BA 052D/06/en/03.02
No. 50095347

Valid as of software version:
V 1.01.XX (amplifier)
V 1.02.XX (amplifier)
V 1.01.XX (communication)

PROline promag 53
FOUNDATION Fieldbus
Electromagnetic Flow Measuring System

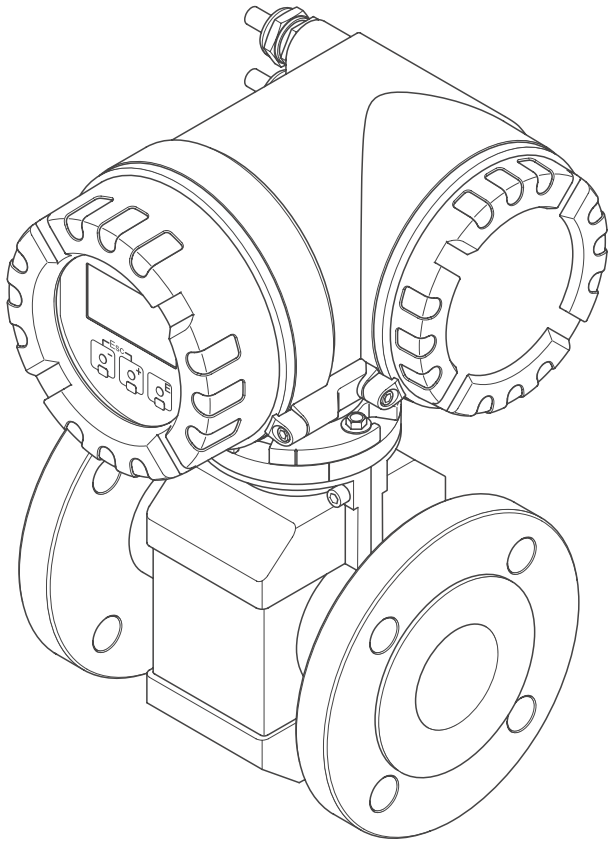








Operating Instructions



Fieldbus Foundation

Endress+Hauser
The Power of Know How

Brief operating instructions

The following brief operating instructions show you how to configure the measuring device quickly and easily:

Safety instructions	Page 7

▼

Installation	Page 13

▼

Wiring	Page 47

▼

Basic configuration (device parameters, automation functions)	Page 78 ff.
Device-specific parameters are configured and the automation functions specified for the FOUNDATION Fieldbus interface by means of configuration programs from various manufacturers. ✎ Note! If the measuring device is equipped with a local display, device-specific parameters and functions can be configured easily and quickly using the “Commissioning” Quick Setup menu, e.g. display language, measured variables, engineering units, etc. → see next page.	

▼

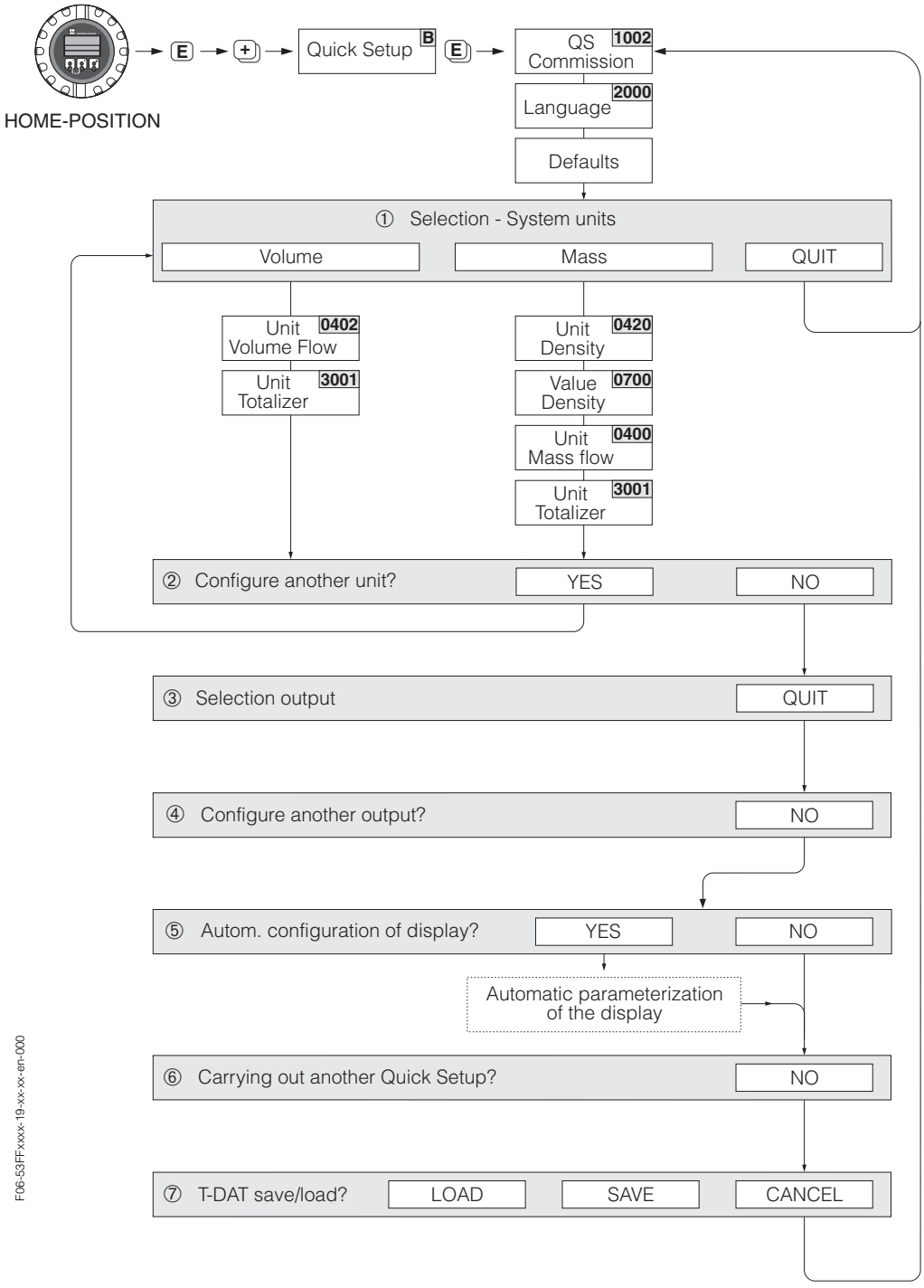
Customer-specific configuration	
Complex measuring operations mean that additional functions must be configured. Users can select these functions individually by means of appropriate device parameters and configure and customise them to suit their process conditions. There are two options open: – Setting parameters via the configuration program (FF) → Page 64 – Setting parameters via the local display (optional) → Page 73 ff. ✎ Note! All functions and device parameters are described in detail in the **“Description of Device Functions”** manual, which is a separate part of these Operating Instructions.	

▼

Trouble-shooting	Page 91 ff.
If faults occur after commissioning or during operation always start trouble-shooting with the checklist on Page 91. The routine takes you directly to the cause of the problem and the appropriate remedial measures. **Returning Devices** If you return a measuring device to Endress+Hauser for repair or calibration, you must complete the “Declaration of contamination” form and enclose it with the device. You will find a preprinted blank of this form at the back of this manual!	

"QUICK SETUP" commissioning

Note:
- You return to the QUICK-SETUP COMMISSIONING (1002) cell if you press the ESC key (⊟+). However, the configuration already made remains valid.
- The system units selected via the Quick Setup are only valid for the local display and for parameters in the Transducer Blocks. They have no effect on the output values (volume flow, calculated mass flow, totalizer) which are transmitted via the FOUNDATION Fieldbus.



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 rate of conductive fluids in closed pipes. A minimum conductivity of 20 µS/cm is required for measuring demineralized water. Most fluids can be metered, provided they have a minimum conductivity of 5 µS/cm, for example:
- acids, alkalis, pastes, mashes, pulps,
- drinking water, wastewater, sewage sludge,
- milk, beer, wine, mineral water, yogurt, molasses, etc.

The manufacturer accepts no liability for damages resulting from incorrect use or use not as designated.

1.2 Installation, commissioning and operation

Note the following points:
- Installation, connection to the electricity supply, commissioning and maintenance of the device must be carried out by trained, qualified specialists authorized to perform such work by the facility's owner-operator. The specialist must have read and understood these Operating Instructions and must follow the instructions it contains.
- The device must be operated by persons authorized and trained by the facility's owner-operator. Strict compliance with the instructions in the Operating Manual is mandatory.
- Endress+Hauser will be happy to assist in clarifying the chemical resistance properties of parts wetted by special mediums, including mediums used for cleaning.
- If welding work is performed on the piping system, do not ground the welding appliance through the Promag flowmeter.
- 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 insulated.
- Invariably, local regulations governing the opening and repair of electrical devices apply.

1.3 Operational safety

Note the following points:
- Measuring systems for use in hazardous environments are accompanied by separate “Ex documentation”, which is an *integral part* of these Operating Instructions. Strict compliance with the installation instructions and ratings as stated in this supplementary documentation is mandatory. The symbol on the front of this supplementary Ex documentation indicates the approval and the test center (Ex Europe, FM USA, CSA Canada).
- The measuring device complies with the general safety requirements in accordance with EN 61010, the EMC requirements of EN 61326/A1, and NAMUR recommendation NE 21.
- Depending on the application, the seals of the process connections of the Promag H sensor require periodic replacement.
- The manufacturer reserves the right to modify technical data without prior notice. Your E+H distributor will supply you with current information and updates to these Operating Instructions.

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 duly completed “Declaration of contamination” form. Only then can Endress+Hauser transport, examine and repair a returned device.
- Enclose special handling instructions if necessary, for example a safety data sheet as per EN 91/155/EEC.
- Remove all residues. Pay special attention to the grooves for seals and crevices which could contain residues. This is particularly important if the substance is hazardous to health, e.g. flammable, toxic, caustic, carcinogenic, etc.

Note:
You will find a *preprinted blank* of the “Declaration of contamination” form at the back of this manual.

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

1.5 Notes on safety conventions and icons

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

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

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

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

2 Identification

2.1 Device designation

The compact version of the “Promag 53” flow measuring system consists of the following components:
- Promag 53 transmitter
- Promag W, Promag P or Promag H sensor

2.1.1 Nameplate of the transmitter

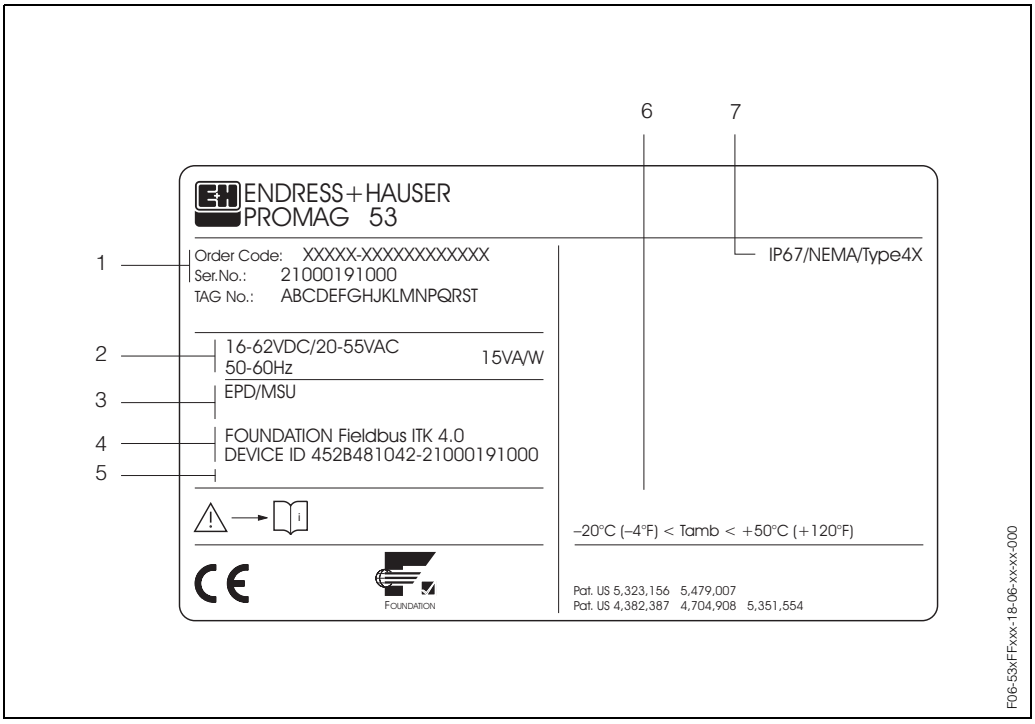


Fig. 1: Nameplate specifications for the “Promag 53” transmitter (example)

1 Ordering code/serial number: See the specifications on the order confirmation for the meanings of the individual letters and digits.
2 Power supply / frequency: 16...62 V DC / 20...55 V AC / 50...60 Hz
Power consumption: 15 VA / W
3 Additional functions and software:
– EPD/MSU: with Empty Pipe Detection
– etc.
4 FOUNDATION Fieldbus: Equipped with FOUNDATION Fieldbus-H1 interface
*ITK 4.0: certified by the Fieldbus FOUNDATION; **I**nteroperability **T**est **K**it, revision 4.0*
DEVICE ID: FOUNDATION Fieldbus device identification
5 Reserved for information on special products
6 Ambient temperature range
7 Degree of protection

2.1.2 Nameplate of the sensor

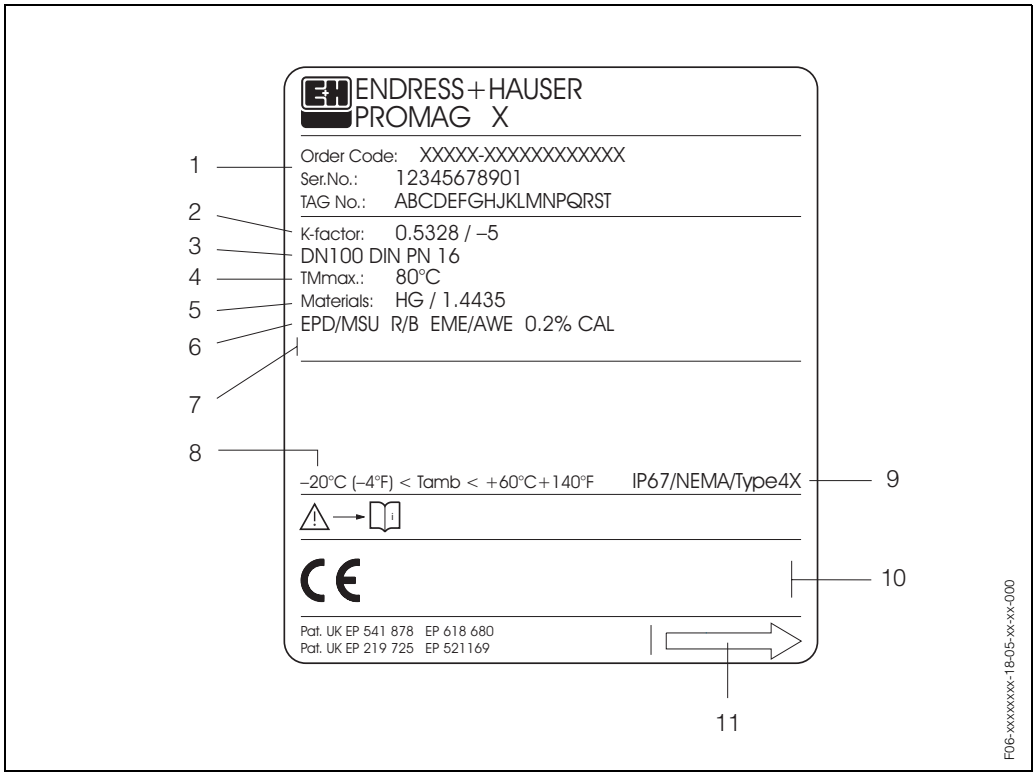


Fig. 2: Nameplate specifications for the "Promag" sensor (example)

1 *Ordering 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*
Pressure rating: DIN PN 16 bar
4 *TMmax +80 °C (max. fluid temperature)*
5 *Materials:*
– Lining: hard rubber (HG)
– Measuring electrodes: stainless steel 1.4435
6 *Additional information (examples):*
– EPD/MSU: with Empty Pipe Detection electrode
– R/B: with reference electrode
– EME/AWE: with exchangeable measuring electrodes
– 0.2% CAL: with 0.2% calibration
7 *Reserved for information on special products*
8 *Ambient temperature range*
9 *Degree of protection*
10 *Reserved for additional information on device version (approvals, certificates)*
11 *Flow direction*

2.2 CE mark, declaration of conformity

The devices are designed to meet state-of-the-art safety requirements, have been tested, and left the factory in a condition in which they are safe to operate. The devices comply with the applicable standards and regulations in accordance with EN 61010 "Protection Measures for Electrical Equipment for Measurement, Control, Regulation and Laboratory Procedures".
The measuring system described in these Operating Instructions is therefore 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.

2.3 Device certification FOUNDATION Fieldbus

The Promag 53 flowmeter has passed all the test procedures implemented and has been certified and registered by the Fieldbus FOUNDATION. The flowmeter thus meets all the requirements of the specifications listed below:

- Certified according to Fieldbus FOUNDATION specification
- The flowmeter meets all the specifications of the FOUNDATION Fieldbus-H1.
- Interoperability Test Kit (ITK), revision 4.0: The device can also be operated in conjunction with other-make certified devices.
- Physical Layer Conformance Test by Fieldbus FOUNDATION

2.4 Registered trademarks

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

TRI-CLAMP ®
is a registered trademark of Ladish & Co., Inc., Kenosha, USA

FOUNDATION Fieldbus™
is a registered trademark of Fieldbus FOUNDATION, Austin, USA

S-DAT™, T-DAT™, F-Chip™, FieldTool™, FieldCheck™, Applicator™
Registered or registration-pending trademarks of Endress+Hauser Flowtec AG, Reinach, CH

3 Installation

3.1 Incoming acceptance, transport and storage

3.1.1 Incoming acceptance

- 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

The following instructions apply to unpacking and to transporting the device to its final location:
- Transport the devices in the containers in which they are delivered.
- Do not remove the protective plates or caps on the process connections until the device is ready to install. This is particularly important in the case of sensors with Teflon linings.

Special notes on 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.
- Do not lift flanged devices by the transmitter housing, or the connection housing in the case of the remote version.

Transporting flanged devices (DN ≤ 300):
Use webbing slings slung round the two process connections (Fig. 3). Do not use chains, as they could damage the housing.

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

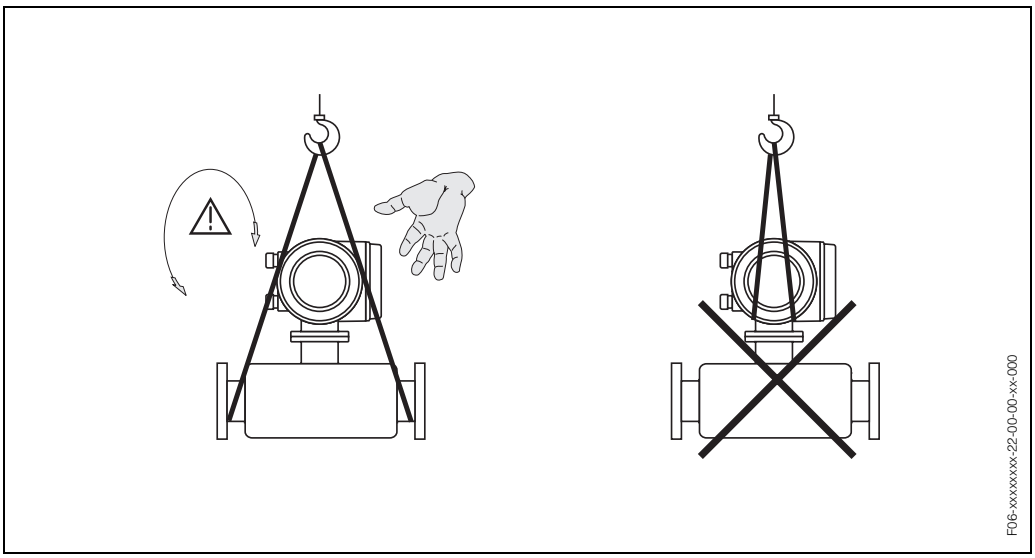


Fig. 3: Transporting transmitters with DN ≤ 300

Transporting flanged devices (DN ≥ 350):
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. This would buckle the casing and damage the internal magnetic coils.

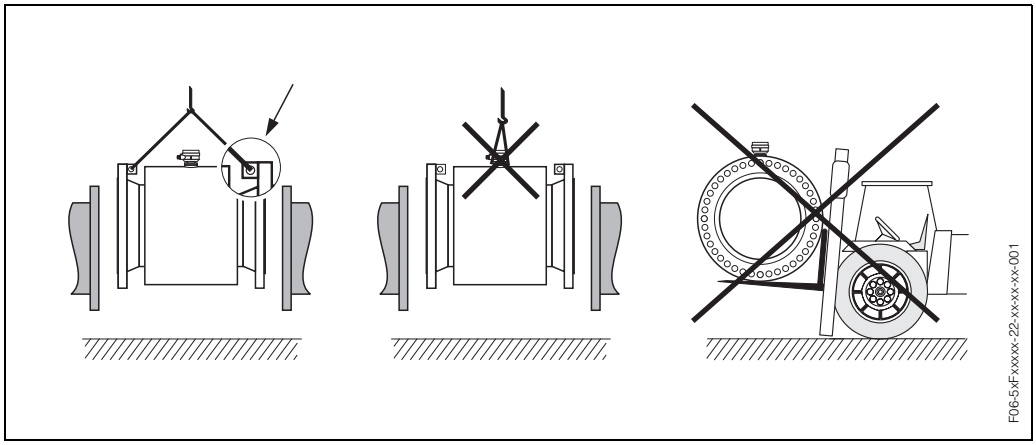


Fig. 4: Transporting sensors with DN ≥ 350

3.1.3 Storage

Note the following points:
- Pack the measuring device in such a way as to protect it reliably against impact for storage (and transportation). The original packaging provides optimum protection.
- The permissible storage temperature is –10...+50 °C (preferably +20 °C).
- Do not remove the protective plates or caps on the process connections until the device is ready to install. This is particularly important in the case of sensors with Teflon linings.

3.2 Installation conditions

3.2.1 Dimensions

Dimensions and the fitting lengths of the transmitter and sensor are on Page 129 ff.

3.2.2 Mounting location

Correct measuring is possible only if the pipe is full. **Avoid** the following locations:
- Highest point in the run. Risk of air accumulating
- Directly upstream from an open pipe outlet in a down pipe.

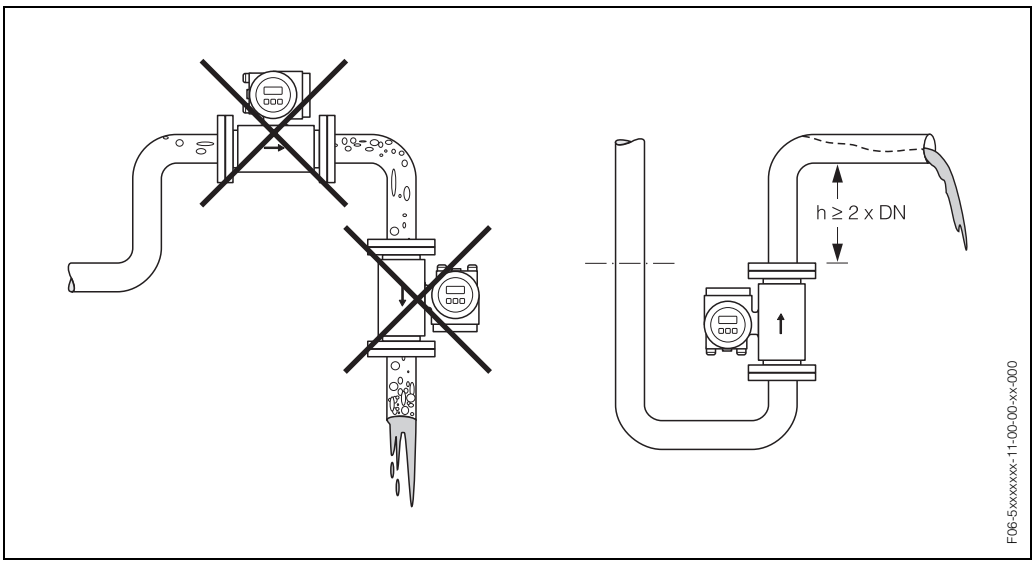


Fig. 5: Location

Installation of pumps
Do not install the sensor on the intake side of a pump. This precaution is to avoid low pressure and the consequent risk of damage to the lining of the measuring tube. Information on the lining's resistance to partial vacuum can be found on Page 120.

It might be necessary to install pulse dampers in systems incorporating reciprocating, diaphragm or peristaltic pumps. Information on the measuring system's resistance to vibration and shock can be found on Page 117.

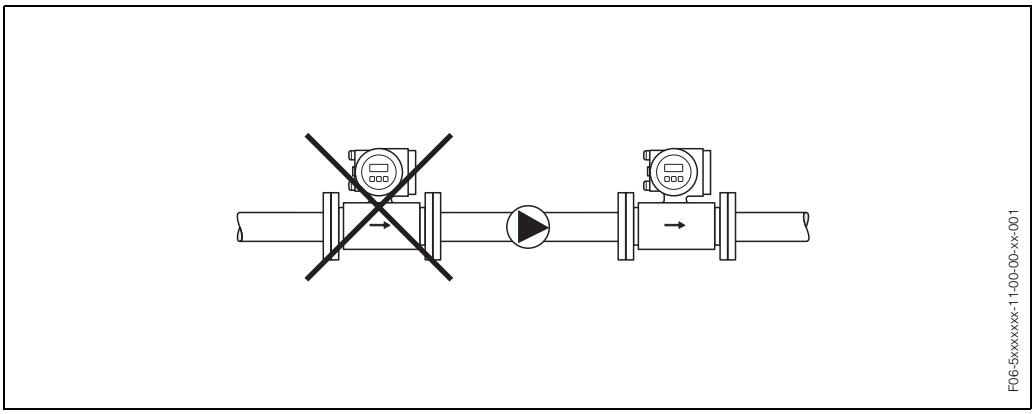


Fig. 6: Installation of pumps

Partially filled pipes
Partially filled pipes with gradients necessitate a drain-type configuration. The Empty Pipe Detection function (see Page 84) offers additional protection by 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.

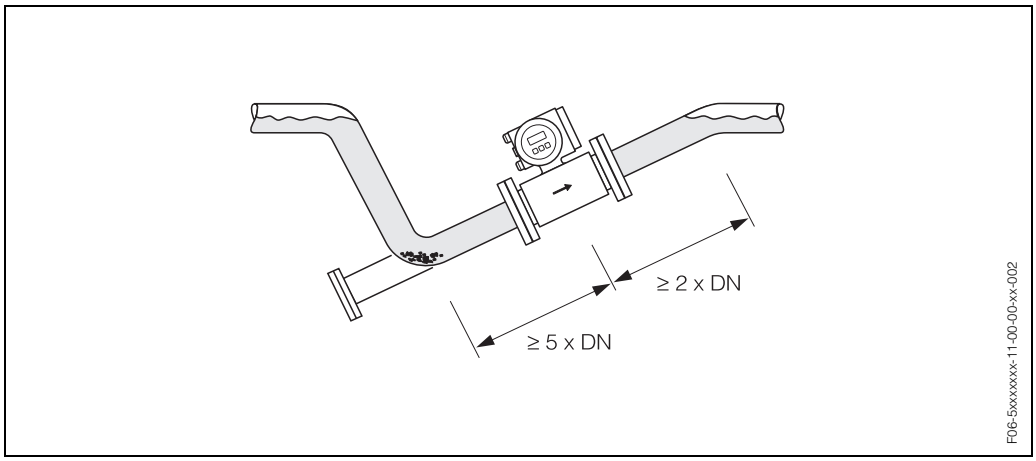


Fig. 7: Installation in partially filled pipe

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. These measures also prevent the system losing prime, which could cause air inclusions.
Information on the lining's resistance to partial vacuum can be found on Page 120.

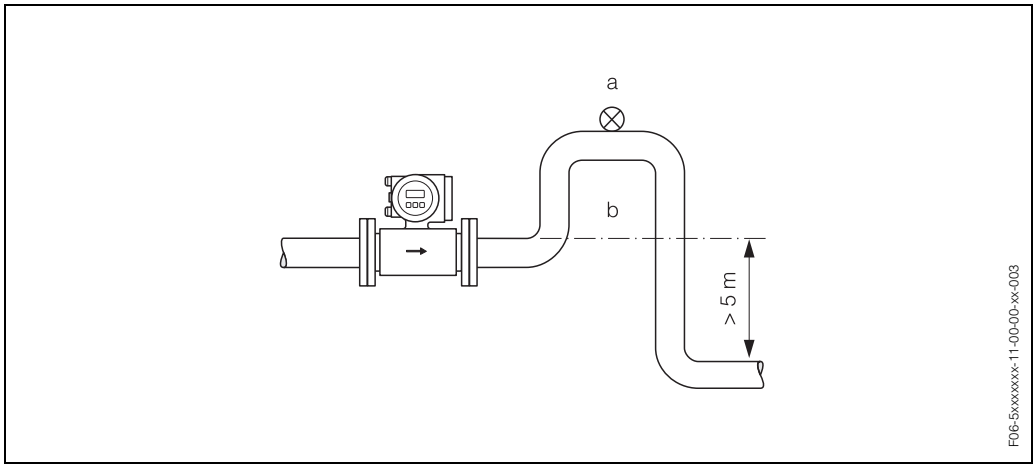


Fig. 8: Measures for installation in a down pipe (a = vent valve; b = siphon)

3.2.3 Orientation

An optimum orientation position helps avoid gas and air accumulations and deposits in the measuring tube. Promag, nevertheless, supplies a range of functions and accessories for correct measuring of problematic fluids:
- Empty Pipe Detection (EPD) ensures the detection of partially filled measuring tubes, e.g. in the case of degassing fluids or varying process pressures (see Page 84)
- Exchangeable measuring electrodes for abrasive fluids (see Page 110)

Vertical orientation
This is the ideal orientation for self-emptying piping systems and for use in conjunction with Empty Pipe Detection.

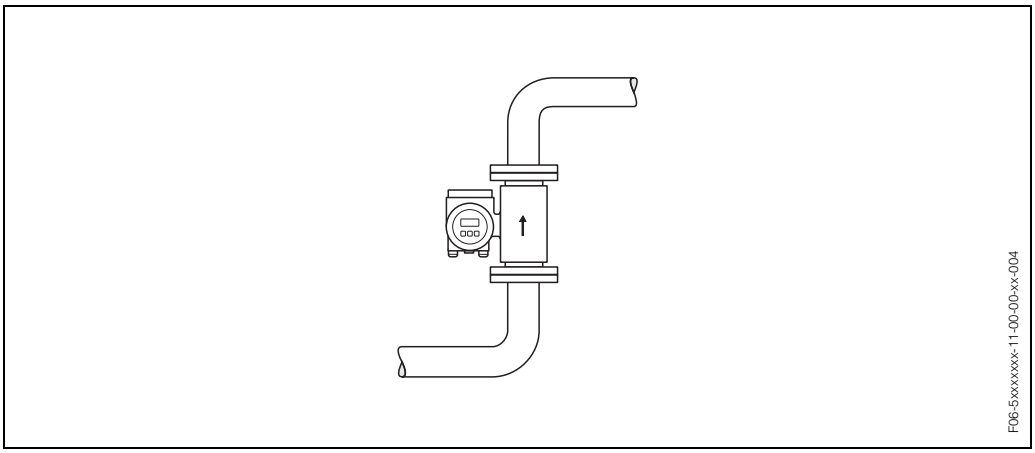


Fig. 9: Vertical orientation

Horizontal orientation
The measuring-electrode plane should be horizontal. This prevents brief insulation of the two electrodes by entrained air bubbles.

Caution:
Empty Pipe Detection functions correctly with the measuring device installed horizontally only when the transmitter housing is facing upward (Fig. 10). Otherwise there is no guarantee that Empty Pipe Detection will respond if the measuring tube is only partially filled or empty.

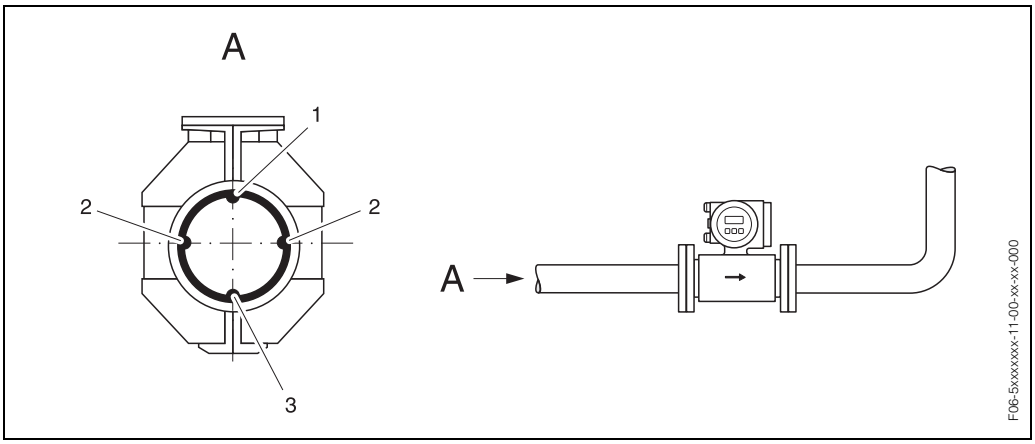


Fig. 10: Horizontal orientation

1 EPD electrode for the detection of empty pipes (not with Promag H, DN 2…8)
2 Measuring electrodes (signal detection)
3 Reference electrode for potential equalisation (not with Promag H)

3.2.4 Inlet and outlet runs

If possible, install the sensor well clear of fittings such as valves, T-pieces, elbows, etc. Compliance with the following requirements for the inlet and outlet runs is necessary in order to ensure measuring accuracy.

- Inlet run ≥ 5 x DN
- Outlet run ≥ 2 x DN

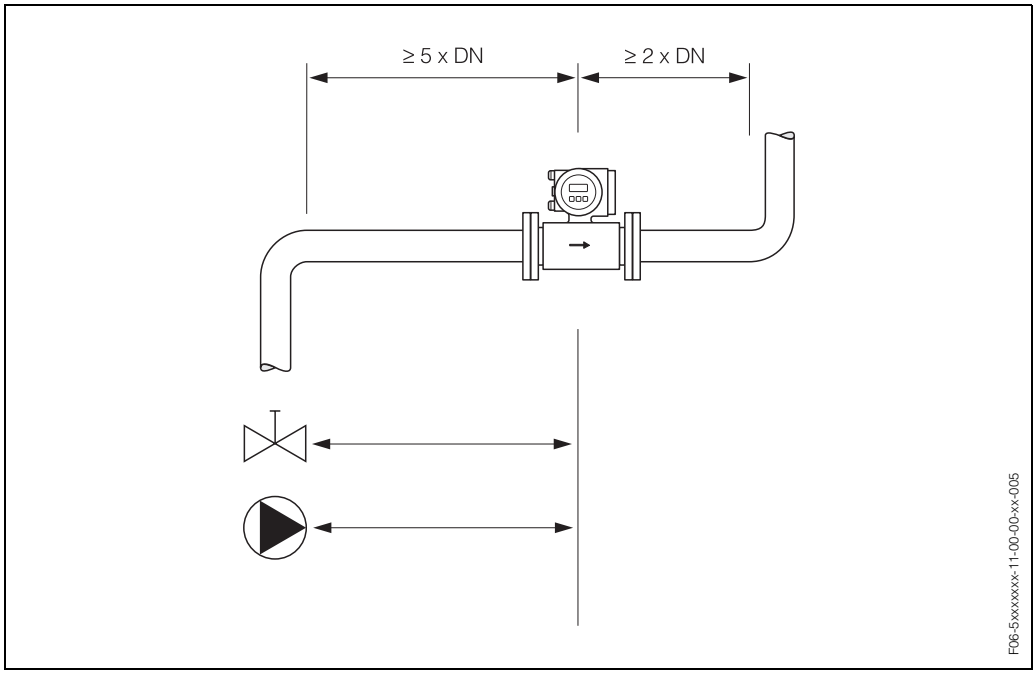


Fig. 11: Inlet and outlet runs

3.2.5 Vibrations

Secure the piping and the sensor if vibration is severe.

Caution:
It is advisable to install sensor and transmitter separately if vibration is excessively severe. Information on resistance to vibration and shock can be found on Page 117.

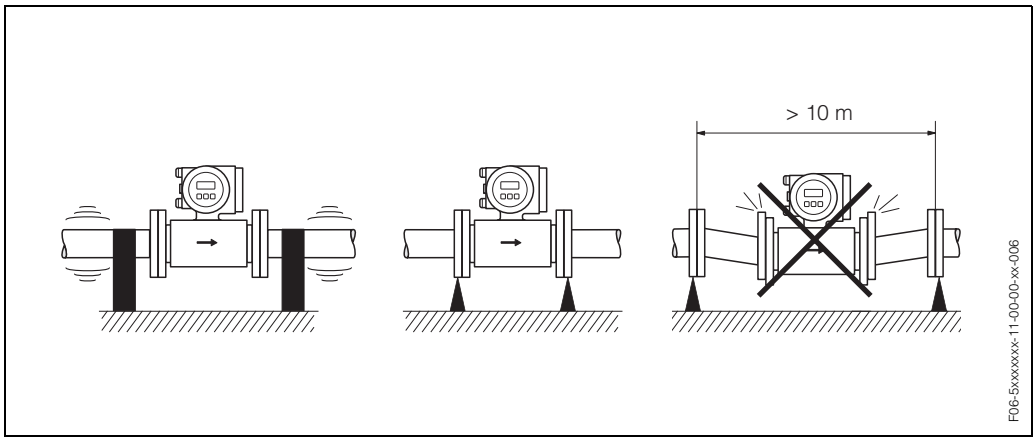


Fig. 12: Measures to prevent vibration of the measuring device

3.2.6 Foundations, supports

If the nominal diameter is DN ≥ 350, mount the transmitter on a foundation of adequate load-bearing strength.

Caution:
Risk of damage. Do not support the weight of the sensor on the metal casing: the casing would buckle and damage the internal magnetic coils.

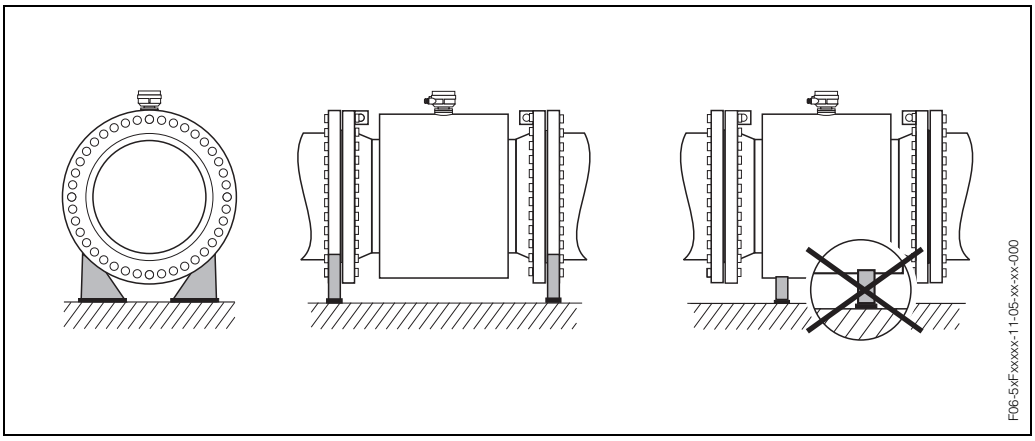


Fig. 13: Correct support for large nominal diameters (DN ≥ 350)

3.2.7 Adapters

Suitable adapters to (E) 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 cross-section reduction:

Note:
The nomogram applies to fluids 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.

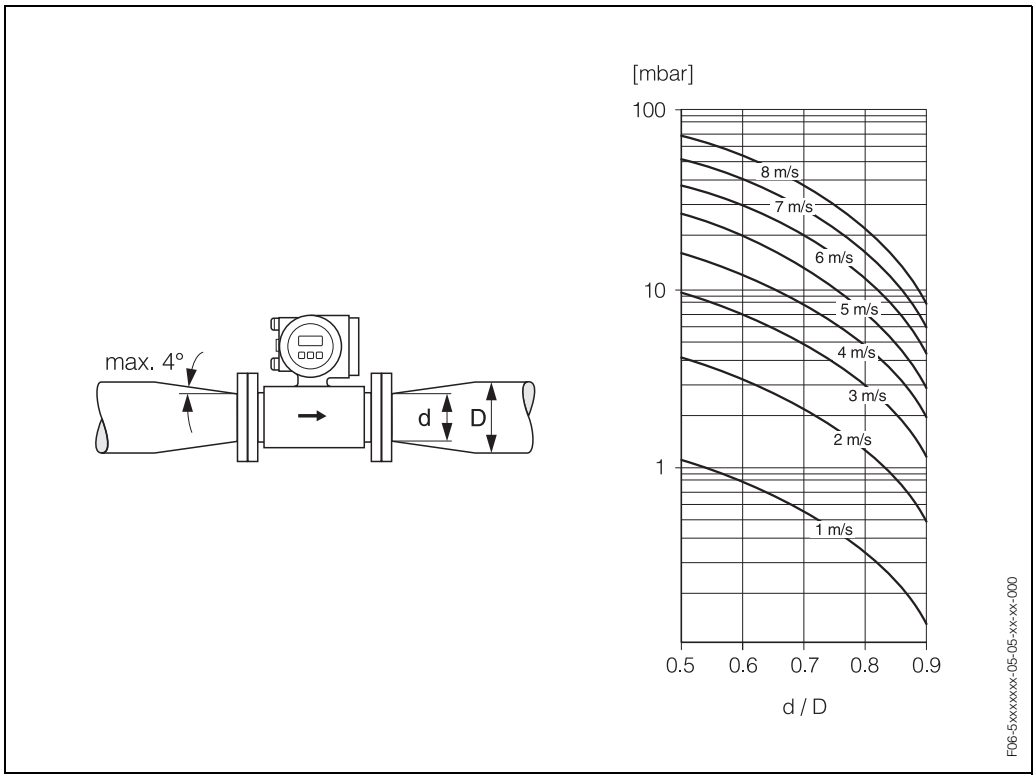


Fig. 14: Pressure loss due to adapters

3.2.8 Nominal diameter and flow rate

The diameter of the pipe and the flow rate determine the nominal diameter of the sensor. The optimum velocity of flow is 2...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 such as potter's clay, lime milk, ore slurry, etc.
- v > 2 m/s: for fluids producing build-up such as wastewater sludge, etc.

Note:
Flow velocity can be increased, if necessary, by reducing the nominal diameter of the sensor (see Page 20).

Promag W

Flow rate characteristic values - Promag W (SI units)

Nominal diameter		Recommended flow rate	Factory settings Low flow cutoff
[mm]	[inch]	min./max. full scale value (v ~ 0.3 or 10 m/s)	(v ~ 0.04 m/s)
25	1"	9…300 dm^3/min	1 dm^3/min
32	1 1/4"	15…500 dm^3/min	2 dm^3/min
40	1 1/2"	25…700 dm^3/min	3 dm^3/min
50	2"	35…1100 dm^3/min	5 dm^3/min
65	2 1/2"	60…2000 dm^3/min	8 dm^3/min
80	3"	90…3000 dm^3/min	12 dm^3/min
100	4"	145…4700 dm^3/min	20 dm^3/min
125	5"	220…7500 dm^3/min	30 dm^3/min
150	6"	20…600 m^3/h	2.5 m^3/h
200	8"	35…1100 m^3/h	5.0 m^3/h
250	10"	55…1700 m^3/h	7.5 m^3/h
300	12"	80…2400 m^3/h	10 m^3/h
350	14"	110…3300 m^3/h	15 m^3/h
400	16"	140…4200 m^3/h	20 m^3/h
450	18"	180…5400 m^3/h	25 m^3/h
500	20"	220…6600 m^3/h	30 m^3/h
600	24"	310…9600 m^3/h	40 m^3/h
700	28"	420…13500 m^3/h	50 m^3/h
–	30"	480…15000 m^3/h	60 m^3/h
800	32"	550…18000 m^3/h	75 m^3/h
900	36"	690…22500 m^3/h	100 m^3/h
1000	40"	850…28000 m^3/h	125 m^3/h
–	42"	950…30000 m^3/h	125 m^3/h
1200	48"	1250…40000 m^3/h	150 m^3/h
–	54"	1550…50000 m^3/h	200 m^3/h
1400	–	1700…55000 m^3/h	225 m^3/h
–	60"	1950…60000 m^3/h	250 m^3/h
1600	–	2200…70000 m^3/h	300 m^3/h
–	66"	2500…80000 m^3/h	325 m^3/h
1800	72"	2800…90000 m^3/h	350 m^3/h
–	78"	3300…100000 m^3/h	450 m^3/h
2000	–	3400…110000 m^3/h	450 m^3/h

Flow rate characteristic values - Promag W (US units)

Nominal diameter		Recommended flow rate	Factory settings Low flow cutoff
[inch]	[mm]	min./max. full scale value (v ~ 0.3 or 10 m/s)	(v ~ 0.04 m/s)
1"	25	2.5…80 gal/min	0.25 gal/min
1 1/4"	32	4…130 gal/min	0.50 gal/min
1 1/2"	40	7…190 gal/min	0.75 gal/min
2"	50	10…300 gal/min	1.25 gal/min
2 1/2"	65	16…500 gal/min	2.0 gal/min
3"	80	24…800 gal/min	2.5 gal/min
4"	100	40…1250 gal/min	4.0 gal/min
5"	125	60…1950 gal/min	7.0 gal/min
6"	150	90…2650 gal/min	12 gal/min
8"	200	155…4850 gal/min	15 gal/min
10"	250	250…7500 gal/min	30 gal/min
12"	300	350…10600 gal/min	45 gal/min
14"	350	500…15000 gal/min	60 gal/min
16"	400	600…19000 gal/min	60 gal/min
18"	450	800…24000 gal/min	90 gal/min
20"	500	1000…30000 gal/min	120 gal/min
24"	600	1400…44000 gal/min	180 gal/min
28"	700	1900…60000 gal/min	210 gal/min
30"	–	2150…67000 gal/min	270 gal/min
32"	800	2450…80000 gal/min	300 gal/min
36"	900	3100…100000 gal/min	360 gal/min
40"	1000	3800…125000 gal/min	480 gal/min
42"	–	4200…135000 gal/min	600 gal/min
48"	1200	5500…175000 gal/min	600 gal/min
54"	–	9…300 Mgal/d	1.3 Mgal/d
–	1400	10…340 Mgal/d	1.3 Mgal/d
60"	–	12…380 Mgal/d	1.3 Mgal/d
–	1600	13…450 Mgal/d	1.7 Mgal/d
66"	–	14…500 Mgal/d	2.2 Mgal/d
72"	1800	16…570 Mgal/d	2.6 Mgal/d
78"	–	18…650 Mgal/d	3.0 Mgal/d
–	2000	20…700 Mgal/d	3.0 Mgal/d

Promag P

Flow rate characteristic values - Promag P (SI units)

Nominal diameter		Recommended flow rate	Factory settings Low flow cutoff
[mm]	[inch]	min./max. full scale value (v ~ 0.3 or 10 m/s)	(v ~ 0.04 m/s)
15	1/2"	4…100 dm^3/min	0.5 dm^3/min
25	1"	9…300 dm^3/min	1 dm^3/min
32	1 1/4"	15…500 dm^3/min	2 dm^3/min
40	1 1/2"	25…700 dm^3/min	3 dm^3/min
50	2"	35…1100 dm^3/min	5 dm^3/min
65	2 1/2"	60…2000 dm^3/min	8 dm^3/min
80	3"	90…3000 dm^3/min	12 dm^3/min
100	4"	145…4700 dm^3/min	20 dm^3/min
125	5"	220…7500 dm^3/min	30 dm^3/min
150	6"	20…600 m^3/h	2.5 m^3/h
200	8"	35…1100 m^3/h	5.0 m^3/h
250	10"	55…1700 m^3/h	7.5 m^3/h
300	12"	80…2400 m^3/h	10 m^3/h
350	14"	110…3300 m^3/h	15 m^3/h
400	16"	140…4200 m^3/h	20 m^3/h
450	18"	180…5400 m^3/h	25 m^3/h
500	20"	220…6600 m^3/h	30 m^3/h
600	24"	310…9600 m^3/h	40 m^3/h

Flow rate characteristic values - Promag P (US units)

Nominal diameter		Recommended flow rate	Factory settings Low flow cutoff
[mm]	[inch]	min./max. full scale value (v ~ 0.3 or 10 m/s)	(v ~ 0.04 m/s)
1/2"	15	1.0…27 gal/min	0.10 gal/min
1"	25	2.5…80 gal/min	0.25 gal/min
1 1/4"	32	4…130 gal/min	0.50 gal/min
1 1/2"	40	7…190 gal/min	0.75 gal/min
2"	50	10…300 gal/min	1.25 gal/min
2 1/2"	65	16…500 gal/min	2.0 gal/min
3"	80	24…800 gal/min	2.5 gal/min
4"	100	40…1250 gal/min	4.0 gal/min
5"	125	60…1950 gal/min	7.0 gal/min
6"	150	90…2650 gal/min	12 gal/min
8"	200	155…4850 gal/min	15 gal/min
10"	250	250…7500 gal/min	30 gal/min
12"	300	350…10600 gal/min	45 gal/min
14"	350	500…15000 gal/min	60 gal/min
16"	400	600…19000 gal/min	60 gal/min
18"	450	800…24000 gal/min	90 gal/min
20"	500	1000…30000 gal/min	120 gal/min
24"	600	1400…44000 gal/min	180 gal/min

Promag H

Flow rate characteristic values - Promag H (SI units)

Nominal diameter		Recommended flow rate	Factory settings Low flow cutoff
[mm]	[inch]	min./max. full scale value (v ~ 0.3 or 10 m/s)	(v ~ 0.04 m/s)
2	1/12"	0.06…1.8 dm^3/min	0.01 dm^3/min
4	5/32"	0.25…7 dm^3/min	0.05 dm^3/min
8	5/16"	1…30 dm^3/min	0.1 dm^3/min
15	1/2"	4…100 dm^3/min	0.5 dm^3/min
25	1"	9…300 dm^3/min	1 dm^3/min
40	1 1/2"	25…700 dm^3/min	3 dm^3/min
50	2"	35…1100 dm^3/min	5 dm^3/min
65	2 1/2"	60…2000 dm^3/min	8 dm^3/min
80	3"	90…3000 dm^3/min	12 dm^3/min
100	4"	145…4700 dm^3/min	20 dm^3/min

Flow rate characteristic values - Promag H (US units)

Nominal diameter		Recommended flow rate	Factory settings Low flow cutoff
[mm]	[inch]	min./max. full scale value (v ~ 0.3 or 10 m/s)	(v ~ 0.04 m/s)
1/12"	2	0.015…0.5 gal/min	0.002 gal/min
5/32"	4	0.07…2 gal/min	0.008 gal/min
5/16"	8	0.25…8 gal/min	0.025 gal/min
1/2"	15	1.0…27 gal/min	0.10 gal/min
1"	25	2.5…80 gal/min	0.25 gal/min
1 1/2"	40	7…190 gal/min	0.75 gal/min
2"	50	10…300 gal/min	1.25 gal/min
2 1/2"	65	16…500 gal/min	2.0 gal/min
3"	80	24…800 gal/min	2.5 gal/min
4"	100	40…1250 gal/min	4.0 gal/min

3.2.9 Length of connecting cable

In order to ensure measuring accuracy, comply with the following instructions when installing the remote version:
- Secure the cable run or route the cable in a conduit. Movement of the cable can falsify the measuring signal, particularly if the fluid conductivity is low.
- Route the cable well clear of electrical machines and switching elements.
- Ensure potential equalisation between sensor and transmitter, if necessary.
- The permissible cable length Lmax depends on the fluid conductivity (Fig. 15). A minimum conductivity of 20 µS/cm is required for measuring demineralized water.

