

Overview of WP-EMF Series Sanitary Electromagnetic Flowmeter

The WP-EMF series sanitary electromagnetic flowmeter is developed based on on-site application experience at home and abroad, and has obtained the American 3-A sanitary standard certification. It is not only durable and easy to operate, but also features stable performance with optional high-frequency and low-frequency excitation. It is mainly used as a flow measurement instrument in industries with extremely high hygiene requirements, such as food, beverage, pharmaceutical and bioengineering.

Working Principle

The measuring system of the electromagnetic flowmeter sensor is based on Faraday's Law of Electromagnetic Induction. A pair of detection electrodes is installed on the pipe wall perpendicular to both the axis of the measuring tube and the magnetic field lines. When the conductive liquid moves along the axis of the measuring tube, it cuts the magnetic field lines and generates an induced electromotive force.

This induced electromotive force is detected by the two electrodes on the measuring tube, and its value is expressed as: $E = KBVD$

Where:

- E: Induced electromotive force
- K: Meter constant
- B: Magnetic induction intensity
- V: Average flow velocity within the cross-section of the measuring tube
- D: Inner diameter of the measuring tube

During flow measurement, the fluid passes through a magnetic field perpendicular to the flow direction, and the flow of conductive liquid induces an electromotive force proportional to the average flow velocity. Therefore, the measured flowing liquid is required to have a conductivity higher than the minimum limit. The induced voltage signal is detected by the two electrodes, transmitted to the converter via cable, and after signal processing and relevant calculations, the total flow and instantaneous flow are displayed on the screen of the converter.

Instrument Features

1. Adopts high-finish PFA lining to ensure extremely smooth fluid contact surfaces and prevent adhesion of materials or microorganisms.
2. Materials and design comply with the internationally recognized 3-A sanitary standards. The surface finish of wetted parts is $Ra < 0.8 \mu m$ ($31.5 \mu in$), and can be as high as $Ra < 0.38 \mu m$ ($15 \mu in$), ensuring suitability for direct contact with food and pharmaceutical production processes.
3. Installation Requirements: When the sensor is installed on a pipeline with a non-full-bore valve, an upstream straight pipe section of 10 times the measuring tube nominal

diameter shall be provided, and the downstream straight pipe section shall be no less than 5 times the measuring tube nominal diameter.

4. Measurement accuracy is unaffected by changes in fluid density, viscosity, temperature, pressure, or conductivity. The meter can measure flow in both forward and reverse directions, providing an effective means for accurate flow measurement.
5. Low power consumption, less than 20W.
6. The converter features good interchangeability; measurement accuracy can be achieved without recalibration with actual fluid.

Technical Specifications

1. Analog Current Output

- Load resistance: 0~1.5 k Ω at 0~10 mA; 0~750 Ω at 4~20 mA
- Basic error: 0.1% \pm 10 μ A

2. Frequency Output

- Frequency range: 1~5000 Hz
- Electrical isolation: Opto-isolation, isolation voltage >1000 V DC
- Drive: FET output, max. withstand voltage 36 V DC, max. load current 250 mA

3. Pulse Output

- Pulse equivalence: 0.001~1.000 m³/cp, 0.001~1.000 Ltr/cp
- Pulse width: 50 ms, automatically converted to square wave at high frequency
- Electrical isolation: Opto-isolation, isolation voltage >1000 V DC
- Drive: FET output, max. withstand voltage 36 V DC, max. load current 250 mA

4. Alarm Output

- Alarm contacts: ALMH – high limit alarm; ALML – low limit alarm
- Electrical isolation: Opto-isolation, isolation voltage >1000 V DC
- Drive: Darlington transistor output, max. withstand voltage 36 V DC, max. load current 250 mA

5. Communication Interface and Protocol

- MODBUS: RTU mode, physical interface RS-485, electrical isolation 1000 V
- HART: Supports standard HART protocol; with HART handheld communicator, online display of measured values and modification of instrument parameters are available

6. Electrical Isolation

- Insulation voltage between analog input and analog output: \geq 500 V
- Insulation voltage between analog input and alarm power supply: \geq 500 V
- Insulation voltage between analog input and AC power supply: \geq 500 V
- Insulation voltage between analog output and AC power supply: \geq 500 V
- Insulation voltage between analog output and ground: \geq 500 V
- Insulation voltage between pulse output and AC power supply: \geq 500 V
- Insulation voltage between pulse output and ground: \geq 500 V

- Insulation voltage between alarm output and AC power supply: ≥ 500 V
- Insulation voltage between alarm output and ground: ≥ 500 V

Ordering Information

Users are requested to read this document carefully before placing an order, understand the model and coding specifications of the product, and confirm the model and specifications according to actual requirements. If necessary, please fill in the Electromagnetic Flowmeter Application Selection Sheet on the last page.

