	3.1
50	2"	9.0	7.7	9.0	8.6	7.3	8.6	3.1
65	2 1/2"	PN 16 — 10.4	9.5	–	PN 16 — 10.0	9.1	–	3.1
80	3"	12.4	10.9	12.4	12.0	10.5	12.0	3.1
100	4"	14.4	13.1	14.4	14.0	12.7	14.0	3.1
125	5"	19.9	19.4	–	19.5	19.0	–	3.1
150	6"	23.9	22.9	23.9	23.5	22.5	23.5	3.1
200	8"	PN 10 — 43.4	40.3	43.4	PN 10 — 43	39.9	43	3.1
250	10"	63.4	67.8	73.4	63	67.4	73	3.1
300	12"	68.4	70.7	108.4	68	70.3	108	3.1
350	14"	113.4		172.4	113		173	3.1
400	16"	133.4		203.4	133		203	3.1
450	18"	173.4		253.4	173		253	3.1
500	20"	173.4		283.4	173		283	3.1
600	24"	233.4		403.4	233		403	3.1
Promag transmitter (compact version): 1.8 kg (weight data apply to standard pressure ratings and without packaging material) *For flanges to AS, only DN 25 and 50 are available.								

Promag H weight data in kg				
Diameter		Compact version	Remote version (without cable)	
[mm]	[inch]	DIN	Sensor	Transmitter
2	1/12"	3.6	2.5	3.1
4	5/32"	3.6	2.5	3.1
8	5/16"	3.6	2.5	3.1
15	1/2"	3.7	2.6	3.1
25	1"	3.9	2.8	3.1
40	1 1/2"	4.9	4.5	3.1
50	2"	7.4	7.0	3.1
65	2 1/2"	7.9	7.5	3.1
80	3"	17.4	17.0	3.1
100	4"	16.9	16.5	3.1
Promag transmitter (compact version): 1.8 (Weight data valid for standard pressure ratings and without packaging material)				

Material	**Promag W and P**
	■ Transmitter housing: powder-coated die-cast aluminium

Promag W and P

- Transmitter housing: powder-coated die-cast aluminium

- Sensor housing
  - DN 25...300: powder-coated die-cast aluminium
  - DN 350...2000: coated steel (Amerlock 400)

- Measuring tube
  - DN < 350: stainless steel 1.4301 or 1.4306/304L
    Flange material with Al/Zn protective coating
  - DN > 300: stainless steel 1.4301 or 1.4306/304
    Flange material with Amerlock 400 coating)

- Flanges
  - EN 1092-1 (DIN2501): RSt37-2 (S235JRG2) / C22 / FE 410W B
    (DN < 350: with Al/Zn protective coating; DN > 300 with Amerlock 400 coating)
  - ANSI: A105
    (DN < 350: with Al/Zn protective coating; DN > 300 with Amerlock 400 coating)
  - AWWA (only Promag W): 1.0425
  - JIS: RSt37-2 (S235JRG2) / HII / 1.0425
    (DN < 350: with Al/Zn protective coating; DN > 300 with Amerlock 400 coating)
  - AS 2129
    - (DN 25, 150, 200, 250, 300, 600) A105 or RSt37-2 (S235JRG2)
    - (DN 50, 80, 100, 350, 400, 500) A105 or St44-2 (S275JR)
  - AS 4087: A105 or St44-2 (S275JR)

- Ground disks: 1.4435/316L or Alloy C-22

- Electrodes: 1.4435/316L, Alloy C-22

- Seals: seals to DIN EN 1514-1

Promag H

- Transmitter housing: powder-coated die-cast aluminium

- Sensor housing: 1.4301/304

- Wall mounting kit: 1.4301 (AISI 304)

- Measuring pipe: 1.4301 (AISI 304) or 1.4306/304L

- Flanges: connections generally made of 1.4404/316L

- Grounding rings: 1.4435/316L (optional: Alloy C-22)

- Electrodes: 1.4435 (AISI 316L) (optional: Alloy C-22)

- Seals
  - DN 2...25: O-ring (EPDM, Viton, Kalrez), moulded seal (EPDM, Viton, silicone)
  - DN 40...100: moulded seal (EPDM, Viton, silicone)

Material load diagram	Material load diagrams (pressure-temperature diagrams) for the process connections can be found in the "Technical Information" of the device in question. List of documentation → Page 83.
Fitted electrodes	Measuring electrodes, reference electrodes and empty pipe detection electrodes available as standard with: ■ Carbon steel 1.4435 (AISI 316L) ■ Alloy C-22 Promag H: DN 2…4 → Without empty pipe detection electrode.

Process connection	**Promag W and P** Flange connections: ■ EN 1092–1 (DIN 2501), DN 65 PN 16 and DN 600 PN 16 exclusively to EN 1092–1 ■ ANSI ■ AWWA (only Promag W) ■ JIS ■ AS **Promag H** With O–ring: ■ Flange EN (DIN), ANSI, JIS ■ External thread With gasket seals: ■ Weld sockets DIN 11850, ODT/SMS ■ TriClamp L14 AM7 ■ Threaded joint DIN 11851, DIN 11864–1, SMS 1145 ■ Flange DIN 11864–2
Surface roughness	■ Measuring tube lining $\rightarrow$ PFA: $\leq 0.4\ \mu m$ ■ Electrodes $\rightarrow$ 1.4435, Alloy C–22: 0.3...0.5 μm ■ Promag H process connection: $\leq 0.8\ \mu m$ All data refer to parts in contact with medium.

10.1.11 Human interface

Display elements	■ Liquid crystal display: unilluminated, two–line, 16 characters per line ■ Display (operating mode) preconfigured: volume flow and totalizer status ■ 1 totalizer
Operating elements	Local operation via three keys (⊟ , ⊞ , E)
Remote operation	Operation via HART protocol and Fieldtool

10.1.12 Certificates and approvals

Ex approvals	Information about currently available Ex versions (ATEX, FM, CSA, etc.) can be supplied by your Endress+Hauser Sales Centre on request. All explosion protection data are given in a separate documentation which is available upon request.

Sanitary compatibility	**Promag W and P** ■ No appropriate approvals or certificates **Promag H** ■ 3A approval and EHEDG–tested ■ Seals: conform to FDA (apart from Kalrez seals)

Pressure measuring device approval	Measuring devices with a nominal diameter smaller than or equal to DN 25 correspond to Article 3 (3) of the EC Directive 97/23/EC (Pressure Equipment Directive) and have been designed and manufactured according to good engineering practice. Where necessary (depending on the medium and process pressure), there are additional optional approvals to Category II/III for larger nominal diameters.

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 Authority (ACA).

