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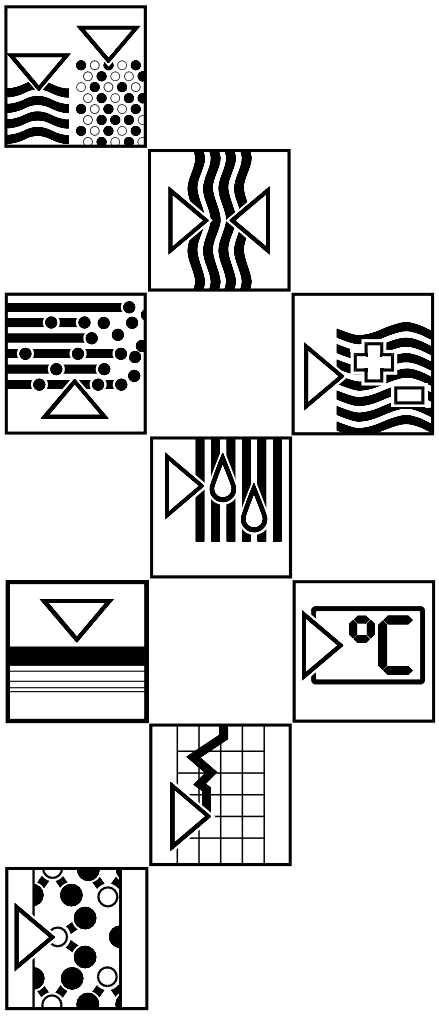
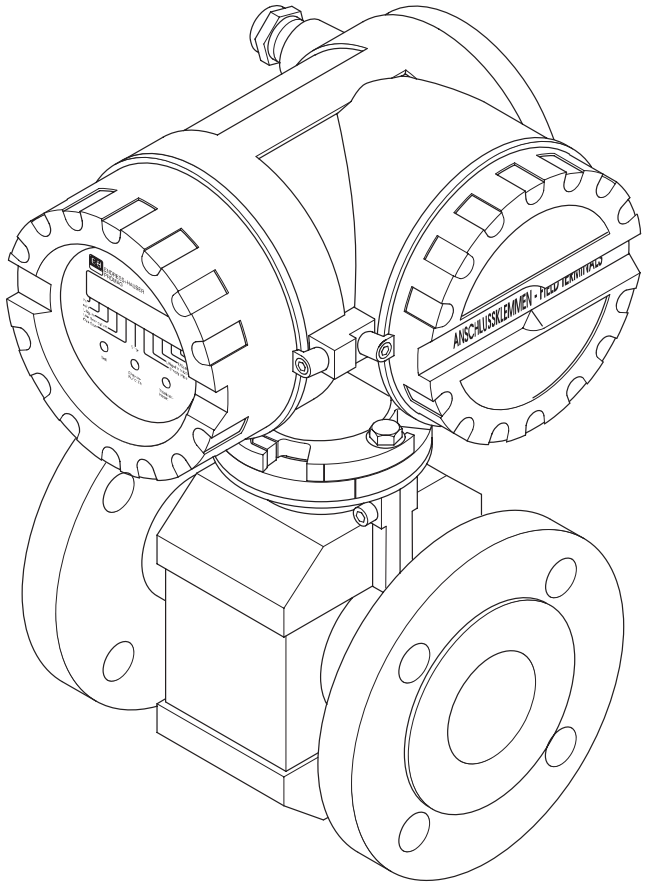
valid from software version
V3.01.XX (measuring amplifier)

promag 31
Electromagnetic Flow Measuring System

Cold Water Fiscal Metering

Operating Manual





Endress+Hauser

Nothing beats know-how

Safety Instructions

Correct Usage

- The Promag 31 is only to be used for measuring the flow of conductive fluids.
- The Promag 31 flowmeter is designed and checked according to the regulations in force EN 61010 “Protection Measures for Electronic Measuring Equipment”). The flowmeter may be dangerous if it is not used for the purpose it was designed for or is used incorrectly.

  Please carefully note the information provided in this Operating Manual indicated by the pictograms:

- The manufacturer assumes no liability for damage caused by incorrect use of the instrument. Modifications and changes to the instrument may not be carried out.

Personnel for Installation, Start-up and Operation

- Mounting, electrical installation, start-up and maintenance of the instrument may only be carried out by trained personnel authorized by the operator of the facility. Personnel must absolutely and without fail read and understand this Operating Manual before carrying out its instructions.
- The instrument may only be operated by personnel who are authorized and trained by the operator of the facility. All instructions in this Manual are to be observed without fail.
- With special fluids incl. those used for cleaning, E+H will be pleased to supply information concerning the chemical resistance properties of wetted parts.
- The installer has to make sure that the measuring system is correctly wired according to the wiring diagrams. The measuring system is to be grounded.
- Please observe all provisions valid for your country and pertaining to the opening and repairing of electrical devices.

Repairs, Dangerous Chemicals

The following procedures must be carried out before a Promag 31 flowmeter is sent to Endress+Hauser for repair:

- A note must always be enclosed with the instrument, containing a description of the fault, the application, and the chemical and physical properties of the product being measured.
- Remove all residue which may be present. Pay special attention to the gasket grooves and crevices where fluid may be present. This is especially important if the fluid is dangerous to health, e.g. corrosive, poisonous, carcinogenic, radioactive, etc.
- No instrument should be returned to us without all dangerous material being removed first, e.g. in scratches or diffused through plastic.

Incomplete cleaning fo the instrument may result in waste disposal or cause harm to personnel (burns, etc.). Any costs arising from this will be charged to the owner of the instrument.

Technical Improvements

The manufacturer reserves the right to modify technical data without prior notice. Your local E+H Sales Office will supply you with all current information and any updates to this Operating Manual.

Contents

Documentation for Ex instruments

Instruments which are used in the explosion hazardous area are supplied with a separate “Ex documentation”, which is an integral part of this Operating Manual. The instructions and connected loads provided in this supplement must absolutely be observed.

An appropriate icon is shown on the front of this document according to the approval given and the test centre.

1. System Description

1.1 Fields of application

The measuring system Promag 31 possesses the PTB licence for the transport of cold water (waste water) and at an attractive price offers accurate magnetic-inductive flow measurement of fresh water with a minimum conductivity of 5 µS/cm. The measuring system operates within a temperature range of 0 to 30 degrees celsius and can be deployed for the following uses in the supply of drinking water:

Local water network	Internal monitoring of delivery pipe network
Junctions	Calculation of the bill from the main supply pipe
Tank inlet points (incl. pump stations)	Monitoring of the water source. For example, the amount of ground water.
Tank outlet points	Certification for the amount supplied to the delivery network
Overland supply pipe of a water network	Monitoring of the withdrawal and supply of different water works in a supply pipe

1.2 Principle of measurement

In accordance with Faraday's law of induction, a voltage is induced in a conductor that is moved through a magnetic field. In the magneto-inductive principle of measurement the flowing medium represents the moving conductor. The induced voltage is proportional to the flow velocity and is fed to the measuring amplifier by a pair of electrodes. Across the cross-section of the pipe the flow volume is calculated. The DC magnetic field is generated by a switched direct current of alternating polarity. Together with the patented "Integrated Autozero Circuit" this assures a stable zero point and makes the measurement independent of the medium and insensitive to entrained solid particles. In our works every unit is calibrated on modern calibrating facilities, referable to international standards. There is no need for it to be adapted to suit changing media.

$U_e = B \cdot L \cdot v$
$Q = v \cdot A$
U_e = induced voltage
B = magnetic induction
L = distance between electrodes
v = flow velocity
Q = volume flow
A = pipe cross-section

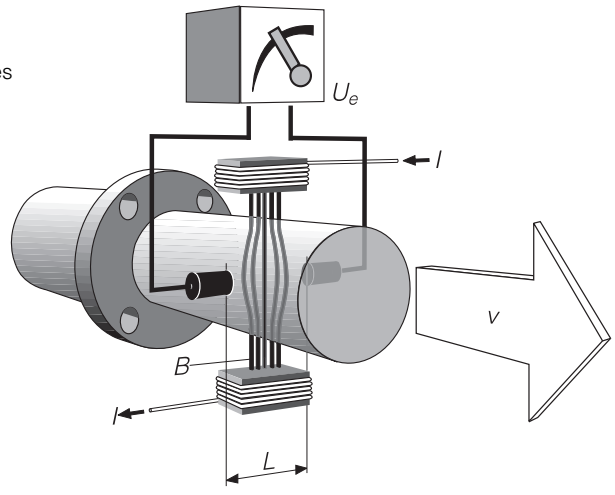


Fig. 1

1.3 The Promag 31 measuring system

The promag measuring system is a fully modular, both mechanically and electrically. The equipment can be extended by exchanging electronic boards. Thus the measuring point can be optimally equipped and updated. The illustration below gives an overview of the complete Promag 31 system.

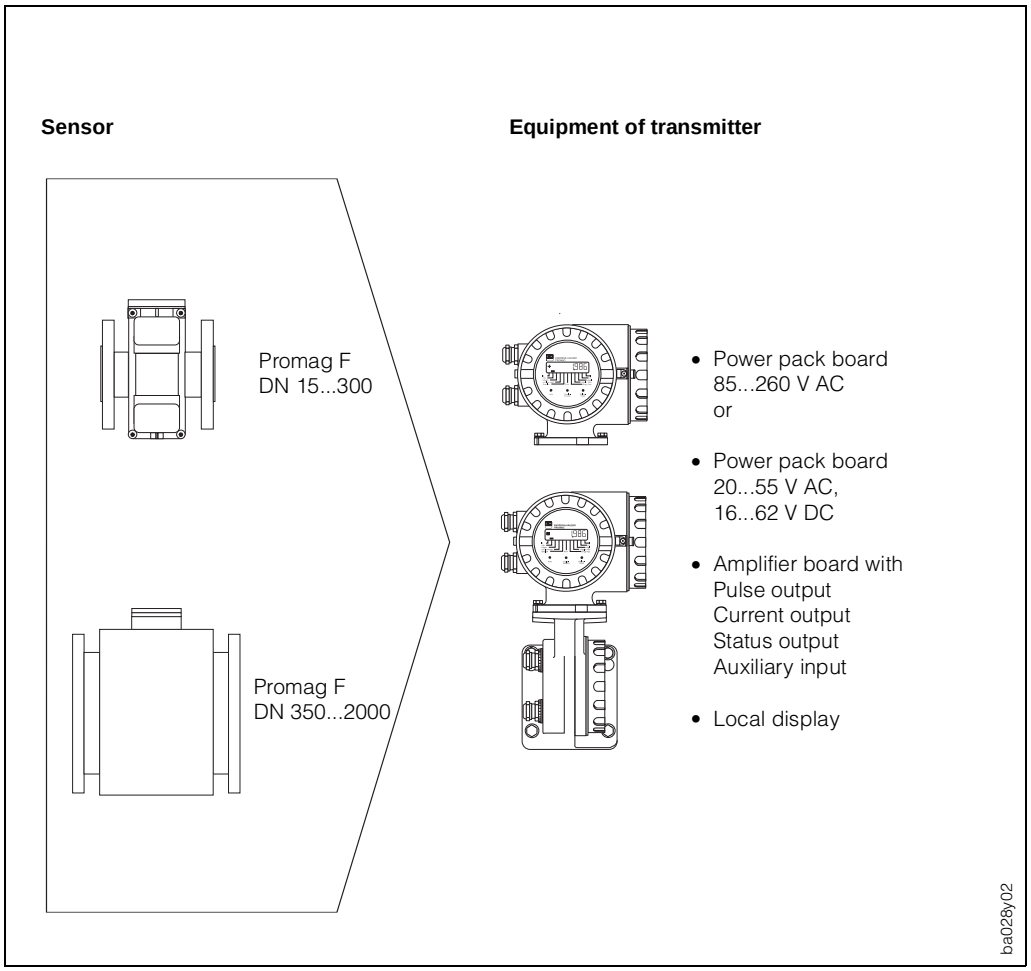


Fig. 2

Caution!

Caution!
The Promag 31 is available with different Ex-certificates. Information about the current status can be found from your existing E+H representive.
Furthermore, all relevant Ex informations and the specifications of the certificates can always be obtained from your E+H representative.

The measuring equipment comprises:
- Transmitter Promag 31 and
- Sensor Promag F

Compact version:

The Promag 31 transmitter and the sensor together form a mechanical unit.

Remote-mounted version (FS version or FL version)

The transmitter is mounted remote from the sensor:

FS version

- Up to 10 m distance — meduim conductivity min. 5 µS/cm
- From 10…200 m distance — max. cable length in terms of the medium conductivity (5...200 µS/cm)

FL version

- Max. cable length 200 m, not dependent on conductivity.
- No EPD available.
- The electrical connection between transmitter and sensor is made in the connection housing

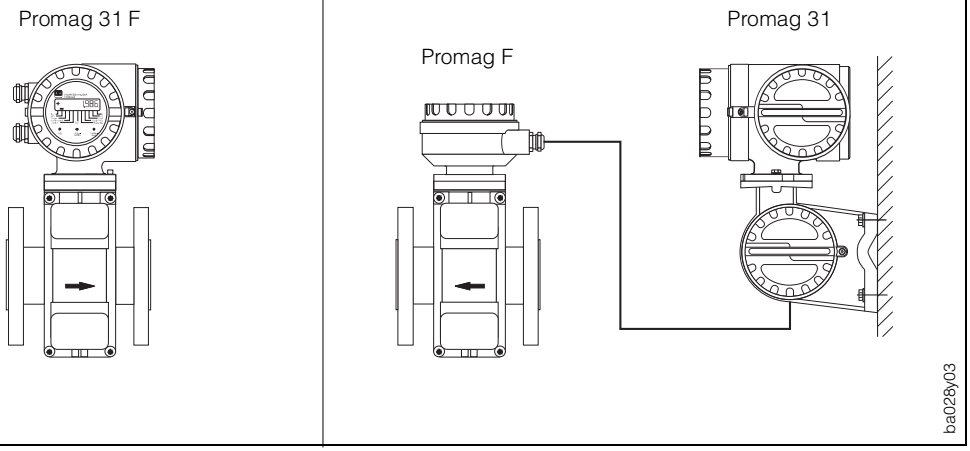


Fig. 3

1.4 Design of the measuring system

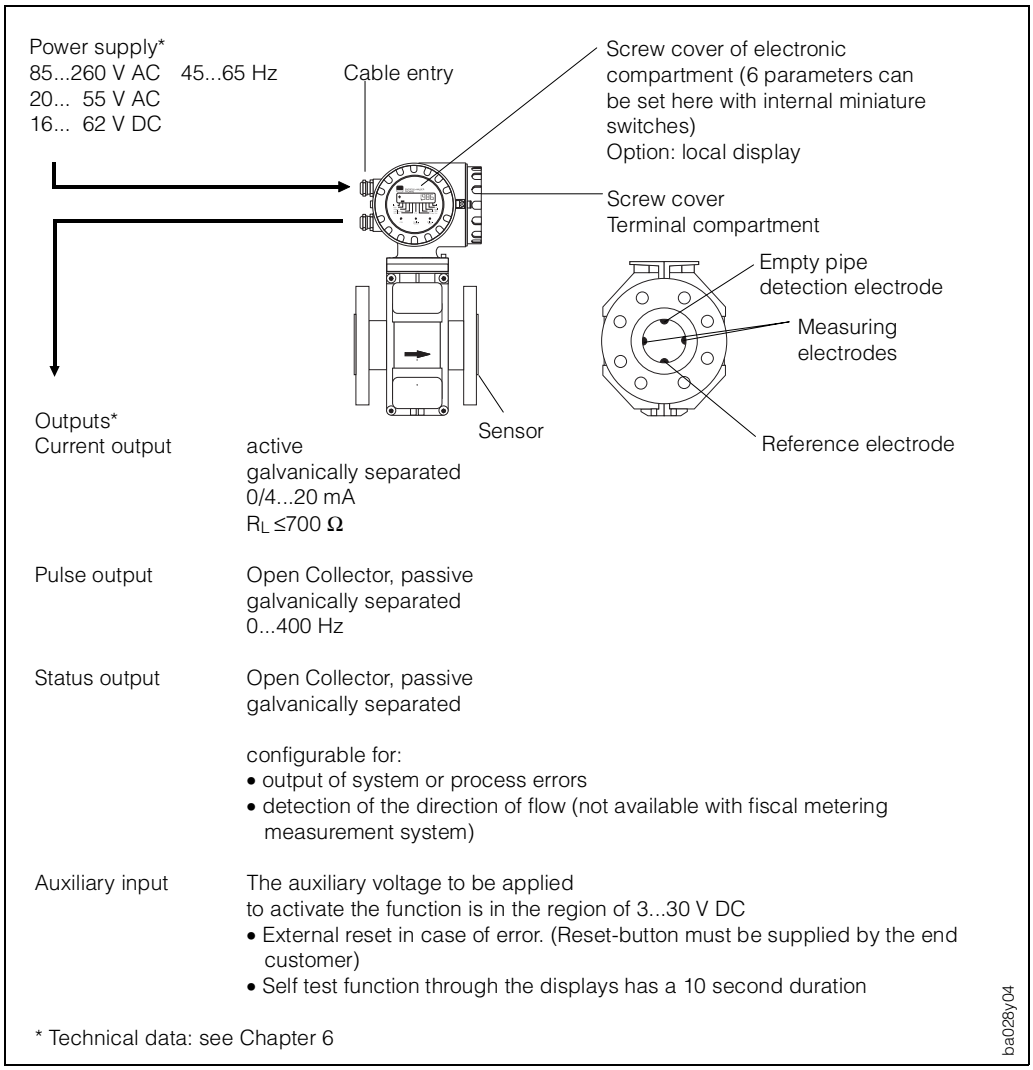


Fig. 4

Special points in the non fiscal use

- After the official calibration inspection of the measuring system, the clutch of the leaded screw (Electronics compartment, Diagram) is sealed. Operation of this measurement system with these DIP switches (page 33) or above the displays keys (page 36) is not possible afterwards.
- After every application of the power supply, also with the first service inspection, “Error” flashes on the display, as an indication of voltage drop. The system remains in normal measurement mode and the status output is not activated. The same applies to failure mode, that happens sporadically whilst in service. The flashing display section is deleted by activating the auxiliary input.
- The system totalises bidirectionaly, during which the pulse and current output remains unidirectional.
- In fiscal use the periodical electrode cleaning is not possible.
- The auxiliary input, in contrast to “normal” use, is configured to suspend for the second stage of interuption on the display like for the trigger of the display tests. A measuremement calculation under pressure or the interuption of the totalisers is not possible through the auxiliary inputs.
- Status output and auxiliary input must be wired by the user of the system.

Operation
Inside the housing of the transmitter there are miniature switches with which altogether six operating parameters can be set (see Chapter 4):

- Current range 0/4...20 mA
- Full-scale value scaling (volume/time), 8 steps
- Pulse weighting in decadic steps (volume), 8 steps
- Engineering units
- Function of the status output
  Output of system/process errors
  Flow direction recognition
- Creep suppression (on/off)

Local display
Using the Promag 31 local display, important parameters can be read off and controlled at the measuring point directly:
- Flow rate and/or totaliser value
- Technical units (SI/US units)
  (US-conformity with fiscal measuring systems is not available)
- Process variables (e.g. creep rate, partial pipe filling)
- Error messages

Using the three operating keys, it is also possible to select and activate various functions. A small pin is used to press the keys down (keep pressed for approx. 0.5...0.8 s).
- After the unit has been certified for fiscal metering, it is sealed and it is not possible to self programe the unit.

Dynamic response
The Promag 31 measuring amplifier has a very high dynamic response of over 1000:1. It measures at medium velocities from less than 10 mm/s to over 10 m/s with the specified accuracy. When the flow is pulsating, the amplifier is not over-driven even above the end value setting at maximum speeds up to 12.5 m/s. There is then no falsification of the measured value, provided the outputs are not over-driven.