WP-EMF Series Sanitary Electromagnetic Flowmeter Performance Indicators



Flange Connection

Clamp Connection

Model	WP-EMF-A/B	WP-EMF-E/F
Installation Type	Flange Type	Clamp (Tri-Clamp) Type
Language Option	Chinese/English display optional	Chinese/English display optional
Nominal Diameter	DN25~DN100	DN25~DN100
Electrode Material	316L	316L
Lining Material	PFA	PFA
Medium	Conductive liquid (including solid-liquid two-phase flow)	Conductive liquid (including solid-liquid two-phase flow)
Accuracy Class	0.2%, 0.5%, 1.0%	0.2%, 0.5%, 1.0%
Medium Conductivity	>5 $\mu\text{S/cm}$ (water >20 $\mu\text{S/cm}$)	>5 $\mu\text{S/cm}$ (water >20 $\mu\text{S/cm}$)
Excitation Mode	Low-frequency square wave excitation; High-frequency square wave excitation (suitable for slurry measurement)	Low-frequency square wave excitation; High-frequency square wave excitation (suitable for slurry measurement)
Flow Velocity Range	0.1~12 m/s (flow unit selectable)	0.1~12 m/s (flow unit selectable)
Connection Standard	GB/T 9124.1-2019	3-A / DIN / ISO
Medium Temperature	Integral type: (-10~+80) $^{\circ}\text{C}$ Split type: (-10~+150) $^{\circ}\text{C}$	Integral type: (-10~+80) $^{\circ}\text{C}$ Split type: (-10~+150) $^{\circ}\text{C}$

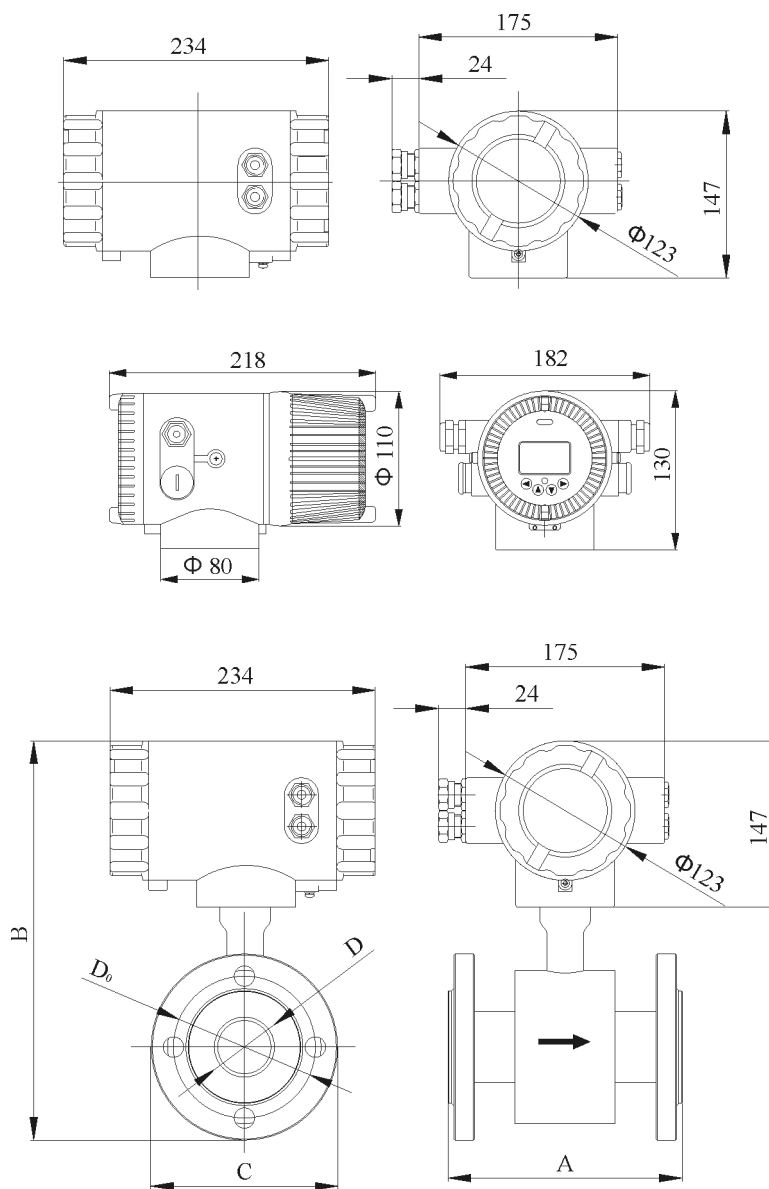


Flange Connection

Clamp Connection

Rated Pressure	Max. working pressure 4.0 MPa	Max. working pressure 1.6 MPa
Ingress Protection	IP67, IP68 (split type only)	IP67, IP68 (split type only)
Output Signal	4~20 mA output, frequency/pulse, alarm	4~20 mA output, frequency/pulse, alarm
Communication	RS485, RS232 (optional), HART (optional)	RS485, RS232 (optional), HART (optional)
Empty Pipe Measurement	Empty pipe measurement without additional electrodes, continuous measurement, fixed value alarm	Empty pipe measurement without additional electrodes, continuous measurement, fixed value alarm
Recording Function	Power failure time recording, automatically logs power interruption duration and compensates missed flow (optional)	Power failure time recording, automatically logs power interruption duration and compensates missed flow (optional)
Infrared Remote Control	Infrared handheld keypad (optional)	Infrared handheld keypad (optional)
Display	Flow velocity, flow rate, percentage, total flow, fault alarm	Flow velocity, flow rate, percentage, total flow, fault alarm
Power Supply	AC220V 50Hz, DC24V	AC220V 50Hz, DC24V
Explosion-proof Mark	Ex db ia q [ia Ga] II C T6 Gb (optional)	None

