



OPERATIONS AND MAINTENANCE MANUALS

Regional Lagoons Manuals > ST56 Boonah STP > Electrical

Builder
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Introduction


Supply of new switchboard and power to new buildings onsite


- Design and construction of new CT metering switchboard
- Installation of new power to MF,PH and Chlorine buildings
- Installation of new Florescent lighting in new buildings


Assets

Asset ID	#AST5	Parent ID	
Description	Switchboard	Service	(5.0) Electrical Distribution
Subservice	(SWB) SWITCHBOARD_MCC	Site	(ST056) Boonah
Process	(1100.0) GENERAL	Sub	(1150) SEWERAGE
Location Description	Boonah	Make	CT metering Switchboard
Model	250 A	Serial Number	
Supplier		Quantity	1
Retail Price \$	32	Install Date	May 15, 2013
Wty Expiry Date	May 15, 2013	Life Expectancy (yrs)	25
Reference Information	Note: The factory warranty is 12 months from installation so this item will be covered by the Principal Contractor until the end of the 12 month defect liability period.		

Asset ID	#AST9	Parent ID	
Description	Lights	Service	(9.0) Other Equipment
Subservice	(HYD) HYDRAULIC_SYS	Site	(ST056) Boonah
Process	(0000) WATER DISTRIBUTION (Non sewerage treatment or pumping processes)	Sub	
Location Description	Newly constructed MF building	Make	Clipsal
Model	WEATHERPROOF IP65 T8 2X36W	Serial Number	
Supplier		Quantity	4
Retail Price \$	60	Install Date	Jun 12, 2013
Wty Expiry Date		Life Expectancy (yrs)	5
Reference Information			

Asset ID	#AST11	Parent ID	
Description	Flow meter	Service	(6.0) Control and Instrumentation
Subservice	(FM_) FLOW_METER	Site	(ST056) Boonah
Process	(2700.0) EFFLUENT REUSE	Sub	(2710) EFFLUENT TREATMENT AND DELIVERY
Location Description	Flow meter chamber	Make	ABB
Model	Mega flow B5 flow meter	Serial Number	50P80-E91B1AC4ABAA
Supplier	ABB	Quantity	1
Retail Price \$	3500	Install Date	Mar 12, 2014
Wty Expiry Date	Mar 12, 2014	Life Expectancy (yrs)	15
Reference Information	Note: The factory warranty is 12 months from installation so this item will be covered by the Principal Contractor until the end of the 12 month defect liability period.		
Documents	 ABB -DS_WM-EN_W.pdf		

Asset ID	#AST15	Parent ID	
Description	Flow meter	Service	(6.0) Control and Instrumentation
Subservice	(FM_) FLOW_METER	Site	(ST056) Boonah
Process	(2390) PROCESS, CONTROL & ELECTRICAL POWER	Sub	(2490) PROCESS, CONTROL & ELECTRICAL POWER
Location Description		Make	Endress & Hauser
Model	Promag 50P1H DN1004"	Serial Number	50P1H-E91A1AC4ABAD
Supplier	Endress & Hauser	Quantity	1
Retail Price \$	3600	Install Date	Mar 12, 2013
Wty Expiry Date	Mar 12, 2014	Life Expectancy (yrs)	15
Reference Information	Note: The factory warranty is 12 months from installation so this item will be covered by the Principal Contractor until the end of the 12 month defect liability period.		
Documents	 DS_WM-EN_S.pdf		

Asset ID	#AST16	Parent ID	
Description	Hydrostatic Level probe	Service	(1.0) Site, Process or Subprocess
Subservice	(SP_) SEWER_PS	Site	(ST056) Boonah
Process	(0100) SEWAGE DELIVERY	Sub	(0190) PROCESS, CONTROL & ELECTRICAL POWER
Location Description	Tank	Make	Endress & Hauser
Model	Waterpilot FMX21	Serial Number	FMX21-15N7/0
Supplier	Endress & Hauser	Quantity	1
Retail Price \$	1000	Install Date	Mar 12, 2013
Wty Expiry Date	Mar 12, 2014	Life Expectancy (yrs)	15
Reference Information	Note: The factory warranty is 12 months from installation so this item will be covered by the Principal Contractor until the end of the 12 month defect liability period.		
Documents	 FMX21 Operating Instructions.pdf		

Operating Instructions

Waterpilot FMX21

Hydrostatic level measurement

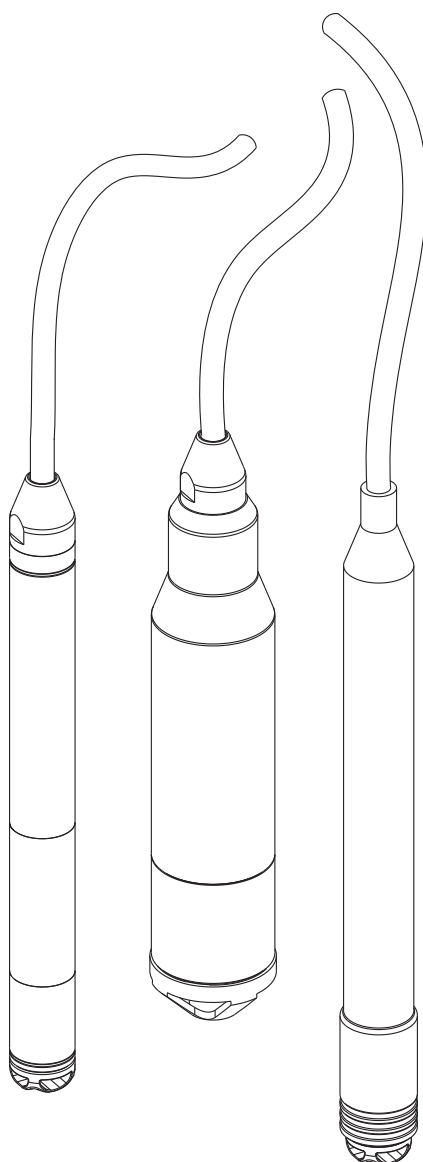






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1 About this document

1.1 Symbols



1.1.1 Safety symbols

Symbol	Meaning
 A0011189-DE	DANGER! This symbol alerts you to a dangerous situation. Failure to avoid this situation will result in serious or fatal injury.
 A0011190-DE	WARNING! This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in serious or fatal injury.
 A0011191-DE	CAUTION! This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in minor or medium injury.
 A0011192-DE	NOTICE! This symbol contains information on procedures and other facts which do not result in personal injury.



1.1.2 Electrical symbols

Symbol	Meaning
 A0018335	Direct current A terminal to which DC voltage is applied or through which direct current flows.
 A0018336	Alternating current A terminal to which alternating voltage is applied or through which alternating current flows.
 A0018337	Direct current and alternating current <ul style="list-style-type: none"> ■ A terminal to which alternating voltage or DC voltage is applied. ■ A terminal through which alternating current or direct current flows.
 A0018338	Ground connection A grounded terminal which, as far as the operator is concerned, is grounded via a grounding system..
 A0018339	Protective ground connection A terminal which must be connected to ground prior to establishing any other connections.
 A0011201	Equipotential connection A connection that has to be connected to the plant grounding system: This may be a potential equalization line or a star grounding system depending on national or company codes of praxis.


1.1.3 Symbols for certain types of information

Symbol	Meaning
 A0011193	Tip Indicates additional information.
 A0015484	Reference to page Refers to the corresponding page number.

1.1.4 Symbols in graphics

Symbol	Meaning
1, 2, 3, 4, ...	Item numbers
A, B, C, D, ...	Views
 A0011187	Hazardous area Indicates a hazardous area.
 A0011188	Safe area (non-hazardous area) Indicates a non-hazardous location.

1.1.5 Symbols at the device

Symbol	Meaning
	Connecting cable immunity to temperature change Indicates that the connecting cables must be able to withstand temperatures of at least 85 °C (185 °F).

1.2 Registered trademarks

GORE-TEX®

Trademark of W.L. Gore & Associates, Inc., USA.

TEFLON®

Trademark of E.I. Du Pont de Nemours & Co., Wilmington, USA.

HART®

Trademark of the HART Communication Foundation, Austin, USA.

FieldCare®

Trademark of Endress+Hauser Process Solutions AG.

iTEMP®

Trademark of Endress+Hauser Wetzler GmbH + Co. KG, Nesselwang, D.

2 Basic safety instructions

2.1 Designated use

The Waterpilot FMX21 is a hydrostatic pressure sensor for measuring the level of fresh water, wastewater and salt water. The temperature is measured simultaneously in the case of sensor versions with a Pt100 resistance thermometer. An optional temperature head transmitter converts the Pt100 signal to a 4 to 20 mA signal with superimposed digital communication protocol HART 6.0.

The manufacturer accepts no liability for damages resulting from incorrect use or use other than that designated.

2.2 Installation, commissioning and operation

The Waterpilot FMX21 and the (optional) TMT182 temperature head transmitter are designed to meet state-of-the-art safety requirements and comply with applicable regulations and EC Directives. If used incorrectly or for applications for which they are not intended, the devices can be a source of application-related danger, e.g. product overflow due to incorrect installation or configuration. For this reason, installation, connection to the electricity supply, commissioning, operation and maintenance of the measuring system must only be carried out by trained, qualified specialists authorized to perform such work by the facility's owner-operator. The specialist staff must have read and understood these Operating Instructions and must follow the instructions they contain. Modifications and repairs to the devices are permissible only if they are expressly allowed in the Operating Instructions. Pay particular attention to the data and information on the nameplate.

2.3 Operational safety and process safety

Alternative monitoring measures have to be taken while configuring, testing or servicing the device to ensure the operational and process safety.

2.3.1 Hazardous area (optional)

Devices for use in hazardous areas bear an additional marking on the nameplate (→ 6). If using the measuring system in hazardous areas, the appropriate national standards and regulations must be observed. The device is accompanied by separate Ex documentation, which is an integral part of this documentation. The installation regulations, connection values and safety instructions listed in this document must be observed. The documentation number of the related Safety Instructions (XA) is also indicated on the nameplate.

- Ensure that all personnel are suitably qualified.
- Measuring point requirements with regard to measurement and safety must be observed.
- Please refer to the "Ordering information" section of Technical Information TI00431P/00/EN for versions for approvals in the order code.

3 Incoming acceptance and product identification

3.1 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.

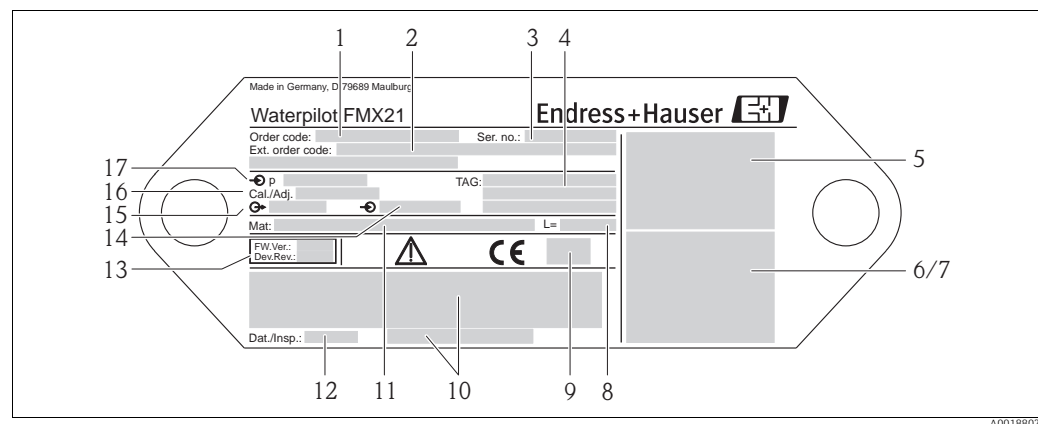
3.2 Product identification

The following options are available for identification of the measuring device:

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

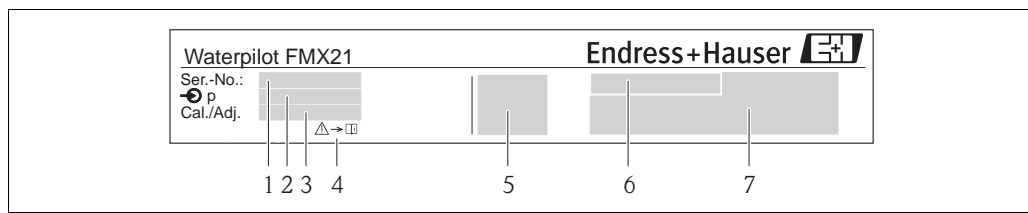
3.2.1 Identifying the measuring device via the nameplate

The nameplate is secured to the extension cable of the FMX21 (→ 9).



- 1 Order code (reduced for re-orders)
See the specifications on the order confirmation for the meanings of the individual letters and digits.
- 2 Extended order code (complete)
- 3 Serial number (for identification)
- 4 TAG (tag name)
- 5 FMX21 connection diagram
- 6 Pt100 connection diagram (optional)
- 7 Warning (hazardous area), (optional)
- 8 Length of the extension cable
- 9 Approval symbol, e.g. CSA, FM, ATEX (optional)
- 10 Text for approval (optional)
- 11 Wetted materials
- 12 Test date (optional)
- 13 Software version/Device Revision
- 14 Supply voltage
- 15 Output signal
- 16 Nominal measuring range
- 17 Set measuring range

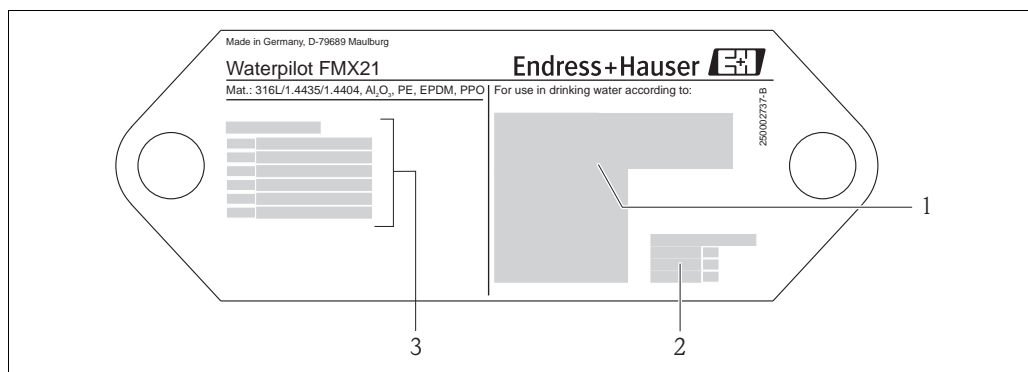
In addition, the FMX21 with an outer diameter of 22 mm (0.87 in) and 42 mm (1.65 in) also bears the following information:



A0018804

- 1 Serial number
- 2 Nominal measuring range
- 3 Set measuring range
- 4 CE mark or approval symbol
- 5 Certificate number (optional)
- 6 Text for approval (optional)
- 7 Reference to documentation (→ 5)

Nameplate for additional approvals



A0018805

- 1 Approval symbol (drinking water approval)
- 2 Reference to appropriate documentation
- 3 Approval number (marine approval)

3.2.2 Identifying the measuring device via the order code

Specific device features make up the order code. You can assign these features in the "Ordering information" section of Technical Information TI00431P/00/EN.

3.2.3 Identifying the sensor type

In the case of relative pressure or gauge pressure sensors, the "Pos. zero adjust" parameter appears in the operating menu. In the case of absolute pressure sensors, the "Position offset" parameter appears in the operating menu.

3.3 Transport and storage

3.3.1 Transport

NOTICE

Devices or cable may be damaged

- ▶ Comply with the safety instructions, transport conditions for devices over 18 kg (39.6lbs) (DIN EN 61010-1).
- ▶ Transport the measuring device to the measuring point in its original packaging.

3.3.2 Storage

The device must be stored in a dry, clean area and protected against damage from impact (EN 837-2).

Storage temperature range:

- FMX21: -40 to +80 °C (-40 to +176 °F)
- TMT182: -40 to +100 °C (-40 to +212 °F)
- Terminal box: -40 to +80 °C (-40 to +176 °F)

3.4 Scope of delivery

The scope of delivery comprises:

- Waterpilot FMX21, optionally with integrated Pt100 resistance thermometer
- Optional accessories (→ 52)

Documentation supplied:

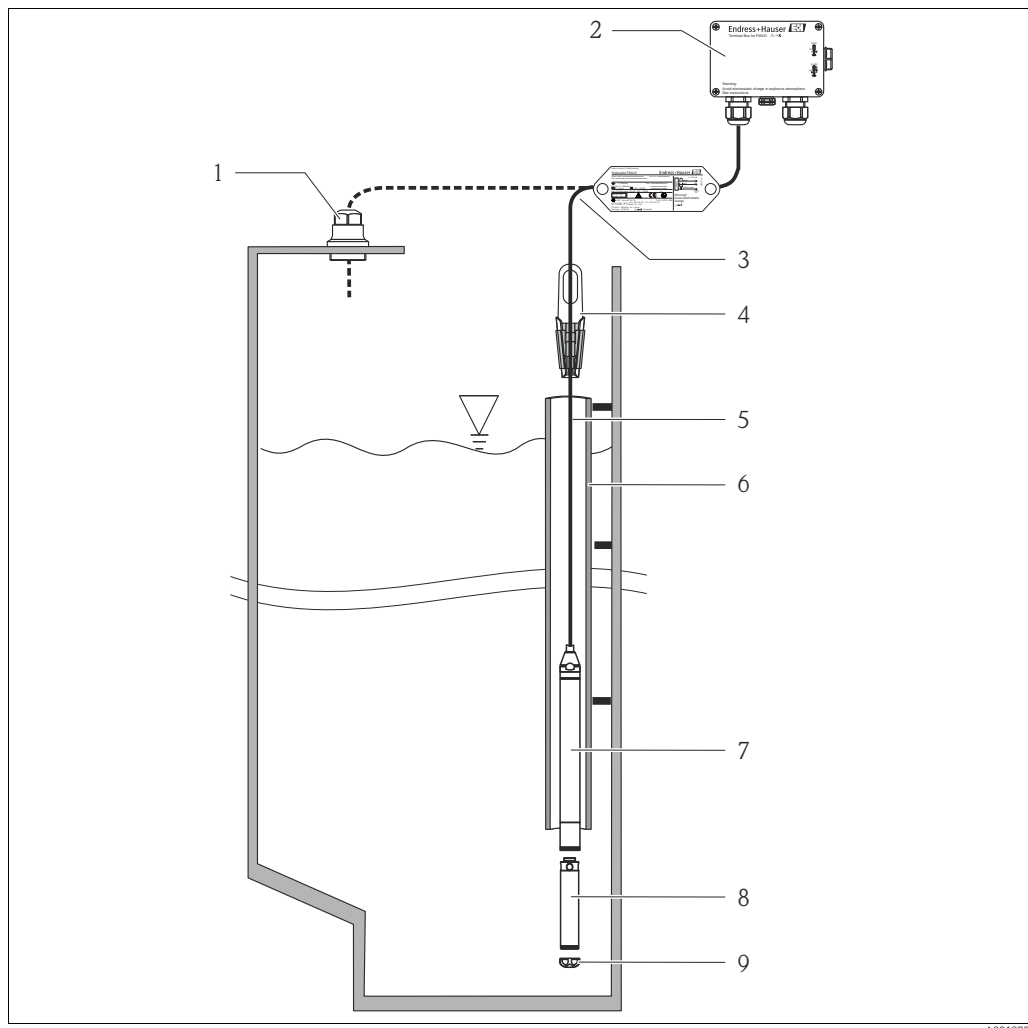
- Operating Instructions BA00380P/00/EN (this document)
- Final inspection report
- Drinking water approval (optional): SD00289P, SD00319P, SD00320P
- Devices suitable for use in hazardous areas: Additional documentation such as Safety Instructions (XA, ZD)

3.5 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 as listed in the EC Declaration of Conformity and thus comply with the legal requirements of the EC Directives. Endress+Hauser confirms the conformity of the device by affixing to it the CE mark.

4 Mounting

4.1 Mounting requirements



Installation examples, here illustrated with FMX21 with an outer diameter of 22 mm (0.87 in), Accessories → 52

- 1 Extension cable mounting screw (can be ordered as an accessory)
- 2 Terminal box (can be ordered as an accessory)
- 3 Extension cable bending radius > 120 mm (4.72 in)
- 4 Mounting clamp (can be ordered as an accessory)
- 5 Extension cable
- 6 Guide pipe
- 7 Waterpilot FMX21
- 8 Additional weight can be ordered as an accessory for FMX21 with an outer diameter of 22 mm (0.87 in) and 29 mm (1.14 in)
- 9 Protection cap

4.1.1 Additional mounting instruction

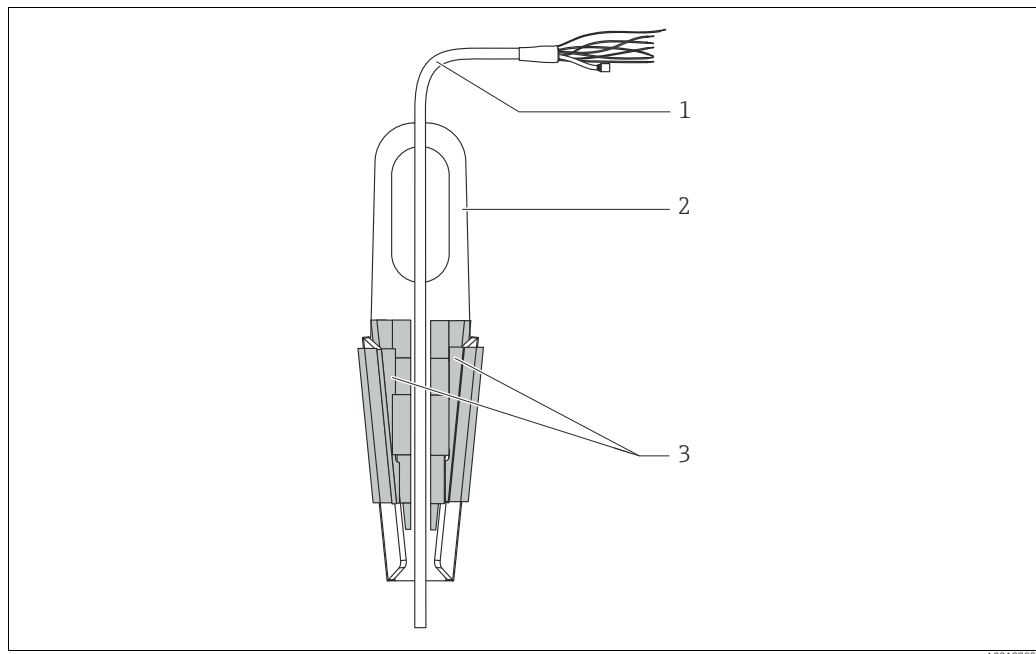
- Cable length
 - Customer-specific length in meters or feet.
 - Limited cable length when performing installation with freely suspended device with extension cable mounting screw or mounting clamp, as well as for FM/CSA approval: max. 300 m (984 ft).
- Sideways movement of the level probe can result in measuring errors. For this reason, install the probe at a point free from flow and turbulence, or use a guide tube. The internal diameter of the guide tube should be at least 1 mm (0.04 in) bigger than the outer diameter of the selected FMX21.

- The device is provided with a protection cap to prevent mechanical damage to the measuring cell.
- The cable must end in a dry room or a suitable terminal box. The terminal box from Endress+Hauser provides optimum humidity and climatic protection and is suitable for outdoor installation.
- If the cable is shortened, the filter at the pressure compensation tube has to be reattached (→ 54 "Cable shortening kit").
- Endress+Hauser recommends using twisted, shielded cables.

4.1.2 Dimensions

For dimensions, please refer to Technical Information TI00431P/00/EN, "Mechanical construction" section (→ see also: www.endress.com → Select Country → Download → Media Type: Documentation).

4.2 Mounting the Waterpilot with a mounting clamp

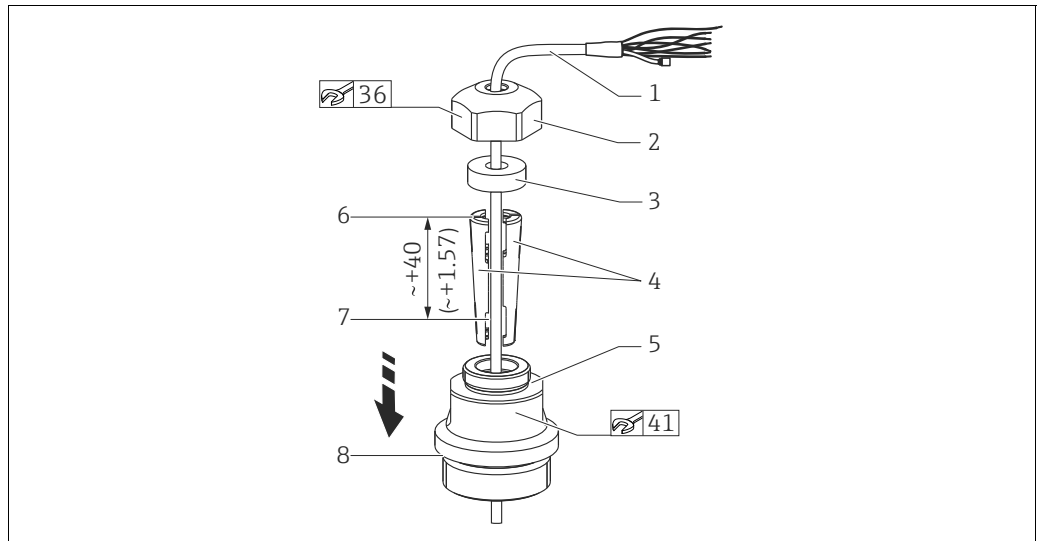


- 1 Extension cable
2 Mounting clamp
3 Clamping jaws

4.2.1 Mounting the mounting clamp:

1. Mount the mounting clamp (item 2). When selecting the place to fix the unit, take the weight of the extension cable (item 1) and the device into account.
2. Raise the clamping jaws (item 3). Position the extension cable (item 1) between the clamping jaws as illustrated in the graphic.
3. Hold the extension cable in position (item 1) and push the clamping jaws (item 3) back down. Tap the clamping jaws gently from above to fix in place.

4.3 Mounting with an extension cable mounting screw



Illustrated with thread G 1 1/2". Dimensions in mm (in)

- 1 Extension cable
- 2 Cover mounting screw
- 3 Sealing ring
- 4 Clamping sleeves
- 5 Mounting screw adapter
- 6 Top edge of clamping sleeve
- 7 Required length of extension cable and Waterpilot probe before assembly
- 8 After assembly, item 7 is located next to the mounting screw with G 1 1/2" thread: height of sealing surface of the adapter or NPT 1 1/2" thread height of thread run-out of adapter



If you want to lower the level probe to a certain depth, place the top edge of the clamping sleeve 40 mm (1.57 in) higher than the required depth. Then push the extension cable and the clamping sleeve into the adapter as described in Step 6 in the following section.

4.3.1 Mounting extension cable mounting screw with G 1 1/2" or NPT 1 1/2" thread:

1. Mark the desired length of the extension cable on the extension cable, see additional information on this page.
2. Insert the probe through the measuring aperture and carefully lower on the extension cable. Fix the extension cable to prevent it from slipping.
3. Push the adapter (item 5) over the extension cable and screw it tightly into the measuring aperture.
4. Push the sealing ring (item 3) and cover (item 2) onto the cable from above. Press the sealing ring into the cover.
5. Place the clamping sleeve (item 4) around the extension cable (item 1) at the mark (item 1) in accordance with step 1.
6. Push the extension cable with the clamping sleeve (item 4) into the adapter (item 5).
7. Push the cover (item 2) and sealing ring (item 3) onto the adapter (item 5) and screw tightly to the adapter.



Reverse the sequence of steps to remove the extension cable mounting screw.

CAUTION

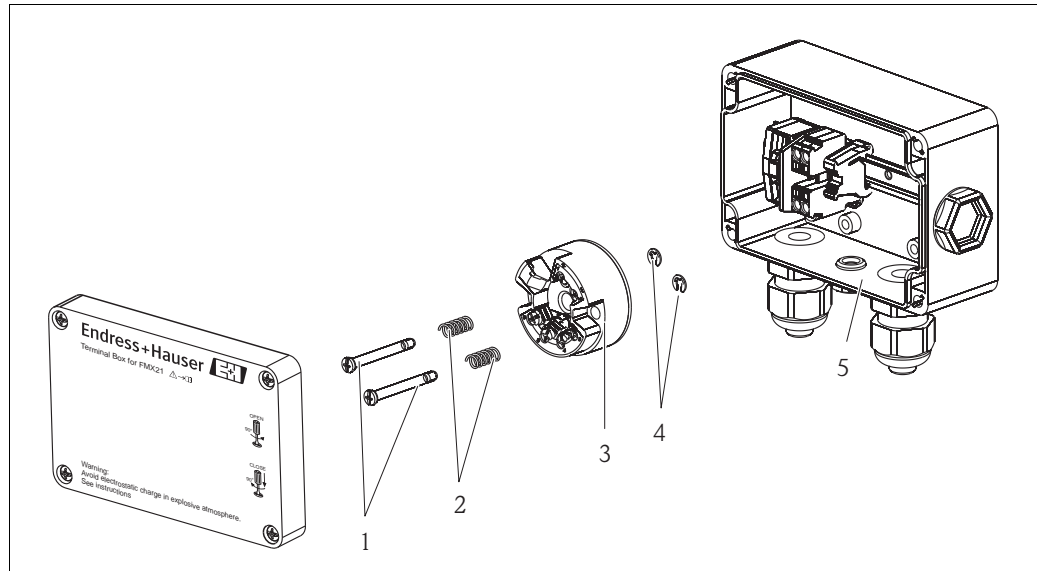
Risk of injury

- Application in unpressurized containers only.

4.4 Mounting the terminal box

The optional terminal box is mounted with four screws (M4). For the dimensions of the terminal box, please refer to Technical Information TI00431P/00/EN, "Mechanical construction" section (→ see also: www.endress.com → Select Country → Download → Media Type: Documentation).

4.5 Mounting the TMT182 temperature head transmitter



Temperature head transmitter with terminal box

- 1 Mounting screws
- 2 Mounting springs
- 3 TMT182 temperature head transmitter
- 4 Circlips
- 5 Terminal box



Only open the terminal box with a screwdriver.

⚠ WARNING

Explosion hazard!

- The TMT182 is not designed for use in hazardous areas.

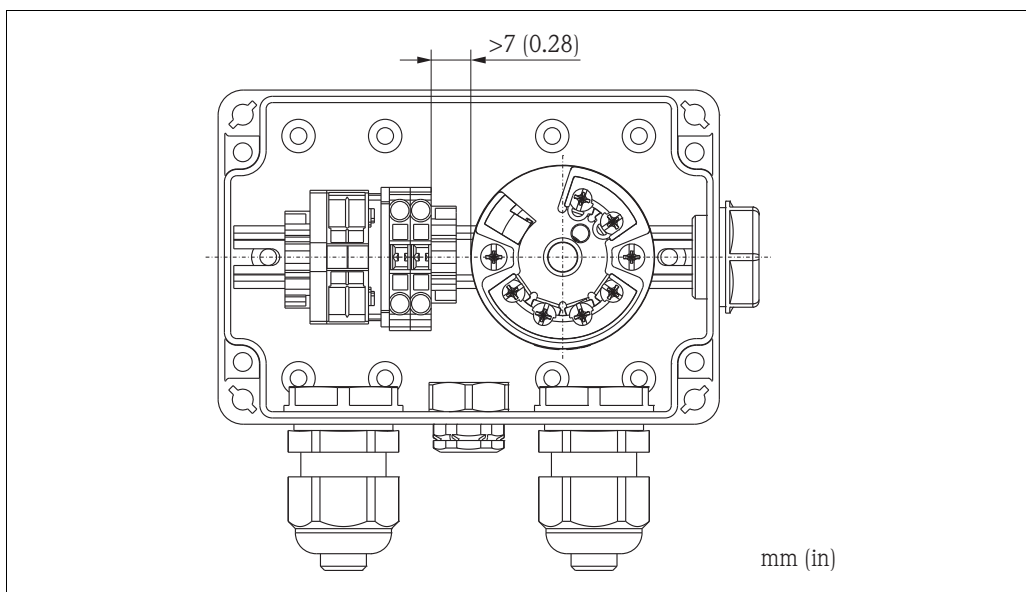
4.5.1 Mounting the temperature head transmitter:

1. Guide the mounting screws (item 1) with the mounting springs (item 2) through the guide holes of the temperature head transmitter (item 3).
2. Fix the mounting screws with the circlips (item 4). Circlips, mounting screws and springs are included in the scope of delivery for the temperature head transmitter.
3. Screw the temperature head transmitter into the field housing tightly. (Max. width of screwdriver blade 6 mm (0.24 in))

NOTICE

Prevent damage to the temperature head transmitter.

- Do not tighten the mounting screw too tightly.



A0018696

NOTICE

A minimum distance of $> 7 \text{ mm}$ ($> 0.28 \text{ in}$) must be maintained between the terminal strip and the TMT182 temperature head transmitter.

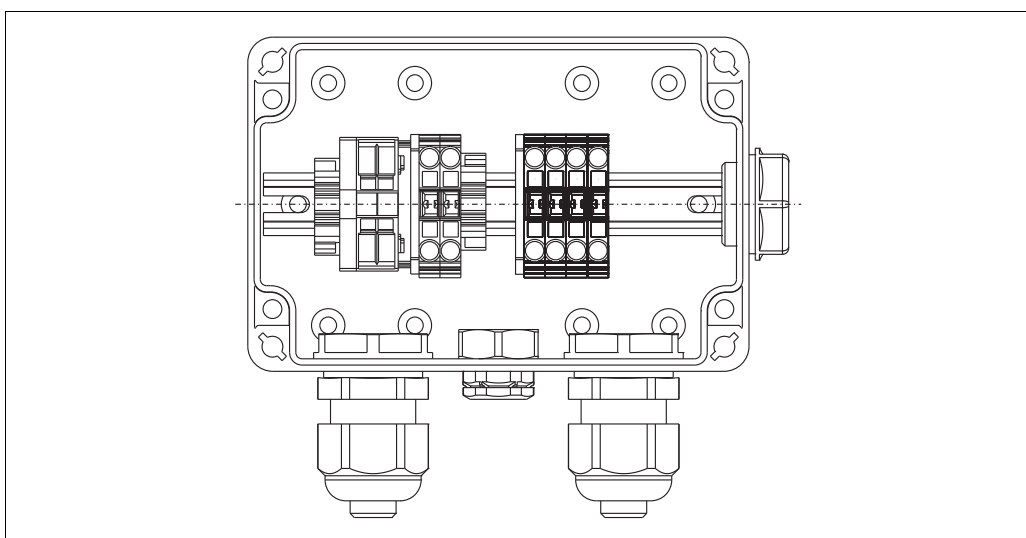
4.6 Mounting the terminal strip for the Pt100 passive (without TMT182)

If the FMX21 with optional Pt100 is supplied without the optional TMT182 temperature head transmitter, the terminal box is accompanied by a terminal strip for wiring the Pt100.

⚠ WARNING

Explosion hazard!

- The Pt100 and the terminal strip are not designed for use in hazardous areas.



A0018815

4.7 Post-mounting check

Check that all screws are firmly seated.

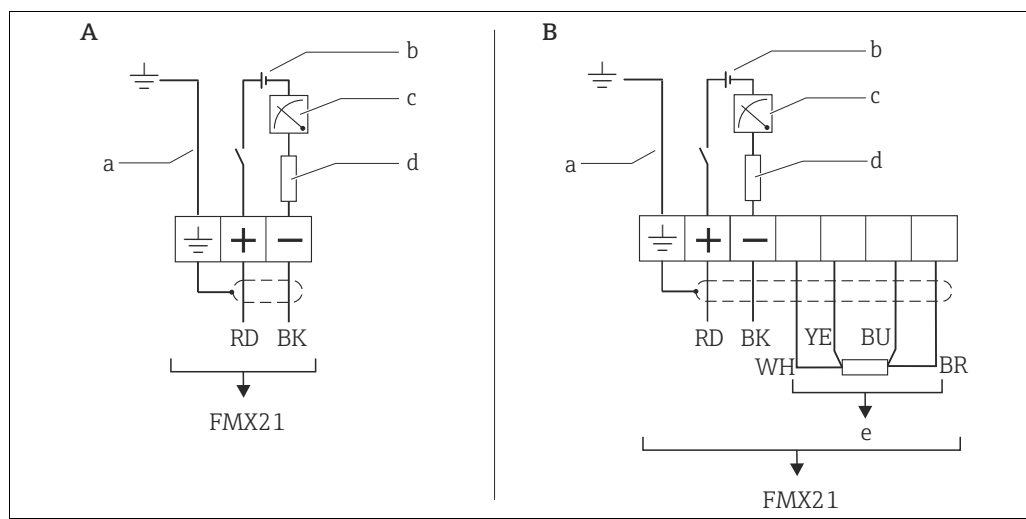
5 Electrical connection

5.1 Connecting the device

⚠ WARNING

Explosion hazard!

- ▶ When using the measuring device in hazardous areas, installation must comply with the corresponding national standards and regulations and the Safety Instructions or Installation or Control Drawings.
- The supply voltage must match the supply voltage on the nameplate (→ 6).
- Switch off the supply voltage before connecting the device.
- The cable must end in a dry room or a suitable terminal box. The IP66/IP67 terminal box with a GORE-TEX® from Endress+Hauser is suitable for outdoor installation (→ 12).
- Connect the device in accordance with the following diagrams. Reverse polarity protection is integrated in the Waterpilot FMX21 and the TMT182 temperature head transmitter. Changing the polarities will not result in the destruction of the devices.
- A suitable circuit breaker should be provided for the device in accordance with IEC/EN 61010.



A0019441

A Waterpilot FMX21

B Waterpilot FMX21 with Pt100 ¹⁾, version "NB" for feature 610 "Accessories" in the order code

a Not for FMX21 with an outer diameter of 29 mm (1.14 in)

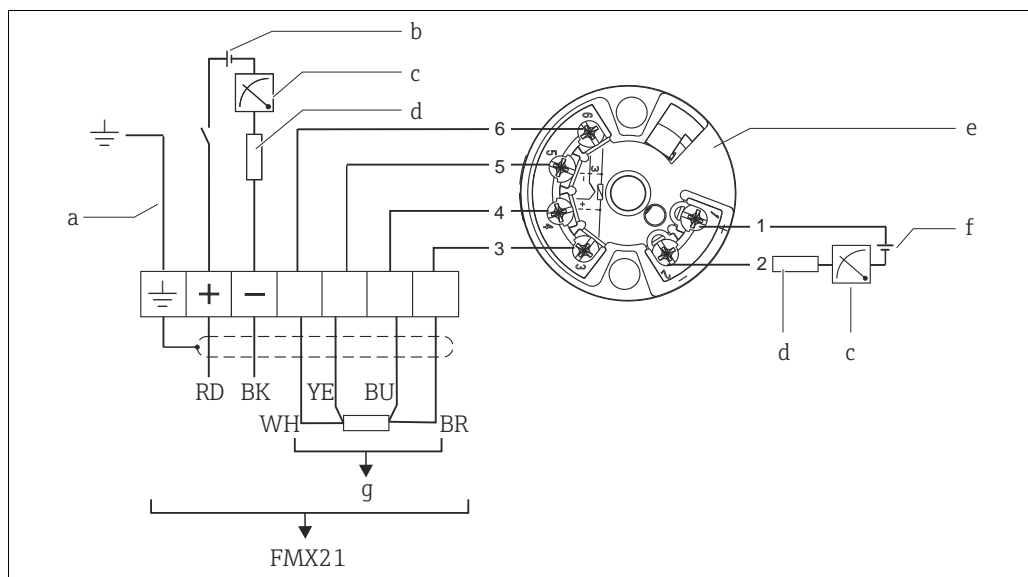
b 10.5 to 30 V DC (Ex), 10.5 to 35 V DC

c 4 to 20 mA

d Resistance (R_L)

e Pt100

¹⁾ Not for use in hazardous areas.



Waterpilot FMX21 with Pt100 and TMT182 temperature head transmitter ¹⁾, versions "NB" and "PT", feature 610 and 620 in the order code (see also → Technical Information TI00431P/00/EN, "Ordering information" section)

- a Not for FMX21 with an outer diameter of 29 mm (1.14 in)
- b 10.5 to 35 V DC
- c 4 to 20 mA
- d Resistance (R_t)
- e TMT182 temperature head transmitter (4 to 20 mA HART)
- f 11.5 to 35 V DC
- g Pt100

¹⁾ Not for use in hazardous areas.

Wire colors

RD = red, BK = black, WH = white, YE = yellow, BU = blue, BR = brown

5.1.1 Connection data

Connection classification as per IEC 61010-1:

- Overvoltage category 1
- Pollution degree 1

Connection data in the hazardous area

4 to 20 mA	Ex ia IIC T4 to T6
U _i	30 V DC
I _i	133 mA
P _i	1.0 W
C _i	10.3 nF (sensor); 180 pF/m (cable)
L _i	0 μH (sensor); 1 μH/m (cable)
T _a	-10 °C (+14 °F) ≤ T _a ≤ +70 °C (+158 °F) for T4 -10 °C (+14 °F) ≤ T _a ≤ +40 °C (+104 °F) for T6

5.1.2 Supply voltage

Version	FMX21	FMX21 + Pt100	TMT182 temperature head transmitter
Version for the non-hazardous area	10.5 to 35 V DC	10.5 to 35 V DC	11.5 to 35 V DC
Version for the hazardous area	10.5 to 30 V DC	–	–



When the device is used in hazardous areas, the supply voltage is restricted as above in accordance with the requirements of the certificate in question.

5.1.3 Cable specification

- FMX21 with optional Pt100
 - Commercially available, shielded instrument cable
 - Terminals, terminal box: 0.08 to 2.5 mm² (28 to 14 AWG)
- TMT182 temperature head transmitter (optional)
 - Commercially available instrument cable
 - Terminals, terminal box: 0.08 to 2.5 mm² (28 to 14 AWG)
 - Transmitter terminals: max. 1.75 mm² (16 AWG)



The extension cables are shielded for versions with outer diameters of 22 mm (0.87 in) or 42 mm (1.65 in).

In the following cases, Endress+Hauser recommends the use of a shielded cable as the cable extension:

- For large distances between the end of the extension cable and the display and/or evaluation unit.
- For large distances between the end of the extension cable and the temperature head transmitter.
- When directly connecting the Pt100 signal to a display and/or evaluation unit.

5.1.4 Power consumption, current consumption

	FMX21	FMX21 + Pt100	TMT182 temperature head transmitter
Power consumption	$\leq 0.805 \text{ W at } 35 \text{ V DC}$ (non-hazardous area) $\leq 0.690 \text{ W at } 30 \text{ V DC}$ (hazardous area)	$\leq 0.805 \text{ W at } 35 \text{ V DC}$	$\leq 0.805 \text{ W at } 35 \text{ V DC}$
Current consumption	Max. $\leq 23 \text{ mA}$ Min. $\geq 3.6 \text{ mA}$	Max. $\leq 23 \text{ mA}$ Min. $\geq 3.6 \text{ mA}$ Pt100: $\leq 0.6 \text{ mA}$	Max. $\leq 23 \text{ mA}$ Min. $\geq 3.5 \text{ mA}$

5.1.5 Load

The maximum load resistance depends on the supply voltage (U) and must be determined individually for each current loop, see formula and diagrams for FMX21 and temperature head transmitter.

The total resistance resulting from the resistances of the connected devices, the connecting cable and, where applicable, the resistance of the extension cable may not exceed the load resistance value.

FMX21

$$R_{Lmax} \leq \frac{U - 10.5 \text{ V}}{23 \text{ mA}} - 2 \cdot 0.09 \frac{\Omega}{\text{m}} \cdot L - R_{add}$$

A0018753-EN

Temperature head transmitter

$$R_{Lmax} \leq \frac{U - 11.5 \text{ V}}{0.023 \text{ A}} - R_{add}$$

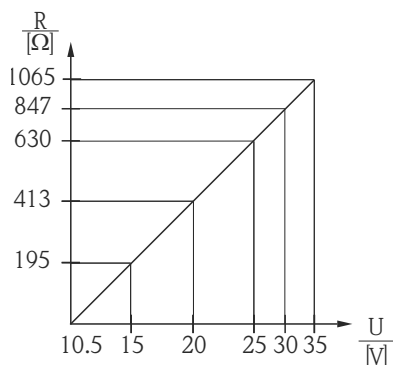
A0018754-EN

R_{Lmax} = Max. load resistance [Ω]

R_{add} = Additional resistances such as resistance of evaluation unit and/or display unit, cable resistance [Ω]

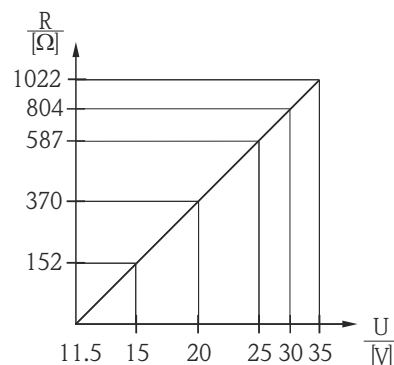
U = Supply voltage [V]

L = Simple length of extension cable [m] (cable resistance per wire $\leq 0.09 \Omega/\text{m}$)



A0018765

FMX21 load chart for estimating the load resistance. Additional resistances, such as the resistance of the extension cable, have to be subtracted from the value calculated as shown in the equation.



A0018766

Temperature head transmitter load chart for estimating the load resistance. Additional resistances have to be subtracted from the value calculated as shown in the equation.

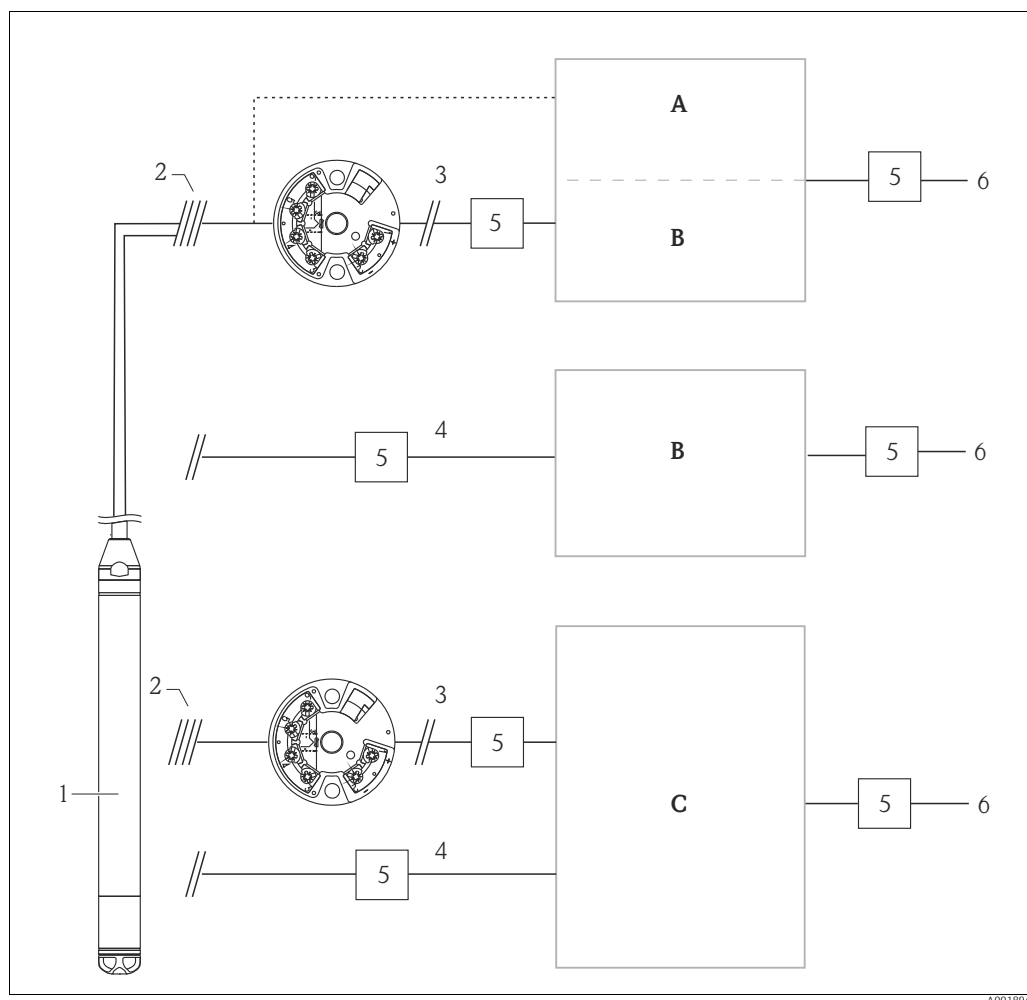


When operating using a HART handheld terminal or a PC with an operating program, a minimum communication resistance of 250 Ω has to be taken into account.

5.2 Connecting the measuring unit

5.2.1 Overvoltage protection

To protect the Waterpilot and the TMT182 temperature head transmitter from large interference voltage peaks, Endress+Hauser recommends installing overvoltage protection upstream and downstream of the display and/or evaluation unit as shown in the graphic.



A0018941

- A Power supply, display and evaluation unit with one input for Pt100
- B Power supply, display and evaluation unit with one input for 4 to 20 mA
- C Power supply, display and evaluation unit with two inputs for 4 to 20 mA

- 1 Waterpilot FMX21 HART
- 2 Connection for integrated Pt100 temperature sensor in the FMX21 HART
- 3 4 to 20 mA HART(Temperature)
- 4 4 to 20 mA HART(Level)
- 5 Overvoltage protection (OP), e.g. HAW from Endress+Hauser (not for use in hazardous areas)
- 6 Power supply



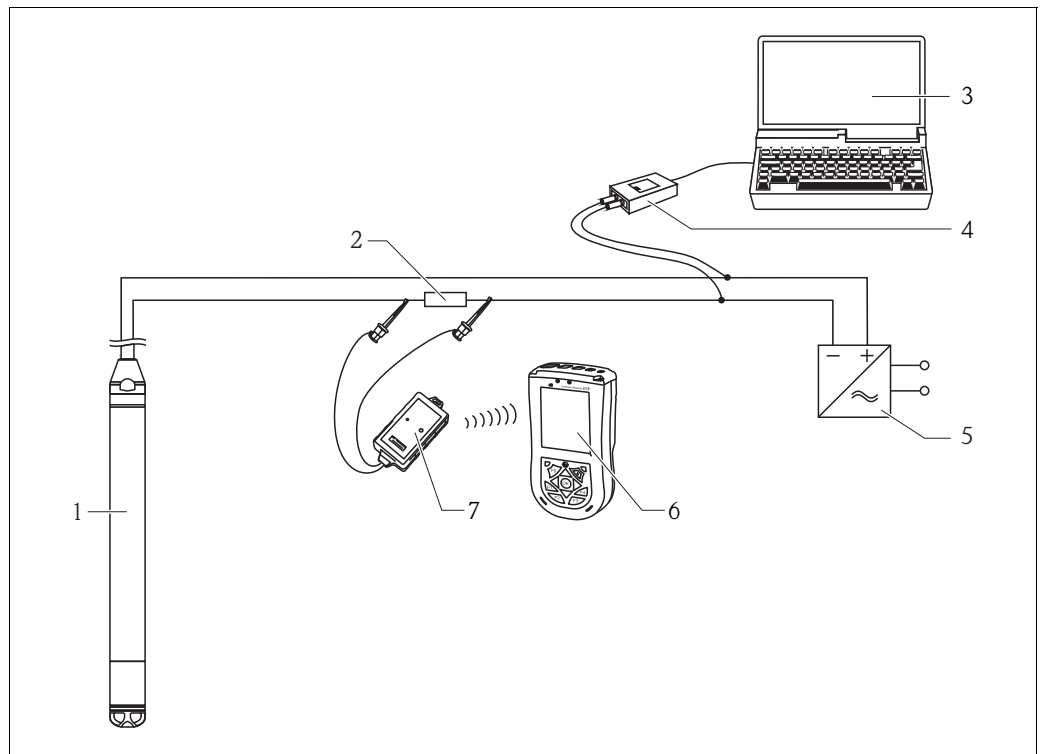
Further information on the TMT182 temperature head transmitter for HART applications from Endress+Hauser can be found in "Technical Information" TI00078R/09/EN.

5.2.2 Connecting Commubox FXA195

The Commubox FXA195 connects intrinsically safe transmitters with the HART protocol to a computer's USB port. This allows remote operation of the transmitter using Endress+Hauser's FieldCare operating program. Power is supplied to the Commubox through the USB port. The Commubox is also suitable for connection to intrinsically safe circuits. → See Technical Information TI00404F/00/EN for further information.

5.2.3 Connecting Field Xpert SFX

Compact, flexible and robust industry handheld terminal for remote configuration and for obtaining measured values via the HART current output (4 to 20 mA). For details, see Operating Instructions BA00060S/04/EN.



- 1 Waterpilot FMX21
- 2 Necessary communication resistor $\geq 250 \Omega$
- 3 Computer with operating tool (e.g. FieldCare)
- 4 Commubox FXA195 (USB)
- 5 Transmitter power supply unit, e.g. RN221N (with communication resistor)
- 6 Field Xpert SFX
- 7 VIATOR Bluetooth-Modem with cable connection



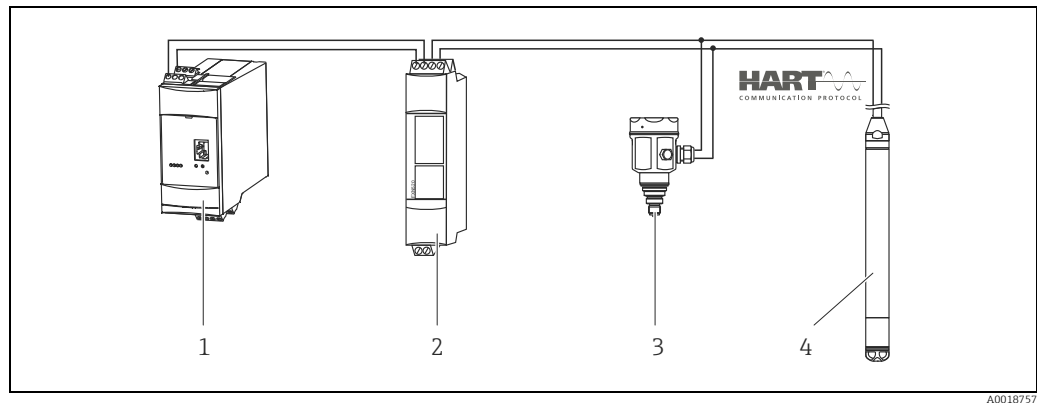
Only use certified operating devices in hazardous area!

⚠ WARNING

Explosion hazard!

- ▶ Do not change the battery of the handheld terminal in the hazardous area.
- ▶ When using the measuring device in hazardous areas, installation must comply with the applicable national standards and regulations and the Safety Instructions (XAs) or the Installation or Control Drawings (ZDs).

5.2.4 Connecting for air pressure compensation with external measured value



- 1 Fieldgate FXA520
 2 Multidrop-Connector FXN520
 3 Cerabar
 4 Waterpilot FMX21

A0018757

It is advisable to use an absolute pressure probe for applications in which condensation can occur. In the case of level measurement with an absolute pressure probe, the measured value is affected by fluctuations in the ambient air pressure. To correct the resulting measured error, you can connect an external absolute pressure sensor (e.g. Cerabar) to the HART signal cable, switch the waterpilot to the burst mode and the Cerabar to operate in mode "Electr. Delta P".

By switching on the application "Electr. Delta P", the external absolute pressure sensor calculates the difference between the two pressure signals and can thus determine the level precisely.

Only one level measured value can be corrected in this way (→ 39).



If using intrinsically safe devices, strict compliance with the rules for interconnecting intrinsically safe circuits as stipulated in IEC60079-14 (proof of intrinsic safety) is mandatory.

5.2.5 Connecting external temperature sensor/temperature head transmitter for density compensation

The Waterpilot FMX21 can correct measured errors that result from fluctuations in the density of the water caused by temperature. Users can choose from the following options:

Use the internally measured sensor temperature of the FMX21

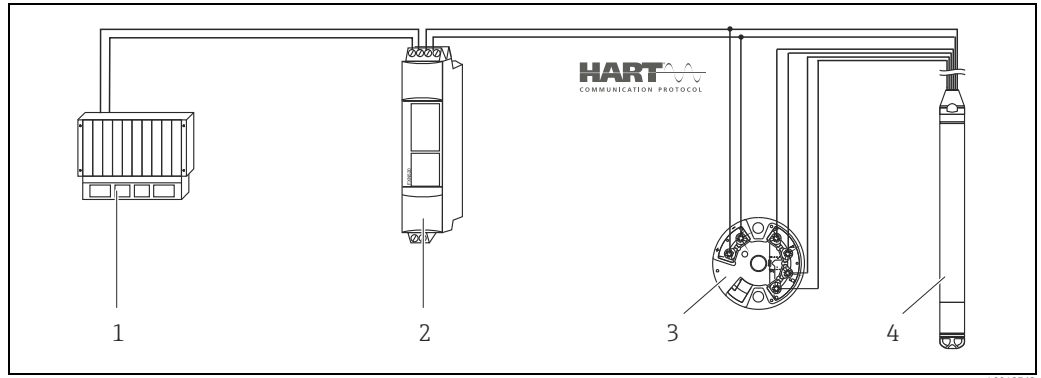
The internally measured sensor temperature is calculated in the Waterpilot FMX21 for density compensation. The level signal is thus corrected according to the density characteristic line of the water (→ 41).

Use the optional internal Pt100 temperature sensor for density compensation in a suitable HART master (e.g. PLC)

The Waterpilot FMX21 is available with an optional Pt100 temperature sensor.

Endress+Hauser additionally offers the TMT182 temperature head transmitter to convert the Pt100 signal to a 4 to 20 mA HART signal.

The temperature and pressure signal is transmitted to the HART master (e.g. PLC) where a corrected level value can be generated using a stored linearization table or the density function (of a chosen medium) → 42.



- 1 HART-Master, e.g. PLC (programmable logic controller)
- 2 Multidrop-Connector FXN520
- 3 TMT182 temperature head transmitter
- 4 Waterpilot FMX21

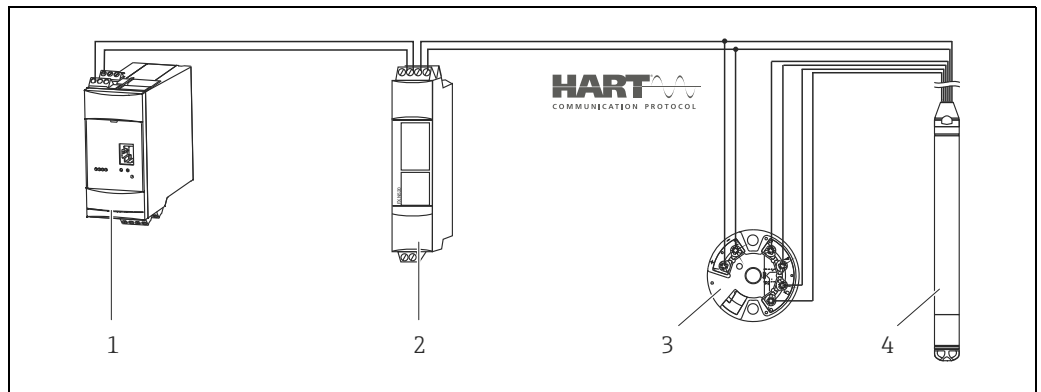
A0018763

Use an external temperature signal which is transmitted to the FMX21 via HART burst mode

The Waterpilot FMX21 is available with an optional Pt100 temperature sensor. In this case, the signal of the Pt100 is analyzed using a HART-compliant (at least HART 5.0) temperature transmitter that supports burst mode. The temperature signal can thus be transmitted to the FMX21. The FMX21 uses this signal for the density correction of the level signal (→ 43).



The TMT182 temperature head transmitter is not suitable for this configuration.



- 1 Fieldgate FXA520
- 2 Multidrop-Connector FXN520
- 3 TMT182 temperature head transmitter (burst mode)
- 4 Waterpilot FMX21

A0018764

Without additional compensation due to the anomaly of water, errors of up to 4 % may occur at a temperature of +70 °C (+158 °F), for example. With density compensation, this error can be decreased to 0.5 % in the entire temperature range from 0 to +70 °C (+32 to +158 °F).



For further information on the devices, please refer to the appropriate Technical Information:

- TI00078R: Temperaturkopfttransmitter TMT182 (4...20 mA HART)
- TI00369F: Fieldgate FXA520
- TI00400F: Multidrop-Connector FXN520

5.3 Post-connection check

The following checks must be performed after completing electrical connection of the device:

- Does the supply voltage match the specifications on the nameplate?
- Is the device connected as per Section 5.1 "Switching on the device"?
- Are all screws firmly tightened?
- Optional terminal box: are the cable glands leaktight?

6 Operability

Endress+Hauser offers comprehensive measuring point solutions with display and/or evaluation units for the Waterpilot FMX21 and TMT182 temperature head transmitter.



Please contact your Endress+Hauser sales representative, if you have any other questions. Contact addresses can be found on the Internet: www.endress.com/worldwide.

6.1 Overview of operation options

6.1.1 Operation via FieldCare

The FieldCare operating program is an Endress+Hauser plant asset management tool based on FDT technology. With FieldCare, you can configure all Endress+Hauser devices as well as devices from other manufacturers that support the FDT standard. Hardware and software requirements can be found on the Internet: www.endress.com → Search: FieldCare → FieldCare → Technical data

FieldCare supports the following functions:

- Configuration of transmitters in online and offline mode
- Loading and saving device data (upload/download)
- Documentation of the measuring point

Connection options:

- HART via Commubox FXA195 and the USB port of a computer
- HART via Fieldgate FXA520




- Further information on FieldCare and software download can be found on the Internet (→ see: www.endress.com → Select Country → Download → Text Search: FieldCare).
- Connecting Commubox FXA195 (→ 19)
- As not all internal device dependencies can be mapped in offline operation, the consistency of the parameters must be checked before the parameters are transmitted to the device.

6.1.2 Operation via Field Xpert SFX

Compact, flexible and robust industry handheld terminal for remote configuration and for obtaining measured values via the HART current output (4 to 20 mA). For details, see Operating Instructions BA00060S/04/EN.

6.1.3 Locking/unlocking operation



Once you have entered all the parameters, you can lock your entries against unauthorized and undesired access. The "Operator code" parameter is used to lock the device.

Parameter name	Description
Operator code Entry Menu path: Setup → Extended Setup → User code	Use this function to enter a code to lock or unlock operation. User input: <ul style="list-style-type: none"> ■ To lock: Enter a number ≠ the release code (value range: 1 to 65535). ■ To unlock: Enter the release code.  The release code is "0" in the order configuration. Another release code can be defined in the "Code definition" parameter. If the user has forgotten the release code, the release code will be visible and unlocked by entering the number "5864". Factory setting: 0

The release code is defined in the "Code definition" parameter.

Parameter name	Description
Code definition Entry Menu path: Setup → Extended Setup → Code definition	Use this function to enter a release code with which the device can be unlocked. User input: <ul style="list-style-type: none"> ■ A number between 0 and 9999 Factory setting: 0

6.1.4 Resetting to factory settings (reset)

By entering a certain code, you can completely, or partially, reset the entries for the parameters to the factory settings (→  64, "System"). Enter the code by means of the "Enter reset code" parameter (menu path: Expert → System → Management → Enter reset code). There are various reset codes for the device. The following table illustrates which parameters are reset by the particular reset codes. Operation has to be unlocked to be able to perform a reset (→  23, "Locking/unlocking operation").



Any customer-specific configurations carried out by the factory are not affected by a reset (customer-specific configuration remains). If you want to change the customer-specific settings configured at the factory, please contact Endress+Hauser Service. Since there is no specific service level, order code and serial number can be changed without a specific release code.

Reset code	Description and effect
62	PowerUp reset (warm start) <ul style="list-style-type: none"> ▶ The device is restarted. Data are read back anew from the EEPROM (processor is initialized again). ▶ Any simulation which may be running is ended.
333	User reset <ul style="list-style-type: none"> ▶ The device is restarted. ▶ Any simulation which may be running is ended. ▶ This code resets all the parameters apart from: <ul style="list-style-type: none"> – Device tag – Linearization table – Operating hours – Event logbook – Current trim

Reset code	Description and effect
7864	Total reset <ul style="list-style-type: none"> ▶ The device is restarted. ▶ Any simulation which may be running is ended. ▶ This code resets all the parameters apart from: <ul style="list-style-type: none"> – Operating hours – Event logbook



After a "Total reset" in FieldCare you have to press the "refresh" button in order to ensure that the measuring units are also reset.

7 Commissioning

7.1 Function check

Before commissioning your measuring point, ensure that the post-installation and post-connection check have been performed.

- For the "Post-installation" checklist (→ [13](#))
- For the "Post-connection" checklist (→ [22](#))

7.2 Commissioning with FieldCare



If a pressure smaller than the minimum permitted pressure or greater than the maximum permitted pressure is present at the device, the following messages are output in succession:

1. "S140 Working range P" or "F140 Working range P" ¹⁾
2. "S841 Sensor range" or "F841 Sensor range" ¹⁾
3. "S971 Sensor range" ¹⁾

¹⁾ Depending on the setting in the "Alarm behavior"

The following languages are available for FieldCare:


- German
- English
- French
- Italian
- Spanish
- Japanese
- Chinese simplified



The device is configured for the Pressure measuring mode as standard. The measuring range and the unit in which the measured value is transmitted correspond to the data on the nameplate.

7.2.1 Basic settings

- Start FieldCare and establish the connection to the Waterpilot FMX21.
- Select the measuring mode and press "Enter" to confirm:

Parameter name	Description
Measuring mode Selection	<p>Select the measuring mode. The operating menu is structured differently depending on the measuring mode selected.</p> <p> If the measuring mode is changed, no conversion takes place. The device has to be recalibrated or as per if the measuring mode is changed.</p> <p>Options:</p> <ul style="list-style-type: none"> ■ Pressure ■ Level <p>Factory setting: Pressure</p>

- Select the pressure unit and press "Enter" to confirm:

Parameter name	Description
Press. eng. unit Selection	<p>Select the pressure unit. If a new pressure unit is selected, all pressure-specific parameters are converted and displayed with the new unit.</p> <p>Options:</p> <ul style="list-style-type: none"> ■ mbar, bar ■ mmH2O, mH2O, inH2O ■ ftH2O ■ Pa, kPa, MPa ■ psi ■ mmHg, inHg ■ kgf/cm² <p>Factory setting: mbar or bar depending on the sensor nominal measuring range, or as per order specifications</p>

7.2.2 Position adjustment

Due to orientation of the device, there may be a zero point shift in the pressure measured value. You can correct this shift with the following parameters:

Parameter name	Description
Position adjustment (relative pressure sensor) Entry	<p>Position adjustment – the pressure difference between the set point and the measured pressure must not be known.</p> <p>Example:</p> <ul style="list-style-type: none"> – Measured value = 2.2 mbar (0.033 psi) – You correct the measured value via the "Pos. zero adjust" parameter with the "Confirm" option. This means that you assign the value 0.0 to the pressure present. – Measured value (after pos. zero adjust) = 0.0 mbar – The current value is also corrected. <p>Factory setting: Abort</p>
Position offset (absolute pressure sensor) Entry	<p>Position adjustment – the pressure difference between zero (set point) and the measured pressure must be known.</p> <p>Example:</p> <ul style="list-style-type: none"> – Measured value = 982.2 mbar (15 psi) – You correct the measured value with the value entered (e.g. 2.2 mbar (0.033 psi)) via the "Position offset" parameter. This means that you assign the value 980.0 to the pressure present. – Measured value (after pos. zero adjust) = 980.0 mbar (15 psi) – The current value is also corrected. <p>Factory setting: 0.0</p>

7.2.3 Configuring the damping

Parameter name	Description
Damping value Entry	<p>The damping affects the speed at which the measured value reacts to changes in pressure.</p> <p>Low damping: reacts quickly, measured value might fluctuate.</p> <p>High damping: reacts slowly, measured value is stable.</p> <p>Factory setting: 2.0 as per order specifications</p>

7.3 Pressure measurement

7.3.1 Calibration with reference pressure (wet calibration)

Example:

In this example, a device with a 400 mbar (6 psi) sensor is configured for the 0 to +300 mbar (4.5 psi) measuring range, i.e. 0 mbar is assigned to the 4 mA value and 300 mbar (4.5 psi) to the 20 mA value.

Prerequisite:

The pressure values 0 mbar and 300 mbar (4.5 psi) can be specified. The device is already mounted, for example.



For a description of the parameters mentioned → 64 "Description of parameters".

	Description	
1	Perform position adjustment → 26.	<p style="text-align: right;">A0018817</p> <p><i>Calibration with reference pressure</i></p> <p>1 See Table, Step 4. 2 See Table, Step 5.</p>
2	Select the "Pressure" measuring mode via the "Measuring mode" parameter. Menu path: Setup → Measuring mode	
3	Select a pressure unit via the "Press eng. unit" parameter, here "mbar" for example. Menu path: Setup → Press. eng. unit	
4	The pressure for the lower-range value (4 mA value) is present at the device, here 0 mbar for example. Select the "Get LRV" parameter. Menu path: Setup → Extended setup → Current output → Get LRV. Confirm the value present by selecting "Confirm". The pressure value present is assigned to the lower current value (4 mA).	
5	The pressure for the upper-range value (20 mA value) is present at the device, here 300 mbar (4.5 psi) for example. Select the "Get URV" parameter. Menu path: Setup → Extended setup → Current output → Get URV. Confirm the value present by selecting "Confirm". The pressure value present is assigned to the upper current value (20 mA).	
6	Result: The measuring range is configured for 0 to +300 mbar (4.5 psi).	

7.3.2 Calibration without reference pressure (dry calibration)

Example:

In this example, a device with a 400 mbar (6 psi) sensor is configured for the 0 to +300 mbar (4.5 psi) measuring range, i.e. 0 mbar is assigned to the 4 mA value and 300 mbar (4.5 psi) to the 20 mA value.

Prerequisite:

This is a theoretical calibration, i.e. the pressure values for the lower and upper range are known.



Due to the orientation of the device, there may be pressure shifts in the measured value, i.e. the measured value is not zero in a pressureless condition. For information on how to perform position adjustment → 26.

	Description	
1	Select the "Pressure" measuring mode via the "Measuring mode" parameter. Menu path: Setup → Measuring mode	 <p>Calibration without reference pressure</p> <p>1 See Table, Step 3. 2 See Table, Step 4.</p> <p>A0018817</p>
2	Select a pressure unit via the "Press eng. unit" parameter, here "mbar" for example. Menu path: Setup → Press. eng. unit	
3	Select the "Set LRV" parameter. Menu path: Setup → Set LRV	
	Enter the value for the "Set LRV" parameter (here 0 mbar) and confirm. This pressure value is assigned to the lower current value (4 mA).	
4	Select the "Set URV" parameter. Menu path: Setup → Set URV	
	Enter the value for the "Set URV" parameter (here 300 mbar (4.5 psi)) and confirm. This pressure value is assigned to the upper current value (20 mA).	
5	Result: The measuring range is configured for 0 to +300 mbar (4.5 psi).	

7.4 Level measurement

7.4.1 Information on level measurement

You have a choice of two methods for calculating the level: "In pressure" and "In height". The table in the "Overview of level measurement" section that follows provides you with an overview of these two measuring tasks.

- The limit values are not checked, i.e. the values entered must be appropriate for the sensor and the measuring task for the device to be able to measure correctly.
- Customer-specific units are not possible.
- The values entered for "Empty calib./Full calib.", "Empty pressure/Full pressure", "Empty height/Full height" and "Set LRV/Set URV" must be at least 1% apart. The value will be rejected, and a message output, if the values are too close together.

7.4.2 Overview of level measurement

Measuring task	Level selection	Measured variable options	Description	Measured value display
Calibration takes place by entering two pressure/level value pairs.	"In pressure"	Via the "Output unit" parameter: %, level, volume or mass units.	<ul style="list-style-type: none"> – Calibration with reference pressure (wet calibration), see → 32, "Section 7.4.4" – Calibration without reference pressure (dry calibration), → 30, Section 7.4.3" 	The measured value display and the "Level before lin" parameter display the measured value.
Calibration takes place by entering the density and two height/level value pairs.	"In height"		<ul style="list-style-type: none"> – Calibration with reference pressure (wet calibration), → 36, "Section 7.4.6" – Calibration without reference pressure (dry calibration), → 34, Section 7.4.5" 	

7.4.3 "In pressure" level selection Calibration without reference pressure (dry calibration)

Example:

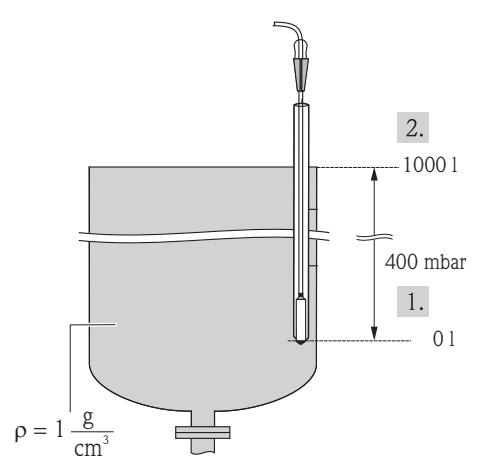
In this example, the volume in a tank should be measured in liters. The maximum volume of 1000 liters (264 US gal) corresponds to a pressure of 400 mbar (6 psi). The minimum volume of 0 liters corresponds to a pressure of 0 mbar since the process isolating diaphragm of the probe is at the start of the level measuring range.

Prerequisite:

- The measured variable is in direct proportion to the pressure.
- This is a theoretical calibration i.e. the pressure and volume values for the lower and upper calibration point must be known.



- The values entered for "Empty calib./Full calib." and "Set LRV/Set URV" must be at least 1% apart. The value will be rejected, and a message output, if the values are too close together. Other limit values are not checked, i.e. the values entered must be appropriate for the sensor and the measuring task for the device to be able to measure correctly.
- Due to the orientation of the device, there may be pressure shifts in the measured value, i.e. when the container is empty or partly filled, the measured value is not zero. For information on how to perform position adjustment → 26.

	Description	
1	Select the "Level" measuring mode via the "Measuring mode" parameter. Menu path: Setup → Measuring mode	 <p style="text-align: right;">A0018818</p> <p>Calibration without reference pressure – dry calibration</p> <p>1 See Table, Steps 6 and 7. 2 See Table, Steps 8 and 9.</p>
2	Select a pressure unit via the "Press eng. unit" parameter, here "mbar" for example. Menu path: Setup → Press. eng. unit	
3	Select the "In pressure" level mode via the "Level selection" parameter. Menu path: Setup → Extended setup → Level → Level selection	
4	Select a volume unit via the "Output unit" parameter, here "l" (liters) for example. Menu path: Setup → Extended setup → Level → Output unit	
5	Select the "Dry" option via the "Calibration mode" parameter. Menu path: Setup → Extended setup → Level → Calibration mode	
6	Enter the volume value for the lower calibration point via the "Empty calib." parameter, here "0 liter" for example. Menu path: Setup → Extended setup → Level → Empty calib.	
7	Enter the pressure value for the lower calibration point via the "Empty pressure" parameter, here "0 mbar" for example. Menu path: Setup → Extended setup → Level → Empty pressure	

	Description	
8	Enter the volume value for the upper calibration point via the "Full calib." parameter, here "1000 liter" (264 US gal) for example. Menu path: Setup → Extended setup → Level → Full calib.	
9	Enter the pressure value for the upper calibration point via the "Full pressure" parameter, here "400 mbar" (6.0 psi) for example. Menu path: Setup → Extended setup → Level → Full pressure	
10	"Adjust density" contains the factory setting 1.0 but can be changed if required. The value pairs subsequently entered must correspond to this density. Menu path: Setup → Extended setup → Level → Adjust density The process density can only be changed if automatic density correction is switched off (see Step 14).	
11	Set the volume value for the lower current value (4 mA) via the "Set LRV" parameter. Menu path: Setup → Extended setup → Current output → Set LRV	
12	Set the volume value for the upper current value (20 mA) via the "Set URV" parameter. Menu path: Setup → Extended setup → Current output → Set URV	
13	If the process uses a medium other than the medium on which the calibration was based, the new density must be specified in the "Density process" parameter. Menu path: Setup → Extended setup → Level → Density process The process density can only be changed if automatic density correction is switched off (see Step 14).	
14	If density correction is required ¹⁾ : assign the temperature probe in the "Auto density corr." parameter. Menu path: Expert → Application → Level → Auto density corr.	<p>Calibration with reference pressure – wet calibration</p> <p>1 See Table, Step 6. 2 See Table, Step 7. 3 See Table, Step 8. 4 See Table, Step 9. 5 See Table, Step 11. 6 See Table, Step 12.</p>
15	Result: The measuring range is set for 0 to 1000 l.	

¹⁾ A density correction is only possible for water. A temperature-density curve that is saved in the device is used. For this reason, the "Adjust density" (Step 10) and "Density process" (Step 13) parameters are not used here.



The measured variables %, level, volume and mass are available for this level mode. See Section 13.2 "Output unit".

7.4.4 "In pressure" level selection Calibration with reference pressure (wet calibration)

Example:

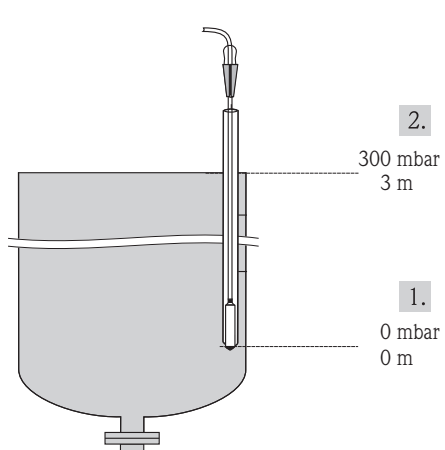
In this example, the level in a tank should be measured in "m". The maximum level is 3 m (9.8 ft). The pressure range is set to 0 to 300 mbar (4.5 psi).

Prerequisite:


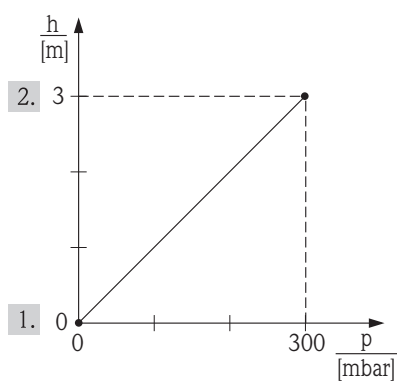
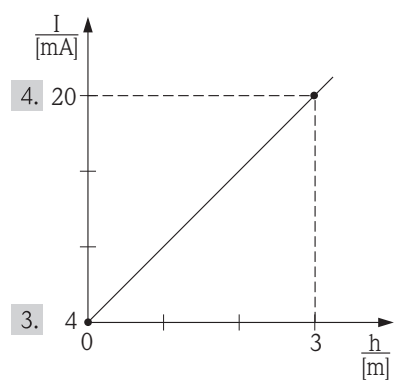

- The measured variable is in direct proportion to the pressure.
- The tank can be filled and emptied.




The values entered for "Empty calib./Full calib." and "Set LRV/Set URV" and the pressures present at the device must be at least 1% apart. The value will be rejected, and a message output, if the values are too close together. Other limit values are not checked, i.e. the values entered must be appropriate for the sensor and the measuring task for the device to be able to measure correctly.

	Description	
1	Perform "position adjustment" → 26.	 <p>Calibration with reference pressure – wet calibration</p> <p>1 See Table, Step 9. 2 See Table, Step 10.</p>
2	Select the "Level" measuring mode via the "Measuring mode" parameter. Menu path: Setup → Measuring mode → Level	
3	Select a pressure unit via the "Press eng. unit" parameter, here "mbar" for example. Menu path: Setup → Press. eng. unit	
4	Select the "In pressure" level mode via the "Level selection" parameter. Menu path: Setup → Extended setup → Level → Level selection	
5	If density correction is required ¹⁾ : assign the temperature probe in the "Auto density corr." parameter. Menu path: Expert → Application → Auto density corr.	
6	Select a level unit via the "Output unit" parameter, here "m" for example. Menu path: Setup → Extended setup → Level → Output unit	
7	Select the "Wet" option via the "Calibration mode" parameter. Menu path: Setup → Extended setup → Level → Calibration mode	

¹⁾ A density correction is only possible for water. A temperature-density curve that is saved in the device is used. For this reason, the "Adjust density" (Step 8) and "Density process" (Step 13) parameters are not used here.