Fiscal acceptance
Note!
Fiscal, magnetic-inductive flow meters may (in contrast to mechanical meters) be operated with $Q_{100} = Q_{max}$.


Note!

Warning!
Only a custody transfer certified flowmeter can be used for cold water fiscal metering.


Warning!

Fiscal-capability
Note!
Fiscal-capable flowmeters for custody transfers are not approved of by the standards authority. These meters are however technically identical to fiscal flowmeters.
These meters may not be used in fiscal-bound custody transfers.
The fiscale-capable flowmeter can however can be examined and approved of by an official standards authority through discussion at a later point in time.
Mass-measuring systems with a maximum flow of >2000 m^3/h are exempted from fiscal-standards. These measuring systems will not be fiscal, but they could be fiscal-capable.


Note!

Memory (DAT)
DAT is an exchangeable memory module. Stored in it are all characteristic data of the sensor, such as calibrated quantities, nominal diameter, sensing rate, version, serial number. When the transmitter has been changed, the previous DAT memory is inserted in the new transmitter. When the measuring system is started, the measuring point continues to operate with the data stored in the DAT memory. Thus the DAT concept assures maximum safety and optimum ease of operation when components of the equipment are exchanged.

After calibration
The user of a fiscal Promag 31 measuring system is obligated to insure that the perscribed standards have been adhered to.

Safety
- A comprehensive self-monitoring facility of the measuring system assures high safety. Any system error messages (coil-current error, amplifier error, DAT error, EEPROM error, ROM error, RAM error) or a power supply failure that do occur are emitted at the configured status output.
- In the event of a power supply failure all data of the measuring system are securely stored in the EEPROM (without a backup battery).
- The Promag 30 measuring system fulfils the safety requirements according to EN 61010 “Protection Measures for Electronic Equipment for Measurement, Control, Regulation and Laboratory Procedures”, and the general requirements for electromagnetic compatibility (EMC) according to EN 50081 Part 1 and 2 / EN 50082 Part 1 and 2 as well as the NAMUR recommendations.
- IP 67 protection (EN 60529) is standard for the transmitter and sensor (remote or compact version). The sensor is also optionally available in IP 68.

2. Mounting and Installation

Caution!
- Pay consistent attention to the notes in this chapter regarding to assure reliable measurement.
- For explosion protected instruments the mounting regulations and the technical data may differ from those stated here. Please refer to the Ex supplement of this operating manual.

Caution!

2.1 General Information

Type of protection IP 67 (EN 60529)
The instruments fulfils all requirements for IP 67. In order to assure the type of protection IP 67 after installation in the field or servicing, it is essential to comply with the following points:

- The housing gaskets must be clean and undamaged when inserted in the sealing groove. If necessary, the gaskets must first be dried, cleaned or renewed.
- All screws in the housing and the screw cover must be screwed up tight.
- The cables used for connection must possess the stipulated outside diameter (see Chapter 6.3).
- Tighten the cable entry (see Fig. 5).
- Loop the cable before inserting. This prevents moisture from penetrating the cable entry (see Fig. 5).
- Any cable entries not used must be stopped with a screw plug.
- The protective grommet must not be removed from the cable entry.

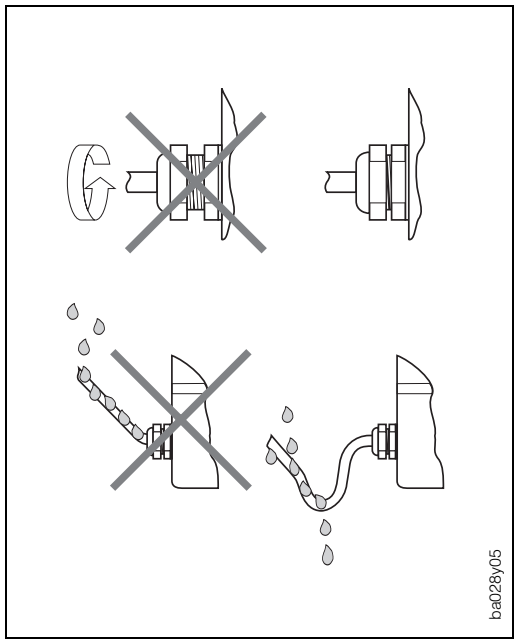


Fig. 5

Caution!
The screws of the Promag sensor housing must not be released, otherwise the guarantee for the type of protection expires.

Caution!

Note!
The sensor Promag F can optionally be supplied with the type of protection IP 68 (permanently under water to a depth of 3 m). In this case the transmitter (IP 67) has to be mounted remote from the sensor.

Note!

Temperature ranges
- The maximum permissible ambient and medium temperatures must be adhered to (see Chapter 6 “Technical Data”).
- When installed outdoors, specially in countries with high ambient temperatures, a weatherproof hood should be provided as protection against direct solar radiation.

2.2 Transport instructions for Promag from DN 350 / 14"

The pipe lining on the flanges is protected by disks to prevent damage when transporting to the installation point. These are to be removed before installation. The instruments are to be transported in the containers they are delivered in.

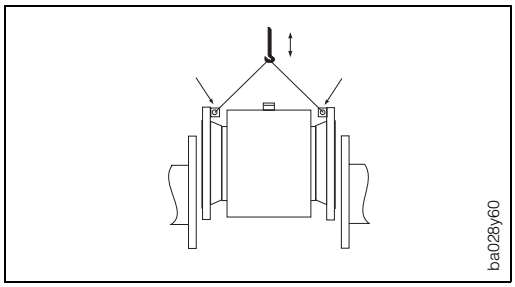


Fig. 6

Transporting to the measuring point
The grips on the flange must be used for lifting out and mounting the sensor in the piping.

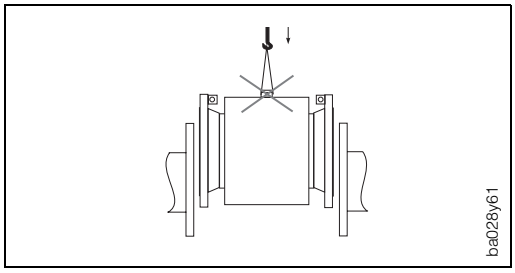


Fig. 7

The sensor should not be lifted by the connection housing.

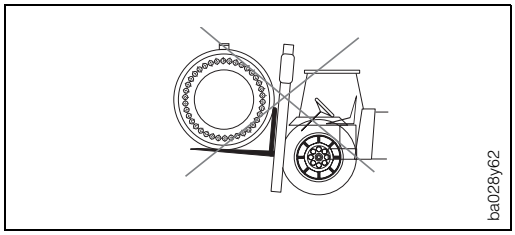


Fig. 8

The sensor should not be lifted by the sheet casing using a forklift truck.
This can buckle the casing and damage the internal magnetic coils.

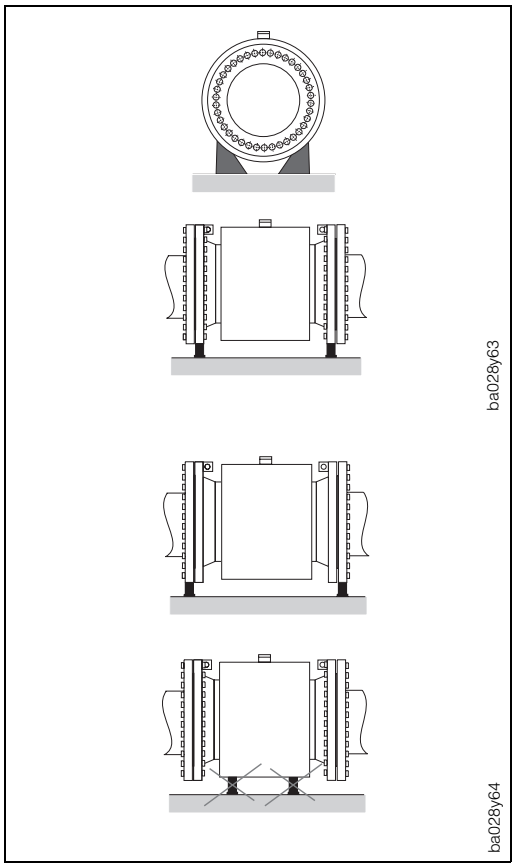


Fig. 9

Base of the sensor
The sensor should stand on a base which is sufficiently strong to withstand its weight.

Note!

Note!
The sensor must not be supported by the sheet casing! This can buckle the casing and damage the internal magnetic coils.

2.3 Mounting Instructions

Please pay attention to the following instructions, in order that you may measure correctly and avoid damage to the equipment.

Mounting position (any)

a) Vertical mounting:
Optimal, with the flow upwards. Entrained solid particles sink and lighter fatty elements in the stationary medium rise away from the electrodes.

b) Horizontal mounting:
The axis of the electrodes must be horizontal, thus preventing brief insulation of the electrodes by entrained air bubbles.

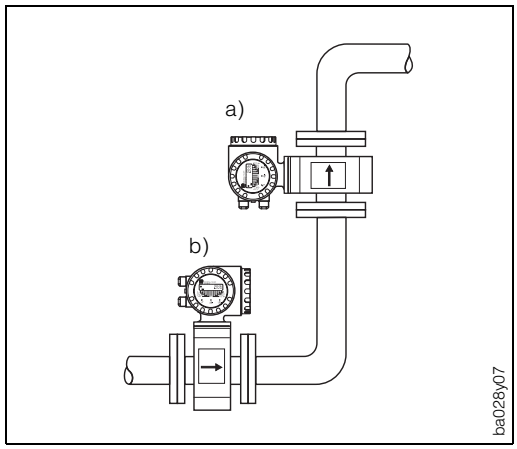


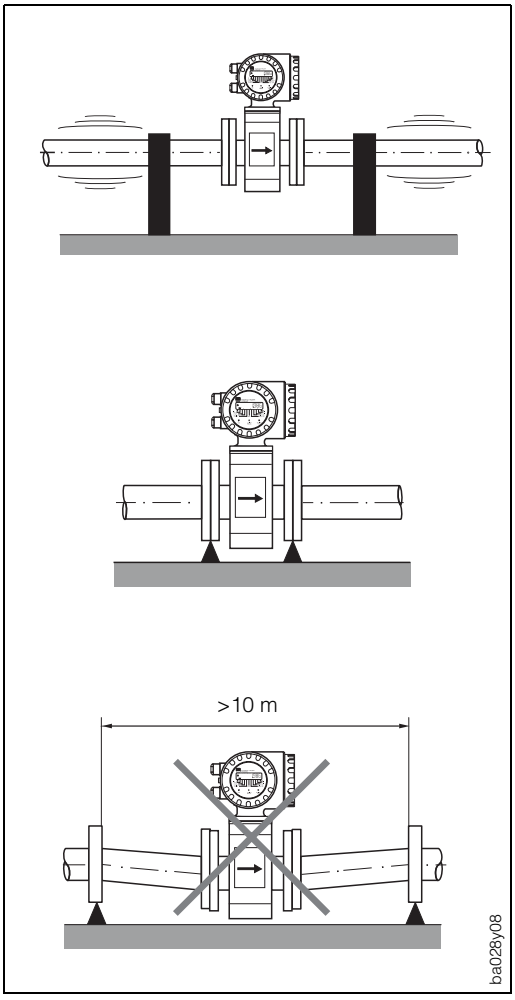
Fig. 10

Vibration

Fasten the piping before and after the sensor.

Caution!
Excessive vibration necessitates separate mounting of the sensor and transmitter (see Chapter 2.6).

With free runs of piping over 10 m long, we recommend mechanical supports.



Caution!

Fig. 11

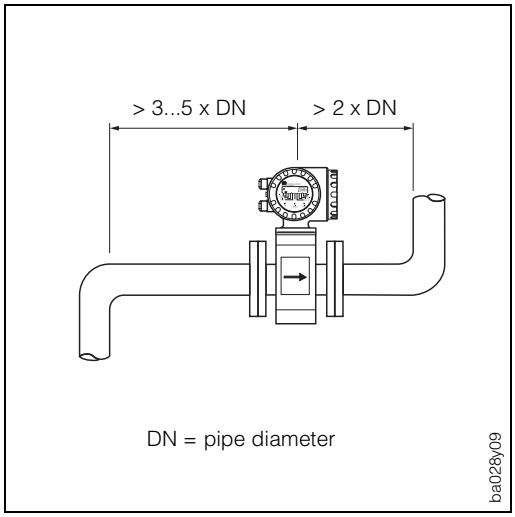


Fig. 12

Inlet and outlet runs
The sensor should be mounted away from fittings liable to generate turbulence (e.g. valves, elbows, T-junctions).

Inlet run: > 3...5 x DN
Outlet run: > 2 x DN

For fiscal use, the straight pipe requirements are 5 x DN upstream and 2 x DN downstream, measured from the meter flanges.

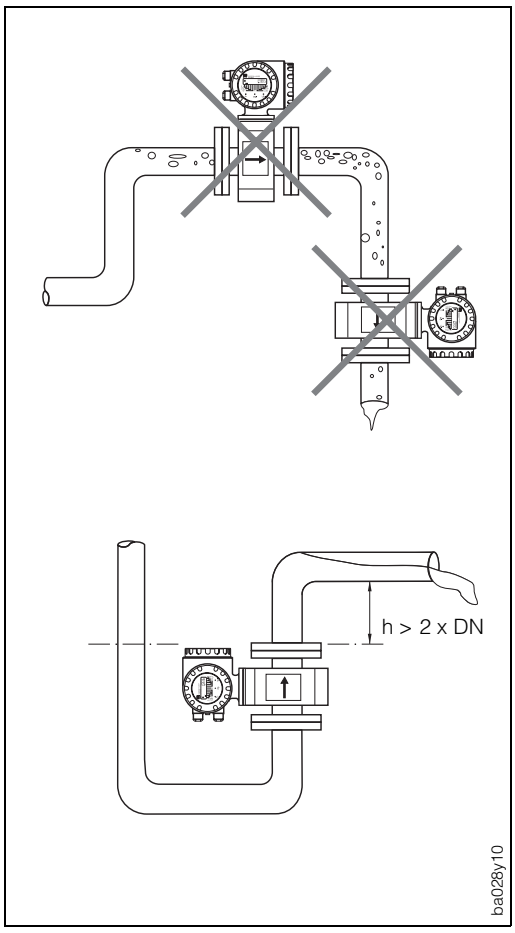
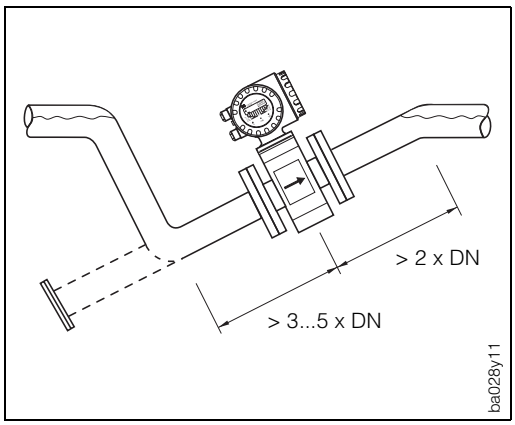


Fig. 13

Mounting location
Correct measurement is only possible when the pipe is full. Consequently the following locations should be avoided:

No installation at the highest point (air accumulation).

No installation immediately before an open pipe outlet in a downward line. The installation shown in Fig. 13, however, permits such a location.



Note!

Fig. 14

Partly filled pipes
For inclines a mounting similar to a drain should be adopted. Do not mount at the lowest point (risk of solids collecting). Added security is offered by Empty Pipe Detection (EPD). This option has an extra electrode in the measuring pipe (standard with Promag F sensor).

Note!
Here, too, the inlet and outlet lengths should be maintained.

Downward pipe (>5 m)
With the suggested installation opposite (siphon, vent valve after the sensor) no partial vacuum is created with such a downward pipe >5 m long.

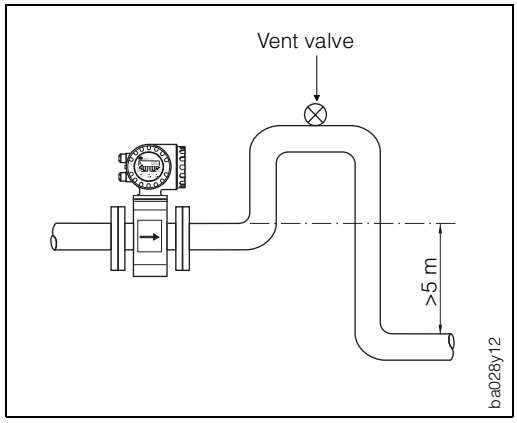


Fig. 15

Installation of pumps
If possible avoid mounting the sensor on the suction side of the pump (danger of vacuum!). Information on the resistance to vacuum of the measuring pipe lining can be found on Chapter 6.2.

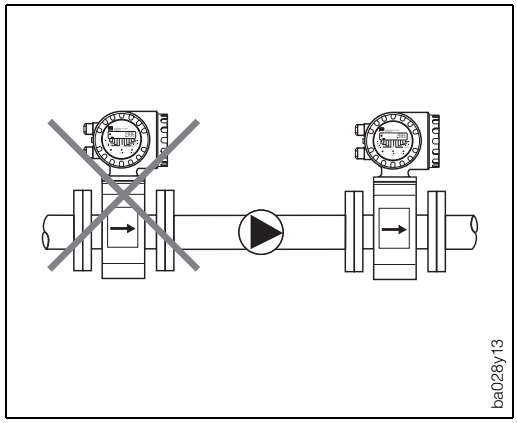


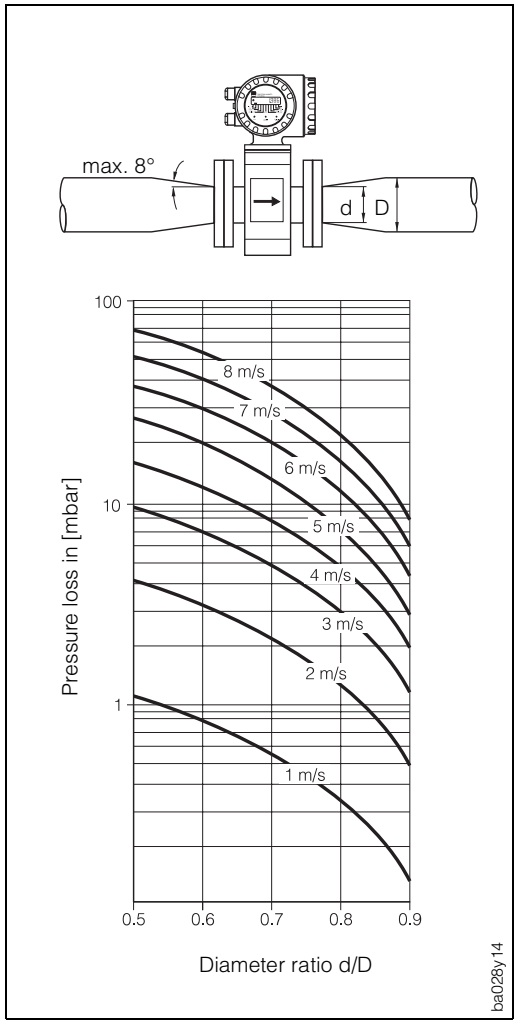
Fig. 16

Adaptor pieces
The sensor can also be mounted in a pipe with a larger nominal diameter when suitable adaptors (reducers and expanders) to DIN 28545 are fitted. The resultant increase in the rate of flow increases the accuracy of measurement with slowly flowing fluids.

The adjacent nomogram can be used to determine the pressure loss caused.

Procedure:
1. Determine the ratio of the diameters d/D.
2. From the nomogram read off the pressure loss at the flow velocity and d/D ratio.

Note!
The nomogram applies to fluids with a viscosity similar to that of water.



Note!

