Practical examples of ordering

SITRANS F M compact installation

MAG 6000 transmitter

+

MAG 3100 sensor

=

MAG 6000 compact mounted on a MAG 3100 sensor

Example

Sensor	**7ME6310-3TC11-1JA1**
Pipe size	DN 100
Liner	Soft rubber
Electrodes	SS 316
Flanges	EN 1092-1, PN 16
Transmitter	**MAG 6000, Polyamide, 115 ... 230 V AC**
Accuracy	± 0.2 % ± 1 mm/s
Supply	230 V AC

Note:
MAG 5000/6000 transmitters and sensors are packed in separate boxes, the final assembly takes place during installation at the customer's place.

SITRANS F M remote installation

Wall bracket

+

MAG 6000

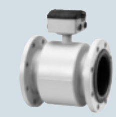
=

MAG 3100

+

2 x cable

=



MAG 3100 remote installation

Example

Sensor	**7ME6310-3TC11-1AA1**
Pipe size	DN 100
Liner	Soft rubber
Electrodes	SS 316
Flanges	EN 1092-1, PN 16
Transmitter	**7ME6920-1AA10-0AA0**
Accuracy	± 0.2 % ± 1 mm/s
Supply	230 V AC
Wall mounting kit	**FDK:085U1018**
Cable kit with sensor cabel and electrode cable	**A5E01181647**

Technical specifications

Flowmeter Calibration and traceability

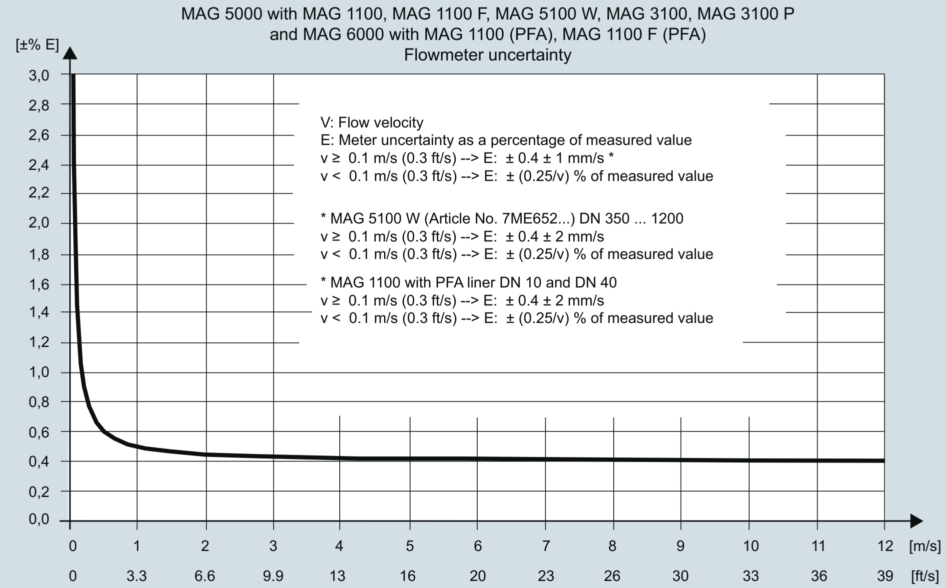
To ensure continuous accurate measurement, flowmeters must be calibrated. The calibration is conducted at Siemens flow facilities with traceable instruments referring directly to the physical unit of measurement according to the International System of Units (SI).

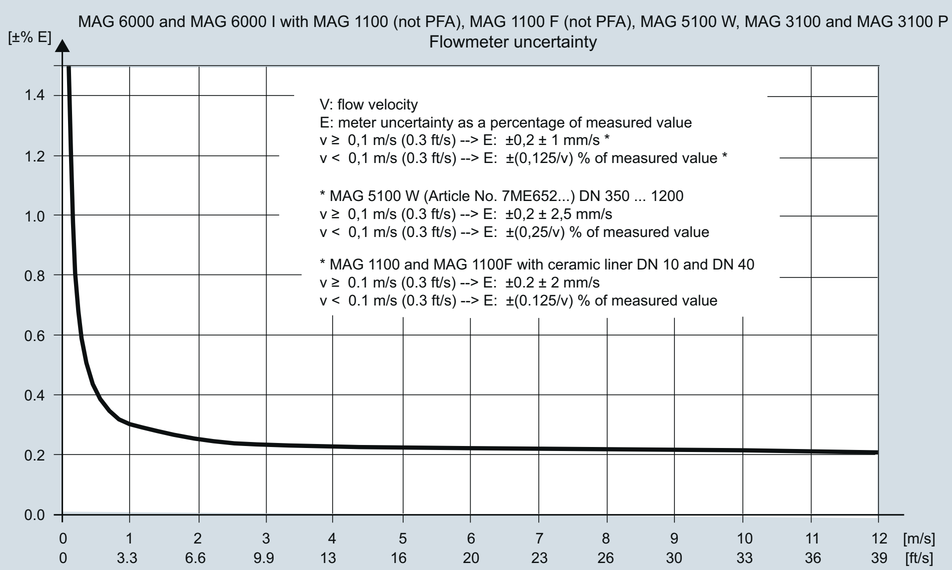
Therefore, the calibration certificate ensures recognition of the test results worldwide, including the US (NIST traceability).

Siemens offers accredited calibrations assured to ISO 17025 in the flow range from 0.0001 m^3/h to 10 000 m^3/h.
Siemens Flow Instruments accredited laboratories are 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 data are stored in the SENSORPROM memory unit.

Flowmeter uncertainty





Calibration reference conditions

Reference conditions (ISO 9104 and DIN EN 29104)	
Temperature medium	20 °C ± 10 K (68 °F ± 18 °F)
Temperature ambient	25 °C ± 10 K (77 °F ± 18 °F)
Supply voltage	U_n ± 1 %
Warming-up time	30 minutes
Incorporation in conductive pipe section	
• Inlet section	10 x DN (DN ≤ 1200/48") 5 x DN (DN > 1200/48")
• Outlet section	5 x DN (DN ≤ 1200/48") 3 x DN (DN > 1200/48")
Flow conditions	Developed flow profile
Additions in the event of deviations from reference conditions	
Current output	As pulse output (± 0.1 % of actual flow + 0.05 % FSO)
Effect of ambient temperature	
• Display / frequency / pulse output	< ± 0.003 %/K act.
• Current output	< ± 0.005 %/K act.
Effect of supply voltage	< 0.005 % of measuring value on 1% change
Repeatability	± 0.1 % of actual flow for v ≥ 0.5 m/s (1.5 ft/s) and conductivity > 10 µS/cm
Certificates	
• EN 10204-2.1	Certificate of conformity, stating that the delivered parts are made of the material quality that was ordered. Available as Z option C15.
• EN 10204-2.2	Test report certificate, a non batch specific material analysis of the ordered material. Available as Z option C14.
• EN 10204-3.1	Material analysis certificate, a batch specific analysis of the material issued by an independent inspector. Certification covers all pressure containing and wetted parts. Available as Z option C12.