Other standards and guidelines	■ EN 60529: Degrees of protection by housing (IP code). ■ EN 61010 Protection Measures for Electrical Equipment for Measurement, Control, Regulation and Laboratory Procedures. ■ EN 61326/A1 (IEC 1326) "Emission in accordance with requirements for Class A". Electromagnetic compatibility (EMC requirements) ■ ANSI/ISA–S82.01 Safety Standard for Electrical and Electronic Test, Measuring, Controlling and related Equipment – General Requirements. Pollution degree 2, Installation Category II. ■ CAN/CSA–C22.2 (No. 1010.1–92) Safety requirements for Electrical Equipment for Measurement and Control and Laboratory Use. Pollution degree 2, Installation Category I.

10.1.13 Ordering information

Your Endress+Hauser service organisation 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 → Page 60. Your Endress+Hauser service organisation can provide detailed information on the order codes in question.

10.1.15 Documentation

■ System Information Promag 10 (SI 042D/06/en)
■ Technical Information Promag 10 W (TI 093D/06/en)
■ Technical Information Promag 10 P (TI 094D/06/en)
■ Technical Information Promag 10 H (TI 095D/06/en)

10.2   Measuring tube specifications

Information on the measuring tube specifications can be found in the following documents:
- Technical Information Promag 10 W (TI 093D/06/en)
- Technical Information Promag 10 P (TI 094D/06/en)
- Technical Information Promag 10 H (TI 095D/06/en)

You can also download these documents as PDF files from Endress+Hauser's Internet site
→ www.endress.com

10.3   Dimensions

Information on the dimensions can be found in the following documents:
- Technical Information Promag 10 W (TI 093D/06/en)
- Technical Information Promag 10 P (TI 094D/06/en)
- Technical Information Promag 10 H (TI 095D/06/en)

You can also download these documents as PDF files from Endress +Hauser's Internet site
→ www.endress.com

11　Appendix

11.1　Illustration of the function matrix

Function groups		Functions				
SYSTEM UNITS (Page 86)	▲	UNIT. VOL. FLOW (Page 86)	UNIT VOLUME (Page 86)			
OPERATION (Page 87)	▲	LANGUAGE (Page 87)	ACCESS CODE (Page 87)	DEFINE PRIVATE CODE		
USER INTERFACE (Page 88)	▲	FORMAT (Page 88)	CONTRAST LCD (Page 88)	TEST DISPLAY (Page 88)		
TOTALIZER (Page 89)	▲	SUM (Page 88)	OVERFLOW (Page 89)	RESET TOTALIZ. (Page 89)		
CURRENT OUTPUT (Page 90)	▲	CURRENT RANGE (Page 90)	VALUE 20 mA (Page 91)	TIME CONSTANT (Page 91)		
PULSE/STATUS OUTP. (Page 92)	▲	OPERATING MODE (Page 92)	PULSE VALUE (Page 92)	PULSE WIDTH (Page 92)	OUTPUT SIGNAL (Page 93)	
			ASSIGN STATUS (Page 93)	SWITCH-ON POINT (Page 93)	SWITCH-OFF POINT (Page 94)	
COMMUNICATION (Page 97)	▲	TAG NAME (Page 97)	TAG DESCR. (Page 97)	BUS ADDRESS (Page 97)	HART WRITE PROTECT.	MANUFACTURER ID (Page 97)	DEVICE ID (Page 97)
PROCESS PARAM. (Page 98)	▲	LOW FLOW CUT OFF (Page 98)	EPD (Page 98)	EPD ADJ. (Page 99)		
SYSTEM PARAM. (Page 100)	▲	INSTALLATION DIRECTION	MEASURING MODE (Page 100)	POS. ZERO-RET. (Page 102)	SYSTEM DAMP. (Page 102)	
SENSOR DATA (Page 103)	▲	K-FACTOR (Page 103)	ZERO POINT (Page 103)	NOMINAL DIAMETER (Page 103)	MEASURING PERIOD (Page 103)	EPD ELECTRODE (Page 103)
SUPERVISION (Page 104)	▲	FAILSAFE MODE (Page 104)	ALARM DELAY (Page 105)	SYSTEM RESET (Page 105)	SELF CHECKING (Page 105)	
SIMULAT. SYSTEM (Page 106)	▲	SIM. FAILSAFE (Page 106)	SIM. MEASURAND (Page 106)	VALUE SIM. MEASURAND		
SENSOR VERSION (Page 107)	▲	SERIAL NUMBER (Page 107)	SENSOR TYPE (Page 107)			
AMPLIFIER VERS. (Page 107)	▲	SW REV. (Page 107)				

11.2   Group SYSTEM UNITS

Functional description SYSTEM UNITS
Use this function group to select the unit required and displayed for the measured variable.

UNIT VOLUME FLOW	Use this function to select the unit required and displayed for the volume flow. The unit you select here is also valid for: ■ Volume flow display ■ Current output ■ Switch points (limit value for volume flow, flow direction) ■ Low flow cut off **Options:** Metric: Cubic centimetre → cm^3/s; cm^3/min; cm^3/h; cm^3/day Cubic decimetre → dm^3/s; dm^3/min; dm^3/h; dm^3/day Cubic metre → m^3/s; m^3/min; m^3/h; m^3/day Millilitre → ml/s; ml/min; ml/h; ml/day Litre → l/s; l/min; l/h; l/day Hectolitre → hl/s; hl/min; hl/h; hl/day Megalitre → Ml/s; Ml/min; Ml/h; Ml/day US: Cubic centimeter → cc/s; cc/min; cc/h; cc/day Acre foot → af/s; af/min; af/h; af/day Cubic foot → ft3/s; ft3/min; ft3/h; ft3/day Fluid ounce → oz f/s; oz f/min; oz f/h; oz f/day Gallon → gal/s; gal/min; gal/h; gal/day Million gallons → Mgal/s; Mgal/min; Mgal/h; Mgal/day Barrel (normal fluids: 31.5 gal/bbl) → bbl/s; bbl/min; bbl/h; bbl/day Barrel (beer: 31.0 gal/bbl) → bbl/s; bbl/min; bbl/h; bbl/day Barrel (petrochemicals: 42.0 gal/bbl) → bbl/s; bbl/min; bbl/h; bbl/day Barrel (filling tanks: 55.0 gal/bbl) → bbl/s; bbl/min; bbl/h; bbl/day Imperial: Gallon → gal/s; gal/min; gal/h; gal/day Mega gallon → Mgal/s; Mgal/min; Mgal/h; Mgal/day Barrel (beer: 36.0 gal/bbl) → bbl/s; bbl/min; bbl/h; bbl/day Barrel (petrochemicals: 34.97 gal/bbl) → bbl/s; bbl/min; bbl/h; bbl/day **Factory setting**: Depends on nominal diameter and country (dm^3/min...m^3/h or US–gal/min), corresponding to the full scale value unit factory setting → Page 108 ff.
UNIT VOLUME	Use this function to select the unit required and displayed for the volume. The unit you select here is also valid for: ■ Totalizer status display ■ Totalizer unit ■ Pulse value (e.g. m^3/p) **Options**: Metric → cm^3; dm^3; m^3; ml; l; hl; Ml US → cc; af; ft3; oz f; gal; Mgal; bbl (normal fluids); bbl (beer); bbl (petrochemicals); bbl (filling tanks) Imperial → gal; Mgal; bbl (beer); bbl (petrochemicals) **Factory setting**: Depends on nominal diameter and country (dm^3...m^3 or US–gal) corresponding to the totalizer unit factory setting. → Page 108 ff.

