MUELLER

MUELLER HBMAG

Electromagnetic Flow Meters

ELECTROMAGNETIC WATER METER

OPERATING INSTRUCTIONS

LEGAL INFORMATION

WARNING NOTICE SYSTEM

This manual contains notices you have to observe in order to ensure your personal safety, as well as to prevent damage to property. The notices referring to your personal safety are highlighted in the manual by a safety alert symbol, notices referring only to property damage have no safety alert symbol. These notices shown below are graded according to the degree of danger.

⚠ DANGER

Indicates that death or severe personal injury will result if proper precautions are not taken.

⚠ WARNING

Indicates that death or severe personal injury may result if proper precautions are not taken.

⚠ CAUTION

With a safety alert symbol, indicates that minor personal injury can result if proper precautions are not taken.

CAUTION

Without a safety alert symbol, indicates that property damage can result if proper precautions are not taken.

⚠ NOTICE

Indicates that an unintended result or situation can occur if the relevant information is not taken into account.

If more than one degree of danger is present, the warning notice representing the highest degree of danger will be used. A notice warning of injury to persons with a safety alert symbol may also include a warning relating to property damage.

QUALIFIED PERSONNEL

The product / system described in this documentation may be operated only by personnel qualified for the specific task in accordance with the relevant documentation, in particular its warning notices and safety instructions. Qualified personnel are those who, based on their training and experience, are capable of identifying risks and avoiding potential hazards when working with these products / systems.

PROPER USE OF MUELLER PRODUCTS

Note the following:

⚠ WARNING

Mueller products may only be used for the applications described in the catalog and in the relevant technical documentation. If products and components from other manufacturers are used, these must be recommended or approved by Mueller. Proper transport, storage, installation, assembly, commissioning, operation and maintenance are required to ensure that the products operate safely and without any problems. The permissible ambient conditions must be complied with. The information in the relevant documentation must be observed.

MUELLER HBMAG

Electromagnetic Flow Meters

TRADEMARKS

All names identified by ® are registered trademarks of Mueller. The remaining trademarks in this publication may be trademarks whose use by third parties for their own purposes could violate the rights of the owner.

DISCLAIMER OF LIABILITY

We have reviewed the contents of this publication to ensure consistency with the hardware and software described. Since variance cannot be precluded entirely, we cannot guarantee full consistency. However, the information in this publication is reviewed regularly and any necessary corrections are included in subsequent editions.

TABLE OF CONTENTS

MUELLER HBMAG
Electromagnetic Flow Meters

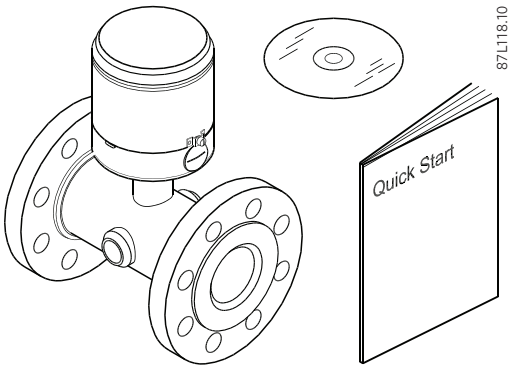
1. INTRODUCTION

These instructions contain all the information you need for using the device.

The instructions are aimed at persons mechanically installing the device, connecting it electronically, configuring the parameters and commissioning it as well as service and maintenance engineers.

Note: It is the responsibility of the customer that the instructions and directions provided in the manual are read, understood and followed by the relevant personnel before installing the device.

1.1 ITEMS SUPPLIED



- HbMAG
- Calibration Certificate
- Operating Instructions
- Literature CD

INSPECTION

1. Check for mechanical damage due to possible improper handling during shipment. All claims for damage are to be made promptly to the shipper.
2. Make sure the scope of delivery, and the information on the type plate corresponds to the ordering information.

DEVICE IDENTIFICATION

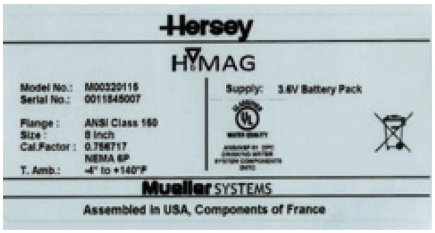


FIGURE 1 - 1 HBMAG LABEL

1.2 HISTORY

The contents of these instructions are regularly reviewed and corrections are included in subsequent editions. We welcome all suggestions for improvement.

The following table shows the most important changes in the documentation compared to each previous edition.

EDITION	REMARKS
1	None

1.3 FURTHER INFORMATION

The contents of these Operating Instructions shall not become part of or modify any prior or existing agreement, commitment or legal relationship. All obligations on the part of Mueller are contained in the respective sales contract which also contains the complete and solely applicable warranty conditions. Any statements contained herein do not create new warranties or modify the existing warranty.

PRODUCT INFORMATION ON THE INTERNET

The Operating Instructions are available on the CD-ROM shipped with the device, and on the Internet on the Mueller homepage, where further information on the range of Mueller HbMAG may also be found: Product information on the internet (http://www.MuellerSystems.com/).

CONTACT INFORMATION

If you need more information or have particular problems not covered sufficiently by the operating instructions, please get in touch with Mueller. You can find additional information for your local contact person at 1-800-423-1323.

2. SAFETY NOTES

2.1 GENERAL SAFETY INSTRUCTIONS

CAUTION

Correct, reliable operation of the product requires proper transport, storage, positioning and assembly as well as careful operation and maintenance. Only qualified personnel should install or operate this instrument.

Note: It is the responsibility of the customer that the instructions and directions provided in the manual are read, understood and followed by the relevant personnel before installing the device.

2.2 LAWS AND DIRECTIVES

GENERAL REQUIREMENTS

Installation of the equipment must comply with local, state and national regulations.

INSTRUMENT SAFETY STANDARDS

The device has been tested at the factory, based on the safety requirements. In order to maintain this condition over the expected life of the device the requirements described in these Operating Instructions must be observed.

CAUTION

Material compatibility

Mueller can provide assistance with the selection of the proper meter. However, the full responsibility for the selection rests with the customer and Mueller can take no responsibility for any failure due to material incompatibility.

2.3 LITHIUM BATTERIES

Lithium batteries are primary power sources with high energy content designed to represent the highest possible degree of safety.

Thus the following basic precautions should be observed when handling and using lithium batteries:

WARNING

Potential hazard

Lithium batteries may present a potential hazard if they are abused electrically or mechanically. This is in most circumstances associated with the generation of excessive heat where internal pressure may cause the cell to rupture.

Thus the following basic precautions should be observed when handling and using lithium batteries:

- Do not short-circuit, recharge or connect with false polarity.
- Do not expose to temperature beyond the specified temperature range or incinerate the battery.
- Do not crush, puncture or open cells or disassemble battery packs.
- Do not weld or solder to the battery's body.
- Do not expose contents to water.

2.4 INSTALLATION IN HAZARDOUS AREA

This device is not approved for use in hazardous areas.

3. DESCRIPTION

3.1 SYSTEM COMPONENTS

AN HBMAG FLOW METER SYSTEM INCLUDES

- A transmitter and a sensor. The transmitter is either compact mounted (integral) or remote mounted at a distance of 33′ max..
- An internally or externally mounted battery supply or 115... 230 VAC or 12/24 V AC/DC power supply with battery backup.

COMMUNICATION SOLUTIONS

The following communication modules are available:

- Encoder interface for AMR and AMI solutions.

3.2 OPERATING PRINCIPLE

HbMAG is a microprocessor-based water meter with graphical display and key for optimum customer operation and information on site. The transmitter drives the magnetic field in the sensor, evaluates the flow signal from the sensor, and calculates the volume passing through. It delivers the required information via the integrated pulse output or communication interfaces as part of a system solution. Its intelligent functionality, information and diagnostics ensure optimum meter performance and information to optimize water supply and billing.

The Mueller HbMAG is configured to achieve up to 6 years of battery life in typical revenue applications with the integral battery and up to 10 years with the remote battery pack.

3.3 DESIGN

HbMAG is a battery-supplied magnetic inductive flow meter for revenue, district and irrigation metering application.

FIGURE 3 - 1 HBMAG COMPACT

FIGURE 3 - 1 HBMAG REMOTE

3.4 BENEFITS

- Simple placement of the meter - install the meter in a meter vault or bury it underground. The IP 68 (NEMA 6P) design is unaffected by meter position or in-line piping stresses, and there is no requirement for filters or strainers.
- Low pressure loss - an unrestricted flow tube ensures minimal pressure loss, even at the highest flow rates. Overall network system pressures can be reduced, helping to prevent leakage from burst pipes and excess stress placed on pumping stations.
- Zero maintenance - designed without moving parts and has up to a 10-year battery life.
- Measurement in both directions - only one meter required for measuring in both directions.
- Intelligent meter - only one meter for leak detection, data logger function, and self-detection of errors.
- Compatible with Mueller AMR and AMI solutions

4. INSTALLING / MOUNTING

4.1 INTRODUCTION

Mueller HbMAG flow meters are suitable for indoor and outdoor installations.

- Make sure that pressure and temperature specifications indicated on the device type plate / label are not exceeded.

GENERAL INFORMATION

This chapter describes how to install the flow meter in the compact version as well as in the remote version.

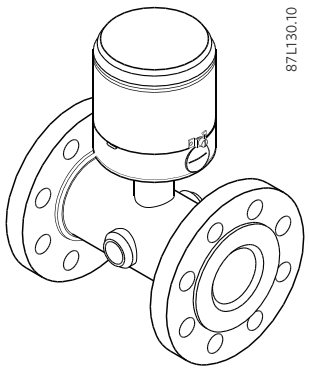


FIGURE 4 - 1 COMPACT INSTALLATION

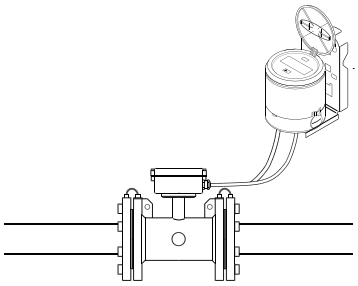


FIGURE 4 - 2 REMOTE INSTALLATION

The installation consists of two steps:

1. Sensor installation.
2. Transmitter installation (remote version only).

4.2 SENSOR INSTALLATION

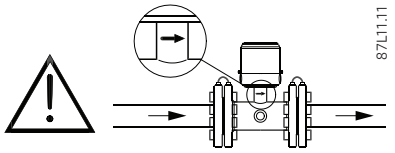
The installation consists of two steps:

1. Locating the sensor.
2. Orienting the sensor.
3. Mounting the sensor.

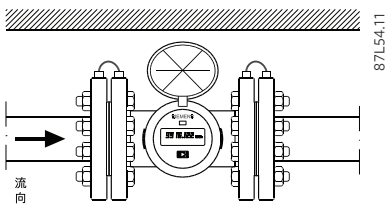
4.2.1 LOCATING THE SENSOR

Ensure that the sensor is located in the most optimum place.

GENERAL INFORMATION



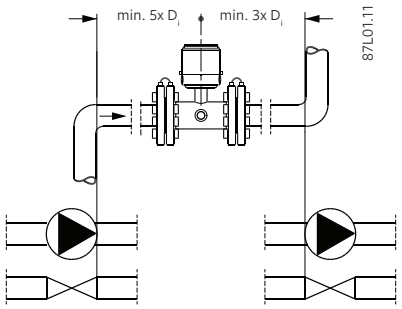
Ensure that sensor is mounted in correct flow direction as indicated on label.



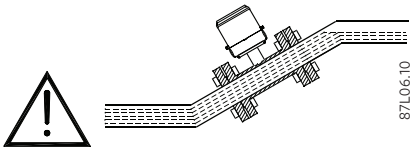
If process flow direction is opposite of flow direction indicated on sensor label, forward flow rates can be restored via software parameter FT327, if factor is adjusted to "-1".

INLET AND OUTLET CONDITION

To achieve most accurate flow measurement it is essential to have certain straight inlet and outlet pipe lengths as shown (Di: sensor diameter).

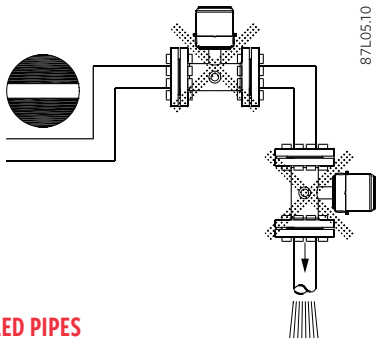


Sensor must be completely full of liquid.



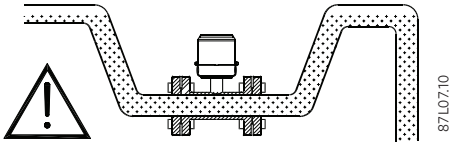
Therefore avoid:

- Air in pipe.
- Installation at the highest point in pipe system.
- Installation in vertical pipes with free outlet.



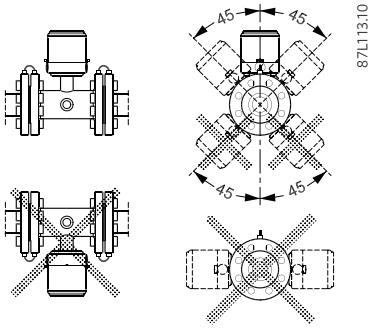
PARTIALLY FILLED PIPES

For partially filled pipes or pipes with downwards flow and free outlet, sensor must be mounted in a U-tube.



4.2.2 ORIENTING THE SENSOR

HORIZONTAL PIPES



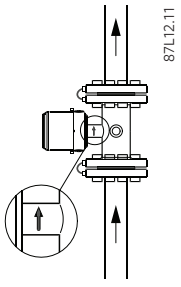
Sensor must be mounted as shown in upper part of figure. Do not mount sensor as shown in lower part of figure as electrodes then will be positioned at top where air bubbles may occur and in bottom, where mud, sludge, sand etc. may deposit.

If "Empty Pipe Detection" is used, sensor should be tilted 45° as shown in upper right figure to maximize full pipe detection and provide accurate volume calculations.

Note: Physical installation of battery pack may influence battery capacity. Optimal battery capacity is achieved with battery pack in an upright position. Installation examples marked with dotted cross will affect battery capacity.

HORIZONTAL PIPES

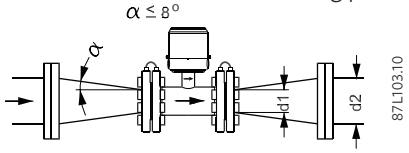
Recommended installation is in a vertical / inclined pipe to minimize wear and deposits in sensor.



INSTALLATION IN LARGE PIPES

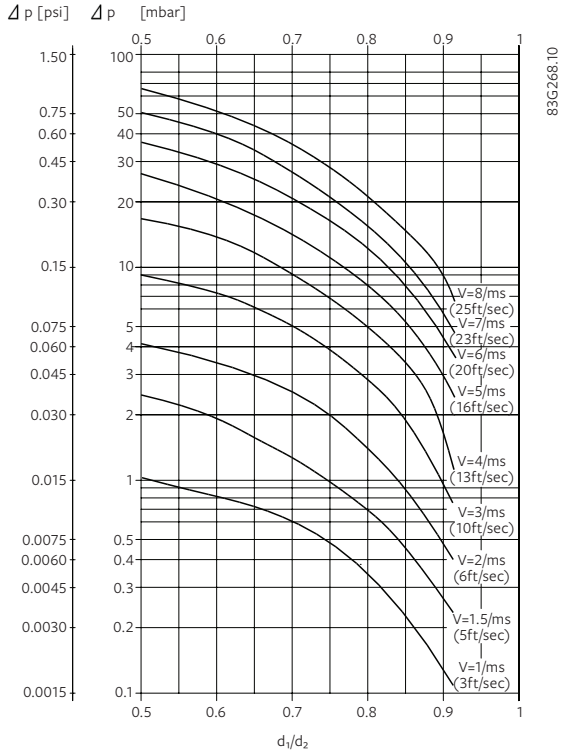
The water meter can be installed between two reducers (e.g. DIN 28545).

With an 8° reducer, the following pressure drop curve applies.



The curves are applicable to water.

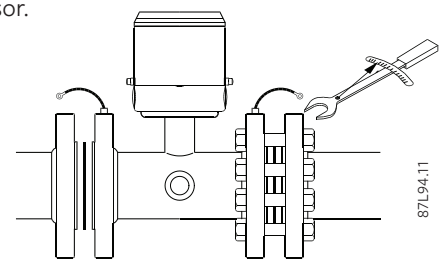
EXAMPLE



A flow velocity of 3 m/s (10 ft/sec) (V) in a sensor with a diameter reduction from 4 Inch to 3 Inch (d1/d2 = 0.8) gives a pressure drop of 0.04 psi.

