

ELECTROMAGNETIC FLOW METER

USER MANUAL

MODEL MGG/JY

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MGG/JY model electromagnetic flow meter

I. Outline drawing of electromagnetic flow meter



II. Application and functions of electromagnetic flow meter

MGG/JY model electromagnetic flow sensor is made depend on Faraday's law of electromagnetic induction, and linearly transfer the fluid flow of pipe into voltage signal, which will be mated with MGG/JY model electromagnetic flow converter to be named MGG/JY model electromagnetic flow meter, and used to measure the flow of kinds of conductive liquids.

Characters of electromagnetic flow sensor as following:

- (a) Without moving parts inside of the sensor, simple structure and reliable running;
- (b) Measuring accuracy will not be influenced by medium temperature, press, viscosity, density and physical parameter; as long as the conductivity of measured medium more than $20\mu\text{s}/\text{cm}$, and indication is not influenced by conductivity changes.
- (c) Sensor is integral sealing structure, and makes the measuring tube and shell to be one body;
- (d) There is nearly no pressure lost and be energy saving when fluid passing through the sensor;
- (e) Wide measuring range, the max flow velocity inside pipe could be any set from 0.01 m/s to 10 m/s, and output signal and flow will be linear relation.
- (f) Because of the small size and light weight of sensor, the requirement to upstream and downstream straight pipe of sensor will be lower and easier to install.

Since above unique characters of electromagnetic flow sensor, which will be widely used to conductive liquids of petroleum chemical, chemical fiber, metallurgy, fertilizer, paper pulp, water supply and drainage, irrigation and sewage treatment industries etc.

III. Components of electromagnetic flow sensor

Connection method of sensor is flange type, to connect with pipes.

Liner and electrode materials as following:

Electrode materials: SUS316L, HB, HC, Ti, Tan and stainless steel coated with tungsten carbide;

Liner materials: Neoprene, PTFE, PU (Polyurethane), FEP, PFA and high temperature rubber.

Different electrode and liner materials will be used to different mediums.

IV. Main technology performance

1. Nominal diameter (mm)

6、10、15、20、25、32、40、50、65、80、100、125、150、200、250、300、350、400、450、500、600、700、800、900、1000、1200、1400、1600、1800、2000、2200、2400、2600、2800、3000

2. Accuracy

±0.2%、±0.5%

3. Measuring range (velocity)

0.01 m/s 至 10m/s

4. Conductivity of measured medium

More than 20μs/cm

5. Nominal pressure (Mpa)

Table 1 nominal pressure of sensors

Nominal diameter (mm)	10-150	200-1000	1200-3000
Nominal pressure (MPa)	1.6~4.0	1.0	0.6

6. Selection of liner and electrode

Selection table of different liners as following:

Liner material	Main performance	Application
Neoprene	Good elasticity and high breaking tenacity, good wearing resistance performance; resist common concentration acid, alkali and salt.	1. Max temperature of medium is 80C; 2. mainly used to measure water, sewage, slurry and pulp etc.
PTFE	The chemical performance of PTFE is the most stable in all plastics, and resist boiling hydrochloric acid, sulfuric acid, nitric acid aqua regia, concentrated alkaline and kinds of organic solutions; food degree;	Temperature of medium is -40C to 180C; mainly used to strong corrosive mediums like concentrated acid, alkali and sanitary mediums.
	With excellent wear resistant property	Max temperature of medium

PU (Polyurethane)	(equals to ten times of natural rubber); but bad acid and alkali resistant property;	should be less than 80C; used to measure pulp and coal slurry with middle strong abrasion.
FEP	Chemical performance is similar with PTFE, negative pressure resistant property is better than PTFE, food degree; price will be higher;	Same with PTFE
PFA	Chemical performance is similar with PTFE, with good negative pressure resistant property, food degree; price will be higher;	Same with PTFE
Hard rubber		