	Description	
8	<p>If the calibration is performed with a medium other than the process medium, enter the density of the calibration medium in the "Adjust density" parameter.</p> <p>Menu path: Setup → Extended setup → Level → Adjust density</p> <p> The process density can only be changed if automatic density correction is switched off (see Step 5).</p>	 <p style="text-align: right;">A0018825</p>  <p style="text-align: right;">A0018826</p>
9	<p>The hydrostatic pressure for the lower calibration point is present at the device, here "0 mbar" for example.</p> <p>Select the "Empty calib." parameter.</p> <p>Menu path: Setup → Extended setup → Level → Empty calib.</p> <p>Enter the level value, here "0 m" for example. Confirming the value means you assign the pressure value present to the lower level value.</p>	
10	<p>The hydrostatic pressure for the upper calibration point is present at the device, here "300 mbar" (4.5 psi) for example.</p> <p>Select the "Full calib." parameter.</p> <p>Menu path: Setup → Extended setup → Level → Full calib.</p> <p>Enter the level value, here "3 m" (9.8 ft) for example. Confirming the value means you assign the pressure value present to the upper level value.</p>	
11	<p>Set the level value for the lower current value (4 mA) by means of "Set LRV", here "0 m" for example.</p> <p>Menu path: Setup → Extended setup → Current output → Set LRV</p>	
12	<p>Set the level value for the upper current value (20 mA) by means of "Set URV", here "3 m" (9.8 ft) for example.</p> <p>Menu path: Setup → Extended setup → Current output → Set URV.</p>	<p><i>Calibration with reference pressure – wet calibration</i></p> <p>1 See Table, Step 9. 2 See Table, Step 10. 3 See Table, Step 11. 4 See Table, Step 12.</p>
13	<p>If the calibration was performed with a medium other than the process medium, enter the density of the process medium in the "Density process" parameter.</p> <p>Menu path: Setup → Extended setup → Level → Density process</p> <p> The process density can only be changed if automatic density correction is switched off (see Step 5).</p>	
14	<p>Result: The measuring range is set for 0 to 3 m (9.8 ft).</p>	



The measured variables %, level, volume and mass are available for this level mode. See →  64 "Output unit".

7.4.5 "In height" level selection Calibration without reference pressure (dry calibration)

Example:

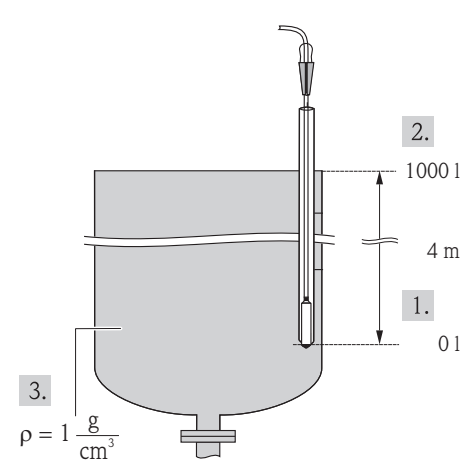
In this example, the volume in a tank should be measured in liters. The maximum volume of 1000 liters (264 US gal) corresponds to a level of 4 m (13 ft). The minimum volume of 0 liters corresponds to a level of 0 m since the process isolating diaphragm of the probe is at the start of the level measuring range.

Prerequisite:

- The measured variable is in direct proportion to the pressure.
- This is a theoretical calibration i.e. the height and volume values for the lower and upper calibration point must be known.



- The values entered for "Empty calib./Full calib.", "Empty height/Full height" and "Set LRV/Set URV" must be at least 1% apart. The value will be rejected, and a message output, if the values are too close together. Other limit values are not checked, i.e. the values entered must be appropriate for the sensor and the measuring task for the device to be able to measure correctly.
- Due to the orientation of the device, there may be pressure shifts in the measured value, i.e. when the container is empty or partly filled, the measured value is not zero. For information on how to perform position adjustment → 26.

	Description	
1	Select the "Level" measuring mode via the "Measuring mode" parameter. Menu path: Setup → Measuring mode	 <p>Calibration without reference pressure – dry calibration</p> <p>1 See Table, Step 10 and 11. 2 See Table, Steps 13 and 14. 3 See Table, Steps 12.</p>
2	Select a pressure unit via the "Press eng. unit" parameter, here "mbar" for example. Menu path: Setup → Press. eng. unit	
3	Select the "In height" level mode via the "Level selection" parameter. Menu path: Setup → Extended setup → Level → Level selection	
4	If density correction is required ¹⁾ : assign the temperature probe in the "Auto density corr." parameter. Menu path: Expert → Application → Auto density corr.	
5	Select a volume unit via the "Output unit" parameter, here "l" (liters) for example. Menu path: Setup → Extended setup → Level → Output unit	
6	Select a height unit via the "Height unit" parameter, here "m" for example. Menu path: Setup → Extended setup → Level → Height unit	
7	Select the "Dry" option via the "Calibration mode" parameter. Menu path: Setup → Extended setup → Level → Calibration mode	

¹⁾ A density correction is only possible for water. A temperature-density curve that is saved in the device is used. For this reason, the "Adjust density" (Step 12) and "Density process" (Step 15) parameters are not used here.

	Description	
8	Enter the volume value for the lower calibration point via the "Empty calib." parameter, here "0 liter" for example. Menu path: Setup → Extended setup → Level → Empty calib.	<p>$h = \frac{p}{\rho \cdot g}$</p> <p>4.08</p> <p>400</p> <p>$\rho = 1 \frac{\text{g}}{\text{cm}^3}$</p> <p>0</p> <p>$\frac{p}{[\text{mbar}]}$</p> <p>A0018828</p>
9	Enter the height value for the lower calibration point via the "Empty height" parameter, here "0 m" for example. Menu path: Setup → Extended setup → Level → Empty height	
10	Enter the volume value for the upper calibration point via the "Full calib." parameter, here "1000 liter" (264 US gal) for example. Menu path: Setup → Extended setup → Level → Full calib.	
11	Enter the height value for the upper calibration point via the "Full height" parameter, here "4 m" (13 ft) for example. Menu path: Setup → Extended setup → Level → Full height	<p>$h = \frac{p}{\rho \cdot g}$</p> <p>4. 1000</p> <p>4.0</p> <p>0</p> <p>$\frac{V}{[\text{l}]}$</p> <p>$\frac{h}{[\text{m}]}$</p> <p>A0018830</p>
12	Enter the density of the medium via the "Adjust density" parameter, here "1 g/cm³" for example. Menu path: Setup → Extended setup → Level → Adjust density	
13	Set the volume value for the lower current value (4 mA) via the "Set LRV" parameter. Menu path: Setup → Extended setup → Current output → Set LRV	
14	Set the volume value for the upper current value (20 mA) via the "Set URV" parameter. Menu path: Setup → Extended setup → Current output → Set URV	<p>I</p> <p>$[\text{mA}]$</p> <p>20</p> <p>4</p> <p>0.0</p> <p>1000</p> <p>$\frac{V}{[\text{l}]}$</p> <p>A0018832</p>
15	If the process uses a medium other than the medium on which the calibration was based, the new density must be specified in the "Density process" parameter. Menu path: Setup → Extended setup → Level → Density process The process density can only be changed if automatic density correction is switched off (see Step 4).	
16	Result: The measuring range is set for 0 to 1000 l.	
		<p>Calibration with reference pressure – wet calibration</p> <p>1 See Table, Step 12. 2 See Table, Step 8. 3 See Table, Step 9. 4 See Table, Step 10. 5 See Table, Step 11. 6 See Table, Step 13. 7 See Table, Step 14.</p>



The measured variables %, level, volume and mass are available for this level mode → Chap. 13.2 "Output unit".

7.4.6 "In height" level selection Calibration with reference pressure (wet calibration)

Example:

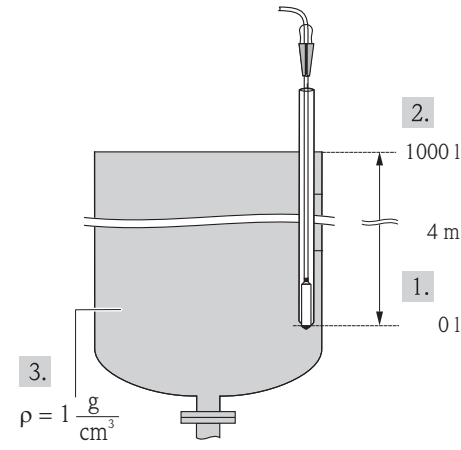
In this example, the volume in a tank should be measured in liters. The maximum volume of 1000 liters (264 US gal) corresponds to a level of 4 m (13 ft). The minimum volume of 0 liters corresponds to a level of 0 m since the process isolating diaphragm of the probe is at the start of the level measuring range. The density of the fluid is 1 g/cm³.

Prerequisite:

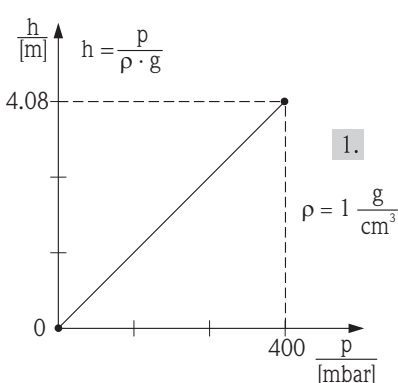
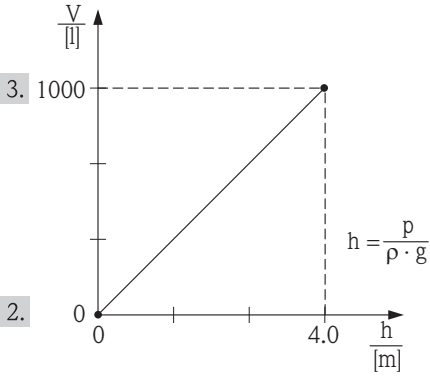

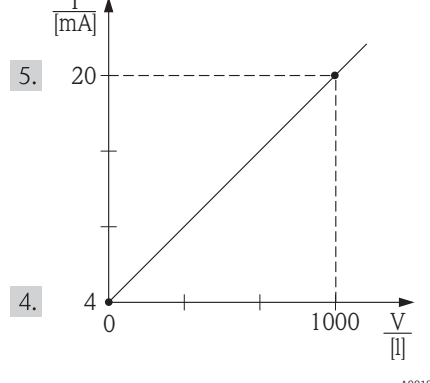

- The measured variable is in direct proportion to the pressure.
- The tank can be filled and emptied.



The values entered for "Empty calib./Full calib." and "Set LRV/Set URV" and the pressures present at the device must be at least 1% apart. The value will be rejected, and a message output, if the values are too close together. Other limit values are not checked, i.e. the values entered must be appropriate for the sensor and the measuring task for the device to be able to measure correctly.

	Description	
1	Perform position adjustment. See → 26.	 <p>Calibration with reference pressure – wet calibration</p> <p>1 See Table, Step 9. 2 See Table, Step 10. 3 See Table, Step 11.</p>
2	Select the "Level" measuring mode via the "Measuring mode" parameter. Menu path: Setup → Measuring mode	
3	Select the "In height" level mode via the "Level selection" parameter. Menu path: Setup → Extended setup → Level → Level selection	
4	If density correction is required ¹⁾ : assign the temperature probe in the "Auto density corr." parameter. Menu path: Expert → Application → Auto density corr.	
5	Select a pressure unit via the "Press eng. unit" parameter, here mbar for example. Menu path: Setup → Press. eng. unit	
6	Select a volume unit via the "Output unit" parameter, here "l" (liters) for example. Menu path: Setup → Extended setup → Level → Output unit	
7	Select a height unit via the "Height unit" parameter, here "m" for example. Menu path: Setup → Extended setup → Level → Height unit	

¹⁾ A density correction is only possible for water. A temperature-density curve that is saved in the device is used. For this reason, the "Adjust density" (Step 11) and "Density process" (Step 14) parameters are not used here.

	Description	
8	Select the "Wet" option via the "Calibration mode" parameter. Menu path: Setup → Extended setup → Level → Calibration mode	 <p>1.</p>
9	The hydrostatic pressure for the lower calibration point is present at the device, here "0 mbar" for example. Enter the volume value for the lower calibration point via the "Empty calib." parameter, here "0 liter" for example. Menu path: Setup → Extended setup → Level → Empty calib.	
10	The hydrostatic pressure for the upper calibration point is present at the device, here "400 mbar" (6.0 psi) for example. Enter the volume value for the upper calibration point via the "Full calib." parameter, here "1000 liter" (264 US gal) for example. Menu path: Setup → Extended setup → Level → Full calib.	 <p>2.</p>
11	If the calibration is performed with a medium other than the process medium, enter the density of the calibration medium in the "Adjust density" parameter. Here "1 g/cm³" for example. Menu path: Setup → Extended setup → Level → Adjust density  The process density can only be changed if automatic density correction is switched off (see Step 4).	
12	Set the volume value for the lower current value (4 mA) via the "Set LRV" parameter. Menu path: Setup → Extended setup → Current output → Set LRV	 <p>3.</p>
13	Set the volume value for the upper current value (20 mA) via the "Set URV" parameter. Menu path: Setup → Extended setup → Current output → Set URV	
14	If the calibration was performed with a medium other than the process medium, enter the density of the process medium in the "Density process" parameter. Menu path: Setup → Extended setup → Level → Density process  The process density can only be changed if automatic density correction is switched off (see Step 4).	<p>4.</p> <p>5.</p> <p>Calibration with reference pressure – wet calibration</p> <p>1 See Table, Step 11. 2 See Table, Step 9. 3 See Table, Step 10. 4 See Table, Step 12. 5 See Table, Step 13.</p>
15	Result: The measuring range is set for 0 to 1000 l.	



The measured variables %, level, volume and mass are available for this level mode, → Chap. 13.2 "Output unit".

7.4.7 Calibration with partially-filled tank (wet calibration)

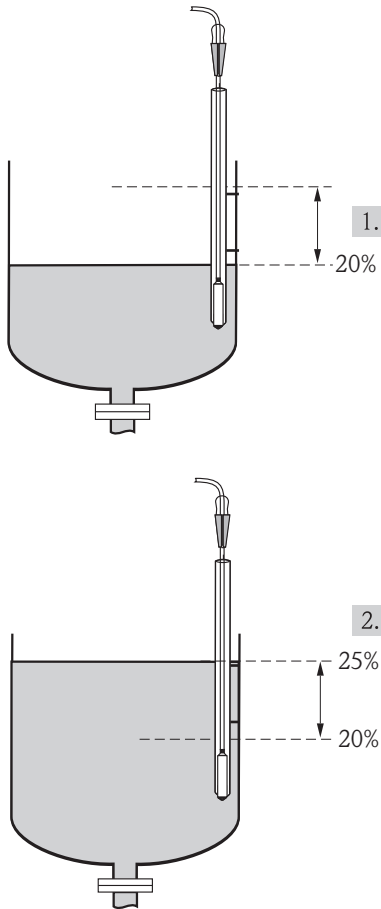
Example:

In this example a wet calibration is shown when it is not possible to empty the vessel and then fill it up to 100%. Here a 20% filling is used as "Empty" and a "25%" filling is used as "Full" calibration point. The calibration is then extended to 0% ... 100% and LRV / URV are adjusted accordingly.

Prerequisite:

The default value in the level mode for calibration mode is "Wet".

However, it can be changed via: Setup → Extended Setup → Level → Calibration mode

	Description	
1	Select the "Level" measuring mode via the "Measuring mode" parameter. Menu path: Setup → Measuring mode	 <p>1.</p> <p>20%</p> <p>2.</p> <p>25%</p> <p>20%</p> <p>A0018841</p> <p>Calibration with partially-filled tank</p> <p>1 See Table, Step 2</p> <p>2 See Table, Step 3</p>
2	Set value for "Empty calib." with acting pressure for Level e.g. 20%. Menu path: Setup → Extended Setup → Level → Empty calibration	
3	Set value for "Full calib." with acting pressure for Level e.g. 25%. Menu path: Setup → Extended Setup → Level → Full calibration	
4	The values for pressure for full or empty vessels are measured automatically at adjustment. As the transmitter automatically sets the pressure values that suit to empty and full calibration to min and max pressure that cause the output current, it is necessary to set the right upper range value (URV) and lower range value (LRV).	



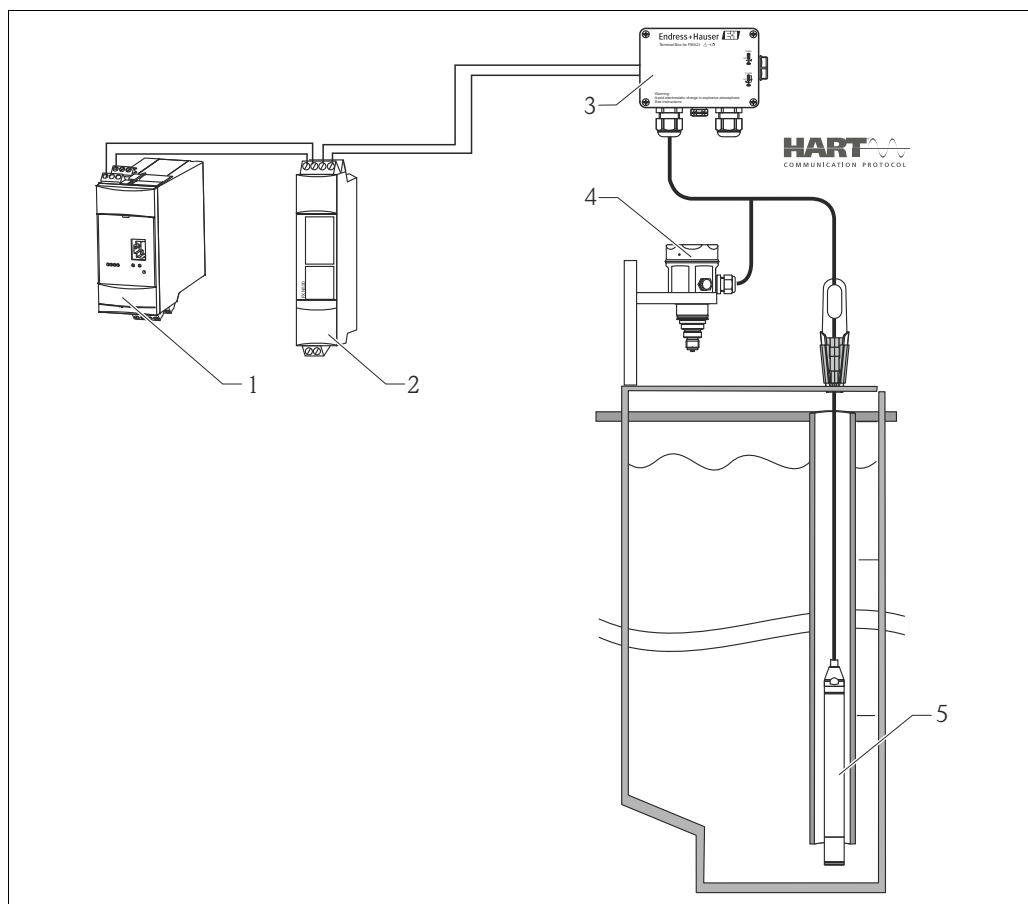
It is also possible to use different liquids for the adjustment. In this case you have to enter the appropriate densities at following menu path:

- Setup → Ext. Setup → Level → Adjust density (e.g. 1.0 kg/l for water)
- Setup → Ext. Setup → Level → Process density (e.g. 0.8 kg/l for oil)

7.4.8 Level measurement with absolute pressure probe and external pressure signal (electrical differential pressure)

Example:

In this example, a Waterpilot FMX21 and a Cerabar M device (each with an absolute pressure measuring cell) are combined via the common communication bus. The level can thus be measured in the deep well, while the influence of the atmospheric pressure is compensated for at the same time.



A0018821

- 1 Fieldgate FXA520
- 2 Multidrop-Connector FXN520
- 3 Terminal box can be ordered as an accessory
- 4 Cerabar M absolute pressure (atmospheric pressure)
- 5 Waterpilot absolute pressure (level)

	Description Adjustment of the level sensor (Waterpilot)
1	Select the "Pressure" measuring mode via the "Measuring mode" parameter. Menu path: Setup → Measuring mode
2	Select a pressure unit via the "Press eng. unit" parameter, here "mbar" for example. Menu path: Setup → Press. eng. unit
3	The sensor is unpressurized, perform position adjustment (→ 26).
4	Switch on burst mode via the "Burst mode" parameter Menu path: Expert → Communication → HART Config.
5	Set the output current to "Fixed" 4.0 mA via the "Current mode" parameter Menu path: Expert → Communication → HART Config.
6	Configure an address $\neq 0$ using the "Bus address" parameter, e.g. bus address = 1. (HART 5.0 master: Range 0 to 15, where address = 0 calls up the "Signaling" setting; HART 6.0 master: range 0 to 63) Menu path: Expert → Communication → HART Config.

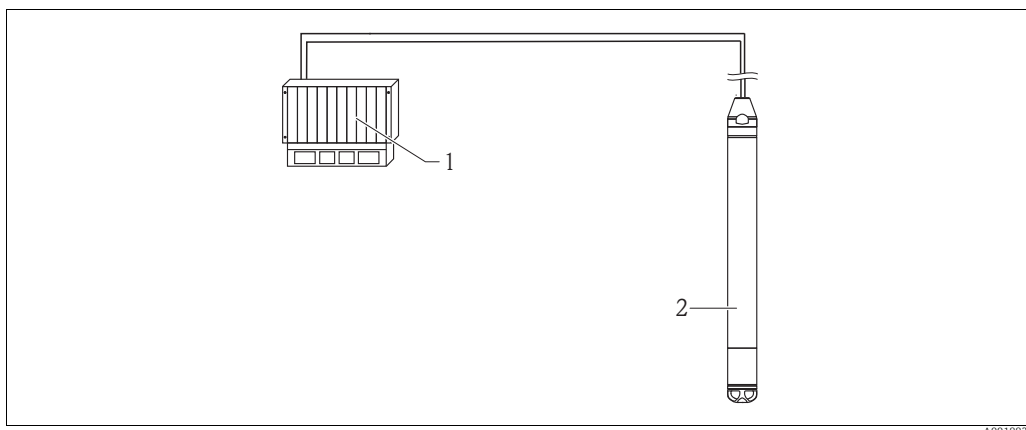
	Description Adjustment of the level sensor (Waterpilot)
1	Select the "Level" measuring mode via the "Measuring mode" parameter. Menu path: Setup → Measuring mode
2	Select a pressure unit via the "Press eng. unit" parameter, here "mbar" for example. Menu path: Setup → Press. eng. unit
3	The sensor is unpressurized, perform position adjustment (→ 26).
4	Set the output current to "Fixed" 4.0 mA via the "Current mode" parameter Menu path: Expert → Communication → HART Config.
5	Configure an address $\neq 0$ using the "Bus address" parameter, e.g. bus address = 2. (HART 5.0 master: Range 0 to 15, where address = 0 calls up the "Signaling" setting; HART 6.0 master: range 0 to 63) Menu path: Expert → Communication → HART Config.
6	Activate the reading of a value sent externally in burst mode via the "Electr. Delta P" parameter Menu path: Expert → Application
7	Perform level adjustment (wet or dry), → 32 ff.
8	Result: The measured value output by the atmospheric pressure sensor equals the level in the deep well (differential signal) and can be read out by means of a HART request of the address of the atmospheric pressure sensor.

- It is not permitted to reverse the assignment of the measuring points to the direction of communication.
- The measured value of the transmitting device (via burst) must always be greater than the measured value of the receiving device (via the "Electr. Delta P" mode).
- Adjustments that result in an offset of the pressure values (e.g. position adjustment, trim) must always be performed in accordance with the individual sensor and its orientation, irrespective of the "Electr. Delta P" application.
- Other settings result in non-permitted use of the "Electr. Delta P" mode and can lead to incorrect measured values.

7.4.9 Automatic density compensation with the internally measured sensor temperature

Example:

In this example, a Waterpilot FMX21 is used for level measurement in water. The change in the water density caused by changing temperatures is automatically factored into the level signal by activating automatic density compensation.



A0018822

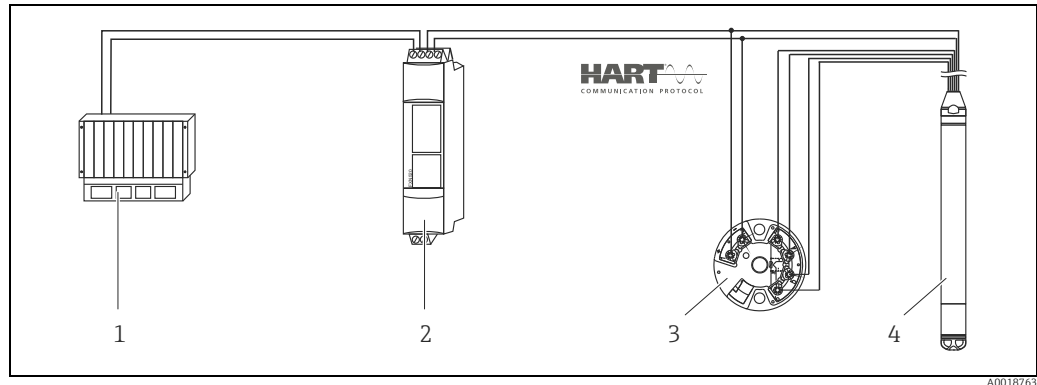
- 1 HART-Master, e.g. PLC (programmable logic controller)
2 Waterpilot FMX21

	Description Adjustment of the Waterpilot for level measurement
1	Select the "Level" measuring mode via the "Measuring mode" parameter. Menu path: Setup → Measuring mode
2	Select a pressure unit via the "Press eng. unit" parameter, here "mbar" for example. Menu path: Setup → Press. eng. unit
3	The sensor is unpressurized, perform position adjustment (→ 26).
4	Set the "Auto density corr." parameter to Sensor temperature. Menu path: Expert → Application
5	Perform level adjustment (wet or dry), → 32 ff.
6	Result: The measured value output by the Waterpilot equals the level in the deep well corrected by means of the density characteristic line of the water.


7.4.10 Automatic density compensation using an integrated Pt100 value for calculation in a suitable HART master (e.g. PLC)

Example:

In this example, the FMX21 with an integrated Pt100 and a temperature head transmitter with HART communication (e.g. TMT182) are combined via the common communication bus. The temperature and pressure signal is transmitted to the HART master (e.g. PLC) where a corrected level value can be generated using a stored linearization table or the density function (of a chosen medium). A pressure signal and a temperature signal can thus be generated with a chosen density function to compensate for a level.



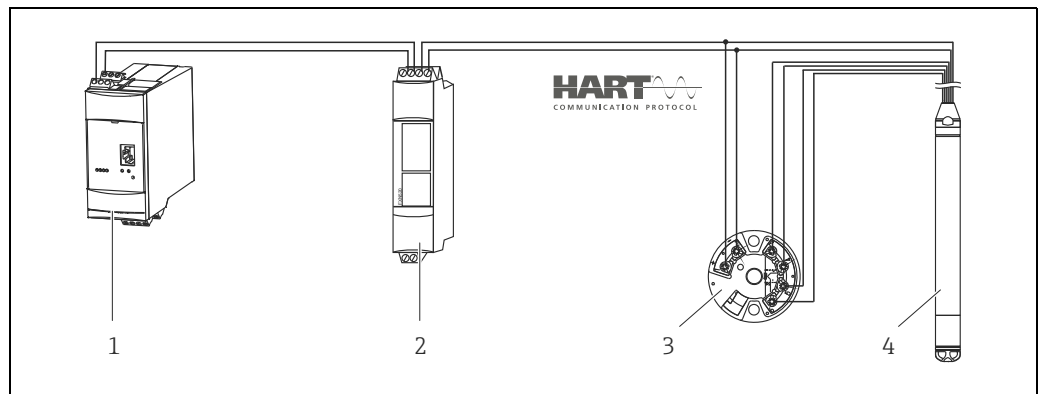
- 1 HART-Master, e.g. PLC (programmable logic controller)
 2 Multidrop-Connector FXN520
 3 TMT182 Temperature head transmitter
 4 Waterpilot FMX21

	Description
	Adjustment of the Waterpilot for pressure measurement
1	Select the "Pressure" measuring mode via the "Measuring mode" parameter. Menu path: Setup → Measuring mode
2	Select a pressure unit via the "Press eng. unit" parameter, here "mbar" for example. Menu path: Setup → Press. eng. unit
3	The sensor is unpressurized, perform position adjustment (→ 26).
4	Set the output current to "Fixed" 4.0 mA via the "Current mode" parameter. Menu path: Expert → Communication → HART Config.
5	Perform level adjustment (wet or dry), → 32 ff.
6	Configure an address ≠ 0 using the "Bus address" parameter, e.g. bus address = 1. (HART 5.0 master: Range 0 to 15, where address = 0 calls up the "Signaling" setting; HART 6.0 master: range 0 to 63) Menu path: Expert → Communication → HART Config.  The output current of the temperature transmitter used must also be set to Fixed and a HART address other than zero (e.g. address = 2) is configured.
7	Result: A corrected level value can be determined for a chosen medium using a suitable density function by calculating the pressure signal and temperature signal in a suitable HART master (e.g. PLC).

7.4.11 Automatic density compensation using an external temperature value for calculation in the FMX21

Example:

In this example, the FMX21 with an integrated Pt100 and a HART-compliant temperature transmitter are combined via the common communication bus. In this case, the signal of the Pt100 is analyzed using a HART-compliant (at least HART 5.0) temperature head transmitter that supports burst mode. The change in the water density caused by changing temperatures is automatically factored into the level signal by activating automatic density compensation.



A0018764

- 1 Fieldgate FXA520
- 2 Multidrop-Connector FXN520
- 3 TMT182 Temperature head transmitter (burst mode)
- 4 Waterpilot FMX21

Description	
Configuring the HART-compliant temperature head transmitter (min. HART 5.0) with burst function	
The output current of the temperature head transmitter used should be set to Fixed and must have a HART address other than zero (e.g. address = 1) configured. The burst function must then be switched on with HART command 1. This step should be performed before the procedure described below in order to avoid a HART input error of the FMX21 being output during commissioning.	
Adjustment of the Waterpilot for level measurement	
1	Select the "Level" measuring mode via the "Measuring mode" parameter. Menu path: Setup → Measuring mode
2	Select a pressure unit via the "Press eng. unit" parameter, here "mbar" for example. Menu path: Setup → Press. eng. unit
3	The sensor is unpressurized, perform position adjustment (→ 26).
4	Set the "Auto density corr." parameter to "External value". Menu path: Expert → Application
5	Perform level adjustment (wet or dry), → 32 ff.
6	Result: The measured value output by the Waterpilot equals the level in the deep well corrected by means of the density characteristic line of the water.





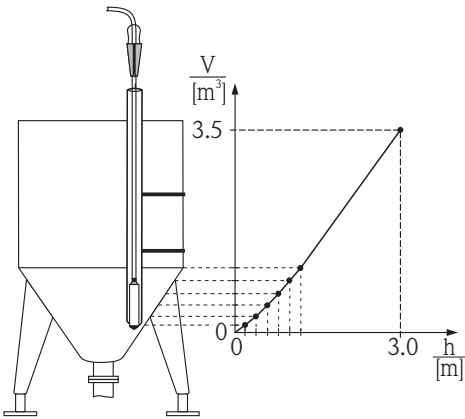
Temperature head transmitter TMT182 is not suitable for this configuration.

7.5 Linearization

7.5.1 Semiautomatic entry of the linearization table

Example:
In this example, the volume in a tank with a conical outlet should be measured in "m³".
Prerequisite:
■ The tank can be filled or be emptied. The linearization characteristic must rise continuously.
■ The "Level" operating mode has been selected.

 For a description of the parameters mentioned →  64.

	Description	
1	Select the "Semiautom. entry" option via the "Lin. mode" parameter. Menu path: Setup → Extended setup → Linearization → Lin. mode	 <small>A0018843</small>
2	Select the volume/mass unit via the "Unit after lin." parameter, e. g. "m ³ ". Menu path: Setup → Extended setup → Linearization → Unit after lin.	
3	Fill the tank to the height of the 1st point.	

	Description	
4	<p>Enter the number of the point in the table via the "Line-numb." parameter.</p> <p>Menu path: Setup → Extended setup → Linearization → Line-numb</p> <p>The current level is displayed via the "X-value" parameter.</p> <p>Menu path: Setup → Extended setup → Linearization → X-value</p> <p>Using the "Y-value" parameter, enter the associated volume value, here "0 m³" for example, and confirm the value.</p> <p>Menu path: Setup → Extended setup → Linearization → Y-value</p>	<p style="text-align: right;">A0018849</p>
5	<p>To enter another point in the table, select the "Next point" option via the "Edit table" parameter.</p> <p>Menu path: Setup → Extended setup → Linearization → Edit table</p>	<p style="text-align: right;">A0018853</p>
6	<p>Once all the points have been entered in the table, select the "Activate table" option via the "Lin. mode" parameter.</p> <p>Menu path: Setup → Extended setup → Linearization → Lin. mode</p>	
7	<p>Result: The measured value after linearization is displayed.</p>	<p><i>Semiautomatic entry of the linearization table</i></p>



1. Error message F510 "Linearization" and alarm current as long as the table is being entered and until the table is activated.
2. The 0% value (= 4 mA) is defined by the lowest pair of values in the table.
The 100% value (= 20 mA) is defined by the maximum pair of values point in the table.
3. You can change the allocation of the volume or mass values to the current values using the "Set LRV" and "Set URV" parameters.

7.5.2 Manual entry of the linearization table

Example:

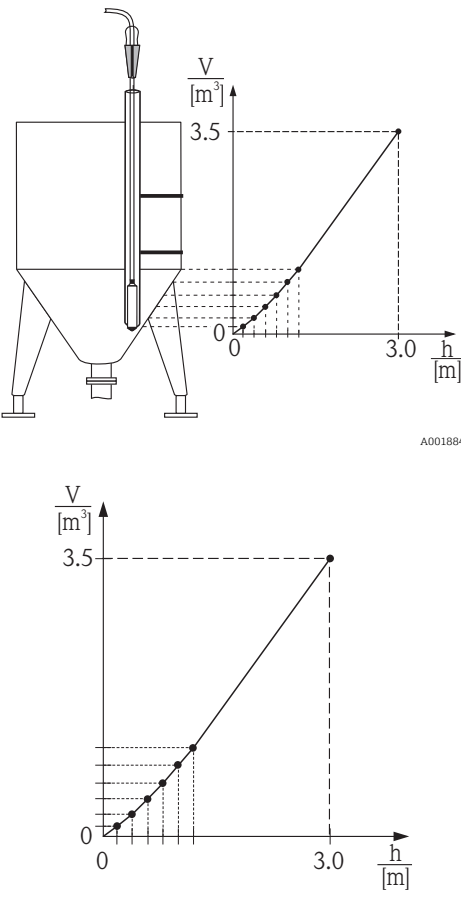
In this example, the volume in a tank with a conical outlet should be measured in "m³".

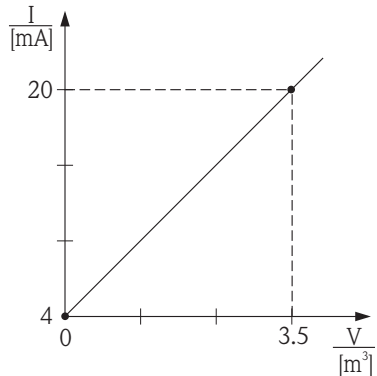
Prerequisite:

- This is a theoretical calibration, i.e. the points for the linearization table are known.
- The "Level" operating mode has been selected.
- A level calibration has been performed.



For a description of the parameters mentioned → 64.

	Description	 <p>A0018843</p> <p>A0018849</p>
1	Select the "Manual entry" option via the "Lin. mode" parameter. Menu path: Setup → Extended setup → Linearization → Lin. mode	
2	Select the volume/mass unit via the "Unit after lin." parameter, e. g. "m ³ ". Menu path: Setup → Extended setup → Linearization → Unit after lin.	
3	Enter the number of the point in the table via the "Line-numb." parameter. Menu path: Setup → Extended setup → Linearization → Line-numb The level (e.g. "0 m") is entered via the "X-value" parameter. Confirm your entry. Menu path: Setup → Extended setup → Linearization → X-value Using the "Y-value" parameter, enter the associated volume value, here "0 m ³ " for example, and confirm the value. Menu path: Setup → Extended setup → Linearization → Y-value	

	Description	
4	<p>To enter another point in the table, select the "Next point" option via the "Edit table" parameter. Enter the next point as explained in Step 3.</p> <p>Menu path: Setup → Extended setup → Linearization → Edit table</p>	 <p style="text-align: right;">A0018853</p> <p>Manual entry of the linearization table</p>
5	<p>Once all the points have been entered in the table, select the "Activate table" option via the "Lin. mode" parameter.</p> <p>Menu path: Setup → Extended setup → Linearization → Lin. mode</p>	
6	<p>Result: The measured value after linearization is displayed.</p>	



1. Error message F510 "Linearization" and alarm current as long as the table is being entered and until the table is activated.
2. The 0% value (= 4 mA) is defined by the lowest pair of values in the table.
The 100% value (= 20 mA) is defined by the maximum pair of values in the table.
3. You can change the allocation of the volume or mass values to the current values using the "Set LRV" and "Set URV" parameters.

8 Troubleshooting

8.1 Messages

The following table lists the messages that can occur. The Diagnostic code parameter shows the message with the highest priority. The device has four different status information codes according to NE107:

- F = failure
- M (warning) = maintenance required
- C (warning) = function check
- S (warning) = outside specification (deviations from the permitted ambient or process conditions determined by the device with the self-monitoring function, or errors in the device itself indicate that the measuring uncertainty is greater than what would be expected under normal operating conditions).



For support and further information, please contact Endress+Hauser Service.

Diagnostic code	Error message	Cause	Remedial action
0	No error	–	–
C412	Backup in prog.	– Downloading.	Wait for download to complete
C482	Current simul.	– Current output simulation is switched on, i.e. the device is not measuring at present.	End the simulation
C484	Error simul.	– Fault state simulation is switched on, i.e. the device is not measuring at present.	End the simulation
C485	Measure simul.	– Simulation is switched on, i.e. the device is not measuring at present.	End the simulation
C824	Process pressure	<ul style="list-style-type: none"> – Overpressure or low pressure present. – This message normally only appears briefly. – Electromagnetic effects are greater than specified in the technical data. 	<ol style="list-style-type: none"> 1. Check the pressure value 2. Restart the device 3. Perform a reset
F002	Unknown sensor	– Sensor does not suit the device (electronic sensor nameplate).	Contact Endress+Hauser Service.
F062	Sensor conn.	<ul style="list-style-type: none"> – Cable connection between the sensor and main electronics is disconnected. – Sensor defective. – Electromagnetic effects are greater than specified in the technical data. This message normally only appears briefly. 	Check the sensor cable
F081	Initialization	<ul style="list-style-type: none"> – Cable connection between the sensor and main electronics is disconnected. – Sensor defective. – Electromagnetic effects are greater than specified in the technical data. This message normally only appears briefly. 	<ol style="list-style-type: none"> 1. Perform a reset 2. Check the sensor cable
F083	Permanent mem.	<ul style="list-style-type: none"> – Sensor defective. – Electromagnetic effects are greater than specified in the technical data. This message normally only appears briefly. 	1. Restart the device

Diagnostic code	Error message	Cause	Remedial action
F140	Working range P	<ul style="list-style-type: none"> Overpressure or low pressure present. Electromagnetic effects are greater than specified in the technical data. Sensor defective. 	<ol style="list-style-type: none"> Check the process pressure Check the sensor range
F261	Electronics	<ul style="list-style-type: none"> Main electronics defective. Fault in the main electronics. 	Restart the device
F282	Data memory	<ul style="list-style-type: none"> Fault in the main electronics. Main electronics defective. 	Restart the device
F283	Permanent mem.	<ul style="list-style-type: none"> Main electronics defective. Electromagnetic effects are greater than specified in the technical data. The supply voltage is disconnected when writing. An error occurred when writing. 	Perform a reset
F411	Up-/download	<ul style="list-style-type: none"> The file is defective. During the download, the data are not correctly transmitted to the processor, e.g. due to open cable connections, spikes (ripple) on the supply voltage or electromagnetic effects. 	<ol style="list-style-type: none"> Download again Use another file Perform a reset
F510	Linearization	<ul style="list-style-type: none"> The linearization table is being edited. 	<ol style="list-style-type: none"> Complete your entries Select "linear"
F511	Linearization	<ul style="list-style-type: none"> The linearization table consists of less than 2 points. 	<ol style="list-style-type: none"> Table too small Correct the table Accept the table
F512	Linearization	<ul style="list-style-type: none"> The linearization table is not monotonic increasing or decreasing. 	<ol style="list-style-type: none"> Tab. not monotonic Correct the table Accept the table
F841	Sensor range	<ul style="list-style-type: none"> Overpressure or low pressure present. Sensor defective. 	<ol style="list-style-type: none"> Check the pressure value Contact Endress+Hauser Service.
F882	Input signal	<ul style="list-style-type: none"> External measured value is not received or displays a failure status. 	<ol style="list-style-type: none"> Check the bus Check the source device Check the setting
M002	Unknown sensor	<ul style="list-style-type: none"> Sensor does not suit the device (electronic sensor nameplate). Device continues measuring. 	Contact Endress+Hauser Service.
M283	Permanent mem.	<ul style="list-style-type: none"> Cause as indicated for F283. Correct measurement can continue as long as you do not need the peakhold indicator function. 	Perform a reset
M431	Adjustment	<ul style="list-style-type: none"> The adjustment performed would cause the sensor nominal range to be undershot or overshoot. 	<ol style="list-style-type: none"> Check the measuring range Check position adjustment Check the setting
M434	Scaling	<ul style="list-style-type: none"> Values for calibration (e.g. lower-range value and upper-range value) are too close together. The lower-range value and/or upper-range value undershoot or exceed the sensor range limits. The sensor was replaced and the customer-specific configuration does not suit the sensor. Unsuitable download carried out. 	<ol style="list-style-type: none"> Check the measuring range Check the setting Contact Endress+Hauser Service.
M438	Data record	<ul style="list-style-type: none"> The supply voltage is disconnected when writing. An error occurred when writing. 	<ol style="list-style-type: none"> Check the setting Restart the device

Diagnostic code	Error message	Cause	Remedial action
M882	Input signal	– External measured value displays a warning status.	1. Check the bus 2. Check the source device 3. Check the setting
S110	Working range T	– High temperature or low temperature present. – Electromagnetic effects are greater than specified in the technical data. – Sensor defective.	1. Check the process temperature 2. Check the temperature range
S140	Working range P	– Overpressure or low pressure present. – Electromagnetic effects are greater than specified in the technical data. – Sensor defective.	1. Check the process pressure 2. Check the sensor range
S822	Process temp.	– The temperature measured in the sensor is higher than the upper nominal temperature of the sensor. – The temperature measured in the sensor is lower than the lower nominal temperature of the sensor.	1. Check the temperature 2. Check the setting
S841	Sensor range	– Overpressure or low pressure present. – Sensor defective.	1. Check the pressure value 2. Contact Endress+Hauser Service.
S971	Adjustment	– The current is outside the permitted range of 3.8 to 20.5 mA. – The pressure present is outside the set measuring range (but might be within the sensor range). – The adjustment performed would cause the sensor nominal range to be undershot or overshoot.	1. Check the pressure value 2. Check the measuring range 3. Check the setting

8.2 Malfunctions of Waterpilot FMX21 with optional Pt100

Error description	Cause	Measures
No measuring signal	4 to 20 mA cable not connected correctly	Connect device in accordance with → 14, Section 5.1.
	No power supplied via the 4 to 20 mA cable	Check current loop.
	Supply voltage too low (min. 10.5 V DC)	– Check supply voltage. – Overall resistance greater than max. load resistance → 14, Section 5.1.
	Waterpilot defective	Replace the Waterpilot.
Temperature measured value is inaccurate/incorrect (only for Waterpilot FMX21 with Pt100)	Pt100 connected in 2-wire circuit, cable resistance was not compensated	– Compensate cable resistance. – Connect Pt100 as 3-wire or 4-wire circuit.

8.3 Malfunctions of TMT182 temperature head transmitter

Error description	Cause	Remedial action
No measuring signal	4 to 20 mA cable not connected correctly	Connect device in accordance with → 14, Section 5.1.
	No power supplied via the 4 to 20 mA cable	Check current loop.
	Supply voltage too low (min. 11.5 V DC)	<ul style="list-style-type: none"> – Check supply voltage. – Overall resistance greater than max. load resistance → 14, Section 5.1.
Error current ≤ 3.6 mA or ≥ 21 mA	Pt100 not connected correctly	Connect device in accordance with → 14, Section 5.1.
	4 to 20 mA cable not connected correctly	Connect device in accordance with → 14, Section 5.1.
	Pt100 resistance thermometer defective	Replace the Waterpilot.
	Temperature head transmitter defective	Replace the temperature head transmitter.
Measured value is inaccurate/incorrect	Pt100 connected in 2-wire circuit, cable resistance was not compensated	<ul style="list-style-type: none"> – Compensate cable resistance. – Connect Pt100 as 3-wire or 4-wire circuit.

8.4 Firmware history

Date	Firmware version	Software modifications	Dokumentationen
05.2009	01.00.zz	Original software. Compatible with: <ul style="list-style-type: none"> – FieldCare version 2.02.00 or higher – Field Communicator DXR375 with Device Rev.: 1, DD Rev.: 1 	BA380P/00/EN/08.09

9 Maintenance

No special maintenance work is required for the Waterpilot and for the optional TMT182 temperature head transmitter.



Terminal box: Keep the pressure compensation tube and GORE-TEX® filter free from contamination.

9.1 Exterior cleaning

Please note the following points when cleaning the devices externally:

- The cleaning agents used should not corrode the housing surface and the seals. Information on this can be found on the nameplate (→ 6).
- Mechanical damage to the process isolating diaphragm or the extension cable must be avoided.
- Only clean the terminal box with water or with a cloth dampened with very diluted ethanol.

10 Repair

10.1 Spare parts

In the W@M Device Viewer (www.endress.com/deviceviewer) all spare parts for the measuring device, along with the order code, are listed here and can be ordered. If available, users can also download the associated Installation Instructions.

10.2 Return

The measuring device must be returned if repairs or a factory calibration are required, or if the wrong measuring device has been ordered or delivered. According to legal regulations, Endress+Hauser, as an ISO-certified company, is required to follow certain procedures when handling returned products that are in contact with medium.

To ensure swift, safe and professional device returns, please read the return procedures and conditions on the Endress+Hauser website at: www.services.endress.com/return-material


10.3 Disposal

When disposing, separate and recycle the device components based on the materials.


11 Accessories

Various accessories, which can be ordered separately from Endress+Hauser, are available for the Waterpilot, see also → Technical Information TI00431P/00/EN, "Ordering information" section.

11.1 Mounting clamp

- Endress+Hauser offers a mounting clamp for easy Waterpilot mounting (→  10).
- Material: 316L (1.4404) and fiberglass reinforced PA (polyamide)
- Order number: 52006151

11.2 Terminal box

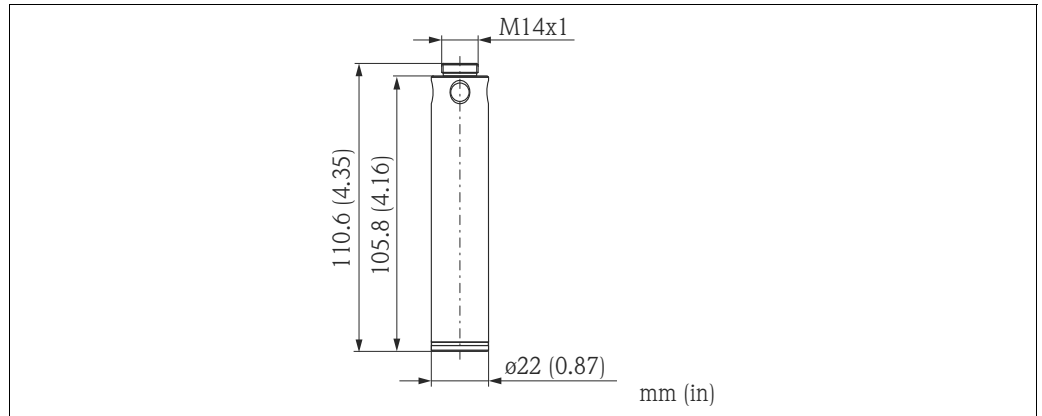
- IP66/IP67 terminal boxes with GORE-TEX® filter incl. integrated terminals.
- The terminal box is also suitable for installing a temperature head transmitter (order number: 51001023) or for four additional terminals (order number: 52008938), →  12.



The terminal box is not intended for the FMX21 with Ex nA explosion protection in the hazardous area. When using the terminal box in hazardous areas, installation must comply with the corresponding national standards and regulations and the Safety Instructions or Installation or Control Drawings.

11.3 Additional weight for Waterpilot with outer diameter of 22 mm (0.87 in) and 29 mm (1.14 in)

Endress+Hauser offers additional weights to prevent sideways movement that results in measuring errors, or to make it easier to lower the device in a guide tube. You can screw several weights together. The weights are then attached directly to the Waterpilot. For the Waterpilot with an outer diameter of 29 mm (1.14 in), version with a plastic insulation, a maximum of 5 weights may be attached.



- Material: 316L (1.4435)
- Weight: 300 g (10.5 oz)
- Order number: 52006153



In combination with the Ex nA approval, for FMX21 with an outer diameter of 29 mm (1.14 in) a maximum of 1 additional weight may be attached.

11.4 TMT182 temperature head transmitter (4 to 20 mA HART)

- 2-wire temperature head transmitter, configured for a measuring range from -20 to $+80$ °C (-4 to $+176$ °F).
This setting offers a temperature range of 100K which can be easily mapped.
Please note that the Pt100 resistance thermometer is designed for a temperature range from -10 to $+70$ °C (-14 to $+158$ °F) → 12.
- Order number: 51001023

⚠ WARNING

Explosion hazard!

- Not for use of the Waterpilot FMX21 in hazardous areas.

11.5 Extension cable mounting screw

Endress+Hauser offers extension cable mounting screws to ease Waterpilot mounting and to seal the measuring aperture (→ 11).

Extension cable mounting screw

- Order number G 1½" A: 52008264
- Order number NPT 1½": 52009311
- Material: 304 (1.4301)

11.6 Terminals

- Four terminals in strip for FMX21 terminal box, suitable for wire cross-sections: 0.08 to 2.5 mm² (28 to 14 AWG)
- Order number: 52008938

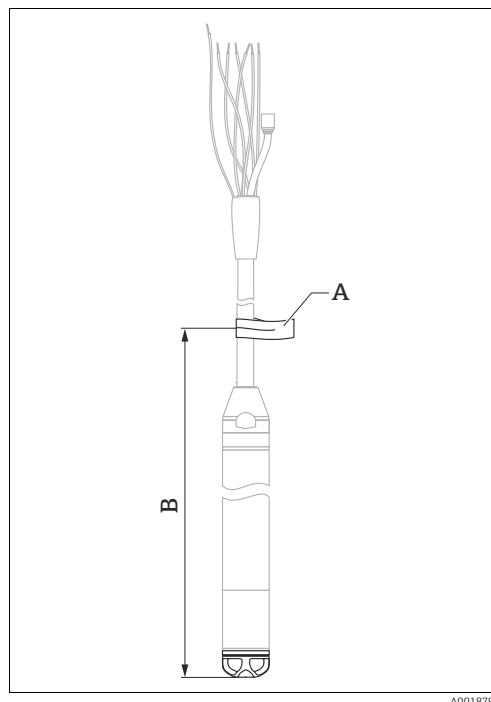
⚠ WARNING

Explosion hazard!

- The 4-terminal strip is not designed for use in hazardous areas incl. CSA: GP.

11.7 Cable marking

To make installation easier, Endress+Hauser marks the customer-specific length on the extension cable, see Technical Information TI00431P/00/EN, "Ordering information" section.



A Cable marking
B Cable marking tolerance

- Cable marking tolerance (distance to the lower end of the cable probe):
Cable length
< 5 m (16 ft): ±17,5 mm (0.69 in)
> 5 m (16 ft): ±0,2 %
- Material: PET, Adhesive: acrylic
- Immunity to temperature change: -30 to +100 °C (-22 to 212 °F)

NOTICE

The mark is only for installation purposes.

- It must be thoroughly removed without trace in the case of devices with drinking water approval. The extension cable must not be damaged in the process.

⚠ WARNING

Explosion hazard!

- Not for use in hazardous areas.

11.8 Cable shortening kit

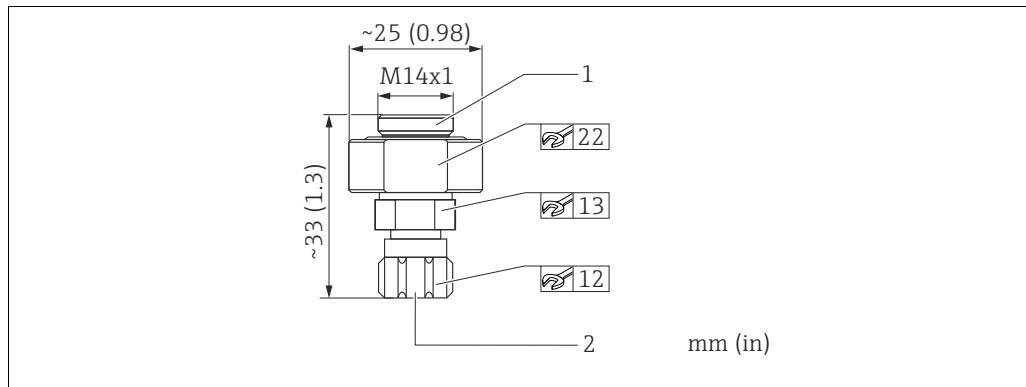
The cable shortening kit is used to easily and professionally shorten a cable, see Technical Information TI00431P/00/EN, "Ordering information" section, and documentation SD00552P/00/A6.



The cable shortening kit is not designed for devices with FM/CSA approval.

11.9 Testing adapter for FMX21 with outer diameter of 22 mm (0.87 in) and outer diameter of 29 mm (1.14 in)

Endress+Hauser offers a testing adapter to ease function-testing of the level probes.



- 1 Connection suitable for Waterpilot
- 2 Compressed air hose connection, internal diameter of quick coupling piece 4 mm (0.16 in)

- Observe the maximum pressure for the compressed air hose and the maximum overload for the level probe. (For the maximum overload of the cable probe, see Technical Information TI00431P/00/EN or go to www.endress.com → Select Country → Download → Media Type: Documentation)
- Maximum pressure of the quick coupling piece supplied: 10 bar (145 psi)
- Adapter material: 304 (1.4301)
- Quick coupling piece material: anodized aluminum
- Adapter weight: 39 g (1.37 oz)
- Order number: 52011868

12 Technical data

For the technical data, please refer to Technical Information TI00431P/00/EN (→ see also: www.endress.com → Select Country → Download → Media Type: Documentation).

13 Appendix

The entire operating menu is depicted on the following pages.



The operating menu has a different structure depending on the measuring mode selected. This means that some function groups are only displayed for one measuring mode, e.g. the "Linearization" function group for the "Level" measuring mode. In addition, there are also parameters that are only displayed if other parameters are appropriately configured.

13.1 Overview of the operating menu

All the parameters are listed in the following table. This overview contains the levels with the associated parameters for the Pressure and Level measuring modes.



The page number refers to where a description of the parameter can be found.

Level 1	Level 2	Level 3	Level 4	Page
Setup				
	Measuring mode			65
	Press. eng. unit			66
	Corrected press.			67
	Position adjustment (relative pressure sensor) Position offset (absolute pressure sensor)			66
	Empty calibration			69
	Full calibration			69
	Set LRV			67
	Set URV			67
	Damping value			66
	Level before lin			70
	Pressure after damping			67
	Extended setup			
		Code definition		64
		Device tag		64
		Operator code		64

Level 1	Level 2	Level 3	Level 4	Page
Setup	Extended setup			
		Level		
			Level selection	68
			Output unit	68
			Height unit	68
			Calibration mode	68
			Empty calib.	69
			Empty pressure	69
			Empty height	69
			Full calib.	69
			Full pressure	69
			Full height	69
			Adjust density	70
			Process density	70
			Level before lin	70
		Linearization		
			Lin. mode	70
			Unit after lin.	70
			Line-numb.	71
			X-value	71
			Y-value	71
			Edit table	71
			Tank description	71
			Tank content	71
		Current output		
			Alarm behav. P	72
			Output fail mode	72
			High alarm curr.	72
			Set min. current	73
			Output current	72
			Get LRV (pressure measuring mode)	73
			Set LRV	73
			Get URV (pressure measuring mode)	73
			Set URV	73

Level 1	Level 2	Level 3	Level 4	Page
Diagnosis				
	Diagnostic code			77
	Last diag. code			78
	Min. meas. press.			77
	Max. meas. press.			77
	Diagnostic list			
		Diagnostic 1		78
		Diagnostic 2		78
		Diagnostic 3		78
		Diagnostic 4		78
		Diagnostic 5		78
		Diagnostic 6		78
		Diagnostic 7		78
		Diagnostic 8		78
		Diagnostic 9		78
		Diagnostic 10		78
	Event logbook			
		Last diag. 1		78
		Last diag. 2		78
		Last diag. 3		78
		Last diag. 4		78
		Last diag. 5		78
		Last diag. 6		78
		Last diag. 7		78
		Last diag. 8		78
		Last diag. 9		78
		Last diag. 10		78
	Instrument info			
		Firmware version		64
		Serial number		64
		Ext. order code		64
		Order identifier		64
		Cust. tag number		64
		Device tag		64
		ENP version		64
		Config. counter		78
		Lower range limit		72
		URL sensor		72
		Manufacturer ID		75
		Device type code		75
		Device revision		75

Level 1	Level 2	Level 3	Level 4	Page		
Diagnosis						
	Measured values					
		Level before lin			70	
		Tank content			71	
		Meas. pressure			67	
		Sensor pressure			67	
		Corrected press.			67	
		Pressure after damping			67	
		Sensor temp.			66	
	Simulation					
		Simulation mode			79	
		Sim. pressure			79	
		Sim. level			79	
		Sim. tank cont.			79	
		Sim. current			79	
		Sim. alarm/warning			79	
Enter reset code						
	Enter reset code			65		
Expert						
	System					
		Code definition			64	
		Operator code			64	
		Instrument info				
			Cust. tag number			64
			Device tag			64
			Serial number			64
			Firmware version			64
			Ext. order code			64
			Order identifier			64
			ENP version			64
			Electr. serial no.			64
			Sensor serial no.			64
		Management				
			Enter reset code			65

Level 1	Level 2	Level 3	Level 4	Page
Expert	Measurement			
		Measuring mode		65
		Basic setup		
			Pos. zero adjust	66
			Calib. offset	66
			Damping value	66
			Press. eng. unit	66
			Temp. eng. unit	66
			Sensor temp.	66
		Pressure		
			Set LRV	67
			Set URV	67
			Meas. pressure	67
			Sensor pressure	67
			Corrected press.	67
			Pressure after damping	67
		Level		
			Level selection	68
			Output unit	68
			Height unit	68
			Calibration mode	68
			Empty calib.	69
			Empty pressure	69
			Empty height	69
			Full calib.	69
			Full pressure	69
			Full height	69
			Density unit	69
			Adjust density	70
			Process density	70
			Level before lin	70
		Linearization		
			Lin. mode	70
			Unit after lin.	70
			Line-numb.	71
			X-value	71
			Y-value	71
			Edit table	71
			Tank description	71
			Tank content	71

Level 1	Level 2	Level 3	Level 4	Page
Expert	Measurement			
		Sensor limits		
			Lower range limit	72
			URL sensor	72
		Sensor trim		
			Lo trim measured	72
			Hi Trim measured value	72
			Lo Trim sensor	72
			Hi Trim sensor	72
	Output			
		Current output		
			Output current	72
			Alarm behavior	72
			Output fail mode	72
			High alarm curr.	72
			Set min. current	73
			Get LRV (pressure measuring mode)	73
			Set LRV	73
			Get URV (pressure measuring mode)	73
			Set URV	73
			Start current	73
			Curr. trim 4mA	73
			Curr. trim 20mA	74
			Offset trim 4mA	74
			Offset trim 20 mA	74
	Communication			
		HART config.		
			Burst mode	74
			Burst option	74
			Current mode	74
			Bus address	74
			Preamble number	75
		HART info		
			Device type code	75
			Device revision	75
			Manufacturer ID	75
			HART version	75
			Description	75
			HART message	75
			HART date	75

Level 1	Level 2	Level 3	Level 4	Page
Expert	Communication			
		HART output		
			Primary value is	75
			Primary value	75
			Secondary val. is	75
			Secondary value	75
			Third value is	75
			Third value	76
			4th value is	76
			4th value	76
		HART input		
			HART input value	76
			HART input stat.	76
			HART input unit	76
			HART input form.	76
	Application			
		Electr. delta P		76
		Fixed ext. value		77
		Auto dens. corr.		77
	Diagnosis			
		Diagnostic code		77
		Last diag. code		77
		Reset logbook		77
		Min. meas. press.		77
		Max. meas. press.		77
		Reset peakhold		77
		Operating hours		78
		Config. counter		78
		Diagnostic list		
			Diagnostic 1	78
			Diagnostic 2	78
			Diagnostic 3	78
			Diagnostic 4	78
			Diagnostic 5	78
			Diagnostic 6	78
			Diagnostic 7	78
			Diagnostic 8	78
			Diagnostic 9	78
			Diagnostic 10	78


Level 1	Level 2	Level 3	Level 4	Page
Expert	Diagnosis			
		Event logbook		
			Last diag. 1	78
			Last diag. 2	78
			Last diag. 3	78
			Last diag. 4	78
			Last diag. 5	78
			Last diag. 6	78
			Last diag. 7	78
			Last diag. 8	78
			Last diag. 9	78
			Last diag. 10	78
		Simulation		
			Simulation mode	79
			Sim. pressure	79
			Sim. level	79
			Sim. tank cont.	79
			Sim. current	79
			Sim. alarm/warning	79

13.2 Description of parameters

This section describes the parameters in the order as they appear in the "Expert" operating menu in FieldCare.

13.2.1 System


Expert → System

Parameter name	Description
Operator code Entry	<p>Use this function to enter a code to lock or unlock operation.</p> <p>Options:</p> <ul style="list-style-type: none"> ■ To lock operation: enter a number ≠ the unlocking code. ■ To unlock operation: enter the unlocking code. <p> The release code is "0" in the order configuration. Another release code can be defined in the "Code definition" parameter. If the user has forgotten the release code, the release code will be visible and unlocked by entering the number "5864".</p> <p>Factory setting: 0</p>
Code definition Entry	<p>Use this function to enter a release code with which the device can be unlocked.</p> <p>Options:</p> <ul style="list-style-type: none"> ■ A number between 0 and 9999 <p>Factory setting: 0</p>


Expert → System → Instrument info

Parameter name	Description
Cust. tag number Entry	<p>Enter device tag e.g. TAG number (max. 8 alphanumeric characters).</p> <p>Factory setting: no entry or as per order specifications</p>
Device tag Entry	<p>Enter device tag e.g. TAG number (max. 32 alphanumeric characters).</p> <p>Factory setting: no entry or as per order specifications</p>
Serial number Display	Displays the serial number of the device (11 alphanumeric characters).
Firmware version Display	Displays the firmware version.
Ext. order code Entry	<p>Enter the extended order code.</p> <p>Factory setting: as per order specifications</p>
Order identifier Entry	<p>Enter the order identifier.</p> <p>Factory setting: as per order specifications</p>
ENP version Display	Displays the ENP version (ENP = electronic nameplate)
Electr. serial no. Display	Displays the serial number of the main electronics (11 alphanumeric characters).
Sensor serial no. Display	Displays the serial number of the sensor (11 alphanumeric characters).


Expert → System → Management

Parameter name	Description
Enter reset code Entry	Reset parameters completely or partially to the factory values or order configuration, →  23, "Resetting to factory settings (reset)". Factory setting: 0

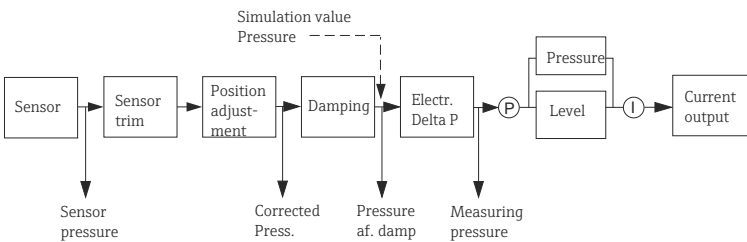
13.2.2 Measurement**Expert → Measurement**

Parameter name	Description
Measuring mode Selection	Select the measuring mode. The operating menu is structured differently depending on the measuring mode selected.  If the measuring mode is changed, no conversion takes place. The device has to be recalibrated or as per if the measuring mode is changed. Options: <ul style="list-style-type: none"> ■ Pressure ■ Level Factory setting: Pressure or as per order specifications


Expert → Measurement → Basic setup



Parameter name	Description
Pos. zero adjust (relative pressure sensor) Selection	<p>Position adjustment – the pressure difference between zero (set point) and the measured pressure need not be known.</p> <p>Example:</p> <ul style="list-style-type: none"> – Measured value = 2.2 mbar (0.033 psi) – You correct the measured value via the "Pos. zero adjust" parameter with the "Confirm" option. This means that you assign the value 0.0 to the pressure present. – Measured value (after pos. zero adjust) = 0.0 mbar – The current value is also corrected. <p>Options:</p> <ul style="list-style-type: none"> ■ Confirm ■ Abort <p>Factory setting: Abort</p>
Calib. offset (absolute pressure sensor) Entry	<p>Position adjustment – the pressure difference between the set point and the measured pressure must be known.</p> <p>Example:</p> <ul style="list-style-type: none"> – Measured value = 982.2 mbar (15 psi) – You correct the measured value with the value entered (e.g. 2.2 mbar (0.033 psi)) via the "Position offset" parameter. This means that you assign the value 980.0 (15 psi) to the pressure present. – Measured value (after pos. zero adjust) = 980.0 mbar (15 psi) – The current value is also corrected. <p>Factory setting: 0.0</p>
Damping value Entry	<p>Enter damping time (time constant τ). The damping affects the speed at which the measured value reacts to changes in pressure.</p> <p>Input range: 0.0 to 999.0 s</p> <p>Factory setting: 2.0 as per order specifications</p>
Press. eng. unit Selection	<p>Select the pressure unit.</p> <p>If a new pressure unit is selected, all pressure-specific parameters are converted and displayed with the new unit.</p> <p>Options:</p> <ul style="list-style-type: none"> ■ mbar, bar ■ mmH2O, mH2O, inH2O ■ ftH2O ■ Pa, kPa, MPa ■ psi ■ mmHg, inHg ■ kgf/cm² <p>Factory setting: mbar or bar depending on the sensor nominal measuring range, or as per order specifications</p>
Temp. eng. unit Selection	<p>Select the unit for the temperature measured values.</p> <p> The setting affects the unit for the "Sensor temp." parameter.</p> <p>Options:</p> <ul style="list-style-type: none"> ■ °C ■ °F ■ K <p>Factory setting: °C</p>
Sensor temp. Display	<p>Displays the temperature currently measured in the sensor. This can deviate from the process temperature.</p>


Expert → Measurement → Pressure

Parameter name	Description
Set LRV Entry	Set the lower-range value – without reference pressure. Enter the pressure value for the lower current value (4 mA). Factory setting: 0.0 or as per order specifications
Set URV Entry	Set the upper-range value – without reference pressure. Enter the pressure value for the upper current value (20 mA). Factory setting: Upper-range limit sensor (→ see "Lower range limit") or as per order specifications
Meas. pressure Display	Displays the measured pressure after sensor trim, position adjustment and damping.  <p style="text-align: right;">A0018875-EN</p>
Sensor pressure Display	Displays the measured pressure before the sensor trim.
Corrected press. Display	Displays the measured pressure after sensor trim and position adjustment.
Pressure after damping Display	Displays the measured pressure after sensor trim, position adjustment and damping.

Expert → Measurement → Level



Parameter name	Description
Level selection Selection	<p>Select the method for calculating the level</p> <p>Options:</p> <ul style="list-style-type: none"> ■ In pressure If this option is selected, specify two pressure/level value pairs. The level value is displayed directly in the unit that you select via the "Output unit" parameter. ■ In height If this option is selected, specify two height/level value pairs. From the measured pressure, the device first calculates the height using the density. This information is then used to calculate the level in the "Output unit" selected using the two value pairs specified. <p>Factory setting: In pressure</p>
Output unit Selection	<p>Select the unit for the measured value display for the level before linearization.</p> <p> The unit selected is only used to describe the measured value. This means that the measured value is not converted when a new output unit is selected.</p> <p>Example:</p> <ul style="list-style-type: none"> ■ Current measured value: 0.3 ft ■ New output unit: m ■ New measured value: 0.3 m <p>Options:</p> <ul style="list-style-type: none"> ■ % ■ mm, cm, dm, m ■ ft, inch ■ m³, in³ ■ l, hl ■ ft³ ■ gal, lgal ■ kg, t ■ lb <p>Factory setting: %</p>
Height unit Selection	<p>Select the height unit. The measured pressure is converted to the selected height unit using the "Adjust density" parameter.</p> <p>Prerequisite: "Level selection" = "In height"</p> <p>Options:</p> <ul style="list-style-type: none"> ■ mm ■ m ■ inch ■ ft <p>Factory setting: m</p>
Calibration mode Selection	<p>Select the calibration mode.</p> <p>Options:</p> <ul style="list-style-type: none"> ■ Wet Wet calibration takes place by filling and emptying the container. With two different levels, the level, volume, mass or percentage value entered is assigned to the pressure measured at this point in time ("Empty calibration" and "Full calibration" parameters). ■ Dry Dry calibration is a theoretical calibration. For this calibration, you specify two pressure/level value pairs via the following parameters: "Empty calib.", "Empty pressure", "Full calib.", "Full pressure". <p>Factory setting: Wet</p>

Parameter name	Description
Empty calib. Entry	<p>Enter the output value for the lower calibration point (container empty). The unit defined in "Output unit" must be used.</p> <p> In the case of wet calibration, the level (e.g. container empty or partially-filled) must actually be available. The associated pressure is then automatically recorded by the device. In the case of dry calibration, the level (container empty) does not have to be available. The associated pressure has to be entered in the "Empty pressure" parameter for the "In pressure" level selection. The associated height has to be entered in the "Empty height" parameter for the "In height" level selection.</p> <p>Factory setting: 0.0</p>
Empty pressure Entry/display	<p>Enter the pressure value for the lower calibration point (container empty). → See also "Empty calib."</p> <p>Prerequisite</p> <ul style="list-style-type: none"> ■ "Level selection" = "In pressure" ■ "Calibration mode" = Wet (display only), Dry (entry) <p>Factory setting: 0.0</p>
Empty height Entry/display	<p>Enter the height value for the lower calibration point (container empty). Select the unit via the "Height unit" parameter.</p> <p>Prerequisite:</p> <ul style="list-style-type: none"> ■ "Level selection" = In height ■ "Calibration mode" = Wet (display only), Dry (entry) <p>Factory setting: 0.0</p>
Full calib. Entry	<p>Enter the output value for the upper calibration point (container full). The unit defined in "Output unit" must be used.</p> <p> In the case of wet calibration, the level (e.g. container full or partially-filled) must actually be available. The associated pressure is then automatically recorded by the device. In the case of dry calibration, the level (container full) does not have to be available. The associated pressure has to be entered in the "Full pressure" parameter for the "In pressure" level mode. The associated height has to be entered in the "Empty height" parameter for the "In height" level selection.</p> <p>Factory setting: 100.0</p>
Full pressure Entry/display	<p>Enter the pressure value for the upper calibration point (container full). → See also "Empty calib."</p> <p>Prerequisite</p> <ul style="list-style-type: none"> ■ "Level selection" = In pressure ■ "Calibration mode" = Wet (display only), Dry (entry) <p>Factory setting: Upper-range limit (URL) of the sensor</p>
Full height Entry/display	<p>Enter the height value for the upper calibration point (container full). Select the unit via the "Height unit" parameter.</p> <p>Prerequisite:</p> <ul style="list-style-type: none"> ■ "Level selection" = In height ■ "Calibration mode" = Wet (display only), Dry (entry) <p>Factory setting: Upper-range limit (URL) is converted to a height unit</p>
Density unit Display	<p>Displays the density unit. The measured pressure is converted to a height using the "Height unit" and "Adjust density" parameters.</p> <p>Setting:</p> <ul style="list-style-type: none"> ■ g/cm³

Parameter name	Description
Adjust density Entry/display	<p>Enter the density of the medium. The measured pressure is converted to a height using the "Height unit" and "Adjust density" parameters.</p> <p>User input:</p> <ul style="list-style-type: none"> ■ Auto dens. corr. = Off <p>Display:</p> <ul style="list-style-type: none"> ■ Auto dens. corr. ≠ Off <p>Factory setting:</p> <p>1.0</p>
Process density Entry/display	<p>Enter a new density value for density correction.</p> <p>The calibration was carried out with water as the medium, for example. Now the container is to be used for another medium with another density. The calibration is corrected appropriately by entering the new density value in the "Process density" parameter.</p> <p> If you change to dry calibration after a wet calibration via the "Calibration mode" parameter, the density must be entered for the "Adjust density" and "Process density" parameters before you switch calibration mode.</p> <p>User input:</p> <ul style="list-style-type: none"> ■ Auto dens. corr. = Off <p>Display:</p> <ul style="list-style-type: none"> ■ Auto dens. corr. ≠ Off <p>Factory setting:</p> <p>1.0</p>
Level before lin Display	Displays the level value prior to linearization.

Expert → Measurement → Linearization

Parameter name	Description
Lin. mode Selection	<p>Select the linearization mode.</p> <p>Options:</p> <ul style="list-style-type: none"> ■ Linear: The level is output without being converted beforehand. "Level before lin." is output. ■ Erase table: The existing linearization table is deleted. ■ Manual entry (sets the table to the edit mode, an alarm is output): The value pairs of the table (X-value and Y-value) are entered manually. ■ Semiautomatic entry (sets the table to the edit mode, an alarm is output): The container is emptied or filled gradually in this entry mode. The device automatically records the level value (X-value). The associated volume, mass or %-value is entered manually (Y-value). ■ Activate table The table entered is activated and checked with this option. The device shows the level after linearization. <p>Factory setting:</p> <p>Linear</p>
Unit after lin. Selection	<p>Select the volume unit (unit of the Y-value).</p> <p>Options:</p> <ul style="list-style-type: none"> ■ % ■ cm, dm, m, mm ■ hl ■ in³, ft³, m³ ■ l ■ in, ft ■ kg, t ■ lb ■ gal ■ lgal <p>Factory setting:</p> <p>%</p>

Parameter name	Description
Line-numb. Entry	Enter the number of the current point in the table. The subsequent entries for "X-value" and "Y-value" refer to this point. Input range: <ul style="list-style-type: none"> 1 to 32
X-value Display/entry	Enter the level value for the specific point in the table and confirm.  If "Lin. mode" = "Manual", the level value has to be entered. If "Lin. mode" = "Semiautomatic" the level value is displayed and has to be confirmed by entering the associated Y-value.
Y-value Entry	Enter the output value for the specific point in the table. The unit is determined by "Unit after lin.".  The linearization table must be monotonic (monotonic increasing or decreasing).
Edit table Selection	Select the function for entering the table. Options: <ul style="list-style-type: none"> Next point: enter the next point. Current point: stay on the current point to correct a mistake for example. Previous point: skip back to the previous point to correct a mistake for example. Insert point: insert an additional point (see example below). Delete point: delete the current point (see example below). Example: Add a point - in this case between the 4th and 5th point for example <ul style="list-style-type: none"> Select point 5 via the "Line-numb." parameter. Select the "Enter point" option via the "Edit table" parameter. Point 5 is displayed for the "Line-numb." parameter. Enter new values for the "X-value" and "Y-value" parameters. Example: Delete a point - in this case the 5th point for example <ul style="list-style-type: none"> Select point 5 via the "Line-numb." parameter. Select the "Delete point" option via the "Edit table" parameter. The 5th point is deleted. All of the subsequent points are moved up one number i.e. following deletion, the 6th point becomes Point 5. Factory setting: current point
Tank description Entry	Enter the tank description (max. 32 alphanumeric characters)
Tank content Display	Displays the level value after linearization.

Expert → Measurement → Sensor limits

Parameter name	Description
Lower range limit Display	Displays the lower-range limit of the sensor.
URL sensor Display	Displays the upper-range limit of the sensor.

Expert → Measurement → Sensor trim

Parameter name	Description
Lo trim measured Display	Displays the reference pressure present to be accepted for the lower calibration point.
Hi trim measured Display	Displays the reference pressure present to be accepted for the upper calibration point.
Lo trim sensor Entry	Sensor recalibration by entering a target pressure while simultaneously and automatically accepting a reference pressure present for the lower calibration point.
Hi trim sensor Entry	Sensor recalibration by entering a target pressure while simultaneously and automatically accepting a reference pressure present for the upper calibration point.

13.2.3 Current output**Expert → Output → Current output**

Parameter name	Description
Output current Display	Displays the current value of the current.
Alarm behav. P Selection	Configure the current output for when the sensor limits are undershot or overshot. Options: <ul style="list-style-type: none"> Warning The device continues measuring. An error message is displayed. Alarm The output signal assumes a value that can be specified by the "Output fail mode" function. Factory setting: Warning
Output fail mode Selection	Select the output fail mode. In the event of an alarm, the current assumes the current value specified with this parameter. Options: <ul style="list-style-type: none"> Max: can be set from 21 and 23 mA → see also "High alarm curr." Hold: last measured value is held. Min: 3.6 mA Factory setting: Max
High alarm curr. Entry	Enter the current value for the high alarm current. → See also "Output fail mode". Input range: 21 to 23 mA Factory setting: 22 mA

Parameter name	Description
Set min. current Entry	<p>Enter the lower current limiting value. Some switching units do not accept current values lower than 4.0 mA.</p> <p>Options:</p> <ul style="list-style-type: none"> ■ 3.8 mA ■ 4.0 mA <p>Factory setting: 3.8 mA</p>
Get LRV Entry	<p>Set the lower-range value – reference pressure is present at the device. The pressure for the lower current value (4 mA) is present at the device. With the "Confirm" option, you assign the lower current value to the pressure value present.</p> <p>Prerequisite: pressure measuring mode</p> <p>Options:</p> <ul style="list-style-type: none"> ■ Abort ■ Confirm <p>Factory setting: Abort</p>
Set LRV Entry	<p>Set the measure value for the lower current value (4 mA).</p> <p>Factory setting: 0.0 (%) in the level measuring mode; 0.0 or in accordance with ordering specifications in the pressure measuring mode</p>
Get URV Entry	<p>Set the upper-range value – reference pressure is present at the device. The pressure for the upper current value (20 mA) is present at the device. With the "Confirm" option, you assign the upper current value to the pressure value present.</p> <p>Prerequisite: pressure measuring mode</p> <p>Options:</p> <ul style="list-style-type: none"> ■ Abort ■ Confirm <p>Factory setting: Abort</p>
Set URV Entry	<p>Set the measure value for the upper current value (20 mA).</p> <p>Factory setting: 100.0 (%) in the level measuring mode; URL sensor or in accordance with ordering information in the pressure measuring mode.</p>
Startcurrent Entry	<p>Use this function to enter the start current. This setting affects the HART Multidrop mode as well.</p> <p>Options:</p> <ul style="list-style-type: none"> ■ Min. alarm ■ 12 mA <p>Factory setting: 12 mA</p>
Curr. trim 4mA Entry	<p>Enter the current value for the lower point (4 mA) of the current linear regression line. You can adapt the current output to the transmission conditions with this parameter and "Curr. trim 20mA".</p> <p>Perform the current trim for the upper point as follows:</p> <ol style="list-style-type: none"> 1. Select the "Current" option in the "Simulation mode" parameter. 2. Set the 4 mA value in the "Sim. current" parameter. 3. Enter the current value measured with the switching unit in the "Curr. trim 4mA" parameter. <p>Input range: Measured current ± 0.2 mA</p> <p>Factory setting: 4 mA</p>

Parameter name	Description
Curr. trim 20mA Entry	<p>Enter the current value for the upper point (20 mA) of the current linear regression line.</p> <p>You can adapt the current output to the transmission conditions with this parameter and "Curr. trim 4mA".</p> <p>Perform the current trim for the upper point as follows:</p> <ol style="list-style-type: none"> 1. Select the "Current" option in the "Simulation mode" parameter. 2. Set the "20 mA" value in the "Sim. current" parameter. 3. Enter the current value measured with the switching unit in the "Curr. trim 20mA" parameter. <p>Input range: Measured current ± 1.0 mA</p> <p>Factory setting: 20 mA</p>
Offset trim 4mA Display/Entry	<p>Displays/Entry the difference between 4 mA and the value entered for the "Curr. trim 4mA" parameter.</p> <p>Factory setting: 0</p>
Offset trim 20mA Display/Entry	<p>Displays/Entry the difference between 20 mA and the value entered for the "Curr. trim 20mA" parameter.</p> <p>Factory setting: 0</p>

13.2.4 Communication

Expert → Communication → HART config

Parameter name	Description
Burst mode Selection	<p>Switch the burst mode on and off.</p> <p>Options:</p> <ul style="list-style-type: none"> ■ On ■ Off <p>Factory setting Off</p>
Burst option Entry	<p>Use this parameter to specify what HART command is sent to the master.</p> <p>Factory setting: 1 (HART command 1)</p>
Current mode Selection	<p>Configure the current mode for HART communication.</p> <p>Options:</p> <ul style="list-style-type: none"> ■ Signaling Measured value transmitted by the current value ■ Fixed current 4.0 mA (multidrop mode) (measured value only transmitted via HART digital communication) <p>Factory setting Signaling</p>
Bus address Entry	<p>Enter the address for exchanging data via the HART protocol. (HART 5.0 master: Range 0 to 15, where address = 0 calls up the "Signaling" setting; HART 6.0 master: range 0 to 63)</p> <p>Factory setting: 0</p>

Parameter name	Description
Preamble number Entry	Enter the number of preambles in the HART protocol. (Synchronization of the modem modules along a transmission path, each modem module could "swallow" one byte; at least 2 bytes must arrive at the end.) Input range: 2 to 20 Factory setting: 5

Expert → Communication → HART info

Parameter name	Description
Device type code Display	Displays the numeric ID of the device. For Waterpilot FMX21: 36
Device revision Display	Displays the device revision. e.g.: 1
Manufacturer ID Display	Displays the manufacturer number in decimal numerical format. Here: 17 (Endress+Hauser)
HART revision Display	Displays the HART revision. Here: 6
Description Entry	Enter the tag description (max. 16 alphanumeric characters).
HART message Entry	Enter a message (max. 32 alphanumeric characters). This message is sent via the HART protocol at the request of the master.
HART date Entry	Enter the date of the last change in configuration. Factory setting: DD/MM/YY (date of the final test)

Expert → Communication → HART output

Parameter name	Description
Primary value is Display	Indicates which measured variable is transmitted as the primary process value via the HART protocol. The variable displayed depends on the "measuring mode" selected: - Pressure measuring mode: "Meas. pressure" - Level measuring mode → "Linear" lin. mode: "Level before lin." - Level measuring mode → "Activate table" lin. mode: "Tank content"
Primary value Display	Displays the primary process value.
Secondary val. is Display	Indicates which measured variable is transmitted as the secondary process value via the HART protocol. The following process values can be displayed depending on the measuring mode selected: - "Meas. pressure" - "Sensor pressure" - "Corrected press." - "Pressure after damping" - "Sensor temp." - "Level before lin" - "Tank content" - "Process density" (corrected)
Secondary value Display	Displays the secondary process value.
Third value is Display	Indicates which measured variable is transmitted as the third process value via the HART protocol. The variable displayed depends on the "measuring mode" selected. See the list for "Secondary val. is"

Parameter name	Description
Third value Display	Displays the third process value.
Fourth value is Display	Indicates which measured variable is transmitted as the fourth process value via the HART protocol. The variable displayed depends on the "measuring mode" selected. See the list for "Secondary val. is"
4th value Display	Displays the fourth process value.

