



LM57 Metal Cone Variable Area Flowmeters

Technical Datasheet



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1 General

LM57 metal cone variable area flowmeters (see fig. 1-1, fig. 1-2) are used for measure instantaneous and accumulated flow rate of liquid, gas and steam in closed pipelines. It is suitable for metering flow value on site or electronic remote.

The measuring principle is based on the hydrodynamic effects, This makes float moving from bottom to top in vertical Pipe. As the displacement of float is in related to flow rate, which can be read from the indicator by means of the magnetic drive system in non-contact form . Also, flowmeters output electrical signal (4-20)mA / hart communication protocol with high / low limit Warning switches/integrating flow PCB board can be configured.

Features:

P8 Mechanical indicator: fig.1-1

- ◆ Stainless steel housing , punch forming , surface finish.
- ◆ Machinery pointer indicates flow value on site.
- ◆ Lightly and beautiful appearance.

P10 Indicator: fig.1-1

- ◆ Modularization design, Exi, Exd explosion protection.
- ◆ 2-wire electrical signal output (4-20)mA / hart communication protocol.
- ◆ Optional limit switches combination.

P10I indicator: fig.1-2

- ◆ Mechanical indicator with explosion protection housing.
- ◆ One or two limit switches are selectable.

P10B Indicator: fig.1-2

- ◆ P10I indicator with LCD display , power supply: 3.6V lithium battery

Typical applications:

Flow measuring and process control of Liquids, gases, vapors in petroleum, chemical industry , metallurgy , electric power , food processing industry, pharmacy, papermaking, etc.

2 Operating principle

LM57 series variable area flowmeters (fig.2-1) is made up of flow sensor and flow indicator. Float is placed vertically inside of conical measuring tube and can freely move up and down along the conical tube owing to hydrodynamic effects. A high-performance permanent magnet is set inside float, by this way the magnetic field around permanent magnet will change along with the float moving up and down. When fluid keeps a stable flow value and float locates in a dynamic balance state in position, the magnetic field around permanent magnet keeps constant also. The magnetic signal will be transmitted in non-contact form by means of the flow Indicator mechanically connected to conical tube. In another word, the indicator is able to detect and process flow value of liquid by magnetic drive system and finally the corresponding flow rate value can be read from the scale on site. Also it can indicate outputs as standard electrical signal (4-20)mA / hart communication protocol.

Measurement of gases

2.1 When the valve is opened suddenly in pipeline or pressure is unstable during metering gases, airflow will be pulsating. As a result, float moves up and down along the conical tube ceaselessly. In the meantime, system is out-of-control since pointer swinging constantly lead to output signal instability. In this conditions, damping device must be installed inside measuring tube (see fig.2-2). The damping device become a self-centering damper of preventing block through special design and precision work of numerical control machine centre. The damping device is consists of aluminum oxide ceramic (purity is 99.99%) and characterized by a long service life, resistant to corrosion, structure novelty, practicality better.