Fig. 17

2.4 Mounting Promag 31 F

Lengths and dimensions
See Chapter 6.1 “Dimensions and weights”

Mounting
The sensor is mounted between the flanges of the pipe (see Fig. 18). Since the lining of the measuring pipe is drawn on over the sensor flange, it performs the sealing function at the same time.

Caution!
The Teflon (PTFE)-lined measuring pipe of the Promag F is fitted with protective discs to guard the liner which is turned over the flanges. These discs may only be removed just before mounting the sensor, thereby making sure that the liner is not damaged at the flange or removed (during storage these discs must remain in position).

Caution!

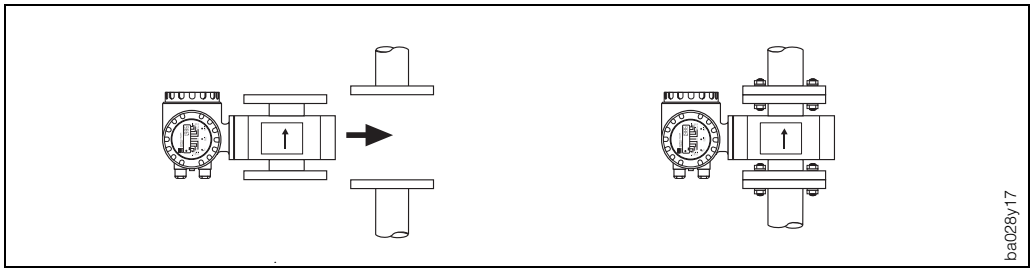


Fig. 18

DN		Pressure stages	Screws	Max. tightening torque [Nm]		
DIN [mm]	ANSI [inch]	DIN [bar]		Hard rubber	Soft rubber (EPDM)	Teflon (PTFE)
15	1/2"		4 x M 12	-	-	15
25	1"		4 x M 12	25	5	33
32	-	PN	4 x M 16	40	8	53
40	1 1/2"	40	4 x M 16	50	11	67
50	2"		4 x M 16	64	15	84
65	-		4 x M 16	87	22	114
80	3"		8 x M 16	53	14	70
100	4"	PN	8 x M 16	65	22	85
125	-	16	8 x M 16	80	30	103
150	6"		8 x M 20	110	48	140
200	8"		8 x M 20	108	53	137
250	10"	PN	12 x M 20	104	29	139
300	12"	10	12 x M 20	119	39	159
350	14"		16 x M 20	141/193	39/79	188/258
400	16"		16 x M 24	191/245	59/111	255/326
-	18"	PN	20 x M 24	170/251	58/111	227/335
500	20"	10/16	20 x M 24	197/347	70/152	262/463
600	24"		20 x M 27	261/529	107/236	348/706
700	28"		24 x M 27	312/355	122/235	-
800	30"	PN	24 x M 30	417/471	173/330	-
900	32"	10/16	28 x M 30	399/451	183/349	-
1000	36"		28 x M 33	513/644	245/470	-
1200	48"		32 x M 36	720	328	-
-	54"		36 x M 39	840	432	-
1400	-		36 x M 39	840	432	-
-	60"	PN	40 x M 45	1217	592	-
1600	-	6	40 x M 45	1217	592	-
-	66"		44 x M 45	1238	667	-
1800	72"		44 x M 45	1238	667	-
-	78"		48 x M 45	1347	749	-
2000	-		48 x M 45	1347	749	-

Screw tightening torques
- The listed tightening torques apply to greased threads.
- Screws tightened up too tightly deform the sealing surface (pay special attention with soft rubber lining).

Gaskets
- With soft rubber/Teflon (PTFE) linings a flange gasket can be dispensed with.
- With soft rubber linings the mating flange should have a thin film of sealing grease applied.
- Use a gasket as per DIN 2690.

Caution!
Do not use sealing media that is electrically conductive, e.g. graphite. On the inside of the measuring pipe this could result in an electrically conductive layer forming which would short-circuit the measuring signal.

Caution!

Replacement measuring electrodes

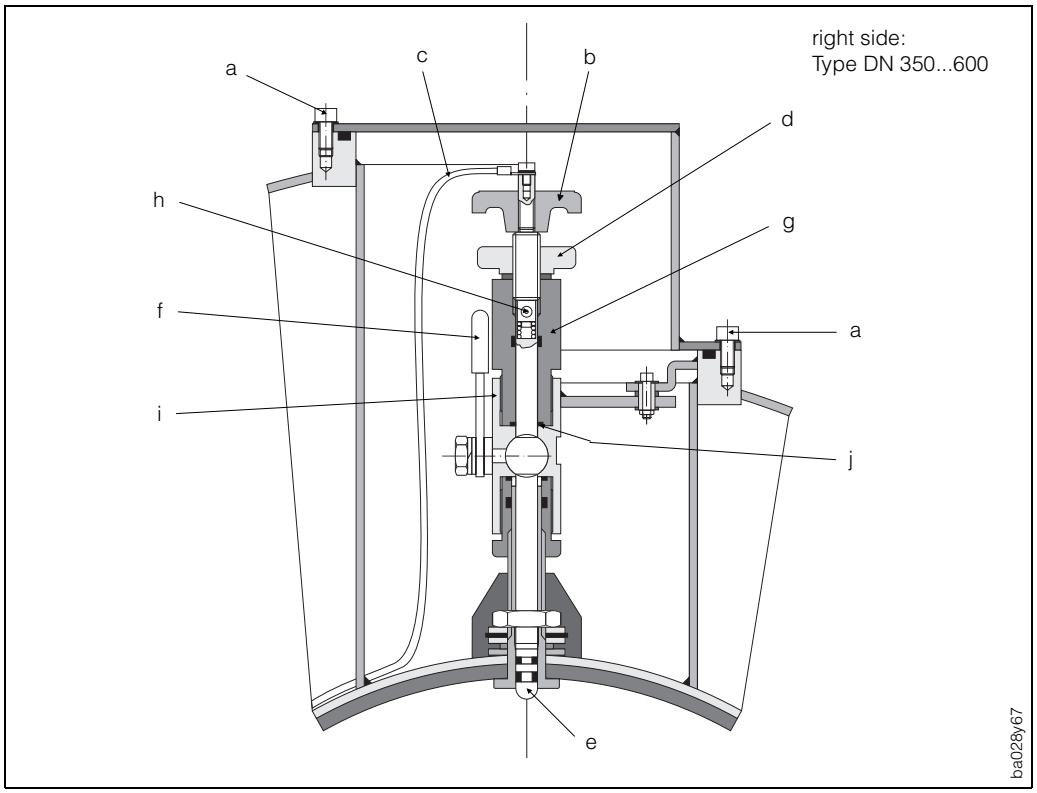


Fig. 19

The Promag F Type DN 350...DN 600 is available with replacement electrodes.
This version enables the measuring electrodes to be cleaned or replaced under process conditions.
Replacing an electrodes is carried out as follows:

Dismantling the electrode:

1. Loosen the Allen screws (a) of the cap/cover.
2. Unscrew the electrode cable (c) attached to the rotary arm (b).
3. Undo the knurled nut (d) by hand. This nut is used as a counter nut.
4. Remove the electrode (e) using the rotary arm (b). This can now be taken out from the holder (g) as far as the stop allows.

   Warning!
   The electrode can spring back to the stop. Keep pressing against it while loosening.

5. Close the shut-off valve (f) after the electrode has been taken out as far as the stop.

   Warning!
   Do not attempt to open the shut-off valve. Keeping it shut prevents medium from escaping.

6. Unscrew the entire electrode along with the holding cylinder (g).
7. Remove the pins (h) below the rotary arm.
8. Replace electrode with a new one.
   A set of new electrodes can be ordered from E+H.

Assembling the electrode:

1. Slide the new electrode (e) through the holding cylinder (g) from below.
   Gaskets at the tip of the electrode must be in place and clean.
2. Connect the rotary arm (b) and electrodes together using the pins (h). Ensure that the small coil spring is in place.
3. Pull back the electrode as far as possible so that the tip does not protrude out from the holding cylinder (g).
4. Screw the holding cylinder onto the shut-off unit (I) and tighten by hand.

   Note!
   Gasket (j) on the holding cylinder must be in place and clean.

5. Open the shut-off value (f) and screw in the electrode using the rotary arm (b). Pull the electrode on by hand.
6. Screw the knurled nut (d) onto the holding cylinder in order to clamp the electrode tight.
7. Secure the electrode cable (c) to the rotary arm using the Allen screw.

   Caution!
   Ensure that the Allen screw of the electrode cable is tight. A close electrical contact cannot otherwise be guaranteed and this can lead to measurement errors.

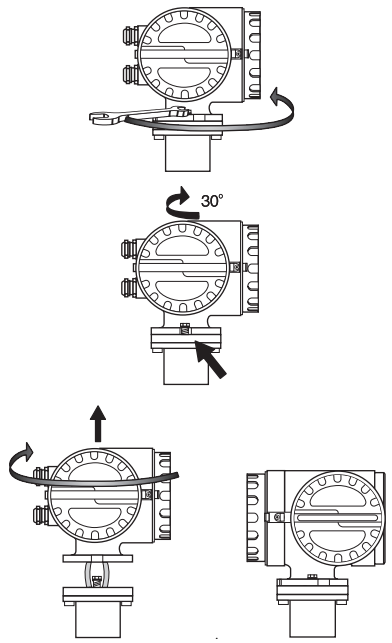
   

2.5 Turning the transmitter housing and local display (compact version)

In the compact version the transmitter housing and the local display can be rotated in steps of 90° relative to the sensor. This enables the unit to be adapted to suit the various mounting positions in the pipe.

Note!

Note!
For instruments with EEx d/de approval the procedure for rotating the instrument is different than that described here and is given in the Ex supplement to this manual.



Turning the transmitter housing

1. Loosen the two fixing screws of the transmitter bayonet catch (appr. 2 turns).
2. Turn the bayonet catch of the transmitter as far as the screw slits.
3. Lift the transmitter housing to the stop.

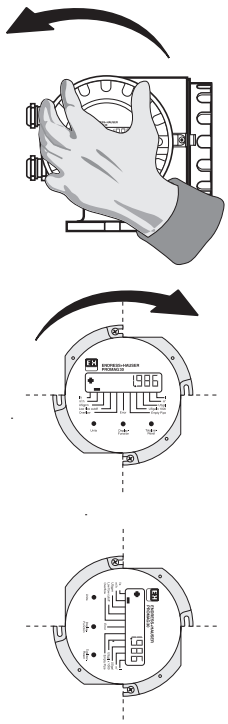
   Note!
   During servicing (and only then) the transmitter housing can be separated from the sensor. To do this the corresponding marking notches on the side of the bayonet flanges should be brought into alignment. Do not damage the cable to the sensor when lifting the transmitter housing.
4. Turn the transmitter housing into the desired position. Engage the bayonet catch and re-tighten the two screws.

ba028y18

Note!

Fig. 20

Warning!



Turning the local display

Warning!
Danger from electric shock. Switch off the power supply, before unscrew the cover of electronics area.

1. Loosen the safety grip of the cover of the electronics area. Loosen the screw with a 3 mm Allen key.
2. Unscrew the cover of the electronics area of the transmitter housing.
3. Unscrew the two Phillips screws which fasten the display module.
4. Rotate the display module to the required position.
5. Securely tighten the Phillips screws.
6. Replace and screw down securely the cover of the electronics area of the transmitter housing.
7. Replace and tighten the safety grip.

ba028y19

Fig. 21

2.6 Mounting the transmitter (remote-mounted version)

It is necessary to mount the transmitter remote from the sensor when:
- Accessibility is difficult
- Space is restricted
- Extreme medium and ambient temperatures prevail
  (for temperature ranges see Chapter 6 “Technical Data”)
- Severe vibration (>2 g/2 h per day; 10...100 Hz)

Caution!
- The permissible length of cable L_{max} between the sensor and the transmitter at a distance of >10 m is governed by the conductivity of the medium (Fig. 22).
- Fix the cable run or lay it in conduit. When the conductivity of the medium is low, cable movements can cause serious changes in capacitance and thereby falsify the measuring signal.
- Do not lay cable in the vicinity of electrical machines or switching elements.
- Pay attention to potential equalization between the transmitter and the sensor.
- Please connect the cable as described on page 23.

Length of cable for the remote-mounted version (FS and FL)

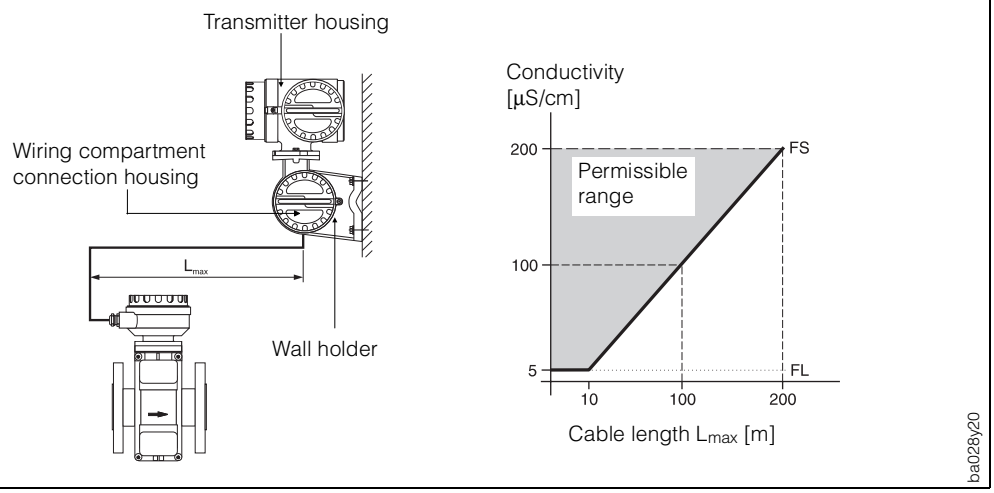
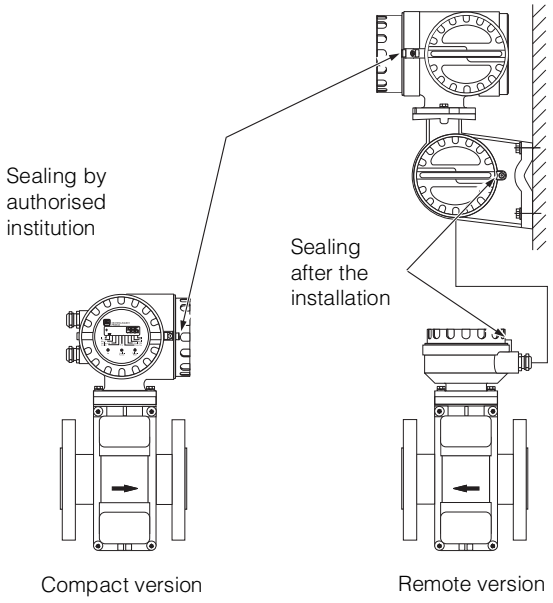


Fig. 22

Fixing the wall holder/Stamped lead seal



Sealing of compact versions

The cover of the electronic compartment of the Promag 31 is separetly sealed. Instead of the conventional cylindric screws a leading screw is used and the seal wire is drawn through it and fixed under the clutch.

Stamped lead seal for remote version (Promag 31 F for example)

In addition to the above mentioned and described seal the connection housing in both the sensor and the electronics will be lead sealed after installation by the service man with a user protection (sealed from works).

Fig. 23

2.7 Potential equalisation

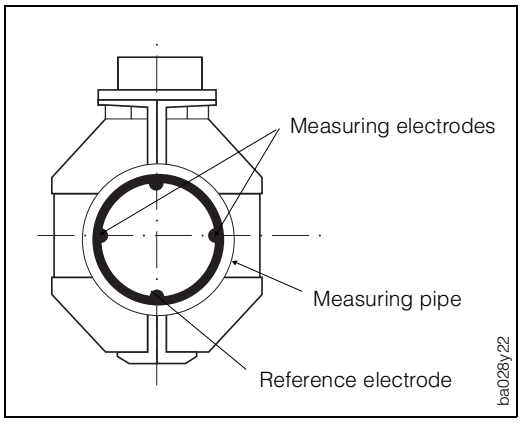


Fig. 24

The sensor and the medium must have roughly the same electrical potential to ensure that measurement is accurate and no galvanic corrosion takes place at the electrodes. Normally the reference electrode in the sensor or the metal pipe ensures that the potentials are equalized. With an existing reference electrode and for media carried in earthed metal piping it is therefore sufficient to connect the earthing terminal of the Promag 31 transmitter housing to the potential equalizing line.
With the remote-mounted version this connection is made at the earth terminal of the connection housing (transmitter).
Fig. 24 shows the reference electrode in the sensor Promag F.

Potential equalisation for some special cases is described below:

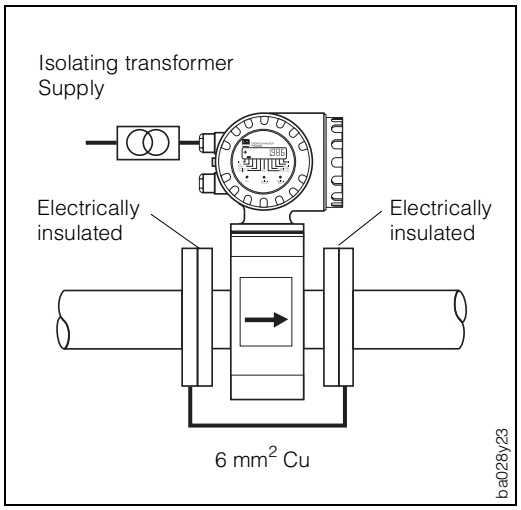
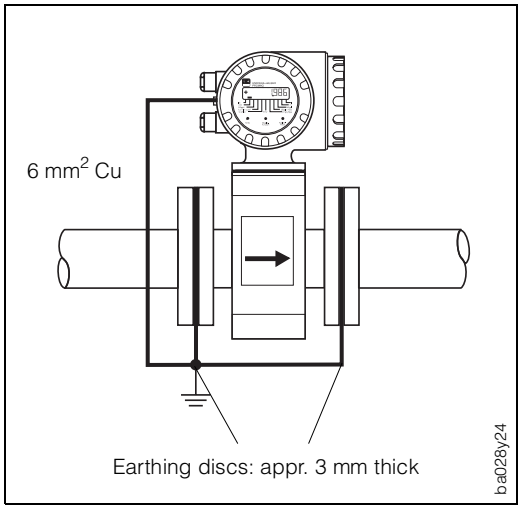


Fig. 25

Potential equalisation for lined pipes with cathodic protection
When the medium cannot be earthed for operational reasons, the measuring unit must be installed that it is potential-free (Fig. 25).

Please pay attention to national regulations regarding potential-free installation (e.g. VDE 0100).

It is also important to ensure that the mounting material used does not result in a conductive bond with the measuring unit and that the material can withstand the tightening torque used.



Caution!

Plastic or lined piping
This arrangement (Fig. 26) is needed if there is no reference electrode present or the medium has to be earthed on account of equalizing currents.

Caution!
Make sure the earthing discs are corrosion-resistant.

Fig. 26

Equalising currents in unearthed metal pipes
The medium may be earthed.
Make the electrical connection from flange to flange and to the measuring unit.

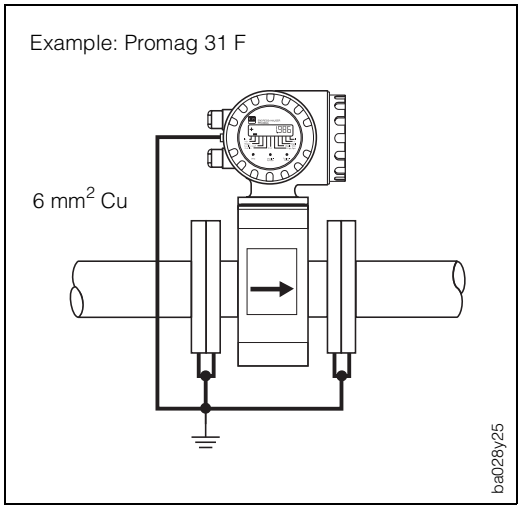


Fig. 27

2.8 Earthing in an area with severe interference

In order to make the most of the electromagnetic compatibility (EMC) of the Promag 31, it is advisable to provide two flange-to-flange links and to connect them jointly with the transmitter housing to earth potential.