7. Selection table of different electrodes as following:

Electrodes material	Main performance and application
SUS316L	Used to industrial water, life water, sewage etc, with weak corrosion; apply to petroleum, chemical, metallurgy industries, and municipal and environmental protection fields;
HB	With good corrosion resistance performance to all concentrations of hydrochloric acid below the boiling point; also resist sulfuric acid, phosphoric acid, hydrofluoric acid, organic acid and other non-oxidizing acid, alkali and hydrochloric acid etc.
HC	Resist non-oxidizing acid, such as the mixture of nitric acid/chromic acid and sulfuric acid; and resist oxidizing salt, such as Fe ³⁺ , Cu ²⁺ and other oxidizing agents like hypochlorite solution and sea water etc.
Titanium	Resist sea water, kinds of chlorides, hypochlorite, oxidizing acid(including nitrosnitric acid), organic acid, alkali etc, but not resist purified reductic acid(sulfuric acid, hydrochloric acid); Corrosion will reduce greatly when it has only oxidizing agent(like nitric acid and ionic mediums with Fe, Cu) in the acid.
Tantalum	Good corrosion resistant property, similar with glass; it could almost resist all chemical mediums(including boiling hydrochloric acid, nitric acid and sulfuric acid below 175C), but not hydrofluoric acid, strong sulfuric acid and alkali.

Stainless steel coated with tungsten carbide	Used to strong wearing mediums, but without corrosion.
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8. Max working temperature of measured mediums

Liner materials	Max working temperature
Neoprene and PU(Polyurethane)	80°C
PTFE	120°C
PFA, FEP and high temperature rubber	180°C

9. Ambient temperature:

-10°C ~ +50°C

10. Output signal:

4-20mA, pulse, 0-10V

11. Communication protocol:

Hart, Modbus, Profibus

V. Working principle and structure

1. Working principle

Sensor is made depend on Faraday’s law of induction, when the conductive fluid move vertically with magnetic line in alternating magnetic field, conductive fluid will cut the magnetic line and produce the electromotive force, and the electrodes installed on the tube wall which is vertical with axis of measuring tube and magnetic line will checkout the induced electromotive force. The electromotive force and flow are proportional, you could derive the flow of sensor if you checkout such electromotive force. As diagram(1). The flow signal(electromotive force) transfer to converter and changed to DC signal 0-10mA, 4-20mA or 0-10kHz frequency output after amplified, and realized the flow measurement.

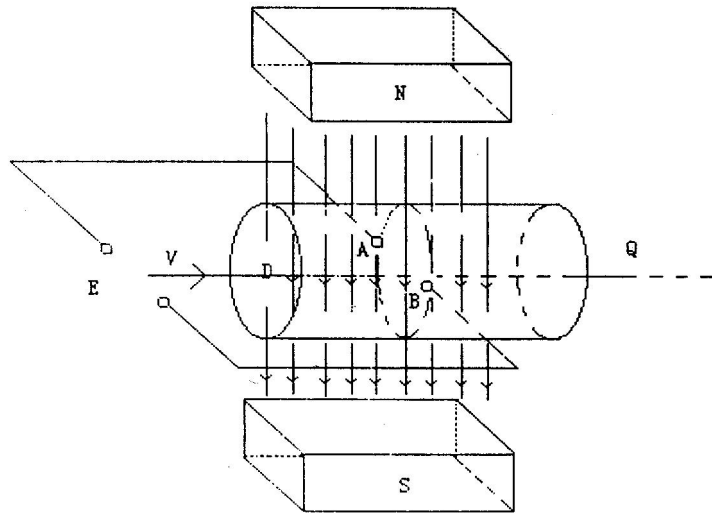


Diagram 1 working principle of electromagnetic flow sensor

2. Flow formula

$$E = B\bar{D}V \quad (1)$$

$$Q = 3600\bar{V} = 3600 \times \frac{E}{BD} \times \frac{\pi D^2}{4} = \frac{900\pi D}{B} \times E \quad (2)$$

Formula: E-----Induced electromotive force (V);

\bar{V} -----Average velocity when fluid passing electrodes surface inside pipe (m/s);

D-----Inner diameter of measuring tube (mm);

B-----Magnetic strength (T);

Q-----Flow value (m³/h);

A-----Area of measuring tube (m²);

3. Structure

Sensor mainly consists of measuring tube, excitation system, electrodes, shell and junction box etc, as the diagram 2.