4.2.3 INTRODUCTION

1. Install gaskets.
2. Ensure connection flange has a smooth surface and is in line with sensor.



Gaskets are recommended but not included in flowmeter delivery.

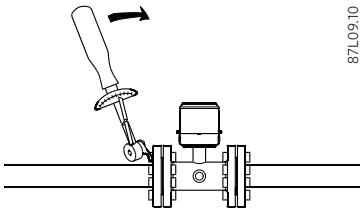
ADVICE FOR GASKET SELECTION

- Only use flat rubber gaskets.
- Thickness 1 ... 6 mm (0.0...0.02 ft) dependent on gap / tolerance.
- Inner diameter must be larger than bore of flowmeter.
- Material should be compatible with process fluid.

Hardness should be maximum 75 Shore A.

MAXIMUM ALLOWABLE TORQUES

Standard bolts must be well lubricated and tightened evenly around gasket.



Leakage / damage to flow meter or piping may arise if bolts are over tightened.

TORQUE CALCULATIONS

All values are theoretical and are calculated on the assumption that:

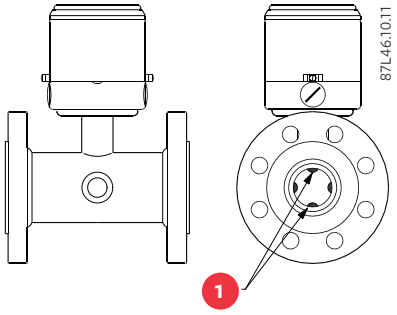
- All bolts are new and material selection is according to EN 1515-1 table 2.
- Gasket material not exceeding 75 shore A is used between the flow meter and mating flanges.
- All bolts are galvanized and adequately lubricated.
- Flanges are made of carbon steel.
- Flow meter and mating flanges are correctly aligned.

TORQUES

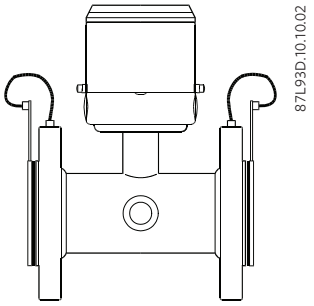
NOMINAL SIZE		CLASS 150		AWWA	
INCH	MM	F / LBS	NM	F / LBS	NM
3″	80	25	34	N/A	N/A
4″	100	19	26	N/A	N/A
5″	125	31	42	N/A	N/A
6″	150	42	57	N/A	N/A
8″	200	65	88	N/A	N/A
10″	250	73	99	N/A	N/A
12″	300	97	132	N/A	N/A
16″	400	155	210	N/A	N/A
18″	450	162	220	N/A	N/A
20″	500	148	200	N/A	N/A
24″	600	207	280	N/A	N/A
28″	700	N/A	N/A	148	200
30″	750	N/A	N/A	177	240
32″	800	N/A	N/A	192	260
36″	900	N/A	N/A	177	240
40″	1000	N/A	N/A	207	280
42″	1050	N/A	N/A	207	280
44″	1100	N/A	N/A	214	290
48″	1200	N/A	N/A	229	310

4.3 POTENTIAL EQUALIZATION

Liquid potential equalization or grounding is accomplished with built-in grounding electrodes and/or grounding rings. The electrodes ensure electrical connection between liquid and meter providing a stable and accurate measurement.



1 Built/in grounding electrode



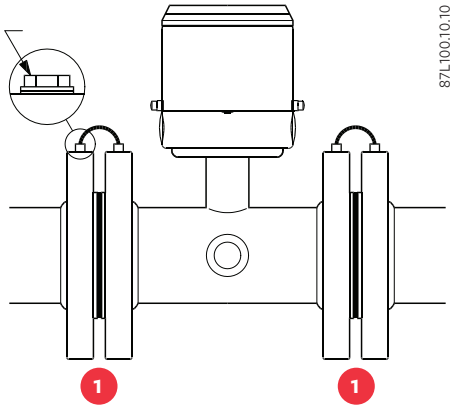
2 Grounding rings mounted on HBMAG

4.4 GROUNDING

The sensor body must be grounded using grounding / bonding straps and/or grounding rings to protect flow signal against stray electrical noise and/or lightning. This ensures that noise is carried through sensor body and that the measuring area within sensor body is noise-free.

METAL PIPES

Connect straps to both flanges with 6 mm (¼") screws.

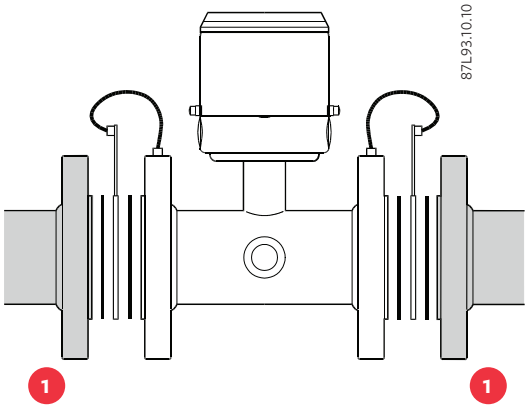


1 Metal Pipes

Bonding / grounding straps are part of delivery and pre-mounted on flow meter.

PLASTIC PIPES AND LINED METAL PIPES

Use optional grounding rings at both ends.

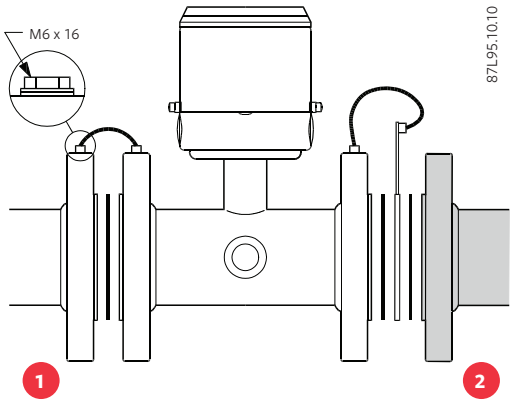


1 Plastic pipes or lined metal pipes

Grounding rings are not included in delivery.

COMBINATION OF METAL AND PLASTIC PIPES

Use straps for metal pipe and grounding rings for plastic pipe.



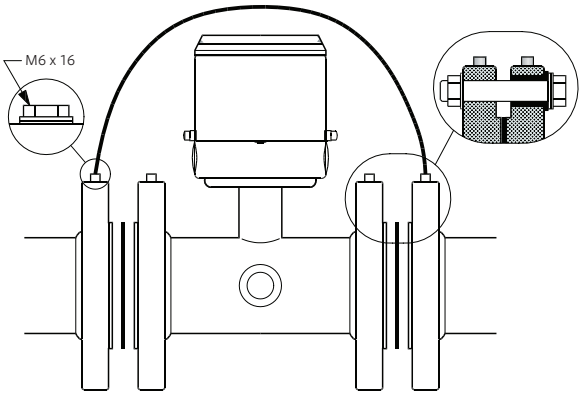
1 Metal Pipe
2 Plastic Pipe

Bonding / grounding straps, grounding rings and straps are not included in delivery.

Note: All straps or grounding wires must be 12 AWG (or heavier) copper wire and connected with 6 mm screws.

4.5 CATHODIC-PROTECTED PIPES

Pay special attention to meter installation in cathodic-protected pipe.



Isolate meter from pipeline by mounting isolation sleeves and washers on flange bolts and connect a wire dimensioned to manage the cathodic current and environmental influence, between pipelines.

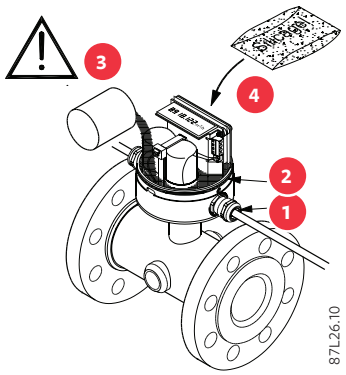
4.6 POTTING AND DIRECT BURIAL

COMBINATION OF METAL AND PLASTIC PIPES

CAUTION

Do not pot meter before electrical connections have been made.

Meter is rated IP68 / NEMA 6P from the factory as standard. If cable glands are added, IP68 / NEMA 6P enclosure rating is obtained by potting transmitter bottom with Sylgard potting kit. Otherwise only an IP67 / NEMA 4 rating is obtained.

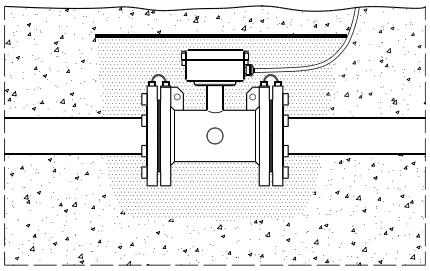


Ensuring IP68 / NEMA 6P enclosure rating and preventing water ingress:

1. Select the proper gland size to fit installed cable size.
2. Mount O-ring properly and correctly and grease with gel.
3. Sylgard potting kit in bottom part of casing.
4. Renew Silicagel bag to prevent condensation within meter, if necessary.

Note: Important - Ensure not to fill Sylgard potting kit in the space for the battery pack.

SUGGESTIONS FOR DIRECT BURIAL OF REMOTE SENSOR



Remote sensor is protected to IP68 / NEMA 6P and can be buried.

The use of pea gravel, at least 12 inches all around sensor, is recommended to provide some drainage and to prevent dirt from solidifying on sensor.

It also helps to locate the sensor should excavation be necessary. Before covering pea gravel with earth, use electrical cable identification tape above gravel.

Run remote sensor cable through a plastic conduit of minimum 2″ or 50 mm.

4.7 TRANSMITTER INSTALLATION

Mount bracket on a wall as shown below or on a horizontal or a vertical pipe using ordinary hose clips or duct straps.

WALL MOUNTING

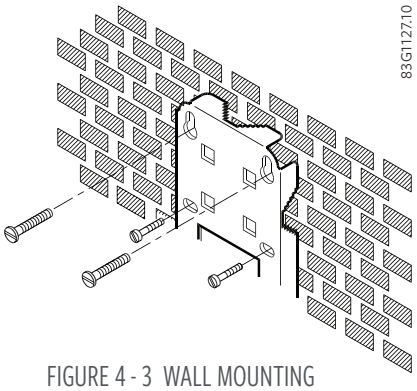
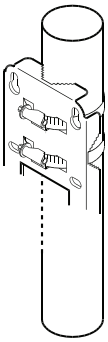


FIGURE 4 - 3 WALL MOUNTING

PIPE MOUNTING



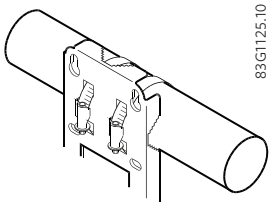


FIGURE 4 - 5 PIPE MOUNTING - HORIZONTAL

FIGURE 4 - 4 PIPE MOUNTING - VERTICAL

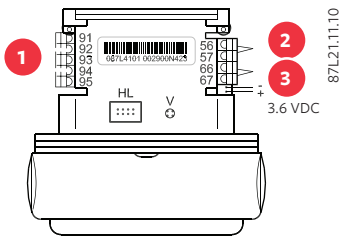
5. CONNECTING

This chapter consists of general safety requirements as well as a description of how to connect the device.

The connection of the device is done in four steps.

1. Wiring sensor and transmitter (remote version only).
2. Connecting power supply.
3. Connecting outputs.
4. Connecting add-on module.

CONNECT DIAGRAM



3.6 VDC battery connector - male and pulse connection terminals are placed in the right side of PCB board - see figure.

Connection for add-on interface modules is placed on the left side.
HL = Hardware lock key connection
V = Push button for verification mode

To configure outputs please see output configuration in Flow Tool (PC-software) ID 400 to 425.

5.1 GENERAL SAFETY REQUIREMENTS

WARNING

The pertinent regulations must be observed for electrical installation.

- Never install the device with the mains voltage switched on!
- Danger of electric shock!
- The electrodes and magnetic current line may only be connected when the device is not connected to the power supply.
- If the housing is under voltage (power supply), the cover may be unscrewed by qualified personnel only.

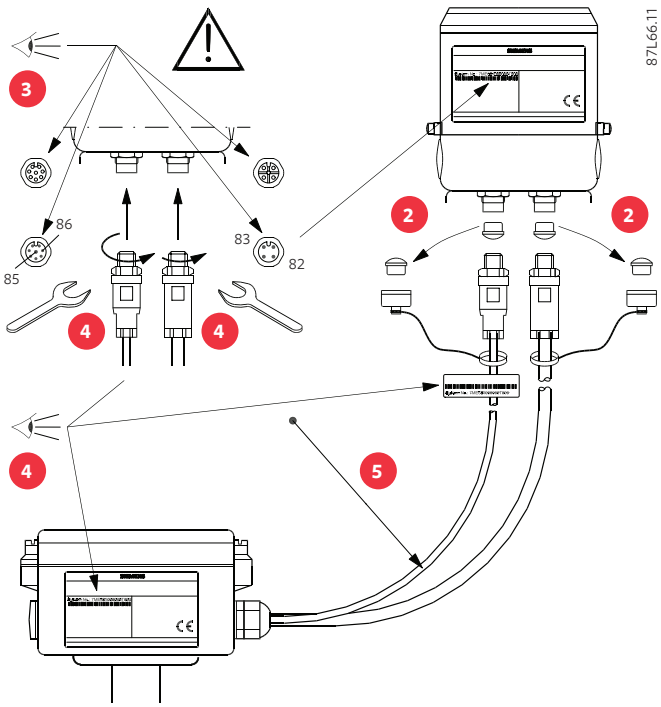
WARNING

Mains supply from building installation Class II

A switch or circuit breaker (max. 15 A) must be installed in close proximity to the equipment and within easy reach of the operator. It must be marked as the disconnecting device for the equipment.

5.2 REMOTE VERSION

REMOTE INSTALLATION

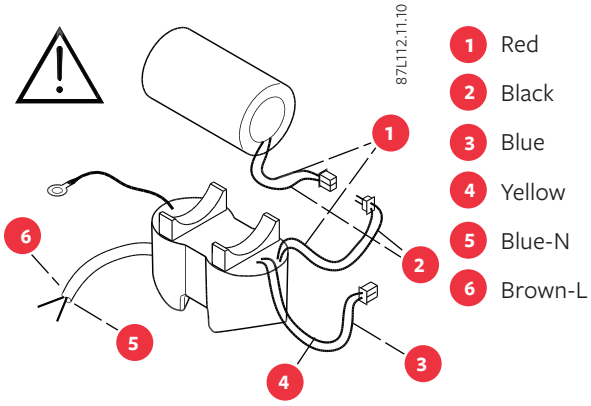


1. Verify that model and serial numbers shown on labels of sensor and transmitter are matched properly.
2. Ensure that cable is safety installed to avoid damage of cable and connectors. Please note the different connector types for coil and electrodes, both having a minimum diameter of 3.6 inches. Save dust covers for future use and protection.
3. Ensure connectors are clean.
4. Ensure connectors are fastened securely to achieve a good connection and watertight seal.
5. Min. r = 1.8 inches.

Note: If dirt enters connector ends, use plain water for cleaning. Ensure connectors are completely dry before making connections.

5.3 POWER SUPPLY

CONNECTION DIAGRAM FOR 115 ... 230 VAC (MAINS) OR 12/24 V AC/DC (LINE) POWER SUPPLY



115 ... 230 VAC (MAINS) POWER SUPPLY

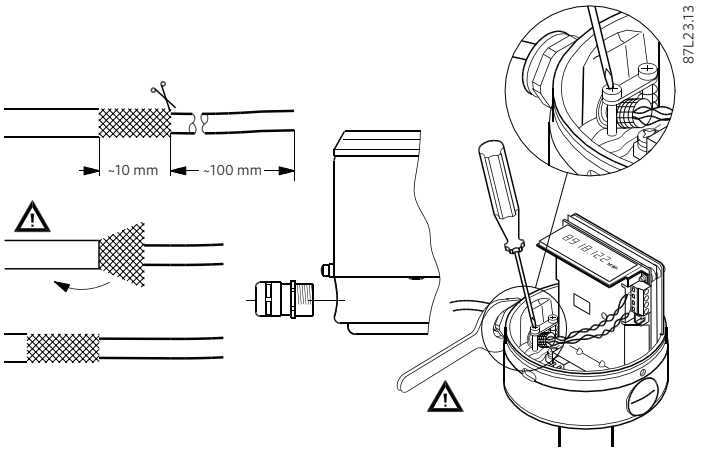
Mains power input	Factory mounted PUR cable with 2 x 1 mm2 (brown wire, blue wire) cable length = 9.8′ (3m) Brown wire - L (line, hot) and blue wire - N (neutral, cold).
Mains power output	Female battery connector with blue and yellow wires; blue wire is ground. Female battery connector has to be connected to male connector 3.6 VDC on PCB board.
Battery backup input	Male battery connector with black and red wires; black wire is ground. Male battery connector has to be connected to female connector on backup battery.
Functional ground	Black wire with terminal must be connected to HbMAG encapsulation with2

Mains power supply has to be connected to a switch near flow meter.