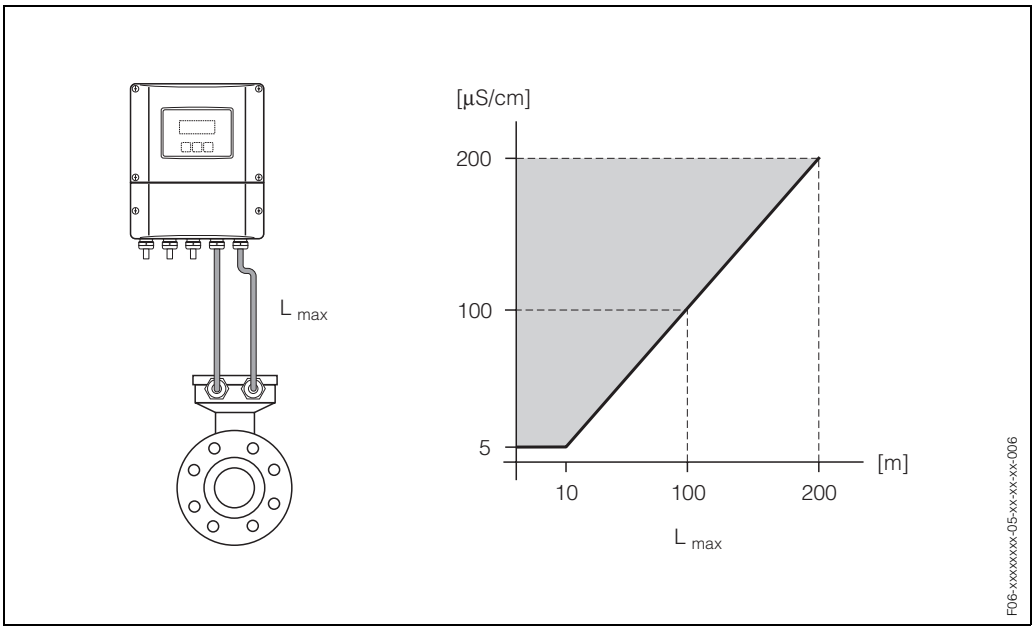


Fig. 15: Permissible cable length for the remote version

Gray shaded area = permissible range
Lmax = length of connecting cable in [m]
Medium conductivity in [µS/cm]

3.3 Installation instructions

3.3.1 Installing the 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 two piping flanges:
- Observe in any case the necessary screw tightening torques on Page 28 ff.
- The mounting of additional ground disks is described on Page 27.

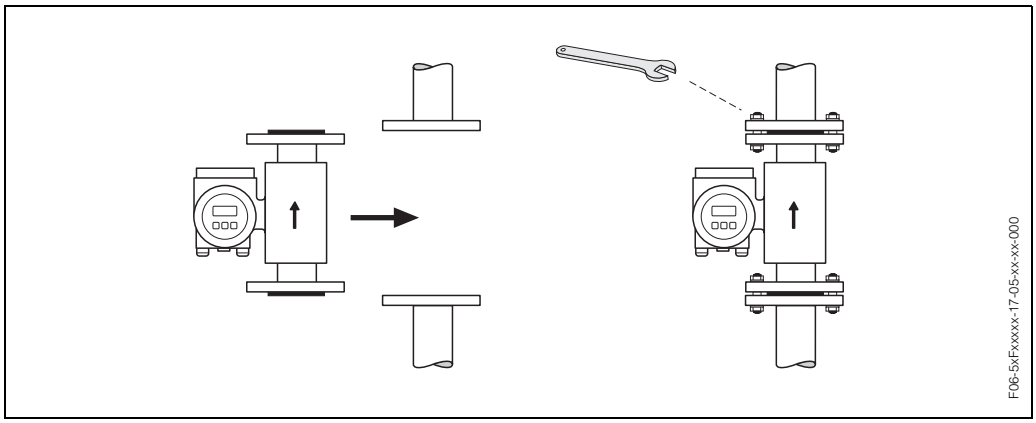


Fig. 16: Installing the Promag W sensor

Seals
Comply with the following instructions when installing seals:
- Hard rubber lining → additional seals are ***always*** necessary!
- Polyurethane lining → additional seals are recommended
- For DIN flanges, use only seals acc. to DIN 2690.
- 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 could form on the inside of the measuring tube and short-circuit the measuring signal.

Ground cable (DN 15…2000)
If necessary, the special ground cable for potential equalisation can be ordered as an accessory (see Page 89). Detailled assembly instructions → Page 59 ff.

Assembly with ground disks (DN 25…300)
Depending on the application, e.g. with lined or ungrounded pipes (see Page 58 ff.), it may be necessary to mount ground disks between the sensor and the pipe flange for potential equalisation. Ground disks can be ordered separately as an accessory from E+H (see Page 89).

Caution:
- In this case, when using ground disks (including seals) the total fitting length increases! Dimensions → Page 139.
- Hard rubber lining → install additional seals between the sensor and ground disk and between the ground disk and pipe flange.
- Polyurethane lining → only install additional seals between the ground disk and pipe flange.

1. Place the ground disk and additional seal(s) between the instrument and the pipe flange (Fig. 17).
2. Insert the bolts through the flange holes. Tighten the nuts so that they are still loose.
3. Now rotate the ground disk as shown in Fig. 17 until the handle strikes the bolts. This will center the ground disk automatically.
4. Now tighten the bolts to the required torque (see Page 28 ff.)
5. Connect the ground disk to ground → Page 60.

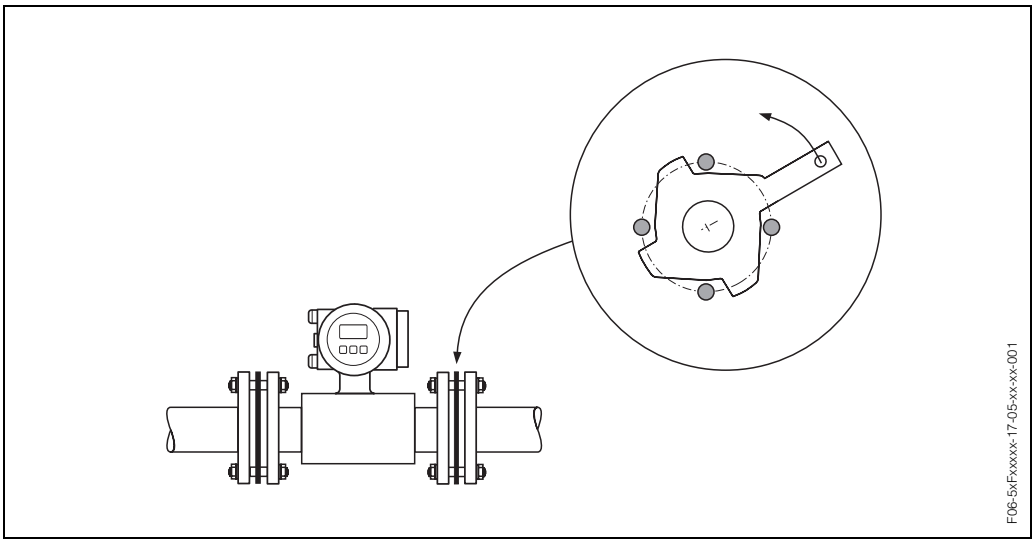


Fig. 17: Assembly with ground disks (Promag W, DN 25…300)

Torques of threaded fasteners (Promag W)

Note the following points:

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

Promag W Nominal diameter	DIN Pressure rating	Threaded fasteners	Max. tightening torque [Nm]	
[mm]	[bar]		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	4 x M 16	65	55
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

Promag W Nominal diameter	DIN Pressure rating	Threaded fasteners	Max. tightening torque [Nm]	
[mm]	[bar]		Hard rubber	Polyurethane
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
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

Promag W Nominal diameter		ANSI Pressure rating	Threaded fasteners	Max. tightening torque [Nm]	
[mm]	[inch]	[lbs]		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

Promag W Nominal diameter		AWWA Pressure rating	Threaded fasteners	Max. tightening torque [Nm]	
[mm]	[inch]			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

Promag W Nominal diameter [mm]	JIS Pressure rating	Threaded fasteners	Max. tightening torque [Nm]	
			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
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

3.3.2 Installing the Promag P sensor

Caution:
- The protective covers mounted on the two sensor flanges guard the Teflon (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 covers must remain in place while the device is in storage.
- Make sure that the lining is not damaged or removed from the flanges.

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 two piping flanges:
- Observe in any case the necessary screw tightening torques on Page 35 ff.
- The mounting of additional ground disks is described on Page 33.

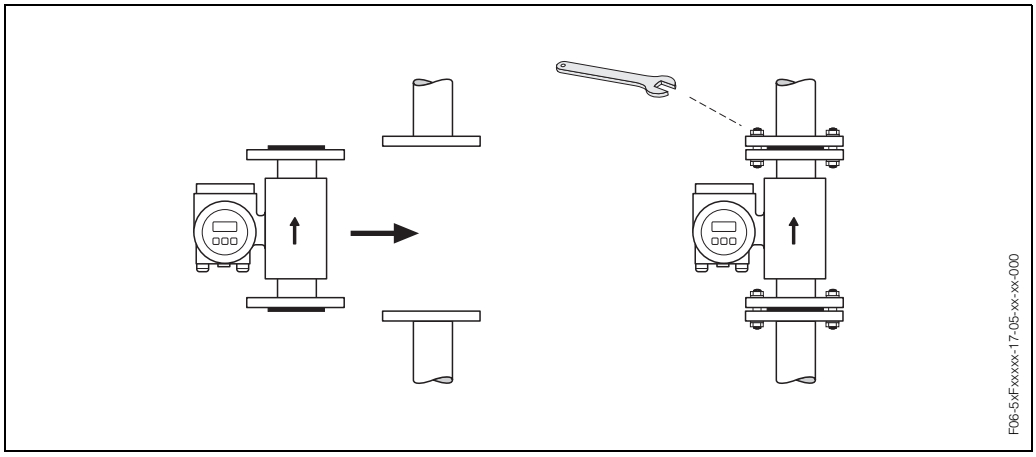


Fig. 18: Installing the Promag P sensor

Seals
Comply with the following instructions when installing seals:
- Measuring tube linings with PFA or PTFE → **No** seals are required.
- In case you use seals with DIN flanges, use only seals according to DIN 2690.
- 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 could form on the inside of the measuring tube and short-circuit the measuring signal.

Ground cable (DN 15…600)
If necessary, a special ground cable for potential equalisation can be ordered as an accessory (see Page 89). Detailled assembly instructions → Page 59 ff.

Assembly with ground disks (DN 15…300)
Depending on the application, e.g. with lined or ungrounded pipes (see Page 58 ff.), it may be necessary to mount ground disks between the sensor and the pipe flange for the potential equalisation. Ground disks can be ordered separately as an accessory from E+H (see Page 89).

Caution:
- In this case, when using ground disks (including seals) the total fitting length increases! Dimensions → Page 139.
- PTFE and PFA lining → only install additional seals between the ground disk and pipe flange.

1. Place the ground disk and the additional seal between the instrument and the pipe flange (Fig. 19).
2. Insert the bolts through the flange holes. Tighten the nuts so that they are still loose.
3. Now rotate the ground disk as shown in Fig. 19 until the handle strikes the bolts. This will center the ground disk automatically.
4. Now tighten the bolts to the required torque (see Page 35 ff.)
5. Connect the ground disk to ground → Page 60.

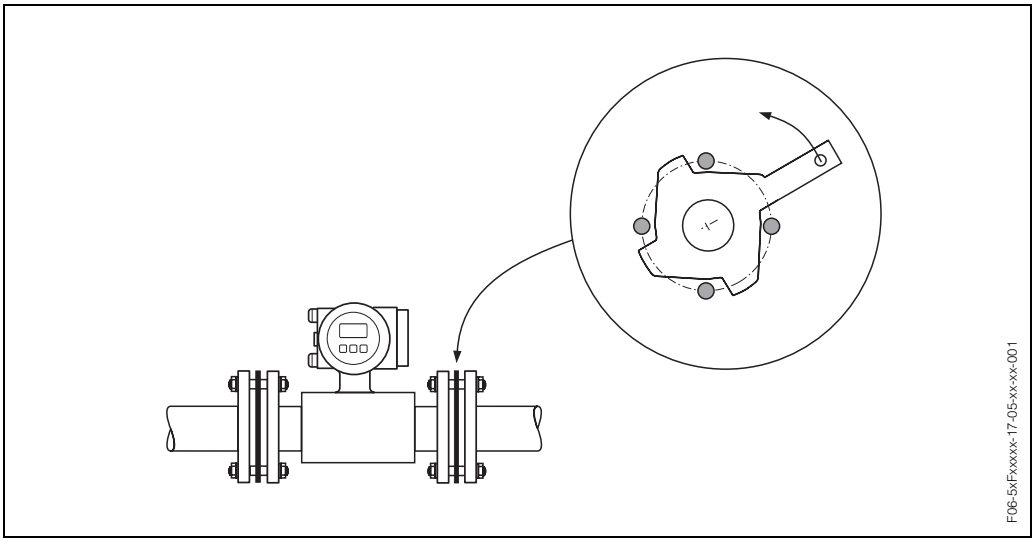


Fig. 19: Assembly with ground disks (Promag P, DN 15…300)

Installing the high-temperature version (with PFA lining)
The high-temperature version has a housing support for the thermal separation of sensor and transmitter. The high-temperature version is always used for applications in which high ambient temperatures are encountered *in conjunction with* high fluid temperatures. The high-temperature version is obligatory if the fluid temperature exceeds +150 °C.

Note:
You will find information on permissible temperature ranges on Page 118

Insulation
Pipes generally have to be insulated if they carry very hot fluids, in order to avoid energy losses and to prevent accidental contact with pipes at temperatures that could cause injury. Guidelines regulating the insulation of pipes have to be taken into account.

Caution:
Risk of measuring electronics overheating. The housing support dissipates heat and its entire surface area must remain uncovered. Make sure that the sensor insulation does not extend past the top of the two sensor shells (Fig. 20).

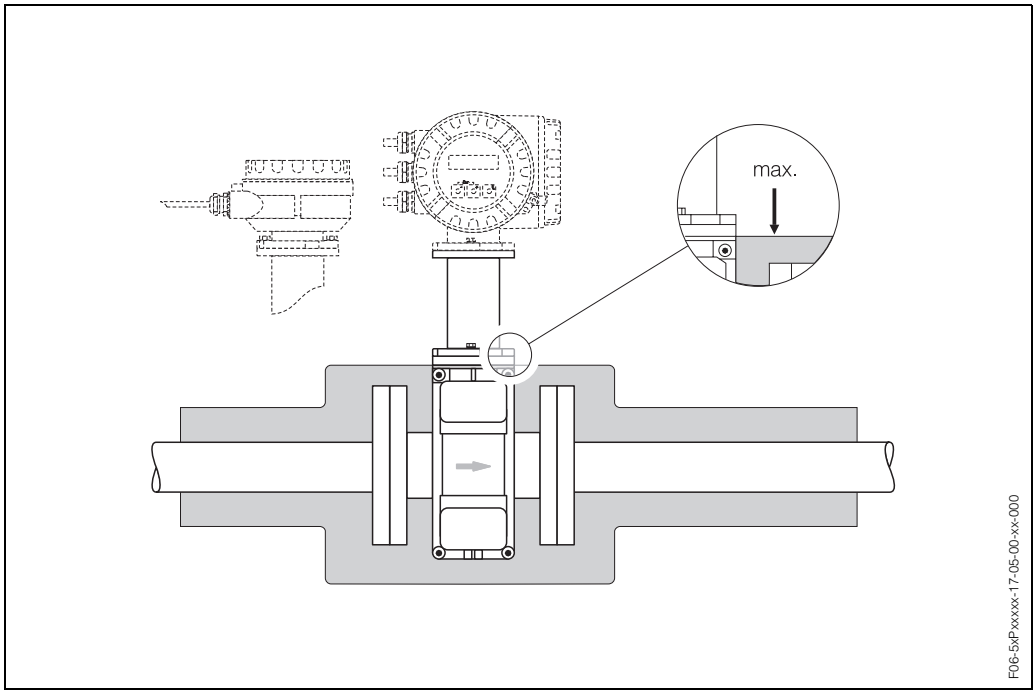


Fig. 20: Promag P (high-temperature version): Insulating the pipe

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

Promag P Nominal diameter	DIN Pressure rating	Threaded fasteners	Max. tightening torque [Nm]	
[mm]	[bar]		PTFE	PFA
15	PN 40	4 x M 12	11	–
25	PN 40	4 x M 12	26	20
32	PN 40	4 x M 16	41	35
40	PN 40	4 x M 16	52	47
50	PN 40	4 x M 16	65	59
65	PN 16	4 x M 16	87	80
65	PN 40	8 x M 16	43	40
80	PN 16	8 x M 16	53	48
80	PN 40	8 x M 16	53	48
100	PN 16	8 x M 16	57	51
100	PN 40	8 x M 20	78	70
125	PN 16	8 x M 16	75	67
125	PN 40	8 x M 24	111	99
150	PN 16	8 x M 20	99	85
150	PN 40	8 x M 24	136	120
200	PN 10	8 x M 20	141	101
200	PN 16	12 x M 20	94	67
200	PN 25	12 x M 24	138	105
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	–

Promag P Nominal diameter	DIN Pressure rating	Threaded fasteners	Max. tightening torque [Nm]	
[mm]	[bar]		PTFE	PFA
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	–

Promag P Nominal diamter		ANSI Pressure rating	Threaded fasteners	Max. tightening torque [Nm]	
[mm]	[inch]	[lbs]		PTFE	PFA
15	1/2"	Class 150	4 x 1/2"	6	–
15	1/2"	Class 300	4 x 1/2"	6	–
25	1"	Class 150	4 x 1/2"	11	10
25	1"	Class 300	4 x 5/8"	14	12
40	1 1/2"	Class 150	4 x 1/2"	24	21
40	1 1/2"	Class 300	4 x 3/4"	34	31
50	2"	Class 150	4 x 5/8"	47	44
50	2"	Class 300	8 x 5/8"	23	22
80	3"	Class 150	4 x 5/8"	79	67
80	3"	Class 300	8 x 3/4"	47	42
100	4"	Class 150	8 x 5/8"	56	50
100	4"	Class 300	8 x 3/4"	67	59
150	6"	Class 150	8 x 3/4"	106	86
150	6"	Class 300	12 x 3/4"	73	67
200	8"	Class 150	8 x 3/4"	143	109
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	–

Promag P Nominal diameter [mm]	JIS Pressure rating	Threaded fasteners	Max. tightening torque [Nm]	
			PTFE	PFA
15	10K	4 x M 12	16	–
15	20K	4 x M 12	16	–
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 the Promag H sensor

The Promag H is supplied to order, with or without pre-installed process connections. Pre-installed process connections are secured to the sensor with hex-head threaded fasteners.

Caution:
- If you intend to use your own process connections, make up the process adapters as specified on Page 144 ff.
- The sensor might require support or additional attachments, depending on the application and the length of the piping run. A wall-mounting kit can be ordered separately from E+H as an accessory (see Page 89).

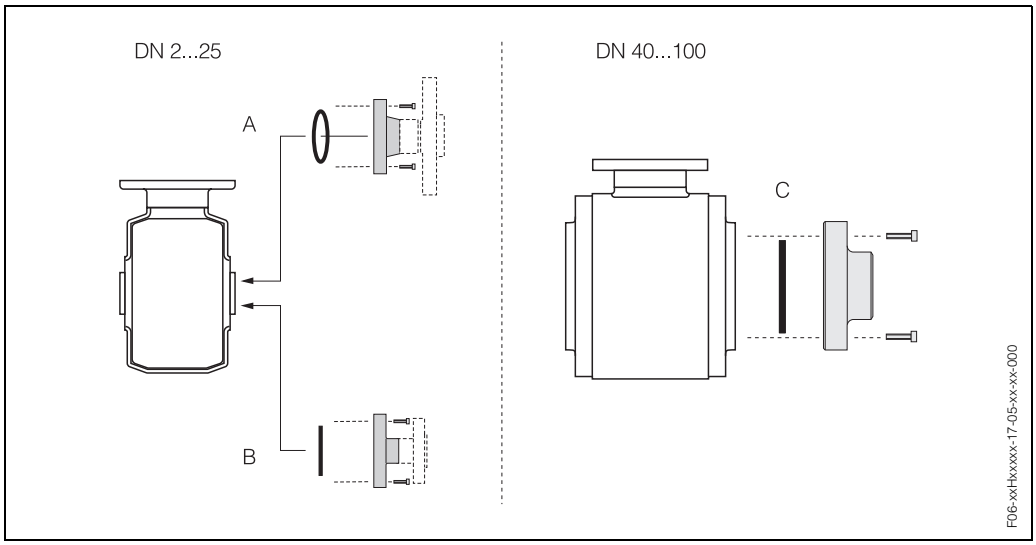


Fig. 21: Promag H process connections (DN 2...25, DN 40...100)

A: DN 2...25 / process connections with O-rings:
Welding flanges (ISO 2463, IPS), flanges (DIN 2635, ANSI B16.5, JIS B2238), PVDF flanges (DIN 2501, ANSI B16.5, JIS B2238), external and internal threads (ISO / DIN), hose adapters, PVC adhesive coupling

B: DN 2...25 / process connections with aseptic gaskets:
Welding adapters (DIN 11850, ODT), Tri-Clamp, Clamp (ISO 2852, DIN 32676), threaded union (DIN 11851, DIN 11864-1, SMS 1145), flange DIN 11864-2

C: DN 40...100 / process connections with aseptic gaskets:
Welding adapters (DIN 11850, ODT), Tri-Clamp, Clamp (ISO 2852, DIN 32676), threaded union (DIN 11851, DIN 11864-1, ISO 2853, SMS 1145), flange DIN 11864-2

Seals
When installing the process connections, make sure that the seals are clean and correctly centered.

Caution:
- With metallic process connections, you must fully tighten the screws. The process connection forms a metallic connection with the sensor, which ensures a defined compression of the seal.
- With plastic process connections, note the max. torques (for PVDF: 3.3 Nm; for PVC: 10 Nm). With plastic flanges, always use seals between connection and counter flange.
- The seals must be replaced periodically, depending on the application, particularly in the case of gasket seals (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 89.

Usage and assembly of ground rings (DN 2…25)
In case the process connections are made of plastic (e.g. flanges or adhesive fittings), the potential between the sensor and the fluid must be equalised using additional ground rings.
If the ground rings are not installed this can affect the accuracy of the measurements or cause the destruction of the sensor through the electrochemical erosion of the electrodes.

Caution:
- Depending on the option ordered, plastic disks may be installed at the process connections instead of ground rings. These plastic disks serve only as spacers and have no potential equalization function. In addition, they provide a sealing function at the interface between the sensor and process connection. For this reason, with process connections without ground rings, these plastic disks/seals must not be removed, or must always be installed.
- Ground rings can be ordered separately from E+H as accessories (see Page 89). When placing the order, make certain that the ground ring is compatible with the material used for the electrodes. Otherwise, there is a risk that the electrodes may be destroyed by electrochemical corrosion! Information about the materials can be found on Page 124.
- Ground rings, including the seals, are mounted within the process connections. Therefore, the fitting length is not affected. The dimensions of the ground rings can be found on Page 151.

1. Loosen the four hexagonal headed bolts (1) and remove the process connection from the sensor (5).
2. Remove the plastic disk (3), including the two O-ring seals (2, 4).
3. Place one seal (2) in the groove of the process connection.
4. Place the metal ground ring (3) on the process connection.
5. Now place the second seal (4) in the groove of the ground ring.
6. Finally, mount the process connection on the sensor again. With plastic process connections, note the max. torques (for PVDF: 3.3 Nm; for PVC: 10 Nm).

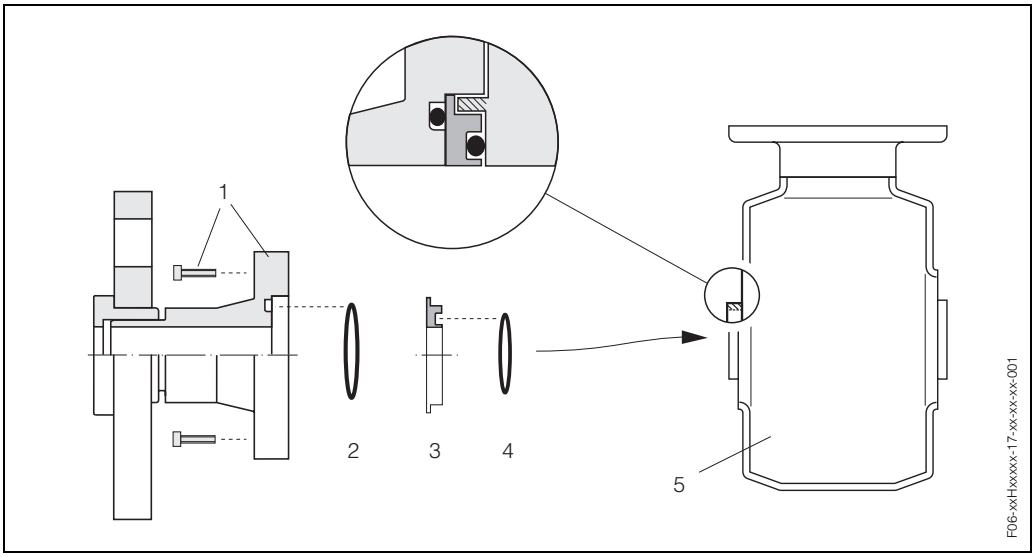


Fig. 22: Installing ground rings with a Promag H (DN 2…25)

1 = Hexagonal headed bolts (process connection), 2 = O-ring seal for the process connection
3 = Plastic disk (placeholder) or ground ring, 4 = O-ring seal for the ground ring
5 = Sensor Promag H

Welding the sensor into the piping (welding adapters)

Caution:
Risk of destroying the measuring electronics. Make sure that the welding machine is *not* grounded via the sensor or the transmitter.

1. Tack-weld the Promag H sensor into the pipe. A suitable welding jig can be ordered separately from E+H as an accessory (see Page 89).
2. Remove the threaded fasteners from the process-connection flange. Remove the sensor complete with seal from the pipe.
3. Weld the process connection to the pipe.
4. Reinstall the sensor in the pipe. Make sure that everything is clean and that the seal is correctly seated.

Note:
- If thin-walled foodstuffs pipes are not welded correctly, the heat could damage the installed seal. It is therefore advisable to remove the sensor and the seal prior to welding.
- The pipe has to be spread approximately 8 mm to permit disassembly.

Cleaning with pigs
If pigs are used for cleaning, it is essential to take the inside diameters of measuring tube and process connection into account (see Page 140 ff.).

3.3.4 Turning the transmitter housing

Turning the aluminum field housing

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

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

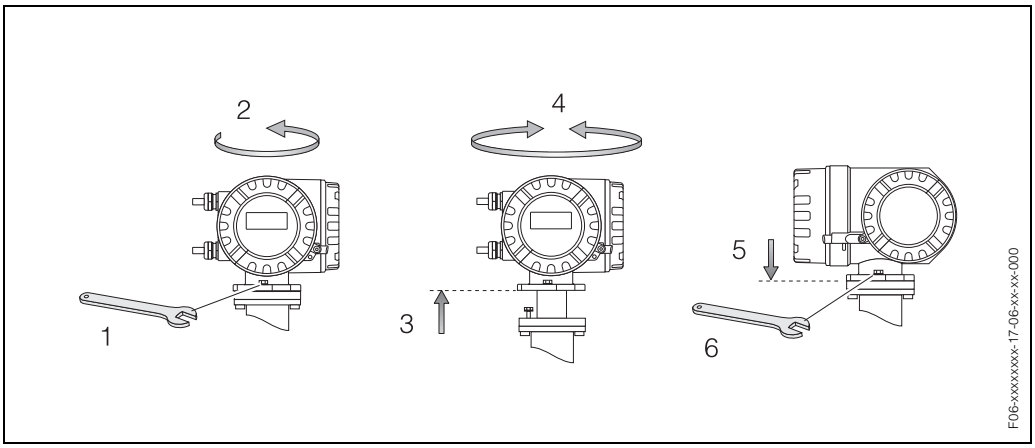


Fig. 23: Turning the transmitter housing (aluminum field housing)

Turning the stainless-steel field housing

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

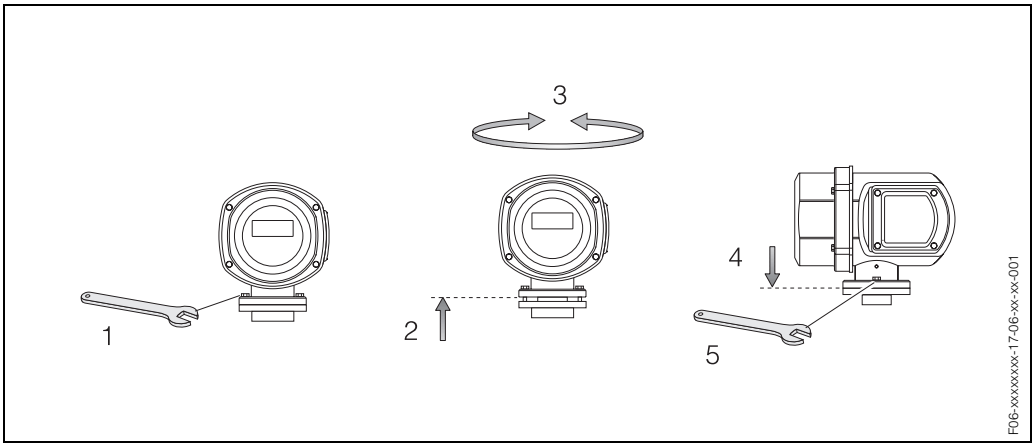


Fig. 24: Turning the transmitter housing (stainless-steel field housing)

3.3.5 Turning the local display

1. Remove the cover of the electronics compartment.
2. Press the side latches on the display module and remove it from the electronics compartment cover plate.
3. Rotate the display to the desired position (max. 4 x 45° in each direction), and place it back into the electronics compartment cover plate.
4. Screw the cover of the electronics compartment firmly onto the transmitter housing.

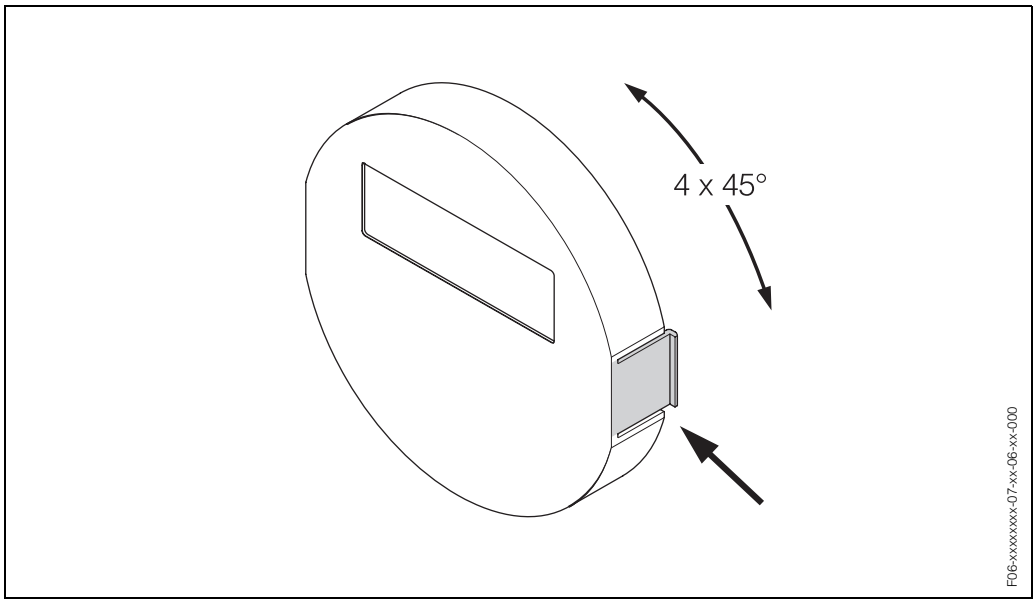


Fig. 25: Turning the local display (field housing)

3.3.6 Installing the wall-mount transmitter housing

There are various ways of installing the wall-mount transmitter housing:
- Mounted directly on the wall
- Installation in control panel (with separate mounting kit, accessories → Page 89)
- Pipe mounting (with separate mounting kit, accessories → Page 89)

Caution:
- Make sure that ambient temperature does not exceed the permissible range (–20…+60 °C). Install the device at a shady location. Avoid direct sunlight.
- Always install the wall-mount housing in such a way that the cable entries are pointing down.

Direct wall mounting

1. Drill the holes as illustrated in Fig. 26.
2. Remove the cover of the connection compartment (a).
3. Push the two securing screws (b) through the appropriate bores (c) in the housing.
   – Securing screws (M6): max. Ø 6.5 mm
   – Screw head: max. Ø 10.5 mm
4. Secure the transmitter housing to the wall as indicated.
5. Screw the cover of the connection compartment (a) firmly onto the housing.

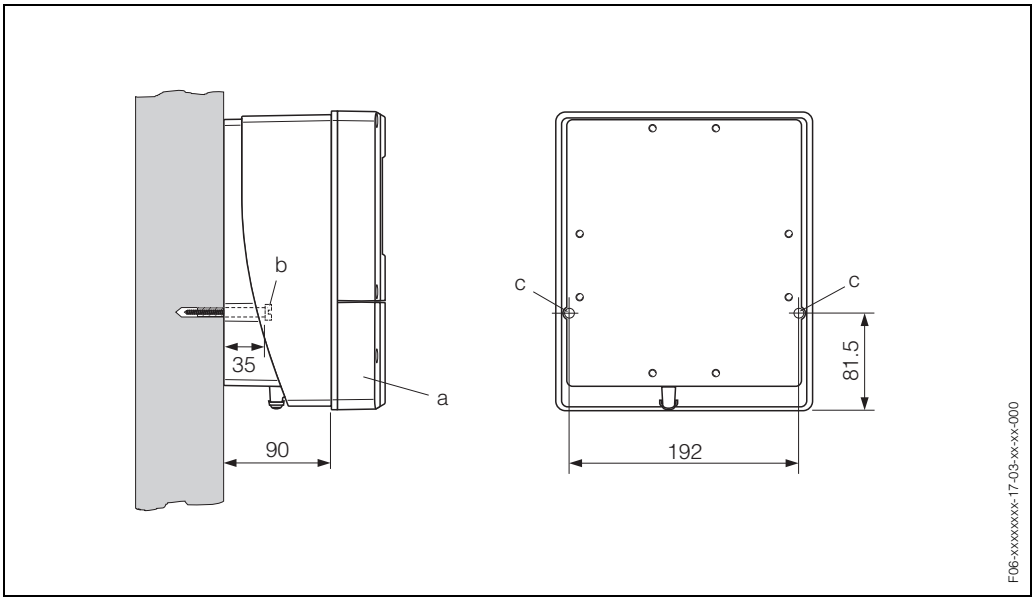


Fig. 26: Mounted directly on the wall

Panel installation

1. Prepare the opening in the panel (Fig. 27).
2. Slide the housing into the opening in the panel from the front.
3. Screw the fasteners onto the wall-mount housing.
4. Place the threaded rods in the fasteners and screw them down until the housing is seated tightly against the panel. Afterwards, tighten the locking nuts. Additional support is not necessary.

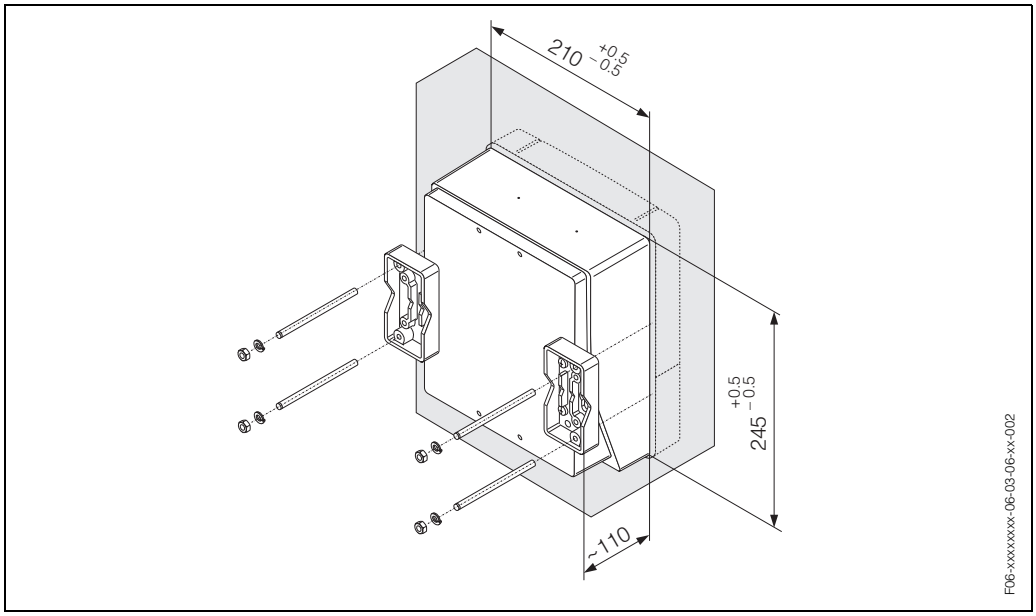


Fig. 27: Panel Installation (wall-mount housing)

Pipe mounting

The assembly should be performed by following the instructions in Fig. 28.

Caution:
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.

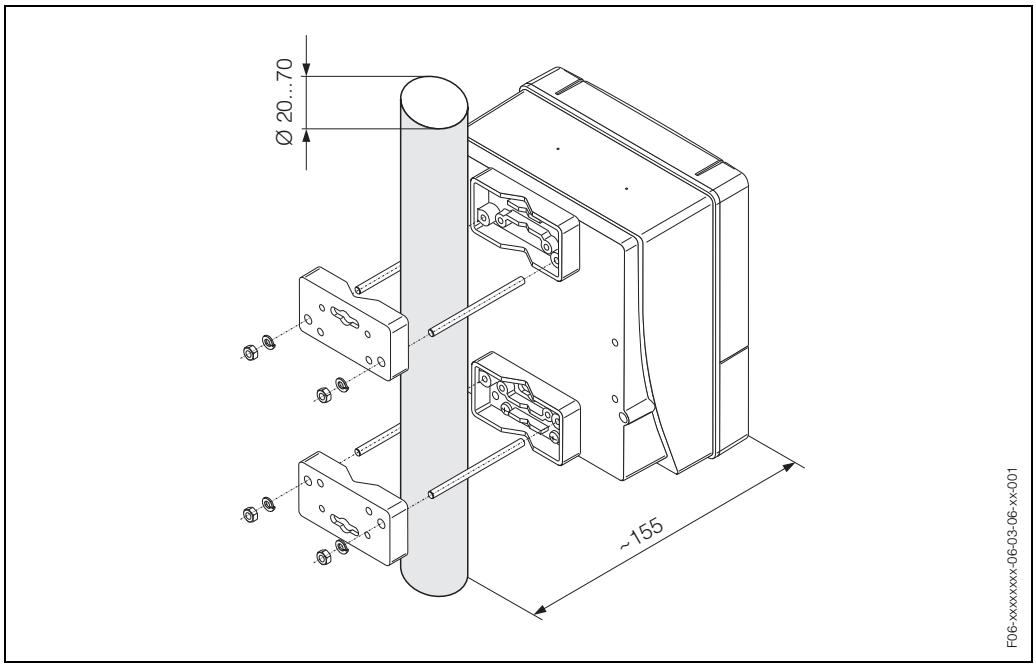


Fig. 28: Pipe mounting (wall-mount housing)

3.4 Post-installation check

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

Device condition and specifications	Notes
Is the device damaged (visual inspection)?	–
Does the device correspond to specifications at the measuring point, including process temperature and pressure, ambient temperature, minimum fluid conductivity, measuring range, etc.?	see Page 113 ff.
Installation	Notes
Does the arrow on the sensor nameplate match the direction of flow through the pipe?	–
Is the measuring electrode axis positioned correctly?	horizontal
Is the position of the Empty Pipe Detection (EPD) electrode correct?	see Page 17
Were all threaded fasteners tightened to the specified torques when the sensor was installed?	see Section 3.3
Hard rubber lining and ground disks: Were the correct seals installed (type, material, installation)?	Promag W → Page 26 Promag P → Page 32 Promag H → Page 38
Are the measuring-point number and labeling 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 (attachment, support)?	Acceleration up to 2 g by analogy with IEC 68-2-6 (see Page 117)

4 Wiring

Warning:
When connecting Ex-certified devices, see the notes and diagrams in the Ex-specific supplement to this Operating Manual. Please do not hesitate to contact your E+H representative if you have any questions.

4.1 Cable specifications for fieldbus

Cable type
Twin-core cable is recommended for connecting the flowmeter to the FOUNDATION Fieldbus H1. By analogy with IEC 61158-2 protocol four different cable types (A, B, C, D) can be used with the FOUNDATION Fieldbus Protocol, only two of which (cable types A and B) are shielded.

- Cable types A or B are particularly preferable for new installations. Only these types have cable shielding that guarantees adequate protection from electromagnetic interference and thus the most reliable data transfer. With cable type B more than one fieldbus (with the same degree of protection) may be operated in a cable. No other circuits are permissible in the same cable.
- Practical experience has shown that cable types C and D should not be used due to the lack of shielding, since the freedom from interference generally does not meet the requirements described in the standard.

The electrical data of the fieldbus cable has not been specified but determines important characteristics of the design of the fieldbus, such as distances bridged, number of participants, electromagnetic compatibility, etc.

	Type A	Type B
Cable structure	twisted pair, shielded	one or more twisted pairs, fully shielded
Wire size	0.8 mm^2 (AWG 18)	0.32 mm^2 (AWG 22)
Loop resistance (DC)	44 Ω/km	112 Ω/km
Impedance at 31.25 kHz	100 Ω ± 20%	100 Ω ± 30%
Attenuation at 39 kHz	3 dB/km	5 dB/km
Capacitive unsymmetry	2 nF/km	2 nF/km
Envelope delay distortion (7.9 through 39 kHz)	1.7 µs/km	*
Shield coverage	90%	*
Max. cable length (inc. spurs >1 m)	1900 m	1200 m
* not specified		

Suitable fieldbus cables (type A) from various manufacturers for the hazardous area are listed below:

- Siemens: 6XV1 830-5BH10
- Belden: 3076F
- Kerpen: CeL-PE/OSCR/PVC/FRLA FB-02YS(ST)YFL
- Turck: FOUNDATION Fieldbus Cable and Cordsets

Maximum overall cable length
The maximum network expansion depends on the type of ignition protection and the cable specifications. The overall cable length combines the length of the main cable and the length of all spurs (>1 m). Fig. 42 on Page 65 shows the structure of a fieldbus network. Note the following points:
- The maximum permissible overall cable length depends on the cable type used (see Page 47).
- If repeaters are used the maximum permissible cable length is doubled. A maximum of three repeaters are permitted between user and master.