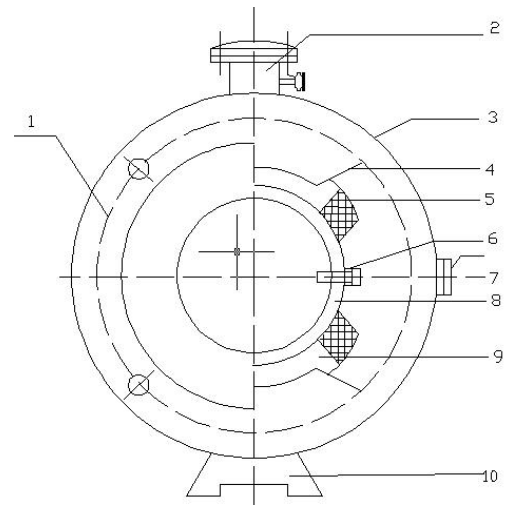
Measuring tube: measuring tube is in the center of sensor, fluid will pass through it. It is made of anti-acid stainless steel tube and flanges by welding, and insulated liner inside.

Excitation system: it mainly consists of excitation coil and magnetic yoke, which will produce a working magnetic field.

Electrodes: it will produce flow signal after electrodes touched with measured medium, that is why electrode material selections will depend on the performance of measured medium.

Shell: it makes supporting, protection and sealing functions.

Junction box: it is on the top of sensor, wiring board inside will connect the sensor with converter.



VI. Installation and operation

1. Installation

1) Selection of installation environment

(a) try the best to be far away from the devices with strong magnetic field.

Diagram

Such as big electric machines and transformer etc.

1-flange 2- junction box 3- shell 4-magnetic yoke 5-excitation coil 6-electrodes

7- grounding bolts 8-insulated liner 9-measuring tube 10- base

(b) keep the installation site without strong shaking and ambient temperature should be stable.

(c) a place easy to install and maintain.

2) Selection of installation position

(a) The fluid direction and flow direction vane on the sensor should keep same;

(b) In such position, you have to ensure the fluid is full of the pipe;

(c) Such position should be far away from pump and local resistance parts (valves and bows);

(d) Please choose the position where it will be not easy to cause the phase separation when you measure the two-phase fluids. Try best to avoid the the position where there is negative pressure in the pipe;

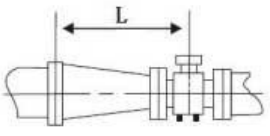
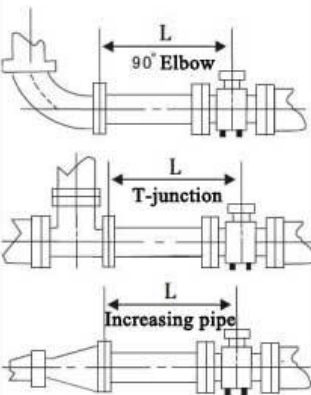
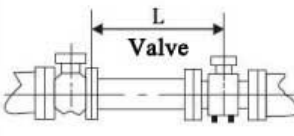
(e) When the electrodes and measuring tube were covered by some adherency or scaling, we suggest that fluid velocity not less than 2m/s.

(f) when the liner was worn by medium, we suggest the fluid velocity not more than 3m/s;

3) Requirements to upstream straight pipe

Please refer to table 2 about the requirements to upstream straight pipe, but there is no requirements to downstream straight pipe, which will not influence the measuring accuracy. If the diameters of upstream and downstream straight pipes are different with the nominal diameter of sensor, you should install the diffusion tube or reducing tube, cone angle should be less than 5 degree, then connect with pipe.