12/24 V AC/DC (LINE) POWER SUPPLY

Line power input	Factory mounted PUR cable with 2 x 1 mm2 (brown wire, blue wire) cable length = 9.8′ (3m) Brown wire - L (line, hot, positive) and blue wire - N (neutral, cold, negative).
Line power output	Female battery connector with blue and yellow wires; blue wire is ground. Female battery connector has to be connected to male connector 3.6 VDC on PCB board.
Battery backup input	Male battery connector with black and red wires; black wire is ground. Male battery connector has to be connected to female connector on backup battery.
Functional ground	Black wire with terminal must be connected to HbMAG encapsulation with a screw.

CABLE INSTALLATION



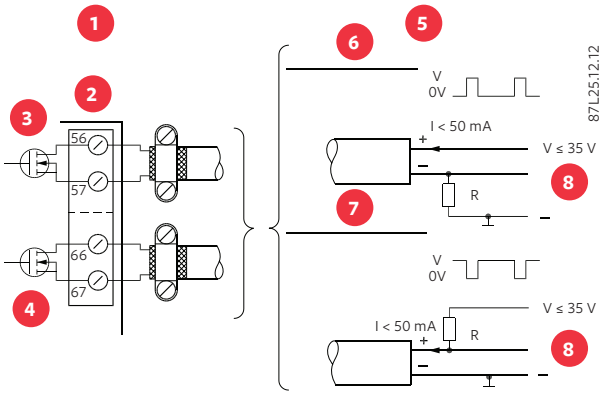
Choose the correct glands for the selected cable type, see Accessories (Page 55) for glands selection. Ensure shield is mounted under cable clamps - do not make pig tails.

NOTICE

Mains or line-powered PUR cable (no shield) has to be mounted under cable clamps. All cable glands have to be sufficiently tightened to ensure NEMA/IP-rating.

5.4 OUTPUTS

PULSE OUTPUT CONNECTION DIAGRAM FOR HBMAG



1. HbMAG Internal connection
2. Passive output - No polarization - Open drain
3. Output A
4. Output B
5. External connection - Connection Variant
6. Positive pulse logic
7. Negative pulse logic
8. Signal

Pulse output can be configured as volume, alarm or call-up, see Commissioning (Page 13).

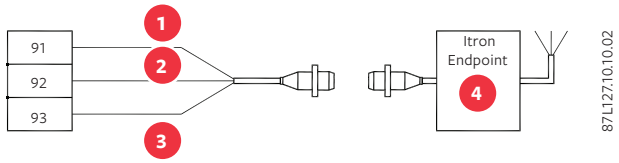
Pulse output is not polarized and can be connected for positive or negative logic.

Pull up / down resistor (R) Is selected in relation to power supply voltage (V) and with a max. current (I) of 50 mA.

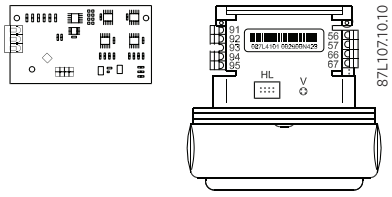
Note: Pulse output must be connected to equipment complying with Low Voltage Directive in order to be considered safe. The isolation within pulse output is only a functional isolation.

5.5 COMMUNICATION MODULES

ENCODER INTERFACE CONNECTION DIAGRAM



MI.NODE	ITRON
1 Red Wire	Black Wire
2 Green / White Wire	Red Wire
3 Black Wire	Unshielded Wire
4 Mi.Node	Endpoint

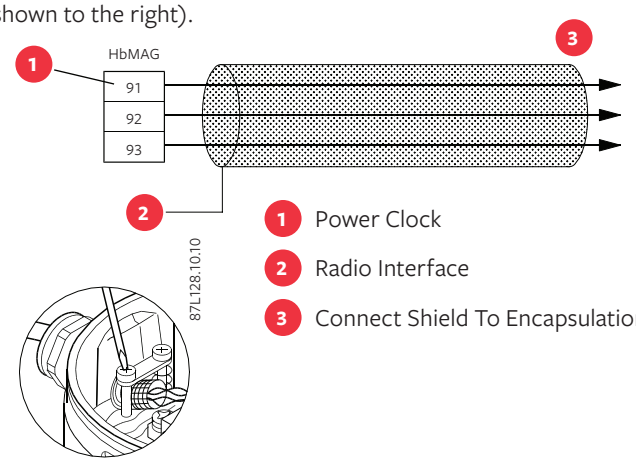


Connect red wire to terminal 91, Green / white red wire to terminal 92 and Black wire to terminal 93.

WARNING

It is important that unshielded wire does not touch any metal part of HbMAG housing.

Other radio interface cable has to be a 3-wire cable with a shield connected to HbMAG housing (mounting cable shield is shown to the right).



1. Power Clock
2. Radio Interface
3. Connect Shield To Encapsulation

5.6 CONNECTION OF ADD-ON MODULES

When the add-on module has been installed, the electrical connections are available on terminal rows 91 - 97

FOR MORE INFORMATION

Refer to the relevant Quick Start or Operating Instructions available at the HbMAG literature CD or on the internet at: www.MuellerSystems.com.

6. OPERATION

6.1 METER OPERATION VIA KEY AND DISPLAY

The meter is designed with a single key and a symbolic display for optimal dialog.

DISPLAY

Display is divided into 3 areas.

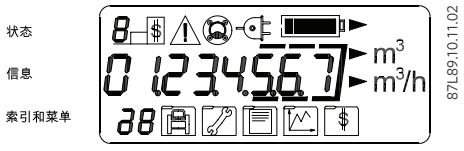


FIGURE 6 - 1 DISPLAY

- Top area with symbols for status information.
- Middle area with actual information.
- Bottom area with index for actual information and selected menu.

Some of the information has additional information connected and display will automatically toggle between information, see menu overview (Page 12). If key is not pressed for 10 minutes, display will time-out and return to default configured operator menu.

KEY

There are three different ways the interface key will respond to being pressed:

1. A brief press (less than 2 seconds) will advance screen to next index or menu.
2. A short press (2 to 5 seconds) will enter a menu or escape menu selection.
3. A long press (more than 5 seconds) while in the operator menu ( ) will activate a reset of selected value (e.g., totalizer or call-up function) indicated by an "r".

A flashing "r" indicates a reset. A request for time and date setup is shown during power-up.

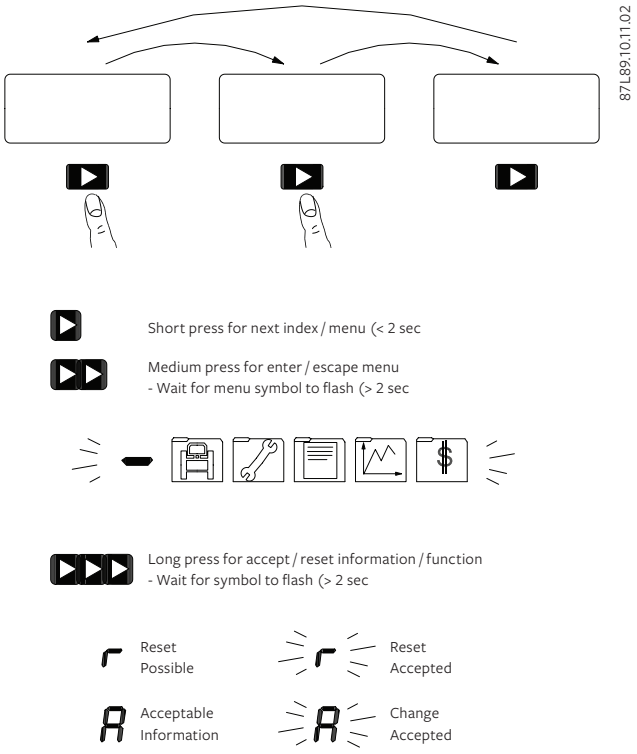


FIGURE 6 - 2 KEY AND DISPLAY OPERATION

6.2 DISPLAY OF SYMBOLS

Top area of display shows status bar.

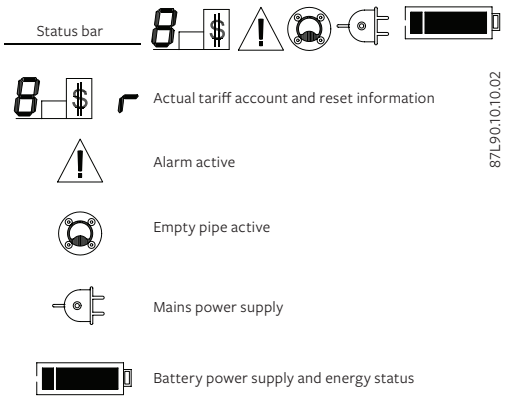


FIGURE6 - 3 STATUS BAR

Status information symbols show actual operation of meter.

Alarm symbol is active when an alarm is active and shown independently of alarm output configuration.

Empty pipe symbol indicates an empty pipe condition. To conserve power and prevent false readings due to exposed measurement electrodes, flow measurement is disabled until a full pipe is detected and the symbol has disappeared.

Power supply type is automatically detected by meter. **Plug** symbol indicates that mains power is supplied.

Battery symbol indicates that battery power is supplied. It also indicates remaining battery capacity, see Operation menu index 1 (Page 12) for more information.

Bottom part of display shows menu bar.

The **menu bar icons** indicate actual selected menu and related index for selected information. Display overview shows relation between menu, index and information.

Only operator menu has information and functions that can be reset. During power-up function battery power can be preset to 100% capacity and time and date can be adjusted - an "A" in index shows acceptable values.
The menu shown in each menu index is the menu bar.

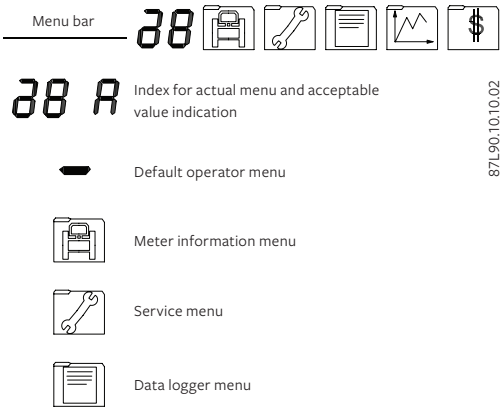


FIGURE 6 - 4 MENU BAR

6.3 DEFAULT DISPLAY INFORMATION AND ACCESSIBLE DISPLAY MENUS

Flow tool parameter FT131 defines default display information with selection between

- Totalizer 1 (Index 1)
- Totalizer 2 (Index 2)
- Flow rate (Index 3, updated with selected measuring frequency)
- Fault codes (Index 4)
- Customer totalizer (Index 5 - resettable)

Default information is shown after power-up as well as after no key operation for 10 minutes.

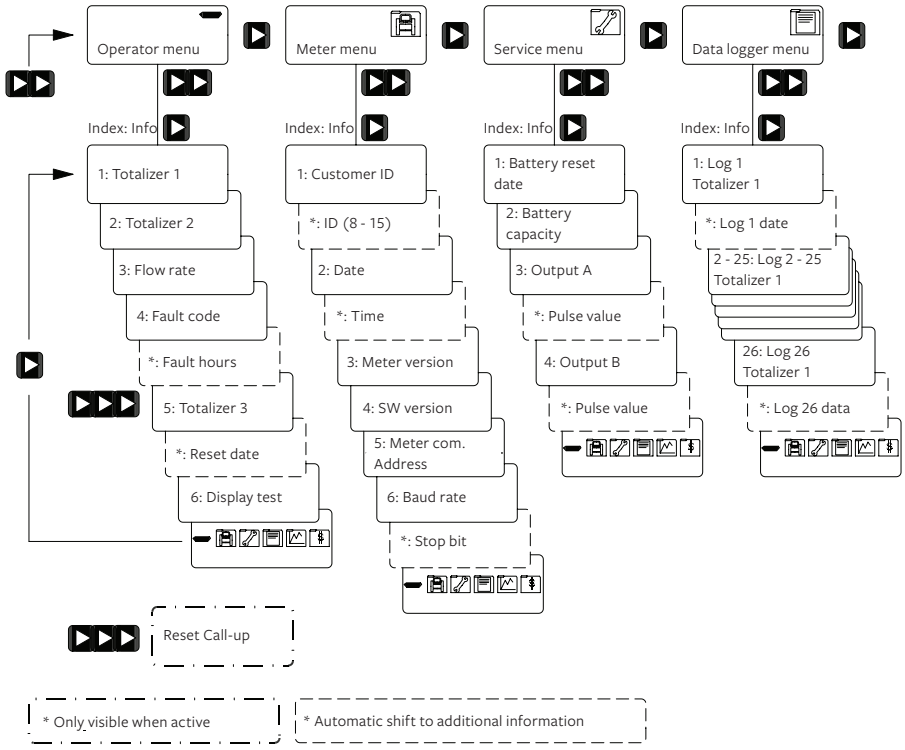
Flow tool parameter FT130 defines accessible menus on display with selection off:

- Operator menu
- Meter info menu
- Service menu
- Data logger menu

Disabling display of menu data will not affect operation of functions.

6.4 OUTPUT OPERATOR MENU

The operator menu consists of several indexes described in the following.



INDEX 1

Totalizer 1

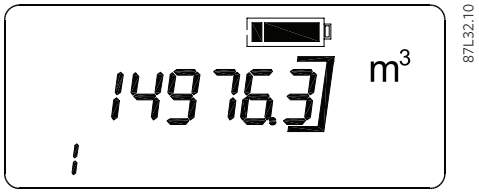


FIGURE 6 - 6 OPERATOR MENU - TOTALIZER 1

Flow volume totalizer 1 (factory-configured for forward flow calculation).

INDEX 2

Totalizer 2

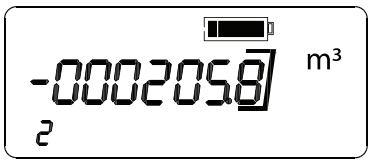


FIGURE6 - 7 OPERATOR MENU - TOTALIZER 2

Flow volume totalizer 2 (factory-configured for reverse flow). A negative value indicates reverse flow calculation.

INDEX 3

Flow rate

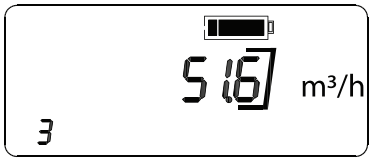


FIGURE 6 - 8 OPERATOR MENU - FLOW RATE

Index 3 shows actual flow rate. If a negative value is indicated, flow is in a reverse direction.

INDEX 4

Active alarm

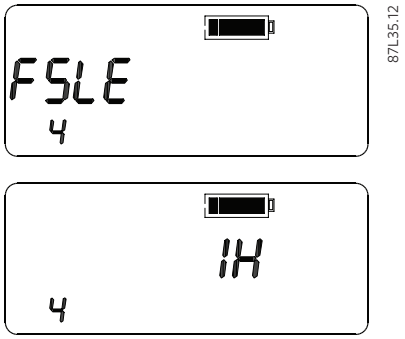


FIGURE 6 - 9 OPERATOR MENU - ACTIVE ALARM

Faults are indicated with the lowest number first. The left of display indicates 3 alarm conditions: low power warning (5), leakage warning (L), and empty pipe warning (E).

Faults 1 to 4 affect meter performance and remain active until alarm condition disappears. Faults 5 to d are warnings that will disappear when alarm condition has been corrected and they are reset via communication interface.

Fault evaluation and service guidelines are made in service section.

After all faults have disappeared, display shows total hours of faults until meter was reset.

Fault information. Each number indicates a dedicated fault:

2	Coil current fault*)
3	Preamplifier overload fault*)
4	Data base checksum fault
5	Low power warning (alarm limits are configurable)
6	Flow overload more than 125% of rated flow
7	Pulse output 1 overflow > PF [Hz] pulse output 1 overflow
8	Pulse output 2 overflow > PF [Hz] pulse output 2 overflow
9	Consumption interval warning (alarm limits are configurable)
E	Empty pipe / low conductivity - when enabled*
C	High conductivity / low impedance warning (alarm limits are configurable)
d	High flow rate warning (alarm limits are configurable)

INDEX 5

Customer totalizer

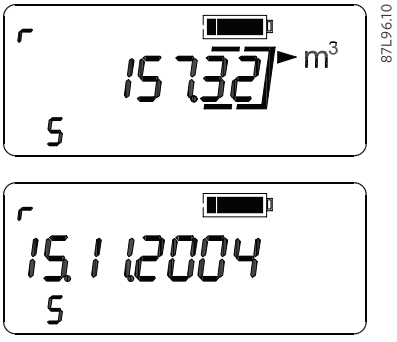


FIGURE 6 - 10 OPERATOR MENU - TOTALIZER / CALL UP RESET

Totalizer 3 indicates totalized volume since last reset. Totalized volume follows totalizer 1 and displayed "r" indicates that it can be reset by activating a long press on key. If key is pressed while "r" is flashing, totalizer 3 value will reset to 0 and actual date and time will be stored permanently in memory. Display information will now alternate between totalizer 3 and reset date.