3

Technical specifications

General specifications	
PROFIBUS device profile	3.00 Class B
Certified	No
MS0 connections	1
MS1 connections	1
MS2 connections	2

Electrical specification DP

Physical layer specifications	
Applicable standard	IEC 61158/EN 50170
Physical Layer (Transmission technology)	RS 485
Transmission speed	≤ 1.5 Mbits/s
Number of stations	Up to 32 per line segment, (maximum total of 126)
Cable specification (Type A)	
Cable design	Two-wire twisted pair
Shielding	CU shielding braid or shielding braid and shielding foil
Impedance	35 up to 165 Ω at frequencies from 3 ... 20 MHz
Cable capacity	< 30 pF per meter
Core diameter	> 0.34 mm^2, corresponds to AWG 22
Resistance	< 110 Ω per km
Signal attenuation	Max. 9 dB over total length of line section
Max. bus length	200 m at 1500 kbit/s, up to 1.2 km at 93.75 kbit/s. Extendable by repeaters

Electrical specification PA

Physical layer specifications	
Applicable standard	IEC 61158/EN 50170
Physical Layer (Transmission technology)	IEC-61158-2
Transmission speed	31.25 Kbits/second
Number of stations	Up to 32 per line segment, (maximum total of 126)
Max. basic current [I_B]	14 mA
Fault current [I_{FDE}]	0 mA
Bus voltage	9 ... 32 V (non Ex)
Preferred cable specification (Type A)	
Cable design	Two-wire twisted pair
Conductor area (nominal)	0.8 mm^2 (AWG 18)
Loop resistance	44 Ω/km
Impedance	100 Ω ± 20 %
Wave attenuation at 39 kHz	3 dB/km
Capacitive asymmetry	2 nF/km
Bus termination	Passive line termination at both
Max. bus length	Up to 1.9 km. Extendable by repeaters

IS (Intrinsic Safety) data	
Required sensor electronics	Compact or remote mounted SITRANS F M MAG 6000 I Ex
FISCO	Yes
Max. U_I	17.5 V
Max. I_I	380 mA
Max. P_I	5.32 V
Max. L_I	0 μH
Max. C_I	0 nF
FISCO cable requirements	
Loop resistance R_C	15 ... 150 Ω/km
Loop inductance L_C	0.4 ... 1 mH/km
Capacitance C_C	80 ... 200 nF/km
Max. Spur length in IIC and IIB	30 m
Max. Trunk length in IIC	1 km
Max. Trunk length in IIB	5 km

PROFIBUS parameter support

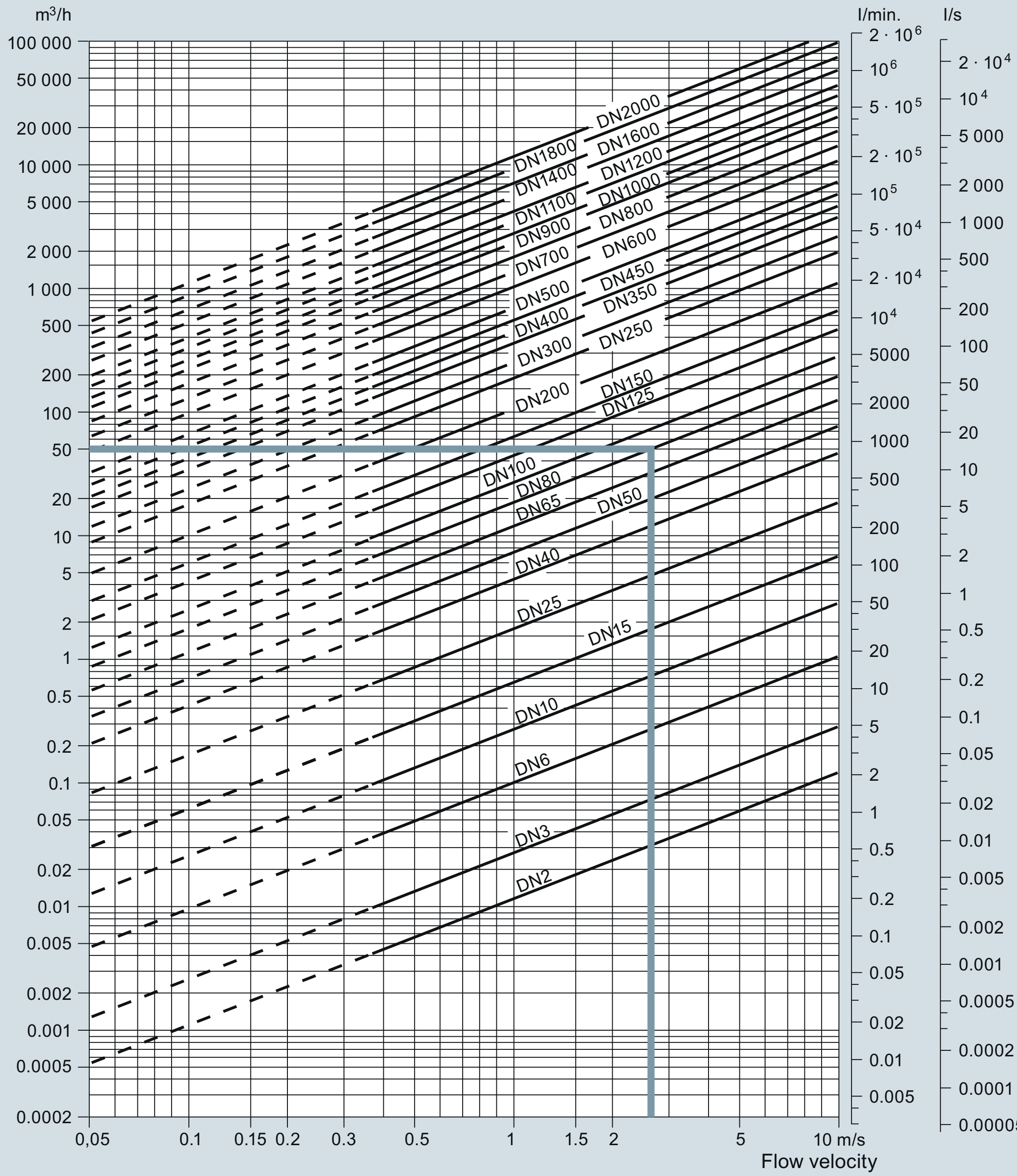
The following parameters are accessible using a MS0 relationship from a Class 1 Master.
MS0 specifies cyclic Data Exchange between a Master and a Slave.