Table 2 Min straight pipe requirements to upstream of sensor

 <p>Note: L is straight pipe length D is nominal diameter</p>		
<p>$L=0D$ (straight pipe)</p>	<p>$L \geq 5D$</p>	<p>$L \geq 10D$</p>

Note: L is the multiple of nominal diameter of sensor, D is nominal diameter of sensor.

4) Horizontal installation

Please follow the horizontal position of two electrodes when horizontal installation, so even if any gas or deposit contained in the medium, it will be not be attached to the surface of electrodes and caused the open circuit, and deposit will not cover the electrodes and caused zero drift. As diagram (3).

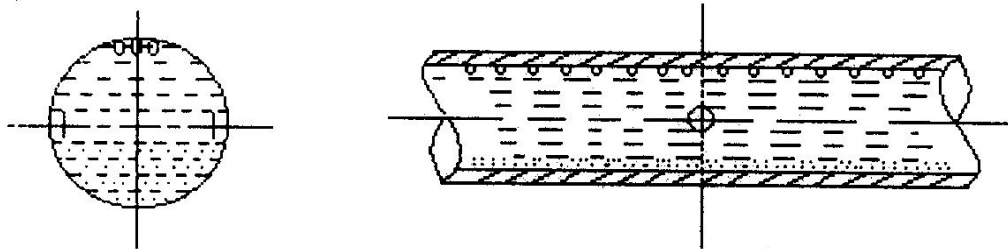


Diagram 3 electrodes position drawing when sensor is horizontally installed

In order to ensure the medium is full of the measuring tube all the time, the position of sensor should be lower than the the height of pipe, or make sensor with certain positive pressure.

5) Vertical installation

Vertical installation is more reasonable to liquid-solid two phase mediums, first to prevent the medium to be separated, secondly to make the liner wearing be balanced.

While vertical installation, medium flow direction should be from down to up, which will ensure the medium will be full of pipe.

6) Sensor installation on pipeline

- (a) Installation site and position depend on the requirements, but axis of electrodes should be horizontal, in order to avoid the electrodes be covered with gas and caused output shaking.
- (b) The medium should be full of measuring pipe;
- (c) Attention to the flow direction;
- (d) The straight pipe should keep 5D on the upstream, and 3D on the downstream(D is inner diameter of pipe).
- (e) To vortex or spiral fluids, you should add upstream and downstream straight pipe or install straight pipe.
- (f) To avoid the strong magnetic field nearby the flow meter;
- (g) It is better to choose vertical installation to wearing mediums;
- (h) To mixed medium by different liquids, please install the flow meter at the position of minimum 30D of upstream or downstream of mixing point.
- (i) Notices as following:
 1. Avoid the measurement error caused by gas, and the damages to PTFE and Neoprene liners caused by vacuum, as diagram 1;
 2. To openly drainage pipes, please install flow meter at the lower section, as diagram 2;
 3. Please install air valve(vacuum) on the downstream to the position where pipe drop more than 5m, as diagram 3;
 4. It is better to install the control valve on the downstream of flow meters to long pipelines, as diagram 4;
 5. It can not be installed at the suction and pumping sides of pipe, as diagram 5;
 6. It can not be installed on the free vibrated pipes;
 7. Install the sensor underground.