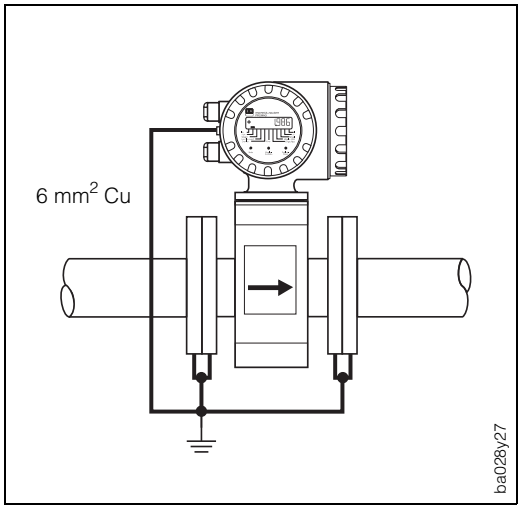


Fig. 28

3. Electrical Connection

3.1 General information

Note!

Please note the information in Chapter 2.1 on maintenance of the type of protection IP 67.

Caution!

Caution!
When connecting explosion protected versions, refer to the corresponding information and connection diagrams in the Ex supplement to this operating manual. Your E+H representative will be pleased to provide you with more information.

3.2 Connection to the transmitter

Warning!

Warning!
- Risk of electric shock. Install or wire the unit when it is not alive. Failure to comply can also result in damage to electronic components.
- Join the protective conductor to the earth terminal of the housing before the supply voltage is switched on.
- Compare the data on the nameplate with the local mains voltage and frequency. Also pay attention to the national rules for installation.

1. Release the safety grip of the screw cover of the terminal compartment using a 3-mm Allen key. Then unscrew the cover from the terminal compartment of the transmitter.

2. Push the supply cable and signal cable in through the appropriate cable entries.

3. Make the connection in accordance with the wiring diagrams (see also wiring diagram in the screw cover):
   - The supply voltage is connected to terminals 1 (L1 oder L+), and 2 (N oder L-) and the earthing terminal (⏚).
   - Fine-wire leads: max. 4 mm^2; put sleeves on the end of the cores. Single-core lead: max. 6 mm^2.

4. Having made the connection, screw the cover up tight again on the transmitter housing. Tighten the Allen screw of the safety grip thoroughly.

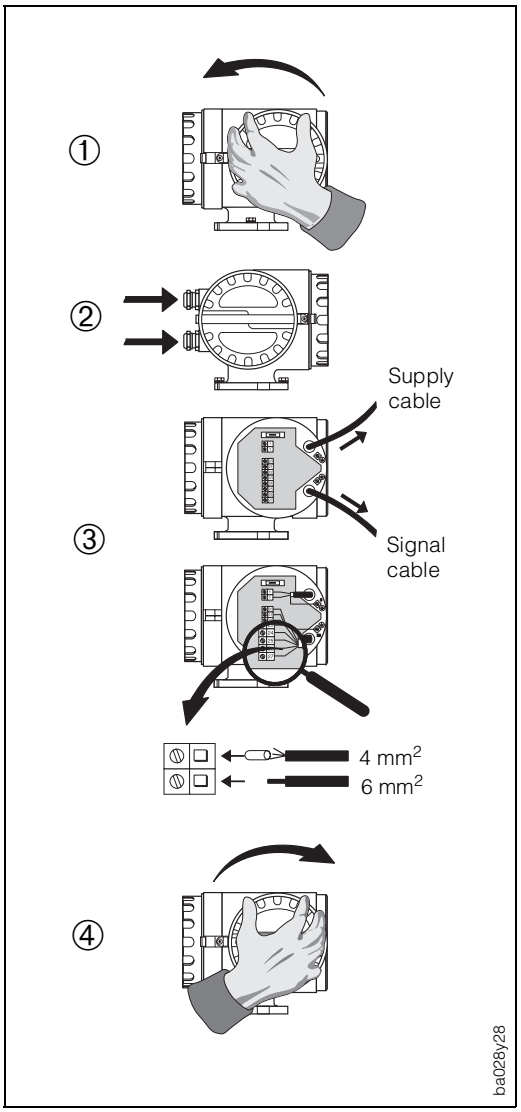


Fig. 29

3.3 Connection of the remote version

Caution!

Caution!
Only connect or disconnect the coil-current cable when the supply is switched off.

1. The connection to the terminal compartment is made as described for the compact version (see Chapter 3.2).
2. Open the covers of the connection housing of the sensor and transmitter by unscrewing the screw cover or the four Phillips screws.
3. Push both cables (signal and coil-current cable) in through the appropriate cable entries.
4. Make the connection between the sensor and transmitter in accordance with the wiring diagrams.
5. Tighten the cover of the connection housing securely.
6. The sealing of a fiscal measurement system is to be done, as described in Chapter 2.6.

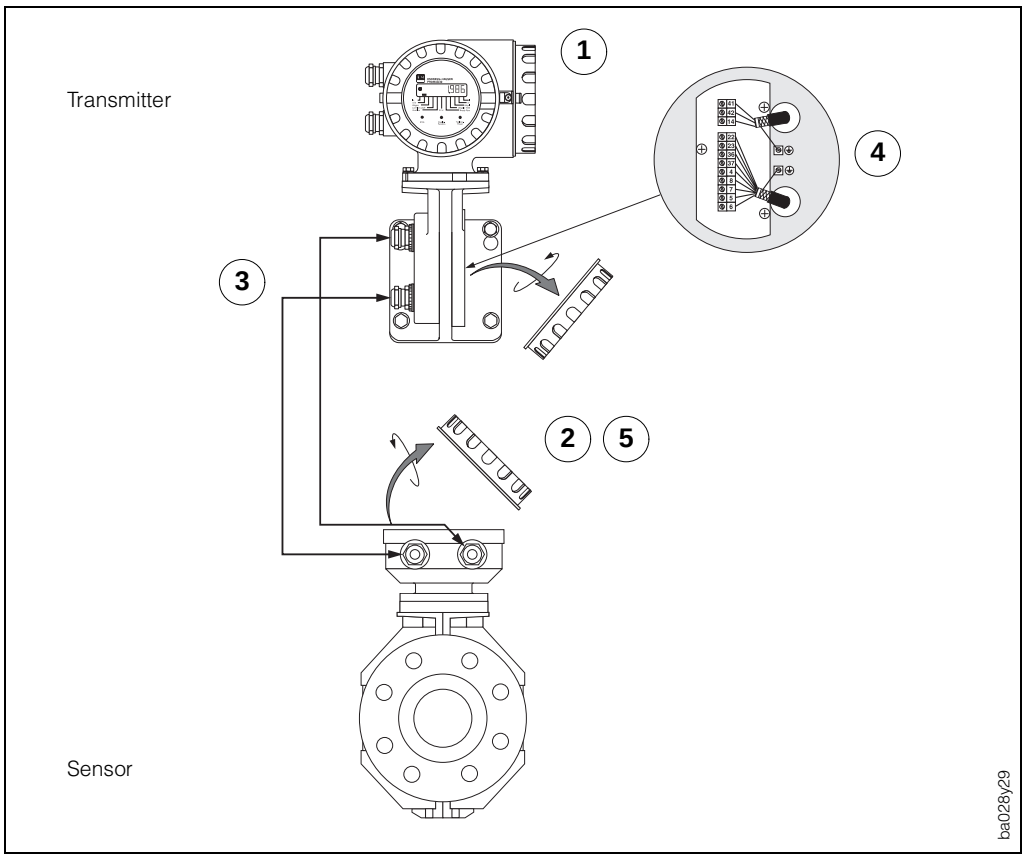


Fig. 30

Note!

Note!
If the sealing is damaged or taken away, please inform your metrology office as soon as possible.

3.4 Wiring diagrams

Electrical connection: supply, inputs and outputs

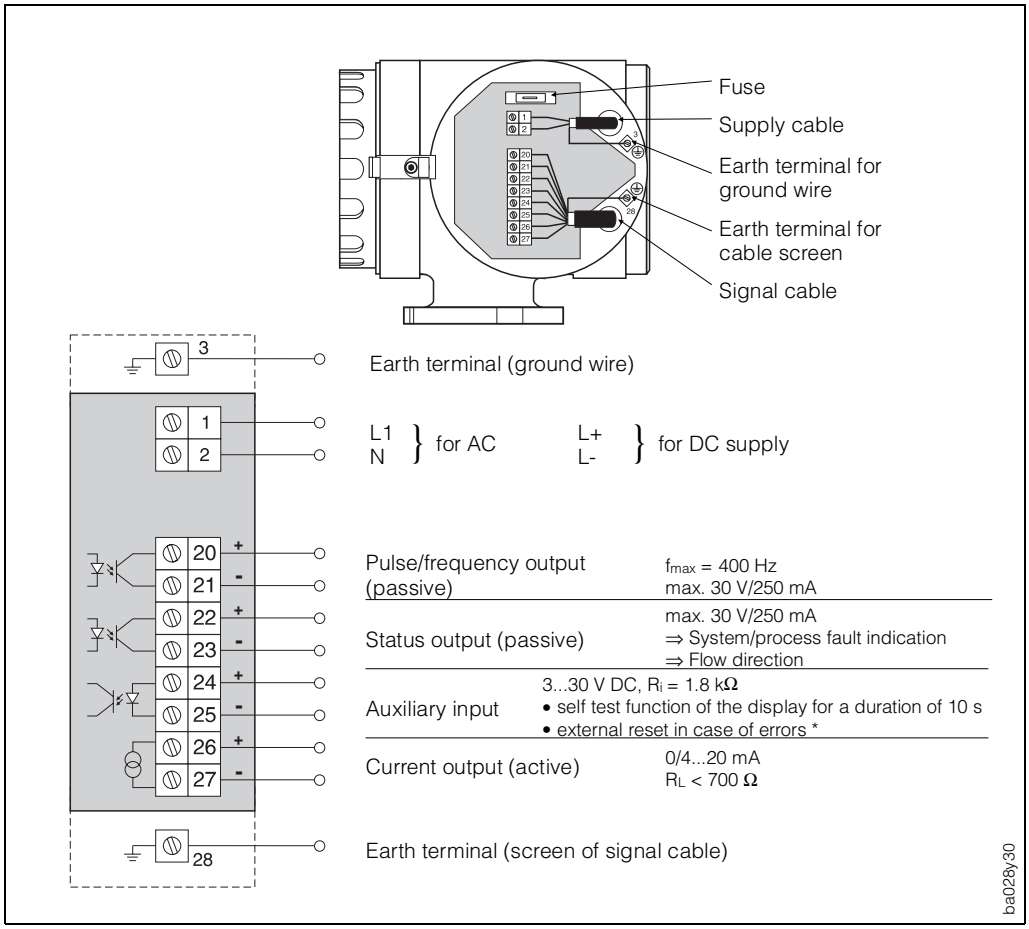


Fig. 31

*After the first operation or in case of an interruption of the power supply the fiscal meter measuring system Promag 31 signals an alarm. With connection through an external reset switch according wiring version 1/2 the alarm can be canceled.

Wiring version 1

Is to chosen if the 24-V power supply is near to the Promag display. The alarm instrument is to be made available from the customer. The switch for the error reset respectively for the display test can be ordered through Endress+Hauser. If this version is not available we refer to wiring version 2.

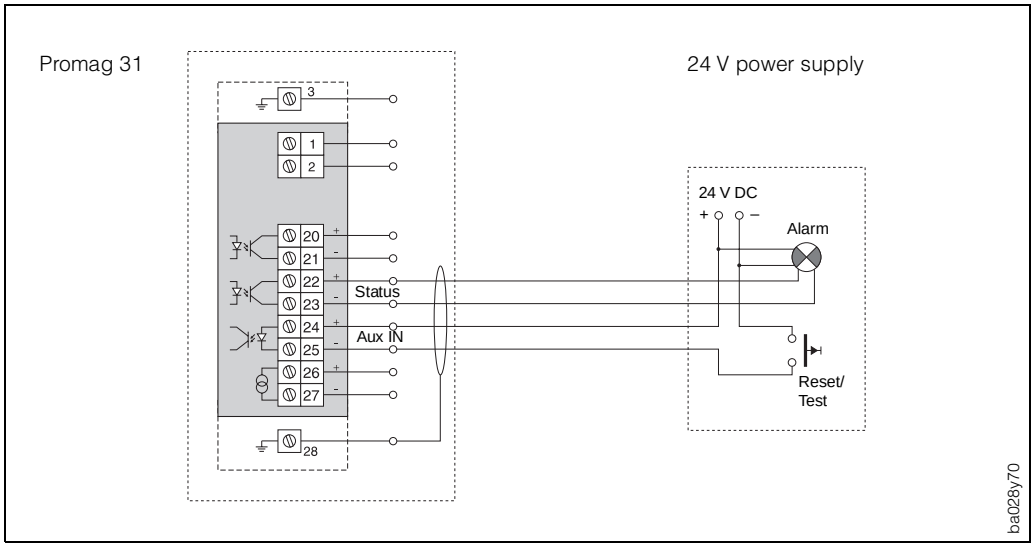


Fig. 32

Wiring version 2
Is to be chosen, if the 24-V power supply is not in the near of the Promag display. The Y-PG cable gland which is used for the supply can be ordered through Endress+Hauser.

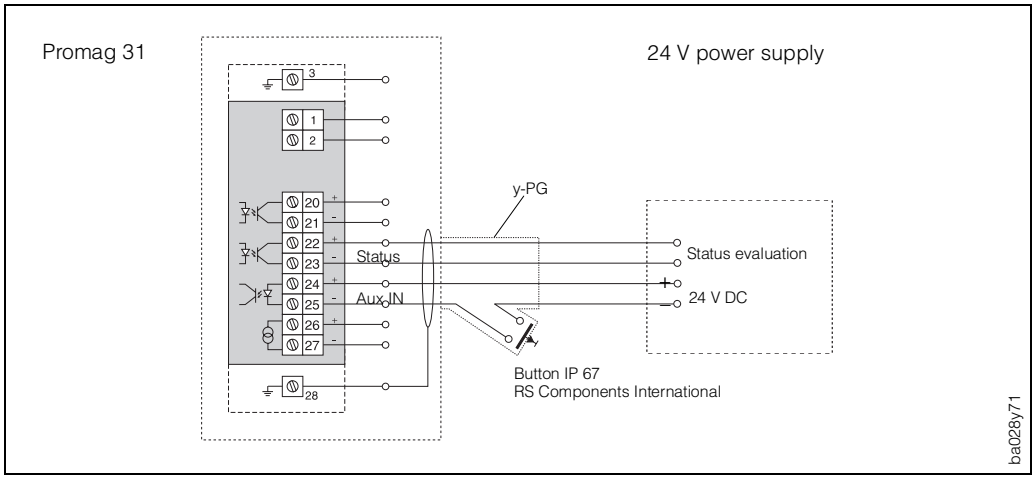


Fig. 33

Remote-mounted version (FS/FL): Connection between sensor and transmitter

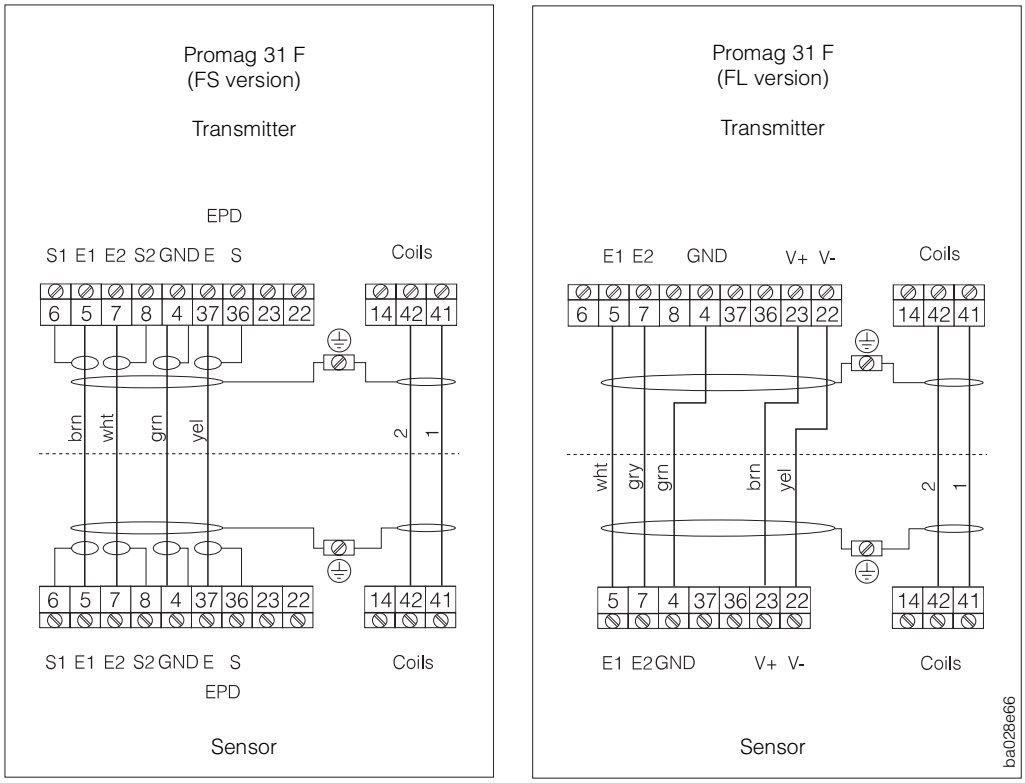


Fig. 34

3.5 Cable specifications

Cable specification for remote-mounted version (FS)

Coil cable: 2 x 0.5 mm^2 PVC cable with common screen
Conductor resistance: ≤37 Ω/km
Capacitance: core/core, screen earthed ≤120 pF/m

Signal cable: 3 x 0.38 mm^2 PVC cable with common screen and separately screened cores.
Conductor resistance: ≤50 Ω/km
Capacitance: core/screen ≤420 pF/m

Cable specification for remote-mounted version (FL)

Coil cable: 2 x 0.5 mm^2 PVC cable with common screen
Conductor resistance: ≤37 Ω/km
Capacitance: core/core, screen earthed ≤120 pF/m

Signal cable: 5 x 0.5 mm^2 PVC cable with common screen
Conductor resistance: ≤37 Ω/km
Capacitance: core/core, screen earthed ≤120 pF/m

Cable specifications for use in areas with severe electrical interference

The Promag 31 measuring equipment fulfils all general requirements for electromagnetic compatibility (EMC) according to EN 50081 Part 1 and 2 / EN 50082 Part 1 and 2 when installed in accordance with the NAMUR recommendations.


Note!

Note!
With the remote-mounted version (FS and FL) the signal and coil cables between sensor and transmitter must always be screened and earthed at both ends.
This is done at the earth terminals inside the connection housing of sensor and transmitter (see page 26).

4. Operation and Commissioning

4.1 Instrument Functions

With Promag 31, various instrument functions can be activated or deactivated using miniature switches (see page 33). Explanations on individual instrument functions are given on the following pages.

➤ **Creep suppression**

Works setting: Switched on
Switch No. 1: ON

Note!
With the fiscal measurement system Promag 31 the creep suppression is always activated.

Creep suppression prevents "false flow" in the lower part of the measuring range from being detected (e.g. varying liquid head at standstill). This enables flows to be suppressed which should not be measured or totalled.