Maximum spur length
The line between distribution box and field unit is described as a spur.
In the case of non ex-rated applications the max. length of a spur depends on the number of spurs (>1 m):

Number of spurs	1...12	13...14	15...18	19...24	25...32
Max. length per spur	120 m	90 m	60 m	30 m	1 m

Number of field devices
According to IEC 61158-2 a maximum of 32 field devices may be connected per fieldbus segment. However, this number may be restricted in certain circumstances (type of ignition protection, bus power option, current consumption of field device).
A maximum of four field devices can be connected to a spur.

Shielding and grounding
The optimum electromagnetic compatibility of systems is only guaranteed if system components and in particular lines are shielded and the shielding provides the most complete coverage possible. Shield coverage of 90% is ideal.

Shielding should be connected as often as possible with the reference ground. The national regulations and guidelines governing the installation of electrical equipment also apply where relevant!
Where there are large differences in potential between the individual grounding points, only one point of the shielding is connected directly with the reference ground.
In systems without potential equalisation, cable shielding of fieldbus systems should only be grounded on one side, for example at the fieldbus supply unit or at safety barriers.

Caution:
If the cable shielding is grounded at more than one point in systems without potential equalisation, network frequency equalisation currents can occur that damage the bus cable or the bus shielding and substantially affect signal transmission.

Bus termination
The start and end of each fieldbus segment are always to be terminated with a bus terminator. With various junction boxes (not ex-rated) the bus termination can be activated via a switch. If this is not the case a separate bus terminator must be installed. Note the following points in addition:
- In the case of a branched bus segment the device furthest from the segment connector represents the end of the bus.
- If the fieldbus is extended with a repeater then the extension must also be terminated at both ends.

Further information
General information and further notes on connections can be found on the website (www.fieldbus.org) of the Fieldbus FOUNDATION.

4.2 Connecting the remote version

4.2.1 Connecting the sensor

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 conductor to the ground terminal on the housing before the power supply is applied.
- If you use remote versions, connect each sensor only to the transmitter having the same serial number. If the devices are not connected in this way communication errors between sensor and transmitter can occur.

Procedure (Fig. 29, 30):

1. Transmitter: Loosen the screws and remove cover (a) from the connection compartment.
2. Sensor: Remove cover (b) from the connection housing.
3. Feed signal cable (c) and coil current cable (d) through the appropriate cable entries.

   Caution:
   – Make sure the connecting cables are secured (see Page 25).
   – Risk of damaging the coil driver. Always switch off the power supply before connecting or disconnecting the coil cable.
4. Preterminate signal cable and coil current cable:
   Promag W, P → Refer to the information on Page 51
   Promag H → Refer to the information on Page 52
5. Establish the connections between sensor and transmitter in accordance with the wiring diagram:
   → Fig. 29, Fig. 30
   → wiring diagram inside the cover

   Caution:
   Insulate the shields of cables that are not connected to eliminate the risk of short-circuits with neighboring cable shields inside the sensor connection housing.
6. Transmitter: Secure cover (a) on the connection compartment.
7. Sensor: Secure cover (b) on the connection housing.

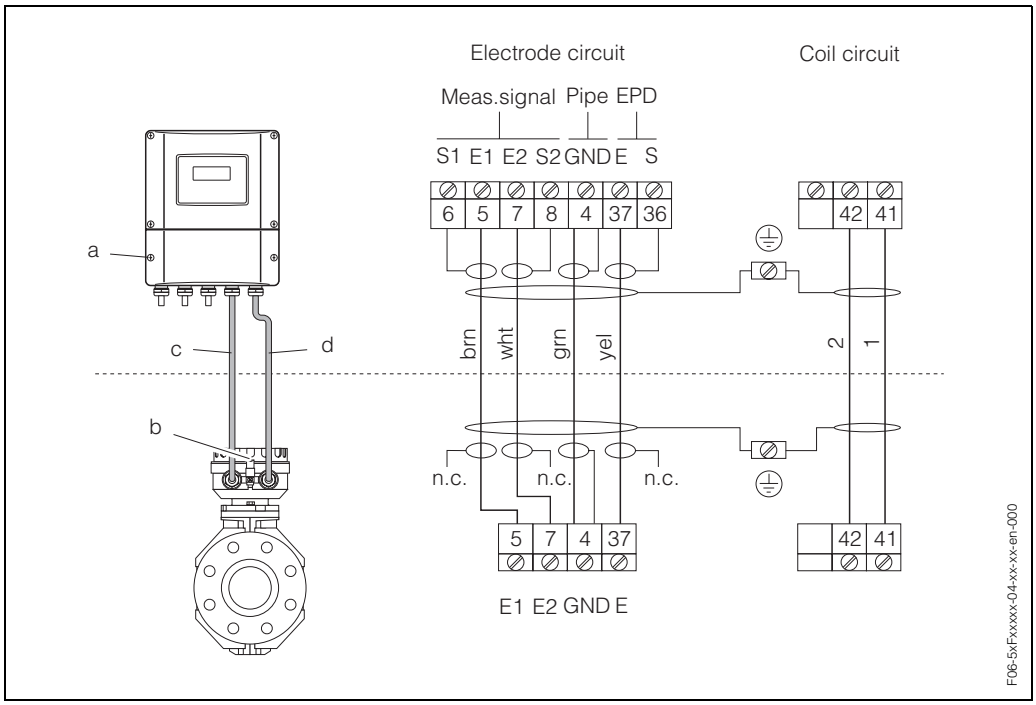


Fig. 29: Connecting the remote version of Promag W/P

a = cover of the connection compartment, b = cover of the sensor connection housing, c = signal cable, d = coil current cable, n.c. = not connected, insulated cable shields

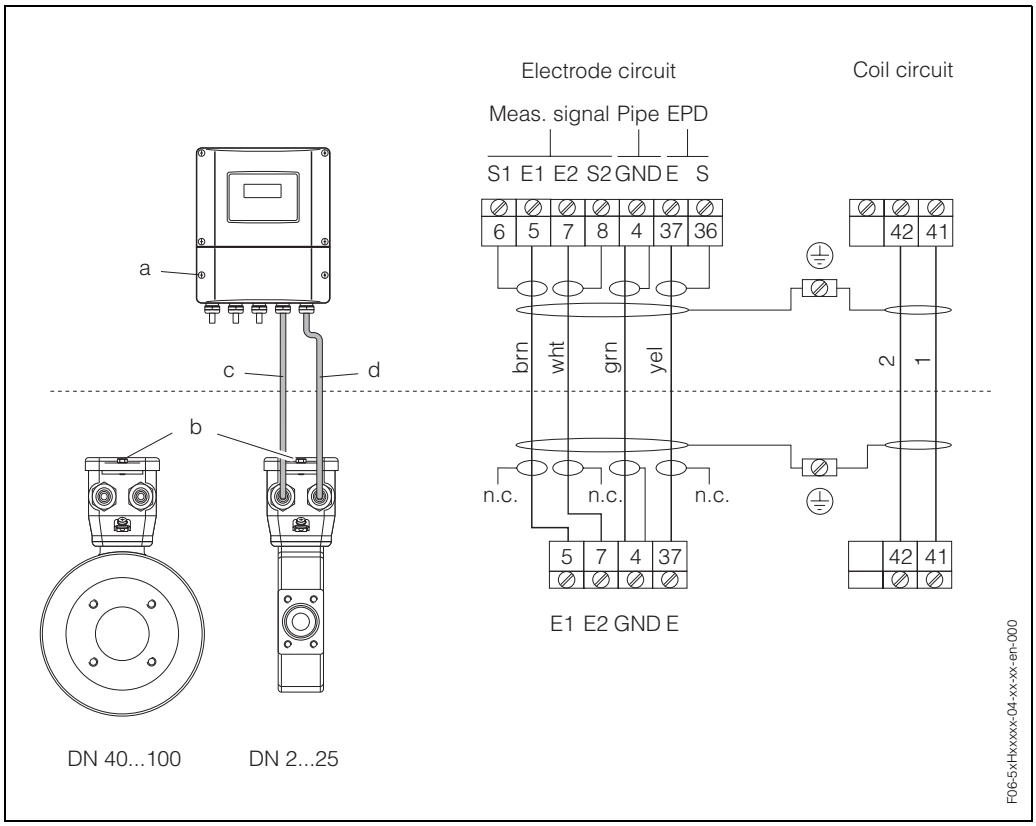


Fig. 30: Connecting the remote version of Promag H

a = cover of the connection compartment, b = cover of the sensor connection housing, c = signal cable, d = coil current cable, n.c. = not connected, insulated cable shields

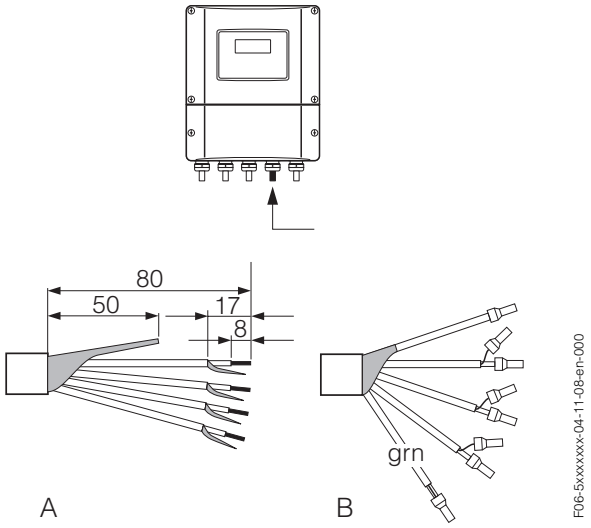
Cable termination for the remote version Promag W / Promag P

Terminate the signal and coil current cables as shown in the figure below (Detail A).
Fit the fine-wire cores with cable end sleeves (Detail B).

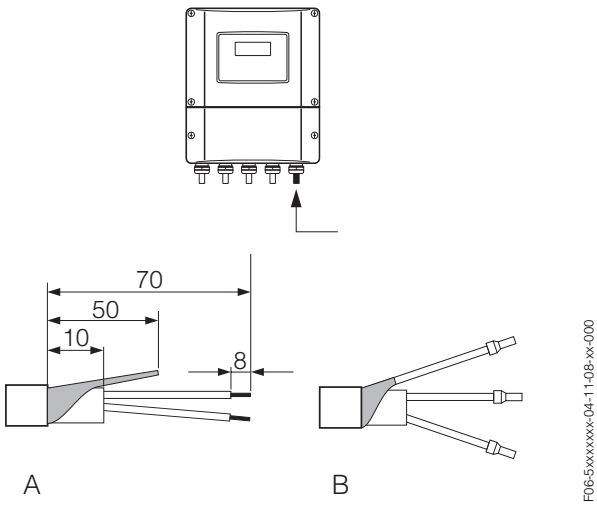
Caution:
When fitting the connectors, pay attention to the following points:
- *Signal cable* → Make sure that the cable end sleeves do not touch the wire shield on the sensor side. Minimum distance = 1 mm (exception "GND" = green cable).
- *Coil current cable* → Insulate one core of the three-core wire at the level of the core reinforcement; you only require two cores for the connection.

TRANSMITTER

Signal cable

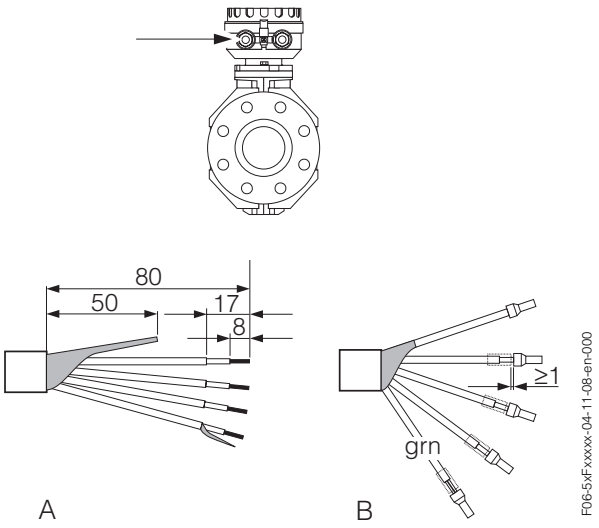


Coil current cable

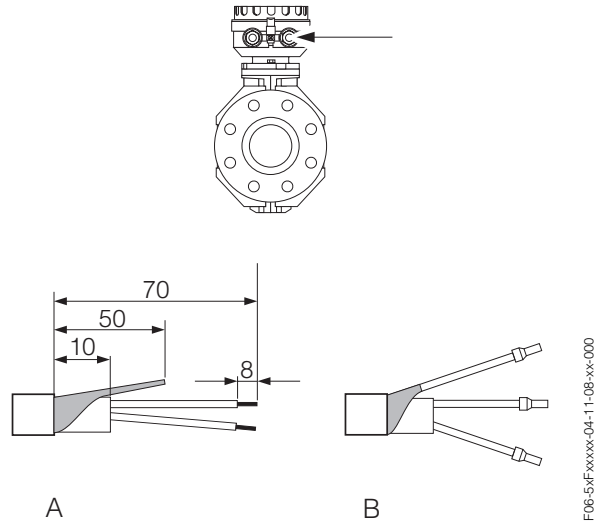


SENSOR

Signal cable



Coil current cable



Cable termination for the remote version Promag H

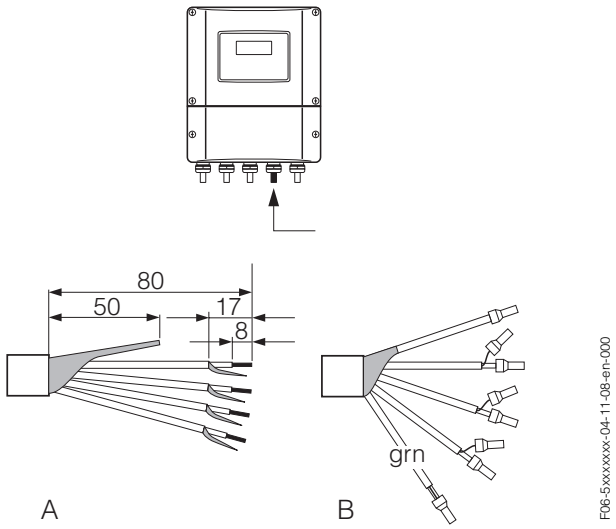
Terminate the signal and coil current cables as shown in the figure below (Detail A).
Fit the fine-wire cores with cable end sleeves (Detail B).

Caution:
When fitting the connectors, pay attention to the following points:

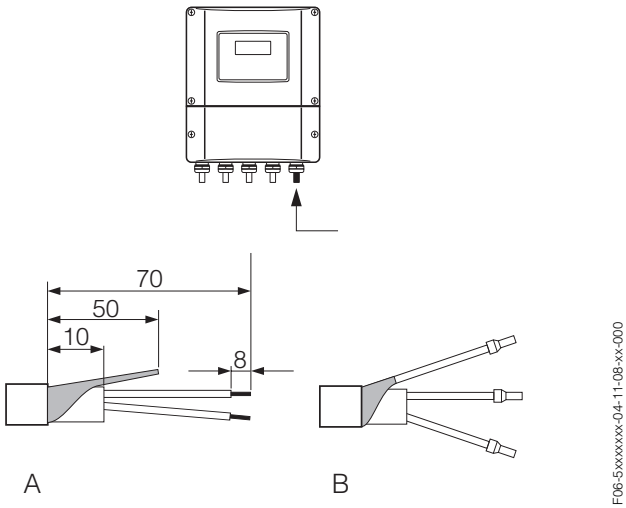
- *Signal cable* → Make sure that the cable end sleeves do not touch the wire shield on the sensor side. Minimum distance = 1 mm (exception "GND" = green cable).
- *Coil current cable* → Insulate one core of the three-core wire at the level of the core reinforcement; you only require two cores for the 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

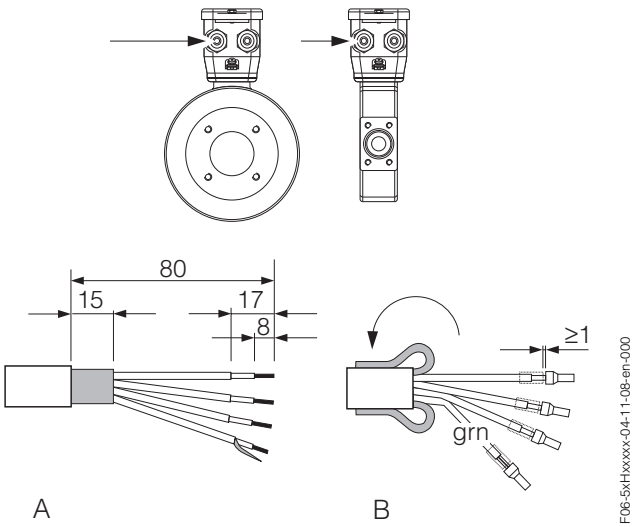


Coil current cable

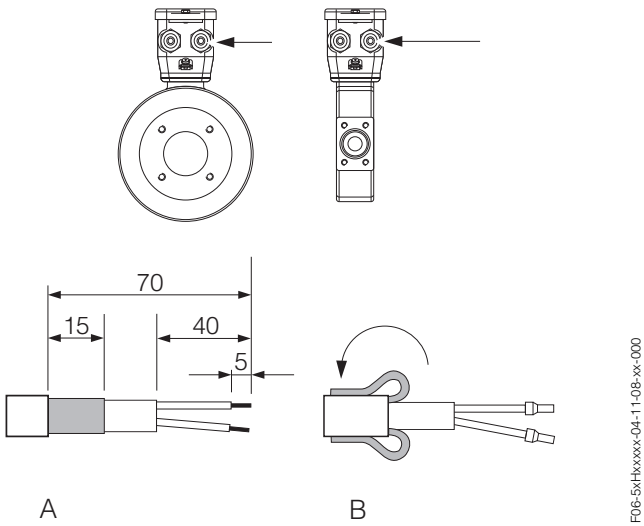


SENSOR

Signal cable



Coil current cable



4.2.2 Cable specifications

Coil cable
- 2 x 0.75 mm^2 PVC cable with common, braided copper shield (Ø approx. 7 mm)
- Conductor resistance: ≤ 37 Ω/km
- Capacitance: core/core, shield grounded: ≤ 120 pF/m
- Permanent 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 (Ø approx. 7 mm) and individually shielded cores
- With Empty Pipe Detection (EPD): 4 x 0.38 mm^2 PVC cable with common, braided copper shield (Ø approx. 7 mm) and individually shielded cores
- Conductor resistance: ≤ 50 Ω/km
- Capacitance: core/shield: ≤ 420 pF/m
- Permanent operating temperature: –20…+80 °C
- Cable cross-section: max. 2.5 mm^2

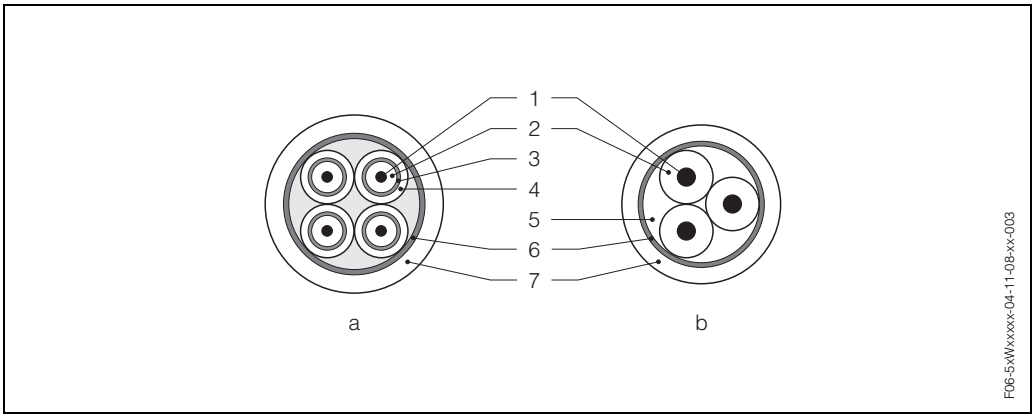


Fig. 31: Cable cross-section (a = Signal cable, b = Coil current cable)

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

As an option, E+H can also deliver reinforced connecting cables with an additional, reinforcing metal braid. We recommend such cables for the following cases:
- Directly buried cable
- Cables endangered by rodents
- Device operation which should comply with the IP 68 standard of protection

Operation in zones of severe electrical interference:
The measuring device complies with the general safety requirements in accordance with EN 61010, the EMC requirements of EN 61326/A1, and NAMUR recommendation NE 21.

Caution:
Grounding is by means of the ground terminals provided for the purpose inside the connection housing. Keep the stripped and twisted lengths of cable shield to the terminals as short as possible.

4.3 Connecting the measuring unit

Field instruments can be connected to the FOUNDATION Fieldbus in two ways:
- Connection via conventional cable gland → Chapter 4.3.1
- Connection using prefabricated fieldbus connector (option) → Chapter 4.3.2

4.3.1 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 conductor to the ground terminal on the housing before the power supply is applied (not necessary if the power supply is galvanically insulated).
- Compare the specifications on the nameplate with the local voltage supply and frequency. The national regulations governing the installation of electrical equipment also apply.

Procedure (see Fig. 32, 33, 34):

1. Remove the cover of the connection compartment (f) from the transmitter housing.

2. Feed the power-supply cable (a) and fieldbus cables (b) through the appropriate cable entries.

   ✎ Note:
   The Promag 53 can also be supplied with the option of a ready-mounted fieldbus connector. More information on this can be found on Page 57.

3. Connect the cables in accordance with the wiring diagram:
   – Wiring diagram (aluminium housing) → Fig. 32
   – Wiring diagram (stainless steel housing) → Fig. 33
   – Wiring diagram (wall-mount housing) → Fig. 34

   ☝ Caution:
   – Do not damage the fieldbus cable!
     If the shielding of the fieldbus cable is grounded at more than one point in systems without additional potential equalisation, network frequency equalisation currents can occur that damage the cable or the shielding.
     In such cases the shielding of the fieldbus cable is to be grounded on only one side, i.e. it must not be connected to the ground terminal of the housing. The shield that is not connected should be insulated!
   – Please also pay special attention to company-internal grounding concepts and national installation standards and regulations.
   – It is not recommended that the fieldbus be looped using conventional cable glands. If you later replace one measuring device, the bus communication for the entire bus will have to be interrupted.

   ✎ Note:
   – The terminals for the fieldbus connection (26/27) have an integral polarity protection. This ensures correct signal transmission via the fieldbus even if lines are confused.
   – Conductor cross-section: max. 2.5 mm^2

4. Screw the cover of the connection compartment (f) firmly onto the transmitter housing.

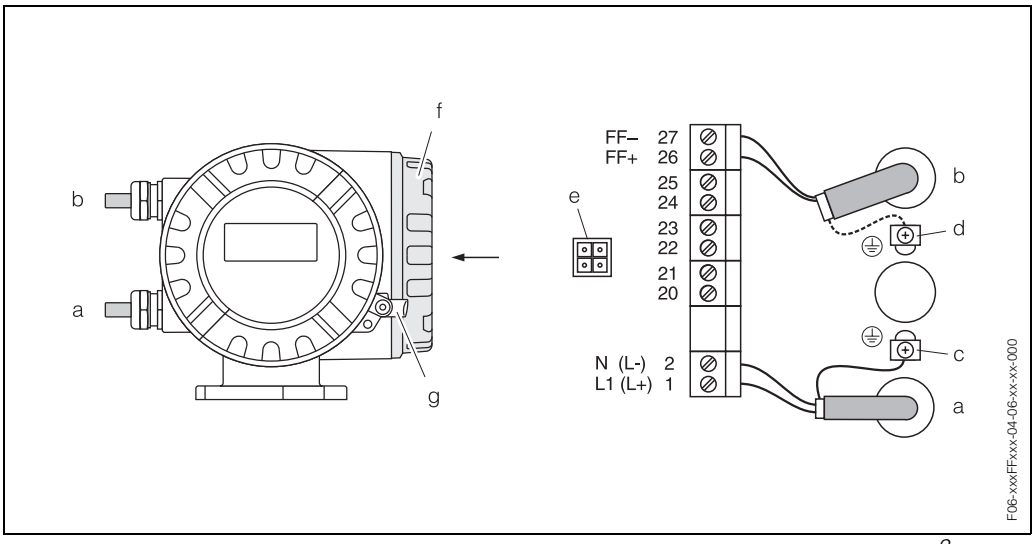


Fig. 32: Connecting the transmitter (aluminium field housing). Cable cross-section: max. 2,5 mm²

a Cable for power supply: 85...260 V AC, 20...55 V AC, 16...62 V DC
Terminal No. 1: L1 for AC, L+ for DC
Terminal No. 2: N for AC, L– for DC
b Fieldbus cable:
Terminal No. 26: FF+ (with integral polarity protection)
Terminal No. 27: FF– (with integral polarity protection)
c Ground terminal for protective conductor
d Ground terminal for fieldbus cable shielding (for notes on connection → Page 48, 54)
e Service adapter for connecting service interface FXA 193 (FieldCheck, FieldTool)
f Cover of the connection compartment
g Safety catch

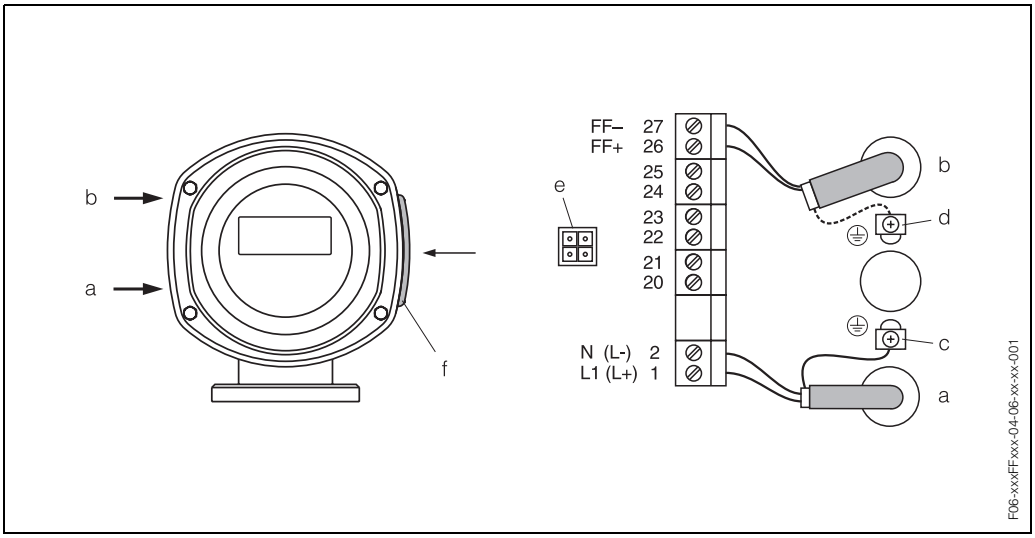


Fig. 33: Connecting the transmitter (stainless steel housing). Cable cross-section: max. 2,5 mm²

a Cable for power supply: 85...260 V AC, 20...55 V AC, 16...62 V DC
Terminal No. 1: L1 for AC, L+ for DC
Terminal No. 2: N for AC, L– for DC
b Fieldbus cable:
Terminal No. 26: FF+ (with integral polarity protection)
Terminal No. 27: FF– (with integral polarity protection)
c Ground terminal for protective conductor
d Ground terminal for fieldbus cable shielding (for notes on connection → Page 48, 54)
e Service adapter for connecting service interface FXA 193 (FieldCheck, FieldTool)
f Cover of the connection compartment

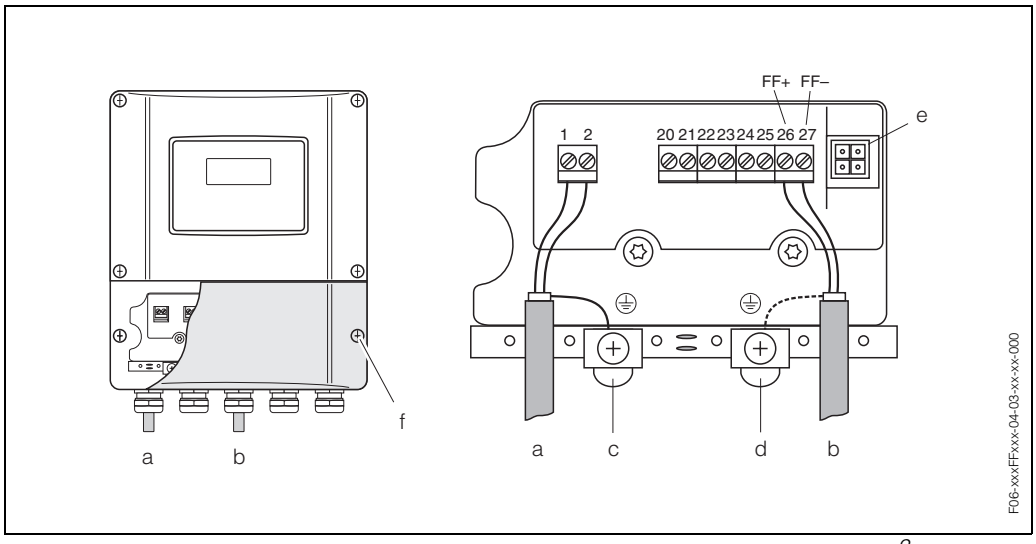


Fig. 34: Connecting the transmitter (wall-mount housing). Cable cross-section: max. 2,5 mm²

a Cable for power supply: 85...260 V AC, 20...55 V AC, 16...62 V DC
Terminal No. 1: L1 for AC, L+ for DC
Terminal No. 2: N for AC, L– for DC
b Fieldbus cable:
Terminal No. 26: FF+ (with integral polarity protection)
Terminal No. 27: FF– (with integral polarity protection)
c Ground terminal for protective conductor
d Ground terminal for fieldbus cable shielding (for notes on connection → Page 48, 54)
e Service adapter for connecting service interface FXA 193 (FieldCheck, FieldTool)
f Cover of the connection compartment

4.3.2 Fieldbus connector

The connection technology of FOUNDATION Fieldbus allows measuring devices to be connected to the fieldbus via uniform mechanical connections such as T-boxes, junction boxes, etc. This connection technology using prefabricated distribution modules and plug-in connectors offers significant advantages over conventional wiring:
- Field devices can be removed, replaced or added at any time during normal operation. There is no interruption of bus communication.
- This simplifies installation and maintenance significantly.
- Existing cable infrastructures can be used and expanded instantly, e.g. when constructing new star distributors using 4-channel or 8-channel junction boxes.

The Promag 53 can therefore be supplied with a ready-mounted fieldbus connector. Fieldbus connectors for retrofitting can be ordered from E+H as a spare part (see Page 104).

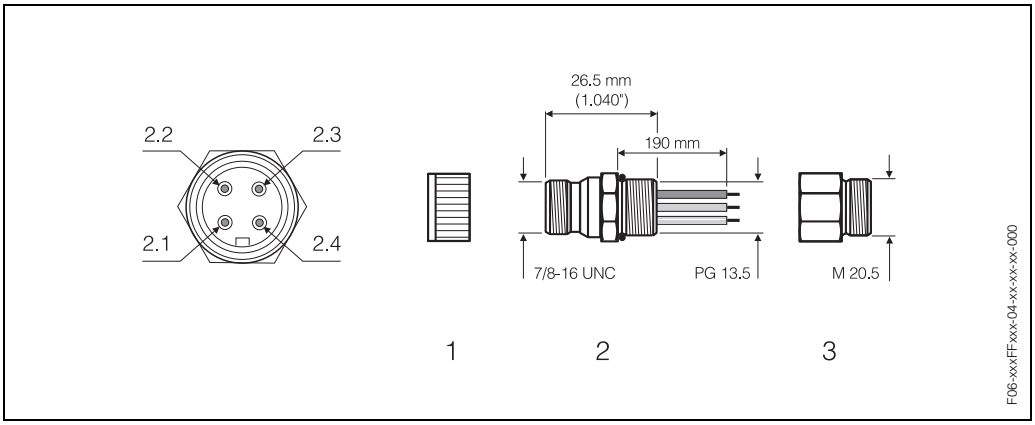


Fig. 35: Connector for connecting to the FOUNDATION Fieldbus

1 Protective cap for connector
2 Fieldbus connector (pinout/colour codes)
2.1 Brown wire: FF+ (terminal 26)
2.2 Blue wire: FF– (terminal 27)
2.3 Not connected
2.4 Green/yellow: ground (notes on connection → Page 48, 54)
3 Adapter PG 13.5 / M 20.5

Technical data (connector):
– Degree of protection IP 67
– Ambient temperature: –40 ... +150 °C

4.4 Potential equalisation

4.4.1 Standard case

Perfect measurement is only ensured when the medium and the sensor have the same electrical potential. Most Promag sensors have a standard installed reference electrode which guarantees the required potential matching. This usually means that additional potential matching measures are unnecessary.

Promag W:
Reference electrode is standard

Promag P:
- Reference electrode is standard for electrode materials 1.4435, Alloy C-22 and tantalum.
- Reference electrode is optional for electrode material Pt/Rh.

Promag H:
- No reference electrode. The metallic process connection provides a permanent electrical connection to the fluid.
- If the process connections are made of a synthetic material, ground disks have to be used to ensure that potential is equalised (see Page 39). Ground rings are accessories which must be ordered separately → Page 89.

Note:
For installation in metal pipes, it is advisable to connect the ground terminal of the transmitter housing to the piping. Please also pay special attention to company-internal grounding concepts.

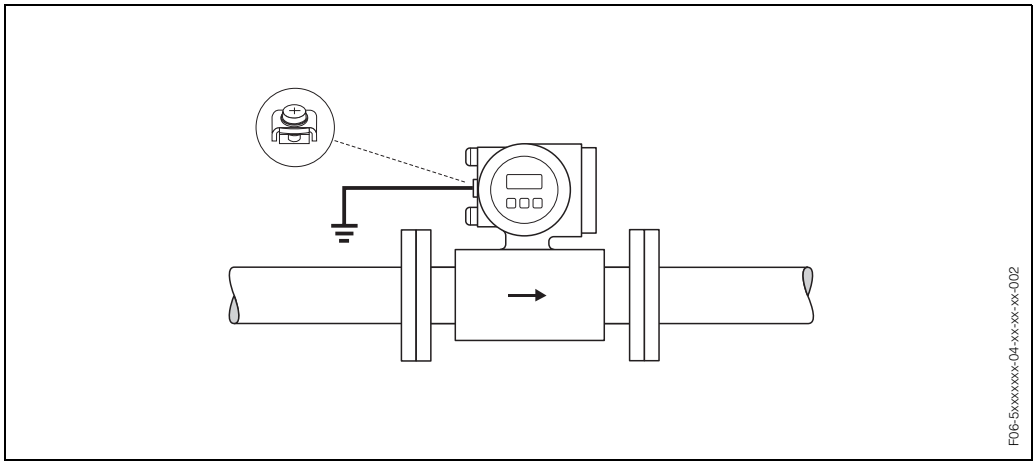


Fig. 36: Potential equalisation by means of the transmitter's ground terminal

Caution:
For sensors without reference electrodes or without metal process terminals, carry out potential equalisation as per the instructions for special cases described below. These special measures are particularly important when standard grounding practice cannot be ensured or extremely strong matching currents are expected.

4.4.2 Special cases

Equalising currents in metallic, ungrounded pipes
In order to prevent outside influences on measurement, it is advisable to use ground cables to connect each sensor flange to its corresponding pipe flange and ground the flanges. Connect the transmitter or sensor connection housing, as applicable, to ground potential by means of the ground terminal provided for the purpose (Fig. 37).

Caution:
Please also pay special attention to company-internal grounding concepts.

Note:
The ground cable for flange-to-flange connections can be ordered separately as an accessory from E+H → Page 89.
- DN ≤ 300: the ground cable is in direct connection with the conductive flange coating and is secured by the flange screws.
- DN ≥ 350: the ground cable connects directly to the metal transport bracket.

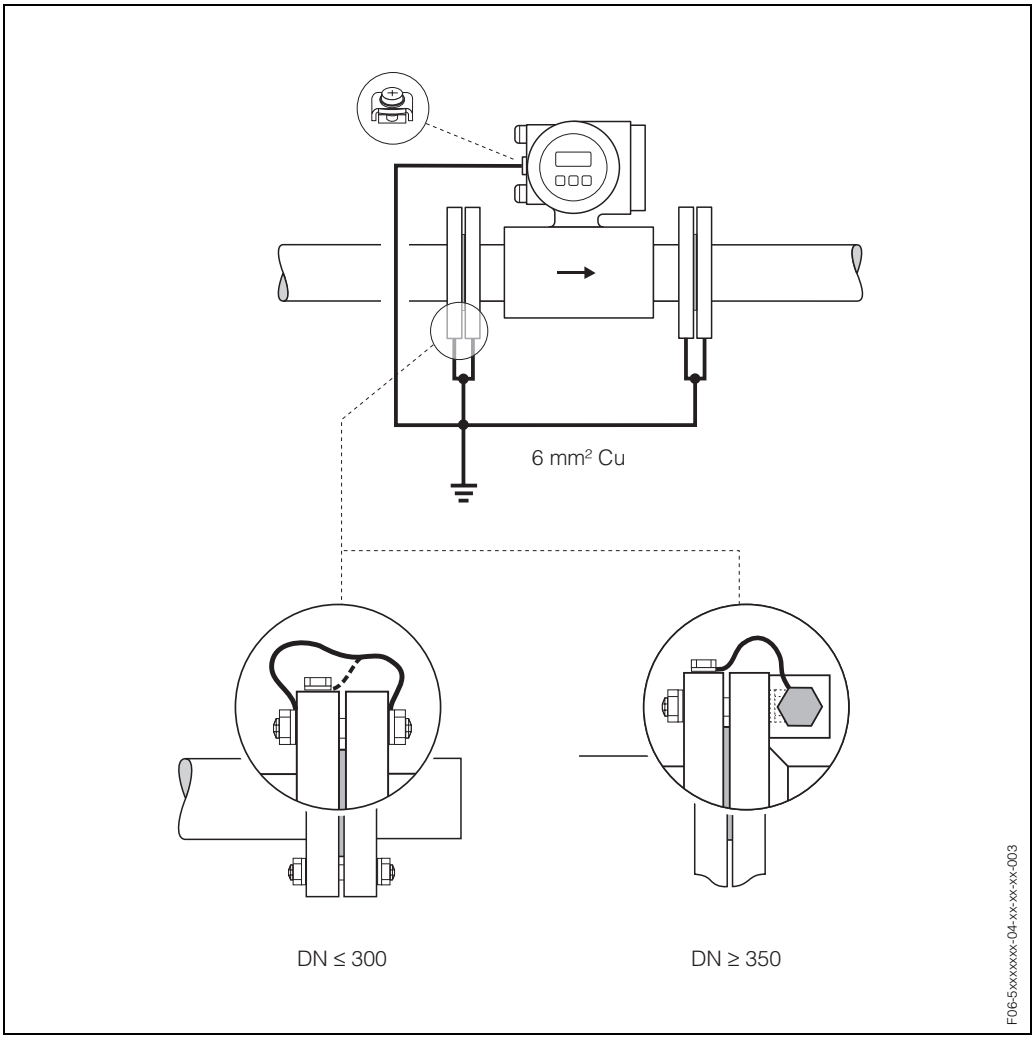


Fig. 37: Potential equalisation with equalising currents in metallic, non-grounded piping systems

Plastic pipes and isolating lined pipes
Normally, potential is matched using the reference electrodes in the measuring tube. However, in exceptional cases it is possible that, due to the grounding plan of a system, large matching cur-rents flow over the reference electrodes. This can lead to destruction of the sensor, e.g. through electrochemical decomposition of the electrodes. In such cases, e.g. for fibre-glass or PVC piping, it is recommended that you use additional ground disks for potential matching (Fig. 38).

Mounting of ground disks → Page 27, 33

Caution:
- Risk of damage by electrochemical corrosion. Note the electrochemical insulation rating, if the ground disks and measuring electrodes are made of different materials.
- Please also pay special attention to company-internal grounding concepts.

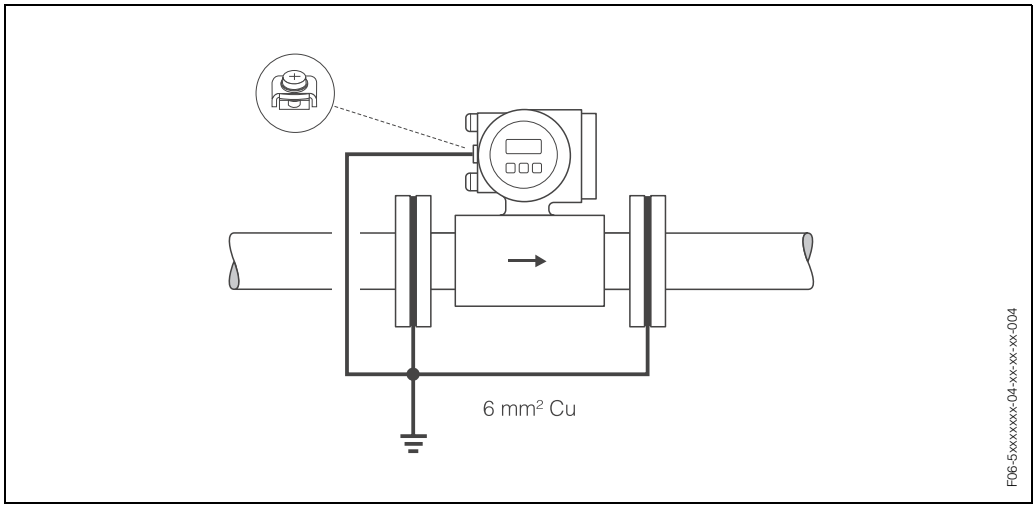


Fig. 38: Potential equalisation/ground disks with plastic pipes or lined pipes

Lined pipes (cathodic protection)
In such cases, install the measuring instrument without potential in the piping:
- When installing the measuring device, make sure that there is an electrical connection between the two piping runs (copper wire, 6 mm^2).
- Make sure that the installation materials do not establish a conductive connection to the measuring device and that the installation materials withstand the tightening torques applied when the threaded fasteners are tightened.
- Also comply with the regulations applicable to potential-free installation.

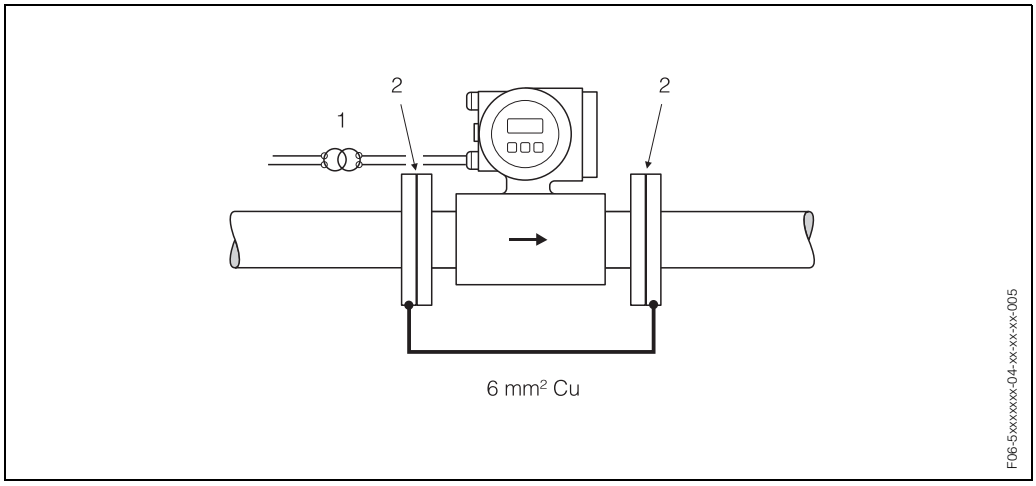


Fig. 39: Potential equalisation and cathode protection
1 = isolating transformer power supply, 2 = electrically insulated

4.5 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 (see Page 115).
- Firmly tighten the cable entries (Fig. 40).
- The cables must loop down before they enter the cable entries ("water trap", Fig. 40). This arrangement prevents moisture penetrating the entry. Always install the measuring device in such a way that the cable entries do not point upwards.
- Remove all unused cable entries and insert plugs instead.
- Do not remove the grommet from the cable entry.

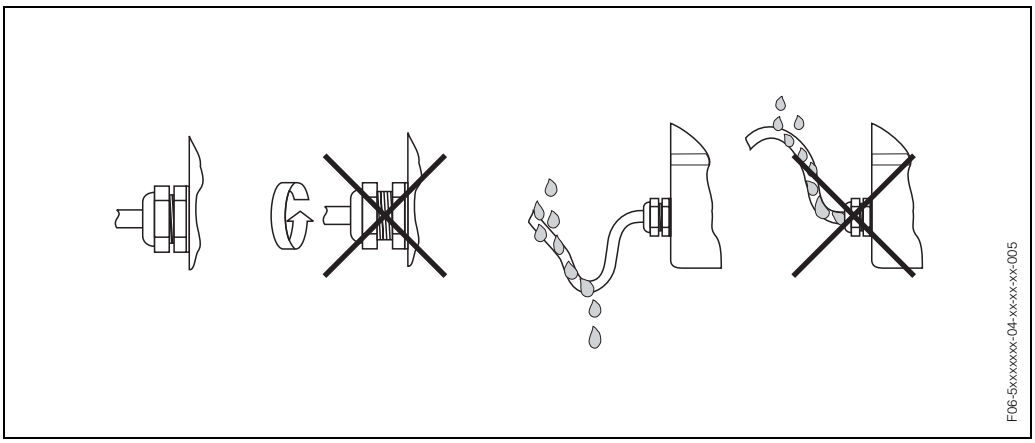


Fig. 40: Installation instructions, cable entries

Caution:
Do not loosen the threaded fasteners of the Promag sensor housing, as otherwise the degree of protection guaranteed by Endress+Hauser no longer applies.

Note:
The Promag W and Promag P sensors can be supplied with IP 68 rating (permanent immersion in water to a depth of 3 meters). In this case the transmitter must be installed remote from the sensor.

4.6 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 of meter	Notes
Does the supply voltage match the specifications on the nameplate?	85...260 V AC (45...65 Hz) 20...55 V AC (45...65 Hz) 16...62 V DC
Do the cables comply with the specifications?	see Page 47, 53, 115
Do the cables have adequate strain relief?	–
Are the cables correctly segregated by type? Without loops and crossovers?	–
Are the power-supply and fieldbus 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?	see Page 58 ff.
Are all cable entries installed, firmly tightened and correctly sealed? Cables looped as “water traps”?	see Page 61
Are all housing covers installed and firmly tightened?	–
Electrical connection of FOUNDATION Fieldbus-H1	Notes
Are all the connecting components (T-boxes, junction boxes, connectors, etc.) connected with each other correctly?	–
Has each fieldbus segment been terminated at both ends with a bus terminator?	–
Has the max. length of the fieldbus cable been observed in accordance with the FF specifications?	see Page 48
Has the max. length of the spurs been observed in accordance with the FF specifications?	see Page 48
Is the fieldbus cable fully shielded (90%) and correctly grounded?	see Page 48

5 Operation

5.1 Quick operation guide

You have a number of options for configuring and commissioning the flowmeter (Fig. 41):

1. Configuration programs (FOUNDATION Fieldbus) → Page 64
FF functions and device-specific parameters are configured primarily via the fieldbus interface. You can obtain special configuration and operating programs from the various manufacturers for these purposes.

2. Jumpers for diverse hardware settings → Page 69
Jumpers on the I/O board provide the means of setting the following hardware parameters for the FOUNDATION Fieldbus:
- Enable/disable simulation mode (AI and DO function block)
- Switch hardware write protection on and off

3. Local display (option) → Page 70
The local display enables you to read all important parameters directly at the measuring point and configure device-specific parameters in the field.