11.3   Group OPERATION

Function description OPERATION	
LANGUAGE	Use this function to select the language for all texts, parameters and messages shown on the local display. **Options**: ENGLISH DEUTSCH FRANCAIS ESPANOL ITALIANO **Factory setting**: Depends on country, see factory setting → Page 108 ff. ✎ Note! If you press the ⊞⊟ keys simultaneously at startup, the language defaults to "ENGLISH".
ACCESS CODE	All data of the measuring system are protected against inadvertent change. Programming is disabled and the settings cannot be changed until a code is entered in this function. If you press the 🗝 keys in any function, the measuring system automatically goes to this function and the prompt to enter the code appears on the display (when programming is disabled). You can activate programming by entering your private code (**factory setting = 10**, see also the subsequent DEFINE PRIVATE CODE function) **User input**: Max. 4-digit number: 0...9999 ✎ Note! ▪ The programming levels are disabled if you do not press a key within 60 seconds following automatic return to the HOME position. ▪ You can also disable programming in this function by entering any number (other than the defined private code). ▪ The Endress+Hauser service organisation can be of assistance if you mislay your personal code.
DEFINE PRIVATE CODE	Use this function to enter a personal code to enable programming. **User input:** 0...9999 (max. 4-digit number) **Factory setting:** 10 ✎ Note! ▪ This function only appears if the private code was entered in the ACCESS CODE function. ▪ Programming is always enabled with the code "0". ▪ Programming has to be enabled before this code can be changed. When programming is disabled this function is not available, thus preventing others from accessing your personal code.

11.4   Group USER INTERFACE

Functional description USER INTERFACE	
FORMAT	Use this function to define the maximum number of places after the decimal point displayed for the reading in the main line. **Options**: XXXXX. XXXX.X XXX.XX XX.XXX X.XXXX **Factory setting**: X.XXXX ✎ Note! ■ Note that this setting only affects the reading as it appears on the display, it has no influence on the accuracy of the system's calculations. ■ The places after the decimal point as computed by the measuring device cannot always be displayed, depending on this setting and the engineering unit. In such instances an arrow appears on the display between the measuring value and the engineering unit (e.g. $1.2 \rightarrow l/h$), indicating that the measuring system is computing with more decimal places than can be shown on the display.
CONTRAST LCD	Use this function to optimise display contrast to suit local operating conditions. **User input**: 10...100% **Factory setting**: 50%
TEST DISPLAY	Use this function to test the operability of the local display and its pixels. **Options**: OFF ON **Factory setting**: OFF **Test sequence**: 1. Start the test by selecting ON. 2. All pixels of the main line and additional line are darkened for minimum 0.75 seconds. 3. The main line and additional line show an "8" in each field for minimum 0.75 seconds. 4. The main line and additional line show a "0" in each field for minimum 0.75 seconds. 5. The main line and additional line show nothing (blank display) for minimum 0.75 seconds. When the test completes the local display returns to its initial state and the setting changes to "OFF".

11.5   Group TOTALIZER

Functional description TOTALIZER	
SUM	The total for the totalizer's measured variable aggregated since measuring commenced appears on the display.
	This value can be positive or negative, depending on:
	■ Flow direction and/or ■ Setting in the MEASURING MODE function → Page 100
	Display: Max. 6-digit floating-point number, incl. sign and unit (e.g. 15467.4 m^3)
	✎ Note! ■ The totalizer's response to faults is defined in the central "FAILSAFE MODE" function → Page 104. ■ The unit of the totalizer is defined in the UNIT VOLUME function → Page 86.
OVERFLOW	The total for the totalizer's overflow aggregated since measuring commenced appears on the display. Total flow quantity is represented by a floating-point number consisting of max. 6 digits. You can use this function to view higher numerical values (>9,999,999) as overflows. The effective quantity is thus the total of the OVERFLOW function plus the value displayed in the SUM function.
	Example: Reading for 2 overflows: 2 E7 dm^3 (= 20,000,000 dm^3) The value displayed in the function "SUM" = 196,845 dm^3 Effective total quantity = 20,196,845 dm^3
	Display: Integer with exponent, including sign and unit, e.g. 2 E7 dm^3
RESET TOTALIZER	Use this function to reset the sum and the overflow of the totalizer to "zero" (= RESET).
	Options: NO YES
	Factory setting: NO

11.6   Group CURRENT OUTPUT

Functional description CURRENT OUTPUT

✎ Note!
The functions of the CURRENT OUTPUT group are only available if the "0" value was entered in the BUS ADDRESS function → **Page 97**.

CURRENT RANGE	Use this function to specify the current range. You can configure the current output either in accordance with the NAMUR recommendation (max. 20.5 mA) or for a maximum drive of 25 mA.

Options:
OFF
4–20 mA (25 mA)
4–20 mA (25 mA) HART
4–20 mA NAMUR
4–20 mA HART NAMUR
4–20 mA US
4–20 mA HART US

Factory setting:
4–20 mA (25 mA) HART NAMUR

Current range, work range and signal on alarm level
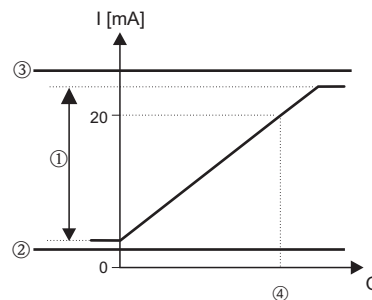
A	①	②	③
OFF	4 mA	–	–
4-20 mA (25 mA)	4 – 24 mA	2	25
4-20 mA (25 mA) HART	4 – 24 mA	2	25
4-20 mA NAMUR	3,8 – 20,5 mA	3,5	22,6
4-20 mA HART NAMUR	3,8 – 20,5 mA	3,5	22,6
4-20 mA US	3,9 – 20,8 mA	3,75	22,6
4-20 mA HART US	3,9 – 20,8 mA	3,75	22,6

F06-10xxxxxx-05-xx-xx-xx-003.eps

A = Work range
① = Work range
② = Lower signal on alarm level
③ = Upper signal on alarm level
④ = Scaled full scale value
Q = Flow
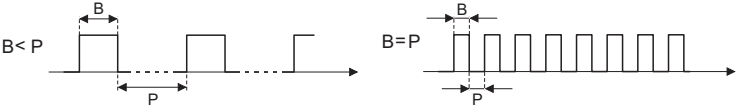
✎   Note!
- If the measured value is outside the measuring range (defined in the VALUE 20 mA function→ Page 91), a notice message is generated.
- The current output's response to faults is defined in the central FAILSAFE MODE function → Page 104.