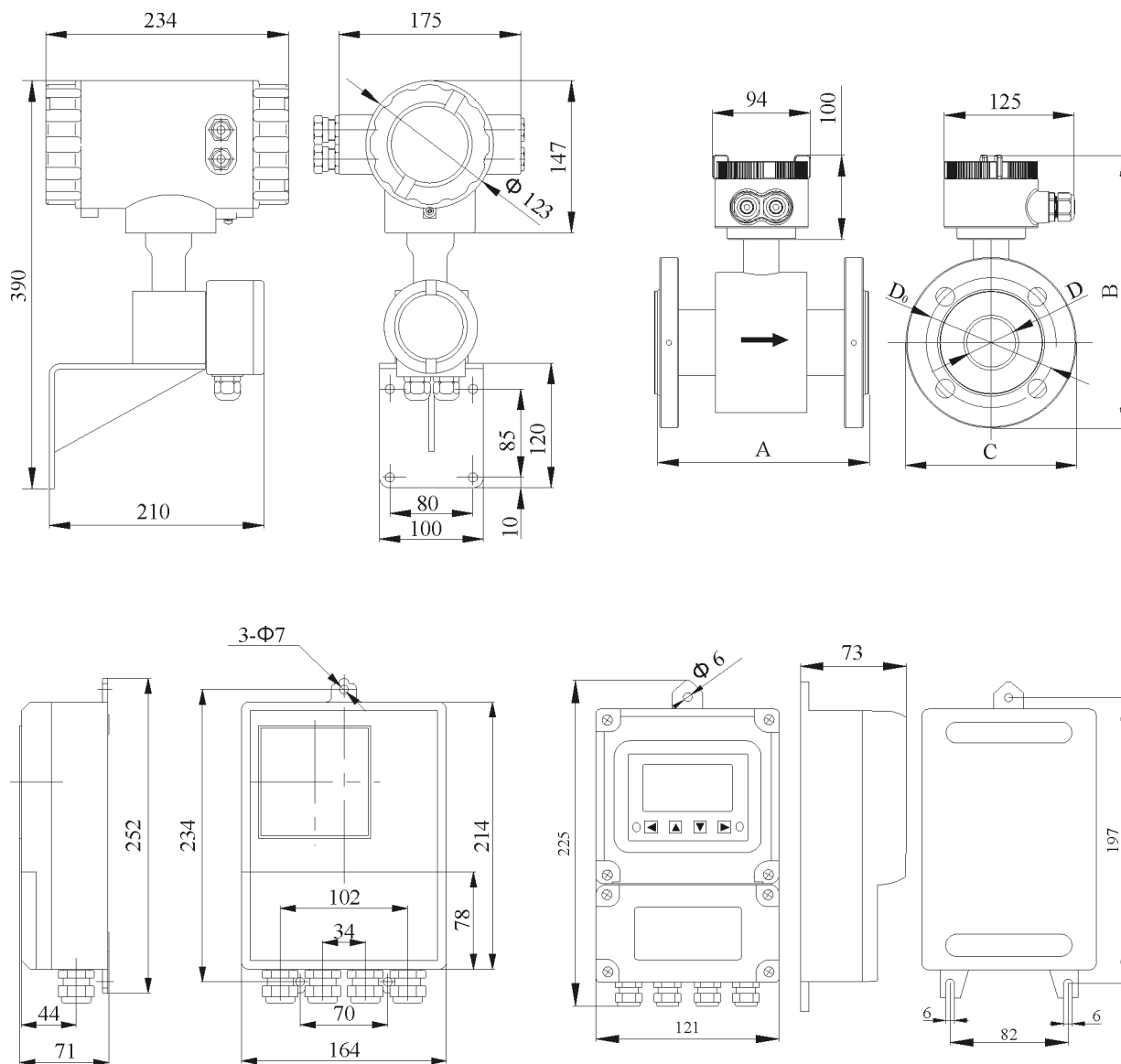
Flange Type Integral Outline Dimensions



Common Specifications of Flange Type Integral Sensor (Reference Dimensions)

Diameter (mm)	Rated Pressure (MPa)	Instrument Outline Dimensions(mm)			Flange Dimensions (mm)		Connection
		A	B	C	D	D ₀	n×Φ
25	4.0	200	337	115	25	85	4×14
32	4.0	200	350	140	32	100	4×18
40	4.0	200	354	150	40	110	4×18
50	4.0	200	376	165	50	125	4×18
65	4.0	200	386	185	65	145	8×18
80	4.0	200	411	200	80	160	8×18
100	1.6	250	431	220	100	180	8×18