Cyclic services		
Input (Master view)	**Parameter**	**MAG 6000/MAG 6000 I**
	Mass flow	
	Volume flow	✓
	Temperature	
	Density	
	Fraction A[1)]	
	Fraction B[1)]	
	Pct Fraction A[1)]	
	Totalizer 1	✓
	Totalizer 2[2)]	✓
	Batch progress[2)]	✓
	Batch setpoint	✓
	Batch compensation	✓
	Batch status (running ...)	✓
Output (Master view)	Set Totalizer 1+2	✓
	Set Mode Totalizer 1+2	✓
	Batch control (start, stop ...)	✓
	Batch setpoint	✓
	Batch compensation	✓

1) Requires a SENSORPROM containing valid fraction data.
2) Value returned is dependent on the BATCH function.
When ON, Batch progress is returned.
When OFF, TOTALIZER 2 is returned.

Flow and speed chart

Metric



Sizing table (DN 2 … DN 2000)

The table shows the relationship between flow velocity v, flow quantity Q and sensor dimension DN.

Guidelines for selection of sensor

Min. measuring range: 0 to 0.25 m/s

Max. measuring range: 0 to 10 m/s

Normally the sensor size is selected so that the nominal flow velocity v lies within the measuring range 1 to 3 m/s.

Example:

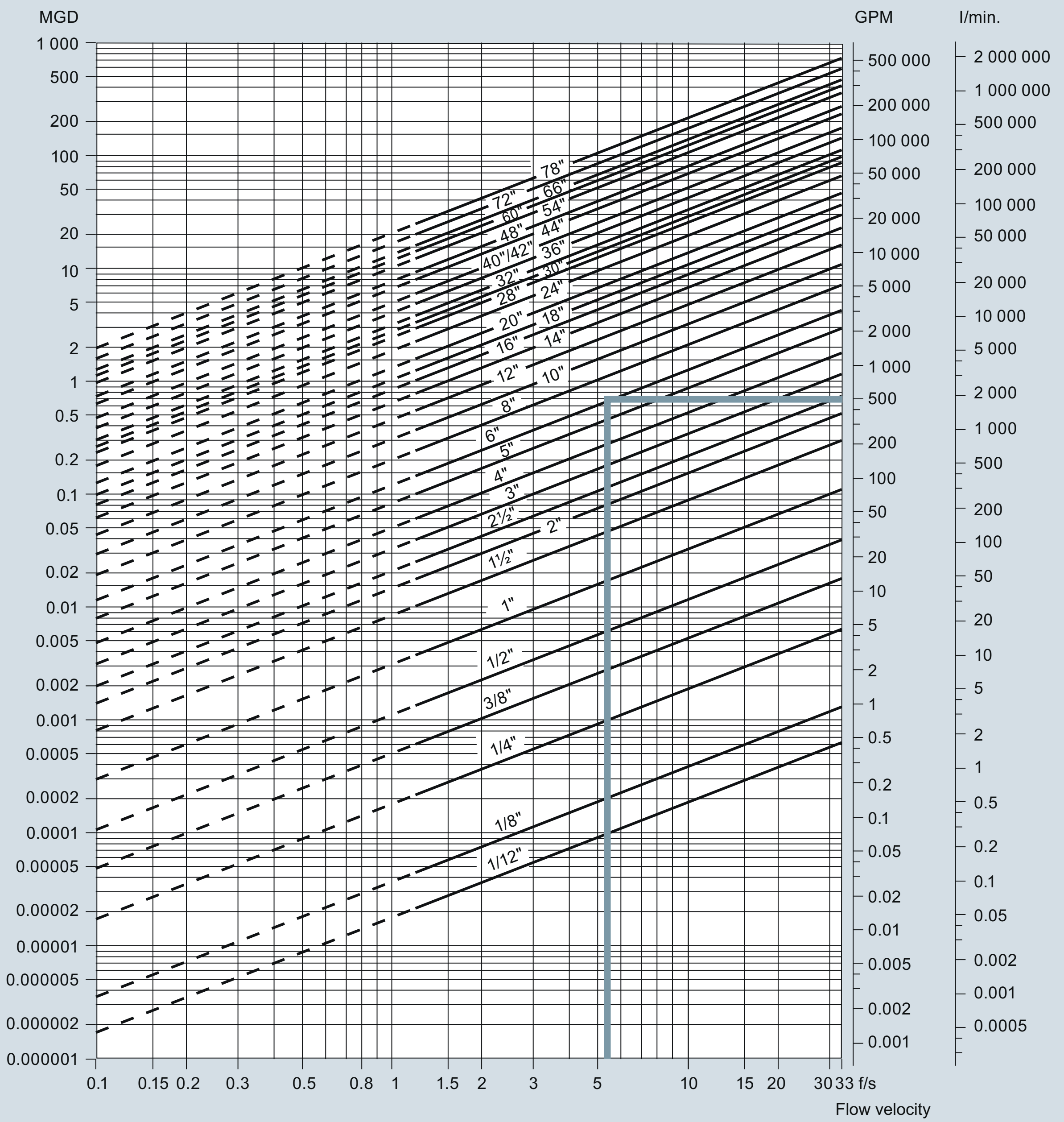
Flow quantity of 50 m^3/h and a sensor dimension of DN 80 gives a flow velocity of 2.7 m/s, which is within the recommended measuring range of 1 to 3 m/s.

