MFE600 Intelligent Electromagnetic Flowmeter

Introduction

MFE600 Intelligent Electromagnetic Flowmeter is designed and manufactured with the most advanced domestic and abroad technology, featuring high accuracy, reliability, good stability and long service life.

We pay our attention to every detail in the process of the product structure design, material selection, manufacturing, assembly and factory testing etc. With a water tower up to 35m as pressure stabilizer for actual flow calibration, we have a professional production line for electromagnetic flowmeter, also we design and develop a series of software and hardware for electromagnetic flowmeter for mass production to ensure high quality in long term use. The product has backlight and wide temperature-ranged Chinese LCD display. With fully practical function, visual display, easy operation, it saves troubles for on-site installation operation and maintenance. MFE600 can be widely used in industrial fields such as petroleum, chemical, metallurgy, water supply and drainage, steel, coal, paper, food, textile, environmental protection and other municipal administration, water conservancy construction field etc.

Working Principle

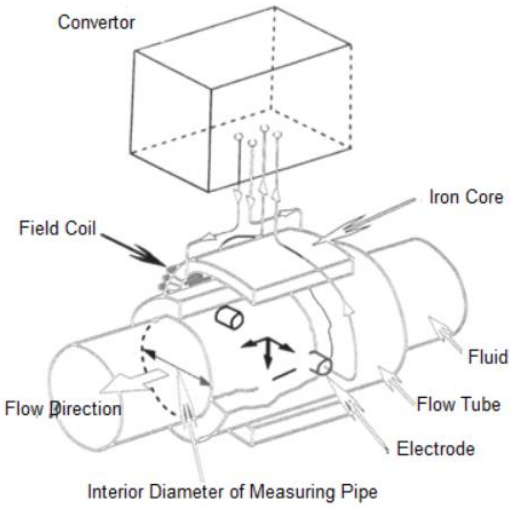
The working principle of Electromagnetic Flowmeter is based on Faraday's Law of Electromagnetic Induction, that is, when the conductive liquid flows through the electromagnetic flowmeter, the induced electromotive force will be produced in the liquid conductor, and the induced electromotive force is directly proportional to the velocity of conductive liquid, magnetic flux density and width of conductor (interior diameter of flowmeter).

Such induced electromotive force is detected by a pair of electrodes on the tube wall of the flowmeter, and the rate of flow can be acquired by mathematical operation. The equation of induced electromotive force is as follows:

$$E = K \times B \times V \times D$$

E: Induced electromotive force　　K: Instrument Constant　　B: Magnetic flux density

V: Velocity　　D: Interior diameter of measuring pipe



The following conditions should be satisfied in order to obtain satisfactory measuring accuracy:

1. The measured liquid shall posses the electrical conductivity;

2. The pipe shall be full of liquid;

3. The components of liquid shall be well mixed;

4. If the liquid has magnetic permeability, the magnetic field of the flowmeter will change, so the flowmeter shall be modified.

During measurement, when the fluid flows through the magnetic field perpendicularly to the flow direction, the flow of the conductive liquid induces an electric potential proportional to the average velocity, thus requiring the conductivity of the flowing liquid measured is higher than the minimum conductivity. The induced voltage signal is detected by the two electrodes. And it is transmitted through the cable to the converter, after signal processing and related operations, integrated flux and instantaneous flux will be displayed on the display screen of the converter.

Features

1. The electromagnetic flowmeter is an instrument for volume flux measurement. The flux measurement will not be influenced by the fluid density, viscosity, temperature, pressure and electrical conductivity changes. There is a linear relationship between the inducing voltage signal of sensor and the average velocity. Its accuracy is high.

2. Due to the unimpeded flow and no moving parts, it will not cause additional energy loss or jam. Therefore it is remarkable for energy saving, especially it is suitable for measurement of liquid-solid two-phase fluids such as sewage, slurry, pulp, coal slurry, pulp etc.

3. The electromagnetic flowmeter has no mechanical inertia. With good sensitivity, it can measure the transient pulsating flux, and has good linearity.

4.It has low requirements for installation. Short straight pipe is needed, generally 5D in front of the flowmeter, 3D behind it (D is the interior diameter of the selected instrument).

5. Only the lining and electrodes contact with the media, as long as the selection of electrode and lining materials is proper, they can be corrosion resistance and abrasive resistance, and are able to ensure long-term use.

6. When power supply is off suddenly, EEPROM can protect parameter setting and cumulative values.

7. The converter uses a low-power consumption single-chip for processing data. And it uses SMD electronic components and SMT surface mounting technology to ensure reliable performance, high accuracy, low power consumption and zero stability. With Chinese dot matrix LCD display, it can display the integrated flux, transient flux, velocity, flow percentage and other parameters.

8.Multi-electrode structure ensures high accuracy. With the grounding electrode, it doesn't need grounding ring, therefore saves the cost.

9. The low-frequency rectangle wave excitation improves the flux stability. It has low power consumption and good low flow characteristics.

10.Bidirectional measurement system can be used for measuring forward flux and reverse flux.

Performance

Electromagnetic Flowmeter Converter Components:

Input signal: signal emitted from the sensor directly proportional to the flow.

Output signal: 4mA ~ 20mA DC (load resistance 0Ω ~ 750Ω).

Select pulse / alarm output by parameter setup

Pulse output: (pulled up resistor already)

4mA ~ 20mA DC Output: Current output is active output.

Alarm output: rated value 30V DC, 100mA

Communication signal: RS485 communication protocol (optional);

RS232 communication protocol (optional)

Load Resistance: 250Ω ~ 600Ω (including cable resistance)

Load Capacitance: 0.22μF (Max)

Load inductance: 3.3mH (Max)

Space between split cables: ≤100m

Input impedance of receiving instrument: ≥10kΩ (@ 2.4kHz)

Measurement Range setting:

The volumetric flux is set by the setup of volume unit, flux value and diameter of flowmeter.

Volume unit: m^3

Velocity unit: m/s

Diameter of flowmeter: mm

Transient flux display: display flux unit, and the percentage of range.

Integrated flux display: display forward and reverse integrated flux and total integrated flux.

Pulse output: By setting an impulse ratio, the pulse quantity expressed in any flux unit can be output.

Pulse width: Duty ratio of 50% or fixed pulse width is available for users to choose.

Output speed: 10 to 400 (PPS) (only applicable when the form of pulse output is selected).

Black-out data protection: data will be stored by EEPROM without backup battery.

Forward and Reverse flux measurement: in the model of forward and reverse flow direction, the reverse flux can be measured.