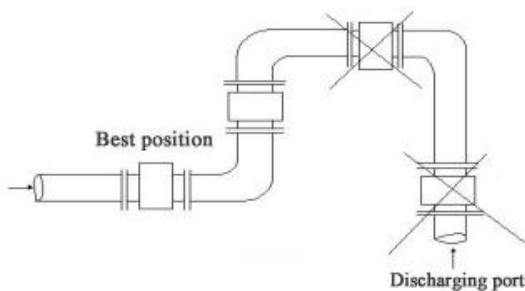
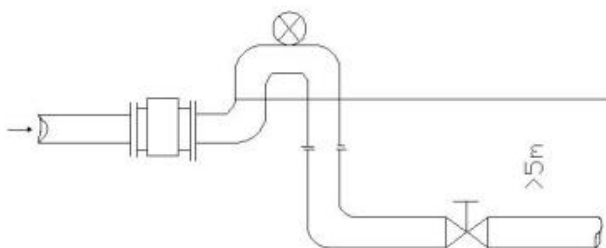


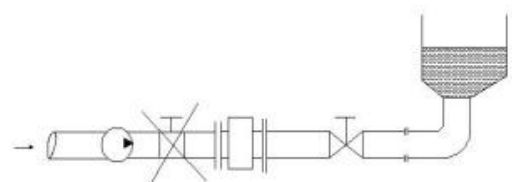
Diagram (1) Highest point of pipe
(bubble inside pipe-trouble test)



Diagram (2) openly injection or drainage
(install flow meter lower section of pipe)



Diagram(3) drop tube more than 5m(16h),
install air valve(vacuum) on the downstream



Diagram(4) long pipelines,
install control valve on the downstream

Flow meter can not be installed in the suction and pumping site of pump

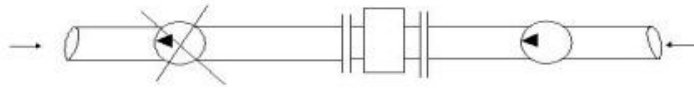
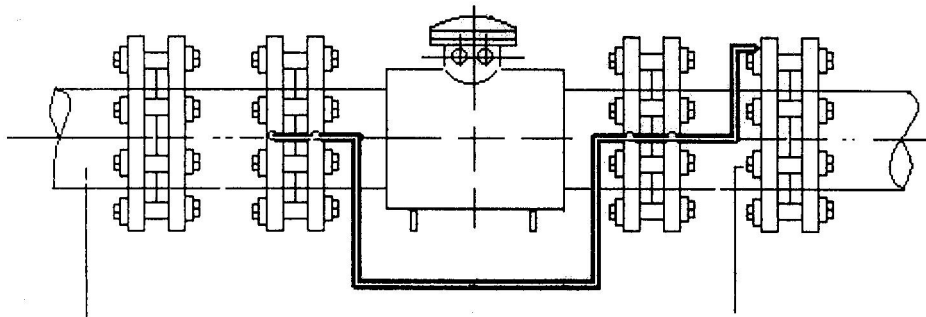


Diagram 5 please do not install on the suction and drainage sides of pipe

7) Installation on insulated pipes

When the sensor was installed on insulated pipes, you should install short metal tube or ground flanges on the two sides, then connect sensor and short metal tube or ground flanges by wire. To some strong corrosive mediums, which can not use short metal tube or ground flanges, you could punch to install ground electrodes on insulated pipes.



Plastic pipe or liner pipe

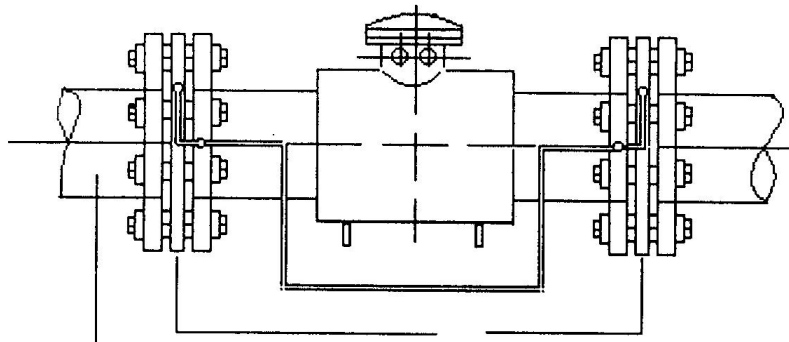
short metal pipe

Diagram 6 installation diagram on insulated pipes (2)

2. Outer and installation size

Please check diagram 7 and table 3 about the outer and installation size of sensor.