Flow velocity calculation formula	Units
$v = 1273.24 \cdot Q / DN^2$ or	v : [m/s], Q : [l/s], DN : [mm]
$v = 353.68 \cdot Q / DN^2$	v : [m/s], Q : [m^3/h], DN : [mm]

Link to "Sizing program":
https://pia.khe.siemens.com/index.aspx?nr=11501

System information SITRANS F M

Imperial



Sizing table ($^{1}/_{12}$" … 78")

The table shows the relationship between flow velocity v, flow quantity Q and sensor dimension size.

Guidelines for selection of sensor

Min. measuring range: 0 to 0.8 ft/s

Max. measuring range: 0 to 33 ft/s

Normally the sensor size is selected so that the nominal flow velocity v lies within the measuring range 3 to 10 ft/s.

Example:

Flow quantity of 500 GPM and a sensor dimension of 6" gives a flow velocity of 5.6 ft/s, which is within the recommended measuring range of 3 to 10 ft/s.

Flow velocity calculation formula	Units
$v = 0.408 \cdot Q / (\text{Pipe I.D.})^2$ or	v : [ft/s], Q : [GPM], Pipe I.D. : [inch]
$v = 283.67 \cdot Q / (\text{Pipe I.D.})^2$	v : [ft/s], Q : [MGD], Pipe I.D. : [inch]

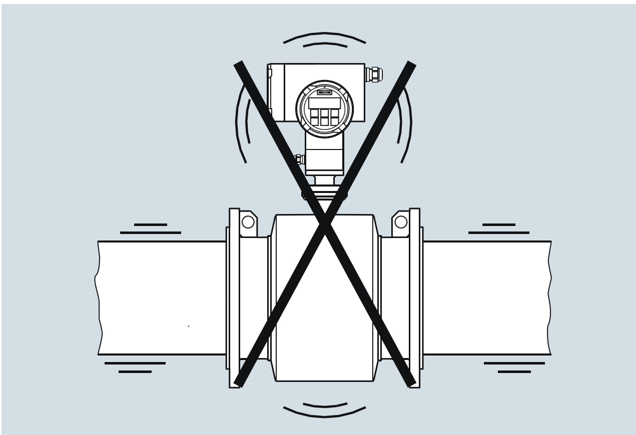
Link to "Sizing program":
https://pia.khe.siemens.com/index.aspx?nr=11501

Installation conditions

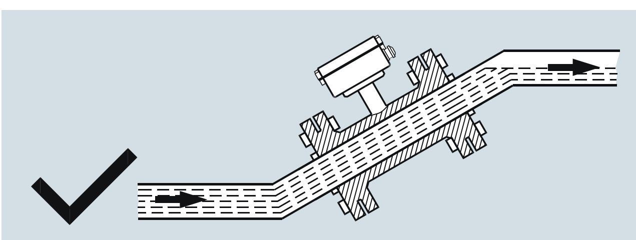
Vibrations

Strong vibrations should be avoided.

In applications with strong vibrations, remote mounting of the transmitter is recommended.



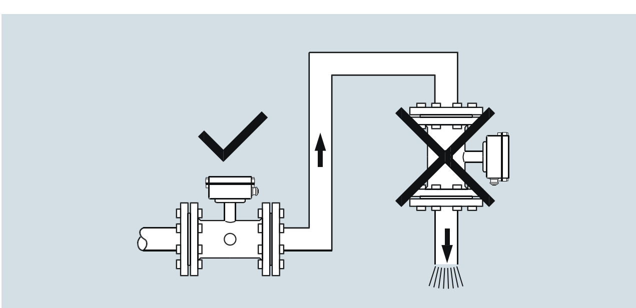
The sensor must always be completely filled with liquid.

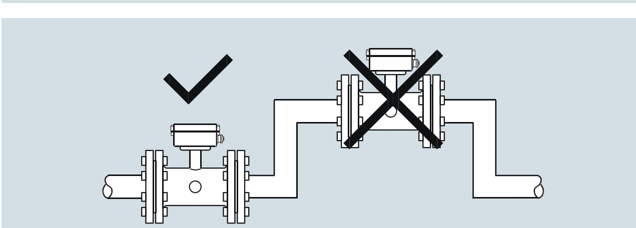


Install in pipelines which are always full

The sensor must always be completely filled with liquid. Therefore avoid:

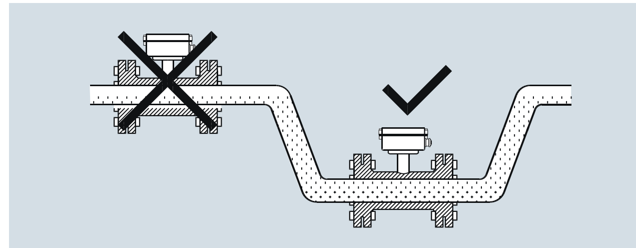
- Installation at the highest point in the pipe system
- Installation in vertical pipes with free outlet





Do not install in pipelines which can run empty

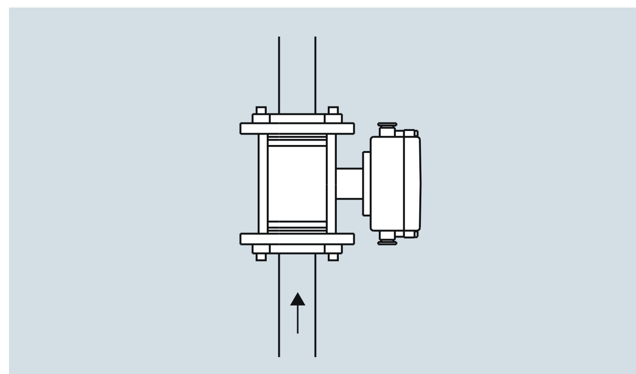
For partially filled pipes or pipes with downward flow and free outlet the flowmeter should be located in a U-Tube.