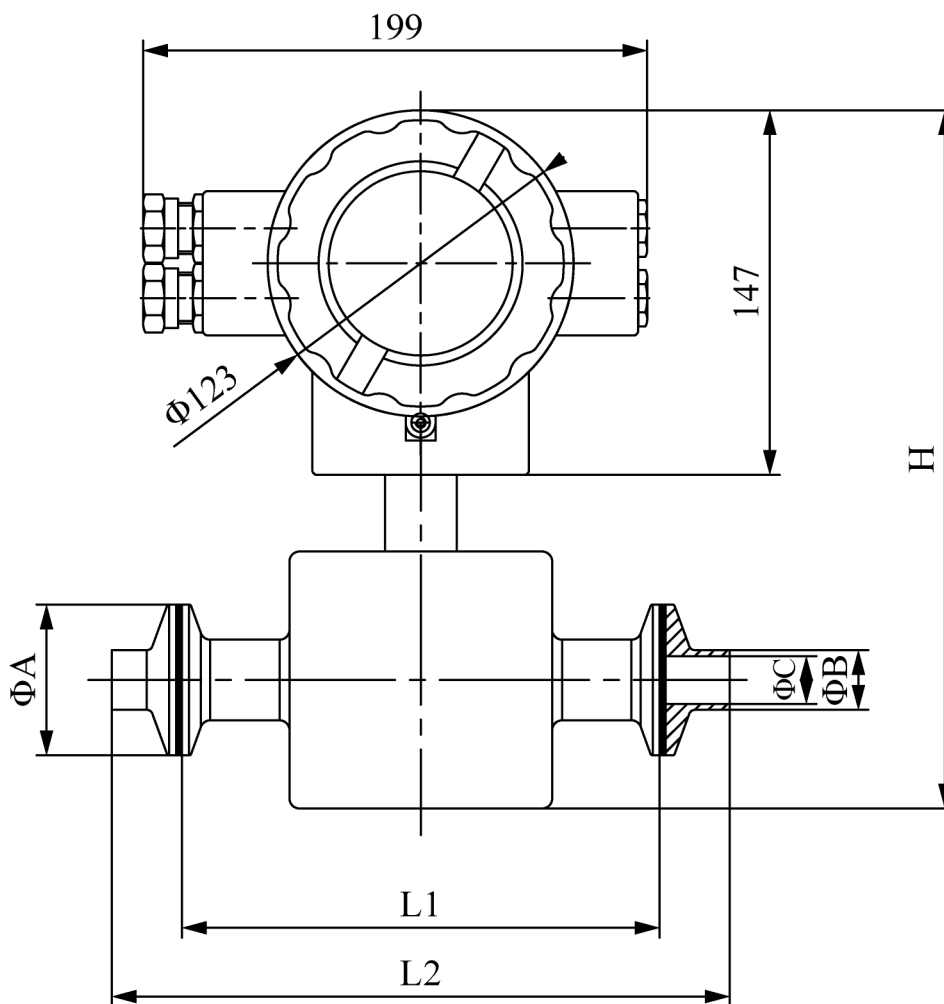
Flange Type Split-Type Outline Dimensions



Common Specifications of Flange Type Split Sensor (Reference Dimensions)

Diameter (mm)	Rated Pressure (MPa)	Instrument Outline Dimensions(mm)			Flange Connection Dimensions (mm)		
		A	B	C	D	D ₀	n× Φ
25	4.0	200	204	115	25	85	4×14
32	4.0	200	216	140	32	100	4×18
40	4.0	200	221	150	40	110	4×18
50	4.0	200	243	165	50	125	4×18
65	4.0	200	253	185	65	145	8×18
80	4.0	200	278	200	80	160	8×18
100	1.6	250	298	220	100	180	8×18

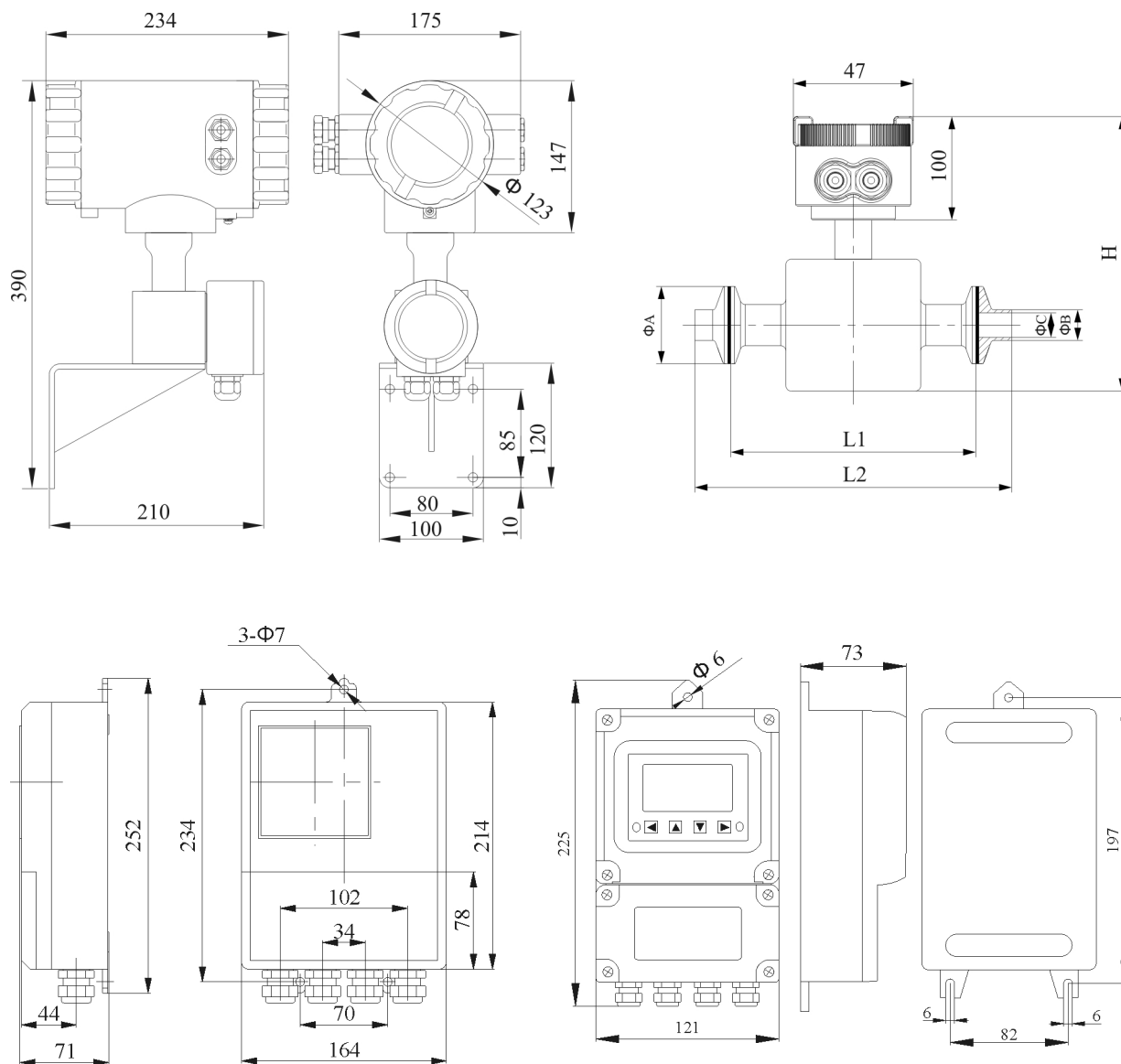
Clamp Type Integral Outline Dimensions



Common Specifications of Clamp Type Integral Sensor (Reference Dimensions)