3. Layout of cable

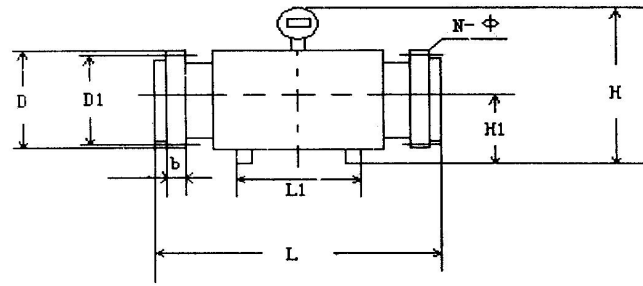


Plastic pipe or liner pipe

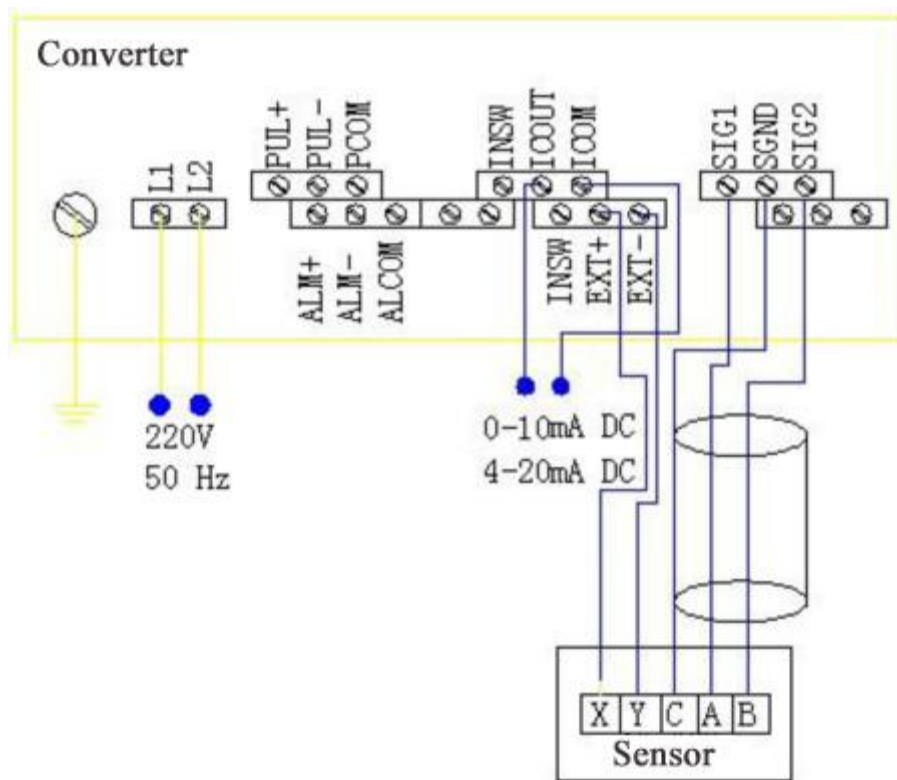
Ground rings or ground flanges

Diagram 7 installation diagram on insulated pipes (2)

Diagram 8 is the electric wiring diagram of sensor and converter, there are two wires to connect sensor and converter; one wire provides excitation power from converter to sensor, another one transfers the signal from sensor to converter. Please notice about layout of cable and connection as following:



- (a) Signal wire can not be parallel laid with the power wire of large current;
- (b) Electric wire connection between sensor and converter should apply to diagram 8;
- (c) Distance between sensor and converter should be not more than 100m; we will provide the standard 15m signal cable and 15m excitation cable when delivery, if the length of cables are not enough, please purchase RVVP model dual core PVC insulation shielding cable, specification is 2*32/0.2, external diameter is $\Phi 8$, or you could also purchase from us.