Upper limit alarm: the transient flux is larger than the upper limit of setting value

Lower limit alarm: the transient flux is smaller than the lower limit of setting value

Damping function: available to set from 0.2s ~ 100s (63% response time)

Normal Working Condition

Environment Temperature: -20℃~60℃

Rated Voltage of Power Supply:

220V AC: 100V~240V AC

DC: 24V DC

Installation and Structure

Installation：

Separate model: converter, 50mm pipe or plane installation

Integrated model: combined with the sensor

Wire connector: ISO M20 ×1.5 female thread

Wire Terminals: M3 screw

Housing material: aluminum alloy

Structure:

Protection class: IP65 (general type); IP68 (waterproof)

MFE600 Electromagnetic Flowmeter Performance Introduction(Flange)

Integrated **Separated**

Diameter	DN10 ~ DN800
Excitation type	Constant flux square wave excitation
Installation	Integrated flanged, Separated Flanged
Lining	Neoprene, Polyurethane rubber, PTFE， F46
Electrode Material	316L, Hc, Hb, Titanium, Tantalum, Platinum iridium, Tungsten carbide
Grounding	Built-in grounding electrode (DN25 and above)
Medium	Conductive liquid
Accuracy Grade	0.2, 0.5, 1.0
Media Conductivity	> 5 μS/cm
Velocity	≤ 15 m/s
Pipe Connection Flange	Flange GB 81～59
Pipe Connection	Flange Connection
Media Temp.	Neoprene: -10℃~ 60℃; PTFE: -10℃~ 120℃ Urethane Rubber: -10℃~80℃; F46: -10℃~ 150℃
Rated Pressure	4.0 MPa; 1.6 MPa; 1.0 MPa
Protection Level	IP65; IP68
Output signal	4mA~ 20mA DC current; Pulse/ Frequency, Alarm after Upper and Lower limits
Cable connection	M20×1.5 female
Communication	RS 485 protocol (Modbus protocol) RS 232 protocol (optional)
Display	Transient flux, Alarm display, Percentage, Velocity, Forward and Reverse Integrated Flux and Total Integrated Flux
Power supply	220V AC，24V DC，3.6 V battery power supply
Type	General, Waterproof
High Voltage	Customized

MFE600 Electromagnetic Flowmeter Performance (Clamp-on)

Diameter	DN10 ~ DN500
Excitation type	Constant flux square wave excitation
Installation	Integrated clamp-on, Separated clamp-on
Lining	Neoprene, Polyurethane rubber, PTFE， F46
Electrode Material	316L, Hc, Hb, Titanium, Tantalum, Platinum iridium, Tungsten carbide
Grounding	Built-in grounding electrode (DN25 and above)
Medium	Conductive liquid
Accuracy Grade	0.2, 0.5, 1.0
Media	> 5μS/cm
Velocity	≤ 15 m/s
Pipe Connection	Flange GB 81～59
Pipe Connection	Flange Connection
Media Temp.	Neoprene: -10℃~ 60℃; PTFE: -10℃ ~ 120℃ Urethane Rubber: -10℃~80℃; F46: -10℃~ 150℃
Rated Pressure	4.0 MPa; 1.6 MPa; 1.0MPa
Protection Level	IP65; IP68
Output signal	4mA~ 20mA DC current; Pulse/ Frequency, Alarm after Upper and Lower limits
Cable connection	M20×1.5 female
Communication	RS 485 protocol（modbus protocol） RS 232 protocol（optional）
Display	Transient flux, Alarm display, Percentage, Velocity, Forward and Reverse Integrated Flux and Total Integrated Flux
Power supply	220V AC，24V DC，3.6V battery power supply
Type	General, Waterproof
High Voltage	Customized

Model Selection

The flowmeter model selection is very important in application of instrument. The related information shows that in practical application of instrument, 2/3 failures are caused by incorrect selection of model and incorrect installation of instrument to which the special attention shall be paid.

1. Technological data collection

   a. The measured fluid name and its chemical substances

   b. Maximum flux, minimum flux and normal flux

   c. Maximum working pressure;

d. Maximum temperature, minimum temperature.

2. The measured liquid shall have certain conductivity, electrical conductivity ≥5μS/cm.

3. The maximum flux and the minimum flux shall meet the values in the measurable flux range table.

4. The actual maximum working pressure shall be less than the rated working pressure of flowmeter.

5. The maximum working temperature and the minimum working temperature shall meet the temperature requirements stipulated for flowmeter.

6. Whether negative pressure exists or not in the processing pipeline shall be confirmed.

You can also select the appropriate flowmeter electromagnetic flowmeter according to actual use, and if the interior diameter of the electromagnetic flowmeter selected differs from that of the existing process pipe, then pipe reduction or expansion shall be considered.

1. If the pipeline should be contracted, whether the pressure loss caused by the pipe contraction will affect the process flow or not shall be considered.

2. Considering the measurement accuracy and price, you can choose a smaller diameter electromagnetic flowmeter, which can reduce the investment relatively.

3. When measuring clean water, the economic velocity is 2m/s ~3m/s; when measuring the solution of crystallization, the velocity shall be increased approximately to common velocity of ≥2 m/s ,in order to prevent the electrode of electromagnetic from flowmeter being covered.

Measurable Flux Range

International Unit（Diameter: mm, Flow: m^3/h）

Diameter	Minimum Range Velocity (0.1m/s)	Maximum Range Velocity (10m/s)
10	0.0283	2.8274
15	0.0636	6.3615
20	0.1131	11.3094
25	0.1767	17.6709
32	0.2895	28.9521
40	0.4524	45.2376
50	0.7068	70.6838
65	1.1946	119.4555
80	1.8095	180.9504
100	2.8274	282.7350
125	4.4177	441.7734
150	6.3615	636.1538
200	11.3094	1130.9400
250	17.6709	1767.0938

300	25.4462	2544.6150
350	34.6350	3463.5038
400	45.2376	4523.7600
500	70.6838	7068.3750
600	101.7846	10178.4600
700	138.5402	13854.0150
800	180.9504	18095.0400
900	229.0154	22901.5350
1000	282.7350	28273.5000
Diameter	Minimum Range Velocity (0.3m/s)	Maximum Range Velocity (10m/s)
1100	1026.3281	34210.9350
1200	1221.4152	40713.8400
1400	1662.4818	55416.0600
1500	1908.4613	63615.3750
1600	2171.4048	72380.1600
1800	2748.1842	91606.1400
2000	3392.8200	113094.0000

Electric Connection

Please notice the following suggestions when connecting wires:

1. In order to ensure interior insulation of sensor junction box, in case of the poor insulation caused by moisture, it is not suggested to connect cable outdoors in the raining weather.