Functional description CURRENT OUTPUT	
VALUE 20 mA	Use this function to assign the 20 mA current a full scale value. Positive and negative values are permitted. The required measuring range is defined by defining the VALUE 20 mA . In the SYMMETRY measuring mode → Page 100, the value assigned applies to both flow directions; in the STANDARD measuring mode it applies only to the flow direction selected. **User input**: 5-digit floating-point number, with sign **Factory setting**: Depends on nominal diameter and country, [value] ∕ ∕ [dm^3...m^3 or US-gal...US-Mgal] Corresponds to the factory setting for the full scale value → Page 108 ff.. ✎ Note! ▪ The appropriate unit is taken from the SYSTEM UNITS group → Page 86. ▪ The value for 4 mA always corresponds to the zero flow (0 [unit]). This value is fixed and cannot be edited.
TIME CONSTANT	Use this function to enter a time constant defining how the current output signal reacts to severely fluctuating measured variables, either very quickly (enter a low time constant) or with damping (enter a high time constant). **User input**: Fixed-point number 0.01...100.00 s **Factory setting**: 1.00 s

11.7   Group PULSE/STATUS OUTPUT

Functional description PULSE/STATUS OUTPUT	
OPERATING MODE	Configuration of the output as a pulse or status output. The functions available in this function group vary, depending on which option you select here. **Options**: OFF PULSE STATUS **Factory setting**: PULSE
PULSE VALUE	✎ Note! This function is not available unless the PULSE setting was selected in the OPERATING MODE function. Use this function to define the flow at which a pulse is triggered. These pulses can be totalled by an external totalizer, and the total flow quantity since measuring started can be registered in this way. In the SYMMETRY measuring mode → Page 100, the value assigned applies to both flow directions; in the STANDARD measuring mode it applies only to the positive flow direction. **User input**: 5-digit floating-point number, [unit] **Factory setting**: Depends on nominal diameter and country, [value] [dm^3...m^3 or US-gal] ∕ pulse; Corresponds to the factory setting for the pulse value → Page 108 ff.. ✎ Note! The appropriate unit is taken from the SYSTEM UNITS group.
PULSE WIDTH	✎ Note! This function is not available unless the PULSE setting was selected in the OPERATING MODE function. Use this function to enter the maximum pulse width of the output pulses. **User input**: 5...2000 ms **Factory setting**: 100 ms Pulse output is always with the pulse width (B) entered in this function. The pauses (P) between the individual pulses are automatically configured. However, they must at least correspond to the pulse width (B = P). P= Intervals between the individual pulses B = Pulse width entered (the illustration applies to positive pulses) ☝ Caution! Buffering (pulse memory) takes place if the number of pulses is too large to output the pulses with the selected pulse width (see PULSE VALUE function on Page 92). The system error message RANGE PULSE is displayed if more pulses are in the pulse memory than can be output in 4 seconds. ✎ Note! ▪ When entering the pulse width, select a value that can still be processed by an external totalizer (e.g. mechanical totalizer, PLC, etc.). ▪ The pulse output's response to faults is defined in the central FAILSAFE MODE function → Page 104.

Functional description PULSE/STATUS OUTPUT	
OUTPUT SIGNAL	✎ **Note!** This function is not available unless the PULSE setting was selected in the OPERATING MODE function. Use this function to configure the output in such a way that it matches an external counter, for example. Depending on the application, you can select the direction of the pulses here. **Options:** PASSIVE – POSITIVE PASSIVE – NEGATIVE **Factory setting:** PASSIVE – NEGATIVE
ASSIGN STATUS OUTPUT	✎ **Note!** This function is not available unless the STATUS setting was selected in the OPERATING MODE function. Configuration of the status output. **Options:** ON (operation) FAULT MESSAGE NOTICE MESSAGE FAULT MESSAGE or NOTICE MESSAGE EPD (empty pipe detection, only if active) FLOW DIRECTION VOLUME FLOW LIMIT VALUE **Factory setting:** FAULT MESSAGE ✎ **Note!** ■ The behaviour of the status output is a normally closed behaviour, in other words the output is closed (transistor conductive) when normal, error-free measuring is in progress. ■ It is very important to read and comply with the information on the switching characteristics of the status output → Page 95.
SWITCH-ON POINT	✎ **Note!** This function is not available unless LIMIT VALUE or FLOW DIRECTION was selected in the ASSIGN STATUS OUTPUT function. Use this function to assign a value to the switch-on point (status output pulls up). The value can be equal to, greater than or less than the switch-off point. Positive and negative values are permitted. **User input:** 5-digit floating-point number, [unit] **Factory setting:** 0 [unit] ✎ **Note!** ■ The appropriate unit is taken from the SYSTEM UNITS group. ■ Only the switch-on point is available for flow direction output (no switch-off point). If you enter a value not equal to the zero flow (e.g. 5), the difference between the zero flow and the value entered corresponds to half the switchover hysteresis.

Functional description PULSE/STATUS OUTPUT	
SWITCH-OFF POINT	✎ Note! This function is not available unless LIMIT VALUE was selected in the ASSIGN STATUS OUTPUT function. Use this function to assign a value to the switch-off point (status output drops off). The value can be equal to, greater than or less than the switch-on point. Positive and negative values are permitted. **User input:** 5-digit floating-point number, [unit] **Factory setting:** 0 [unit] ✎ Note! ▪ The appropriate unit is taken from the SYSTEM UNITS group. ▪ If SYMMETRY is selected in the MEASURING MODE function and values with different signs are entered for the switch-on and switch-off points, the notice message "INPUT RANGE EXCEEDED" appears.

11.7.1 Information on the response of the status output

General

If you have configured the status output for "LIMIT VALUE" or "FLOW DIRECTION", you can configure the requisite switch points in the SWITCH-ON POINT and SWITCH-OFF POINT functions. When the measured variable in question reaches these predefined values, the status output switches as shown in the illustrations below.

Status output configured for flow direction

Switch-off point/switch-on point
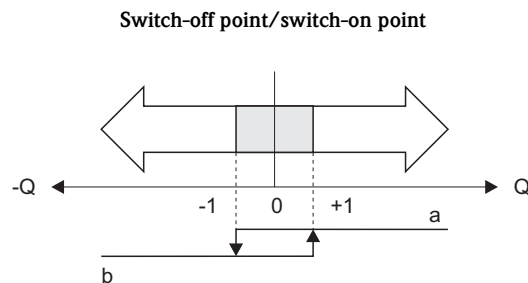
A0001236

a = Status output conductive
b = Status output not conductive

The value you entered in the function SWITCH-ON POINT defines the switch point for the positive and negative directions of flow. If, for example, the switch point entered is = 1 m3/h, the status output switches off at −1 m3/h (not conductive) and switches on again at +1 m3/h (conductive). Set the switch point to 0 if your process calls for direct switchover (no switching hysteresis). If low flow cut off is used, it is advisable to set hysteresis to a value greater than or equal to the low flow cut off rate.