Diameter (mm)	Rated Pressure (MPa)	Instrument Outline Dimensions (mm)					
		A	B	C	H	L1	L2
25	1.6	50.5	28	25	302	165	208
32	1.6	50.5	34	31	307	165	208
40	1.6	64	45	41	317	165	208
50	1.6	77.5	57	53	327	165	208
65	1.6	91	70	66	347	165	208
80	1.6	106	85	81	362	165	208
100	1.6	119	104	100	390	215	258

Clamp Type Split-Type Outline Dimensions



Common Specifications of Clamp Type Split Sensor (Reference Dimensions)

Diameter (mm)	Rated Pressure (MPa)	Instrument Outline Dimensions (mm)					
		A	B	C	H	L1	L2
25	1.6	50.5	28	25	269	165	208
32	1.6	50.5	34	31	274	165	208
40	1.6	64	45	41	284	165	208
50	1.6	77.5	57	53	294	165	208
65	1.6	91	70	66	314	165	208
80	1.6	106	85	81	329	165	208
100	1.6	119	104	100	357	215	258

WP-EMF Series Sanitary Electromagnetic Flowmeter Model Chart

Model	Structure
WP-EMF-A	Integral Flange Electromagnetic Flowmeter
WP-EMF-B	Split Flange Electromagnetic Flowmeter (10m cable as standard)
WP-EMF-E	Integral Clamp Electromagnetic Flowmeter
WP-EMF-F	Split Clamp Electromagnetic Flowmeter (10m cable as standard)
Code	Diameter
()	DN25~DN100 (indicated by number)
Code	Electrode
1	Stainless Steel (316L)
Code	Lining Material
D	Perfluoroalkoxy Alkane (PFA) (negative pressure resistant)
Code	Working Pressure
1	4.0MPa (DN25~DN80, flange type only)
2	1.6MPa (DN25~DN80 clamp type; DN100 flange type only)
3	1.0MPa (DN100)
Code	Grounding Ring
A	None
B	Standard Grounding Ring (316L, flange type only)
C	Hubbed Grounding Ring (316L, flange type only)
D	Grounding Electrode (3-electrode, flange type only)
Y	Others (flange type only)
Code	Protection Class
B	IP67
C	IP68 (split type only)
Code	Output
0	No output
1	4~20mA Frequency/Pulse
Code	Communication

0	No communication
1	RS485 (standard)
2	RS232
3	HART
Code Power Supply	
T	AC220V 50Hz
W	DC24V
Code Accuracy Class	
4	0.2 class
5	0.5 class
6	1.0 class
Code Converter Type	
2	Integral Type II
3	Split Type I
6	Split Type III
Code Function Type	
K	Sanitary Type
KD	Sanitary Explosion-proof & Intrinsically Safe Type (Ex db ia q [ia Ga] II C T6 Gb)
Code Max Flow Rate	
()	Specify maximum flow in m ³ /h
Selection Example	WP-EMF-A(100)1A3AB11T52KD(80)

Selection Details for WP-EMF Series Sanitary Electromagnetic Flowmeter

Selection Precautions

Correct selection of an electromagnetic flowmeter is a prerequisite for ensuring its proper operation. The selection shall be determined based on the user's process flow, physical and chemical properties of the measured fluid, installation and operating environment, and other factors, so that parameters such as flowmeter structure, nominal diameter, flow range, lining and electrode materials, installation environment, and output signals can meet measurement requirements.

To select a flowmeter correctly and reasonably, consideration may be given to the following aspects according to specific application conditions.

Selection of Flowmeter Nominal Diameter and Measuring Range

For a flowmeter, its nominal diameter and measuring range must first be determined, i.e., the flow velocity range inside the sensor measuring tube shall be defined. The selection of the flowmeter measuring range is critical to improving its operational reliability and accuracy. The full-scale range shall be selected based on the principle of not being lower than the estimated maximum flow rate. The normal operating flow rate should preferably not exceed 50% of the full scale, so that higher measurement accuracy can be achieved. The sensor is usually selected with the same nominal diameter as the process pipeline or a slightly smaller size. With the flow rate determined, the nominal diameter is selected according to different measuring objects and the flow velocity inside the sensor measuring tube.

Based on its measuring principle, the flow velocity of the fluid measured by an electromagnetic flowmeter can be set quite high, up to 10 m/s in some applications. However, under general operating conditions, considering the relationship between flow velocity and head loss in the pipeline, a flow velocity of 2–4 m/s is most appropriate. Under special conditions, the velocity shall be determined according to different application requirements:

- For fluids containing particles that may cause pipe wall abrasion, the flow velocity is generally ≤ 3 m/s.
- For fluids prone to adhering to the pipe wall, the flow velocity is generally ≥ 2 m/s.
- When measuring pulp, increasing the flow velocity to above 4 m/s can automatically remove fibers attached to the electrodes.