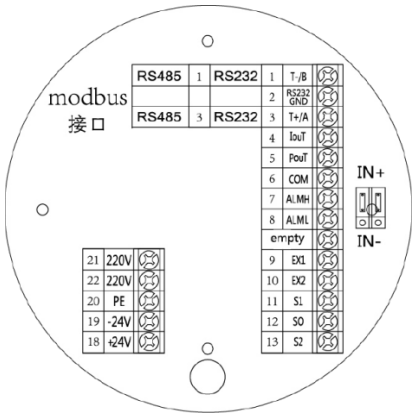
2. When connecting the power cable and signal cable, both ends of the cable should be wrapped with circular lugs.

3. Conduit tube is suggested to use. The conduit tube material can use thick and sturdy steel pipe or flexible metal pipe.

4. All the power cable and non 4-core 24V DC signal cable must be equipped with metal cable protection tube.

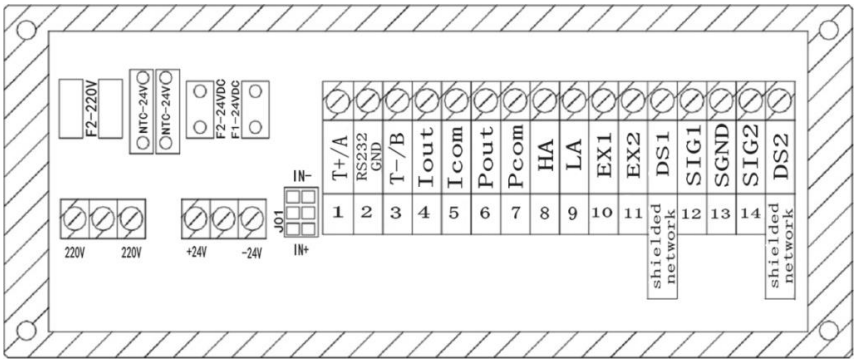
5. When equipped with waterproof seal cable connector, it must be tightened to ensure that no water seepage inside the box.

6.In order to protect the operator and maintenance personnel from electric shocks and to prevent the influence of external noise, the ground should be connected to the sign ⏚ (≤10Ω).



Integrated Type Wire Connection

Terminal Symbol		Function
1	T-/B	RS485 Communication Output RS232 Communication Output (optional)
2	RS232 GND	
3	T+/A	
4	IOUT	4mA～20mA DC current output
5	POUT	2-way flow pulse output/frequency output
6	COM	
7	ALMH	Alarm output for Upper Limit of flux
8	ALML	Alarm output for Lower Limit of flux
	Empty(Null)	
9	EX1	Excitation Current
10	EX2	
11	S1	Electrode wire
12	S0	Grounding wire
13	S2	Electrode wire
20	PE	
21	220V	220V AC power supply access point
22	220V	
19	-24V	24V DC power supply access point
18	+24V	
Short Circuit lugs	IN+	When lugs is connected to (IN +) , the flux output is positive; when lugs is connected to (IN-) , the flux output is negative.
	IN-	



Separated Type Wire Connection

Terminal Symbol		Function	
1	T-/A	RS485 Communication Output RS232 Communication Output(optional)	
2	RS232 GND		
3	T+/B		
4	Iout	4mA~20mA DC Current output	Active output; If it is passive output, Please pull out the lug.
5	Icom	Current output	
6	Pout	2-way flow pulse output/frequency output	
7	Pcom	Pulse output	
8	HA	Alarm output for Upper Limit of flux	
9	LA	Alarm output for Lower Limit of flux	
10	EX1	Excitation Current	
11	EX2		
Shielding Network	DS1		
12	SIG1	Electrode wire	
13	SGND	Grounding wire	
14	SIG2	Electrode wire	
Shielding network	DS2		
	220V	220V AC power supply access point	
	220V		
	-24V	24V DC power supply access point	
	+24V		
Short Circuit lugs	IN+	When lugs is connected to (IN +) , the flux output is positive; when lugs is connected to (IN-) , the flux output is negative.	
	IN-		

Flowmeter Model Instruction

Name	Specification Code	Instruction
Instrument Type	MFE600	Electromagnetic Flowmeter
Measurement Pipe Diameter	XXX	For Example: 100 represents DN100
Electrode Type	1	Standard Mount (required)
Electrode Material	0	SS316L
	1	Platinum Pt
	2	Hastelloy B (HB)
	3	Tantalum (Ta)
	4	Titanium (Ti)
	5	Hastelloy C (HC)
Lining Material	3	Neoprene
	4	Polyurethane Rubber
	5	F4(PTFE) Polyfluoroethylene F4
	6	F46(FEP) Polyperfluorethylene-propylene F46
Rated Pressure(MPa)	4.0	DN 10 ~ 80
	1.6	DN 100 ~ 150
	1.0	DN 200 ~ 1000
	0.6	DN 1100 ~ 2000
Media Working Temp.	E	< 60℃
	H	< 120℃
Ground	1	Built-in Grounding Electrode
Protection	0	IP65
	1	IP68
Converter Type	0	Integrated
	1	Separated
Analog Signal	0	4mA~20mA DC (with pulse/frequency)
Digital Signal	0	No digital signal
	1	RS-485 (ModBus protocol)
	2	RS232
	3	Others (customized)
Housing Material	0	Carbon Steel
	1	Stainless Steel
Flange Material	0	Carbon Steel
	1	Stainless Steel
Companion Flange	0	Without
	1	With
Power Supply	0	220V AC
	1	24V DC

	2	Battery supply
Instrument Range	（XXX）	For example: (200)means 20mA corresponds to the maximum flux 200m^3/h.

Version Code Example: MFE600-200-103-1.0E1-0001-0010 (max)