Wire Connection

Diagram 8 wiring diagram of sensor and converter

Table 3 Outer size and installation size of sensor

DN	L	L1	H	H1	D	D1	b	N-Φ	Bolt	Weight (kg)
10	140	76	245	65	95	65	14	4-Φ14	M12	4
15	200	76	225	70	95	65	14	4-Φ14	M12	5
20	200	76	235	75	105	75	16	4-Φ14	M12	6
25	200	76	235	75	115	85	16	4-Φ14	M12	7
32	200	76	250	85	140	100	18	4-Φ18	M16	8
40	200	76	260	95	150	110	18	4-Φ18	M16	9
50	200	76	270	100	165	125	20	4-Φ18	M16	10
65	250	76	285	110	185	145	22	8-Φ18	M16	12
80	250	76	295	120	200	160	24	8-Φ18	M16	14
100	250	100	316	130	220	180	26	8-Φ18	M16	15
125	250	140	330	145	250	210	26	8-Φ18	M16	18
150	300	170	350	285	240	65	28	8-Φ22	M20	23
200	250	230	420	190	340	295	24	8-Φ22	M20	27
250	450	280	295	220	395	350	26	12-Φ22	M20	38
300	500	290	540	240	445	400	28	12-Φ22	M20	48
350	550	300	550	285	505	460	28	16-Φ22	M20	65
400	600	360	635	305	565	515	30	16-Φ26	M24	80
450	600	360	720	326	615	565	30	20-Φ26	M24	100
500	600	360	750	335	670	620	32	20-Φ26	M24	120
600	600	356	825	410	780	725	36	20-Φ30	M27	210
700	700	440	950	470	895	840	36	24-Φ30	M27	300
800	800	500	1080	530	1015	950	38	24-Φ33	M30	400
900	900	550	1175	575	1115	1050	42	28-Φ33	M30	500
1000	1000	610	1285	670	1230	1160	44	28-Φ36	M33	700
1200	1200	730	1500	750	1405	1340	40	32-Φ33	M30	850
1400	1400	800	1700	840	1630	1540	44	36-Φ33	M33	1100

								6		
1600	1600	900	2100	975	1830	1760	48	40-Φ3 6	M33	1500
1800	1800	1000	2600	1300	2045	1970	50	44-Φ3 9	M36	1900
2000	2000	1100	2800	1400	2265	2180	54	48-Φ4 2	M39	2300
2200	2200				2475	2390	60	52-Φ4 2	M39	2850
2400	2400				2885	2500	62	56-Φ4 8	M42	3330
2600	2600				2905	2810	64	60-Φ4 8	M42	3895
2800	2800				3115	3020	68	64-Φ4 8	M42	4950
3000	3000				3315	3220	70	68-Φ4 8	M42	5600

4. Ground connection

The flow signal sensor produced is very weak, generally it is microvolt or millivolt, so preventing external electromagnetic preference is one of the most important requirement to operate electromagnetic flow meter well.

Grounding connection requirement to sensor as following:

Measured medium: ground terminals and shielding layer of flow signal cable should be communicated with measured medium.

Grounding connection:

(a) Make ground be zero potential, reduce external disturbance. Generally, process pipes are metal, it will be ground connected in itself. But if the disturbance of external electromagnetic field too big, specially when the stray current on pipe is too big, you should set the grounding devices, and total section of grounding cable should be more than 4mm² and keep cooper material, but note that the grounding cable of sensor can be connected with electric machines or other electric equipment, ground resistance should be less than 10Ω.

(b) When the process pipes are metal material, you should ensure the contact resistance of upstream and downstream pipes and shell of sensor nearly be zero.

