

WaterMaster Electromagnetic flowmeter



The Company

We are 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 part of ABB, a world leader in process automation technology, we offer customers application expertise, service and support worldwide.

We are committed to teamwork, high quality manufacturing, advanced technology and unrivalled service and support.

The quality, accuracy and performance of the Company's products result from over 100 years experience, combined with a continuous program of innovative design and development to incorporate the latest technology.

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1 Safety

Information in this manual is intended only to assist our customers in the efficient operation of our equipment. Use of this manual for any other purpose is specifically prohibited and its contents are not to be reproduced in full or part without prior approval of the Technical Publications Department.

1.1 Electrical Safety

This equipment complies with the requirements of CEI/IEC 61010-1:2001-2 'Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use' and complies with NIST and OSHA. If the equipment is used in a manner NOT specified by the Company, the protection provided by the equipment may be impaired.

1.2 Symbols

One or more of the following symbols may appear on the equipment labelling:

	Warning – Refer to the manual for instructions		Direct current supply only
	Caution – Risk of electric shock		Alternating current supply only
	Protective earth (ground) terminal		Both direct and alternating current supply
	Earth (ground) terminal		The equipment is protected through double insulation

1.3 Health & Safety

To ensure that our products are safe and without risk to health, the following points must be noted:

- The safety requirements of this equipment, any associated equipment and the local environment must be taken into consideration during installation.
- Install and use this equipment and any associated equipment in accordance with the relevant national and local standards.
- The relevant sections of these instructions must be read carefully before proceeding.
- Warning labels on containers and packages must be observed.
- Installation, operation, maintenance and servicing must only be carried out by suitably trained personnel and in accordance with the information given.
- Normal safety precautions must be taken to avoid the possibility of an accident occurring when operating in conditions of high pressure and / or temperature.
- Chemicals must be stored away from heat, protected from temperature extremes and powders kept dry. Normal safe handling procedures must be used.
- When disposing of chemicals ensure that no two chemicals are mixed.
- Product liability – advice and assistance provided without charge is given in good faith but without liability.

Safety advice concerning the use of the equipment described in this manual or any relevant hazard data sheets (where applicable) may be obtained from the Company address on the back cover, together with servicing and spares information.

2 Introduction

WaterMaster™ is a range of high performance electromagnetic flowmeters for the measurement of electrically conductive fluids and systems are normally supplied factory-configured and calibrated.

This User Guide provides installation, connection, security, start-up and basic setup details. For programming and configuration information refer to the Programming Guide – IM/WMP.

Warning.

- System configuration must be carried out only by users or personnel with approved access rights (user privileges).
- Read all relevant sections of this guide before configuring the system or modifying system parameters.
- Install and use associated equipment in accordance with the relevant national and local standards.

This User Guide should be used in conjunction with the following publications:

- Programming Guide – IM/WMP

For Profibus DP variants (FEX100-DP)

- User Guide Supplement, PROFIBUS RS485 Physical Layer (FEX100-DP) – IM/WMPBS-EN
- User Guide Supplement, PROFIBUS FEX100-DP Parameter Tables – IM/WMPBST-EN

For Modbus variants (FEX100-MB)

- User Guide Supplement, MODBUS RS485 Physical Layer COI/FEX100/MOD-EN
- User Guide Supplement, MODBUS Tables COI/FEX100/MOD/TBL-EN

2.1 Quality Control

The UKAS Calibration Laboratory No. 0255 is just one of the ten flow calibration plants operated by the Company and is indicative of our dedication to quality and accuracy.



Fig. 2.1 UKAS Calibration Laboratory No. 0255

3 Mechanical Installation

3.1 Unpacking

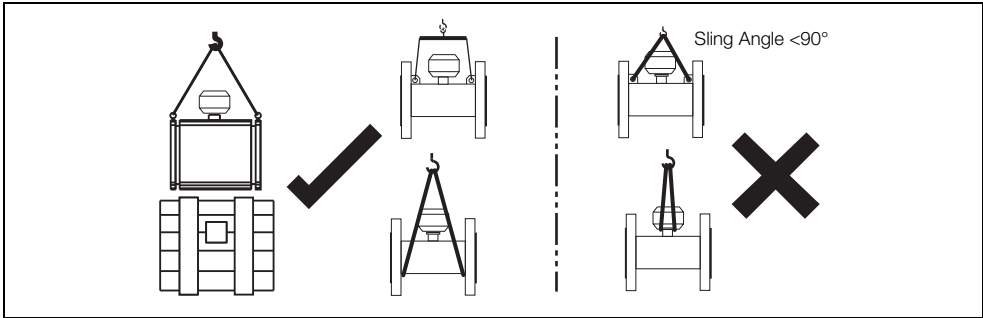


Fig. 3.1 Unpacking

Caution. Visually inspect equipment for damage before installing. Do not install damaged or faulty equipment.

3.2 Installation Conditions

Caution. Do NOT exceed the maximum working pressure marked on the equipment.