Cut-in point
When the velocity of the medium is less than 0.02 m/s creep suppression is activated and all output signals (pulse and analogue signals) are set to the fall back value (0/4 mA, logical "0").

Cut-off point
When the velocity of the medium again exceeds v = 0.04 m/s, creep suppression is deactivated.

Nominal diameter		Cut-in point	Cut-off point
DIN [mm]	ANSI [inch]	at v = 0.02 m/s in [m^3/h]	at v = 0.04 m/s in [m^3/h]
15	$^1/_2$"	0.013	0.025
25	1"	0.035	0.071
32	$1^1/_4$"	0.058	0.116
40	$1^1/_2$"	0.090	0.181
50	2"	0.141	0.283
65	$2^1/_2$"	0.239	0.478
80	3"	0.362	0.724
100	4"	0.565	1.131
125	5"	0.884	1.767
150	6"	1.272	2.545
200	8"	2.262	4.524
250	10"	3.534	7.069
300	12"	5.089	10.179
350	14"	6.927	13.854
400	16"	9.048	18.096
450	18"	11.451	22.902
500	20"	14.137	28.274
600	24"	20.358	40.715
700	28"	27.709	55.418
750	30"	31.809	63.617
800	32"	36.191	72.382
900	36"	45.804	91.609
1000	40"	56.549	113.097
1200	48"	81.443	162.860
1350	54"	103.060	206.120
1400	56"	110.836	221.672
1500	60"	127.234	254.468
1600	64"	144.764	289.528
1700	66"	163.426	326.852
1800	72"	183.218	366.436
2000	78"	226.194	452.388

Note!

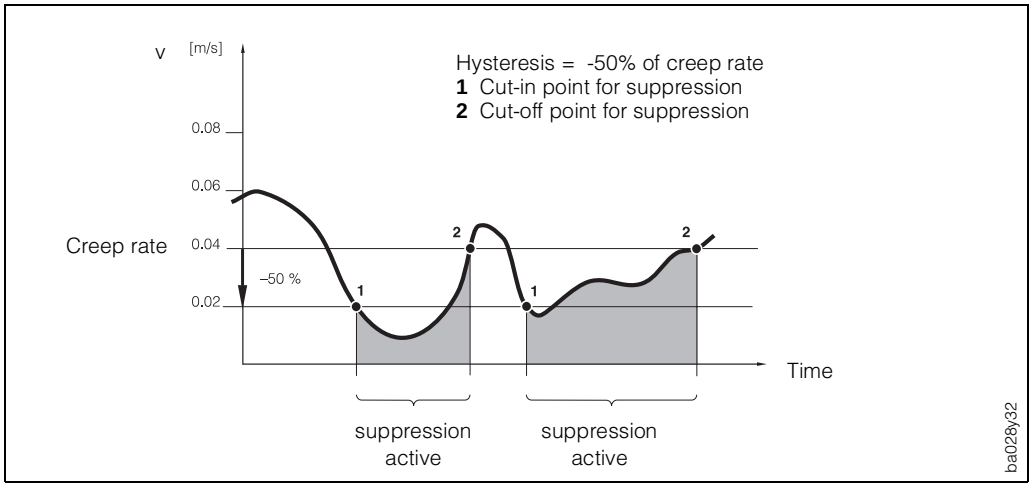


Fig. 35

➤ Status output

Works setting: Error messages
Switch No. 2: OFF

This switched output can optionally be configured for:

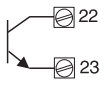
- 1) Signalling the flow direction
- Error messages: Fault (System error: coil current error, amplifier error DAT error, EEPROM error, ROM error, RAM error)
  Alarm (Process error: measuring range exceeded, v ≥12.5 m/s)
  Supply failure)

The status output acts as a normally closed contact, i.e. in normal operation fault, the output is closed (transistor conducting, see Fig. 36).

1) The “error messages” are always activated in the fiscal meter.

Note!

Note!
The behaviour of the outputs in the event of a fault is described in Chapter 5.1.

Configuration of status output	Status	Behaviour of open collector output 
Signalling of system and process errors	System OK	closed 
	Fault signal/alarm	open 
	Supply failure	open 
	«closed»: open collector ⇒ conducting «open»: open collector ⇒ not conducting	

ba028y33

Fig. 36

➤ System units

Works setting: SI units
Switch No. 3: OFF

SI units: volume in [l, m^3]
US units: volume in [US gal]

Note!

Note!
With the fiscal Promag 31 the SI units are always activated!

➤ Current range

Works setting: 4...20 mA
Switch No. 4: OFF

The current at zero flow (Q = 0) can be set to 0 or 4 mA. The current for the full-scale value is always 20 mA. Extension to 20.5 mA is possible.

Note!
With the fiscal Promag 31 the switch is always in OFF-position.

Note!

Note!
The Promag 31 measuring system can be operated in a bidirectional or unidirectional mode. Selecting this mode is dependent on the status output and functions as follows:

Note!

Configuration of status output	Operating mode	Function
Flow direction (only for none fiscal measurement operation!)	Bidirectional	• Continuous current and pulse output
System and process errors This type of operation is only used for fiscal measurement.	Unidirectional	• Current and pulse output for positive flow direction only

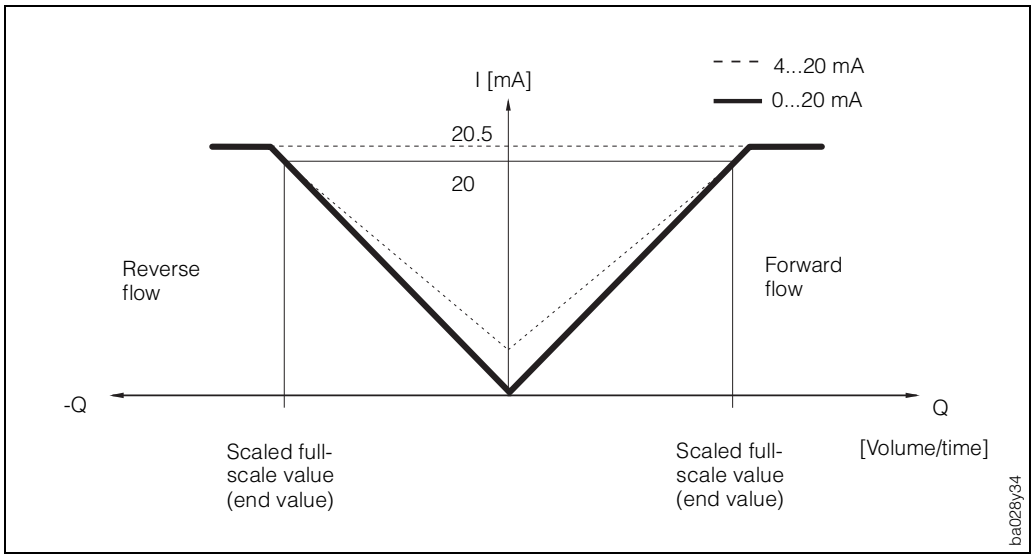


Fig. 37

➤ Pulse value

Works setting: at v ~ 2.5 m/s
Switches No. 5, 6, 7: OFF-OFF-ON

The pulse value indicates for what freely selected volume flow an output pulse is emitted. With an external counter these pulses can be totalled enabling the total volume flow to be determined.

The pulse-pause ratio is approx. 1:1. The pulse width is limited to a maximum of 2 s (≤0.25 Hz). At f = 400 Hz the maximum pulse width is 1 ms.

For the Promag 31 measuring system eight preset pulse-value steps can be selected in terms of the nominal diameter. Setting is made by means of three miniature switches (see Chapter 4.2).

➤ Setting the full-scale value

Works setting: at v ~ 2.5 m/s
Switches No. 8, 9, 10: OFF-OFF-ON

The current output supplies signals between 0/4 and 20 mA, corresponding to the momentary value of the flow. By setting the full-scale, a flow is assigned to the current of 20 mA. This setting always applies to both directions of flow (bidirectional). The direction of flow is emitted at the status output with appropriate configuration.
In practice the maximum rate of flow that occurs is not always reliably known. Therefore it is possible to extend up to 125% (500 Hz).
For the Promag 31 measuring system eight preset pulse-value steps can be selected in terms of the nominal diameter. Setting is made by means of three miniature switches (see Chapter 4.2).

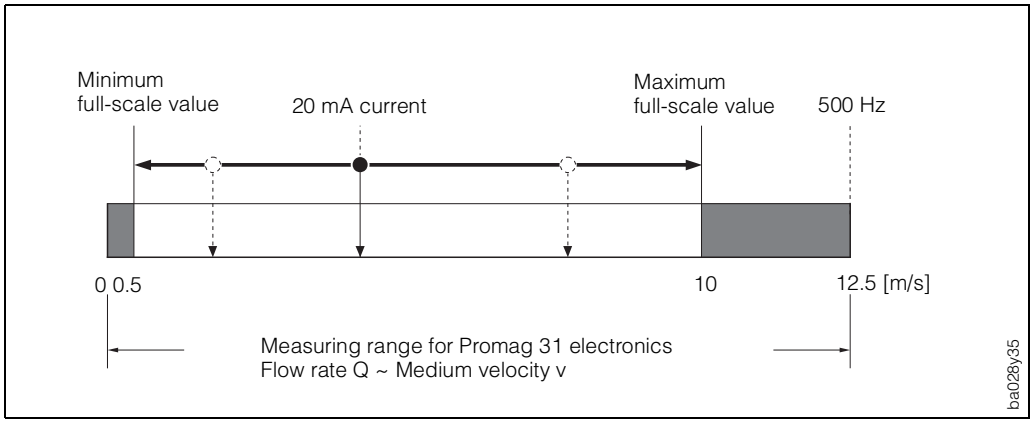


Fig. 38

➤ Auxiliary input

The auxiliary input cannot be affected by the miniature switches

Error reset and self test function of the display
In fiscal operation a pulse (3...30 V DC, min. 100 ms) resets a possible error.
Further more a display-self test runs for about 10 s.

Electrode Cleaning Circuit ECC (Option)
Conductive material build-up on the electrodes (e.g. magnetite) can lead to errors in measurement. The electrode cleaning circuit (ECC) has, therefore, been developed to prevent such a build-up. The cleaning cycles are carried out every 30 minutes for 2...5 secs each depending on the scanning frequency. If the Promag 31 measuring system is equipped with the electrode cleaning circuit option (ECC), then this can be switched on and off using the miniature switches on the amplifier board (see Fig. 44, on page 42). When delivered from the factory, the electrode cleaning circuit is always switched on. The ECC is not available with the FL version.

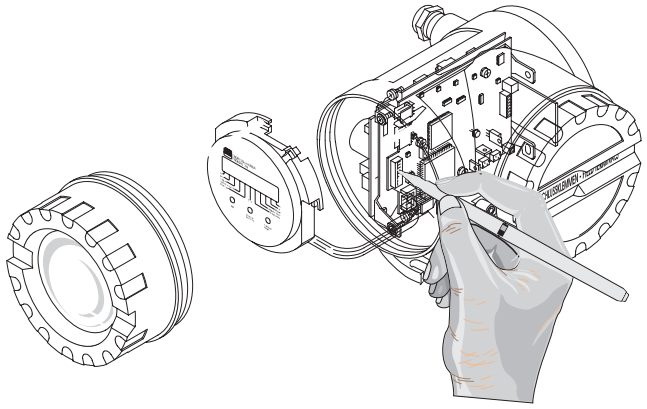

Caution!

Caution!
If the ECC is switched off for a long period of time in an application with conductive build-up, then material build-up in the measuring pipe can lead to measuring errors. If there is a large concentration of build-up at one point, then, under certain circumstances, switching on the ECC may not remove it. In such cases the measuring pipe is to be cleaned and the build-up removed.

4.2 Setting unit parameters with miniature switches

Warning!
Danger of electric shock! Switch off the supply voltage before you unscrew the cover of the electronic compartment of the transmitter housing.
Do not fail to observe the supplementary Ex documentation for Ex-certified instruments (in particular regarding rates of cooling).

1. Loosen the screws of the safety grip (3 mm Allen key).
2. Unscrew the cover of the electronics area.
3. Remove the local display (if present).
4. Set the miniature switches.
5. Put back the local display
6. Screw the cover to the electronics area securely on the transmitter housing and tighten the Allen screws of the safety grip securely.



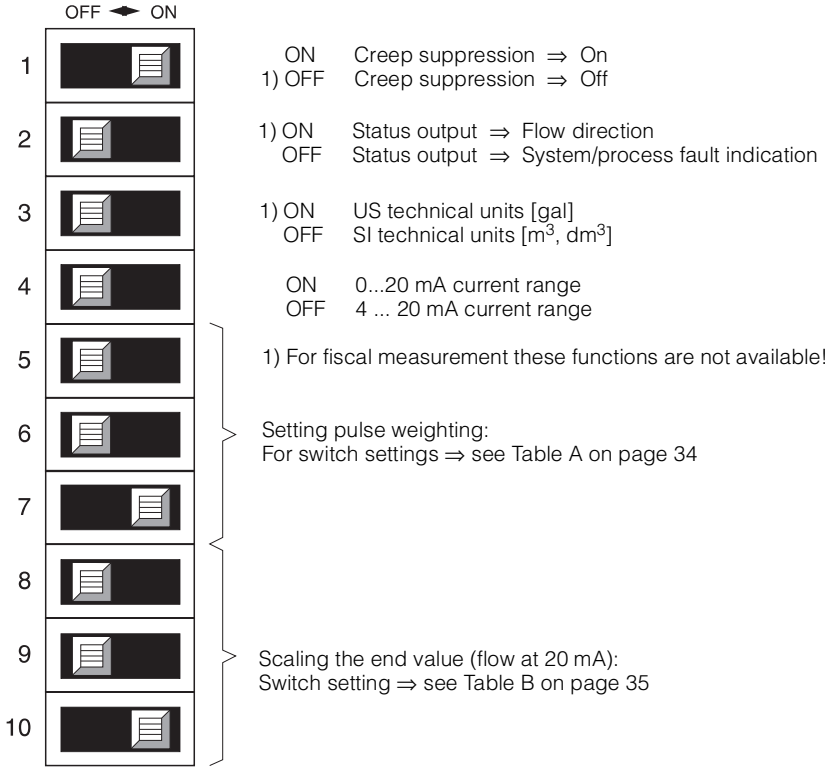


Fig. 39

Table A

Pulse value ⇒ SI units [dm³/pulse, m³/pulse]

Switch No. 5, 6 and 7

ba028yt4

DN [mm]								
ON	5 6 7	5 6 7	5 6 7	5 6 7	5 6 7	5 6 7	5 6 7	5 6 7
OFF								(f_{max} = 400 Hz at v = 10 m/s)
15	0.01 dm³	0.1 dm³	1 dm³	10 dm³	100 dm³	1 m³	10 m³	0.004418 dm³
25	0.1 dm³	1 dm³	10 dm³	100 dm³	1 m³	10 m³	100 m³	0.012272 dm³
32	0.1 dm³	1 dm³	10 dm³	100 dm³	1 m³	10 m³	100 m³	0.020106 dm³
40	0.1 dm³	1 dm³	10 dm³	100 dm³	1 m³	10 m³	100 m³	0.031416 dm³
50	0.1 dm³	1 dm³	10 dm³	100 dm³	1 m³	10 m³	100 m³	0.049087 dm³
65	0.1 dm³	1 dm³	10 dm³	100 dm³	1 m³	10 m³	100 m³	0.082958 dm³
80	1 dm³	10 dm³	100 dm³	1 m³	10 m³	100 m³	1000 m³	0.125664 dm³
100	1 dm³	10 dm³	100 dm³	1 m³	10 m³	100 m³	1000 m³	0.196350 dm³
125	1 dm³	10 dm³	100 dm³	1 m³	10 m³	100 m³	1000 m³	0.306796 dm³
150	1 dm³	10 dm³	100 dm³	1 m³	10 m³	100 m³	1000 m³	0.441786 dm³
200	1 dm³	10 dm³	100 dm³	1 m³	10 m³	100 m³	1000 m³	0.785398 dm³
250	10 dm³	100 dm³	1 m³	10 m³	100 m³	1000 m³	10000 m³	1.22718 dm³
300	10 dm³	100 dm³	1 m³	10 m³	100 m³	1000 m³	10000 m³	1.76715 dm³
350	10 dm³	100 dm³	1 m³	10 m³	100 m³	1000 m³	10000 m³	2.40528 dm³
400	10 dm³	100 dm³	1 m³	10 m³	100 m³	1000 m³	10000 m³	3.14159 dm³
450	10 dm³	100 dm³	1 m³	10 m³	100 m³	1000 m³	10000 m³	3.97608 dm³
500	10 dm³	100 dm³	1 m³	10 m³	100 m³	1000 m³	10000 m³	4.90874 dm³
600	10 dm³	100 m³	1 m³	10 m³	100 m³	1000 m³	10000 m³	7.06858 dm³
700	100 dm³	1 m³	10 m³	100 m³	1000 m³	10000 m³	100000 m³	9.62113 dm³
800	100 dm³	1 m³	10 m³	100 m³	1000 m³	10000 m³	100000 m³	12.5664 dm³
900	100 dm³	1 m³	10 m³	100 m³	1000 m³	10000 m³	100000 m³	15.9043 dm³
1000	100 dm³	1 m³	10 m³	100 m³	1000 m³	10000 m³	100000 m³	19.6350 dm³
1200	100 dm³	1 m³	10 m³	100 m³	1000 m³	10000 m³	100000 m³	28.2743 dm³
1400	100 dm³	1 m³	10 m³	100 m³	1000 m³	10000 m³	100000 m³	38.4845 dm³
1600	100 dm³	1 m³	10 m³	100 m³	1000 m³	10000 m³	100000 m³	50.2655 dm³
1800	100 dm³	1 m³	10 m³	100 m³	1000 m³	10000 m³	100000 m³	63.6173 dm³
2000	100 dm³	1 m³	10 m³	100 m³	1000 m³	10000 m³	100000 m³	78.5398 dm³

Caution!

Caution!
Work with this table only when you have turned switch No. 3 to "OFF" (SI units).

For each nominal diameter is a choice of eight pulse values (in decadic steps).
A definite frequency value (f_{max} = 400 Hz at v = 10 m/s, pulse width = 1 ms) is only available for a single switch position.

Example:
A maximum permissible pulse frequency f_{max} = 20 Hz (input frequency of electronic counter) should not be exceeded. The nominal diameter is assumed to be 25 mm; the rate of flow Q = 10.8 m³/h

$$\text{Pulse value} = \frac{Q}{f_{max}} = \frac{10.8\ m^3/h}{20\ s^{-1}} = \frac{3\ dm^3/s}{20\ s^{-1}} = 0.15\ dm^3$$

At DN 25 select the switch position for the next higher pulse value ⇒ 1 dm³ per pulse. Conversely, when the flow rate Q is known and a pulse value has been selected, the exact pulse frequency can be calculated.