Once the flow velocity is determined, the nominal diameter of the sensor can be determined using the following relationship.

$$V = 353.678 \frac{Q}{d^2} (\text{m/s})$$

Where: d – sensor nominal diameter (mm) Q – volumetric flow rate (m^3/s)

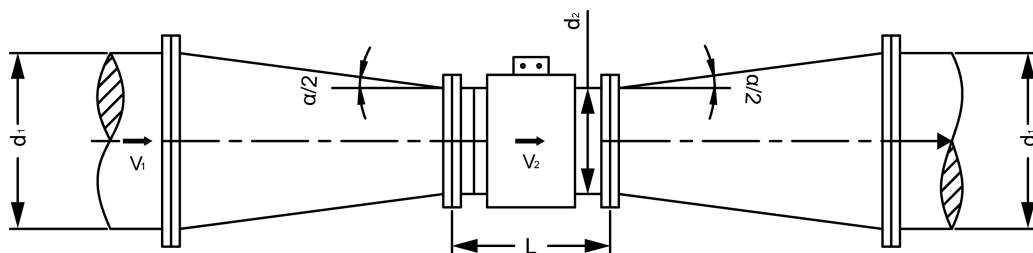
When the medium flow velocity in the pipeline is within the range of 0.3 m/s~12 m/s, the sensor diameter may be selected the same as the connected process pipeline diameter. This selection ensures convenient installation without the need for reducers. During the initial commissioning of a new project, flow velocity is relatively low; as the project is fully operational later, the flow velocity will increase accordingly. The meter can adapt simply by modifying the full-scale flow setting on site, without replacing the instrument. The relationship among flow rate, flow velocity and diameter can be referred to the relevant curve chart.

The sensor diameter should be different from the process pipeline diameter under the following conditions:

- A. When the flow velocity in the pipeline is low and the process flow is relatively stable, to meet the flow velocity requirements of the meter, a smaller sensor diameter is selected to locally increase flow velocity. Reducers shall be installed upstream and downstream of the sensor.
- B. For cost considerations, the price of large-diameter electromagnetic flowmeters increases with diameter. For applications with low pipeline flow velocity and stable process parameters, a smaller-diameter sensor may be adopted. This not only allows the meter to operate under favorable conditions but also reduces instrument investment cost.

Points for Attention when Installing Reducers

- A. To avoid excessive disturbance to the flow profile and maintain the accuracy of the electromagnetic flowmeter after installing reducers, reducers can be regarded as part of the straight pipe section. The central cone angle α of the reducer shall be no more than 15° , the smaller the better.



Example: Value of ξ when $\alpha = 8^\circ$

d_1/d_2	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0
ξ_1	0.018	0.023	0.0255	0.028	0.03	0.0308	0.0315	0.0323	0.0332
ξ_3	0.01	0.02	0.07	0.15	0.26	0.43	0.64	0.9	1.25

- B. Installing reducers will result in pressure loss.

The total pressure loss consists of three parts:

- Pressure loss in the reducing pipe $\Delta P_1 = \frac{\rho}{2} \xi_1 V_1^2$

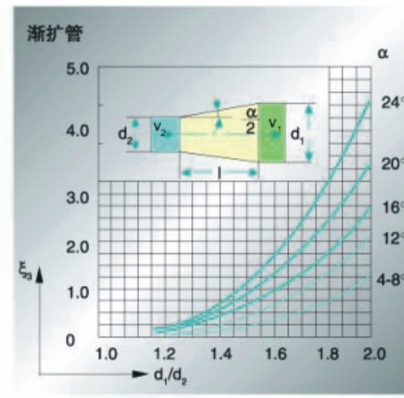
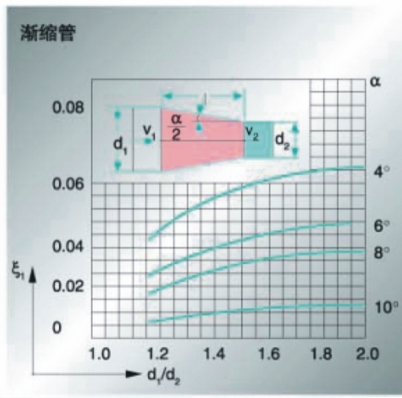
- Pressure loss in the expanding pipe $\Delta P_3 = \frac{\rho}{2} \xi_3 V_1^2$

- Pressure loss in the sensor measuring tube $\Delta P_2 = \frac{\rho}{2} \xi_2 V_2^2$

The total pressure loss is: $\Delta P = 0.01 (\Delta P_1 + \Delta P_2 + \Delta P_3)$ (mbar)

Where:

- ρ is the medium density, in kg/m³;
- ξ_1 and ξ_3 are coefficients related to Reynolds number for the reducing pipe and expanding pipe respectively;
- $\xi_2 = 0.02$ is the coefficient of the sensor measuring tube;
- V_1 and V_2 are the flow velocities in the process pipeline and sensor measuring tube respectively, Unit: m/s.



Selection of Electrode Materials

Electrode Material	Corrosion Resistance
Molybdenum-containing stainless steel OCr18Ni12Mo2Ti	Offers strong corrosion resistance to nitric acid, <5% sulfuric acid at room temperature, boiling phosphoric acid, formic acid, alkaline solutions, sulfurous acid under certain pressure, seawater, acetic acid and other media. Widely used in petrochemical, urea, vinylon and other industries.