Status output configured for limit value

The status output switches as soon as the measured variable undershoots or overshoots a defined switch point.

Application: monitoring flow or process-related boundary conditions.
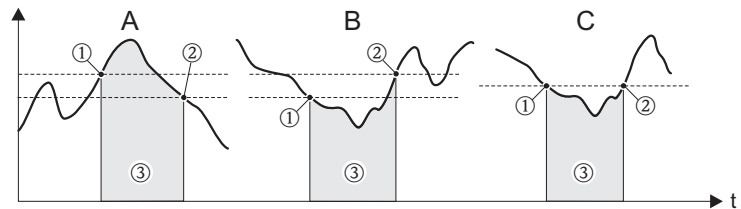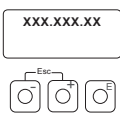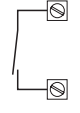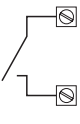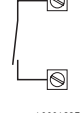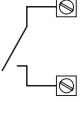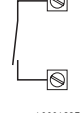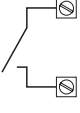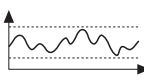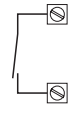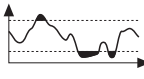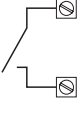
A0001235

- A = Maximum safety:
  → ① SWITCH-OFF POINT > ② SWITCH-ON POINT
- B = Minimum safety:
  → ① SWITCH-OFF POINT ② SWITCH-ON POINT
- C = Minimum safety:
  → ① SWITCH-OFF POINT = ② SWITCH-ON POINT (this configuration should be avoided)
- ③ = Relay de-energised

11.7.2   Switching behaviour of the status output

Function	State		Open collector behaviour (Transistor)	
ON (operation)	System in measuring mode	xxx.xxx.xx	conductive	A0001237
	System not in measuring mode (power supply failed)	xxx.xxx.xx	not conductive	A0001239
Fault message	System OK	xxx.xxx.xx	conductive	A0001237
	(System error or process error) fault → Response to error, outputs/inputs and totalizers	xxx.xxx.xx	not conductive	A0001239
Notice message	System OK	xxx.xxx.xx	conductive	A0001237
	(System error or process error) Notice → Continuation of measuring	xxx.xxx.xx	not conductive	A0001239
Continued overleaf.				
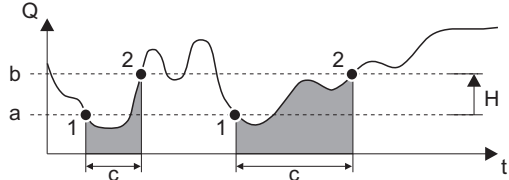
Function	State		Open collector behaviour (Transistor)	
Fault message or notice message	System OK	xxx.xxx.xx	conductive	A0001237
	(System error or process error) Fault → Response to error or Notice → Continuation of measuring	xxx.xxx.xx	not conductive	A0001239
Empty pipe detection (EPD)	Measuring tube full		conductive	A0001237
	Measuring tube partially filled / empty measuring tube		not conductive	A0001239
Flow direction	Forwards	A0001241	conductive	A0001237
	Backwards	A0001242	not conductive	A0001239
Volume flow limit value	Limit value not overshot or undershot	A0001243	conductive	A0001237
	Limit value overshot or undershot	A0001244	not conductive	A0001239

11.8   Group COMMUNICATION
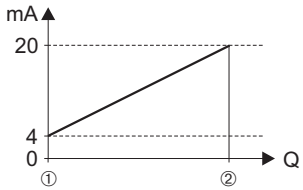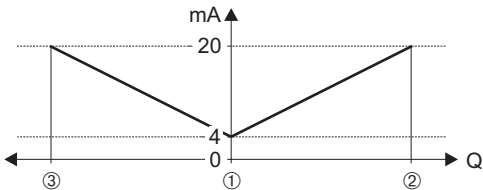
Functional description COMMUNICATION
✎   Note! The communication group is only visible if the HART option was selected in the CURRENT RANGE function.

TAG NAME	Use this function to enter a tag name for the measuring device. You can edit and read this tag name at the local display or via the HART protocol. **User input**: Max. 8-character text, permitted characters are: A–Z, 0–9, +,-, underscore, space, period **Factory setting**: "_ _ _ _ _ _ _ _" (no text)
TAG DESCRIPTION	Use this function to enter a tag description for the measuring device. You can edit and read this tag description at the local display or via the HART protocol. **User input**: Max. 16-character text, permitted characters are: A–Z, 0–9, +,-, underscore, space, period **Factory setting**: "_ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _" (no text)
BUS ADDRESS	Use this function to define the address for the exchange of data with the HART protocol. **User input**: 0...15 **Factory setting**: 0 ✎ Note! Addresses 1...15: a constant 4 mA current is applied.
HART WRITE PROTECTION	Use this function to activate HART write protection. **Options**: OFF = function can be edited/read via the HART protocol ON = HART protocol write-protected (only readable) **Factory setting**: OFF
MANUFACTURER ID	Use this function to view the manufacturer ID in decimal numerical format. **Display**: – Endress+Hauser – 17 ($\cong$ 11 hex) for Endress+Hauser
DEVICE ID	Use this function to view the device ID in hexadecimal numerical format. **Display**: 45 hex ($\cong$ 69 dec) for Promag 10
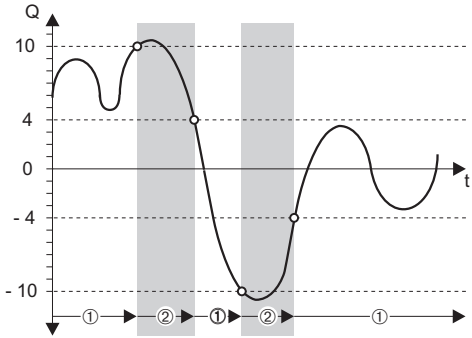
11.9   Group PROCESS PARAMETER