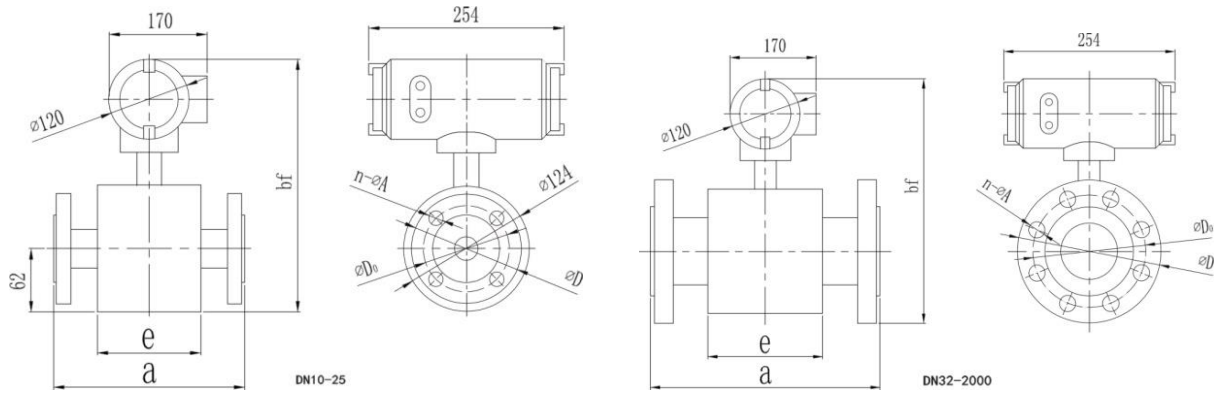
Explanation: MFE600 Electromagnetic flowmeter; DN200 diameter; with fixed stainless steel electrodes and Neoprene lining; with rated pressure of 1.0MPa and internal grounding electrode, temperature <60℃; IP65 protection, integrated, with 4mA~20mA DC(frequency or pulse output) and RS485 digital signal; carbon steel housing and flange, with companion mounting flange (including bolts and nuts), 220VAC power supply.

Electromagnetic Flowmeter Outline Construction

Diameter (DN)	Rated Pressure (MPa)	Instrument Outline Dimension (mm)			Flange Connection Dimension (mm)			Weight (kg)
		a	Bf	c	D	D0	n×A	
10	4.0	150	322	82	90	60	4-Φ14	7
15		150	322	82	95	65	4-Φ14	8
20		150	322	78	105	75	4-Φ14	8
25		150	312	78	115	85	4-Φ14	8
32		150	327	74	135	100	4-Φ18	9
40		150	335	74	145	110	4-Φ18	11
50		200	354	86	160	125	4-Φ18	12
65		200	366	92	180	145	8-Φ18	14
80		200	385	92	195	160	8-Φ18	15
100	1.6	250	406	114	215	180	8-Φ18	18
125		250	436	114	245	210	8-Φ18	20
150		300	465	136	280	240	8-Φ23	24
200	1.0	350	518	156	335	295	8-Φ23	44
250		400	570	202	390	350	12-Φ23	54
300		500	620	230	440	400	12-Φ23	76
350		500	675	278	500	460	16-Φ23	79
400		600	733	320	565	515	16-Φ23	100
450		600	782	374	615	565	20-Φ25	130
500		600	835	388	670	620	20-Φ25	140
600		600	940	408	780	725	20-Φ30	205
700		700	1048	520	895	840	24-Φ30	305
800		800	1160	580	1010	950	24-Φ34	415
900		900	1260	660	1110	1050	28-Φ34	505
1000		1000	1370	720	1220	1160	28-Φ34	635
1200	0.6	1200	1585	1130	1405	1340	32-Φ34	725
1400		1400	1810	1260	1630	1560	36-Φ36	1185
1600		1600	2040	1450	1830	1760	40-Φ36	1505

1800		1800	2250	1640	2045	1970	44-Φ39	2035
2000		2000	2460	1820	2265	2180	48-Φ42	2555

The model selection of the electromagnetic flowmeter is preferably performed by a technician who is familiar with on-site technological conditions. The technician shall select proper diameter, lining material and electrode and so on according to the measurable range table in the type selection material, and the selection preferably confirmed by an end user who is familiar with the on-site technological conditions.



Select flowmeter type

Integrated and Separated type

Both the integrated type and separated type have their own advantages, and basic principles for selection are as follows:

The separated type is generally used in situations inconvenient for on-site maintenance and numerical reading when commissioning is difficult or the flow meter is often immersed in water and with other functions. It is also used in poor application situations, such as high temperature fluid, a position with vibration source and explosive environment. In most cases, both the integrated and separated type can meet usage requirements.

The Sensor Diameter and the Process Pipe Diameter Connected

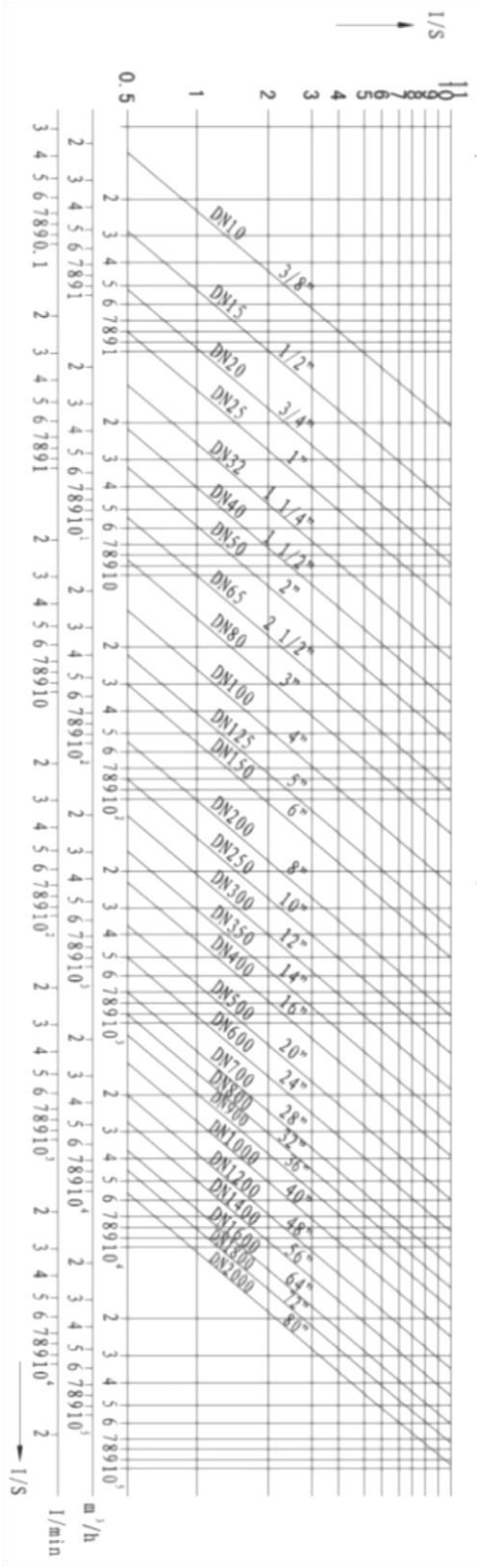
Generally, for the sake of easy installation, please do not select reducing pipe, provided that the flux used in the flowmeter pipe shall be within the range of 0.3m/s ~ 10m/s. This kind of selection is usually applicable to a newly-designed project for which not only current working conditions are considered when choosing a velocity, but also a situation of running at full load of the device in the future shall be considered. For the relationships among the flux, velocity and diameter, see curve graph, however, sometimes we also choose a sensor with a different diameter with the connected pipelinediameter, for example:

1. The velocity in the pipeline is low and the process flux is stable. In order to meet the demand of the instrument for flux range and improve local velocity of the flowmeter, select a sensor with smaller diameter than the technological pipeline and additionally connect a reducing pipe at front and rear part of the sensor.