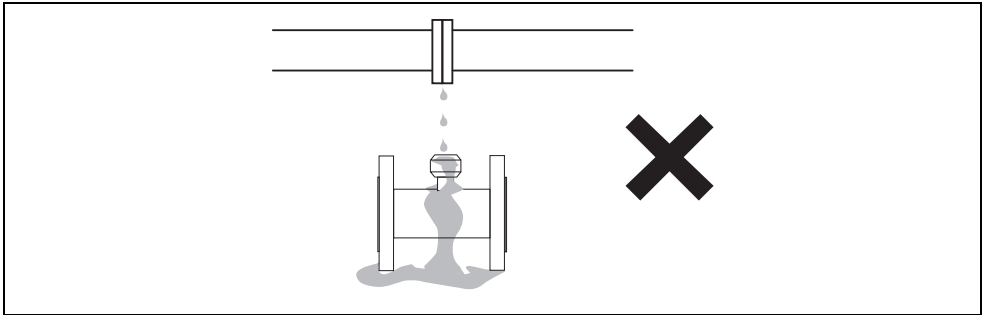


Fig. 3.2 Spillage

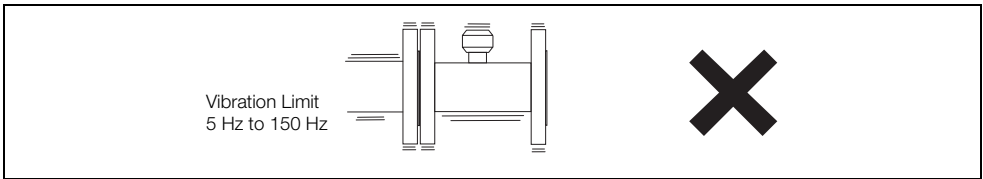


Fig. 3.3 Vibration

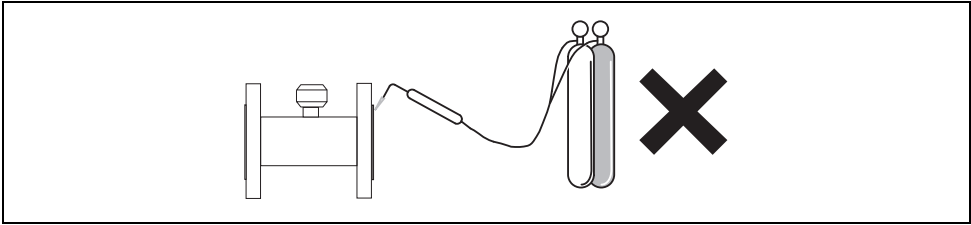


Fig. 3.4 Localized Heat

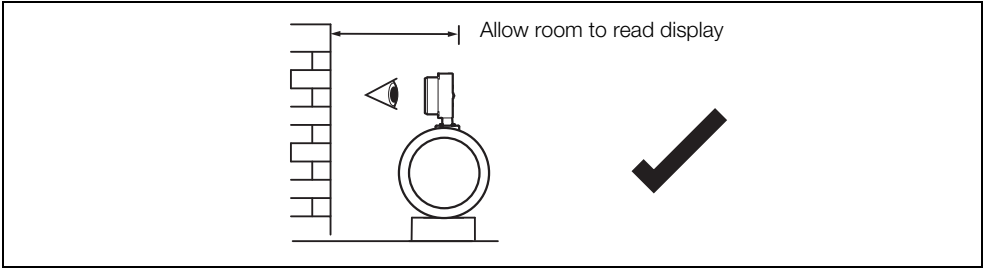


Fig. 3.5 Siting

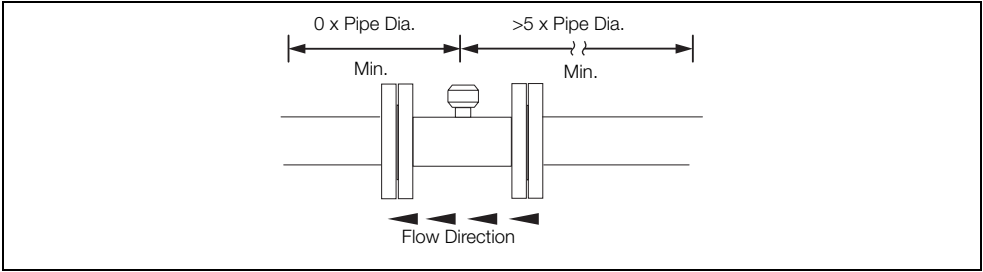


Fig. 3.6 Straight Pipe Requirements

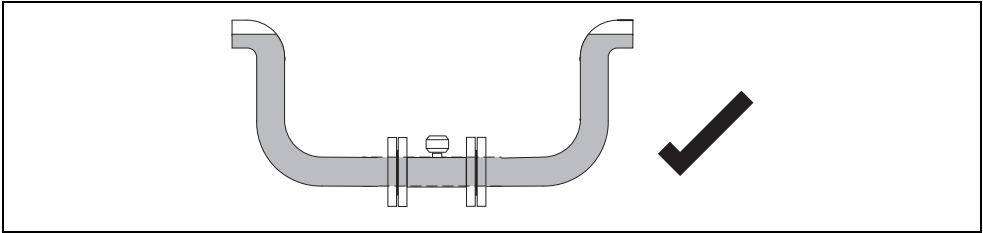


Fig. 3.7 Fluid Level

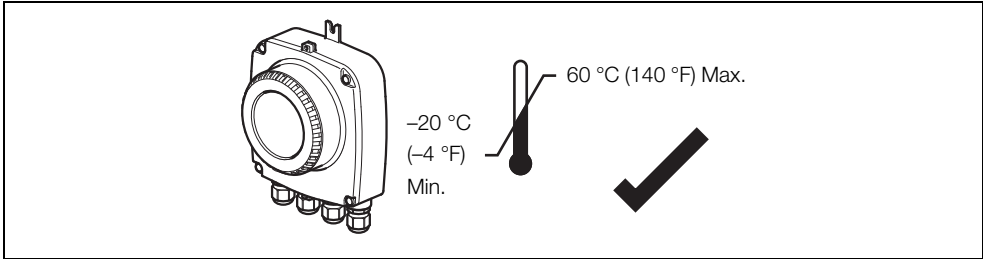


Fig. 3.8 Within Temperature Limits

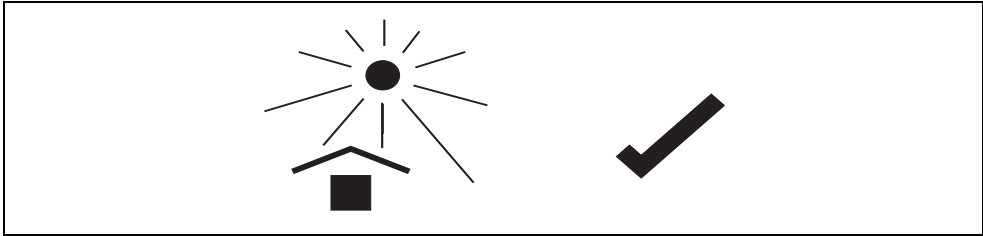


Fig. 3.9 Shade

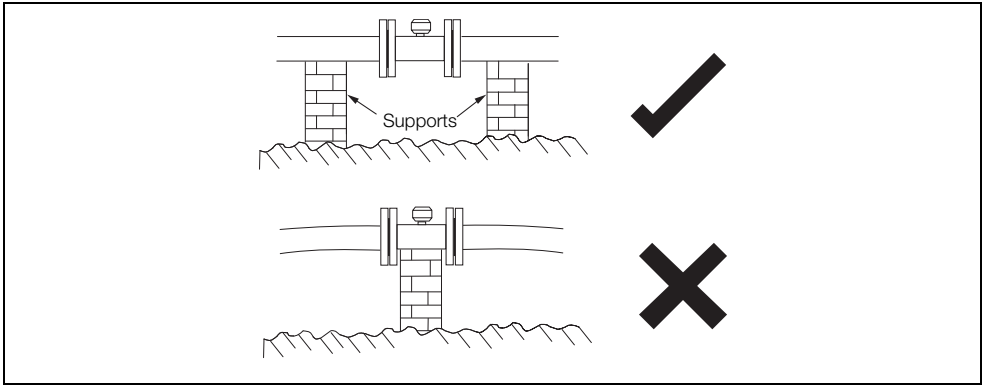


Fig. 3.10 Above Ground

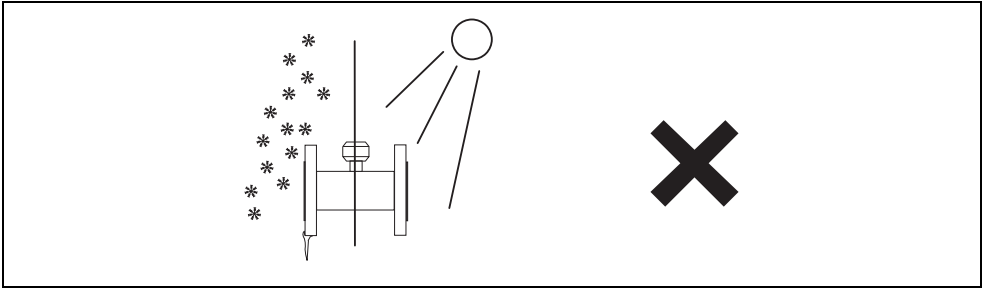


Fig. 3.11 Temperature Difference

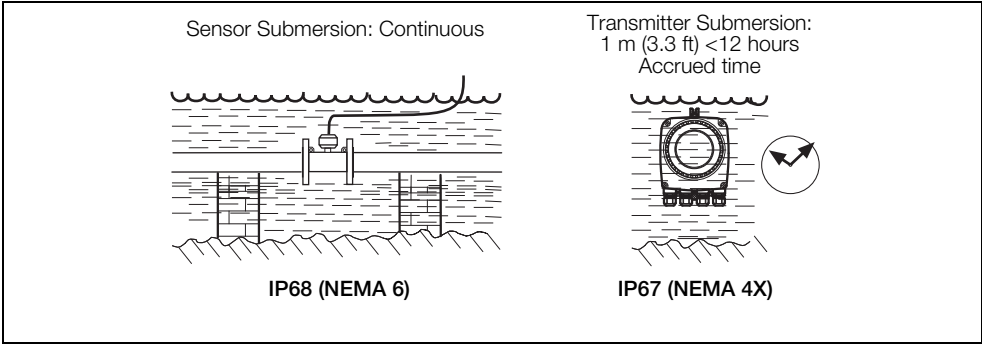


Fig. 3.12 Within Environmental Rating

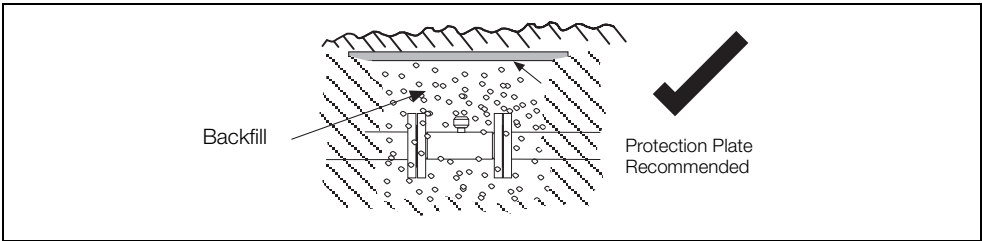


Fig. 3.13 Underground

Note. For further details when burying flow sensors contact the ABB Service Organization.

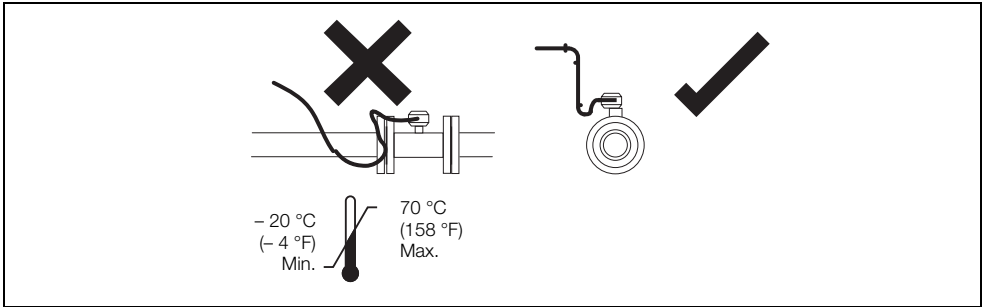


Fig. 3.14 Cable Routing

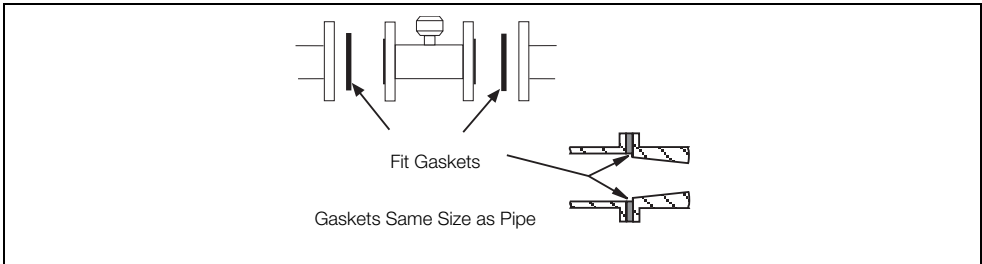


Fig. 3.15 Gasket Fitting

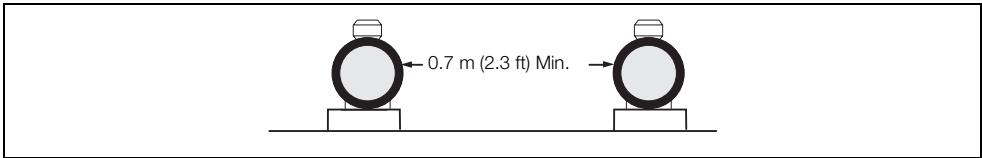


Fig. 3.16 Separation of Sensors

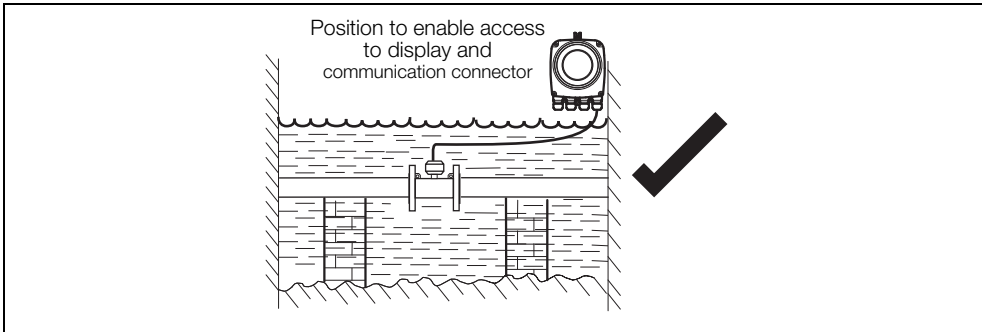


Fig. 3.17 Access to Transmitter

3.3 Dimensions

3.3.1 Transmitter Dimensions

Dimensions in mm (in).

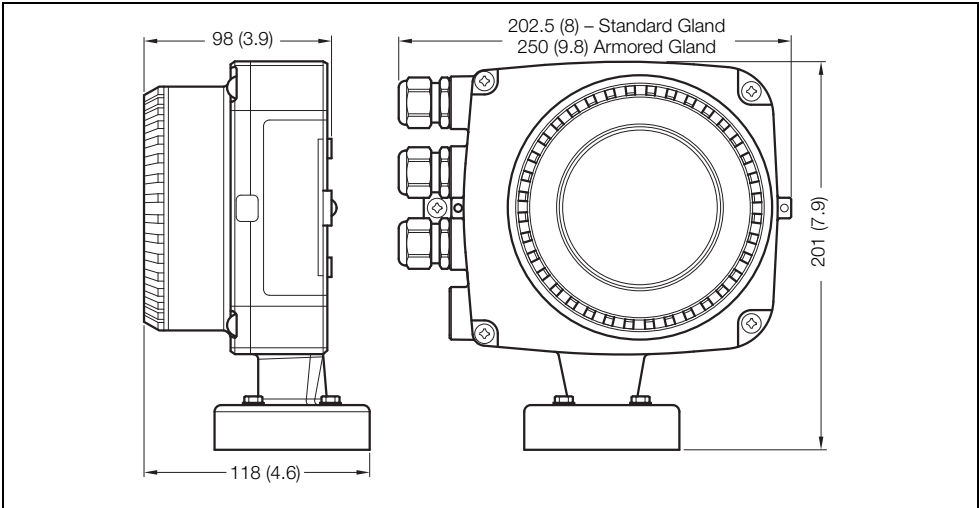


Fig. 3.18 Integral Transmitter Dimensions (Standard Gland Shown)

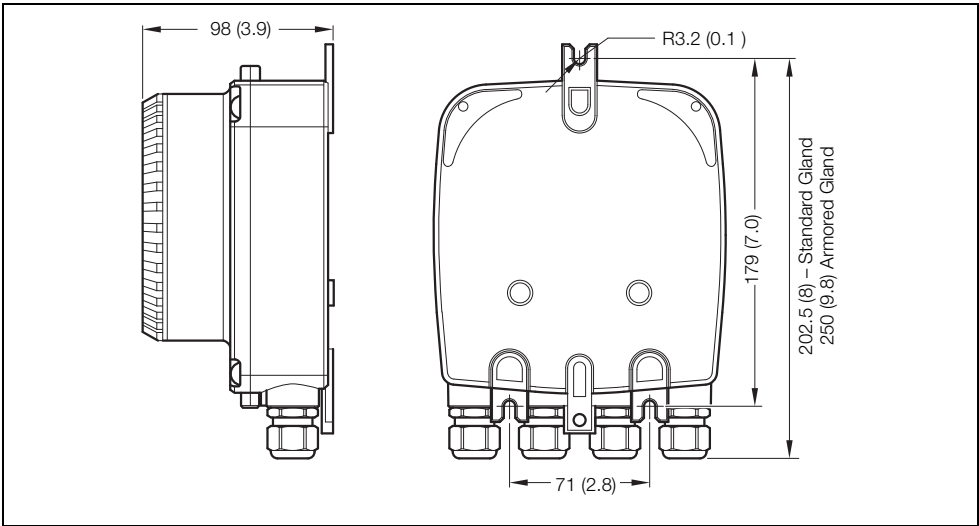


Fig. 3.19 Remote Transmitter Dimensions (Standard Gland Shown)

Note. Fix remote transmitter to a secure surface using 3 M5 screws (not supplied).