Expert → Communication → HART input

Parameter name	Description
HART input value Display	Displays the HART input value.
HART input stat. Display	Displays the HART input status Bad / Uncertain / Good
HART input unit Selection	Select the HART input value. Options: <ul style="list-style-type: none"> ■ Unknown ■ mbar, bar ■ mmH2O, ftH2O, inH2O ■ Pa, hPa, kPa, MPa ■ psi ■ mmHg, inHg ■ Torr ■ g/cm², kg/cm² ■ lb/ft² ■ atm ■ °C, °F, K, R Factory setting: unknown
HART input form. Selection	Specify the format for displaying the HART input value. Options: <ul style="list-style-type: none"> ■ x.x (default) ■ x.xx ■ x.xxx ■ x.xxxx ■ x.xxxxx Factory setting: x.x


13.2.5 Application**Expert → Application**

Parameter name	Description
Electr. delta P Entry	For switching the electr. delta P application on or off with an external or constant value. Options: Off External value Constant Factory setting: Off

Parameter name	Description
Fixed ext. value Entry	Use this function to enter the constant value. The value refers to "HART input unit" Factory setting: 0.0
Auto dens. corr. Selection	For switching the auto dens. corr. application on or off with an external or internal temperature value. Before performing a calibration (dry or wet), auto-density compensation must be switched on if this function is to be used. As soon as "Auto-dens. corr." is switched on, the field for entering the "Process density" and "Adjust density" is disabled. The calibration density remains the last value until it is overwritten by a calibration. The process density remains the last value until it is overwritten when the system recalculates the value. Automatic density compensation is performed for the 0 to 70 °C (32...158 °F) temperature range. The density values for water are used for this density compensation. Options: Off Sensor temperature External value (only if the option selected for Electr. delta P is Off or Constant) Prerequisite <ul style="list-style-type: none"> Level mode Factory setting: Off

13.2.6 Diagnosis

Expert → Diagnosis

Parameter name	Description
Diagnostic code Display	Displays the diagnostic message with the highest priority currently present.
Last diag. code Display	Displays the last diagnostic message that occurred and was rectified.  Digital communication: the last message is displayed. The messages listed in the "Last diag. code" parameter can be deleted via the "Reset logbook" parameter.
Reset logbook Selection	With this parameter, you reset all the messages of the "Last diag. code" parameter and the "Last diag. 1" to "Last diag. 10" event log. Options: <ul style="list-style-type: none"> Abort Confirm Factory setting: Abort
Min. meas. press. Display	Displays the lowest pressure value measured (peakhold indicator). You can reset this indicator by means of the "Reset peakhold" parameter.
Max. meas. press. Display	Displays the highest pressure value measured (peakhold indicator). You can reset this indicator by means of the "Reset peakhold" parameter.
Reset peakhold Selection	You can reset the "Min. meas. press." and "Max. meas. press." indicators with this parameter. Options: <ul style="list-style-type: none"> Abort Confirm Factory setting: Abort

Parameter name	Description
Operating hours Display	Displays the hours of operation. This parameter cannot be reset.
Config. counter Display	Displays the configuration counter. This counter is increased by one every time a parameter or group is changed. The counter counts up to 65535 and then starts again at zero.

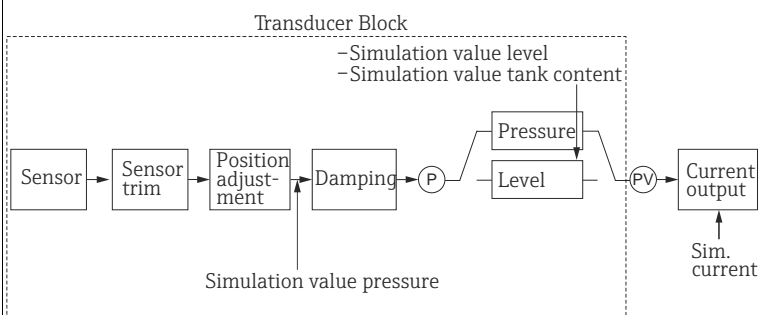
Expert → Diagnosis → Diagnostic list

Parameter name	Description
Diagnostic 1 Diagnostic 2 Diagnostic 3 Diagnostic 4 Diagnostic 5 Diagnostic 6 Diagnostic 7 Diagnostic 8 Diagnostic 9 Diagnostic 10	These parameters contain up to ten diagnosis messages that are currently pending, arranged in order of priority.

Expert → Diagnosis → Event logbook

Parameter name	Description
Last diag. 1 Last diag. 2 Last diag. 3 Last diag. 4 Last diag. 5 Last diag. 6 Last diag. 7 Last diag. 8 Last diag. 9 Last diag. 10	These parameters contain the last 10 diagnosis messages to occur and be rectified. They can be reset with the "Reset logbook" parameter. Errors which have occurred several times are indicated only once.

Expert → Diagnosis → Simulation

Parameter name	Description
Simulation mode Selection	<p>Switch on simulation and select the simulation mode. Any simulation running is switched off if the measuring mode or level selection ("in pressure" or "in height" is changed.</p> <p>Option:</p> <ul style="list-style-type: none"> ■ None ■ Pressure → see also this table, "Sim. pressure" parameter ■ Level → see this table, "Sim. level" parameter ■ Tank content → see this table, "Sim. tank cont." parameter ■ Current → see this table, "Sim. current" parameter ■ Alarm/warning → see this table, "Sim. error no." parameter  <p>Factory setting: None</p>
Sim. pressure Entry	<p>Enter the simulation value. → See also "Simulation mode".</p> <p>Prerequisite:</p> <ul style="list-style-type: none"> ■ "Simulation mode" = Pressure <p>Factory setting: Current pressure measured value</p>
Sim. level Entry	<p>Enter the simulation value. → See also "Simulation mode".</p> <p>Prerequisite:</p> <ul style="list-style-type: none"> ■ "Measuring mode" = Level and "Simulation mode" = Level
Sim. tank cont. Entry	<p>Enter the simulation value. → See also "Simulation mode".</p> <p>Prerequisites:</p> <ul style="list-style-type: none"> ■ "Measuring mode" = Level, "Activate table" lin. mode and "Simulation mode" = Tank content.
Sim. current Entry	<p>Enter the simulation value. → See also "Simulation mode".</p> <p>Prerequisite:</p> <ul style="list-style-type: none"> ■ "Simulation mode" = Current value <p>Factory setting: Current value of the current</p>
Sim. alarm/warning Entry	<p>Enter the diagnostic message number. → See also "Simulation mode".</p> <p>Prerequisite:</p> <ul style="list-style-type: none"> ■ "Simulation mode" = Alarm/warning <p>Factory setting: 484 (simulation active)</p>

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Waterpilot FMX21



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Data sheet DS/WM-EN Rev. W

WaterMaster

Electromagnetic flowmeter

Measurement made easy

The perfect fit for all water and waste water applications



State-of-the-art technology

- revolutionary data storage enables transmitter interchange and commissioning without the need for re-configuration
- self-calibrating transmitter with ultra-low temperature coefficient for highest accuracy

Versatile and simple configuration

- 'Through-the-Glass' (TTG) configuration eliminating the need to remove the cover
- smart key based functionality
- 'Easy Setup' function

VeriMaster in situ verification software option

- enables the customer to perform in situ verification of the flowmeter system

Unparalleled service ability

- fault-finding Help texts on the display
- minimized downtime with replaceable electronics cartridges

MID and OIML R49 approved with R49 self-checking

- type-approved to accuracy Class 1 and Class 2 for any pipe orientation and bidirectional flows
- type P-approved continuous self-checking of the sensor and transmitter to ensure the highest accuracy and long term performance

Innovative sensors for all applications

- optimized full-bore series for optimum turndown / low pressure drop, irrigation applications
- full-bore series for general-purpose water metering applications
- reduced-bore series for high turn down applications, for example, leakage
- buriable sensors eliminate the need for costly chamber construction

HART, Profibus DP and Modbus

- full system and PLC integration

Power and productivity
for a better world™



WaterMaster

Electromagnetic flowmeter

The Company

ABB is an established world force in the design and manufacture of instrumentation for industrial process control, flow measurement, gas and liquid analysis and environmental applications.

As a world leader in process automation technology our worldwide presence, comprehensive service and application-oriented know-how make ABB a leading supplier of flow measurement products.

Introduction

Setting the standard for the Water Industry

The WaterMaster range, available in sizes 10 to 2400 mm ($\frac{3}{8}$ to 96 in.), is designed specifically for use on the many diverse applications encountered in the Water and Waste-water industry. The modular design concept offers flexibility, cost-saving operation and reliability while providing a long service life and exceptionally low maintenance.

Integration into ABB asset management systems and use of the self-monitoring and diagnostic functions increase the plant availability and reduce downtimes.

VeriMaster – the verification tool

An easy-to-use utility, available through the infra red service port. Uses the advanced self-calibration and diagnostic capability of WaterMaster, coupled with fingerprinting technology, to determine the accuracy status of the WaterMaster flowmeter to within ± 1 % of its original factory calibration. VeriMaster also supports printing of calibration verification records for regulatory compliance.



Diagnostic functions

Using its diagnostic functions, the flowmeter monitors both its own operability and the process. Limit values for the diagnostic parameters can be set locally. When these limits are exceeded, an alarm is tripped. In the event of an error, diagnostic-dependent help text appears on the display. This considerably simplifies and accelerates the troubleshooting procedure.

In accordance with NAMUR NE107, alarms and warnings are classified with the status of 'Maintenance Required', 'Check Function', 'Failure' and 'Out of Specification'.

Flow performance

Utilizing its advanced filtering methods, the WaterMaster improves accuracy even under difficult conditions. WaterMaster has an operating flow range with ± 0.4 % accuracy as standard (± 0.2 % optional) in both forward and reverse flow directions.

Easy and quick commissioning

'Fit-and-Flow' data storage inside WaterMaster eliminates the need to match sensor and transmitter in the field. On initial installation, the self-configuration sequence automatically replicates into the transmitter all calibration factors, meter size and serial numbers, as well as customer site-specific settings, eliminating the potential for error.

Intuitive, convenient navigation

The 'Easy Setup' function reliably guides unpracticed users through the menu step by step. The smart key based functionality makes handling a breeze – it's just like using a cell phone. During configuration, the permissible range of each parameter is indicated on the display and invalid entries are rejected.

Universal transmitter – powerful and flexible

The backlit display can be rotated easily without the need for tools. The contrast is adjustable and the display fully-configurable. The character size, number of lines and display resolution (number of decimal points) can be set as required. In multiplex mode, several different display options can be pre-configured and invoked one after the other.

The smart modular design of the transmitter unit enables easy disassembly without the need to unscrew cables or unplug connectors. HART is used as the standard communications protocol. Optionally, the transmitter is available with PROFIBUS DP or MODBUS communication.

Assured quality

WaterMaster is designed and manufactured in accordance with international quality procedures (ISO 9001) and all flowmeters are calibrated on nationally-traceable calibration rigs to provide the end-user with complete assurance of both quality and performance of the flowmeter.



WaterMaster

Electromagnetic flowmeter

WaterMaster – always the first choice

WaterMaster sets the standard for the water industry. The specification, features and user benefits offered by this range are based on ABB's worldwide experience in this industry and they are all targeted specifically to the industry's requirements.

Submersible and buriable

WaterMaster sensors have a rugged, robust construction to ensure a long, maintenance-free life under the arduous conditions experienced in the Water and Waste Industry. The sensors are, as standard, inherently submersible (IP68, NEMA 6P), thus ensuring suitability for installation in chambers and metering pits that are susceptible to flooding.

A unique feature of the WaterMaster sensors is that sizes DN40 to DN2400 (1½ to 96 in. NB) are buriable; installation simply involves excavating to the underground pipe, fitting the sensor, cabling back to the transmitter and then backfilling the hole.



The WaterMaster family

Overview of the WaterMaster

A wide range of features and user benefits are built into WaterMaster as standard:

- bi-directional flow
- unique self-calibrating transmitter (patented) for the ultimate in stability and repeatability
- OIML-type continuous self-checking, with alarms, ensures both sensor and transmitter accuracy
- true electrode and coil impedance measurement
- comprehensive simulation mode
- universal switch-mode power supply (options are available for AC and DC supplies)
- comprehensive self-diagnostics compliant with NAMUR NE107
- programmable multiple-alarm capability
- bus options: HART (4 to 20 mA), PROFIBUS DP (RS485), MODBUS (RS485)
- 3 configurable pulse / frequency and alarm outputs
- advanced infrared service port supports remote HMI, HART, cyclic data out and parameter download
- VeriMaster in situ verification software available as option
- read-only switch and ultra-secure service password for total security



WaterMaster

Electromagnetic flowmeter

OIML / MID approved

WaterMaster has been type tested and Internationally approved to the highest accuracy class 1 and 2 for cold and hot potable water meters – OIML R49-1 (Organisation Internationale de Métrologie Légale). For full details, OIML R49 is available to download from www.oiml.org. Its requirements are very similar to other International standards, such as EN14154 and ISO4064.

WaterMaster has been assessed by type approval at the National Measurement Office (NMO) to OIML R49 and passed to the very highest accuracy designations for sizes DN40 to DN200 (1½ to 8 in. NB).

The approval is for:

- Class 1 and Class 2 accuracy (calibration option)
- Environmental class T50 for water temperatures of 0.1 to 50 °C (32.18 to 122 °F)
- Electromagnetic Environment E2 (10 V/m)
- Any pipe orientation
- 5 Diameters upstream pipe
- 0 Diameters downstream pipe
- Pressure Loss Class <0.25 bar (3.62 psi)
- Integral or remote transmitter (<200 m [<656 ft.] cable)
- DN40 to DN200 (1½ to 8 in. NB), bi-directional flow

A major advance in WaterMaster is the self-checking capabilities that meet and exceed the R49 requirements and is the first electromagnetic flowmeter to be approved to OIML Type P permanent self checking during normal operation (not just at startup) and alarm indication for:

- transmitter and sensor status, with an accuracy alarm
- program ROM and RAM status
- double, independent storage of totalizer values, in both the sensor and transmitter non-volatile memories
- display test

The OIML R49-1 certificate of conformity is available from:

<http://www.abb.com/product/seitp330/b42ec2377d3293cdc12573de003db93b.aspx>

WaterMaster is also approved under the EU Measuring Instruments Directive (MID) 2004/22/EC, that covers putting into use water flowmeters for certain applications. MID WaterMaster is secured against tampering and is available as an option, along with fingerprinting for ABB VeriMaster in situ verification product, with certificate printout to ± 1 % accuracy.

WaterMaster certificates of EC type-examination of a measuring instrument are available from:

<http://www.abb.com/product/seitp330/b42ec2377d3293cdc12573de003db93b.aspx>

Superior control through advanced sensor design

The innovative, patented octagonal sensor design improves flow profile and reduces up- and down-stream piping requirements for the most commonly used sizes of 40 to 200 mm (1½ to 8 in.). This optimized full bore meter provides impressive results in the most difficult of installation requirements.

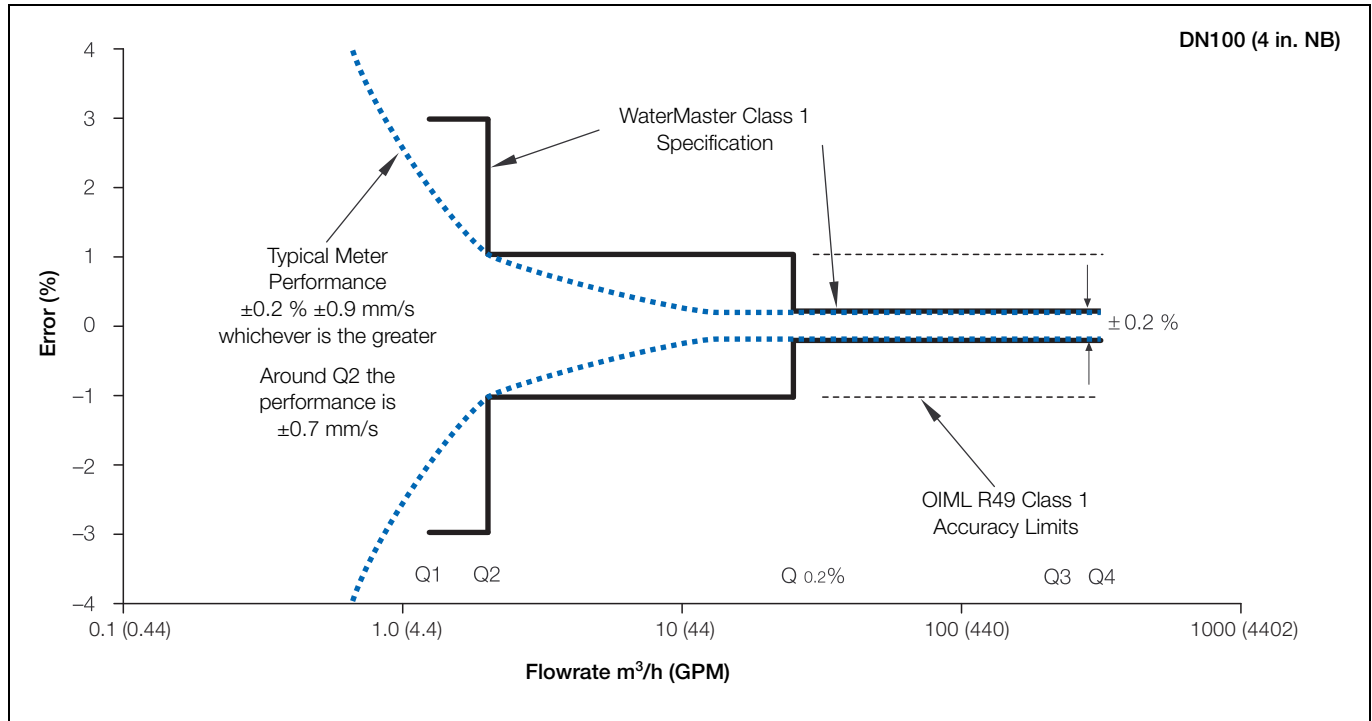


WaterMaster sensors are also available in reduced-bore geometries giving the ultimate in low-flow performance with a very high turn-down range.

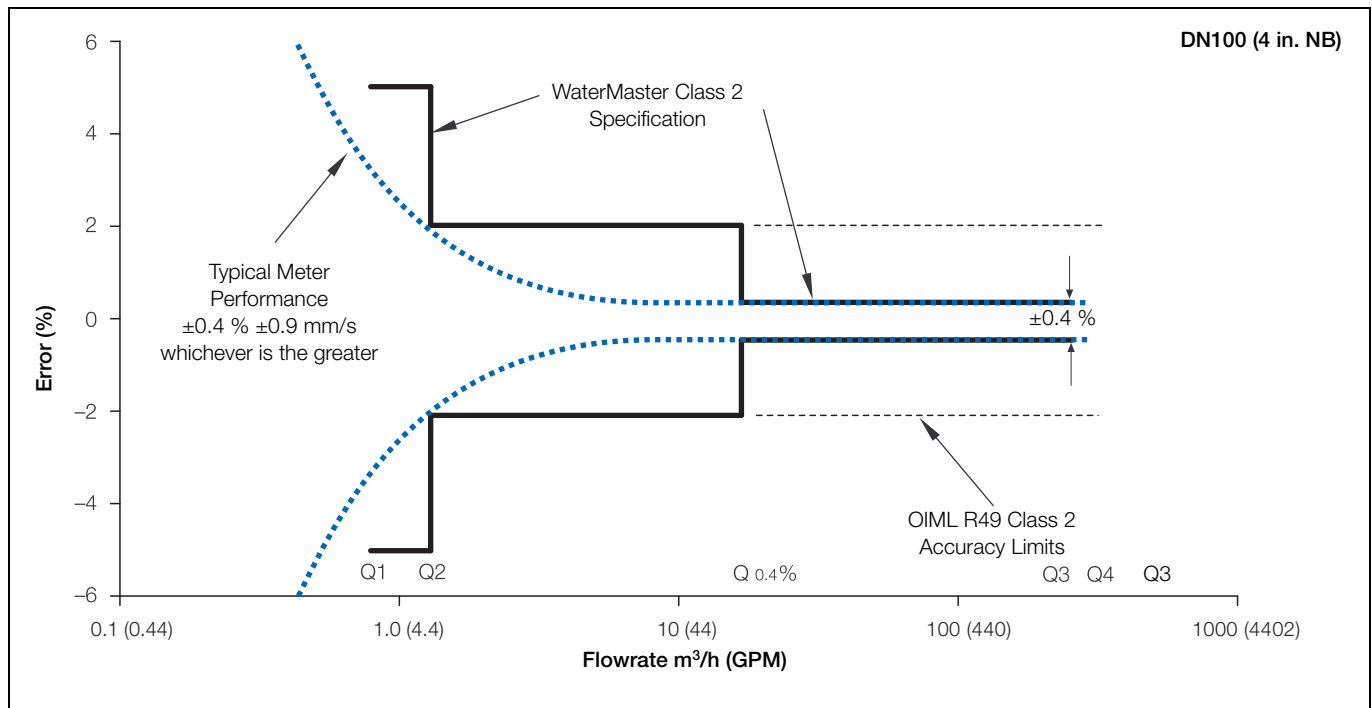
The unique design of the reduced-bore sensor conditions the flow profile in the measuring section so that distortions in the flow profile, either upstream or downstream, are flattened. The result is excellent in situ flowmeter performance, even with very bad hydraulic installation conditions.

Specification

WaterMaster specification to OIML R49 Class 1



WaterMaster specification to OIML R49 Class 2



Although OIML R49 does not define the flow accuracy below Q1, WaterMaster continues to measure flow at lower flow rates down to a cutoff velocity of $\pm 5 \text{ mm/s}$ ($\pm 0.2 \text{ in./s}$). The accuracy between cutoff and Q1 is typically $\pm 0.9 \text{ mm/s}$ ($\pm 0.04 \text{ in./s}$).

WaterMaster optimized full-bore meter (FEV) / full-bore meters (FEF, FEW) flow performance – m³/h

DN	Q4	Q3	Standard Calibration – 0.4 % Class 2			High Accuracy Calibration – 0.2 % Class 1		
			Q _{0.4%}	Q2	Q1	Q _{0.2%}	Q2	Q1
10	3.1	2.5	0.167	0.013	0.008	0.31	0.02	0.012
15	7.88	6.3	0.42	0.032	0.02	0.79	0.05	0.03
20	12.5	10	0.67	0.05	0.032	1.25	0.08	0.05
25	20	16	1.1	0.08	0.05	2	0.13	0.08
32	31.25	25	1.67	0.13	0.08	3	0.20	0.13
40*	50	40	4.2	0.2	0.13	6	0.32	0.2
50*	79	63	4.2	0.32	0.20	7.9	0.5	0.32
65*	125	100	6.7	0.5	0.32	12.5	0.8	0.5
80*	200	160	10.7	0.81	0.51	16	1.3	0.8
100*	313	250	16.7	1.3	0.79	25	2	1.25
125*	313	250	16.7	1.3	0.79	25	2	1.25
150*	788	630	42	3.2	2.0	63	5	3.2
200*	1,250	1,000	67	5.1	3.2	100	8	5
250	2,000	1,600	107	8.1	5.1	160	13	8
300	3,125	2,500	167	12.7	7.9	250	20	12.5
350	5,000	4,000	267	20.3	12.7	400	32	20
400	5,000	4,000	267	20.3	12.7	400	32	20
450	7,875	6,300	420	32	20	630	50	32
500	7,875	6,300	420	32	20	630	50	32
600	12,500	10,000	667	51	32	1000	80	50
700	20,000	16,000	1600	102	64	1600	160	100
750	20,000	16,000	1600	102	64	1600	160	100
30 in (750)	20,000	16,000	1600	102	64	1600	160	100
800	20,000	16,000	1600	102	64	1600	160	100
900	31,250	25,000	2500	160	100	2500	250	156
1000	31,250	25,000	2500	160	100	2500	250	156
42 in	31,250	25,000	2500	160	100	2500	250	156
1100	31,250	25,000	2500	160	100	2500	250	156
1200	50,000	40,000	4000	256	160	4000	400	250
1350	78,750	63,000	6300	403	252	6300	630	394
1400	78,750	63,000	6300	403	252	6300	630	394
1500	78,750	63,000	6300	403	252	6300	630	394
60 in (1500)	78,750	63,000	6300	403	252	6300	630	394
1600	78,750	63,000	6300	403	252	6300	630	394
1650	78,750	63,000	6300	403	252	6300	630	394
1800	125,000	100,000	10000	640	400	10000	1000	625
1950	125,000	100,000	10000	640	400	10000	1000	625
2000	125,000	100,000	10000	640	400	10000	1000	625
2200	200,000	160,000	16000	1024	640	16000	1600	1000
2400	200,000	160,000	16000	1024	640	16000	1600	1000

* OIML R49 Certificate of Conformance to Class 1 and Class 2, with OIML R49 and MID versions available.

Note. OIML R49–1 allow Class 1 only for meters with $Q_3 \geq 100 \text{ m}^3/\text{h}$. Meters outside this range have been tested and conform to Class 1.

WaterMaster optimized full-bore meter (FEV) / full-bore meters (FEF, FEW) flow performance – gal/min

NPS/NB (DN)	Q4	Q3	Standard Calibration 0.4 % Class 2			High Accuracy Calibration 0.2 % Class 1		
			Q _{0.4%}	Q2	Q1	Q _{0.2%}	Q2	Q1
3/8 (10)	13.8	11	0.73	0.06	0.035	1.38	0.09	0.053
1/2 (15)	34.7	27.7	1.85	0.14	0.09	3.48	0.22	0.14
3/4 (20)	55	44	2.94	0.22	0.14	5.5	0.35	0.22
1 (25)	88	70.4	4.7	0.35	0.22	8.8	0.57	0.35
1 1/4 (32)	137.6	110	7.3	0.57	0.35	13.2	0.88	0.57
1 1/2 (40)	220	176	18.5	0.89	0.56	26.4	1.41	0.88
2 (50)	347	277	18.5	1.41	0.88	34.7	2.22	1.39
2 1/2 (65)	550	440	29.4	2.24	1.40	55.0	3.52	2.20
3 (80)	881	704	47.0	3.58	2.24	70.4	5.64	3.52
4 (100)	1,376	1,101	73.4	5.59	3.49	110	8.81	5.50
5 (125)	1,376	1,101	73.4	5.59	3.49	110	8.81	5.50
6 (150)	3,467	2,774	185	14.1	8.81	277	22.2	13.9
8 (200)	5,504	4,403	294	22.4	14.0	440	35.2	22.0
10 (250)	8,806	7,045	470	35.8	22.4	704	56.4	35.2
12 (300)	13,759	11,007	734	55.9	34.9	1,101	88.1	55.0
14 (350)	22,014	17,611	1,174	89.5	55.9	1,761	141	88.1
16 (400)	22,014	17,611	1,174	89.5	55.9	1,761	141	88.1
18 (450)	34,673	27,738	1,849	141	88.1	2,774	222	139
20 (500)	34,673	27,738	1,849	141	88.1	2,774	222	139
24 (600)	55,036	44,029	2,935	224	140	4,403	352	220
27/28" (700)	88,057	70,446	7,045	451	282	7,045	704	440
30 (750)	88,057	70,446	7,045	451	282	7,045	704	440
32 (800)	88,057	70,446	7,045	451	282	7,045	704	440
36 (900)	137,590	110,072	11,007	704	440	11,007	1,100	688
39/40" (1000)	137,590	110,072	11,007	704	440	11,007	1,100	688
42 (1050)	137,590	110,072	11,007	704	440	11,007	1,100	688
44 (1100)	137,590	110,072	11,007	704	440	11,007	1,100	688
48 (1200)	220,143	176,115	17,611	1,127	704	17,611	1,761	1,101
52 (1350)	346,726	277,381	27,738	1,775	1,110	27,738	2,773	1,733
54 (1400)	346,726	277,381	27,738	1,775	1,110	27,738	2,773	1,733
60 (1500)	346,726	277,381	27,738	1,775	1,110	27,738	2,773	1,733
66 (1600)	346,726	277,381	27,738	1,775	1,110	27,738	2,773	1,733
68 (1650)	346,726	277,381	27,738	1,775	1,110	27,738	2,773	1,733
77 (1800)	550,358	440,287	44,029	2,818	1,761	44,029	4,403	2,752
77 (1950)	550,358	440,287	44,029	2,818	1,761	44,029	4,403	2,752
78 (2000)	550,358	440,287	44,029	2,818	1,761	44,029	4,403	2,752
78 (2000)	550,358	440,287	44,029	2,818	1,761	44,029	4,403	2,752
84 (2200)	880,573	704,459	70,446	4,509	2,818	70,446	7,045	4,403
96 (2400)	880,573	704,459	70,446	4,509	2,818	70,446	7,045	4,403

*Size is dependent on flange specification

WaterMaster reduced-bore meter (FER) flow performance – m³/h (gal/min)

Size		Q ₄		Q ₃		Class 2 specification			Class 1 specification			
						Q _{0.4 %}	Q ₂	Q ₁	Q _{0.2 %}	Q ₂	Q ₁	R
mm	in.	m³ / h (Ugal / min)	m³ / h (Ugal / min)	m³ / h (Ugal / min)	m³ / h (Ugal / min)	m³ / h (Ugal / min)	m³ / h (Ugal / min)	m³ / h (Ugal / min)	m³ / h (Ugal / min)	m³ / h (Ugal / min)	m³ / h (Ugal / min)	R
40	1 1/2	31 (138)	25 (110)	0.83 (1.05)	0.063 (0.28)	0.04 (0.18)	630	1.7 (7.48)	0.1 (0.44)	0.063 (0.28)	400	
50	2	50 (220)	40 (176)	1.0 (4.40)	0.1 (0.44)	0.063 (0.28)	630	2.0 (8.8)	0.16 (0.7)	0.1 (0.44)	400	
65	2 1/2	79 (347)	63 (277)	1.6 (7.04)	0.16 (0.7)	0.1 (0.44)	630	3.2 (10.56)	0.25 (1.1)	0.16 (0.7)	400	
80	3	125 (550)	100 (440)	2.0 (8.80)	0.25 (1.1)	0.16 (0.7)	630	4.0 (17.6)	0.4 (1.76)	0.25 (1.1)	400	
100	4	200 (880)	160 (704)	3.2 (10.56)	0.41 (1.8)	0.25 (1.1)	630	6.4 (28)	0.64 (2.8)	0.4 (1.76)	400	
125	5	200 (880)	160 (704)	3.2 (10.56)	0.41 (1.8)	0.25 (1.1)	630	6.4 (28)	0.64 (2.8)	0.4 (1.76)	400	
150	6	500 (2200)	400 (1760)	8.0 (35.20)	1.0 (4.4)	0.63 (2.77)	630	16 (70.4)	1.6 (7)	1.0 (4.4)	400	
200	8	788 (3470)	630 (2770)	13.0 (57.2)	1.6 (7.04)	1.0 (4.4)	630	25 (110)	2.5 (11)	1.6 (7)	400	
250	10	1250 (5500)	1000 (4400)	20 (88)	2.5 (11.01)	1.6 (7)	630	40 (176)	4.0 (17.6)	2.5 (11)	400	
300	12	2000 (8810)	1600 (7045)	32 (140.8)	4.1 (18.05)	2.5 (11)	630	64 (281.6)	6.4 (28)	4.0 (17.6)	200	
350	14	2000 (8810)	1600 (7045)	32 (140.8)	6.4 (28.18)	4.0 (17.6)	400	64 (281.6)	12.8 (56)	8.0 (35.2)	200	
375	15	2000 (8810)	1600 (7045)	32 (140.8)	6.4 (28.18)	4.0 (17.6)	400	64 (281.6)	12.8 (56)	8.0 (35.2)	200	
400	16	3125 (13760)	2500 (11007)	50 (220)	10 (44)	6.3 (27.7)	400	100 (440)	20 (88)	12.5 (55)	200	
450	18	3125 (13760)	2500 (11007)	50 (220)	10 (44)	6.3 (27.7)	400	100 (440)	20 (88)	12.5 (55)	200	
500	20	5000 (22014)	4000 (17610)	80 (352)	16 (70.45)	10 (44)	400	160 (70.4)	32 (141)	20 (88)	200	
600	24	7875 (34670)	6300 (27740)	126 (554.4)	25.2 (110.9)	15.8 (70)	400	252 (1108)	50.4 (222)	31.5 (138.7)	200	

WaterMaster

Electromagnetic flowmeter

Specification – sensor**Functional specification****Pressure limitations**

As per flange rating – non approved
PN16 for OIML R49, MID Approved

Pressure equipment directive 97/23/EC

This product is applicable in networks for the supply, distribution and discharge of water and associated equipment and is therefore exempt.

Temperature limitations

Ambient temperature
Remote transmitter –20 to 70 °C (–4 to 158 °F)
Integral transmitter –20 to 60 °C (–4 to 140 °F)
Process temperature See table below.
0.1 to 50 °C (32.2 to 122 °F) – OIML R49 T50
Approved

Code	Lining	Flange material	Medium temperature °C (°F)	
			Minimum	Maximum
FEF, FEW3	Hard rubber	Carbon steel	–10 (14)	80 (176)
		Stainless steel	–10 (14)	80 (176)
FEW1	PTFE	Carbon steel	–10 (14)	80 (176)
		Stainless steel	–25 (–13)	80 (176)
FEW3	PTFE	Carbon steel	–10 (14)	80 (176)
		Stainless steel	–10 (14)	80 (176)
FEW3	Elastomer	Carbon steel	–5 (23)	80 (176)
		Stainless steel	–5 (23)	80 (176)
FEF, FER	Elastomer	Carbon steel	–6 (21)	70 (158)
FEV	Polypropylene		–6 (21)	70 (158)

IP rating

IP68 (NEMA 6) to 7 m (20 ft.) depth
Note. Not sizes DN10 to DN32 ($\frac{3}{8}$ – $1\frac{1}{4}$ in. NB)
IP67 (NEMA 4X) – DN10 to DN32 ($\frac{3}{8}$ – $1\frac{1}{4}$ in. NB)

Buriable (sensor only)

FEV, FEF and FEW – DN450 to 2400 (18 to 96 in. NB)
to 5 m (16 ft.) depth

Conductivity

>20 $\mu\text{S cm}^{-1}$

Transmitter mounting

Integral (not FEF) or remote

Electrical connections

20 mm glands
 $\frac{1}{2}$ in. NPT
20 mm armored glands

Sensor cable

ABB WaterMaster cable available in two forms –
standard and armored
Maximum length 200 m (660 ft.)

Suspended solids

Suspended solids percentage of process medium should
not exceed 6 % of total volume

Physical specification**Wetted parts****Electrode material**

Stainless steel 316 L / 316 Ti
Super-austenitic steel
Hastelloy® C-22 and Hastelloy C4
(other electrode materials available on request)

Potential equalizing rings

Minimum of 1 recommended

Lining material / potable water approvals

Code	Size Range	Liner	Potable Water Approvals					
			WRAS	WRAS 60°C	ACS	DVGW	NSF	AZ/ NZS 4020
FEW1	DN10 – 32 ($\frac{3}{8}$ – $1\frac{1}{4}$ in. NB)	PTFE	✓					
FEW3	DN10 – 600 ($\frac{3}{8}$ – 24 in. NB)	PTFE						
FEW3	DN40 – 2400 ($1\frac{1}{2}$ – 96 in. NB)	Elastomer	✓					✓
FEW3	DN40 – 2400 ($1\frac{1}{2}$ – 96 in. NB)	Hard rubber	✓	✓		✓	NSF approved material	
FEV	DN40 – 200 ($1\frac{1}{2}$ – 8 in. NB)	Polypropylene	✓		✓	✓	NSF-61	✓
FEF	DN250 – 600 (10 – 24 in. NB)	Elastomer	✓		✓	✓	NSF-61	✓
FEF	DN250 – 600 (10 – 24 in. NB)	Hard rubber	✓	✓		✓	NSF approved material	
FER	DN40 – 600 ($1\frac{1}{2}$ – 24 in. NB)	Elastomer	✓		✓	✓		✓

*Size is dependent on flange specification

Lining protection plates

Not required

Installation conditions (recommended)

Straight pipe requirements

Upstream Downstream

FEW / FEF 5 x DN 2 x DN

FEV 5x DN 0 x DN

FER 0 x DN 0 x DN

Pressure loss

Negligible at Q3 All full bore meters
<0.25 bar (<3.62 psi) at Q3 FEV (DN40 to 200 [$1\frac{1}{2}$ to 8 in. NB])
<0.63 bar (<9.13 psi) at Q3 FER (DN40 to 600 [$1\frac{1}{2}$ to 24in. NB])

WaterMaster

Electromagnetic flowmeter

Non-wetted parts**Flange material**

Carbon steel	DN20 to DN2400 ($\frac{3}{4}$ to 96 in. NB)
Stainless steel	DN10 to DN2400 ($\frac{3}{8}$ to 96 in. NB)
SG iron	FEV – DN40 to DN150 (1 $\frac{1}{2}$ to 6 in. NB)
	FER – DN40 to DN150 (1 $\frac{1}{2}$ to 6 in. NB)

Housing material

Carbon steel	FEV – DN40 to 200 (1 $\frac{1}{2}$ to 8 in. NB)
	FEW – DN450 to 2400 (18 to 96 in. NB)
Plastic	FEF – DN250 to 600 (10 to 24 in. NB)
Aluminium	FEW – DN10 to 400 ($\frac{3}{8}$ to 16 in. NB)

Terminal box material

Polycarbonate

Cable gland material

Plastic, brass

Paint specification

Zinc-based primed (all sensors), paint coat $\geq 70 \mu\text{m}$ thick RAL 9002 (light grey), in accordance with C4 paint standard

WaterMaster

Electromagnetic flowmeter

Specification – transmitter

Functional specification

Power supply

Mains	85 to 265 V AC @ <7 VA
Low voltage	24 V AC +10 % / -30 % @ <7 VA
DC	24 V ±30 % @ <0.4 A

Supply voltage fluctuations within the specified range have no effect on accuracy

Digital Outputs (3)

- Rating 30 V @ 220 mA, open collector, galvanically isolated *
- Maximum output frequency 5250 Hz
- 1 off dedicated to Alarm / Logic, programmable function
- 2 off configurable to either Pulse / Frequency or Alarm/Logic function

Current output – HART FEX100 variant

- 4 to 20 mA or 4 to 12/20 mA, galvanically isolated *
- Maximum loop resistance 750 Ω
- HART protocol Version 5.7 (HART registered)
- Signal levels compliant with NAMUR NE 43 (3.8 to 20.5 mA)
- Low alarm 3.6 mA, High alarm 21.8 mA

Additional accuracy

- ±0.1 % of reading
- Temperature coefficient: typically <±20 ppm/°C

RS485 Communications – PROFIBUS FEX100-DP variant

- Registered name: FEX100-DP
- RS485 (9.6kbps to 1.5Mbps), galvanically isolated
- DPV0, DPV1
- PA Profile 3.01
- Standard idents: 9700, 9740, 9741
- FEX100-DP specific ident: 3431
- 3 Concurrent MS2 master connections

RS485 Communications – MODBUS FEX100-MB variant

- MODBUS RTU protocol
- RS485 (9.6kbps to 115.2kbps), galvanically isolated

Electrical connections

- 20 mm glands 1/2 in. NPT, 20 mm armored glands

Temperature limitations

- Ambient temperature -20 to 60 °C (-4 to 140 °F)
- Temperature coefficient Typically <±10 ppm/°C @ Vel ≥0.5 m/s

Environmental protection

- Humidity: 0 to 100 %
- Rating: IP67 (NEMA 4X) to 1m (3.3 ft.) depth

Tamper-proof security

- Write access prevented by internal switch combined with external security seals for MID applications

Languages

- English, French, German, Italian, Spanish, Polish

Infrared service port

- USB adapter (accessory), USB 1.1. and 2.0 compatible
- Driver software for Windows 2000, XP, 7 (32-bit) and Vista

Housing material

- Powder-coated aluminium with glass window

Paint specification

- Paint coat ≥70 µm thick RAL 9002 (light grey)

Transmitter vibration testing

- Vibration level: 7 m/s²
- Frequency range: 20 to 150 Hz
- No. of sweeps in 3 orthogonal planes: 20
- Undetectable shift in transmitter span or zero performance

Hazardous approvals

- FM & FmC Class 1 Div 2
 - (FM listing NI / 1 / 2 / ABCD / T4, S / II, III / 2 / FG / T4, Ta=60C; Type 4X, IP67 – for transmitter and integral mounting
 - Ta=70C, Type 6P, IP68 – for remote sensor type, IP67 on DN10 to 32 [3/8 to 1 1/4 in.NB])
 - (FmC listing NI / 1 / 2 / ABCD / T4, DIP / II, III / 2 / FG / T4, Ta=60C; Type 4X, IP67 – for transmitter and integral mounting
 - Ta=70C, Type 6P, IP68 – for remote sensor type, IP67 on DN10 to 32 [3/8 to 1 1/4 in.NB])

FET, FEV, FEW and FEF DN700 to 2200 (27/28* to 84 in. NB) only

*Size is dependent on flange specification

ATEX* Zone 2, 21 & 22

- II 3 G Ex nA IIC T5 Gc
- II 2 D Ex tb IIIC T100°C Db
- TA = -20°C to +60°C (integral transmitter)
- TA = -20°C to +70°C (remote sensor)

IECEx* Zone 2, 21 & 22

- Ex tb IIIC T100°C Db
- Ex nA IIC T5 Gc
- TA = -20°C to +60°C (integral transmitter)
- TA = -20°C to +70°C (remote sensor)

*FEW, FEV, FET and FEF ≥700 (27/28 in. NB) only

Declaration of Conformance

Copies of CE certification will be available on request.

WaterMaster has OIML R49 Certificate of Conformity to accuracy class 1 and 2 (FEV DN40 to 200 [1 1/2 to 8 in.NB]). Copies of accuracy certification are available on request.

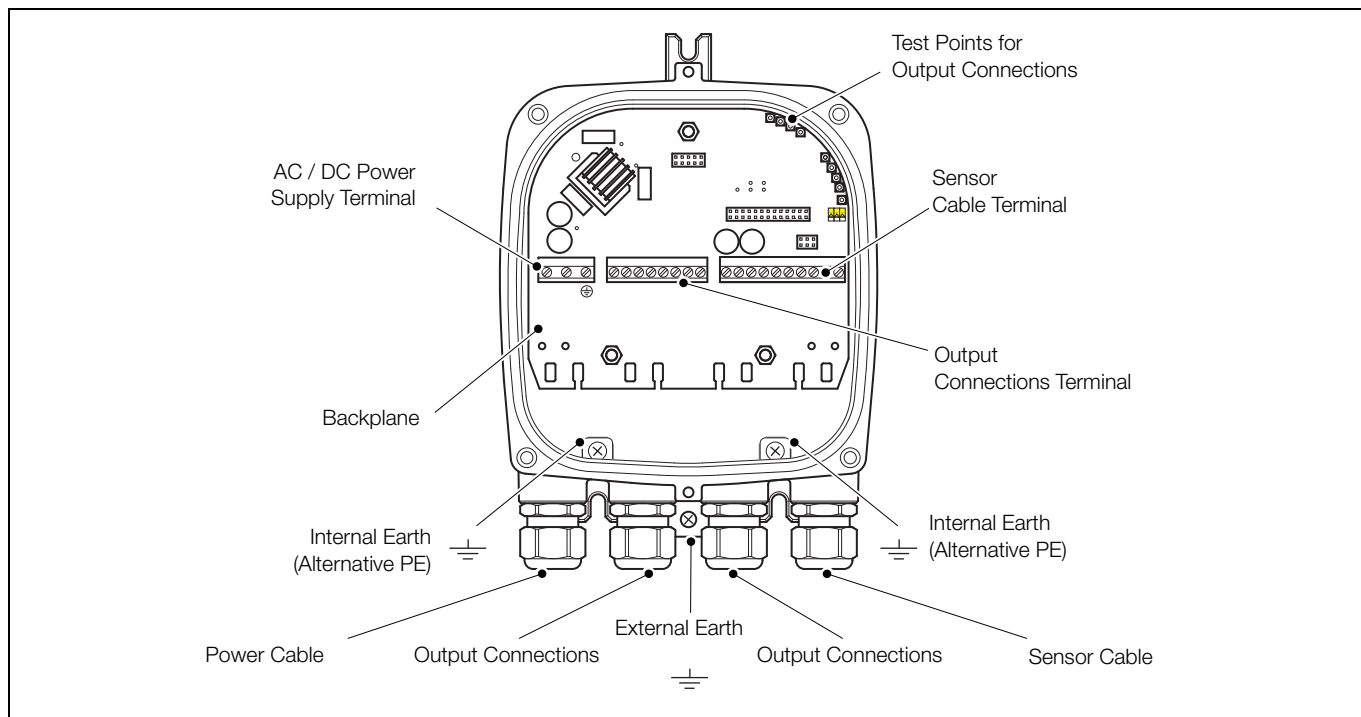
WaterMaster (FEV DN40 to 200 [1 1/2 to 8 in.NB]) has been type examined under directive MID 2004/22/EC, Annex MI-001. Copies of this certificate are available on request.

* When installed, do not leave galvanically isolated circuits (pulse and current) floating.

Transmitter connections

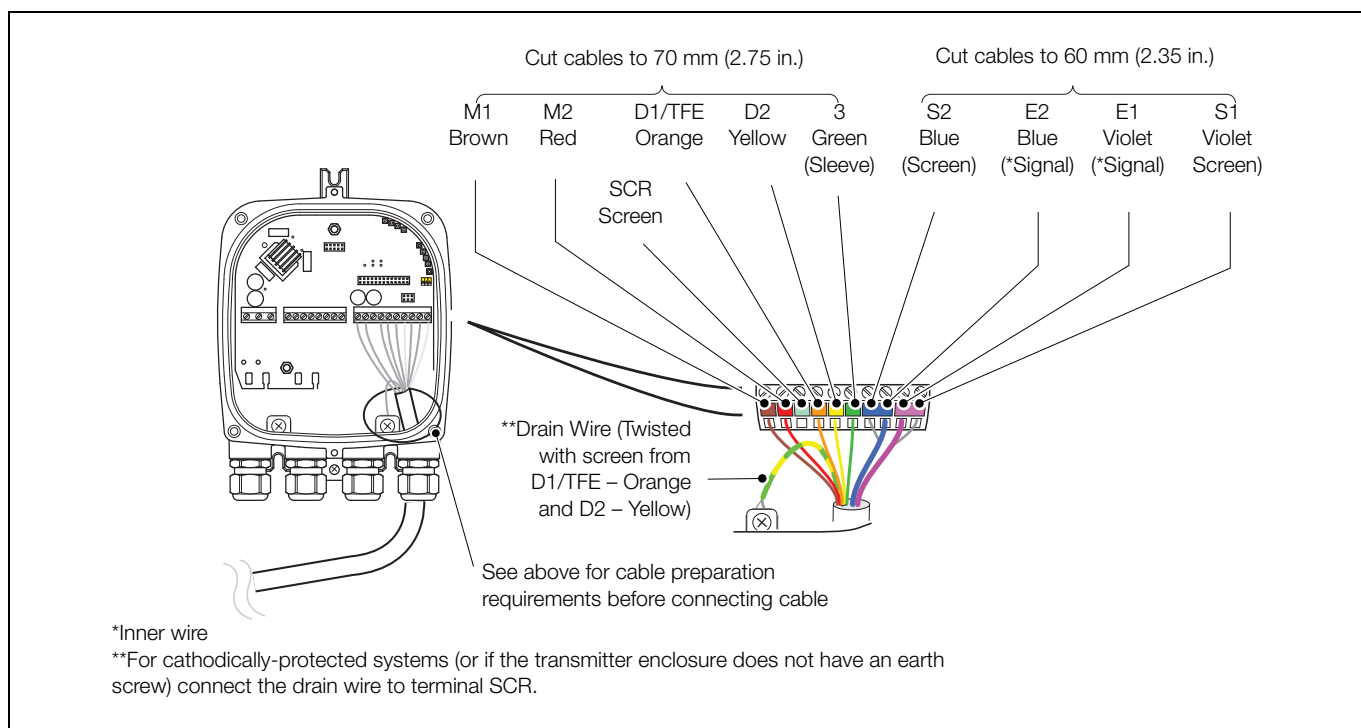
Transmitter terminal connections overview

This section is intended to give an overview of installation of a flowmeter. For Installation requirements, technical information and Health and safety precautions – refer to the User Guide OI/FET100-EN.



Cable gland / conduit entry (Remote transmitter shown)

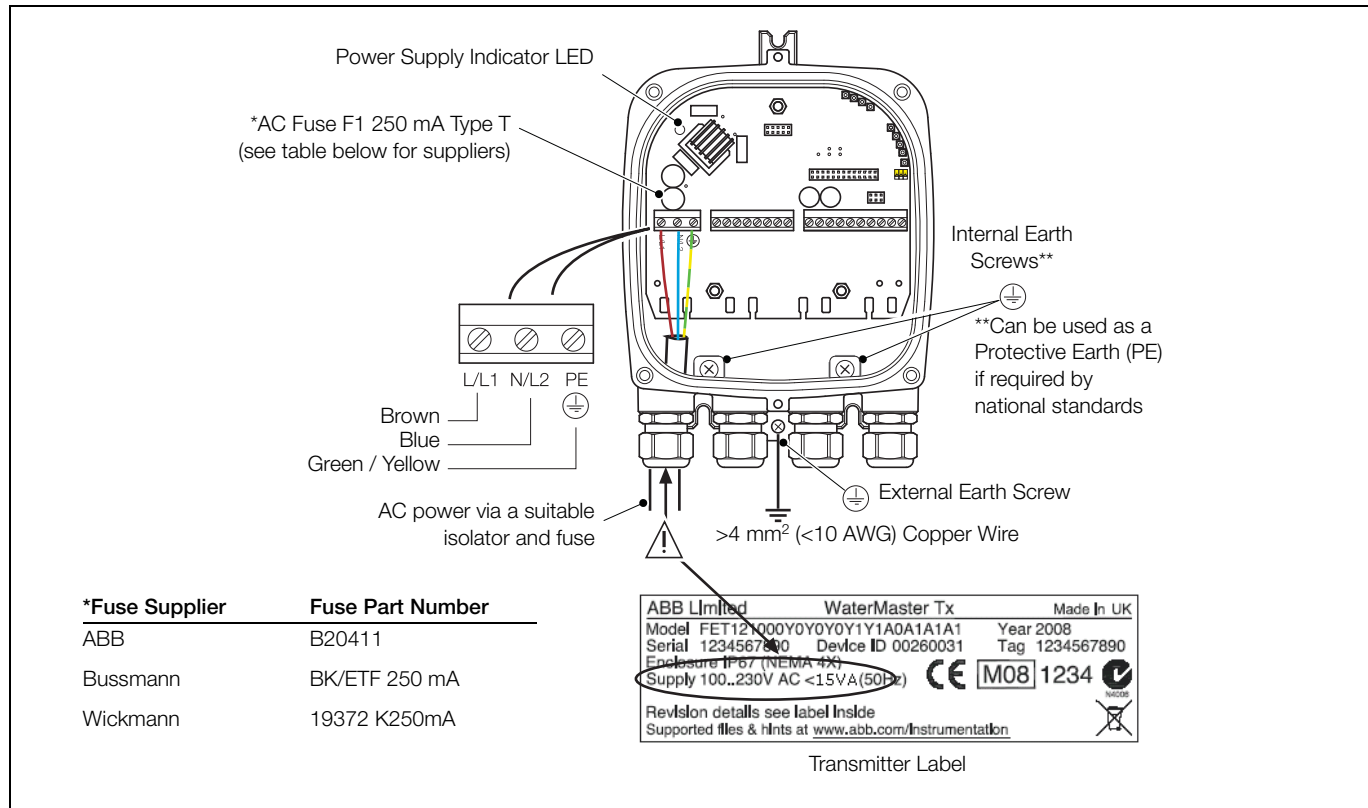
Sensor cable terminal connections and recommended cable lengths



Sensor cable connections at transmitter terminal block – remote transmitter

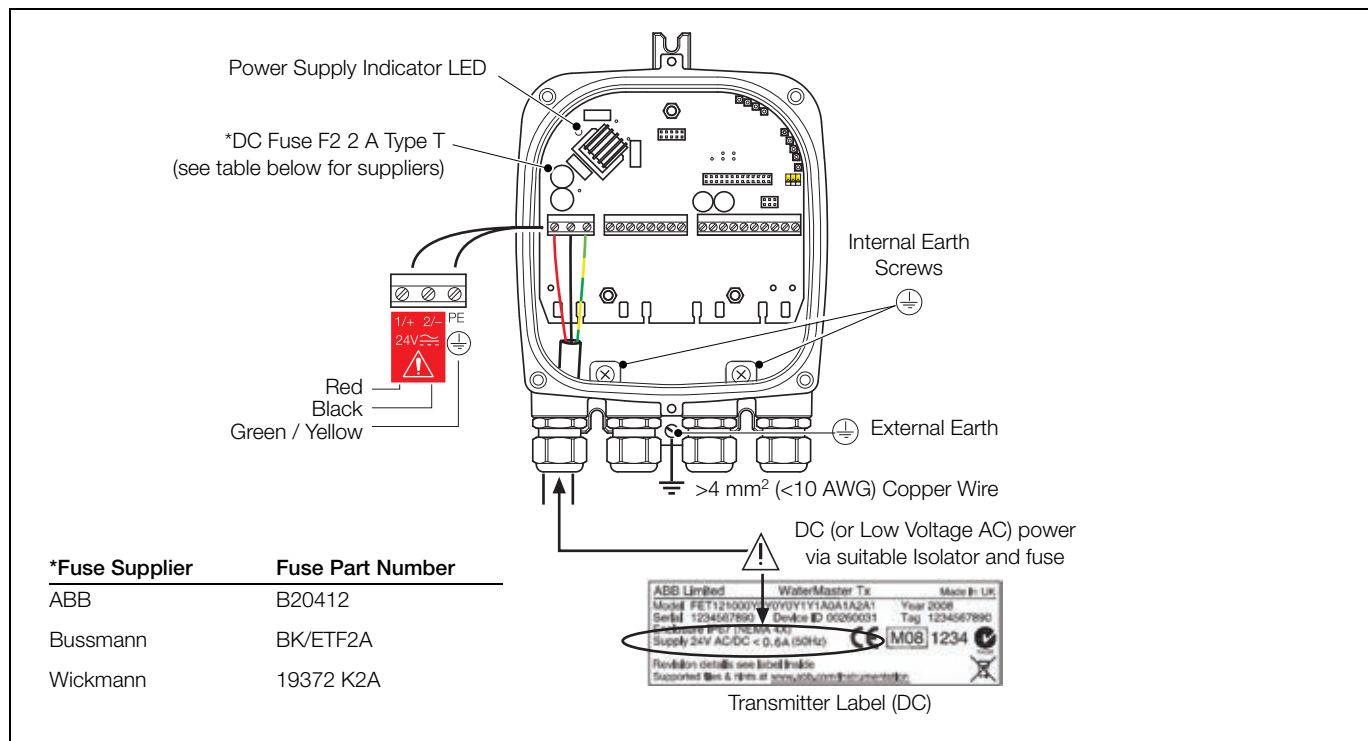
Power supply connections

AC power supply



AC power supply connections

DC (and low voltage AC) power supply



DC (and low voltage AC) power supply connections

WaterMaster

Electromagnetic flowmeter

Configuration DIP switches

Three configuration DIP switches are mounted on the transmitter backplane board.

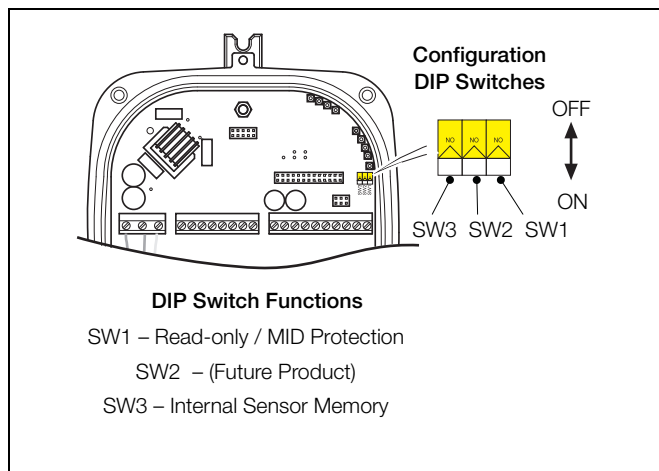
These are factory-set as follows:

- Remote transmitter – all OFF
- Integral transmitter – SW3 ON

For MID-compliant flowmeters the read-only / MID protection switch is set to 'ON' to ensure the meter is secure from tampering.

For HART software versions prior to 01.02.XX, this switch (set after commissioning) prevents login via the keypad or bus at any security level.

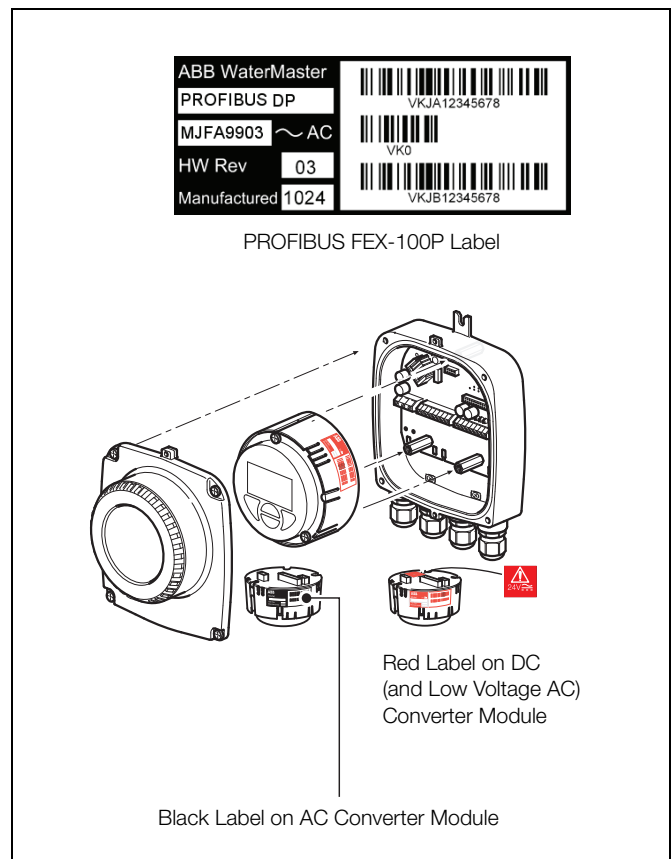
From HART software version 01.03.XX onwards and for all PROFIBUS software versions, on MID meters, all metrological-related parameters are locked and inaccessible at the Service level. Standard and Advanced user level parameters can still be modified via the HMI or bus.



Configuration DIP switches

Transmitter module identification

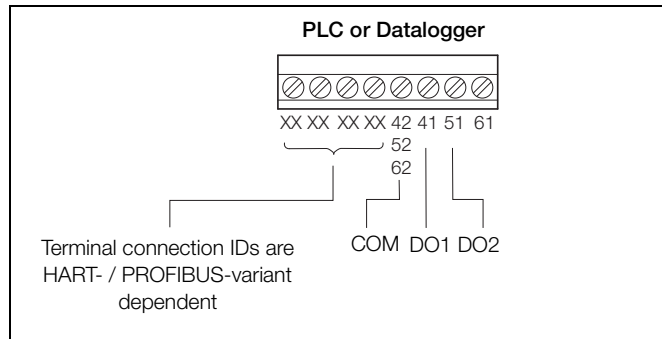
Note. The communications bus type is HART FEX100 if not specified on the transmitter module label. An example of the PROFIBUS FEX100-DP variant transmitter module label is shown below.



Transmitter module identification

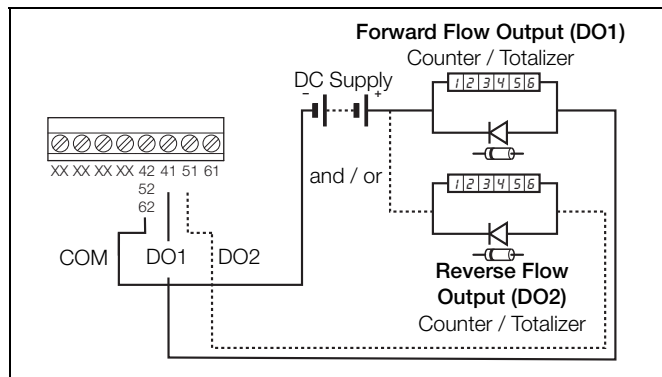
Output connections

Frequency outputs

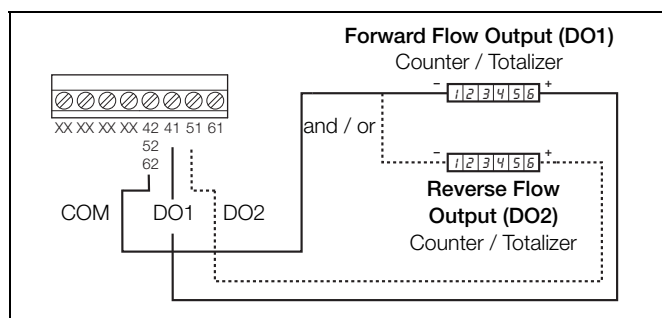


PLC / Datalogger connections

Note. Digital outputs DO1 and DO2 are polarity sensitive. The common (negative) connection for these outputs is designated 'COM'.

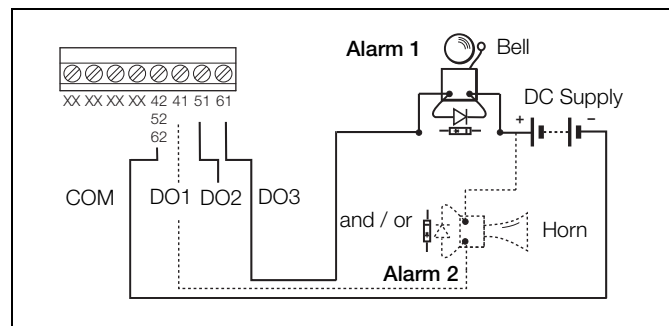
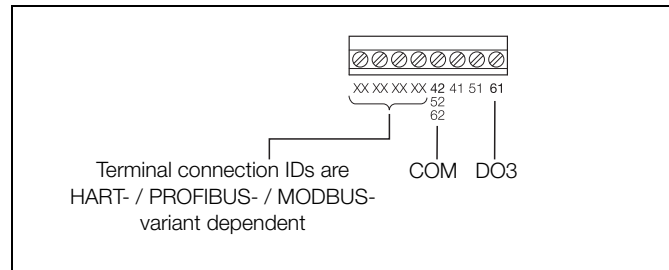


Electromechanical connections



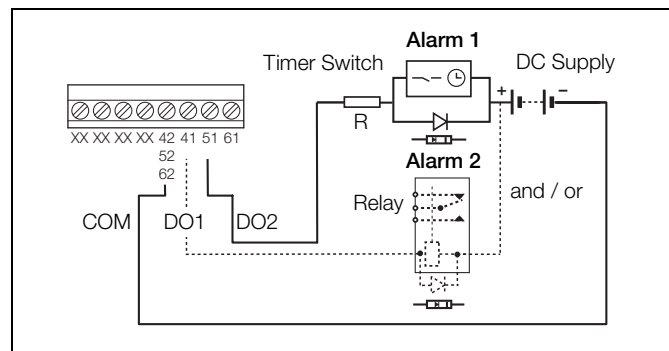
Telemetry / Electronic counters connections

Alarm outputs



Note.

- Normal alarm / logic output is from DO3 (terminal 61). DO1 (41) and DO2 (51) can also be configured as alarms if required but are then NOT available as frequency / pulse outputs as shown in *Electromechanical connections* and *Telemetry / Electronic counters connections*, opposite.
- Bell and horn shown for example only. Any suitable alarm device may be used (for example, lamp, siren, buzzer etc.).

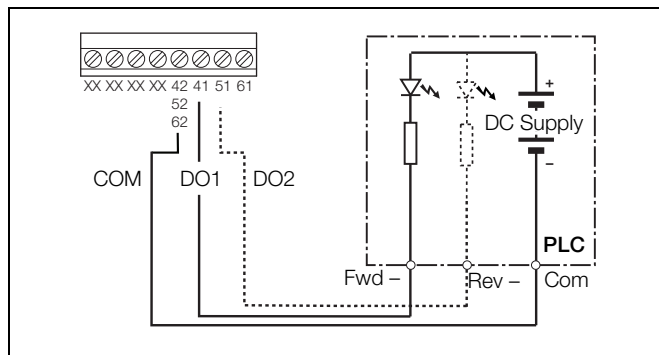
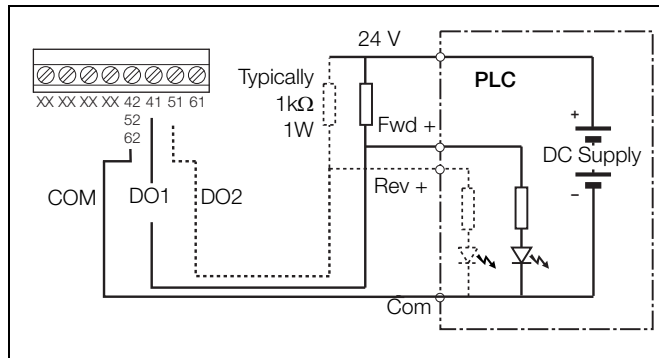


Note. Relay and timer switch shown for example only.

WaterMaster

Electromagnetic flowmeter

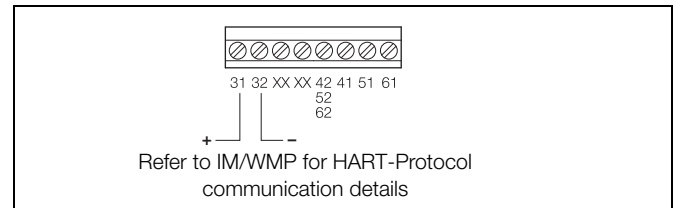
PLC interface



Note.

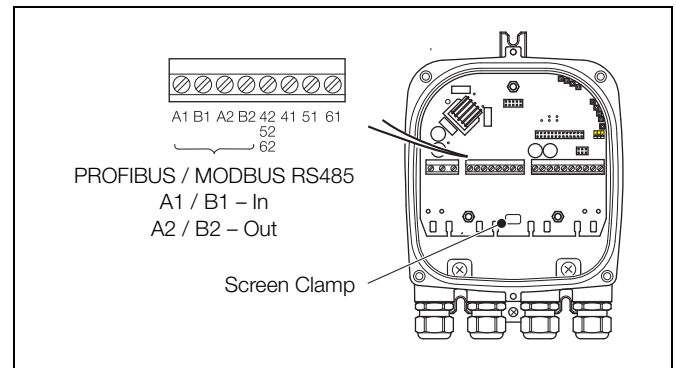
- WaterMaster digital outputs are NPN optocoupled transistors used as switches.
- Maximum allowed voltage at collector is 30 V DC
- Maximum allowed current across transistor is 220 mA.

Current output (4 to 20 ma) – HART (FEX100) variant



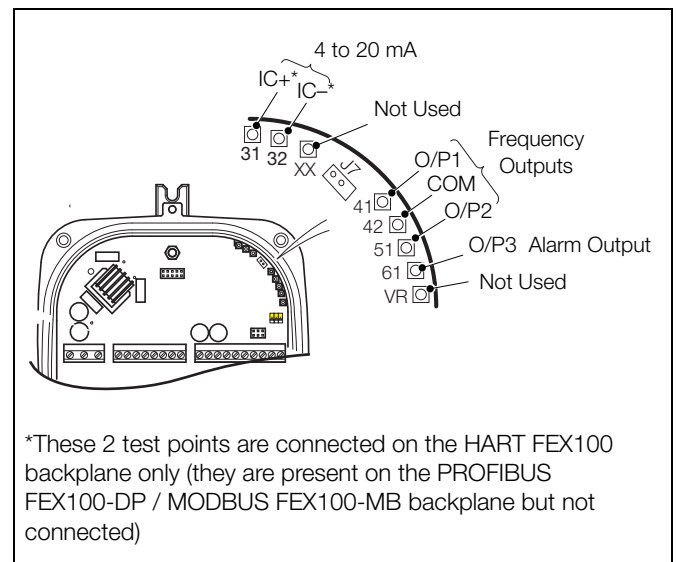
Current output (4 to 20 mA) – HART (FEX100) variant

RS485 communications – PROFIBUS (FEX100-DP) and MODBUS (FEX100-MB) variants



Test point access

Note. A typical DVM probe can access (fit) the PCB's test holes.



*These 2 test points are connected on the HART FEX100 backplane only (they are present on the PROFIBUS FEX100-DP / MODBUS FEX100-MB backplane but not connected)

WaterMaster

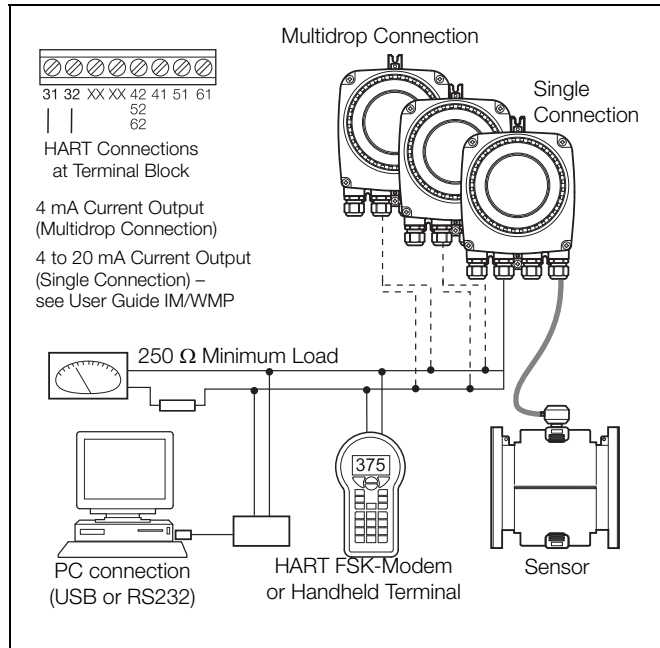
Electromagnetic flowmeter

Digital communication

The transmitter has the following options for digital communication.

HART protocol

The unit is registered with HART Communication Foundation.



HART protocol	
Configuration	Directly on the Device Software Asset Vision Basic (+ HART -DTM)
Transmission	Install a HART modem (FSK [Frequency Shift Keyed]-Modem) for HART-Communication when connecting to a PC. The HART-Modem converts the analog 4 to 20 mA signal into a digital output signal (Bell Standard 202) and connects to the PC using a USB (or RS232C) connector
Max. signal amplitude	1.2 mA
Current output load	Min. 250Ω, max. = 560Ω
Cable	AWG 24 twisted
Max. cable length	1500 m (4921 ft.)
Baud rate	1.200 baud

System integration

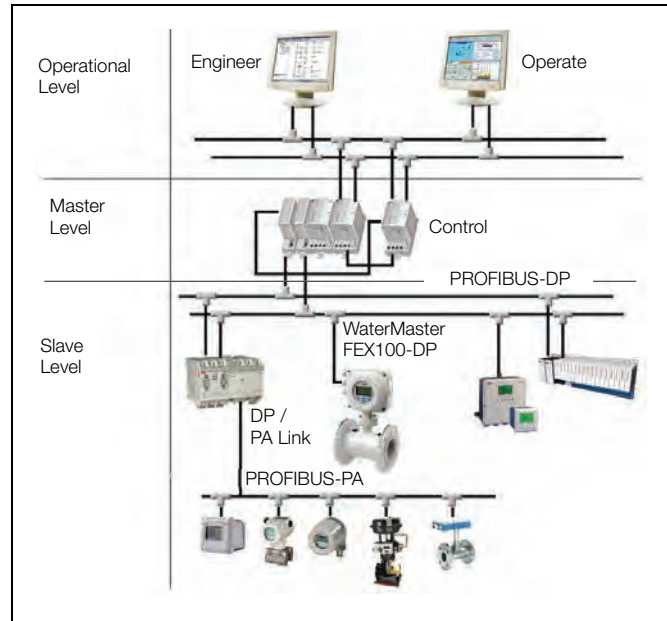
WaterMaster can be integrated into control systems and configuration devices using any Frame application, such as ABB AssetVision or similar third-party applications. ABB Device Type Managers (DTMs) for WaterMaster provide a unified structure for accessing device parameters, configuring and operating the devices and diagnosing problems. FDT (Field Device Tool) technology standardizes the communication and configuration interface between all field devices and host systems.

PROFIBUS DP protocol

PROFIBUS is a manufacturer-independent, open Fieldbus standard for a wide range of applications in manufacturing, process and building automation. Manufacturer independence and openness are ensured by the international standard EN 50170.

PROFIBUS DP ID no.	0x3431
Alternative standard ID no.	0x9701 or 0x9741
Configuration	Directly on the device Software Asset Vision Basic (+PROFIBUS DP-DTM)
Transmission signal	Accuracy to IEC 61158-2
Cable	Shielded, twisted cable (accurate to IEC 61158-2, types A or B)

All devices are connected in a bus structure ('line') as shown in below. Up to 32 stations (master or slaves) can be linked to create one 'segment', although it is recommended not to install more than 16 devices on a single segment. Each end of a segment must be terminated by an active bus terminating resistor. Both bus terminators must always be powered to ensure fault-free operation, therefore it is strongly recommended that they are connected to a back-up power supply. The use of bus amplifiers (repeaters) and segment couplers can be used to extend the network.



WaterMaster

Electromagnetic flowmeter

System integration

The GSD file for WaterMasters specifies the device-specific Ident No. 3431. It conforms to the PROFIBUS standard, providing a clear and comprehensive description of each instrument in a precisely defined format.

This enables the system configuration tool to use the information automatically when configuring a PROFIBUS bus system.

The ABB GSD file (Ident No. 3431) is divided into 2 sections:

■ General specifications

Identification of the device, together with hardware and software versions, baud rates supported and the possible time intervals for monitoring times.

■ DP slave-related specifications

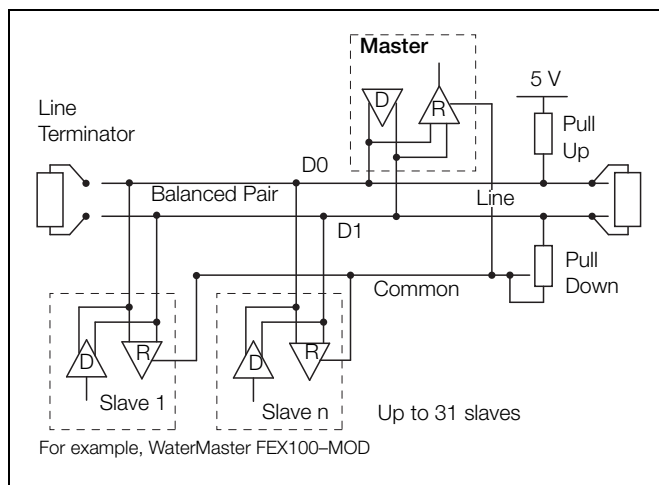
Information about the user parameter block for device-specific configuration and modules containing details of the input and output data that can be exchanged cyclically with a PROFIBUS master.

The WaterMaster GSD file (ABB_3431.gsd) is available for download from the ABB website at: www.abb.com/fieldbus (follow the link for PROFIBUS DP field devices).

MODBUS protocol

MODBUS is an open standard that is owned and administered by an independent group of device manufacturers called the Modbus Organization (www.modbus.org).

Using the MODBUS protocol, devices from different manufacturers exchange information on the same communications bus without the need for special interface equipment. WaterMaster FEX100-MB follows the specification for Modbus Over Serial Line V1.02, using 2-wire TIA/EIA-485 (RS485) physical layer.



Cable Properties

The end-to-end length of the trunk cable must be limited. The maximum length depends on the Baud rate, the cable (gauge, capacitance or characteristic impedance), the number of loads on the daisy chain and the network configuration (2-wire or 4-wire).

For 9600 Baud rate and AWG26 (or wider) gauge, the maximum length is 1000 m (3280 ft.). Where 4-wire cabling is used as a 2-wire cabling system the maximum length must be divided by 2. The tap cables must be short, never more than 20 m (65.6 ft.). If a multi-port tap is used with n derivations, each one must have a maximum length of 40 m (131 ft.) divided by n .

The maximum serial data transmission line length for RS485 systems is 1200 m (3937 ft.). The lengths of cable that can be used are determined by the cable type, typically:

- Up to 6 m (19.7 ft.) – standard screened or twisted pair cable.
- Up to 300 m (984 ft.) – twin twisted pair with overall foil screen and an integral drain wire – for example, Belden 9502 or equivalent.
- Up to 1200 m (3937 ft.) – twin twisted pair with separate foil screens and integral drain wires – for example, Belden 9729 or equivalent.

Category 5 cables may be used for RS485-MODBUS to a maximum length of 600 m (1968 ft.). For the balanced pairs used in an RS485-system, a characteristic impedance with value higher than 100Ω is preferred especially for 19200 and higher Baud rates.

WaterMaster

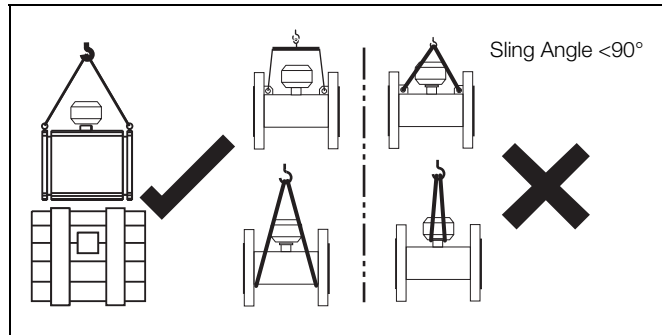
Electromagnetic flowmeter

Installation requirements

This section is intended to give an overview of installation of a flowmeter. For Installation requirements, technical information and Health and Safety precautions refer to User Guide OI/FEF/FEV/FEW-EN.

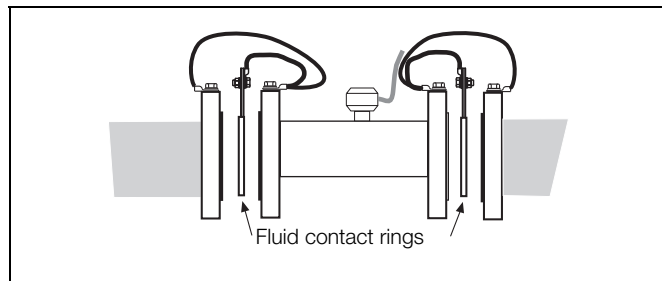
Unpacking the flowmeter

Care must be taken when lifting the flowmeter to use the lifting hooks provided or sling under the body of the meter. Never lift using the terminal connection box of the sensor cable as this will cause damage and invalidate warranty.



Grounding

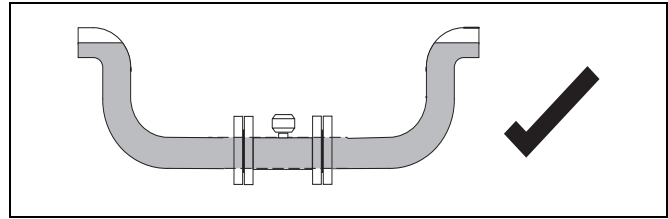
The flowmeter sensor must be cross-bonded to the upstream and downstream pipes and fluid. For technical reasons, this potential should be identical to the potential of the metering fluid. For plastic or insulated lined pipelines, the fluid is grounded by installing a minimum of 1 earthing rings. When there are stray potentials present in the pipeline, an earthing ring is recommended on both ends of the meter sensor.



Mounting

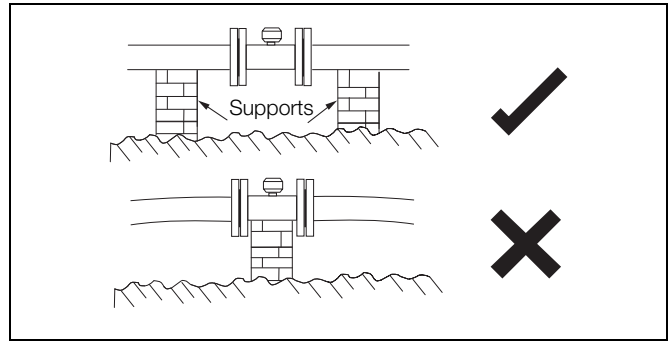
The installation conditions shown below must be observed to achieve the best operational results.