Table B

Full-scale value setting ⇒ SI units [m^3/h]

Switch No. 8, 9 and 10

ba028yt5

DN [mm]	0.5 m/s		1 m/s		1.5 m/s		2 m/s		2.5 m/s		4 m/s		8 m/s		10 m/s (v = 10 m/s)	
ON / OFF	8 9 10		8 9 10		8 9 10		8 9 10		8 9 10		8 9 10		8 9 10		8 9 10	
15	0.3	m^3/h	0.6	m^3/h	0.9	m^3/h	1.2	m^3/h	1.5	m^3/h	3	m^3/h	4.8	m^3/h	6	m^3/h
25	1	m^3/h	2	m^3/h	3	m^3/h	4	m^3/h	5	m^3/h	10	m^3/h	16	m^3/h	20	m^3/h
32	1.5	m^3/h	3	m^3/h	4.5	m^3/h	6	m^3/h	7.5	m^3/h	15	m^3/h	24	m^3/h	30	m^3/h
40	2	m^3/h	4	m^3/h	6	m^3/h	8	m^3/h	10	m^3/h	20	m^3/h	32	m^3/h	40	m^3/h
50	4	m^3/h	8	m^3/h	12	m^3/h	16	m^3/h	20	m^3/h	40	m^3/h	64	m^3/h	80	m^3/h
65	6	m^3/h	12	m^3/h	18	m^3/h	24	m^3/h	30	m^3/h	60	m^3/h	96	m^3/h	120	m^3/h
80	10	m^3/h	20	m^3/h	30	m^3/h	40	m^3/h	50	m^3/h	100	m^3/h	160	m^3/h	200	m^3/h
100	15	m^3/h	30	m^3/h	45	m^3/h	60	m^3/h	75	m^3/h	150	m^3/h	240	m^3/h	300	m^3/h
125	20	m^3/h	40	m^3/h	60	m^3/h	80	m^3/h	100	m^3/h	200	m^3/h	320	m^3/h	400	m^3/h
150	30	m^3/h	60	m^3/h	90	m^3/h	120	m^3/h	150	m^3/h	300	m^3/h	480	m^3/h	600	m^3/h
200	50	m^3/h	100	m^3/h	150	m^3/h	200	m^3/h	250	m^3/h	500	m^3/h	800	m^3/h	1000	m^3/h
250	100	m^3/h	200	m^3/h	300	m^3/h	400	m^3/h	500	m^3/h	1000	m^3/h	1600	m^3/h	2000	m^3/h
300	150	m^3/h	300	m^3/h	450	m^3/h	600	m^3/h	750	m^3/h	1500	m^3/h	2400	m^3/h	3000	m^3/h
350	200	m^3/h	400	m^3/h	600	m^3/h	800	m^3/h	1000	m^3/h	2000	m^3/h	3200	m^3/h	4000	m^3/h
400	200	m^3/h	400	m^3/h	600	m^3/h	800	m^3/h	1000	m^3/h	2000	m^3/h	3200	m^3/h	4000	m^3/h
450	300	m^3/h	600	m^3/h	900	m^3/h	1200	m^3/h	1500	m^3/h	3000	m^3/h	4800	m^3/h	6000	m^3/h
500	400	m^3/h	800	m^3/h	1200	m^3/h	1600	m^3/h	2000	m^3/h	4000	m^3/h	6400	m^3/h	8000	m^3/h
600	600	m^3/h	1200	m^3/h	1800	m^3/h	2400	m^3/h	3000	m^3/h	6000	m^3/h	9600	m^3/h	12000	m^3/h
700	800	m^3/h	1600	m^3/h	2400	m^3/h	3200	m^3/h	4000	m^3/h	8000	m^3/h	12800	m^3/h	16000	m^3/h
800	1000	m^3/h	2000	m^3/h	3000	m^3/h	4000	m^3/h	5000	m^3/h	10000	m^3/h	16000	m^3/h	20000	m^3/h
900	1000	m^3/h	2000	m^3/h	3000	m^3/h	4000	m^3/h	5000	m^3/h	10000	m^3/h	16000	m^3/h	20000	m^3/h
1000	1500	m^3/h	3000	m^3/h	4500	m^3/h	6000	m^3/h	7500	m^3/h	15000	m^3/h	24000	m^3/h	30000	m^3/h
1200	2000	m^3/h	4000	m^3/h	6000	m^3/h	8000	m^3/h	10000	m^3/h	20000	m^3/h	32000	m^3/h	40000	m^3/h
1400	3000	m^3/h	6000	m^3/h	9000	m^3/h	12000	m^3/h	15000	m^3/h	30000	m^3/h	48000	m^3/h	60000	m^3/h
1600	4000	m^3/h	8000	m^3/h	12000	m^3/h	16000	m^3/h	20000	m^3/h	40000	m^3/h	64000	m^3/h	80000	m^3/h
1800	5000	m^3/h	10000	m^3/h	15000	m^3/h	20000	m^3/h	25000	m^3/h	50000	m^3/h	80000	m^3/h	100000	m^3/h
2000	5000	m^3/h	10000	m^3/h	15000	m^3/h	20000	m^3/h	25000	m^3/h	50000	m^3/h	80000	m^3/h	100000	m^3/h

Caution!

Caution!
Work with this table only when you have turned switch No. 3 to "OFF" (SI units).

For each nominal diameter, at a current of 20 mA, eight predefined flow end values according the above table can be chosen. With a max. flow $Q_{max.}$ >2000 m^3/h there is no such obligation.

4.3 Local display

Note!

Note!
For the fiscal measurement system Promag 31 there is no operation possible, because the access is sealed!

With the Promag 31 local display important variables can be read off and controlled directly at the measuring point:
- Flow rate and/or totaliser value
- Technical units (SI or US)
- Process conditions (creep. partially empty pipe)
- Error messages

It is possible to access, activate, and set various functions in sequence with the help of the three operating keys on the local display.

1. Loosen Allen screw (3 mm) of the safety grip. Unscrew the cover of the electronics compartment.
2. The keys may now be operated by pressing with a thin (non-conductive) pin. A switching cycle takes about 0.5...0.8 seconds.
3. Firmly screw back the cover of the electronics compartment to the transmitter housing once the settings have been entered. Firmly tighten the Allen screw of the safety grip.

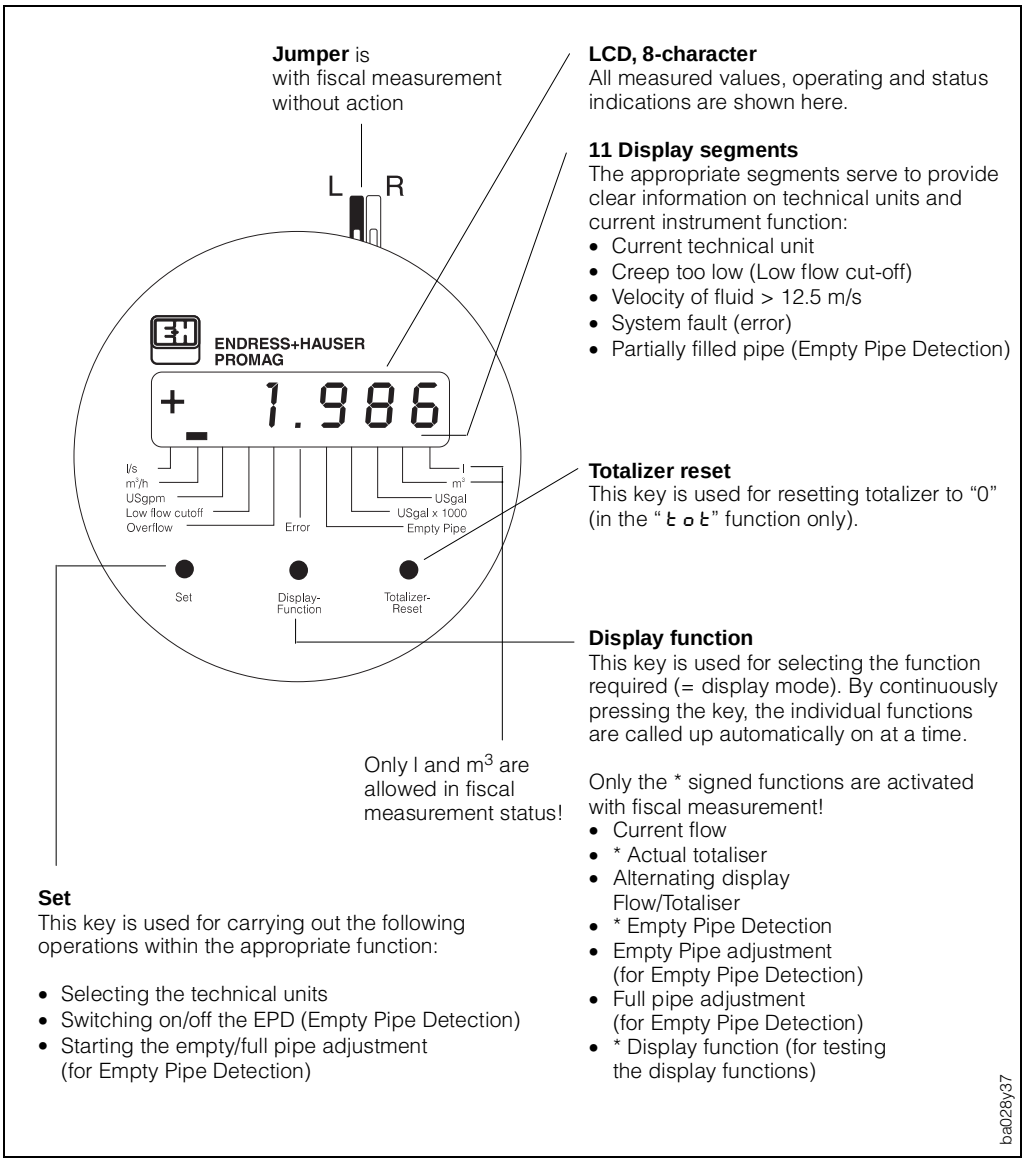


Fig. 40

Display functions

Display	Function	Description
tot	Display totaliser	Display of the current flow rate or totaliser volume. A negative flow direction is indicated by a negative digit. To select the measuring unit ⇒ press "**Set**" key
rAtE	Display flow rate only in ***non fiscal*** operation!	Caution! Setting of SI/US units is done by miniature switches on the measuring amplifier board (see Chapter 4.2).
diSP-0F	Display overflow totalis er (is only possible if you break the seal)	Display of the number of overflows at numerical values > 99 999 999. Note! A maximum of 21 overflows is displayed. Starting with the 22nd overflow, the totaliser begins to sum up from "0" upwards.
rAtE-tot	Display Flow rate/totaliser	Only with **non fiscal** measurement operation! Alternating display (about every 10 seconds) of the current flow rate and totaliser value.
EPd-oFF	Empty Pipe Detection (EPD)	The EPD function detects whether a measuring pipe is only partially filled with liquid For ON/OFF switching ⇒ press "**Set**" key
EPd-Ad_E	Empty pipe adjustment	Only with **non fiscal** measurement operation! Empty/full pipe adjustment for EPD To start adjustment ⇒ press "**Set**" key
EPd-Ad_F	Full pipe adjustment	Note! • Any adjustment has to be done **before** switching on EPD (otherwise the ADJ_ERROR message is displayed). • During adjustment the message ADJ_BUSY is displayed for about 0.5 s. After any adjustment ADJ_DONE is displayed
tESt	Test function	This function can only be activated with fiscal measurement status over the auxiliary input! Accessing this function activates an automatic test sequence of all display elements; the following displays are shown: 1. + 88 888 888 (incl. display segments) 2. - 00 000 000 (without display segments) 3. All display elements are blank 4. Flow indication

Additional Information!

- In case of system or process errors (incl. EPD) outputs react as described in Chapter 5.1 of the Operating Manual.
- In case of a supply breakdown, all measuring data (e.g. totaliser value) and configurations are saved and again available once the device is restarted.
- If a sensor equipped with an EPD electrode has to be exchanged during servicing, then the EPD calibration must always be carried out again.


Caution!


Note!


Note!


Note!

4.4 Commissioning

Before switching the measuring equipment on for the first time repeat the following checks:

- Check the electrical connections and the allocation of the terminals.
- Compare the data on the nameplate with the local mains voltage and frequency.
- Does the direction of the arrow on the nameplate (sensor) agree with the actual direction of flow in the piping?

If the results of these checks are satisfactory, switch on the supply voltage.
The unit is ready for operation.

5. Fault Location and Remedies

5.1 Behaviour of the measuring equipment in the event of a fault or alarm

Notes!

- Errors which occur while operation is in progress are emitted at the status output, provided its configuration is appropriate (see Chapter 4).
- An LED is also situated on the amplifier board of the Promag 31 (see Fig. 44). This LED is always lit as long as the measuring system is operating correctly. In case of error the LED is flushing, thus indicating an error. If the LED ist neither lit nor flashing there is a power supply breakdown. The LED is not accessable for the fiscal measurement version (seal!).


Note!

The Promag 31 measuring system reacts to faults or an alarm in the following manner:

Type of fault	Behaviour of the outputs
System error (fault, failure) Process error (alarm) Supply failure	➤ Status output open, i.e. open collector not conducting (see page 36). ➤ Pulse output: No output of pulses until the fault has been cleared. ➤ Current output: The current is set to a definite value until the fault has been cleared. 0...20 mA ⇒ 0 mA 4...20 mA ⇒ 2 mA

Note!

With measured value suppression the following points are important:

- System errors are given as usual over the status output.
- Process errors have a lower priority and are not given at the status output with active measured value suppression.
- With the fiscal measurement system Promag 31 the active measured value suppression is not available.


Note!

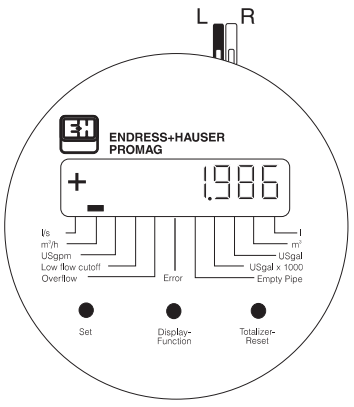
Error messages on the display	
 ba028y38	➤ System error ⇒ ERROR segment visible ➤ Process error ⇒ EDP segment visible (Empty Pipe) Not available with fiscal measurement system Promag 31! ➤ Overflow ⇒ Overflow segment visible

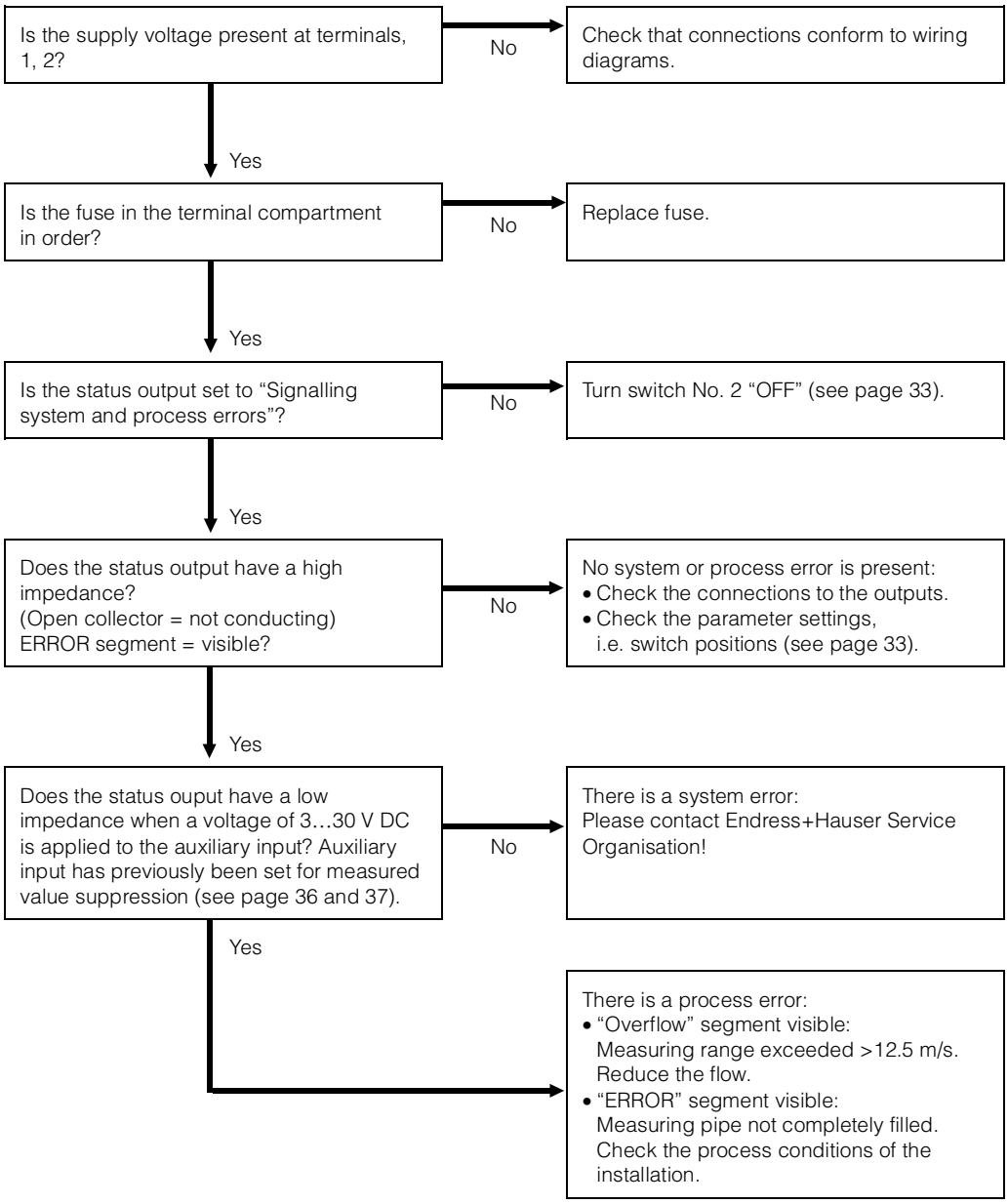
Fig. 41

5.2 Instructions for fault location and remedies

Note!
This instruction is only for the custody transfer meter Promag 31!
Please contact the E+H service for the fiscal measurement system.

During manufacture all units pass through various stages of quality control. The last inspection is wet calibration, which is carried out on a calibration rig designed according to the latest state of the art.

As an initial help in the location of faults, here is an overview of possible causes of faults:



5.3 Replacing the transmitter electronics

Note!
The exchange of the transmitter electronics on the fiscal measuring unit Promag 31 can only be done by breaking the seal!
After the exchange the authorised standards institution has to be contacted (seal!).

Note!

Warning!
- Danger from electric shock! Switch off the power supply before removing the cover to the electronics area of the transmitter housing.

Warning!

Caution!
- When replacing the electronic boards, ensure that their markings are identical.
- The local power supply voltage and frequency must be the same as the technical specifications of the power supply boards.

Caution!

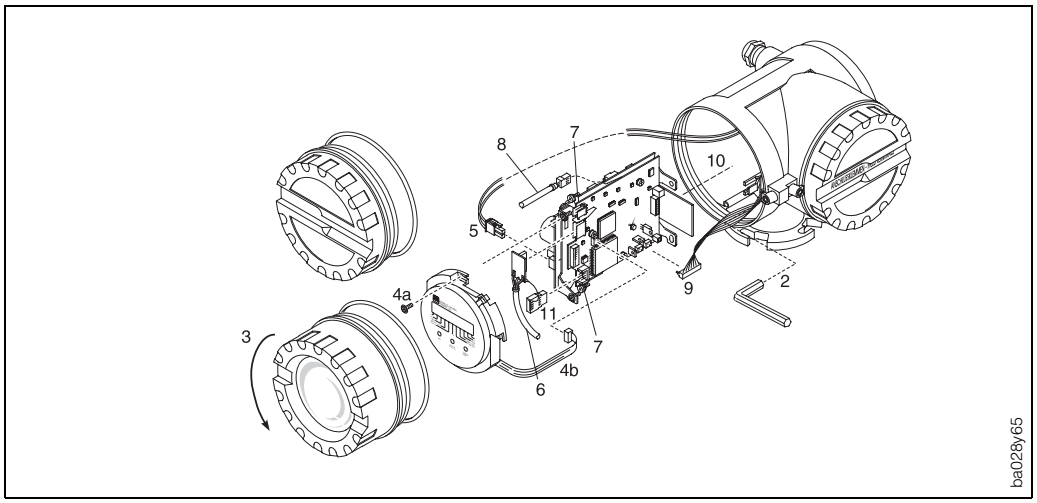


Fig. 42

Procedure:
1. Switch off the power supply (isolating the measuring system)
2. Loosen the Allen screws of the safety grip (3-mm Allen key).
3. Unscrew the cover of the electronics area of the transmitter housing.
4. Remove the local display (if present):
   a) Loosen the mounting screws of the display module.
   b) Unplug the ribbon cable of the display module form the amplifier board.
5. Remove the 2-pole plug of the power supply cable by pressing the catch of the power supply board at the same time (Fig. 43: V4).
6. Remove the cable board of the screened signal cable from the amplifier board (Fig. 44: V5).
7. Loosen the two Phillips screws of the board support plate.
   Carefully remove the support plate approx. 4–5 cm out of the transmitter housing.
8. Remove the coil current cable plug from the power supply board (Fig. 43: V1).
9. Remove the ribbon cable plug (connection cable to the connection terminal area) from the amplifier board (Fig. 44: V8, V9).
10. The entire transmitter electronics, together with the board support plate can now be completely removed from the housing.
11. If necessary, remove the DAT module from the pin strip (Fig. 44: V 10) on the amplifier board:
    – Required when replacing the transmitter electronics → plug the old DAT in the new amplifier board.
    – Required when replacing a defective DAT → plug the new DAT on the old amplifier board.
12. Replace the old transmitter electronics with new transmitter electronics.
13. Reassemble in reverse sequence.