2. In terms of large diameter electromagnetic flowmeter, the larger the diameter is, the higher the price will be. As for the situations with low velocity in the pipeline and stable technological parameter, small diameter flowmeter

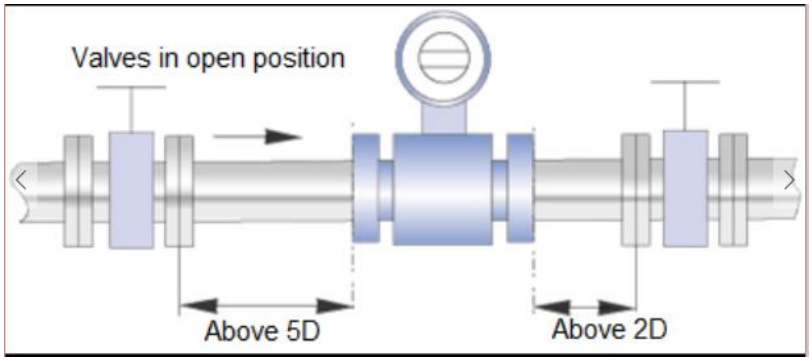
can be chosen. This not only runs the flowmeter under good working state, but also reduces investment cost.

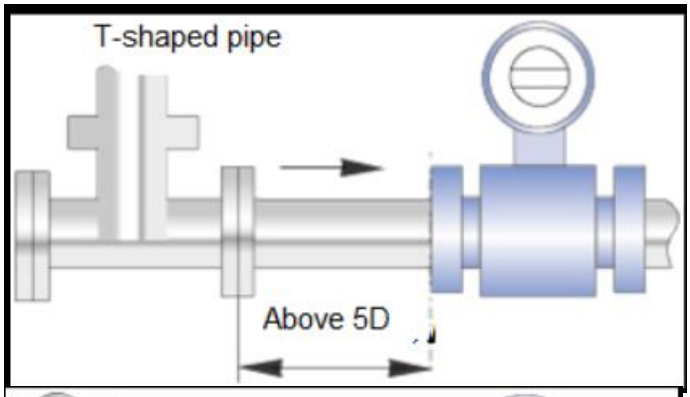
FlowmeterDiameter,Velocity and Flow Relation Graph

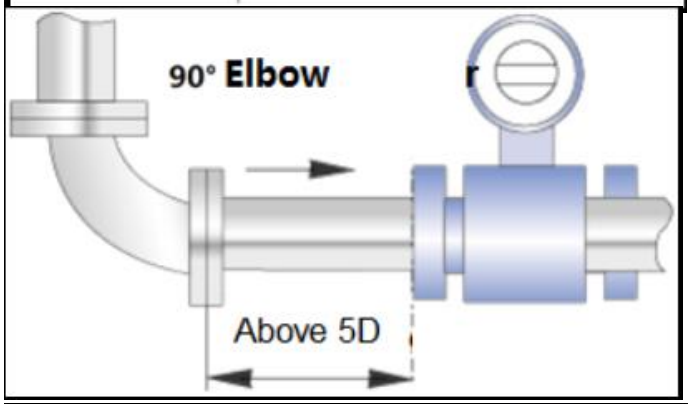


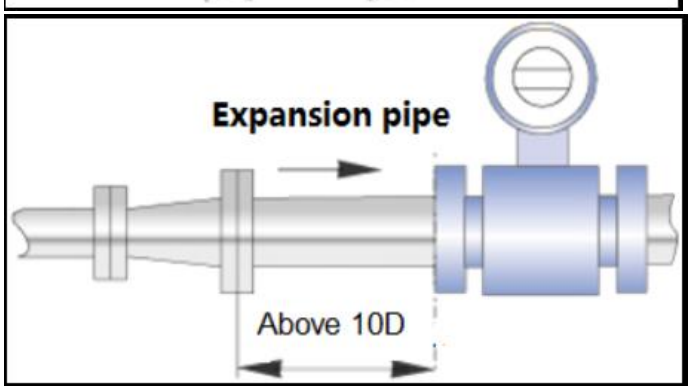
Straight Pipeline Length

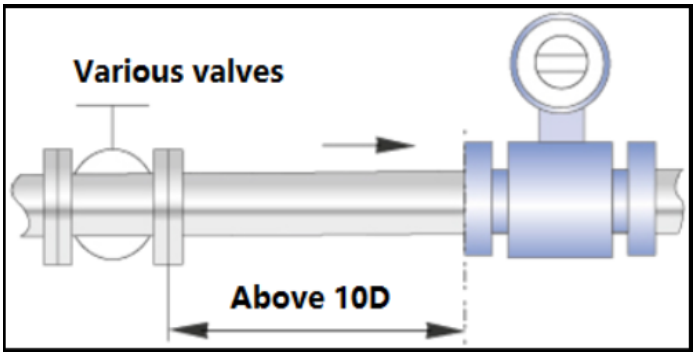
In order to ensure upstream pipe condition required for achieveing high measurement accuracy of electromagnetic flowmeter, pipeline conditions as shown in following are recommended according to standards above and measured data of pipeline condition.











Minimum Length of Required Straight Pipe

Notes for Installing a Reducing Pipe additionally

For not mapping distribution of flux field after installing the reducing pipe and not influencing precision of the electromagnetic flowmeter, the reducing pipe can be regarded as a part of the straight pipe segment. The central core angle α of the reducing pipe shall be no more than 150 degree, and the smaller, the better.