The sensor tube must always be completely full.

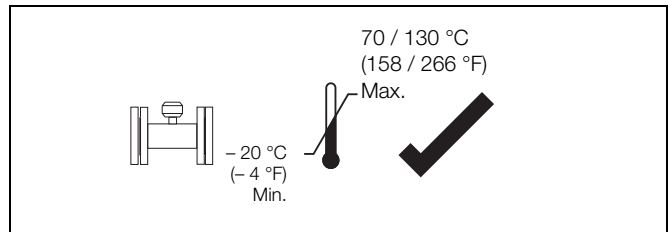


The flow direction must correspond to the identification plate. The device measures the flowrate in both directions. Forward flow is the factory setting.

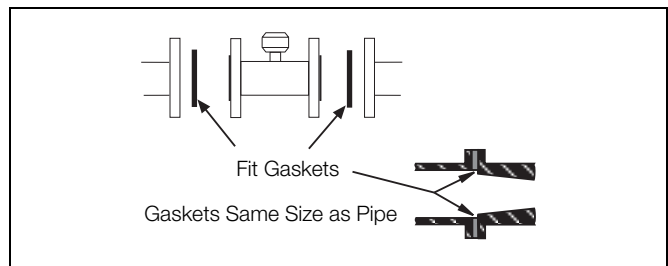
The devices must be installed without mechanical tension (torsion, bending). If required support the pipeline.



The flange seals must be made from a compatible material for the fluid and fluid temperatures if required.



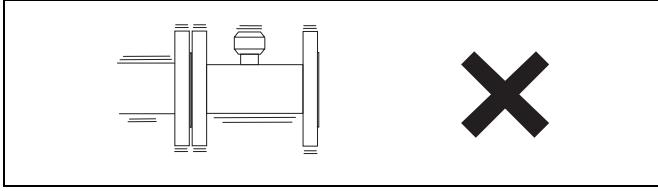
Seals must not extend into the flow area since possible turbulence could influence the device accuracy.



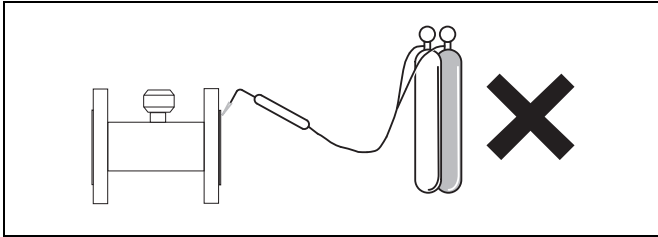
WaterMaster

Electromagnetic flowmeter

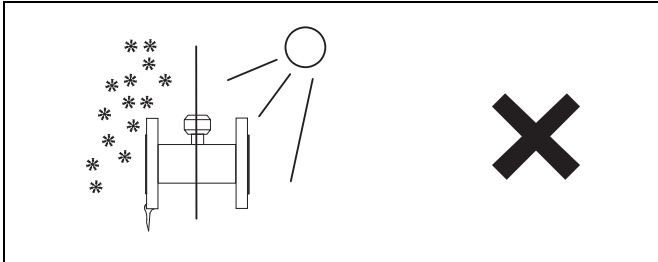
The pipeline may not exert any unallowable forces and torques on the device, such as vibration.



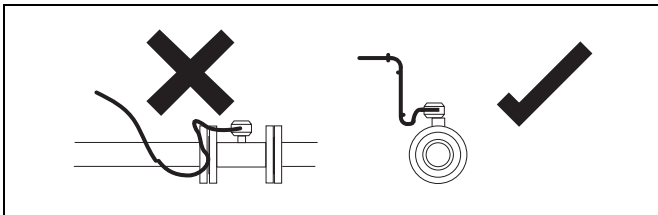
The flowmeter must not be submitted to any localized heat during installation; take care to remember this is a measuring instrument.



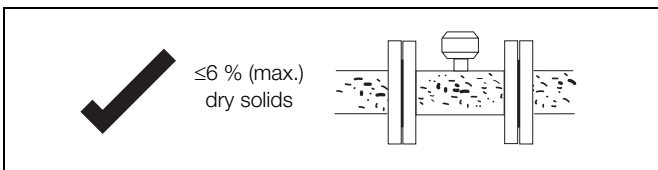
The flowmeter must not be exposed to direct sunlight or provide for appropriate sun protection where necessary.



The cable to the flowmeter should be installed neatly or within a conduit, both loose or conduit should have a u shape below the terminal connection box height to allow any water run off to avoid any capillary action into the flowmeter sensor.

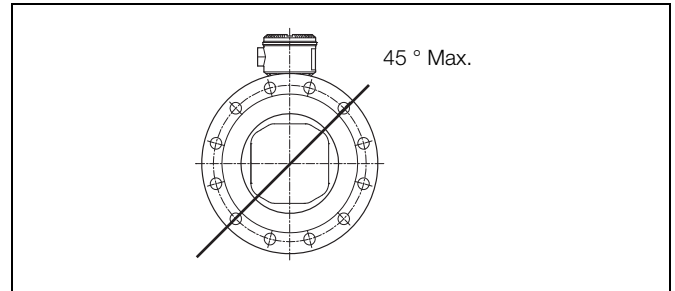


Ensure a maximum 6 % dry solids content flow through pipe – for higher dry solids content, refer to ABB's ProcessMaster range.



Electrode axis

Electrode axis should be horizontal if at all possible or no more than 45° from horizontal.



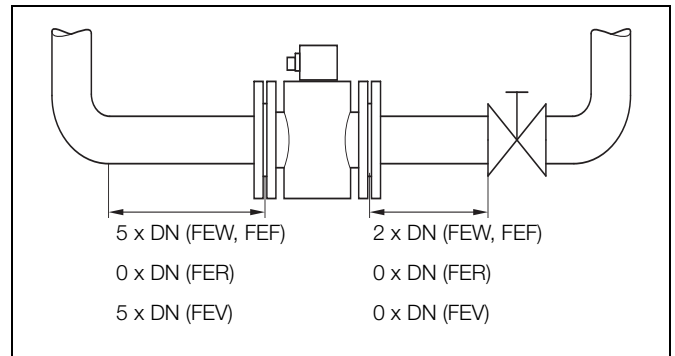
Upstream and Downstream pipe sections

The metering principle is tolerant of the flow profile.

- Wherever possible do not install fittings (for example, manifolds, valves) directly in front of the flowmeter sensor.
- Butterfly valves should be installed so that the valve plate does not extend into the flowmeter sensor.
- Valves or other turn-off components should be installed in the Downstream pipe section.

Experience has shown that, in most installations, straight upstream sections 3 x DN long and straight downstream sections 2 x DN long are normally sufficient. We would recommend conditions of 5 x DN straight upstream and 2 x DN straight downstream where possible.

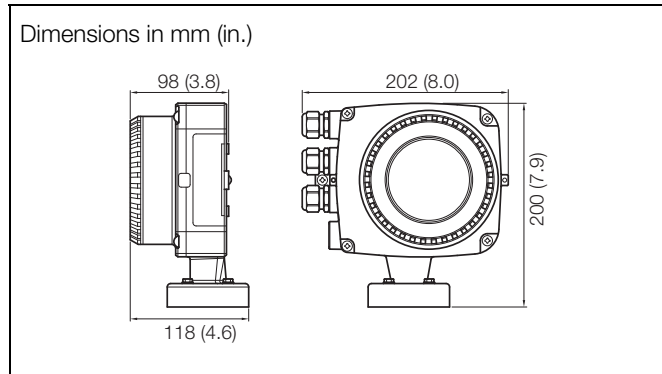
For reduced-bore meters (FER), these straight pipe sections are often not necessary.



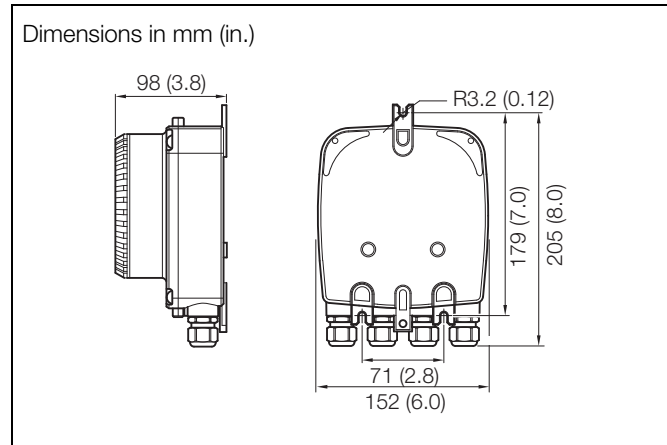
WaterMaster
Electromagnetic flowmeter

Transmitter dimensions

Integral transmitter

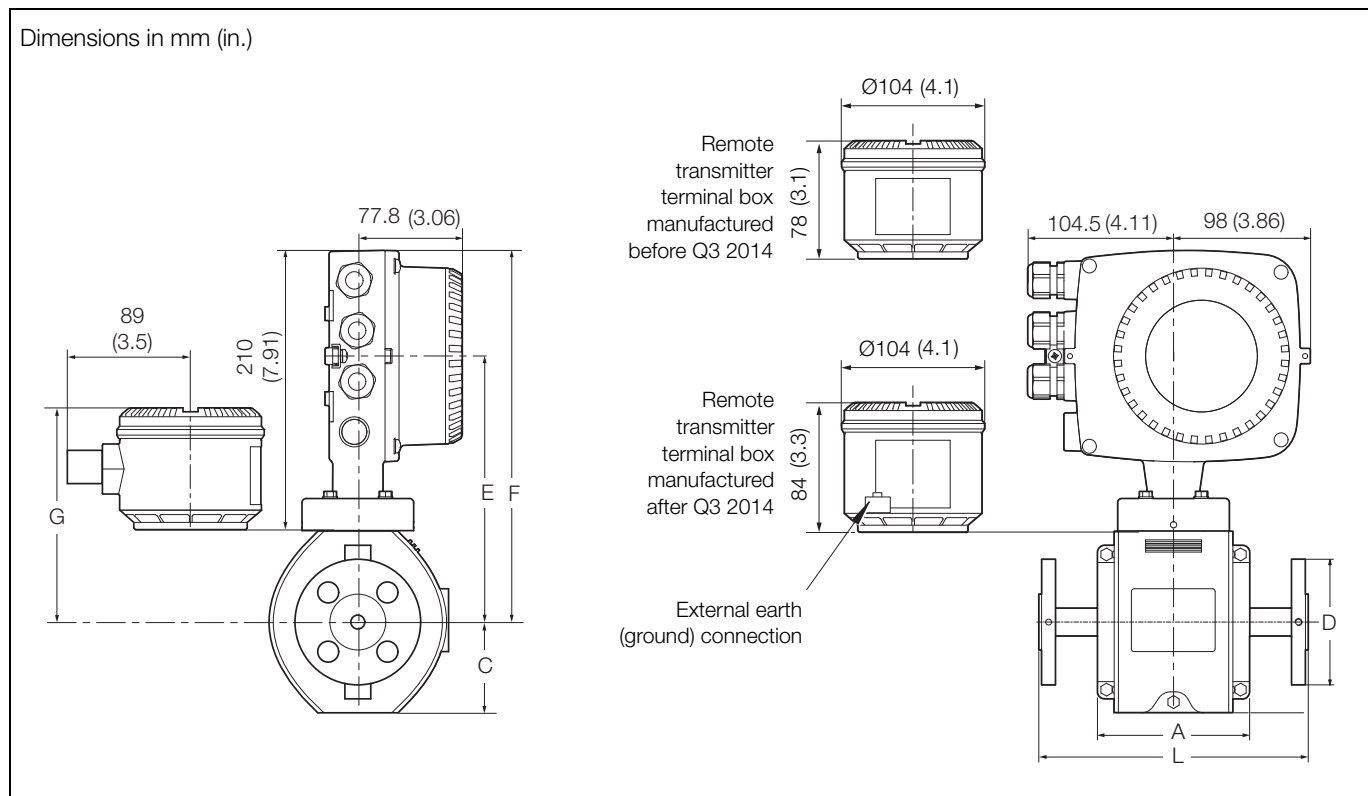


Remote transmitter



Sensor dimensions

FEW – DN10 to 125 ($\frac{3}{8}$ to 5 in. NB)

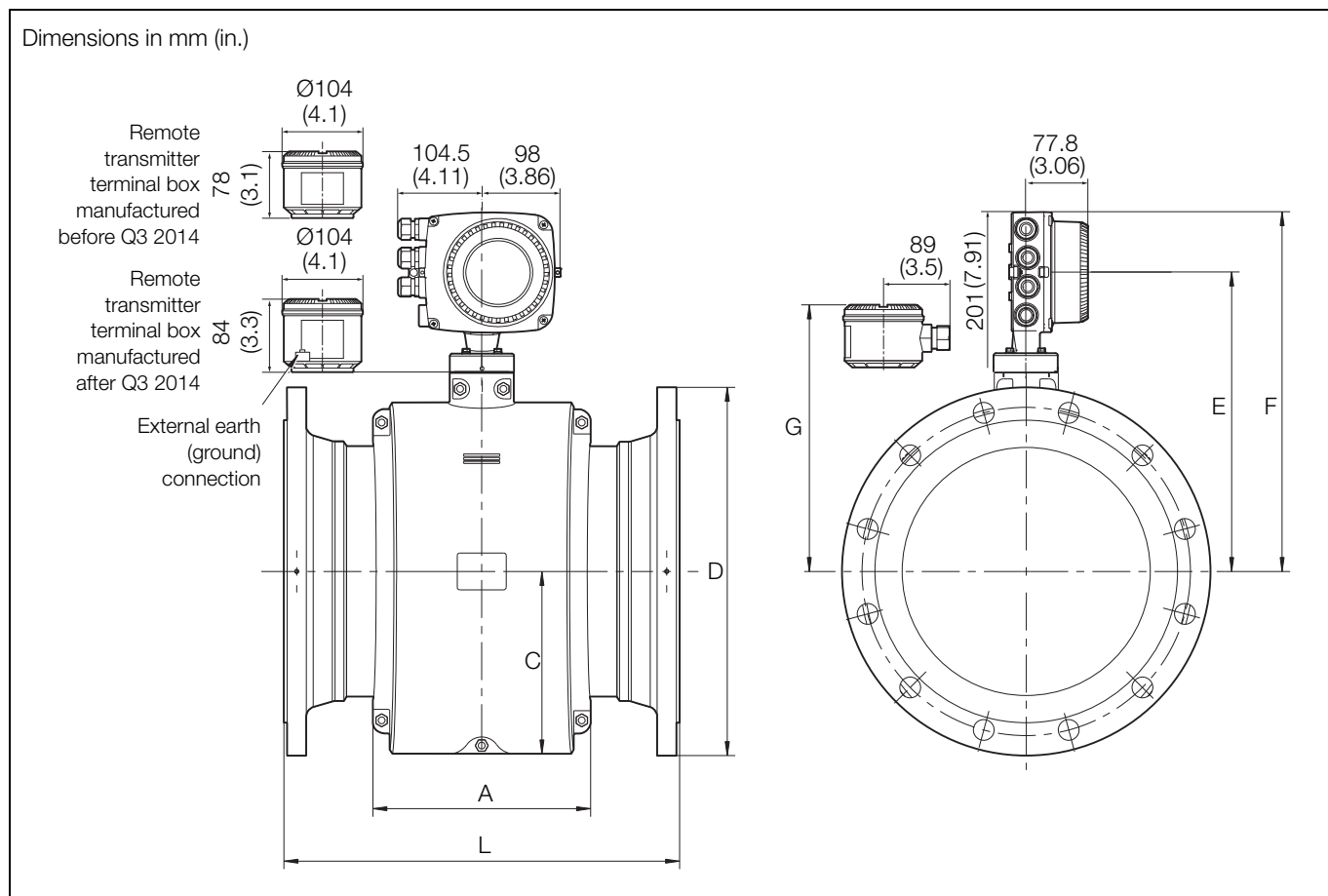


DN10 to 125 ($\frac{3}{8}$ to 5 in. NB) (FEW)

DN	Process connection type	Dimensions in mm (in.)							Approx. weight in kg (lb)	
		D	L	F	C	E	G	A	Integral	Remote
DN10 (³ / ₈ in.)	JIS10K	90 (3.54)	200 (7.87)	268 (10.55)	82 (3.23)	193 (7.6)	148 (5.83)	113 (4.45)	6 (13)	4 (9)
	PN10 to 40	90 (3.54)								
	ASME B16.5 CL150	90 (3.54)								
	ASME B16.5 CL300	96 (3.78)								
DN15 (¹ / ₂ in.)	PN10 to 40	95 (3.74)	200 (7.87)	268 (10.55)	82 (3.23)	193 (7.6)	148 (5.83)	113 (4.45)	8 (18)	6 (13)
	JIS5K	80 (3.15)								
	JIS10K	95 (3.74)								
	ASME B16.5 CL300	95 (3.74)								
DN20 (³ / ₄ in.)	ASME B16.5 CL150	90 (3.54)								
	PN10 to 40	105 (4.13)	200 (7.87)	268 (10.55)	82 (3.23)	193 (7.6)	148 (5.83)	113 (4.45)	9 (20)	7 (15)
	JIS5K	85 (3.35)								
	JIS10K	100 (3.94)								
DN25 (1 in.)	ASME B16.5 CL300	115 (4.53)								
	ASME B16.5 CL150	98 (3.86)	200 (7.87)	268 (10.55)	82 (3.23)	193 (7.6)	148 (5.83)	113 (4.45)	10 (22)	8 (18)
	PN10 to 40	115 (4.53)								
	JIS5K	95 (3.74)								
DN32 (1 ¹ / ₄ in.)	JIS10K	125 (4.88)								
	ASME B16.5 CL300	125 (4.88)	200 (7.87)	275 (10.83)	92 (3.62)	200 (7.87)	155 (6.10)	113 (4.45)	11 (24)	9 (20)
	ASME B16.5 CL150	108 (4.25)								
	PN10 to 40	140 (5.51)								
DN40 (1 ¹ / ₂ in.)	JIS5K	115 (4.53)								
	JIS10K	135 (5.31)	200 (7.87)	275 (10.83)	92 (3.62)	200 (7.87)	155 (6.10)	113 (4.45)	12 (26)	10 (22)
	ASME B16.5 CL300	135 (5.31)								
	ASME B16.5 CL150	117 (4.61)								
DN50 (2 in.)	PN10 to 40	150 (5.91)								
	JIS5K	120 (4.72)	200 (7.87)	281 (11.06)	97 (3.82)	206 (8.11)	161 (6.34)	115 (4.53)	13 (29)	11 (24)
	JIS10K	140 (5.51)								
	ASME B16.5 CL300	155 (6.10)								
DN65 (2 ¹ / ₂ in.)	ASME B16.5 CL150	127 (5.00)								
	PN10 to 40	165 (6.5)	200 (7.87)	292 (11.50)	108 (4.25)	217 (8.54)	172 (6.77)	104 (4.09)	15 (33)	13 (29)
	JIS5K	130 (5.12)								
	JIS10K	155 (6.10)								
DN80 (3 in.)	AS4087 PN16	150 (5.91)								
	AS4087 PN35	165 (6.50)	200 (7.87)	292 (11.5)	108 (4.25)	217 (8.54)	172 (6.77)	104 (4.09)	17 (37)	15 (33)
	ASME B16.5 CL150	152 (5.98)								
	ASME B16.5 CL300	165 (6.50)								
DN100 (4 in.)	PN10 to 40	185 (7.28)								
	JIS5K	155 (6.10)	200 (7.87)	314 (12.36)	122 (4.8)	239 (9.41)	194 (7.64)	125 (4.92)	19 (42)	17 (37)
	JIS10K	175 (6.89)								
	AS4087 PN16	165 (6.50)								
DN125 (5 in.)	AS4087 PN35	185 (7.28)								
	ASME B16.5 CL150	178 (7.01)	250 (9.84)	324 (12.76)	130 (5.12)	249 (9.8)	204 (8.03)	125 (4.92)	22 (48)	20 (44)
	ASME B16.5 CL300	190 (7.48)								
	PN10 to 40	200 (7.87)								
DN150 (6 in.)	JIS5K	180 (7.09)								
	JIS10K	185 (7.28)	250 (9.84)	324 (12.76)	130 (5.12)	249 (9.8)	204 (8.03)	125 (4.92)	23 (51)	21 (46)
	AS4087 PN16	185 (7.28)								
	AS4087 PN35	205 (8.07)								
DN200 (8 in.)	ASME B16.5 CL150	190 (7.48)								
	ASME B16.5 CL300	210 (8.28)	250 (9.84)	324 (12.76)	130 (5.12)	249 (9.8)	204 (8.03)	125 (4.92)	23 (51)	21 (46)
	PN10 to 16	220 (8.66)								
	PN25 to 40	235 (9.25)								
DN250 (10 in.)	JIS5K	200 (7.87)								
	JIS10K	210 (8.27)	250 (9.84)	324 (12.76)	130 (5.12)	249 (9.8)	204 (8.03)	125 (4.92)	29 (64)	27 (59)
	AS4087 PN16	215 (8.46)								
	AS4087 PN35	230 (9.06)								
DN300 (12 in.)	ASME B16.5 CL300	255 (1.04)								
	ASME B16.5 CL150	229 (9.00)								
	PN10 to 16	250 (9.84)	250 (9.84)	324 (12.76)	130 (5.12)	249 (9.8)	204 (8.03)	125 (4.92)	22 (48)	20 (44)
	PN25 to 40	270 (10.63)								
DN350 (14 in.)	JIS5K	235 (9.25)								
	JIS10K	250 (9.84)								
	ASME B16.5 CL150	254 (10.00)								
	ASME B16.5 CL300	280 (11.02)								
DN400 (16 in.)	PN10 to 16	250 (9.84)	250 (9.84)	324 (12.76)	130 (5.12)	249 (9.8)	204 (8.03)	125 (4.92)	35 (77)	33 (73)
	PN25 to 40	270 (10.63)								
	JIS5K	235 (9.25)								
	JIS10K	250 (9.84)								
DN450 (18 in.)	ASME B16.5 CL150	254 (10.00)								
	ASME B16.5 CL300	280 (11.02)								
	PN10 to 16	250 (9.84)	250 (9.84)	324 (12.76)	130 (5.12)	249 (9.8)	204 (8.03)	125 (4.92)	35 (77)	33 (73)
	PN25 to 40	270 (10.63)								
DN500 (20 in.)	JIS5K	235 (9.25)								
	JIS10K	250 (9.84)								
	ASME B16.5 CL150	254 (10.00)								
	ASME B16.5 CL300	280 (11.02)								

DN10 to 125 (³/₈ to 5 in. NB) (FEW) dimensions / weights

FEW – DN150 to 400 (6 to 16 in. NB)



DN150 to 400 (6 to 16 in. NB) (FEW)

DN	Process connection type	Dimensions in mm (in.)							Approx. weight in kg (lb)	
		D	L	F	C	E	G	A	Integral	Remote
DN150 (6 in.)	PN10 to 16	285 (11.22)	300 (11.81)	371 (14.61)	146 (9.88)	296 (11.65)	251 (9.88)	166 (6.54)	33 (73)	31 (68)
	PN25 to 40	300 (11.81)							39 (86)	37 (81)
	JIS5K	265 (10.43)							33 (73)	31 (68)
	JIS10K	280 (11.02)								
	AS4087 PN16	280 (11.02)								
	AS4087 PN35	305 (11.81)							39 (86)	37 (81)
	ASME B16.5 CL300	320 (12.60)							47 (103)	45 (99)
DN200 (8 in.)	ASME B16.5 CL150	279 (10.98)	350 (13.78)	411 (16.18)	170 (6.69)	336 (13.23)	291 (11.46)	200 (7.87)	33 (73)	31 (68)
	PN10	340 (13.39)							41 (90)	39 (86)
	PN16	340 (13.39)								
	PN25	360 (14.17)							55 (121)	53 (117)
	PN40	375 (14.76)							65 (143)	63 (139)
	AS4087 PN16	335 (13.19)							41 (90)	39 (86)
	AS4087 PN35	370 (14.57)							65 (143)	63 (139)
	JIS5K	320 (12.60)							41 (90)	39 (86)
	JIS10K	330 (12.99)								
	ASME B16.5 CL300	380 (14.96)							72 (158)	70 (154)
DN250 (10 in.)	ASME B16.5 CL150	345 (13.58)	450 (17.72)	426 (16.77)	198 (7.80)	351 (13.82)	306 (12.05)	235 (9.62)	50 (110)	48 (106)
	PN10	395 (15.55)							61 (134)	59 (130)
	PN16	405 (15.94)							65 (143)	63 (139)
	PN25	425 (16.73)							84 (185)	82 (180)
	PN40	450 (17.72)							95 (209)	93 (205)
	AS4087 PN16	405 (15.94)							65 (143)	63 (139)
	AS4087 PN35	430 (16.93)							95 (209)	93 (205)
	JIS5K	385 (15.16)							65 (143)	63 (139)
	JIS10K	400 (15.75)								
	ASME B16.5 CL300	445 (17.52)							105 (231)	103 (227)
DN300 (12 in.)	ASME B16.5 CL150	405 (15.94)	500 (19.69)	449 (17.68)	228 (8.98)	374 (14.72)	329 (12.95)	272 (10.71)	70 (154)	68 (150)
	PN10	445 (17.52)							74 (163)	72 (158)
	PN16	460 (18.11)							80 (176)	78 (172)
	PN25	485 (19.09)							100 (220)	98 (216)
	JIS5K	430 (16.93)							80 (176)	78 (172)
	JIS10K	445 (17.52)								
	AS4087 PN16	455 (17.91)								
	AS4087 PN35	490 (19.29)							130 (286)	128 (282)
	ASME B16.5 CL300	520 (20.47)							150 (330)	148 (326)
	ASME B16.5 CL150	485 (19.09)							105 (231)	103 (227)
DN350 (14 in.)	PN40	515 (20.28)	550 (21.65)	464 (18.27)	265 (10.43)	389 (15.31)	344 (13.54)	322 (12.68)	130 (286)	128 (282)
	PN10	505 (19.88)							95 (209)	93 (205)
	PN16	520 (20.47)							110 (242)	108 (238)
	PN25	555 (21.85)							145 (319)	143 (315)
	JIS5K	480 (18.90)							95 (209)	93 (205)
	JIS10K	490 (19.29)								
	AS4087 PN16	525 (20.67)							130 (286)	128 (282)
	AS4087 PN35	550 (21.65)							185 (407)	183 (403)
	ASME B16.5 CL300	585 (23.03)							140 (308)	138 (304)
	ASME B16.5 CL150	535 (21.06)							105 (231)	103 (227)
DN400 (16 in.)	PN40	580 (22.83)	600 (23.62)	506 (19.92)	265 (10.43)	431 (16.97)	386 (15.20)	322 (12.68)	195 (429)	193 (425)
	PN10	565 (22.24)							103 (227)	101 (222)
	PN16	580 (22.83)							126 (277)	124 (273)
	PN25	620 (24.41)							170 (374)	168 (370)
	JIS5K	540 (21.26)							103 (227)	101 (223)
	JIS10K	560 (22.05)							116 (255)	114 (251)
	AS4087 PN16	580 (22.83)							154 (339)	152 (335)
	AS4087 PN35	610 (24.02)							302 (664)	300 (660)
	ASME B16.5 CL300	650 (25.59)							265 (583)	263 (578)
	ASME B16.5 CL150	600 (23.62)							175 (385)	173 (381)
DN400 (16 in.)	PN40	660 (25.98)	650 (25.59)						258 (568)	256 (564)

DN150 to 400 (6 to 5 in. NB) (FEW) dimensions / weights

Dimensions in mm (in.)

The drawing includes the following dimensions and labels:

- Front View (Left):** Shows a circular flange with a diameter of 201 mm (7.91 in.). The distance from the center to the top of the terminal box is 77.8 mm (3.06 in.). The distance from the center to the bottom of the terminal box is 89 mm (3.5 in.). The distance from the center to the side of the terminal box is 104.5 mm (4.11 in.). The distance from the center to the side of the terminal box is 98 mm (3.86 in.). The distance from the center to the side of the terminal box is 104.5 mm (4.11 in.). The distance from the center to the side of the terminal box is 98 mm (3.86 in.).
- Side View (Right):** Shows the profile of the terminal box with a height of 78 mm (3.1 in.). The distance from the center to the side of the terminal box is 84 mm (3.3 in.).
- Detail View (Bottom):** Shows the terminal box with a diameter of 104 mm (4.1 in.). The distance from the center to the side of the terminal box is 84 mm (3.3 in.).
- Labels:** "Remote transmitter terminal box manufactured before Q3 2014", "Remote transmitter terminal box manufactured after Q3 2014", "External earth (ground) connection", "A", "L (1.0D)", "L (1.3D)", "C", "D", "E", "F", "G".

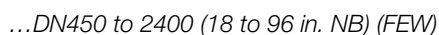
		Dimensions in mm (in.)								Approx. weight in kg (lb)	
DN	Process connection type	D	L (1.0D)	L (1.3D)	F	C	E	G	A	Integral	Remote
DN450 (18 in.)	PN10	615 (24.21)	N/A	600 (23.62)	514 (20.24)	310 (12.20)	439 (17.28)	394 (15.51)	328 (12.91)	173 (381)	171 (377)
	PN16	640 (25.20)								188 (414)	186 (410)
	JIS5K	605 (23.82)								165 (364)	163 (359)
	JIS10K	620 (24.41)								177 (390)	175 (386)
	AS4087 PN16	640 (25.20)								232 (511)	230 (507)
	AS4087 PN35	675 (26.57)								328 (723)	326 (718)
	ASME B16.5 CL300	710 (27.95)								368 (811)	366 (807)
	ASME B16.5 CL150	635 (25.00)	250 (551)	248 (547)							
	PN25	670 (26.38)	N/A	686 (27.01)						245 (540)	243 (536)
PN40	685 (26.97)	315 (694)			313 (690)						
DN500 (20 in.)	PN10	670 (26.38)	N/A	600 (23.62)	514 (20.24)	310 (12.20)	439 (17.28)	394 (15.51)	367 (14.45)	190 (418)	188 (413)
	PN16	715 (28.15)								240 (528)	238 (524)
	JIS5K	655 (25.79)								190 (418)	188 (413)
	JIS10K	675 (26.57)									
	AS4087 PN16	705 (27.76)								290 (638)	288 (634)
	AS4087 PN35	735 (28.94)								435 (957)	433 (953)
	ASME B16.5 CL150	700 (27.56)								300 (660)	298 (656)
	ASME B16.5 CL300	775 (30.51)	N/A	762						490 (1080)	488 (1076)
	PN25	730 (28.74)	N/A	700						300 (661)	298 (657)
	PN40	755 (29.72)	N/A	762						392 (864)	390 (860)
	DN600 (24 in.)	PN10	780 (30.71)	N/A						800 (31.50)	565 (22.24)
PN16		840 (33.07)	318 (700)		316 (695)						
PN25		845 (33.27)	460 (1012)		458 (1008)						
JIS5K		770 (30.31)	275 (605)		273 (600)						
JIS10K		795 (31.30)	306 (673)		304 (668)						
AS4087 PN16		825 (32.48)	382 (840)		380 (835)						
AS4087 PN35		850 (33.46)	452 (994)		450 (990)						
ASME B16.5 CL300		915 (36.02)	550 (1210)		548 (1205)						
ASME B16.5 CL150		815 (32.09)	425 (935)		423 (930)						
PN40		890 (35.04)	N/A	890	600 (1320)	598 (1316)					

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WaterMaster
Electromagnetic flowmeter

DN	Process connection type	Dimensions in mm (in.)								Approx. weight in kg (lb)	
		D	L (1.0D)	L (1.3D)	F	C	E	G	A	Integral	Remote
DN700 (28 in.)	JIS 5K	875 (34.45)	700 (27.56)	910 (35.83)	604 (23.77)	403 (15.87)	528 (20.79)	488 (19.21)	444 (17.48)	216 (475)	214 (471)
	JIS 10K	905 (35.63)								282 (620)	280 (616)
	PN6	860 (33.86)								225 (495)	223 (491)
	PN10	895 (35.24)								303 (667)	301 (662)
	PN16	910 (35.83)								337 (741)	335 (737)
	AWWA C207 CLASS B	927 (36.50)								249 (548)	247 (543)
	AWWA C207 CLASS D	927 (36.50)								280 (616)	278 (612)
	AS4087 PN16	910 (35.83)								359 (790)	357 (785)
	AS2129 TABLE-D	910 (35.83)								263 (579)	261 (574)
	AS2129 TABLE-E	910 (35.83)								337 (741)	335 (737)
	PN25	960 (37.80)								471 (10.36)	469 (1032)
	PN40	995 (39.17)								586 (1289)	584 (1285)
	AWWA C207 CLASS E	927 (36.50)								472 (1038)	470 (1034)
	AWWA C207 CLASS F	1035 (40.75)								715 (1573)	713 (1569)
	AS4087 PN35	935 (36.80)								539 (1186)	537 (1181)
	ASME CL150 SERIES A	925 (36.42)								503 (1107)	501 (1102)
	ASME CL150 SERIES B	835 (32.87)								323 (711)	321 (706)
	ASME CL300 SERIES B	920 (36.22)								631 (1388)	629 (1384)
DN750 (30 in.)	JIS 5K	945 (37.20)	750 (29.52)	990 (38.98)	630 (24.79)	429 (16.89)	554 (21.81)	514 (20.23)	444 (17.48)	251 (552)	249 (548)
	JIS 10K	970 (38.19)								327 (719)	325 (715)
	AWWA C207 CLASS B	984 (38.74)								273 (601)	271 (596)
	AWWA C207 CLASS D	984 (38.74)								344 (757)	342 (752)
	AS4087 PN16	995 (39.17)								467 (1027)	465 (1023)
	AS2129 TABLE-D	995 (39.17)								340 (748)	338 (744)
	AS2129 TABLE-E	995 (39.17)								454 (999)	452 (994)
	AWWA C207 CLASS E	984 (38.74)								496 (1091)	494 (1087)
	AWWA C207 CLASS F	1092 (43.99)								790 (1738)	788 (1734)
	AS4087 PN35	1015 (39.96)								663 (1459)	661 (1454)
	ASME CL150 SERIES A	985 (38.78)								544 (1197)	542 (1192)
	ASME CL150 SERIES B	885 (34.84)								320 (704)	318 (700)
	ASME CL300 SERIES B	990 (38.98)								748 (1646)	746 (1641)
DN800 (32 in.)	JIS 5K	995 (39.17)	800 (31.49)	1040 (40.04)	654 (25.74)	453 (17.83)	578 (22.76)	538 (21.18)	542 (21.34)	280 (616)	278 (612)
	JIS 10K	1020 (40.16)								364 (801)	362 (796)
	PN6	975 (38.39)								294 (647)	292 (642)
	PN10	1015 (39.96)								406 (893)	404 (889)
	PN16	1025 (40.35)								469 (1032)	467 (1027)
	AWWA C207 CLASS B	1060 (41.73)								328 (722)	326 (717)
	AWWA C207 CLASS D	1060 (41.73)								408 (898)	406 (893)
	AS4087 PN16	1060 (41.73)								530 (1166)	528 (1162)
	AS2129 TABLE-D	1060 (41.73)								386 (849)	384 (845)
	AS2129 TABLE-E	1060 (41.73)								519 (1142)	517 (1137)
	PN25	1085 (42.72)								615 (1353)	613 (1349)
	PN40	1140 (44.88)								866 (1905)	864 (1901)
	AWWA C207 CLASS E	1060 (41.73)								634 (1395)	632 (1390)
	AWWA C207 CLASS F	1150 (45.28)								897 (1973)	895 (1969)
	AS4087 PN35	1060 (41.73)								751 (1652)	749 (1648)
	ASME CL150 SERIES A	1060 (41.73)								700 (1540)	698 (1536)
	ASME CL150 SERIES B	940 (37.01)								406 (893)	404 (889)
	ASME CL300 SERIES B	1055 (41.54)								933 (2053)	931 (2048)
DN900 (36 in.)	JIS 5K	1095 (43.11)	900 (35.43)	1170 (46.06)	705 (27.7)	504 (19.84)	629 (24.76)	589 (23.19)	570 (22.44)	369 (812)	367 (807)
	JIS 10K	1120 (44.09)								445 (979)	443 (975)
	PN6	1075 (42.32)								390 (858)	388 (854)
	PN10	1115 (43.90)								502 (1104)	500 (1100)
	PN16	1125 (44.29)								589 (1296)	587 (1291)
	AWWA C207 CLASS B	1168 (45.98)								417 (917)	415 (913)
	AWWA C207 CLASS D	1168 (45.98)								493 (1085)	491 (1080)
	AWWA C207 CLASS E	1168 (45.98)								827 (1819)	825 (1815)
	AWWA C207 CLASS F	1270 (50.00)								1150 (2530)	1148 (2526)
	AS4087 PN16	1175 (46.26)								706 (1553)	704 (1549)
	AS2129 TABLE-D	1175 (46.26)								514 (1131)	512 (1126)
	AS2129 TABLE-E	1175 (46.26)								694 (1527)	692 (1522)
	PN25	1185 (46.65)								819 (1802)	817 (1797)
	PN40	1250 (49.21)								1158 (2548)	1156 (2543)
	AS4087 PN35	1185 (46.65)								1044 (2297)	1042 (2292)
	ASME CL150 SERIES A	1170 (46.06)								961 (2114)	959 (2110)
	ASME CL150 SERIES B	1055 (41.54)								595 (1309)	593 (1305)
	ASME CL300 SERIES B	1170 (46.06)								1147 (2523)	1145 (2519)

DN450 to 2400 (18 to 96 in. NB) (FEW) dimensions / weights (Continued)



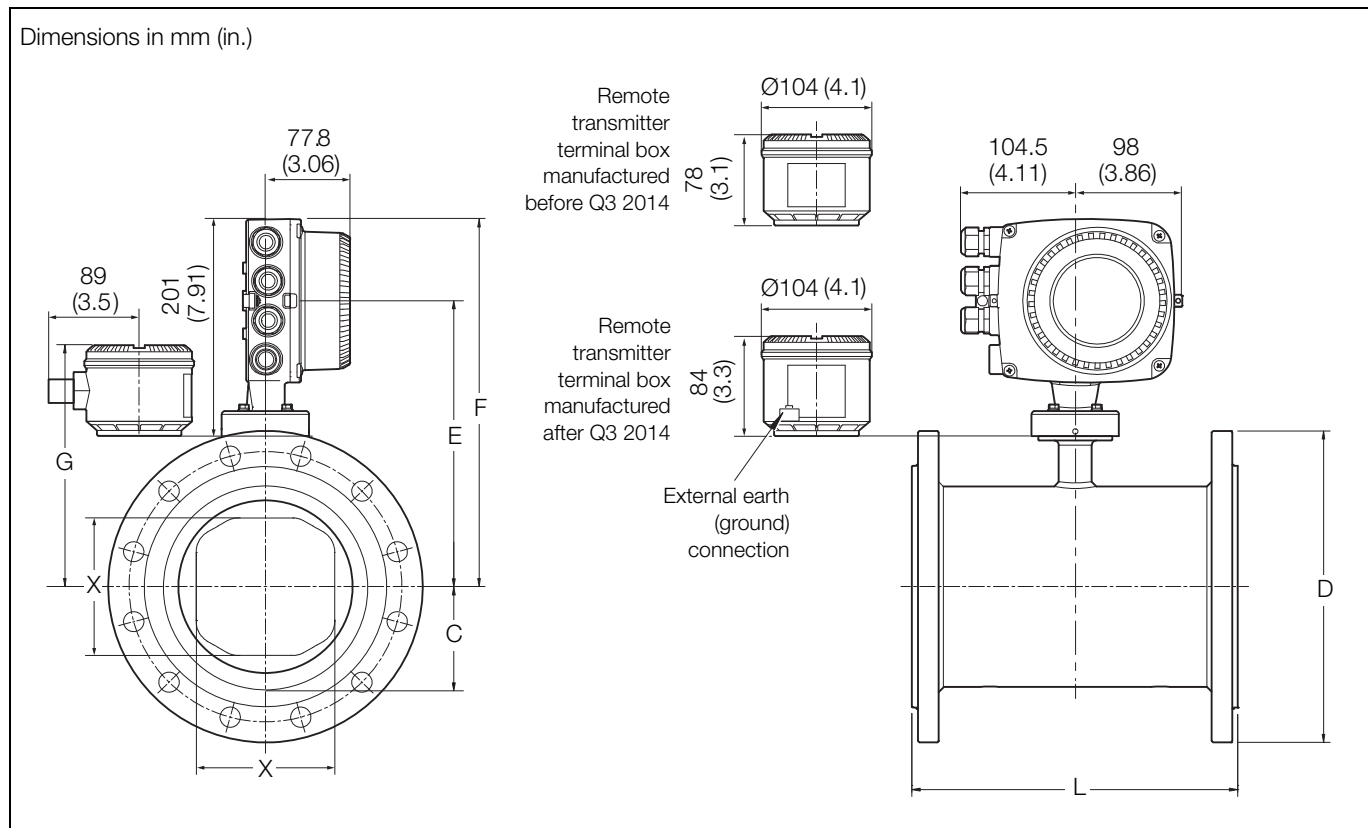
...DN450 to 2400 (18 to 96 in. NB) (FEW) dimensions / weights

DN	Process connection type	Dimensions in mm (in.)								Approx. weight in kg (lb)	
		D	L (1.0D)	L (1.3D)	F	C	E	G	A	Integral	Remote
DN1200 (48 in.)	JIS 5K	1420 (55.91)	1200 (47.24)	1560 (61.42)	860 (33.85)	659 (25.94)	784 (30.87)	744 (29.29)	802 (31.57)	651 (1432)	649 (1428)
	JIS 10K	1465 (57.68)								967 (2127)	965 (2123)
	PN6	1405 (55.31)								710 (1562)	708 (1558)
	PN10	1455 (57.28)								1107 (2435)	1105 (2431)
	PN16	1485 (58.46)								1363 (2999)	1361 (2994)
	AWWA C207 CLASS B	1511 (59.49)								772 (1698)	770 (1694)
	AWWA C207 CLASS D	1511 (59.49)								999 (2198)	997 (2193)
	AWWA C207 CLASS E	1511 (59.49)								1458 (3208)	1456 (3203)
	AWWA C207 CLASS F	1651 (65.00)								2400 (5280)	2398 (5276)
	AS4087 PN16	1490 (58.66)								1253 (2757)	1251 (2752)
	AS2129 TABLE-D	1490 (58.66)								1023 (2251)	1021 (2246)
	AS2129 TABLE-E	1490 (58.66)								1272 (2798)	1270 (2794)
	PN25	1530 (60.24)								1559 (3430)	1557 (3425)
	PN40	1575 (62.01)								2133 (4693)	2131 (4688)
	AS4087 PN35	1530 (60.24)								2115 (4653)	2113 (4649)
	ASME CL150 SERIES A	1510 (59.45)								1707 (3755)	1705 (3751)
	ASME CL300 SERIES A	1465 (57.68)								2163 (4759)	2161 (4754)
	ASME CL150 SERIES B	1390 (54.72)								1085 (2387)	1083 (2383)
	ASME CL300 SERIES B	1510 (59.45)								2352 (5174)	2350 (5170)
DN1350 (54 in.)	AWWA C207 CLASS B	1683 (66.26)	1350 (53.15)	1755 (69.09)	955 (37.59)	754 (29.69)	879 (34.61)	839 (33.03)	902 (35.51)	981 (2158)	979 (2154)
	AWWA C207 CLASS D	1683 (66.26)								1213 (2669)	1211 (2664)
	AWWA C207 CLASS E	1683 (66.26)								1942 (4272)	1940 (4268)
DN1400 (56 in.)	PN6	1630 (64.17)	1400 (55.11)	1820 (71.65)						1085 (2387)	1083 (2383)
	PN10	1675 (65.94)								1731 (3808)	1729 (3804)
	PN16	1685 (66.34)								1770 (3894)	1768 (3890)
	ASME CL150 SERIES B	1600 (62.99)								1593 (3505)	1591 (3500)
	PN25	1755 (69.09)								2368 (5210)	2366 (5205)
	PN40	1795 (70.67)								3086 (6789)	3084 (6785)
	ASME CL150 SERIES A	1745 (68.70)								2556 (5623)	2554 (5619)
	ASME CL300 SERIES A	1710 (67.32)								3376 (7427)	3374 (7423)
	ASME CL300 SERIES B	1765 (69.49)								3758 (8268)	3756 (8263)
DN1500 (60 in.)	JIS 5K	1730 (68.11)	1500 (59.05)	1950 (76.77)	1065 (41.92)	864 (34.02)	989 (38.94)	949 (37.36)	910 (35.83)	1029 (2264)	1027 (2259)
	JIS 10K	1795 (70.67)								1504 (3309)	1502 (3304)
	ASME CL150 SERIES B	1725 (67.91)								2031 (4468)	2029 (4464)
	AWWA C207 CLASS B	1854 (72.99)								1229 (2704)	1227 (2699)
	AWWA C207 CLASS D	1854 (72.99)								1514 (3331)	1512 (3326)
	AWWA C207 CLASS E	1854 (72.99)								2544 (5597)	2542 (5592)
	ASME CL150 SERIES A	1855 (73.03)								3084 (6785)	3082 (6780)
	ASME CL300 SERIES A	1810 (71.26)								3875 (8525)	3873 (8521)
	ASME CL300 SERIES B	1880 (74.02)								4181 (9198)	4179 (9194)
DN1600 (64 in.)	PN6	1830 (72.05)	1600 (62.99)	2080 (81.89)	1066 (41.96)	865 (34.06)	990 (38.98)	950 (37.4)	1000 (39.37)	1434 (3155)	1432 (3150)
	PN10	1915 (75.39)								2525 (5555)	2523 (5551)
	PN25	1975 (77.76)								3201 (7042)	3199 (7038)
	PN16	1930 (75.98)								2768 (6090)	2766 (6085)
	PN40	2025 (79.72)								4375 (9625)	4373 (9621)
DN1650 (66 in.)	AWWA C207 CLASS B	2032 (80.00)	N/A	2145 (84.45)	1116 (43.94)	915 (36.02)	1040 (40.94)	1000 (39.37)	1000 (39.37)	1504 (3309)	1502 (3304)
	AWWA C207 CLASS D	2032 (80.00)								2025 (4455)	2023 (4451)
DN1800 (72 in.)	PN6	2045 (80.51)	N/A	2340 (92.13)	1181 (46.50)	980 (38.58)	1105 (43.50)	1065 (41.93)	1100 (43.31)	1853 (4077)	1851 (4072)
	PN10	2115 (83.27)								3180 (6996)	3178 (6992)
	PN16	2130 (83.86)								3657 (8045)	3655 (8041)
	PN25	2195 (86.42)								4422 (9728)	4420 (9724)
	AWWA C207 CLASS B	2197 (86.50)								1773 (3901)	1771 (3896)
	AWWA C207 CLASS D	2197 (86.50)								2387 (5251)	2385 (5247)
DN1950 (78 in.)	AWWA C207 CLASS B	2362 (92.99)	N/A	2535 (99.80)	1291 (50.81)	1090 (42.91)	1215 (47.83)	1175 (46.26)	1180 (46.46)	2309 (5080)	2307 (5075)
	AWWA C207 CLASS D	2362 (92.99)								3037 (6681)	3035 (6677)
DN2000 (80 in.)	PN6	2265 (89.17)	N/A	2600 (102.36)						2581 (5678)	2579 (5674)
	PN10	2325 (91.54)								4254 (9359)	4252 (9354)
	PN16	2345 (92.32)								4556	4554
	PN25	2425 (95.47)								5896	5894
DN2100 (84 in.)	AWWA C207 CLASS B	2534 (99.76)	N/A	2730 (107.48)	1395 (54.91)	1194 (47.01)	1319 (51.93)	1279 (50.35)	1180 (46.46)	2641 (5810)	2639 (5806)
	AWWA C207 CLASS D	2534 (99.76)								3487 (7671)	3485 (7667)
DN2200 (88 in.)	PN6	2475 (97.44)	N/A	2860 (112.60)					1330 (52.36)	3363 (7399)	3361 (7394)
	PN10	2550 (100.39)								5795	5793
DN2400 (96 in.)	PN6	2685 (105.71)	N/A	3120 (122.83)	1495 (58.85)	1294 (50.94)	1419 (55.87)	1379 (54.29)	1450 (57.09)	4100 (9020)	4098 (9016)
	PN10	2760 (108.66)								6968	6966

...DN450 to 2400 (18 to 96 in. NB) (FEW) dimensions / weights (Continued)

WaterMaster
Electromagnetic flowmeter

FEV – DN40 to 200 (1½ to 8 in. NB)



DN40 to 200 (1½ to 8 in. NB) (FEV)

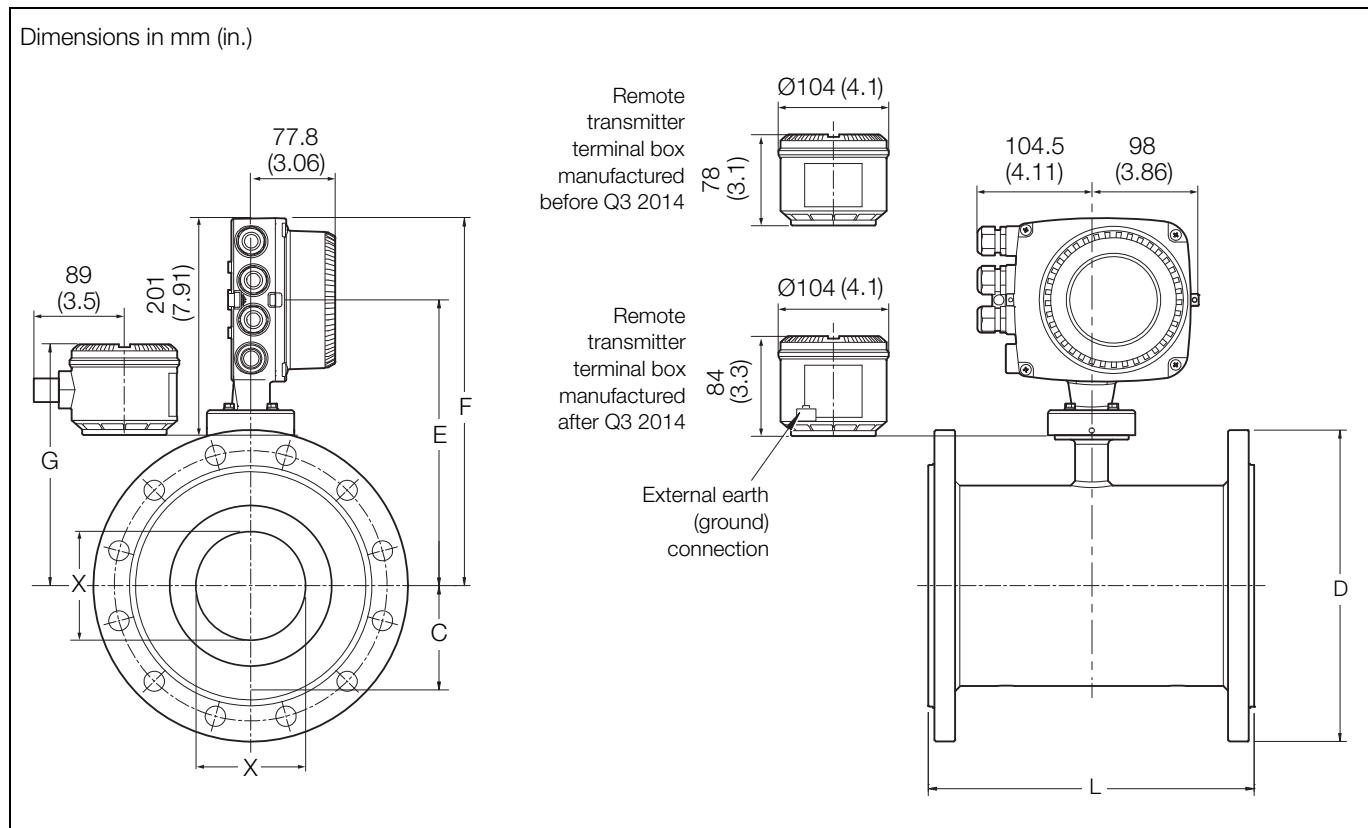
DN	Process connection type	Dimensions in mm (in.)						Approx. weight in kg (lb)	
		D	L	F	E	G	X	Integral	Remote
DN40 (1½ in.)	EN1092-1 PN10, 16, 25, 40	150 (5.91)	200 (7.87)	260 (10.24)	185 (7.28)	137 (5.39)	30 (1.18)	12.8 (28.16)	11.8 (25.96)
	ASME B16.5 CLASS 150								
	AS2129 TABLE D, E, F								
DN50 (2 in.)	EN1092-1 PN10, 16, 25, 40	165 (6.50)	200 (7.87)	261 (10.28)	186 (7.32)	138 (5.43)	38 (1.5)	13.75 (30.25)	12.75 (28.05)
	ASME B16.5 CLASS 150								
	AS2129 TABLE D, E, F								
DN80 (3 in.)	EN1092-1 PN10, 16, 25, 40	200 (7.87)	200 (7.87)	280 (11.04)	205.5 (8.09)	157.5 (6.2)	61 (2.4)	17.2 (37.84)	16.2 (35.64)
	ASME B16.5 CLASS 150								
	AS4087 PN16, 21								
DN100 (4 in.)	EN1092-1 PN10, 16, 25, 40	225 (8.86)	250 (9.84)	300.5 (11.83)	225.5 (8.88)	177.5 (6.98)	70 (2.76)	19.3 (42.5)	18.3 (40.3)
	ASME B16.5 CLASS 150								
	AS4087 PN16								
DN150 (6 in.)	EN1092-1 PN10, 16, 25, 40	300 (11.81)	300 (11.81)	333.5 (13.13)	258.5 (10.18)	210.5 (8.29)	103 (4.06)	35.1 (77.2)	34.1 (75)
	ASME B16.5 CLASS 150								
	AS4087 PN16								
DN200 (8 in.)	EN1092-1 PN10, 16	375 (11.76)	350 (13.78)	358.7 (14.12)	283.7 (11.17)	235.7 (9.28)	150 (5.91)	67 (147.4)	66 (145.2)
	ASME B16.5 CLASS 150								
	AS2129 TABLE C, D, E, F								
	AS4087 PN14, 16, 21								

WaterMaster integral / remote FEV – DN40 to 200 (1½ to 8 in.) cast iron sensor dimensions / weights

DN	Process connection type	Dimensions in mm (in.)							Approx. weight in kg (lb)	
		D	L	F	C	E	G	X	Integral	Remote
DN40 (1½ in.)	EN1092-1 PN10, PN40	150 (5.91)	200 (7.87)	260 (10.24)	30.4 (1.20)	185 (7.28)	138 (5.43)	30 (1.18)	12 (27)	11 (24)
	ASME B16.5 CLASS 150	127 (5.00)								
	JIS 10K	140 (5.51)								
	AS2129 TABLE F	140 (5.51)								
	AS2129 TABLE C D E	135 (5.31)								
	AS4087 PN14	135 (5.31)								
DN50 (2 in.)	EN1092-1 PN10, PN16	165 (6.50)	200 (7.87)	270 (10.63)	38.3 (1.51)	195 (7.68)	146 (5.75)	38 (1.50)	13 (29)	12 (27)
	ASME B16.5 CLASS 150	152.4 (6.00)								
	JIS 10K	155 (6.10)								
	AS4087 PN21	165 (6.50)								
	AS2129 TABLE F	165 (6.50)								
	AS2129 TABLE C D E	150 (5.91)								
	AS4087 PN14, PN16	150 (5.91)								
DN65 (2½ in.)	AS4087 PN14, PN16	165 (6.50)	200 (7.87)	275 (10.83)	45.2 (1.78)	200 (7.87)	152 (5.98)	48 (1.89)	15 (33)	14 (31)
	AS2129 TABLE C D E	165 (6.50)								
	EN1092-1 PN10	185 (7.28)								
	EN1092-1 PN16	185 (7.28)								
DN80 (3 in.)	EN1092-1 PN10, PN16	200 (7.87)	200 (7.87)	280 (11.02)	51.5 (2.03)	205 (8.07)	156 (6.14)	61 (2.40)	16 (36)	15 (33)
	ASME B16.5 CLASS 150	190 (7.48)								
	JIS 7.5K	211 (8.31)								
	JIS 10K	185 (7.28)								
	AS2129 TABLE C D E	185 (7.28)								
	AS4087 PN14, PN16	185 (7.28)								
	AS2129 TABLE F	205 (8.07)								
	AS4087 PN21	205 (8.07)								
DN100 (4 in.)	EN1092-1 PN10, PN16	220 (8.66)	250 (9.84)	320 (12.60)	63.75 (2.51)	245 (9.65)	196.8 (7.75)	70 (2.76)	19 (42)	18 (40)
	ASME B16.5 CLASS 150	228.6 (9.00)								
	JIS 7.5K	238 (9.37)								
	JIS 10K	210 (8.27)								
	AS2129 TABLE C D	215 (8.46)								
	AS4087 PN14, PN16	215 (8.46)								
	AS2129 TABLE E	215 (8.46)								
	AS4087 PN21	230 (9.06)								
	AS2129 TABLE F	230 (9.06)								
DN125 (5 in.)	EN1092-1 PN10, PN16	250 (9.84)	250 (9.84)	320 (12.60)	63.75 (2.51)	245 (9.65)	197 (7.76)	70 (2.76)	20 (44)	19 (42)
	ASME B16.5 CLASS 150	254 (10.00)								
	JIS 10K	250 (9.84)								
	AS2129 TABLE C D E	255 (10.04)								
	AS2129 TABLE F	280 (11.02)								
DN150 (6 in.)	EN1092 PN10, PN16	285 (11.22)	300 (11.81)	340 (13.39)	84.4 (3.32)	265 (10.43)	217 (8.54)	103 (4.06)	32 (70)	31 (68)
	ASME B16.5 CLASS 150	279 (10.98)								
	JIS 7.5k	290 (11.42)								
	JIS 10K	280 (11.02)								
	AS2129 TABLE C D	280 (11.02)								
	AS4087 PN14, PN16	280 (11.02)								
	AS2129 TABLE E	280 (11.02)								
	AS2129 TABLE F	305 (12.01)								
	AS4087 PN21	305 (12.01)								
DN200 (8 in.)	EN1092-1 PN10	340 (13.39)	350 (13.78)	365 (14.37)	109.8 (4.32)	290 (11.42)	243 (9.57)	150 (5.91)	49 (108)	48 (105)
	EN1092-1 PN16	340 (13.39)								
	ASME B16.5 CLASS 150	345 (13.58)								
	JIS 7.5K	342 (13.46)								
	JIS 10K	330 (12.99)								
	AS2129 TABLE C D	335 (13.19)								
	AS4087 PN14, PN 16	335 (13.19)								
	AS2129 TABLE E	335 (13.19)								
	AS2129 TABLE F	370 (14.57)								
	AS4087 PN21	370 (14.57)								

DN40 to 200 (1½ to 8 in. NB) (FEV) dimensions / weights

FER – DN40 to 300 (1½ to 12 in. NB)



DN40 to 300 (1½ to 12 in. NB) (FER)

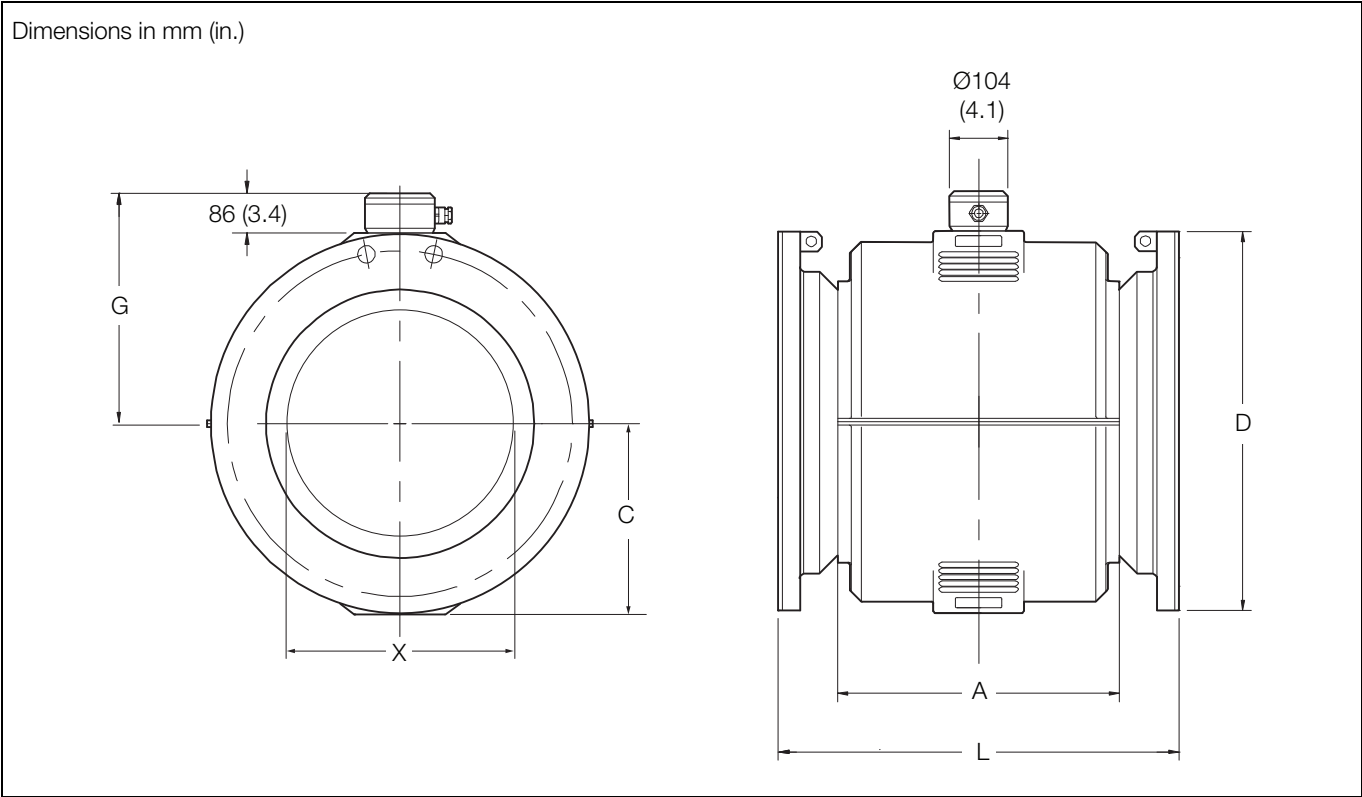
DN	Process connection type	Dimensions in mm (in.)						Approx. weight in kg (lb)	
		D	L	F	E	G	X	Integral	Remote
DN40 (1½ in.)	EN1092-1 PN10, 16, 25, 40	150 (5.91)	200 (7.87)	260 (10.24)	185 (7.28)	137 (5.39)	23.5 (0.93)	13.4 (29.5)	12.4 (27.3)
	ASME B16.5 CLASS 150								
	AS2129 TABLE D, E, F								
DN50 (2 in.)	EN1092-1 PN10, 16, 25, 40	165 (6.50)	200 (7.87)	261 (10.28)	186 (7.32)	138 (5.43)	29 (1.14)	14.75 (32.45)	13.75 (30.25)
	ASME B16.5 CLASS 150								
	AS2129 TABLE D, E, F								
DN80 (3 in.)	EN1092-1 PN10, 16, 25, 40	200 (7.87)	200 (7.87)	280 (11.04)	205.5 (8.09)	157.5 (6.2)	47 (1.85)	21.2 (46.64)	20.2 (44.4)
	ASME B16.5 CLASS 150								
	AS4087 PN16, 21								
DN100 (4 in.)	EN1092-1 PN10, 16, 25, 40	225 (8.86)	250 (9.84)	300.5 (11.83)	225.5 (8.88)	177.5 (6.98)	64 (2.52)	27.3 (60)	26.3 (58)
	ASME B16.5 CLASS 150								
	AS4087 PN16								
DN150 (6 in.)	EN1092-1 PN10, 16, 25, 40	300 (11.81)	300 (11.81)	333.5 (13.13)	258.5 (10.18)	210.5 (8.29)	100.2 (3.94)	27.3 (60)	26.3 (58)
	ASME B16.5 CLASS 150								
	AS4087 PN16								
DN200 (8 in.)	EN1092-1 PN10, 16	375 (11.76)	350 (13.78)	358.7 (14.12)	283.7 (11.17)	235.7 (9.28)	126.7 (5.00)	68 (150)	67 (147.4)
	ASME B16.5 CLASS 150								
	AS2129 TABLE C, D, E, F								
	AS4087 PN14, 16, 21								

DN40 to 200 (1½ to 8 in.) (FER) cast iron sensor dimensions / weights

DN	Process connection type	Dimensions in mm (in.)							Approx. weight in kg (lb)	
		D	L	F	C	E	G	X	Integral	Remote
DN40 (1½ in.)	EN1092-1 PN10, 16, 25, 40	150 (5.91)	200 (7.87)	260 (10.24)	30.4 (1.20)	185 (7.28)	138 (5.43)	23.5 (0.93)	13 (29)	11 (24)
	ASME B16.5 CLASS 150	127 (5.00)								
	JIS 10K	140 (5.51)								
	AS2129 TABLE C D E	135 (5.31)								
	AS2129 TABLE F	140 (5.51)								
	AS4087 PN14	135 (5.31)								
DN50 (2 in.)	EN1092-1 PN10, 16, 25, 40	165 (6.50)	200 (7.87)	270 (10.63)	38.3 (1.51)	195 (7.68)	146 (5.75)	29 (1.14)	14 (31)	12 (27)
	ASME B16.5 CLASS 150	152.4 (6.00)								
	JIS 10K	155 (6.10)								
	AS4087 PN21	165 (6.50)								
	AS2129 TABLE F	165 (6.50)								
	AS2129 TABLE C D E	150 (5.91)								
	AS4087 PN14, PN16	150 (5.91)								
DN65 (2½ in.)	EN1092-1 PN10, 16, 25, 40	185 (7.28)	200 (7.87)	275 (10.83)	45.2 (1.78)	200 (7.87)	152 (5.98)	37 (1.46)	15 (33)	13 (29)
	ASME B16.5 CLASS 150	178 (7.00)								
	JIS 10K	175 (6.89)								
	AS2129 TABLE C D E	165 (6.50)								
	AS2129 TABLE F	185 (7.28)								
	AS4087 PN14, 16	165 (6.50)								
	AS4087 PN21	185 (7.28)								
DN80 (3 in.)	EN1092-1 PN10, 16, 25, 40	200 (7.87)	200 (7.87)	280 (11.02)	51.5 (2.03)	205 (8.07)	156 (6.14)	47 (1.85)	20 (44)	18 (40)
	ASME B16.5 CLASS 150	190 (7.48)								
	JIS 10K	185 (7.28)								
	AS2129 TABLE C D E	185 (7.28)								
	AS4087 PN14, 16	185 (7.28)								
	AS2129 TABLE F	205 (8.07)								
	AS4087 PN21	205 (8.07)								
DN100 (4 in.)	EN1092-1 PN10, 16	220 (8.66)	250 (9.84)	320 (12.60)	63.75 (2.51)	245 (9.65)	196.8 (7.75)	64 (2.52)	27 (59)	25 (55)
	EN1092-1 PN25, 40	235 (9.25)								
	ASME B16.5 CLASS 150	228.6 (9.00)								
	JIS 7.5K	238 (9.37)								
	JIS 10K	210 (8.27)								
	AS2129 TABLE C D	215 (8.46)								
	AS4087 PN14, 16	215 (8.46)								
	AS4087 PN21	230 (9.06)								
DN125 (5 in.)	EN1092-1 PN10, 16	250 (9.84)	250 (9.84)	320 (12.60)	63.75 (2.51)	245 (9.65)	197 (7.76)	64 (2.52)	27 (59)	25 (55)
	EN1092-1 PN25, 40	270 (10.63)								
	ASME B16.5 CLASS 150	254 (10.00)								
	JIS 10K	250 (9.84)								
	AS2129 TABLE C D	255 (10.04)								
DN150 (6 in.)	EN1092 PN10, 16	285 (11.22)	300 (11.81)	340 (13.39)	84.4 (3.32)	265 (10.43)	217 (8.54)	100.2 (3.94)	33 (72)	31 (68)
	EN1092 PN25, 40	300 (11.81)								
	ASME B16.5 CLASS 150	279 (10.98)								
	JIS 7.5k	290 (11.42)								
	JIS 10K	280 (11.02)								
	AS2129 TABLE C D	280 (11.02)								
	AS4087 PN14, 16	280 (11.02)								
	AS4087 PN21	305 (12.01)								
DN200 (8 in.)	EN1092-1 PN10, 16	340 (13.39)	350 (13.78)	365 (14.37)	109.8 (4.32)	290 (11.42)	243 (9.57)	126.7 (4.99)	50 (110)	48 (106)
	EN1092-1 PN25, 40	360 (14.17)								
	ASME B16.5 CLASS 150	345 (13.58)								
	JIS 7.5K	342 (13.46)								
	JIS 10K	330 (12.99)								
	AS2129 TABLE C D	335 (13.19)								
	AS4087 PN14, 16	335 (13.19)								
	AS4087 PN21	370 (14.57)								
DN250 (10 in.)	EN1092-1 PN10	395 (15.55)	450 (17.72)	389 (15.31)	136.8 (5.39)	313 (12.33)	268 (10.55)	153.5 (6.04)	77 (169)	75 (165)
	EN1092-1 PN16	405 (15.94)								
	EN1092-1 PN25	425 (16.73)								
	ASME B16.5 CLASS 150	405 (15.94)								
	JIS 7.5K	400 (15.75)								
	JIS 10K	400 (15.75)								
	AS2129 TABLE C D	405 (15.94)								
	AS4087 PN14, 16	405 (15.94)								
	AS4087 PN21	430 (16.93)								
DN300 (12 in.)	EN1092-1 PN10	445 (17.52)	500 (19.69)	414 (16.30)	162.2 (6.39)	338.6 (13.33)	294 (11.57)	203.5 (8.01)	114 (251)	112 (247)
	EN1092-1 PN16	460 (18.11)								
	EN1092-1 PN25	485 (19.09)								
	ASME B16.5 CLASS 150	485 (19.09)								
	JIS 10K	445 (17.52)								
	AS2129 TABLE C D	455 (17.91)								
	AS4087 PN14, 16	455 (17.91)								
	AS4087 PN21	490 (19.29)								

DN40 to 300 (1½ to 12 in. NB) (FER) dimensions / weights

FER – DN350 to 600 (14 to 24 in. NB) remote sensor



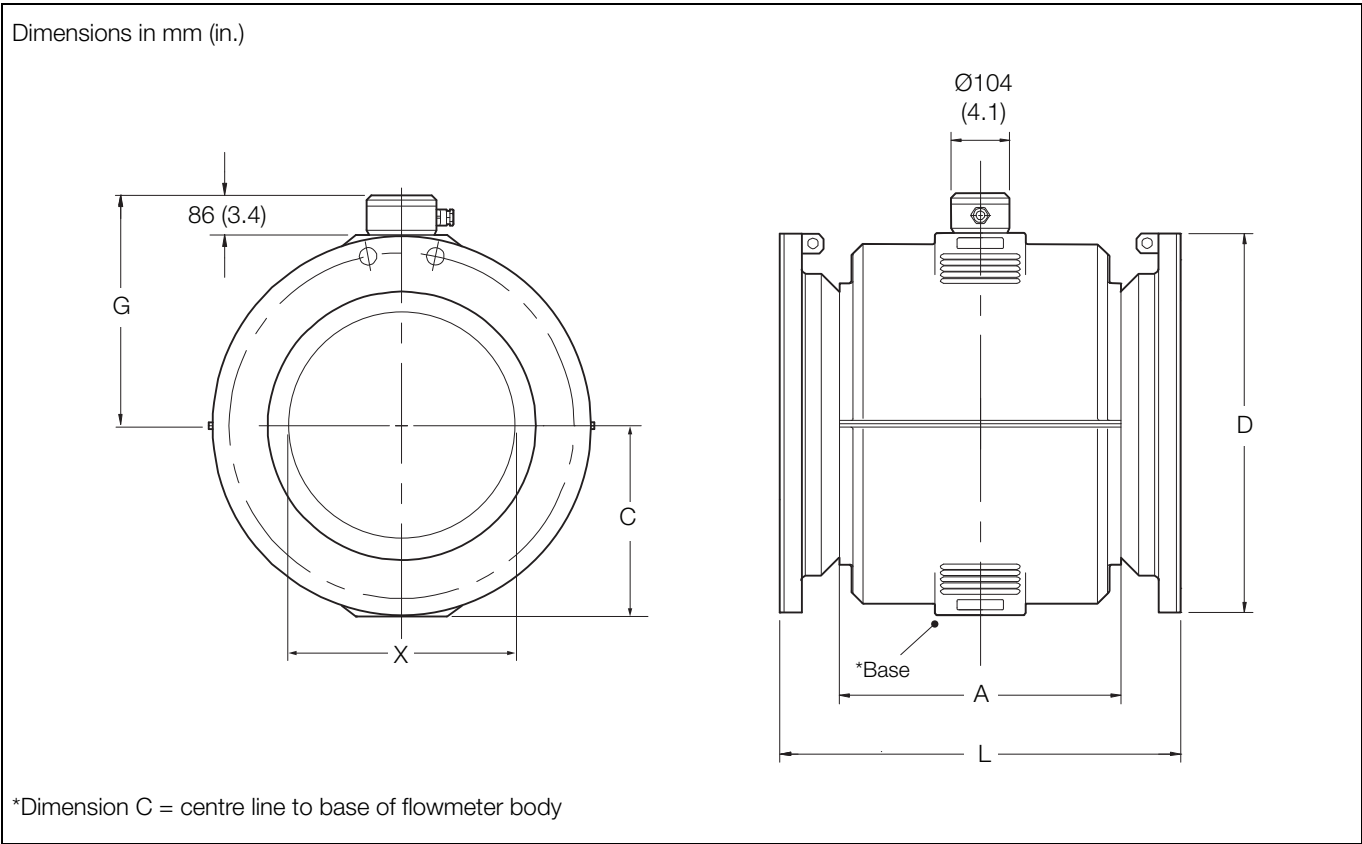
DN350 to 600 (14 to 24 in. NB) (FER) remote sensor

DN	Process connection type	Dimensions in mm (in.)								Approx. weight in kg (lb)
		D	L	F	C	E	G	A	X	Remote
DN350 (14 in.)	EN1092-1 PN10	505 (19.88)	550 (21.65)	472 (18.58)	231 (9.09)	402 (15.83)	325 (12.80)	376 (14.80)	293 (11.53)	100 (220)
	EN1092-1 PN16	520 (20.47)								
	EN1092-1 PN25	555 (21.85)								
	EN1092-1 PN40	580 (22.83)								
	JIS 5K	480 (18.90)								
	JIS 10K	490 (19.29)								
	AS2129 TABLE C D E	525 (20.67)								
	AS2129 TABLE F	550 (21.65)								
	AS4087 PN14, PN16	525 (20.67)								
	AS4087 PN21	550 (21.65)								
DN400 (16 in.)	EN1092-1 PN10	565 (22.24)	600 (23.62)	502 (19.76)	257.5 (10.14)	432 (17.01)	355 (13.98)	420 (16.54)	343 (13.50)	115 (253)
	EN1092-1 PN16	580 (22.83)								
	EN1092-1 PN25	620 (24.41)								
	EN1092-1 PN40	660 (25.98)								
	JIS 5K	540 (21.26)								
	JIS 10K	560 (22.05)								
	AS2129 TABLE C D E	580 (22.83)								
	AS2129 TABLE F	610 (24.02)								
	AS4087 PN14, PN16	580 (22.83)								
	AS4087 PN21	610 (24.02)								
DN450 (18 in.)	EN1092-1 PN10	615 (24.21)	700 (27.56)	537 (21.14)	285 (11.22)	467 (18.39)	390 (15.35)	480 (18.90)	394 (15.52)	160 (352)
	EN1092-1 PN16	640 (25.20)								
	EN1092-1 PN25	670 (26.38)								
	EN1092-1 PN40	685 (26.97)								
	JIS 5K	605 (23.82)								
	JIS 10K	620 (24.41)								
	AS2129 TABLE C D E	640 (25.20)								
	AS2129 TABLE F	675 (26.57)								
	AS4087 PN14, PN16	640 (25.20)								
	AS4087 PN21	675 (26.57)								
DN500 (20 in.)	EN1092-1 PN10	670 (26.38)	770 (30.31)	557 (21.93)	317.5 (12.50)	487 (19.17)	410 (16.14)	520 (20.47)	443 (17.44)	217 (477)
	EN1092-1 PN16	715 (28.15)								
	EN1092-1 PN25	730 (28.74)								
	EN1092-1 PN40	755 (29.72)								
	JIS 5K	655 (25.79)								
	JIS 10K	675 (26.57)								
	AS2129 TABLE C D E	705 (27.76)								
	AS2129 TABLE F	735 (28.94)								
	AS4087 PN14, PN16	705 (27.76)								
	AS4087 PN21	735 (28.94)								
DN600 (24 in.)	EN1092-1 PN10	780 (30.71)	920 (36.22)	602 (23.70)	345 (13.58)	532 (20.94)	455 (17.91)	610 (24.02)	494 (19.45)	315 (693)
	EN1092-1 PN16	840 (33.07)								
	EN1092-1 PN25	845 (33.27)								
	EN1092-1 PN40	890 (35.04)								
	JIS 5K	770 (30.31)								
	JIS 10K	795 (31.30)								
	AS2129 TABLE C D E	825 (32.48)								
	AS2129 TABLE F	850 (33.46)								
	AS4087 PN14, PN16	825 (32.48)								
	AS4087 PN21	850 (33.46)								

DN350 to 600 (14 to 24 in. NB) (FER) remote sensor dimensions / weights

WaterMaster
Electromagnetic flowmeter

FEF – DN250 to 600 (10 to 24 in. NB)

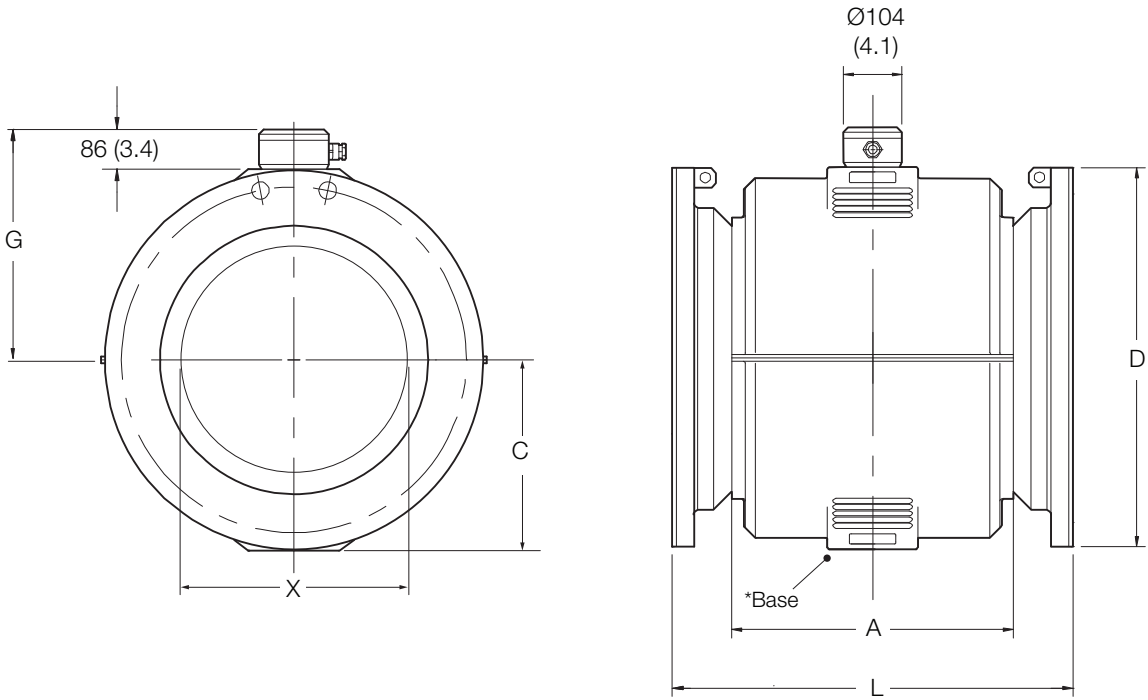


DN250 to 600 (10 to 24 in. NB) (FEF)

		Dimensions in mm (in.)							
DN	Process connection type	D	L	C	G	A	X	Approx. weight in kg (lb)	
DN250 (10 in.)	ASME B16.5 CLASS 150	405 (15.94)	450 (17.72)	215 (8.46)	301 (11.85)	300 (11.81)	250 (9.84)	88 (194)	
	ASME B16.5 CLASS 300	445 (17.52)	490 (19.29)						
	EN1092 -1 PN10	395 (15.55)	450 (17.72)						
	EN1092 – 1 PN16	405 (15.94)	450 (17.72)						
	EN1092 – 1 PN25	425 (16.73)							
	EN1092 – 1 PN40	450 (17.72)							
	JIS 5K	385 (15.16)							
	JIS 10K	400 (15.75)							
	AS4087 PN14, PN16	405 (15.94)							
	AS2129 TABLE C D	430 (16.93)							
	AS2129 TABLE E								
	AS4087 PN21								
	AS2129 TABLE F								
DN300 (12 in.)	ASME B16.5 CLASS 150	485 (19.09)		500 (19.69)	231 (9.09)	317 (12.48)	352 (13.86)	300 (11.81)	128 (282)
	ASME B16.5 CLASS 300	520 (20.47)		540 (21.26)					
	EN1092 – 1 PN10	445 (17.52)	500 (19.69)						
	EN1092 – 1 PN16	460 (18.11)	500 (19.69)						
	EN1092 – 1 PN25	485 (19.09)	540 (21.26)						
	EN1092 – 1 PN40	515 (20.28)	540 (21.26)						
	JIS 5K	430 (16.93)	500 (19.69)						
	JIS 10K	445 (17.52)	500 (19.69)						
	AS4087 PN14, PN16	455 (17.91)	500 (19.69)						
	AS2129 TABLE TABLE C D	455 (17.91)	500 (19.69)						
	AS2129 TABLE E	455 (17.91)	500 (19.69)						
	AS4087 PN21	490 (19.29)	500 (19.69)						
	AS2129 TABLE F	490 (19.29)	500 (19.69)						
DN350 (14 in.)	ASME B16.5 CLASS 150	535 (21.06)	550 (21.65)	257.5 (10.14)	346 (13.62)	376 (14.80)	350 (13.78)	100 (220)	
	ASME B16.5 CLASS 300	585 (23.03)	570 (22.44)						
	EN1092 – 1 PN10	505 (19.88)	550 (21.65)						
	EN1092 – 1 PN16	520 (20.47)	550 (21.65)						
	EN1092 – 1 PN25	555 (21.85)	570 (22.44)						
	EN1092 – 1 PN40	580 (22.83)	570 (22.44)						
	JIS 5K	480 (18.90)	550 (21.65)						
	JIS 7.5K	530 (20.87)	550 (21.65)						
	JIS 10K	490 (19.29)	550 (21.65)						
	AS4087 PN14, PN16	525 (20.67)	550 (21.65)						
	AS2129 TABLE C D E	525 (20.67)	550 (21.65)						
	AS4087 PN21	550 (21.65)	550 (21.65)						
	AS2129 TABLE F	550 (21.65)	550 (21.65)						
	AS4087 PN35	550 (21.65)	570 (22.44)						
	AS2129 TABLE H	550 (21.65)	570 (22.44)						
DN375 (15 in.)	AS4087 PN14, PN16	550 (21.65)	550 (21.65)	257.5 (10.14)	346 (13.62)	376 (14.80)	350 (13.78)	115 (253)	
	AS2129 TABLE C	550 (21.65)	550 (21.65)						
	AS4087 PN35	580 (22.83)	570 (22.44)						
DN400 (16 in.)	ASME B16.5 CLASS 150	600 (23.62)	600 (23.62)	285 (11.22)	371 (14.61)	420 (16.54)	400 (15.75)	115 (253)	
	ASME B16.5 CLASS 300	650 (25.59)	620 (24.41)						
	EN1092 – 1 PN10	565 (22.24)	600 (23.62)						
	EN1092 – 1 PN16	580 (22.83)	600 (23.62)						
	EN1092 – 1 PN25	620 (24.41)	620 (24.41)						
	EN1092 – 1 PN40	660 (25.98)	620 (24.41)						
	JIS 5K	540 (21.26)	600 (23.62)						
	JIS 7.5K	582 (22.91)	600 (23.62)						
	JIS 10K	560 (22.05)	600 (23.62)						
	AS4087 PN14, PN16	580 (22.83)	600 (23.62)						
	AS2129 TABLE C D E	580 (22.83)	600 (23.62)						
	AS4087 PN21	610 (24.02)	600 (23.62)						
	AS2129 TABLE F	610 (24.02)	600 (23.62)						
	AS4087 PN35	610 (24.02)	620 (24.41)						
	AS2129 TABLE H	610 (24.02)	620 (24.41)						

DN250 to 600 (10 to 24 in. NB) (FEF) dimensions / weights

Dimensions in mm (in.)