DISPLAY TEST

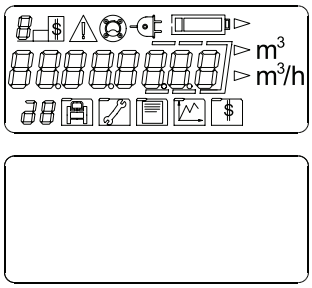


FIGURE 6 - 11 OPERATOR MENU - DISPLAY TEST

All segments of display are alternately flashed on and off during this test.

MENU SELECTION

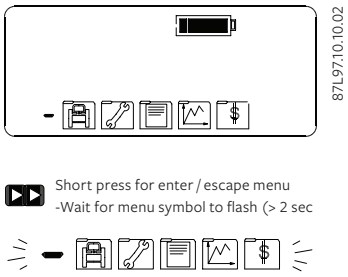


FIGURE 6 - 12 OPERATOR MENU - MENU SELECTION

If key is pressed shortly (2 to 5 seconds), menu selection will flash indicating that a new selection can be made.

After toggling to desired menu, a short press on key will enable chosen menu.

INDEX 0 (WHEN ACTIVE)

Call up reset

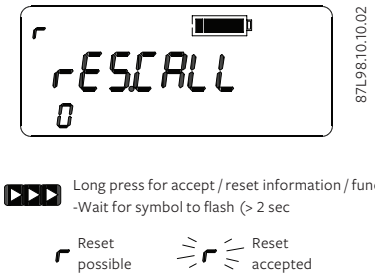


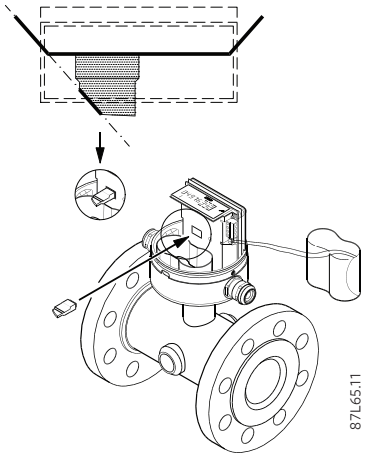
FIGURE 6 - 13 OPERATOR MENU - CALL UP RESET

Call-up reset window (index 0) is only shown when call-up function is activated. ″r″ indicates that it can be reset by a long press on key. When releasing key while ″r″ is flashing, call-up function will be reset and window disappears.

6.5 DATA PROTECTION

USING HARDWARE KEY

A hardware key is installed in the HL hole to change protected parameters. The HL hole is located in the front of the PCB board behind the battery. (FT = Flow Tool parameter number).



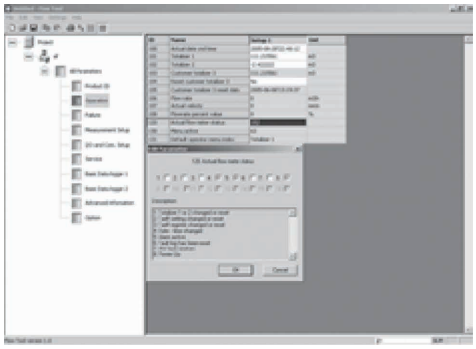
PROTECTED PARAMETERS ARE

NEW PASSWORD	
FT5	Sensor tube diameter
FT7	Meter No.
FT8	Totalizer unit
FT9	Flow unit
FT10	Qn (Q3)
FT300	Totalizer unit factor
FT301	Flow unit factor
FT302	Pipe size
FT321	Calibration date
FT323	Calibration factor
FT325	Sensor offset
FT332	Max. sensor excitation frequency

6.6 INTERNAL DATA HANDLING

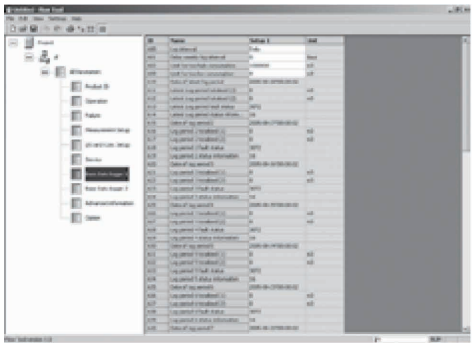
METER STATUS

Meter status parameter (FT120) gives a fast indication of reliability of revenue data.



It shows whether important information has been reset or manipulated, for instance if meter has been powered down.

Status information can only be reset while hardware lock key is mounted.



DATA LOGGER / CONSUMPTION ALARM

Integrated data logger has 26 logging periods in which data can be stored daily, weekly or monthly.

Logger stores the consumption for totalizer 1 and totalizer 2 in selected period.

Forward consumption is stored as a positive value and reverse consumption is stored as a negative value.

Alarm and meter status are also stored for the same period to indicate alarms that have been active, or that revenue data has been influenced in the specific period.

ID	Name	Setup 1	Unit
600	Log interval	Daily	
601	Delay log interval	0	days
602	High log consumption alarm	1000000.000000	m3
603	Low log consumption alarm	0.000000	m3
610	Date of last logging 1	2004-05-26T00:00:34	
611	Last Log1 Totalizer 1	0.000000	m3
612	Last Log1 Totalizer 2	0.000000	m3
613	Last Log1 fault status	1024	
614	Last Log1 status information	153	

Logged information has a time and date stamp. Data logger never stops storing data - old data is overwritten following the first in / first out principle. Log 1 is the last stored information which is moved to log 2 when next logging is made and so on.

Consumption alarm indicates that actual consumption on totalizer 1 is above or below consumption limits.

6.7 BATTERY-POWERED OPERATION

The HbMAG is factory-configured for 6 years of typical operation on internal battery pack (1 D-cell). High or low temperature, frequent use of IrDA communication, high pulse output rate, and high excitation frequency in leakage detection mode will reduce actual operation time.

The HbMAG power management function controls each power consuming element and measures the temperature for optimal calculation of remaining battery power capacity.

BATTERY STATUS AND ALARM INDICATION

Battery power capacity for operation is indicated in 3 levels.

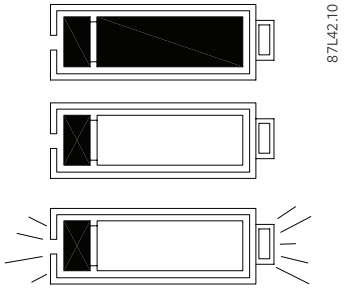


FIGURE 6 - 12 OPERATOR MENU - MENU SELECTION

- Full symbol indicates battery capacity is above battery alarm level (% preset parameter FT206).
- Low symbol indicates that battery should be replaced; however, measurement will remain active. Level is based on a preset alarm level.
- When low symbol is flashing, measurement and communication is disabled until battery pack has been replaced and reset.

"Low battery" is a selectable % parameter (FT206) of 100% full capacity. Meter calculates remaining capacity every four hours, including all consuming elements and influence of temperature changes.

CONSUMPTION AND OPERATION TIME CALCULATION

Battery operation time depends on connected battery pack as well as operation conditions of meter. Every 4 hours the advanced power management system calculates the real power consumption and remaining operation capacity.

Power consumption calculation includes flow measurement, meter dialog (communication and display) and pulse output.

Temperature is also measured to control and adjust its influence on the battery capacity.

For the HbMAG, the internal battery pack has a nominal capacity of 33 Ah giving a typical operation time of 6 years in a revenue application. Nominal capacity of external battery packs is 66 Ah and operation time is limited to battery lifetime - typically 10 years. Configuration and operation conditions for a typical revenue application are shown in the table below.

SCENARIO – REVENUE APPLICATION

Output A	Pulse - 10 Hz
Output B	Alarm or Call up
Meter dialog	1 hour per month
Excitation frequency	1/15 Hz
Country main frequency	50 Hz / 60 Hz

HBMAG

EXCITATION FREQUENCY (24 HOURS OPERATION)		1/60 HZ	1/30 HZ	1/15 HZ	1/5 HZ	1.5625 HZ	3.125 HZ	6.25 HZ
Two D-Cell Ah Internal battery pack	1″... 6″	8 years	8 years	6 years	40 months	8 months	4 months	2 months
	8″ ... 24″	8 years	6 years	4 years	20 months	4 months	2 months	N/A
	28″ .... 48″	6 years	4 years	2 years	1 year	2 months	N/A	N/A
Four D-Cell Ah Internal battery pack	1″... 6″	N/A	10years	10 years	80 months	16 months	8 months	battery 66 4 months
	8″ ... 24″	N/A	10 years	10 years	40 months	8 months	4 months	N/A
	28″ ... 48″	10 years	8 years	4 years	2 years	4 months	N/A	N/A

Typical operation time of 6 years is based on only 80% battery capacity and an operation time / temperature profile of 5% at 0 °C (32 °F), 80% at 15 °C (59 °F) and 15% at 50 °C (122 °F).

The effect of other temperatures are shown in the figure below.

A variation in temperature from 15 °C to 55 °C (59 °F to 131 °F) reduces the capacity by 17% (in the table from 15 Ah to 12 ½ Ah).

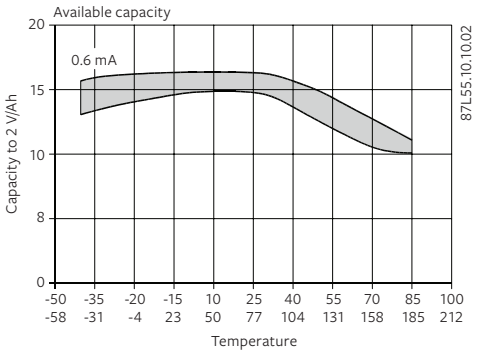


FIGURE 6 - 15 AVAILABLE CAPACITY

Note: Installation orientation of battery pack may influence battery capacity. Optimal battery capacity is achieved with battery pack in an upright position.

BATTERY CONFIGURATION

Battery figures (generated as customer parameter list, see section Customer-selected parameter list in chapter Setting basic parameters (Page 43) show power management information.

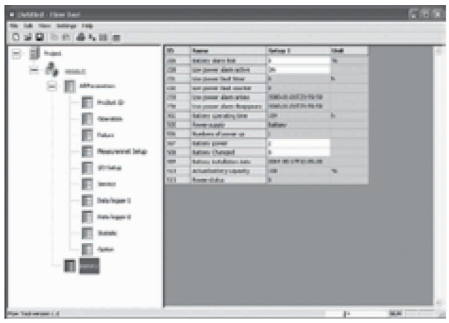


FIGURE 6 - 15 BATTERY CONFIGURATION

At each battery replacement capacity is reset to 100% (Flow Tool parameter FT508-FT510) which is then reduced with real meter consumption every 4 hours.

Battery limit (FT206) is the level at which low power alarm is activated generating an alarm or call-up (if configured).

Power status (FT513) follows battery symbol on display.

When switching between battery power from internal and external battery packs, "Battery power" (FT507) must be adjusted to match actual number of batteries connected.

7. SERVICE AND MAINTENANCE

7.1 MAINTENANCE

The device is maintenance-free, however, a periodic inspection according pertinent directives and regulations must be carried out.

An inspection can include check of:

- Ambient conditions
- Seal integrity of the process connections, cable entries, and cover screws
- Reliability of power supply, lightning protection, and grounds

7.2 HBMAG SERVICE GUIDELINES

The HbMAG battery-operated water meter is based on a very reliable measurement technology and the advanced alarm monitoring and diagnostics provide valuable information concerning the meter performance, faults, and service conditions.

Optimal meter performance requires proper meter selection, proper installation, and proper commissioning for the particular application. This service guideline section indicates how to detect and solve the most common problems. Meter and application problems are indicated by the alarm program via the main fault and warning symbol on the display and the comprehensive data logging and monitoring available via the communication interface.

Alarm monitoring includes individual registration of each alarm, how many hours the alarm has been active, when the alarm first appeared, and when it disappeared last. The alarm log can be reset with its own date and time registration. A common fault hour counter includes all active alarms in one counter. Additionally, active alarms are logged in the data logger to monitor when the alarms have been activated.

Fatal faults 1 through 4 are the most important to resolve as they influence the operation of the meter. Fatal faults will disappear as soon as the alarm condition is corrected.

7.3 REPLACING TRANSMITTER OR PCB BOARD

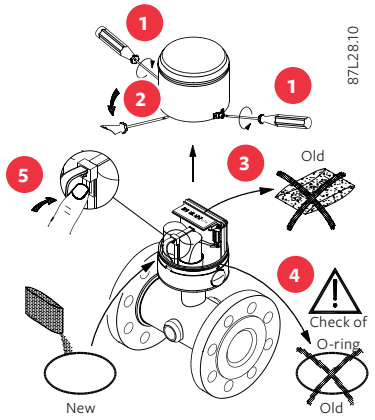
Since the HbMAG does not have a removable EEprom, special care must be taken when replacing a damaged or defective transmitter or PCB board to ensure proper operation and continued accuracy. There are three ways to achieve an easy and successful replacement meter:

1. Order a complete transmitter as a spare part, which comes configured the same way as the original meter left the factory. The system serial number of the original meter must be provided when ordering the replacement.
2. Order a complete transmitter as a spare part with default settings and a blank product label. Final configuration is done on-site. Missing data and configuration can be uploaded from the old meter or it can be read from the old meter product label.
3. Order only a replacement PCB board. The PCB board can only be order for an advanced version and only with default settings. When making the configuration on site, the service mode must be selected in the Flow Tool / software and the hardware lock key must be mounted on PCB board to change important parameters.

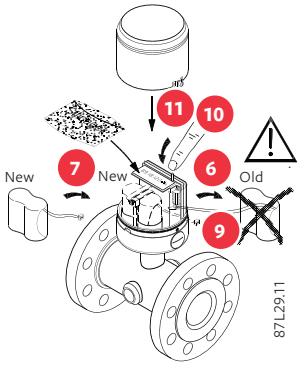
7.4 BATTERY REPLACEMENT

REPLACING BATTERY

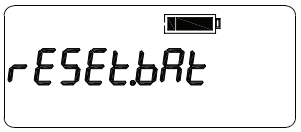
1. Loosen screws on transmitter top.
2. Remove transmitter top using a screwdriver.



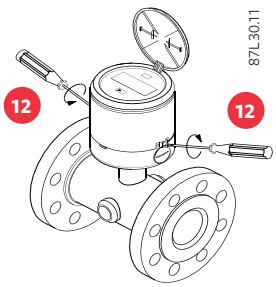
3. Dispose of silica gel bag.
4. Replace O-ring to ensure continued IP68 enclosure rating.
   - Check O-ring for damage or deformity.
   - Smear O-ring with acid-free lubricating gel.
5. Push locking tab and loosen strip.



6. Remove battery pack with power still connected.
7. Place and secure new battery pack.
8. Add new Silica gel bag
   - Remove plastic bag from new silica gel bag.
   - Place new silica gel bag on top of battery pack to prevent condensation within meter.
   - To maintain IP68 enclosure the silica gel bag may not be in contact with the Sylgard.
9. Disconnect old battery pack and connect new one.
10. Press key within 6 seconds to reset battery (i.e. operating time and remaining capacity) when display shows:

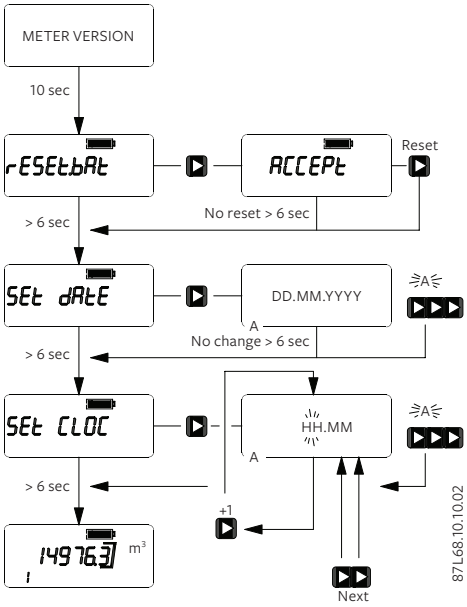


11. Mount top lid.
12. Fasten screws to reassemble meter completely.



If necessary, adjust time and date via software, see Battery power-up.