The installation of a reducing pipe will cause pressure loss

The total pressure loss consists of three parts:

1. Pressure loss in reducing pipe ΔP1 = ρ / 2ξ1V22
2. Pressure loss in increasing pipe ΔP3 = ρ / 2ξ3V22
3. Pressure loss in sensor measuring pipe ΔP2 = ρ / 2ξ3V22

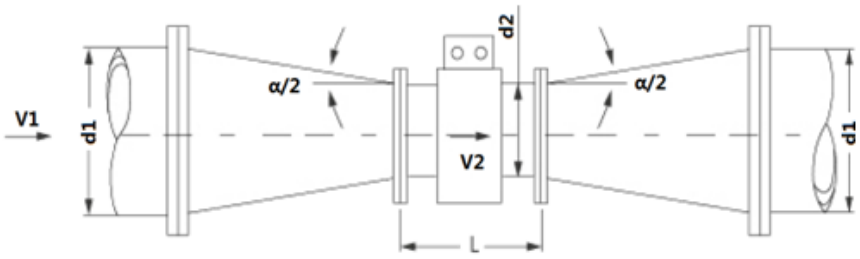
The total pressure loss: ΔP = 0.01 (ΔP1 + ΔP2 + ΔP3) (mbar)

NOTE: ρ is the medium density, the unit is kg / m ³

ξ1, ξ3 are respectively coefficient related with the Reynolds number of reducing pipe and increasing pipe;

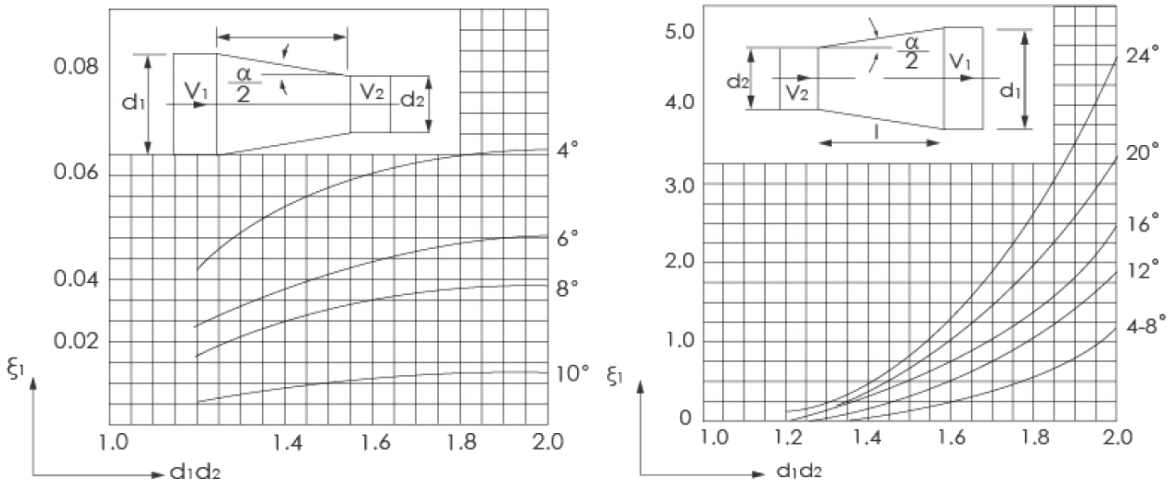
ξ2 = 0.02 is coefficient of sensor measuring pipe;

V1, V2 are respectively velocities in the technological pipeline and sensor measuring pipe, in unit of m/s;



E.g. ξ' valve when α=8°

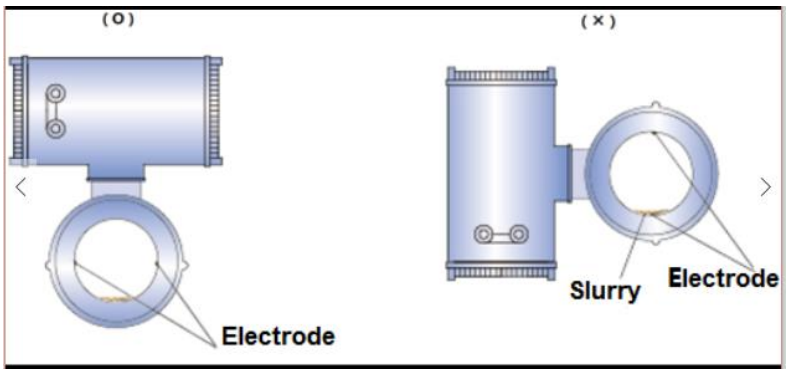
d1/d2	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0
ξ1	0.018	0.023	0.0255	0.028	0.03	0.0308	0.0315	0.0323	0.0332
ξ3	0.01	0.02	0.07	0.15	0.26	0.43	0.64	0.9	1.25



Reducing pipe **Increasing pipe**

Installation Direction

When installing the electromagnetic flowmeter, in general, the axis of the electrodes shall be approximately level in horizontal installation. If the axis of the electrodes is perpendicular to the ground, bubbles will be easily collected near the electrodes located on the upper side, while the electrode located at lower side and stopping the liquid contacting with the same is covered by slurry. The converter shall be installed above the pipeline to prevent water from entering the converter.



Electromagnetic flowmeter must work in full pipe conditions, that is to say, the flowmeter cannot work normally in partially filled pipe or empty pipe conditions.

The positive direction in which fluid flows is generally in the same direction as the arrows in the sensors. There must be enough installation and maintenance space close to the flowmeter to prevent the flowmeter from being vibrated. During installation of the flowmeter, supports for supporting pipeline shall be provided on the two sides of the flowmeter. Stress is prevented from being affected because of pipeline vibration, impact and shrinkage. For

heavily polluted fluid, a consideration that a flowmeter is installed on the pipeline should be given.

The positive direction of the liquid flow should be consistent with the general direction of the arrow on the sensor, and there must be sufficient space for installation and maintenance to prevent the flowmeter from vibration.

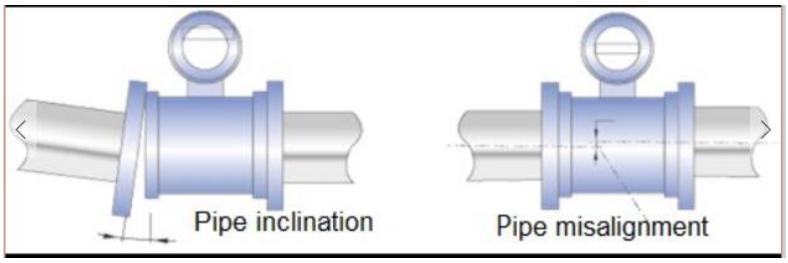
FlowmeterPiping

Pipeline misalignment or inclination is a reason why the pipeline flanges bounces and breaks.

1. When flowmeter is installed, pipeline misalignment or inclination, and installation distance deviation between two flanges should be corrected first.

2.Whenflowmeter is installed, generally there are some foreign matters (e.g., welding slag and scraps) within pipeline path. Prior to installing the flowmeter, these impurities should be washed away.

Fluid Conductivity



The electromagnetic flowmeter cannot be installed in the pipeline where the fluid conductivity is very uneven. Especially, when chemicals are injected from the upstream of the instrument, it is easily to cause unevenness of conductivity, thereby seriously interfering the measurement of flowmeter. In this case, we recommend that chemicals should be injected from the downstream of the instrument. If chemicals must be injected from the upstream of the instrument, a straight pipe segment which is long enough must be installed to ensure that fluids are mixed well.