Fig.1-1

Fig.1-2

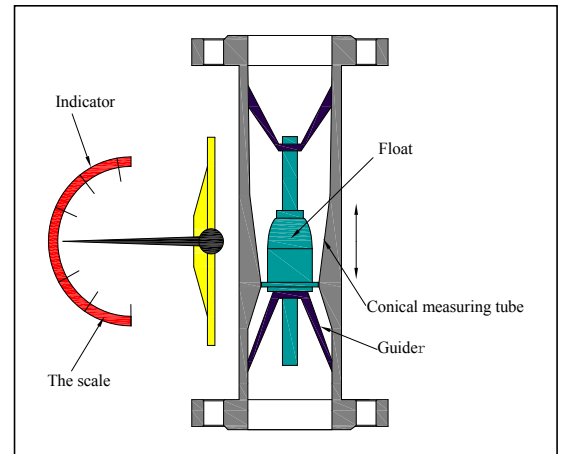


Fig.2-1

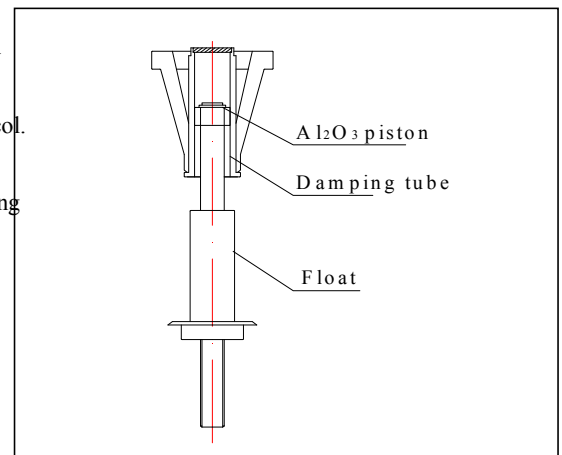


Fig.2-2

3 Technical data

Type	LM57		
Medium	Liquids, gases, vapors		
Rang(conversion to 100% value of reference fluid)	Water : 20°C	(10-300000)L/h , Special order on request	
	Air : 0.1013MPa, 20°C	(0.7-3000)Nm ³ /h, Special order on request	
The turn-down ratio	10 : 1		
Accuracy class	Mechanical indicator	1.0, 1.5, 2.0, 2.5	
	Mechanical indicator with LCD (battery powered, service life: 2 years)	1.0, 1.5, 2.0, 2.5	
	Mechanical indicator with two-wire signal output (4-20)mA/hart communication	1.0, 1.5, 2.0, 2.5	
Medium temperature	Machinery indicator with LCD (battery powered, service life: 2 years)	-80°C~+300°C (PTFE:0~80°C) High temperature 400°C	
	Mechanical indicator (battery powered, service life : 2 years)	-40°C~+120°C (PTFE:0~80°C) High temperature 400°C	
	Mechanical indicator with two-wire signal output (4-20)mA/hart communication protocol	-40°C~+120°C (PTFE:0~80°C) High temperature 400°C	
Ambient temperature	Mechanical indicator	-40°C~+120°C	
	Mechanical indicator with LCD (battery powered, service life: 2 years)	-20°C~+60°C	
	Mechanical indicator with two-wire signal output (4-20)mA/hart communication	-20°C~+60°C	
Viscosity of fluid	DN15: F15.00~F15.03 η<5 mPa.s, F15.04~F15.30 η<30 mPa.s; DN25: η<250 mPa.s; DN50~250: η<300 mPa.s		
Nominal pressure	DN15~DN50	4.0MPa (Max DN15: 42MPa, DN25: 42MPa, DN50: 32MPa)	
	DN80~DN250	1.6MPa (Max DN80: 10MPa, DN100: 6.4MPa, DN125: 4.0MPa, DN150: 4.0MPa, DN200: 2.5MPa, DN250: 2.5Mpa)	
Process connection	Flange connection, Standard: DIN2501, ANSI, JIS (select Chinese standard freely, priority select DIN)		
	Hygiene clamp, screw joint are selected in the order		
Electrical connection	M20×1.5 1/2"G 1/2"NPT 3/4"G 3/4"NPT		
Installation	Vertical mounting (bottom in up out and up in bottom out, Horizontal mounting (left in right out and right in left out) bottom in side out, side in side out		
Straight unimpeded inlet run	≥ 5D		
Straight unimpeded outlet run	≥ 250 mm		
Degree of protection	IP67(Others need specify in the order)		
TS &ATEX MARKING	TS Ex db IIC T6 Gb,Ex tb IIIC T100 C Db		
	XP/II/1/ABCD/T6:DIP/II,III /1/EFG/T6:Type 4X		
TS electrical data	U _i = 28V I _i = 93mA P _i = 0.65W C _i ≤ 5nF L _i = 0mH		
Safety barrier data	U _o ≤ 28V I _o ≤ 93mA P _o ≤ 0.65W C _o ≥ C _i +C _e L _o ≥ L _i +L _c		
Carried Standard	JB/T 6844-93		