7.5 POWER UP WITH BATTERY RESET, DATE AND TIME SET UP



When new batteries have been installed, power-up procedure will enable resetting battery capacity and setting up date and time. Battery capacity reset, date and time can also be corrected via functions FT508 and FT200.

When battery plug is connected, meter will display meter version for 10 seconds. Display will then show ″rESEt.bAt″ indicating the option to reset internal battery power calculation. To execute reset, press key within 6 seconds. If key is not pressed, meter will proceed to set date, set clock, and finally normal operation mode.

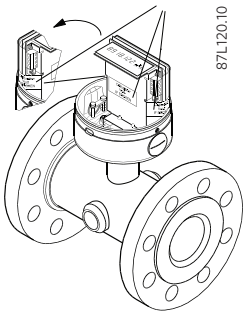
If key is pressed within reset battery time, display will indicate ″Accept″ to ensure that reset should take place. Reset will take place only if key is pressed again within the next 6 seconds. If not, normal operation will begin.

For setting up date and time, the different key function must be used - see Operator menu index 1 (Page 54). An ″A″ indicates an acceptable value and a flashing ″A″ indicates that value is stored when key is released.

Reset function also sets actual date as battery replacement date.

7.6 VERIFICATION

Verification mode increases measurement frequency to provide maximum measurements per second. This function is especially useful to minimize calibration rig time when validating flowmeter accuracy. Frame around digits will blink slowly to indicate that verification mode is enabled. Maximum pulse rate on output A is increased to 1 kHz and pulse width is set to 1 ms. When verification mode is exited the previous pulse setting is restored. Pulse widths other than 1 ms can be selected by storing new pulse values. This setting remains when verification mode is exited.



ACTIVATION OF VERIFICATION MODE

Verification mode is enabled in one of the following ways:

- Pressing push button through hole in front screen or
- Writing integer ′1′ to parameter register ″CalibrationMode″ (FT320).

VERIFICATION MODE

The following indicate that meter is in verification mode:

- Frame surrounding digits in LCD starts flashing.
- Excitation frequency is set to maximum allowable frequency.
  - (ExcitationFreqNo = ExcitationFreqNoLimit)
- Resolution in display is set to 3 digits after decimal point.
  - (DecimalPoint = 3)

DEACTIVATION OF VERIFICATION MODE

Verification mode is deactivated in one of the following ways:

- Pressing push button again.
- Writing integer ′0′ to parameter register ″CalibrationMode″ (FT320).

Verification mode automatically stops if not manually deactivated within 4 hours.

7.7 USING SEALING

The HbMAG can be sealed to provide tamper detection.
Sealing device

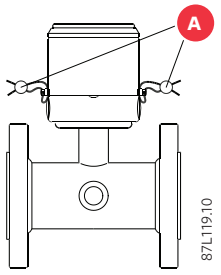


FIGURE 8 - 1 HBMAG USER SEALING (A)

7.8 TECHNICAL SUPPORT

CAUTION

Repair and service must be carried out by approved Mueller personnel only.

Note: Mueller defines sensors as non-repairable products.

TECHNICAL SUPPORT

If you have any technical questions about the device described in these Operating Instructions and do not find the right answers, you can contact Technical Support:

Via the Internet using the Contact Us:
(http://www.muellersystems.com)

- Phone: 1-800-423-1323

SERVICE & SUPPORT ON THE INTERNET

In addition to our documentation, we offer comprehensive product listings online on the Internet at:

Service and support (http://www.muellersystems.com/)

There you will find:

- The latest product information
- AMR / AMI Systems information for Water, Gas, and Electric
- News, Events and Training
- History and Case Studies
- Resource Library

ADDITIONAL SUPPORT

Please contact your local Mueller representative if you have additional questions call Customer Care at 1-800-423-1323.

7.9 RETURN PROCEDURES

Contact Mueller Customer Care at 1-800-423-1323 or your local Mueller sales representative or distributor to arrange all product returns and dispositions. No returns will be accepted without proper documentation and authorization.

7.10 BATTERY DISPOSAL

Please check your local ordinances for information concerning battery disposal and follow all acceptable practices.

8. TROUBLESHOOTING / FAQS

8.1 FAULT CODES

ERROR SYSTEM

The HbMAG can detect and report 14 different faults.

The faults are divided into two types: Fatal errors and Warnings.

Fatal errors: Faults 2, 3, and 4

Warnings: Faults 5, 6, 7, 8, 9, E, C, d, and 14

FAULT CODES	NAME / TEXT	DESCRIPTION	CAUSE	REMEDY
2	Coil current fault	Error in the coil circuit. Coil current has not settled within specified period. A short-circuit in the coil can NOT be detected.	• Coils have been disconnected could be caused by broken cable or wires.	Check cable and wiring installation. Alarm remains active until the fault condition is corrected.
3	Preamplifier overload	Input signal is outside expected range. Input amplifier circuit cannot provide a stable measurement. A short circuit between the two electrodes or between a electrode and common can NOT be detected.	• Electrodes have been disconnected, or connected to ground.	Check cable and wiring installation. Alarm remains active until the fault condition is corrected.
4	Database checksum	Corrupted data in EEprom detected by checksum test made during power-up.	• Power failure during EEprom write.	**1.** Reset checksum repair alarm via FT560 and check data. – All data is checked after operation (e.g., new flow calculation, writing to the EEprom, etc.) with a checksum control. If the checksum result fails, data will not be considered as valid and repair data must be made. **2.** If data is wrong or checksum error reoccurs, replace the PCB board. The alarm is active until the fault condition is corrected.
5	Low Power Alarm	Battery capacity is below preset threshold (default 10%. Power up (temporary warning – will disappear after 4 hours).	• Battery capacity low. • Meter has been powered up.	Check calculated battery capacity (FT510) versus battery alarm limit (FT206) and replace batteries if necessary. Flow measurement and communication stop, but display remains active as long as power is available. The alarm remains active until the fault condition is resolved.
6	Flow Overload	Flow rate has exceeded 125% of Q3.	• Wrong sizing –flow sensor too small.	Check meter sizing for actual installation. Alarm remains active until fault condition is resolved.

FAULT CODES	NAME / TEXT	DESCRIPTION	CAUSE	REMEDY
7	PulseA overload	Duty cycle of output A has exceeded maximum possible of 50.	• Wrong settings for output A.	Change volume per pulse to a higher value-see Technical data for pulse selection. Reminder: basic version is limited to 50 Hz maximum; advanced version to 100 Hz maximum. The alarm remains active until output pulse rate drops below maximum pulse rate.
8	PulseB overload	Duty cycle of output B has exceeded maximum possible of 50.	• Wrong settings for output B.	Change volume per pulse to a higher value-see Technical data for pulse selection. Reminder: basic version is limited to 50 Hz maximum; advanced version to 100 Hz maximum. The alarm remains active until output pulse rate drops below maximum pulse rate.
9	Consumption interval	Accumulated volume on totalizer 1 during data log period has exceeded the too low or too high consumption limit.	• Flowrate higher or lower than expected • Wrong parameter setup.	Check data logger values and consumption limit. Alarm remains active until it is manually reset via FT209.
E	Empty Pipe	Measured electrode impedence is below low conductivity threshold (FT542), i.e. water has a high conductivity.	• Pipe not filled with water.	Ensure sensor is filled with water. Alarm remains active until fault condition is resolved.
C	Low Conductivity	Measured electrode impedence is below low conductivity threshold (FT542), i.e. water has a high conductivity.	• Water is polluted (e.g. saltwater in fresh water).	Alarm is active until water resistance is above low media alarm limit.
d	Flow Limit	The flow rate is greater than the flow alarm limit FT553).	• Water network failure-pipe burst.	Alarm remains active until flow rate drops below flow arm limit.
	Reverse Flow	Flow rate is below a preset threshold (default -1E9).	• Water network failure-non-return valve is broken.	

Note: Reset of fault log (FT204) also resets all alarms. Once reset, only active alarms become visible again.

8.2 BUILT-IN FUNCTIONS

EMPTY PIPE DETECTION

Electrode impedance is measured with 800 Hz at 50 Hz mains frequency (960 Hz at 60 Hz mains frequency). This is done by toggling the electrode control pin every 6 respectively 5 samples – the sample frequency is 9600 Hz. The impedance value is averaged over 100 measurements. The electrode impedance A and B are measured in turns.

The unfiltered impedance value (a fast warning indication) is compared with a limit and the empty pipe warning is reported when it exceeds this limit – but only if the detection is ON and if there is no overload failure.

During empty pipe detection the coil current is held OFF and the flow value is forced zero.

Default settings for Electrode Impedance Limit is 25,000 ohm corresponding to a water conductivity of 20 µS/cm (10 000 ohm ≈ 50 µS/cm).

COIL-CURRENT TEST

When H-bridge is turned and just before making samples (4 times each measurement), the coil current is checked via a comparator. If the coil current is not settled, a failure is reported.

During coil current failure the flow value is forced zero.

PREAMPLIFIER TEST

Overload is possible both from the AD conversion of sensor signal and from the pre-amplifier. These checks are made at each sample and if one of the sample fails with an overload, this measurement is cancelled and a failure is reported.

During overload detection the coil current is held OFF and the flow value is forced zero.

CHECKING FACILITIES

The HbMAG is equipped with checking facilities of types P, I, and N. (2.5.5 in OIML R49). The automatic checks are performed without operator intervention.

Type P permanent checking facilities are automatic checks performed constantly during meter operation. They include:

- Coil current test
- Preamplifier test
- Empty pipe test
- Flow overload
- Pulse overload

Type I intermittent checking facilities are automatic checks performed at certain time intervals or per fixed number of measurements. They include:

Type N non-automatic checking facilities are checks that are not performed automatically including all other diagnosis functions in the HbMAG.

8.3 FLOW SIMULATIONS

The HbMAG has a built-in flow simulator (FT551 & FT552) to verify and adjust pulse output to any connected device or system.

WARNING

Totalized values are changed during simulation and actual flow is NOT measured.

Simulation continues until it is manually turned off (normal operation restored).

9. TECHNICAL DATA

9.1 HBMAG

TECHNICAL SPECIFICATIONS

FIGURE 9 - 1 3″ HBMAG W/ INTEGRAL DISPLAY

For further features, see features list in appendix (Page 57).

METER		HBMAG
Accuracy	Standard Calibration	± 0.4% of rate ± 2 mm/s
Media Conductivity		Clean water > 20 µs/cm
Temperature	Ambient	–4 ... +140 °F (–20 ... +60 °C)
	Media	32 ... +158 °F (0 ... 70 °C)
	Storage	–22 ... +158 °F (–40 ... +70 °C)
Enclosure		NEMA 6P/IP68 rating. Cable glands mounted requires Sylgard potting kit to remain NEMA 6P/ IP68, otherwise NEMA 4/IP68 rating is obtained. Factory mounted cable provides NEMA 6P/IP68 rating.
Approvals	Drinking water Approvals	NSF 61 (cold water) USA

9.2 SENSOR

TECHNICAL SPECIFICATIONS

SENSOR		HBMAG
Size, flange and pressure range	ANSI 16.5 Class 150 lb.	3″ ... 24″: 290 psi or 20 bar
	AWWA C-207	28″ ... 48″: PN 10
Max excitation frequency Basic version	Battery-powered	1/15 Hz for sensor size 3″ ... 6″ 1/30 Hz for sensor size 8″ ... 24″ 1/60 Hz for sensor size 28″ ... 48″
	Mains-powered	6.25 Hz for sensor size 3″ ... 6″ 3.125 Hz for sensor size 8″ ... 24″ 1.5625 Hz for sensor size 28″ ... 48″
Liner Electrode and grounding		EPDM Hastelloy C276

9.3 TRANSMITTER

TRANSMITTER		HBMAG
Installation		Integral (compact) or remote with factory-mounted cable in 25′ lengths with NEMA 6P/ IP68 connectors. Connection is made at the transmitter bottom.
Material	Top housing	Stainless steel (AISI 316)
	Bottom	Coated brass
	Wall mounting bracket	Stainless steel (AISI 304)
Cable entries		
Display and key	Display	8 digits for main information. Index, menu and status symbols for dedicated information.
	Key	For toggling through information and resetting of customer totalizer and call-up function.
	Menus	Selectable default information and accessible menus: - Operator - Meter - Service - Data Logger
	Resolution	Totalized information can be displayed with 1, 2 or 3 decimals or automatic adjustment for maximum resolution.
Flow unit	Mexico, Canada std.	Volume: m^3 Flow rate: m^3/h
	US std.	Volume: Gallon or CF Flow rate: GPM
	Other selectable units	Volume: m^3 x 100, l x 100, G x 100, G x 1000, MG, CF x 100, CF x 1000, AF, Al, kl Flow rate: m^3/min, m^3/d, l/s, l/min, l/h, GPS, GPH, GPD, MGD, CFS, CFM, CFH Units other than G, CF and GPM (ordered from factory or manually configured onsite by changing scaling factors) are shown by a label on the display.
Digital output	Nos. Load	2 passive outputs (MOS), individually galvanically isolated. Max. ± 35 V DC, 50 mA short circuit protected.
	Output A	Programmable as: Pulse volume Forward Reverse Forward / net Reverse / net
	Output B	Programmable as: Pulse volume Forward Reverse Forward / net Reverse / net Alarm Call-up
	Pulse rate	Max. 50 Hz
	Pulse width	5, 10, 50, 100, 500 ms
	IrDA	Standard integrated infrared communication interface with MODBUS RTU protocol.
	Add-on modules	Encoder interface module (for Hot Rod, Mi.Net, Itron Endpoints) ″protocol″.

9.4 POWER SUPPLY

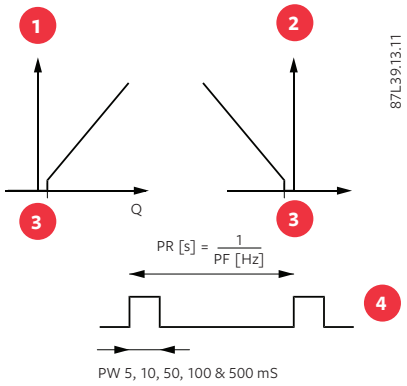
TECHNICAL SPECIFICATIONS

POWER SUPPLY		HBMAG
Battery power supply [1]		Auto-detection of power source with displayed symbol for remaining power. In battery mode, excitation frequency is manually selected.
	Internal battery pack	21D_Cell 3.6 V / 16 Ah
	Internal battery pack	2 D_Cell 3.6 V / 33 Ah
	External battery pack	4 D_Cell 3.6 V / 66 Ah
12-24 V AC/DC power supply	Input voltage range	12/24 V AC/DC (10 ... 32 V DC)
	Power consumption	2 VA
	Isolation	Class II
	Fuse	1000 mA T - Not replaceable
	Short circuit protection	Module is protected from short circuit on the output connector. Both during mains and backup supply.
115 ... 230 VAC mains supply	Input voltage range	115 ... 230 VAC, +15% to –20%, 50-60 Hz
	Power consumption	2 VA
	Isolation	Class II
	Fuse	250 mA T - Not replaceable
	Short circuit protection	Module is protected from short circuit on the output connector. Both during mains and backup supply.
Input cable for 12/24 V AC/DC and 115 ... 230 VAC power supply	Factory-mounted PUR cable	2 x 1 mm2 (brown, blue) Length = 9.8′
	Resistance	Sunlight and water
	Outer diameter	0.28″ (7 mm)
	Rated voltage	300 ... 500 VAC
	Testing voltage	2000 VAC
	Temperature range	Fixed laying: -40 ... 194 °F (–40 ... +90 °C)
	Flexible application	-22 ... 176 °F (–30 ... +80 °C)
	Bending radius	Min. 1.1″ (28 mm) (fixed installation)
	Pulling force	Max. 200 N
	Output	Female connector
	Backup battery	Male connector

1) Lithium batteries are subject to special transportation regulations according to United Nations "Regulation of Dangerous Goods, UN 3090 and UN 3091". Special transport documentation is required to observe these regulations. This may influence both transport time and costs.

9.5 OUTPUT CHARACTERISTICS

This chapter describes how the HbMAG outputs work.



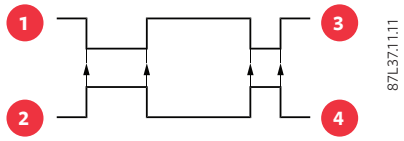
OUTPUT A AND B AS PULSE VOLUME

1 Forward
2 Reverse
3 Cut-off

PR Pulse rate
PF Pulse frequency
PW Pulse width

HBMAG

When output A or B is configured as volume per pulse, the output delivers a pulse when the preset volume based on either Forward / Reverse or Net Forward / Net Reverse flow has passed the sensor in the selected direction. The volume per pulse is freely scalable, from 0.000001 to 10,000 units per pulse, and should not exceed the pulse rate of the output configuration table.