Selection of Lining Materials

Properties and Application Scope of Common Lining Materials

Lining Material	Main Properties	Application Scope
Perfluoroalkoxy (PFA)	1. Chemical stability, electrical insulation, lubricity, non-stickiness and non-flammability are similar to PTFE, while PFA offers better strength and aging resistance. 2. Good adhesion to metals; better wear resistance than PTFE and F46.	1. Long-term operating temperature: -40°C ~ +260°C 2. Strong corrosive media such as acids and alkalis

	3. Low smoke, flame retardant, high temperature resistant; high-temperature mechanical strength is twice that of PTFE.	3. Hygienic / sanitary media
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Selection of Protection Class

In accordance with the national standard GB/T 4208-2017 and IEC standard IEC 60529:2001 for enclosure protection, the ratings are defined as follows:

IP67: Dust-tight and protected against temporary immersion. The instrument can be fully submerged in water for a short period. During testing, the highest point of the enclosure shall be at least 150 mm below water level, the lowest point at least 1000 mm below water level, for a minimum duration of 30 minutes.

IP68: Dust-tight and protected against continuous immersion in water under specified conditions. The instrument shall operate in water for a long term; the maximum immersion depth shall be agreed between the manufacturer and the user.

The protection class shall be selected based on the above requirements and actual operating conditions.

- If the instrument is installed below ground level and subject to frequent flooding, IP68 is recommended.
- If installed above ground level, IP67 may be selected.

Selection of Grounding Ring (Flange Type Only)

If the pipeline connected to the instrument is electrically insulating (relative to the measured medium), a grounding ring shall be used, either standard type or hubbed type, both made of 316L.

If the measured medium is abrasive, a hubbed grounding ring is recommended to protect the lining at the inlet and outlet ends and extend service life.

Selection of Cable Length

The connecting cable between the sensor and the transmitter is a special multi-shielded cable. The cable length specified in the model specification table refers to this cable. Its maximum length depends on medium conductivity: the maximum length is 5 times that corresponding to the lowest conductivity, and generally shall not exceed 100 m (longer lengths require coordination with the manufacturer).

The connecting cable between sensor and transmitter shall normally be protected by steel conduit during on-site installation.

Cable splicing is not allowed. In case of accidental breakage or need for extension, please contact the manufacturer.

Precautions for Cable Laying (Split Type)

1. The input signal cable of the transmitter must be laid separately in steel conduit, which shall be properly grounded.

2. Signal cables and excitation cables shall not be routed parallel to other cables such as those for motors, transformers or other power cables. The distance between them shall be at least 1m.
3. Signal cables and excitation cables shall not be cut off or broken midway, and shall not be extended by welding or any other splicing method.
4. No short circuit is allowed between excitation terminals, and no load other than the sensor excitation coil shall be connected.
5. For power cables and other output signal cables, please use rubber-sheathed cables with an outer diameter of 10.5 mm (to be provided by the user).
6. Conduits may be heavy-gauge threaded pipes, seamless steel pipes, or welded steel pipes complying with GB/T 14823.1. At least 5 full threads shall be engaged at the connection between conduit and fitting.

Precautions for Sensor Installation

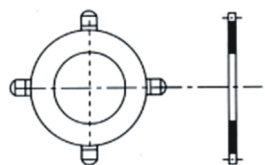
Sensor Grounding

Since the flow signal detected by the electrodes of the electromagnetic flowmeter is very weak, external interference has a significant impact on it. Therefore, good grounding largely determines the measurement accuracy and stability of the flowmeter. The measured fluid itself acts as an electrolytic conductor, and other irrelevant electromagnetic interference must be eliminated.

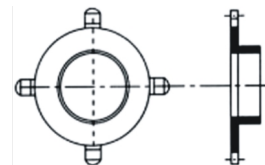
The flowmeter is usually installed on metal pipelines, and the pipeline must be connected to the sensor's grounding terminal. If the pipeline connected to the sensor has an insulating coating on the inner wall or is a non-metallic pipeline, grounding rings shall be installed on both sides of the sensor.

1. Types of Grounding Ring (Flange Type Only)

- A. Standard grounding ring: Material is 316L, thickness $\leq 5\text{mm}$.
- B. Hubbed grounding ring: Material is 316L, thickness $\leq 5\text{mm}$. It is used for abrasive media such as slurry. It can protect the lining at the end of the measuring tube and extend the service life of the sensor. This type of grounding ring must be ordered together with the instrument; otherwise, using it on an instrument not originally equipped with this type of grounding ring will affect the measurement accuracy.



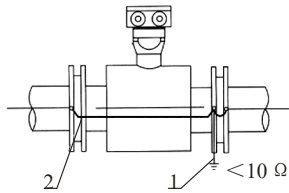
A. Standard or PVC Grounding Ring



B. Hubbed Grounding Ring

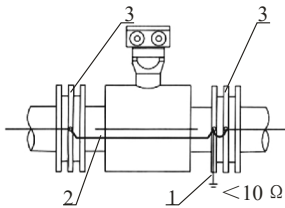
2. Grounding Method

A. Installation of Sensor on Metal Pipelines: If the inner wall of the metal pipeline has no insulating coating, ground the sensor as shown in the figure below.



1. Grounding device wire (installed when external interference is significant)
2. Instrument grounding wire (attached upon delivery)

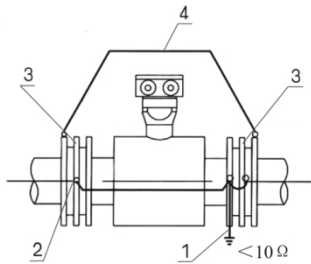
B. Installation of Sensor on Plastic Pipelines or Pipelines with Insulating Coatings/Paints: Grounding rings (or short pipes with grounding wires) shall be installed at both ends of the sensor to short-circuit the flowing measured medium to the ground, ensuring it has zero potential. Otherwise, the electromagnetic flowmeter cannot work properly.