5. Attentions of installation

(1) When you move and hang the sensors, please put the sling on the neck of sensors (nearby flanges), but do not plug any bar or tube into the measure tube to sling, to avoid the damages to liner.

(2) Before installation, please clean the oily contaminant on the electrodes surface by alcohol cotton or clean muslin.

(3) Please check following technical index by multimeter before installation:

(a)Resistance value of excitation coil: 20~80Ω. Using multimeter to measure the resistance value of X and Y in junction box. If the resistance value is infinite or zero, that means the disconnection or short circuit.

(b)Electrodes resistance value: signal terminal A and B are corresponding with electrodes conductivity, resistance value nearly be zero.

(c)Insulation resistance: resistance among excitation coil, signal terminal and shell should be infinite. Using multimeter to test the resistance between shell and X,Y,A,B terminals in junction box, it should be not conductive.

If any abnormal phenomenon, please contact with us.

(4)Please keep the inner diameter of sealing washer and the inner diameter of liner be corresponding when you install.

(5)Pleasure ensure the junction box be dry.

6.Preparation before running

(1)please check again if wire connections are correct after installation and before running.

(2)open front valves and close back valve, to make measured medium be full of sensor.

(3)please check following technical index by multimeter:

(a) resistance between shell and X, Y terminals of excitation coil should be infinite.

(b) terminal C in junction box and shell of sensor, front and back pipes should be same point position, means that resistance be zero.

(c) setting multimeter to be gear 1kΩ to measure the resistance between signal terminal A, B and C, the resistance is about 3~10kΩ and with charge and discharge phenomenon.

(4) switch on the power of converter.

(5) Using DC 2.5V or 10V gears of multimeter to test excitation coil X, Y terminals, if the needle of multimeter occurs low frequency swing, that means excitation system is normal.

(6) After finish the preparation, please open upstream valve, then open downstream valve, and observe the direction changes of flow display, that means signal cable connection is correct. Otherwise, please cut power, and change the positions of signal cable A and B.

(7) open the front and back valves, and discharge the liquid and gas in the pipe.

(8) close the downstream valve, then close upstream valve, and fill measured medium to the sensor, and making mated adjustment, please read converter manual to set instrument coefficient and adjust the zero point of sensor and converter.

VII. Maintenance and common trouble removals

1. Maintenance

Generally, sensors do not need to be regularly maintained, but you have to timely clean the scaling on the electrodes and liner, and do not damage the liner and electrodes while cleaning.

2. Trouble removals

If you install the sensor according to above requirements, there will be no trouble generally. If troubles, please find the fault according to item 6 above.

VIII. Unpack and complete list

Please check sensor model, specification and production code when you unpack the box and confirm that if there were some damages.

Complete list including:

A) MGG/JY-GB model electromagnetic flow meter	1 set
B) Signal cable	15 m
C) Excitation cable	15 m
D) Documents:	
(a) Installation manual of MGG/JY-GB model electromagnetic flow meter	1 piece
(b) User manual of electromagnetic flow converter	1 piece
(c) Manufacturer certificate	1 piece
(d) Packing list	1 piece

IVV. Ordering instruction

Please choose suitable sensor according to your medium and measuring condition before order, and notice as following:

- (a) Full scale flow should be not less than the max flow of measured fluid, and keep working flow more than 50% of full scale, in order to get higher accuracy;
- (b) Please choose suitable electrodes and liner according to the corrosion situation and temperature of medium.

VV. Transportation and storage

In order to avoid electromagnetic flow meter to be damaged while running, please keep the same package as ours before arrived at installation site. And the storage site should satisfy following condition:

- (a) Keep dry;
- (b) Weak mechanical vibration, avoid to be impacted;
- (c) Temperature range -20~60°C;
- (d) Humidity less than 80%, it is better to keep about 50%;
- (e) Clean the medium attached to electrodes and liner before store the used sensor.
- (f) Performance of electromagnetic flow meter will be influenced if open air storage.