3.3.2 Sensor Dimensions

Note. Lay length – all sensors conform to ISO13359.

DN 10 to 32 Full Bore

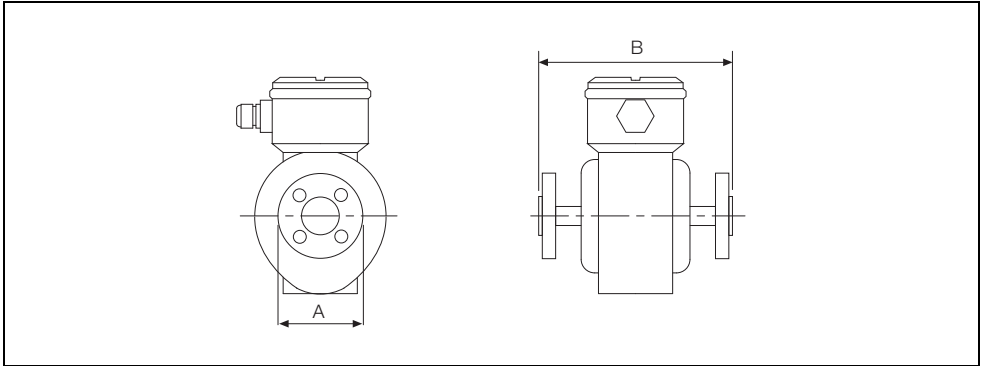


Fig. 3.20 DN10 to 32 (3/8 to 1 1/4 NB) Full-bore

Meter Size		Dimensions mm (in)	
DN	NPS/NB	A*	B
10	3/8	93 (3.7)	200 (7.9)
15	1/2	95 (3.7)	200 (7.9)
20	3/4	111 (4.4)	200 (7.9)
25	1	120 (4.7)	200 (7.9)
32	1 1/4	137 (5.4)	200 (7.9)

*Dimensions are approximate and vary depending on flange type

Table 3.1 DN10 to 32 (3/8 to 1 1/4 NB) Full-bore

DN 40 to 200 Full Bore

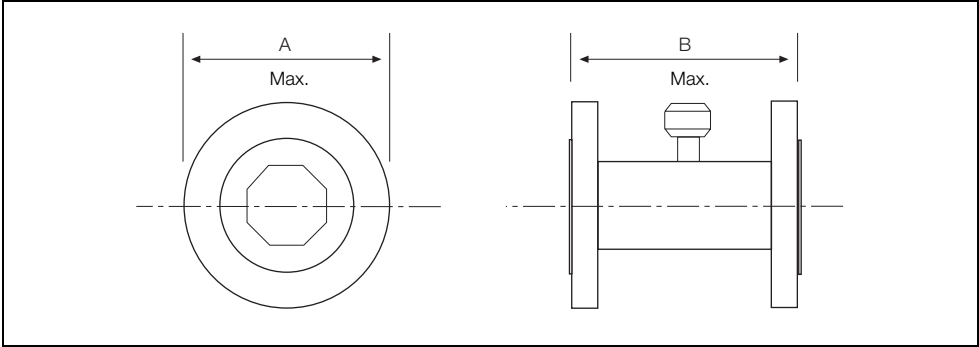


Fig. 3.21 DN40 to 200 (1 1/2 to 8 NB) Full-bore

Meter Size		Dimensions mm (in)	
DN	NPS/NB	A*	B
40	1 1/2	150 (5.9)	200 (7.9)
50	2	165 (6.5)	200 (7.9)
65	2.5	185 (7.2)	200 (7.9)
80	3	200 (7.9)	200 (7.9)
100	4	230 (9.1)	250 (9.8)
125	5	250 (9.9)	250 (9.8)
150	6	280 (11.0)	300 (11.8)
200	8	345 (13.6)	350 (13.8)

*Dimensions are approximate and vary depending on flange type

Table 3.2 DN40 to 200 (1 1/2 to 8 NB) Full-bore

DN 250 to 2200 Full Bore

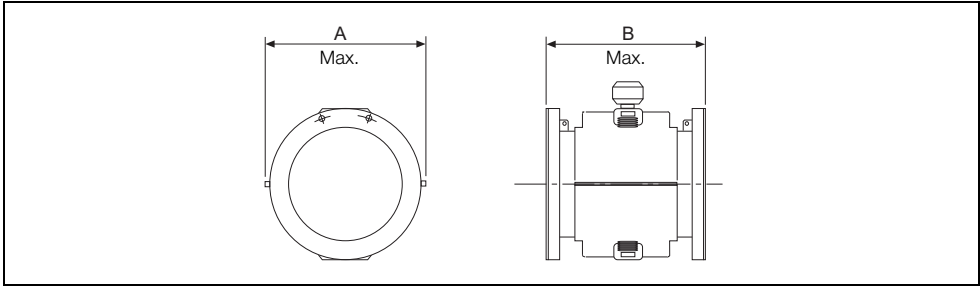


Fig. 3.22 DN 250 to 600 (10 to 24 NB) Full Bore

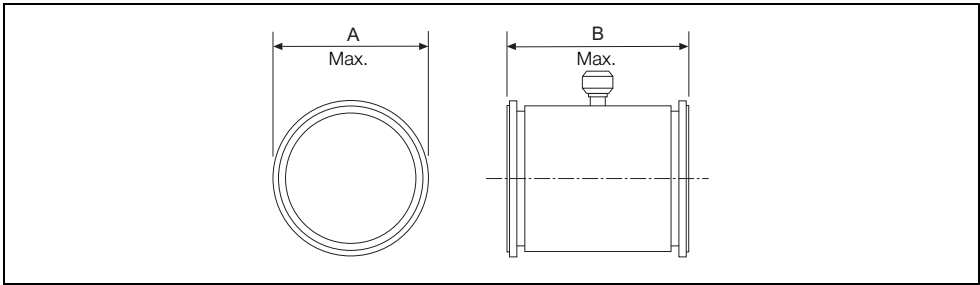


Fig. 3.23 DN 700 to 2200 (28 to 84 NB) Full Bore

Meter Size		Dimensions in mm (in)		
DN	NPS/NB	A	B (<PN25)	B (PN25, PN40, ASME, CL300)
250	10	405 (15.99)	450 (17.7)**	488 (19.2)
300	12	460 (18.1)	500 (19.7)**	538 (21.2)
350	14	535 (21.1)	550 (21.7)**	568 (22.3)
400	16	600 (23.6)	600 (23.6)**	618 (24.3)
450	18	640 (25.2)	698 (27.5)**	698 (27.5)
500	20	715 (28.1)	768 (30.2)**	768 (30.2)
600	24	840 (33.1)	918 (36.1)**	918 (36.1)
700	27/28*	927 (36.5)	700 (27.6)***	–
760	30	985 (38.8)	762 (30)***	–
800	32	1060 (41.7)	800 (31.5)***	–
900	36	1170 (46.1)	900 (35.4)***	–
1000	39/40*	1290 (50.8)	1000 (39.4)***	–
1050	42	1405 (55.3)	1067 (42)***	–
1100	44	1405 (55.3)	1067 (42)***	–
1200	48	1511 (59.5)	1200 (47.2)***	–
1400	54	1745 (68.7)	1400 (55.1)***	–
1500	60	1855 (73.0)	1524 (59)***	–
1600	66	2032 (80.0)	1600 (63)***	–
1800	72	2197 (86.5)	2250 (88.6)***	–
2000	78	2362 (93.0)	2500 (98.4)***	–
2200	84	2534 (100.0)	2750 (110)***	–

* Size is dependent on flange specification

Typical tolerances:

** +0/–10 mm (0.40 in) *** +0/–20 mm (1.0 in)

Table 3.3 DN250 to 2200 (10 to 84 NB) full-bore

4 Electrical Installation

4.1 Grounding

Caution. For safety reasons and optimum performance, the flowmeter, pipelines and medium must be correctly bonded and grounded according to regulations.

Note.

- The flow sensor must not be connected to a ground spike.
- For bonding connections use $\geq 4\text{mm}^2$ ($< 10\text{AWG}$) cable.