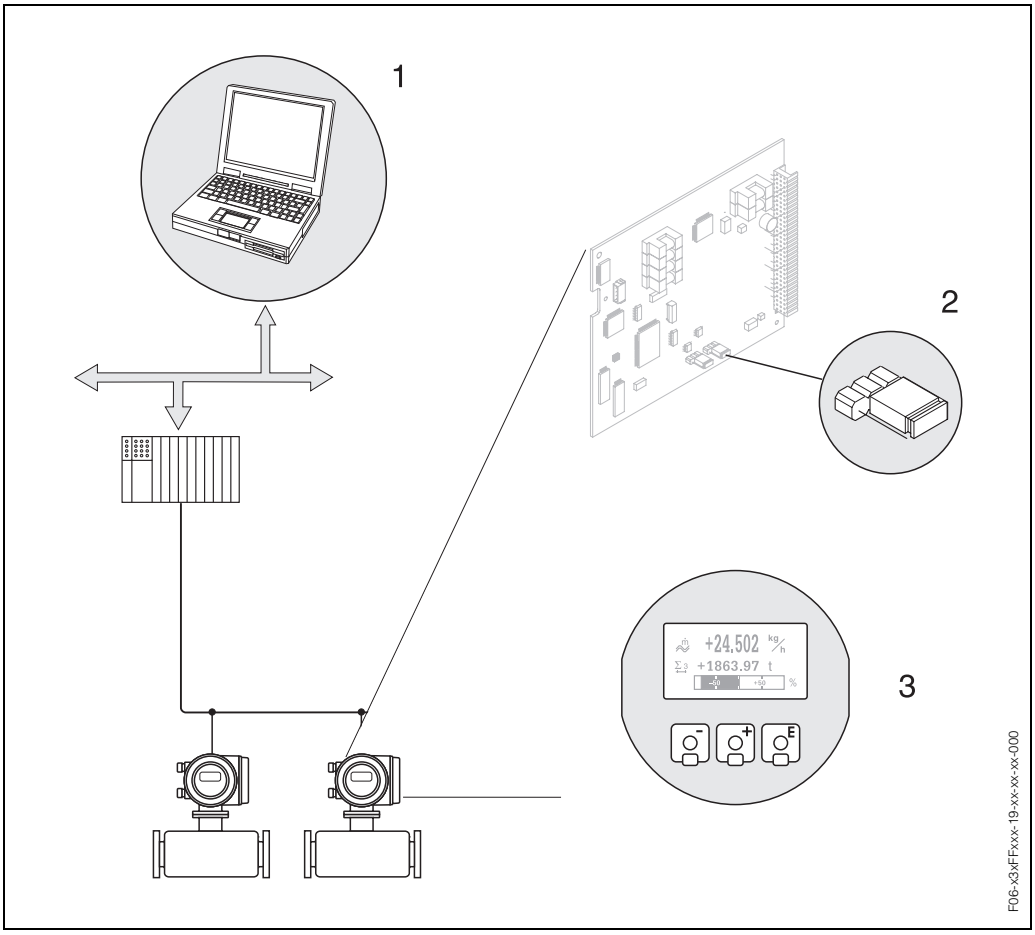


Fig. 41: Options for operating the Promag 53 FOUNDATION Fieldbus

1 Configuration/operating programs for control via the fieldbus (FF functions, device parameters)
2 Jumpers for hardware settings (write protection, simulation mode)
3 Local display for configuring device parameters in the field (option)

5.2 Operating with the FF configuration programs

The user can obtain special configuration and operating programs offered by the different manufacturers for use in configuration. These can be used for configuring both the FF functions and all the device-specific parameters. The predefined function blocks allow uniform access to all the network and fieldbus device data.

A step-by-step description of the procedure for commissioning the FF functions is given on Page 78 ff., along with the configuration of device-specific parameters.
You will find general information on the FOUNDATION Fieldbus on → Page 65 ff.

System files
You will need the following files for commissioning and network configuration:
- Commissioning → Device description (Device Description: *.sym, *.ffo)
- Network configuration → CFF file (Common File Format: *.cff)

You can obtain these files as follows:
- Free of charge via the Internet → www.endress.com / www.endress.de
- From Endress+Hauser stating the order number (No. 50097199)
- Via the Fieldbus Foundation Organisation → www.fieldbus.org

Note:
Ensure you use the correct system files for linking the field devices into the host system. Appropriate version information can be called up in Promag 53 via the following functions/parameters:

Local display:
- HOME → BASIC FUNCTION → FOUND. FIELDBUS → INFORMATION → DEVICE REVISION (6243)
- HOME → BASIC FUNCTION → FOUND. FIELDBUS → INFORMATION → DD REVISION (6244)

FF configuration program:
- Resource Block → Parameter DEV_REV
- Resource Block → Parameter DD_REV

Example (with local display):
Display in the DEVICE REVISION (6243) function → 02
Display in the DD REVISION (6244) function → 01
Required Device Description file (DD) → 0201.sym / 0201.ffo

5.3 FOUNDATION Fieldbus technology

The FOUNDATION Fieldbus (FF) is a purely digital, serial communication system that connects fieldbus devices (sensors, actors), automation and process control systems with each other. As a local communications network (LAN) for field devices the FF was primarily designed for the requirements of process technology. The FF thus forms the basic network throughout the hierarchy of a communication system.

5.3.1 System architecture

The following figure shows two typical examples of a FOUNDATION Fieldbus network with the associated components.

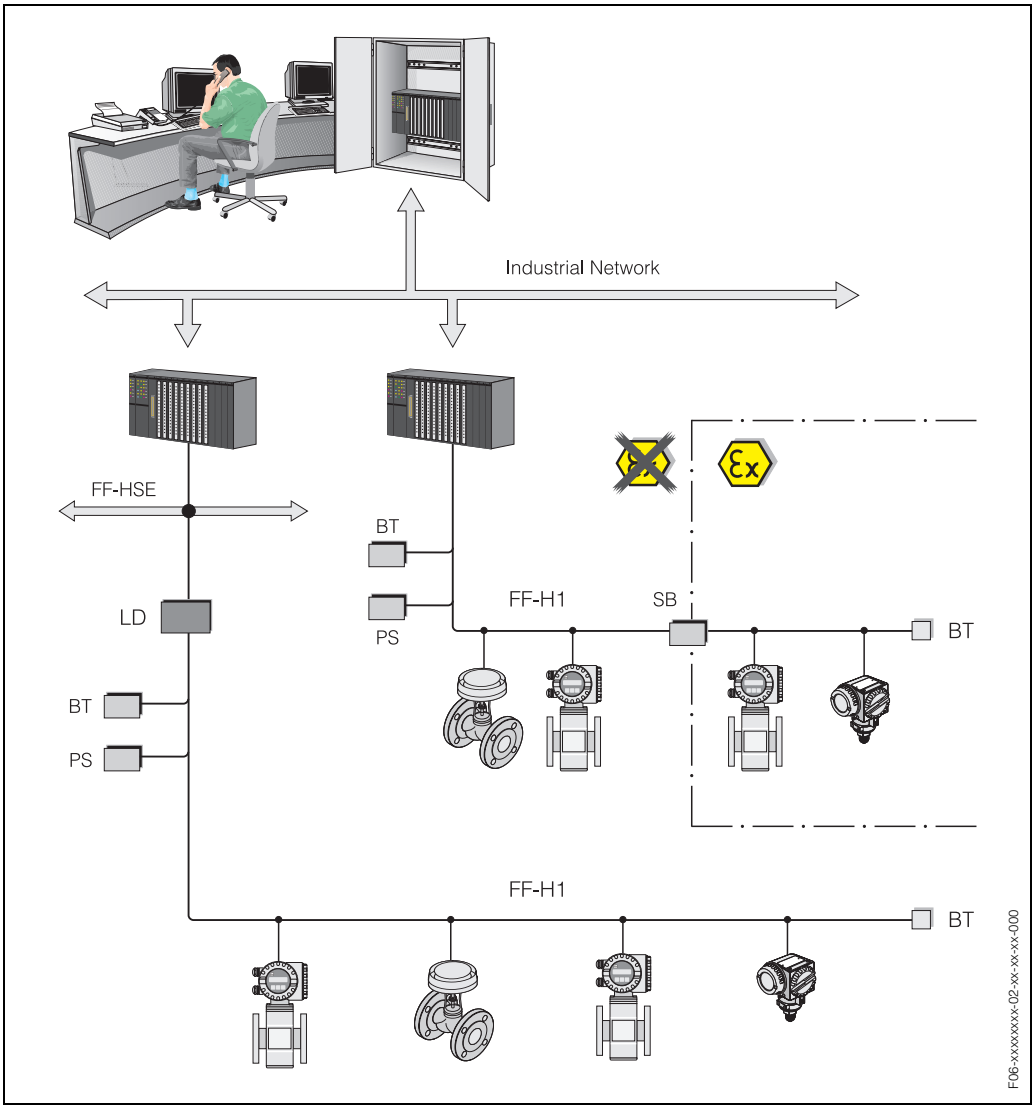


Fig. 42: System architecture of the FOUNDATION Fieldbus with associated components (line structure)

FF-HSE = High Speed Ethernet, FF-H1 = FOUNDATION Fieldbus-H1, LD = Linking Device FF-HSE/FF-H1, PS = Fieldbus Power Supply, SB = Safety Barrier, BT = Bus Terminator

The following possibilities can be realised in respect of system connection:
- *A linking device can be used to connect to higher ranking fieldbus levels (e.g. to the High Speed Ethernet - HSE)*
- *An FF-H1 card is required for direct connection to a process control system.*
- *System inputs are available directly for FF-H1 and FF-H2 (FF-HSE).*

The system architecture of the FOUNDATION Fieldbus can be divided into two sub-networks:

H1 bus system:
At process-near level fieldbus devices are connected only via the slower H1 bus system that is specified according to IEC 61158-2. The H1 bus system allows simultaneous feed to the two-wire field devices and data transfer on the two-wire line.

The following points describe some important characteristics of the H1 bus system:
- All fieldbus devices are powered via the H1 bus. Like the fieldbus devices, the power supply is connected in parallel to the bus line. Devices requiring external power must use a separate power supply.
- One of the most common network structures is the line structure. Star, tree or mixed network structures are also possible using connecting components (junction boxes).
- The bus connection to the individual fieldbus devices is achieved by means of a T-connector or via a spur. This has the advantage that individual fieldbus devices can be connected or disconnected without interrupting the bus or the bus communication.
- The number of connected fieldbus devices depends on various factors, such as use in hazardous areas, length of spur, cable types, current consumption of field devices, etc. (see Page 47 ff.).
- If using fieldbus devices in a hazardous area the H1 bus must be equipped with an intrinsically safe barrier before the transition to the hazardous area.
- A bus terminator is required at each end of the bus segment.

High Speed Ethernet (HSE):
The superior H2 bus system is realised via the High Speed Ethernet (HSE) with a transmission rate of max. 100 MBit/s. This serves as the “backbone” (basic network) between various local sub-networks and/or where there are a large number of network users.

5.3.2 Link Active Scheduler (LAS)

The FOUNDATION Fieldbus works according to the “producer-consumer” relationship. This provides various advantages.
Data can be directly exchanged between field devices, e.g. a sensor and an actuating valve. Each bus user “publishes” its data on the bus and all the bus users configured accordingly obtain this data. Publication of this data is carried out by a “bus administrator” known as the “Link Active Scheduler”, which controls the sequence of bus communication centrally. The LAS organises all the bus activities and sends appropriate commands to the individual field devices.

Other tasks of the LAS are:
- Recognition and reporting of newly connected devices.
- Reporting the removal of devices no longer communicating with the fieldbus.
- Keeping the “Live List”. This list, in which all the fieldbus users are recorded, is checked by the LAS regularly. New or removed devices are immediately transferred to the Live List and sent to all the devices.
- Requesting process data from the field devices in accordance with a fixed schedule
- Allocation of send rights (tokens) to devices between the untimed data transfer

The LAS can be run redundantly, i.e. it exists both in the process control system and in the field device. If one LAS fails, the other LAS can accurately take over communication. Through precise timing of the bus communication via the LAS, the FF can run exact processes at regular intervals. (Deterministic).

Note:
Fieldbus devices such as the Promag 53, which can take over the LAS function in the event of failure of the primary master, are called “Link Master”. In contrast, “Basic Devices” can only receive signals and send them to the central process control system. They do not have the capability to become the LAS function.

5.3.3 Data transfer

We distinguish between two types of data transfer:
- *Scheduled data transfer (cyclic):* all time-critical process data (i.e. continuous measurement or actuating signals) are transferred and processed in accordance with a fixed schedule.
- *Unscheduled data transfer (acyclic):* device parameters that are not time-critical for the process and diagnosis information are only transferred to the fieldbus when needed. This data transfer is always carried out in the intervals between timed communication.

5.3.4 Device ID, addressing

Within the FF network each fieldbus device is identified by a unique device ID (DEVICE_ID).

The fieldbus host system (LAS) automatically gives the network address for this to the field device. The network address is the address that the fieldbus currently uses.
The FOUNDATION Fieldbus uses addresses between 0 and 255:
- Groups/DLL: 0...15
- Devices in operation: 20...35
- Reserve devices: 232...247
- Offline/substitute devices: 248...251

The field device tag name (PD_TAG) is given to the device in question during commissioning (see Page 78). It remains stored in the device even during a power supply failure.

5.3.5 Function blocks

The FOUNDATION Fieldbus uses predefined function blocks to describe the functions of a device and to specify uniform data access. The function blocks implemented in each fieldbus device provide information on the tasks which a device can accept in the whole of the automation strategy.

In the case of sensors these are typically the following blocks:
- 'Analog Input' or
- 'Discrete Input' (digital input)

Actuating valves normally have the function blocks:
- 'Analog Output' or
- 'Discrete Output' (digital output)

For control tasks there are the blocks:
- PD controller or
- PID controller

Note:
More information on this can be found in the "Description of Device Functions" manual.

5.3.6 Field based process control

With the FOUNDATION Fieldbus field devices can carry out simple process control functions themselves, thereby relieving pressure on the superior process control system. Here the Link Active Scheduler (LAS) coordinates data exchange, e.g. between the sensor and a control valve, and makes sure that two field devices cannot access the bus at the same time.
To do this, configuration software such as the NI-FBUS Configurator from National Instruments is used to connect the various function blocks to the desired control strategy – generally graphically (see Page 82).

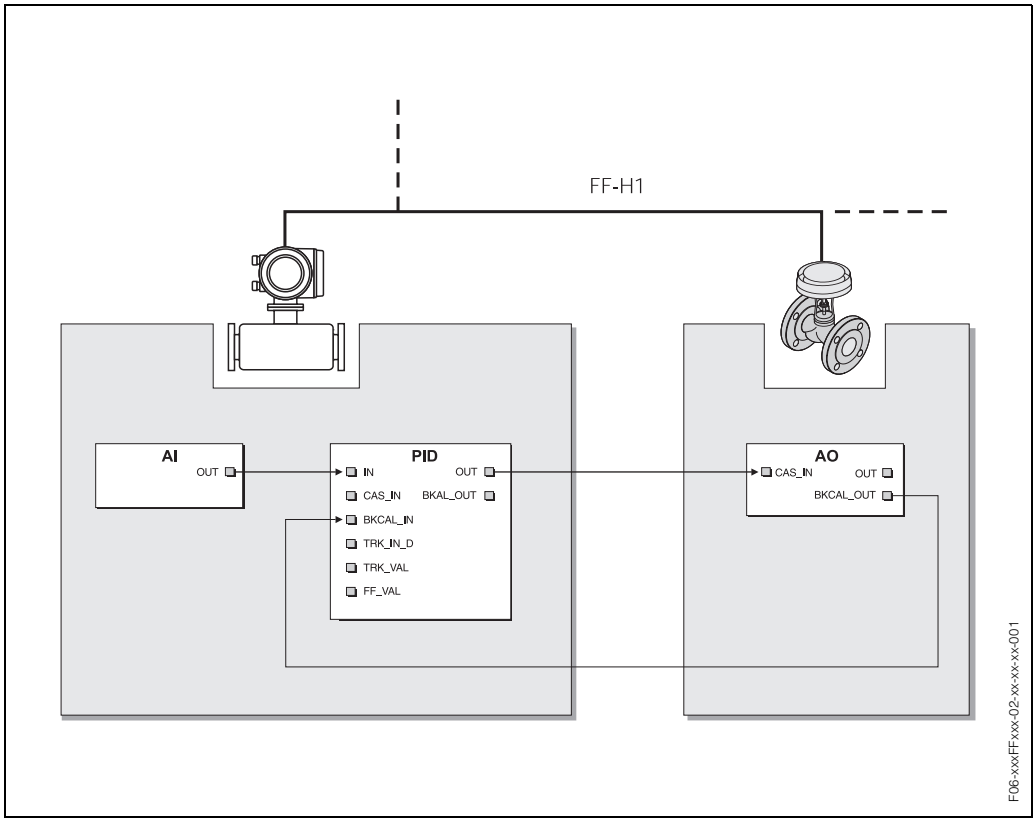


Fig. 43: Example of field based process control (flow control)
AI = Analog Input Function Block, PID = PID Function Block, AO = Analog Output Function Block

The producer-consumer relationship means that in FF systems the control loop can be closed directly between sensor and control valve. The superior system only specifies the setpoint value.

5.3.7 Device Description

For commissioning, diagnosis, configuration, etc. make sure that process control systems or superior configuration systems can access all device data and that the operating structure is uniform.
The device-specific information required for this is stored as so-called device description data in special files (the “Device Description” - DD). This enables the device data to be interpreted and shown via the configuration program. The DD is thus a kind of “device driver”.
Predefined standard DDs are available for the basic functions of measuring devices and these can be ordered from Fieldbus FOUNDATION. Expanded device descriptions are always required if a manufacturer implements additional functions and parameters in his measuring device.
On the other hand, a CFF file (CFF = Common File Format) is required for the network configuration in ON-line and OFF-line mode. These files are available from the device manufacturer.

5.4 Hardware configuration

Two jumpers on the I/O board provide the means of activating or deactivating hardware write protection and simulation mode (for AI and DO Function Blocks).

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

1. Switch off power supply.
2. Remove I/O board → Page 105 ff.
3. Configure hardware write protection and simulation mode appropriately using the jumpers (Fig. 44).
4. Installation of the I/O board is the reverse of the removal procedure.

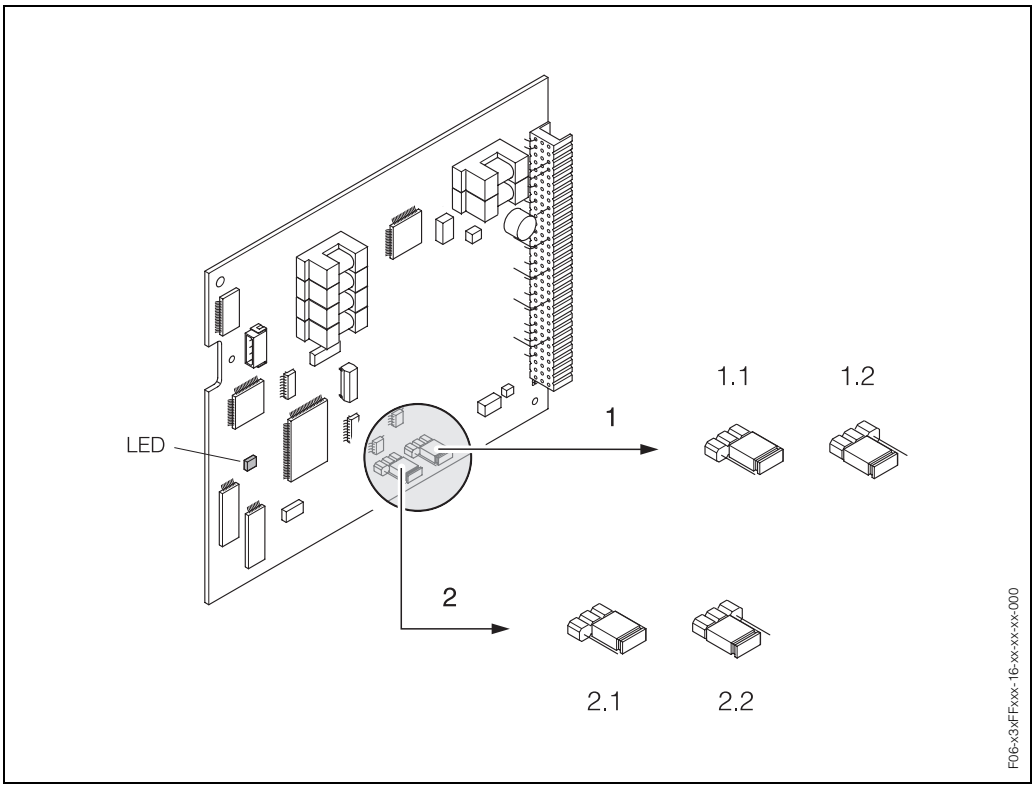


Fig. 44: Hardware configuration (I/O board)

1 Jumper for hardware write protection:
1.1 Disabled (factory setting) = access to device parameters via FF interface is possible
*1.2 Enabled = access to device parameters via FF interface is **not** possible*

2 Jumper for simulation mode:
2.1 Enabled (factory setting) = simulation in the Analog Input Function Block and in the Discrete Output Function Block is possible
*2.2 Disabled = simulation in the Analog Input Function Block and in the Discrete Output Function Block is **not** possible*

LED:
– continuously lit → ready (no communication via FF active)
– not lit → not ready
– flashes slowly → ready (communication via FF active)
– flashes fast → device failure present (error message type "Fault message") → Page 95 ff.

5.5 Operation with the local display

5.5.1 Display and operating elements

The local display enables you to read all important parameters directly at the measuring point and configure the device using the “Quick Setup” or the function matrix.

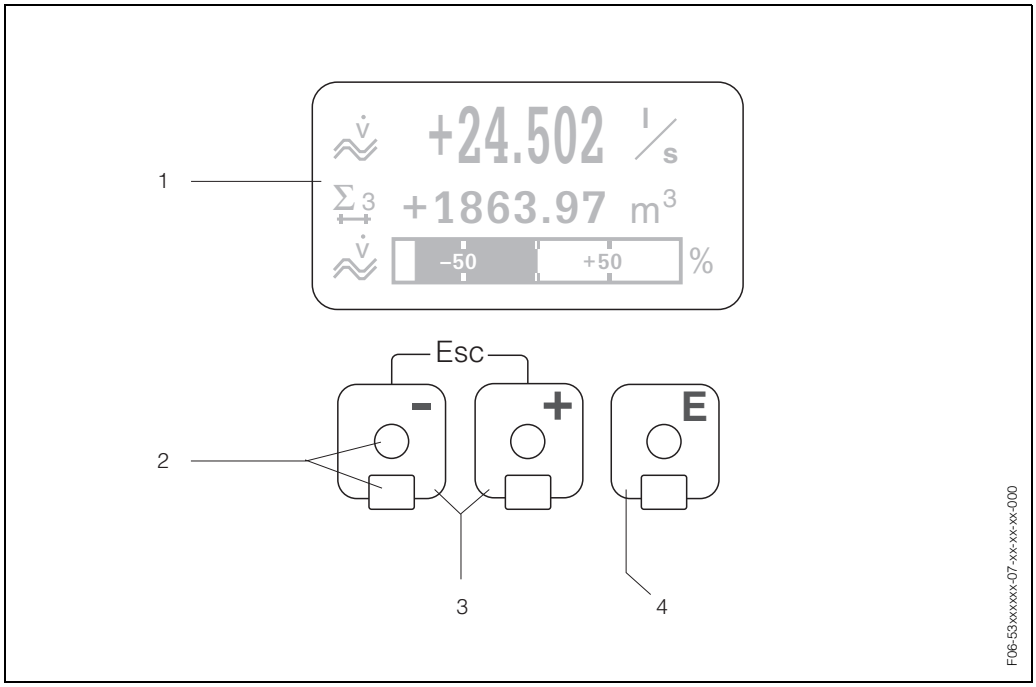


Fig. 45: Display and operating elements

Liquid-crystal display (1)

The backlit, four-line liquid-crystal display shows measured values, dialog texts and both system and process error messages. The display as it appears when normal measuring is in progress is known as the HOME position (operating mode).

Optical sensors for Touch Control (2)

Plus / Minus keys (3)

- *HOME position → Direct access to totalizer values and actual values of inputs/outputs*
- *Enter numerical values, select parameters*
- *Select different blocks, groups or function groups within the function matri*

Press the +/– keys simultaneously to trigger the following functions:

- *Exit the function matrix step by step → HOME position*
- *Press and hold down +/– keys for longer than 3 seconds → Return directly to the HOME position*
- *Cancel data entry*

Enter key (4)

- *HOME position → Entry into the function matrix*
- *Save the numerical values you input or settings you change*

Display (operation mode)
The display area consists of three lines in all; this is where measured values are displayed, and/or status variables (direction of flow, partially filled pipe, bargraph, etc.). You can change the assignment of display lines to variables at will in order to customize the display to suit your needs and preferences (→ see the "Description of Device Functions" manual).

Multiplex mode:
A maximum of two different display variables can be assigned to each line. Variables multiplexed in this way alternate every 10 seconds on the display.

Error messages:
The display modes for system and process error messages are described in detail on Page 75 ff.

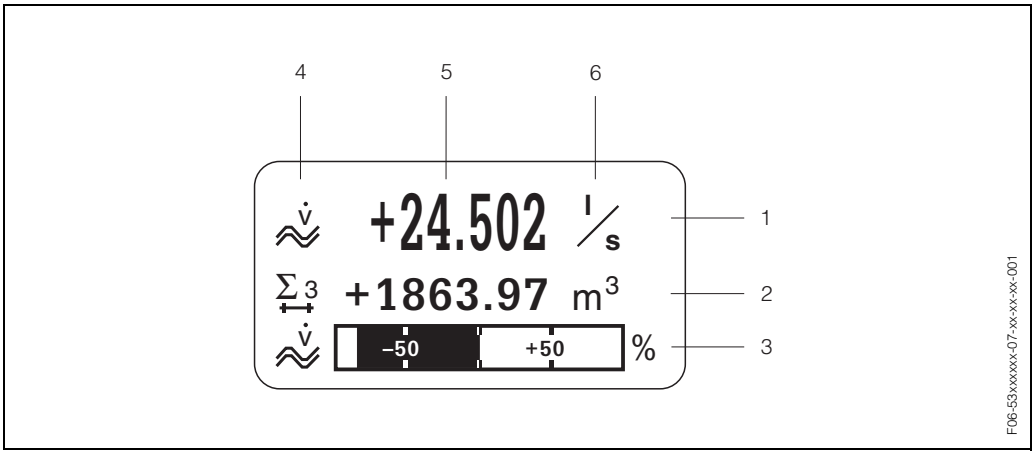


Fig. 46: Typical display for normal operating mode (HOME position)

1 Main line shows primary measured values, e.g. volume flow in [l/s].
2 Supplementary line shows supplementary measured variables, e.g. totalizer No. 3 in [m^3]
3 Information line shows additional information on the measured variables, e.g. bar graph of the limit value reached by the volume flow.
4 "Info icons" field: Icons representing additional information on the measured values are shown in this field. See Page 72 for a full list of the icons and their meanings.
5 "Measured values" field: The current measured values appear in this field.
6 "Unit of measure" field: The units of measure and time defined for the current measured values appear in this field.

Note:
In the HOME position, you can use the +/– keys to call up a list containing the following information:
- Totalizer values (including overflow)
- Tag name (DEVICE PD-TAG

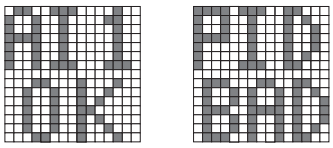
Press ⊞⊟ → to view individual values in the list
Simultaneously press Esc key (⊟⊞) → to return to HOME position

Icons

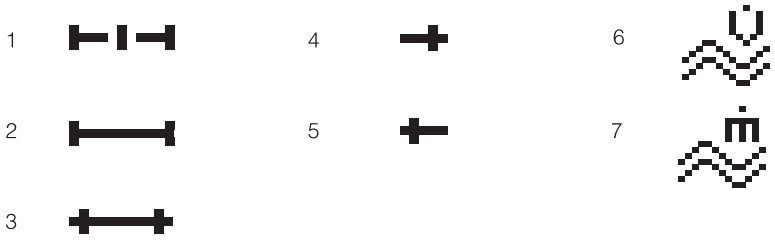
The icons which appear in the field on the left make it easier to read and recognise measured variables, device status, and error messages.

Icon	Meaning
S	System error
P	Process error
ϟ	Fault message (measuring is interrupted)
!	Notice message (measuring continues despite the message)
Σ 1...n	Totalizer 1...n
AI 1 (...n)	Analog Input Function Block 1 (...n), output value OUT
PID	PID Function Block: A PID function block value as listed below is output, depending on the assignment of the lines in the local display: – OUT value (= manipulated variable) – IN value (= control variable) – CAS_IN value (= external setpoint)
The messages listed below describe the status of the OUT value of the Analog Input Function Block and the value assigned to the PID Function Block.	
OK	Status = GOOD (valid)
UNC	Status = UNCERTAIN (conditionally valid)
BAD	Status = BAD (invalid)

Examples:



Other icons



1 Measuring mode = SYMMETRY (bidirectional)
2 Measuring mode = STANDARD
3 Counting mode, totalizer = BALANCE (forwards and reverse flow)
4 Counting mode, totalizer = forwards
5 Counting mode, totalizer = reverse
6 Icon for volume flow
7 Icon for mass flow

5.5.2 Brief operating instruction to the function matrix

Note:
- See the general notes on Page 74.
- Function descriptions → see the “Description of Device Functions” manual

1. HOME position → E → Enter the function matrix
2. Select a block (e.g. MEASURED VARIABLES)
3. Select a group (e.g. SYSTEM UNITS)
4. Select a function group (e.g. CONFIGURATION)
5. Select a function (e.g. UNIT VOLUME FLOW)

   Change parameter / enter numerical values:
   ± → select or enter enable code, parameters, numerical values
   E → save your entries

6. Exit the function matrix:
   – Press and hold down Esc key (esc) for longer than 3 seconds → HOME position
   – Repeatedly press Esc key (esc) → return step by step to HOME position

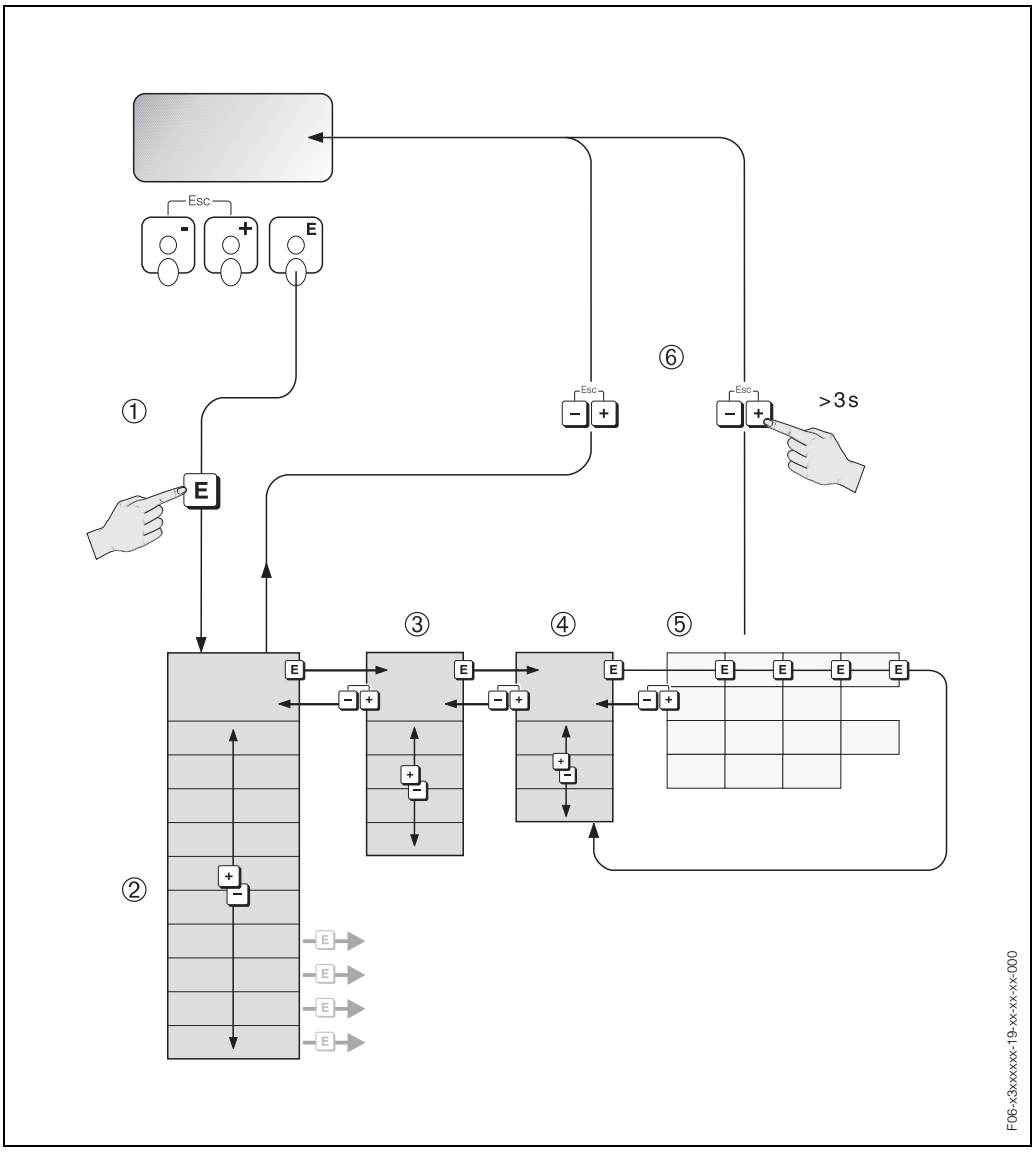


Fig. 47: Selecting functions and configuring parameters (function matrix)

General notes
The Quick Setup menu (see Page 83) is adequate for commissioning in most instances (functions, device-specific parameters). 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 on a number of menu levels (blocks, groups, and function groups).

Comply with the following instructions when configuring functions:
- You select functions as described on Page 73. Each cell in the function matrix is dentified by a numerical or letter code on the display.
- 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 parameterized values remain safely stored in the EEPROM.

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

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 = 53) has to be entered before settings can be changed.
If you use a code number of your choice, you exclude the possibility of unauthorized persons accessing data (→ see the "Description of Device Functions" Manual).

Comply with the following instructions when entering codes:
- If programming is disabled and the ⊞ keys are pressed in any function, a prompt for the code automatically appears on the display.
- If "0" is entered as the customer's code, programming is always enabled.
- The E+H 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 system, particularly measuring accuracy. There is no need to change these parameters under normal circumstances and consequently, they are protected by a special code known only to the E+H service organization. Please contact Endress+Hauser if you have any questions.
- With FOUNDATION Fieldbus, programming is enabled separately in the Transducer Blocks.

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

5.5.3 Error messages

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 the one shown on the display.

The measuring system distinguishes between two types of error:
- *System errors:* This group comprises all device errors, e.g. communication errors, hardware errors, etc.
- *Process errors:* This group comprises all application errors, e.g. empty pipe, etc.

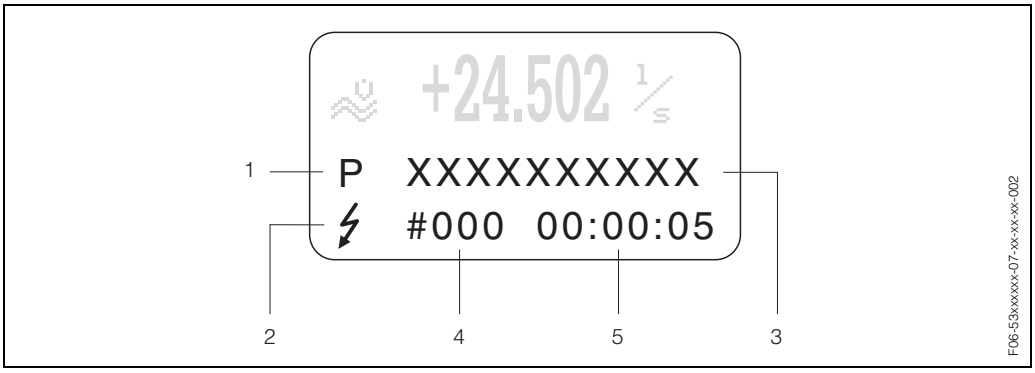


Fig. 48: Error messages on the display (example)

1 Error type: P = process error, S = system error
*2 Error message type: ϟ = fault message; **!** = notice message*
3 Error designation: e.g. EMPTY PIPE = measuring tube is only partly filled or completely empty
4 Error number: e.g. #401
5 Duration of most recent error occurrence (in hours, minutes and seconds)

Error message type
The flowmeter assigns system error and process error to two error message types (fault message or notice message) in accordance with a predefined algorithm and classifies them accordingly → Page 95 ff.
Serious system errors, e.g. module defects, are always identified and classed as “fault messages” by the measuring device.

Notice message (!)
- The error in question has no effect on measurement currently in progress.
- Displayed as → Exclamation mark (!), error type (S: system error, P: process error).
- Presentation on the FOUNDATION Fieldbus → Notice messages are transmitted to subsequent function blocks or higher-level process control systems by means of the status “UNCERTAIN” of the output value OUT (AI Block).

Fault message (ϟ)
- The error in question interrupts or stops measurement currently in progress.
- Displayed as → Lightning flash *(ϟ),* error designation (S: system error, P: process error).
- Presentation on the FOUNDATION Fieldbus → Fault messages are transmitted to subsequent function blocks or higher-level process control systems by means of the status “BAD” of the output value OUT (AI Block).

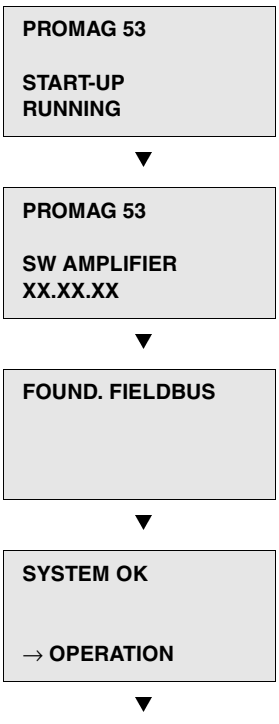
6 Commissioning

6.1 Function check

Make sure that all final checks have been completed before you start up your measuring point:
- Checklist for “Post-installation check” → Page 45
- Checklist for “Post-connection check” → Page 62

Note:
- The technical function data of the FOUNDATION Fieldbus interface to IEC 61158-2 must be maintained.
- The bus voltage of 9...32 V and the current consumption of 12 mA at the measuring device (FF interface) can be checked using a normal multimeter.
- Using the LED on the I/O board (see Page 69) it is possible to carry out a simple function check on the fieldbus communication in the hazardous area.

Function check using the local display (optional)
Once the function checks have been successfully completed, it is time to switch on the power supply. The device is now operational.
The measuring device performs a number of power on self-tests. As this procedure progresses the following sequence of messages appears on the local display:



Start-up message

Current software version

Beginning of normal measuring mode

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

Note:
If start-up fails, an error message indicating the cause is displayed.

6.2 Commissioning

Note the following points:
- The system files required for commissioning and network configuration can be obtained as described on Page 64.
- The device is identified by the FOUNDATION Fieldbus in the host or configuration system via the device identification (DEVICE_ID). The DEVICE_ID is a combination of the manufacturer ID, device type and device serial number. It is unique and can never be duplicated. The DEVICE_ID of the Promag 53 is composed as follows:

  DEVICE_ID = 452B481042-XXXXXXXXXXX
  452B48 = Endress+Hauser
  1042 = Promag 53
  XXXXXXXXXXX = device serial number (11-digit)

6.2.1 Commissioning

The following description allows step-by-step commissioning of the measuring device and all the necessary configuration for the FOUNDATION Fieldbus:

1. Switch on the measuring device.
2. Note the DEVICE_ID on the device nameplate (see Page 9).
3. Open the configuration program.
4. Load the device description file or CFF file into the host system or into the configuration program. Ensure you use the correct system files. Refer to the example on Page 64.
   The first time it is connected Promag 53 reports as follows:
   – E+H_PROMAG_53_ xxxxxxxxxxx (Tag name PD-TAG)
   – 452B481042- xxxxxxxxxxx (Device_ID)
   – Block structure:

Display text (xxx... = serial number)	Base index	Description
RESOURCE_ xxxxxxxxxxx	258	Resource Block
TRANSDUCER_FLOW_xxxxxxxxxxx	1100	Transducer Block “Flow”
TRANSDUCER_DISP_xxxxxxxxxxx	1500	Transducer Block “Display”
TRANSDUCER_TOT_xxxxxxxxxxx	1550	Transducer Block “Totalizer”
TRANSDUCER_DIAG_xxxxxxxxxxx	1600	Transducer Block “Diagnosis”
ANALOG_INPUT_1_ xxxxxxxxxxx	350	Analog Input Funktionsblock 1
ANALOG_INPUT_2_ xxxxxxxxxxx	390	Analog Input Funktionsblock 2
ANALOG_INPUT_3_ xxxxxxxxxxx	430	Analog Input Funktionsblock 3
ANALOG_INPUT_4_ xxxxxxxxxxx	470	Analog Input Funktionsblock 4
ANALOG_INPUT_5_ xxxxxxxxxxx	510	Analog Input Funktionsblock 5
DISCRETE_OUTPUT_ xxxxxxxxxxx	780	Discrete Output Funktionsblock
PID_ xxxxxxxxxxx	810	PID Funktionsblock

✎ Note:
The Promag 53 is supplied with the bus address “250” and is thus in the address range reserved for readdressing of field devices, between 248 and 251. This means that the LAS (Link Active Scheduler) automatically assigns the device a free bus address in the initialization phase.

5. Identify the field device using the DEVICE_ID that you noted down and assign the desired field device tag name (PD_TAG) to the fieldbus device in question.
   Factory setting: E+H_PROMAG_53_xxxxxxxxxxx

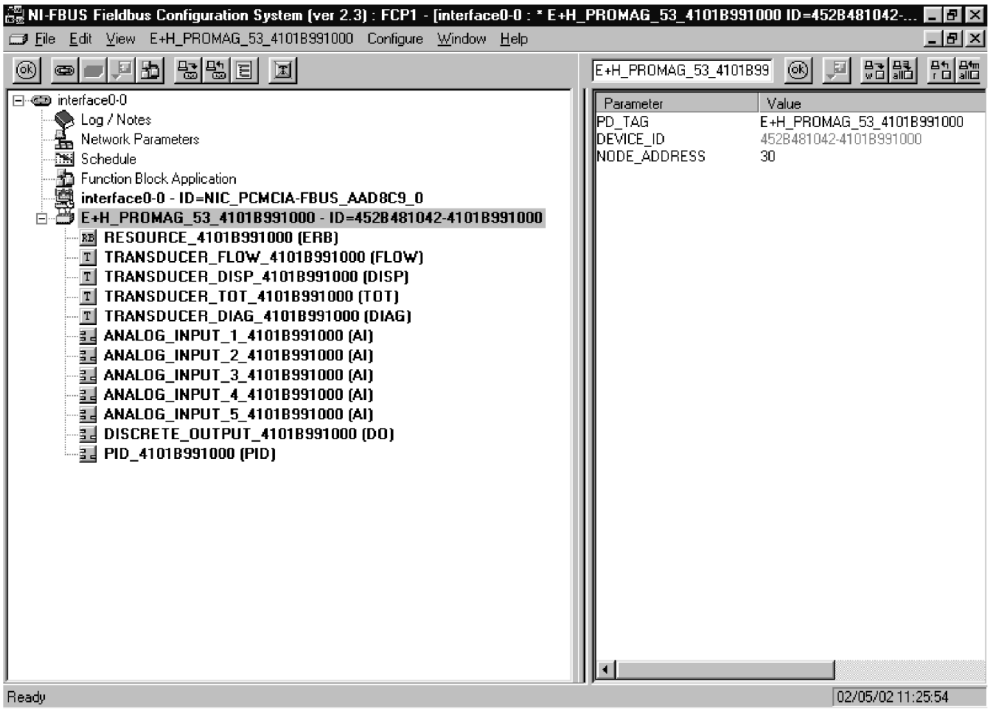


Fig. 49: Screen display in the configuration program "NI-FBUS Configurator" (National Instruments) after connecting

Configuration of the "Resource Block" (Base index 258)

6. Open the Resource Block.

7. On delivery write protection is disabled so that you can access all the write parameters via FF. Check this status via the parameter WRITE_LOCK:
   – Write protection activated = LOCKED
   – Write protection deactivated = NOT LOCKED

   Deactivate the write protection if necessary → Page 69.

8. Enter the desired block name (optional).
   Factory setting: RESOURCE_ xxxxxxxxxxx

9. Set the operating mode in the parameter group MODE_BLK (parameter TARGET) to AUTO.

Configuration of the "Transducer Blocks"
The individual Transducer Blocks contain various parameter groups which are sorted by device-specific functions:

Flow measurement	→	Transducer Block "Flow" (Base index: 1100)
Local display functions	→	Transducer Block "Display" (Base index: 1500)
Totalizer 1–3	→	Transducer Block "Totalizer" (Base index: 1550)
Diagnosis functions	→	Transducer Block "Diagnosis" (Base index: 1600)

The following description provides an example for the Transducer Block "Flow" (Base index 1100).

10. Enter the desired block name (optional).
    Factory setting: TRANSDUCER_FLOW_xxxxxxxxxxx

11. Open the Transducer Block "Flow".

12. Now configure all the device-specific parameters for your application.

    ✎ Note:
    – Note that changes to the device parameters can only be made after entering a valid access code in the parameter "Un-/Locking - Access Code".
    – The selection of the system units in the "Flow" Transducer Block has no effect on the output value OUT (AI Block). Units of the process variables which are transmitted via the FF-interface must be specified separately in the Analog Input function block via the XD_SCALE and OUT_SCALE parameter group.

13. Set the "Flow" and "Totalizer" Transducer Blocks in the MODE_BLK parameter group (TARGET parameter) to the AUTO operating mode. Only then can you ensure that the process variables can be correctly processed by the subsequent AI function blocks.

Configuration of the "Analog Input Function Blocks"

The Promag 53 has five Analog Input Function Blocks that can be assigned optionally to various process variables. The following description provides an example for the Analog Input Function Block 1 (Base index 350).

14. Enter the desired name for the Analog Input Function Block (optional).
    Factory setting: ANALOG_INPUT_1_ xxxxxxxxxxx

15. Open the Analog Input Function Block 1.

16. Set the operating mode in the parameter group MODE_BLK (parameter TARGET) to OOS, i.e. block Out Of Service.

17. Using the parameter CHANNEL select the process variable that is to be used as input value for the function block algorithm (scaling and limit value monitoring functions). The following configurations are possible:
    – CHANNEL = 1 (Calculated mass flow)
    – CHANNEL = 2 (Volume flow)
    – CHANNEL = 7 (Totalizer 1)
    – CHANNEL = 8 (Totalizer 2)
    – CHANNEL = 9 (Totalizer 3)

18. In parameter group XD_SCALE select the desired unit of measure and the block input range (measurement range of the flow application) for the process variable in question (see following example).

    Caution:
    Make sure that the selected unit is suitable for the measurement variable of the selected process variable. Otherwise the parameter BLOCK_ERROR will display the error message “Block Configuration Error” and the block operating mode cannot be set to AUTO.

19. In the parameter L_TYPE select the type of linearisation for the input value (Direct, Indirect, Indirect Sq Root) → see “Description of Device Functions” Manual.