Functional description PROCESS PARAMETER	
SWITCH-ON POINT LOW FLOW CUT OFF	Use this function to enter the switch-on point for low flow cut off. Low flow cut off is active if the value entered is not equal to 0. The sign of the flow value is highlighted on the display to indicate that low flow cut off is active. **User input**: 5-digit floating-point number, [unit] **Factory setting**: Depends on nominal diameter and country, [value] / [dm3...m3 or US-gal] Corresponds to the factory setting for the low flow cut off → Page 108 ff. ✎ Note! The appropriate unit is taken from the SYSTEM UNITS group. The switch-off point is specified as a positive hysteresis from the switch-on point with 50%. *Q Flow [volume/time]* *t Time* *H Hysteresis* *a SWITCH-ON POINT LOW FLOW CUT OFF = 200 dm^3/h* *b Low flow cut off switch-off point = 50%* *c Low flow cut off active* *1 Low flow cut off is switched on at 200 dm^3/h* *2 Low flow cut off is switched off at 300 dm^3/h*
EPD	Activating empty pipe detection (EPD). **Options**: OFF ON (empty pipe detection) **Factory setting**: OFF ✎ Note! ■ The ON option is not available unless the sensor is equipped with an EPD electrode. ■ The default setting for the EPD function when the device is delivered is OFF. The function must be activated as required. ■ When delivered, the measuring device is calibrated with water (500 μS/cm). If the fluid differs from this conductivity, empty-pipe and full-pipe adjustment has to be performed on site. ■ To activate the function (ON option), valid adjustment coefficients have to be available. ■ The following error messages are displayed if the empty-pipe and full-pipe adjustment is incorrect: ■ ADJUSTMENT FULL = EMPTY: the adjustment values for empty pipe and full pipe are identical. ■ ADJUSTMENT NOT OK: adjustment is not possible as the fluid conductivity values are outside the permitted range. ■ In such instances, empty-pipe adjustment/full-pipe adjustment must be carried out again.

Functional description PROCESS PARAMETER	
EPD-MODE (continued)	**Notes on empty pipe detection (EPD)** ■ Flow cannot be measured correctly unless the measuring tube is completely full. This status can be monitored at all times by means of the EPD. ■ An empty or partially filled pipe is a process error. A default factory setting defines that a notice message is issued and that this process error does not have any effect on the outputs. ■ The EPD process error can be output via the configurable status output. **Response to partially filled pipe** If the EPD is switched on and responds to a partially filled or empty pipe, the notice message "EMPTY PIPE" appears on the display and zero flow is indicated. If the pipe is partially empty and the EPD is not switched on, the response can vary in identically configured systems: ■ Flow reading fluctuates ■ Zero flow ■ Excessively high flow values
EPD ADJUSTMENT	Use this function to activate adjustment for an empty or full measuring tube. **Options:** OFF EPD EMPTY PIPE ADJ. EPD FULL PIPE ADJUST **Factory setting:** OFF ✎ Note! An exact description of the procedure for an EPD empty-pipe/full-pipe adjustment is provided on Page 58.

11.10   Group SYSTEM PARAMETER

Functional description SYSTEM PARAMETER

INSTALLATION DIRECTION SENSOR	Use this function to reverse the sign of the flow quantity, if necessary. **Options**: FORWARDS (flow as indicated by the arrow) BACKWARDS (flow opposite to direction indicated by the arrow) **Factory setting**: FORWARDS ✎ Note! Ascertain the actual direction of fluid flow with reference to the direction indicated by the arrow on the sensor (nameplate).
MEASURING MODE	Use this function to select the measuring mode for all outputs and for the internal totalizer. **Options**: STANDARD SYMMETRY **Factory setting**: STANDARD The responses of the individual outputs and the internal totalizer in each of the measuring modes are described in detail on the following pages: **Current output** STANDARD Only the flow components for the selected flow direction are output, (positive or negative full scale value ② = flow direction). Flow components in the opposite direction are not taken into account (suppression). Example for current output: A0001248 SYMMETRY The output signals of the current output are independent of the direction of flow (absolute amount of the measured variable). The "VALUE20mA" (e.g. backflow) corresponds to the mirrored VALUE20mA ② (e.g. flow). Positive and negative flow components are taken into account. Example for current output: A0001249 ✎ Note! The direction of flow can be output via the configurable status output.

Functional description SYSTEM PARAMETER

| Measuring mode (Contd) | **Pulse output**

STANDARD
Only flow components of the positive flow direction are output.
Components in the opposite direction are not taken into account.

SYMMETRY
The absolute value of the positive and negative flow components is taken into account.

Status output

✎   Note!
The information is only applicable if LIMIT VALUE was selected in the function ASSIGN STATUS OUTPUT.

STANDARD
The status output signal switches at the defined switch points.

SYMMETRY
The status output signal switches at the defined switch points, irrespective of the sign. In other words, if you define a switch point with a positive sign, the status output signal switches as soon as the value is reached in the negative direction (negative sign), (see illustration).

Example for the SYMMETRY measuring mode:
Switch-on point: Q = 4
Switch-off point: Q = 10
① = Status output switched on (conductive)
② = Status output switched off (non-conductive)

F-xxxxxxxx-05-xx-xx-xx-005

Totalizer
STANDARD
Only positive flow components are output.
Negative components are not taken into account.

SYMMETRY
The positive and negative flow components are balanced.
In other words, net flow in the flow direction is registered. |

Functional description SYSTEM PARAMETER	
POSITIVE ZERO RETURN	Use this function to interrupt evaluation of measured variables. This is necessary when a piping system is being cleaned, for example. This setting acts on all function and outputs of the measuring device. **Options**: OFF ON → Signal output is set to the "ZERO FLOW" value. **Factory setting**: OFF
SYSTEM DAMPING	Use this function to set the filter depth of the digital filter. This reduces the sensitivity of the measuring signal to interference peaks (e.g. high solids content, gas bubbles in the fluid, etc.). The system reaction time increases with the filter setting. **User input**: 0 ...4 **Factory setting**: 3 ✎ Note! ▪ The system damping acts on all functions and outputs of the measuring device. ▪ The higher the value set, the stronger the damping (higher response time).

11.11   Group SENSOR DATA

Functional description SENSOR DATA
All sensor data (calibration factors, zero point and nominal diameter etc.) are set at the factory. ☞   Caution! Under normal circumstances you should not change the following parameter settings, because changes affect numerous functions of the entire measuring facility in general and the accuracy of the measuring system in particular. Therefore, the functions described below are provided with an additional prompt (with the code 10) once you enter your private code.