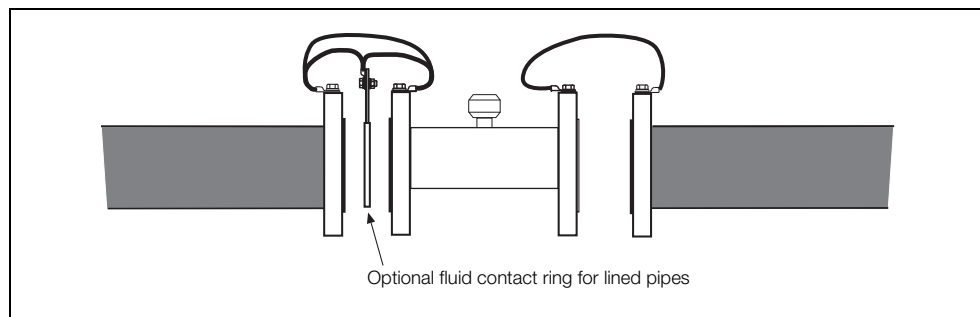


Fig. 4.1 All Metal Pipe (Including Lined Metal Pipe)

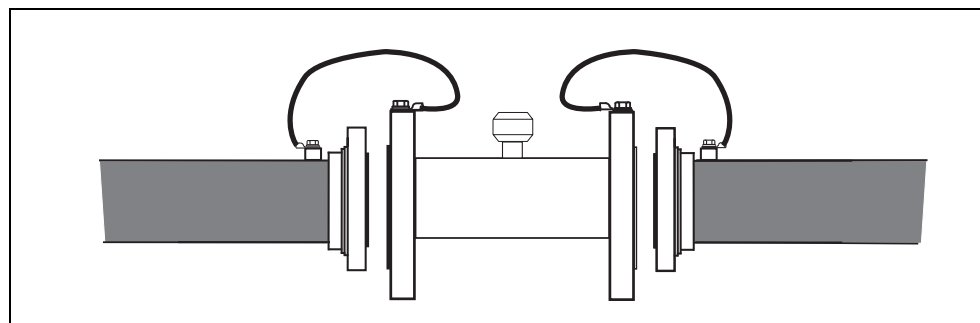


Fig. 4.2 Metal Pipe with Flange Adaptor

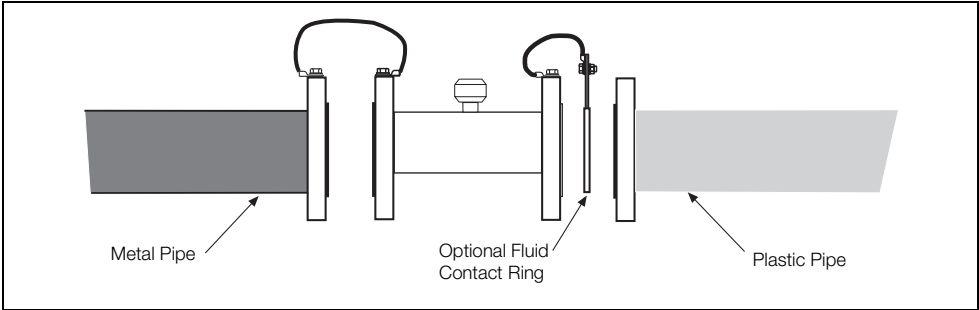


Fig. 4.3 Flanged Metal Pipe to Plastic Pipe

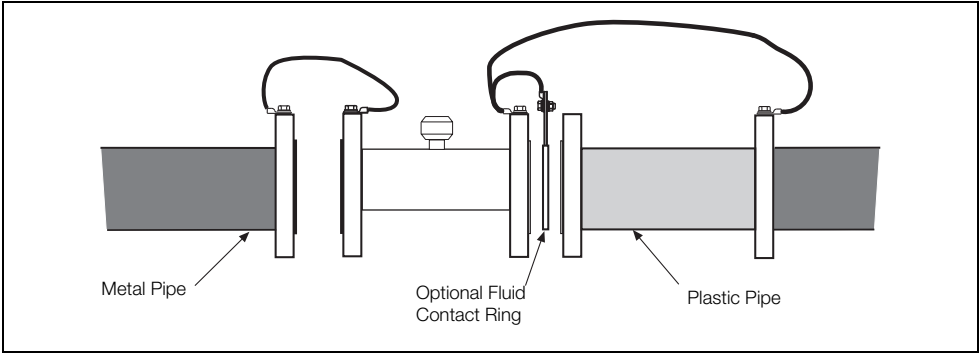


Fig. 4.4 Metal Pipe with Plastic Make-up Insert

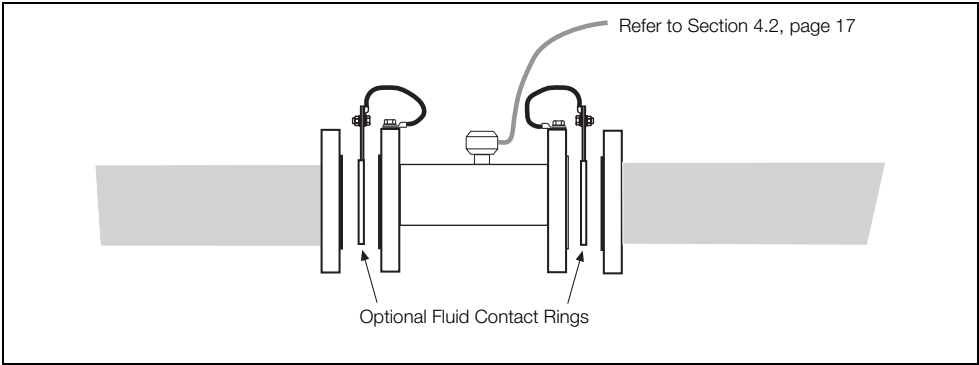


Fig. 4.5 All-plastic Pipe

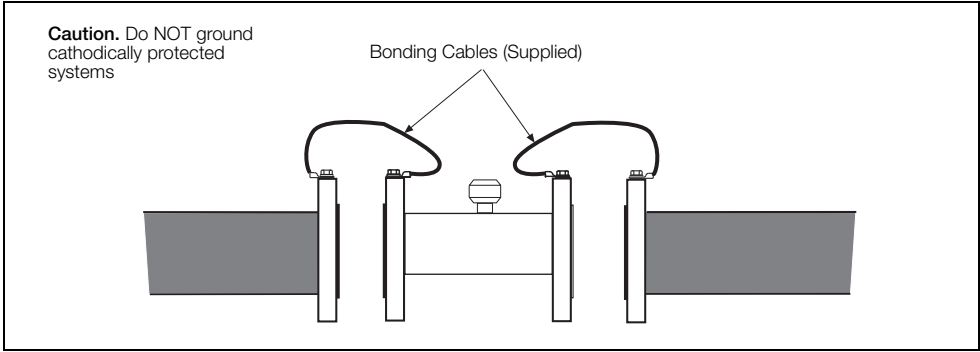


Fig. 4.6 Pipelines with Cathodic Protection

4.2 Remote Transmitter / Sensor Arrangement

Note. For bonding connections use $\geq 4\text{mm}^2$ ($< 10\text{AWG}$) cable.

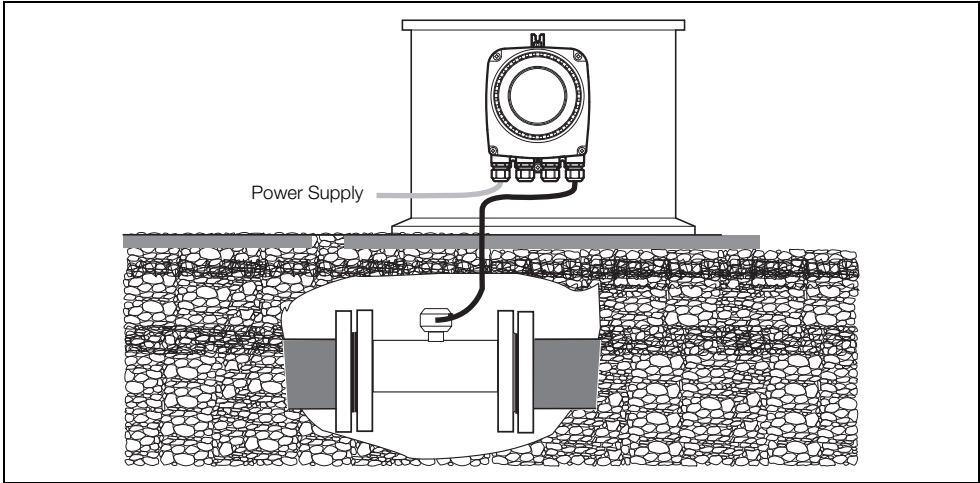


Fig. 4.7 Remote Transmitter in Roadside Cabinet

4.3 Transmitter Terminal Connections

Warning. Isolate the transmitter from power supplies before removing the cover.

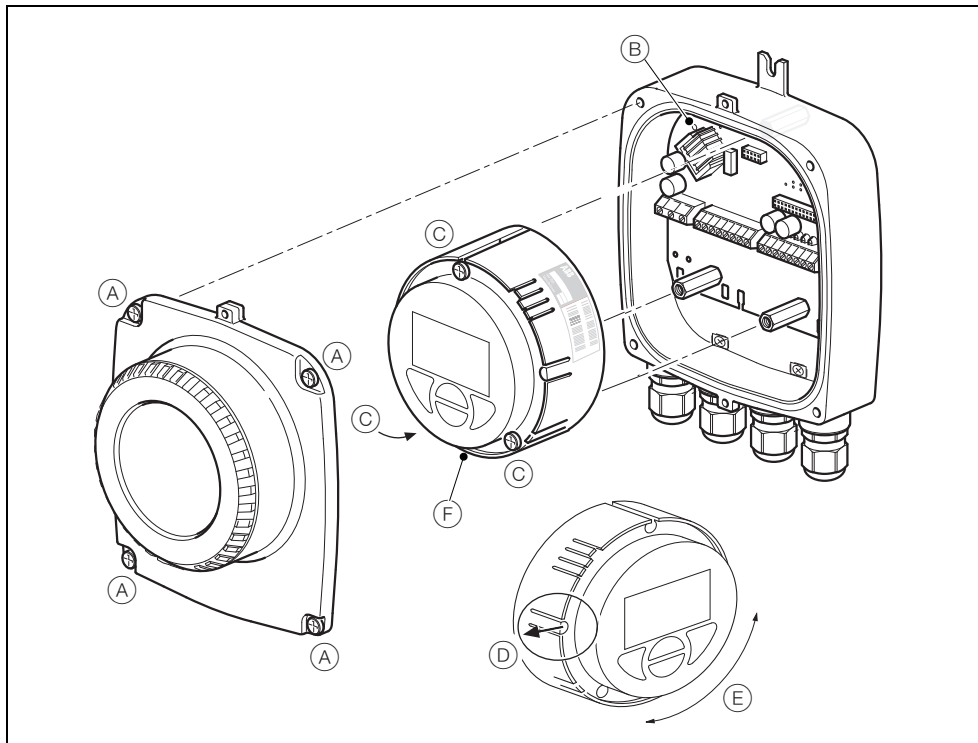


Fig. 4.8 Accessing the Transmitter Terminals

Referring to Fig. 4.8:

1. Slacken (but do not remove) the four transmitter cover screws (A).
2. Remove the transmitter cover.
3. Check that the power indicator LED (B) on the backplane is **not** lit.

Warning. If the power indicator LED (B) is lit, the transmitter is still powered up. Before continuing, isolate the transmitter power supply.

4. If screws (C) are not visible, access them by gently pulling the rotation lock (D) back and rotating the cartridge (E) until the cartridge screw access holes align with the cartridge screw heads.
5. Slacken the three cartridge screws and lift the cartridge (F) away from the housing.