    Caution:
    Note that with the type of linearisation “Direct” the configuration of the parameter group OUT_SCALE must agree with the configuration of the parameter group XD_SCALE. Otherwise the block operating mode cannot be set to AUTO. Such incorrect configuration is indicated via the parameter BLOCK_ERROR with the “Block Configuration Error” message.

    Example:
    – The measurement range of the sensor is 0...30 m^3/h.
    – The output range to the process control system should be 0...30 m^3/h as well.

    The following settings should be made:
    – Analog Input Function Block / Parameter CHANNEL (selection of input value): Selection 2 → Volume flow
    – Parameter L_TYPE → Direct
    – Parameter group XD_SCALE

      XD_SCALE 0 % = 0
      XD_SCALE 100 % = 30
      XD_SCALE UNIT = m^3/h

    – Parameter group OUT_SCALE

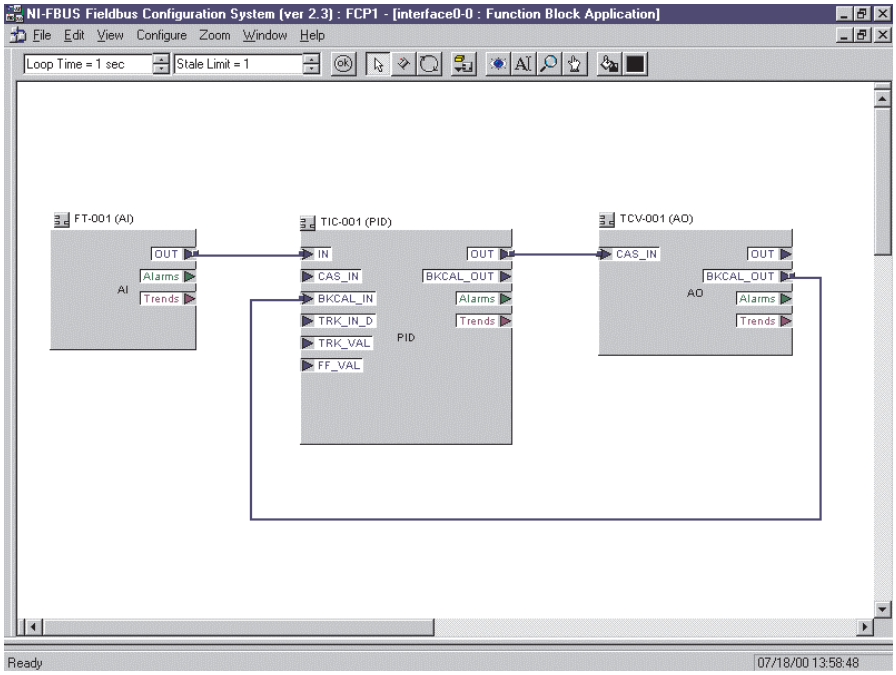
      OUT_SCALE 0 % = 0
      OUT_SCALE 100 % = 30
      OUT_SCALE UNIT = m^3/h

20. Use the following parameters to define the limit values for alarm and warning messages:
    – HI_HI_LIM → limit value for the upper alarm
    – HI_LIM → limit value for the upper warning
    – LO_LIM → limit value for the lower warning
    – LO_LO_LIM → limit value for the lower alarm

    The limit values entered must be within the value range specified in the parameter group OUT_SCALE.

21. In addition to the actual limit values you must also specify the action taken if a limit value is exceeded using so-called “alarm priorities” (parameters HI_HI_PRI, HI_PRI, LO_PR, LO_LO_PRI) → see “Description of Device Functions” Manual. Reporting to the fieldbus host system only takes place if the alarm priority is higher than 2.

22. System configuration/connection of function blocks (Fig. 50):
    A concluding “overall system configuration” is essential so that the operating mode of the Analog Input Function Block can be set to AUTO and so that the field device is integrated into the system application.
    To do this, configuration software such as the NI-FBUS Configurator from National Instruments is used to connect the function blocks to the desired control strategy – generally graphically – and then the sequence of the individual process control functions is specified.



F06-xxxFFxxx-20-xx-xx-xx-000

Fig. 50: Connecting function blocks using the NI-FBUS Configurator

23. After specifying the active LAS, download all the data and parameters into the field device.

24. Set the operating mode in the parameter group MODE_BLK (parameter TARGET) to AUTO. However, this is only possible if two conditions are met:
    – The function blocks are correctly connected with each other.
    – The Resource Block is in operating mode AUTO.

6.2.2 Quick Setup "Commissioning"

If the measuring device is equipped with a local display, all the device parameters important for standard operation can be configured quickly and easily by means of the "Commissioning" Quick Setup menu (Fig. 51).
If the measuring device does not have a local display, the individual parameters and functions must be configured via the configuration programme, e.g. NI-FBUS Configurator.

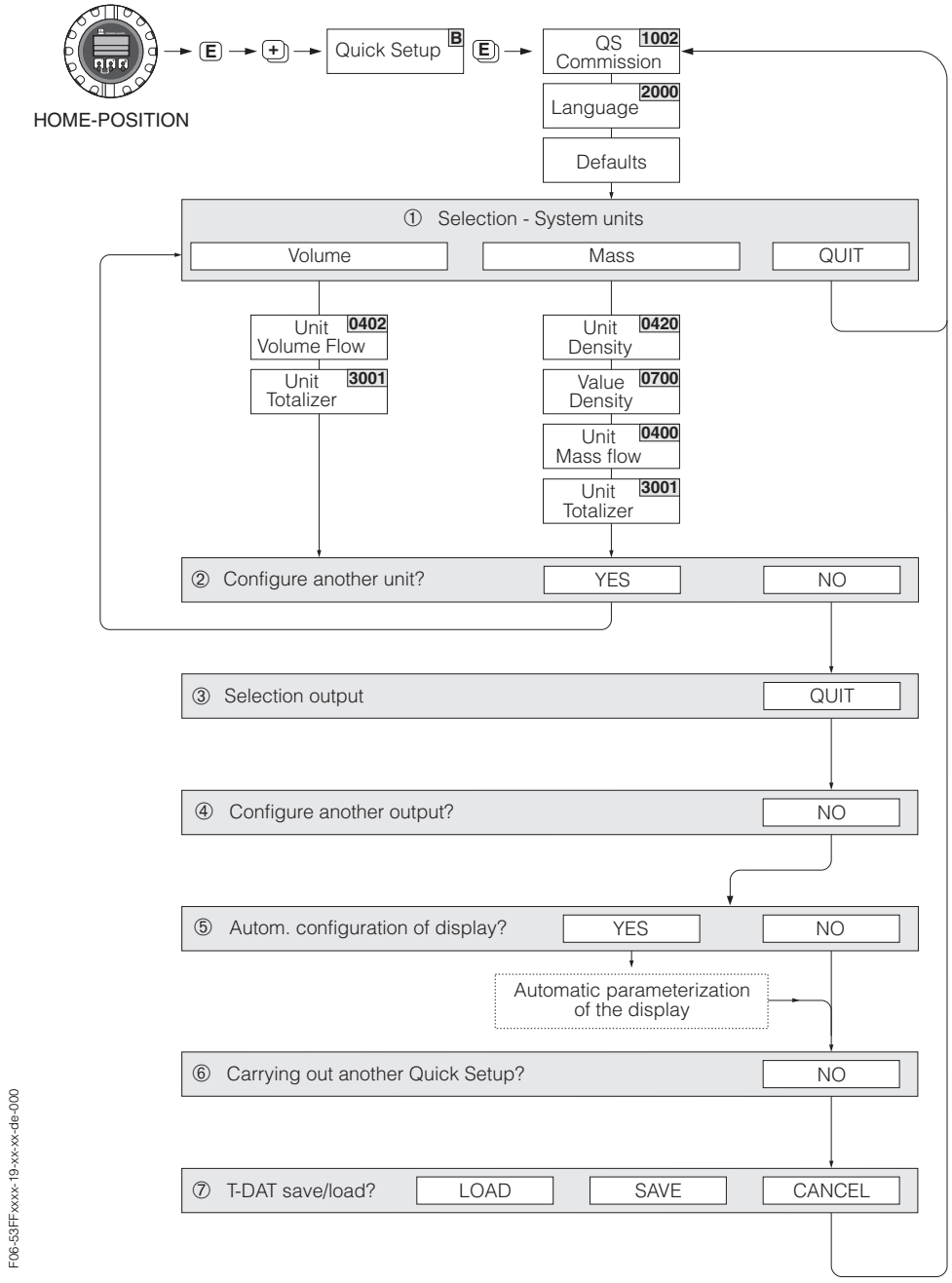


Fig. 51: Quick Setup "Commissioning" (with local display only)

Note:
- You return to the QUICK-SETUP COMMISSIONING (1002) cell if you press the ESC key (- +). However, the configuration already made remains valid.
- The system units selected via the Quick Setup are only valid for the local display and for parameters in the Transducer Blocks. They have no effect on the process variables (volume flow, calculated mass flow, totalizer) which are transmitted via the FOUNDATION Fieldbus.

6.2.3 Empty-pipe/full-pipe adjustment

Flow cannot be measured correctly unless the measuring tube is full. This status can be monitored at all times with the Empty Pipe Detection function.
- EPD = Empty Pipe Detection (with the help of an EPD electrode)
- OED = Open Electrode Detection (Empty Pipe Detection with the help of the measuring electrodes, if the sensor is not equipped with an EPD electrode or the orientation is not suitable for using EPD).

Note:
- The EPD function is not available unless the sensor is fitted with an EPD electrode.
- The default setting for EPD/OED when the devices are delivered is OFF; the function has to be activated if required.
- The sensor is calibrated ex-works with water, i.e. at approximately 500 µS/cm. If the fluid conductivity differs from this reference, empty pipe/full pipe adjustment has to be performed again on site.
- Further information on EPD/OED can be found in the separate "Description of Device Functions" Manual.

Response to partially filled pipe
If EPD/OED is on and activated according to a partially filled or empty measuring tube, a corresponding message appears on the local display and/or in the Transducer Block "Diagnosis" (Parameter "Diagnosis - Actual System Condition"). This behaviour is transmitted to subsequent function blocks via the status "UNCERTAIN" of the AI Block output variable OUT.
If the pipe is partially filled or empty and EPD/OED is **not** on, response can vary in identically configured systems:
- Flow reading fluctuates
- Zero flow
- Excessively high flow readings

Performing empty-/full-pipe adjustment (using the local display)

1. Select the appropriate function in the function matrix:
   HOME → E → ± → BASIC FUNCTIONS → E → ± → PROCESSPARAMETER → E → ± → ADJUSTMENT → E → EPD/OED ADJUSTMENT
2. Empty the piping. Make sure that the wall of the measuring tube is wetted with fluid for the adjustment procedure.
3. Start empty pipe adjustment: Select "EMPTY PIPE ADJUST" and press E to confirm.
4. After a successfull adjustment, fill the pipe with fluid.
5. Start full pipe adjustment with the fluid at a standstill: Select "FULL PIPE ADJUST" and press E to confirm.
6. After a successful adjustment, select "OFF" and leave the function with E .
7. Now select the EPD/OED MODE function. Switch on empty pipe detection by selecting the "EPD" or "OED" setting and confirming with E .

Caution:
The adjustment coefficients must be valid before you can activate the EPD/OED 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.

Performing empty-/full-pipe adjustment (using a configuration program)

1. Make sure that the hardware write protection is disabled → Page 69.
2. In the configuration program, open the Transducer Block “Flow” (TRANSDUCER_FLOW_xxxxxxxxxxx / Base index 1100).
3. Accessing configuration level:
   – Enter the access code in the parameter “Un-/Locking - Access Code”.
   – The parameter “Un-/Locking - Access System Status” should now display “ACCESS CUSTOMER”.
4. Empty the piping. Make sure that the wall of the measuring tube is wetted with fluid for the adjustment procedure.
5. Start empty pipe adjustment:
   – In the parameter “EPD/OED - Adjustment” select setting “Empty Pipe Adjust”.
   – Now start empty pipe adjustment by sending this setting to the field device.
6. After a successful empty pipe calibraton, fill the pipe with fluid.
7. Start full pipe adjustment when the fluid is at a standstill:
   – In the parameter “EPD/OED - Adjustment” select setting “Full Pipe Adjust”.
   – Now start full pipe adjustment by sending this setting to the field device.
8. After a successful adjustment, select “OFF” and leave the function by sending this setting to the field device.
9. Now select the “EPD/OED - Param. Mode” parameter. Switch on empty pipe detection by selecting the setting “ON (for EPD)” or “OED” and sending it to the field device.

   Caution:
   The adjustment coefficients must be valid before you can activate the EPD/OED function. If an adjustment is faulty, the following messages are output in the “Diagnosis” Transducer Block (base index 1600) via the “Diagnosis - Actual System Condition” parameter:

   – *EPD adjustment wrong*
     The adjustment values for empty pipe and full pipe are identical. In cases of this nature EPD/OED adjustment **must** be repeated. This error (see Page 100) is transmitted to subsequent function blocks via the status “BAD” of the AI Block output variable OUT.
   – *EPD adjustment not possible*
     EPD adjustment is not possible because the fluid's conductivity is out of range. This error (see Page 100) is transmitted to subsequent function blocks via the status “UNCERTAIN” of the AI Block output variable OUT.

6.3 Data storage device (DAT, F-Chip)

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

T-DAT (Transmitter-DAT)
The T-DAT is an exchangeable data storage device in which all transmitter parameters and settings are stored.
Storing of specific parameter settings from the EEPROM to the T-DAT and vice versa has to be carried out by the user (= **manual** save function). Detailed instructions regarding this can be found in the handbook “Description of Device Functions”.

F-Chip (Function-Chip)
The F-Chip is a microprocessor chip that contains additional software packages that extend the functionality and application possibilities of the transmitter. In the case of a later upgrade, the F-Chip can be ordered as an accessory (see Page 89) and can simply be plugged on to the I/O board (see Page 104). After start up, the software is immediately made available to the transmitter.

Caution:
To ensure an unambiguous assignment, the F-Chip is coded with the transmitter serial number once it is plugged on to the I/O board (type FOUNDATION Fieldbus). Thus, it can **not** be reused with other measuring devices.

7 Maintenance

The Promag 53 flow measuring system requires no special maintenance.

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.

Seals
The seals of the Promag H sensor must be replaced periodically, particularly in the case of gaskets (aseptic version). The period between changes depends on the frequency of cleaning cycles, the cleaning temperature and the fluid temperature.

Replacement seals (accessories) → Page 89

8 Accessories

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

Accessory	Description	Ordering code
Transmitter Promag 53	Transmitter for replacement or for stock. Use the order code to define the following specifications: – Approvals – Degree of protection / version – Cable type for the remote version – Cable entries – Display / power supply / operation – Software – Outputs / inputs	53XXX – XXXXX * * * * * * * *
Ground cable for Promag W/P	Set consists of two ground cables.	DK5GC – * * *
Ground disk for Promag W, P	Ground disk for potential equalisation	DK5GD – * * *
Mounting kit for Promag H	Mounting kit for Promag H, comprising: – 2 process connections (see Page 144 ff.) – Threaded fasteners – Seals	DKH * * – * * * *
Adapter connection for Promag A/H	Adapter connections for installing Promag 53 H instead of a Promag 30/33 A or Promag 30/33 H / DN 25.	DK5HA – * * * * * *
Ground rings for Promag H	If the process connections are made of PVC or PVDF, ground rings are necessary to ensure that potential is matched. A set comprises 2 ground rings.	DK5HR – * * * *
Set of seals for Promag H	For regular replacement of the seals of the Promag H sensor.	DK5HS – * * *
Wall-mounting kit Promag H	Wall-mounting kit for the Promag H sensor	DK5HM – * *
Welding jig for Promag H	Welding nipple as process connection: welding jig for installation in pipe.	DK5HW – * * *
Applicator	Software for selecting and configuring flowmeters. Applicator can be downloaded from the Internet (→ *www.applicator.com*) or ordered on CD-ROM for installation on a local PC. Contact your E+H representative for more information.	DKA80 – *

Accessory	Description	Ordering code
FieldTool	Configuration and service software for flowmeters in the field: – Commissioning, maintenance analysis – Configuring flowmeters – Service functions – Visualisation of process data – Trouble-shooting – Interpretation of the verification data from the “FieldCheck” tester/simulator Contact your E+H representative for more information.	DXS10 – * * * * *
FieldCheck	Tester/simulator for testing flowmeters in the field. When used in conjunction with the “FieldTool” software package, test results can be imported into a database, printed and used for official certification. Contact your E+H representative for more information.	DXC10 – * *

9 Trouble-shooting

9.1 Trouble-shooting instructions

Always start trouble-shooting with the checklists below if faults occur after startup or during operation. The routine takes you directly to the cause of the problem and the appropriate remedial measures.

Caution:
In the event of a serious fault, a flowmeter might have to be returned to the manufacturer for repair. The procedures on Page 8 must be carried out before you return a flowmeter to Endress+Hauser. Always enclose a duly completed "Declaration of contamination" form. You will find a preprinted form at the back of this manual.

Checking the local display (if installed)	
No display visible. No connection to the FF host system	1. Check the power supply → Terminals 1, 2 2. Check the power line fuse → Page 109 85...260 V AC: 0.8 A slow-blow / 250 V 20...55 V AC and 16...62 V DC: 2 A slow-blow / 250 V 3. Measuring electronics defective → order spare parts → Page 104
No display visible, but connection established to the FF host system.	1. Check whether the ribbon-cable connector of the display module is correctly plugged into the amplifier board → Page 106, 108 2. Display module defective → order spare parts → Page 104 3. Measuring electronics defective → order spare parts → Page 104
Display texts are in a foreign language.	Switch off power supply. Press and hold down both the ⊞⊟ keys and switch on the measuring device. The display text will appear in English (default) and is displayed at maximum contrast.
No connection can be established with the FF host system, even though measured value reading is visible.	See following checkpoints

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Faulty connection to the fieldbus host system	
No connection can be made between the fieldbus host system and the measuring device. Check the following points:	
Supply voltage Transmitter	Check the supply voltage → terminals 1/2
Device fuse	Check the device fuse → Page 109 85...260 V AC: 0.8 A slow-blow / 250 V 20...55 V AC and 16...62 V DC: 2 A slow-blow / 250 V
Fieldbus connection	Check the fieldbus connection → terminals 26/27
Fieldbus connector (option)	– Check pin assignment/wiring → Page 57 – Check connection between connector/fieldbus port. Is the coupling ring tightened correctly?
Fieldbus voltage	Check that a min. bus voltage of 9 V DC is present at terminals 26/27. Permissible range: 9...32 V DC
Network structure	Check permissible fieldbus length and number of spurs → Page 47 ff.
Basic current	Is there a basic current of min. 12 mA?

Terminators	Is the FOUNDATION Fieldbus-H1 network correctly terminated? Each bus segment must always be terminated with a terminator at both ends (start and finish). Otherwise interference may affect communication.
Current consumption Permissible feed current	Check the current consumption of the bus segment: The current consumption of the bus segment in question (= total of basic currents of all fieldbus devices) must not exceed the max. permissible feed current of the fieldbus power supply.
Device Description (DD)	Instal the DD if you cannot access the manufacturer-specific parameters. ✎ Note: Ensure you use the correct system files for linking the field devices into the host system. Appropriate version information can be called up in Promag 53 via the following functions/parameters: *Local display:* – HOME → BASIC FUNCTION → FOUND. FIELDBUS → INFORMATION → DEVICE REVISION (6243) – HOME → BASIC FUNCTION → FOUND. FIELDBUS → INFORMATION → DD REVISION (6244) *FF configuration program:* – Resource Block → Parameter DEV_REV – Resource Block → Parameter DD_REV *Example (with local display):* Display in the DEVICE REVISION (6243) function → 02 Display in the DD REVISION (6244) function → 01 Required Device Description files (DD) → 0201.sym / 0201.ffo

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Problems with configuration of function blocks	
Transducer Blocks: The operating mode cannot be set to AUTO.	Check whether the operating mode of the Resource Block is in AUTO mode → Parameter group MODE_BLK / parameter TARGET.
Analog Input Function Block: The operating mode cannot be set to AUTO.	There may be several reasons for this. Check the following in sequence: 1. Check whether the operating mode of the Analog Input Function Block is in AUTO mode → Parameter group MODE_BLK / parameter TARGET. If not and the mode cannot be set to AUTO, first check the following. 2. Make sure that the parameter CHANNEL (selection process variable) is already configured in the Analog Input Function Block → Page 80. The selection “CHANNEL = 0” (Uninitialized) is not valid. 3. Make sure that the parameter group XD_SCALE (input range, unit) is already configured in the Analog Input Function Block → Page 81 (with configuration example). ☝ Caution: Make sure that the selected unit is suitable for the process variable selected in the CHANNEL parameter. Otherwise the parameter BLOCK_ERROR will display the error message “Block Configuration Error”. In this status the block operating mode cannot be set to AUTO. (Continued on next page)

	4. Make sure that the parameter L_TYPE (type of linearisation) is already configured in the Analog Input Function Block → Page 81 Caution: Make sure that with the type of linearisation “Direct” the scaling of the parameter group OUT_SCALE is identical to that of the parameter group XD_SCALE. If set incorrectly the parameter BLOCK_ERROR will display the error message “Block Configuration Error”. In this status the block operating mode cannot be set to AUTO. Configuration example → Page 81 5. Check whether the operating mode of the Resource Block is in AUTO mode → Parameter group MODE_BLK/parameter TARGET. 6. Make sure that the function blocks are correctly connected to each other and that this system configuration has been sent to the fieldbus users → Page 82
Analog Input Function Block: The operating mode is set to AUTO but the status of the AI output value OUT is “BAD” or “UNCERTAIN”.	1. Check whether the operating mode of the Transducer Blocks is set to AUTO → MODE_BLK parameter group / TARGET parameter. When using the different CHANNEL parameters, the following Transducer Blocks must be set to the AUTO operating mode: Transducer Block “Flow”: – CHANNEL 1 (Calculated mass flow) – CHANNEL 2 (Volume flow) Transducer Block “Totalizer”: – CHANNEL 7 (Totalizer 1) – CHANNEL 8 (Totalizer 2) – CHANNEL 9 (Totalizer 3) 2. Check whether an error is present in the “Flow” or “Totalizer” Transducer Blocks → Transducer Block “Diagnosis” → Parameter “Diagnosis - Actual System Condition”. Error messages → Page 95 ff.
– Parameters cannot be modified or – No write access to parameter	1. Parameters that only display values or settings cannot be modified! 2. Hardware write protection is enabled → Deactivate the write protection → Page 69 Note: You can use the parameter WRITE_LOCK in the Resource Block to check whether hardware write protection is activated or deactivated: LOCKED = write protection enabled (activated) UNLOCKED = no write protection (deactivated) 3. The block operating mode is wrong. Certain parameters can only be modified in mode OOS (Out Of Service) or MAN (MANual) → Set the operating mode of the block to the required mode → Parameter group MODE_BLK. 4. The value entered is outside the specified input range for the parameter in question: → Enter suitable value → Increase input range if necessary 5. Transducer Blocks: The programming level is locked → Unlock by entering code in the parameter “Un-/Locking - Access Code” or via the service code in the service parameters.

Transducer Blocks: The manufacturer-specific parameters are not visible.	The device description file (Device Description, DD) has not been loaded into the host system or the configuration program → Load the file into the configuration system. Reference sources of the DD → Page 64 ✎ Note: Ensure you use the correct system files for linking the field devices into the host system. Appropriate version information can be called up in Promag 53 via the following functions/parameters: *Local display:* – HOME → BASIC FUNCTION → FOUND. FIELDBUS → INFORMATION → DEVICE REVISION (6243) – HOME → BASIC FUNCTION → FOUND. FIELDBUS → INFORMATION → DD REVISION (6244) *FF configuration program:* – Resource Block → Parameter DEV_REV – Resource Block → Parameter DD_REV *Example (with local display):* Display in the DEVICE REVISION (6243) function → 02 Display in the DD REVISION (6244) function → 01 Required Device Description files (DD) → 0201.sym / 0201.ffo
Analog Input Fct. Block: The output value OUT is not updated despite having the valid status “GOOD”.	Simulation is active → Deactivate simulation via parameter group SIMULATE.

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Error messages
Error messages in the FF configuration program → Page 95 ff. Error messages on the local display → Page 95 ff.

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Other error (without error message)	
Some other error has occurred.	Diagnosis and rectification → Page 102

9.2 System/process error messages

General notes
The flowmeter assigns current system and process errors to two error message types in accordance with a predefined algorithm and classifies them accordingly:

Error message type "Fault message":
- A message of this type immediately interrupts or stops measurement.
- Presentation on the FOUNDATION Fieldbus → Fault messages are transmitted to subsequent function blocks or higher-level process control systems by means of the status "BAD" of the output value OUT (AI Block).
- Local display → A flashing lightning symbol (ϟ) is displayed

Error message type "Notice message":
- Measurement continues despite this message.
- Presentation on the FOUNDATION Fieldbus → Notice messages are transmitted to subsequent function blocks or higher-level process control systems by means of the status "UNCERTAIN" of the output value OUT (AI Block).
- Local display → A flashing exclamation mark (!) is displayed.

Serious system errors, e.g. module defects, are always classed and displayed as "Fault messages" by the measuring device. Simulations in the Transducer Block "Flow" and positive zero return, on the other hand, are identified as "Notice messages" only.

Error messages in the FF configuration programs → see Table
In the Promag 53, system and process errors are recognised and reported in the Transducer Blocks. Such errors are displayed via the following parameters specified in the FOUNDATION Fieldbus specification:
- BLOCK_ERR
- Transducer Error

Detailed information on the cause of the error is shown in the Transducer Block "Diagnosis" via the (manufacturer-specific) parameter "Diagnosis - Actual System Condition" by appropriate device status messages.

Error messages on the local display → see Table
You will find more details on how error messages are presented on Page 75.

Error messages: – *FOUNDATION Fieldbus (FF) ** – *Local display*	**No.**	**Transducer block Error messages**	**Analog Input Funct. Block Error messages**	**Cause/remedy**
* With FF, error messages are displayed in the "Diagnosis" Transducer Block via the "Diagnosis - Actual System Condition" parameter (manufacturer-specific).				
Device status message (FF): ROM / RAM failure – Err. No. 001 *Local display:* S CRITICAL FAILURE ϟ # 001	1	BLOCK_ERR = Device needs maintenance now	OUT. QUALITY = BAD	*Cause:* ROM / RAM error. Error when accessing the program memory (ROM) or random access memory (RAM) of the processor. *Remedy:* Replace the amplifier board. Spare parts → Page 104
		Transducer_Error = Electronics failure	OUT. SUBSTATUS = Device Failure	
			BLOCK_ERR = Input Failure (faulty input value from the Transducer Blocks)	

Error messages: – *FOUNDATION Fieldbus (FF) ** – *Local display*	**No.**	**Transducer block Error messages**	**Analog Input Funct. Block Error messages**	**Cause/remedy**
Device status message (FF): Amplifier EEPROM failure – Err. No. 011 *Local display:* S AMP HW EEPROM ↯ # 011	11	BLOCK_ERR = Device needs maintenance now	OUT. QUALITY = BAD	*Cause:* Measuring amplifier has faulty EEPROM *Remedy:* Replace the amplifier board. Spare parts → Page 104
		Transducer_Error = Data integrity error	OUT. SUBSTATUS = Device Failure	
			BLOCK_ERR = Input Failure (faulty input value from the Transducer Blocks)	
Device status message (FF): Amplifier EEPROM data inconsistent – Err. No. 012 *Local display:* S AMP SW EEPROM ↯ # 012	12	BLOCK_ERR = Device needs maintenance now	OUT. QUALITY = BAD	*Cause:* Error when accessing data of the measuring amplifier EEPROM *Remedy:* Perform a “warm restart” (restart the measuring system without disconnecting mains power): • FF: Transducer Block “Diagnosis” (Base index 1600) → Parameter “System - Reset” → RESTART SYSTEM • Local display: SUPERVISION → SYSTEM → OPERATION → SYSTEM RESET (→ RESTART SYSTEM)
		Transducer_Error = Data integrity error	OUT. SUBSTATUS = Device Failure	
			BLOCK_ERR = Input Failure (faulty input value from the Transducer Blocks)	
Device status message (FF): S-DAT failure / S-DAT not inserted – Err. No. 031 *Local display:* S SENSOR HW DAT ↯ # 031	31	BLOCK_ERR = Device needs maintenance now	OUT. QUALITY = BAD	*Cause:* 1. S-DAT is faulty 2. S-DAT is not plugged into amplifier board (missing) *Remedy:* 1. Replace the S-DAT. Spare parts → Page 104 Use the spare part set number to check that the new, replacement DAT is compatible with the measuring electronics. 2. Plug S-DAT into amplifier board → Page 106, 108
		Transducer_Error = Electronics failure	OUT. SUBSTATUS = Device Failure	
			BLOCK_ERR = Input Failure (faulty input value from the Transducer Blocks)	

Error messages: – *FOUNDATION Fieldbus (FF) ** – *Local display*	**No.**	**Transducer block Error messages**	**Analog Input Funct. Block Error messages**	**Cause/remedy**
Device status message (FF): S-DAT data inconsistent – Err. No. 032 *Local display:* S SENSOR SW DAT ϟ # 032	32	BLOCK_ERR = Device needs maintenance now	OUT. QUALITY = BAD	*Cause:* Error accessing the values stored in the S-DAT. *Remedy:* 1. Check whether the S-DAT is correctly plugged into the amplifier board → Page 106, 108 2. Replace S-DAT if faulty. Spare parts → Page 104 Use the spare part set number to check that the new, replacement DAT is compatible with the measuring electronics. 3. Replace measuring electronics boards if necessary. Spare parts → Page 104
		Transducer_Error = Data integrity error	OUT. SUBSTATUS = Device Failure	
			BLOCK_ERR = Input Failure (faulty input value from the Transducer Blocks)	
Device status message (FF): T-DAT failure – Err. No. 041 *Local display:* S TRANSM. HW-DAT ϟ # 041	41	BLOCK_ERR = Device needs maintenance now	OUT. QUALITY = BAD	*Cause:* 1. T-DAT is faulty 2. T-DAT is not plugged into amplifier board. *Remedy:* 1. Replace the T-DAT. Spare parts → Page 104 Use the spare part set number to check that the new, replacement DAT is compatible with the measuring electronics. 2. Plug T-DAT into amplifier board → Page 106, 108
		Transducer_Error = Electronics failure	OUT. SUBSTATUS = Device Failure	
			BLOCK_ERR = Input Failure (faulty input value from the Transducer Blocks)	
Device status message (FF): T-DAT data inconsistent – Err. No. 042 *Local display:* S TRANSM. SW-DAT ϟ # 042	42	BLOCK_ERR = Device needs maintenance now	OUT. QUALITY = BAD	*Cause:* Error accessing the calibration values stored in the T-DAT *Remedy:* 1. Check whether the T-DAT is correctly plugged into the amplifier board → Page 106, 108 2. Replace T-DAT if faulty. Spare parts → Page 104 Use the spare part set number to check that the new, replacement DAT is compatible with the measuring electronics. 3. Replace measuring electronics boards if necessary. Spare parts → Page 104
		Transducer_Error = Data integrity error	OUT. SUBSTATUS = Device Failure	
			BLOCK_ERR = Input Failure (faulty input value from the Transducer Blocks)	

Error messages: – *FOUNDATION Fieldbus (FF) ** – *Local display*	**No.**	**Transducer block Error messages**	**Analog Input Funct. Block Error messages**	**Cause/remedy**
Device status message (FF): Compatibility problem amplifier – I/O module – Err. No. 051 *Local display:* S A / C COMPATIB. ϟ # 051	51	BLOCK_ERR = Device needs maintenance now	OUT. QUALITY = BAD	*Cause:* The I/O board and the amplifier board are not compatible. *Remedy* Use only compatible modules and boards. Check the compatibility of the modules used. Check the: – Spare part set number – Hardware revision code
		Transducer_Error = I/O failure (input/output failure)	OUT. SUBSTATUS = Device Failure	
			BLOCK_ERR = Input Failure (faulty input value from the Transducer Blocks)	
Device status message (FF): F-Chip failure - Err. No. 061 *Local display:* S HW F-CHIP ϟ # 061	61	BLOCK_ERR = Device needs maintenance now	OUT. QUALITY = BAD	*Cause:* 1. F-Chip is faulty. 2. F-Chip not plugged into I/O board. *Remedy:* 1. Replace F-Chip. Accessories → Page 89 2. Plug F-Chip into the I/O board → Page 106, 108
		Transducer_Error = I/O failure (input/output failure)	OUT. SUBSTATUS = Device Failure	
			BLOCK_ERR = Input Failure (faulty input value from the Transducer Blocks)	
Device status message (FF): Totalizer could not be restored at startup – Err. No. 111 *Local display:* S CHECKSUM TOTAL. ϟ # 111	111	BLOCK_ERR = Device needs maintenance now	OUT. QUALITY = BAD	*Cause:* Totalizer checksum error *Remedy:* 1. Restart the measuring device 2. Replace the amplifier board if necessary. Spare parts → Page 104
		Transducer_Error = Electronics failure	OUT. SUBSTATUS = Device Failure	
			BLOCK_ERR = Input Failure (faulty input value from the Transducer Blocks)	
Device status message (FF): Software compatibility problem amplifier - I/O module - Err. No. 121 *Local display:* S A / C KOMPATIB. ϟ # 121	121	BLOCK_ERR = Device needs maintenance now	OUT. QUALITY = BAD	*Cause:* Due to different software versions, I/O board and amplifier board are only partially compatible (possibly restricted functionality). *Remedy:* Replace module with lower software version. Spare parts → Page 104
		Transducer_Error = I/O failure (input/output failure)	OUT. SUBSTATUS = Device Failure	
			BLOCK_ERR = Input Failure (faulty input value from the Transducer Blocks)	

Error messages: – *FOUNDATION Fieldbus (FF) ** – *Local display*	**No.**	**Transducer block Error messages**	**Analog Input Funct. Block Error messages**	**Cause/remedy**
Device status message (FF): Save to T-DAT failed – Err. No. 205 *Local display:* S LOAD T-DAT ϟ # 205	205	BLOCK_ERR = Device needs maintenance now	OUT. QUALITY = BAD	*Cause:* Data backup (download) to T-DAT failed or error when accessing the values stored in the T-DAT (upload). *Remedy:* 1. Check whether the T-DAT is correctly plugged into the amplifier board → Page 106, 108 2. Replace T-DAT if faulty. Spare parts → Page 104 Use the spare part set number to check that the new, replacement DAT is compatible with the measuring electronics. 3. Replace measuring electronics boards if necessary. Spare parts → Page 104
		Transducer_Error = Electronics failure	OUT. SUBSTATUS = Device Failure	
			BLOCK_ERR = Input Failure (faulty input value from the Transducer Blocks)	
Device status message (FF): Restore from T-DAT failed – Err. No. 206 *Local display:* S SAVE T-DAT ϟ # 206	206	BLOCK_ERR = Device needs maintenance now	OUT. QUALITY = BAD	
		Transducer_Error = Electronics failure	OUT. SUBSTATUS = Device Failure	
			BLOCK_ERR = Input Failure (faulty input value from the Transducer Blocks)	
Device status message (FF): Communication failure amplifier – Err. No. 261 *Local display:* S COMMUNICATION I/O ϟ # 261	261	BLOCK_ERR = Device needs maintenance now	OUT. QUALITY = BAD	*Cause:* Communication error. No data reception between amplifier and I/O board or faulty internal data transfer. *Remedy:* Check whether the electronics boards are correctly inserted in their holder → Page 106, 108
		Transducer_Error = I/OFailure (Communication problems)	OUT. SUBSTATUS = Device Failure	
			BLOCK_ERR = Input Failure (faulty input value from the Transducer Blocks)	
Device status message (FF): Coil Current out of tolerance – Err. No. 321 *Local display:* S TOL. COIL CURR. ϟ # 321	321	BLOCK_ERR = Device needs maintenance now	OUT. QUALITY = BAD	*Cause:* The coil current of the sensor is outside the tolerance. *Remedy:* 1. Switch off the power supply and check the connectors of the coil cable → Page 106, 108 1. Replace measuring electronics boards if necessary. Spare parts → Page 104
		Transducer_Error = Mechanical failure	OUT. SUBSTATUS = Device Failure	
			BLOCK_ERR = Input Failure (faulty input value from the Transducer Blocks)	
Device status message (FF): Empty Pipe detected – Err. No. 401 *Local display:* P EMPTY PIPE ϟ # 401	401		OUT. QUALITY = UNCERTAIN	*Cause:* Alarm by Empty Pipe Detection (EPD). Measuring tube partially filled or empty. *Remedy:* – Check the process conditions of the plant – Fill the measuring tube
			OUT. SUBSTATUS = Non specific	

Error messages: – *FOUNDATION Fieldbus (FF) ** – *Local display*	**No.**	**Transducer block Error messages**	**Analog Input Funct. Block Error messages**	**Cause/remedy**
Device status message (FF): EPD adjustment not possible – Err. No. 461 *Local display:* P ADJ. NOT OK **!** # 461	461	Transducer_Error = Configuration error	OUT. QUALITY = UNCERTAIN	*Cause:* EPD adjustment not possible because the fluid's conductivity is either too low or too high. *Remedy:* The EPD function cannot be used with fluids of this nature.
			OUT. SUBSTATUS = Configuration error	
Device status message (FF): EPD adjustment wrong – Err. No. 463 *Local display:* P FULL = EMPTY ϟ # 463	463	Transducer_Error = Configuration error	OUT. QUALITY = BAD	*Cause:* The EPD adjustment values for empty pipe and full pipe are identical, therefore incorrect. *Remedy:* Repeat EPD adjustment, making sure procedure is correct → Page 84
			OUT. SUBSTATUS = Configuration error	
			BLOCK_ERR = Input Failure (faulty input value from the Transducer Blocks)	
Device status message (FF): Download device software active – Err. No. 501 *Local display:* S DOWNLOAD AKTIV **!** # 501	501		OUT. QUALITY = UNCERTAIN	*Cause:* New amplifier software version is loaded via the service interface. Currently no other commands are possible. *Remedy:* Wait until process is finished. Then restart the device.
			OUT. SUBSTATUS = Non specific	
Device status message (FF): Positive zero return active – Err. No. 601 *Local display:* S POS. ZERO-RETURN ϟ # 601	601		OUT. QUALITY = UNCERTAIN	*Cause:* Positive zero return is active *Remedy:* Deactivate positive zero return: • FF: Transducer Block "Flow" (Base index 1100) → Parameter "System - Positive Zero Return" → OFF • Local display: BASIC FUNCTIONS → SYSTEM PARAMETERS → CONFIGURATIONS → POS. ZERO RETURN (→ OFF)
			OUT. SUBSTATUS = Non specific	

Error messages: – *FOUNDATION Fieldbus (FF) ** – *Local display*	**No.**	**Transducer block Error messages**	**Analog Input Funct. Block Error messages**	**Cause/remedy**
Device status message (FF): Simulation Failsafe active – Err. No. 691 *Local display:* S SIM. FAILSAFE ϟ # 691	691	BLOCK_ERR = Simulation active	OUT. QUALITY = UNCERTAIN	*Cause:* Simulation is active *Remedy:* Switch off simulation: • FF: Transducer Block "Diagnosis" (Base index 1600) → Parameter "System - Simulation Failsafe Mode" → OFF • Local display: SUPERVISION → SYSTEM → OPERATION → SIM. FAILSAFE MODE (→ OFF)
			OUT. SUBSTATUS = Non specific	
			BLOCK_ERR = Simulation active	
Device status message (FF): Simulation Volume flow active – Err. No. 692 *Local display:* S SIM. VOL. FLOW ϟ # 692	692	BLOCK_ERR = Simulation active	OUT. QUALITY = UNCERTAIN	*Cause:* Simulation is active *Remedy:* Switch off simulation: • FF: Transducer Block "Flow" (Base index 1100) → Parameter "Simulation - Measurand" → OFF • Local display: SUPERVISION → SYSTEM → OPERATION → SIM. MEASURAND (→ OFF)
			OUT. SUBSTATUS = Non specific	
			BLOCK_ERR = Simulation active	
No Communication to Amplifier	–	BLOCK_ERR = Device needs maintenance now	OUT. QUALITY = BAD	*Cause:* Communication error. No communication with measuring amplifier. *Remedy:* 1. Switch power supply off and on again. 2. Check whether the printed circuit boards are correctly inserted in their holder → Page 106, 108
		Transducer_Error = General Error	OUT. SUBSTATUS = Device Failure	
			BLOCK_ERR = Input Failure (faulty input value from the Transducer Blocks)	

9.3 Process errors without messages

Symptoms	Rectification
You may have to change or correct certain settings in parameters in order to rectify the fault. The parameters listed below, e.g. “Install. Direction Sensor”, are explained in detail in the separate “Description of Device Functions” Manual.	
Flow values are negative, even though the fluid is flowing forwards through the pipe.	Modify the sign of the flow rate variable accordingly: – FF: Transducer Block “Flow” (Base index 1100) → Parameter “System Param. - Install. Direction Sensor” – Local display: HOME → BASIC FUNCTIONS → SYSTEM PARAMETER → CONFIGURATION → INSTL. DIR. SENSOR
Measured-value reading fluctuates even though flow is steady.	1. Check grounding and potential equalisation → Page 58 ff. 2. The fluid is not homogenous. Check the following fluid properties: – Proportion of gas bubbles – too high? – Proportion of solids – too high? – Conductivity fluctuations – too high? 3. Increase the system damping value: – FF: Analog Input Function Block → Parameter PV_FTIME – FF: Transducer Block “Flow” (Base index 1100) → Parameter “System Param. - Flow Damping” – Local display: HOME → BASIC FUNCTIONS → SYSTEM PARAMETER → CONFIGURATION → SYSTEM DAMPING 4. Increase the display damping: – FF: Transducer Block “Display” (Base index 1500) → Parameter “Configuration - Display Damping” – Local display: HOME → USER INTERFACE → CONTROL → BASIC CONFIG. → DISPLAY DAMPING
Measured-value reading or measured-value output pulsates or fluctuates, e.g. because of reciprocating pump, peristaltic pump, diaphragm pump or pump with similar delivery characteristic.	1. Increase the system damping value: – FF: Analog Input Funktionsblock → Parameter PV_FTIME – FF: Transducer Block “Flow” (Basisindex 1100) → Parameter “System Param. - Flow Damping” – Local display: HOME → BASIC FUNCTION → SYSTEM-PARAMETER → CONFIGURATION → FLOW DAMPING 2. Increase the display damping: – FF: Transducer Block “Display” (Basisindex 1500) → Parameter “Configuration - Display Damping” – Local display: HOME → USER INTERFACE → CONTROL → BASIC CONFIG. → DISPLAY DAMPING
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 58 ff. 2. Check the fluid for presence of gas bubbles. 3. Enter a value (>0) for the low flow cutoff or increase this value. – FF: Transducer Block “Flow” (Base index 1100) → Parameter “Low Flow Cut Off - On-Value” – Local display: HOME → BASIC FUNCTIONS → PROCESS-PARAMETER → CONFIGURATION → ON-VAL. LF-CUTOFF
Measured-value reading on display, even though measuring tube is empty.	1. Perform empty-pipe/full-pipe adjustment and then switch on Empty Pipe Detection → Page 84 2. Fill the measuring tube.

Symptoms	Rectification
The fault cannot be rectified, or some other fault not described above has arisen. In these instances, please contact your E+H service organisation.	The following options are available for tackling problems of this nature: **Request the services of an E+H service technician** If you contact our service organization to have a service technician sent out, please be ready to quote the following information: – Brief description of the fault – Nameplate specifications (Page 9 ff.): Ordering code and serial number **Returning devices to E+H** The procedures on Page 8 must be carried out before you return a flowmeter requiring repair or calibration to Endress+Hauser. Always enclose a duly completed “Declaration of contamination” form with the flowmeter. You will find a preprinted blank of this form at the back of this manual. **Replace transmitter electronics** Measuring electronics parts defective → order spare parts → Page 104

9.4 Spare parts

Chap. 9.1 contains a detailed trouble-shooting guide. The measuring device, moreover, provides additional support in the form of continuous self-diagnosis and error messages.
Fault rectification can entail replacing defective components with tested spare parts. The illustration below shows the available scope of spare parts.

Note:
You can order spare parts directly from your E+H service organization by quoting the serial number printed on the transmitter nameplate (see Page 9).

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

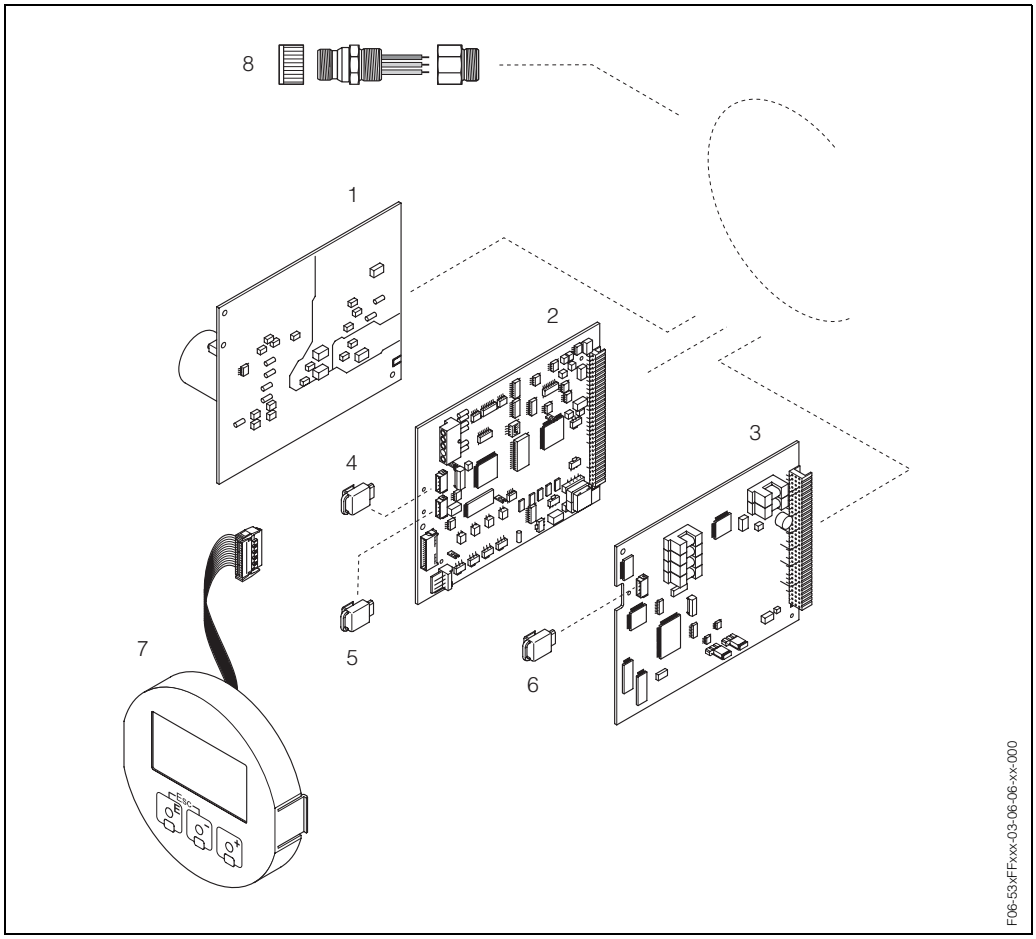


Fig. 52: Spare parts for Promag 53 transmitter

1 Power unit board (85...260 V AC, 20...55 V AC, 16...62 V DC)
2 Amplifier board
3 I/O board (type FOUNDATION Fieldbus)
4 S-DAT (sensor data memory)
5 T-DAT (transmitter data memory)
6 F-Chip (function chip for optional software)
7 Display module
8 Fieldbus connector consisting of: protective cap, connector, adapter PG 13.5 / M 20.5 Part No. 50094984

9.5 Removing and installing printed circuit boards

Field housing: removing and installing printed circuit boards (Fig. 53)

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!