K-FACTOR	Use this function to display the current calibration factor (positive and negative flow direction) for the sensor. The calibration factor is determined and set at the factory. **User input:** 5-digit fixed-point number: 0.5000 ...2.0000 **Factory setting:** Depends on nominal diameter and calibration ✎ Note! This value is also provided on the sensor nameplate.
ZERO POINT	This function shows the current zero-point correction value for the sensor. Zero-point correction is determined and set at the factory. **User input:** Max. 4-digit number: –1000...+1000 **Factory setting:** Depends on nominal diameter and calibration ✎ Note! This value is also provided on the sensor nameplate.
NOMINAL DIAMETER	This function shows the nominal diameter for the sensor. The nominal diameter depends on the size of the sensor and is set at the factory. **Options:** 2...2000 mm 1/12...78" **Factory setting:** Depends on the size of the sensor ✎ Note! This value is also provided on the sensor nameplate.
MEASURING PERIOD	Use this function to set the time for a full measuring period. The duration of the measuring period is calculated from the rise time of the magnetic field, the brief recovery time, the (automatically tracked) integration time and the empty pipe detection time. **User input:** 10...1000 ms **Factory setting:** Depends on nominal diameter
EPD ELECTRODE	Indicates whether the sensor is equipped with an EPD electrode. **Display:** YES NO **Factory setting:** YES → Electrode fitted as standard

11.12   Group SUPERVISION

Functional description SUPERVISION	
FAILSAFE MODE	The dictates of safety render it advisable to ensure that the device signal processing assumes a predefined state in the event of a fault. The setting you select here is valid for: ■ Current output ■ Pulse output ■ Totalizer ✎ Note! This has no effect on the display. **Options**: MINIMUM VALUE MAXIMUM VALUE ACTUAL VALUE **Factory setting**: MINIMUM VALUE The response of the individual outputs and the totalizer is listed below. **Current output**: MINIMUM VALUE The current output adopts the value of the lower signal on alarm level (as defined in the CURRENT RANGE function → Page 90). MAXIMUM VALUE The current output is set to the upper value of the signal on alarm level. (The values in question can be found in the CURRENT RANGE function on → Page 90). ACTUAL VALUE Measured value output is based on the current flow measurement. The fault is ignored. **Pulse output**: MINIMUM or MAXIMUM VALUE Output is zero pulse ACTUAL VALUE Measured value output is based on the current flow measurement (fault is ignored). **Totalizer**: MINIMUM or MAXIMUM VALUE The totalizer is paused until the fault is rectified. ACTUAL VALUE The totalizer continues to count on the basis of the current flow value. The fault is ignored.

Functional description SUPERVISION

ALARM DELAY	Use this function to define a time span in which the criteria for an error have to be satisfied without interruption before an error or notice message is generated. Depending on the setting and the type of error, this suppression acts on: ■ Display ■ Current output ■ Pulse/status output **User input:** 0...100 s (in steps of one second) **Factory setting:** 0 s 🖐 Caution! If this function is activated error and notice messages are delayed by the time corresponding to the setting before being forwarded to the higher-order controller (process controller, etc.). It is therefore imperative to check in advance in order to make sure whether a delay of this nature could affect the safety requirements of the process. If error and notice messages cannot be suppressed, a value of 0 seconds must be entered here.
SYSTEM RESET	Use this function to perform a reset of the measuring system. **Options:** NO RESTART SYSTEM (Restart without disconnecting main power) RESET DELIVERY (Restart without disconnecting main power, the saved settings of the delivery status (factory settings) are applied). **Factory setting:** NO
SELF CHECKING	Use this function to switch on and off the self-checking function of the electrode amplifier. When the function is switched on, the electrode signal circuit is checked against a reference voltage at 60-second intervals. If there is an impermissible deviation from the value, system error message #101 is output and displayed on the local display. **Options:** ON OFF **Factory setting:** OFF

11.13   Group SIMULATION SYSTEM

Functional description SIMULATION SYSTEM	
SIMULATION FAILSAFE MODE	Use this function to set all outputs and the totalizer to their defined failsafe modes, in order to check whether they respond correctly. During this time, the words "SIMULATION FAILSAFE MODE" appear on the display. **Options**: ON OFF **Factory setting**: OFF
SIMULATION MEASURAND	Use this function to set all outputs and the totalizer to their defined flow-response modes, in order to check whether they respond correctly. During this time, the words "SIMULATION MEASURAND" appear on the display. **Options**: OFF VOLUME FLOW **Factory setting**: OFF ✎ Note! ■ The measuring device cannot be used for measuring while this simulation is in progress. ■ The setting is not saved if the power supply fails.
VALUE SIMULATION MEASURAND	✎ Note! This function is not available unless the SIMULATION MEASURAND function is active (= VOLUME FLOW). In this function, a freely selectable value (e.g. 12 m^3/s) is specified. This value is used to test downstream devices and the flowmeter itself. **User input**: 5-digit floating-point number [unit], with sign **Factory setting**: 0 [unit] ☝ Caution! The setting is not saved if the power supply fails. ✎ Note! The appropriate unit is taken from the SYSTEM UNITS group.

11.14   Group SENSOR VERSION

Functional description SENSOR VERSION	
SERIAL NUMBER	Use this function to view the serial number of the sensor.
SENSOR TYPE	Use this function to view the sensor type.

11.15   Group AMPLIFIER VERSION

Functional description AMPLIFIER VERSION	
SOFTWARE REVISION NUMBER	Use this function to view the software revision number of the electronics board.

11.16   Factory settings

11.16.1   SI units (not for USA and Canada)

Low flow cut off, full scale value, pulse value, totalizer

Diameter		Low flow cut off		Current output full scale value		Pulse value		Totalizer
[mm]	[inch]	(approx. v = 0.04 m/s)		(approx. v = 2.5 m/s)		(approx. 2 pulses/s at v = 2.5 m/s)		
2	1/12"	0.01	dm3/min	0.5	dm3/min	0.005	dm3	dm3
4	5/32"	0.05	dm3/min	2	dm3/min	0.025	dm3	dm3
8	5/16"	0.1	dm3/min	8	dm3/min	0.10	dm3	dm3
15	1/2"	0.5	dm3/min	25	dm3/min	0.20	dm3	dm3
25	1"	1	dm3/min	75	dm3/min	0.50	dm3	dm3
32	1 1/4"	2	dm3/min	125	dm3/min	1.00	dm3	dm3
40	1 1/2"	3	dm3/min	200	dm3/min	1.50	dm3	dm3
50	2"	5	dm3/min	300	dm3/min	2.50	dm3	dm3
65	2 1/2"	8	dm3/min	500	dm3/min	5.00	dm3	dm3
80	3"	12	dm3/min	750	dm3/min	5.00	dm3	dm3
100	4"	20	dm3/min	1200	dm3/min	10.00	dm3	dm3
125	5"	30	dm3/min	1850	dm3/min	15.00	dm3	dm3
150	6"	2.5	m3/h	150	m3/h	0.025	m3	m3
200	8"	5.0	m3/h	300	m3/h	0.05	m3	m3
250	10"	7.5	m3/h	500	m3/h	0.05	m3	m3
300	12"	10	m3/h	750	m3/h	0.10	m3	m3
350	14"	15	m3/h	1000	m3/h	0.10	m3	m3
400	16"	20	m3/h	1200	m3/h	0.15	m3	m3
450	18"	25	m3/h	1500	m3/h	0.25	m3	m3
500	20"	30	m3/h	2000	m3/h	0.25	m3	m3
600	24"	40	m3/h	2500	m3/h	0.30	m3	m3
700	28"	50	m3/h	3500	m3/h	0.50	m3	m3
–	30"	60	m3/h	4000	m3/h	0.50	m3	m3
800	32"	75	m3/h	4500	m3/h	0.75	m3	m3
900	36"	100	m3/h	6000	m3/h	0.75	m3	m3
1000	40"	125	m3/h	7000	m3/h	1.00	m3	m3
–	42"	125	m3/h	8000	m3/h	1.00	m3	m3
1200	48"	150	m3/h	10000	m3/h	1.50	m3	m3
–	54"	200	m3/h	13000	m3/h	1.50	m3	m3
1400	–	225	m3/h	14000	m3/h	2.00	m3	m3
–	60"	250	m3/h	16000	m3/h	2.00	m3	m3
1600	–	300	m3/h	18000	m3/h	2.50	m3	m3
–	66"	325	m3/h	20500	m3/h	2.50	m3	m3
1800	72"	350	m3/h	23000	m3/h	3.00	m3	m3
–	78"	450	m3/h	28500	m3/h	3.50	m3	m3
2000	–	450	m3/h	28500	m3/h	3.50	m3	m3