*Dimension C = centre line to base of flowmeter body

...DN250 to 600 (10 to 24 in. NB) (FEF)

		Dimensions in mm (in.)					X	Approx. weight in kg (lb)
DN	Process connection type	D	L	C	G	A		
DN450 (18 in.)	ASME B16.5 CLASS 150	635 (25.00)	700 (27.56)	317.5 (12.50)	402 (15.83)	480 (18.90)	450 (17.72)	160 (352)
	ASME B16.5 CLASS 300	710 (27.95)						
	EN1092 – 1 PN10	615 (24.21)						
	EN1092 – 1 PN16	640 (25.20)						
	EN1092 – 1 PN25	670 (26.38)						
	EN1092 – 1 PN40	685 (26.97)						
	JIS 5K	605 (23.82)						
	JIS 7.5K	652 (25.67)						
	JIS 10K	620 (24.41)						
	AS4087 PN14, PN16	640 (25.20)						
	AS2129 TABLE C D	640 (25.20)						
	AS2129 TABLE E	640 (25.20)						
	AS4087 PN21	675 (26.57)						
	AS2129 TABLE F	675 (26.57)						
	AS4087 PN35	675 (26.57)						
	AS2129 TABLE H	675 (26.57)						
DN500 (20 in.)	ASME B16.5 CLASS 150	700 (27.56)	770 (30.31)	345 (13.58)	429 (16.89)	520 (20.47)	500 (19.69)	217 (455)
	ASME B16.5 CLASS 300	775 (30.51)						
	EN1092 – 1 PN10	670 (26.38)						
	EN1092 – 1 PN16	715 (28.15)						
	EN1092 – 1 PN25	730 (28.74)						
	EN1092 – 1 PN40	755 (29.72)						
	JIS 5K	655 (25.79)						
	JIS 7.5K	706 (27.80)						
	JIS 10K	675 (26.57)						
	AS4087 PN 14, PN16	705 (27.76)						
	AS2129 TABLE C D E	705 (27.76)						
	AS4087 PN21	735 (28.94)						
	AS2129 TABLE F	735 (28.94)						
	AS4087 PN35	735 (28.94)						
	AS2129 TABLE H	735 (28.94)						
DN600 (24 in.)	ASME B16.5 CLASS 150	815 (32.09)	920 (36.22)	387.5 (15.25)	472 (18.58)	610 (24.02)	600 (23.62)	315 (693)
	ASME B16.5 CLASS 300	915 (36.02)						
	EN1092 – 1 PN10	780 (30.71)						
	EN1092 – 1 PN16	840 (33.07)						
	EN1092 – 1 PN25	845 (33.27)						
	EN1092 – 1 PN40	890 (35.04)						
	JIS 5K	770 (30.31)						
	JIS 7.5K	810 (31.89)						
	JIS 10K	795 (31.30)						
	AS4087 PN14, PN16	825 (32.48)						
	AS2129 TABLE C D	825 (32.48)						
	AS2129 TABLE E	825 (32.48)						
	AS4087 PN21	850 (33.46)						
	AS2129 TABLE F	850 (33.46)						
	AS4087 PN35	850 (33.46)						
	AS2129 TABLE H	850 (33.46)						

...DN250 to 600 (10 to 24 in. NB) (FEF) dimensions / weights

WaterMaster
Electromagnetic flowmeter

Ordering information

Electromagnetic flowmeter WaterMaster – FEW11, FEW12 and FEW18

Product coding field number										1 ... 5	6	7 ... 9	10	11	12	13	14, 15	16	17	18	19	20	21	22	23	24	25	26	27	Options										
Flowmeter system – full bore, integral mount (DN10 to DN32 only)											FEW11																													
Flowmeter system – full bore, remote mount											FEW12					X	XXX	X	X	X	X	XX	X	X	X	X	X	X	X	X	X	X	X							
Full bore sensor only – for use with WaterMaster transmitter / remote											FEW18																													
Design																																								
Non-hazardous areas											1																													
Hazardous areas											5																													
Bore diameter																																								
DN10 (3/8 in.)																																								
DN15 (1/2 in.)																																								
DN20 (3/4 in.)																																								
DN25 (1 in.)																																								
DN32 (1 1/4 in.)																																								
Liner material																																								
PTFE – DN10 to 32 (3/8 to 1 1/4 in. NB)																A																								
Electrode design																																								
Standard																																								
Other																																								
Measuring electrodes material																																								
Hastelloy® C-4 (2.4610)																					D																			
Grounding accessories																																								
Not required																																								
One potential equalizing ring (stainless steel)																																								
Two potential equalizing rings (stainless steel)																																								
Other																																								
Process connection type (refer to pages 21 and 20)																																								
ASME B16.5 B class 150																																								
ASME B16.5 B class 300																																								
ISO / EN PN40																																								
DIN PN40																																								
Other																																								
Process connection material																																								
Carbon steel flanges – DN20 to 32 (3/4 to 1 1/4 in. NB)																																								
Stainless steel flange 1.4571 (316 Ti) – DN10 to 15 (3/8 to 1/2 in. NB)																																								
Other																																								
Usage certifications																																								
Standard (without PED)																																								
Other																																								
Calibration type																																								
Class 2 calibration – standard accuracy 0.4 %																																								
Class 1 calibration – high accuracy 0.2 %																																								
Extended range, class 1 calibration – high accuracy 0.2 %																																								
Extended range, class 2 calibration – standard accuracy 0.4 %																																								
Temperature range installation / ambient temperature range																																								
Standard design / –20 ... 60 °C (–4 ... 140 °F)																																								
Nameplate																																								
Adhesive																																								
Signal cable length and type																																								
Without signal cable																																								
5 m (15 ft.) cable																																								
10 m (30 ft.) cable																																								
20 m (60 ft.) cable																																								
30 m (100 ft.) cable																																								
50 m (165 ft.) cable																																								
80 m (260 ft.) cable																																								
100 m (325 ft.) cable																																								
150 m (490 ft.) cable																																								
Special length or cable type																																								
Explosion protection certification																																								
General purpose (non-Ex design)																																								
FM Class 1 Div. 2																																								
usFMc Class 1 Div. 2																																								
ATEX / IECEx Zone 2, 21 & 22																																								

Continued on next page...

WaterMaster

Electromagnetic flowmeter

Product coding field number					1 ... 5	6	7 ... 9	10	11	12	13	14, 15	16	17	18	19	20	21	22	23	24	25	26	27	Options	
Flowmeter system – full bore, integral mount (DN10 to DN32 only)					FEW11																					
Flowmeter system – full bore, remote mount					FEW12	X	XXX	X	X	X	X	XX	X	X	X	X	X	X	X	X	X	X	X	X	X	
Full bore sensor only – for use with WaterMaster transmitter / remote					FEW18																					
Protection class transmitter / protection class sensor																										
IP67 (NEMA 4X) / IP67 (NEMA 4X) – cable not fitted and potted to sensor																					1					
IP67 (NEMA 4X) / IP67 (NEMA 4X) – cable fitted and potted to sensor																					7					
Cable conduits*																										
M20 x 1.5 (plastic)																					A					
NPT 1/2 in. (blanked when cable not fitted)																					B					
M20 SWA (armored)																					D					
M20 SWA sensor, M20 x 1.5 (plastic) power / output																					F					
Without																					Y					
Power supply																										
Without																					0					
100... 230 V AC, 50 Hz																					1					
24 V AC or 24 V DC, 50 Hz																					2					
100... 230 V AC, 60 Hz																					3					
24 V AC or 24 V DC, 60 Hz																					4					
Input and output signal type																										
HART + 20 mA + pulse + contact output																							A			
PROFIBUS DP RS485 physical layer + pulse + contact output (general-purpose design only)																							G			
MODBUS RTU RS485 physical layer + pulse + contact output (general-purpose design only)																							M			
Without																							Y			
Configuration type / diagnostics type																										
Not required																							0			
Factory default/ standard																							1			
Options**																										
Accessories																										
Configuration lead					AC																					
Documentation language																										
German					M1					Chinese					M6											
Italian					M2					Swedish					M7											
Spanish					M3					Finnish					M8											
French					M4					Portuguese					MA											
English					M5 (default)					Danish					MF											
										Norwegian					MN											
Verification type																										
Without fingerprint					V0																					
VeriMaster					V3																					
Potable water approval																										
WRAS cold water approval					CWA																					
Without					CWY																					
Power supply frequency (FEW 18 only)																										
50 Hz					F5																					
60 Hz					F6																					
Number of testpoints (FEW 10 to 32 only)																										
1 Point					T1																					
3 Points					T3																					

* For FM or FMC Approved versions, NPT only permitted.

** Add codes for options.

WaterMaster
Electromagnetic flowmeter

Electromagnetic flowmeter WaterMaster FEV11, FEV12 and FEV18

Product coding field number						6	7 ... 9	10	11	12	13	14, 15	16	17	18	19	20	21	22	23	24	25	26	27	Options
Flowmeter system, optimized full bore, integral mount						FEV11																			
Flowmeter system, optimized full bore, remote mount						FEV12	X	XXX	X	X	X	XX	X	X	X	X	X	X	X	X	X	X	X	X	
Optimized full bore sensor only, for use with WaterMaster transmitter / remote						FEV18																			
Design																									
Non-hazardous areas						1																			
Hazardous areas						5																			
Bore diameter																									
DN40 (1½ in.)							040																		
DN50 (2 in.)							050																		
DN65 (2½ in.)							065																		
DN80 (3 in.)							080																		
DN100 (4 in.)							100																		
DN125 (5 in.)							125																		
DN150 (6 in.)							150																		
DN200 (8 in.)							200																		
Liner material																									
Polypropylene – DN40 to 200 (1½ to 8 in. NB)								V																	
Electrode design																									
Standard									1																
Measuring electrodes material																									
Stainless steel 316																									
Hastelloy® C-22																									
Super-austenitic steel																									
Grounding accessories																									
Standard																									
One potential equalizing ring (stainless steel)																									
Two potential equalizing rings (stainless steel)																									
Process connection type (refer to pages 29 and 28)																									
Flanges ASME B16.5 class 150													A1												
Flanges AS 4087 PN21 (≥ DN50 [2 in. NB])													E0												
Flanges AS 4087 PN16 (≥ DN50 [2 in. NB])													E1												
Flanges AS 4087 PN14													E2												
Flanges AS 2129 Table F													E3												
Flanges AS 2129 Table E													E4												
Flanges AS 2129 Table D													E5												
Flanges AS 2129 Table C													E6												
Flanges JIS G5527 7.5K (≥ DN100 [4 in. NB])													J0												
Flanges JIS B2220 10K													J1												
ISO/EN PN10													S1												
ISO / EN PN16 (≥ DN50 [2 in. NB])													S2												
ISO / EN PN40 (DN40 [1½ in. NB] only) 16 bar rated													S4												
Process connection material																									
Carbon steel flanges																									
Usage certifications																									
Standard																									
Calibration type																									
Class 2 Calibration – standard accuracy 0.4 %																									
Class 1 Calibration – high accuracy 0.2 %																									
Extended range, class 1 calibration – high accuracy 0.2 %																									
Extended range, class 2 calibration – standard accuracy 0.4 %																									

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WaterMaster
Electromagnetic flowmeter

Product coding field number		1 ... 5	6	7 ... 9	10	11	12	13	14, 15	16	17	18	19	20	21	22	23	24	25	26	27	Options	
Flowmeter system, optimized full bore, integral mount		FEV11																					
Flowmeter system, optimized full bore, remote mount		FEV12	X	XXX	X	X	X	X	XX	X	X	X	X	X	X	X	X	X	X	X	X		
Optimized full bore sensor only, for use with WaterMaster transmitter / remote		FEV18																					
Options**																							
Accessories																							
Configuration lead			AC																				
Documentation language																							
German	M1		Chinese	M6																			
Italian	M2		Swedish	M7																			
Spanish	M3		Finnish	M8																			
French	M4		Portuguese	MA																			
English	M5 (default)		Danish	MF																			
			Norwegian	MN																			
Other usage certifications																							
Measuring Instruments Directive (MID)			CM1																				
OIML R49 Calibration			CM2																				
Verification type																							
Without fingerprint			V0																				
VeriMaster			V3																				
Potable water approval																							
WRAS cold water approval			CWA																				
NSF 61 meter approval			CWC																				
DVGW			CWD																				
ACS			CWF																				
Without			CWY																				
Power supply frequency (sensor FEV18 only)																							
50 Hz			F5																				
60 Hz			F6																				
Number of testpoints																							
1 Point			T1																				
3 Points			T3																				

**Add codes for options.

WaterMaster
Electromagnetic flowmeter

Electromagnetic flowmeter WaterMaster FEF12 and FEF18

Product coding field number 1 ... 5					6	7 ... 9	10	11	12	13	14, 15	16	17	18	19	20	21	22	23	24	25	26	27	Options
Flowmeter system, full bore, remote mount					FEF12	X	XXX	X	X	X	XX	X	X	X	X	X	X	X	X	X	X	X	X	
Full bore sensor only, for use with WaterMaster transmitter / remote					FEF18																			
Design																								
Non-hazardous areas					1																			
Hazardous areas (DN≥700 [27 in. NB])					5																			
Bore diameter																								
DN250 (10 in.)						250																		
DN300 (12 in.)						300																		
DN350 (14 in.)						350																		
DN375 (15 in.)						375																		
DN400 (16 in.)						400																		
DN450 (18 in.)						450																		
DN500 (20 in.)						500																		
DN600 (24 in.)						600																		
Others						999																		
Liner material																								
Elastomer – DN250 to 600 (10 to 24 in. NB)																								
Hard rubber – DN250 to 600 (10 to 24 in. NB)																								
Other																								
Electrode design																								
Standard																								
Others																								
Measuring electrodes material																								
Stainless steel 316																								
Hastelloy® C-22																								
Super-austenitic steel (DN250 to 600 [10 to 24 in. NB])																								
Others																								
Grounding accessories																								
Standard																								
One potential equalizing ring (stainless steel)																								
Two potential equalizing rings (stainless steel)																								
Others																								
Process connection type (refer to pages 35 to 33)																								
Flanges ASME B16.5 class 150																								
Flanges ASME B16.5 class 300																								
Flanges AWWA C207 class B																								
Flanges AWWA C207 class D																								
Flanges AS 4087 PN21																								
Flanges AS 4087 PN16																								
Flanges AS 4087 PN14																								
Flanges AS 2129 Table F																								
Flanges AS 2129 Table E																								
Flanges AS 2129 Table D																								
Flanges AS 2129 Table C																								
Flanges AS 2129 Table H																								
Flanges AS 4087 PN35																								
Flanges JIS G5527 7.5K																								
Flanges JIS B2220 10K																								
Flanges JIS B2220 5K																								
Flanges ISO / EN PN6																								
Flanges ISO / EN PN10																								
Flanges ISO / EN PN16																								
Flanges ISO / EN PN25																								
Flanges ISO / EN PN40																								
Others																								
Note. DN80 to 200 (3 to 10 in. NB) available only with PN16																								
Process connection material																								
Carbon steel flanges																								
Others																								
Usage certifications																								
Standard																								
Calibration type																								
Class 2 calibration – standard accuracy 0.4 %																								
Class 1 calibration – high accuracy 0.2 %																								
Extended range, class 1 calibration – high accuracy 0.2 %																								
Extended range, class 2 calibration – standard accuracy 0.4 %																								

Continued on next page ...

WaterMaster
 Electromagnetic flowmeter

Product coding field number										1	...	5	6	7	...	9	10	11	12	13	14, 15	16	17	18	19	20	21	22	23	24	25	26	27	Options																												
Flowmeter system, full bore, remote mount										FEF12										X	XXX	X	X	X	X	XX	X	X	X	X	X	X	X		X	X	X																									
Full bore sensor only, for use with WaterMaster transmitter / remote										FEF18										X																																										
Temperature range installation / ambient temperature range										Standard design / -20 ... 60 °C (-4 ... 140 °F)										1																																										
Nameplate										Adhesive										A																																										
Signal cable length and type*										Without signal cable										0																																										
										5 m (15 ft.) cable										1																																										
										10 m (30 ft.) cable										2																																										
										20 m (60 ft.) cable										3																																										
										30 m (100 ft.) cable										4																																										
										50 m (165 ft.) cable										5																																										
										80 m (260 ft.) cable										6																																										
										100 m (325 ft.) cable										7																																										
										150 m (490 ft.) cable										8																																										
										Special Length > 150 m (> 490 ft.) (and / or armored cable)										9																																										
Explosion protection certification										General purpose (non-Ex design)										A																																										
Protection class transmitter / protection class sensor										IP67 (NEMA 4X) / IP68 (NEMA 6P) – cable not fitted and not potted										2																																										
										IP67 (NEMA 4X) / IP68 (NEMA 6P) – cable fitted and potted										3																																										
Cable conduits**										M20 x 1.5 (plastic)										A																																										
										NPT 1/2 in. (blanked when cable not fitted)										B																																										
										M20 SWA (armored)										D																																										
										M20 SWA sensor, M20 x 1.5 (plastic) power / output										F																																										
										Without										Y																																										
Power supply										Without										0																																										
										100... 230 V AC (50 Hz)										1																																										
										24 V AC or 24 V DC (50 Hz)										2																																										
										100... 230 V AC (60 Hz)										3																																										
										24 V AC or 24 V DC (60 Hz)										4																																										
Input and output signal type										HART + 20 mA + pulse + contact output										A																																										
										PROFIBUS DP RS485 physical layer + pulse + contact output										G																																										
										MODBUS RTU RS485 physical layer + pulse + contact output										M																																										
										Without										Y																																										
Configuration type / diagnostics type										Without										0																																										
										Factory defaults / standard diagnostics										1																																										
Options***																																																														
Accessories																																																														
Configuration lead										AC																																																				
Documentation language																																																														
German										M1										Chinese										M6																																
Italian										M2										Swedish										M7																																
Spanish										M3										Finnish										M8																																
French										M4										Portuguese										MA																																
English										M5 (default)										Danish										MF																																
																				Norwegian										MN																																
Verification type																																																														
Without fingerprint										V0																																																				
VeriMaster										V3																																																				
Potable water approvals																																																														
WRAS cold water approval										CWA																																																				
NSF 61 meter approval										CWC																																																				
DVGW										CWD																																																				
ACS										CWF																																																				
WRAS 60 °C (140 °F) water approval										CWK																																																				
Without										CWY																																																				
Power supply frequency (sensor FEF 18 only)																																																														
50 Hz										F5																																																				
60 Hz										F6																																																				
Number of testpoints																																																														
1 Point										T1																																																				
3 Points										T3																																																				

*Size is dependent on flange specification

**The type of signal cable supplied (standard or armored) depends on the type of cable conduit (variant digit number 24) ordered – for FM or FMC Approved versions, NPT only permitted.

***Add codes for options.

WaterMaster
Electromagnetic flowmeter

Electromagnetic flowmeter WaterMaster – FEW31, FEW32 and FEW38

Product coding field number 1 ... 5					6	7 ... 9	10	11	12	13	14, 15	16	17	18	19	20	21	22	23	24	25	26	27	Options		
Flowmeter system – full bore, integral mount					FEW31																					
Flowmeter system – full bore, remote mount					FEW32	X	XXX	X	X	X	X	XX	X	X	X	X	X	X	X	X	X	X	X	X		
Full bore sensor only – for use with WaterMaster transmitter / remote					FEW38																					
Design																										
Non-hazardous areas					1																					
Hazardous areas					5																					
Bore diameter																										
DN10 (3/8 in.)							010																			
DN15 (1/2 in.)							015																			
DN20 (3/4 in.)							020																			
DN25 (1 in.)							025																			
DN32 (1 1/4 in.)							032																			
DN40 (1 1/2 in.)							040																			
DN50 (2 in.)							050																			
DN65 (2 1/2 in.)							065																			
DN80 (3 in.)							080																			
DN100 (4 in.)							100																			
DN125 (5 in.)							125																			
DN150 (6 in.)							150																			
DN200 (8 in.)							200																			
DN250 (10 in.)							250																			
DN300 (12 in.)							300																			
DN350 (14 in.)							350																			
DN400 (16 in.)							400																			
DN450 (18 in.)							450																			
DN500 (20 in.)							500																			
DN600 (24 in.)							600																			
DN700 (28 in.)							700																			
DN750 (30 in.)							750																			
DN800 (32 in.)							800																			
DN900 (36 in.)							900																			
DN1000 (40 in.)							001																			
DN1050 (42 in.)							051																			
DN1100 (44 in.)							101																			
DN1200 (48 in.)							201																			
DN1350 (54 in.)							351																			
DN1400 (56 in.)							401																			
DN1500 (60 in.)							501																			
DN1600 (64 in.)							601																			
DN1650 (66 in.)							651																			
DN1800 (72 in.)							801																			
DN1950 (78 in.)							951																			
DN2000 (80 in.)							002																			
DN2100 (84 in.)							102																			
DN2200 (88 in.)							202																			
DN2400 (96 in.)							402																			
Others							999																			
Liner material																										
PTFE – DN10 to 600 (3/8 to 24 in. NB)								A																		
Hard rubber – DN40 to 2400 (1 1/2 to 96 in. NB)								H																		
Elastomer – DN40 to 2400 (1 1/2 to 96 in. NB)								K																		
Electrode design																										
Standard								1																		
Other								9																		
Measuring electrodes material																										
Hastelloy® C-4 (2.4610)																								D		
Stainless steel 316Ti/316L																								S		
Hastelloy C-22																								C		
Grounding accessories																										
Not required																								0		
Standard																								1		
One potential equalizing ring (stainless steel)																								3		
Two potential equalizing rings (stainless steel)																								4		
Continued on next page...																										

Continued on next page...

WaterMaster
Electromagnetic flowmeter

Product coding field number										1 ... 5	6	7 ... 9	10	11	12	13	14, 15	16	17	18	19	20	21	22	23	24	25	26	27	Options				
Flowmeter system – full bore, integral mount										FEW31																								
Flowmeter system – full bore, remote mount										FEW32	X	XXX	X	X	X	X	XX	X	X	X	X	X	X	X	X	X	X	X	X	X	X			
Full bore sensor only – for use with WaterMaster transmitter / remote										FEW38																								
Process connection type (refer to pages 21 to 26)																																		
Flanges ASME B16.47 series B / B16.5 Class 150																	A1																	
Flanges ASME B16.47 series B / B16.5 Class 300																	A3																	
Flanges ASME B16.47 series A Class 150																	B1																	
Flanges ASME B16.47 series A Class 300																	B3																	
Flanges AWWA C207 Class B																	C1																	
Flanges AWWA C207 Class D																	C2																	
Flanges AWWA C207 Class E																	C3																	
Flanges AWWA C207 Class F																	C4																	
Flanges JIS 10K																	J1																	
Flanges JIS 5K																	J2																	
Flanges AS 4087 PN 16																	E1																	
Flanges AS 2129 Table E																	E4																	
Flanges AS 2129 Table D																	E5																	
Flanges AS 4087 PN 35																	E8																	
ISO 7005, DIN, EN 1092-1 PN6																	S0																	
ISO 7005, DIN, EN 1092-1 PN10																	S1																	
ISO 7005, DIN, EN 1092-1 PN16																	S2																	
ISO 7005, DIN, EN 1092-1 PN25																	S3																	
ISO 7005, DIN, EN 1092-1 PN40																	S4																	
Process connection material																																		
Carbon steel flanges																		B																
Stainless steel flange																		D																
Usage certifications																																		
Standard (without PED)																				1														
Calibration type																																		
Class 2 calibration – standard accuracy 0.4 %																																		
Class 1 calibration – high accuracy 0.2 %																																		
Temperature range installation / ambient temperature range																																		
Standard design/ –20 ... 60 °C (–4 ... 140 °F)																																		
Nameplate																																		
Adhesive																																		
Signal cable length and type																																		
Without signal cable																																		
5 m (15 ft.) cable																																		
10 m (30 ft.) cable																																		
20 m (60 ft.) cable																																		
30 m (100 ft.) cable																																		
50 m (165 ft.) cable																																		
80 m (260 ft.) cable																																		
100 m (325 ft.) cable																																		
150 m (490 ft.) cable																																		
Special length or cable type																																		
Explosion protection certification*																																		
General purpose (non-Ex design)																																		
FM Class 1 Div. 2																																		
usFMc Class 1 Div. 2																																		
ATEX / IECEx Zone 2, 21 & 22																																		

Continued on next page...

WaterMaster
 Electromagnetic flowmeter

Product coding field number					1 ... 5	6	7 ... 9	10	11	12	13	14, 15	16	17	18	19	20	21	22	23	24	25	26	27	Options	
Flowmeter system – full bore, integral mount					FEW31																					
Flowmeter system – full bore, remote mount					FEW32	X	XXX	X	X	X	X	XX	X	X	X	X	X	X	X	X	X	X	X	X	X	
Full bore sensor only – for use with WaterMaster transmitter / remote					FEW38																					
Protection class transmitter / protection class sensor																										
IP67 (NEMA 4X) / IP67 (NEMA 4X) – cable not fitted and not potted to sensor																						1				
IP 67 (NEMA 4x) / IP68 (NEMA 6P) – cable not fitted and not potted to sensor																						2				
IP 67 (NEMA 4x) / IP68 (NEMA 6P) – cable fitted and potted to sensor																						3				
Cable conduits **																										
M20 x 1.5 (plastic)																							A			
NPT 1/2 in. (blanked when cable not fitted)																							B			
M20 SWA (armored)																							D			
M20 SWA sensor, M20 x 1.5 (plastic) power / output																							F			
Without																							Y			
Power supply																										
Without																								0		
108.. 230 V AC, 50 Hz																								1		
24 V AC or 24 V DC, 50 Hz																								2		
100 ... 230 V AC, 60 Hz																								3		
24 V AC or 24 V DC, 60 Hz																								4		
Input and output signal type																										
HART + 20 mA + pulse + contact output																								A		
PROFIBUS DP RS485 physical layer + pulse + contact output																								G		
MODBUS RTU RS485 physical layer + pulse + contact output																								M		
Without																								Y		
Configuration type / diagnostics type																										
Not required																									0	
Factory default / Standard																										1
Options***																										
Accessories																										
Configuration lead																										
Documentation language																										
German					M1																					M6
Italian					M2																					M7
Spanish					M3																					M8
French					M4																					MA
English					M5 (default)																					MF
																										MN
Lay length																										
ISO length – DN10 to 600 (3/8 to 24 in.) and 1.25D DN1800 to 2400 (72 to 96 in.)																										JB
1.3D DN700 to 2400 (28 to 96 in.) – see dimensional pages 25, 26, 27																										JK
1.0D DN700 to 1600 (28 to 64 in.) – see dimensional pages 25, 26, 27																										JH
Verification type																										
Without fingerprint																										V0
VeriMaster																										V3
Potable water approval																										
WRAS cold water approval																										CWA
DVGW																										CWD
WRAS 60 °C (140 °F) water approval																										CWK
NSF material approval																										CWM
Without																										CWY
Power supply frequency (sensor FEW38 only)																										
50 Hz																										F5
60 Hz																										F6
Number of testpoints																										
1 Point																										T1
3 Points																										T3
5 Points																										T5

* FM approval in process. FEF product still available with full FM approval

** The type of signal cable supplied (standard or armored) depends on the type of cable conduit (variant digit number 24) ordered. For FM or FMC Approved versions, NPT only permitted.

*** Add codes for options.

WaterMaster
Electromagnetic flowmeter

WaterMaster FER reduced-bore sensor flowmeter series

Product coding field number	1 ... 6	7 ... 9	10	11	12	13	14,15	16	17	18	19	20	21	22	23	24	25	26	27	Options
WaterMaster system. Reduced-bore sensor with remote mounted transmitter	FER121																			
WaterMaster system. Reduced-bore sensor with integral transmitter	FER111	XXX	X	X	X	X	XX	X	X	X	X	X	X	X	X	X	X	X	X	
WaterMaster reduced-bore sensor only, remote mount, without transmitter	FER181																			
Bore diameter																				
DN 40 (1½ in.)		040																		
DN 50 (2 in.)		050																		
DN 65 (2½ in.)		065																		
DN 80 (3 in.)		080																		
DN 100 (4 in.)		100																		
DN 125 (5 in.)		125																		
DN 150 (6 in.)		150																		
DN 200 (8 in.)		200																		
DN 250 (10 in.)		250																		
DN 300 (12 in.)		300																		
DN 350 (14 in.)		350																		
DN 375 (15 in.)		375																		
DN 400 (16 in.)		400																		
DN 450 (18 in.)		450																		
DN 500 (20 in.)		500																		
DN 600 (24 in.)		600																		
Liner material																				
Elastomer – DN40 to 600 (1½ to 24 in. NB)			K																	
Electrode design																				
Standard					1															
Measuring electrodes material																				
Stainless steel 316						S														
Super austenitic steel (1.4529)						U														
Grounding accessories																				
1 x Stainless steel equalizing ring																			3	
2 x Stainless steel equalizing rings																			4	
Process connection type (refer to pages 30 and 30)																				
Flanges ANSI / ASME B16.5 / 16.47 series B Class 150		(40 / 50 / 80 / 100 / 150 ... 300)					A1													
Flanges AWWA C207 Class E		(40 / 50 / 80)					C3													
Flanges JIS 7.5K		(100 / 150 ... 300)					J0													
Flanges JIS 10K		(40 / 50 / 80 / 100 / 150 ... 300)					J1													
Flanges AS 4087 PN 21		(50 / 80 / 100 / 150 ... 600)					E0													
Flanges AS 4087 PN 16		(50 / 80 / 100 / 150 ... 350 / 450 ... 600)					E1													
Flanges AS 4087 PN 14		(40 / 50 / 80 / 100 / 150 ... 600)					E2													
Flanges AS 2129 Table F		(40 / 50 / 80 / 100 / 150 ... 600)					E3													
Flanges AS 2129 Table E		(40 / 50 / 80 / 100 / 125 / 150 ... 600)					E4													
Flanges AS 2129 Table D		(40 / 50 / 80 / 100 / 150 ... 300)					E5													
Flanges AS 2129 Table C		(40 / 50 / 80 / 100 / 150 ... 300)					E6													
ISO 7005 PN 10 EN 1092-1		(40 ... 600)					S1													
ISO 7005 PN 16 EN 1092-1		(40 ... 600)					S2													
ISO 7005 PN 40 EN 1092-1		(40)					S4													
Process connection material																				
Carbon steel								B												
Usage certifications																				
Standard																				1

Continued on next page...

WaterMaster
 Electromagnetic flowmeter

Product coding field number						1 ... 6	7 ... 9	10	11	12	13	14,15	16	17	18	19	20	21	22	23	24	25	26	27	Options	
WaterMaster system. Reduced-bore sensor with remote mounted transmitter						FER121																				
WaterMaster system. Reduced-bore sensor with integral transmitter						FER111	XXX	X	X	X	X	XX	X	X	X	X	X	X	X	X	X	X	X	X		
WaterMaster reduced-bore sensor only, remote mount, without transmitter						FER181																				
						See previous page																				
Calibration type																										
Class 2 calibration – standard accuracy 0.4 %																										
Class 1 calibration – high accuracy 0.2																										
Extended range, class 1 calibration – high accuracy 0.2 %																										
Extended range, class 2 calibration – standard accuracy 0.4 %																										
Installation temperature range / ambient temperature range																										
Standard design –20 ... 60 °C (–4 ... 140 °F)																										
Name plate																										
Adhesive label																										
Signal cable length and type																										
Without signal cable																										
5 m (16.4 ft)																										
10 m (32.8 ft)																										
20 m (65.6 ft)																										
30 m (98.4 ft)																										
50 m (164.0 ft)																										
80 m (262.5 ft)																										
100 m (325 ft)																										
150 m (490 ft)																										
Others																										
Explosion protection certification																										
General purpose (non-Ex design)																										
Protection class transmitter / protection class sensor																										
IP67 (NEMA 4X) / IP68 (NEMA 6P) – cable not fitted and not potted																										
IP67 (NEMA 4X) / IP68 (NEMA 6P) – cable fitted and potted																										
Cable conduits*																										
M20 x 1.5																										
NPT 1/2 in (blanked when cable not fitted)																										
M20 SWA armored (FEV121 and FEV181 only)																										
M20 SWA sensor, output and power connector (FEV121 and FEV181 only)																										
Power supply																										
Without (FEV18 only)																										
100... 230 V AC, 50 Hz																										
24 V AC or 24 V DC, 50 Hz																										
100... 230 V AC, 60 Hz																										
24 V AC or 24 V DC, 60 Hz																										
Input and output signal type																										
HART + 20 mA + pulse + contact output																										
PROFIBUS DP RS485 physical layer + pulse + contact output (FEV111 and FEV121 only)																										
MODBUS RTU RS485 physical layer + pulse + contact output (FEV111 and FEV121 only)																										
Without (FEV181 only)																										
Configuration type / diagnostics type																										
Without (FEV18 only)																										
Factory defaults / standard diagnostics (FEV11 and FEV12 only)																										
Options**																										
Documentation language																										
German M1																										

WaterMaster
Electromagnetic flowmeter

Electromagnetic flowmeter transmitter for WaterMaster FET10 and FET12

Product coding field number															Options
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
Transmitter module					FET10										
Remote transmitter					FET12	X	X	X	X	X	X	X	X	X	
Design															
Non-hazardous area					1										
Hazardous area					5										
Temperature range installation / ambient temperature range															
Standard design / -20 ... 60 °C (-4 ... 140 °F)						1									
Nameplate															
Adhesive							A								
Signal cable length															
Without signal cable								0							
Explosion protection															
Without (transmitter only)									Y						
FM Class 1 Div. 2									G						
usFMc Class 1 Div. 2									P						
ATEX / IECEx Zone 2, 21 & 22									M						
Protection class transmitter / protection class sensor															
IP67 (NEMA 4X) / IP67 (NEMA 4X)										1					
Cable conduits															
M20 x 1.5 (plastic)											A				
NPT 1/2 in. (blanked when cable not fitted)											B				
M20 SWA (armored)											D				
M20 SWA sensor, M20 x 1.5 (plastic) power / output											F				
Without											Y				
Power supply															
100... 230 V AC												1			
24 V AC or 24 V DC												2			
Input and output															
HART + 20 mA + pulse + contact output													A		
PROFIBUS DP RS485 physical layer + pulse + contact output													G		
MODBUS RTU RS485 physical layer + pulse + contact output													M		
Configuration type / diagnostics type															
Factory defaults / standard diagnostics														1	
Options**															
Accessories															
Configuration lead									AC						
Documentation															
German	M1		Chinese	M6											
Italian	M2		Swedish	M7											
Spanish	M3		Finnish	M8											
French	M4		Portuguese	MA											
English	M5 (default)		Danish	MF											
			Norwegian	MN											
Other usage															
Measuring Instruments Directive (MID)									CM1						

*The transmitter converter module Input and Output Signal Type must match the transmitter backplane output configuration (HART or PROFIBUS) – see OI/FET100-EN.

**Add codes for options.

WaterMaster

Electromagnetic flowmeter

Common accessories

Accessory	Item Number
WaterMaster AC Fuse F1 Type T 250 mA A/S TR5	B20411
WaterMaster DC Fuse F2 Type T 2 A A/S TR5	B20412
WaterMaster Infra Red Comms Pack	MJBX9932
WaterMaster Backplane PCB Board (STD)	WATX2505
WaterMaster Sensor PCB Board	WATX2506
WaterMaster Comms Cable	WEBC2500
Signal cable for remote WaterMaster transmitter 5 m (15 ft.) 10 m (30 ft.) 20 m (60 ft.) 30 m (100 ft.) 50 m (165 ft.) 80 m (260 ft.) 100 m (325 ft.) 150 m (490 ft.) 500 m (1650 ft.)	STT4500/05 STT4500/10 STT4500/20 STT4500/30 STT4500/50 STT4500/80 STT4500/100 STT4500/150 STT4500/500
Armored signal cable for remote WaterMaster transmitter 5 m (15 ft.) 10 m (30 ft.) 20 m (60 ft.) 30 m (100 ft.) 50 m (165 ft.) 80 m (260 ft.) 100 m (325 ft.) 150 m (490 ft.) 500 m (1650 ft.)	STT4501/05 STT4501/10 STT4501/20 STT4501/30 STT4501/50 STT4501/80 STT4501/100 STT4501/150 STT4501/500

Acknowledgements

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3KXF211101R1001



Sales



Service



Software

Maintenance

Electrical Components

1 - Monthly

- Carry out the following tasks in accordance with AS3666, SAHB32 and the Public Health Act
- Check for signs of burnt, hot connections and burnt contacts on starters and relays. Confirm tightness and report any defects.
- Check operation of each item of equipment.
- Examine general condition of conduits, connectors switches and wiring, especially in damp and outdoor areas.
- Replace any faulty indicator lights.

3 - Monthly

- Check and inspect for faulty meters and/or control switches.

12 - Monthly

Switchboard and Wiring

- Check all fuses for correct rating.
- Check all time delays where possible.
- Check and report where wiring diagrams are considered to be incorrect.
- Check connections to (a) motors, (b) switchboards, or (c) equipment subject to vibration.
- Check for existence of Switch Board card.
- Check overload ratings against motor nameplate.
- Check that conduits are securely fixed.
- Check, and rectify where necessary, condition of exposed cable insulation.
- Examine and rectify panel seals.
- Examine external switches for damage to seals.
- Reattach any labels that have fallen off. Report any labels that have been removed.
- Test operation of all time switches where possible.
- Vacuum clean interior of all switchboards.
- Carry out the following tasks in accordance with AS3666, SAHB32 and the Public Health Act
- The following tasks were supplied by AIRAH and are indicative only.

For Servicing The Following Assets

[#AST5](#), [#AST9](#), [#AST11](#), [#AST15](#), [#AST16](#)

Operations & Tech Data

Promag 50 Operating Instructions

Service : (1.0) Site, Process or Subprocess

Subservice : (SP_) SEWER_PS

Note: factory set password for this flowmeter is 50.

Linked Documents

 [Promag 50 Operating Instructions.pdf](#)

Proline Promag 50 Technical Data

Service : (1.0) Site, Process or Subprocess

Subservice : (SP_) SEWER_PS

Linked Documents

 [Proline Promag 50 Technical Data.pdf](#)



Level



Pressure



Flow



Temperature

Liquid
Analysis

Registration

Systems
Components

Services

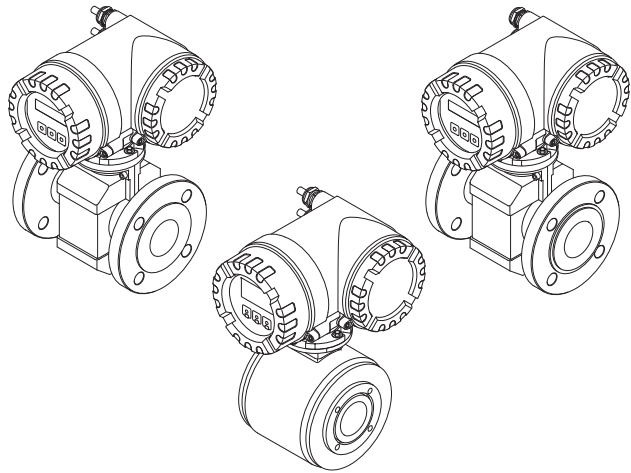


Solutions

Brief Operating Instructions

Proline Promag 50

Electromagnetic Flow Measuring System



These Brief Operating Instructions are not intended to replace the Operating Instructions provided in the scope of supply.

Detailed information is provided in the Operating Instructions and the additional documentation on the CD-ROM supplied.

The complete device documentation consists of:

- These Brief Operating Instructions
- Depending on the device version:
 - Operating Instructions and the Description of Device Functions
 - Approvals and safety certificates
 - Special safety instructions in accordance with the approvals for the device (e.g. explosion protection, pressure equipment directive etc.)
 - Additional device-specific information

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1 Safety instructions

1.1 Designated use

- The measuring device is to be used only for measuring the flow of conductive liquids in closed pipes. A minimum conductivity of 20 $\mu\text{S}/\text{cm}$ is required for measuring demineralized water. Most liquids can be measured as of a minimum conductivity of 5 $\mu\text{S}/\text{cm}$.
- Any use other than that described here compromises the safety of persons and the entire measuring system and is, therefore, not permitted.
- The manufacturer is not liable for damage caused by improper or non-designated use.

1.2 Installation, commissioning and operation

- The measuring device must only be installed, connected, commissioned and maintained by qualified and authorized specialists (e.g. electrical technicians) in full compliance with the instructions in these Brief Operating Instructions, the applicable norms, legal regulations and certificates (depending on the application).
- The specialists must have read and understood these Brief Operating Instructions and must follow the instructions they contain. If you are unclear on anything in these Brief Operating Instructions, you must read the Operating Instructions (on the CD-ROM). The Operating Instructions provide detailed information on the measuring device.
- The measuring device should only be installed in a de-energized state free from outside loads or strain.
- The measuring device may only be modified if such work is expressly permitted in the Operating Instructions (on the CD-ROM).
- Repairs may only be performed if a genuine spare parts kit is available and this repair work is expressly permitted.
- If performing welding work on the piping, the welding unit may not be grounded by means of the measuring device.

1.3 Operational safety

- The measuring device is designed to meet state-of-the-art safety requirements, has been tested, and left the factory in a condition in which it is safe to operate. Relevant regulations and European standards have been observed.
- The manufacturer reserves the right to modify technical data without prior notice. Your Endress+Hauser distributor will supply you with current information and updates to these Operating Instructions.
- The information on the warning notices, nameplates and connection diagrams affixed to the device must be observed. These contain important data on the permitted operating conditions, the range of application of the device and information on the materials used.
- If the device is not used at atmospheric temperatures, compliance with the relevant marginal conditions as specified in the device documentation supplied (on CD-ROM) is mandatory.
- The device must be wired as specified in the wiring and connection diagrams. Interconnection must be permitted.




- All parts of the device must be included in the potential equalization of the system.
- Cables, certified cable glands and certified dummy plugs must be suitable to withstand the prevailing operating conditions, such as the temperature range of the process. Housing apertures that are not used must be sealed with dummy plugs.
- The device should only be used for fluids to which all the wetted parts of the device are sufficiently resistant. With regard to special fluids, including fluids used for cleaning, Endress+Hauser will be happy to assist in clarifying the corrosion-resistant properties of wetted materials.

However, minor changes in temperature, concentration or in the degree of contamination in the process may result in variations in corrosion resistance.

For this reason, Endress+Hauser does not accept any responsibility with regard to the corrosion resistance of wetted materials in a specific application. The user is responsible for the choice of suitable wetted materials in the process.

- When hot fluid passes through the measuring tube, the surface temperature of the housing increases. In the case of the sensor, in particular, users should expect temperatures that can be close to the fluid temperature. If the temperature of the fluid is high, implement sufficient measures to prevent burning or scalding.

■ Hazardous areas

Measuring devices for use in hazardous areas are labeled accordingly on the nameplate. Relevant national regulations must be observed when operating the device in hazardous areas. The Ex documentation on the CD-ROM is an integral part of the entire device documentation. The installation regulations, connection data and safety instructions provided in the Ex documentation must be observed. The symbol and name on the front page provides information on the approval and certification (e.g.  Europe,  USA,  Canada). The nameplate also bears the documentation number of this Ex documentation (XA***D/./..).

- For measuring systems used in SIL 2 applications, the separate manual on functional safety (on the CD-ROM) must be observed.

■ Hygienic applications

Measuring devices for hygienic applications have their own special labeling. Relevant national regulations must be observed when using these devices.

■ Pressure instruments

Measuring devices for use in systems that need to be monitored are labeled accordingly on the nameplate. Relevant national regulations must be observed when using these devices. The documentation on the CD-ROM for pressure instruments in systems that need to be monitored is an integral part of the entire device documentation. The installation regulations, connection data and safety instructions provided in the Ex documentation must be observed.

- Endress+Hauser will be happy to assist in clarifying any questions on approvals, their application and implementation.

1.4 Safety conventions



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!

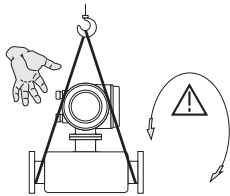
"Note" indicates an action or procedure which, if not performed correctly, can have an indirect effect on operation or trigger an unexpected response on the part of the device.

2 Installation

2.1 Transporting to the measuring point

- Transport the measuring device to the measuring point in the original packaging.
- Do not remove the covers or caps until immediately before installation.

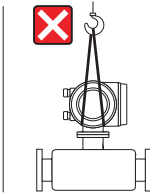
2.1.1 Transporting flanged devices $DN \leq 300$ ($\leq 12''$)



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To transport the unit, use slings slung around the process connections or use lugs (if available).

Warning!
Risk of injury! The device can slip.
The center of gravity of the measuring device may be higher than the holding points of the slings.
Always ensure that the device cannot slip or turn around its axis.



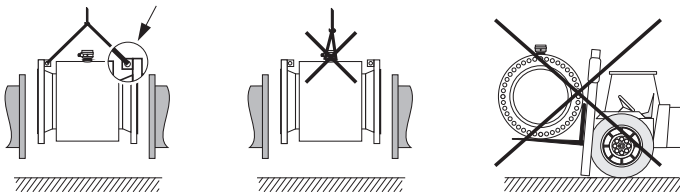
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Do not lift measuring devices by the transmitter housing or the connection housing in the case of the remote version. Do not use chains as they could damage the housing.

2.1.2 Transporting flanged devices $DN > 300$ ($> 12''$)

Use only the metal eyes provided on the flanges to transport, lift or position 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.



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2.2 Installation conditions

2.2.1 Dimensions

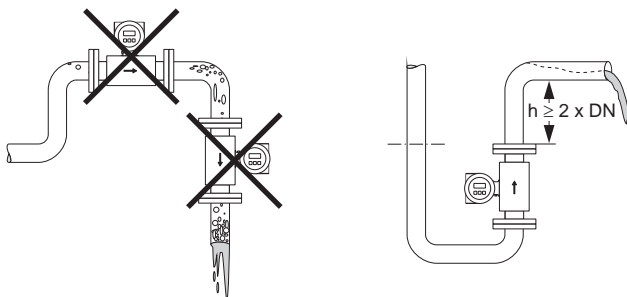
For the dimensions of the measuring device, see the associated Technical Information on the CD-ROM.

2.2.2 Mounting location

The accumulation of air or formation of gas bubbles in the measuring tube can result in an increase in measuring errors.

For this reason avoid the following mounting locations in the pipe:

- At the highest point of a pipeline. Risk of air accumulating!
- Directly upstream from a free pipe outlet in a down pipe.

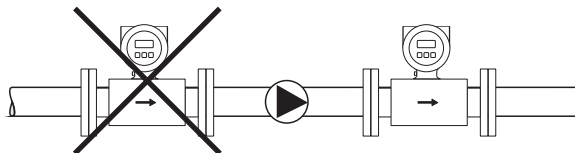


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Installation of pumps

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. It might be necessary to use pulse dampers in systems incorporating piston pumps, piston diaphragm pumps or peristaltic pumps.

Information on the measuring system's pressure tightness and resistance to vibration and shock can be found in the Operating Instructions of the CD-ROM.

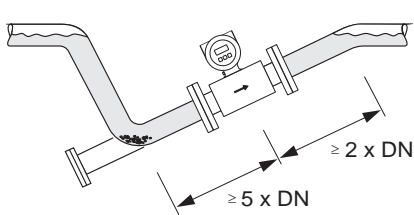


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Partially filled pipes

Partially filled pipes with gradients necessitate a drain-type configuration. The empty pipe detection (EPD) function 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.

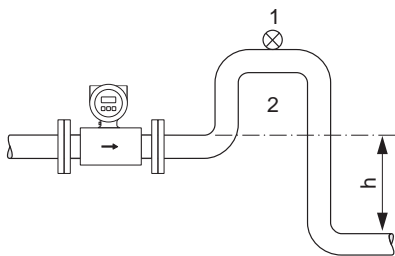


Installation in a partially filled pipe

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Down pipes

Install a siphon or a vent valve downstream of the sensor in down pipes longer than 5 meters (16 ft). This precaution is to avoid low pressure and the consequent risk of damage to the lining of the measuring tube. This measure also prevents the system losing prime, which could cause air pockets.
For information on the pressure tightness of the measuring tube lining, see the Operating Instructions on the CD-ROM.



Measures for installation in a down pipe (h > 5 m/16 ft)

- 1. Vent valve
- 2. Siphon

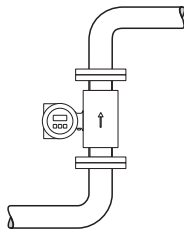
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2.2.3 Orientation

An optimum orientation helps avoid gas and air accumulations and buildup in the measuring tube. The measuring device, nevertheless, supplies a range of functions and tools to measure problematic fluids correctly:

- Electrode cleaning circuitry (ECC) to prevent electrically conductive deposits in the measuring tube, e.g. for fluids causing buildup
- Empty pipe detection (EPD) for detecting partially filled measuring tubes, e.g. in the case of degassing fluids or varying process pressures
- Exchangeable measuring electrodes for abrasive fluids (only Promag W)

Vertical orientation



This orientation is optimum for self-emptying piping systems and when using empty pipe detection (EPD) or open electrode detection (OED).

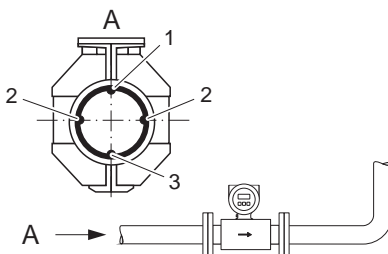
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Horizontal orientation

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

⚠ Caution!

In the case of horizontal orientation, empty pipe detection only works correctly if the transmitter housing is facing upwards. Otherwise there is no guarantee that empty pipe detection will respond if the measuring tube is only partially filled or empty.

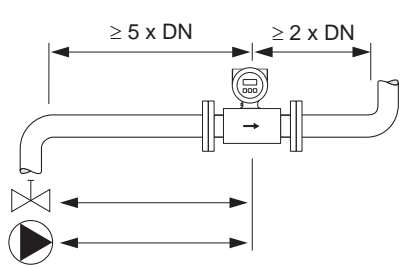


1. EPD electrode for empty pipe detection (not for Promag H, DN 2 to 15, 1/12" to 1/2").
2. Measuring electrodes for signal detection
3. Reference electrode for potential equalization (not for Promag H)

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Inlet and outlet runs

If possible, install the sensor upstream from fittings such as valves, T-pieces, elbows, etc.



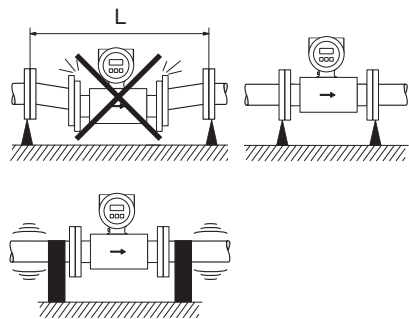
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The following inlet and outlet runs must be observed in order to meet accuracy specifications:

- Inlet run: $\geq 5 \times \text{DN}$
- Outlet run: $\geq 2 \times \text{DN}$

2.2.4 Vibrations

Secure and fix both the piping and the sensor if vibrations are severe.



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Measures to prevent device vibration
($L > 10 \text{ m}/33 \text{ ft}$)



Caution!

It is advisable to install the sensor and transmitter separately if vibration is excessively severe. For information on the permitted shock and vibration resistance, see the Operating Instructions on the CD-ROM.

2.2.5 Foundations, supports

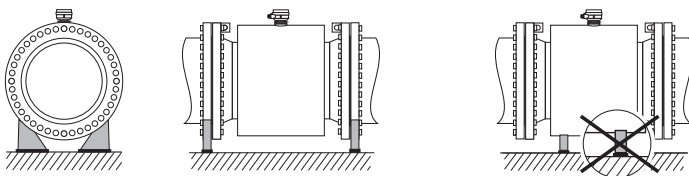
If the nominal diameter is $DN \geq 350$ ($\geq 14"$), mount the sensor on a foundation of adequate load-bearing strength.



Caution!

Risk of damage! Do not support the weight of the sensor on the metal casing.

This would buckle the casing and damage the internal magnetic coils.

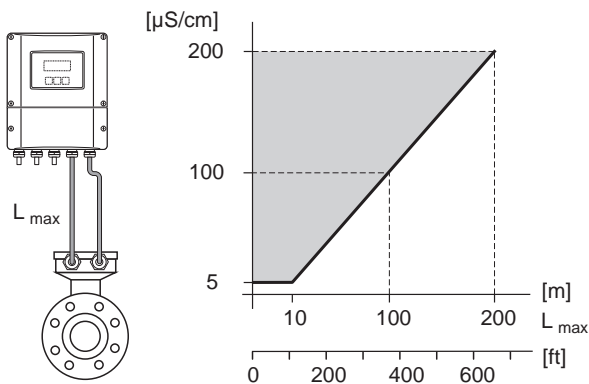


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2.2.6 Length of connecting cable

Comply with the following instructions in order to ensure correct measuring results:

- Secure the cable run or route the cable in an armored 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 equalization between the sensor and transmitter, if necessary.
- The permissible cable length L_{\max} depends on the fluid conductivity.

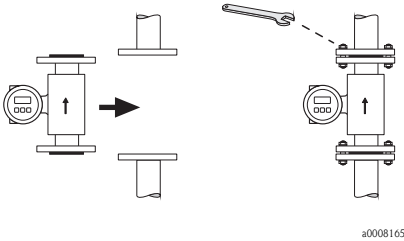


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2.3 Installing the Promag L sensor

Caution!

- The protective covers mounted on the two sensor flanges (DN 50...300) are used to hold the lap joint flanges in place and to protect the PTFE liner during transportation. Consequently, do not remove these covers until immediately before the sensor is installed in the pipe.
- The protective plates must always remain mounted while the device is in storage.
- Make sure that the lining at the flange is not damaged or removed.



Note!

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

The sensor is installed between the two pipe flanges:

- The requisite torques must be observed → 13
- If grounding disks are used, follow the mounting instructions which will be enclosed with the shipment.
- To comply with the device specification, a concentric installation in the measuring section is required

2.3.1 Seals

Comply with the following instructions when installing seals:

- Hard rubber lining → additional seals are **always** required!
- Polyurethane lining → **no** seals are required.
- **No** seals are required for PFTE measuring tube lining.
- For DIN flanges, only use seals to DIN EN 1514-1.
- Make sure that the mounted seals do not protrude into the piping cross-section.

Caution!

Risk of short circuit!

Do not use electrically conductive sealing compounds such as graphite! An electrically conductive layer could form on the inside of the measuring tube and short-circuit the measuring signal.

2.3.2 Ground cable

If necessary, special ground cables can be ordered as accessories for potential equalization.

2.3.3 Screw tightening torques (Promag L)

Please note the following:

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

Promag L tightening torques for EN (DIN)

Nominal diameter [mm]	EN (DIN) Pressure rating [bar]	Threaded fasteners	Max. tightening torque		
			Hard rubber [Nm]	Polyurethane [Nm]	PTFE [Nm]
50	PN 10/16	4 × M 16	-	15	40
65*	PN 10/16	8 × M 16	-	10	22
80	PN 10/16	8 × M 16	-	15	30
100	PN 10/16	8 × M 16	-	20	42
125	PN 10/16	8 × M 16	-	30	55
150	PN 10/16	8 × M 20	-	50	90
200	PN 10	8 × M 20	-	65	130
250	PN 10	12 × M 20	-	50	90
300	PN 10	12 × M 20	-	55	100
350	PN 6	12 × M 20	111	120	-
350	PN 10	16 × M 20	112	118	-
400	PN 6	16 × M 20	90	98	-
400	PN 10	16 × M 24	151	167	-
450	PN 6	16 × M 20	112	126	-
450	PN 10	20 × M 24	153	133	-
500	PN 6	20 × M 20	119	123	-
500	PN 10	20 × M 24	155	171	-
600	PN 6	20 × M 24	139	147	-
600	PN 10	20 × M 27	206	219	-
700	PN 6	24 × M 24	148	139	-
700	PN 10	24 × M 27	246	246	-
800	PN 6	24 × M 27	206	182	-
800	PN 10	24 × M 30	331	316	-
900	PN 6	24 × M 27	230	637	-
900	PN 10	28 × M 30	316	307	-
1000	PN 6	28 × M 27	218	208	-
1000	PN 10	28 × M 33	402	405	-
1200	PN 6	32 × M 30	319	299	-
1200	PN 10	32 × M 36	564	568	-
1400	PN 6	36 × M 33	430	-	-

Nominal diameter	EN (DIN)		Max. tightening torque		
			Hard rubber	Polyurethane	PTFE
[mm]	Pressure rating [bar]	Threaded fasteners	[Nm]	[Nm]	[Nm]
1400	PN 10	36 × M 39	654	618	-
1400	PN 16	36 × M 45	729	762	-
1600	PN 6	40 × M 33	440	417	-
1600	PN 10	40 × M 45	946	893	-
1600	PN 16	40 × M 52	1007	1100	-
1800	PN 6	44 × M 36	547	521	-
1800	PN 10	44 × M 45	961	895	-
1800	PN 16	44 × M 52	1108	1003	-
2000	PN 6	48 × M 39	629	605	-
2000	PN 10	48 × M 45	1047	1092	-
2000	PN 16	48 × M 56	1324	1261	-
2200	PN 6	52 × M 39	698	-	-
2200	PN 10	52 × M 52	1217	-	-
2400	PN 6	56 × M 39	768	-	-
2400	PN 10	56 × M 52	1229	-	-
* Designed acc. to EN 1092-1 (not to DIN 2501)					

Promag L tightening torques for ANSI

Nominal diameter		ANSI	Threaded fasteners	Max. tightening torque					
				Hard rubber		Polyurethane		PTFE	
[mm]	[inch]	Pressure rating [lbs]		[Nm]	[lbf · ft]	[Nm]	[lbf · ft]	[Nm]	[lbf · ft]
50	2"	Class 150	4 × 5/8"	-	-	15	11	40	29
80	3"	Class 150	4 × 5/8"	-	-	25	18	65	48
100	4"	Class 150	8 × 5/8"	-	-	20	15	44	32
150	6"	Class 150	8 × ¾"	-	-	45	33	90	66
200	8"	Class 150	8 × ¾"	-	-	65	48	125	92
250	10"	Class 150	12 × 7/8"	-	-	55	41	100	74
300	12"	Class 150	12 × 7/8"	-	-	68	56	115	85
350	14"	Class 150	12 × 1"	135	100	158	117	-	-
400	16"	Class 150	16 × 1"	128	94	150	111	-	-
450	18"	Class 150	16 × 1 1/8"	204	150	234	173	-	-
500	20"	Class 150	20 × 1 1/8"	183	135	217	160	-	-
600	24"	Class 150	20 × 1 ¼"	268	198	307	226	-	-

Promag L tightening torques for AWWA

Nominal diameter		AWWA Pressure rating	Threaded fasteners	Max. tightening torque					
				Hartgummi		Polyurethane		PTFE	
[mm]	[inch]			[Nm]	[lbf · ft]	[Nm]	[lbf · ft]	[Nm]	[lbf · ft]
700	28"	Class D	28 × 1 ¼"	247	182	292	215	-	-
750	30"	Class D	28 × 1 ¼"	287	212	302	223	-	-
800	32"	Class D	28 × 1 ½"	394	291	422	311	-	-
900	36"	Class D	32 × 1 ½"	419	309	430	317	-	-
1000	40"	Class D	36 × 1 ½"	420	310	477	352	-	-
1050	42"	Class D	36 × 1 ½"	528	389	518	382	-	-
1200	48"	Class D	44 × 1 ½"	552	407	531	392	-	-
1350	54"	Class D	44 × 1 ¾"	730	538	-	-	-	-
1500	60"	Class D	52 × 1 ¾"	758	559	-	-	-	-
1650	66"	Class D	52 × 1 ¾"	946	698	-	-	-	-
1800	72"	Class D	60 × 1 ¾"	975	719	-	-	-	-
2000	78"	Class D	64 × 2"	853	629	-	-	-	-
2150	84"	Class D	64 × 2"	931	687	-	-	-	-
2300	90"	Class D	68 × 2 ¼"	1048	773	-	-	-	-

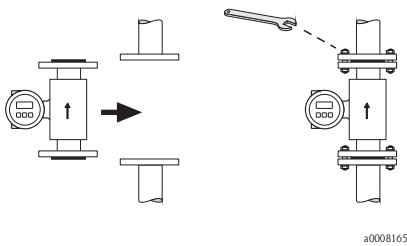
Promag L tightening torques for AS 2129

Nominal diameter	AS 2129 Pressure rating	Threaded fasteners	Max. tightening torque		
			Hard rubber	Polyurethane	PTFE
[mm]			[Nm]	[Nm]	[Nm]
350	Table E	12 × M 24	203	-	-
400	Table E	12 × M 24	226	-	-
450	Table E	16 × M 24	226	-	-
500	Table E	16 × M 24	271	-	-
600	Table E	16 × M 30	439	-	-
700	Table E	20 × M 30	355	-	-
750	Table E	20 × M 30	559	-	-
800	Table E	20 × M 30	631	-	-
900	Table E	24 × M 30	627	-	-
1000	Table E	24 × M 30	634	-	-
1200	Table E	32 × M 30	727	-	-

Promag L tightening torques for AS 4087

Nominal diameter [mm]	AS 4087 Pressure rating	Threaded fasteners	Max. tightening torque		
			Hard rubber [Nm]	Polyurethane [Nm]	PTFE [Nm]
350	PN 16	12 × M 24	203	-	-
375	PN 16	12 × M 24	137	-	-
400	PN 16	12 × M 24	226	-	-
450	PN 16	12 × M 24	301	-	-
500	PN 16	16 × M 24	271	-	-
600	PN 16	16 × M 27	393	-	-
700	PN 16	20 × M 27	330	-	-
750	PN 16	20 × M 30	529	-	-
800	PN 16	20 × M 33	631	-	-
900	PN 16	24 × M 33	627	-	-
1000	PN 16	24 × M 33	595	-	-
1200	PN 16	32 × M 33	703	-	-

2.4 Installing the W sensor



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

The sensor is installed between the two pipe flanges:

- The requisite torques must be observed → 18
- If grounding disks are used, follow the mounting instructions which will be enclosed with the shipment.
- To comply with the device specification, a concentric installation in the measuring section is required

2.4.1 Seals

Comply with the following instructions when installing seals:

- Hard rubber lining → additional seals are **always** necessary.
- Polyurethane lining → **no** seals are required.
- For DIN flanges, use only seals according to EN 1514-1.
- Make sure that the seals do not protrude into the piping cross-section.



Caution!

Risk of short circuit!

Do not use electrically conductive sealing compounds such as graphite! An electrically conductive layer could form on the inside of the measuring tube and short-circuit the measuring signal.

2.4.2 Ground cable

If necessary, special ground cables can be ordered as accessories for potential equalization.

2.4.3 Screw tightening torques (Promag W)

Please note the following:

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

Promag W tightening torques for EN (DIN)

Nominal diameter [mm]	EN (DIN) Pressure rating [bar]	Threaded fasteners	Max. tightening torque [Nm]	
			Hard rubber	Polyurethane
25	PN 40	4 × M 12	-	15
32	PN 40	4 × M 16	-	24
40	PN 40	4 × M 16	-	31
50	PN 40	4 × M 16	48	40
65*	PN 16	8 × M 16	32	27
65	PN 40	8 × M 16	32	27
80	PN 16	8 × M 16	40	34
80	PN 40	8 × M 16	40	34
100	PN 16	8 × M 16	43	36
100	PN 40	8 × M 20	59	50
125	PN 16	8 × M 16	56	48
125	PN 40	8 × M 24	83	71
150	PN 16	8 × M 20	74	63
150	PN 40	8 × M 24	104	88
200	PN 10	8 × M 20	106	91
200	PN 16	12 × M 20	70	61
200	PN 25	12 × M 24	104	92
250	PN 10	12 × M 20	82	71
250	PN 16	12 × M 24	98	85
250	PN 25	12 × M 27	150	134
300	PN 10	12 × M 20	94	81
300	PN 16	12 × M 24	134	118
300	PN 25	16 × M 27	153	138
350	PN 6	12 × M 20	111	120
350	PN 10	16 × M 20	112	118
350	PN 16	16 × M 24	152	165
350	PN 25	16 × M 30	227	252
400	PN 6	16 × M 20	90	98
400	PN 10	16 × M 24	151	167
400	PN 16	16 × M 27	193	215
400	PN 25	16 × M 33	289	326
450	PN 6	16 × M 20	112	126
450	PN 10	20 × M 24	153	133

Nominal diameter [mm]	EN (DIN) Pressure rating [bar]	Threaded fasteners	Max. tightening torque [Nm]	
			Hard rubber	Polyurethane
450	PN 16	20 × M 27	198	196
450	PN 25	20 × M 33	256	253
500	PN 6	20 × M 20	119	123
500	PN 10	20 × M 24	155	171
500	PN 16	20 × M 30	275	300
500	PN 25	20 × M 33	317	360
600	PN 6	20 × M 24	139	147
600	PN 10	20 × M 27	206	219
600 *	PN 16	20 × M 33	415	443
600	PN 25	20 × M 36	431	516
700	PN 6	24 × M 24	148	139
700	PN 10	24 × M 27	246	246
700	PN 16	24 × M 33	278	318
700	PN 25	24 × M 39	449	507
800	PN 6	24 × M 27	206	182
800	PN 10	24 × M 30	331	316
800	PN 16	24 × M 36	369	385
800	PN 25	24 × M 45	664	721
900	PN 6	24 × M 27	230	637
900	PN 10	28 × M 30	316	307
900	PN 16	28 × M 36	353	398
900	PN 25	28 × M 45	690	716
1000	PN 6	28 × M 27	218	208
1000	PN 10	28 × M 33	402	405
1000	PN 16	28 × M 39	502	518
1000	PN 25	28 × M 52	970	971
1200	PN 6	32 × M 30	319	299
1200	PN 10	32 × M 36	564	568
1200	PN 16	32 × M 45	701	753
1400	PN 6	36 × M 33	430	398
1400	PN 10	36 × M 39	654	618
1400	PN 16	36 × M 45	729	762
1600	PN 6	40 × M 33	440	417
1600	PN 10	40 × M 45	946	893
1600	PN 16	40 × M 52	1007	1100
1800	PN 6	44 × M 36	547	521
1800	PN 10	44 × M 45	961	895
1800	PN 16	44 × M 52	1108	1003
2000	PN 6	48 × M 39	629	605
2000	PN 10	48 × M 45	1047	1092
2000	PN 16	48 × M 56	1324	1261
* Designed acc. to EN 1092-1 (not to DIN 2501)				

Promag W tightening torques for ANSI

Nominal diameter		ANSI Pressure rating [lbs]	Threaded fasteners	Max. tightening torque			
[mm]	[inch]			Hard rubber		Polyurethane	
				[Nm]	[lbf · ft]	[Nm]	[lbf · ft]
25	1"	Class 150	4 × ½"	-	-	7	5
25	1"	Class 300	4 × 5/8"	-	-	8	6
40	1 ½"	Class 150	4 × ½"	-	-	10	7
40	1 ½"	Class 300	4 × ¾"	-	-	15	11
50	2"	Class 150	4 × 5/8"	35	26	22	16
50	2"	Class 300	8 × 5/8"	18	13	11	8
80	3"	Class 150	4 × 5/8"	60	44	43	32
80	3"	Class 300	8 × ¾"	38	28	26	19
100	4"	Class 150	8 × 5/8"	42	31	31	23
100	4"	Class 300	8 × ¾"	58	43	40	30
150	6"	Class 150	8 × ¾"	79	58	59	44
150	6"	Class 300	12 × ¾"	70	52	51	38
200	8"	Class 150	8 × ¾"	107	79	80	59
250	10"	Class 150	12 × 7/8"	101	74	75	55
300	12"	Class 150	12 × 7/8"	133	98	103	76
350	14"	Class 150	12 × 1"	135	100	158	117
400	16"	Class 150	16 × 1"	128	94	150	111
450	18"	Class 150	16 × 1 1/8"	204	150	234	173
500	20"	Class 150	20 × 1 1/8"	183	135	217	160
600	24"	Class 150	20 × 1 ¼"	268	198	307	226

Promag W tightening torques for JIS

Nominal diameter [mm]	JIS Pressure rating	Threaded fasteners	Max. tightening torque [Nm]	
			Hard rubber	Polyurethane
25	10K	4 × M 16	-	19
25	20K	4 × M 16	-	19
32	10K	4 × M 16	-	22
32	20K	4 × M 16	-	22
40	10K	4 × M 16	-	24
40	20K	4 × M 16	-	24
50	10K	4 × M 16	40	33
50	20K	8 × M 16	20	17
65	10K	4 × M 16	55	45
65	20K	8 × M 16	28	23
80	10K	8 × M 16	29	23
80	20K	8 × M 20	42	35
100	10K	8 × M 16	35	29

Nominal diameter [mm]	JIS Pressure rating	Threaded fasteners	Max. tightening torque [Nm]	
			Hard rubber	Polyurethane
100	20K	8 × M 20	56	48
125	10K	8 × M 20	60	51
125	20K	8 × M 22	91	79
150	10K	8 × M 20	75	63
150	20K	12 × M 22	81	72
200	10K	12 × M 20	61	52
200	20K	12 × M 22	91	80
250	10K	12 × M 22	100	87
250	20K	12 × M 24	159	144
300	10K	16 × M 22	74	63
300	20K	16 × M 24	138	124

Promag W tightening torques for AWWA

Nominal diameter		AWWA Pressure rating	Threaded fasteners	Max. tightening torque			
				Hard rubber		Polyurethane	
[mm]	[inch]			[Nm]	[lbf · ft]	[Nm]	[lbf · ft]
700	28"	Class D	28 × 1 ¼"	247	182	292	215
750	30"	Class D	28 × 1 ¼"	287	212	302	223
800	32"	Class D	28 × 1 ½"	394	291	422	311
900	36"	Class D	32 × 1 ½"	419	309	430	317
1000	40"	Class D	36 × 1 ½"	420	310	477	352
1050	42"	Class D	36 × 1 ½"	528	389	518	382
1200	48"	Class D	44 × 1 ½"	552	407	531	392
1350	54"	Class D	44 × 1 ¾"	730	538	633	467
1500	60"	Class D	52 × 1 ¾"	758	559	832	614
1650	66"	Class D	52 × 1 ¾"	946	698	955	704
1800	72"	Class D	60 × 1 ¾"	975	719	1087	802
2000	78"	Class D	64 × 2"	853	629	786	580

Promag W tightening torques for AS 2129

Nominal diameter [mm]	AS 2129 Pressure rating	Threaded fasteners	Max. tightening torque [Nm] Hard rubber
50	Table E	4 × M 16	32
80	Table E	4 × M 16	49
100	Table E	8 × M 16	38
150	Table E	8 × M 20	64
200	Table E	8 × M 20	96
250	Table E	12 × M 20	98
300	Table E	12 × M 24	123

Nominal diameter [mm]	AS 2129 Pressure rating	Threaded fasteners	Max. tightening torque [Nm] Hard rubber
350	Table E	12 × M 24	203
400	Table E	12 × M 24	226
450	Table E	16 × M 24	226
500	Table E	16 × M 24	271
600	Table E	16 × M 30	439
700	Table E	20 × M 30	355
750	Table E	20 × M 30	559
800	Table E	20 × M 30	631
900	Table E	24 × M 30	627
1000	Table E	24 × M 30	634
1200	Table E	32 × M 30	727

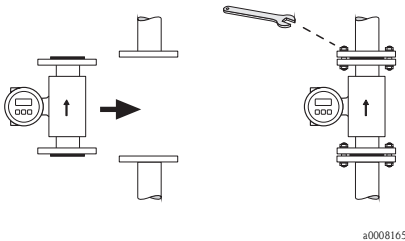
Promag W tightening torques for AS 4087

Nominal diameter [mm]	AS 4087 Pressure rating	Threaded fasteners	Max. tightening torque [Nm] Hard rubber
50	Table E	4 × M 16	32
80	PN 16	4 × M 16	49
100	PN 16	4 × M 16	76
150	PN 16	8 × M 20	52
200	PN 16	8 × M 20	77
250	PN 16	8 × M 20	147
300	PN 16	12 × M 24	103
350	PN 16	12 × M 24	203
375	PN 16	12 × M 24	137
400	PN 16	12 × M 24	226
450	PN 16	12 × M 24	301
500	PN 16	16 × M 24	271
600	PN 16	16 × M 27	393
700	PN 16	20 × M 27	330
750	PN 16	20 × M 30	529
800	PN 16	20 × M 33	631
900	PN 16	24 × M 33	627
1000	PN 16	24 × M 33	595
1200	PN 16	32 × M 33	703

2.5 Installing the Promag P sensor

☞ Caution!

- The plates mounted on the two sensor flanges protect the PTFE which is turned over the flanges and, consequently, should not be removed until **immediately prior** to mounting the sensor.
- The protective plates must always remain mounted while the device is in storage.
- Make sure that the lining at the flange is not damaged or removed.



✎ Note!

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

The sensor is installed between the two pipe flanges:

- The requisite torques must be observed → 25
- If grounding disks are used, follow the mounting instructions which will be enclosed with the shipment.

2.5.1 Seals

Comply with the following instructions when installing seals:

- **No** seals are required for PFA or PFTE measuring tube lining.
- For DIN flanges, only use seals to DIN EN 1514-1.
- Make sure that the mounted seals do not protrude into the piping cross-section.

☞ Caution!

Risk of short circuit! Do not use electrically conductive sealing compounds such as graphite! An electrically conductive layer could form on the inside of the measuring tube and short-circuit the measuring signal.

2.5.2 Ground cable

If necessary, special ground cables can be ordered as accessories for potential equalization.

2.5.3 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 in the Operating Instructions of the CD-ROM

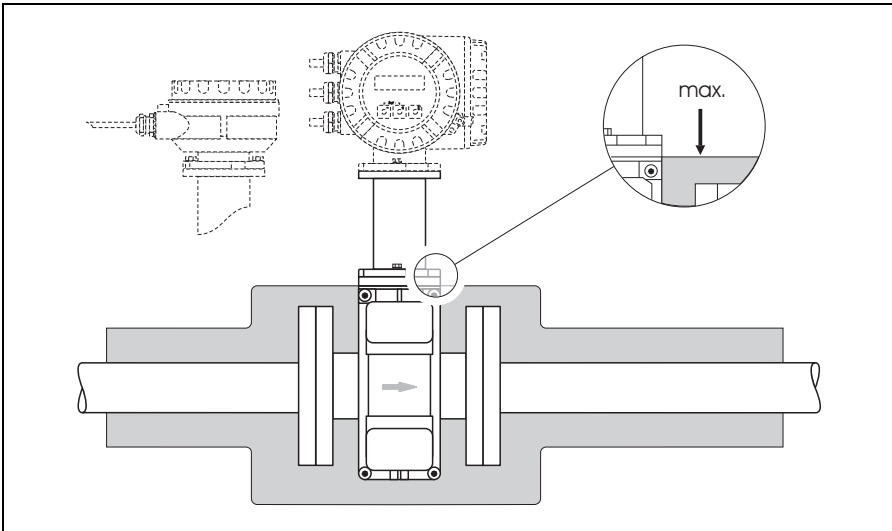
Insulation

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.