Install in U-tubes when pipe is partially filled

Installation in vertical pipes

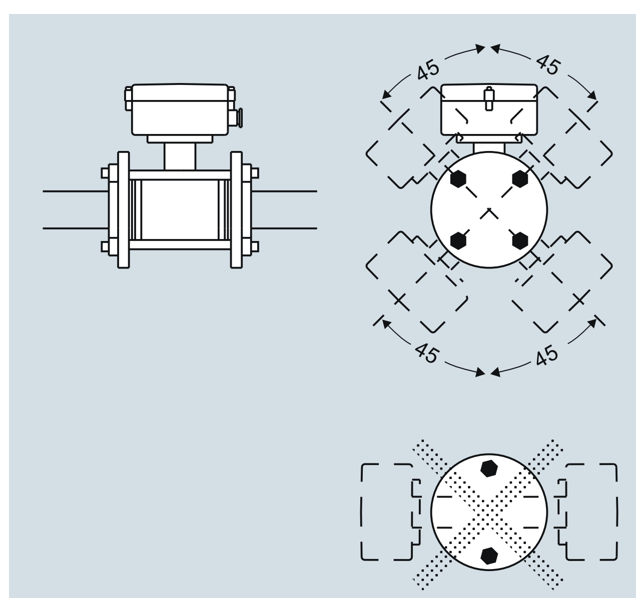
Recommended flow direction: upwards. This minimizes the effect on the measurement of any gas/air bubbles in the liquid.



Install in vertical pipes with upward flow direction

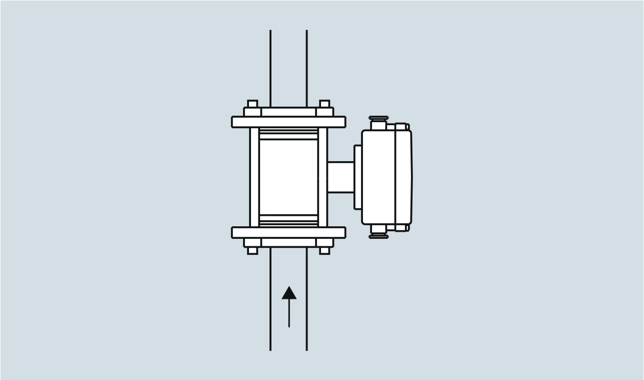
Installation in horizontal pipes

The sensor must be mounted as shown in the below figure. Do not mount the sensor as shown in the lower figure. This will position the electrodes at the top where there is possibility for air bubbles and at the bottom where there is possibility for mud, sludge, sand etc.



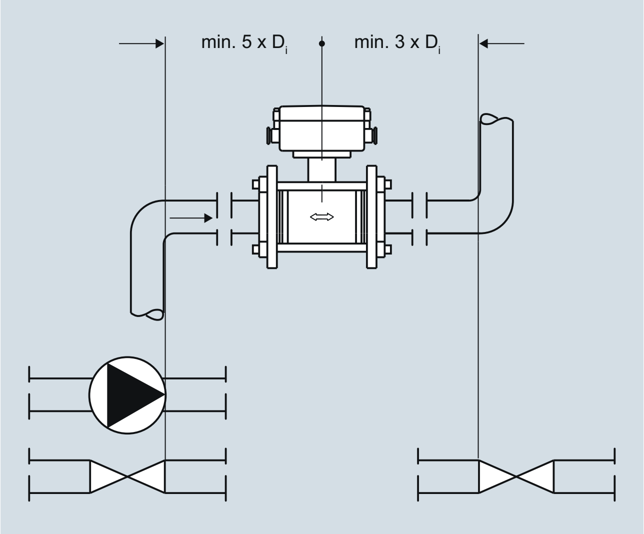
Measuring abrasive liquids and liquids containing particles

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



Install in vertical pipelines with upward flow direction if measuring abrasive liquids

Inlet and outlet conditions



Installation between elbows, pumps and valves: standard inlet and outlet pipe sections

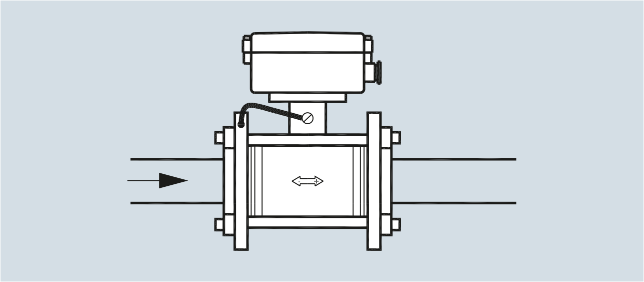
To achieve maximum accurate flow measurement it is essential to have straight length of inlet and outlet pipes and a certain distance between the flowmeter and pumps or valves.

It is also important to center the flowmeter in relation to pipe flange and gaskets.

Ambient temperature-Installation

Temperature changes can cause expansion or contraction in the pipe system. To avoid damage on the sensor use of proper gasket and torque should be ensured. For more information see sensor instruction.

Potential equalization

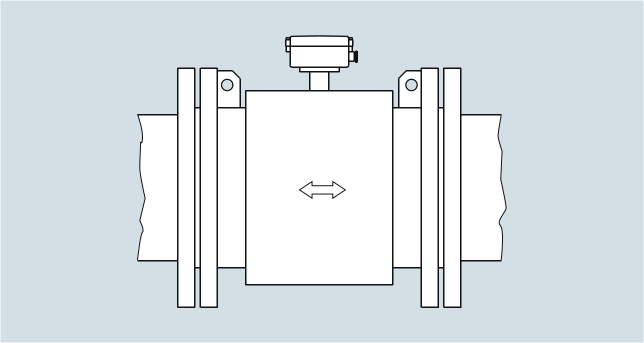


Potential equalization

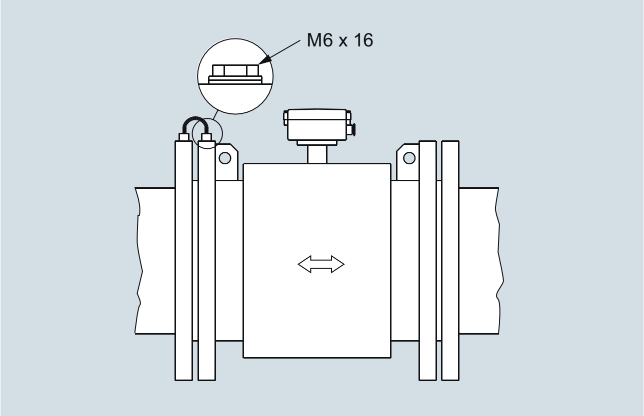
The electrical potential of the liquid must always be equal to the electrical potential of the sensor. This can be achieved in different ways depending on the application:

- Wire jumper between sensor and adjacent flange (MAG 1100, MAG 3100)
- Direct metallic contact between sensor and fittings (MAG 1100 F)
- Build-in grounding electrodes (MAG 3100, MAG 5100 W)
- Optional grounding/protection flanges/rings (MAG 1100, MAG 3100, MAG 8000)
- Optional graphite gaskets on MAG 1100 (standard for MAG 1100 High Temperature)
- MAG 8000 installed in plastic or coated pipes: two grounding rings to be used.