OUTPUT B AS ALARM OUTPUT

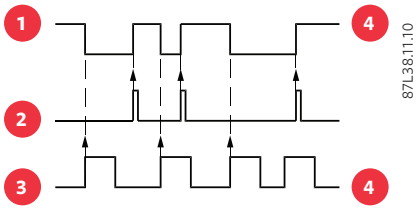
1 Alarm outputs
2 Alarm status
3 On - Off
4 No Error

HBMAG

When output B is configured as an ″alarm″ output, it will follow the internal alarms that were previously chosen in the Alarm Configuration List.

Note: Alarm output is inverted to a pulse output providing an alarm if power disappears or cable connection is interrupted.

OUTPUT B AS CALL-UP OUTPUT



1 Call up output
2 Call up reset
3 Call up status
4 On - Off

When output B is configured as ″call-up″, the output is activated by an alarm condition and remains on until it is reset via meter display key or communication interface.

A new alarm will not activate a ″call-up″ function if the ″call-up″ function is still active from a previous alarm.

Note: Like alarm output, call-up output inverts to a pulse output providing a call-up if power disappears or cable connection is interrupted.

HBMAG

When output B is configured as an ″call-up″ output, it will follow the internal alarms that were previously chosen in the Alarm Configuration List.

Note: Call-up output is inverted to a pulse output providing an alarm if power disappears or cable connection is interrupted.

FACTORY REGIONAL SETTINGS

SIZE (INCH)	PULSE WIDTH MS	MEXICO, CANADA M^3	USA GALLONS
3″, 4″, 6″	50	0.1	10
8″, 10″, 12″, 14″, 16″, 18″, 20″	50	1	100
24″, 28″, 30″, 32″, 36″, 40″, 42″, 44″, 48″	50	10	100

Pulse A is set to ON - Forward flow. Pulse B is set to Alarm.

Note: You can select other units than the defaults via the software. The pulse output will only be enabled if the meter selected is ordered with the pulse output as an option.

PULSE OUTPUT, VOLUME SELECTION (HBMAG)

DN (INCHES)	MAX. FLOW RATE QN (Q3) M^3	GUIDELINES FOR MIN.VOLUME PER PULSE AT QN VOLUME [M^3] = QN [M^3/S] * (2*PW [S])						
		5 MS PW M^3	10 MS PW M^3	50 MS PW M^3	50 MS PW GALLON	50 MS PW ML	100 MS PW M^3	500 MS PW M^3
		[50HZ]	[50HZ]	[10HZ]	[10HZ]	[10HZ]	[5HZ]	[1HZ]
3″ 80	160	0.0004	0.0009	0.004	1.174	0.000004	0.009	0.044
4″ 100	250	0.0007	0.0014	0.007	1.835	0.000007	0.014	0.069
5″ 125	400	0.0011	0.0022	0.011	2.935	0.000011	0.022	0.111
6″ 150	630	0.0018	0.0035	0.018	4.623	0.000018	0.035	0.175
8″ 200	1000	0.0028	0.0056	0.028	7.338	0.000028	0.056	0.278
10″ 250	1600	0.0044	0.0089	0.044	11.741	0.000044	0.089	0.444
12″ 300	2500	0.0069	0.0139	0.069	18.345	0.000069	0.139	0.694
14″ 350	3463	0.0096	0.0192	0.096	25.412	0.000096	0.192	0.962
16″ 400	4523	0.0126	0.0251	0.126	33.190	0.000126	0.251	1.256
18″ 450	5725	0.0159	0.0318	0.159	42.010	0.000159	0.318	1.590
22″ 500	7068	0.0196	0.0393	0.196	51.865	0.000196	0.393	1.963
24″ 600	10178	0.0283	0.0565	0.283	74.687	0.000283	0.565	2.827
28″ 700	13854	0.0385	0.0770	0.385	101.662	0.000385	0.770	3.848
30″ 750	15904	0.0442	0.0884	0.442	116.705	0.000442	0.884	4.418
32″ 800	18095	0.0503	0.1005	0.503	132.782	0.000503	1.005	5.026
36″ 900	22902	0.0636	0.1272	0.636	168.057	0.000636	1.272	6.362
40″ 1000	28274	0.0785	0.1571	0.785	207.477	0.000785	1.571	7.854
42″ 1050	31175	0.0866	0.1732	0.866	228.750	0.000866	1.732	8.659
44″ 1100	34211	0.0950	0.1901	0.950	251.043	0.000950	1.901	9.503
48″ 1200	40715	0.1131	0.2262	1.131	298.770	0.001131	2.262	11.310

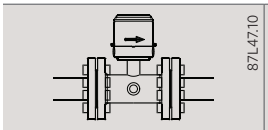
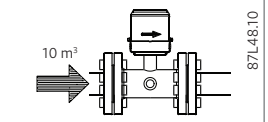
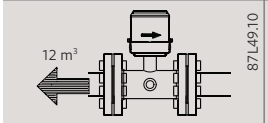
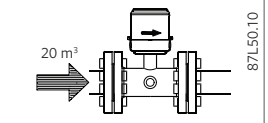
PW = pulse width

Note: Display volume for 5 ms pulse width is based on a basic version with maximum 50 Hz pulse output rate. The calculated numbers of pulses are an average of the measuring period.

NET FLOW OUTPUT

The HbMAG has a special net pulse output that includes bi-directional flow calculations.

The example shows that over time, the net pulse output indicates the bi-directional totalizer as calculated internally. The same principle applies for forward and reverse flow calculation. By changing the status of the pulse output, the internal pulse calculator will be reset.

	NET TOTALIZER IN METER DISPLAY VOLUME [M³] (BI-DIRECTIONAL)	PULSE OUTPUT FORWARD UNI-DIRECTIONAL MODE VOLUME [M³]		PULSE OUTPUT NET FORWARD BI-DIRECTIONAL MODE VOLUME [M³]	
	VOLUME [M³]	INTERNAL CALCULATION	DELIVERED VOLUME	INTERNAL CALCULATION	DELIVERED VOLUME
 87L47.10	0	-	0	0	0
 87L48.10	10	-	10	0	10
 87L49.10	–2	-	0	-12	0
 87L50.10	18	-	20	–12+20=	8
Total accounted volume [m³] Forward / Reverse	18F	-	30F	-	18F

9.6 METER UNCERTAINTY

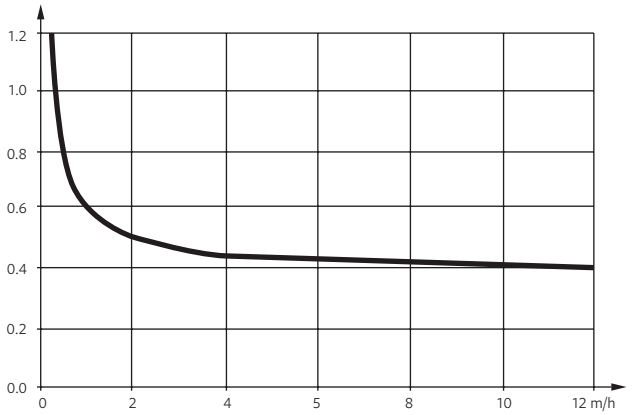
To ensure continuous accurate measurement, flow meters must be calibrated. The calibration is conducted at facilities with traceable instruments referring directly to the physical unit of measurement according to the International System of Units (SI).

Therefore, the calibration certificate ensures recognition of the test results worldwide, including the US (NIST traceability). Accredited calibrations are offered assured to ISO 17025 in the flow range from 0.0001 m³/h to 10,000 m³/h. The laboratories are accredited laboratories and recognized by ILAC MRA (International Laboratory Accreditation Corporation

- Mutual Recognition Arrangement) ensuring international traceability and recognition of the test results worldwide.

A calibration certificate is shipped with every sensor and calibration

The selected calibration determines the accuracy of the water meter. An HbMAG calibration results in max. ±0.4% of rate ±2 mm/s uncertainty.



Flowrate

Calibration references conditions (ISO 9104 and DIN EN 29104) Media temperature:20°C ± 5K (68°F ± 9°F)

Ambient temperature:20°C ± 5K (68°F ± 9°F)

Warming-up time: 30 min.

Incorporation in pipe section

Inlet section 10 x inlet pipe diameter

Outlet section 5 x inlet pipe diameter

Flow conditions: Fully developed flow profile

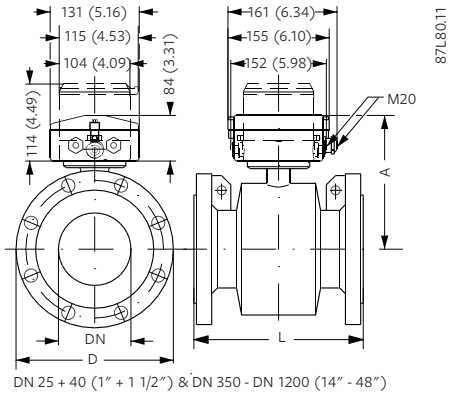
9.7 THE EFFECT OF TEMPERATURE HBMAG

IMPERIAL (PRESSURES IN PSI)					
SIZES > 12"					
FLANGE SPEC.	FLANGE RATING	TEMPERATURE °F			
		32	50	122	158
ANSI 16.5	150 lb	286	286	280	261
SIZES 3" 12"					
ANSI 16.5	150 lb	145	286	286	235

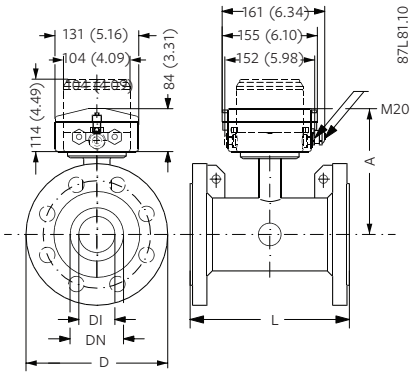
9.8 DIMENSIONS AND DRAWINGS

METER DIMENSIONS

DIMENSIONS FOR HBMAG



DN 25 + 40 (1″ + 1 1/2″) & DN 350 - DN 1200 (14″ - 48″)



DN 50 - 300 (2 - 12″)

NOMINAL SIZE DN	A	L, LENGHTS		D, DIAMETER		APPROX. WEIGHT [1]	
		ANSI 16.5 CI.150	AWWA	DI	D		
INCH (MM)	INCH (MM)	INCH	INCH	MM (INCH)		LBS	KG
3 (80)	8.2 (207)	7.9	N/A	67 (2.64)	2)	34	15
4 (100)	8.5 (214)	9.8	N/A	81 (3.19)	2)	38	17
5 (125)	8.9 (224)	9.8	N/A	101 (3.98)	2)	50	22
6 (150)	9.5 (239)	11.8	N/A	131 (5.16)	2)	63	28
8 (200)	10.5 (264)	13.8	N/A	169 (6.65)	2)	113	50
10 (250)	11.5 (291)	17.7	N/A	212 (8.35)	2)	160	71
12 (300)	12.6 (317)	19.7	N/A	265 (10.43)	2)	198	88
14 (350)	14.6 (369)	21.7	N/A	350 (13.78)	2)	279	127
16 (400)	15.6 (394)	23.6	N/A	400 (15.75)	2)	318	145
18 (450)	16.8 (425)	23.6	N/A	450 (17.72)	2)	394	175
20 (500)	17.8 (450)	26.8	N/A	500 (19.68)	2)	494	225
24 (600)	19.8 (501)	32.3	N/A	600 (23.62)	2)	747	340
28 (700)	21.4 (544)	N/A	27.6	700 (27.55)	2)	694	316
30 (750)	22.5 (571)	N/A	29.5	750 (29.52)	2)	N/A	N/A
32 (800)	23.9 (606)	N/A	31.5	800 (31.49)	2)	1045	398
36 (900)	25.7 (653)	N/A	35.4	900 (35.42)	2)	1045	476
40 (1000)	27.7 (704)	N/A	39.4	1000 (39.36)	2)	1322	602
42 (1050)	27.7 (704)	N/A	41.3	1050 (41.33)	2)	N/A	N/A
44 (1100)	29.7 (755)	N/A	43.3	1100 (43.30)	2)	N/A	N/A
48 (1200)	31.9 (810)	N/A	47.2	1200 (47.23	2)	1996	887

1) For remote version the sensor weight is reduced with 4.5 lb (2 kg)
2) See flange table (Page 38)

REMOTE VERSION

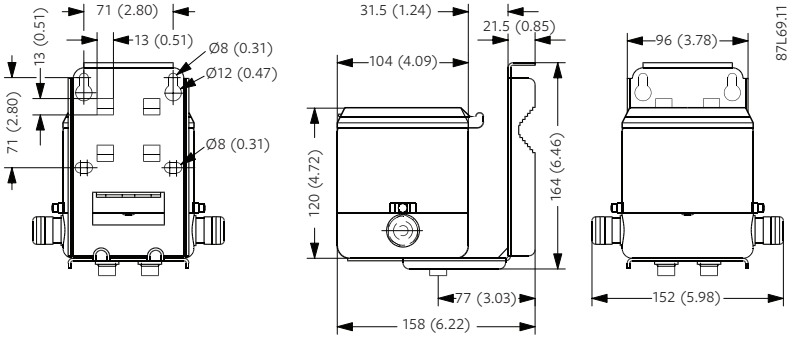
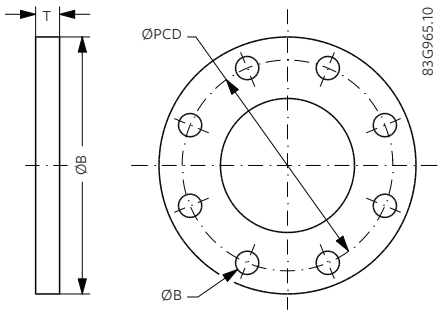


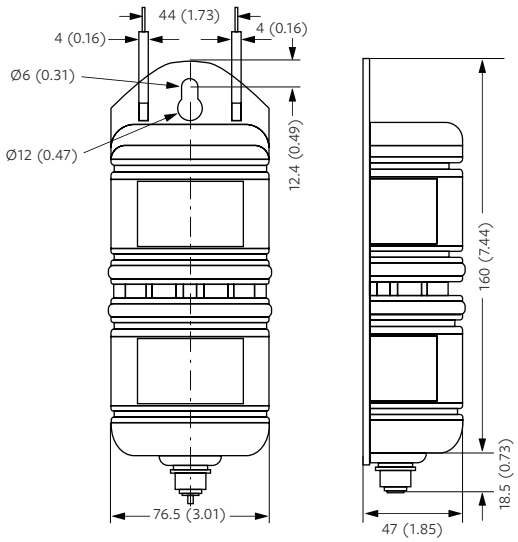
FIGURE 9 - 2 DIMENSIONS IN MM (INCH), WEIGHT 3.5 KG (8 LBS)

FLANGE DIMENSIONS



HBMAG

	DIMENSIONS INCHES				BOLTING	
SIZE	D	PCD	T	B	HOLES	BOLTS
			ANSI CLASS 150			
3″	7.5	6	0.94	0.75	4	5⁄8″
4″	9	7.5	0.94	0.75	8	5⁄8″
6″	11	9.5	1	0.88	8	3⁄4″
8″	13.5	11.75	1.12	0.88	8	3⁄4″
10″	16	14.25	1.19	1.00	12	7⁄8″
12″	19	17	1.25	1.00	12	7⁄8
14″	21	18.75	1.38	1.12	12	1″
16″	23.5	21.25	1.44	1.12	16	1″
18″	25	22.75	1.56	1.25	16	1 1⁄8″
20″	27.5	25	1.69	1.25	20	1 1⁄8″
24″	32	29.5	1.88	1.38	20	1 1⁄4″



EXTERNAL BATTERY PACK

Note: Physical orientation of battery pack may influence battery capacity. Optimal battery capacity is achieved with battery pack in an upright position as shown.

* Worn industry batteries may be disposed at the manufacturer or the importer who originally marketed the battery, or where new batteries are bought.