2.5.4 Tightening torques for threaded fasteners (Promag P)

Please note the following:

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

Promag P tightening torques for EN (DIN)

Nominal diameter [mm]	EN (DIN) Pressure rating [bar]	Threaded fasteners	Max. tightening torque [Nm]	
			PTFE	PFA
15	PN 40	4 × M 12	11	–
25	PN 40	4 × M 12	26	20
32	PN 40	4 × M 16	41	35
40	PN 40	4 × M 16	52	47
50	PN 40	4 × M 16	65	59
65 *	PN 16	8 × M 16	43	40
65	PN 40	8 × M 16	43	40
80	PN 16	8 × M 16	53	48
80	PN 40	8 × M 16	53	48
100	PN 16	8 × M 16	57	51
100	PN 40	8 × M 20	78	70
125	PN 16	8 × M 16	75	67
125	PN 40	8 × M 24	111	99
150	PN 16	8 × M 20	99	85
150	PN 40	8 × M 24	136	120
200	PN 10	8 × M 20	141	101
200	PN 16	12 × M 20	94	67
200	PN 25	12 × M 24	138	105
250	PN 10	12 × M 20	110	–
250	PN 16	12 × M 24	131	–
250	PN 25	12 × M 27	200	–
300	PN 10	12 × M 20	125	–
300	PN 16	12 × M 24	179	–
300	PN 25	16 × M 27	204	–
350	PN 10	16 × M 20	188	–
350	PN 16	16 × M 24	254	–
350	PN 25	16 × M 30	380	–
400	PN 10	16 × M 24	260	–
400	PN 16	16 × M 27	330	–
400	PN 25	16 × M 33	488	–
450	PN 10	20 × M 24	235	–
450	PN 16	20 × M 27	300	–

Nominal diameter [mm]	EN (DIN) Pressure rating [bar]	Threaded fasteners	Max. tightening torque [Nm]	
			PTFE	PFA
450	PN 25	20 × M 33	385	–
500	PN 10	20 × M 24	265	–
500	PN 16	20 × M 30	448	–
500	PN 25	20 × M 33	533	–
600	PN 10	20 × M 27	345	–
600 *	PN 16	20 × M 33	658	–
600	PN 25	20 × M 36	731	–

* Designed acc. to EN 1092-1 (not to DIN 2501)

Promag P tightening torques for ANSI

Nominal diameter		ANSI Pressure rating [lbs]	Threaded fasteners	Max. tightening torque			
				PTFE		PFA	
[mm]	[inch]			[Nm]	[lbf · ft]	[Nm]	[lbf · ft]
15	½"	Class 150	4 × ½"	6	4	–	–
15	½"	Class 300	4 × ½"	6	4	–	–
25	1"	Class 150	4 × ½"	11	8	10	7
25	1"	Class 300	4 × 5/8"	14	10	12	9
40	1 ½"	Class 150	4 × ½"	24	18	21	15
40	1 ½"	Class 300	4 × ¾"	34	25	31	23
50	2"	Class 150	4 × 5/8"	47	35	44	32
50	2"	Class 300	8 × 5/8"	23	17	22	16
80	3"	Class 150	4 × 5/8"	79	58	67	49
80	3"	Class 300	8 × ¾"	47	35	42	31
100	4"	Class 150	8 × 5/8"	56	41	50	37
100	4"	Class 300	8 × ¾"	67	49	59	44
150	6"	Class 150	8 × ¾"	106	78	86	63
150	6"	Class 300	12 × ¾"	73	54	67	49
200	8"	Class 150	8 × ¾"	143	105	109	80
250	10"	Class 150	12 × 7/8"	135	100	–	–
300	12"	Class 150	12 × 7/8"	178	131	–	–
350	14"	Class 150	12 × 1"	260	192	–	–
400	16"	Class 150	16 × 1"	246	181	–	–
450	18"	Class 150	16 × 1 1/8"	371	274	–	–
500	20"	Class 150	20 × 1 1/8"	341	252	–	–
600	24"	Class 150	20 × 1 ¼"	477	352	–	–

Promag P tightening torques for JIS

Nominal diameter [mm]	JIS Pressure rating	Threaded fasteners	Max. tightening torque [Nm]	
			PTFE	PFA
25	10K	4 × M 16	32	27
25	20K	4 × M 16	32	27
32	10K	4 × M 16	38	–
32	20K	4 × M 16	38	–
40	10K	4 × M 16	41	37
40	20K	4 × M 16	41	37
50	10K	4 × M 16	54	46
50	20K	8 × M 16	27	23
65	10K	4 × M 16	74	63
65	20K	8 × M 16	37	31
80	10K	8 × M 16	38	32
80	20K	8 × M 20	57	46
100	10K	8 × M 16	47	38
100	20K	8 × M 20	75	58
125	10K	8 × M 20	80	66
125	20K	8 × M 22	121	103
150	10K	8 × M 20	99	81
150	20K	12 × M 22	108	72
200	10K	12 × M 20	82	54
200	20K	12 × M 22	121	88
250	10K	12 × M 22	133	–
250	20K	12 × M 24	212	–
300	10K	16 × M 22	99	–
300	20K	16 × M 24	183	–

Promag P tightening torques for AS 2129


Nominal diameter [mm]	AS 2129 Pressure rating	Threaded fasteners	Max. tightening torque [Nm] PTFE
25	Table E	4 × M 12	21
50	Table E	4 × M 16	42

Promag P tightening torques for AS 4087

Nominal diameter [mm]	AS 4087 Pressure rating	Threaded fasteners	Max. tightening torque [Nm] PTFE
50	PN 16	4 × M 16	42


2.6 Installing the Promag H sensor

Depending on the order specifications, the sensor is supplied with or without ready-mounted process connections. Mounted process connections are fixed to the sensor with 4 or 6 hexagonal-headed bolts.

-  **Caution!**
Depending on the application and length of the pipe, the sensor may have to be supported or additionally secured. The sensor must be secured if using plastic process connections. An appropriate wall mounting kit can be ordered separately from Endress+Hauser as an accessory.

2.6.1 Seals


When mounting the process connections, make sure that the seals in question are free from dirt and centered correctly.

-  **Caution!**
- The screws must be securely tightened in the case of metal process connections. Together with the sensor, the process connection forms a metal connection that ensures defined seal compression.
 - With regard to process connections made of plastic material, comply with the max. torques for lubricated threads (7 Nm / 5.2 lbf ft). A seal must always be used between the connection and counterflange for plastic flanges.
 - The seals should be replaced periodically depending on the application, particularly if molded seals are used (aseptic version)! The intervals between seal replacement depend on the frequency of the cleaning cycles and the fluid and cleaning temperatures. Replacement seals can be ordered as an accessory.

2.6.2 Using and mounting grounding rings (DN 2 to 25, 1/12" to 1")

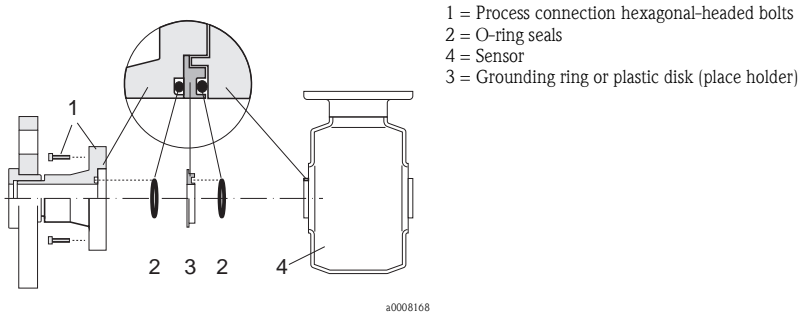
In the case of process connections made of plastic (e.g. flange connections or adhesive couplings), potential equalization between the sensor and fluid must be ensured via additional grounding rings.

If grounding rings are missing, this can affect accuracy or result in the destruction of the sensor due to electrochemical electrode reduction.

-  **Caution!**
- Depending on the order option, appropriate plastic disks are used instead of grounding rings for the process connections. These plastic disks only act as a kind of "place holder" and do not have any potential equalization function whatsoever. In addition, they also assume an important sealing function at the sensor/connection interface. Thus, these plastic disks/seals should never be removed and should always be mounted for process connections without metal grounding rings!
 - Grounding rings can be ordered separately from Endress+Hauser as an accessory. When ordering, make sure that the grounding rings are compatible with the electrode material. Otherwise there is the risk that electrodes can be damaged by electrochemical corrosion! For information on materials, see the Operating Instructions on the CD-ROM.

- Grounding rings, incl. seals, are mounted inside the process connections.
 The face-to-face length is not affected.

Installing the grounding rings



- Release the 4 or 6 hexagonal-headed bolts (1) and remove the process connection from the sensor (4).
- Remove the plastic disk (3) including the two O-ring seals (2) from the process connection.
- Insert one of the O-ring seals (2) back into the groove of the process connection.
- Place the metal grounding ring (3) into the process connection as illustrated.
- Now insert the second O-ring seal (2) into the groove of the grounding ring.
- Mount the process connection back onto the sensor. In doing so, make sure to observe the max. torques for lubricated threads (7 Nm) (5.2 lbf ft).

2.6.3 Welding the sensor into the pipe (weld nipples)



Caution!

Risk of destroying the electronics! Make sure that the welding system is not grounded via the sensor or transmitter.

- Secure the sensor with a few welding points in the pipe.
 A welding jig suitable for this purpose can be ordered separately as an accessory.
- Release the screws on the process connection flange and remove the sensor, including the seal, from the pipe.
- Weld the process connection into the pipe.
- Mount the sensor back into the pipe.
 In doing so, make sure the seals are clean and correctly positioned.



Note!

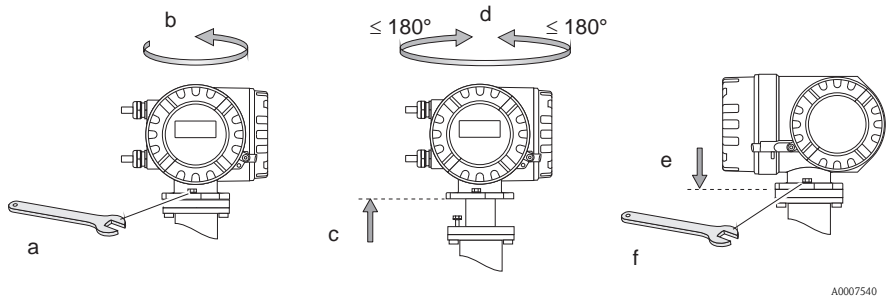
- When welding is performed correctly with thin-walled pipes carrying food, the seal is not damaged by the heat even when it is mounted. It is recommended, however, to disassemble the sensor and seal.
- For the disassembly work, it must be possible to open the pipe approx. 8 mm (0.31 in) in total.

2.7 Installing the transmitter housing

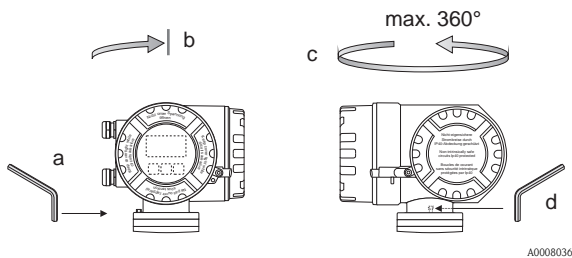
2.7.1 Turning the transmitter housing

Turning the aluminum field housing

Aluminum field housing for non-Ex area



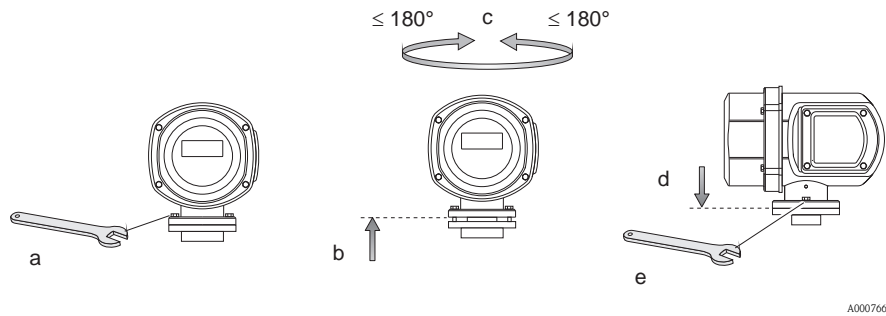
Aluminum field housing for Zone 1 or Class I Div. 1



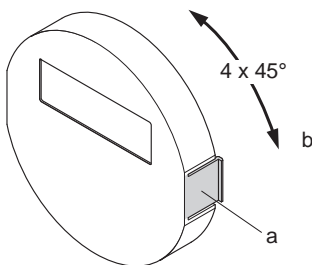
For Zone 1 or Class I Div. 1:

- a. Release the setscrew.
- b. Turn the transmitter housing gently clockwise until the stop (end of the thread).
- c. Turn the transmitter counterclockwise (max. 360°) to the desired position.
- d. Retighten the setscrew.

Turning the stainless steel field housing



2.7.2 Turning the onsite display



- Press in the side latches on the display module and remove the module from the cover plate of the electronics compartment.
- Turn the display to the desired position (max. $4 \times 45^\circ$ in both directions) and reset it onto the cover plate of the electronics compartment.

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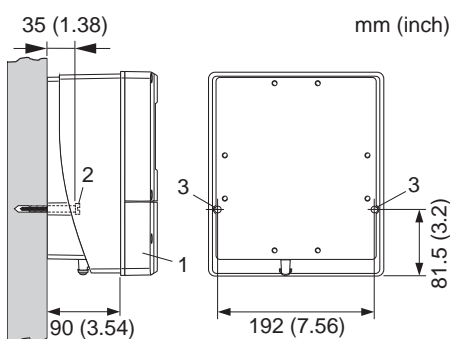
2.7.3 Installing the wall-mount housing



Caution!

- Make sure that the ambient temperature does not exceed the permitted range.
- Always install the wall-mount housing in such a way that the cable entries point downwards.

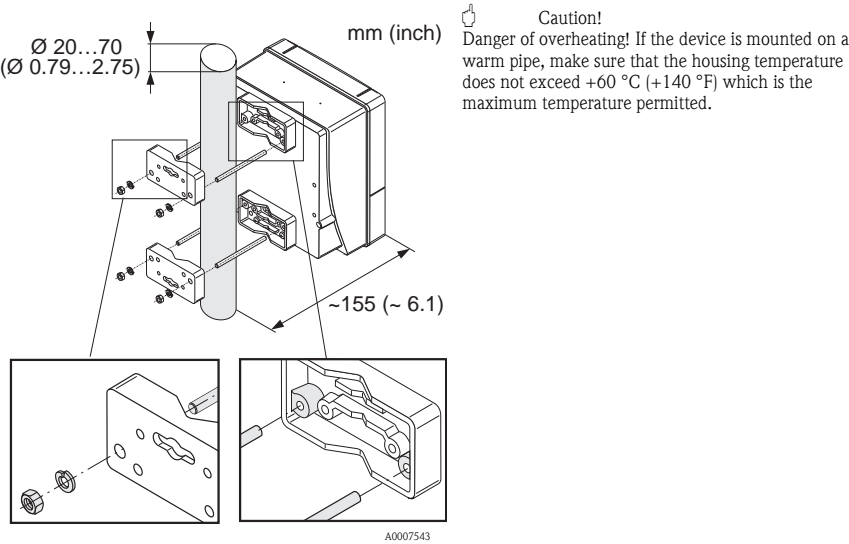
Mounted directly on the wall



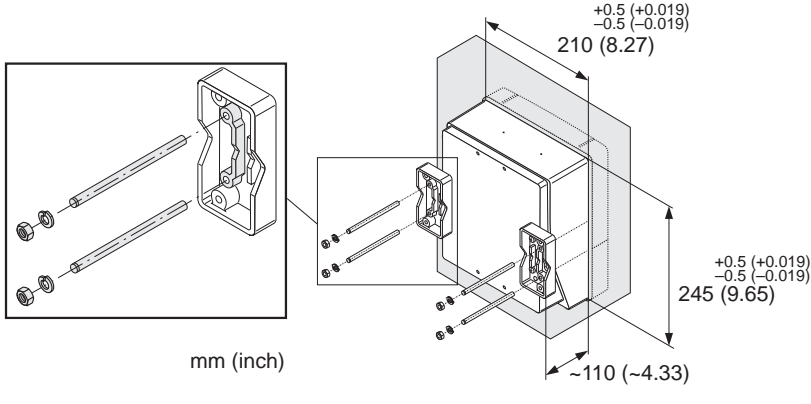
- Connection compartment
- Securing screws M6 (max. \varnothing 6.5 mm (0.25")); screw head max. \varnothing 10.5 mm (0.4")
- Housing bores for securing screws

A0007542

Pipe mounting



Panel mounting



2.8 Post-installation check

- Is the measuring 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.?
- Does the arrow on the sensor nameplate match the actual direction of flow through the pipe?
- Is the position of the measuring electrode plane correct?
- Were all screws tightened to the specified torques when the sensor was installed?
- Were the correct seals used (type, material, installation)?
- Are the measuring point number and labeling correct (visual inspection)?
- Were the inlet and outlet runs respected?
 - Inlet run $\geq 5 \times \text{DN}$
 - Outlet run $\geq 2 \times \text{DN}$
- 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 600 68-2-8

3 Wiring



Warning!

Risk of electric shock! Components carry dangerous voltages.

- Never mount or wire the measuring device while it is connected to the power supply.
- Before connecting the power supply, check the safety equipment.
- Route the power supply and signal cables so they are securely seated.
- Seal the cable entries and covers tight.



Caution!

Risk of damaging the electronic components!

- Connect the power supply in accordance with the connection data on the nameplate.
- Connect the signal cable in accordance with the connection data in the Operating Instructions or the Ex documentation on the CD-ROM.

In addition, for the remote version



Caution!

Risk of damaging the electronic components!

- Only connect sensors and transmitters with the same serial number.
- Observe the cable specifications of the connecting cable → Operating Instructions on the CD-ROM.



Note!

Install the connecting cable securely to prevent movement.

In addition, for measuring devices with fieldbus communication



Caution!

Risk of damaging the electronic components!

- Observe the cable specification of the fieldbus cable → Operating Instructions on the CD-ROM.
- Keep the stripped and twisted lengths of cable shield as short as possible.
- Screen and ground the signal lines → Operating Instructions on the CD-ROM.
- When using in systems without potential equalization → Operating Instructions on the CD-ROM.

In addition, for Ex-certified measuring devices



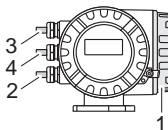
Warning!

When wiring Ex-certified measuring devices, all the safety instructions, wiring diagrams, technical information etc. of the related Ex documentation must be observed
→ Ex documentation on the CD-ROM.

3.1 Connecting the various housing types

Wire the unit using the terminal assignment diagram inside the cover.

3.1.1 Compact version

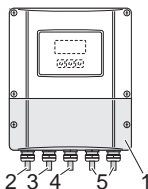


A0007545

Transmitter connection:

- 1 Connection diagram inside the connection compartment cover
- 2 Power supply cable
- 3 Signal cable or fieldbus cable
- 4 Optional

3.1.2 Remote version (transmitter): non-Ex Zone, Ex Zone 2, Class I Div. 2



A0012690

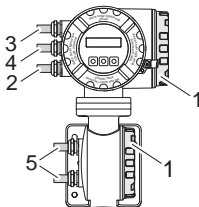
Transmitter connection:

- 1 Connection diagram inside the connection compartment cover
- 2 Power supply cable
- 3 Signal cable
- 4 Fieldbus cable

Connecting the connecting cable (→ 36):

- 5 Sensor/transmitter connecting cable

3.1.3 Remote version (transmitter): Ex Zone 1, Class I Div. 1



A0008218

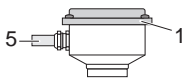
Transmitter connection:

- 1 Connection diagram inside the connection compartment cover
- 2 Power supply cable
- 3 Signal cable or fieldbus cable
- 4 Optional

Connecting the connecting cable (→ 36):

- 5 Sensor/transmitter connecting cable

3.1.4 Remote version (sensor)



A0008037

Transmitter connection:

- 1 Connection diagram inside the connection compartment cover

Connecting cable connection:

- 5 Sensor/transmitter connecting cable

3.2 Connecting the remote version connecting cable

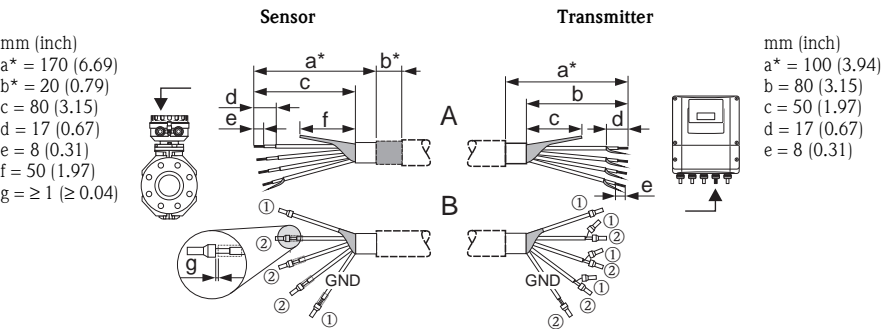
3.2.1 Connecting cable for Promag W, P and L

Connecting cable termination

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

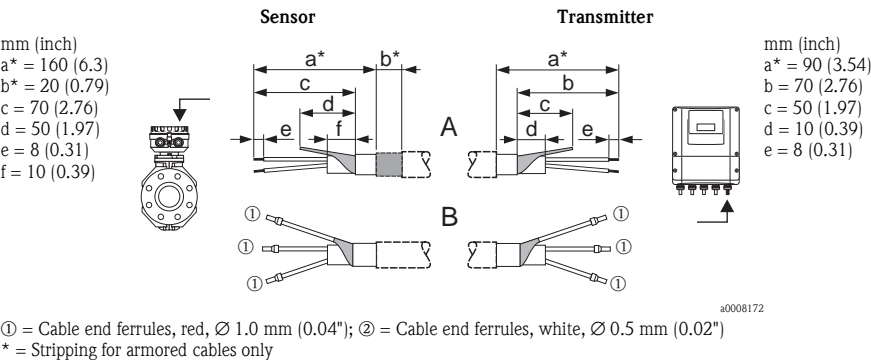
Signal cable termination

Make sure that the cable end ferrules do not touch the wire shields on the sensor side! Minimum distance = 1 mm (0.04 in), exception "GND" = green cable.



Coil current cable termination

Insulate one core of the three-core cable at the level of the core reinforcement; you only require two cores for the connection.



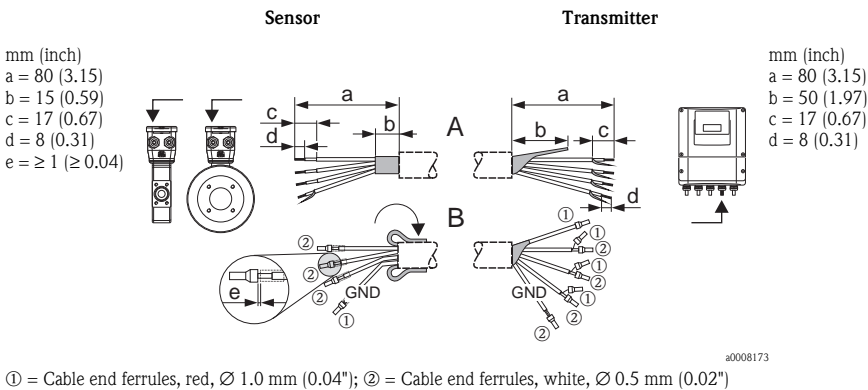
3.2.2 Promag H connecting cable

Connecting cable termination

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

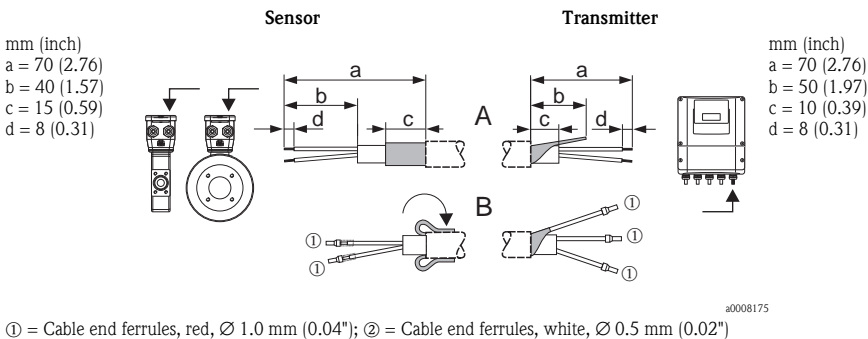
Signal cable termination

Make sure that the cable end ferrules do not touch the wire shields on the sensor side! Minimum distance = 1 mm (0.04 in), exception "GND" = green cable.



Coil current cable termination

Insulate one core of the three-core cable at the level of the core reinforcement; you only require two cores for the connection.



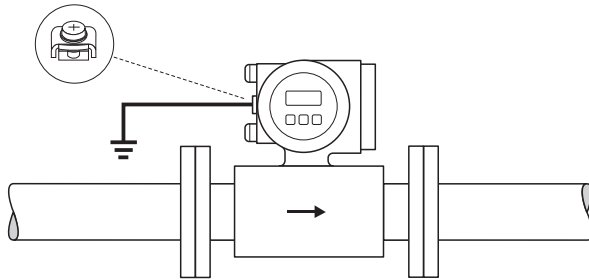
3.3 Potential equalization

Perfect measurement is only ensured when the medium and the sensor have the same electrical potential. Most sensors have a reference electrode installed as standard, which guarantees the required potential connection. This usually means that the use of ground disks or other measures are unnecessary.

- Promag L, Promag W and Promag P
Reference electrode available as standard.
- Promag H
 - No reference electrode available. There is always an electrical connection to the fluid via the metal process connection.
 - In the case of plastic process connections, potential equalization must be ensured through the use of grounding rings.

Standard situation

Potential equalization takes place via the ground terminal of the transmitter when using the device in metal, grounded pipes.



A0004375



Note!

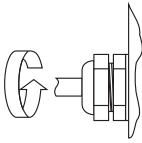
Potential equalization for other areas of application → Operating Instructions on the CD-ROM.

3.4 Degree of protection

The devices meet all the requirements for IP 67.

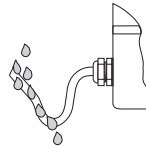
After mounting in the field or service work, the following points have to be observed to ensure that IP 67 protection is retained:

- Install the measuring device in such a way that the cable entries do not point upwards.
- Do not remove the seal from the cable entry.
- Remove all unused cable entries and plug them with suitable/certified drain plugs.
- Use cable entries and drain plugs with a long-term operating temperature range in accordance with the temperature specified on the nameplate.



A0007549

Tighten the cable entries correctly.



A0007550

The cables must loop down before they enter the cable entries ("water trap").

3.5 Post-connection check

- Are cables or the device damaged (visual inspection)?
- Does the supply voltage match the information on the nameplate?
- Do the cables used comply with the necessary specifications?
- Do the mounted cables have adequate strain relief and are they routed securely?
- Is the cable type route completely isolated? Without loops and crossovers?
- Only remote version:
 - Is the flow sensor connected to the matching transmitter electronics?
 - Is the connecting cable between sensor and transmitter connected correctly?
- Are all screw terminals firmly tightened?
- Have all the measures for grounding and potential equalization been correctly implemented?
- Are all cable entries installed, firmly tightened and correctly sealed?
- Cable routed as a "water trap" in loops?
- Are all the housing covers installed and securely tightened?

In addition, for measuring devices with fieldbus communication:

- 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 specifications?
- Has the max. length of the spurs been observed in accordance with the specifications?
- Is the fieldbus cable fully shielded and correctly grounded?

4 Hardware settings

This section only deals with the hardware settings needed for commissioning. All other settings (e.g. output configuration, write protection, etc.) are described in the associated Operating Instructions on the CD-ROM.



Note!

No hardware settings are needed for measuring devices with HART or FOUNDATION Fieldbus-type communication.

4.1 Device address

Has to be set for measuring devices with the following communication methods:

- PROFIBUS DP/PA

The device address can be configured via:

- Miniature switches → see description below
- Local operation → see **Software settings section** → 48

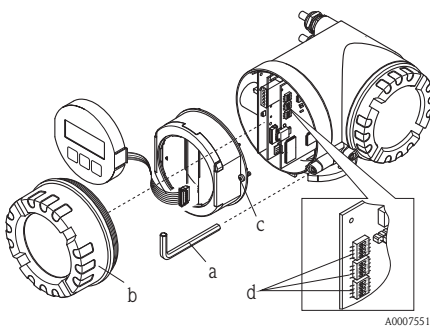
Addressing via miniature switches



Warning!

Risk of electric shock! Risk of damaging the electronic components!

- All the safety instructions for the measuring device must be observed and all the warnings heeded → 34.
- Use a workspace, working environment and tools purposely designed for electrostatically sensitive devices.



Warning!

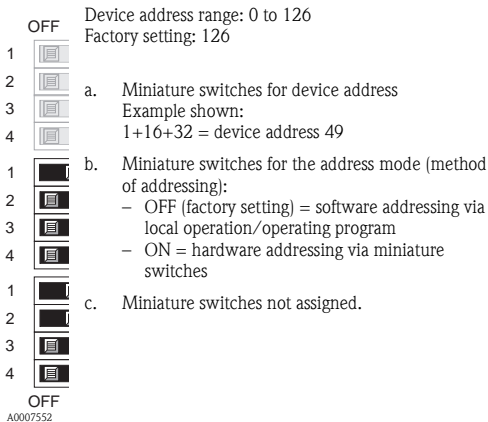
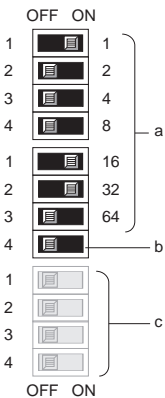
Switch off the power supply before opening the device.

- a. Loosen the cheese head screw of the securing clamp with an Allen key (3 mm)
- b. Unscrew cover of the electronics compartment from the transmitter housing.
- c. Loosen the securing screws of the display module and remove the onsite display (if present).
- d. Set the position of the miniature switches on the I/O board using a sharp pointed object.

Installation is the reverse of the removal procedure.

A0007551

PROFIBUS



4.2 Terminating resistors



Note!

If the measuring device is used at the end of a bus segment, termination is required. This can be performed in the measuring device by setting the terminating resistors on the I/O board. Generally, however, it is recommended to use an external bus terminator and not perform termination at the measuring device itself.

Has to be set for measuring devices with the following communication methods:

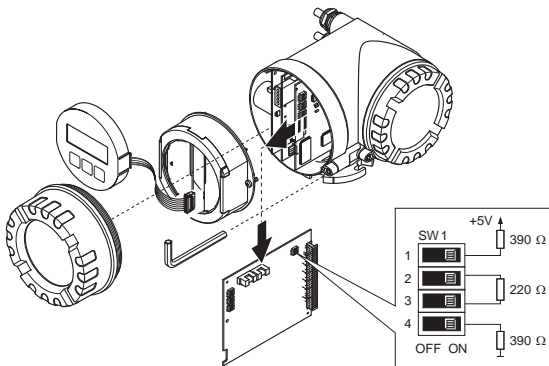
- PROFIBUS DP
 - Baudrate ≤ 1.5 MBaud \rightarrow Termination can be performed at the measuring device, see graphic
 - Baudrate > 1.5 MBaud \rightarrow An external bus terminator must be used



Warning!

Risk of electric shock! Risk of damaging the electronic components!

- All the safety instructions for the measuring device must be observed and all the warnings heeded \rightarrow 34.
- Use a workspace, working environment and tools purposely designed for electrostatically sensitive devices.



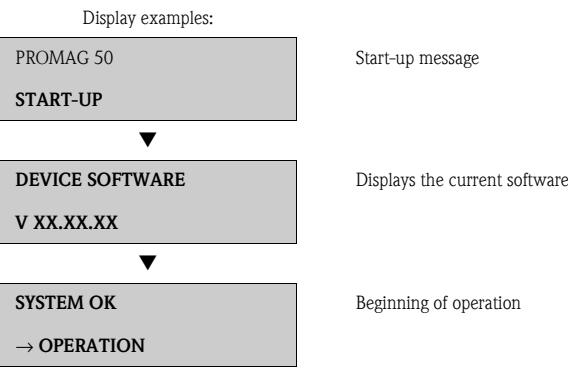
A0007556

5 Commissioning

5.1 Switching on the measuring device

On completion of the installation (successful post-installation check), wiring (successful post-connection check) and after making the necessary hardware settings, where applicable, the permitted power supply (see nameplate) can be switched on for the measuring device.

When the power supply is switched on, the measuring device performs a number of power-up checks and device self-checks. As this procedure progresses the following messages can appear on the onsite display:



The measuring device starts operating as soon as the startup procedure is complete. Various measured values and/or status variables appear on the display.

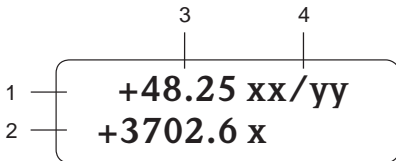


Note!

If an error occurs during startup, this is indicated by an error message. The error messages that occur most frequently when a measuring device is commissioned are described in the Troubleshooting section → 48.

5.2 Operation

5.2.1 Display elements

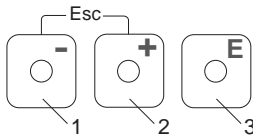


A0007557

Display lines/fields

1. Main line for primary measured values
2. Additional line for additional measured variables/status variables
3. Current measured values
4. Engineering units/time units

5.2.2 Operating elements



A0007559

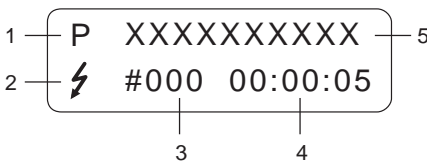
Operating keys

1. (-) Minus key for entering, selecting
2. (+) Plus key for entering, selecting
3. Enter key for calling the function matrix, saving

When the +/- keys are pressed simultaneously (Esc):

- Exit the function matrix step-by-step:
- > 3 sec. = cancel data input and return to the measured value display

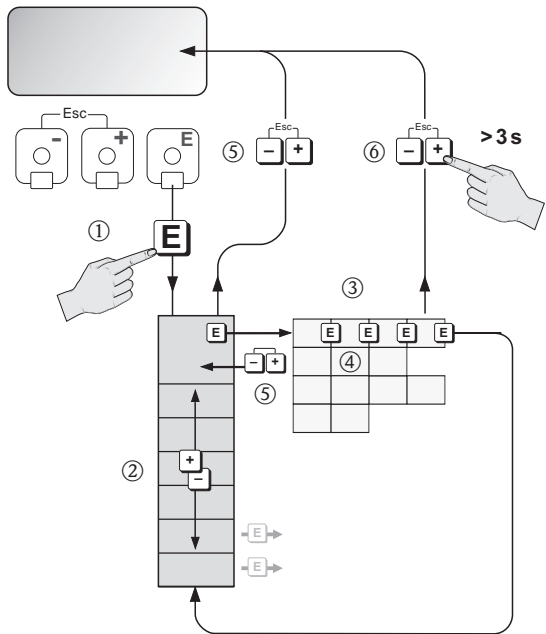
5.2.3 Displaying error messages



A0007561

1. Type of error:
P = Process error, S = System error
2. Error message type:
⚡ = Fault message, ! = Notice message
3. Error number
4. Duration of the last error that occurred:
Hours: Minutes: Seconds
5. Error designation
List of all error messages, see associated Operating Instructions on the CD-ROM

5.3 Navigating within the function matrix















A0007562

1. → Enter the function matrix (starting with measured value display)
2. → Select the group (e.g. OPERATION)
 → Confirm selection
3. → Select function (e.g. LANGUAGE)
4. → Enter code **50** (only for the first time you access the function matrix)
 → Confirm entry
- Change function/selection (e.g. ENGLISH)
 → Confirm selection
5. → Return to measured value display step by step
6. > 3 s → Return immediately to measured value display

5.4 Calling the Commissioning Quick Setup

All the functions needed for commissioning are called up automatically with the Quick Setup. The functions can be changed and adapted to the process in question.

1.  → Enter the function matrix (starting with measured value display)
2.  → Select the group QUICK SETUP
 → Confirm selection
3. QUICK SETUP COMMISSIONING function appears.
4. Intermediate step if configuration is blocked:
 → Enter the code **50** (confirm with ) and thus enable configuration
5.  → Go to Commissioning Quick Setup
6.  → Select YES
 → Confirm selection
7.  → Start Commissioning Quick Setup
8. Configure the individual functions/settings:
 - Via -key, select option or enter number
 - Via -key, confirm entry and go to next function
 - Via -key, return to Setup Commissioning function (settings already made are retained)



Note!

Observe the following when performing the Quick Setup:

- Configuration selection: Select the ACTUAL SETTING option
- Unit selection: This is not offered again for selection after configuring a unit
- Output selection: This is not offered again for selection after configuring an output
- Automatic configuration of the display: select YES
 - Main line = Mass flow
 - Additional line = Totalizer 1
 - Information line = Operating/system conditions
- If asked whether additional Quick Setups should be executed: select NO

All the available functions of the measuring device and their configuration options as well as additional Quick Setups, if available, are described in detail in the "Description of Device Functions" Operating Instructions. The related Operating Instructions can be found on the CD-ROM.

The measuring device is ready for operation on completion of the Quick Setup.

5.5 Software settings

5.5.1 Device address

Has to be set for measuring devices with the following communication methods:

- PROFIBUS DP/PA → device address range 0 to 126, factory setting 126

The device address can be configured via:














- Miniature switches → see Hardware settings → 41
- Local operation → see description below



Note!

The COMMISSIONING SETUP must be executed before setting the device address.

Calling the Communication Quick Setup

1.  → Enter the function matrix (starting with measured value display)
2.  → Select the group QUICK SETUP
 → Confirm selection
3.  → Select the QUICK SETUP COMMUNICATION function
4. Intermediate step if configuration is blocked:  → Enter the code **50**
(confirm with ) and thus enable the configuration
5.  → Go to Communication Quick Setup
6.  → Select YES;  → confirm selection
7.  → Start Communication Quick Setup
8. Configure the individual functions/settings:
 - Via -key, select option or enter number
 - Via -key, confirm entry and go to next function
 - Via -key, return to Setup Commissioning function
(settings already made are retained)

All the available functions of the measuring device and their configuration options as well as additional Quick Setups, if available, are described in detail in the "Description of Device Functions" Operating Instructions. The related Operating Instructions can be found on the CD-ROM.

The measuring device is ready for operation on completion of the Quick Setup.

5.6 Troubleshooting

A complete description of all the error messages is provided in the Operating Instructions on the CD-ROM.



Note!

The output signals (e.g. pulse, frequency) of the measuring device must correspond to the higher-order controller.

www.endress.com/worldwide

Endress+Hauser 
People for Process Automation



Level



Pressure



Flow



Temperature

Liquid
Analysis

Registration

Systems
Components

Services



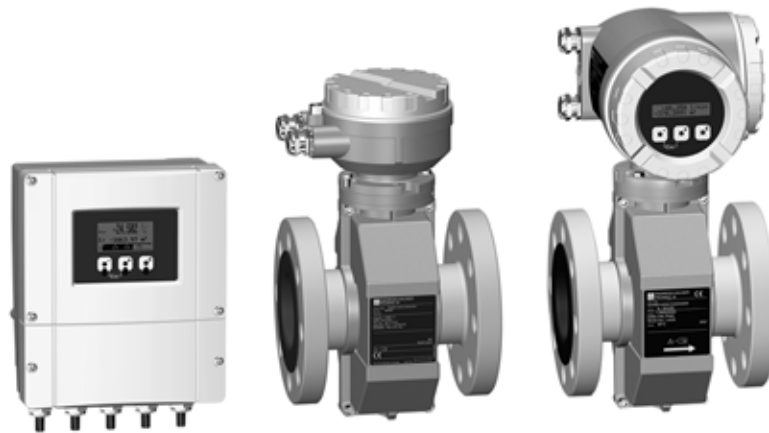
Solutions

Technical Information

Proline Promag 50W, 53W

Electromagnetic Flow Measuring System

Flow measurement in water or wastewater applications



Application

Electromagnetic flowmeter for bidirectional measurement of liquids with a minimum conductivity of $\geq 5 \mu\text{S}/\text{cm}$:

- Drinking water
- Wastewater
- Wastewater sludge
- Flow measurement up to $110,000 \text{ m}^3/\text{h}$
- Fluid temperature up to $+80^\circ\text{C}$
- Process pressures up to 40 bar
- Fitting lengths to DVGW/ISO

Application-specific lining materials:

- Polyurethane and hard rubber

Approvals for hazardous area:

- ATEX, FM, CSA

Lined measuring pipes with materials approved for drinking water:

- KTW, WRAS, NSF, ACS, etc.

Connection to process control system:

- HART, PROFIBUS DP/PA, FOUNDATION Fieldbus, MODBUS RS485

Your benefits

Promag measuring devices offer you cost-effective flow measurement with a high degree of accuracy for a wide range of process conditions.

The uniform **Proline transmitter concept** comprises:

- Modular device and operating concept resulting in a higher degree of efficiency
- Software options for electrode cleaning
- Uniform operating concept

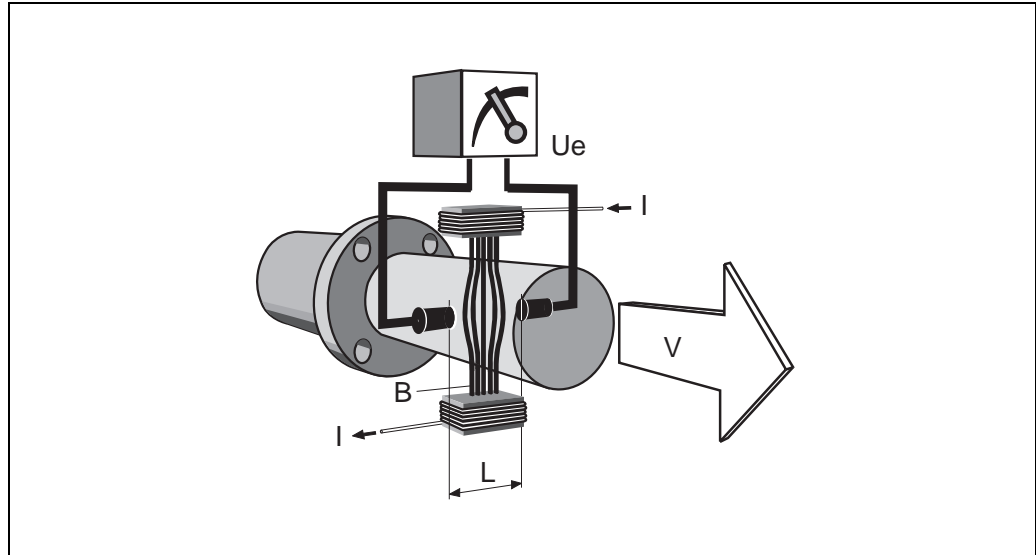
The tried-and-tested **Promag sensors** offer:

- No pressure loss
- Not sensitive to vibrations
- Simple installation and commissioning

Function and system design

Measuring principle

Faraday's law of induction states that a voltage is induced in a conductor moving in a magnetic field. In electromagnetic measuring, the flowing medium corresponds to the moving conductor. The induced voltage is proportional to the flow velocity and is detected by two measuring electrodes and transmitted to the amplifier. Flow volume is computed on the basis of the pipe's diameter. The constant magnetic field is generated by a switched direct current of alternating polarity.



$$U_e = B \cdot L \cdot v$$

$$Q = A \cdot v$$

U_e = induced voltage

B = magnetic induction (magnetic field)

L = electrode gap

v = flow velocity

Q = volume flow

A = pipe cross-section

I = current strength

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 50 (user interface with push buttons for operation, two-line display)
- Promag 53 ("Touch Control" without opening the housing, four-line display)

Sensor:

- DN 25...2000

Input

Measured variable	Flow rate (proportional to induced voltage)
Measuring range	Typically $v = 0.01 \dots 10$ m/s with the specified measuring accuracy
Operable flow range	Over 1000 : 1
Input signal	<p>Status input (auxiliary input): $U = 3 \dots 30$ V DC, $R_i = 5$ kΩ, galvanically isolated. Configurable for: totalizer(s) reset, measured value suppression, error-message reset.</p> <p>Status input (auxiliary input) with PROFIBUS DP and MODBUS RS485: $U = 3 \dots 30$ V DC, $R_i = 3$ kΩ, galvanically isolated Switching level: $3 \dots 30$ V DC, independent of polarity Configurable for: totalizer(s) reset, measured value suppression, error-message reset, batching start/stop (optional), batch totalizer reset (optional)</p> <p>Current input (for Promag 53 only): Active/passive selectable, galvanically isolated, full scale value selectable, resolution: $3 \mu\text{A}$, temperature coefficient: typ. 0.005% o.r./°C (o.r. = of reading) active: $4 \dots 20$ mA, $R_i \leq 150 \Omega$, $U_{\text{out}} = 24$ V DC, short-circuit-proof passive: $0/4 \dots 20$ mA, $R_i \leq 150 \Omega$, $U_{\text{max}} = 30$ V DC</p>

Output

Output signal	<p>Promag 50</p> <p>Current output: active/passive selectable, galvanically isolated, time constant selectable (0.01...100 s), full scale value selectable, temperature coefficient: typ. 0.005% o.r./°C (o.r. = of reading), resolution: $0.5 \mu\text{A}$</p> <ul style="list-style-type: none"> ■ active: $0/4 \dots 20$ mA, $R_L < 700 \Omega$ (HART: $R_L \geq 250 \Omega$) ■ passive: $4 \dots 20$ mA, operating voltage V_S 18...30 V DC, $R_i \leq 150 \Omega$ <p>Pulse/frequency output: passive, open collector, 30 V DC, 250 mA, galvanically isolated.</p> <ul style="list-style-type: none"> ■ Frequency output: full scale frequency $2 \dots 1000$ Hz ($f_{\text{max}} = 1250$ Hz), on/off ratio 1:1, pulse width max. 10 s. ■ Pulse output: pulse value and pulse polarity selectable, max. pulse width configurable (0.5...2000 ms) <p>PROFIBUS DP interface:</p> <ul style="list-style-type: none"> ■ Transmission technology (Physical Layer): RS485 in accordance with ANSI/TIA/EIA-485-A: 1998, galvanically isolated ■ Profile version 3.0 ■ Data transmission rate: 9.6 kBaud...12 MBaud ■ Automatic data transmission rate recognition ■ Function blocks: 1 x analog input, 3 x totalizer ■ Output data: volume flow, totalizer ■ Input data: positive zero return (ON/OFF), totalizer control, value for local display ■ Cyclic data transmission compatible with previous model "Promag 33" ■ Bus address adjustable via miniature switches or local display (optional) at the measuring device
----------------------	---

PROFIBUS PA interface:

- Transmission technology (Physical Layer): IEC 61158-2 (MBP), galvanically isolated
- Profile version 3.0
- Current consumption: 11 mA
- Permissible supply voltage: 9...32 V
- Bus connection with integrated reverse polarity protection
- Error current FDE (Fault Disconnection Electronic): 0 mA
- Function blocks: 1 x analog input, 1 x totalizer
- Output data: volume flow, totalizer
- Input data: positive zero return (ON/OFF), control totalizer, value for local display
- Cyclic data transmission compatible with previous model "Promag 33"
- Bus address adjustable via miniature switches or local display (optional) at the measuring device

Promag 53

Current output:

active/passive selectable, galvanically isolated, time constant selectable (0.01...100 s), full scale value selectable, temperature coefficient: typically 0.005% o.r./°C (o.r. = of reading), resolution: 0.5 μ A

- active: 0/4...20 mA, $R_L < 700 \Omega$ (HART: $R_L \geq 250 \Omega$)
- passive: 4...20 mA, operating voltage V_S 18...30 V DC, $R_i \leq 150 \Omega$

Pulse/frequency output:

active/passive selectable, galvanically isolated (Ex i version: only passive)

- active: 24 V DC, 25 mA (max. 250 mA during 20 ms), $R_L > 100 \Omega$
- passive: open collector, 30 V DC, 250 mA
- Frequency output: full scale frequency 2...10000 Hz ($f_{max} = 12500$ Hz), EEx-ia: 2...5000 Hz; on/off ratio 1:1; pulse width max. 10 s.
- Pulse output: pulse value and pulse polarity adjustable, pulse width configurable (0.05...2000 ms)

PROFIBUS DP interface:

- Transmission technology (Physical Layer): RS485 in accordance with ANSI/TIA/EIA-485-A: 1998, galvanically isolated
- Profile version 3.0
- Data transmission rate: 9.6 kBaud...12 MBaud
- Automatic data transmission rate recognition
- Function blocks: 2 x analog input, 3 x totalizer
- Output data: volume flow, calculated mass flow, totalizer 1...3
- Input data: positive zero return (ON/OFF), totalizer control, value for local display
- Cyclic data transmission compatible with previous model "Promag 33"
- Bus address adjustable via miniature switches or local display (optional) at the measuring device
- Available output combination → Page 7 ff.

PROFIBUS PA interface:

- Transmission technology (Physical Layer): IEC 61158-2 (MBP), galvanically isolated
- Profile version 3.0
- Current consumption: 11 mA
- Permissible supply voltage: 9...32 V
- Bus connection with integrated reverse polarity protection
- Error current FDE (Fault Disconnection Electronic): 0 mA
- Function blocks: 2 x analog input, 3 x totalizer
- Output data: volume flow, calculated mass flow, totalizer 1...3
- Input data: positive zero return (ON/OFF), totalizer control, value for local display
- Cyclic data transmission compatible with previous model "Promag 33"
- Bus address adjustable via miniature switches or local display (optional) at the measuring device

MODBUS interface:

- Transmission technology (Physical Layer): RS485 in accordance with ANSI/TIA/EIA-485-A: 1998, galvanically isolated
- MODBUS device type: Slave
- Address range: 1...247
- Bus address adjustable via miniature switches or local display (optional) at the measuring device
- Supported MODBUS function codes: 03, 04, 06, 08, 16, 23
- Broadcast: supported with the function codes 06, 16, 23
- Transmission mode: RTU oder ASCII
- Supported baudrate: 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200 Baud
- Response time:
 - Direct data access = typically 25...50 ms
 - Auto-scan buffer (data range) = typically 3...5 ms
- Available output combination → Page 7 ff.

FOUNDATION Fieldbus interface:

- FOUNDATION Fieldbus H1
- Transmission technology (Physical Layer): IEC 61158-2 (MBP), galvanically isolated
- ITK version 4.01
- Current consumption: 12 mA
- Error current FDE (Fault Disconnection Electronic): 0 mA
- Bus connection with integrated reverse polarity protection
- Function blocks: 5 x analog input, 1 x discrete output, 1 x PID
- Output data: volume flow, calculated mass flow, temperature, totalizer 1...3
- Input data: positive zero return (ON/OFF), reset totalizer
- Link Master (LM) functionality is supported

Signal on alarm

- Current output → failure response selectable (e.g. in accord. with NAMUR Recom. NE 43)
- Pulse/frequency output → failure response selectable
- Status output (Promag 50) → non-conductive by fault or power supply failure
- Relay output (Promag 53) → de-energized by fault or power supply failure

Load

See "Output signal"

Switching output

Status output (Promag 50, Promag 53):
 Open collector, max. 30 V DC / 250 mA, galvanically isolated.
 Configurable for: error messages, Empty Pipe Detection (EPD), flow direction, limit values.

Relay outputs (Promag 53):
 Normally closed (NC or break) or normally open (NO or make) contacts available
 (default: relay 1 = NO, relay 2 = NC),
 max. 30 V / 0.5 A AC; 60 V / 0.1 A DC, galvanically isolated.
 Configurable for: error messages, Empty Pipe Detection (EPD), flow direction, limit values, batching contacts.

Low flow cutoff

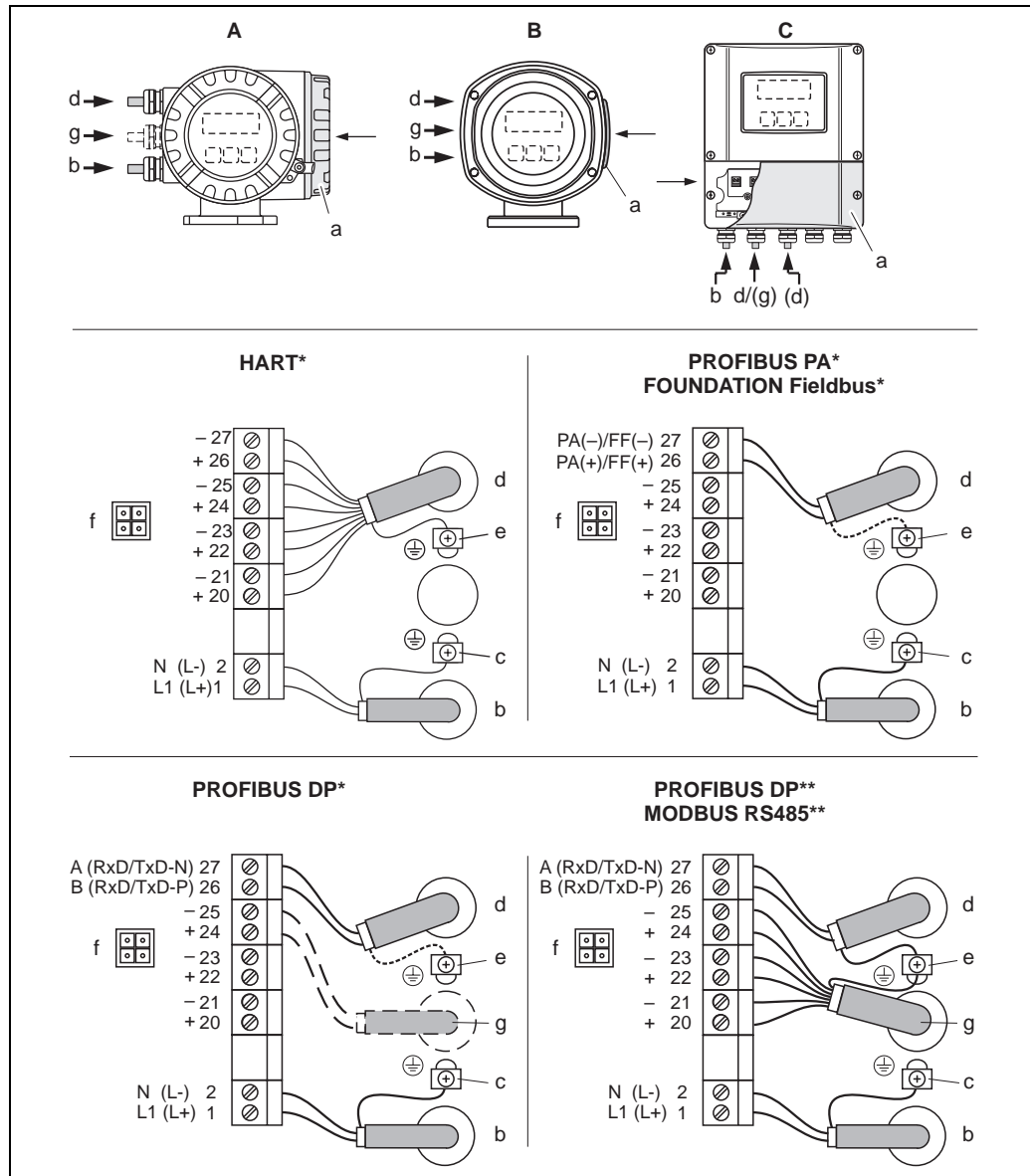
Switch points for low flow cutoff are selectable

Galvanic isolation

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

Power supply

Electrical connection Measuring unit



Anschließen des Messumformers, Leitungsquerschnitt max. 2,5 mm²

80002441

A View A (field housing)

B View B (stainless steel field housing)

C View C (wall-mount housing)

*) not changeable communication board

**) changeable communication board

a Cover of the connection compartment

b 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

c Ground terminal for protective conductor

d Signal cable: see Terminal assignment → Page 7 ff.

Fieldbus cable:

Terminal No. 26: DP (A) / PA (+) / FF (+) / MODBUS RS485 (A) / (PA, FF: with reverse polarity protection)

Terminal No. 27: DP (B) / PA (-) / FF (-) / MODBUS RS485 (B) / (PA, FF: with reverse polarity protection)

e Ground terminal for signal-cable shield / Fieldbus cable / RS485 line

f Service connector for connecting service interface FXA 193 (Fieldcheck, Tof Tool - Fieldtool Package)

g Signal cable: see Terminal assignment → Page 7 ff.

Cable for external termination (only for PROFIBUS DP with fixed assignment communication board):

Terminal No. 24: +5 V

Terminal No. 25: DGND

Terminal assignment, Promag 50

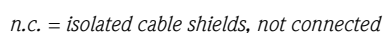
Order variant	Terminal No. (inputs / outputs)			
	20 (+) / 21 (-)	22 (+) / 23 (-)	24 (+) / 25 (-)	26 (+) / 27 (-)
50***_*****W	–	–	–	Current output HART
50***_*****A	–	–	Frequency output	Current output HART
50***_*****D	Status input	Status output	Frequency output	Current output HART
50***_*****H	–	–	–	PROFIBUS PA
50***_*****J	–	–	+5 V (external termination)	PROFIBUS DP
50***_*****S	–	–	Frequency output Ex i, passive	Current output Ex i active, HART
50***_*****T	–	–	Frequency output Ex i, passive	Current output Ex i passive, HART
Ground connection, power supply → Page 6				

Terminal assignment, Promag 53

The inputs and outputs on the communication board can be either permanently assigned or variable, depending on the version ordered (see table). Replacements for modules which are defective or which have to be replaced can be ordered as accessories.

Order variant	Terminal No. (inputs / outputs)			
	20 (+) / 21 (-)	22 (+) / 23 (-)	24 (+) / 25 (-)	26 (+) / 27 (-)
<i>Fixed communication boards (fixed assignment)</i>				
53***_*****A	–	–	Frequency output	Current output HART
53***_*****B	Relay output 2	Relay output 1	Frequency output	Current output HART
53***_*****F	–	–	–	PROFIBUS PA Ex i
53***_*****G	–	–	–	FOUNDATION Fieldbus, Ex i
53***_*****H	–	–	–	PROFIBUS PA
53***_*****J	–	–	–	PROFIBUS DP
53***_*****K	–	–	–	FOUNDATION Fieldbus
53***_*****Q	–	–	Status input	MODBUS RS485
53***_*****S	–	–	Frequency output Ex i	Current output Ex i active, HART
53***_*****T	–	–	Frequency output Ex i	Current output Ex i passive, HART
<i>Flexible communication boards</i>				
53***_*****C	Relay output 2	Relay output 1	Frequency output	Current output HART
53***_*****D	Status input	Relay output	Frequency output	Current output HART
53***_*****L	Status input	Relay output 2	Relay output 1	Current output HART

Electrical connection remote version



E06-5xFxxxxxx-04-xx-xx-en-001

Power-supply and signal cables (inputs/outputs):

- Cable entry M20 x 1.5 (8...12 mm)
- Sensor cable entry for armoured cables M20 x 1.5 (9.5...16 mm)
- Threads for cable entries 1/2" NPT, G 1/2"

Connecting cable for remote version:

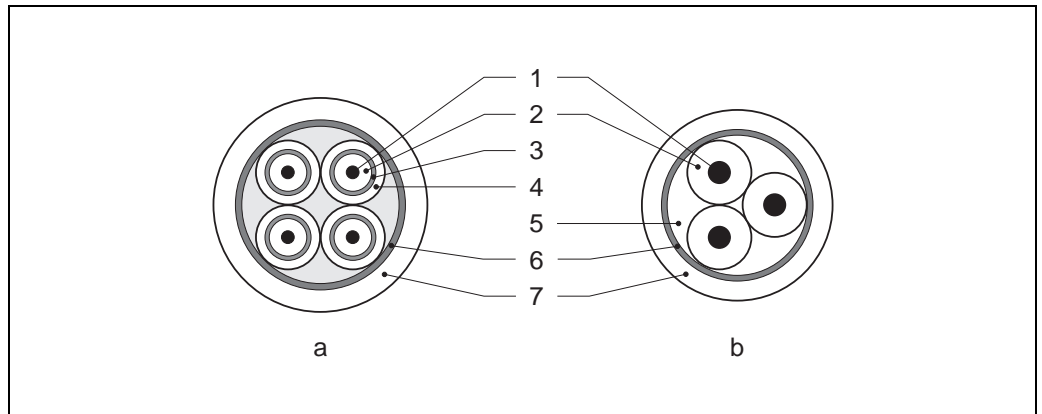
- Cable entry M20 x 1.5 (8...12 mm)
- Sensor cable entry for armoured cables M20 x 1.5 (9.5...16 mm)
- Threads for cable entries 1/2" NPT, G 1/2"

**Cable specifications
remote version****Coil cable:**

- 2 x 0.75 mm² PVC cable with common, braided copper shield (Ø approx. 7 mm)
- Conductor resistance: $\leq 37 \Omega/\text{km}$
- Capacitance: core/core, shield grounded: $\leq 120 \text{ pF/m}$
- Permanent operating temperature: $-20 \dots +80 \text{ }^\circ\text{C}$
- Cable cross-section: max. 2.5 mm²

Signal cable:

- 3 x 0.38 mm² PVC cable with common, braided copper shield (Ø approx. 7 mm) and individually shielded cores.
- With Empty Pipe Detection (EPD): 4 x 0.38 mm² PVC cable with common, braided copper shield (Ø approx. 7 mm) and individually shielded cores.
- Conductor resistance: $\leq 50 \Omega/\text{km}$
- Capacitance: core/shield: $\leq 420 \text{ pF/m}$
- Permanent operating temperature: $-20 \dots +80 \text{ }^\circ\text{C}$
- Cable cross-section: max. 2.5 mm²



a = signal cable, b = coil current cable (cross-section: max. 2.5 mm²)

*1 = core, 2 = core insulation, 3 = core shield, 4 = core jacket, 5 = core strengthening,
6 = cable shield, 7 = outer jacket*

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Optionally, Endress+Hauser also supplies reinforced connecting cables with an additional, metal strengthening braid. We recommend such cables for the following cases:

- Cables laid underground
- Danger of rodent attack
- Device used with ingress protection IP 68

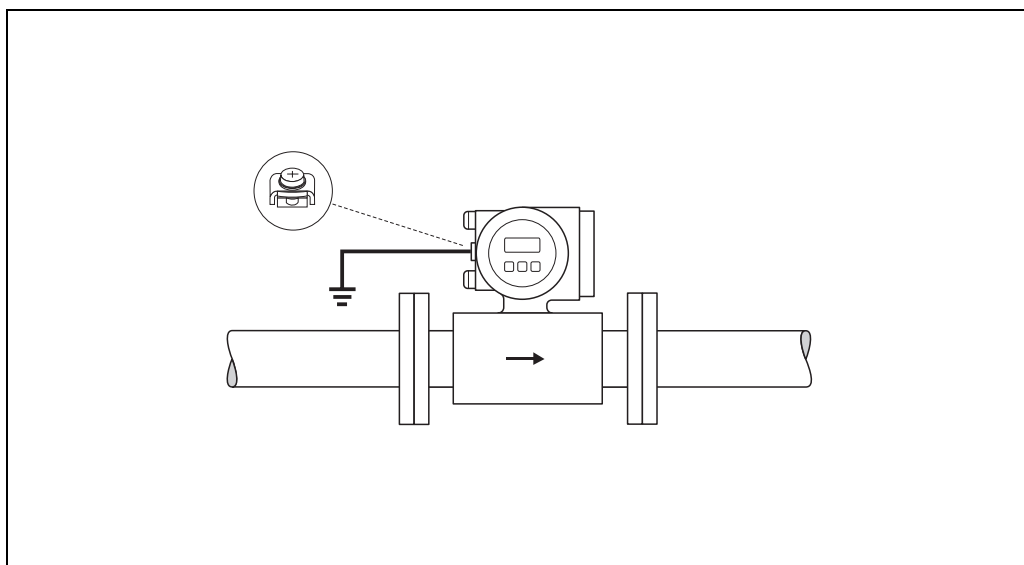
Operation in zones of severe electrical interference:

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.

Supply voltage	85...260 V AC, 45...65 Hz 20...55 V AC, 45...65 Hz 16...62 V DC PROFIBUS PA and FOUNDATION Fieldbus Non-Ex: 9...32 V DC Ex i: 9...24 V DC Ex d: 9...32 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 (Promag 53 only) retain the measuring system data in the event of a power supply failure ■ S-DAT: exchangeable data storage chip which stores the data of the sensor (nominal diameter, serial number, calibration factor, zero point etc.)
Potential equalisation	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 connection. This usually means that additional potential matching measures are unnecessary. Note! For installation in metal pipes, it is advisable to connect the ground terminal of the transmitter housing to the piping. Also, observe company-internal grounding guidelines.



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Caution!

For sensors without reference electrodes or without metal process terminals, carry out potential matching 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.

Metal, ungrounded piping

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 means of the ground terminal provided for the purpose.

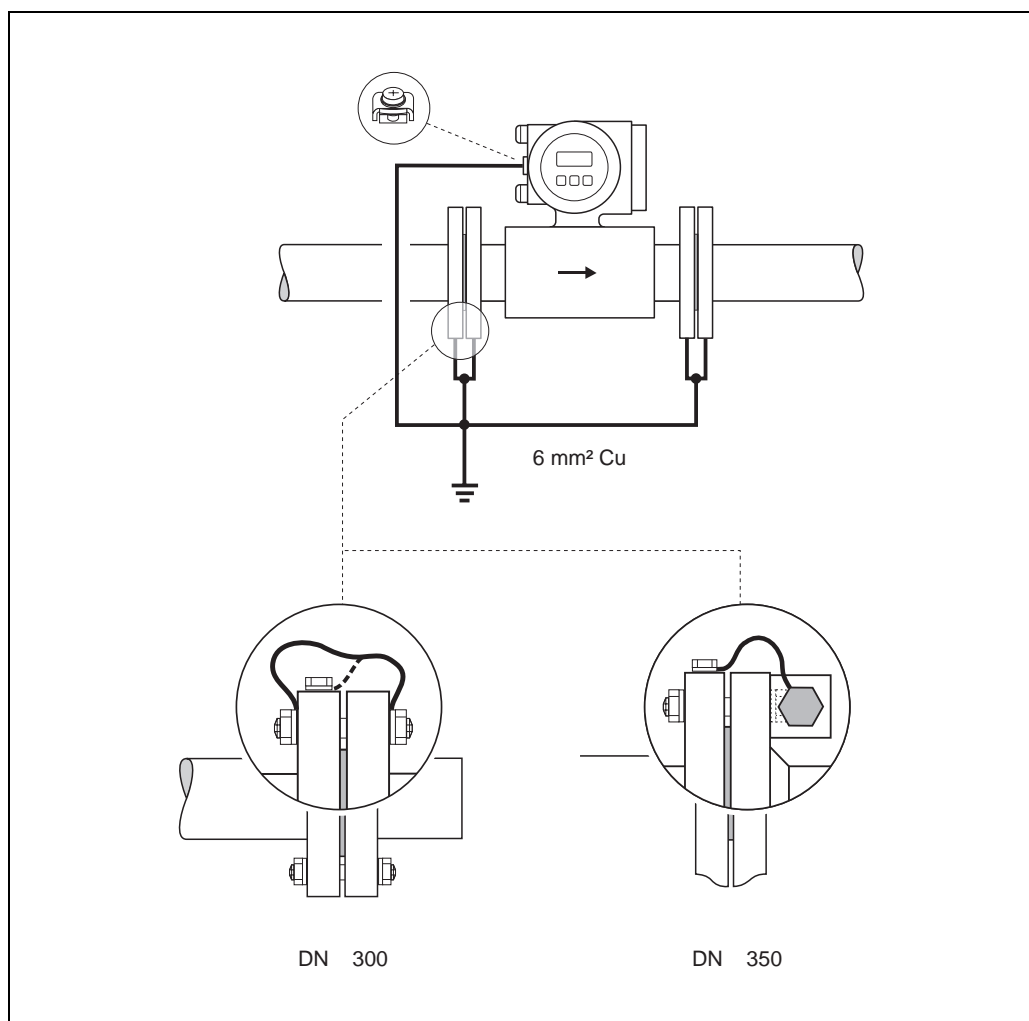
Caution!

Also, observe company-internal grounding guidelines.

Note!

The ground cable for flange-to-flange connections can be ordered separately as an accessory from Endress+Hauser.

- $DN \leq 300$: The ground cable is in direct connection with the conductive flange coating and is secured by the flange screws.
- $DN \geq 350$: The ground cable connects directly to the metal transport bracket.



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Plastic pipes and isolating lined pipes

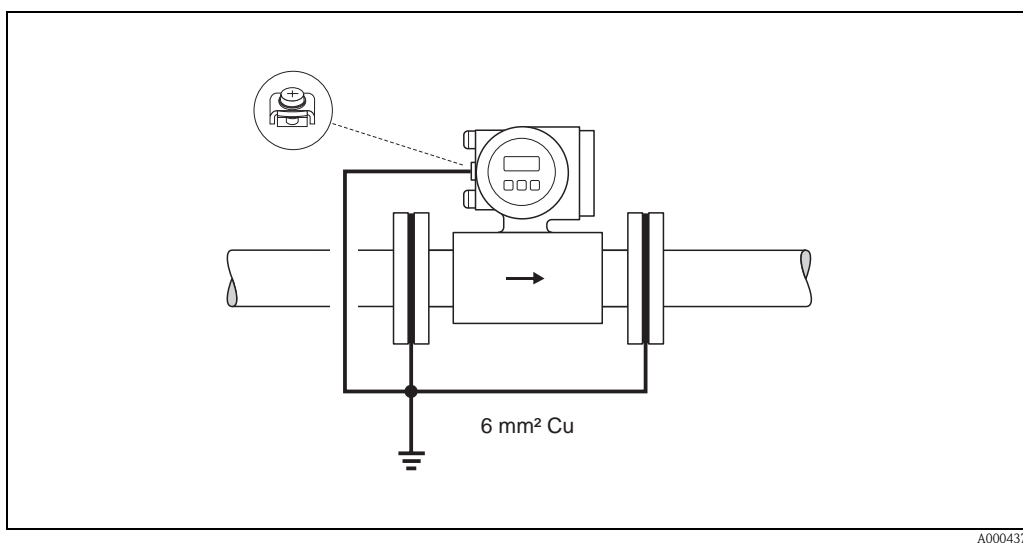
Normally, potential is matched using the reference electrodes in the measuring tube. However, in exceptional cases it is possible that, due to the grounding plan of a system, large matching currents flow over the reference electrodes. This can lead to destruction of the sensor, e.g. through electrochemical 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.

When using ground disks, note the following points:

- Ground disks (DN 15...300) can be ordered separately from Endress+Hauser as an accessory.
- Ground disks (incl. seals) increase the installation length. You can find the dimensions of ground disks on Page 30.

Caution!

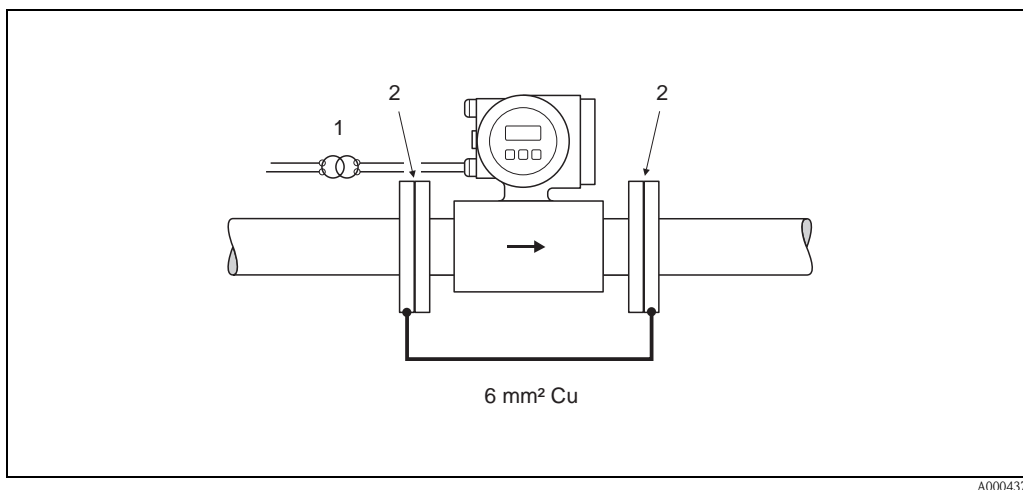
- Risk of damage from electrochemical corrosion. Note the electrochemical insulation rating, if the ground disks and measuring electrodes are made of different materials.
- Also, observe company-internal grounding guidelines.



Pipes with 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 mm²).
- 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.



1 = isolating transformer, 2 = electrically insulated

Performance characteristics

Reference operating conditions

To DIN EN 29104 and VDI/VDE 2641:

- Medium temperature: $+28\text{ °C} \pm 2\text{ K}$
- Ambient temperature: $+22\text{ °C} \pm 2\text{ K}$
- Warm-up period: 30 minutes

Installation:

- Inlet run $>10 \times \text{DN}$
- Outlet run $> 5 \times \text{DN}$
- Sensor and transmitter grounded.
- Sensor centred relative to the pipe.

Maximum measured error

Promag 50:

Pulse output: $\pm 0.5\%$ o.r. $\pm 1\text{ mm/s}$ (o.r. = of reading)

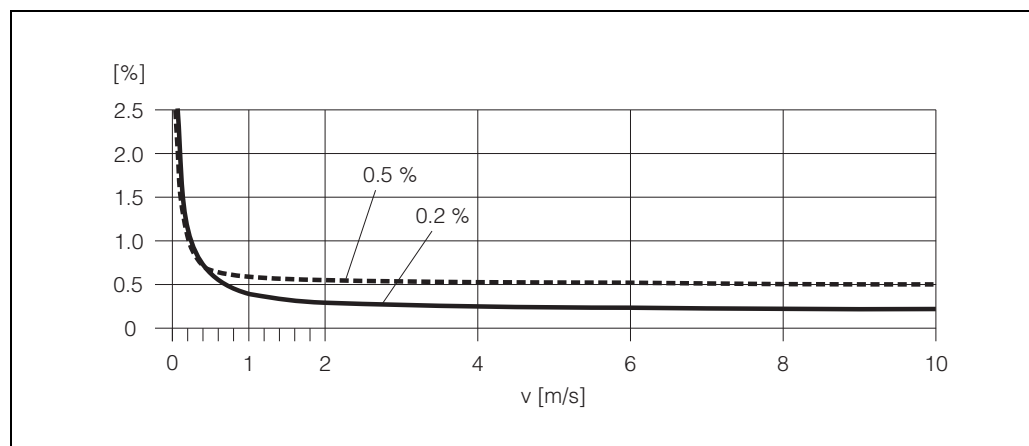
Current output: plus typically $\pm 5\text{ }\mu\text{A}$

Promag 53:

Pulse output: $\pm 0.2\%$ o.r. $\pm 2\text{ mm/s}$ (o.r. = of reading)

Current output: plus typically $\pm 5\text{ }\mu\text{A}$

Supply voltage fluctuations have no effect within the specified range.



Max. measured error in % of reading

F06-5xxxxxxx-05-xx-xx-xx-000

Repeatability

max. $\pm 0.1\%$ o.r. $\pm 0.5\text{ mm/s}$ (o.r. = of reading)

Operating conditions

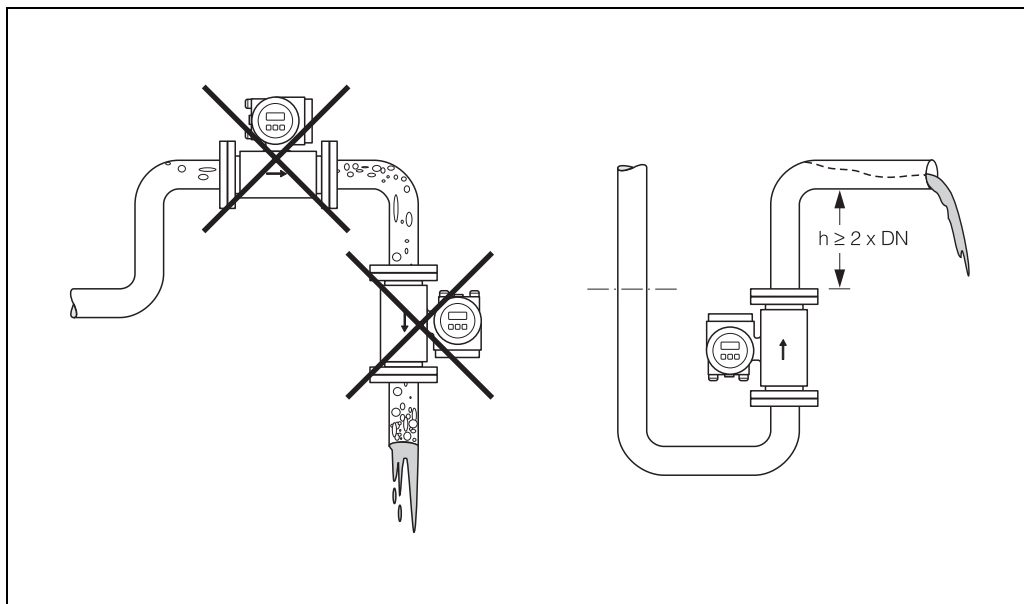
Installation conditions

Installation instructions

Mounting location

Correct measuring is possible only if the pipe is full. Avoid the following locations:

- Highest point of a pipeline. Risk of air accumulating
- Directly upstream of a free pipe outlet in a vertical pipe.

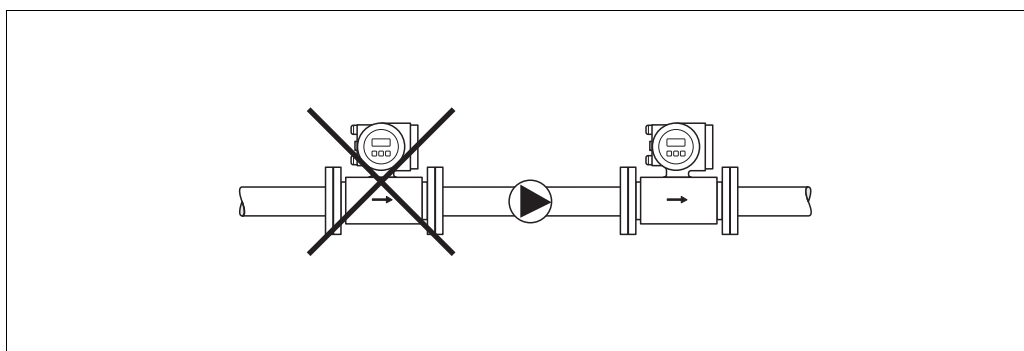


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Installation of pumps

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 20.

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 20.



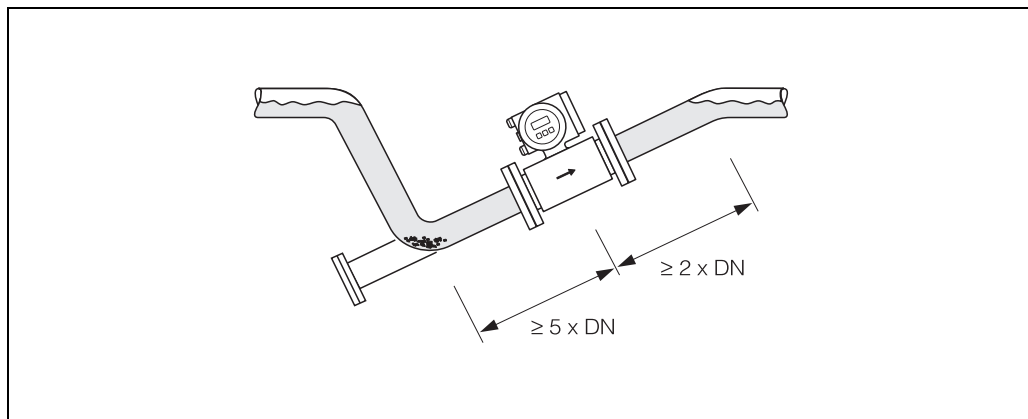
F06-5xxxxxxx-11-00-00-xx-001

Partially filled pipes

Partially filled pipes with gradients necessitate a drain-type configuration. The Empty Pipe Detection (EPD) function offers additional protection by detecting empty or partially filled pipes.

Caution!

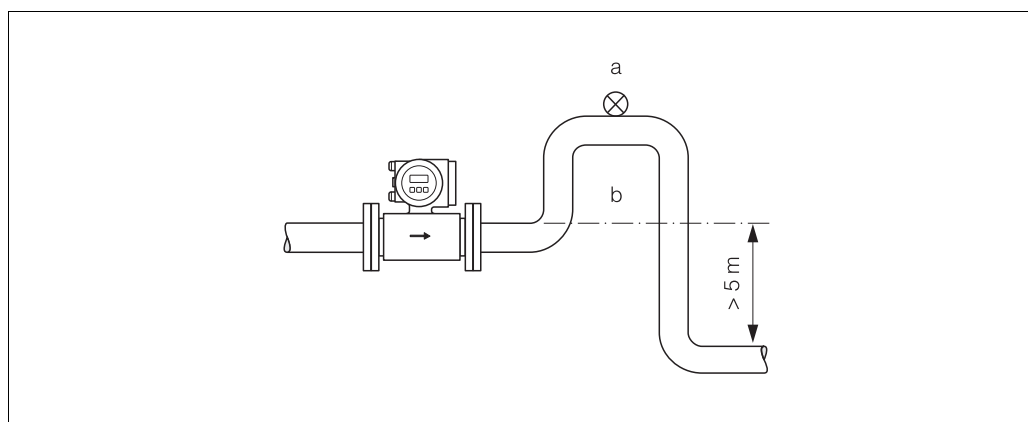
Risk of solids accumulating. Do not install the sensor at the lowest point in the drain. It is advisable to install a cleaning valve.



F06-5xxxxxxx-11-00-00-xx-002

Vertical pipes

Install a siphon (b) or a vent valve (a) downstream of the sensor in vertical 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 20.



F06-5xxxxxxx-11-00-00-xx-003

a = vent valve, b = siphon

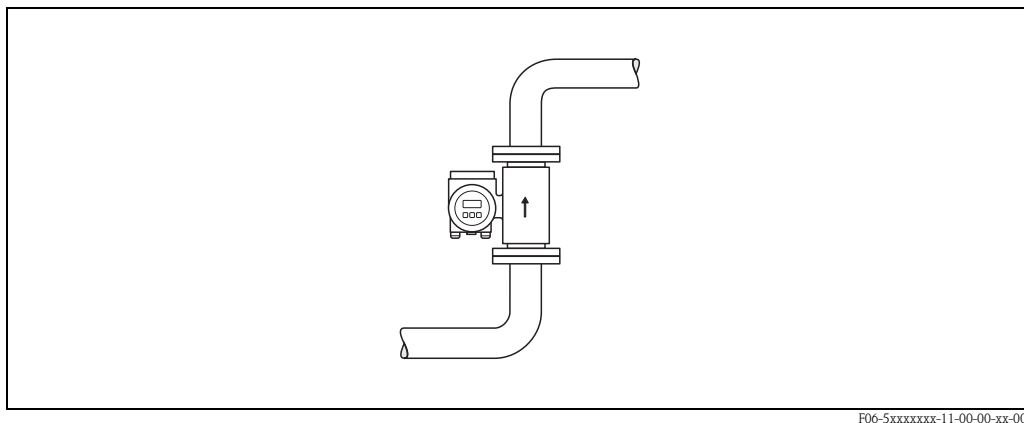
Orientation

An optimum orientation helps avoid gas and air accumulations and deposits in the measuring tube. Promag, nevertheless, supplies a range of options and accessories for correct measuring of problematic mediums:

- Electrode Cleaning Circuitry (ECC) to remove electrically conductive deposits in the measuring tube, e.g. in accretive mediums.
- Empty Pipe Detection (EPD) for recognition of partially filled measuring tubes, or for degassing mediums or for applications with fluctuating process pressure.
- Exchangeable measuring electrodes for abrasive mediums.