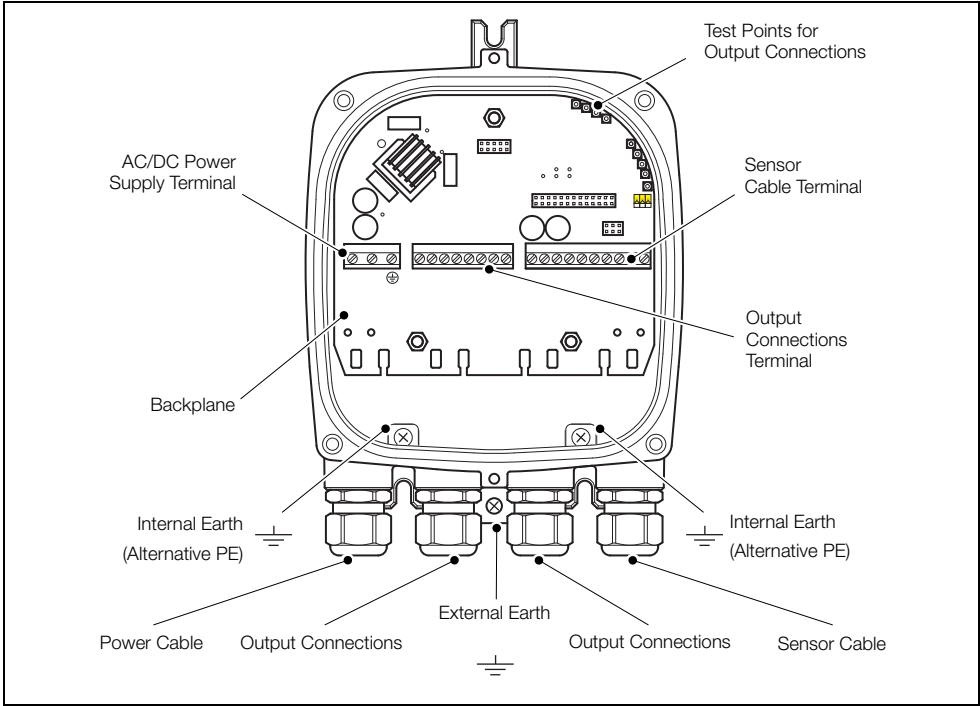


Fig. 4.9 Cable Gland / Conduit Entry (Remote Transmitter Shown)

4.4 Cable Preparation (Remote Systems Only)

Caution. Maintain Environmental Protection at all times – See Section 4.5.2, page 22.

To prepare the cable for connection at the transmitter and sensor terminal blocks:

1. Remove the outer cable insulation and Mylar® wrap.
2. Ensure the drain wire is sleeved.
3. Cut the cable connection wires to the lengths shown in Figs 4.10 and 4.11, page 21.

4.5 Transmitter / Sensor Cable Connections

Caution.

- Make connections only as shown.
- Twist the screen wire of D1 / TFE + D2 with the outer screen drain wire and sleeve them.
- For standard (non-cathodically protected) systems, connect the drain wire to the earth screw.
- For cathodically protected systems, connect the drain wire to terminal SCR, ensuring no braid or wires touch the exposed copper areas within the transmitter sensor cable wiring area.
- If an earth screw is not available at the transmitter enclosure, connect the drain wire to terminal SCR.
- Ensure the seal and mating surfaces are clean to maintain environmental rating.
- Conduit connections must provide cable entry sealing.
- Ensure cable glands are tightened after wiring. Do not overtighten the plastic cable glands to avoid destroying their sealing properties. Initially, tighten finger-tight, then a further $\frac{1}{2}$ to $\frac{3}{4}$ turn using a suitable spanner or wrench.
- Fit blanking plugs where required.

4.5.1 Sensor Cable Terminal Connections and Recommended Cable Lengths

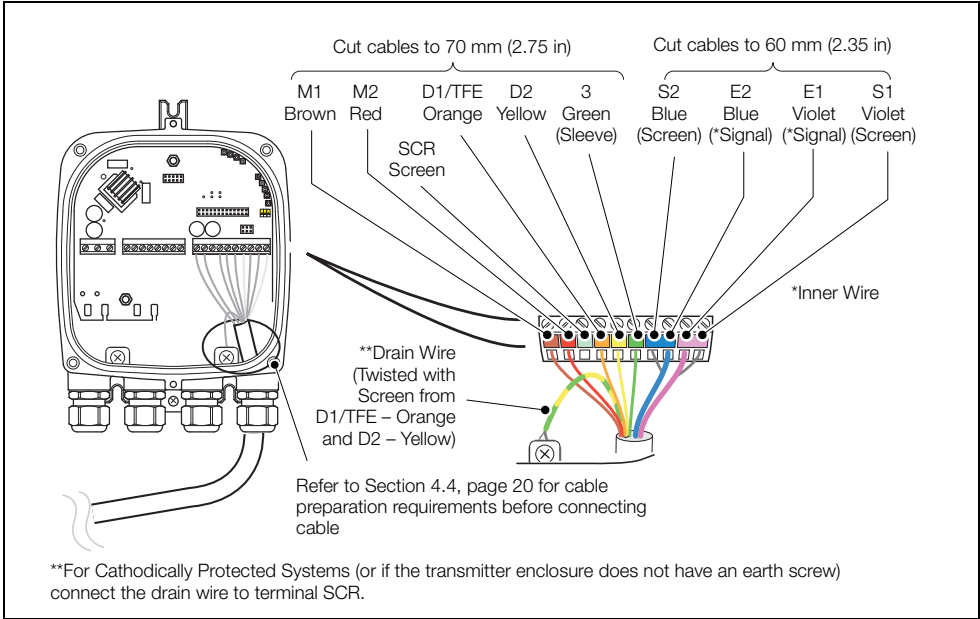


Fig. 4.10 Sensor Cable Connections at Transmitter Terminal Block – Standard System

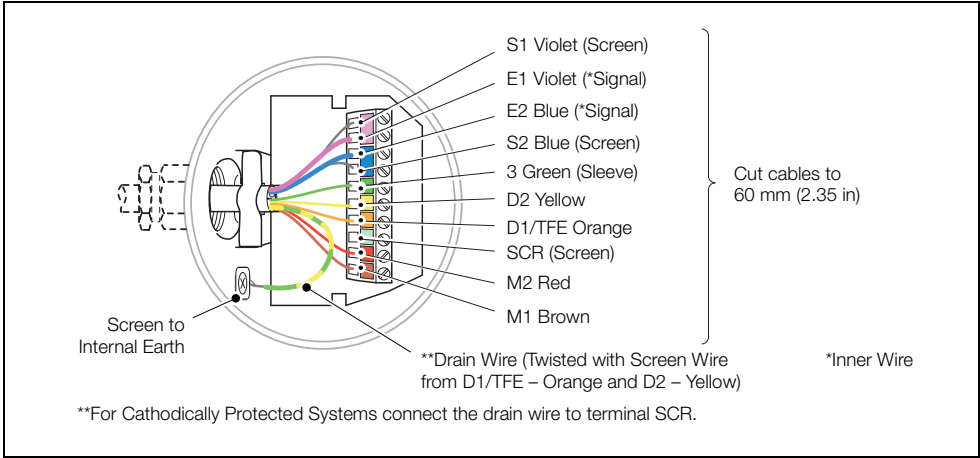


Fig. 4.11 Sensor Cable Connections at Sensor Terminal Block – Standard System

4.5.2 Environmental Protection

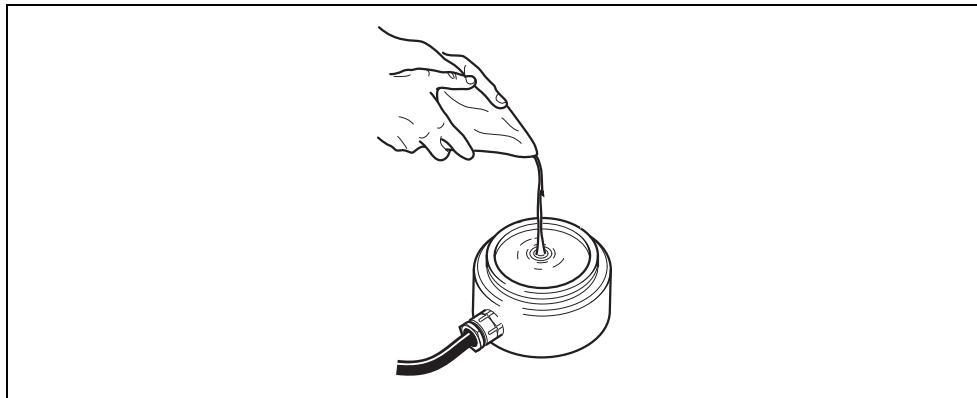


Fig. 4.12 Potting the Sensor Terminal Box

Warning.

- Potting materials are toxic. Read the manufacturers' instructions carefully before preparing the potting material and use suitable safety precautions.
- Power up and check all connections before potting.
- The remote sensor terminal box connections must be potted immediately on completion to prevent the ingress of moisture.
- Do not overfill or allow the potting material to come into contact with 'O' rings or grooves.
- Do not let potting material enter conduit (if used).

4.6 Output Connections

Caution.

- Refer to page 36 for output ratings.
- Inductive loads must be suppressed or clamped to limit voltage swings.
- Operation of outputs is programmable.
- External isolators are not normally required as the pulse and alarm circuit is electrically separated from all other WaterMaster connections.

4.6.1 Frequency Outputs

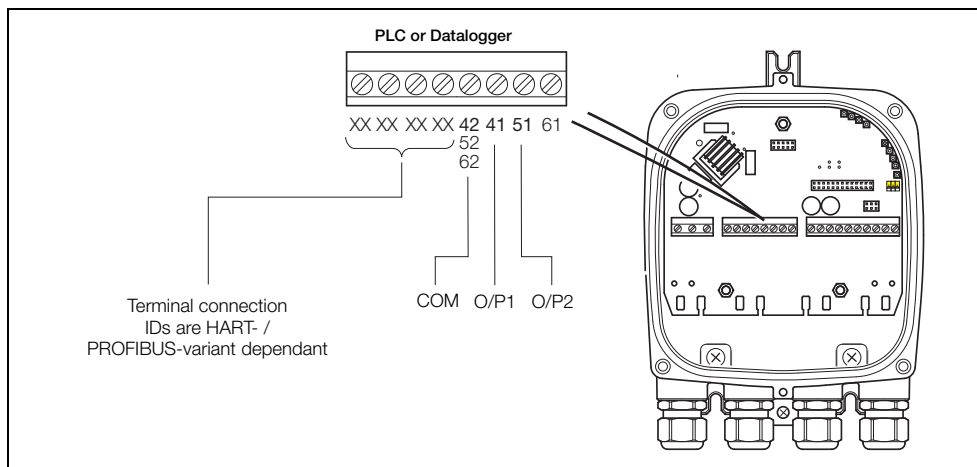


Fig. 4.13 Frequency Output Connections

Note. Outputs 1 and 2 are polarity sensitive. The common (negative) connection for these outputs is designated 'COM'.