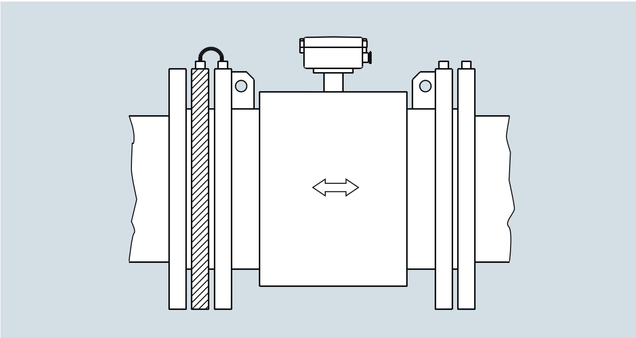
Grounding



MAG 3100 (not PTFE), MAG 5100 W: with earthing electrodes in conductive and non-conductive pipes (no further action necessary)



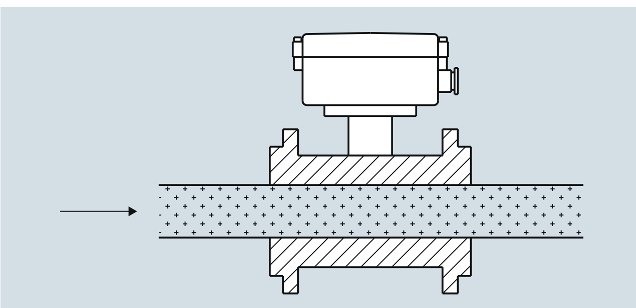
MAG 1100, MAG 3100 (PTFE): without earthing electrodes in conductive pipes (MAG 1100 use graphite gasket)



Without earthing electrodes in non-conductive pipes use grounding ring (MAG 1100 use graphite gasket)

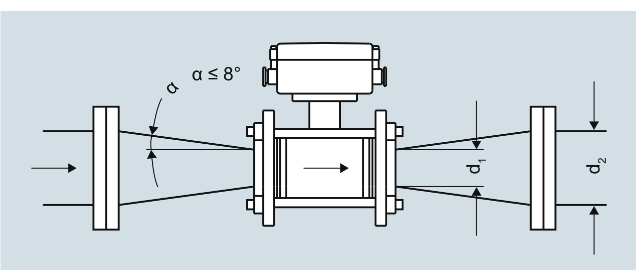
MAG 1100 F grounding via process connections. MAG 8000 grounding see MAG 8000 pages.

Vacuum



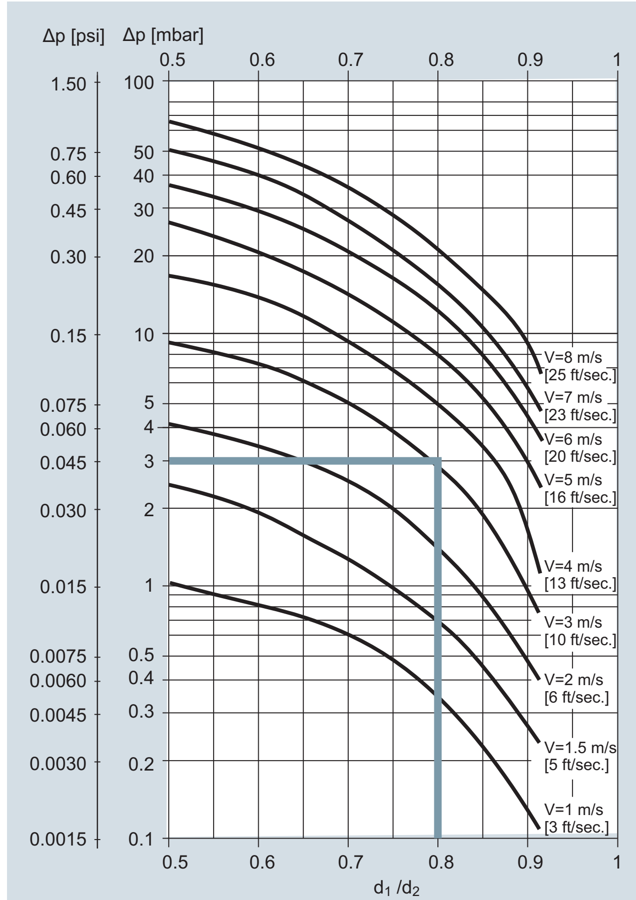
Avoid a vaccum in the measuring pipe, because this can damage certain liners.

Installation in large pipes



Reduction in nominal pipe diameter

The flowmeter can be installed between two reducers (e.g. DIN 28545). Assuming that at 8° the following pressure drop curve applies. The curves are applicable to water.

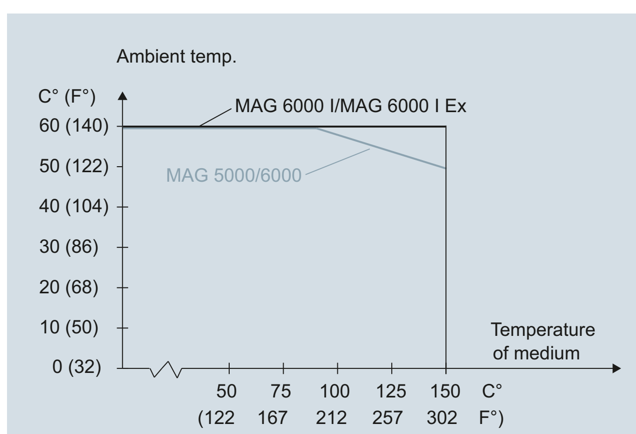


Pressure drop as function of diameter reduction between reducers

Example:

Flow velocity (v) of 3 m/s (10 ft/s) in a sensor with a diameter reduction DN 100 (4") to DN 80 (3") (d_1/d_2 = 0.8) gives a pressure drop of 2.9 mbar (0.04 psi).

Ambient temperature



Max. ambient temperature as a function of temperature of medium

The transmitter can be installed either compact or remote.