GROUND RINGS

Sizes 3″...12″

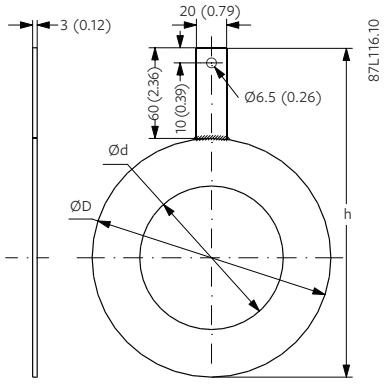


FIGURE 10 - 3 FLAT RING

A. APPENDIX

A.1 UNIT CONVERSION TABLES

TOTALIZER / VOLUME UNIT (FT8)	CORRECTION FACTOR PARAMETER FT300
Default	1 m³
m³*100	0.01
Gallon (US)	264.1721
G*100 (100*Gallon)	2.641721
G*1000 (1000*Gallon)	0.2641721
CF*100 (100*ft3)	0.3531467
CF*1000 (1000*ft3)	0.03531467

FLOW RATE UNIT (FT9)	CORRECTION FACTOR PARAMETER FT301
Default	1 m³ / s
m³ / min (m³ / minute)	60
m³ / h (m³ / hour)	3600
m³ / d (m³ / day)	86400
GPS (Gallon / second)	264.1721
GPM (Gallon / minute)	15850.32
GPH (Gallon / hour)	951019.4
GPD (Gallon / day)	22824465
CFS (ft³ / second)	35.31467
CFM (ft³ / minute)	2118.882
CFH (ft³ / hour)	127132.8

A.2 PARAMETER LISTS

HbMAG is delivered with factory settings that are not stored as default values. Because defaults values are not present in the meter, an automatic return to factory values is not possible.

The default settings are available at www.MuellerSystems.com Display information is indicated in the table by menu and index number. Remember to enable displayed menus FT130.

The abbreviations used in the display menu table are: Operator menu = O, Meter menu = M, Service menu = Se, Data Logger menu = L, Statistic menu = St, Revenue menu = R.

A.2.1 1 - 99

FT ID NUMBER	METER VERSION	DISPLAY VIEW	PARAMETER / DATA TYPE	FACTORY SETTINGS	DATA RANGE
				FIXED PARAMETER OR METER DATA THAT NOT ARE CHANGEABLE	
1	All	M1	Application identifier	Identity	Max. 14 characters. Only numbers are visible on the display
2	All	-	Application location	Location	Max. 14 characters
3	All	M3	Module type	Product variant depended	Basic
4	All	M4	Software version		x.xxPxx (x.xxPx.x)
5	All	-	Sensor size	Sensor related	3″ ... 48″
6	All	-	Vendor name	Mueller	Mueller
8	All		Totalizer unit	Product variant depended	Max. 10 characters
9	All		Flowrate unit	Product variant depended	Max. 10 characters
10	All		Qn (Q3)	Sensor related	0 to 1x109
11	All		Product code number		
12	All		Serial number	XXXXXXXXXX	

A.2.2 100 - 199

FT ID NUMBER	METER VERSION	DISPLAY VIEW	PARAMETER / DATA TYPE	FACTORY SETTINGS	DATA RANGE
				FIXED PARAMETER OR METER DATA THAT NOT ARE CHANGEABLE	
100	All	M2	Actual date and time	Production date and time	year-month-day T hours:minutes:seconds
101	All	O1	Totalizer 1	0	0 ... ±2x109
102	All	O2	Totalizer 2	0	0 ... ±2x109
103	All	O5	Customer totalizer 3	0	0 ... +±2x109
104	All	O5	Reset customer totalizer 3	No	Yes / No
105	All	-	Customer totalizer 3 reset date	Production date and time	year-month-day T hours:minutes:seconds
106	All	-	Flow rate		0 ... 1.25 Qn (Q3)
107	All	-	Actual velocity		0 ... 12500
108	All	-	Flowrate percent value		0 ... 125% (Q4)

FT ID NUMBER	METER VERSION	DISPLAY VIEW	PARAMETER / DATA TYPE	FACTORY SETTINGS	DATA RANGE
				FIXED PARAMETER OR METER DATA THAT NOT ARE CHANGEABLE	
120	All	-	Actual flow meter status	0	0 ... 255, binary presented with information 1 for bit 0 1: Totalizer 1 or 2 changed or reset 4: Date - time changed 5: Alarm have been active 6: Fault log has been reset 7: Hardware key has been activated 8: Meter has been powered up
130	All	-	Menu active	63=all menus active	0 ... 63, binary presented with information 1 for bit 0 1: Operator menu 2: Meter info menu 3: Service menu 4: Log menu
131	All	Default operator menu index			Totalizer 1 Totalizer 1, Totalizer 2, Actual Flow rate, Fault codes, Customer Totalizer

A.2.3 200 - 299

FT ID NUMBER	METER VERSION	DISPLAY VIEW	PARAMETER / DATA TYPE	FACTORY SETTINGS	DATA RANGE
				FIXED PARAMETER OR METER DATA THAT NOT ARE CHANGEABLE	
200	All	O4	Fault status	0	0 to 8191, binary presented with information 1 for bit 0 2: Coil current error 3: Preamplifier overload 4: Database checksum error 5: Low power warning 6: Flow overload warning 7: Pulse A overload warning 8: Pulse B overload warning 9: Consumption interval warning 11/E: Empty pipe warning 12/C: Low impedance (high conductivity) warning 13/d: Flow limit warning
201	All	-	Alarm configuration list	= Alarm 2 ... 8 enabled 0 ..	0 ... 8191, See 200
202	All	-	Date of fault log reset	Production date and time	year-month-day T hours:minutes:seconds
203	All	O4	Non optimal measure time 0		
204	All	-	Reset the fault log and faults	2000-01-01 T 00:00:00	
205	All	-	Call up acknowledge	No	Yes / No
206	All	-	Battery alarm level	10%	0 ... 100%
208	All	-	Reset leakage fault	No	Yes / No
209	All	-	Reset consumption log fault	No	Yes / No
215	All	-	Coil current alarm output enable	Yes	Yes / No
216	All	-	Coil current fault hours	0	
217	All	-	Coil current fault counter	0	

FT ID NUMBER	METER VERSION	DISPLAY VIEW	PARAMETER / DATA TYPE	FACTORY SETTINGS	DATA RANGE
				FIXED PARAMETER OR METER DATA THAT NOT ARE CHANGEABLE	
218	All	-	Coil current fault appears	2000-01-01 T 00:00:00	
219	All	-	Coil current fault disappears	2000-01-01 T 00:00:00	
220	All	-	Amplifier alarm output enable	Yes	Yes / No
221	All	-	Amplifier fault hours		
222	All	-	Amplifier fault counter		
223	All	-	Amplifier fault appears	2000-01-01 T 00:00:00	
224	All	-	Amplifier fault disappears	2000-01-01 T 00:00:00	
225	All	-	Database alarm output enable	Yes	Yes / No
226	All	-	Database fault hours	0	
227	All	-	Database fault counter	0	
228	All	-	Database fault appears	2000-01-01 T 00:00:00	
229	All	-	Database fault disappears	2000-01-01 T 00:00:00	
230	All	-	Low power alarm output enable	Yes	Yes / No
231	All	-	Low power fault hours	0	
232	All	-	Low power fault counter	0	
233	All	-	Low power fault appears	2000-01-01 T 00:00:00	
234	All	-	Low power fault disappears	2000-01-01 T 00:00:00	
235	All	-	Flow overflow alarm output enable	Yes	Yes / No
236	All	-	Overflow fault hours	0	
237	All	-	Overflow fault counter	0	
238	All	-	Overflow fault appears	2000-01-01 T 00:00:00	
239	All	-	Overflow fault disappears	2000-01-01 T 00:00:00	
240	All	-	Pulse A overload alarm output enable	Yes	Yes / No
241	All	-	Pulse A overload fault hours	0	
242	All	-	Pulse A overload fault counter	0	
243	All	-	Pulse A overload fault appears	2000-01-01 T 00:00:00	
243	All	-	Pulse A overload fault appears	2000-01-01 T 00:00:00	
244	All	-	Pulse A overload fault disappears	2000-01-01 T 00:00:00	
245	All	-	Pulse B overload alarm output enable	Yes	Yes / No
246	All	-	Pulse B overload fault hours	0	
247	All	-	Pulse B overload fault counter	0	
248	All	-	Pulse B overload fault appears	2000-01-01 T 00:00:00	
249	All	-	Pulse B overload fault disappears	2000-01-01 T 00:00:00	
250	All	-	Consumption alarm output enable	No	Yes / No
251	All	-	Consumption fault hours	0	
252	All	-	Consumption fault counter	0	

FT ID NUMBER	METER VERSION	DISPLAY VIEW	PARAMETER / DATA TYPE	FACTORY SETTINGS	DATA RANGE
				FIXED PARAMETER OR METER DATA THAT NOT ARE CHANGEABLE	
253	All	-	Consumption fault appears	2000-01-01 T 00:00:00	
254	All	-	Consumption fault disappears	2000-01-01 T 00:00:00	
260	All	-	Empty pipe alarm output enable	No	Yes / No
261	All	-	Empty pipe fault timer	0	
262	All	-	Empty pipe fault counter	0	
263	All	-	Empty pipe fault appears	2000-01-01 T 00:00:00	
264	All	-	Empty pipe fault disappears	2000-01-01 T 00:00:00	
265	All	-	Low impedance alarm output enable	No	Yes / No
266	All	-	Low impedance fault timer	0	
267	All	-	Low impedance fault counter	0	
268	All	-	Low impedance fault appears	2000-01-01 T 00:00:00	
269	All	-	Low impedance fault disappears	2000-01-01 T 00:00:00	
270	All	-	High flow alarm output enable	No	
271	All	-	High flow alarm fault timer	0	
272	All	-	High flow alarm fault counter	0	
273	All	-	High flow alarm fault appears	2000 01-01 T 00:00:00	
274	All	-	High flow alarm fault disappears	2000 01-01 T 00:00:00	

A.2.4 300 - 399

FT ID NUMBER	METER VERSION	DISPLAY VIEW	PARAMETER / DATA TYPE	FACTORY SETTINGS	DATA RANGE
				FIXED PARAMETER OR METER DATA THAT NOT ARE CHANGEABLE	
300	All	-	Totalizer volume unit factor	Product variant depended	0 ... 1*x010
301	All	-	Flow unit factor	Product variant depended	0 ... 1*x010
302	All	-	Pipe size	Sensor-related	3″...48″ (DN 80 ... 1200)
303	All	-	Meter excitation frequency 1/15 Hz (in battery power mode)	1/15 Hz	1/60 Hz, 1/30 Hz, 1/15 Hz, 1/5 Hz, 1.5625 Hz, 3.125 Hz, 6.25 Hz
304	All	-	Mains frequency	Product variant depended	50 or 60 Hz mains
305	All	-	Decimal point	Automatic point adjustment No point, One digit after point,	Two digits after point, Three digits after point, Automatic point adjust
306	All	-	Displayed unit	Product variant depended	Product variant depended
310	All	-	Flow direction totalizer 1	Forward	forward, reverse or bi-directional net flow
311	All	-	Totalizer 1 changes date	Production date and time	
312	All	-	Flow direction totalizer 2	Reverse	forward, reverse or bi-directional net flow

FT ID NUMBER	METER VERSION	DISPLAY VIEW	PARAMETER / DATA TYPE	FACTORY SETTINGS	DATA RANGE
				FIXED PARAMETER OR METER DATA THAT NOT ARE CHANGEABLE	
313	All	-	Totalizer 2 changes date	Production date and time	
320	All	-	Verification mode enable	No	Yes / No
321	All	-	Calibration date	Calibration date	year-month-day T hours:minutes:seconds
323	All	-	Calibration factor	Sensor-related	
324	All	-	Gain correction	Sensor-related	HbMAG: 6.25 Hz (DN3 ... 200 (3″... 8″) 3.125 Hz (DN250 ... 600 (10″ ... 24″) (DN250 ... 600 (10″ ... 24″) 1.5625 Hz (DN700 ... 1200 (28″ ... 48″)
325	All	-	Sensor offset	Sensor-related	Yes / No
327	All	-	Adjustment Factor	1	-2 ... 2
328	All	-	Low flow cut off	0.05%	0 ... 9.9%
329	All	-	Filter time constant	5 Tau	1 ... 1000
331	All	-	Excitation frequency limit	1/15 Hz	1/60 Hz, 1/30 Hz, 1/15 Hz, 1/5 Hz, 1.5625 Hz, 3.125 Hz, 6.25 Hz
332	All	-	Excitation frequency sensor limit	Sensor-related	HbMAG: 6.25 Hz (DN3 ... 200 (3″... 8″) 3.125 Hz (DN250 ... 600 (10″ ... 24″) 1.5625 Hz (DN700 ... 1200 (28″ ... 48″)
333	All	-	Empty pipe detection enable	Yes	Yes / No
334	All	-	Empty pipe limit	25 000 ohm = 20 µS/cm	0 ... 2.15x109

A.2.5 400 - 499

FT ID NUMBER	METER VERSION	DISPLAY VIEW	PARAMETER / DATA TYPE	FACTORY SETTINGS	DATA RANGE
				FIXED PARAMETER OR METER DATA THAT NOT ARE CHANGEABLE	
400	All	-	Output A enable	Yes	Yes / No
401	All	Se3	Pulse A function	Forward	Forward, Reverse, Forward net, Reverse net
402	All	Se3	Amount per pulse A	Sensor-related	0 ... 1x1010
403	All		Pulse width for pulse A	50 ms	5 ms, 10 ms, 50 ms, 100 ms,
500 ms					
404	All		Output B enable	Yes	Yes / No
405	All	Se4	Pulse B function	Alarm	Pulse, Alarm, Call-up
406	All		Pulse B direction	Reverse	Forward, Reverse, Forward net, Reverse net
407	All	Se4	Amount per pulse B	Sensor-related	0 ... 1x1010
408	All		Pulse width for pulse B	Sensor-related	5 ms, 10 ms, 50 ms, 100 ms, 500 ms
420	All	M5	Device Communication Address		1 ... 32
421	All	M6	Baudrate	19 200	1200, 2400, 4800, 9600, 19 200, 38 400

FT ID NUMBER	METER VERSION	DISPLAY VIEW	PARAMETER / DATA TYPE	FACTORY SETTINGS	DATA RANGE
				FIXED PARAMETER OR METER DATA THAT NOT ARE CHANGEABLE	
422	All	M7	Parity	Even 1 stop	Even 1 stop, Odd 1 stop, None 1 stop, None 2 stop,
423	All	-	Interframe space	35	35 ... 255
424	All	-	Response delay	5	1 ... 50 ms
425	All	-	Reset communication driver	No	Yes / No

A.2.6 500 - 599

FT ID NUMBER	METER VERSION	DISPLAY VIEW	PARAMETER / DATA TYPE	FACTORY SETTINGS	DATA RANGE
				FIXED PARAMETER OR METER DATA THAT NOT ARE CHANGEABLE	
500	All	-	Latest service date	Production date and time	year-month-day T hours:minutes:seconds
501	All	-	Operating hours since power-up	0	hours
502	All	-	Battery operating time	0	hours
505	All	-	Power supply	Power supply level	Battery or mains power
506	All	-	Numbers of power-up	Product variant depended	1 to 4 batteries
507	All	-	Battery power		
508	All	-	Battery change enable	No	Yes / No
509	All	Se1	Battery installation date	Production date and time	year-month-day T hours:minutes:seconds
510	All	Se2	Actual battery capacity	100%	100 ... 0%
512	All	-	Excitations no.	0	
513	All	-	Power status	0	Normal operation, 1: Battery alarm. Actual battery capacity is below battery alarm level (% of max capacity) 2: Too low power (enters stand by mode) 3: As value 1 and 2 together 4: External power gone 5: As value 1 and 4 together 6: As value 2 and 4 together 7: As value 1 and 2 and 4 together
514	All	-	Transmitter temperature	Actual degree celsius	
540	All	-	Electrode impedance A	Measured values	0 ... 185,000 ohm
541	All	-	Electrode impedance B	Measured values	0 ... 185,000 ohm
542	All	-	Low medium impedance alarm	0	0 ... 2.15x109
550	All	-	Coil current disable	No	Yes / No
551	All	-	Fixed flow mode enable	No	Yes / No
552	All	-	Fixed flow value	0	-1x10x109 ... 1x10x109
553	All	-	Flow alarm limit	1 000 000 000	0 ... 1x109

FT ID NUMBER	METER VERSION	DISPLAY VIEW	PARAMETER / DATA TYPE	FACTORY SETTINGS	DATA RANGE
				FIXED PARAMETER OR METER DATA THAT NOT ARE CHANGEABLE	
560	All	-	Repair checksum	No	Yes / No
570	All	-	Device Product ID	10779	