4 Materials

Type	Measuring tube	Flange	Float
LM57/IS,LM57/SS LM57/AS,LM57/AA LM57/SA,LM57/SI	304/304SS, 304L/304LSS 316/316SS, 316L/316LSS 317/317SS, 317L/317LSS	304/304SS, 304L/304LSS 316/316SS, 316L/316LSS 317/317SS, 317L/317LSS	304/304SS, 304L/304LSS 316/316SS, 316L/316LSS 317/317SS, 317L/317LSS Al, Ti
LM57/TF	1Cr18Ni9Ti With PTFE liner	1Cr18Ni9Ti	PTFE Hastelloy-B1, B2, C4 Ti
LM57/PVC	PVC	PVC	PVC
LM57/PP	PP	PP	PP
LM57/HC	Hastelloy-B1, B2, C4 N6	Hastelloy-B1, B2, C4 N6	Hastelloy-B1, B2, C4 Ti N6
LM57/Ti	Ti	Ti	Ti Hastelloy-B1, B2, C4
LM57/Zr	Zr	Zr	Zr
LM57/CU			Cu
LM57/Al			Al

Note: Hastelloy: nickel base alloy, PTFE:Teflon, Ti:titanium alloy

5 Dimensions

5.1 Flange connection dimensions (mm)

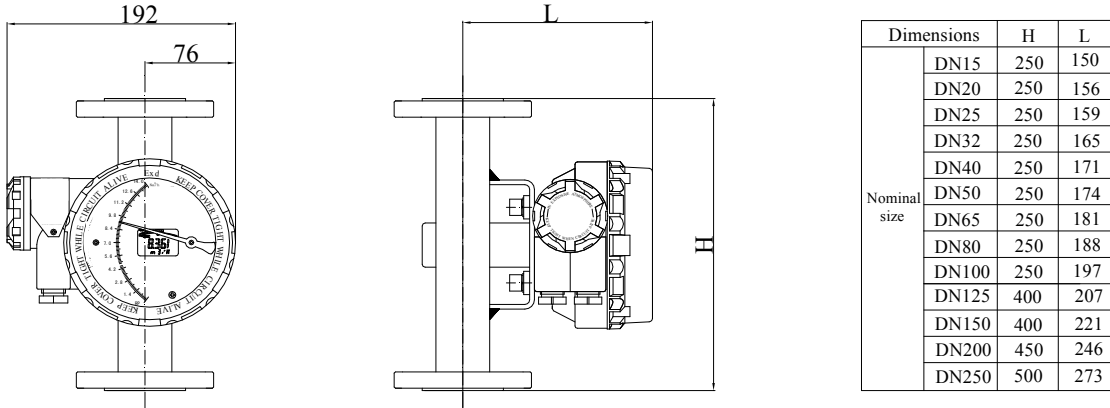


Fig. 5-1 Vertical mounting

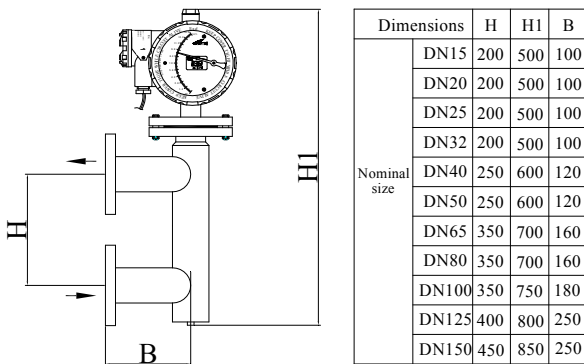


Fig. 5-2 Side in side out mounting

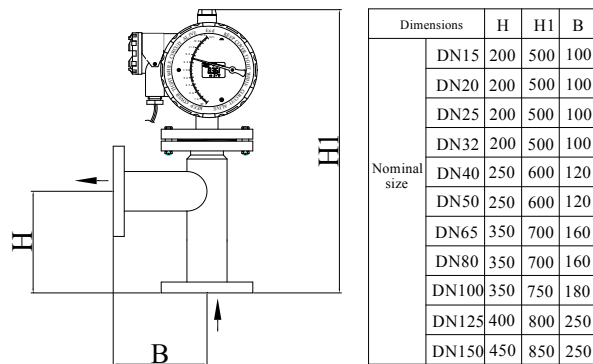


Fig. 5-3 Bottom in side out mounting

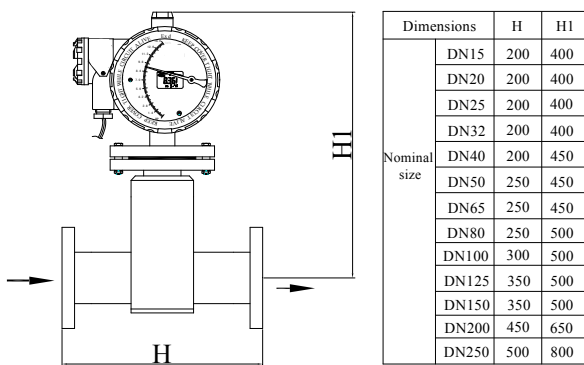


Fig. 5-4 Horizontal mounting

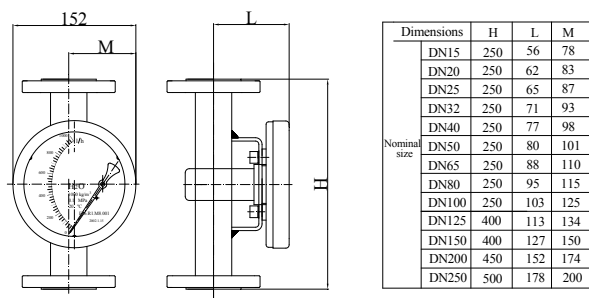
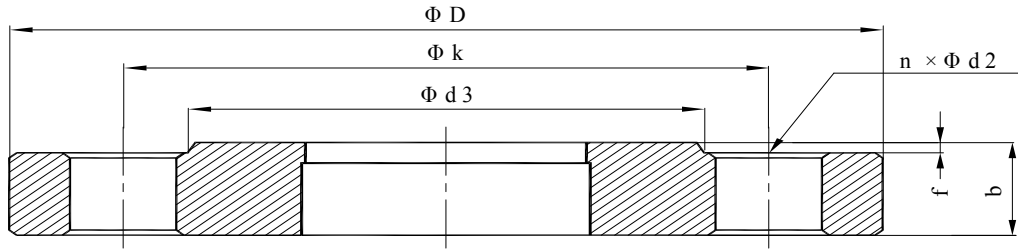


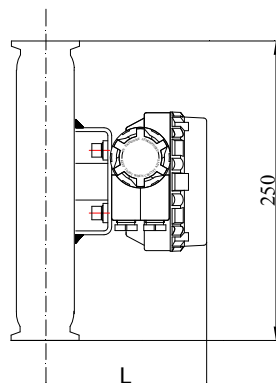
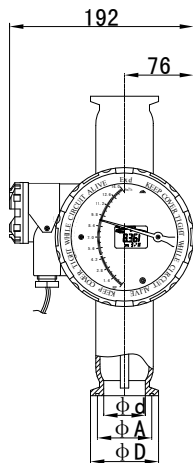
Fig. 5-5 P8 mounting