4.6.2 Alarm Outputs

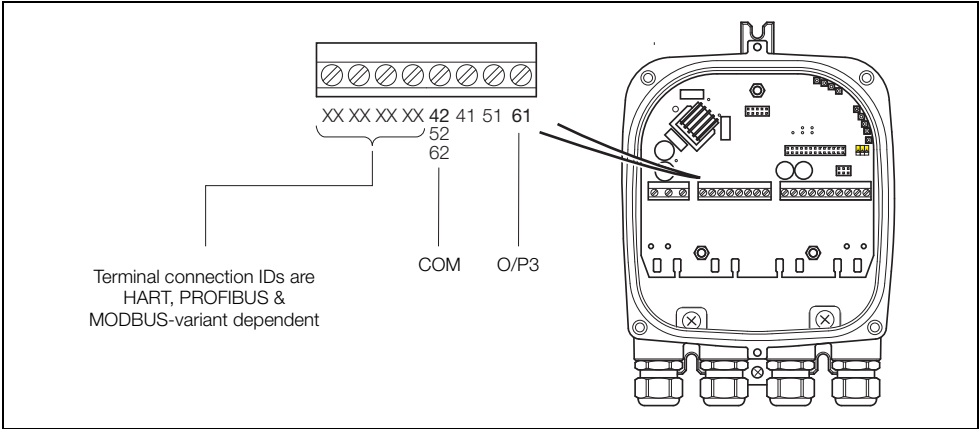


Fig. 4.14 Alarm Output Connections

4.6.3 Current Output (4 to 20 mA) – HART (FEX100) Variant

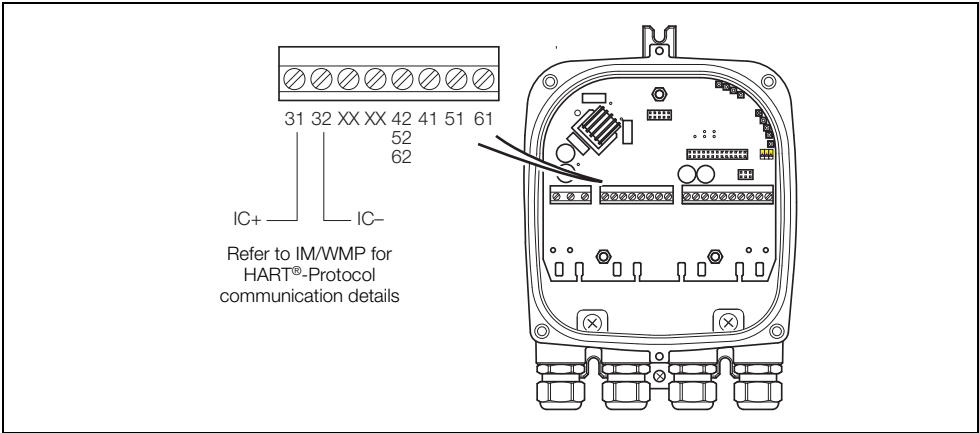


Fig. 4.15 Current Output (4 to 20 mA) – HART (FEX100) Variant

4.6.4 RS485 Communications – PROFIBUS (FEX100–DP) and MODBUS (FEX100–MB) Variants

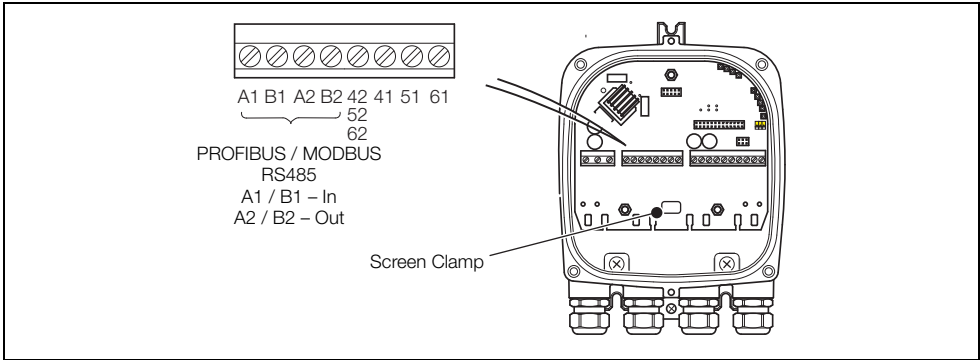


Fig. 4.16 WaterMaster RS485 Backplane Connections to PROFIBUS Network

4.6.5 Test Point Access

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

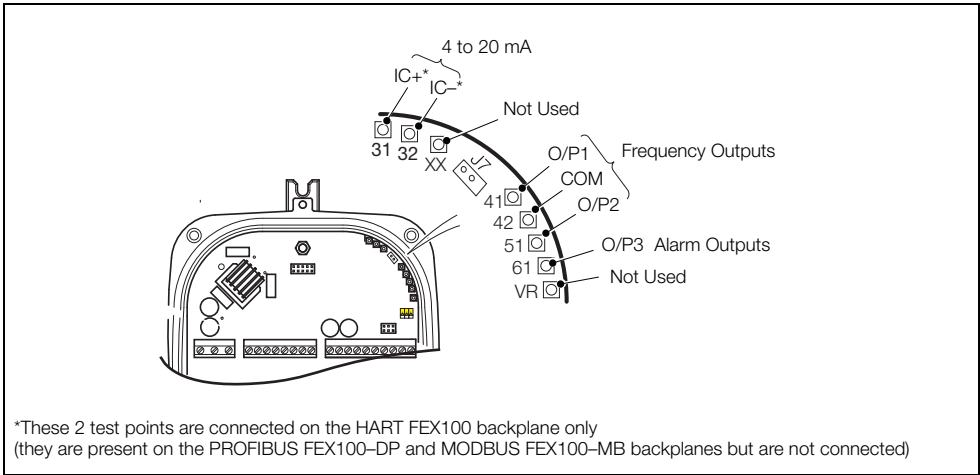


Fig. 4.17 Transmitter PCB Board Test Point Access

4.7 Power Supply Connections

Warning.

- Electrical installation and earthing (grounding) must be in accordance with relevant national and local standards.
- Power must be connected via a suitable isolator and fused in accordance with relevant standards.
- When changing fuses F1 or F2, isolate the power supply and wait 20 s before opening the enclosure.
- Replace fuses with the correct part, see Fig 4.18 (AC power) and 4.19, page 27 (DC power).

4.7.1 AC Power Supply

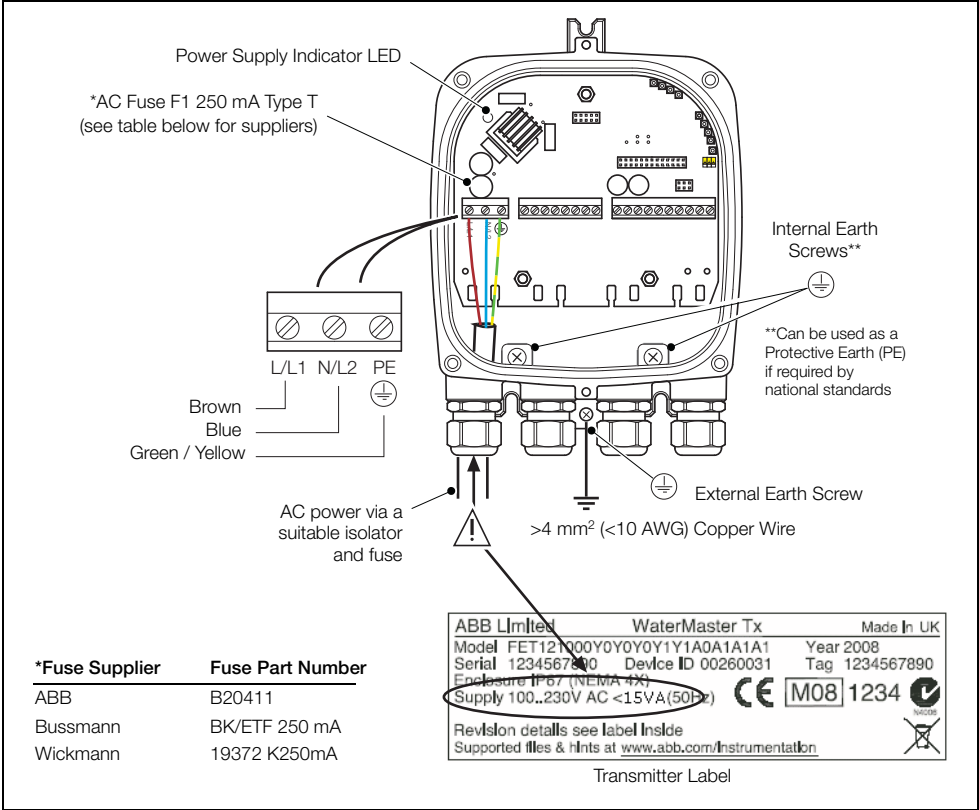


Fig. 4.18 AC Power Supply Connections

4.7.2 DC (and Low Voltage AC) Power Supply

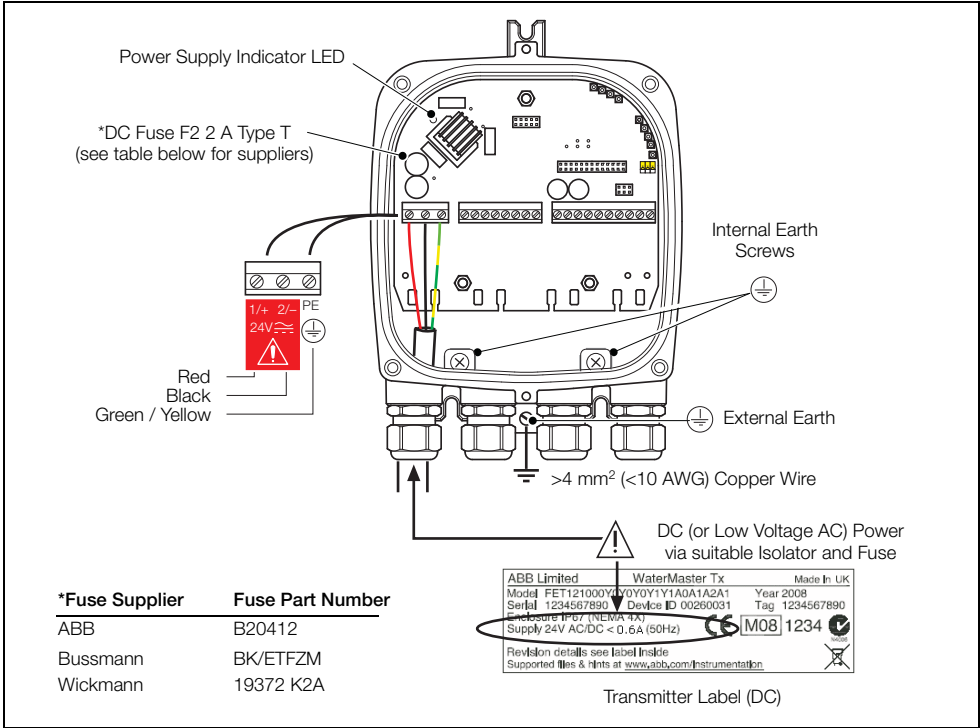


Fig. 4.19 DC (and Low Voltage AC) Power Supply Connections

4.7.3 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 set the read-only / MID protection switch 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.