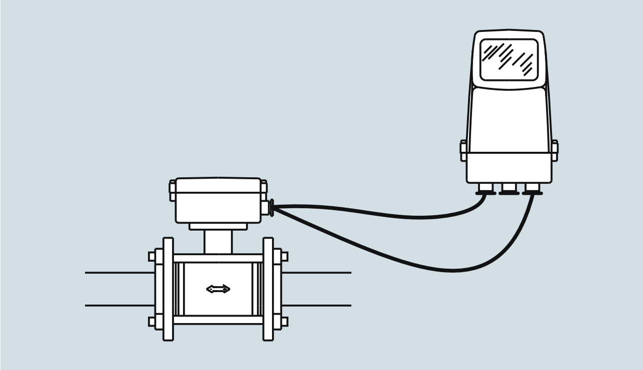
With compact installation the temperature of medium must be according to the graph.

System information SITRANS F M

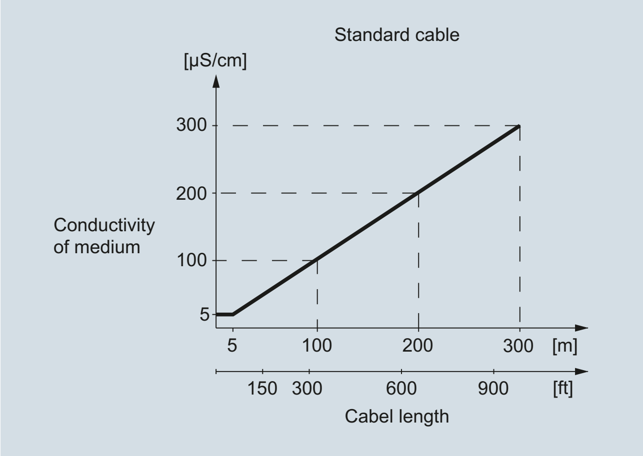
Sensor cables and conductivity of medium

Compact installation:

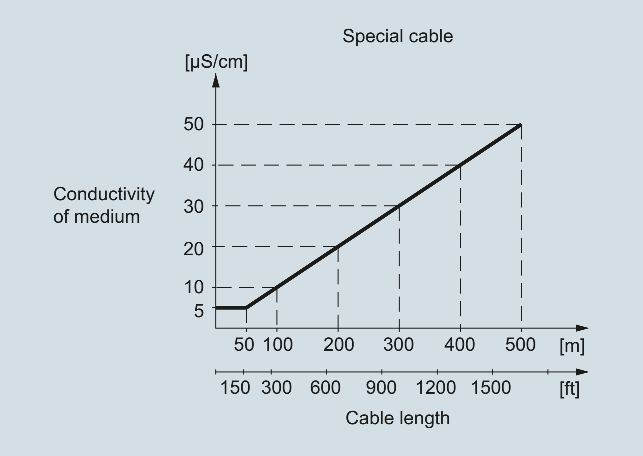
Liquids with an electrical conductivity ≥ 5 µS/cm.



Remote installation



Minimum conductivity of medium (using standard electrode cable)



Minimum conductivity of medium (using special electrode cable)

Empty pipe detection

The installation has to fulfill the following limitations for usage of the empty pipe detection function:

- media conductivity ≥ 20 µS/cm
- length of cable at remote installation ≤ 50 m (150 ft)
- special shield cable must be used

Note for MAG 1100 sizes DN 2 and DN 3:

- empty pipe detection is not available
- the media conductivity must be ≥ 30 µS/cm

Note for MAG 5000/6000 CT (FW 3.03):

- empty pipe detection is not available

Function

All electromagnetic flowmeters are based on Faraday's law of induction:

$U_M = B \cdot v \cdot d \cdot k$

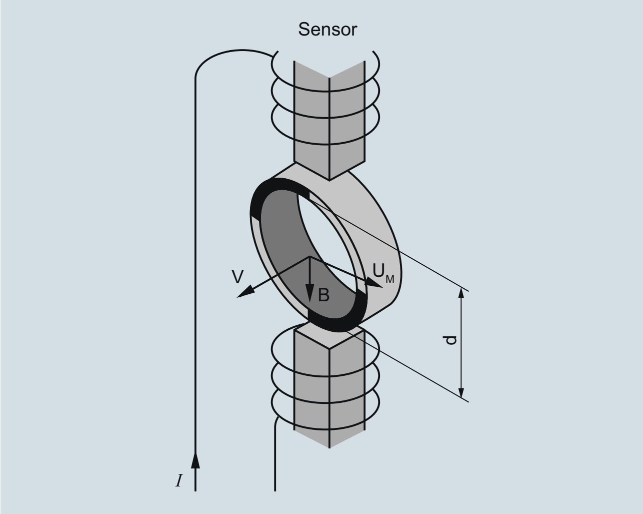
U_M = Measured voltage induced in the medium perpendicular to the magnetic field and the flow direction. The voltage is tapped at two point electrodes.

B = Magnetic flux density which permeates the flowing medium perpendicular to the flow direction.

v = flow velocity of medium

d = internal diameter of metering tube

k = proportionality factor or sensor constant



Function and measuring principle of electromagnetic measurement

An electromagnetic flowmeter generally consists of a magnetically non-conducting metering tube with an internal electrically non-conducting surface, magnet coils connected in series and mounted diametrically on the tube, and at least two electrodes which are inserted through the pipe wall and are in contact with the measured medium. The magnet field coils through which the current passes generate a pulsed electromagnetic field with the magnetic flux density B perpendicular to the pipe axis.

This magnetic field penetrates the magnetically non-conducting metering tube and the medium flowing through it, which must have a minimum electrical conductivity.

According to Faraday's law of induction, a voltage U_M is generated in an electrically conducting medium, and is proportional to the flow velocity v of the medium, the magnetic flux density B, and the distance between the electrodes d (internal diameter of pipe).

The signal voltage U_M is tapped by the electrodes which are in contact with the medium, and passed through the insulating pipe wall. The signal voltage U_M which is proportional to the flow velocity is converted by an associated transmitter into appropriate standard signals such as 4 to 20 mA.

SITRANS F M diagnostics

The diagnostic functions are all internal tools in the meter:

- Identification in clear text and error log
- Error categories: function; warning; permanent and fatal errors
- Transmitter self-check including all outputs and the accuracy
- Sensor check: coil and electrode circuit test
- Overflow
- Empty pipe: partial filling; low conductivity; electrode fouling

SITRANS F M Verificator (MAG 5000 and 6000)

The SITRANS F M Verificator is an external tool designed for MAG 5000 and MAG 6000 with MAG 1100, MAG 1100 F, MAG 3100, MAG 3100 P or MAG 5100 W sensors to verify the entire product, the installation and the application.