Power supply board (Promag 31)

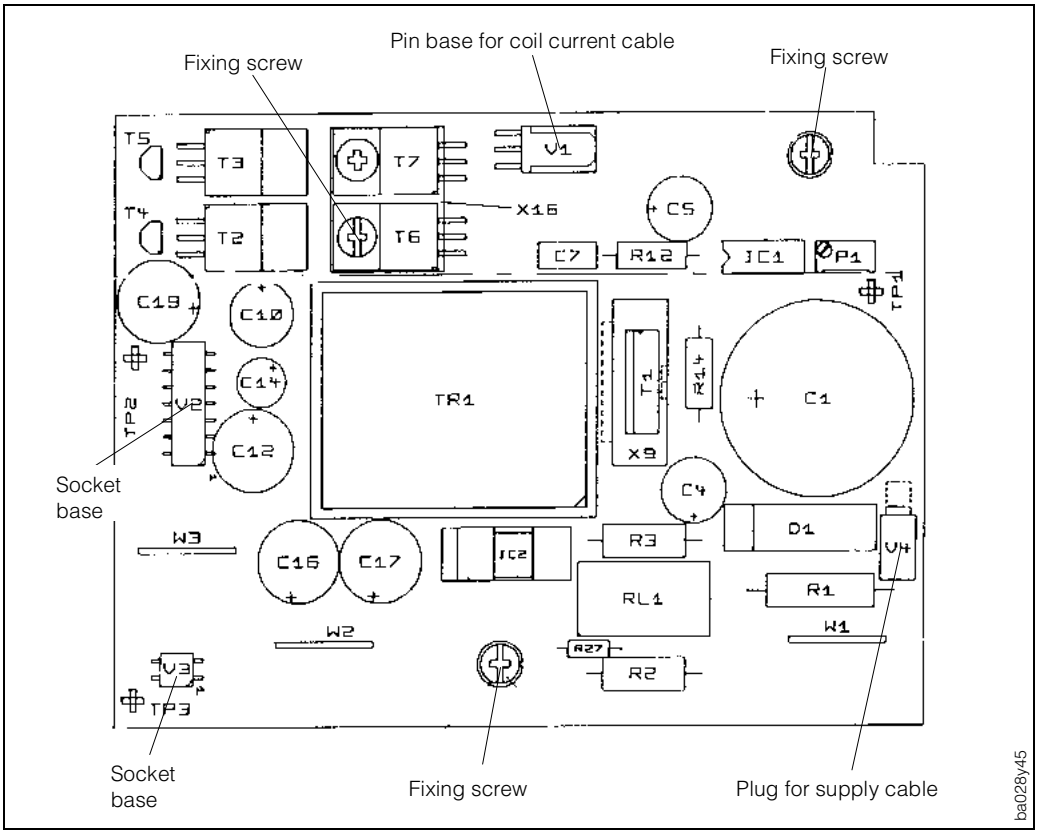


Fig. 43

Measuring amplifier board (Promag 31)

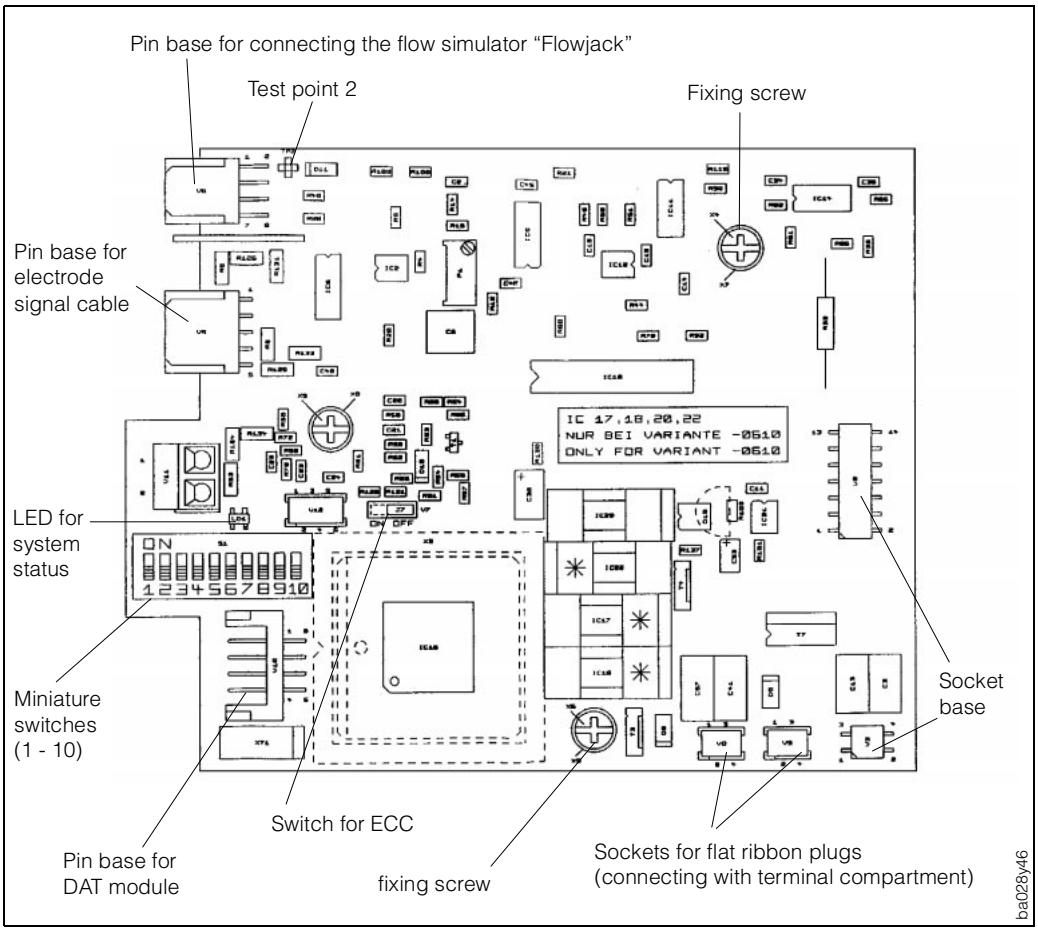


Fig. 44

5.4 Repairs

If you return a Promag 31 measuring unit to Endress+Hauser for repair, please enclose a note giving the following information:
- Description of the application
- Description of the fault
- Chemical and physical properties of the medium measured.

Caution!
Please carry out the following before you return the Promag 31 unit for repair:
- Remove all traces of the medium still adhering.
- This is particularly important if the medium is harmful for health, i.e. caustic, poisonous, cancerogenous, radioactive, etc. Please ensure that full handling details i.e. “Fluid Data Sheets” are enclosed.
- We must request you not to return a unit if it is not completely certain that harmful substances can be removed (e.g. cracks have been penetrated or substances have diffused through plastics).


Caution!

Incomplete cleaning of the instrument may result in waste disposal or cause harm to personnel (burns, etc). Any costs arising from this will be charged to the owner of the instrument.

6. Technical Data

6.1 Dimensions and weights

Note!
The dimensions and weights of explosion protected versions may differ from the specifications given here. These are given in the Ex supplement to this manual.

Promag 31 F, DN 15...300
Compact version

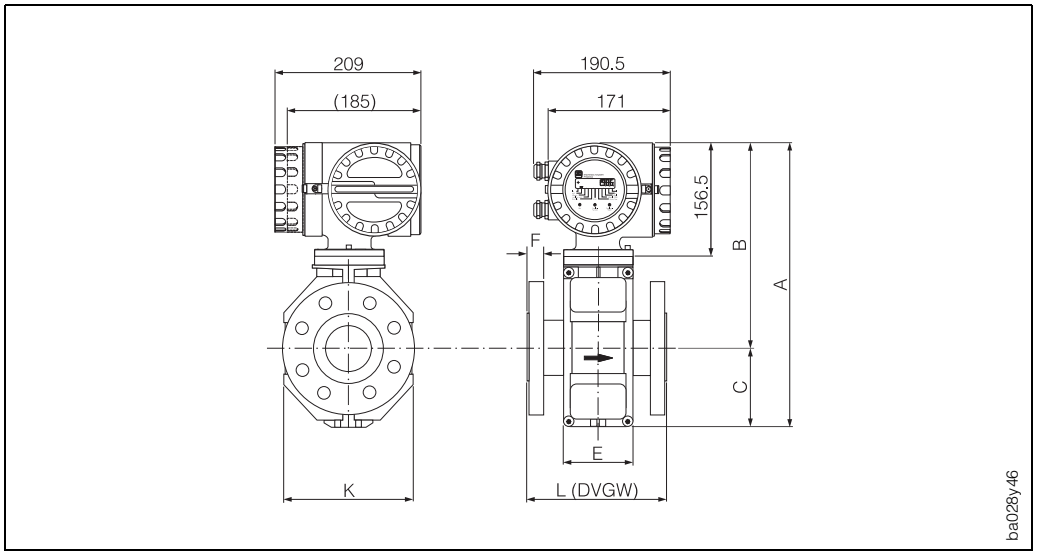


Fig. 45

Remote-mounted version (FS/FL)

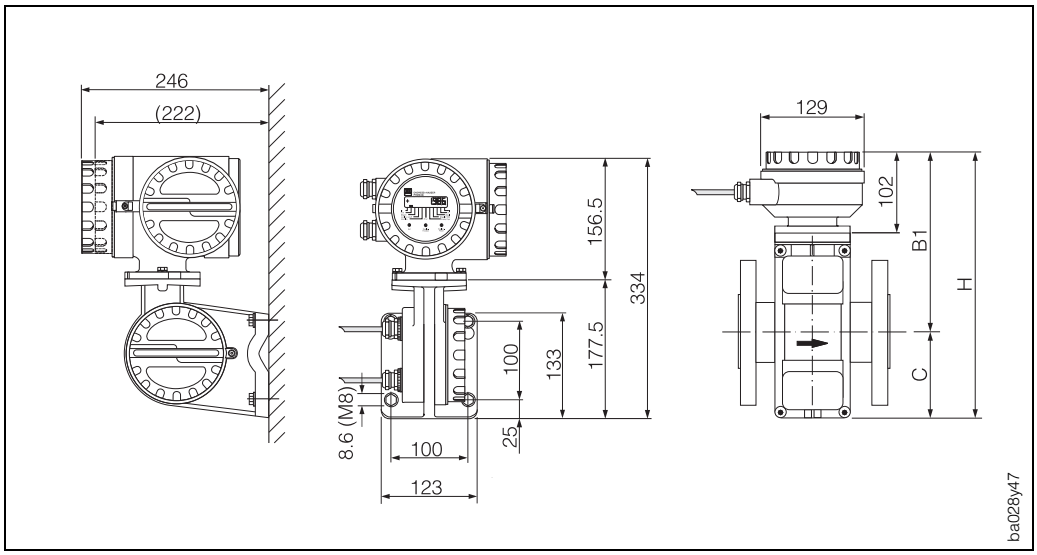


Fig. 46

DN		PN			L[1]	A	B	C	K	E	F		H	B1	Weight[2]
[mm]	[inch]	DIN [bar]	ANSI [lbs]	JIS	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	DIN [mm]	ANSI [mm]	[mm]	[mm]	[kg]
15	1/2"	40	150	20K	200	340.5	256.5	84	120	94	14	11.2	286	202	6.5
25	1"	40	150	20K	200	340.5	256.5	84	120	94	16	14.2	286	202	7.3
32	-	40	-	20K	200	340.5	256.5	84	120	94	18	-	286	202	8.0
40	1 1/2"	40	150	20K	200	340.5	256.5	84	120	94	18	17.5	286	202	9.4
50	2"	40	150	10K	200	340.5	256.5	84	120	94	20	19.1	286	202	10.6
65	-	16	-	10K	200	390.5	281.5	109	180	94	18	-	336	227	12.0
80	3"	16	150	10K	200	390.5	281.5	109	180	94	20	23.9	336	227	14.0
100	4"	16	150	10K	250	390.5	281.5	109	180	94	22	23.9	336	227	16.0
125	-	16	-	10K	250	471.5	321.5	150	260	140	24	-	417	267	21.5
150	6"	16	150	10K	300	471.5	321.5	150	260	140	24	25.4	417	267	25.5
200	8"	10	150	10K	350	526.5	346.5	180	324	156	26	28.4	472	292	35.3
250	10"	10	150	10K	450	576.5	371.5	205	400	166	28	30.2	522	317	48.5
300	12"	10	150	10K	500	626.5	396.5	230	460	166	28	31.8	572	342	57.5

[1] The face-to-face length is identical with the selected nominal diameter and independent of pressure rating.
[2] Weight of compact version

Weights
Compact version: see table above
Promag 31 transmitter: 3 kg (5 kg when wall-mounted)
Sensor connection housing: appr. 1 kg

Promag 31 F, DN 350...2000
(In general measuring points with DN >600 are don't have to have the PTB licence for the transport of cold water (waste water).

Compact version

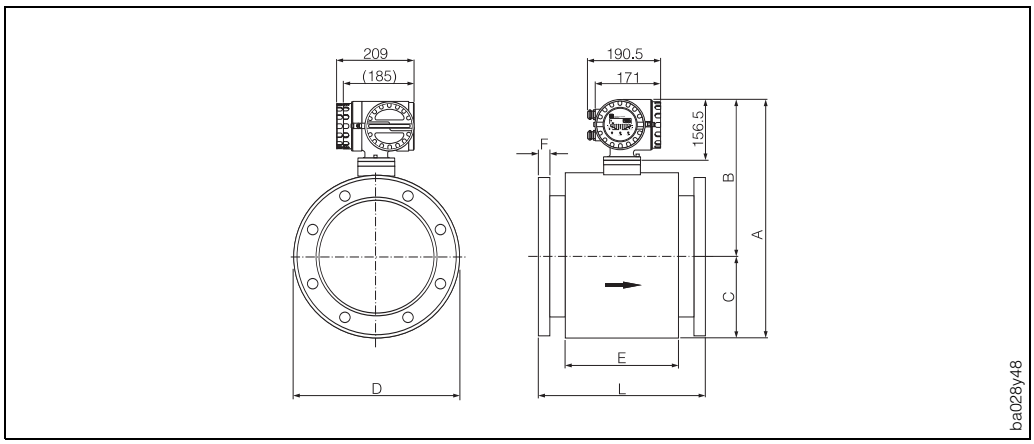


Fig. 47

Remote-mounted version (FS/FL)

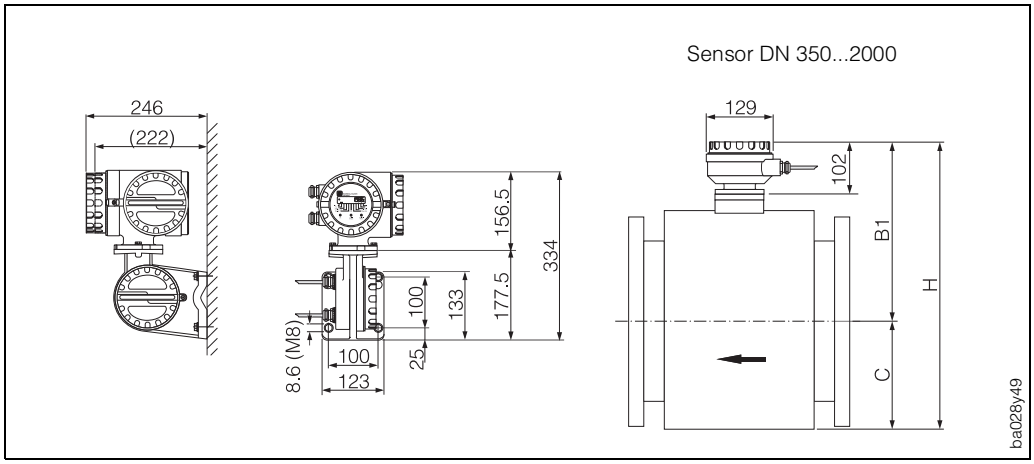


Fig. 48

DN		PN			L^1	A	B	C	K	E	F			H	B1	Weight[2]
[mm]	[inch]	DIN [bar]	ANSI [Class]	AWWA [Class]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	DIN [mm]	ANSI [mm]	AWWA [mm]	[mm]	[mm]	PN10/ANSI [kg]
350	14"	10	150	-	550	738	456	282	564	276	26	34.9	-	683.5	401.5	110
400	16"	10	150	-	600	790	482	308	616	276	26	36.5	-	735.5	427.5	130
450	18"	-	150	-	650	840	507	333	666	292	-	39.7	-	785.5	452.5	240
500	20"	10	150	-	650	891	532.5	358.5	717	292	28	42.9	-	836.5	478	170
600	24"	10	150	-	780	995	584.5	410.5	821	402	28	47.6	-	940.5	530	230
700	28"	10	-	D	910	1198	686	512	1024	589	30	-	33.3	1143.5	631.5	350
750	30"	-	-	D	975	1198	686	512	1024	626	-	-	34.9	1143.5	631.5	450
800	32"	10	-	D	1040	1241	707.5	533.5	1067	647	32	-	38.1	1186.5	653	450
900	36"	10	-	D	1170	1394	784	610	1220	785	34	-	41.3	1339.5	729.5	600
1000	40"	10	-	D	1300	1546	860	686	1372	862	34	-	41.3	1491.5	805.5	720
1050	42"	-	-	D	1365	1598	886	712	1424	912	-	-	44.5	1543.5	831.5	1050
1200	48"	6	-	D	1560	1796	985	811	1622	992	28	-	44.5	1741.5	930.5	1200
1350	54"	-	-	D	1755	1998	1086	912	1824	1252	-	-	54.0	1943.5	1031.5	2150
1400	-	6	-	-	1820	2148	1161	987	1974	1252	32	-	-	2093.5	1106.5	1800
1500	60"	-	-	D	1950	2196	1185	1011	2022	1392	-	-	57,2	2141.5	1130.5	2600
1600	-	6	-	-	2080	2286	1230	1056	2112	1482	34	-	-	2231.5	1175.5	2500
1650	66"	-	-	D	2145	2360	1267	1093	2186	1482	-	-	63.5	2305.5	1212.5	3700
1800	72"	6	-	D	2340	2550	1362	1188	2376	1632	36	-	66.7	2495.5	1307.5	3300
2000	78"	6	-	D	2600	2650	1412	1238	2476	1732	38	-	69.9	2595.5	1357.5	4100

[1] The face-to-face length is identical with the selected nominal diameter and independent of pressure rating.
[2] Weight of compact version