Fluid Sealant

Please note below points during usage of fluid sealant:

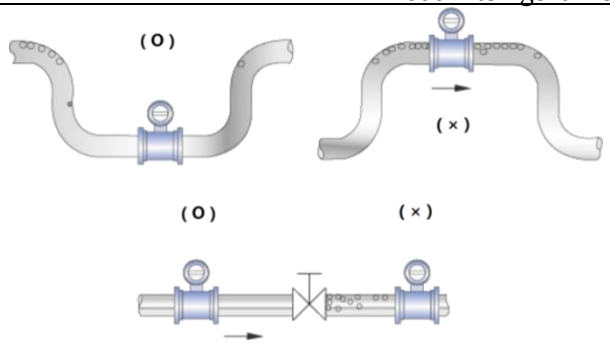
Do not let it cover the surface of the electrode and the grounding ring, because this will influence the measurement of flux.

Using Cut-off valve and the Bypass valve

For easy maintenance and zero setting, cut-off valve and the bypass valve are recommended to use.

Ensure no air bubbles in flowmeter.

Pipeline design should ensure that no air bubbles come out from the fluid. Generally the flowmeter should be installed on the upstream of the valve, because the pressure in the pipeline is reduced under the action of the valve, thereby producing bubble.



Selection of the electrode material

The electrode material should be selected according to the corrosivity of measured medium, and selected by the users who are familiar with the on-site conditions. In general, the corrosion resistance of electrode material is higher than that of pipeline material by one grade. For ordinary media, please consult related anti-corrosion manuals. For media having complex components such as mixed acid, coupon tests should be done.

Electrode Material Properties (for reference only)

Electrode Material	Material Measured Performance（for reference only）	Corrosion Resistance
316L	Domestic water, industrial water, raw wells water, urban sewage, weak corrosive acid, alkali, salt solution	
Hastelloy B（HB）	Hydrochloric acid (concentration <10%) and other non-oxidizing acid Sodium hydroxide (concentration <50%), Ammonium hydroxide alkaline solution on all concentration level; Phosphoric acid, organic acid	not applicable for Nitric acid
Hastelloy C（HC）	Mixed acid such as chromic acid and sulfuric acid solution Oxidizing salts such as: Fe ++++, Cu ++, seawater	not applicable for Hydrochloric acid
Titanium	Salts, such as: (1) chloride (oxide / magnesium / aluminum / calcium / ammonium / iron, etc.) (2) the sodium salt, potassium salt, ammonium salt and sodium hypochlorite salts, as well as potassium hydroxide, ammonium hydroxide, barium hydroxide caustic soda solutions with sea water concentration <50%	Not applicable for hydrochloric acid, sulfuric acid, phosphoric acid, hydrofluoric acid and other reducing acids
Tantalum	Hydrochloric acid (concentration <40%), dilute sulfuric acid and concentrated sulfuric acid (not	Not applicable for alkalo and hydrofluoric acid

	including oleum) chlorine dioxide, ferric chloride, hypochloriteacid, sodium hudroxide, lead acetate Nitric acid (including fuming nitric acid) and other oxidizing acid, aqua regia at temperature below 80℃	
Platinum	Almost all of the acid, alkali, salt solution (including fuming sulfuric acid, fuming nitric acid)	Not applicable for aqua regia, ammonium salt
Tungsten Carbide	Pulp, sewage, solid particles with anti-interference property	Not applicable for inorganic acids, organic acids, chlorides

Ground ring materials selection

Ground ring material can be the same as the electrode material. Generally material with the same corrosion resistance as the pipeline material is optional.

Lining material selection

Lining materials should be chose according to type and temperature of measured fluid. PFA is a kind of fluorinated plastic, with good corrosion resistance to strong acid and alkali. It can withstand high temperature, with no deformation and reduction in insulation resistance at high temperature. 99.9% high-purity alumina is used for making ceramic lining fabrication so that the instrumentation can measure the flux with high precision. In comparison with traditional high polymer material, ceramics cannot create high temperature, high pressure deformation, and have good wear resistance.

Polytetrafluoroethylene (PTFE) Advantages

● High temperature resistance - working temperature is up to 120℃.

● Low temperature resistance - good mechanical toughness; even if the temperature drops to -20℃, it still can maintain 5% elongation.

● Corrosion resistance - for many chemicals and solvents, it presents inertness and is resistant to strong acid, strong alkali, water and various organic solvent.

● Weather resistance - boasting the best aging lifetime of plastics

● High lubrication - boasting the lowest coefficient of friction in solid materials.

● Non-adhesion -boasting the lowest surface tension in solid materials and not adhering to any substances.

● Non-hazardous - with physiological inertness and can be implanted in human bodies for a long term as blood vessel prosthesis and visceral organ, with no adverse reactions.

F46 Advantages

● F46 has the same excellent corrosion resistance like PTFE, but has higher temperature resistance than PTFE, up to

140℃. It can be used for sanitary products and jetted molding, and is easier to be processed.

Polyurethane rubber Advantage

● Code (UR), is the polymerization of polyester (or polyether) with disocyanate compound. Performance: it is a rubber with the highest abrasive resistance. Advantages includes: high strength and elasticity, good oil resistance, good ozone resistance, aging resistance, and good air tightness. Disadvantages includes: poor moisture resistance, low water resistance and alkali resistance, poor solvent resistance. It applies to places requiring high abrasive resistance, high strength and oil resistance.

Neoprene Advantage

● Good adhesion, softness and abrasion resistance, good water resistance, ageing resistance and other characteristics. In contrast, it has poor oil resistance, and is prone to ageing corrosion in environment with mixed oil and gas.