1. Remove the cover of the electronics compartment.
2. Remove the local display (1) as follows:
   – Press in the latches (1.1) at the side and remove the display module.
   – Disconnect the ribbon cable (1.2) of the display module from the amplifier board.
3. Remove the screws and remove the cover (2) from the electronics compartment.
4. Remove power unit board (4) and I/O board (6):
   Insert a thin pin into the hole (3) provided for the purpose and pull the board clear of its holder.
5. Remove amplifier board (5):
   – Disconnect the plug of the electrode signal cable (5.1) including S-DAT (5.3) from the board.
   – Disconnect the plug of the coil current cable (5.2) from the board.
   – Insert a thin pin into the hole (3) provided for the purpose and pull the board clear of its holder.
6. Installation is the reverse of the removal procedure.

Caution:
Use only original Endress+Hauser parts.

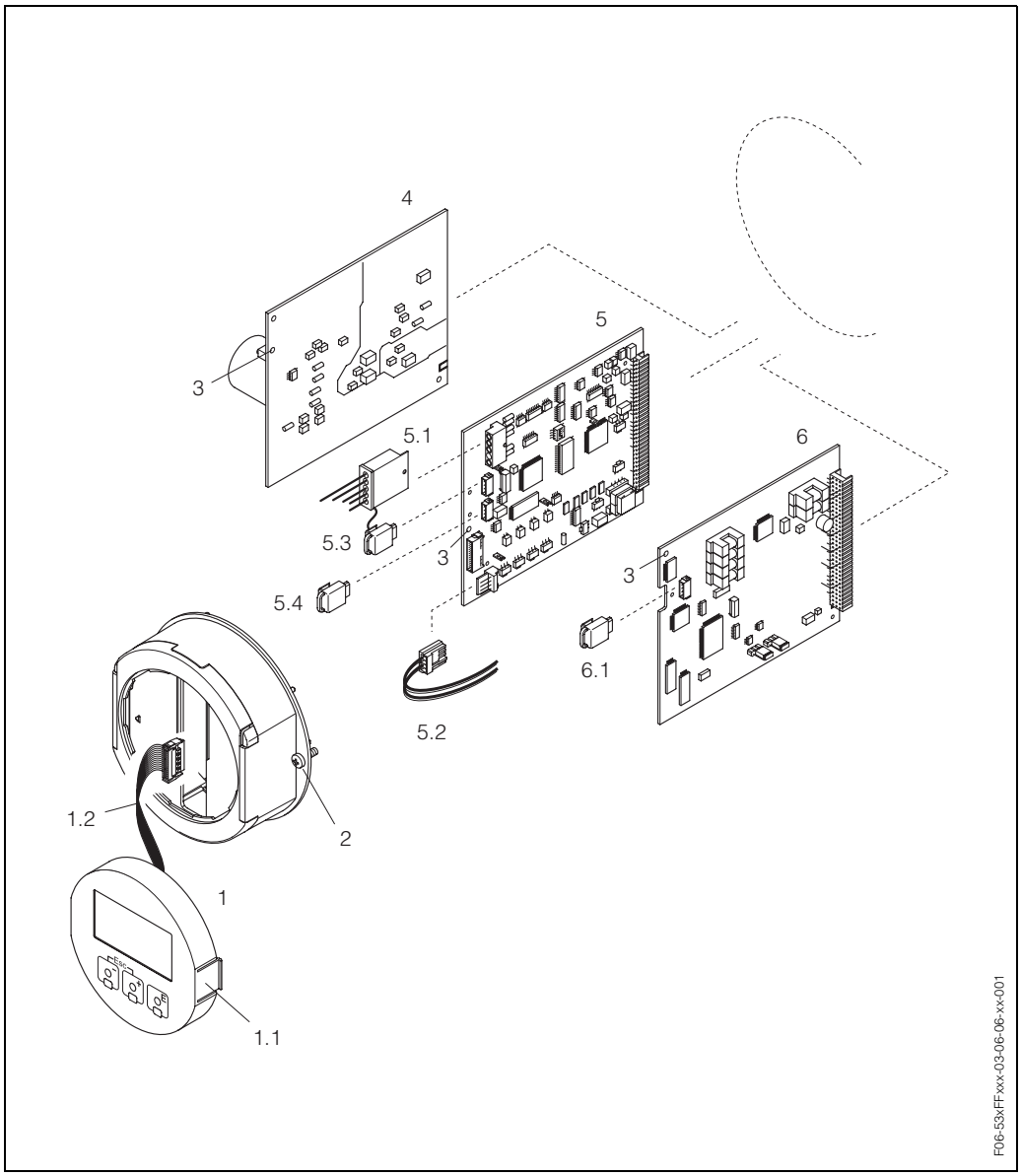


Fig. 53: Field housing: removing and installing printed circuit boards

1 Local display
1.1 Latch
1.2 Ribbon cable (display module)
2 Screws of electronics compartment cover
3 Aperture for installing/removing boards
4 Power unit board
5 Amplifier board
5.1 Electrode signal cable (sensor)
5.2 Coil current cable (sensor)
5.3 S-DAT (sensor data memory)
5.4 T-DAT (transmitter data memory)
6 I/O board (type FOUNDATION Fieldbus)
6.1 F-Chip (function chip for optional software)

Wall-mount housing: removing and installing printed circuit boards (Fig. 54)

Warning:
- Risk of electric shock. Exposed components carry dangerous voltages. Make sure that the power supply is switched off before you remove the cover of the electronics compartment.
- Risk of damaging electronic components (ESD protection). Static electricity can damage electronic components or impair their operability. Use a workplace with a grounded working surface, purposely built for electrostatically sensitive devices!

1. Remove the screws and open the hinged cover (1) of the housing.
2. Remove the screws securing the electronics module (2). Then push up electronics module and pull it as far as possible out of the wall-mounted housing.
3. Disconnect the following cable plugs from amplifier board (7):
   – Unplug electrode signal cable (7.1) including S-DAT (7.3)
   – Unplug coil current cable (7.2)
   – Unplug ribbon cable (3) of the display module
4. Remove the cover (4) from the electronics compartment by loosening the screws.
5. Remove the boards (6, 7, 8):
   Insert a thin pin into the hole (5) provided for the purpose and pull the board clear of its holder.
6. Installation is the reverse of the removal procedure.

Caution:
Use only original Endress+Hauser parts.

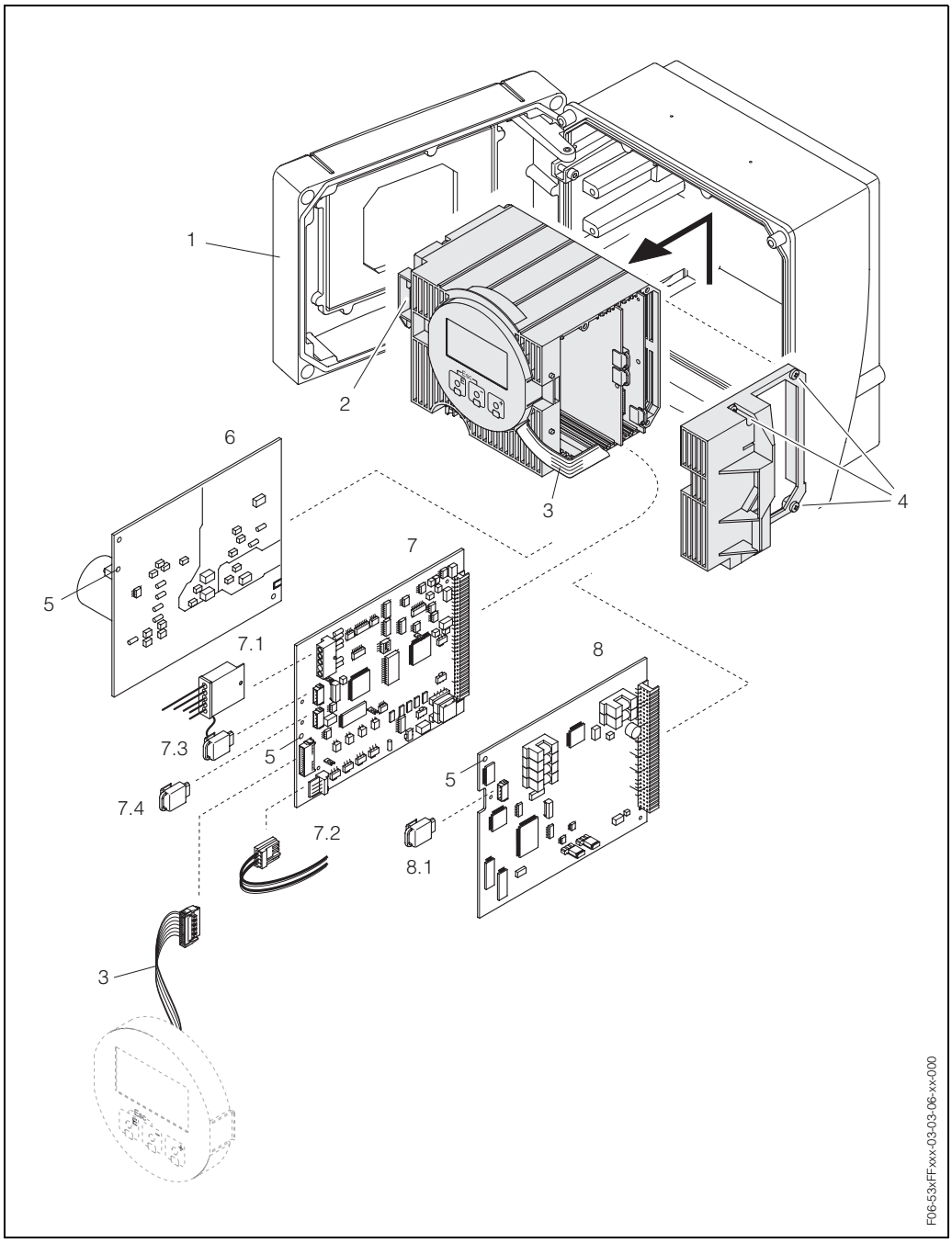


Fig. 54: Wall-mounted housing: removing and installing printed circuit boards

1 Housing cover
2 Electronics module
3 Ribbon cable (display module)
4 Screws of electronics compartment cover
5 Aperture for installing/removing boards
6 Power unit board
7 Amplifier board
7.1 Electrode signal cable (sensor)
7.2 Coil current cable (sensor)
7.3 S-DAT (sensor data memory)
7.4 T-DAT (transmitter data memory)
8 I/O board (type FOUNDATION Fieldbus)
8.1 F-Chip (function chip for optional software)

9.6 Replacing the device fuse

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

The main fuse is on the power unit board (Fig. 55).
The procedure for replacing the fuse is as follows:

1. Switch off power supply.
2. Remove the power unit board → Page 105 ff.
3. Remove cap (1) and replace the device fuse (2).
   Use only fuses of the following type:
   – Power supply 20...55 V AC / 16...62 V DC
     → 2.0 A slow-blow / 250 V; 5.2 x 20 mm
   – Power supply 85...260 V AC → 0.8 A slow-blow / 250 V; 5.2 x 20 mm
   – Ex-rated devices → see the Ex documentation.
4. Assembly is the reverse of the disassembly procedure.

☝ Caution:
Use only original Endress+Hauser parts.

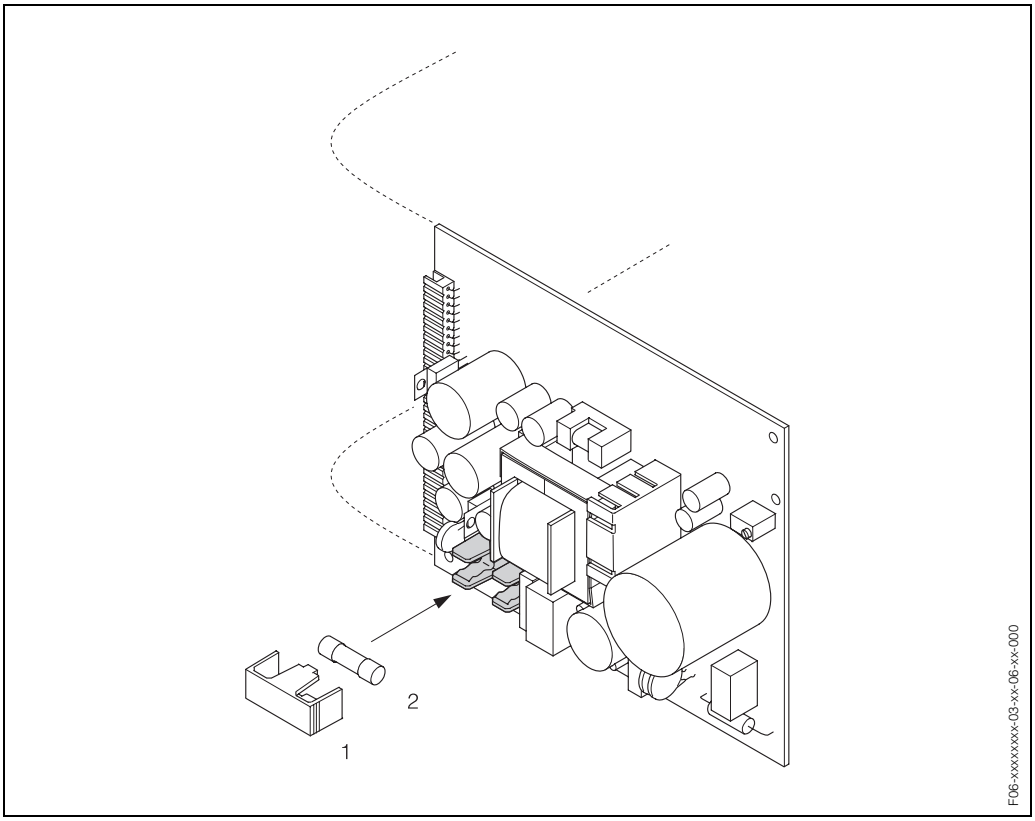


Fig. 55: Replacing the device fuse on the power unit board

1 Protective cap
2 Device fuse

9.7 Exchanging replaceable electrodes

The Promag W sensor (DN 350...2000) is available with exchangeable measuring electrodes as an option. This design permits the measuring electrodes to be replaced or cleaned under process conditions (see Page 111).

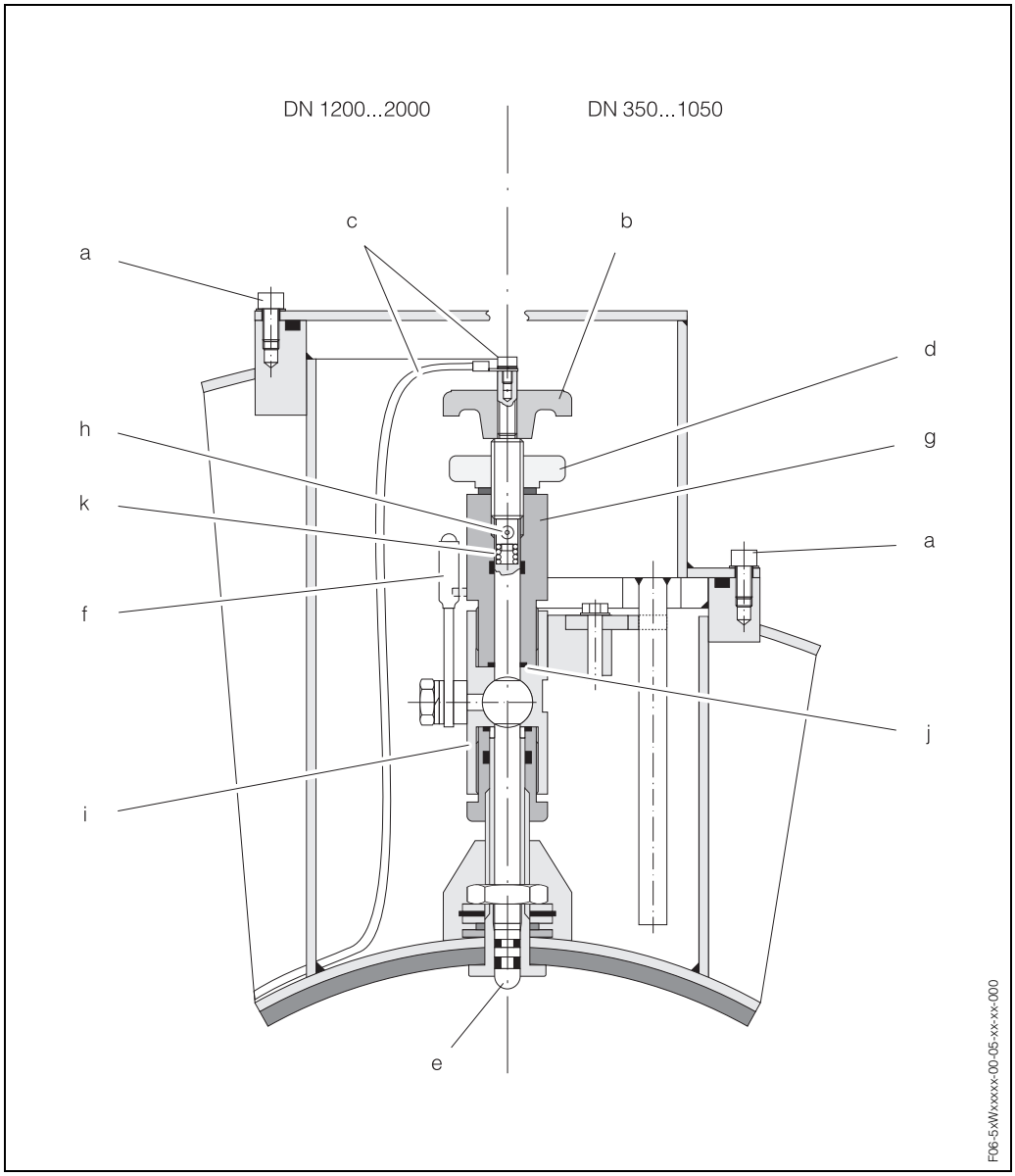


Fig. 56: Apparatus for replacing exchangeable measuring electrodes (Replacing → Page 111)

a Allen screw
b Handle
c Electrode cable
d Knurled nut (locknut)
e Measuring electrode
f Stop cock
g Retaining cylinder
h Locking pin (for handle)
i Ball valve housing
j Seal (retaining cylinder)
k Coil spring

Removing the electrode		Installing the electrode	
1	Loosen Allen screw (a) and remove the cover.	1	Insert new electrode (e) into retaining cylinder (g) from below. Make sure that the seals at the tip of the electrode are clean.
2	Remove electrode cable (c) secured to handle (b).	2	Mount handle (b) on the electrode and insert locking pin (h) to secure it in position. ☝ Caution: Make sure that coil spring (k) is inserted. This is essential to ensure correct electrical contact and correct measuring signals.
2	Loosen knurled nut (d) by hand. This knurled nut acts as a locknut.	2	Pull the electrode back until the tip of the electrode no longer protrudes from retaining cylinder (g).
3	Remove electrode (e) by turning handle (b). The electrode can now be pulled out of retaining cylinder (g) as far as a defined stop. ⚠ Warning: Risk of injury. Under process conditions (pressure in the piping system) the electrode can recoil suddenly against its stop. Apply counter-pressure while releasing the electrode.	3	Screw the retaining cylinder (g) onto ball-valve housing (i) and tighten it by hand. Seal (j) on the cylinder must be correctly seated and clean. ✎ Note: Make sure that the rubber hoses on retaining cylinder (g) and stop cock (f) are of the same color (red or blue).
4	Close stop cock (f) after pulling out the electrode as far as it will go. ⚠ Warning: Do not subsequently open the stop cock, in order to prevent fluid escaping.	4	Open stop cock (f) and turn handle (b) to screw the electrode all the way into the retaining cylinder.
5	Remove the electrode complete with retaining cylinder (g).	5	Screw knurled nut (d) onto the retaining cylinder. This firmly locates the electrode in position.
6	Remove handle (b) from electrode (e) by pressing out locking pin (h). Take care not to lose coil spring (k).	6	Use the Allen screw to secure electrode cable (c) to handle (b). ☝ Caution: Make sure that the machine screw securing the electrode cable is firmly tightened. This is essential to ensure correct electrical contact and correct measuring signals.
7	Remove the old electrode and insert the new electrode. Replacement electrodes can be ordered separately from E+H.	7	Reinstall the cover and tighten (a) Allen screw.

9.8 Software history

Software version / Date	Changes to software	Changes to documentation
Amplifier		
V 1.00.00 / 07.2000	Original software	–
V 1.01.00 / 08.2000	Software expansion (functional adaptations)	none
V 1.01.01 / 09.2000	Software adaptation	none
V 1.02.00 / 06.2001	Software expansion New functionalities	• General instrument functions • "Batching" software functions (not for FF) • "OED" software function • "Advanced Diagnostics" software function (not for FF)
V 1.02.01 / 11.2001	Software adaptation	none
Communication module (I/O board Type FF)		
V 1.00.00 / 04.2000	Original software: • Device Revision 1, DD Revision 1 • Certification No. IT 005700 • ITK 3.5 • 1 Resource Block, 1 Transducer Block, 2 Analog Input Blocks, 1 PID Block • Output data (AI Block): Volume flow → Channel 1 Totalizer → Channel 2 • Without support of the local display for FF • CFF version 1.5	–
V 1.00.01 / 09.2000	Software adaptation	none
V 1.00.02 / 05.2001	Software adaptation	none
V 1.01.00 / 03.2002	Software expansion - New functionalities: • Device Revision 2, DD Revision 2 • Certification No. IT 014600 • ITK 4.0 • CFF version 1.5 • Regrouping of blocks: 1 Resource Block, 4 Transducer Blocks, 5 Analog Input Blocks, 1 PID Block, 1 Discrete Output Block • Output data (AI Block): Calculated mass flow → Channel 1 Volume flow → Channel 2 Totalizer 1 → Channel 7 Totalizer 2 → Channel 8 Totalizer 3 → Channel 9 • Input data DO Block • Support of the local display for FF	• Description of the new FF Blocks • Description of the local display and the corresponding function matrix

10 Technical data

10.1 Technical data at a glance

10.1.1 Application

Application	• Measuring the flow rate of fluids in closed piping systems. • A minimum conductivity of ≥ 5 µS/cm is required for measuring; the minimum conductivity required in the case of demineralised water is ≥ 20 µS/cm. • Applications in measuring, control and regulation technology for monitoring processes, filling and batching operations.

10.1.2 Function and system design

Measuring principle	Electromagnetic flow measurement on the basis of 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 single mechanical unit. • Remote version: transmitter and sensor are installed separately. *Transmitter:* • Promag 53 *Sensor:* • Promag W (for water/wastewater applications) DN 25…2000, hard rubber or polyurethane lining • Promag P (for chemical and process applications) DN 15…600, PFA or PTFE lining • Promag H (for hygienic applications) DN 2…100, PFA lining

10.1.3 Input

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

10.1.4 Output values (FF)

Output signal	Physical data transmission (Physical Layer Type): • Fieldbus interface to IEC 61158-2 • corresponds to device variant type 112 of the FOUNDATION Fieldbus specification: type 112 – standard data transfer (±9 mA, symmetrical), separate supply to field device (4-wire), intrinsically safe execution of the FF interface • with integral polarity protection
Signal on alarm	Status messages as per FOUNDATION Fieldbus specification
Startup current	Less than basic current

Basic current	12 mA
Fault current	0 mA
Permissible fieldbus supply voltage	9 ... 32 V
Data transmission rate	31.25 kbit/s, voltage mode
Signal coding	Manchester II
Bus times	Min. idle time between two telegrams: MIN_INTER_PDU_DELAY = 6 octet time (transfer time per octet)

Block information
Execution time

Block	Base index	Execution time [ms]
Resource Block	258	–
Transducer Block “Flow”	1100	–
Transducer Block “Display”	1500	–
Transducer Block “Totalizer”	1550	–
Transducer Block “Diagnosis”	1600	–
Analog Input Function Block 1	350	50
Analog Input Function Block 2	390	50
Analog Input Function Block 3	430	50
Analog Input Function Block 4	470	50
Analog Input Function Block 5	510	50
PID Funktionsblock	810	100
Discrete Output Function Block	780	50

Output data

Transducer Blocks / Analog Input Function Blocks

Block	Process variable	Channel parameter (AI Block)
Transducer Block “Flow”	Calculated mass flow	1
	Volume flow	2
Transducer Block “Totalizer”	Totalizer 1	7
	Totalizer 2	8
	Totalizer 3	9

Input data

Discrete Output Function Block

Status change			Action
Discrete state 0	→	Discrete state 1	reserved
Discrete state 0	→	Discrete state 2	Positive zero return ON
Discrete state 0	→	Discrete state 3	Positive zero return OFF
Discrete state 0	→	Discrete state 4	reserved
Discrete state 0	→	Discrete state 5	reserved
Discrete state 0	→	Discrete state 6	reserved
Discrete state 0	→	Discrete state 7	Reset Totalizer 1, 2, 3
Discrete state 0	→	Discrete state 8	Reset Totalizer 1
Discrete state 0	→	Discrete state 9	Reset Totalizer 2
Discrete state 0	→	Discrete state 10	Reset Totalizer 3

Communication profiles supported

31 PS → Publisher, Subscriber
31 L → Link Master

LAS function

LAS function supported

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 47 ff.

Cable entry

Power-supply and signal cables (inputs/outputs):
- Cable entry M20 x 1.5 (8…12 mm)
- Threads for cable entries, PG 13.5 (5…15 mm), 1/2" NPT, G 1/2"

Connecting cable for remote version:
- Cable entry M20 x 1.5 (8…12 mm)
- Threads for cable entries, PG 13.5 (5…15 mm), 1/2" NPT, G 1/2"

Cable specifications

FOUNDATION Fieldbus → Page 47
Remote version → Page 53

Supply voltage

85…260 V AC, 45…65 Hz
20…55 V AC, 45…65 Hz
16…62 V DC

Power consumption

AC: <15 VA (including sensor)
DC: <15 W (including sensor)

Switch-on current
- max. 13.5 A (< 50 ms) at 24 V DC
- max. 3 A (< 5 ms) at 260 V AC

Power supply failure

Lasting min. 1 power cycle
- EEPROM or T-DAT saves measuring system data if power supply fails
- S-DAT: exchangeable data storage chip which stores the data of the sensor (nominal diameter, serial number, calibration factor, zero point, etc.)

Potential equalisation

see Page 58 ff.

10.1.6 Performance characteristics

Reference operating conditions

To DIN 19200 and VDI/VDE 2641:
- Fluid temperature: +28 °C ± 2 K
- Ambient temperature: +22 °C ± 2 K
- Warm-up time: 30 minutes

Installation:
- Inlet run >10 x DN
- Outlet run > 5 x DN
- Sensor and transmitter grounded.
- Sensor centered relative to the pipe.

Maximum measured error

± 0.2% o.r. ± 2 mm/s (o.r. = of reading)
Supply-voltage fluctuations have no effect within the specified range.

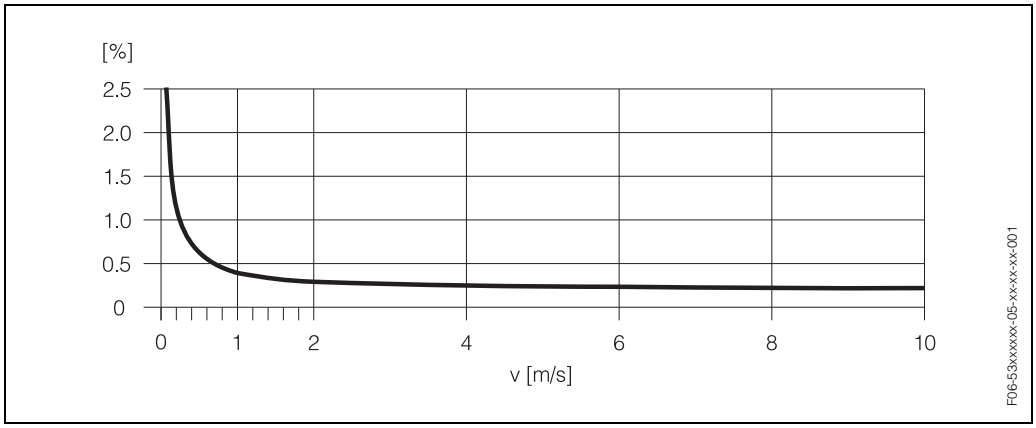


Fig. 57: Max. measured error in % of reading

Repeatability

max. ± 0.1% o.r. ± 0.5 mm/s (o.r. = of reading)

10.1.7 Operating conditions

Installation

Installation instructions	Any orientation (vertical, horizontal) Restrictions and additional installation instructions → Page 15 ff.
Inlet and outlet runs	Inlet run: typically ≥ 5 x DN Outlet run: typically ≥ 2 x DN
Length of connecting cable	• For the remote version the permissible cable length L_{max} depends on the conductivity of the medium (see Page 25). • A minimum conductivity of 20 µS/cm is required for measuring demineralized water.

Environment

Ambient temperature	–20…+60 °C (sensor, transmitter) Note the following points: • Install the device at a shady location. Avoid direct sunlight, particularly in warm climatic regions. • If both fluid and ambient temperatures are high, install the transmitter at a remote location from the sensor (→ "Medium temperature range").
Storage temperature	–10…+50 °C (preferably +20 °C)
Degree of protection	• Standard: IP 67 (NEMA 4X) for transmitter and sensor • Optional: IP 68 (NEMA 6P) for remote version of Promag W and P sensor
Shock and vibration resistance	Acceleration up to 2 g by analogy with IEC 68-2-6 (high-temperature version: no data available)
CIP cleaning	Promag W: not possible Promag P: possible (note max. temperature) Promag H: possible (note max. temperature)
SIP cleaning	Promag W: not possible Promag P: possible with PFA (note max. temperature) Promag H: possible (note max. temperature)
Electromagnetic compatibility (EMC)	To EN 61326/A1 and NAMUR recommendation NE 21

Process

Medium temperature range

The permissible fluid temperature depends on the lining of the measuring tube:

Promag W
0…+80 °C for hard rubber (DN 65…2000)
–20…+70 °C for polyurethane (DN 25…2000)

Promag P
–40…+130 °C for PTFE (DN 15…600), for restrictions → refer to diagrams
–20…+180 °C for PFA (DN 25…200), for restrictions → refer to diagrams

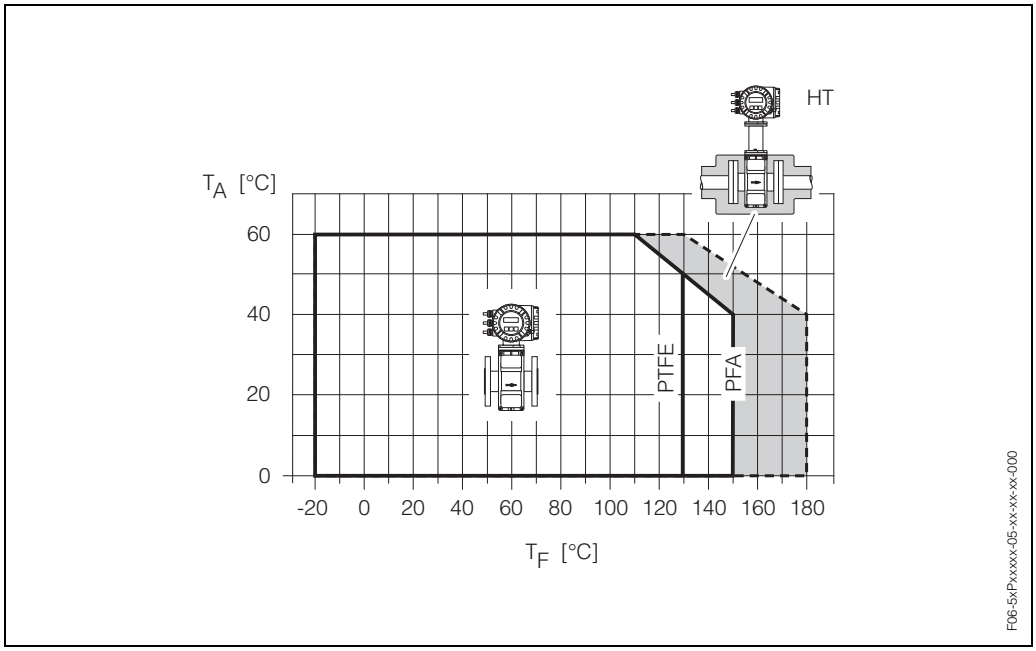


Fig. 58: Compact version Promag P (with PFA or PTFE lining)
T_A = ambient temperature, T_F = fluid temperature, HT = high-temperature version, with insulation

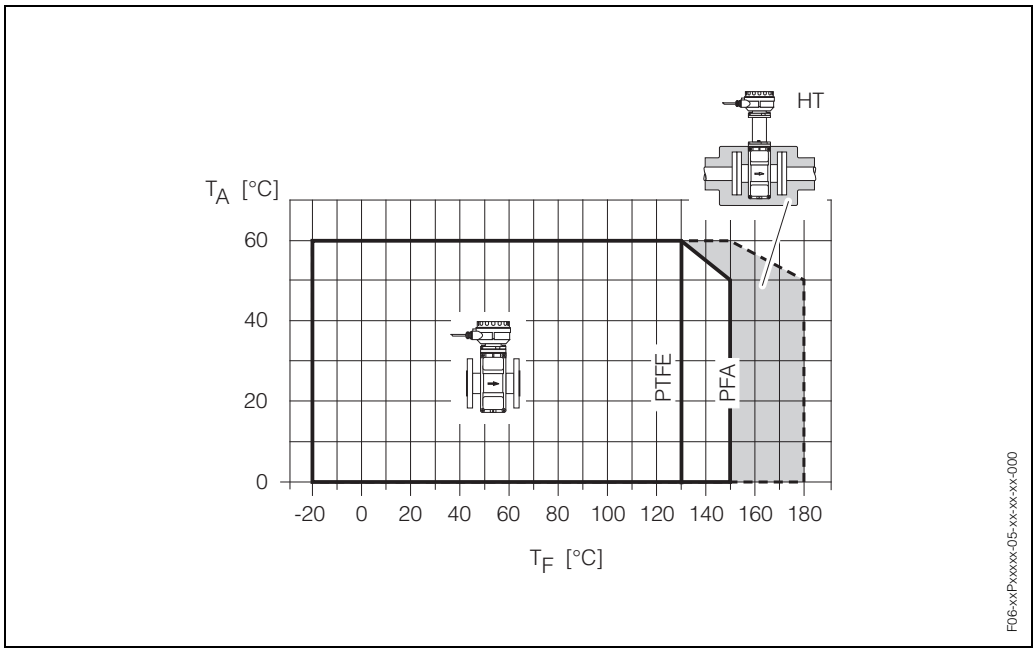


Fig. 59: Remote version Promag P (with PFA or PTFE lining)
T_A = ambient temperature, T_F = fluid temperature, HT = high-temperature version, with insulation

Promag H
Sensor:
- DN 2…25: –20…+150 °C (+180 °C in prep.)
- DN 40…100: –20…+150 °C

Seal:
- EPDM: –20…+130 °C
- Silicone: –20…+150 °C
- Viton: –20…+150 °C
- Kalrez: –20…+150 °C

Conductivity

Minimum conductivity:
- ≥ 5 µS/cm for fluids generally
- ≥ 20 µS/cm for demineralised water

Note that in the case of the remote version, the requisite conductivity is also influenced by the length of the connecting cable → Page 25.

Limiting medium pressure range (nominal pressure)

Promag W
- 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 B16.5: Class 150 (1…24"), Class 300 (1…6")
- AWWA: Class D (28…78")
- JIS B2238: 10K (DN 50…300), 20K (DN 25…300)

Promag P
- DIN 2501: PN 10 (DN 200…600), PN 16 (DN 65…600), PN 25 (DN 200…600), PN 40 (DN 15…150)
- ANSI B16.5: Class 150 (1/2…24"), Class 300 (1/2…6")
- JIS B2238: 10K (DN 50…300), 20K (DN 15…300)

Promag H
The permissible nominal pressure depends on the process connection and seal:
- 40 bar: flange, weld nipple (with O-ring seal)
- 16 bar: all other process connections

Pressure tightness (liner)

Promag W Nominal diameter		Measuring tube lining	Resistance of measuring tube lining to partial vacuum Limit values for abs. pressure [mbar] at various fluid temperatures						
[mm]	[inch]		25 °C	70 °C	80° C	100 °C	130 °C	150 °C	180 °C
25…2000	1…78"	Polyurethane	0	0	–	–	–	–	–
65…2000	3…78"	Hard rubber	0	0	0	–	–	–	–

Promag P Nominal diameter		Measuring tube lining	Resistance of measuring tube lining to partial vacuum Limit values for abs. pressure [mbar] at various fluid temperatures					
[mm]	[inch]		25 °C	80 °C	100 °C	130 °C	150 °C	180 °C
15	1/2"	PTFE	0	0	0	100	–	–
25	1"	PTFE / PFA	0 / 0	0 / 0	0 / 0	100 / 0	– / 0	– / 0
32	–	PTFE / PFA	0 / 0	0 / 0	0 / 0	100 / 0	– / 0	– / 0
40	1 1/2"	PTFE / PFA	0 / 0	0 / 0	0 / 0	100 / 0	– / 0	– / 0
50	2"	PTFE / PFA	0 / 0	0 / 0	0 / 0	100 / 0	– / 0	– / 0
65	–	PTFE / PFA	0 / 0	*	40 / 0	130 / 0	– / 0	– / 0
80	3"	PTFE / PFA	0 / 0	*	40 / 0	130 / 0	– / 0	– / 0
100	4"	PTFE / PFA	0 / 0	*	135 / 0	170 / 0	– / 0	– / 0
125	–	PTFE / PFA	135 / 0	*	240 / 0	385 / 0	– / 0	– / 0
150	6"	PTFE / PFA	135 / 0	*	240 / 0	385 / 0	– / 0	– / 0
200	8"	PTFE / PFA	200 / 0	*	290 / 0	410 / 0	– / 0	– / 0
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 quoted.								

Promag H Nominal diameter		Measuring tube lining	Resistance of measuring tube lining to partial vacuum 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 20 ff.

Pressure loss

- No pressure loss if the sensor is installed in a pipe of the same nominal diameter (Promag H: only DN 8 and larger).
- Pressure losses for configurations incorporating adapters according to (E) DIN EN 545 → Page 20

10.1.8 Mechanical construction

Design / dimensions see Page 129 ff.

Weight

Weight data of Promag W in kg

Nominal diameter		Compact version				Remote version (without cable)				
						Sensor				Wall housing
[mm]	[inch]	DIN		ANSI / AWWA		DIN		ANSI / AWWA		
25	1"	PN 40	7.3	Class 150	7.3	PN 40	5.3	Class 150	5.3	6.0
32	1 1/4"		8.0		–		6.0		–	6.0
40	1 1/2"		9.4		9.4		7.4		7.4	6.0
50	2"		0.6		10.6		8.6		8.6	6.0
65	2 1/2"	PN 16	12.0		–	PN 16	10.0		–	6.0
80	3"		14.0		14.0		12.0		12.0	6.0
100	4"		16.0		16.0		14.0		14.0	6.0
125	5"		21.5		–		19.5		–	6.0
150	6"		25.5		25.5		23.5		23.5	6.0
200	8"	PN 10	45		45	PN 10	43		43	6.0
250	10"		65		75		63		73	6.0
300	12"		70		110		68		108	6.0
350	14"		115		175		113		173	6.0
400	16"		135		205		133		203	6.0
450	18"		175		255		173		253	6.0
500	20"		175		285		173		283	6.0
600	24"		235		405		233		403	6.0
700	28"		355	Class D	400		353	Class D	398	6.0
–	30"		–		460		–		458	6.0
800	32"		435		550		433		548	6.0
900	36"		575		800		573		798	6.0
1000	40"		700		900		698		898	6.0
–	42"	PN 6	–		1100	PN 6	–		1098	6.0
1200	48"		850		1400		848		1398	6.0
–	54"		–		2200		–		2198	6.0
1400	–		1300		–		1298		–	6.0
–	60"		–		2700		–		2698	6.0
1600	–		1700		–		1698		–	6.0
–	66"		–		3700		–		3698	6.0
1800	72"		2200		4100		2198		4098	6.0
–	78"		–		4600		–		4598	6.0
2000	–		2800		–		2798		–	6.0

Transmitter Promag (compact version): 3.4 kg
(Weight data valid for standard pressure ratings and without packaging material)

Weight data of Promag P in kg

Nominal diameter		Compact version				Remote version (without cable)				
						Sensor				Wall housing
[mm]	[inch]	DIN		ANSI / AWWA		DIN		ANSI / AWWA		
15	1/2"	PN 40	6.5	Class 150	6.5	PN 40	4.5	Class 150	4.5	6.0
25	1"		7.3		7.3		5.3		5.3	6.0
32	1 1/4"		8.0		–		6.0		–	6.0
40	1 1/2"		9.4		9.4		7.4		7.4	6.0
50	2"		10.6		10.6		8.6		8.6	6.0
65	2 1/2"	PN 16	12.0		–	PN 16	10.0		–	6.0
80	3"		14.0		14.0		12.0		12.0	6.0
100	4"		16.0		16.0		14.0		14.0	6.0
125	5"		21.5		–		19.5		–	6.0
150	6"		25.5		25.5		23.5		23.5	6.0
200	8"	PN 10	45		45	PN 10	43		43	6.0
250	10"		65		75		63		73	6.0
300	12"		70		110		68		108	6.0
350	14"		115		175		113		173	6.0
400	16"		135		205		133		203	6.0
450	18"		175		255		173		253	6.0
500	20"		175		285		173		283	6.0
600	24"		235		405		233		403	6.0

Transmitter Promag (compact version): 3.4 kg
High-temperature version: +1.5 kg
(Weight data valid for standard pressure ratings and without packaging material)

Weight data of Promag H in kg

Nominal diameter		Compact version	Remote version (without cable)	
[mm]	[inch]	DIN	Sensor	Wall housing
2	1/12"	5.2	2.5	6.0
4	5/32"	5.2	2.5	6.0
8	5/16"	5.3	2.5	6.0
15	1/2"	5.4	2.6	6.0
25	1"	5.5	2.8	6.0
40	1 1/2"	6.5	4.5	6.0
50	2"	9.0	7.0	6.0
65	2 1/2"	9.5	7.5	6.0
80	3"	19.0	17.0	6.0

Transmitter Promag (compact version): 3.4 kg
(Weight data valid for standard pressure ratings and without packaging material)

Materials

Promag W

Transmitter housing:
- Compact housing: powder coated die-cast aluminium or stainless steel field housing (1.4301/316L)
- Wall-mounted housing: powder coated die-cast aluminium

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

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

Flange:
- DIN : Stainless steel 1.4571, ST37 / FE 410W B (DN < 350 with Al/Zn protective coating; DN > 300 with Amerlock 400 paint)
- ANSI: A105, 316L (DN < 350 with Al/Zn protective coating, DN > 300 with Amerlock 400 paint)
- AWWA: A105
- JIS: S20C, SUS 316L (DN < 350 with Al/Zn protective coating, DN > 300 with Amerlock 400 paint)

Ground disks: : 1.4435/316L or Alloy C-22
Electrodes: 1.4435 or Alloy C-22, tantalum
Seals: Seals to DIN 2690

Promag P

Transmitter housing:
- Compact housing: powder coated die-cast aluminium or stainless steel field housing (1.4301/316L)
- Wall-mounted housing: powder coated die-cast aluminium

Sensor housing:
- DN 25…300: powder-coated die-cast aluminium
- DN 350…600: painted steel (Amerlock 400)

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

Flange:
- DIN : Stainless steel 1.4571, ST37 / FE 410W B (DN < 350 with Al/Zn protective coating, DN > 300 with Amerlock 400 paint)
- ANSI: A105, 316L (DN < 350 with Al/Zn protective coating, DN > 300 with Amerlock 400 paint)
- JIS: S20C, SUS 316L (DN < 350 with Al/Zn protective coating, DN > 300 with Amerlock 400 paint)

Ground disks: 1.4435/316L or Alloy C-22
Electrodes: 1.4435, platinum/rhodium 80/20 or Alloy C-22, tantalum
Seals: Seals to DIN 2690

Promag H

Transmitter housing:
- Compact housing: powder coated die-cast aluminium or stainless-steel field housing (1.4301/316L)
- Wall-mounted housing: powder coated die-cast aluminium

Sensor housing: 1.4301
Wall mounting (holder panel): 1.4301

Measuring tube: stainless steel 1.4301 or 1.4306/304L

Flange:
- All connections 1.4404/316L
- Flanges (DIN, ANSI, JIS) made of PVDF
- Adhesive fitting made of PVC

Ground rings: 1.4435/316L, platinum (Basic material: Titanium Grade 2, Platinum coating at least 12 µm), Alloy C-22

Electrodes:
- Standard: 1.4435
- Option: Alloy C-22, tantalum, platinum/rhodium 80/20 (up to DN 25 only)

Seals:
- DN 2…25: O-ring (EPDM, Viton, Kalrez) or gasket seal (EPDM, silicone, Viton)
- DN 40…100: gasket seal (EPDM, silicone)

Material load diagram

The material load diagrams (pressure-temperature graphs) for the process connections are to be found in the following documents:
- Technical Information “Promag 50/53 W” (TI 046D/06/en)
- Technical Information “Promag 50/53 P” (TI 047D/06/en)
- Technical Information “Promag 50/53 H” (TI 048D/06/en)

Fitted electrodes

Promag W:
Measuring, reference and EPD electrodes
- Standard available with 1.4435, Alloy C-22, tantalum
- Optional: exchangeable measuring electrodes made of 1.4435 (DN 350…2000)

Promag P:
Measuring, reference and EPD electrodes
- Standard available with 1.4435, Alloy C-22, tantalum
- Optional: reference electrode and EPD electrodes made of platinum/rhodium 80/20

Promag H:
Measuring electrodes and EPD electrodes
- Standard available with 1.4435, Alloy C-22, tantalum, platinum/rhodium
- DN 2…8: without EPD electrode

Process connections	Promag W: Flange connection: DIN (dimensions to DIN 2501), ANSI, AWWA, JIS Promag P: Flange connection: DIN (dimensions to DIN 2501), ANSI, AWWA, JIS Promag H: • With O-ring: weld nipples (ISO 2463, IPS), flanges (DIN, ANSI, JIS), PVDF flanges (DIN, ANSI, JIS), external pipe thread, internal pipe thread, hose connection, PVC adhesive fittings • With gasket seals: weld nipples (DIN 11850, ODT), clamps (ODT, ISO 2852, DIN 32676), threaded fasteners (DIN 11851, DIN 11864-1, ISO 2853, SMS1145), flanges DIN 11864-2
Surface roughness	• PFA liner: ≤ 0.3 µm • Electrodes: – 1.4435, Alloy C-22: ≤ 0.4 µm – Tantalum, platinum/rhodium: ≤ 0.8 µm • Process connection Promag H: ≤ 0.8 µm (all data relate to parts in contact with medium)

10.1.9 Human interface

Display elements	• Liquid-crystal display: illuminated, four lines with 16 characters per line • Custom configurations for presenting different measured values and status variables • 3 totalizers
Operating elements	• Local operation with three optical keys (–, +, E) • Application-spezific Quick Setup menus for straightforward commissioning
Remote operation	Operation via FOUNDATION Fieldbus using suitable configuration or operation software.