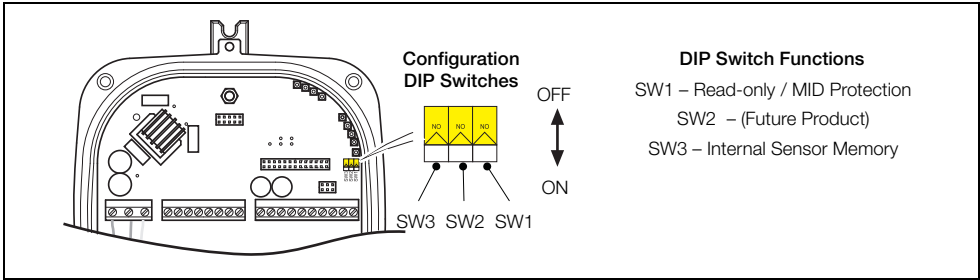


Fig. 4.20 Configuration DIP Switches

4.8 Refitting the Cartridge and Cover

Warning. Ensure the transmitter is isolated from power supplies before refitting the cover.

Caution.

- The communications bus type is HART FEX100 if not specified on the cartridge label. An example of the PROFIBUS FEX100-DP variant cartridge label is shown on the right.
- The cartridge communications type must match the communications type of the transmitter backplane pcb.
- To avoid damaging the cartridge during refitting, do not overtighten the cartridge screws.

ABB WaterMaster
PROFIBUS DP
MFA903 ~ AC
HW Rev 03
Manufacturer 0024

PROFIBUS variant
cartridge label

Referring to Fig. 4.21:

1. Confirm that the cartridge to be fitted is of the correct power supply and for the correct communications bus type (HART, PROFIBUS or Modbus) by checking the label (A) on the side of the cartridge:
 - AC cartridges have one **black** label on the cartridge side.
 - DC (and low voltage AC) cartridges have two **red** DC labels – one on the cartridge side and one on the cartridge rear plate.
2. Align the three cartridge screws (B) with the cartridge housing pillars and tighten the screws carefully until the cartridge is held in position.
3. If necessary, rotate the cartridge to the required orientation before refitting the cover – see Fig. 4.8, page 18 for details.
4. For high integrity / security installations, set DIP switch SW1 to the 'ON' (Read-only) position – see Fig. 4.20, page 28.
5. Align the transmitter cover with the housing and tighten the four cover screws (C) carefully.
6. For high integrity / security installations or where MID is required, fit anti-tamper seals to the security fixtures (D).

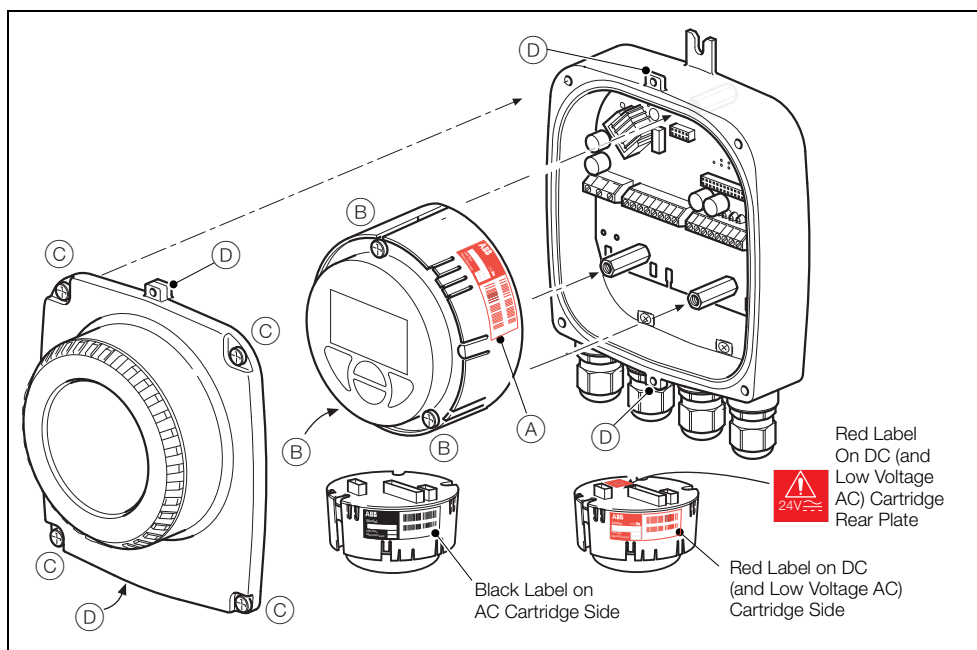


Fig. 4.21 Refitting the Cartridge and Cover

5 Start-up and Operation

Note. This section describes the options available at the 'Easy Setup' menu. Refer to the Programming Manual (IM/WMP) for comprehensive details of all end-user menus and operating levels.

5.1 Navigating the Menus and Parameters

The four keys below the display are used to navigate through the menus and to execute all system commands and selections.

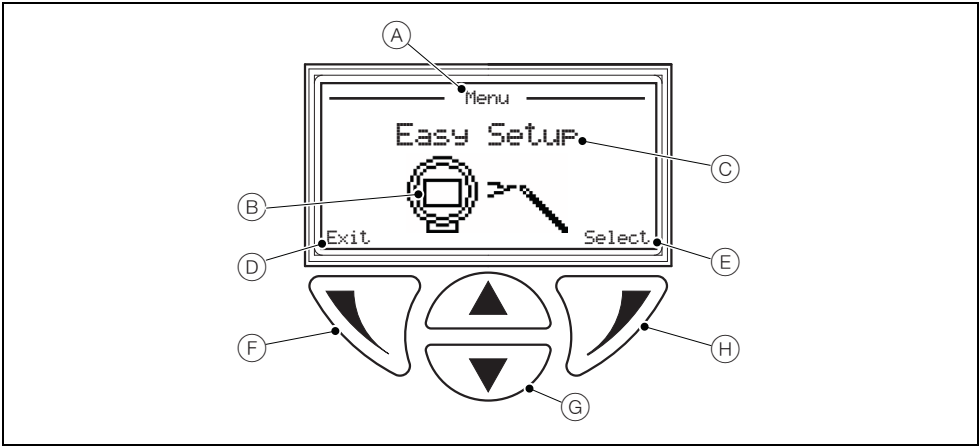


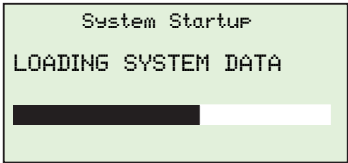
Fig. 5.1 Display and Keys

Item	Description
A	Screen title at the current level / parameter
B	Main level icon
C	Menu level title
D	Prompt executed by pressing the  key
E	Prompt executed by pressing the  key
F	Left key – used for parameter navigation and to enter editable parameters
G	Up / Down keys – used to scroll through menu options and to increase / decrease values in editable parameters
H	Right key – used to accept / select parameter values / selections and exit sub-levels

5.2 Start-up Screens

At start-up, the type of screen displayed indicates the status of the system.

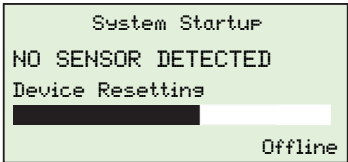
There are four common start-up screen types as follows:



System Start-up

At system start-up, a progress bar is displayed for the duration of the start-up period.

After this period, one of the four following screens is displayed according to the current status of the system.



No Sensor Connected

If no sensor is detected during start-up, an auto-recovery routine is run to look for the sensor. If no sensor is detected, this routine continues until it is stopped manually.

If 'Offline' is selected during auto-recovery (by pressing the  key) the transmitter ceases to operate as a flowmeter and the following conditions apply at the transmitter:

- Plant and transmitter data can be configured.
- Sensor data cannot be configured.

Note. If this screen is displayed on an integral transmitter, check that DIP switch SW3 is in the 'ON' position (refer to Fig. 4.20, page 28).

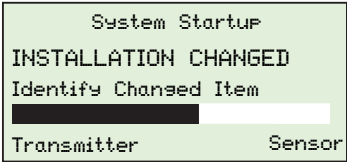


Dual Sensor Memory

Integral and retrofit systems have the sensor memory mounted on the transmitter backplane board.

If two sensor memory types (integral and remote) are detected at start-up, the warning 'DUAL SENSOR MEMORY' is displayed.

To correct this condition, set DIP switch SW3 to the 'OFF' position (refer to Fig. 4.20, page 28).



Installation Changed

If the sensor data stored in the transmitter memory does not match the data of the connected sensor, the warning 'INSTALLATION CHANGED' is displayed.

The changed item(s) (transmitter or sensor) can be identified and data copied as follows:

Transmitter

Selecting this option copies plant and stack data from the sensor memory to the transmitter memory and loads the totalizer from the sensor memory.

It is used to make the following changes:

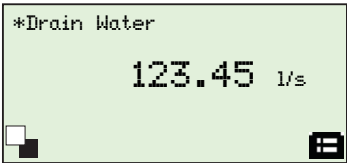
- Remote or integral cartridge change
- Remote Tx change
- New installation

Sensor

Selecting this option copies data from the transmitter memory to the sensor and loads the totalizer from the sensor memory.

It is used to make the following changes:

- Integral backplane change
- Sensor change
- Integral transmitter change



Process Display (Operator Page)

When the 'Process Display' (Operator Page) is displayed, normal operation is assumed.

To access menus at a permitted access level, press the  key to display the 'Access Level' screen – see Section 5.3, page 33.

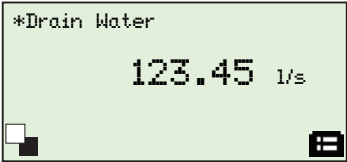
**Example legend only*

5.3 Security Levels and Password Access

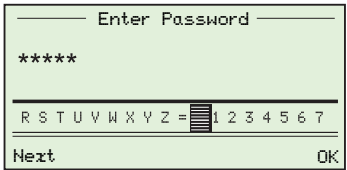
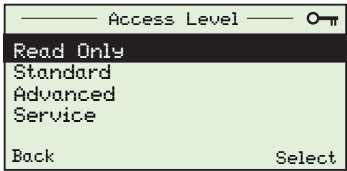
At power-up, the 'Start-up Display' and 'Process Display' screens are activated in sequence.

Note.

- Passwords at 'Standard' and 'Advanced' level can be set and changed by end-users.
- Access to the 'Service' level is reserved for factory-only personnel and not available to end-users.
- To navigate from the 'Operator Page(s)' directly back to the menus, accept the default access level selection at the 'Access Level' screen and press the  key.



**Example legend only*



Operator Pages (Process Display)

When the start-up routine is completed, and if no changes have occurred since last start-up, the 'Process Display' (Operator Page) screen is displayed.
Press the  key to display the 'Access Level' screen where the level of user access is selected.

Access Level

Passwords are required for 'Standard' and 'Advanced' level access. Passwords are not required for 'Read Only' access.
Select the permitted level of access and press the  key to display the 'Enter Password' screen (the 'Enter Password' screen is bypassed if 'Read Only' is selected).