A.2.7 600 - 799

FT ID NUMBER	METER VERSION	DISPLAY VIEW	PARAMETER / DATA TYPE	FACTORY SETTINGS	DATA RANGE
				FIXED PARAMETER OR METER DATA THAT NOT ARE CHANGEABLE	
600	All	-	Log interval	Monthly	Daily, Weekly (7 days), Monthl
601	All	-	Delay weekly log interval	0	0 ... 30
602	All	-	Limit too high for consumption	1 000 000	-1x109 ... 1x109
603	All	-	Limit too low for consumption	0	-1x109 ... 1x109
610	All	L1	Date of latest log period	2000-01-01 T 00:00:00	year-month-day T hours:minutes:seconds
611	All	L1	Latest Log period totalized (1)		
612	All	-	Latest Log period totalized (2)	0	
613	All	-	Latest Log period fault status	0	Active faults in log period; 2: Coil current error 3: Preamplifier overload 4: Database checksum error 5: Low power warning 6: Flow overload warning 7: Pulse A overload warning 8: Pulse B overload warning 9: Consumption interval warning 11/E: Empty pipe warning 12/C: Low impedance/ high conductivity warning 13/d: High flow limit warning 14/15/16: Not used
614	All	-	Latest Log period status information	0	Meter operation conditions in log period 1: Totalizer 1 or 2 changed or reset 4: Date - time changed 5: Alarm active in logged period (See alarm fault log for same period) 6: Fault log has been reset 7: HW lock broken 8: Power Up
615	All	L2	Date of log period 2		
616	All	L2	Log period 2 totalized (1)		
617	All	-	Log period 2 totalized (2)		
618	All	-	Log period 2 fault status		See 613
619	All	-	Log period 2 status information		See 614
620	All	L3	Date of log period 3		
621	All	L3	Log period 3 totalized (1)		
622	All	-	Log period 3 totalized (2)		

FT ID NUMBER	METER VERSION	DISPLAY VIEW	PARAMETER / DATA TYPE	FACTORY SETTINGS	DATA RANGE
				FIXED PARAMETER OR METER DATA THAT NOT ARE CHANGEABLE	
623	All	-	Log period 3 fault status	See 613	
624	All	-	Log period 3 status information	See 614	
625	All	L4	Date of log period 4		
626	All	L4	Log period 4 totalized (1)		
627	All	-	Log period 4 totalized (2)		
628	All	-	Log period 4 fault status	See 613	
629	All	-	Log period 4 status information	See 614	
630	All	L5	Date of log period 5		
631	All	L5	Log period 5 totalized (1)		
632	All	-	Log period 5 totalized (2)		
633	All	-	Log period 5 fault status	See 613	
634	All	-	Log period 5 status information	See 614	
635	All	L6	Date of log period 6		
636	All	L6	Log period 6 totalized (1)		
637	All	-	Log period 6 totalized (2)		
638	All	-	Log period 6 fault status	See 613	
639	All	-	Log period 6 status information	See 614	
640	All	L7	Date of log period 7		
641	All	L7	Log period 7 totalized (1)		
642	All	-	Log period 7 totalized (2)		
643	All	-	Log period 7 fault status	See 613	
644	All	-	Log period 7 status information	See 614	
645	All	L8	Date of log period 8		
646	All	L8	Log period 8 totalized (1)		
647	All	-	Log period 8 totalized (2)		
648	All	-	Log period 8 fault status	See 613	
649	All	-	Log period 8 status information	See 614	
650	All	L9	Date of log period 9		
651	All	L9	Log period 9 totalized (1)		
652	All	-	Log period 9 totalized (2)		
653	All	-	Log period 9 fault status	See 613	
654	All	-	Log period 9 status information	See 614	
655	All	L10	Date of log period 10		
656	All	L10	Log period 10 totalized (1)		
657	All	-	Log period 10 totalized (2)		
658	All	-	Log period 10 fault status	See 613	
659	All	-	Log period 10 status information	See 614	

FT ID NUMBER	METER VERSION	DISPLAY VIEW	PARAMETER / DATA TYPE	FACTORY SETTINGS	DATA RANGE
				FIXED PARAMETER OR METER DATA THAT NOT ARE CHANGEABLE	
660	All	L11	Date of log period 11		
661	All	L11	Log period 11 totalized (1)		
662	All	-	Log period 11 totalized (2)		
663	All	-	Log period 11 fault status	See 613	
664	All	-	Log period 11 status information	See 614	
665	All	L12	Date of log period 12		
666	All	L12	Log period 12 totalized (1)		
667	All	L12	Log period 12 totalized (2)		
668	All	-	Log period 12 fault status	See 613	
669	All	-	Log period 12 status information	See 614	
670	All	L13	Date of log period 13		
671	All	L13	Log period 13 totalized (1)		
672	All	-	Log period 13 totalized (2)		
673	All	-	Log period 13 fault status	See 613	
674	All	-	Log period 13 status information	See 614	
675	All	L14	Date of log period 14		
676	All	L14	Log period 14 totalized (1)		
677	All	-	Log period 14 totalized (2)		
678	All	-	Log period 14 fault status	See 613	
679	All	-	Log period 14 status information	See 614	
680	All	L15	Date of log period 15		
681	All	L15	Log period 15 totalized (1)		
682	All	-	Log period 15 totalized (2)		
683	All	-	Log period 15 fault status	See 613	
684	All	-	Log period 15 status information	See 614	
685	All	L16	Date of log period 16		
686	All	L16	Log period 16 totalized (1)		
687	All	-	Log period 16 totalized (2)		
688	All	-	Log period 16 fault status	See 613	
689	All	-	Log period 16 status information	See 614	
690	All	L17	Date of log period 17		
691	All	L17	Log period 17 totalized (1)		
692	All	-	Log period 17 totalized (2)		
693	All	-	Log period 17 fault status	See 613	
694	All	-	Log period 17 status information	See 614	
695	All	L18	Date of log period 18		
696	All	L18	Log period 18 totalized (1)		

FT ID NUMBER	METER VERSION	DISPLAY VIEW	PARAMETER / DATA TYPE	FACTORY SETTINGS	DATA RANGE
				FIXED PARAMETER OR METER DATA THAT NOT ARE CHANGEABLE	
697	All	-	Log period 18 totalized (2)		
698	All	-	Log period 18 fault status	See 613	
699	All	-	Log period 18 status information	See 614	
700	All	L19	Date of log period 19		
701	All	L19	Log period 19 totalized (1)		
702	All	-	Log period 19 totalized (2)		
703	All	-	Log period 19 fault status	See 613	
704	All	-	Log period 19 status information	See 614	
705	All	L20	Date of log period 20		
706	All	L20	Log period 20 totalized (1)		
707	All	-	Log period 20 totalized (2)		
708	All	-	Log period 20 fault status	See 613	
709	All	-	Log period 20 status information	See 614	
710	All	L21	Date of log period 21		
711	All	L21	Log period 21 totalized (1)		
712	All	-	Log period 21 totalized (2)		
713	All	-	Log period 21 fault status	See 613	
714	All	-	Log period 21 status information	See 614	
715	All	L22	Date of log period 22		
716	All	L22	Log period 22 totalized (1)		
717	All	-	Log period 22 totalized (2)		
718	All	-	Log period 22 fault status	See 613	
719	All	-	Log period 22 status information	See 614	
720	All	L23	Date of log period 23		
721	All	L23	Log period 23 totalized (1)		
722	All	-	Log period 23 totalized (2)		
723	All	-	Log period 23 fault status	See 613	
724	All	-	Log period 23 status information	See 614	
725	All	L24	Date of log period 24		
726	All	L24	Log period 24 totalized (1)		
727	All	-	Log period 24 totalized (2)		
728	All	-	Log period 24 fault status	See 613	
729	All	-	Log period 24 status information	See 614	
730	All	L25	Date of log period 25		
731	All	L25	Log period 25 totalized (1)		
732	All	-	Log period 25 totalized (2)		
733	All	-	Log period 25 fault status	See 613	

FT ID NUMBER	METER VERSION	DISPLAY VIEW	PARAMETER / DATA TYPE	FACTORY SETTINGS	DATA RANGE
				FIXED PARAMETER OR METER DATA THAT NOT ARE CHANGEABLE	
734	All	-	Log period 25 status information	See 614	
735	All	L26	Date of log period 26		
736	All	L26	Log period 26 totalized (1)		
737	All	-	Log period 26 totalized (2)		
738	All	-	Log period 26 fault status	See 613	
739	All	-	Log period 26 status information	See 614	

A.3 SIZING SENSOR

A.3.1 SIZING TABLE 3" ... 48" (DN 80 ... 1200)

The following table shows the relationship between flow velocity (V), flow quantity (Q) and sensor dimension.

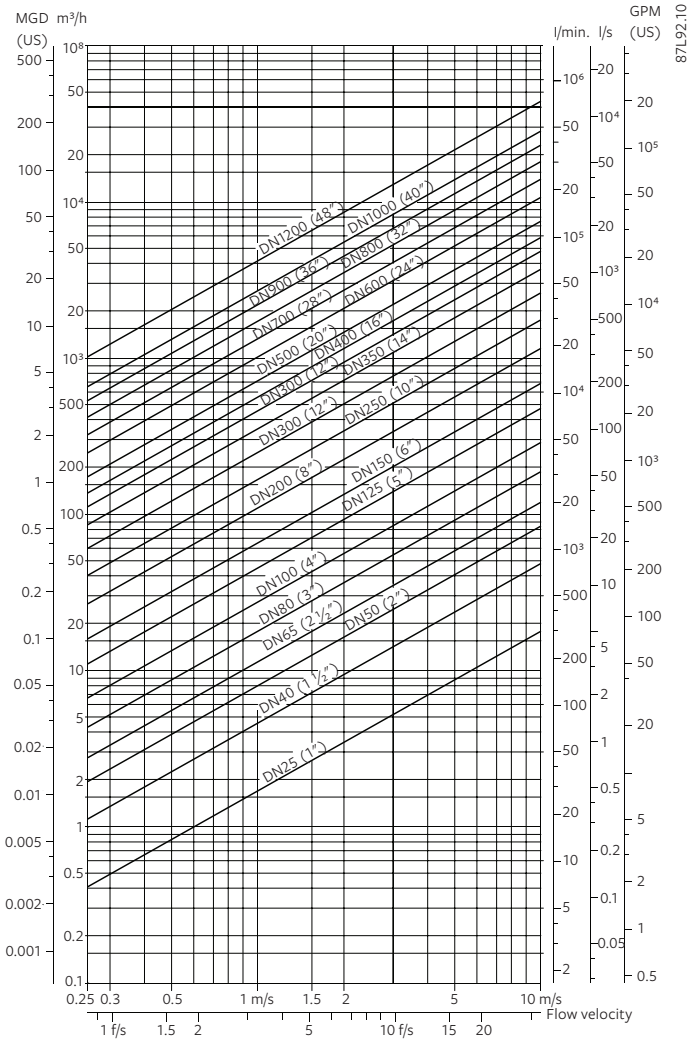


FIGURE A - 1 SIZING TABLE

GUIDELINES FOR SELECTION OF SENSOR

Normally the sensor is selected so that V lies within the measuring range 3 ... 7 ft/sec.

- Min. measuring range: 0 ... 0.8 ft/sec
- Max. measuring range: 0 ... 33 ft/sec

FLOW VELOCITY CALCULATION FORMULA

- Imperial measures:

  V = Q x 0.408 / (Pipe I.D.)2 (V: [ft/s]; Q: [GPM]; Pipe I.D.: [inch])

  or

  V = Q x 283.67 / (Pipe I.D.)2 (V: [ft/s]; Q: [MGD]; Pipe I.D.: [inch])

A.4 CERTIFICATES

A.4.1 CERTIFICATES

All certificates are available by calling Mueller Customer Care at 1-800-423-1323.

A.5 SPARE PARTS / ACCESSORIES

A.5.1 ORDERING

In order to ensure that the ordering data you are using is not outdated, the latest ordering data is always available on the Internet: http://www.MuellerSystems.com).

ACCESSORIES

DESCRIPTION	IMAGE
IrDa infrared interface with adapter	
Back-up battery for mains power supply	
Internal battery pack	
External battery pack	

DESCRIPTION	IMAGE
Mains power supply	
One cable entry	
One cable entry with reduction	
Potting kit	
Hardware key	

SPARE PARTS

DESCRIPTION	IMAGE
HbMAG compact replacement kit	
Se HbMAG remote replacement kit	

DESCRIPTION	IMAGE
PCB replacement kit	
Enclosure top including lid, screws and blank product label	
Cable for external battery pack	
Encoder interface cables 25′ Nicor Connector for Hot Rod and Mi.Net connections 25′ Itron in line connector for all Itron Endpoints 25′ 3 wire unterminated 22 gauge wire for retrofits	
Service tool kit package with various components for service and replacement	
Remote cable set	

A.6 FEATURES

FEATURES / VERSION	HBMAG
Measuring frequency (battery power)	Max. 1/15 Hz
Totalizer	3
Pulse output	2, max. 50 Hz
Communication	Encoder
IrDA	Yes
Time and date	Yes
Data protection	Yes
Data logger	Yes
Application identifier	Yes
Alarm handling	Yes
Meter status	Yes
Diagnostics	Yes
Battery power management	Yes

APPLICATION IDENTIFICATION (FT1 & FT2)

Tag number (visible on display if numbers are selected) and meter location, up to 15 characters per information.

TIME AND DATE (FT100)

Real time clock and date (max. 15 min. drift per year).

TOTALIZER (FT101 & FT102 & FT103)

- 2 totalizer: Forward, reverse, bidirectional netflow calculation and freely selectable start value
- 1 customer totalizer, following totalizer 1 settings and resettable via display key or software with logging of date and time

MEASUREMENT (FT300...FT334)

- Freely selectable volume and flow unit, where m^3 and m^3/h is default in display. All other units are displayed with a display label
- Excitation frequency in battery operation (manually selected):
  - Max. selectable excitation frequency of 1/15 Hz
  - HbMAG default excitation frequency is selected for typically 6 years' operation in a revenue application:

    1/15 Hz for 3″ ... 6″
    1/30 Hz for 8″ ... 24″
    1/60 Hz for 28″ ... 48″

- Excitation frequency with mains power follows maximum sensor excitation frequency
- Filter constant as numbers of excitations
- Low flow cut off, % of Qn (Q3)
- Empty pipe detection (active symbol on display when active)
- Filter selection for mains power frequency (50/60 Hz)
- Correction factor for change of flow direction or to adjust flow measurement

DATA LOGGER (FT600...FT739)

- Logging of 26 records: selectable as daily, weekly or monthly logging
- Each logging includes:
  - Consumption on totalizer 1
  - Consumption on totalizer 2
  - Alarm in current period (13 alarms)
  - Meter status (8 values)
  - Alarm on high or low consumption for selected logging period
  - Totalizer 1 values for all 26 periods can be read on the display

ALARM (FT200 ... FT274)

- Active alarm is indicated on the display
- Monitoring of all alarms with statistic recording on each alarm
  - Total hours an alarm has been active
  - Numbers of time the alarm has been activated
  - First time an alarm appears
  - Last time the alarm disappears
- Fatal faults interrupt the measurement, if active
  - Coil current – Fault in driving magnetic sensor field
  - Amplifier – Fault in signal circuit
  - Check sum – Fault in calculation or handling of data
- Warning faults
  - Low Power – Customer-selectable battery alarm level or power drop-out
  - Flow overflow – Flow in sensor exceeds Qmax (125% Qn (Q3, Q4))
  - Pulse overflow on output A and B – Selected pulse volume is too small compared to actual flow rate and max. output pulse rate
  - Consumption – Saved data logger consumption exceeds customer selected limit on high or low consumption
  - Empty pipe – No water in the pipe / sensor
  - Low impedance – Measured electrode impedance below customer low impedance level
  - Flow limit – Actual flow exceeds selected high flow limited

METER STATUS (FT120)

Monitoring of important revenue parameters and data:

- Changing totalizers 1 and 2
- Changing date and time
- Alarm has been active (see alarm log for details)
- Fault log has been reset
- Hardware key has been broken
- Meter has been re-powered

DATA PROTECTION

- All data stored in an EEPROM. Totalizers 1 and 2 are backed up every 10 min., statistic every hour and power consumption and temperature measurement every 4 hours
- Password protection of all parameters and hardware protection of calibration and revenue parameters

BATTERY POWER MANAGEMENT

- Optimal battery information on remaining capacity
- Calculated capacity includes all consuming elements and available battery capacity is adjusted related to change in ambient temperature

MUELLER HBMAG
Electromagnetic Flow Meters

DIAGNOSTIC

- Continuous self test including
  - Coil current to drive the magnetic field
  - Signal input circuit
  - Data calculation, handling and storing
- Features
  - Alarm statistics and logging for fault analyzing
  - Electrode impedance to check actual media contact
  - Flow simulation to check pulse and communication signal chain for correct scaling
  - Number of sensor measurements (excitations)
  - Transmitter temperature (battery capacity calculation)
  - Low impedance alarm for change in media
  - Flow alarm when defined high flow exceeds
  - Verification mode for fast measure performance check

I. INDEX

For more information about Mueller or to view our full line of water products, please visit muellersystems.com or call Mueller customer service at 1.800.423.1323.

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