10.1.10 Certificates and approvals

Ex Approvals	Information on the currently available Ex-rated versions (ATEX, FM, CSA, etc.) is available on request from your E+H sales outlet. All information relevant to explosion protection is available in separate Ex documents that you can order as necessary.
Sanitary compatibility	Promag W: No applicable approvals or certification Promag P: No applicable approvals or certification Promag H: • 3A authorization and EHEDG-tested • Seals in conformity with FDA (except Kalrez seals)
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.

Certification FOUNDATION Fieldbus

The Promag 53 flowmeter has passed all the test procedures implemented and has been certified and registered by the Fieldbus FOUNDATION. The flowmeter thus meets all the requirements of the specifications listed below:

- Certified according to Fieldbus FOUNDATION specification
- The flowmeter meets all the specifications of the FOUNDATION Fieldbus-H1.
- Interoperability Test Kit (ITK), revision 4.0: The device can also be operated in conjunction with other-make certified devices.
- Physical Layer Conformance Test by Fieldbus FOUNDATION

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)
Electromagnetic compatibility (EMC requirements)

NAMUR NE 21
Association for Standards for Control and Regulation in the Chemical Industry

10.1.11 Ordering information

The E+H service organisation can provide detailed ordering information and information on specific order codes on request.

10.1.12 Accessories

Various accessories, which can be ordered separately from E+H, are available for the transmitter and the sensor (see Page 89). The E+H service organisation can provide detailed information on request.

10.1.13 Supplementary documentation

- System Information Promag (SI 028D/06/en)
- Technical Information Promag 50/53 W (TI 046D/06/en)
- Technical Information Promag 50/53 P (TI 047D/06/en)
- Technical Information Promag 50/53 H (TI 048D/06/en)
- Description of Device Functions Promag 53 FF (BA 051D/06/en)
- Supplementary documentation on Ex-ratings: ATEX, FM, CSA, etc.
- Operating Instructions FOUNDATION Fieldbus Overview, Installation and commissioning guidelines (BA 013S/04/en)

10.2 Measuring-tube specifications

Promag W Nominal diameter		Pressure rating				Inside diameter of measuring tube	
DIN [mm]	ANSI [inch]	DIN [bar]	ANSI [lbs]	AWWA	JIS	Hard rubber	Polyurethane
25	1"	PN 40	Cl 150	–	20K	–	24
32	–	PN 40	–	–	20K	–	32
40	1 1/2"	PN 40	Cl 150	–	20K	–	38
50	2"	PN 40	Cl 150	–	10K	–	50
65	–	PN 16	–	–	10K	66	66
80	3"	PN 16	Cl 150	–	10K	79	79
100	4"	PN 16	Cl 150	–	10K	102	102
125	–	PN 16	–	–	10K	127	127
150	6"	PN 16	Cl 150	–	10K	156	156
200	8"	PN 10	Cl 150	–	10K	204	204
250	10"	PN 10	Cl 150	–	10K	258	258
300	12"	PN 10	Cl 150	–	10K	309	309
350	14"	PN 10	Cl 150	–	–	342	342
400	16"	PN 10	Cl 150	–	–	392	392
450	18"	PN 10	Cl 150	–	–	437	437
500	20"	PN 10	Cl 150	–	–	492	492
600	24"	PN 10	Cl 150	–	–	594	594
700	28"	PN 10	–	Class D	–	692	692
–	30"	–	–	Class D	–	742	742
800	32"	PN 10	–	Class D	–	794	794
900	36"	PN 10	–	Class D	–	891	891
1000	40"	PN 10	–	Class D	–	994	994
–	42"	–	–	Class D	–	1043	1043
1200	48"	PN 6	–	Class D	–	1197	1197
–	54"	–	–	Class D	–	1339	1339
1400	–	PN 6	–	–	–	1402	1402
–	60"	–	–	Class D	–	1492	1492
1600	–	PN 6	–	–	–	1600	1600
–	66"	–	–	Class D	–	1638	1638
1800	72"	PN 6	–	Class D	–	1786	1786
2000	78"	PN 6	–	Class D	–	1989	1989

Promag P Nominal diameter		Pressure rating			Inside diameter of measuring tube	
DIN [mm]	ANSI [inch]	DIN [bar]	ANSI [lbs]	JIS	with PFA [mm]	with PTFE [mm]
15	1/2"	PN 40	Cl 150	20K	–	15
25	1"	PN 40	Cl 150	20K	23	26
32	–	PN 40	–	20K	32	35
40	1 1/2"	PN 40	Cl 150	20K	36	41
50	2"	PN 40	Cl 150	10K	48	52
65	–	PN 16	–	10K	63	67
80	3"	PN 16	Cl 150	10K	75	80
100	4"	PN 16	Cl 150	10K	101	104
125	–	PN 16	–	10K	126	129
150	6"	PN 16	Cl 150	10K	154	156
200	8"	PN 10	Cl 150	10K	201	202
250	10"	PN 10	Cl 150	10K	–	256
300	12"	PN 10	Cl 150	10K	–	306
350	14"	PN 10	Cl 150	–	–	337
400	16"	PN 10	Cl 150	–	–	387
450	18"	PN 10	Cl 150	–	–	432
500	20"	PN 10	Cl 150	–	–	487
600	24"	PN 10	Cl 150	–	–	593

Promag H Nominal diameter		Pressure ratings *	Inside diameter of measuring tube **
DIN [mm]	ANSI [inch]	DIN [bar]	PFA
2	1/12"	PN 16 / PN 40	2.25
4	5/32"	PN 16 / PN 40	4.5
8	5/16"	PN 16 / PN 40	9.0
15	1/2"	PN 16 / PN 40	16.0
25	1"	PN 16 / PN 40	22.6
25	1"	PN 16 / PN 40	26.0
40	1 1/2"	PN 16 / PN 40	35.3
50	2"	PN 16 / PN 40	48.1
65	2 1/2"	PN 16 / PN 40	59.9
80	3"	PN 16 / PN 40	72.6
100	4"	PN 16 / PN 40	97.5

* The pressure rating depends on the process connections and the seals (see Page 119).
** Inside diameters of process connections → Page 144 ff.

10.3 Dimensions wall-mounted housing

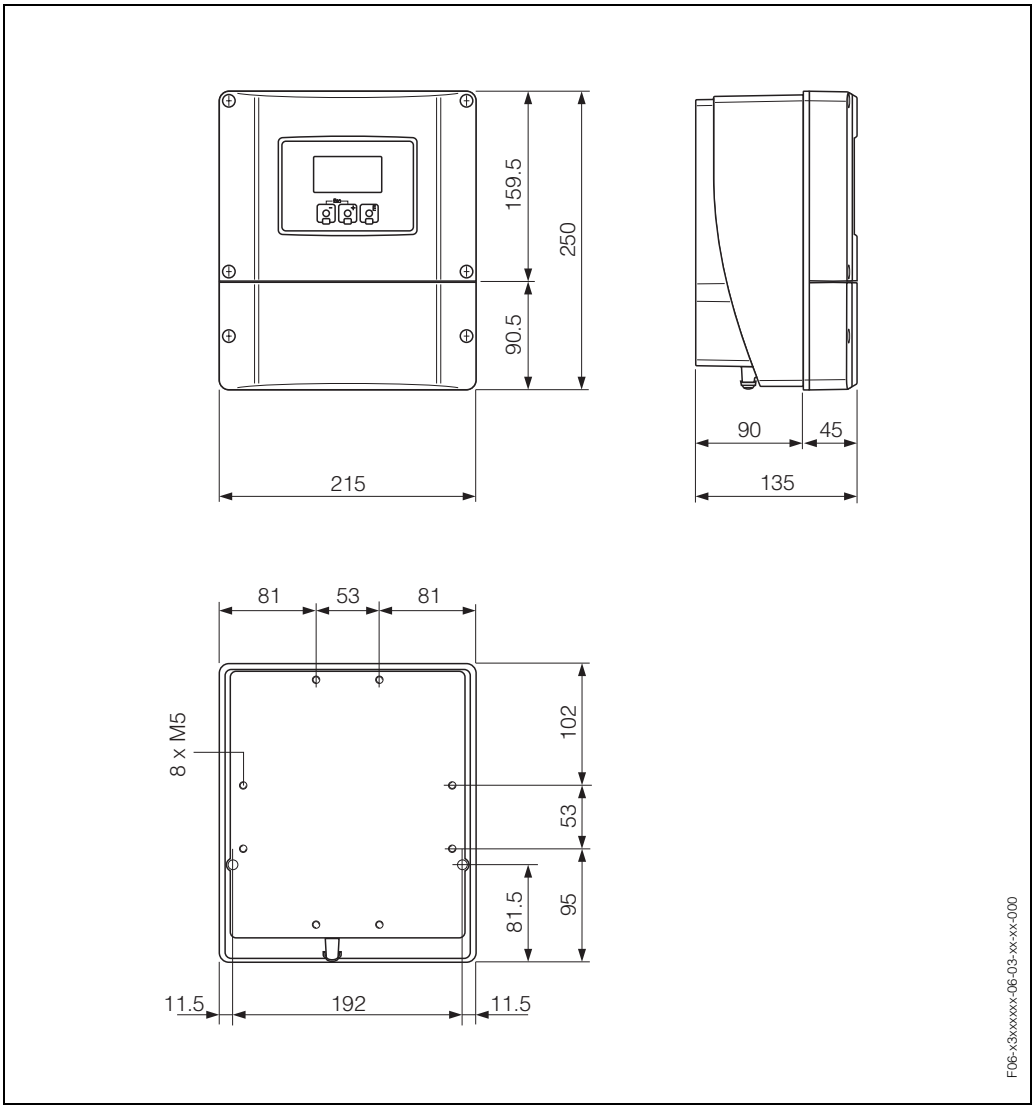


Fig. 60: Dimensions wall-mounted housing (for panel installation and pipe mounting → Page 44)

10.4 Dimensions Promag 53 W

Promag W / DN ≤ 300 (compact version)

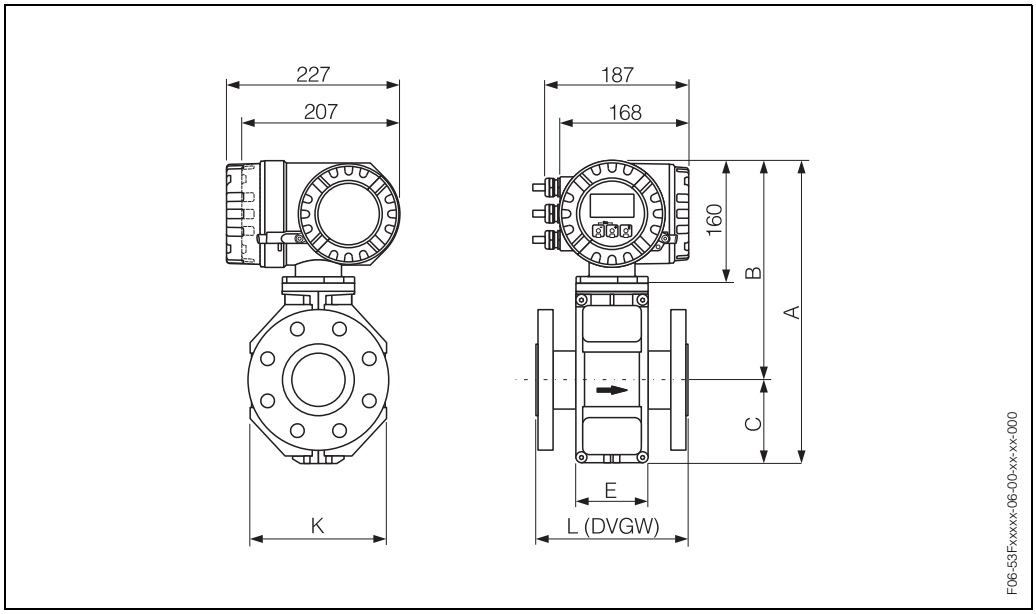


Fig. 61: Dimensions Promag W / DN ≤ 300 (compact version)

DN		L	A	B	C	K	E
DIN [mm]	ANSI [inch]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]
25	1"	200	341	257	84	120	94
32	–	200	341	257	84	120	94
40	1 1/2"	200	341	257	84	120	94
50	2"	200	341	257	84	120	94
65	–	200	391	282	109	180	94
80	3"	200	391	282	109	180	94
100	4"	250	391	282	109	180	94
125	–	250	472	322	150	260	140
150	6"	300	472	322	150	260	140
200	8"	350	527	347	180	324	156
250	10"	450	577	372	205	400	156
300	12"	500	627	397	230	460	166
The fitting length (L) is always the same, regardless of the pressure rating.							

Promag W / DN ≤ 300 (remote version)

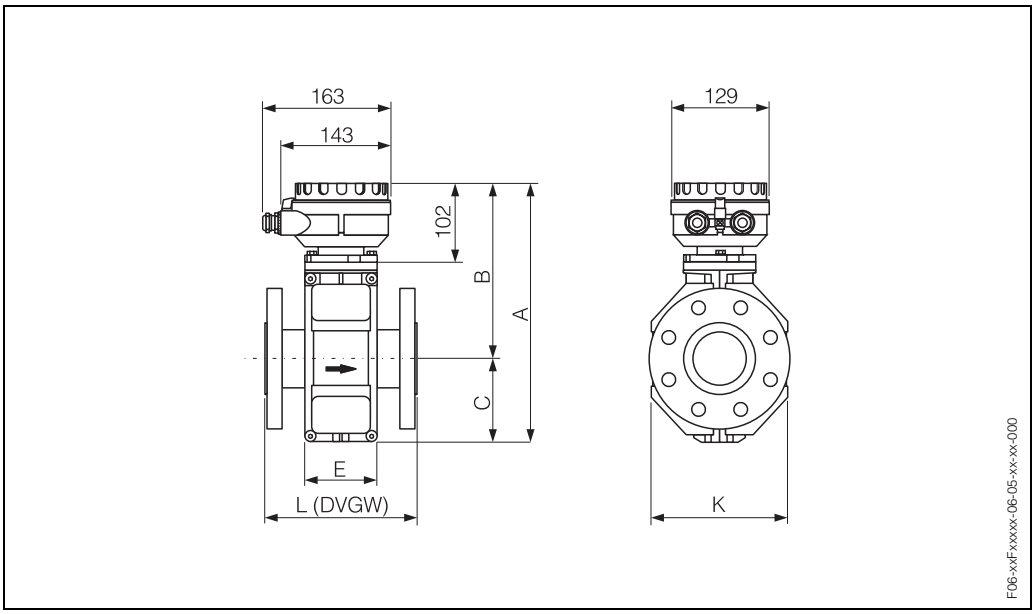


Fig. 62: Dimensions Promag W / DN ≤ 300 (remote version)
Dimensions of wall-mount housing → Page 129

DN		L	A	B	C	K	E
DIN [mm]	ANSI [inch]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]
25	1"	200	286	202	84	120	94
32	–	200	286	202	84	120	94
40	1 1/2"	200	286	202	84	120	94
50	2"	200	286	202	84	120	94
65	–	200	336	227	109	180	94
80	3"	200	336	227	109	180	94
100	4"	250	336	227	109	180	94
125	–	250	417	267	150	260	140
150	6"	300	417	267	150	260	140
200	8"	350	472	292	180	324	156
250	10"	450	522	317	205	400	156
300	12"	500	572	342	230	460	166
The fitting length (L) is always the same, regardless of the pressure rating.							

Promag W / DN ≥ 350 (compact version)

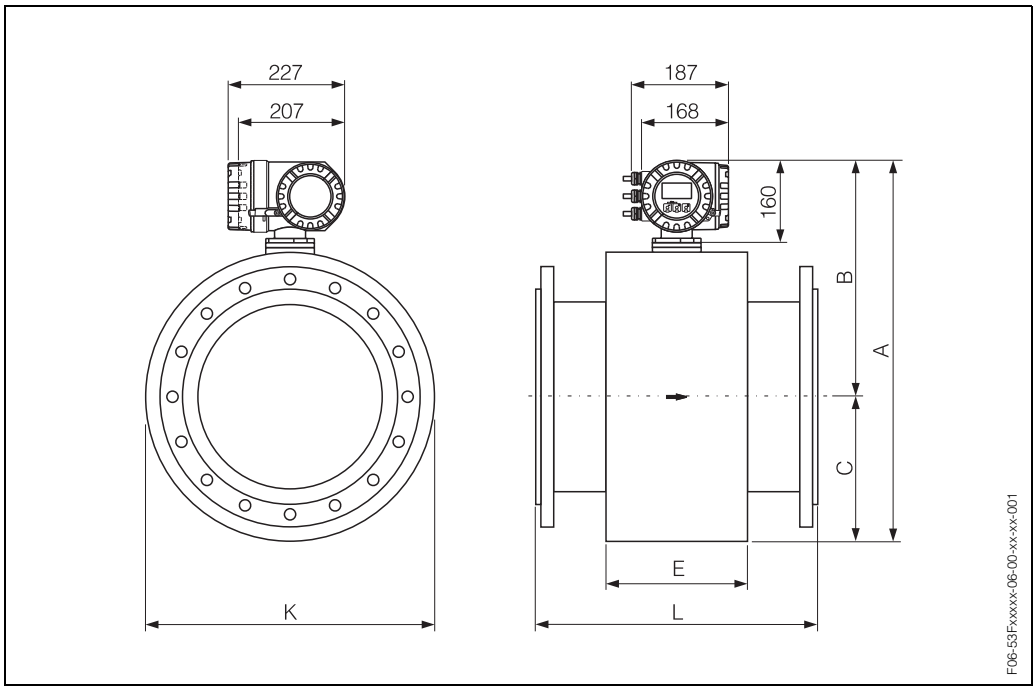


Fig. 63: Dimensions Promag W / DN ≥ 350 (compact version)

DN		L	A	B	C	K	E
DIN [mm]	ANSI [inch]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]
350	14"	550	738.5	456.5	282.0	564	276
400	16"	600	790.5	482.5	308.0	616	276
450	18"	650	840.5	507.5	333.0	666	292
500	20"	650	891.5	533.0	358.5	717	292
600	24"	780	995.5	585.0	410.5	821	402
700	28"	910	1198.5	686.5	512.0	1024	589
750	30"	975	1198.5	686.5	512.0	1024	626
800	32"	1040	1241.5	708.0	533.5	1067	647
900	36"	1170	1394.5	784.5	610.0	1220	785
1000	40"	1300	1546.5	860.5	686.0	1372	862
1050	42"	1365	1598.5	886.5	712.0	1424	912
1200	48"	1560	1796.5	985.5	811.0	1622	992
1350	54"	1755	1998.5	1086.5	912.0	1824	1252
1400	56"	1820	2148.5	1161.5	987.0	1974	1252
1500	60"	1950	2196.5	1185.5	1011.0	2022	1392
1600	64"	2080	2286.5	1230.5	1056.0	2112	1482
1650	66"	2145	2360.5	1267.5	1093.0	2186	1482
1800	72"	2340	2550.5	1362.5	1188.0	2376	1632
2000	78"	2600	2650.5	1412.5	1238.0	2476	1732
The fitting length (L) is always the same, regardless of the pressure rating.							

Promag W / DN ≥ 350 (remote version)

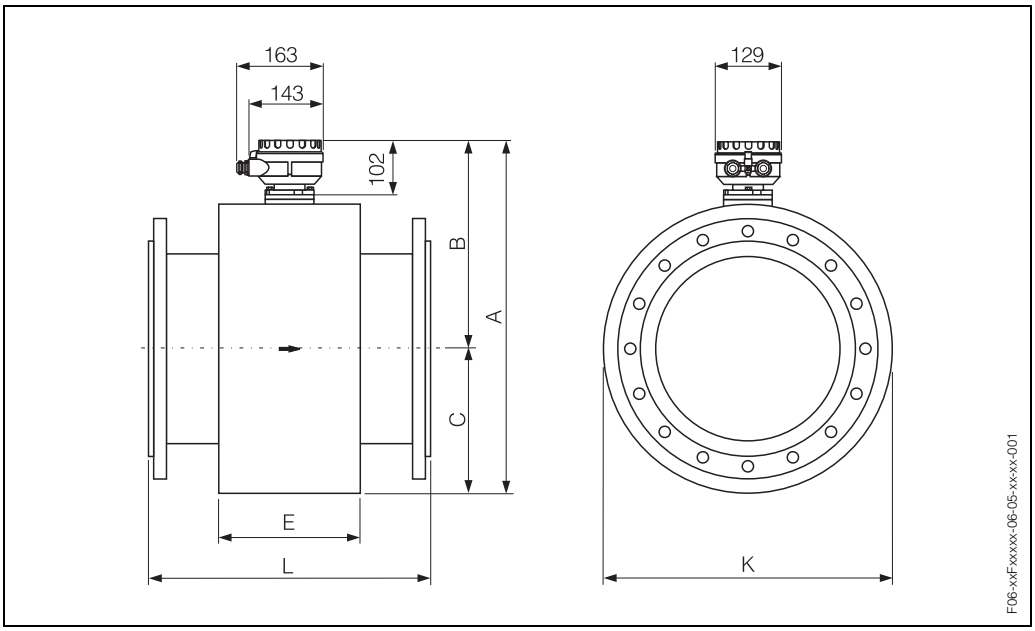


Fig. 64: Dimensions Promag W / DN ≥ 350 (remote version)
Dimensions of wall-mount housing → Page 129

DN		L	A	B	C	K	E
DIN [mm]	ANSI [inch]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]
350	14"	550	683.5	401.5	282.0	564	276
400	16"	600	735.5	427.5	308.0	616	276
450	18"	650	785.5	452.5	333.0	666	292
500	20"	650	836.5	478.0	358.5	717	292
600	24"	780	940.5	530.0	410.5	821	402
700	28"	910	1143.5	631.5	512.0	1024	589
750	30"	975	1143.5	631.5	512.0	1024	626
800	32"	1040	1186.5	653.0	533.5	1067	647
900	36"	1170	1339.5	729.5	610.0	1220	785
1000	40"	1300	1491.5	805.5	686.0	1372	862
1050	42"	1365	1543.5	831.5	712.0	1424	912
1200	48"	1560	1741.5	930.5	811.0	1622	992
1350	54"	1755	1943.5	1031.5	912.0	1824	1252
1400	56"	1820	2093.5	1106.5	987.0	1974	1252
1500	60"	1950	2141.5	1130.5	1011.0	2022	1392
1600	64"	2080	2231.5	1175.5	1056.0	2112	1482
1650	66"	2145	2305.5	1212.5	1093.0	2186	1482
1800	72"	2340	2495.5	1307.5	1188.0	2376	1632
2000	78"	2600	2595.5	1357.5	1238.0	2476	1732
The fitting length (L) is always the same, regardless of the pressure rating.							

10.5 Dimensions Promag 53 P

Promag P / DN ≤ 300 (compact version)

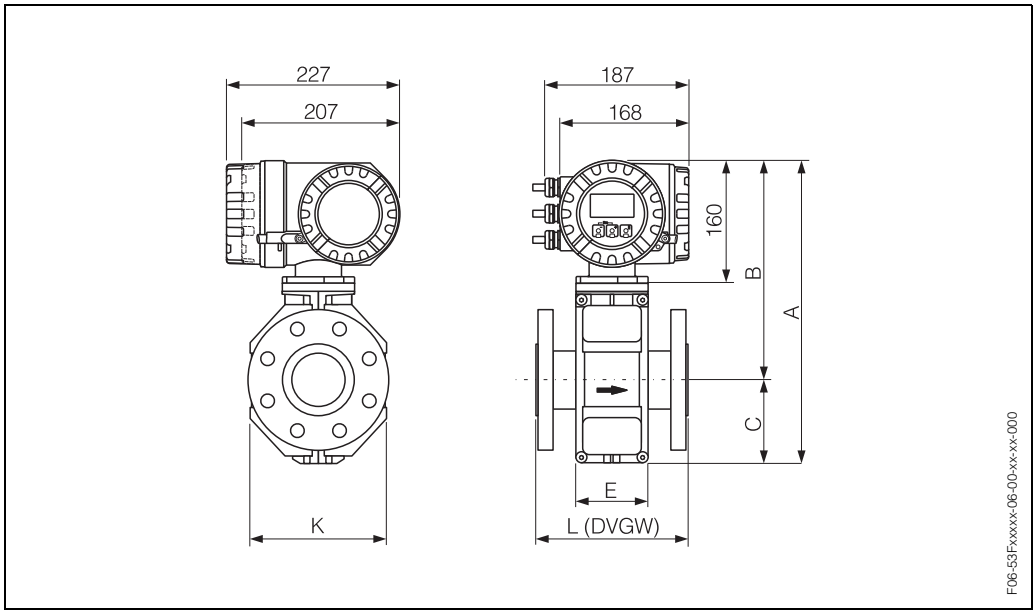


Fig. 65: Dimensions Promag P / DN ≤ 300 (compact version)

DN		L	A	B	C	K	E
DIN [mm]	ANSI [inch]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]
15	1/2"	200	341	257	84	120	94
25	1"	200	341	257	84	120	94
32	–	200	341	257	84	120	94
40	1 1/2"	200	341	257	84	120	94
50	2"	200	341	257	84	120	94
65	–	200	391	282	109	180	94
80	3"	200	391	282	109	180	94
100	4"	250	391	282	109	180	94
125	–	250	472	322	150	260	140
150	6"	300	472	322	150	260	140
200	8"	350	527	347	180	324	156
250	10"	450	577	372	205	400	156
300	12"	500	627	397	230	460	166
The fitting length (L) is always the same, regardless of the pressure rating.							

Promag P / DN ≤ 300 (remote version)

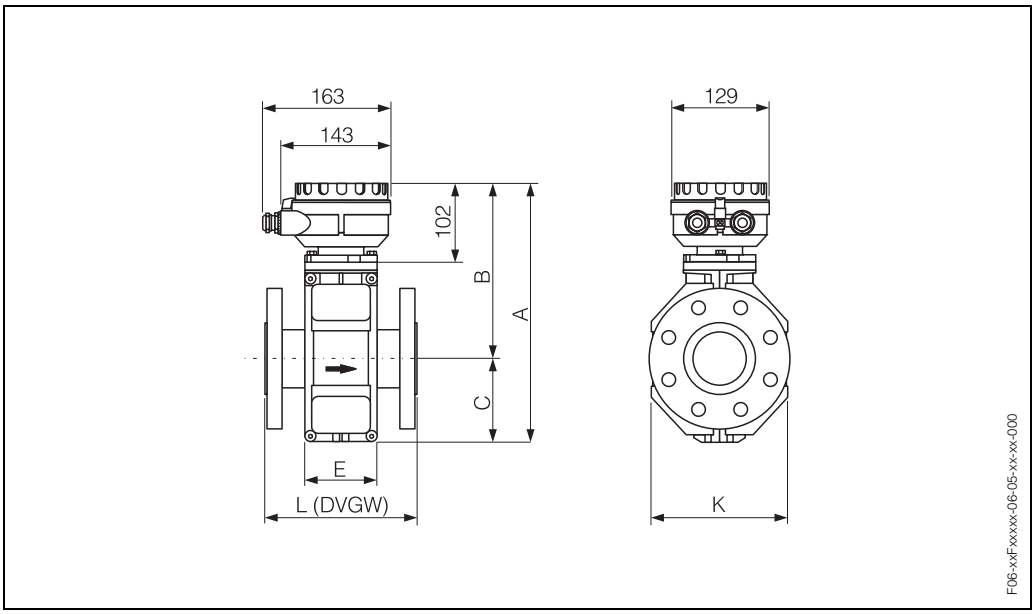


Fig. 66: Dimensions Promag P / DN ≤ 300 (remote version)
Dimensions of wall-mount housing → Page 129

DN		L	A	B	C	K	E
DIN [mm]	ANSI [inch]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]
15	1/2"	200	286	202	84	120	94
25	1"	200	286	202	84	120	94
32	–	200	286	202	84	120	94
40	1 1/2"	200	286	202	84	120	94
50	2"	200	286	202	84	120	94
65	–	200	336	227	109	180	94
80	3"	200	336	227	109	180	94
100	4"	250	336	227	109	180	94
125	–	250	417	267	150	260	140
150	6"	300	417	267	150	260	140
200	8"	350	472	292	180	324	156
250	10"	450	522	317	205	400	156
300	12"	500	572	342	230	460	166
The fitting length (L) is always the same, regardless of the pressure rating.							

Promag P / DN ≤ 300 / high-temperature version (compact version)

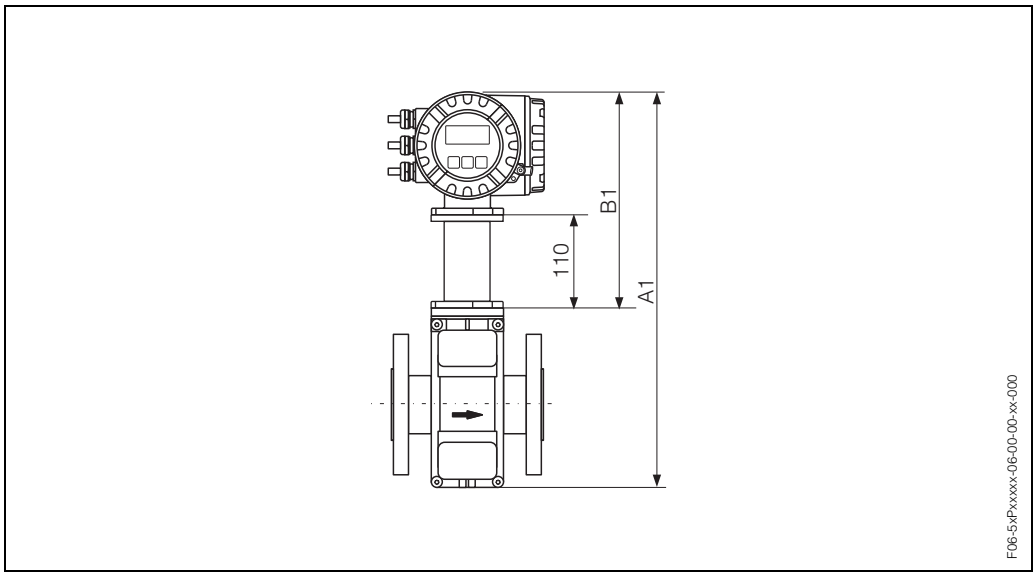


Fig. 67: Dimensions of high-temperature version (Promag P, DN ≤ 300, compact)
Dimensions A1, B1 = A, B of standard version plus 110 mm

Promag P / DN ≤ 300 / high-temperature version (remote version)

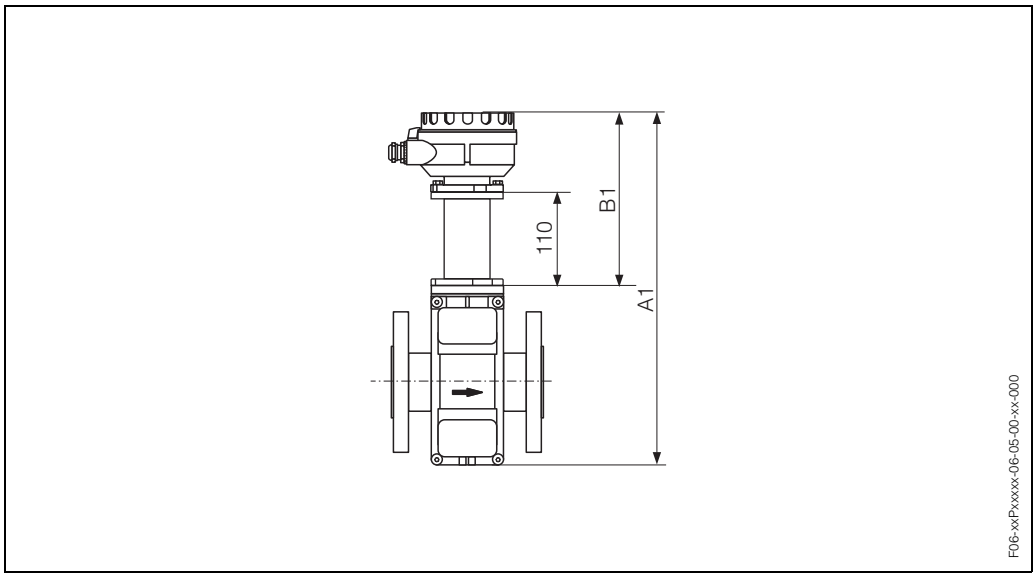


Fig. 68: Dimensions of high-temperature version (Promag P, DN ≤ 300, remote)
Dimensions A1, B1 = A, B of standard version plus 110 mm

Promag P / DN ≥ 350 (compact version)

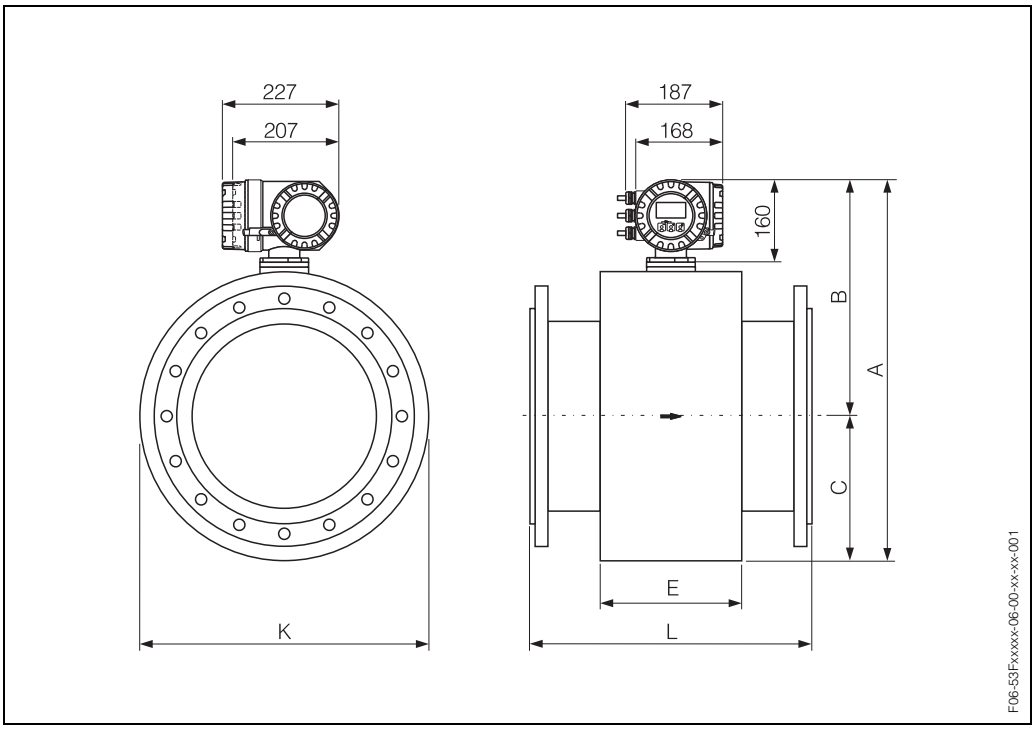


Fig. 69: Dimensions Promag P / DN ≥ 350 (compact version)

DN		L	A	B	C	K	E
DIN [mm]	ANSI [inch]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]
350	14"	550	738.5	456.5	282.0	564	276
400	16"	600	790.5	482.5	308.0	616	276
450	18"	650	840.5	507.5	333.0	666	292
500	20"	650	891.5	533.0	358.5	717	292
600	24"	780	995.5	585.0	410.5	821	402
The fitting length (L) is always the same, regardless of the pressure rating.							

Promag P / DN ≥ 350 (remote version)

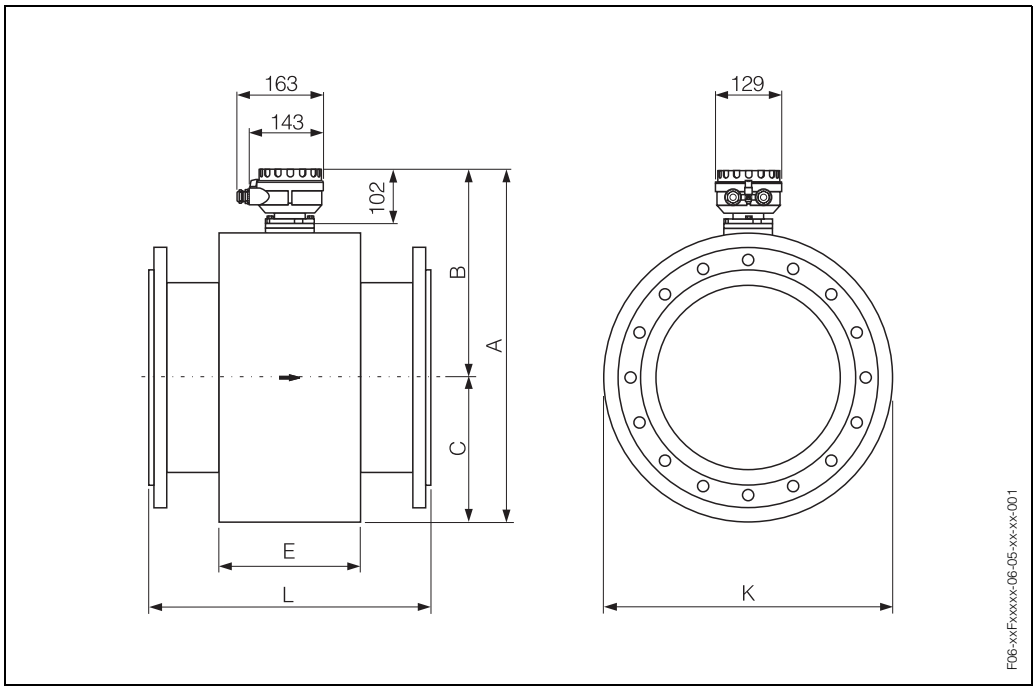


Fig. 70: Dimensions Promag P / DN ≥ 350 (remote version)
Dimensions of wall-mount housing → Page 129

DN		L	A	B	C	K	E
DIN [mm]	ANSI [inch]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]
350	14"	550	683.5	401.5	282.0	564	276
400	16"	600	735.5	427.5	308.0	616	276
450	18"	650	785.5	452.5	333.0	666	292
500	20"	650	836.5	478.0	358.5	717	292
600	24"	780	940.5	530.0	410.5	821	402
The fitting length (L) is always the same, regardless of the pressure rating.							

10.6 Dimensions of ground disks (Promag W, P)

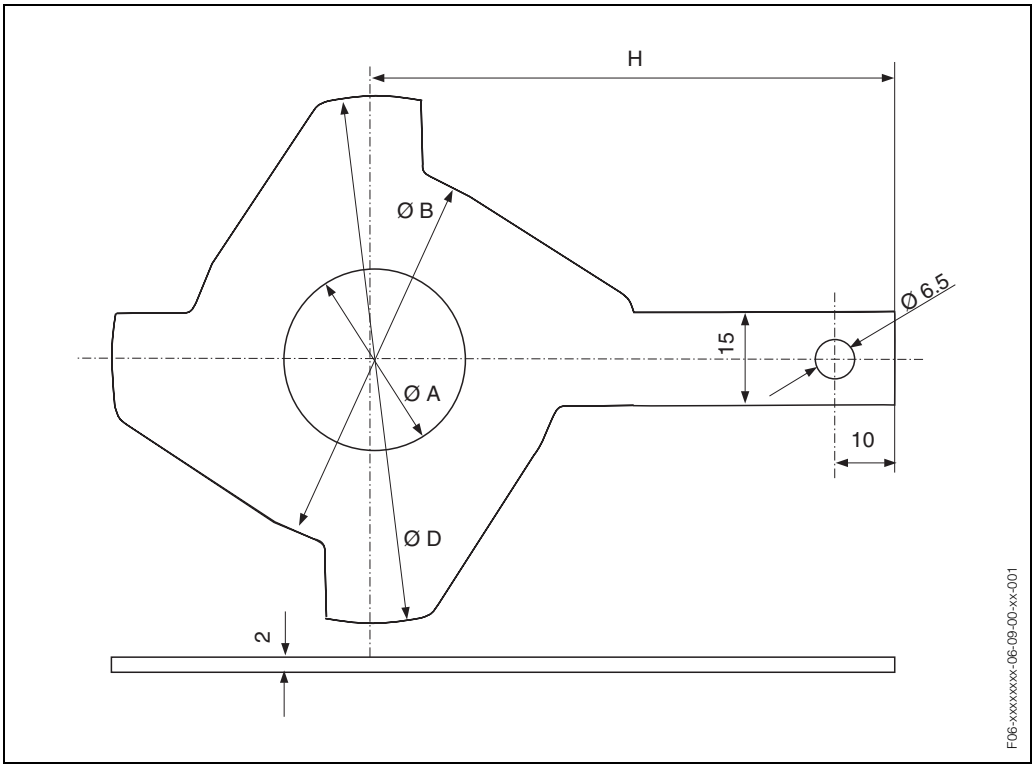


Fig. 71: Dimensions of ground disks (Promag W, P / DN 15…300)

DN [1]		A	B	D	H
DIN [mm]	ANSI [inch]	[mm]	[mm]	[mm]	[mm]
15	1/2"	19	43	61.5	73
25	1"	30	62	77.5	87.5
32	–	38.5	80	87.5	94.5
40	1 1/2"	44.5	82	101	103
50	2"	56.5	101	115.5	108
65	–	72.5	121	131.5	118
80	3"	85	131	154.5	135
100	4"	110	156	186.5	153
125	–	135	187	206.5	160
150	6"	163	217	256	184
200	8"	210.5	267	288	205
250	10"	265	328	359	240
300 [2]	12" [2]	317	375	413	273
300 [3]	12" [3]	317	375	404	268

[1] Ground disks can, with the exception of DN 300, be used for all flange norms / pressure ratings.
[2] PN 10/16, Class 150
[3] PN 25, JIS 10K/20K

10.7 Dimensions Promag 53 H

Promag H / DN 2…25 (compact version)

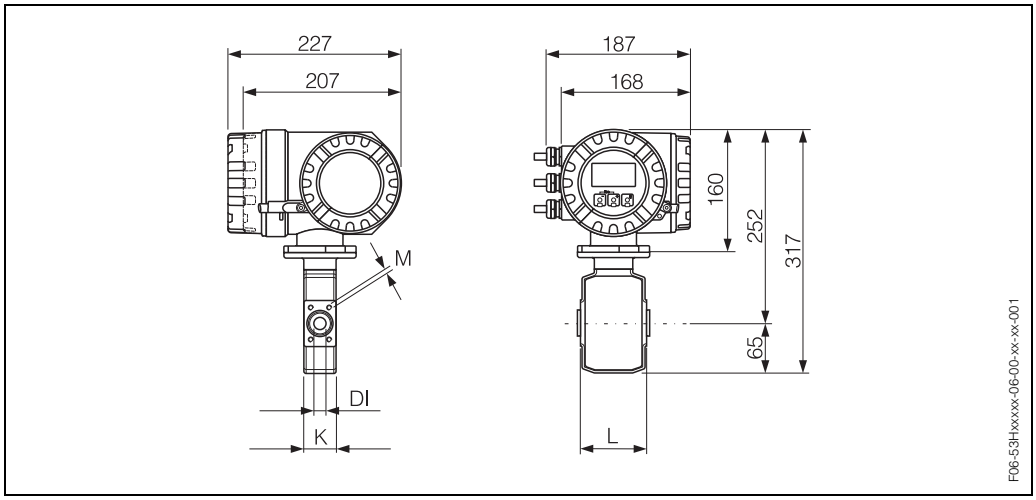


Fig. 72: Dimensions Promag H / DN 2…25 (compact version, aluminum field housing)

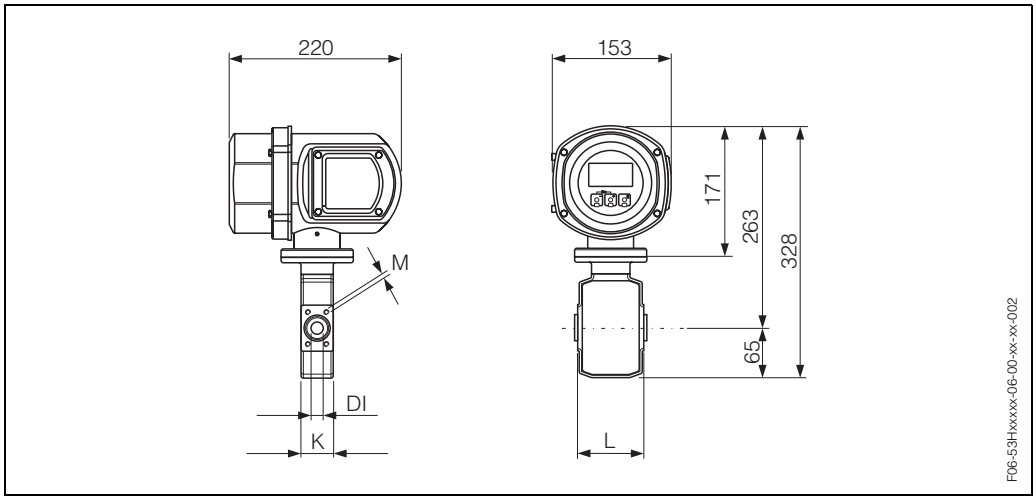


Fig. 73: Dimensions Promag H / DN 2…25 (compact version, stainless-steel field housing)

DN		PN **	DI	L	K	M
DIN [mm]	ANSI [inch]	DIN [bar]	[mm]	[mm]	[mm]	[mm]
2	–	16/40	2.25	86	43	M 6x4
4	–	16/40	4.5	86	43	M 6x4
8	–	16/40	9.0	86	43	M 6x4
15	–	16/40	16.0	86	43	M 6x4
–	1"	16/40	22.6	86	53	M 6x4
25	–	16/40	26.0	86	53	M 6x4

Overall fitting length will depend on the process connections → Page 144 ff.

** The permissible nominal pressure depends on the process connection and seal:
– 40 bar: flange, welded nipples (with O-ring seal)
– 16 bar: all other process connections

Promag H / DN 2…25 (remote version)

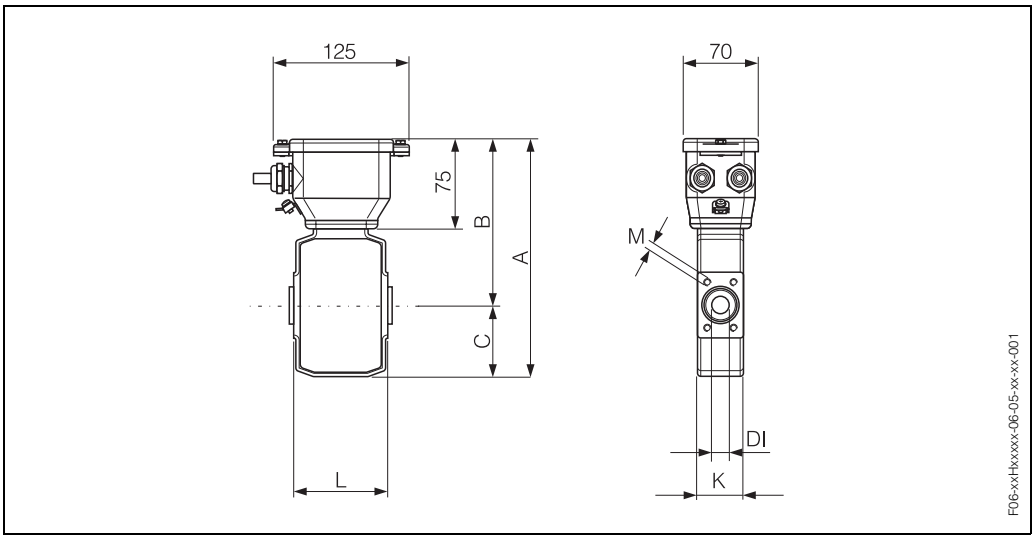


Fig. 74: Dimensions Promag H / DN 2…25 (remote version)
Dimensions of wall-mount housing → Page 129

DN		PN *	DI	L	A	B	C	K	M
DIN [mm]	ANSI [inch]	DIN [bar]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]
2	–	16/40	2.25	86	213	148	65	43	M 6x4
4	–	16/40	4.5	86	213	148	65	43	M 6x4
8	–	16/40	9.0	86	213	148	65	43	M 6x4
15	–	16/40	16.0	86	213	148	65	43	M 6x4
–	1"	16/40	22.6	86	213	148	65	53	M 6x4
26	–	16/40	26.0	86	213	148	65	53	M 6x4

Overall fitting length will depend on the process connections → Page 144 ff.