6.2 Technical data: Sensor

	Promag F
Nominal diameter	DN 15...2000
Nominal pressure	DIN: PN 10 (DN 200…2000) PN 16 (DN 65...150) PN 40 (DN 25...50) PN 16/25 (DN 200...300), Option PN 40 (DN 65...100), Opt. 20K (DIN 50...300), Opt.
Process connection	Flange connection (DIN, ANSI, JIS) (DN 15...100)
Flange material	DIN: St. 37.2, stainless steel 1.4571
Fluid temperature range, liner material	–40...+130 °C PTFE (DN 25...600) –20...+120 °C Soft rubber (DN 65...2000) 0...+80 °C Hard rubber (DN 65...2000) 0...+30 °C with the fiscal measurement unit, not dependent upon lining materials
Ambient temperature range	–20...+60 °C
Electrode material	1.4435, Platinum/Rhodium 80/20, Hastelloy C-22, Tantalum
Electrodes fitted	DN 15...2000: Measuring, reference and EPD electrodes (standard for 1.4435 and Hastelloy C-22)
Min. conductivity	5 µS/cm
Gasket material	—
Housing material	DN 25...300: powder-coated die-cast aluminium DN 350...2000: varnished steel
Type of protection (DIN 40050)	IP 67 (IP 68 option) NEMA 4X (NEMA 6P as option)
CIP cleanable	Yes (note max. temperature)
SIP cleanable	—
Power Supply	The sensor is supplied by the measuring transmitter
Explosion protected version	CENELEC: EEx d/de;
Approvals	—
Cable entries (Remote-mounted version)	PG 11 cable glands (5...12 mm) or NPT $^1/_2$", M20 x 1.5 (8...15 mm), G $^1/_2$"

Inside diameter of measuring pipe [mm]

Sensor	DN		PN			Inside diameter of measuring pipe in mm, lining		
	[mm]	[inch]	DIN [bar]	ANSI [lbs]	JIS	PFA	PTFE (Teflon)	Hard rubber, Soft rubber (EPDM)
Promag F	15	1/2"	40	Class 150	20K	–	15	–
	25	1"	40	Class 150	20K	–	26	–
	32	–	40	Class 150	20K	–	35	–
	40	1 1/2"	40	Class 150	20K	–	41	–
	50	2"	40	Class 150	10K	–	52	–
	65	–	16	Class 150	10K	–	68	65
	80	3"	16	Class 150	10K	–	80	78
	100	4"	16	Class 150	10K	–	105	100
	125	–	16	Class 150	10K	–	130	126
	150	6"	16	Class 150	10K	–	156	154
	200	8"	10	Class 150	10K	–	207	205
	250	10"	10	Class 150	10K	–	259	259
	300	12"	10	Class 150	10K	–	309	310
	–	14"	10	Class 150	–	–	337	341
	400	16"	10	Class 150	–	–	387	391
	–	18"	–	Class 150	–	–	–	436
	500	20"	10	Class 150	–	–	487	491
	600	24"	10	Class 150	–	–	593	593
	700	28"	10	–	–	–	–	692
	–	30"	–	–	–	–	–	741
	800	32"	10	–	–	–	–	794
	900	36"	10	–	–	–	–	893
	1000	40"	10	–	–	–	–	995
	–	42"	–	–	–	–	–	1042
	1200	48"	6	–	–	–	–	1195
	–	54"	–	–	–	–	–	1338
	1400	–	6	–	–	–	–	1401
	–	60"	–	–	–	–	–	1491
	1600	–	6	–	–	–	–	1599
	–	66"	–	–	–	–	–	1637
	1800	72"	6	–	–	–	–	1799
	–	78"	–	–	–	–	–	1981
	2000	–	6	–	–	–	–	1995

Resistance of the lining to vacuum (Standard version)

Sensor	DN		Lining	Limits for vacuum [mbar abs] at different medium temperatures					
	[mm]	[inch]		25 °C	80 °C	100 °C	120 °C	130 °C	150 °C
Promag F	65... 600	3...78"	Hard rubber, Soft rubber (EPDM)	0	0				
	25...2000	1...78"		0	0	0	0		
	15... 50	1/2...2"	PTFE (Teflon)	0	0	0	✶	100	
	65... 80	3"		0	✶	40	✶	130	
	100	4"		0	✶	135	✶	170	
	125...150	6"		135	✶	240	✶	385	
	200	8"		200	✶	290	✶	410	
	250	10"		330	✶	400	✶	530	
	300	12"		400	✶	500	✶	630	
	350	14"		470	✶	600	✶	730	
	400	16"		540	✶	670	✶	800	
	450...600	18...24"		Vacuum not permitted!					
✶ Values not available									

Temperature ranges of sensors

The maximum permissible ambient and medium temperatures must be adhered to at all times. When installed outdoors, specially in countries with high ambient temperatures please provide a weatherproof hood as protection against direct solar radiation.

- Promag F

Ambient temperature:	–20... + 60 °C	
Medium temperature:	–40... +130 °C	PTFE (Teflon)
	–20... +120 °C	soft rubber (EPDM)
	0... + 80 °C	hard rubber


Note!

Note!
In fiscal metering applications operates within a temperature range of 0...+30 °C for cold water.


Caution!

Caution!
At high medium and ambient temperatures it is necessary to mount the Promag F sensor and Promag 31 transmitter separately. Risk of the electronics becoming over-heated!

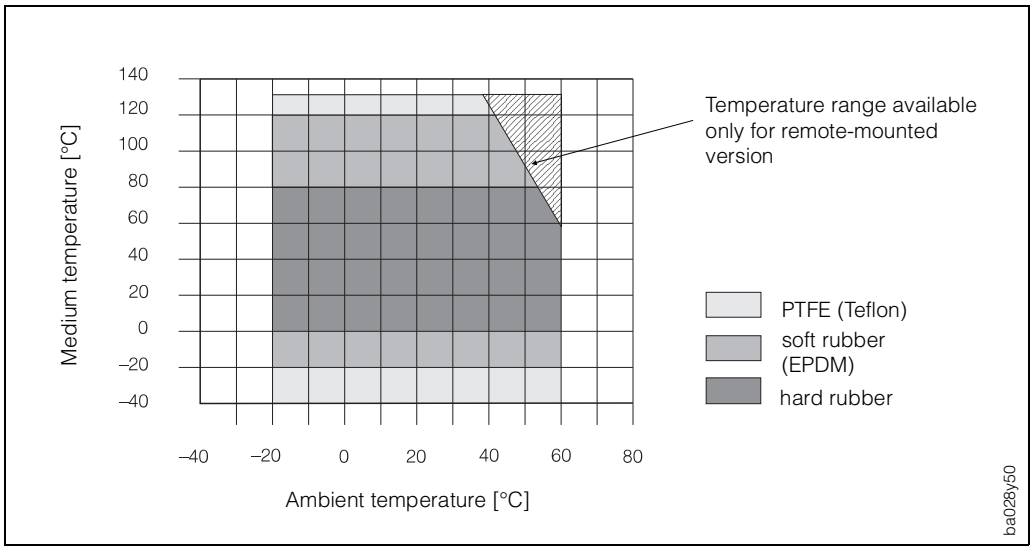


Fig. 49:
Limits of application in terms of temperature for compact version and lining

Pressure limitations

Promag F sensor (flange-mounted)

Pressure limitations due to fluid temperature (DIN 2413 and 2505)
Flange material: steel 37.2

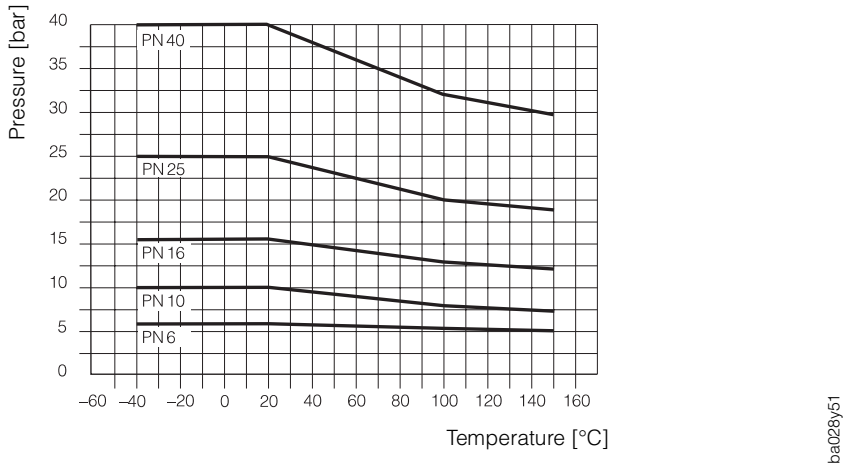


Fig. 50

Pressure limitations due to fluid temperature (DIN 2413 and 2505)
Flange material: stainless steel 1.4571

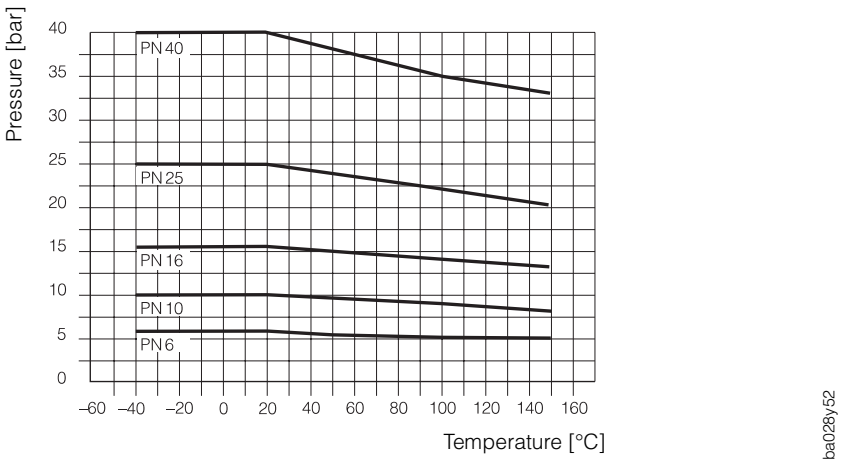


Fig. 51

6.3 Technical data: Transmitter and measuring system

Housing material	Powder-coated die-cast aluminium
Protection	IP 67 (EN 60529)
Ambient temperature	-20...+60 °C
Resistance to shock and vibration	Acceleration up to 2 g/2 h per day; 10...100 Hz (complete measuring system)
Cable entries	Power supply cable and signal cable (inputs/outputs) PG 13.5 cable glands (5...15 mm) Coil cable and signal cable (remote-mounted version): PG 11 cable glands (5...12 mm)
Power supply	85...260 V AC, 45...65 Hz 20... 55 V AC, 16...62 V DC Supply failure: Bridging over min. 1 mains cycle (22 ms)
Power consumption	AC: <15 VA (incl. sensor) DC: <15 W (incl. sensor)
Galvanic separation	Input and output galvanically separated from supply, from sensor and from one another (U_{max} = 500 V)
Full-scale value scaling	0.4...10 m/s
Current output	0/4...20 mA adjustable, galvanically separated, R_L <700 Ω, Time constant: automatically assigned full-scale value can be set, Temperature coefficient: 0.01 % o.r./°C, additional error: 0.3 % o.r.
Pulse output (open collector)	f_{max} = 400 Hz, U_{max} 30 V, I_{max} 250 mA, galvanically separated, pulse value adjustable, pulse/pause ratio appr. 1:1, pulse width max. 2 s,
Status output (open collector)	U_{max} 30 V, I_{max} 250 mA; Adjustable for: System and process error messages, Flow direction recognition
Auxiliary input (Measured value suppression)	U = 3...30 V DC, R_i = 1.8 kΩ, galvanically separated Adjustable for measured value suppression or external totaliser reset (if instrument fitted with display).
Compatibility with interference (EMC)	As per EN 50081 Part 1 and 2 / EN 50082 Part 1 and 2, and NAMUR recommendations (complete measuring system)
Explosion protected version	Compact and remote versions for: CENELEC: EEx d/de
Approvals	PTB-licence for the transport of cold water (waste water)

6.4 Nominal diameter and flow rate

As a rule the pipe diameter governs the nominal diameter of the sensor. When the volume flow is known, it is possible to estimate from the table below whether the optimal velocity range of 2...3 m/s can be adhered to.
The flow velocity (v) also has to matched to the physical properties of the medium:
- v < 2 m/s: with abrasive media (potter's clay, lime milk, or slurry)
- v > 2 m/s: with media forming a coating (waste-water sludge, etc.)

If it is necessary to increase the flow velocity, this can be done by reducing the nominal diameter of the sensor.

The table below summarizes the minimum and maximum full-scale values (incl. works setting) which can be set by miniature switches in Promag 31.

DN [mm]	Metrological Classes A [m^3/h] $Q_{n\,(min)}$	$Q_{min} : Q_n$	A [m^3/h] $Q_{n\,(max)}$	B [m^3/h] $Q_{n\,(min)}$	$Q_{min} : Q_n$	B [m^3/h] $Q_{n\,(max)}$
15	0.8	1 : 25	3	1.6	1 : 50	3
25	2.2		8.8	4.4		8.8
32	3.6		15	7.2		15
40	5.6		22	11.3		22
50	9.0		35	*15	1 : 33	35
65	15		60	20		60
80	*15	1 : 12.5	90	30		90
100	18		140	46		140
125	28		220	73		220
150	40		220	105		220
200	70		550	190		550
250	110		880	290		880
300	160		1250	420		1250
350	215		1700	570		1700
400	280		2200	750		2200
500	440		3500	1170		3500
600	640		5000	1700		5000

$Q_{n\,(min)}$ with reference to Q_{min} (v = 0.05 m/s)
$Q_{n\,(max)}$ with reference to v = 5 m/s
* = Limit range Q ≥15 m^3/h

Diameters DN 800...DN 2000 are also approved.
Measuring points with these diameters are however normally not approved for cold water fiscal metering (Q_{max} >2000 m^3/h).

6.5 Conceptual definitions

Temperature ranges for cold water: 0...30 °C

Metrological Classes

A+B Indicate the range from Q_{max} (full scale value) down to Q_{min} in which the approved fiscal meter can measure. Within this complete range, the maximum error as defined by the metrology office shall not be exceeded.

Limiting values of flow rate

Q_{max} Highest flow rate without damaging the measuring unit and without exceeding the maximum permissible error.

Q_n The nominal flow rate is half the value of the highest flow rate Q_{max} and is to characterize the measuring unit.

Q_{min} Lowest flow rate from which the measuring unit shall not exceed the maximum permissible error. It is dependent on Q_n and the metrological class.

Q_t Is the transition flow rate, which separates the lower and the upper maximum permissible range from each other with different error values. Q_t is dependent on Q_n and the metrological class.

Error limits

Q_{min}…Q_t lower range: ±5%

Q_t…Q_{max} upper range: ±2%

Metrology classes

Class		Q_n	
		<15 m³/h	>15 m³/h
Class A	range of Q_{min} range of Q_t	0.04 Q_n 0.10 Q_n	0.08 Q_n 0.30 Q_n
Class B	range of Q_{min} range of Q_t	0.02 Q_n 0.08 Q_n	0.03 Q_n 0.20 Q_n

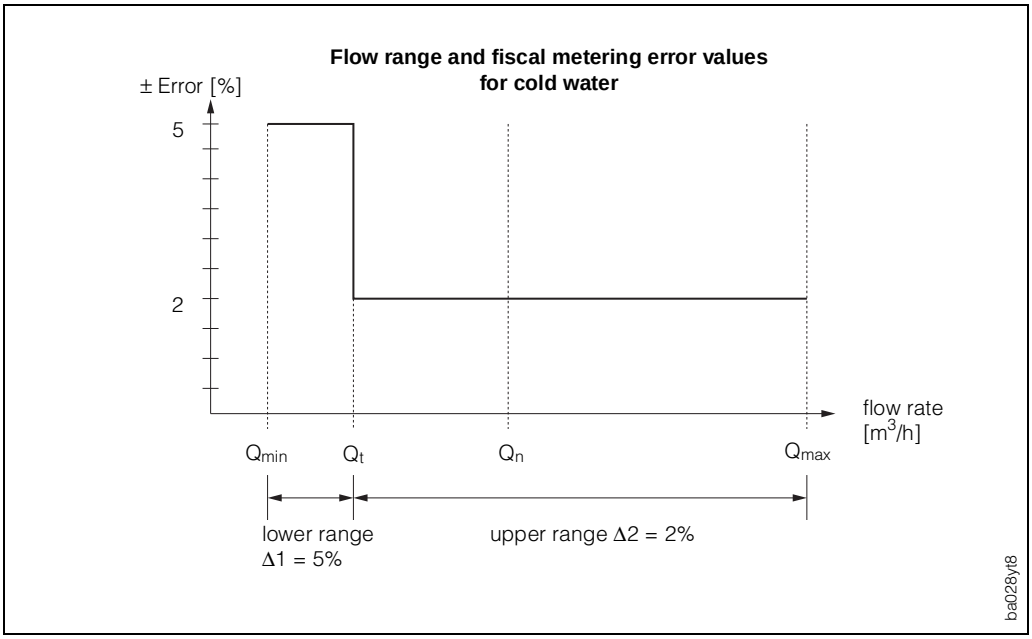


Fig. 52

6.6 Error limits

Measuring uncertainty under reference conditions

Pulse output	± 0.5% o.r. ± 0.01% o.f.s. (full-scale value = 10 m/s)
Current output	plus typ. ±10 µA
Repeatability	± 0.1% o.r. ± 0.005% o.f.s.
Options	Promag 31 F: ± 0.2% o.r. ± 0.05% of Q_k Q_k = desired reference flow rate for calibration (v = 2...10 m/s). Please quote Q_k when ordering
Power supply voltage	Within the specified range, fluctuation of the supply voltage has no effect.

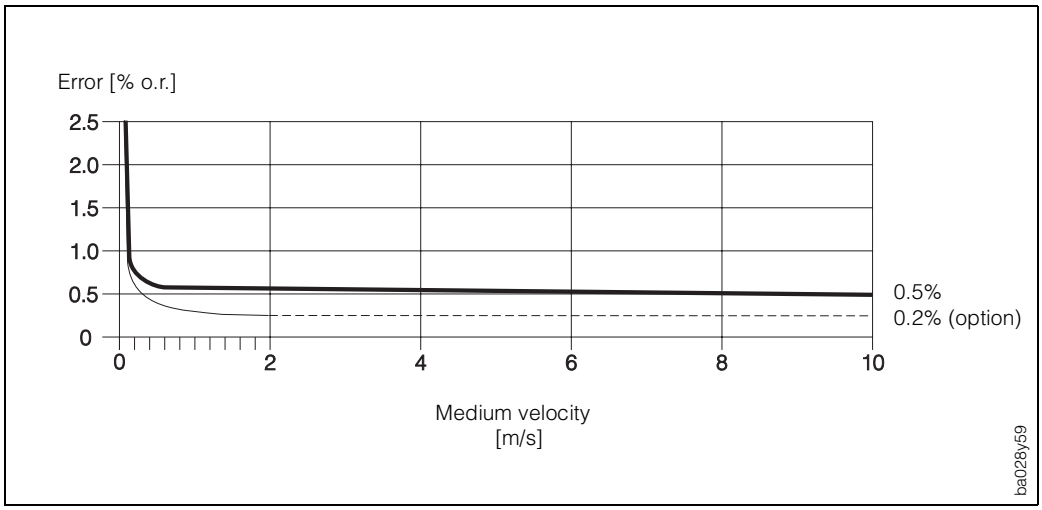


Fig. 53

Reference conditions (DIN 19200 and VDI/VDE 2641)

Medium temperature	+28 °C ± 2 K
Ambient temperature	+22 °C ± 2 K
Heating-up time	30 minutes
Installation at reference conditions	inlet length >10 x DN outlet length >5 x DN Sensor and transmitter are earthed. The sensor is mounted centrally in the pipe.

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