The goal is to improve operation, reduce downtime and maintain measurement accuracy as long as possible.

The SITRANS F M Verificator is highly advanced and carries out the complex verification and performance check of the entire flowmeter system, according to unique Siemens patented principles. The whole verification test is automated and easy to operate so there is no opportunity for human error or influence. The system is traceable to international standards and tested by WRc (Water Research Council).

SITRANS F M Verificator

- Stand alone Verificator to measure a number of selected parameters in the flow sensor and a transmitter which affects the integrity of the flow measurement
- Up to 20 measurements can be stored in the Verificator
- The Verificator can be connected via a serial cable to a PC enabling download of the data. A Windows program enables printing and management of verificator reports.

Verification - Steps

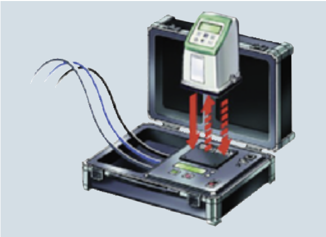
Verification of a SITRANS F M flowmeter consists of the following test routines:

1. Transmitter test
2. Flowmeter and cable insulation test
3. Sensor magnetism test

SITRANS F M Verificator

1. Transmitter test

The transmitter test is the traditional way of on-site testing on the market and checks the complete electronic system from signal input to output.

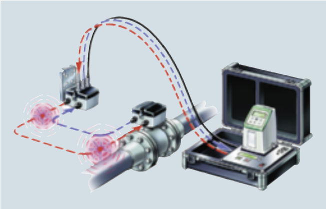


Transmitter test

Using the excitation power output, which is generated to drive the magnetic field of the sensor, the verificator simulates flow signal to the transmitter input. By measuring the transmitter outputs the verificator calculates its accuracy against defined values. Test includes:

- Excitation power to drive the magnetic field
- Signal function from signal input to output
- Signal processing – gain, offset and linearity
- Test of analogue and frequency output

2. Insulation test



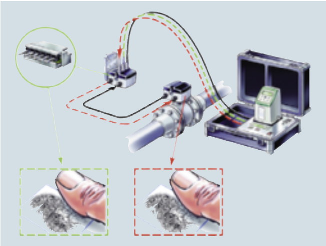
Flowmeter insulation test

The verification test of the flowmeter insulation is a „cross talk" test of the entire flowmeter which ensures that the flow signal generated in the sensor is not affected by any external influences.

In the "cross-talk" test the verificator generates a high voltage disturbance within the coil circuit and then looks for any "cross-talk" induced in the flow signal circuit. By generating dynamic disturbances close-coupled to the flow signal, the flowmeter is tested for noise immunity to a maximum level:

- EMC influence on the flow signal
- Moisture in sensor, connection and terminal box
- Non-conductive deposit coating the electrodes within the sensor
- Missing or poor grounding, shielding and cable connection.

3. Sensor magnetism test



Sensor magnetism test

The verification of the sensor magnetism is a "boost" test of the magnetic field coil. The test ensures that the magnetism behaviour is like the first time, by comparing the current sensor magnetism with the "fingerprint" which was determined during initial calibration and stored in the SENSORPROM memory unit.
In the "boost" test the verificator changes the magnetic field in certain pattern and with high voltage to get quick stable magnetic condition. This unique test is fulfilled without any interference or compensation of surrounding temperature or interconnecting cabling.

- Changes in dynamic magnetic behaviour
- Magnetic influence inside and outside the sensor
- Missing or poor coil wire and cable connection

Certificate

The test certificate generated by a PC contains:

- Test result with passed or failed
- Installation specification
- Flowmeter specification and configuration
- Verificator specification with date of calibration ensuring traceability to international standards.

MAGFLO® Verification Certificate

Customer:
Name
Address

Phone
Email

MAGFLO® Identification:
TAG No./Name 0
Sensor Code No. 7ME634
Sensor Serial No. 057701H142
Transmitter Code No. 7ME692
Transmitter Serial No. 109418N080
Location

Results:
Verification file name or No. FT-103FT2801
Transmitter Passed
Sensor Insulation Passed
Magnetic Circuit Passed

Velocity	Current Output			Frequency Output		
Theoretical	Theoretical	Actual	Deviation	Theoretical	Actual	Deviation
0.5m/s	4.800mA	4.802mA	0.25%	0.500kHz	0.501kHz	0.11%
1.0m/s	5.600mA	5.601mA	0.08%	1.000kHz	1.001kHz	0.07%
3.0m/s	8.800mA	8.804mA	0.08%	3.000kHz	3.004kHz	0.14%

Current Output 4-20mA Frequency Output 0-10kHz

Transmitter Settings:

Basic	Qmax.	2.00000 m³ /h
	Flow Direction	Positive
	Low flow Cut-off	1.50%
	Empty Pipe	ON
Output	Current Output	ON (4-20mA)
	Time Constant	5.0 Sec.
	Relay Output	Error Level
	Digital Output	Pulse
	Frequency Range	N/A
	Time Constant	N/A
	Volume/pulse	1.0 l/p
	Pulse width	0.51999998 sec.
	Pulse polarity	Positiv
Totalizer 1 value before test		819442.93213 l
Totalizer 1 value after test		819458.92334 l
Totalizer 2 value before test		693.87579 l
Totalizer 2 value after test		693.88145 l
Operating time in days		1068

Sensor Details:

Size	DN 15 1/2 IN
Cal. Factor	0.16531426
Correction Factor	1.0
Excitation Freq.	12.5Hz

Verificator Details (083F5060)

Serial No.	107920N490
Device No.	94683
Software Version	1.40
PC-Software Version	5.01
Cal. date	2012.10.26
ReCal. date	2013.10.26

Comments

These tests verify that the flowmeter is functioning within 2% deviation of the original test parameters.
Verification is traceable to National and International Standards.

Date and signature
2013.04.17

Description	Article No.
SITRANS F M Verificator	
• 11 ... 30 V DC, 11 ... 24 V AC, 115 ... 230 V, 50 Hz	**FDK:083F5060**
• 11 ... 30 V DC, 11 ... 24 V AC, 115 ... 230 V, 60 Hz	**FDK:083F5061**

Note:
It is mandatory to have the Verificator returned to the factory once a year for check and re-verification.