Enter Password

Enter the password and press the  key to display menus available at the permitted access level.
Note. If a time-out occurs (5 minutes of no activity), enter the password again to access the menus.

5.3.1 Default Passwords

The WaterMaster transmitter is supplied with default passwords for access to 'Standard' and 'Advanced' level menus.

The two passwords are:

- 'Standard' access password: 2 or blank
- 'Advanced' access password: 3 or blank

Passwords can contain up to 5 characters and are not case sensitive.

To prevent unauthorized access ABB recommend the default passwords are changed on commissioning.

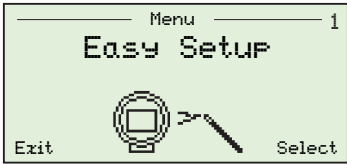
Note. When allocating passwords, record a copy of each password and store in a safe location. It is not possible to interrogate the transmitter to 'recover' passwords once they have been set.

5.3.2 Entering Passwords

To select password characters and enter passwords:

1. Scroll to the 'Access Level' screen and select the required access level. Press the  key to display the 'Enter Password' screen.
2. Use the  and  keys to scroll to and highlight the first password character to be selected.
3. Press the  key to select the highlighted character (add it to the password set).
4. Use the  and  keys to highlight the next password character to be selected.
5. Repeat steps 2 to 4 until all characters have been added to the password.
6. Press the  key to accept the password and display menus available at the requested access level.

5.4 Easy Setup



Easy Setup

The 'Easy Setup' level is used to set the system up quickly and contains a series of options for users with 'Standard' and 'Advanced' access permission. Users with 'Read Only' access cannot make selections at this level.

To navigate the 'Easy Setup' parameters:

- Enter 'Easy Setup' by pressing the  key at the 'Select' prompt.
- View and edit a parameter by pressing the  key at the 'Edit' prompt.
- Scroll parameter options by pressing the  and  keys (press and retain contact to scroll multiple options consecutively).
- Edit parameters by pressing the  key at the 'Next' prompt to enter the text field and press the  and  keys to increase or decrease the value. Press the  key at the 'OK' prompt to accept the new value.
- Accept a highlighted parameter by pressing the  key at the 'OK' prompt.
- Exit the current parameter without changing the setting by pressing the  key at the 'Cancel' prompt.
- Move to the next parameter by pressing the  key at the 'Next' prompt.
- Exit 'Easy Setup' level by pressing the  key at the 'Exit' prompt on the 'Easy Setup' main level screen.

Parameter	Range	[Default] Note
Language	English, Deutsch, Français, Español, Italiano, Polski, Portuguese	[English] Selectable
Q (Flowrate) Unit	m ³ /s, m ³ /min, m ³ /h, m ³ /d, ft ³ /s, ft ³ /min, ft ³ /h, ft ³ /d, ugal/s, ugal/min, ugal/h, ugal/d, Mugal/d, ical/s, ical/min, ical/h, ical/d, bls/s, bls/min, bls/h, bls/d, hl/h, ml/s, ml/min, l/s, l/min, l/h, Ml/d,	[m ³ /h] Selectable
Qmax	Dependant on sensor size	[Factory set]
Volume & Pulse Unit	m ³ , l, ml, ft ³ , hl, ical, ugal, bls, Ml, Mugal	Selectable*
Pulse Width	0.09 to 2000.00 ms	[0.09 ms] Editable
Pulses / Unit	0.000010 to 10,000,000 pulses / unit	[1.0] Editable (Only shown when Pulse Mode is Pulse / Unit)
Fullscale Frequency	0.250000 to 10,000,000 Hz	[5,000.000] Editable (Only shown when Pulse Mode is Fullscale Frequency)
Damping	0.02 to 60 s	[3.00 s] Editable
Mains Frequency	50 or 60 Hz	[50 Hz] Selectable

* For OIML and MID flowmeters, only m³ must be used.

6 WaterMaster Flow Performance

6.1 WaterMaster flow performance – m³/h

DN	Q4 (m³/h)	Q3 (m³/h)	Standard Calibration 0.4 % Class 2			High Accuracy Calibration 0.2 % Class 1		
			Q0.4% (m³/h)	Q2 (m³/h)	Q1 (m³/h)	Q0.2% (m³/h)	Q2 (m³/h)	Q1 (m³/h)
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
30 in	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

DN	Q4 (m³/h)	Q3 (m³/h)	Standard Calibration 0.4 % Class 2			High Accuracy Calibration 0.2 % Class 1		
			Q0.4% (m³/h)	Q2 (m³/h)	Q1 (m³/h)	Q0.2% (m³/h)	Q2 (m³/h)	Q1 (m³/h)
1000	31,250	25,000	2500	160	100	2500	250	156
42 in	31,250	25,000	2500	160	100	2500	250	156
1200	50,000	40,000	4000	256	160	4000	400	250
1400	78,750	63,000	6300	403	252	6300	630	394
60 in	78,750	63,000	6300	403	252	6300	630	394
1600	78,750	63,000	6300	403	252	6300	630	394
1800	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

* 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.

6.2 WaterMaster flow performance – gal/min

NPS/NB (DN)	Q4 (gal/min)	Q3 (gal/min)	Standard Calibration 0.4 % Class 2			High Accuracy Calibration 0.2 % Class 1		
			Q0.4% (gal/min)	Q2 (gal/min)	Q1 (gal/min)	Q0.2% (gal/min)	Q2 (gal/min)	Q1 (gal/min)
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 (760)	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
48 (1200)	220,143	176,115	17,611	1,127	704	17,611	1,761	1,101
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
72 (1800)	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

*Size is dependent on flange specification

7 Specification – Sensor

Functional specification

Pressure limitations

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

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	–6 to 70 °C (21 to 158 °F) – non approved 0.1 to 50 °C (32.2 to 122 °F) – OIML R49 T50 Approved

Environmental protection

Rating:
IP68 (NEMA 6) to 10m (33 ft) depth (not DN10 to DN32)
IP67 (NEMA 4X) – DN10 to DN32

Buriable (sensor only)

FEW (DN10 to 32)	No
FEV and FEF	Yes

Conductivity

>5µS cm^{–1}

Transmitter mounting

Integral or remote

Electrical connections

20 mm glands
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)

Physical Specification

Wetted parts

Lining material / potable water approvals

			Potable Water Approvals			
Product Code	Size Range	Liner	WRAS	ACS	NSF-61	AZ/NZS 4020
FEV	DN40 – 200	Polypropylene	✓		Approved Meter	✓
FEF	DN250 – 2200	Elastomer	✓	✓	Approved Meter	✓
FEF	DN250 – 2200	Neoprene				
FEF	DN250 – 6200	Polyurethane				
FEF	DN250 – 600	Linatex				
FEW	DN10 – 32	PTFE	✓	✓		

Electrode material

- Stainless steel 316 L
- Hastelloy® C-22 (Hastelloy C4 on DN10 to DN32)
- (Other electrode materials available on request)

Potential equalizing rings

Optional (recommended at least 1 for insulated bore upstream and downstream pipes)

Lining protection plates

Not required

Installation conditions (recommended)

- Upstream ≥ 5D
- Downstream ≥ 0D (FEV, FEF and FEW [DN10 to 32])

Pressure loss

- <0.25 bar at Q3 (DN40 to 200 [1½ to 8 NB])
- Negligible at Q3 (DN10 to 32 [¾ to 1¼ NB], DN250 to 2200 [10 to 84 NB])

Non-wetted parts

Flange material

Carbon steel	(DN20 to DN2200 [$\frac{3}{4}$ to 84 NB])
Stainless steel	(DN10 to DN15 [$\frac{3}{8}$ to $\frac{1}{2}$ NB])

Housing material

Carbon steel	FEV and FEF (DN40 to 200 [$1\frac{1}{2}$ to 8 NB] and DN700 to 2200 [28 to 84 NB])
Plastic	FEF (DN250 to 600 [10 to 24 NB])
Aluminium	FEW (DN10 to DN32 [$\frac{3}{8}$ to $1\frac{1}{4}$ NB])

Terminal box material

Polycarbonate

Cable gland material

Plastic or brass

8 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 off)

- 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 (9.6 kbps to 1.5 Mbps), 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 (9.6 kbps to 115.2 kbps), 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 1 m (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

Hazardous approvals (HART variant only)

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)
(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)

FET, FEV, FEW and FEF DN700 to 2200 (27/28" to 84) only

*Size is dependent on flange specification

Declaration of Conformance

Copies of CE and PED certification will be available on request.

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

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

DS/WM-EN Rev. J

Notes

Products and customer support

Automation Systems

For the following industries:

- Chemical & Pharmaceutical
- Food & Beverage
- Manufacturing
- Metals and Minerals
- Oil, Gas & Petrochemical
- Pulp and Paper

Drives and Motors

- AC and 6 Drives, AC and DC Machines, AC Motors to 1kV
- Drive Systems
- Force Measurement
- Servo Drives

Controllers & Recorders

- Single and Multi-loop Controllers
- Circular Chart and Strip Chart Recorders
- Paperless Recorders
- Process Indicators

Flexible Automation

- Industrial Robots and Robot Systems

Flow Measurement

- Electromagnetic Flowmeters
- Mass Flowmeters
- Turbine Flowmeters
- Wedge Flow Elements

Marine Systems & Turbochargers

- Electrical Systems
- Marine Equipment
- Offshore Retrofit and Refurbishment

Process Analytics

- Process Gas Analysis
- Systems Integration

Transmitters

- Pressure
- Temperature
- Level
- Interface Modules

Valves, Actuators and Positioners

- Control Valves
- Actuators
- Positioners

Water, Gas & Industrial Analytics Instrumentation

- pH, Conductivity and Dissolved Oxygen Transmitters and Sensors
- Ammonia, Nitrate, Phosphate, Silica, Sodium, Chloride, Fluoride, Dissolved Oxygen and Hydrazine Analyzers
- Zirconia Oxygen Analyzers, Katharometers, Hydrogen Purity and Purge-gas Monitors, Thermal Conductivity

Customer support

We provide a comprehensive after sales service via a Worldwide Service Organization. Contact one of the following offices for details on your nearest Service and Repair Centre.

UK

ABB Limited

Tel: +44 (0)1453 826661

Fax: +44 (0)1453 829671

USA

ABB Inc.

Tel: +1 215 674 6000

Fax: +1 215 674 7183

China

ABB Engineering (Shanghai) Ltd.

Tel: +86 (0) 21 6105 6666

Fax: +86 (0) 21 6105 6992

Mail: china.instrumentation@cn.abb.com

Client Warranty

Prior to installation, the equipment referred to in this manual must be stored in a clean, dry environment, in accordance with the Company's published specification.

Periodic checks must be made on the equipment's condition. In the event of a failure under warranty, the following documentation must be provided as substantiation:

- A listing evidencing process operation and alarm logs at time of failure.
- Copies of all storage, installation, operating and maintenance records relating to the alleged faulty unit.

ABB Limited

Process Automation

Oldends Lane
Stonehouse
Gloucestershire GL10 3TA
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Fax: +44 1453 829 671

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Process Automation

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