1. Grounding device wire (installed when external interference is significant)
2. Instrument grounding wire (attached upon delivery)
3. Grounding flange or grounding ring

Installation of Sensor on Cathodic Protection Pipelines

Installation of the sensor on cathodic protection pipelines: Pipelines with cathodic protection have a certain potential difference relative to the ground, resulting in a very high common-mode grounding potential of the measured medium. Therefore, grounding rings must be used for the sensor.



1. Grounding device wire (installed when external interference is significant)
2. Instrument grounding wire (attached upon delivery)
3. Grounding flange or grounding ring must be insulated from the flange of the connected pipeline.
4. The connecting wire, with a copper core cross-sectional area of 16 mm^2 , is used to isolate the cathodic protection potential from the sensor.

Notes:

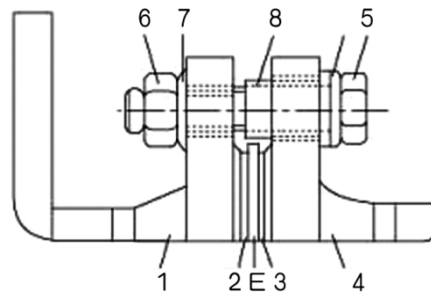
(1) Grounding rings shall be installed on both end faces of the sensor. They must be insulated from the flanges of the connected pipelines, and connected to the sensor and the grounding rings via the instrument grounding wire (2). The material of the grounding

rings shall be resistant to medium corrosion; the standard material provided by the manufacturer is stainless steel 1Cr18Ni9Ti.

- (2) The flanges of the connecting pipes on both sides of the instrument shall be connected with a copper wire of 16 mm² cross-sectional area, bypassing the sensor, to isolate the cathodic protection potential from the sensor.

For pipelines with cathodic corrosion protection, the sensor is insulated from the connecting pipelines on both sides. The following points shall be noted during installation:

- Grounding rings insulated from the pipeline flanges must be installed at both ends of the flowmeter at the same time. The grounding rings, the flowmeter and the grounding device wire must be connected to each other.
- The pipeline flanges must be connected to each other with a copper cable (L), and care must be taken not to connect it to the sensor.
- The flange connecting bolts must be insulated (as shown in the figure). The user must use bushes and washers made of insulating materials.



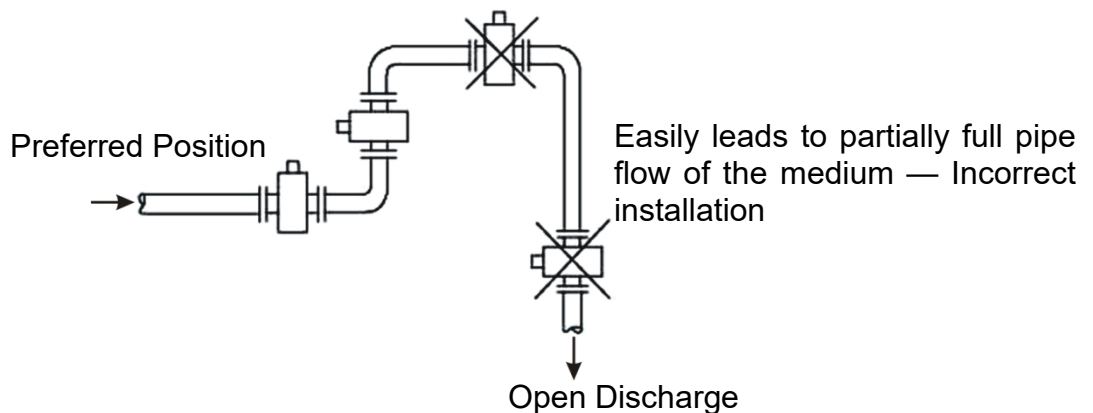
E Grounding Ring	3 Sealing Ring	6 Nut
1 Sensor Flange	4 Pipe Flange	7 Washer
2 Lining	5 Bolt	8 Insulating Bushing

Installation Position

To avoid measurement errors caused by entrained gas, as well as damage to PTFE and rubber linings induced by vacuum, please refer to the following:

Do NOT install at the highest point of the pipeline route

(This is an incorrect installation method, as it will easily cause air bubbles to accumulate in the measuring tube)

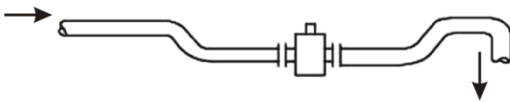


Install on the slightly upward sloping section of the horizontal pipeline

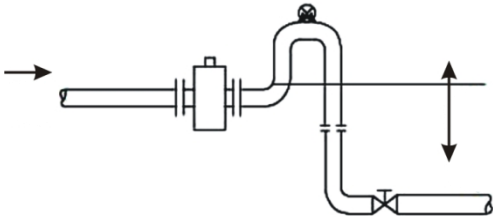


For long pipelines, control valves and shut-off valves shall always be installed downstream of the flowmeter.

Install the instrument in the low section of the pipeline for open feed or open discharge applications.



When the length of the drop pipe exceeds 5m (16ft). Install an automatic air vent valve at the highest point downstream of the flowmeter to prevent vacuum conditions.



Never install the flowmeter on the suction side of the pump to avoid vacuum.