Vertical orientation:

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



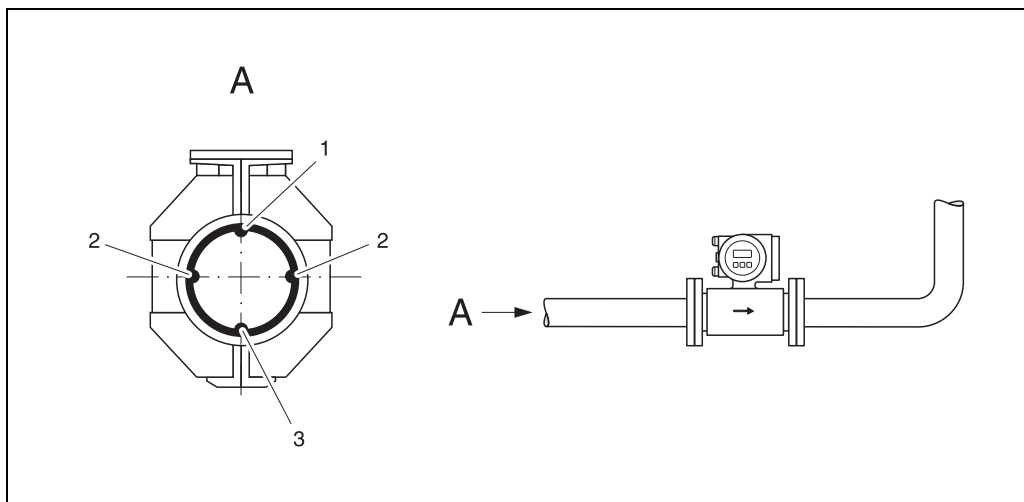
F06-5xxxxxxx-11-00-00-xx-004

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 only when the measuring device is installed horizontally and the transmitter housing is facing upward. Otherwise there is no guarantee that Empty Pipe Detection will respond if the measuring tube is only partially filled or empty.



F06-5xxxxxxx-11-00-xx-xx-000

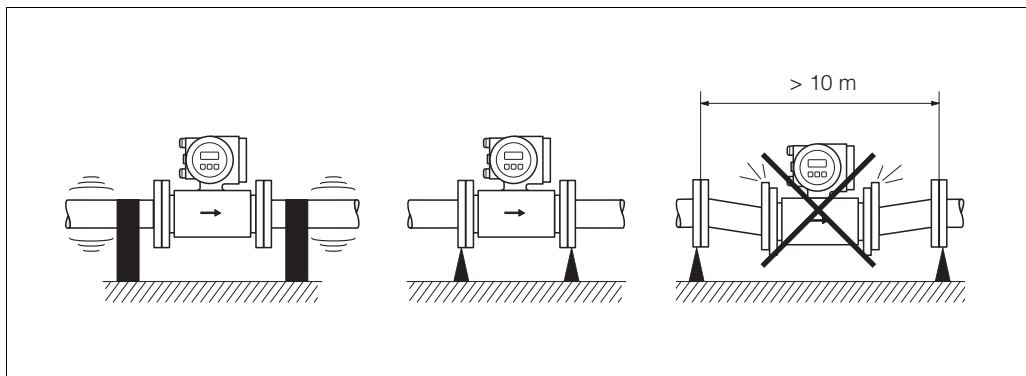
- 1 = EPD electrode (Empty Pipe Detection)
 2 = Measuring electrodes (signal detection)
 3 = Reference electrode (potential equalisation)

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 20.



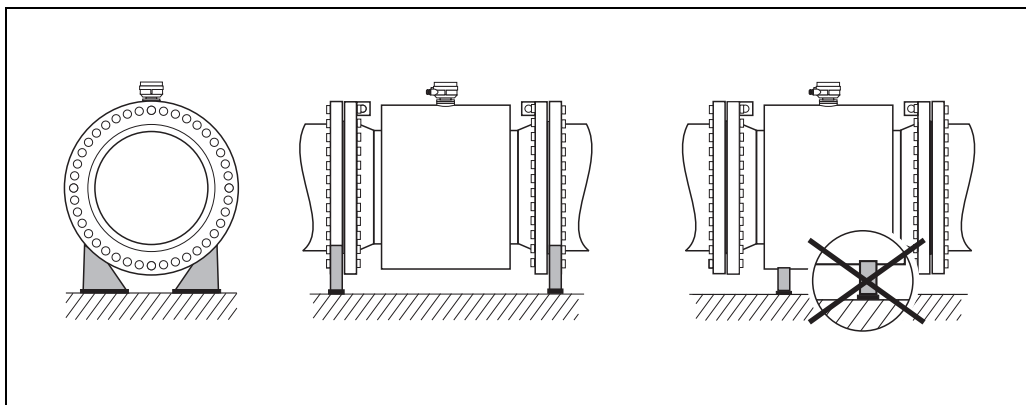
F06-5xxxxxx-11-00-00-xx-006

Foundations, supports

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

Caution!

Do not allow the casing to take the weight of the sensor. This would buckle the casing and damage the internal magnetic coils.

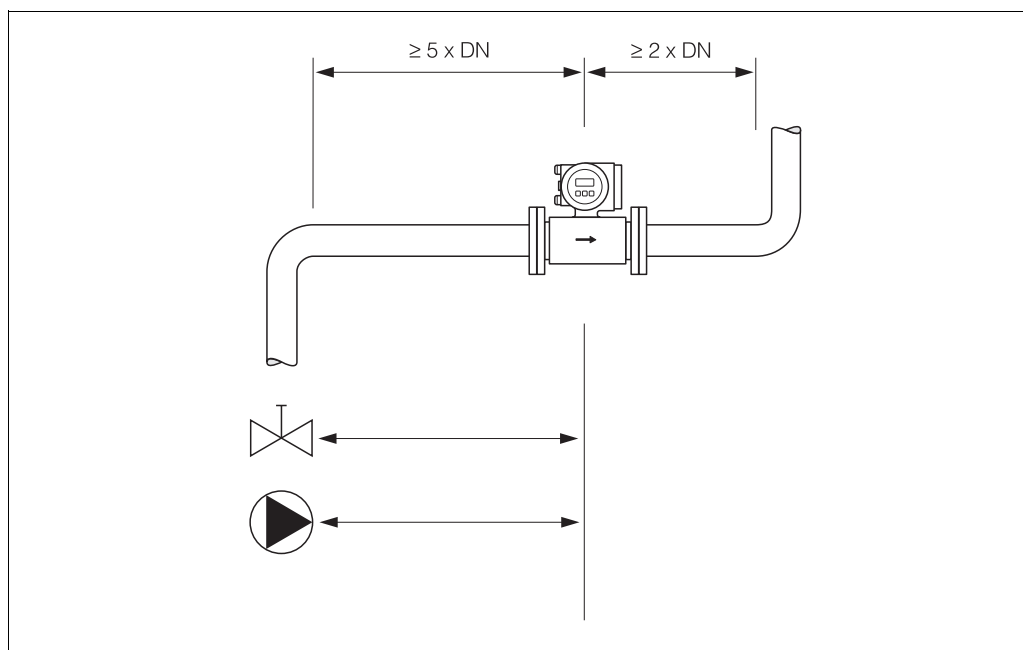


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Inlet and outlet runs

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 $\geq 5 \times \text{DN}$
- Outlet run $\geq 2 \times \text{DN}$



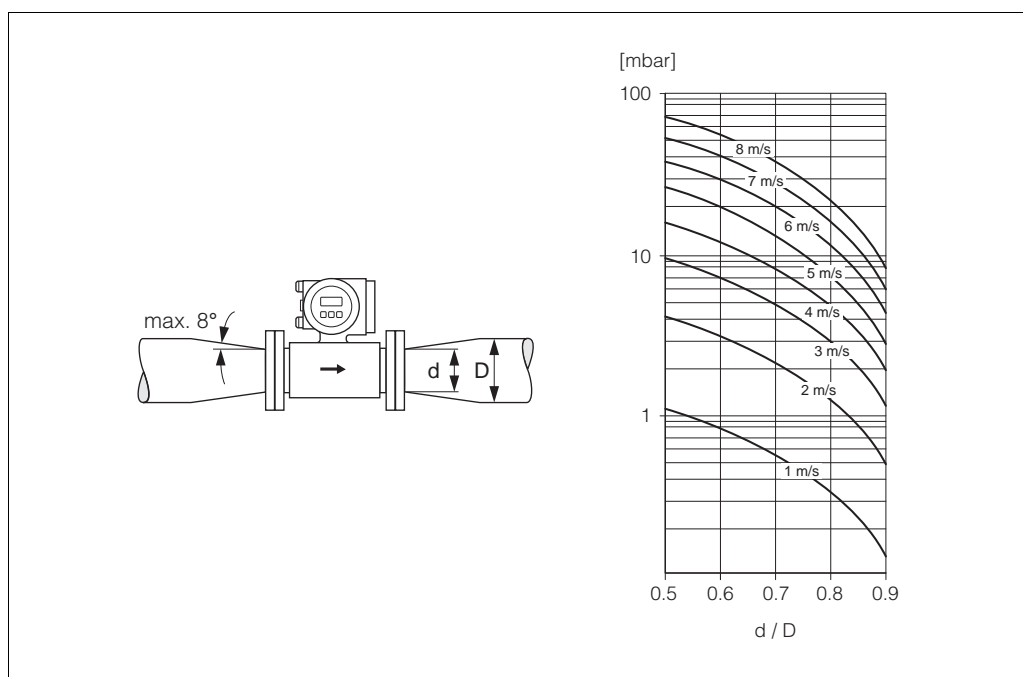
F06-5xxxxxxx-11-00-00-xx-005

Adapters

Suitable adapters to DIN EN 545 (double flange junction sections) can be used to install the sensor in larger-diameter pipes. The resultant increase in the rate of flow improves measuring accuracy with very slow-moving fluids.

The nomogram shown here can be used to calculate the pressure loss caused by reducers and expanders. The nomogram applies only to fluids of viscosity similar to water.

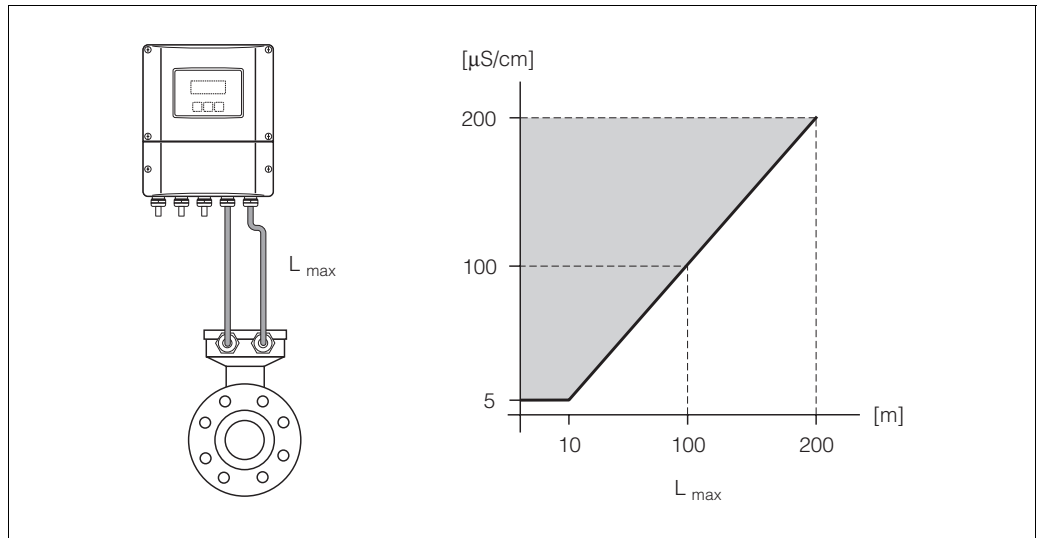
1. Calculate the ratio of the diameters d/D .
2. From the nomogram read off the pressure loss as a function of flow velocity (downstream from the reduction) and the d/D ratio.



F06-5xxxxxxx-05-05-xx-xx-000

Length of connecting cable

Permissible cable length L_{max} depends on the conductivity of the medium. A minimum conductivity of $20 \mu\text{S/cm}$ is required for measuring demineralized water.



Gray shaded area = permissible range for medium conductivity

L_{max} = length of connecting cable in [m]

Medium conductivity in $\mu\text{S/cm}$

F06-5xxxxxxx-05-xx-xx-xx-006

In order to ensure measuring accuracy, moreover, 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 conductivity of the medium is low.
- Route the cable well clear of electrical machines and switching elements.
- Ensure potential equalisation between sensor and transmitter, if necessary.

Environment**Ambient temperature**

Transmitter:

- Standard: $-20...+60 \text{ }^{\circ}\text{C}$
- Optional: $-40...+60 \text{ }^{\circ}\text{C}$

Note!

At ambient temperatures below $-20 \text{ }^{\circ}\text{C}$ the readability of the display may be impaired.

Sensor:

- Flange material carbon steel: $-10...+60 \text{ }^{\circ}\text{C}$
- Flange material stainless steel: $-40...+60 \text{ }^{\circ}\text{C}$

Caution!

It is not allowed to use the device beyond the min. and max. lining specified temperature values (→ "Medium temperature range").

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

- The storage temperature corresponds to the ambient temperature range of the transmitter and sensor (see "Ambient temperature").
- The measuring device must be protected against direct sunlight during storage in order to avoid unacceptably high surface temperatures.
- Choose a storage location where moisture does not collect in the measuring device. This will help prevent fungus and bacteria infestation which can damage the liner.
- Do not remove the protective plates or caps on the process connections until you are ready to install the device.

Degree of protection	<ul style="list-style-type: none"> ■ Standard: IP 67 (NEMA 4X) for transmitter and sensor ■ Optional: IP 68 (NEMA 6P) for sensor in remote version
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Shock and vibration resistance	Acceleration up to 2 g by analogy with IEC 60068-2-6.
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Electromagnetic compatibility (EMC)	To EN 61326/A1 and NAMUR recommendation NE 21.
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Process conditions

Medium temperature range	The permissible medium temperature depends on the measuring-tube lining: <ul style="list-style-type: none"> ■ 0...+80 °C for hard rubber (DN 65...2000) ■ -20...+50 °C for polyurethane (DN 25...1000)
---------------------------------	--

Conductivity	Minimum conductivity: $\geq 5 \mu\text{S/cm}$ for liquids generally $\geq 20 \mu\text{S/cm}$ for demineralised water
---------------------	--

Note that in the case of the remote version, the minimum conductivity is also influenced by the length of the connecting cable → see "Length of connecting cable"

Medium pressure range (nominal pressure)	EN 1092-1 (DIN 2501): PN 6 (DN 1200...2000) PN 10 (DN 200...2000) PN 16 (DN 65...2000) PN 25 (DN 200...1000) PN 40 (DN 25...150) ANSI 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) AS 2129: Table E (DN 80, 100, 150...400, 500, 600) AS 4087: Cl. 14 (DN 80, 100, 150...400, 500, 600)
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Pressure tightness (liner)

Nominal diameter		Measuring tube lining	Resistance to partial vacuum of measuring tube lining						
[mm]	[inch]		Limit values for abs. pressure [mbar] at various fluid temperatures						
			25 °C	50 °C	80 °C	100 °C	130 °C	150 °C	180 °C
25...1000	1...40"	Polyurethane	0	0	–	–	–	–	–
65...2000	3...78"	Hard rubber	0	0	0	–	–	–	–

Limiting flow

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 medium:

- $v < 2$ m/s: for abrasive mediums such as potter's clay, lime milk, ore slurry, etc.
- $v > 2$ m/s: for accretive mediums such as wastewater sludge, etc.

Flow characteristics (SI units)						
Nominal diameter		Recommended flow rate	Factory settings			
[mm]	[inch]	Min./max. full scale value (v ~ 0.3 or 10 m/s)	Full scale value (v ~ 2.5 m/s)	Pulse weighting (~ 2 pulse/s)	Creepage (v ~ 0.04 m/s)	
25	1"	9...300 dm ³ /min	75 dm ³ /min	0.50 dm ³	1	dm ³ /min
32	1 1/4"	15...500 dm ³ /min	125 dm ³ /min	1.00 dm ³	2	dm ³ /min
40	1 1/2"	25...700 dm ³ /min	200 dm ³ /min	1.50 dm ³	3	dm ³ /min
50	2"	35...1100 dm ³ /min	300 dm ³ /min	2.50 dm ³	5	dm ³ /min
65	2 1/2"	60...2000 dm ³ /min	500 dm ³ /min	5.00 dm ³	8	dm ³ /min
80	3"	90...3000 dm ³ /min	750 dm ³ /min	5.00 dm ³	12	dm ³ /min
100	4"	145...4700 dm ³ /min	1200 dm ³ /min	10.00 dm ³	20	dm ³ /min
125	5"	220...7500 dm ³ /min	1850 dm ³ /min	15.00 dm ³	30	dm ³ /min
150	6"	20...600 m ³ /h	150 m ³ /h	0.025 m ³	2.5	m ³ /h
200	8"	35...1100 m ³ /h	300 m ³ /h	0.05 m ³	5.0	m ³ /h
250	10"	55...1700 m ³ /h	500 m ³ /h	0.05 m ³	7.5	m ³ /h
300	12"	80...2400 m ³ /h	750 m ³ /h	0.10 m ³	10	m ³ /h
350	14"	110...3300 m ³ /h	1000 m ³ /h	0.10 m ³	15	m ³ /h
400	16"	140...4200 m ³ /h	1200 m ³ /h	0.15 m ³	20	m ³ /h
450	18"	180...5400 m ³ /h	1500 m ³ /h	0.25 m ³	25	m ³ /h
500	20"	220...6600 m ³ /h	2000 m ³ /h	0.25 m ³	30	m ³ /h
600	24"	310...9600 m ³ /h	2500 m ³ /h	0.30 m ³	40	m ³ /h
700	28"	420...13500 m ³ /h	3500 m ³ /h	0.50 m ³	50	m ³ /h
–	30"	480...15000 m ³ /h	4000 m ³ /h	0.50 m ³	60	m ³ /h
800	32"	550...18000 m ³ /h	4500 m ³ /h	0.75 m ³	75	m ³ /h
900	36"	690...22500 m ³ /h	6000 m ³ /h	0.75 m ³	100	m ³ /h
1000	40"	850...28000 m ³ /h	7000 m ³ /h	1.00 m ³	125	m ³ /h
–	42"	950...30000 m ³ /h	8000 m ³ /h	1.00 m ³	125	m ³ /h
1200	48"	1250...40000 m ³ /h	10000 m ³ /h	1.50 m ³	150	m ³ /h
–	54"	1550...50000 m ³ /h	13000 m ³ /h	1.50 m ³	200	m ³ /h
1400	–	1700...55000 m ³ /h	14000 m ³ /h	2.00 m ³	225	m ³ /h
–	60"	1950...60000 m ³ /h	16000 m ³ /h	2.00 m ³	250	m ³ /h
1600	–	2200...70000 m ³ /h	18000 m ³ /h	2.50 m ³	300	m ³ /h
–	66"	2500...80000 m ³ /h	20500 m ³ /h	2.50 m ³	325	m ³ /h
1800	72"	2800...90000 m ³ /h	23000 m ³ /h	3.00 m ³	350	m ³ /h
–	78"	3300...100000 m ³ /h	28500 m ³ /h	3.50 m ³	450	m ³ /h
2000	–	3400...110000 m ³ /h	28500 m ³ /h	3.50 m ³	450	m ³ /h

Flow characteristics (US units)					
Nominal diameter		Recommended flow rate	Factory settings		
[inch]	[mm]	Min./max. full scale value (v ~ 0.3 or 10 m/s)	Full scale value (v ~ 2.5 m/s)	Pulse weighting (~ 2 pulse/s)	Creepage (v ~ 0.04 m/s)
1"	25	2.5...80 gal/min	18 gal/min	0.20 gal	0.25 gal/min
1 1/4"	32	4...130 gal/min	30 gal/min	0.20 gal	0.50 gal/min
1 1/2"	40	7...190 gal/min	50 gal/min	0.50 gal	0.75 gal/min
2"	50	10...300 gal/min	75 gal/min	0.50 gal	1.25 gal/min
2 1/2"	65	16...500 gal/min	130 gal/min	1 gal	2.0 gal/min
3"	80	24...800 gal/min	200 gal/min	2 gal	2.5 gal/min
4"	100	40...1250 gal/min	300 gal/min	2 gal	4.0 gal/min
5"	125	60...1950 gal/min	450 gal/min	5 gal	7.0 gal/min
6"	150	90...2650 gal/min	600 gal/min	5 gal	12 gal/min
8"	200	155...4850 gal/min	1200 gal/min	10 gal	15 gal/min
10"	250	250...7500 gal/min	1500 gal/min	15 gal	30 gal/min
12"	300	350...10600 gal/min	2400 gal/min	25 gal	45 gal/min
14"	350	500...15000 gal/min	3600 gal/min	30 gal	60 gal/min
16"	400	600...19000 gal/min	4800 gal/min	50 gal	60 gal/min
18"	450	800...24000 gal/min	6000 gal/min	50 gal	90 gal/min
20"	500	1000...30000 gal/min	7500 gal/min	75 gal	120 gal/min
24"	600	1400...44000 gal/min	10500 gal/min	100 gal	180 gal/min
28"	700	1900...60000 gal/min	13500 gal/min	125 gal	210 gal/min
30"	–	2150...67000 gal/min	16500 gal/min	150 gal	270 gal/min
32"	800	2450...80000 gal/min	19500 gal/min	200 gal	300 gal/min
36"	900	3100...100000 gal/min	24000 gal/min	225 gal	360 gal/min
40"	1000	3800...125000 gal/min	30000 gal/min	250 gal	480 gal/min
42"	–	4200...135000 gal/min	33000 gal/min	250 gal	600 gal/min
48"	1200	5500...175000 gal/min	42000 gal/min	400 gal	600 gal/min
54"	–	9...300 Mgal/d	75 Mgal/d	0.0005 Mgal	1.3 Mgal/d
–	1400	10...340 Mgal/d	85 Mgal/d	0.0005 Mgal	1.3 Mgal/d
60"	–	12...380 Mgal/d	95 Mgal/d	0.0005 Mgal	1.3 Mgal/d
–	1600	13...450 Mgal/d	110 Mgal/d	0.0008 Mgal	1.7 Mgal/d
66"	–	14...500 Mgal/d	120 Mgal/d	0.0008 Mgal	2.2 Mgal/d
72"	1800	16...570 Mgal/d	140 Mgal/d	0.0008 Mgal	2.6 Mgal/d
78"	–	18...650 Mgal/d	175 Mgal/d	0.001 Mgal	3.0 Mgal/d
–	2000	20...700 Mgal/d	175 Mgal/d	0.001 Mgal	3.0 Mgal/d

Pressure loss

- No pressure loss if the sensor is installed in a pipe of the same nominal diameter.
- Pressure losses for configurations incorporating adapters to DIN EN 545 → Page 18

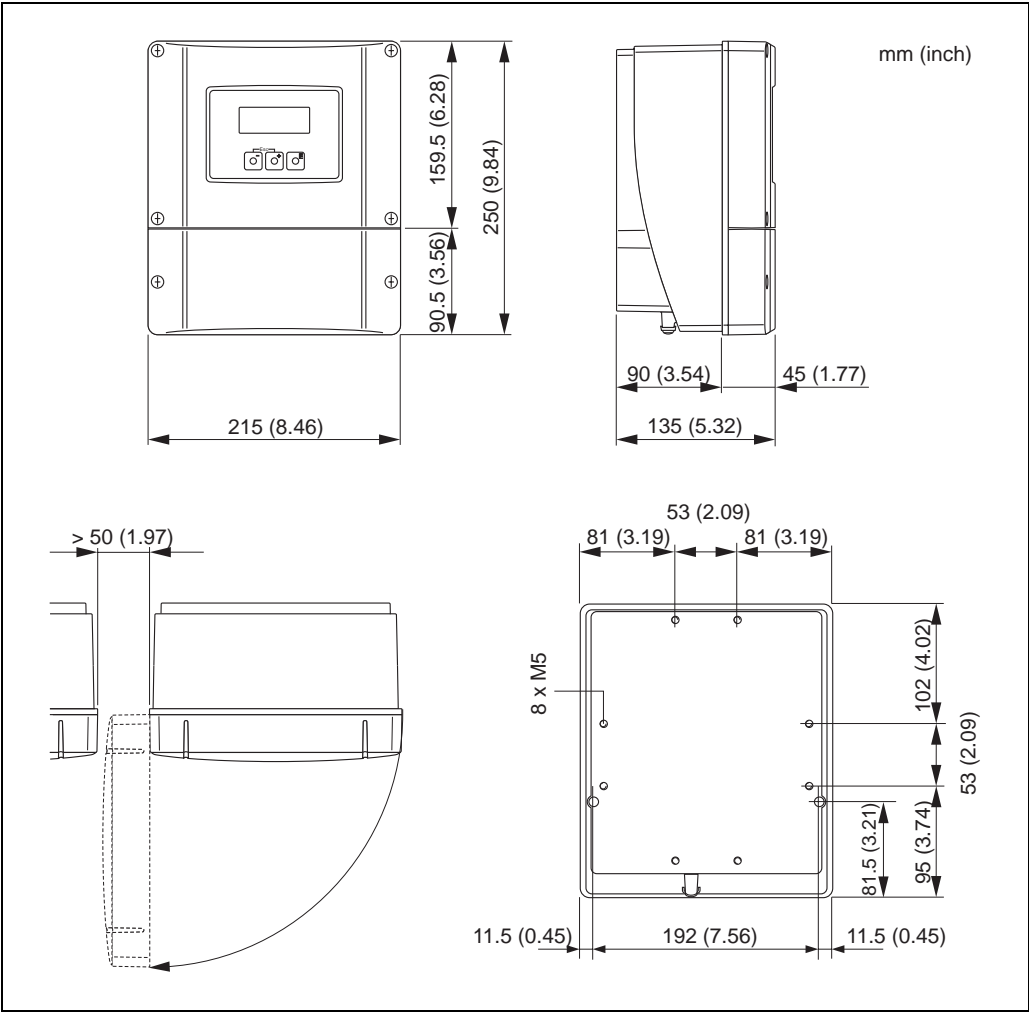
Measuring-tube specifications

Nominal Diameter		Pressure rating						Inside diameter of measuring tube	
[mm]	[inch]	EN (DIN) [bar]	AS 2129	AS 4087	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	Table E	Cl.14	Cl 150	–	10K	79	79
100	4"	PN 16	Table E	Cl.14	Cl 150	–	10K	102	102
125	–	PN 16	–	–	–	–	10K	127	127
150	6"	PN 16	Table E	Cl.14	Cl 150	–	10K	156	156
200	8"	PN 10	Table E	Cl.14	Cl 150	–	10K	204	204
250	10"	PN 10	Table E	Cl.14	Cl 150	–	10K	258	258
300	12"	PN 10	Table E	Cl.14	Cl 150	–	10K	309	309
350	14"	PN 10	Table E	Cl.14	Cl 150	–	–	342	342
400	16"	PN 10	Table E	Cl.14	Cl 150	–	–	392	392
450	18"	PN 10	–	–	Cl 150	–	–	437	437
500	20"	PN 10	Table E	Cl.14	Cl 150	–	–	492	492
600	24"	PN 10	Table E	Cl.14	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

Mechanical construction

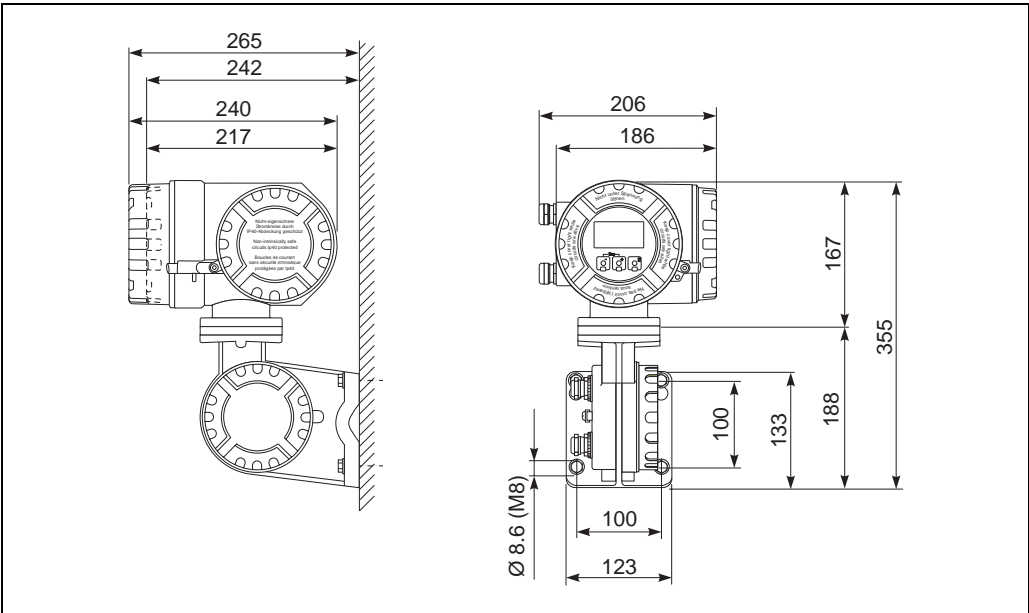
Design / dimensions

Dimensions: Wall-mount housing (non hazardous area and II3G / zone 2)



A0001150

Dimensions: Remote field housing (II2GD / zone 1)

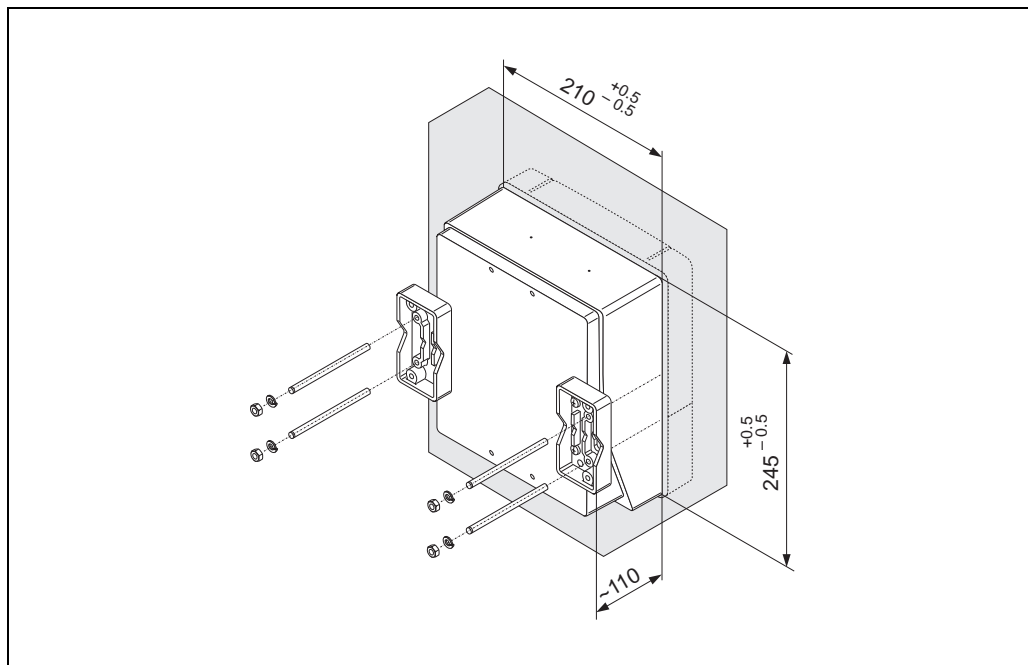


A0002128

There is a separate mounting kit for the wall-mounted housing. It can be ordered from Endress+Hauser as an accessory. The following installation variants are possible:

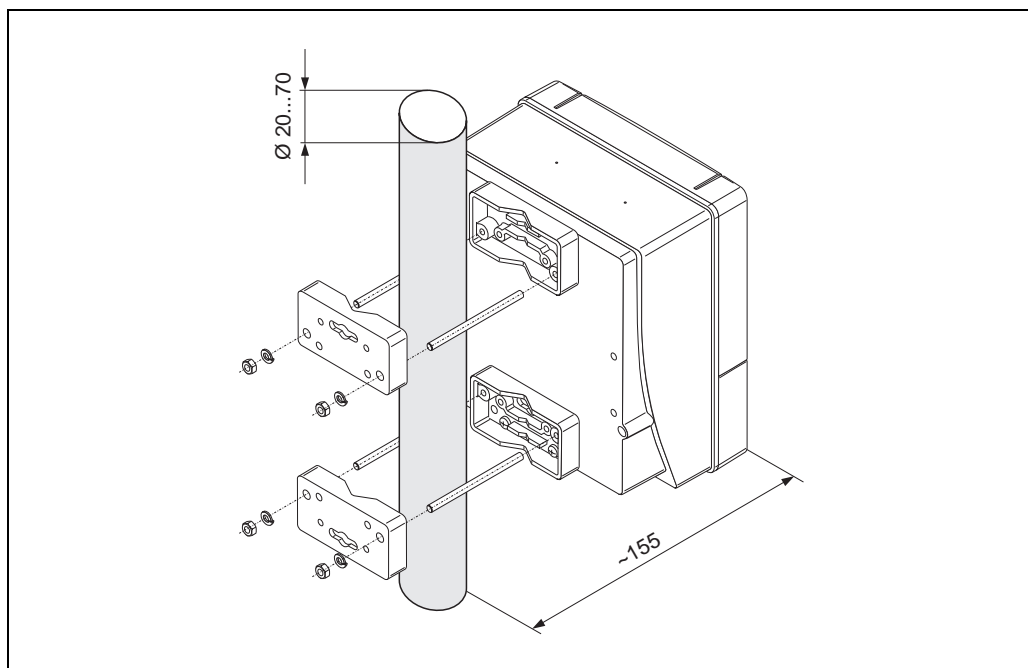
- Panel-mounted installation
- Pipe mounting

Panel-mounted installation

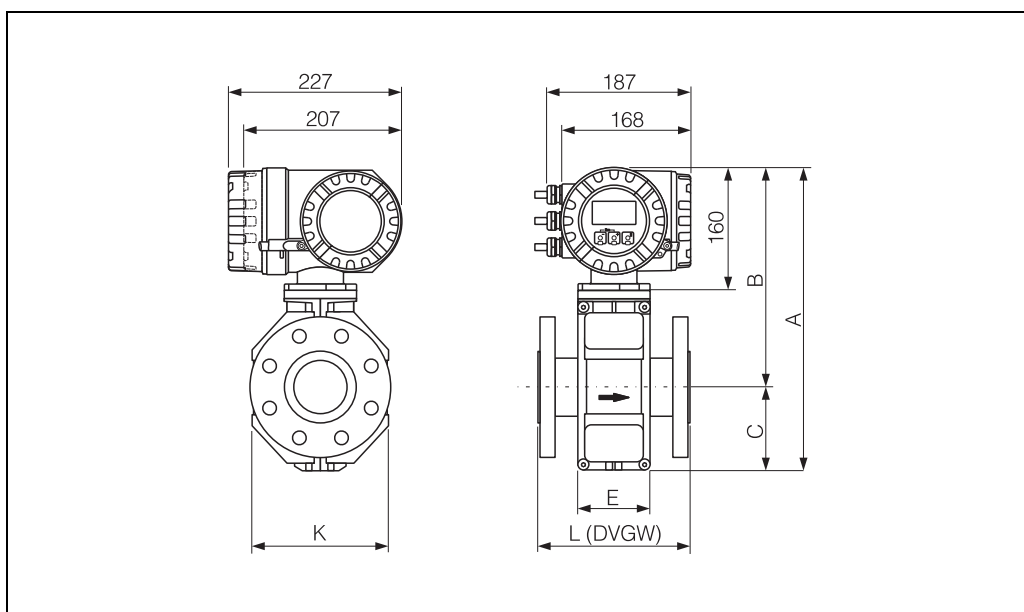


A0001131

Pipe mounting



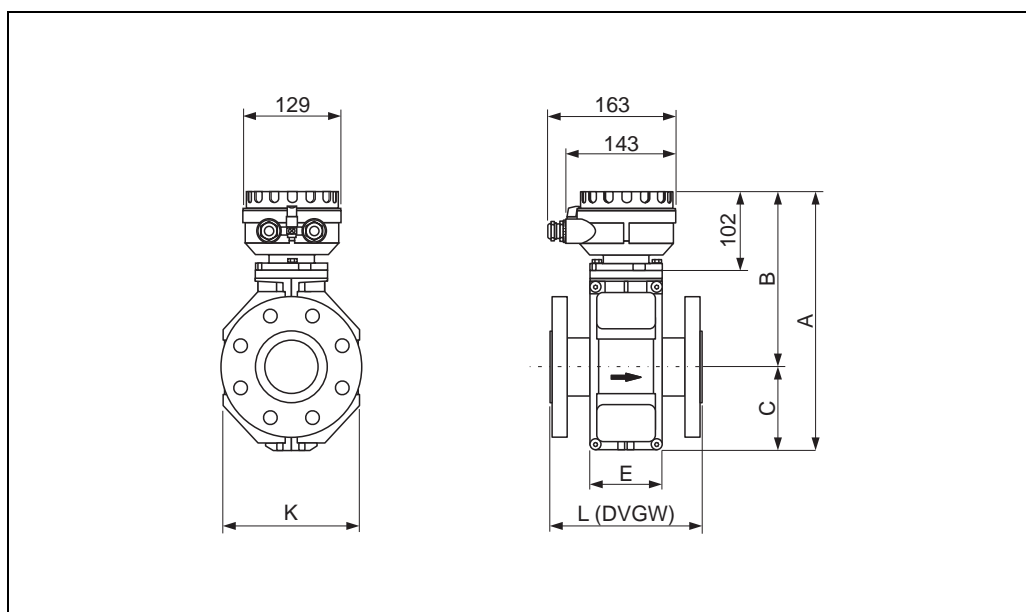
A0001132

Compact version DN ≤ 300

F06-53Fxxxxx-06-00-xx-xx-000

DN		L	A	B	C	K	E
EN (DIN) / JIS / AS*	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.
 * Only DN 80, 100 and 150...300 are available if flanges according to AS are used.

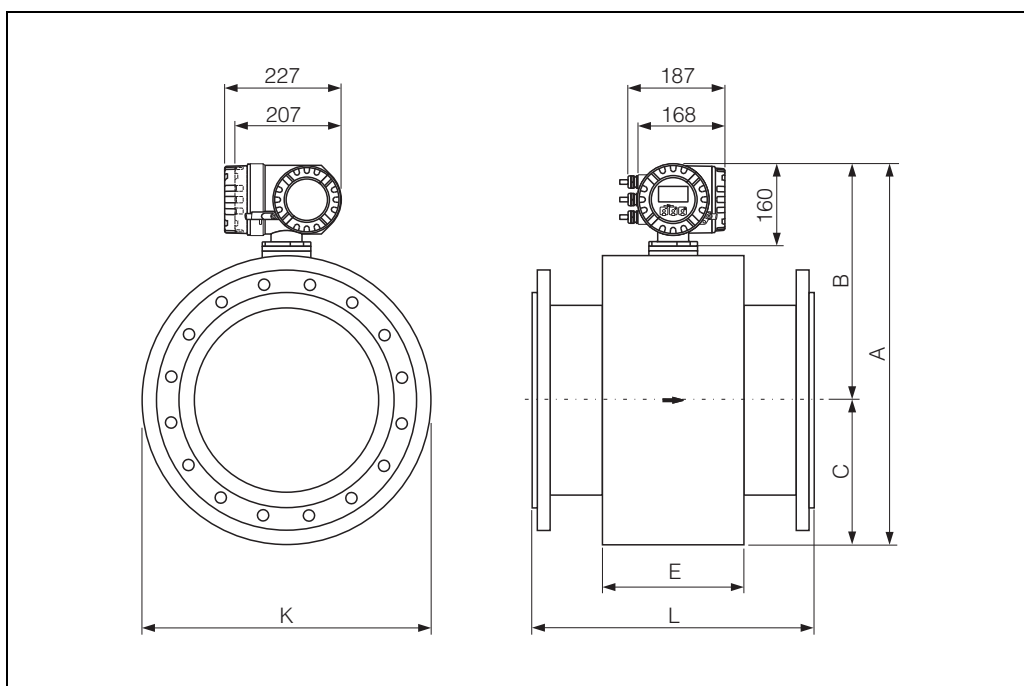
Remote version DN ≤ 300

A0003219

DN		L	A	B	C	K	E
EN (DIN) / JIS / AS* [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.

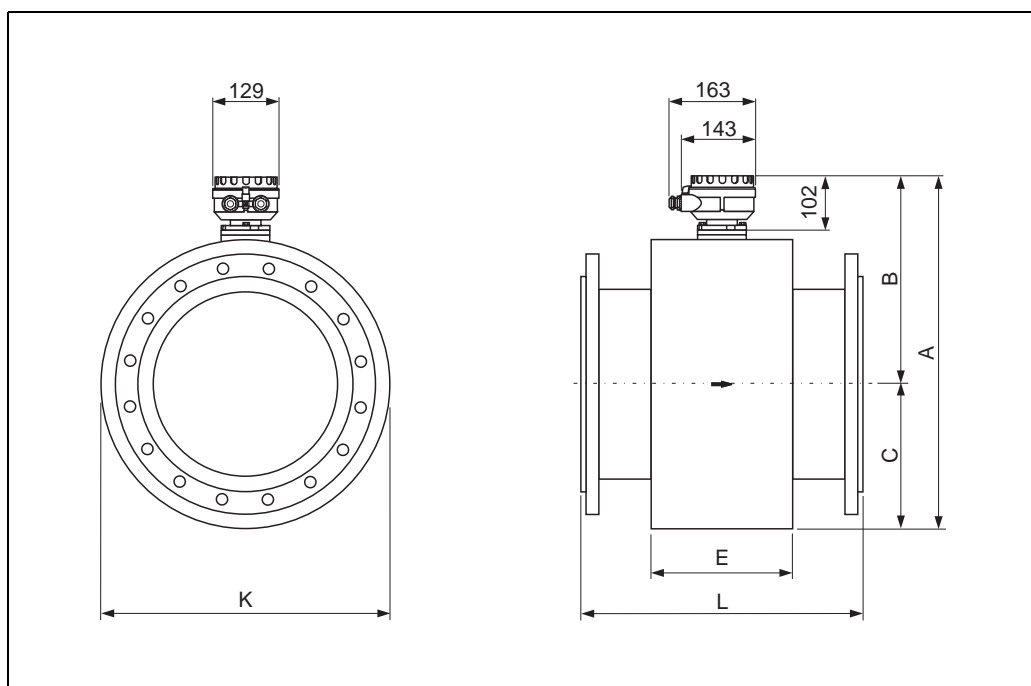
* Only DN 80, 100 and 150...300 are available if flanges according to AS are used.

Compact version DN ≥ 350

F06-xxFxxxxx-06-05-xx-xx-000

DN		L	A	B	C	K	E
EN (DIN) / AS ¹⁾ [mm]	ANSI / AWWA ²⁾ [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.							
¹⁾ Only DN 350, 400, 500 and 600 are available if flanges according to AS are used.							
²⁾ DN < 700 only to ANSI, DN > 600 only to AWWA.							

Remote version DN ≥ 350

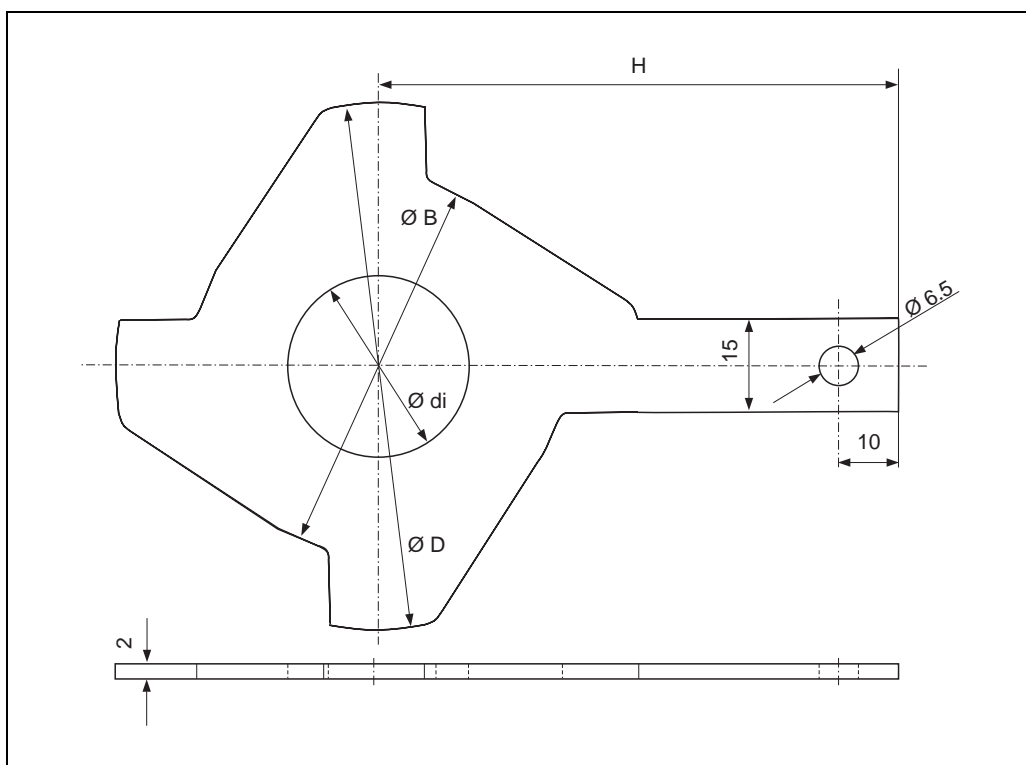


A0003220

DN		L	A	B	C	K	E
EN (DIN) / AS ¹⁾ [mm]	ANSI / AWWA ²⁾ [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.

¹⁾ Only DN 350, 400, 500 and 600 are available if flanges according to AS are used.²⁾ DN < 700 only to ANSI, DN > 600 only to AWWA.

Ground disk (DN 25...300)

A0003221

DN ¹⁾		di	B	D	H
EN (DIN) / JIS / AS ⁴⁾	ANSI	[mm]	[mm]	[mm]	[mm]
25	1"	26	62	77.5	87.5
32	—	35	80	87.5	94.5
40	1 1/2"	41	82	101	103
50	2"	52	101	115.5	108
65	—	68	121	131.5	118
80	3"	80	131	154.5	135
100	4"	104	156	186.5	153
125	—	130	187	206.5	160
150	6"	158	217	256	184
200	8"	206	267	288	205
250	10"	260	328	359	240
300 ²⁾	12" ²⁾	312	375	413	273
300 ³⁾	12" ³⁾	310	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, Cl. 150
³⁾ PN 25, JIS 10K/20K
⁴⁾ DN 32, 40, 65 and 125 are not available if flanges according to AS are used.

Weight

Weight data in kg												
Nominal diameter		Compact version				Remote version (without cable)						
[mm]	[inch]	EN (DIN) / AS*		JIS	ANSI/AWWA	EN (DIN) / AS*		Sensor		ANSI/AWWA	Wall housing	
								JIS				
25	1"	PN 40	7.3	7.3		7.3	PN 40	5.3	5.3		6.0	
32	1 1/4"		8.0	7.3		–		6.0	5.3		–	6.0
40	1 1/2"		9.4	8.3		9.4		7.4	6.3		7.4	6.0
50	2"		10.6	9.3		10.6		8.6	7.3		8.6	6.0
65	2 1/2"	PN 16	12.0	11.1	Class 150	–	PN 16	10.0	9.1		6.0	
80	3"		14.0	12.5		14.0		12.0	10.5		12.0	6.0
100	4"		16.0	14.7		16.0		14.0	12.7		14.0	6.0
125	5"		21.5	21.0		–		19.5	19.0		–	6.0
150	6"		25.5	24.5		25.5		23.5	22.5		6.0	
200	8"		45	41.9		45		43	39.9	Class 150	6.0	
250	10"		65	69.4		75		63	67.4		73	6.0
300	12"		70	72.3		110		68	70.3		108	6.0
350	14"		115			175		113			173	6.0
400	16"	PN 10	135			205	PN 10	133			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	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			6.0	
–	42"	PN 6	–			1100	PN 6	–			6.0	
1200	48"		850	1400		848		1398	6.0			
–	54"		–	2200		–		2198	6.0			
1400	–		1300	–		1298		–	6.0			
–	60"		–			2700		–			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) * Only DN 80, 100, 150...400, 500 and 600 are available if flanges according to AS are used.												

Materials

Transmitter housing:

- Compact housing: powder coated die-cast aluminium
- 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:

- EN 1092-1 (DIN 2501): 316L / 1.4571; RSt37-2 (S235JRG2) / C22 / FE 410W B
(with flanges made of carbon steel: DN < 350 with Al/Zn protective coating;
DN > 300 with Amerlock 400 paint)
- ANSI: A105, F316L
(with flanges made of carbon steel: DN < 350 with Al/Zn protective coating;
DN > 300 with Amerlock 400 paint)
- AWWA: 1.0425 (with Amerlock 400 paint)
- JIS: RSt37-2 (S235JRG2) / H II / 1.0425 / 316L
(with flanges made of carbon steel: DN < 350 with Al/Zn protective coating;
DN > 300 with Amerlock 400 paint)
- AS 2129: (DN 150, 200, 250, 300, 600) A105 or RSt37-2 (S235JRG2)
(DN 80, 100, 350, 400, 500) A105 or St44-2 (S275JR)
(with flanges made of carbon steel: DN < 350 with Al/Zn protective coating;
DN > 300 with Amerlock 400 paint)
- AS 4087: A105 or St44-2 (S275JR)
(with flanges made of carbon steel: 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

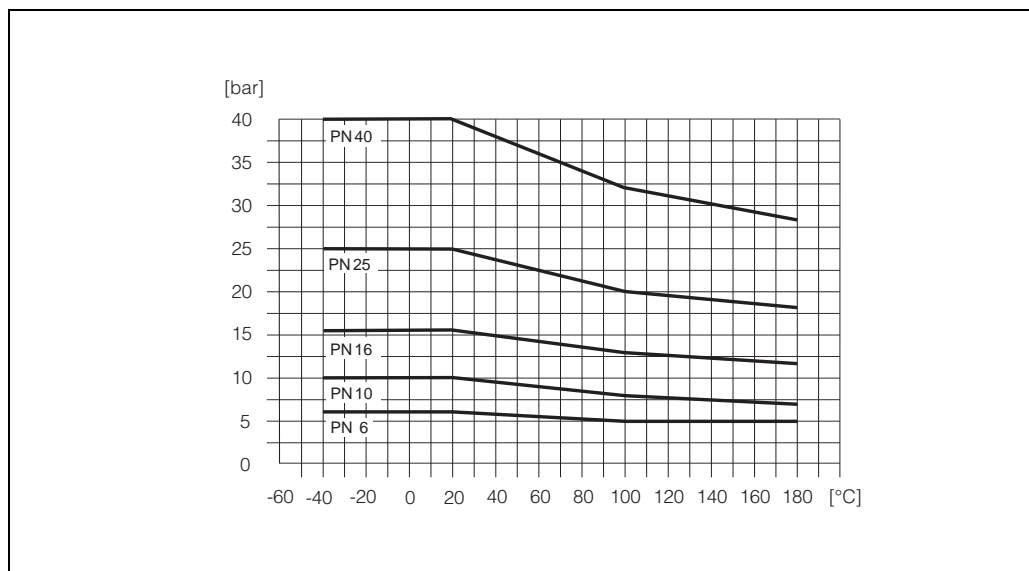
Seals: Seals to DIN EN 1514-1

Material load diagrams**Caution!**

The following diagrams contain material load curves (reference curves) for various process connections relating to the fluid temperature. But the maximal permissible fluid temperature always depends on the lining material of the sensor and/or of the sealing material (Page 20).

Flange connection to EN 1092-1 (DIN 2501)

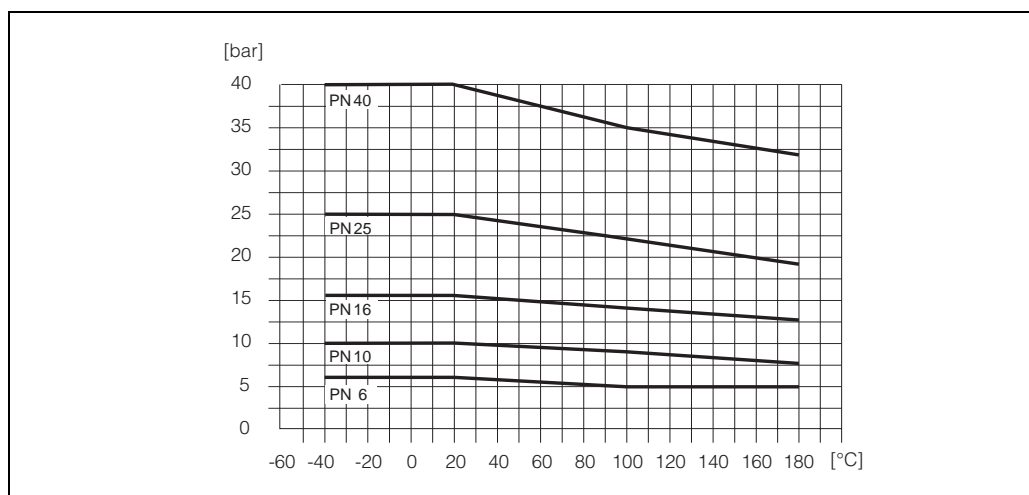
Material: RSt37-2 (S235JRG2) / C22 / FE 410W B



F06-xxFxxxxx-05-xx-xx-xx-000

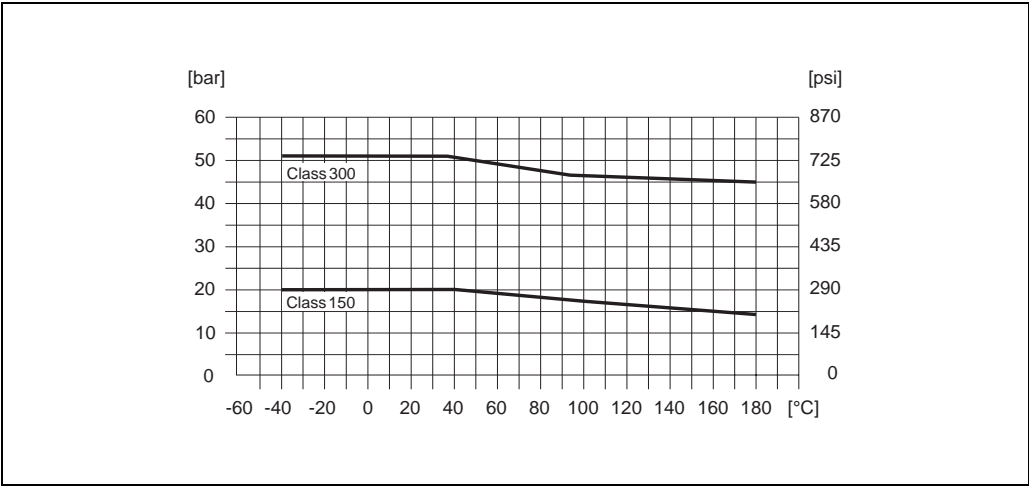
Flange connection to EN 1092-1 (DIN 2501)

Material: 316L / 1.4571



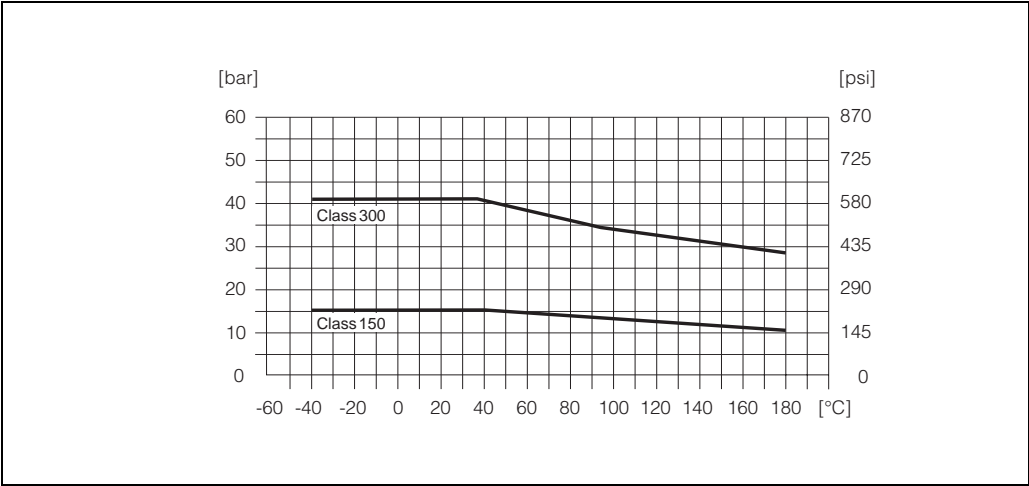
F06-xxFxxxxx-05-xx-xx-xx-001

Flange connection to ANSI B16.5
Material: A105



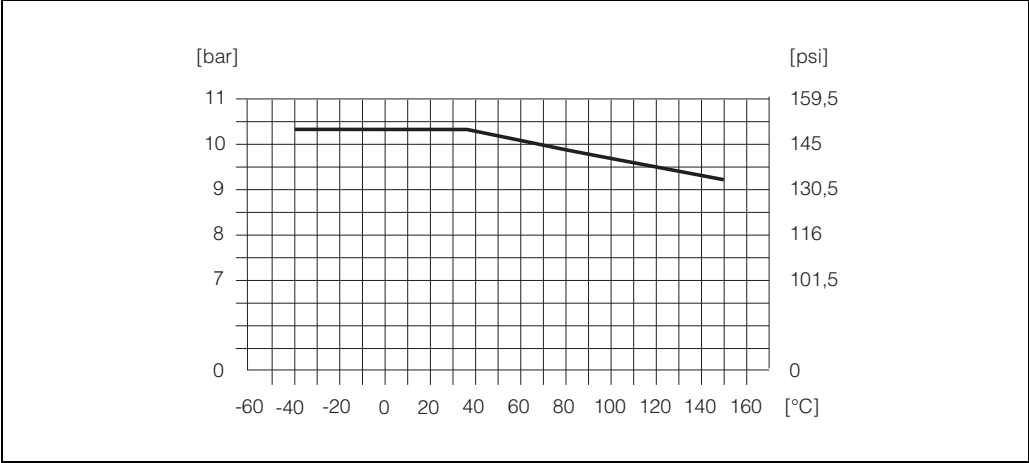
A0003226

Flange connection to ANSI B16.5
Material: F316L



F06-xxFxxxxx-05-xx-xx-xx-002

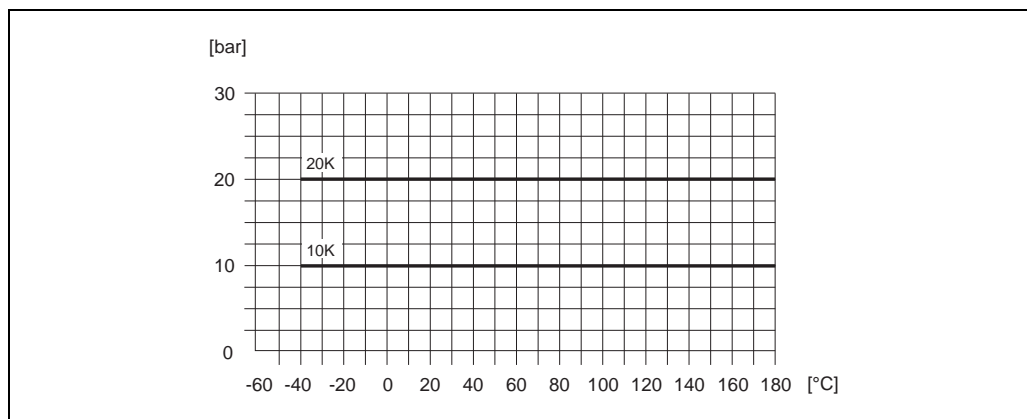
Flange connection to AWWA C 207, Class D
Material: 1.0425



F06-xxFxxxxx-05-xx-xx-xx-004

Flange connection to JIS B2238

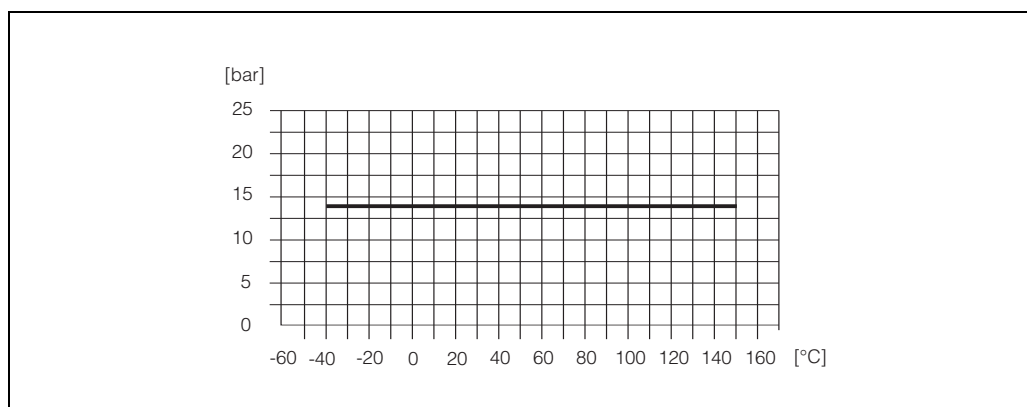
Material: RSt37-2 (S235JRG2) / H II / 1.0425



A0003228

Flange connection to AS2129 Table E or AS4087 Cl. 14

Material: A105 / RSt37-2 (S235JRG2) / St44-2 (S275JR)



F06-xxFxxxxx-05-xx-xx-xx-010

Fitted electrodes

Measuring, reference and EPD electrodes:

- Standard with: 1.4435, Alloy C-22, tantalum
- Optional: exchangeable measuring electrodes made of 1.4435 (DN 350...2000)

Process connection

Flange connection:

- EN 1092-1 (DIN 2501), < DN 350 Form A, > DN 300 Form B
(dimensions acc. to DIN 2501; DN 65 PN 16 and DN 600 PN 16 exclusively to EN 10921)
- ANSI B16.5
- AWWA C 207, Class D
- JIS B2238
- AS2129 Table E
- AS4087 Cl. 14

Surface roughness

- Electrodes:
 - 1.4435, Alloy C-22, Tantalum: 0.3...0.5 µm
- (all data relate to parts in contact with the medium)

Human interface

Display elements	<ul style="list-style-type: none"> ■ Liquid-crystal display: backlit, two lines (Promag 50) or four lines (Promag 53) with 16 characters per line ■ Custom configurations for presenting different measured-value and status variables ■ Totalizer: <ul style="list-style-type: none"> Promag 50: 2 totalizers Promag 53: 3 totalizers
Operating elements	<p>Unified operation concept for both types of transmitter:</p> <p>Promag 50:</p> <ul style="list-style-type: none"> ■ Local operation with three push buttons (–, +, E) ■ Quick Setup menus for straightforward commissioning <p>Promag 53:</p> <ul style="list-style-type: none"> ■ Local operation with three optical keys (–, +, E) ■ Application-specific Quick Setup menus for straightforward commissioning
Language group	<p>Language groups available for operation in different countries:</p> <p>Promag 50, Promag 53:</p> <ul style="list-style-type: none"> ■ Western Europe and America (WEA): English, German, Spanish, Italian, French, Dutch and Portuguese ■ Eastern Europe and Scandinavia (EES): English, Russian, Polish, Norwegian, Finnish, Swedish and Czech ■ South and east Asia (SEA): English, Japanese, Indonesian <p>Promag 53:</p> <ul style="list-style-type: none"> ■ China (CIN): English, Chinese <p>You can change the language group via the operating program “ToF Tool – Fieldtool Package.”</p>
Remote operation	<p>Promag 50: Remote control via HART, PROFIBUS DP/PA</p> <p>Promag 53: Remote control via HART, PROFIBUS DP/PA, MODBUS RS485, FOUNDATION Fieldbus</p>

Certificates and approvals

Ex approvals	Information about currently available Ex versions (ATEX, FM, CSA) can be supplied by your Endress+Hauser Sales Centre on request. All explosion protection data are given in a separate documentation which is available upon request.
CE mark	The measuring system is in conformity with the statutory requirements of the EC Directives. Endress+Hauser confirms successful testing of the device by affixing to it the CE mark.
C-Tick mark	The measuring system is in conformity with the EMC requirements of the Australian Communications Authority (ACA).
Pressure Equipment Directive	Flow meters with a nominal diameter smaller or equal DN 25 are covered by Art. 3(3) of the European directive 97/23/EG (Pressure Equipment Directive) and are designed according to sound engineer practice. For larger nominal diameter, optional approvals according to Cat. III are available when required (depends on fluid and process pressure).
PROFIBUS DP/PA certification	<p>The flow device has successfully passed all the test procedures carried out and is certified and registered by the PNO (PROFIBUS User Organisation). The device thus meets all the requirements of the following specifications:</p> <ul style="list-style-type: none"> ■ Certified to PROFIBUS PA, profile version 3.0 (device certification number: on request) ■ The device can also be operated with certified devices of other manufacturers (interoperability)
FOUNDATION Fieldbus certification	<p>The flow device has successfully passed all the test procedures carried out and is certified and registered by the Fieldbus Foundation. The device thus meets all the requirements of the following specifications:</p> <ul style="list-style-type: none"> ■ Certified to FOUNDATION Fieldbus Specification ■ The device meets all the specifications of the FOUNDATION Fieldbus H1. ■ Interoperability Test Kit (ITK), revision status 4.0 (device certification number: on request) ■ The device can also be operated with certified devices of other manufacturers ■ Physical Layer Conformance Test of the Fieldbus Foundation
MODBUS certification	The measuring device meets all the requirements of the MODBUS/TCP conformity test and has the “MODBUS/TCP Conformance Test Policy, Version 2.0”. The measuring device has successfully passed all the test procedures carried out and is certified by the “MODBUS/TCP Conformance Test Laboratory” of the University of Michigan.
Other standards, guidelines	<p>EN 60529: Degrees of protection by housing (IP code)</p> <p>EN 61010: Protection Measures for Electrical Equipment for Measurement, Control, Regulation and Laboratory Procedures.</p> <p>EN 61326/A1 (IEC 6326): Electromagnetic compatibility (EMC requirements)</p> <p>NAMUR NE 21: Electromagnetic compatibility (EMC) of industrial process and laboratory control equipment.</p> <p>NAMUR NE 43: Standardisation of the signal level for the breakdown information of digital transmitters with analogue output signal.</p> <p>NAMUR NE 53: Software of field devices and signal-processing devices with digital electronics.</p>

Ordering information

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

Accessories

Various accessories, which can be ordered separately from Endress+Hauser, are available for the transmitter and the sensor. The Endress+Hauser service organisation can provide detailed information on request.

Supplementary documentation

- Flow Measurement (FA005D/06/en)
- Operating Instructions Promag 50 (BA046D/06/en, BA049D/06/en)
- Operating Instructions Promag 50 PROFIBUS PA (BA055D/06/en, BA056D/06/en)
- Operating Instructions Promag 53 (BA047D/06/en, BA048D/06/en)
- Operating Instructions Promag 53 PROFIBUS DP/PA (BA053D/06/en, BA054D/06/en)
- Operating Instructions Promag 53 FOUNDATION Fieldbus (BA051D/06/en, BA052D/06/en)
- Operating Instructions Promag 53 MODBUS (BA117D/06/en und BA118D/06/en)
- Supplementary documentation on Ex-ratings: ATEX, FM, CSA, etc.

Registered trademarks

HART®

Registered trademark of HART Communication Foundation, Austin, USA

PROFIBUS®

Registered trademark of the PROFIBUS User Organisation, Karlsruhe, Germany

FOUNDATION™ Fieldbus

Registered trademark of the Fieldbus FOUNDATION, Austin, USA

MODBUS®

Registered trademark of the MODBUS Organisation

HistoROM™, S-DAT®, T-DAT™, F-CHIP®, ToF Tool - Fieldtool® Package, Fieldcheck®, Applicator®

Registered or registration-pending trademarks of Endress+Hauser Flowtec AG, Reinach, CH

Subject to modification

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Endress+Hauser 
People for Process Automation

Warranties

MPA Engineering - Letter of Warranty

MPA Engineering warrant their works from the date of practical completion for 12 months as per the terms and conditions of their contract with Thomas & Coffey.

Thomas & Coffey will warrant the works until the end of the defect liability period.

Commissioning Information

FAT documents

Linked Documents

 [20142 4 Lagoons Boonah Completed FAT.pdf](#)

SAT documents

Linked Documents

 [Boonah site.pdf](#)

Boonah Level Sensor Calibration Certificate

Linked Documents

 [Level Sensor Callibration Certificate- Boonah.pdf](#)



Engineering Pty Ltd

Specialists in Machine Plant Automation

QUU 4 LAGOON BOONAH STP UPGRADES

QUEENSLAND URBAN UTILITIES

4 LAGOON

BOONAH

FACTORY ACCEPTANCE TEST MAIN SWITCHBOARD

MPA Engineering

Job Number 20142

THE ENGINEERS, THE IDEAS, THE SOLUTIONS

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Document Control			
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Revision History				
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1.0	22 October 2012	GK	Document created	



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1. 4 Lagoon Boonah Main Switchboard FAT

This document describes the process of testing the switchboards to ensure that they conform to the standards and the design drawings, are electrically safe, function as designed and interface with the PLC controls as required. The FAT testing is carried out at MPA Engineering workshop, 22 Strathwyn Street, Brendale.

1.1 References

AS/NZS 3000:2007 Wiring Rules

AS/NZS 3008.1.1:2009 Cable Selection

AS/NZS 3017 Electrical Installations – Verification Guidelines

AS/NZS 3049.1:2002 Low Voltage Switchgear

AS/NZS 4836:2001 Safe Working on Low Voltage Electrical Installations

QUU SSM001/002/030/090

1.2 Objectives

To conduct thorough and electrically safe tests of switchboard.

Tests include:

- Inspecting all metalwork to ensure conformance to design
- Ensuring that the correct equipment is installed as defined in the design drawings
- Conducting a visual check to ensure conformity with Australian Standards
- Conducting a check to ensure connections are secure
- Measuring the insulation resistance of the switchboard to ensure conformance with Australian Standards
- Completing a point to point test of all wiring to ensure conformity with the design drawings
- Installing a temporary supply to the switchboard
- Testing all power circuits
- Testing the operation of all circuit breakers
- Testing the motor control operation
- Testing the operation of the PLC interposing signals
- Testing the operation of the pump protection equipment

1.3 Equipment & Software Requirements

The following Tools and Equipment will be needed to conduct the FAT:

- 1.3.1** Fluke 1652C installation Tester
- 1.3.2** Fluke 177 multimeter
- 1.3.3** Project drawings
- 1.3.4** Safety barrier and flashing amber light
- 1.3.5** Temporary 3 phase and neutral supply



1.4 Methodology

1.4.1 De-energised Testing

The following steps are to be carried out on each section of the electrical equipment listed above.

- 1.4.1.1** Referring to the drawings listed in Appendix A, confirm that the correct equipment is installed and is placed in the correct position.
- 1.4.1.2** Referring to the drawings listed in Appendix A, use the multimeter to carry out point to point tests and confirm that all wiring conforms to the design drawings. Drawings will be highlighted and signed to record the point to point tests.
- 1.4.1.3** Conduct a visual check to ensure conformity with Australian Standards.
- 1.4.1.4** Using appropriate tools, check at least 30% of connections to ensure that connections are secure.
- 1.4.1.5** Disconnect or isolate surge diverters, RCD's, power analyser and any voltage sensitive equipment. Using the insulation resistance tester, measure the insulation resistance of the switchboards and circuits to ensure conformance with Australian Standards. Reconnect any equipment that was disconnected.
- 1.4.1.6** Where required, adjust circuit breakers, motor overloads and timer to appropriate settings
- 1.4.1.7** Complete the FAT documentation as inspections and tests are carried out
- 1.4.1.8** Ensure that all items including MEN link, which were disconnected for insulation resistance testing, have been reconnected.

1.4.2 Energised Testing

- 1.4.2.1** Complete safe work method statement for live commissioning. All personnel to contribute, read, understand and sign the document
- 1.4.2.2** Install barrier tape around the area to exclude unauthorised personnel.
- 1.4.2.3** Install a temporary three phase and neutral supply to the switchboard.
- 1.4.2.4** Communicate with personnel and install signage to warn personnel of live switchboard testing
- 1.4.2.5** Install a flashing light to warn of live testing
- 1.4.2.6** Turn on power to the switchboards
- 1.4.2.7** Using the Multimeter to test for correct connections and polarity, test for 415 VAC and 240VAC where appropriate around the switchboard.
- 1.4.2.8** Switch on circuit breakers for the 24 VDC power supplies. Use the multimeter to measure and if necessary adjust the output of the supplies for 24 VDC.
- 1.4.2.9** Test operation of items listed in the function test sections
- 1.4.2.10** Test the operation of the pump protection equipment
- 1.4.2.11** Test the functionality of all the RTU interposing signals
- 1.4.2.12** Test the operation of all the controls
- 1.4.2.13** Test the operation of light circuits



2. Tests Summary

2.1 Inspection and Test Plan 4 Lagoon Boonah Main Switchboard

Client: QUV		Project: Boonah 4 LA Goon		Switchboard: MAIN SWITCHBOARD		Job No: 20142	
ITEM	ACTIVITY	ACCEPTANCE STANDARD		RECORD	REMARKS	INSP	SIGN
Pre FAT Inspection							
1	Cabinet inspection	AS3000, AS3439, SSM001/002/030/090		Sect 2.3		H	yk
2	Cabinet finish	SSM001/002/030/090		Sect 2.3	Metal colour and detailing acceptable	H	yk
3	Electrical design	AS3000, AS3439, SSM001/002/030/090		SCH	Electrical design to meet specifications and relevant standards	H	yk
FAT Testing							
4	Electrical equipment	GA, AS3000, AS3439, SSM001/002/030/090		SCH, Sect 2.4	Electrical equipment to meet specifications and standards	H	yk
5	Wiring implementation	SCH, AS3000, AS3439, SSM001/002/030/090		SCH, Sect 2.4	Point to point tests highlighted on schematics	H	yk
6	Insulation resistance testing	AS3000, AS3439, AS3017		Sect 2.5	Insulation resistance tested with kV tester	H	yk
8	PLC signals testing	SCH		Sect 2.6	PLC I/O are tested as far as practical	H	yk
9	Electrical functional testing	SCH		QWI 07.13	Electrical functional testing	H,W	yk
10	Photos and records stored	Present in the correct folder on server		Sect 2.13	Photos and records stored in project directory	H	yk
11	Drawing markups incorporated	Drawings revised, checked and stored in the correct folder on the server		SCH	All drawings updated into AS BUILT revision	H	yk
Pre Shipping							
12	Documentation placed in switchboard	AS BUILT drawings, test documents and manuals placed in the switchboard		Sect 2.13	AS BUILT drawings, test documents and manuals placed in the switchboard	H	yk
13	Review of quality records	Quality documents completed and stored on the server		Sect 2.13	Quality documents are completed and reviewed	R	yk
14	Packing and despatch	Switchboard is suitably protected		Sect 2.13	Switchboard is prepared for transport	H	yk
H = Hold Point DR = Document Required R = Review W = Witness X = Self Inspection GA = General Arrangement Drawings SCH = Electrical Schematics							



2.2 Enclosure Inspection 4 Lagoon Boonah Main Switchboard

ENCLOSURE INSPECTION	N/A	Pass	Comments
Switchboard material as per specification		✓	
Switchboard Finish as per specification		✓	
Hood, sun shields provided		✓	
Laptop tray provided		✓	
Legend provided for distribution board		✓	
Drawing support installed		✓	
Doors square and even		✓	
Door hinges tight		✓	
Doors level		✓	
Doors are all the same width		✓	
Door mounted equipment is level		✓	
Door gaskets fitted		✓	
1/4 turns / 3point locks correctly adjusted		✓	
Doors open and close with ease		✓	
Escutcheons are square and even		✓	
Hinges are tight		✓	
Cut outs are square and edges painted		✓	
1/4 turns locks correctly adjusted		✓	
Escutcheons open and close with ease		✓	
Escutcheon mounted equipment is level		✓	
Plinth is mounted tight to board		✓	
Lift off panels have handles fitted		✓	
Dome nuts are drilled in Supply Authority tiers		✓	
Gland plates fitted with gasket		✓	
Earthing stud fitted to Gland plate		✓	
Swarf removed and board vacuumed out			
Board wiped down and cleaned			
Busbar connections torque marked		✓	
Busbars phase identified		✓	
Busbar zone clear of debris		✓	
All clearances in accordance with AS3439		✓	
Neutral and earth terminations provided for largest incoming cable		✓	
Neutral and earth bar connections numbered (if in Specs)		✓	
Neutral and earth bar bolts are provided		✓	
Individual modules tested before installation	✓		
Modules fitted correctly	✓		

Testing Officer: GREG KELLY	Licence No: 401705	Signature: G Kelly	Date: 20/2/13
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2.3 Enclosure Fit-out Inspection 4 Lagoon Boonah Main Switchboard

ELECTRICAL FITOUT INSPECTION	N/A	Pass	Comments
6mm SDI (Minimum) fitted to line side of control fuses for high fault level takeoffs		✓	
Check surge arrestor line side cabling size		✓	
Check cable size with cable schedule		✓	
Check cable size with rating of CB		✓	
All control wiring ferruled as required		✓	
All control wiring numbers and colours as per drawings		✓	
Wiring looms to doors incorporates suitable slack		✓	
All terminal numbers fitted		✓	
Terminals randomly checked for tightness		✓	
Check contactors, O/L's and CB's are correct for particular operation		✓	
Check fuses for continuity		✓	
Check fuses for correct current rating		✓	
All indicators correct colour and voltage		✓	
All pushbuttons correct colour	✓		
Labels correct sizes, colours and wording		✓	
All labels secured with screws		✓	
All internal equipment labelled		✓	
Ammeters and CT's correct range		✓	
Meter fuses fed from line side of main switch and CT's		✓	
CT test block fitted	✓		
Voltmeters correct range	✓		
Bolts fitted to incoming terminations		✓	
Phase separators and shrouds provided	✓		
Fit fuse cartridges		✓	
Sample check tightness of connections		✓	
All protective covers in place		✓	
All duct lid fitted		✓	
All pole fillers fitted		✓	
Lighting operation correct	✓		
Door limit switches operational	✓		
All doors are earthed		✓	
All escutcheons are earthed		✓	
C.T secondary's earthed		✓	
All transformer secondaries are earthed	✓		
All power supplies 0 Volts are earthed	✓		
Check correct screen connections of analog and VSD cable	✓		
Adjust O/L settings to motor current or minimum		✓	
Adjust timers to correct values	✓		
Adjust CB settings	✓		
Adjust RCD settings	✓		
Point to point wiring check completed		✓	

Testing Officer: <u>GREG KELLY</u>	Licence No: <u>401705</u>	Signature: <u>dykelly</u>	Date: <u>20/2/13</u>
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2.4 Insulation Resistance Testing 4 Lagoon Boonah Main Switchboard

1000 VOLT APPLIED FOR 1 MINUTE

INSULATION RESISTANCE TESTS					
<i>Before performing the insulation resistance tests, disconnect or isolate the MEN link, RCD earths and neutrals, surge arrestors and any equipment that could be damaged by the tests. Carry out the tests with the test instrument on the 2500 Volt range.</i>					
MAINS SUPPLY AND BUSBAR SYSTEM INSULATION RESISTANCE TESTS – PASS CRITERIA IS > 1 MΩ					
Red – White	>1GΩ	White - Blue	>1GΩ	Red - Blue	>1GΩ
Red – Neutral	>1GΩ	White - Neutral	>1GΩ	Blue - Neutral	>1GΩ
Red – Earth	>1GΩ	White - Earth	>1GΩ	Blue - Earth	>1GΩ
Neutral – Earth	>1GΩ				
DISTRIBUTION BOARD INSULATION RESISTANCE TESTS – PASS CRITERIA IS > 1 MΩ					
Red – White	>1GΩ	White - Blue	>1GΩ	Red - Blue	>1GΩ
Red – Neutral	>1GΩ	White - Neutral	>1GΩ	Blue - Neutral	>1GΩ
Red – Earth	>1GΩ	White - Earth	>1GΩ	Blue - Earth	>1GΩ
Neutral – Earth					
Reconnect all equipment isolated for the insulation tests					

Testing Officer: <u>GREG KELLY</u>	Licence No: <u>401705</u>	Signature: <u>G Kelly</u>	Date: <u>20/2/13</u>
------------------------------------	---------------------------	---------------------------	----------------------

**2.5 Electrical Operational Testing 4 Lagoon Boonah Main Switchboard**

ELECTRICAL OPERATIONAL TESTING	N/A	Pass	Comment
<i>Before applying power to the switchboard for testing, connect test equipment where appropriate. Install barrier tape and flashing light to limit pedestrian access.</i>			
Check connections and phasing of all power circuits			
Check operation of operation of electrical switches		✓	
Check mechanical interlocks		✓	
Adjust 24 VDC power supply output if appropriate		✓	
Test operation of aerator protection equipment		✓	
Contactors operation quiet		✓	
Test ammeter operation		✓	
Test surge protection operation		✓	
Test the operation of all equipment as far as practical		✓	
Test RCD operation		✓	
Test alarm operation		✓	
Test SCADA interfaces		✓	

Testing Officer: <u>GREG KELLY</u>	Licence No: <u>401705</u>	Signature: <u>G Kelly</u>	Date: <u>20/2/13</u>
------------------------------------	---------------------------	---------------------------	----------------------

**3. Corrective Action**

ITEM	DESCRIPTION	DATE COMPLETE	INITIAL
1	X1,X2 LABEL	22/2/13	lyk
2	LOCKDOGS NOT YET ARRIVED	22/2/13	lyk.
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			

**4. Witness**

ACCEPTANCE			
NAME	COMPANY	SIGNATURE	DATE
GREG KELLY	MPA ENGINEERING	<i>gkelly</i>	20/2/13



5. Attachments

5.1 4 Lagoon Boonah main switchboard drawings 486/5/7-0286-nnn



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Brendale Qld 4500
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Fax 07 3881 0723

3703

CERTIFICATE OF: (Mark relevant check-box)

- ☒ **TESTING AND COMPLIANCE** (Electrical Installations)
Issued in accordance with section 159 of the *Electrical Safety Regulation 2002*
- ☒ **TESTING AND SAFETY** (Electrical Equipment)
Issued in accordance with section 15 of the *Electrical Safety Regulation 2002*

Worked Performed for:

Name Thomas and Coffey

Address Gorkow Rd, Boonah

Details of work carried out:

Visual Inspection:

Cables

- Current rating ☒
Installation ☒
Terminations ☒
Identification ☒
Colours ☒

Switchboard

- Location / Access ☒
Protective devices ☒
Isolating devices ☒
Labelling ☒
Connections ☒

Electrical Equipment

- Isolating / switching devices ☒
Connections ☒
Compliance with Codes ☒
Interlocks / Guards ☒
Emergency Stop Check ☒

Earthing lead & electrode / Bonding conductors / MEN Connection / Identification ☒

Electrical Testing:

Result

- | | | |
|--|-------------------------------------|-------------------------------|
| Main earthing conductor resistance | <input checked="" type="checkbox"/> | <u>0.15</u> (Max 0.5 ohm) |
| Equipotential bonding conductor resistance | <input checked="" type="checkbox"/> | <u>0.2</u> (Max 0.5 ohm) |
| Insulation resistance | <input checked="" type="checkbox"/> | <u>200MΩ</u> (Min 1.0 megohm) |
| Verification of polarity | <input checked="" type="checkbox"/> | _____ |
| Circuit connections | <input checked="" type="checkbox"/> | _____ |
| Earth fault loop impedance | <input checked="" type="checkbox"/> | _____ |
| RCD's trip tested by test button | <input checked="" type="checkbox"/> | _____ |

Comments: Results meet and Exceed the requirements
of AS/NZS 3000

For **electrical installations**, this certifies that the electrical installation, to the extent it is affected by the electrical work carried out, has been tested to ensure that it is electrically safe and is in accordance with the requirements of the wiring rules and any other standard applying under the *Electrical Safety Regulation 2002* to the electrical installation.