Language

Country	Language
Belgium	English
Denmark	English
Germany	Deutsch
England	English
Finland	English
France	Francais
Holland	English
Hong Kong	English
International Instruments	English
Italy	Italiano
Japan	English
Malaysia	English
Norway	English
Austria	Deutsch
Sweden	English
Switzerland	Deutsch
Singapore	English
Spain	Espanol
South Africa	English
Thailand	English

11.16.2 US units (only for USA and Canada)

Low flow cut off, full scale value, pulse value, totalizer

Diameter		Low flow cut off		Current output full scale value		Pulse value		Totalizer
[inch]	[mm]	(approx. v = 0.04 m/s)		(approx. v = 2.5 m/s)		(approx. 2 pulses/s at v = 2.5 m/s)		
1/12"	2	0.002	gal/min	0.1	gal/min	0.001	gal	gal
5/32"	4	0.008	gal/min	0.5	gal/min	0.005	gal	gal
5/16"	8	0.025	gal/min	2	gal/min	0.02	gal	gal
1/2"	15	0.10	gal/min	6	gal/min	0.05	gal	gal
1"	25	0.25	gal/min	18	gal/min	0.20	gal	gal
1 1/4"	32	0.50	gal/min	30	gal/min	0.20	gal	gal
1 1/2"	40	0.75	gal/min	50	gal/min	0.50	gal	gal
2"	50	1.25	gal/min	75	gal/min	0.50	gal	gal
2 1/2"	65	2.0	gal/min	130	gal/min	1	gal	gal
3"	80	2.5	gal/min	200	gal/min	2	gal	gal
4"	100	4.0	gal/min	300	gal/min	2	gal	gal
5"	125	7.0	gal/min	450	gal/min	5	gal	gal
6"	150	12	gal/min	600	gal/min	5	gal	gal
8"	200	15	gal/min	1200	gal/min	10	gal	gal
10"	250	30	gal/min	1500	gal/min	15	gal	gal
12"	300	45	gal/min	2400	gal/min	25	gal	gal
14"	350	60	gal/min	3600	gal/min	30	gal	gal
16"	400	60	gal/min	4800	gal/min	50	gal	gal
18"	450	90	gal/min	6000	gal/min	50	gal	gal
20"	500	120	gal/min	7500	gal/min	75	gal	gal
24"	600	180	gal/min	10500	gal/min	100	gal	gal
28"	700	210	gal/min	13500	gal/min	125	gal	gal
30"	–	270	gal/min	16500	gal/min	150	gal	gal
32"	800	300	gal/min	19500	gal/min	200	gal	gal
36"	900	360	gal/min	24000	gal/min	225	gal	gal
40"	1000	480	gal/min	30000	gal/min	250	gal	gal
42"	–	600	gal/min	33000	gal/min	250	gal	gal
48"	1200	600	gal/min	42000	gal/min	400	gal	gal
54"	–	1.3	Mgal/d	75	Mgal/d	0.0005	Mgal	Mgal
–	1400	1.3	Mgal/d	85	Mgal/d	0.0005	Mgal	Mgal
60"	–	1.3	Mgal/d	95	Mgal/d	0.0005	Mgal	Mgal
–	1600	1.7	Mgal/d	110	Mgal/d	0.0008	Mgal	Mgal
66"	–	2.2	Mgal/d	120	Mgal/d	0.0008	Mgal	Mgal
72"	1800	2.6	Mgal/d	140	Mgal/d	0.0008	Mgal	Mgal
78"	–	3.0	Mgal/d	175	Mgal/d	0.001	Mgal	Mgal
–	2000	3.0	Mgal/d	175	Mgal/d	0.001	Mgal	Mgal

Language

Country	Language
USA	English
Canada	English

Index

Declaration of Contamination
Erklärung zur Kontamination

Endress+Hauser

People for Process Automation

Because of legal regulations and for the safety of our employees and operating equipment, we need the "declaration of contamination", with your signature, before your order can be handled. Please make absolutely sure to include it with the shipping documents, or – even better – 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", bevor Ihr Auftrag bearbeitet werden kann. Legen Sie diese unbedingt den Versandpapieren bei oder bringen Sie sie idealerweise außen an der Verpackung an.

Type of instrument / sensor
Geräte-/Sensortyp _____

Serial number
Seriennummer _____

Process data/ *Prozessdaten*

Temperature / *Temperatur* _____ [°C]   Pressure / *Druck* _____ [Pa]

Conductivity / *Leitfähigkeit* _____ [S]   Viscosity / *Viskosität* _____ [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; oxidising; dangerous for the environment; biological risk; radioactive
* *explosiv; brandfördernd; umweltgefährlich; biogefährlich; radioaktiv*

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

Reason for return / *Grund zur Rücksendung* _____

_____

_____

Company data / *Angaben zum Absender*

Company / *Firma* _____

_____

Address / *Adresse*

_____

_____

Contact person / *Ansprechpartner* _____

Department / *Abteilung* _____

Phone number/ *Telefon* _____

Fax / E-Mail _____

Your order No. / *Ihre Auftragsnr.* _____

We hereby certify that the returned parts have been carefully cleaned. To the best of our knowledge they are free from any residues in dangerous quantities.
Hiermit bestätigen wir, dass die zurückgesandten Teile sorgfältig gereinigt wurden, und nach unserem Wissen frei von Rückständen in gefahrbringender Menge sind.

P/SF/Konta VIII

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

_____
(Company stamp and legally binding signature)
(Firmenstempel und rechtsverbindliche Unterschrift)

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People for Process Automation

BA082D/06/en/05.05
50104788
FM+SGML6.0 ProMoDo