Main performance and application range (for reference only) of Electromagnetic flowmeter liner

Lining Material		Performance	Application range	Measurable medium examples	Notice
	PTFE（F4）	1. Excellent chemical stability, but chlorine and sodium at molten state may be corrosive to such materil. 2, Resistant to hydrochloric acid, sulfuric acid, and aqua regia, and the organic solvents does not resistant to it. 3. Low abrasive resistance and poor adhesion performance. 4. Excellent electrical insulation properties, but poor resistance to corona.	1. Flow meter long-term use temperature is -10℃~120℃. 2. It can be used to measure most acids, alkalis, strong oxidizing agents and other corrosive media, but not suitable for KOH, nitric acid, hydrofluoric acid and the like. 3. Sanitary media.	1, Hydrochloric acid, sulfuric acid, aqua regia. 2, Most other acids, alkalis and oxidizing agents.	1. It does not apply to chlorine trifluoride, liquid fluorine at high flow rates. 2. Generally not used for measuring the electrolyte, such as NaCl solution flowing out of the electrolytic cell. 3. Not suitable for medias with solid particles.
	FEP（F46）	1. It has same chemical stability, electrical insulation, lubrication, non-stick feature and incombustibility as that of PTFE (F4), but FEP material strength, aging resistance, heat	1. The Flow meter long-term use temperature is -40℃~80℃. 2. It can be used to measure most strong acids, alkalis, strong	1. Hydrochloric acid, sulfuric acid, aqua regia. 2. Most other acids, alkalis and oxidizing agents. 3. Medium containing small	1. It does not apply to the molten alkali metal, fuming nitric acid, chlorine trifluoride and the like. 2. It is generally

		resistance and low temperature toughness is better than PTFE's . 2. Good adhesion to metal and better wear resistance than PTFE's. 3. High tear resistance.	oxidizing agents and other corrosive media, but not suitable for KOH, nitric acid, hydrofluoric acid and the like. 3. Sanitary Medias.	amount of tiny particles .	not used for measuring the electrolyte, such as NaCl solution flowing out from the electrolytic cell.
	PFA	1. It closes to FEP (F46) in chemical stability, electrical insulation, lubrication, Non-stick performance and incombustibility, but PFA material strength, aging resistance, heat resistance and low temperature toughness is better than PTFE, FEP. 2. Excellent adhesion to metals and better wear resistance than that of PTFE, FEP. 3. Low smoke, flame retardant, high temperature resistance, two times high-temperature mechanical strength than PTFE's.	1. The Flow meter long-term use temperature is -40℃~160℃. 2. It can be used to measure most acids, alkalis, strong oxidizing agents and other corrosive media, but not suitable for KOH, nitric acid, hydrofluoric acid and the like. 3. Sanitary medias.	1. Hydrochloric acid, sulfuric acid, aqua regia. 2. Most other acids, alkalis and oxidizing agents. 3. Media with a small amount of fine particles. 4. Beer, saponification liquid gas.	1. PFA is as similar chemical properties as PTFE. 2. Usually not used to measure the mud, coal slurry, pulp.
Urethane Rubber		1. It has excellent wear resistance, good oil resistance. 2. It has high strength, good tear resistance, but poor acid and impact resistance. 3. Poor heat resistance, generally 60℃.	1. General long-term use temperature is -10℃~60℃. 2, Good wear resistance, suitable for liquid containing solid particles.	1. Neutral wear strength pulp, coal slurry, mud. 2. Domestic water, industrial water, sewage, water.	1. The fluid temperature ranges from 0℃~40℃. 2. Generally not used to measure medium of mixed organic solvent.

		3. Cannot be used to measure water containing organic solvent.		
Neoprene Rubber	1. It has good flexibility and tear resistance, certain oil resistance. 2. Poor aging resistance, brittleness temperature is at -28℃. 3. The wear resistance is worse than that of polyurethane rubber. 4. It can bear the corrosion of general low concentration of acid, alkali, salt medium, but is not resistant to the oxidizing medium corrosion.	1. Long-term use temperature is -10℃~80℃. 2. As it contains antioxidant D, it is a little polluting. 3. Generally suitable for low concentration of acid, alkali, salt medium and sewage measurement.	1. Regular water, sewage. 2. slurries，Pulp.	1. It cannot be used to measure food. 2. It does not apply to the measurement of acid, alkali, strong oxidizing medium.
Ceramics	1. High strength, no deformation at high temp. and pressure. 2. It has the unique platinum - alumina cermet electrode. 3. It has a good anti-mud noise performance, suitable for permeable fluid. 4. Good wear resistance, and the wear resistance is 10 times that of polyurethane rubber.	1. Suitable for high temperature and pressure fluid, viscous fluid, corrosive fluids. 2. Permeable fluids, slurries containing solid particles.	1. The slurry containing hard solids, corrosive fluids, viscous fluids, high temperature high pressure fluid. 2. Chromium sulfate, 25% sodium hypochlorite, nitric acid and the like.	1. It does not apply to hydrofluoric acid, nitric acid, aqua regia, NaOH, 70% concentration sulfuric acid. 2. It can not be used for measurement of copper sulfate, sodium salts and other salts materials.。

Protection Level Selection

According to GB4208-84, the International Electrotechnical Commission IEC standards (IEC529-76) on enclosure protection class: IP65 (protection against water jets), that is, water projected by a nozzle (water pressure 30kPa

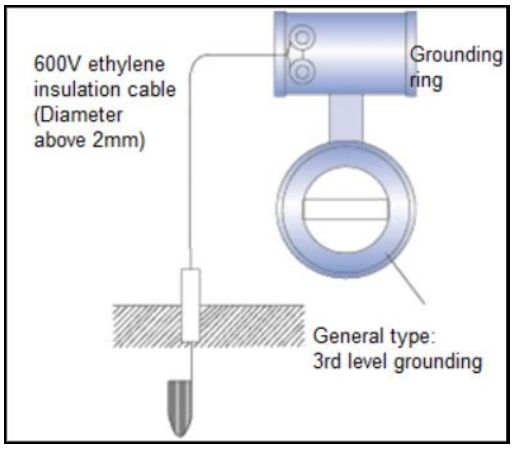
(0.3bar), water volume 12.5L/min, 3m distance) against enclosure from any direction shall have no harmful effects. IP67 (protection against immersion in a short time), that is, ingress of water in harmful quantity shall not be possible when the enclosure is immersed in water under defined conditions of pressure and time (at least 150cm in water, submersion of 30min.). IP68 (protection against immersion in long time), that is, submersion in the water for long time use. The maximum depth of submersion shall be agreed by manufacturer and user.

Protection Selection should be defined according to the above requirements and actual working conditions of instrument. If the meter is below ground, and often immersed in water, IP68 shall be selected; if the meter is installed on the ground, and not in humid environment, IP65 is ok.

Sensor Grounding

Since the voltage of inductive signal of electromagnetic flowmeter is small, it is easily affected by noise. Its reference potential must be the same to the measured liquid potential. Therefore, the reference potential of the sensor (terminal potential), the reference potential of converters and amplifiers are also the same to measured liquid potential, and the liquid potential have to be the same as the ground potential. The electromagnetic flowmeter is equipped with a ground loop, which is for establishing a liquid ground via contact with liquid, and for protecting lining meanwhile.

The instrument grounding is shown as below:



Noise Suppression

Do not install Electromagnetic Flowmeter near motors, transformers or power device which is easy to cause induction interference.