* The permissible nominal pressure depends on the process connection and seal:
– 40 bar: flange, welded nipples (with O-ring seal)
– 16 bar: all other process connections

Wall mounting set for Promag H / DN 2…25

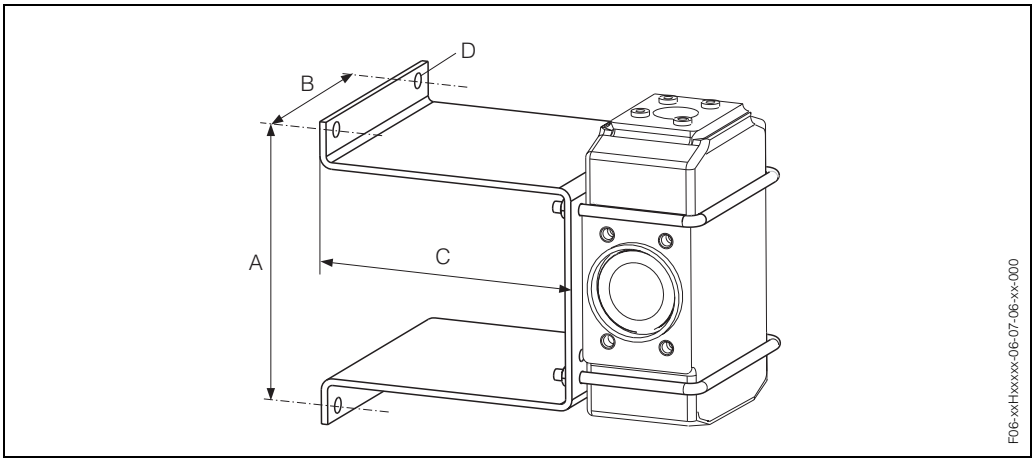


Fig. 75: Wall mounting set for Promag H / DN 2…25
A = 125 mm, B = 88 mm, C = 120 mm, D = Ø 7 mm

Promag H / DN 40…100 (compact version)

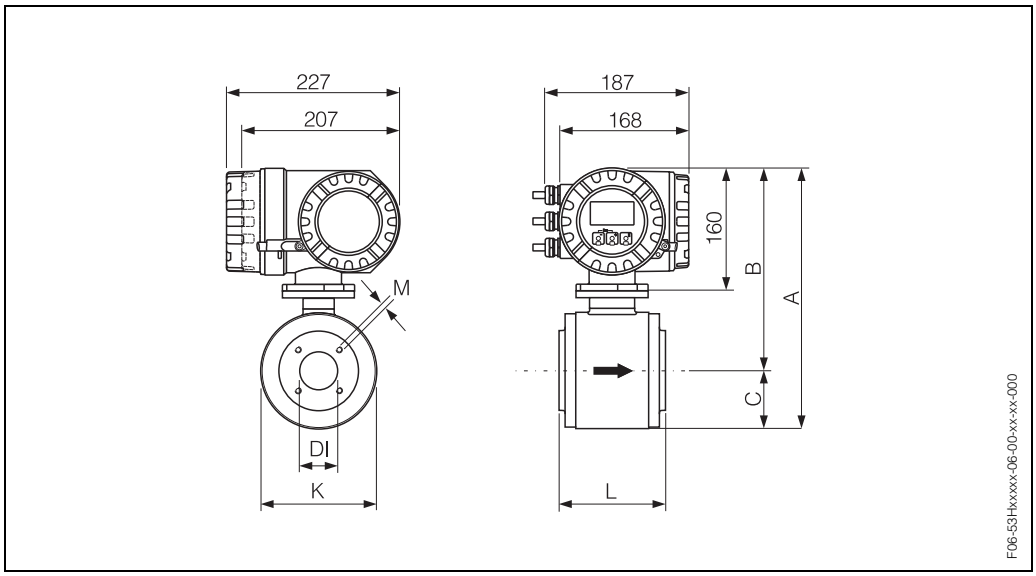


Fig. 76: Dimensions Promag H / DN 40…100 (compact version, aluminum field housing)

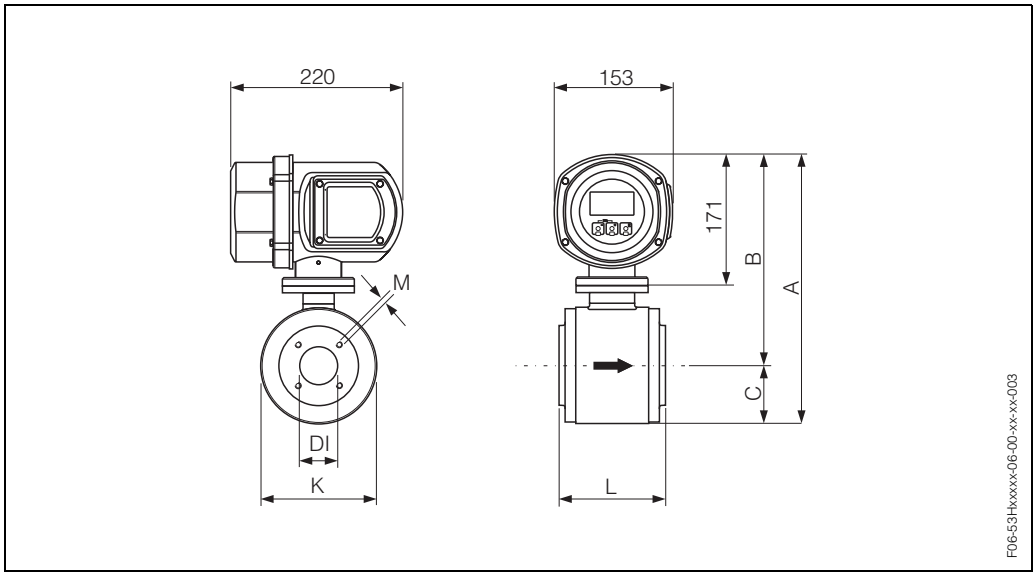


Fig. 77: Dimensions Promag H / DN 40…100 (compact version, stainless-steel field housing)

DN		PN	DI	L	A *	B *	C	K	M
DIN [mm]	ANSI [inch]	DIN [bar]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]
40	1 1/2"	16	35.3	140	319 (330)	255 (266)	64	128	M 6x4
50	2"	16	48.1	140	344 (355)	267 (278)	77	153	M 8x4
65	2 1/2"	16	59.9	140	344 (355)	267 (278)	77	153	M 8x4
80	3"	16	72.6	200	394 (405)	292 (303)	102	203	M 12x4
100	4"	16	97.5	200	394 (405)	292 (303)	102	203	M 12x4

Overall fitting length will depend on the process connections → Page 152 ff.
* () = Dimensions stainless steel field housing

Promag H / DN 40…100 (remote version)

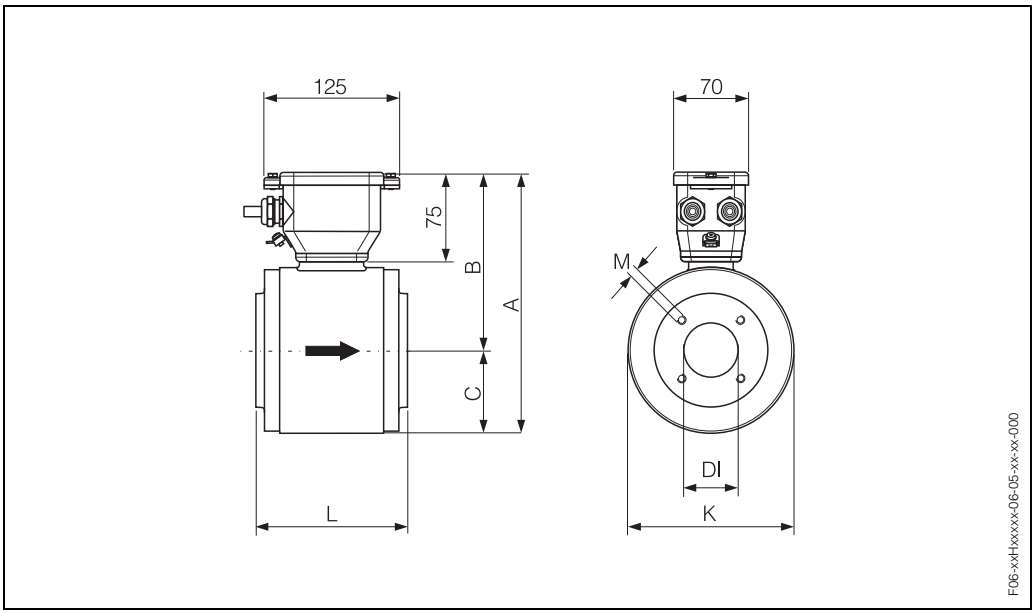


Fig. 78: Dimensions Promag H / DN 40…100 (remote version)
Dimensions of wall-mount housing → Page 129

DN		PN	DI	L	A	B	C	K	M
DIN [mm]	ANSI [inch]	DIN [bar]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]
40	1 1/2"	16	35.3	140	216	151.5	64.5	129	M 6x4
50	2"	16	48.1	140	241	164.0	77.0	154	M 8x4
65	2 1/2"	16	59.9	140	241	164.0	77.0	154	M 8x4
80	3"	16	72.6	200	290	188.5	101.5	203	M 12x4
100	4"	16	97.5	200	290	188.5	101.5	203	M 12x4
Fitting length depends on process connections → Page 152 ff.									

10.8 Process connections Promag H (DN 2…25)

Front view of sensor Promag H / DN 2…25 (without process connections)

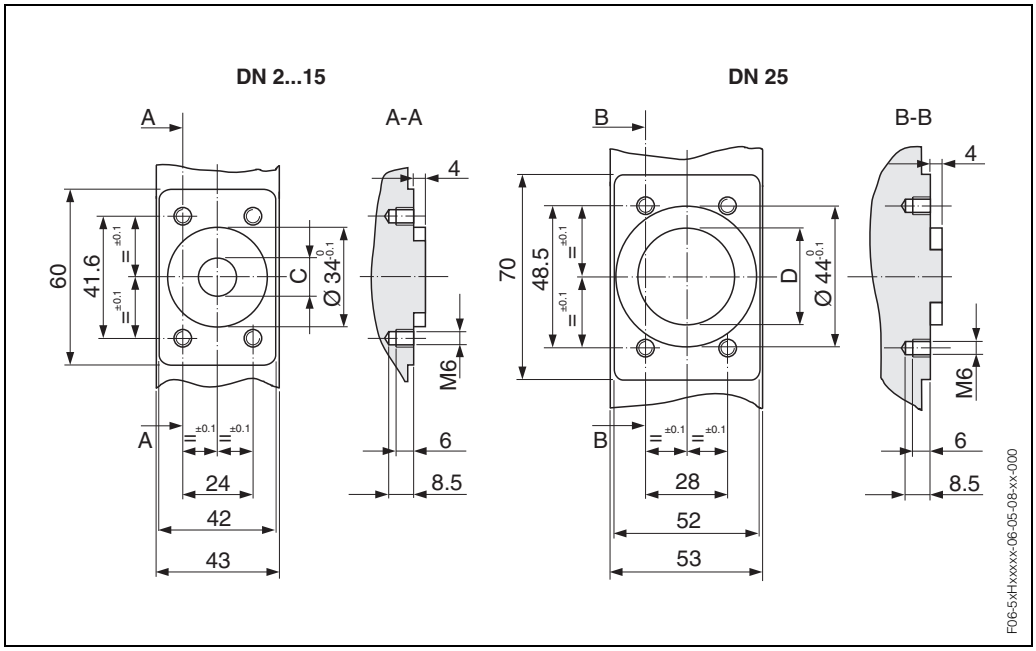
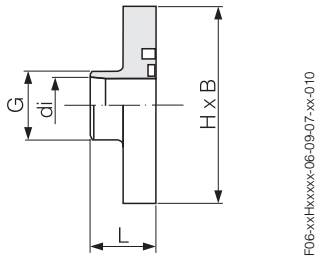
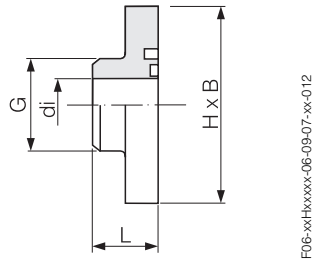


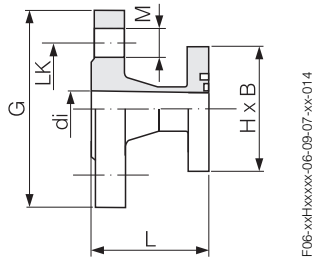
Fig. 79: Dimensions front view of sensor DN 2…25

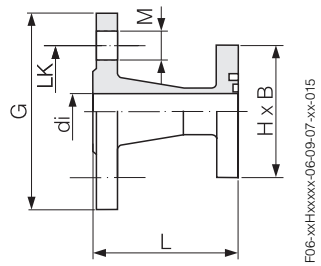
DN	C [mm]	D (DIN) [mm]	D (ANSI) [mm]
2…8	9	–	–
15	16	–	–
25	–	26	22.6

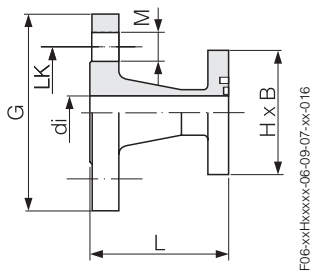
Process connections with O-ring seals (DN 2…25)

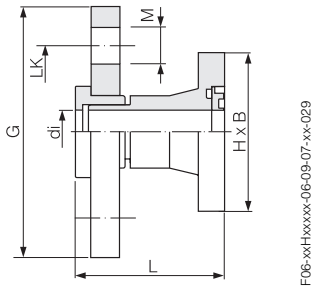
Weld nipples for ISO 2463 pipe 1.4404 / 316L 5*H**-B**********	**Sensor** DN [mm]	**Pipe** Tube	**di** [mm]	**G** [mm]	**L** [mm]	**H x B** [mm]
	2…8	13.5 x 1.6	10.3	13.5	20.3	60 x 42
	15	21.3 x 1.6	18.1	21.3	20.3	60 x 42
	25 (DIN)	33.7 x 2	29.7	33.7	20.3	70 x 52
	Fitting length = (2 x L) + 86 mm					

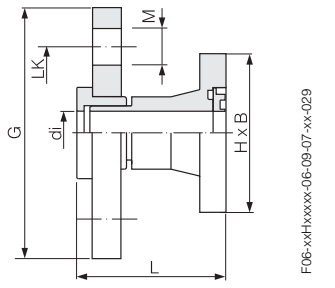
Weld nipples for IPS pipe 1.4404 / 316L 5*H**-C**********	**Sensor** DN [mm]	**Pipe** Tube (ODT / SMS)	**di** [mm]	**G** [mm]	**L** [mm]	**H x B** [mm]
	2…8	13.5 x 2.3	9.0	13.5	20.3	60 x 42
	15	21.3 x 2.65	16.0	21.3	20.3	60 x 42
	1" (25 ANSI)	33.7 x 3.25	27.2	33.7	22.3	70 x 52
	Fitting length = (2 x L) + 86 mm					

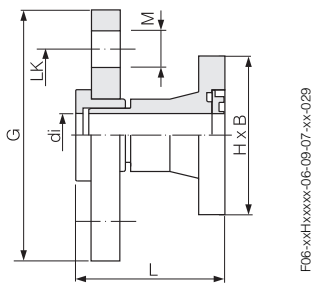
Flange PN 40 / DIN 2635 1.4404 / 316L 5*H**-D**********	**Sensor** DN [mm]	**Pipe** Flange	**di** [mm]	**G** [mm]	**L** [mm]	**LK** [mm]	**M** [mm]	**H x B** [mm]
	2…8	DN 10	13.6	90	56.2	60	14	60 x 42
	15	DN 15	17.3	95	56.2	65	14	60 x 42
	25 (DIN)	DN 25	28.5	115	56.2	85	14	70 x 52
	Fitting length = (2 x L) + 86 mm Fitting length to DVGW (200 mm)							

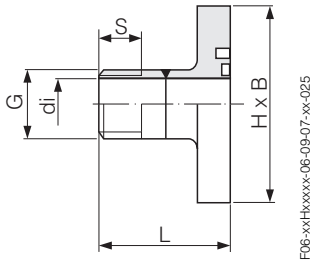
Flange Cl 150 / ANSI 16.5 1.4404 / 316L 5*H**-E**********	**Sensor** DN [mm]	**Pipe** Flange [inch]	**di** [mm]	**G** [mm]	**L** [mm]	**LK** [mm]	**M** [mm]	**H x B** [mm]
	2…8	1/2"	15.7	89	66.0	60.5	15.7	60 x 42
	15	1/2"	16.0	89	66.0	60.5	15.7	60 x 42
	1" (25 ANSI)	1"	26.7	108	71.8	79.2	15.7	70 x 52
	Fitting length = (2 x L) + 86 mm							

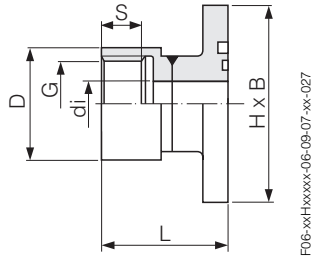
Flange 20 K / JIS B2238 1.4404 / 316L 5*H**-F**********	**Sensor** DN [mm]	**Pipe** Flange	**di** [mm]	**G** [mm]	**L** [mm]	**LK** [mm]	**M** [mm]	**H x B** [mm]
	2…8	ND 10	10	90	67	65	15	60 x 42
	15	ND 15	16	95	67	70	15	60 x 42
	25 (DIN)	ND 25	26	125	67	95	19	70 x 52
	Fitting length = (2 x L) + 86 mm							

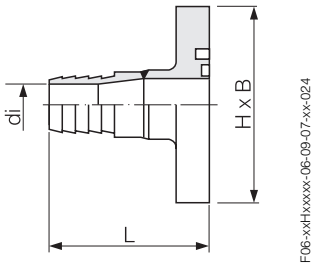
Flange PN 16 / DIN 2501 PVDF 5*H**-G**********	**Sensor** DN [mm]	**Pipe** Flange	**di** [mm]	**G** [mm]	**L** [mm]	**M** [mm]	**LK** [mm]	**H x B** [mm]
	2…8	DN 15	15.7	95	57	14	65	60 x 42
	15	DN 15	15.7	95	57	14	65	60 x 42
	25 (DIN)	DN 25	27.3	115	57	14	85	70 x 52
	– Fitting length = (2 x L) + 86 mm – Fitting length to DVGW (200 mm) – The requisite ground rings can be ordered as accessories (Order No. DK5HR-****)							

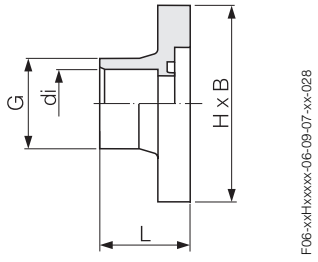
Flange Cl 150 / ANSI 16.5 PVDF 5*H**-H**********	**Sensor** DN [mm]	**Pipe** Flange [inch]	**di** [mm]	**G** [mm]	**L** [mm]	**M** [mm]	**LK** [mm]	**H x B** [mm]
	2…8	1/2"	15.7	95	57	16	60	60 x 42
	15	1/2"	15.7	95	57	16	60	60 x 42
	1" (25 ANSI)	1"	27.3	115	57	16	79	70 x 52
	– Fitting length = (2 x L) + 86 mm – The requisite ground rings can be ordered as accessories (Order No. DK5HR-****)							

Flange 10 K / JIS B2238 PVDF 5*H**-J**********	**Sensor** DN [mm]	**Pipe** Flange	**di** [mm]	**G** [mm]	**L** [mm]	**M** [mm]	**LK** [mm]	**H x B** [mm]
	2…8	ND 15	15.7	95	57	15	70	60 x 42
	15	ND 15	15.7	95	57	15	70	60 x 42
	25 (DIN)	ND 25	27.3	125	57	19	90	70 x 52
	– Fitting length = (2 x L) + 86 mm – The requisite ground rings can be ordered as accessories (Order No. DK5HR-****)							

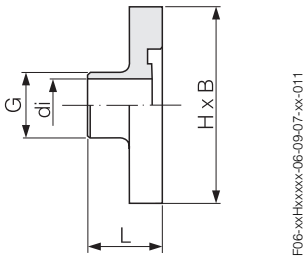
External pipe thread ISO 228 / DIN 2999, 1.4404 / 316L 5*H**-K**********	**Sensor** DN [mm]	**Pipe** Internal thread [inch]	**di** [mm]	**G** [inch]	**L** [mm]	**S** [mm]	**H x B** [mm]
	2…8	R 3/8"	10	3/8"	40	10.1	60 x 42
	15	R 1/2"	16	1/2"	40	13.2	60 x 42
	1" (25 ANSI)	R 1"	25	1"	40	16.5	70 x 52
	Fitting length = (2 x L) + 86 mm						

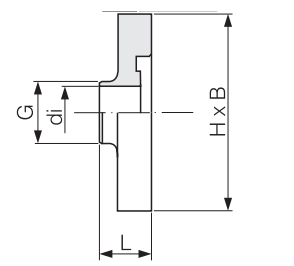
Internal pipe thread ISO 228 / DIN 2999, 1.4404 / 316L 5*H**-L**********	**Sensor** DN [mm]	**Pipe** External thread [inch]	**di** [mm]	**G** [inch]	**D** [mm]	**L** [mm]	**S** [mm]	**H x B** [mm]
	2…8	Rp 3/8"	8.9	3/8"	22	45	13	60 x 42
	15	Rp 1/2"	16.0	1/2"	27	45	14	60 x 42
	1" (25 ANSI)	Rp 1"	27.2	1"	40	49	17	70 x 52
	Fitting length = (2 x L) + 86 mm							

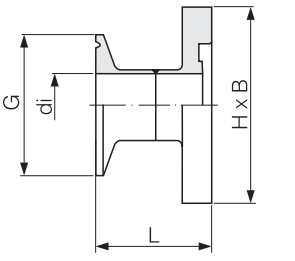
Hose connection 1.4404 / 316L 5*H**-M/N/P**********	**Sensor** DN [mm]	**Hose** Inside diameter [mm]	**di** [mm]	**LW** [mm]	**L** [mm]	**H x B** [mm]
	2…8	13	10.0	13	49	60 x 42
	15	16	12.6	16	49	60 x 42
	15	19	16.0	19	49	70 x 52
	Fitting length = (2 x L) + 86 mm					

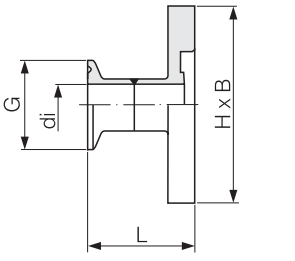
Adhesive fitting PVC 5*H**-R/S**********	**Sensor** DN [mm]	**Pipe** Glued joint [inch]	**di** [mm]	**G** [mm]	**L** [mm]	**H x B** [mm]
	2…8	1/2"	21.5	27.3	28.0	60 x 42
	15	20 x 2	20.2	27.0	38.5	60 x 42
	– Fitting length = (2 x L) + 86 mm – The requisite ground rings can be ordered as accessories (Order No. DK5HR-****)					

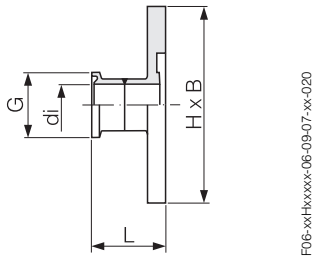
Process connections with aseptic gasket seal (DN 2…25)

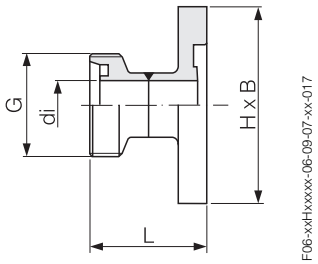
Weld nipple for DIN 11850 pipe 1.4404 / 316L 5*H**-U**********	**Sensor** DN [mm]	**Pipe** Tube	**di** [mm]	**G** [mm]	**L** [mm]	**H x B** [mm]
	2…8	14 x 2	10	14	23.3	60 x 42
	15	20 x 2	16	20	23.3	60 x 42
	25 (DIN)	30 x 2	26	30	23.3	70 x 52
	– Fitting length = (2 x L) + 86 mm – If pigs are used for cleaning, it is essential to take the inside diameters of measuring tube (Page 140) and process connection (di) into account.					

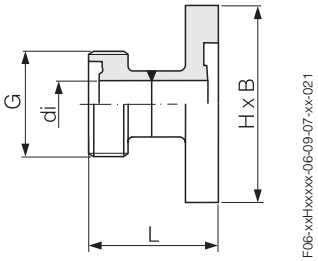
Weld nipples for ODT/SMS pipe 1.4404 / 316L 5*H**-V**********	**Sensor** DN [mm]	**Pipe** Tube	**di** [mm]	**G** [mm]	**L** [mm]	**H x B** [mm]
	2…8	12.7 x 1.65	9.4	12.7	16.1	60 x 42
	15	19.1 x 1.65	15.8	19.1	16.1	60 x 42
	1" (25 ANSI)	24.5 x 1.65	22.1	25.4	16.1	70 x 52
	– Fitting length = (2 x L) + 86 mm – If pigs are used for cleaning, it is essential to take the inside diameters of measuring tube (Page 140) and process connection (di) into account.					

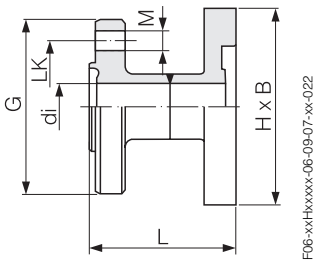
Clamp ISO 2852 1.4404 / 316L 5*H**-W**********	**Sensor** DN [inch]	**Pipe** Clamp	**di** [mm]	**G** [mm]	**L** [mm]	**H x B** [mm]
	1" (25 ANSI)	Tube 25.4 x 1.65 (ISO; 1")	22.6	50.5	44.5	70 x 52
	– Fitting length = (2 x L) + 86 mm – If pigs are used for cleaning, it is essential to take the inside diameters of measuring tube (Page 140) and process connection (di) into account.					

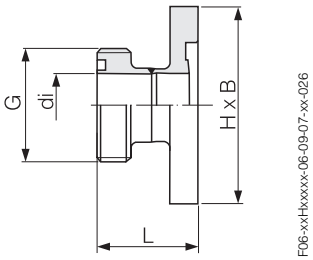
Clamp DIN 32676 1.4404 / 316L 5*H**-0**********	**Sensor** DN [mm]	**Pipe** Clamp	**di** [mm]	**G** [mm]	**L** [mm]	**H x B** [mm]
	2…8	Tube 14 x 2 (DIN 11850; DN 10)	10	34.0	41.0	60 x 42
	15	Tube 20 x 2 (DIN 11850; DN 15)	16	34.0	41.0	60 x 42
	25 (DIN)	Tube 30 x 2 (DIN 11850; DN 25)	26	50.5	44.5	70 x 52
	– Fitting length = (2 x L) + 86 mm – If pigs are used for cleaning, it is essential to take the inside diameters of measuring tube (Page 140) and process connection (di) into account.					

Tri-clamp **1.4404 / 316L** 5*H**-1**********	**Sensor** DN [mm]	**Pipe** Tri-Clamp	**di** [mm]	**G** [mm]	**L** [mm]	**H x B** [mm]
	2…8	Tube 12.7 x 1.65 (ODT 1/2")	9.4	25.0	28.5	60 x 42
	15	Tube 19.1 x 1.65 (ODT 3/4")	15.8	25.0	28.5	60 x 42
	1" (25 ANSI)	Tube 24.5 x 1.65 (ODT 1")	22.1	50.4	28.5	70 x 52
	– Fitting length = (2 x L) + 86 mm – If pigs are used for cleaning, it is essential to take the inside diameters of measuring tube (Page 140) and process connection (di) into account.					

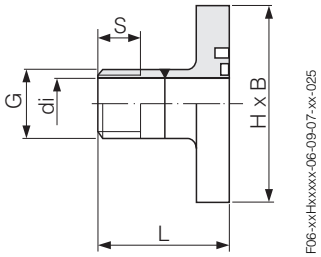
Coupling DIN 11851 **1.4404 / 316L** 5*H**-2**********	**Sensor** DN [mm]	**Pipe** Coupling	**di** [mm]	**G** [mm]	**L** [mm]	**H x B** [mm]
	2…8	Tube 12 x 1 (DN 10)	10	Rd 28 x 1/8"	44	60 x 42
	15	Tube 18 x 1 or 1.5 (DN 15)	16	Rd 34 x 1/8"	44	60 x 42
	25 (DIN)	Tube 28 x 1 or 1.5 (DN 25)	26	Rd 52 x 1/6"	52	70 x 52
	– Fitting length = (2 x L) + 86 mm – If pigs are used for cleaning, it is essential to take the inside diameters of measuring tube (Page 140) and process connection (di) into account.					

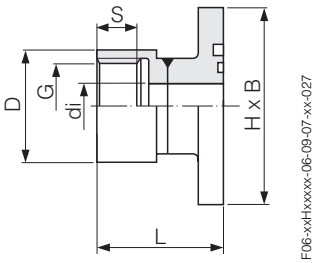
Coupling DIN 11864-1 **1.4404 / 316L** 5*H**-3**********	**Sensor** DN [mm]	**Pipe** Coupling	**di** [mm]	**G** [mm]	**L** [mm]	**H x B** [mm]
	2…8	Tube 13 x 1.5 (DIN 11850; DN 10)	10	Rd 28 x 1/8"	42	60 x 42
	15	Tune 19 x 1.5 (DIN 11850; DN 15)	16	Rd 34 x 1/8"	42	60 x 42
	25 (DIN)	Tube 29 x 1.5 (DIN 11850; DN 25)	26	Rd 52 x 1/6"	49	70 x 52
	– Fitting length = (2 x L) + 86 mm – If pigs are used for cleaning, it is essential to take the inside diameters of measuring tube (Page 140) and process connection (di) into account.					

Flange DIN 11864-2 Form A **1.4404 / 316L** 5*H**-4**********	**Sensor** DN [mm]	**Pipe** Flange	**di** [mm]	**G** [mm]	**L** [mm]	**LK** [mm]	**M** [mm]	**H x B** [mm]
	2…8	Tube 13 x 1.5 (DIN 11850; DN 10)	10	54	48.5	37	9	60 x 42
	15	Tube 19 x 1.5 (DIN 11850; DN 15)	16	59	48.5	42	9	60 x 42
	25 (DIN)	Tube 29 x 1.5 (DIN 11850; DN 25)	26	70	48.5	53	9	70 x 52
	– Fitting length = (2 x L) + 86 mm – If pigs are used for cleaning, it is essential to take the inside diameters of measuring tube (Page 140) and process connection (di) into account.							

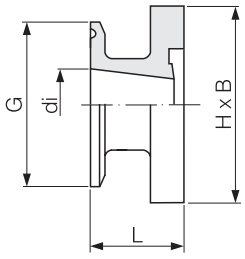
Coupling SMS 1145 **1.4404 / 316L** 5*H**-5**********	**Sensor** DN [mm]	**Pipe** Coupling [inch]	**di** [mm]	**G** [mm]	**L** [mm]	**H x B** [mm]
	1" (25 ANSI)	1"	22.1	Rd 40 x 1/6"	30.8	70 x 52
	– Fitting length = (2 x L) + 86 mm – If pigs are used for cleaning, it is essential to take the inside diameters of measuring tube (Page 140) and process connection (di) into account.					

Process connections orderable only as accessories (with O-ring seal, DN 2…25)

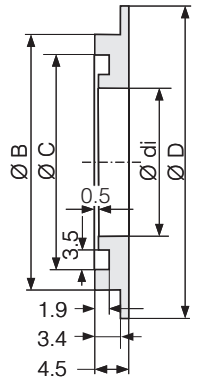
External pipe thread NPT **1.4404 / 316L** DKH**-GD**	**Sensor** DN [mm]	**Pipe** Internal thread [inch]	**di** [mm]	**G** [inch]	**L** [mm]	**S** [mm]	**H x B** [mm]
	2…8	NPT 3/8"	10	3/8"	50	15.5	60 x 42
	15	NPT 1/2"	16	1/2"	50	20.0	60 x 42
	1" (25 ANSI)	NPT 1"	25	1"	55	25.0	70 x 52
	Fitting length = (2 x L) + 86 mm						

Internal pipe thread NPT **1.4404 / 316L** DKH**-GC**	**Sensor** DN [mm]	**Pipe** External thread [inch]	**di** [mm]	**G** [inch]	**D** [mm]	**L** [mm]	**S** [mm]	**H x B** [mm]
	2…8	NPT 3/8"	8.9	3/8"	22	45	13	60 x 42
	15	NPT 1/2"	16.0	1/2"	27	45	14	60 x 42
	1" (25 ANSI)	NPT 1"	27.2	1"	40	49	17	70 x 52
	Fitting length = (2 x L) + 86 mm							

Process connections orderable only as accessories (with aseptic gasket seal)

Tri-Clamp 1.4404 / 316L DKH**-HF***	Sensor DN [mm]	Pipe Tri-Clamp	di [mm]	G [mm]	L [mm]	H x B [mm]
	15	Tube 25.4 x 1.5 (ODT; 1")	22.1	50.4	28.5	60 x 42
	– Fitting length = (2 x L) + 86 mm – If pigs are used for cleaning, it is essential to take the inside diameters of measuring tube (Page 140) and process connection (di) into account.					

Ground rings (accessories for PVDF flanges / PVC adhesive fitting)

Ground ring 1.4435/316L, Alloy C-22, titanium (Pt/Rh coated) DK5HR – ****	Sensor DN [mm]	di [mm]	D [mm]	B [mm]	C [mm]
	2…8	9.0	33.9	22.0	17.6
	15	16.0	33.9	29.0	24.6
	25 (DIN)	22.6	43.9	36.5	31.2
	1" (25 ANSI)	26.0	43.9	39.0	34.6

10.9 Process connections of Promag H (DN 40…100)

Front view of sensor Promag H / DN 40…100 (without process connection)

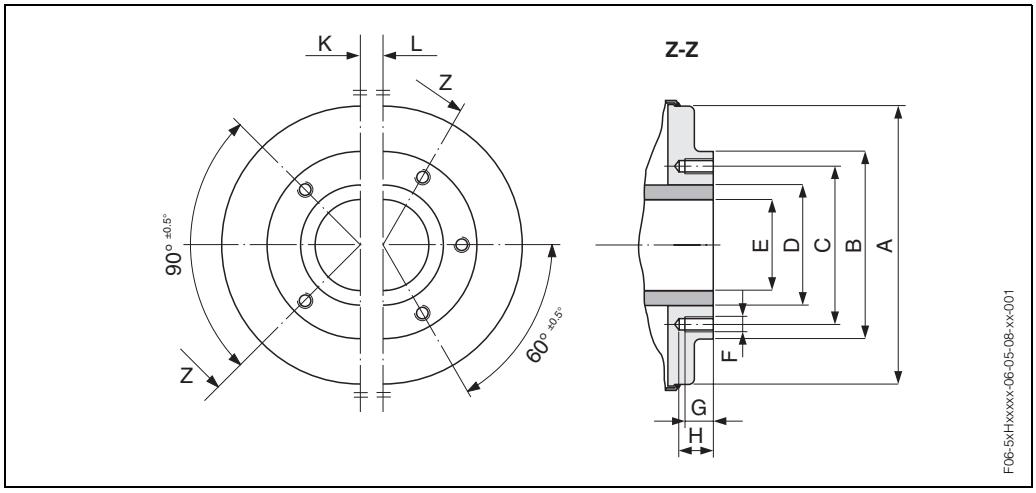
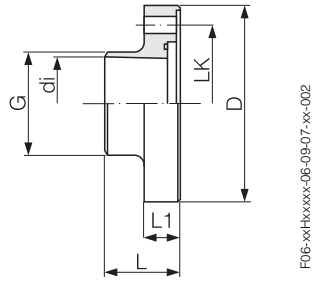
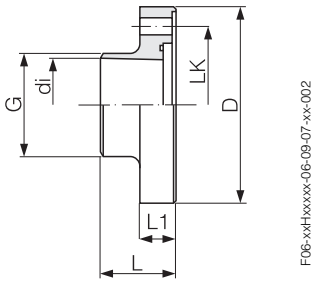


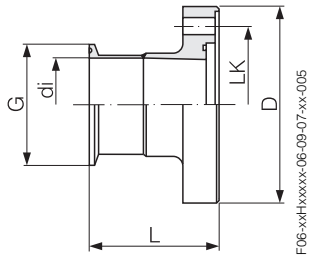
Fig. 80: Dimensions front view of sensor DN 40…100

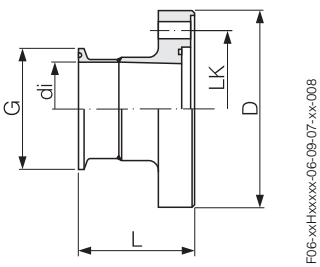
DN	A	B	C	D	E	F	G	H	L	K
[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	Threaded holes	
40	122.0	86	71.0	51.0	35.3	M 8	15	18	–	4
50	147.0	99	83.5	63.5	48.1	M 8	15	18	–	4
65	147.0	115	100.0	76.1	59.9	M 8	15	18	6	–
80	197.0	141	121.0	88.9	72.6	M 12	15	20	–	4
100	197.0	162	141.5	114.3	97.5	M 12	15	20	6	–

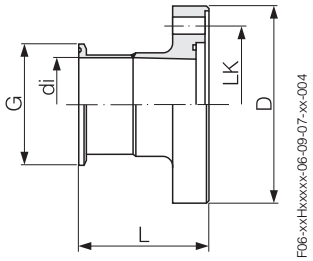
Process connections with gasket seal (DN 40…100)

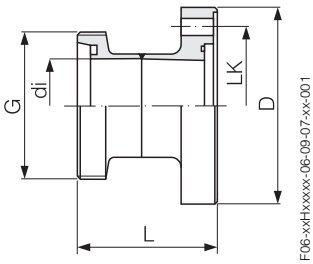
Weld nipples for DIN 11850 pipe 1.4404 / 316L 5*H**-U**********	**DN** [mm]	**di** [mm]	**G** [mm]	**D** [mm]	**L** [mm]	**L1** [mm]	**LK** [mm]
	40	38.0	43	92	42	19	71.0
	50	50.0	55	105	42	19	83.5
	65	66.0	72	121	42	21	100.0
	80	81.0	87	147	42	24	121.0
	100	100.0	106	168	42	24	141.5
	– Fitting length = (2 x L) + 140 mm (DN 40…65) / + 200 mm (DN 80…100) – If pigs are used for cleaning, it is essential to take the inside diameters of measuring tube (Page 142) and process connection (di) into account.						

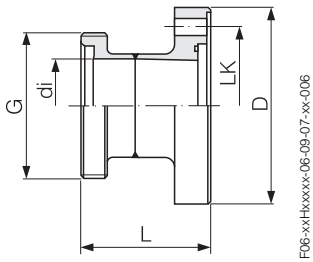
Weld nipples for ODT pipe 1.4404 / 316L 5*H**-V**********	**DN** [mm]	**di** [mm]	**G** [mm]	**D** [mm]	**L** [mm]	**L1** [mm]	**LK** [mm]
	40	35.3	40	92	42	19	71.0
	50	48.1	55	105	42	19	83.5
	65	59.9	66	121	42	21	100.0
	80	72.6	79	147	42	24	121.0
	100	97.5	104	168	42	24	141.5
	– Fitting length = (2 x L) + 140 mm (DN 40…65) / + 200 mm (DN 80…100) – If pigs are used for cleaning, it is essential to take the inside diameters of measuring tube (Page 142) and process connection (di) into account.						

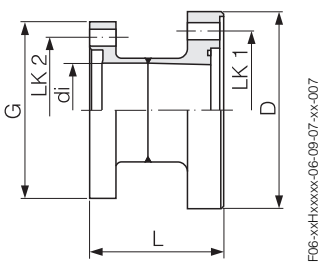
Clamp ISO 2852 1.4404 / 316L 5*H**-W**********	**DN** [mm]	**di** [mm]	**G** [mm]	**D** [mm]	**L** [mm]	**LK** [mm]
	40	35.6	50.5	92	68.5	71.0
	50	48.6	64.0	105	68.5	83.5
	65	60.3	77.5	121	68.5	100.0
	80	72.9	91.0	147	68.5	121.0
	100	97.6	119.0	168	68.5	141.5
	– Fitting length = (2 x L) + 140 mm (DN 40…65) / + 200 mm (DN 80…100) – If pigs are used for cleaning, it is essential to take the inside diameters of measuring tube (Page 142) and process connection (di) into account.					

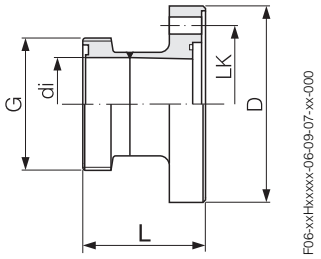
Clamp DIN 32676 1.4404 / 316L 5*H**-0**********	**DN** [mm]	**di** [mm]	**G** [mm]	**D** [mm]	**L** [mm]	**LK** [mm]
	40	38	50.5	92	61.5	71.0
	50	50	64.0	105	61.5	83.5
	65	66	91.0	121	68.0	100.0
	80	81	106.0	147	68.0	121.0
	100	100	119.0	168	68.0	141.5
	– Fitting length = (2 x L) + 140 mm (DN 40…65) / + 200 mm (DN 80…100) – If pigs are used for cleaning, it is essential to take the inside diameters of measuring tube (Page 142) and process connection (di) into account.					

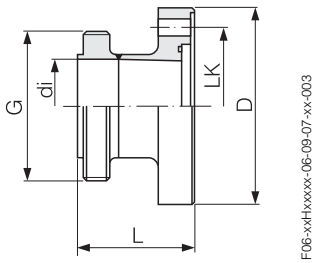
Tri-Clamp **1.4404 / 316L** 5*H**-1**********	**DN**		**di**	**G**	**D**	**L**	**LK**
	[mm]	[inch]	[mm]	[mm]	[mm]	[mm]	[mm]
	40	1 1/2"	34.8	50.4	92	68.6	71.0
	50	2"	47.5	63.9	105	68.6	83.5
	65	–	60.2	77.4	121	68.6	100.0
	80	3"	72.9	90.9	147	68.6	121.0
	100	4"	97.4	118.9	168	68.6	141.5
	– Fitting length = (2 x L) + 140 mm (DN 40…65) / + 200 mm (DN 80…100) – If pigs are used for cleaning, it is essential to take the inside diameters of measuring tube (Page 142) and process connection (di) into account.						

Coupling DIN 11851 **1.4404 / 316L** 5*H**-2**********	**DN** [mm]	**di** [mm]	**G** [mm]	**D** [mm]	**L** [mm]	**LK** [mm]
	40	38	Rd 65 x 1/6"	92	72	71.0
	50	50	Rd 78 x 1/6"	105	74	83.5
	65	66	Rd 95 x 1/6"	121	78	100.0
	80	81	Rd 110 x 1/4"	147	83	121.0
	100	100	Rd 130 x 1/4"	168	92	141.5
	– Fitting length = (2 x L) + 140 mm (DN 40…65) / + 200 mm (DN 80…100) – If pigs are used for cleaning, it is essential to take the inside diameters of measuring tube (Page 142) and process connection (di) into account.					

Coupling DIN 11864-1 Form A **1.4404 / 316L** 5*H**-3**********	**DN** [mm]	**di** [mm]	**G** [mm]	**D** [mm]	**L** [mm]	**LK** [mm]
	40	38	Rd 65 x 1/6"	92	71	71.0
	50	50	Rd 78 x 1/6"	105	71	83.5
	65	66	Rd 95 x 1/6"	121	76	100.0
	80	81	Rd 110 x 1/4"	147	82	121.0
	100	100	Rd 130 x 1/4"	168	90	141.5
	– Fitting length = (2 x L) + 140 mm (DN 40…65) / + 200 mm (DN 80…100) – If pigs are used for cleaning, it is essential to take the inside diameters of measuring tube (Page 142) and process connection (di) into account.					

Flange DIN 11864-2 Form A **1.4404/316L** 5*H**-4**********	**DN** [mm]	**di** [mm]	**G** [mm]	**D** [mm]	**L** [mm]	**LK1** [mm]	**LK2** [mm]
	40	38	82	92	64	71.0	65
	50	50	94	105	64	83.5	77
	65	66	113	121	64	100.0	95
	80	81	133	147	98	121.0	112
	100	100	159	168	98	141.5	137
	– Fitting length = (2 x L) + 140 mm (DN 40…65) / + 200 mm (DN 80…100) – If pigs are used for cleaning, it is essential to take the inside diameters of measuring tube (Page 142) and process connection (di) into account.						

Coupling SMS 1145 **1.4404 / 316L** 5*H**-5**********	**DN** [mm]	**di** [mm]	**G** [mm]	**D** [mm]	**L** [mm]	**LK** [mm]
	40	35.5	Rd 60 x 1/6"	92	63	71.0
	50	48.5	Rd 70 x 1/6"	105	65	83.5
	65	60.5	Rd 85 x 1/6"	121	70	100.0
	80	72.0	Rd 98 x 1/6"	147	75	121.0
	100	97.6	Rd 132 x 1/6"	168	70	141.5
	– Fitting length = (2 x L) + 140 mm (DN 40…65) / + 200 mm (DN 80…100) – If pigs are used for cleaning, it is essential to take the inside diameters of measuring tube (Page 142) and process connection (di) into account.					

Coupling ISO 2853 **1.4404 / 316L** 5*H**-6**********	**DN** [mm]	**di** [mm]	**G** [mm]	**D** [mm]	**L** [mm]	**LK** [mm]
	40	35.6	50.6	92	61.5	71.0
	50	48.6	64.1	105	61.5	83.5
	65	60.3	77.6	121	61.5	100.0
	80	72.9	91.1	147	61.5	121.0
	100	97.6	118.1	168	61.5	141.5
	– Fitting length = (2 x L) + 140 mm (DN 40…65) / + 200 mm (DN 80…100) – If pigs are used for cleaning, it is essential to take the inside diameters of measuring tube (Page 142) and process connection (di) into account.					

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Dear customer,
Because of legal determinations and for the safety of our employes and operating equipment we need this "Declaration of contamination" with your signature before your order can be handled. Please put the completely filled in declaration to the instrument and to the shipping documents in any case. Add also safety sheets and/or specific handling instructions if necessary.

type of instrument / sensor: _____ serial number: _____

medium / concentration: _____ temperature: _____ pressure: _____

cleaned with: _____ conductivity: _____ viscosity: _____

Warning hints for medium used:

☐ radioactive ☐ explosive ☐ caustic ☐ poisonous ☐ harmful of health ☐ biological hazardous ☐ inflammable ☐ safe

Please mark the appropriate warning hints.

Reason for return:

_____

_____

Company data:

company: _____ contact person: _____

_____ _____

_____ department: _____

address: _____ phone number: _____

_____ Fax/E-Mail: _____

_____ your order no.: _____

I hereby certify that the returned equipment has been cleaned and decontaminated acc. to good industrial practices and is in compliance with all regulations. This equipment poses no health or safety risks due to contamination.

_____ _____

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