For **electrical equipment**, this certifies that the electrical equipment, to the extent it is affected by the electrical work carried out, is electrically safe.

Date of Test: 15/5/13

Tested by: Troy Conway

Licence No: 127 277

Signature: _____

MPA Job No.

20142



MPA Engineering Pty Ltd

Quality Assurance

ISO 9001 2008

UNCONTROLLED – VALID ONLY ON THE DATE OF ISSUE

Effective Date: 15/10/10

Issue: 1

QWI 07.31

Pages: 1

Boonah STP WORK INSTRUCTION INSTALLATION TEST SHEET

TEST	CIRCUIT		CIRCUIT		CIRCUIT		CIRCUIT	
	Existing Treatment Plant Value	Pass	Colt Course DB Value	Pass	Former DB Value	Pass	Aerator 1 Value	Pass
Circuit breaker								
Protection Size	63 Amp	/	63 Amp	/	63 Amp	/	20 Amp	/
1 Ø or 3 Ø	3Ø	/	3Ø	/	3Ø	/	3Ø	/
Visual Inspection complete				/		/		/
Main earth resistance < 0.5 Ohms								
Bonding conductors < 0.5 ohms								
Correct polarity and connections		/		/		/		/
Insulation Resistance Ø(L1) to Ø(L2 or N) > 1mΩ	200 MΩ	/	200 MΩ	/	200 MΩ	/	200 MΩ	/
Insulation Resistance Ø(L2) to Ø(L3) > 1mΩ	200 MΩ	/	200 MΩ	/	200 MΩ	/	200 MΩ	/
Insulation Resistance Ø(L3) to Ø(L1) > 1mΩ	200 MΩ	/	200 MΩ	/	200 MΩ	/	200 MΩ	/
Insulation Resistance Ø(L1) to earth > 1mΩ	200 MΩ	/	200 MΩ	/	200 MΩ	/	200 MΩ	/
Insulation Resistance Ø(L2) to earth > 1mΩ	200 MΩ	/	200 MΩ	/	200 MΩ	/	200 MΩ	/
Insulation Resistance Ø(L3) to earth > 1mΩ	200 MΩ	/	200 MΩ	/	200 MΩ	/	200 MΩ	/
Insulation Resistance neutral to earth > 1mΩ	200 MΩ	/	200 MΩ	/	200 MΩ	/	200 MΩ	/
Fault loop impedance correct for circuit		/		/		/		/
Thermal overload set (motors)	—		—		—			/
Motor runs in correct direction (motors)	—		—		—			/
Operates correctly (motors)	—		—		—			/
Connection (Y/Δ) – as per nameplate (motors)	—		—		—			/

I certify that the electrical installation, to the extent that it is effected by the electrical work, has been tested to ensure it is electrically safe and is in accordance with the requirements of the wiring rules and any other standard applying to the electrical installation under state legislation.

Tested By	License No.	Signature	Date
Toy Conroy	127 277		15/5/13



MPA Engineering Pty Ltd

Quality Assurance

ISO 9001 2008

UNCONTROLLED – VALID ONLY ON THE DATE OF ISSUE

Effective Date: 15/10/10

Issue: 1

QWI 07.31

Pages: 1

WORK INSTRUCTION
INSTALLATION TEST SHEET

TEST	CIRCUIT		CIRCUIT		CIRCUIT		CIRCUIT	
	Value	Pass	Value	Pass	Value	Pass	Value	Pass
Circuit breaker	New MF Board		PT control Panel		Chloride dosing		PT + MF Lighting	
Protection Size	100 Amp	✓	200 Amp	✓	20 Amp	✓	20 Amp	✓
1 Ø or 3 Ø	3Ø	✓	1Ø	✓	3Ø	✓	1Ø	✓
Visual Inspection complete		✓		✓		✓		✓
Main earth resistance < 0.5 Ohms								
Bonding conductors < 0.5 ohms								
Correct polarity and connections		✓		✓		✓		✓
Insulation Resistance Ø(L1) to Ø(L2 or N) > 1mΩ	200 MΩ	✓	200 MΩ	✓	200 MΩ	✓	200 MΩ	✓
Insulation Resistance Ø(L2) to Ø(L3) > 1mΩ	200 MΩ	✓	200 MΩ	✓	200 MΩ	✓	200 MΩ	✓
Insulation Resistance Ø(L3) to Ø(L1) > 1mΩ	200 MΩ	✓	200 MΩ	✓	200 MΩ	✓	200 MΩ	✓
Insulation Resistance Ø(L1) to earth > 1mΩ	200 MΩ	✓	200 MΩ	✓	200 MΩ	✓	200 MΩ	✓
Insulation Resistance Ø(L2) to earth > 1mΩ	200 MΩ	✓	200 MΩ	✓	200 MΩ	✓	200 MΩ	✓
Insulation Resistance Ø(L3) to earth > 1mΩ	200 MΩ	✓	200 MΩ	✓	200 MΩ	✓	200 MΩ	✓
Insulation Resistance neutral to earth > 1mΩ	200 MΩ	✓	200 MΩ	✓	200 MΩ	✓	200 MΩ	✓
Fault loop impedance correct for circuit		✓		✓		✓		✓
Thermal overload set (motors)	—		—		—		—	
Motor runs in correct direction (motors)	—		—		—		—	
Operates correctly (motors)	—		—		—		—	
Connection (Y/Δ) – as per nameplate (motors)	—		—		—		—	

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Tested By	License No.	Signature	Date
Troy Conway	127 277		15/5/13



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Effective Date: 15/10/10

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Pages: 1

WORK INSTRUCTION
INSTALLATION TEST SHEET

TEST	CIRCUIT		CIRCUIT		CIRCUIT		CIRCUIT	
	Value	Pass	Value	Pass	Value	Pass	Value	Pass
Circuit breaker	Track Fill DB							
Protection Size	20 Amp	✓						
1 Ø or 3 Ø	3Ø	✓						
Visual Inspection complete								
Main earth resistance < 0.5 Ohms								
Bonding conductors < 0.5 ohms								
Correct polarity and connections		✓						
Insulation Resistance Ø(L1) to Ø(L2 or N) > 1mΩ	200 MΩ	✓						
Insulation Resistance Ø(L2) to Ø(L3) > 1mΩ	200 MΩ	✓						
Insulation Resistance Ø(L3) to Ø(L1) > 1mΩ	200 MΩ	✓						
Insulation Resistance Ø(L1) to earth > 1mΩ	200 MΩ	✓						
Insulation Resistance Ø(L2) to earth > 1mΩ	200 MΩ	✓						
Insulation Resistance Ø(L3) to earth > 1mΩ	200 MΩ	✓						
Insulation Resistance neutral to earth > 1mΩ	200 MΩ	✓						
Fault loop impedance correct for circuit		✓						
Thermal overload set (motors)	—							
Motor runs in correct direction (motors)	—							
Operates correctly (motors)	—							
Connection (Y/Δ) – as per nameplate (motors)	—							

I certify that the electrical installation, to the extent that it is effected by the electrical work, has been tested to ensure it is electrically safe and is in accordance with the requirements of the wiring rules and any other standard applying to the electrical installation under state legislation.

Tested By

License No.

Signature

Date

Trey Conway

127 277

15/5/13



LEVEL SENSOR CALIBRATION CERTIFICATE

Site: Boonah Sewage Treatment Plant

Address: Gorkow Rd, Boonah

Equipment: Vegason 61 – 4...20 mA/ HART

Date of calibration: 20th of November 2013

The lagoon level sensor at Boonah has been calibrated to the following levels, which were provided by Queensland Urban Utilities:

	BWL RL	BWL (0%) sensor reading	TWL RL	TWL (100%) sensor reading	Level sensor RL
Boonah	80.845	1.455	81.4	0.9	82.3

We hereby confirm that the above equipment has been installed and calibrated in accordance with the manufacturer's specifications.

For changes to these levels, please refer to the instructions in the level sensor section of Operations and Maintenance manual.

Calibrated by

Toby Grayson

Help & Contact

MPA Engineering

Trade or Product: Electrical

Contact & Address Details:

Elmo Allan

Branch Manager

MPA Engineering Pty Ltd | 117 Toongarra Road, Ipswich QLD 4305

P +61 (0) 7 3413 8850 F +61 (0) 7 3413 8879

D +61 (0) 7 3413 8854

W www.mpaeng.com.au E Elmo.Allan@MpaEng.com.au

As Built Drawings

As Built drawings

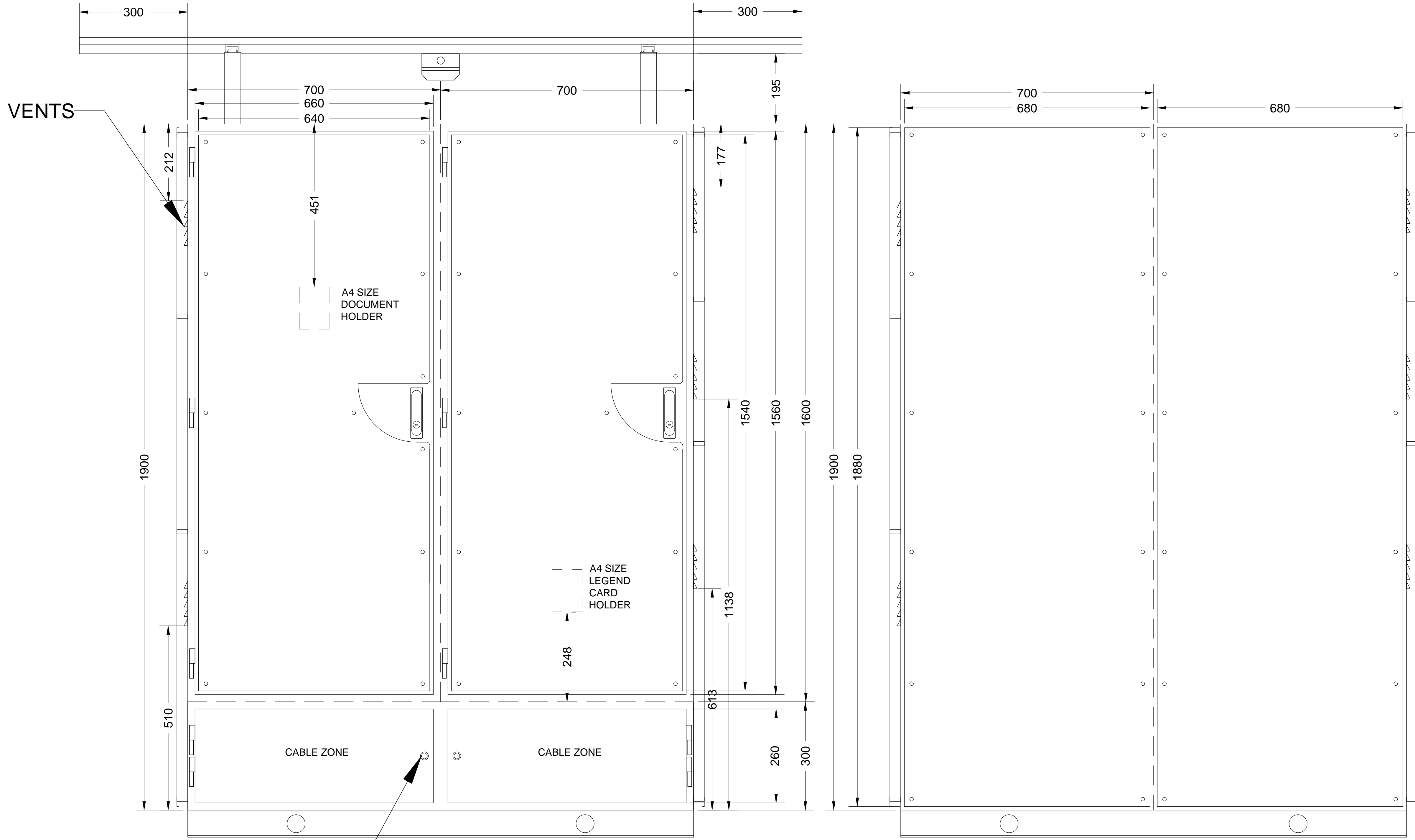
Site: (ST056) Boonah

Process: (1100.0) GENERAL

Sub: (1150) SEWERAGE

Linked Documents

 [20142 - Boonah As Built.pdf](#)




92268 LOCKED
FRONT VIEW SHOWING OUTER DOORS AND SUN SHIELDS

BACK VIEW SHOWING SUN SHIELDS, ROOF REMOVED

AS CONSTRUCTED DETAILS

I CERTIFY THAT THE "AS CONSTRUCTED" DETAILS SHOWN ON THIS PLAN ARE A TRUE AND ACCURATE RECORD OF THE WORKS.

SIGNED:  DATE: 11/06/13

NAME of SIGNATORY: GREG BOTT

RPEQ No. or LICENCE: 10036

COMPANY NAME: MPA Engineering Pty. Ltd.

START DATE: 1/7/12 FINISH DATE: 30/6/13


MPA ENGINEERING PTY LTD



BRENDALE OFFICE
UNIT 3/22 STRATHWYN STREET
BRENDALE
Phone:- 07 3881 0722
Fax:- 07 3881 0723
Website:- www.mpaeng.com.au
Job No:- 20142

NAME SIGNATURE DATE

QUEENSLAND URBAN UTILITIES DELEGATE
(AUTHORISED FOR 12 MONTHS FROM DATE SHOWN)



AS BUILT

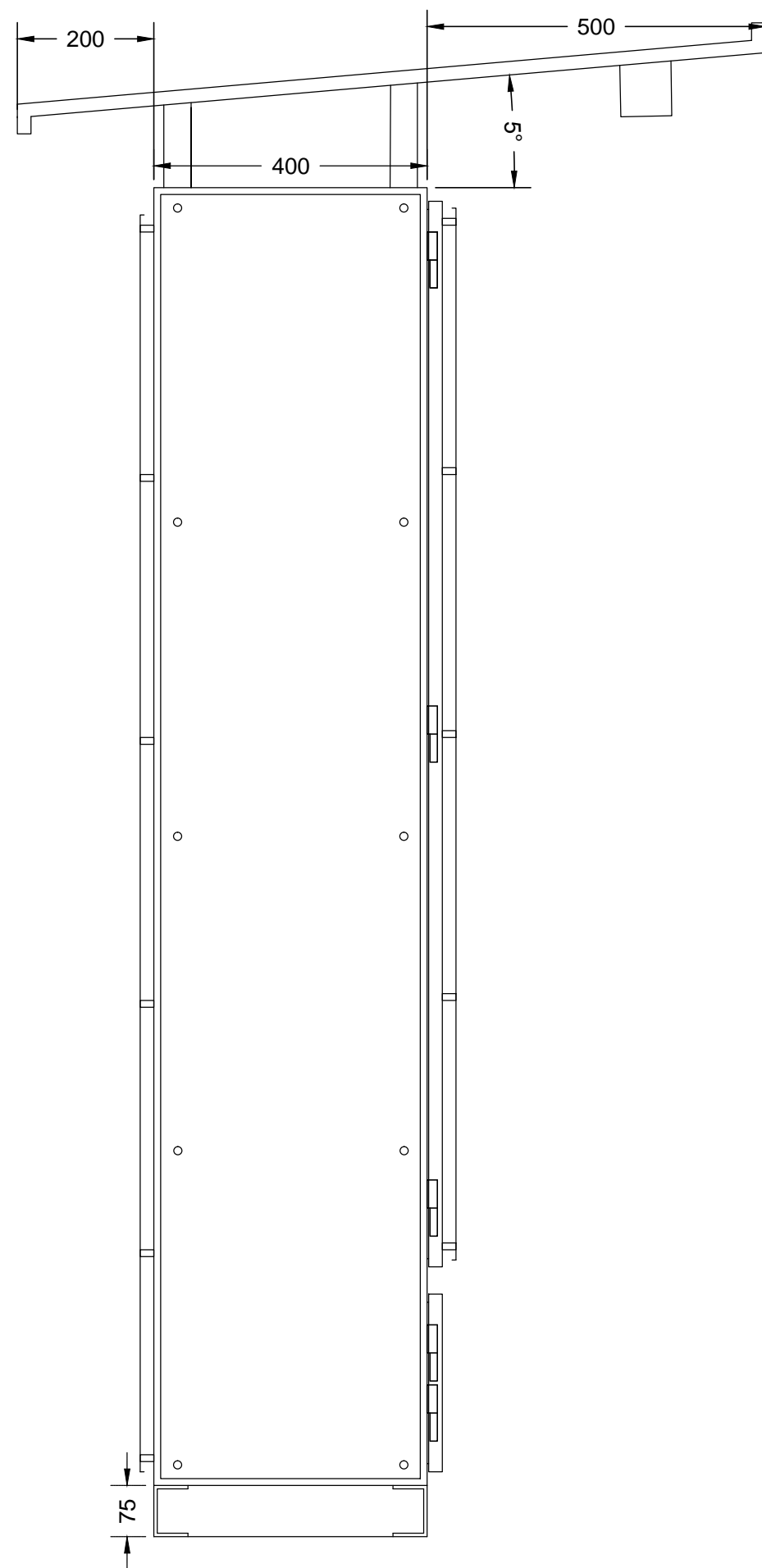
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B	12/12/12	FOR REVIEW	CX	EA	DESIGN W.O. No.		DRAFTING CHK	PAUL KAJEWSKI	DESIGN	R.P.E.Q. No.			DATE		
A	22/11/12	FOR REVIEW	CX	EA	CONSTRUCT W.O. No.		CAD FILE	486-5-5-0108-150_1.dwg	GREG BOTT	10036			11/06/13		
No.	DATE	AMENDMENT	DWN	APD	FUNDED BY Q.U.U. (✓)	EXTERNAL ()	Q.U.U. FILE No.		DESIGN CHECK	R.P.E.Q. No.			DATE		
										APPROVED BY (CONSULTANT)	SIGNATURE	DATE			

SHEET No. 01 OF 08		
QUEENSLAND URBAN UTILITIES DRAWING No.		AMEND.
486/5/5-0108-150		1

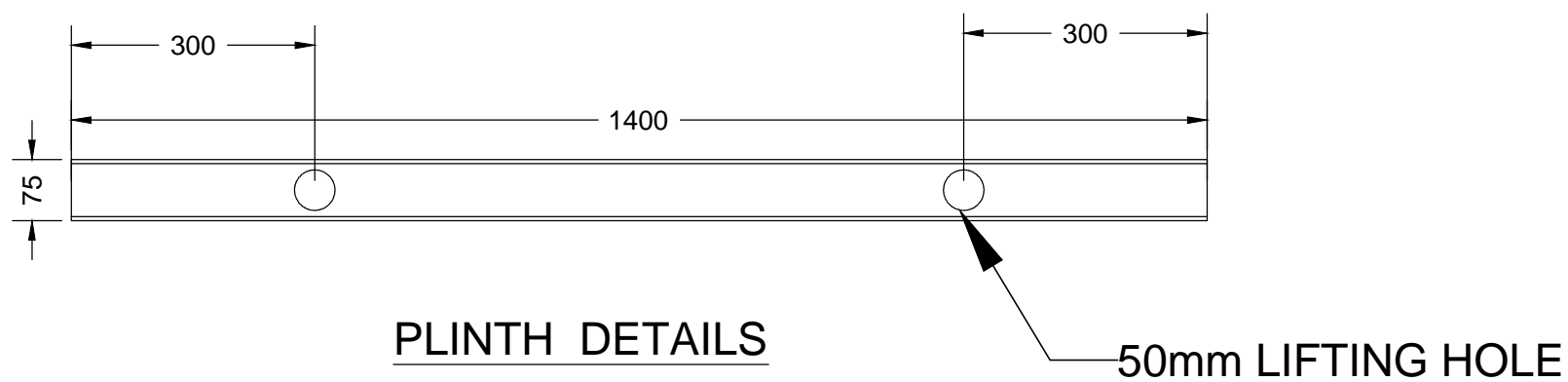
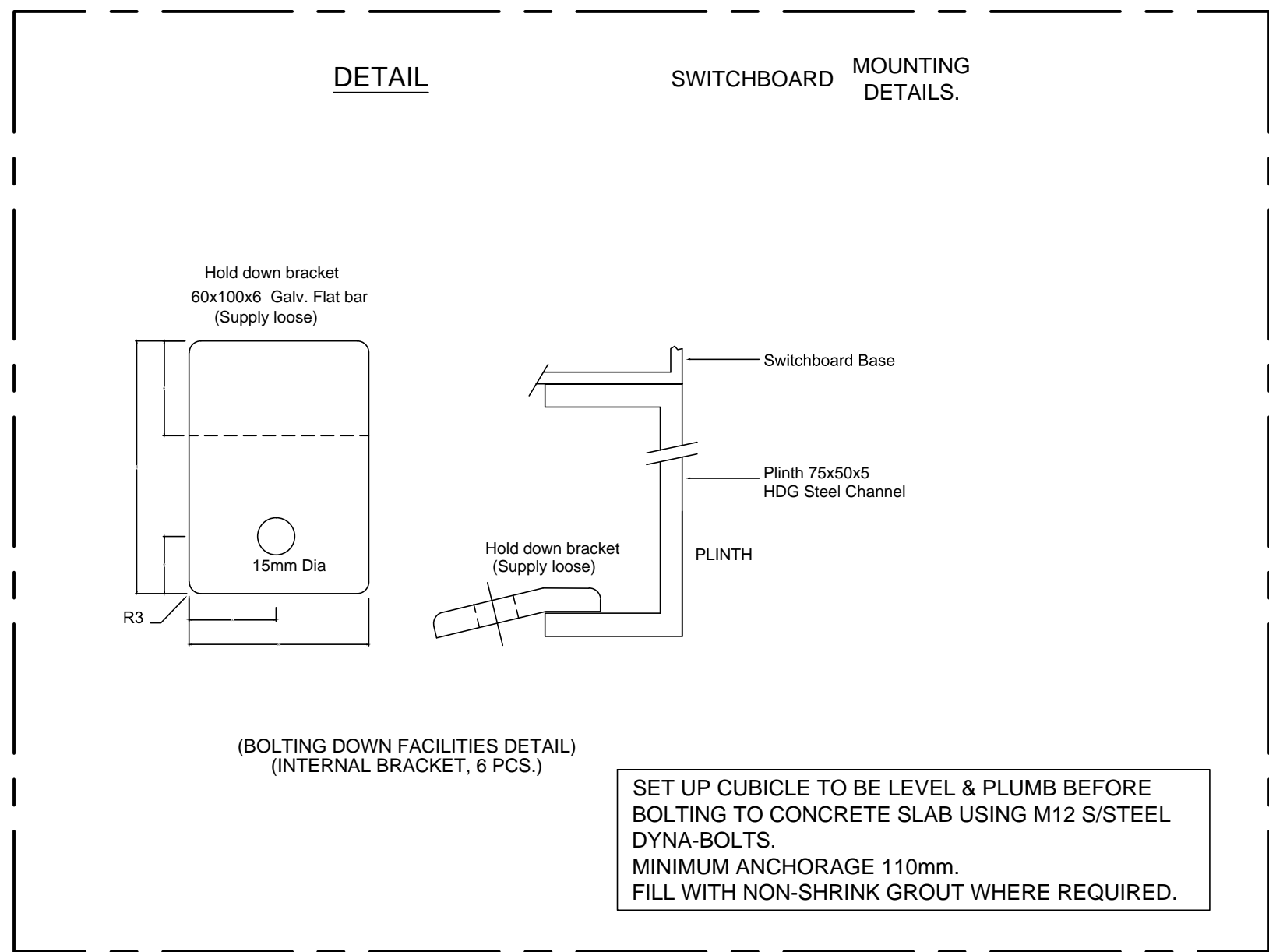
SHEET No.	01	OF	08
QUEENSLAND URBAN UTILITIES DRAWING No.		AMEND.	
486/5/5-0108-150		1	



RIGHT VIEW



LEFT VIEW



PLINTH DETAILS

PLINTH TO BE TOE IN

AS BUILT

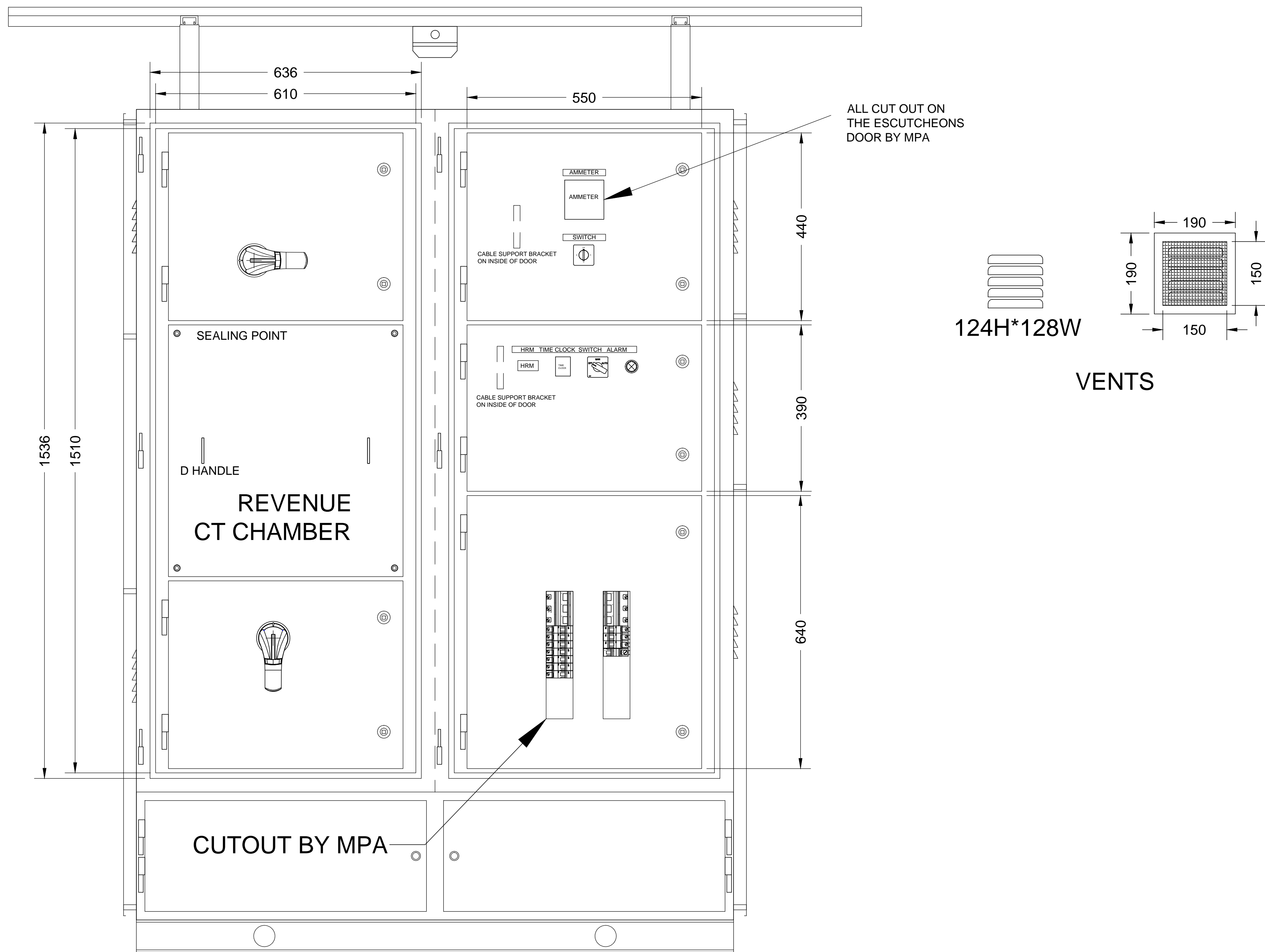
AS CONSTRUCTED DETAILS	
I CERTIFY THAT THE "AS CONSTRUCTED" DETAILS SHOWN ON THIS PLAN ARE A TRUE AND ACCURATE RECORD OF THE WORKS.	
SIGNED:	DATE: 11/06/13
NAME of SIGNATORY: GREG BOTT	
RPEQ No. or LICENCE: 10036	
COMPANY NAME: MPA Engineering Pty. Ltd.	
START DATE: 1/7/12	FINISH DATE: 30/6/13

MPA ENGINEERING PTY LTD	
BRENDALDE OFFICE UNIT 3/22 STRATHWYN STREET BRENDALDE QLD 4500 Phone:- 07 3881 0722 Fax:- 07 3881 0723 Website:- www.mpaeng.com.au Job No:- 20142	

NAME	SIGNATURE	DATE
QUEENSLAND URBAN UTILITIES DELEGATE (AUTHORISED FOR 12 MONTHS FROM DATE SHOWN)		

SHEET No. 02 OF 08
QUEENSLAND URBAN UTILITIES DRAWING No. AMEND.
486/5/5-0108-151 1

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B	12/12/12	FOR REVIEW	CX	EA	DESIGN W.O. No.		DRAFTING CHK	PAUL KAJEWSKI	DESIGN	R.P.E.Q. No.			DATE
A	22/11/12	FOR REVIEW	CX	EA	CONSTRUCT W.O. No.		CAD FILE	486-5-5-0108-150_1.dwg	GREG BOTT	10036			11/06/13
No.	DATE	AMENDMENT	DWN	APD	FUNDED BY Q.U.U. (✓)	EXTERNAL ()	Q.U.U. FILE No.		DESIGN CHECK	R.P.E.Q. No.			DATE
APPROVED BY (CONSULTANT) SIGNATURE DATE													



FRONT VIEW , OUTER DOORS AND SUN SHIELDS REMOVED

AS CONSTRUCTED DETAILS

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SIGNED: DATE: 11/06/13

NAME of SIGNATORY: GREG BOTT

RPEQ No. or LICENCE: 10036

COMPANY NAME: MPA Engineering Pty. Ltd.

START DATE: 1/7/12 FINISH DATE: 30/6/13

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BRENDALE OFFICE
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BRENDALE QLD 4500
Phone:- 07 3881 0722
Fax:- 07 3881 0723
Website:- www.mpaeng.com.au
Job No:- 20142

NAME SIGNATURE DATE

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(AUTHORISED FOR 12 MONTHS FROM DATE SHOWN)

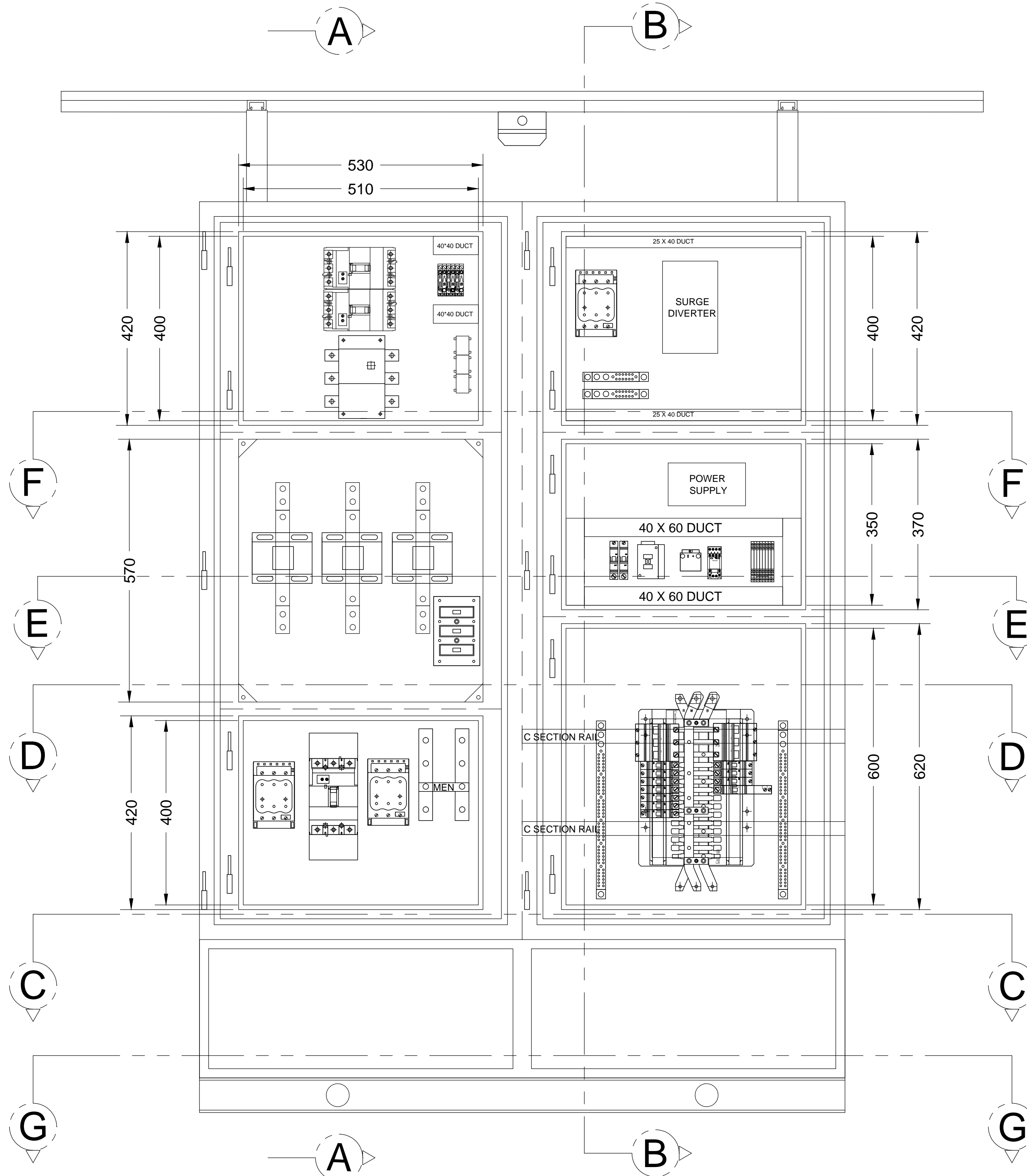
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QUEENSLAND URBAN UTILITIES DRAWING No. AMEND.

486/5/5-0108-152 1

AS BUILT

1	21/02/13	AS BUILT	CX	EA	FUNDING		DRAFTED	CLAIRE XU	GREG BOTT		10036	ASSET/PROJECT QUU FOUR LAGOONS STP UPGRADES	DRAWING TITLE BOONAH MAIN SWITCHBOARD GENERAL ARRANGEMENT	SHEET No. 03 OF 08	
B	12/12/12	FOR REVIEW	CX	EA	DESIGN W.O. No.		DRAFTING CHK	PAUL KAJEWSKI	DESIGN	R.P.E.Q. No.	DATE			QUEENSLAND URBAN UTILITIES DRAWING No.	AMEND.
A	22/11/12	FOR REVIEW	CX	EA	CONSTRUCT W.O. No.		CAD FILE	486-5-5-0108-150_1.dwg	GREG BOTT	10036	11/06/13			486/5/5-0108-152	
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										APPROVED BY (CONSULTANT)	SIGNATURE	DATE			



FRONT VIEW , SHOWING INNER ESCUTCHEONS,
SUN SHIELD AND VENTS REMOVED

AS BUILT

AS CONSTRUCTED DETAILS

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NAME SIGNATURE DATE

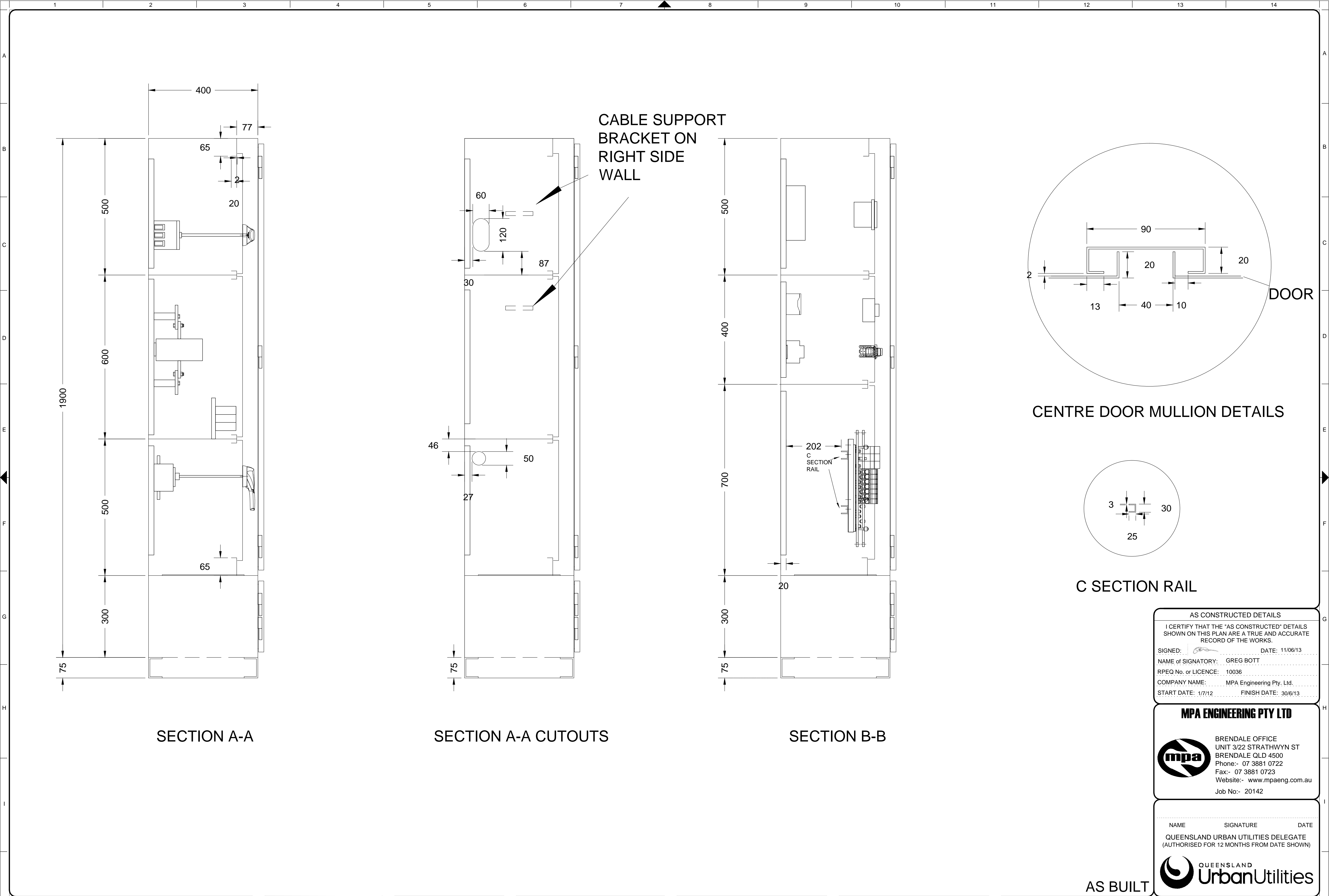
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SHEET No. 04 OF 08

QUEENSLAND URBAN UTILITIES DRAWING No. AMEND.

486/5/5-0108-153 **2**

2	22/03/13	FOR ERGON REQUIREMENT	CX	EA	FUNDING		DRAFTED	CLAIRE XU	GREG BOTT	10036	ASSET/PROJECT QUU FOUR LAGOONS STP UPGRADES	DRAWING TITLE BOONAH MAIN SWITCHBOARD GENERAL ARRANGEMENT
1	21/02/13	AS BUILT	CX	EA	DESIGN W.O. No.		DRAFTING CHK	PAUL KAJEWSKI	DESIGN	R.P.E.Q. No. DATE		
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No.	DATE	AMENDMENT	DWN	APD	FUNDED BY Q.U.U. (✓) EXTERNAL ()		Q.U.U. FILE No.		DESIGN CHECK	R.P.E.Q. No. DATE		
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1	21/02/13	AS BUILT	CX	EA	FUNDING		DRAFTED	CLAIRE XU	GREG BOTT	10036	ASSET/PROJECT QUU FOUR LAGOONS STP UPGRADES	DRAWING TITLE BOONAH MAIN SWITCHBOARD GENERAL ARRANGEMENT				
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	1	2	3	4	5		6		7		8	9	10	11	12	LAST

AS CONSTRUCTED DETAILS

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SIGNED:  DATE: 11/06/13

NAME of SIGNATORY: GREG BOTT

RPEQ No. or LICENCE: 10036

COMPANY NAME: MPA Engineering Pty. Ltd.

START DATE: 1/7/12 FINISH DATE: 30/6/13

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Job No:- 20142

NAME SIGNATURE DATE

QUEENSLAND URBAN UTILITIES DELEGATE
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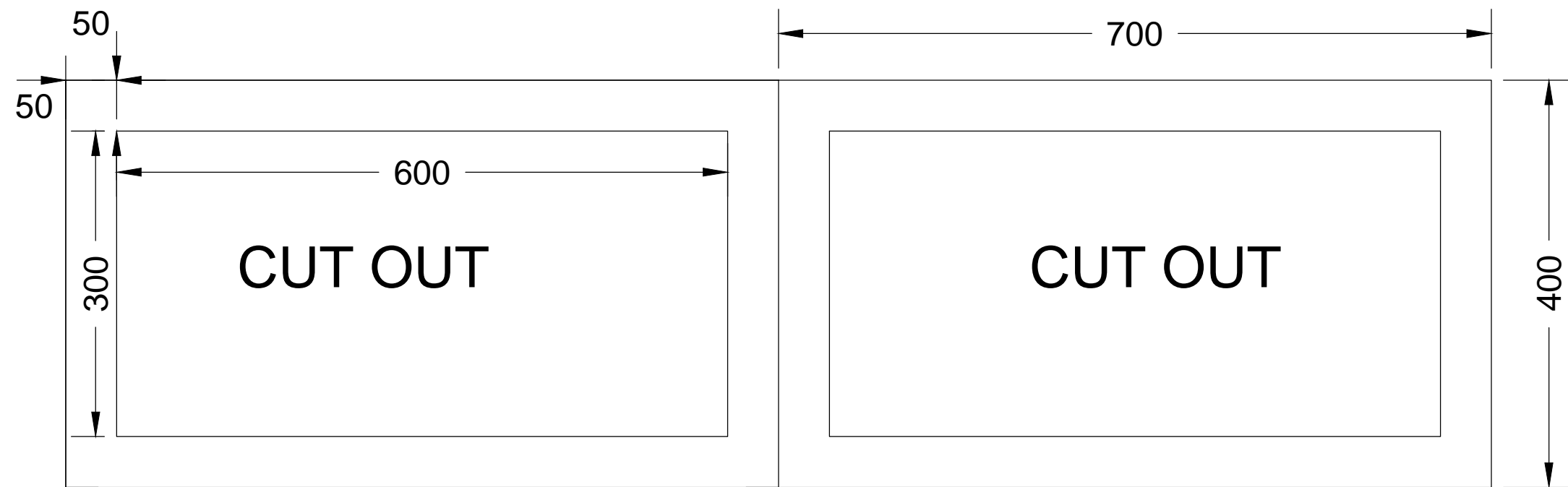


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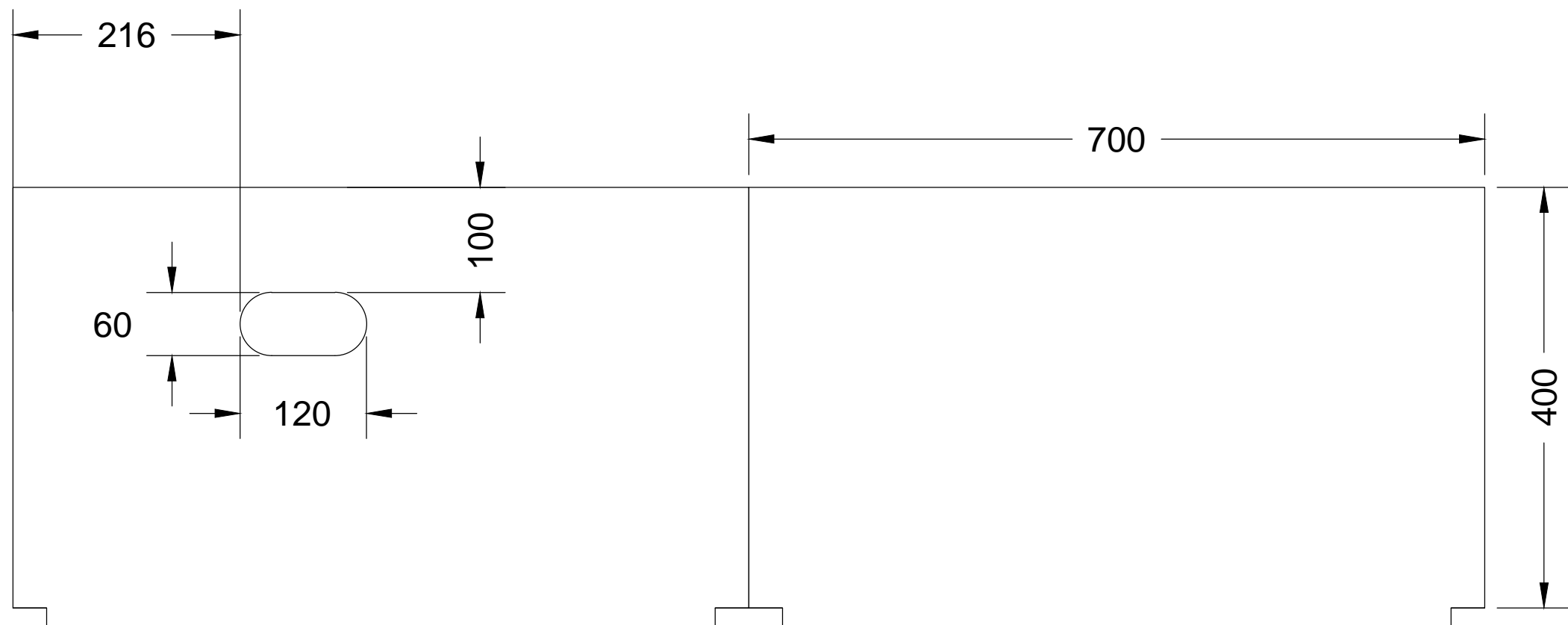
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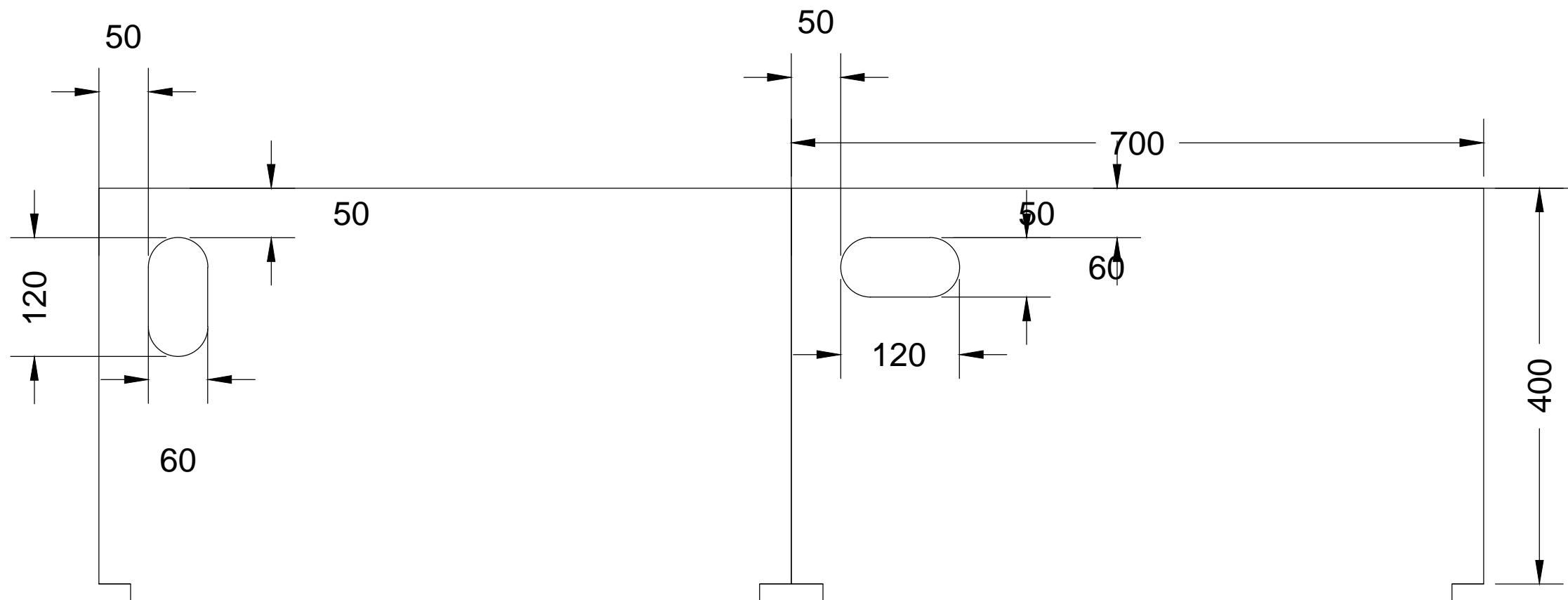
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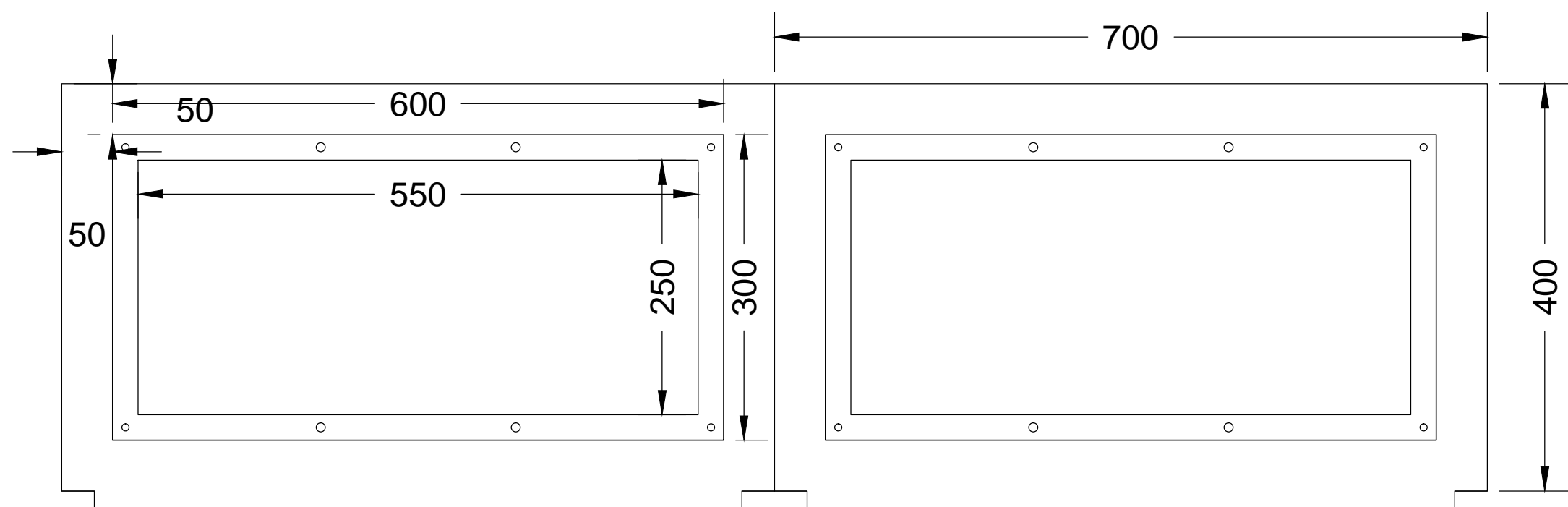
SECTION G-G CUT-OUTS



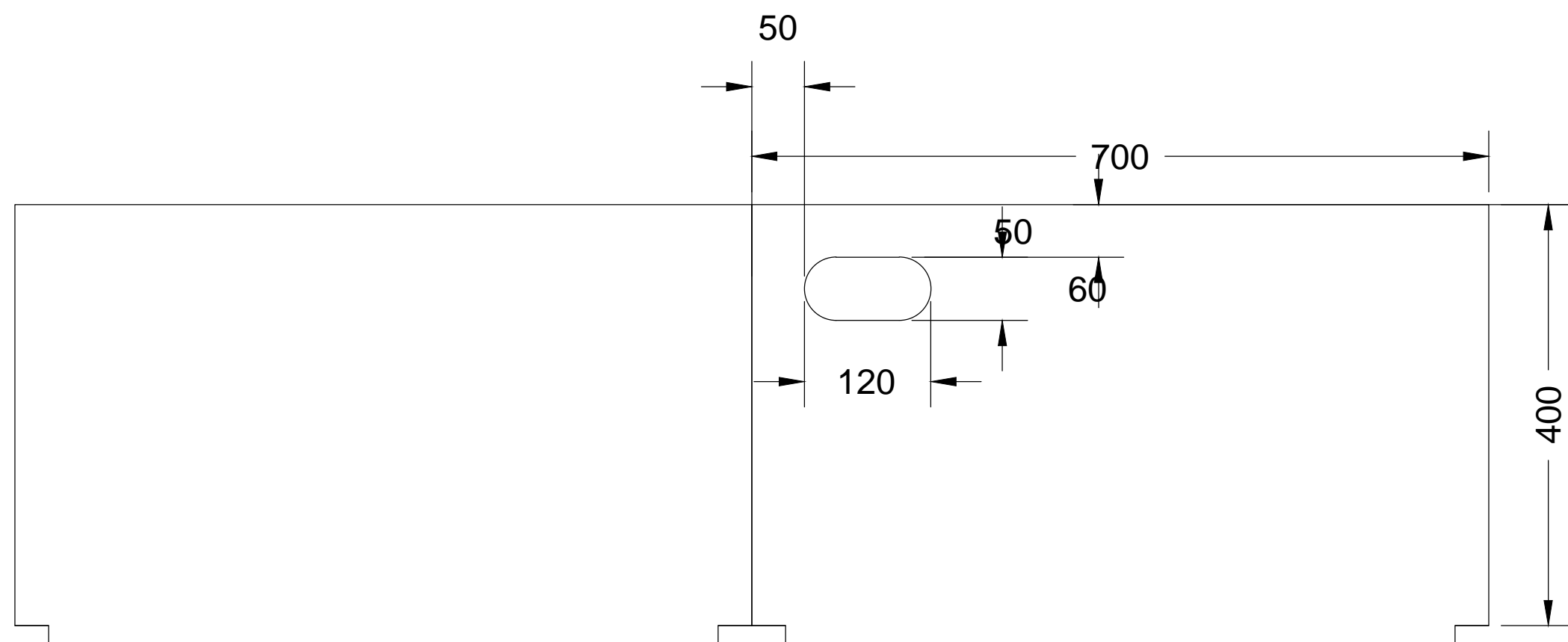
SECTION D-D CUT-OUTS



SECTION F-F CUT-OUTS




SECTION C-C GLAND PLATES



SECTION E-E CUT-OUTS

AS CONSTRUCTED DETAILS

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SIGNED:  DATE: 11/06/13


NAME of SIGNATORY: GREG BOTT

RPEQ No. or LICENCE: 10036

COMPANY NAME: MPA Engineering Pty. Ltd.


START DATE: 1/7/12 FINISH DATE: 30/6/13

MPA ENGINEERING PTY LTD

 BRENDALDE OFFICE
UNIT 3/22 STRATHWYN ST
BRENDALDE QLD 4500
Phone:- 07 3881 0722
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Website:- www.mpaeng.com.au
Job No:- 20142

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QUEENSLAND URBAN UTILITIES DELEGATE
(AUTHORISED FOR 12 MONTHS FROM DATE SHOWN)



SHEET No. 06 OF 08

QUEENSLAND URBAN UTILITIES DRAWING No. AMEND.

486/5/5-0108-155 **1**

AS BUILT

1	21/02/13	AS BUILT	CX	EA	FUNDING		DRAFTED	CLAIRE XU	GREG BOTT	10036	APPROVED BY (CONSULTANT) SIGNATURE DATE	ASSET/PROJECT QUU FOUR LAGOONS STP UPGRADES	DRAWING TITLE BOONAH MAIN SWITCHBOARD GENERAL ARRANGEMENT	SHEET No. 06 OF 08 QUEENSLAND URBAN UTILITIES DRAWING No. AMEND. 486/5/5-0108-155 1
B	12/12/12	FOR REVIEW	CX	EA	DESIGN W.O. No.		DRAFTING CHK	PAUL KAJEWSKI	DESIGN	R.P.E.Q. No.	DATE			
A	22/11/12	FOR REVIEW	CX	EA	CONSTRUCT W.O. No.		CAD FILE	486-5-5-0108-150_1.dwg	GREG BOTT	10036	11/06/13			
No.	DATE	AMENDMENT	DWN	APD	FUNDED BY Q.U.U. (✓) EXTERNAL ()		Q.U.U. FILE No.		DESIGN CHECK	R.P.E.Q. No.	DATE			

CONSTRUCTION NOTES

ENCLOSURE.
FINISH .
MOUNTING PANS.

3mm MARINE GRADE ALUMINIUM.
DULUX 36648 MIST GREEN ,MATT FINISH.
BRIGHT WHITE 32166. 3mm MARINE GRADE ALUMINIUM.

OPERATIONAL FREQUENCY. 50 HZ
RATED VOLTAGE 415V
RATED INSULATION VOLTAGE 660V
RATED AUXILIARY VOLTAGE 24VDC
RATED CURRENT 400A
SHORT CIRCUIT CURRENT /SC 20kA
DURATION OF /SC 0.1 SEC
SERVICE CONDITION OUTDOOR
FORM OF SEPARATION FORM 2
IP RATING IP56
PLINTH MATERIAL 75 mm STEEL CHANEL ,HOT DIP GAL, TOE-IN
FINISH
CABLE ENTRY
SWITCHBOARD MOUNTING
SPARE
SWITCHBOARD TYPE
GLAND PLATE MATERIAL
DOORS STAYS ON OUTDOOR
A4 SIZE LENGEND CARD HOLDER AND DOCUMENT HOLDER ARE INSIDE THE OUTER DOOR
NO PARTITION BETWEEN THE CABLE ZONE

SUN SHIELD NOTES:

CONSTRUCTION:
* MACHINE FORMED AND CONTINUOUS SEAM WELDED FROM 3mm ALUMINIUM.
* SUN SHIELDS ON FRONT,BACK AND SIDES.
* ENSURE HEATSHIELDS ARE DESIGNED SO ANY DOOR MAY OPEN TO 100 DEGREE WITHOUT CLASHING ON ADJACENT DOOR.

* FULL LENGTH EXTERNAL DOOR REINFORCED WITH DOOR STIFFENER.
* NUTS, BOLTS & OTHER FASTENINGS TO BE 316 STAINLESS STEEL (MIN).
* ALL DOORS INNER & OUTER TO HAVE 6mm EARTH STUDS WELDED TO THE RIGHT HAND CORNER OF THE DOOR & ON THE SIDE OF THE CUBICLE AT EACH DOOR.

SEALING / LOCKING:
* FULL RETURN GUTTERS ON MULLIONS.
* CLOSED CELL NEOPRENE GASKET FITTED TO DOORS AND COVERS.
* EXTERNAL DOORS FITTED WITH 316 STAINLESS STEEL LOCKABLE SWING HANDLES KEYED 92268 WITH 3 POINT LOCKING MECHANISM ON FULL LENGTH DOOR.
* HINGES SHALL BE 316 STAINLESS STEEL WITH 316 STAINLESS STEEL PINS.
* INTERNAL DOORS FITTED WITH QUARTER TURNS,316 STAINLESS STEEL

AS BUILT

AS CONSTRUCTED DETAILS

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Job No:- 20142

NAME SIGNATURE DATE

QUEENSLAND URBAN UTILITIES DELEGATE
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SHEET No. 07 OF 08

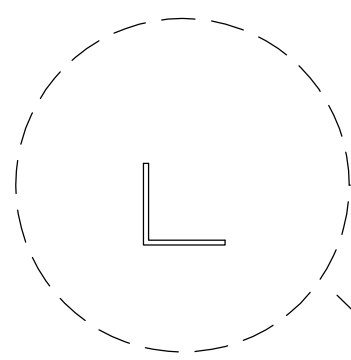
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486/5/5-0108-156 1

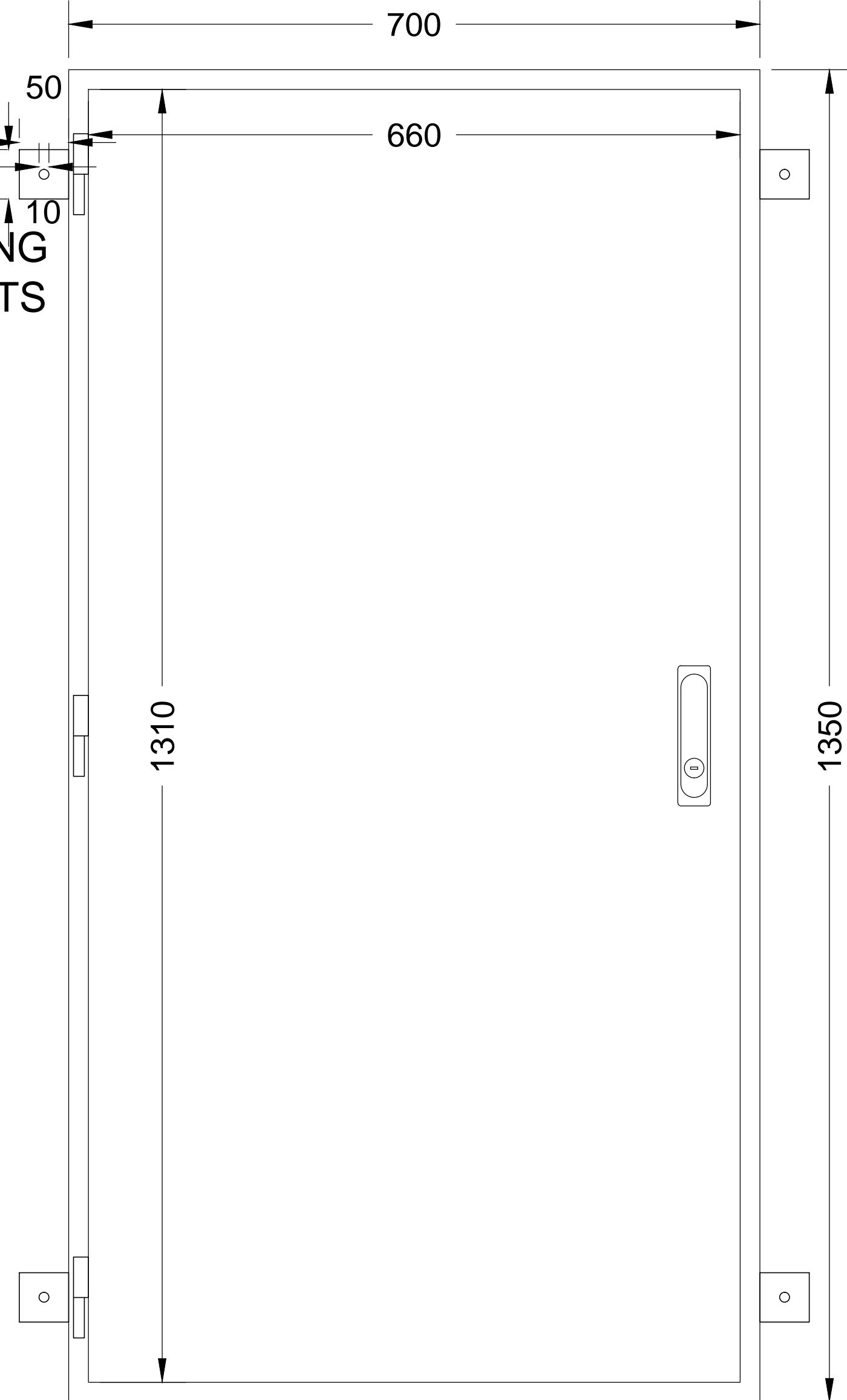
J	1	21/02/13	AS BUILT	CX	EA	FUNDING		DRAFTED	CLAIRE XU	GREG BOTT	10036	APPROVED BY (CONSULTANT)	SIGNATURE	DATE	ASSET/PROJECT QUU FOUR LAGOONS STP UPGRADES	DRAWING TITLE BOONAH MAIN SWITCHBOARD GENERAL ARRANGEMENT
	B	12/12/12	FOR REVIEW	CX	EA	DESIGN W.O. No.		DRAFTING CHK	PAUL KAJEWSKI	DESIGN	R.P.E.Q. No.					
	A	22/11/12	FOR REVIEW	CX	EA	CONSTRUCT W.O. No.		CAD FILE	486-5-5-0108-150_1.dwg	GREG BOTT	10036					
	No.	DATE	AMENDMENT	DWN	APD	FUNDED BY Q.U.U. (✓)	EXTERNAL ()	Q.U.U. FILE No.		DESIGN CHECK	R.P.E.Q. No.					

METER BOX

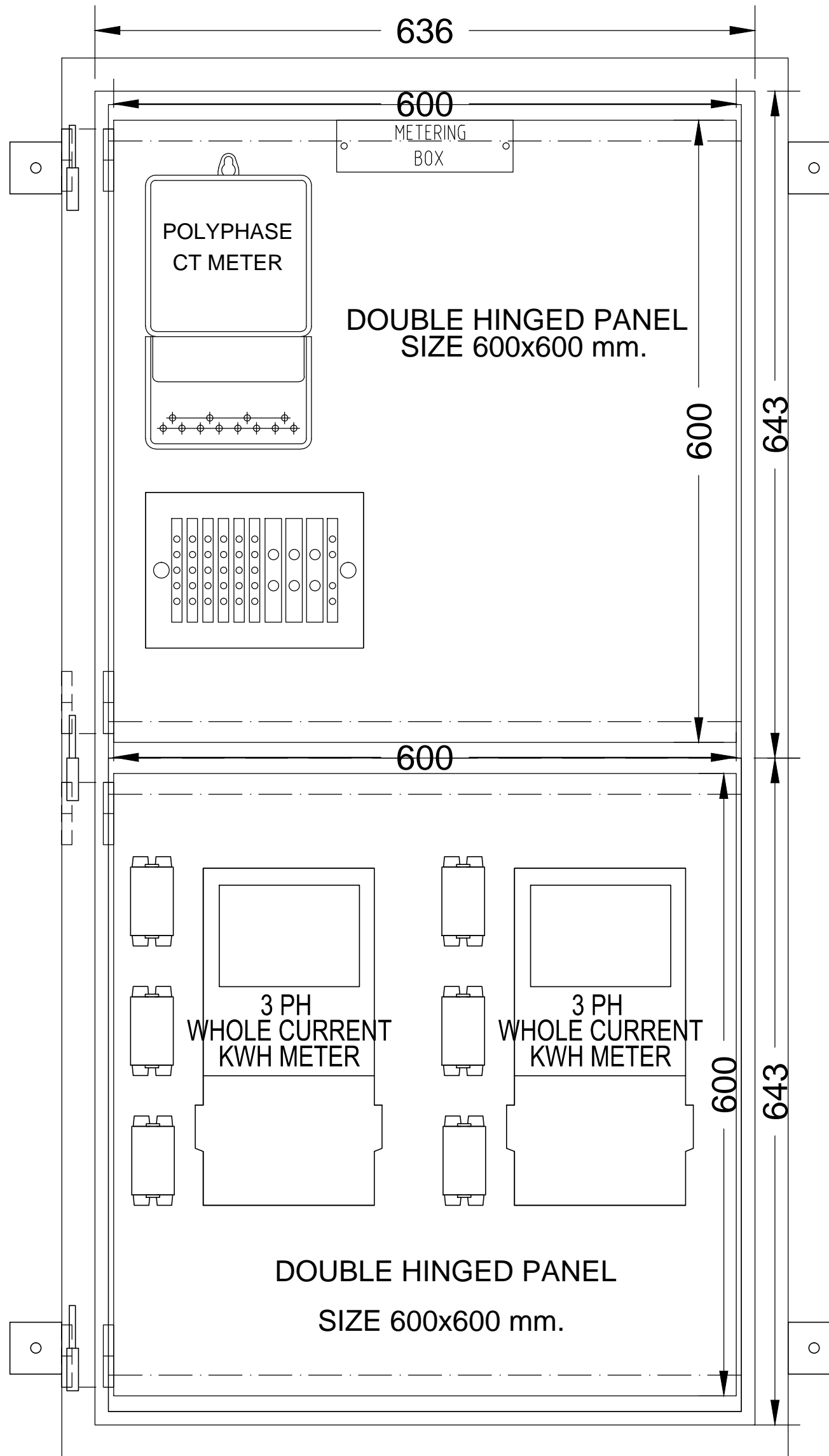
TOP VIEW OF
MOUNTING
BRACKET



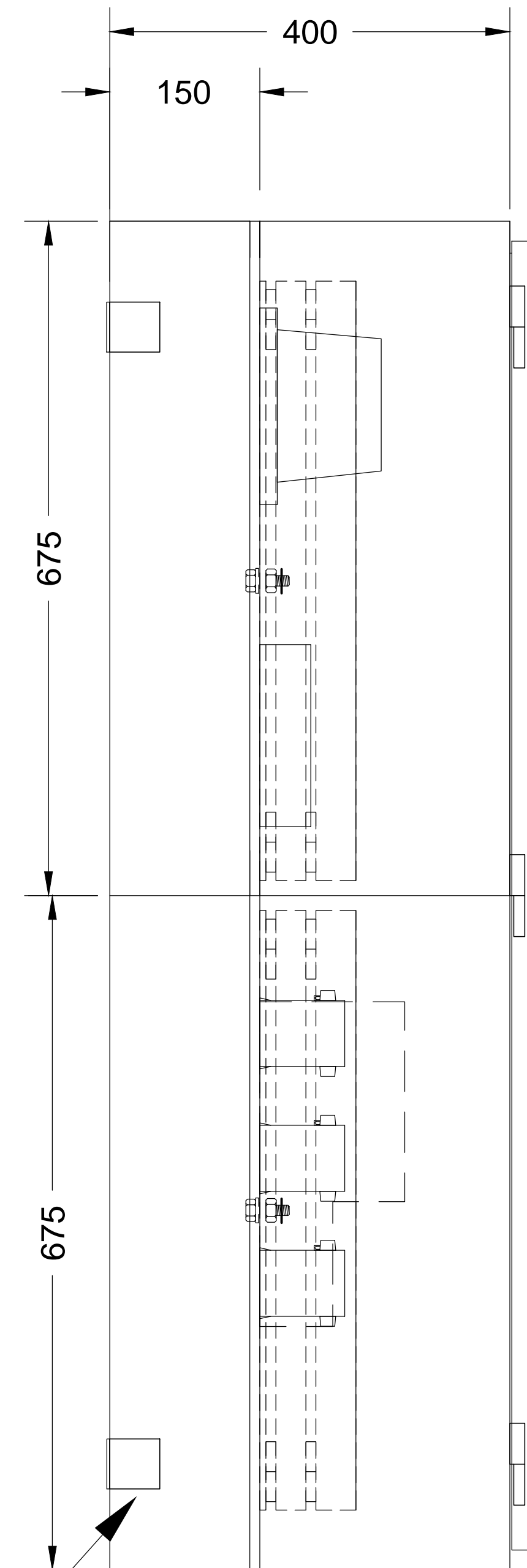
MOUNTING
BRACKETS



FRONT VIEW SHOWING OUTER DOORS



FRONT VIEW , OUTER DOORS REMOVED



SIDE VIEW

AS CONSTRUCTED DETAILS

I CERTIFY THAT THE "AS CONSTRUCTED" DETAILS SHOWN ON THIS PLAN ARE A TRUE AND ACCURATE RECORD OF THE WORKS.

SIGNED: DATE: 11/06/13

NAME of SIGNATORY: GREG BOTT

RPEQ No. or LICENCE: 10036

COMPANY NAME: MPA Engineering Pty. Ltd.

START DATE: 1/7/12 FINISH DATE: 30/6/13

MPA ENGINEERING PTY LTD

BRENDALDE OFFICE
UNIT 3/22 STRATHWYN ST
BRENDALDE QLD 4500
Phone:- 07 3881 0722
Fax:- 07 3881 0723
Website:- www.mpaeng.com.au
Job No:- 20142

NAME SIGNATURE DATE

QUEENSLAND URBAN UTILITIES DELEGATE
(AUTHORISED FOR 12 MONTHS FROM DATE SHOWN)

UrbanUtilities

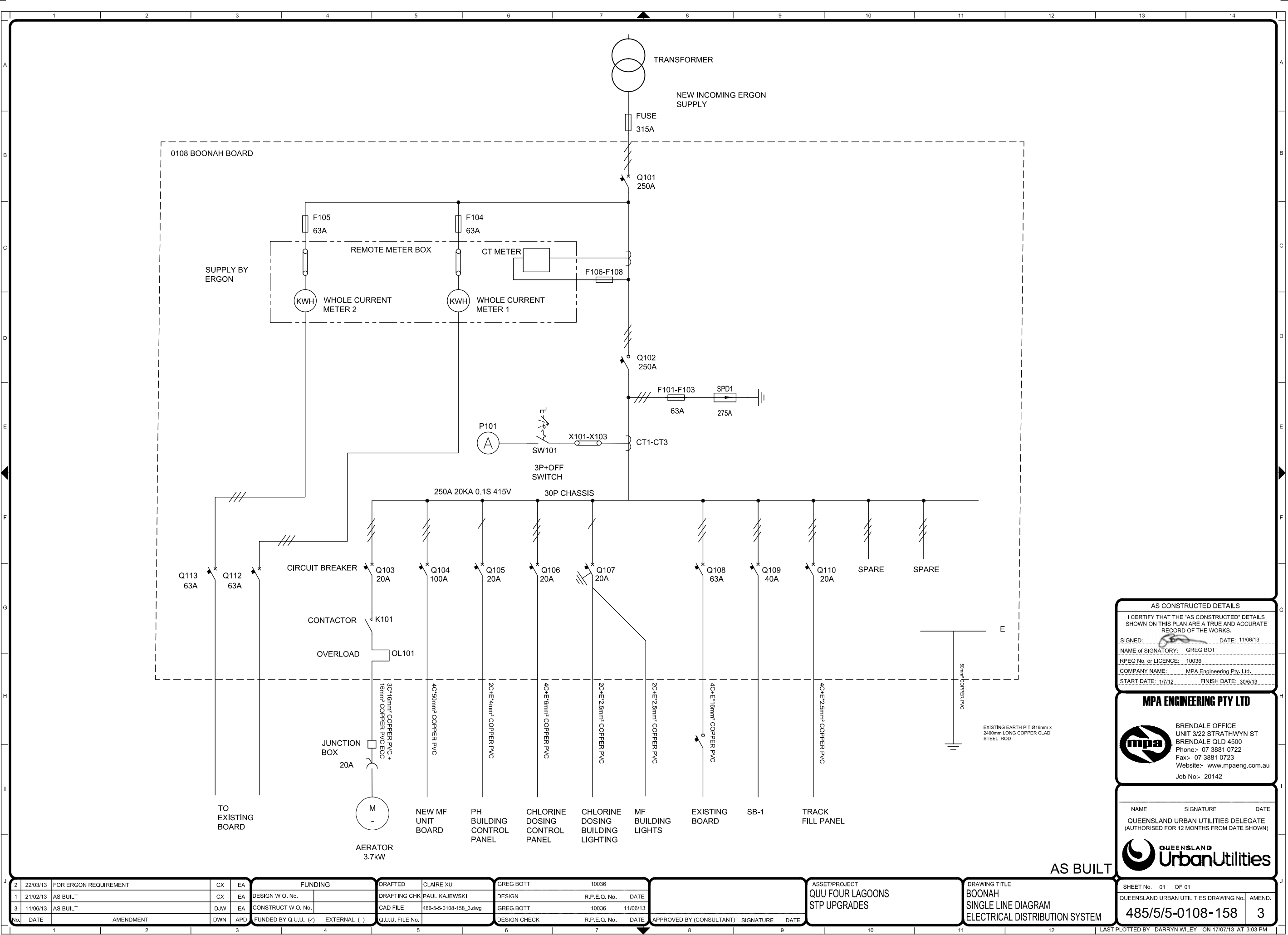
SHEET No. 08 OF 08

QUEENSLAND URBAN UTILITIES DRAWING No. AMEND.

486/5/5-0108-157 **1**

AS BUILT

1	21/02/13	AS BUILT	CX	EA	FUNDING		DRAFTED	CLAIRE XU	GREG BOTT	10036	APPROVED BY (CONSULTANT) SIGNATURE DATE	ASSET/PROJECT QUU FOUR LAGOONS STP UPGRADES	DRAWING TITLE BOONAH MAIN SWITCHBOARD GENERAL ARRANGEMENT	SHEET No. 08 OF 08		
B	05/02/13	FOR REVIEW	CX	EA	DESIGN W.O. No.		DRAFTING CHK	PAUL KAJEWSKI	DESIGN	R.P.E.Q. No.				DATE	QUEENSLAND URBAN UTILITIES DRAWING No. AMEND.	
A	04/02/13	FOR REVIEW	CX	EA	CONSTRUCT W.O. No.		CAD FILE	486-5-5-0108-150_1.dwg	GREG BOTT	10036				11/06/13	486/5/5-0108-157 1	
No.	DATE	AMENDMENT	DWN	APD	FUNDED BY Q.U.U. (✓) EXTERNAL ()		Q.U.U. FILE No.		DESIGN CHECK	R.P.E.Q. No.				DATE		
1 2 3 4 5 6 7 8 9 10 11 12 LAST PLOTTED BY DARRYN WILEY ON 17/07/13 AT 3:03 PM																



AS CONSTRUCTED DETAILS

I CERTIFY THAT THE "AS CONSTRUCTED" DETAILS SHOWN ON THIS PLAN ARE A TRUE AND ACCURATE RECORD OF THE WORKS.

SIGNED: _____ DATE: 11/06/13

NAME of SIGNATORY: GREG BOTT

RPEQ No. or LICENCE: 10036

COMPANY NAME: MPA Engineering Pty. Ltd.

START DATE: 1/7/12 FINISH DATE: 30/6/13

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BRENDALE OFFICE
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BRENDALE QLD 4500
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NAME SIGNATURE DATE

QUEENSLAND URBAN UTILITIES DELEGATE
(AUTHORISED FOR 12 MONTHS FROM DATE SHOWN)

QUEENSLAND UrbanUtilities

SHEET No. 01 OF 01

QUEENSLAND URBAN UTILITIES DRAWING No. AMEND.

485/5/5-0108-158 3

2	22/03/13	FOR ERGON REQUIREMENT	CX	EA	FUNDING	DRAFTED	CLAIRE XU	GREG BOTT	10036
1	21/02/13	AS BUILT	CX	EA	DESIGN W.O. No.	DRAFTING CHK	PAUL KAJEWSKI	DESIGN	R.P.E.Q. No. DATE
3	11/06/13	AS BUILT	DJW	EA	CONSTRUCT W.O. No.	CAD FILE	486-5-5-0108-158_3.dwg	GREG BOTT	10036 11/06/13
No.	DATE	AMENDMENT	DWN	APD	FUNDED BY Q.U.U. (✓) EXTERNAL ()	Q.U.U. FILE No.	DESIGN CHECK	R.P.E.Q. No.	DATE

APPROVED BY (CONSULTANT) SIGNATURE DATE

ASSET/PROJECT
QUU FOUR LAGOONS
STP UPGRADES

DRAWING TITLE
BOONAH
SINGLE LINE DIAGRAM
ELECTRICAL DISTRIBUTION SYSTEM

LAST PLOTTED BY DARRYN WILEY ON 17/07/13 AT 3:03 PM