Flange dimensions and table



Nominal size	Flange dimensions (Standard :ANSI B 16.5 150 lb RF)						Nominal size/ pressure	Flange dimensions (Standard :DIN2501)						
	DN	D	k	d3	f	n		d2	DN	D	k	d3	f	n
1/2"	88.9	60.5	35.1	1.6	4	15.7	15/4.0	95	65	45	1.5	4	14	
3/4"	98.6	69.9	42.9	1.6	4	15.7	20/4.0	105	75	55	1.5	4	14	
1"	108.0	79.2	50.8	1.6	4	15.7	25/4.0	115	85	65	1.5	4	14	
1-1/4"	117.3	88.9	63.5	1.6	4	15.7	32/4.0	140	100	76	1.5	4	18	
1-1/2"	127.0	98.6	73.2	1.6	4	15.7	40/4.0	150	110	86	1.5	4	18	
2"	152.4	120.7	91.9	1.6	4	19.1	50/4.0	165	125	100	2.0	4	18	
2-1/2"	177.8	139.7	104.6	1.6	4	19.1	65/1.6	185	145	120	2.0	4	18	
3"	190.5	152.4	127.0	1.6	4	19.1	80/1.6	200	160	136	2.0	8	18	
4"	228.6	190.5	157.2	1.6	8	19.1	100/1.6	220	180	156	2.0	8	18	
5"	254.0	215.9	185.7	1.6	8	22.4	125/1.6	250	210	186	2.0	8	18	
6"	279.4	241.3	215.9	1.6	8	22.4	150/1.6	285	240	212	2.0	8	22	
8"	342.9	298.5	269.7	1.6	8	22.4	200/1.6	340	295	268	2.0	12	22	
10"	406.4	362.0	323.9	1.6	12	25.4	250/1.6	405	355	320	2.0	12	26	

5.2 Hygienic Clamp connection dimensions (mm)



Dimensions		D	A	d	L
Nominal size	DN15	34	28	15	150
	DN20	34	28	19	155
	DN25	51	44	24	159
	DN32	51	44	30	164
	DN40	51	44	36	170
	DN50	64	57	48	174
	DN65	91	84	64	181
	DN80	106	97	78	188
DN100	119	110	97	197	

6 Process connection installation guide

6.1 Process connection

◆ Vertical: see fig. 6-1:

Flowmeter is must be ensured less than 2 degrees of included angle between center vertical line and vertical line during mounting.

A straight unimpeded inlet run before the flowmeter and straight unimpeded outlet run behind the flowmeter are recommended.

In addition, straight pipe bores should be the same nominal size as

the flowmeter.

Length of straight unimpeded run:

L1 (Straight unimpeded inlet run) $\geq 5 \times DN$ (Nominal size of inlet),

L2 (Straight unimpeded outlet run) ≥ 250 mm ,

L3: Magnetic filter . Dimensions see fig. 6.2:

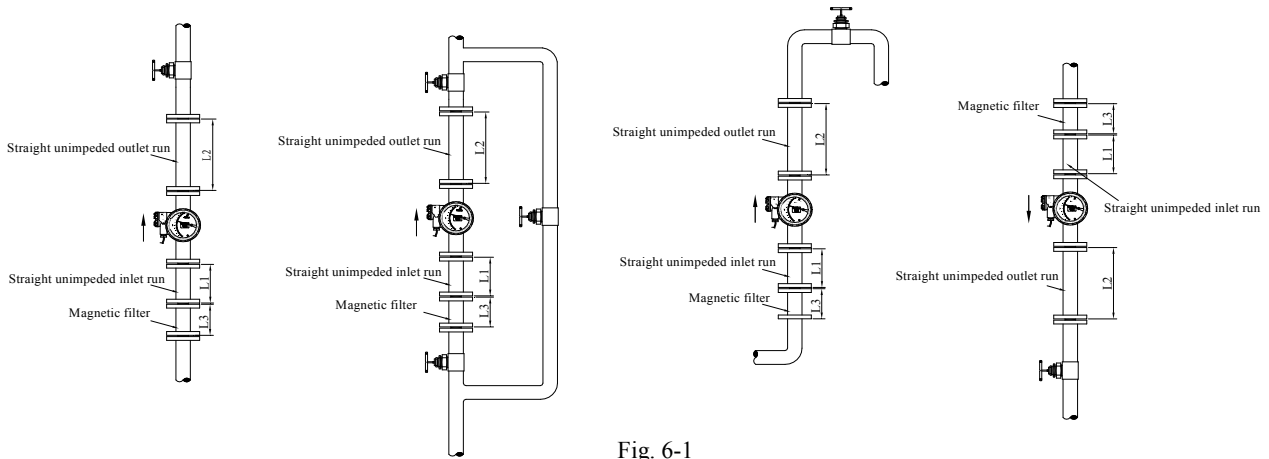


Fig. 6-1

◆ Side in side out

Fig. 6-3, Flowmeter is must be ensured less than 2 degrees of included angle between center vertical line and vertical line during mounting. Length of straight unimpeded run is not Required .

◆ Bottom in side out

Drawing 6-2, Flowmeter is must be ensured less than 2 degrees of included angle between center vertical line and vertical line during mounting. Length of straight unimpeded run is not Required .

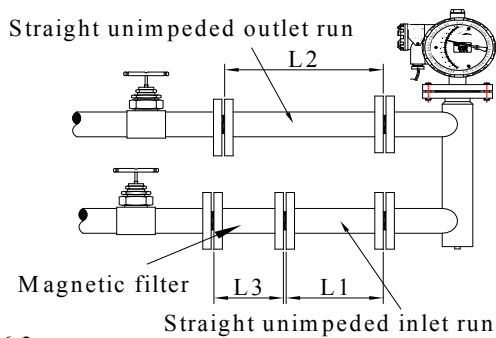


Fig. 6-2

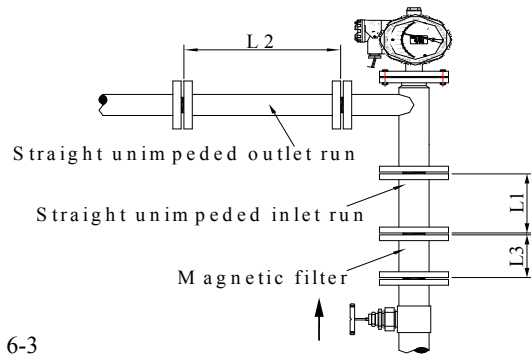


Fig. 6-3

◆ Horizontal

Fig. 6-4, Flowmeter is must be ensured less than 2 degrees of included angle between center vertical line and vertical line during mounting. Length of straight unimpeded run is not required.

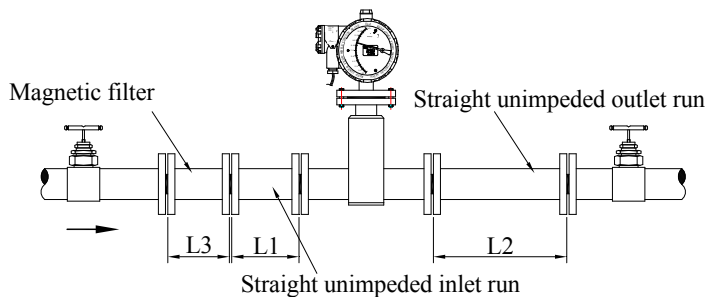


Fig. 6-4

6.2 Installation guide

6.2.1 Before mounting:

Flowmeter belongs to precision instrument so it must be carefully and gently moved during the progress of transportation, installation, storing and using, forbidding wild transport, overstressing installation as well as ensuring the holistic position of indicator and sensor because flowmeter has been calculated, checked, tested when it leaves factory. If indicator and sensor are disassembled, the measuring accuracy will be influenced. Indicator and sensor may be disassembled under the direction of after sales service personnel or contacting manufacturer.

Remove all packing from the flowmeter body, check the delivery for damage prior to mount on pipeline. Before the flowmeter is installed, pipeline should be cleared, blown any foreign matter preventing magnetic particles which would be attached to flowmeter. A magnetic filter is to be installed in the flow direction before the flowmeter so as to avoid float locking. Magnetic filter see fig. 6-5:

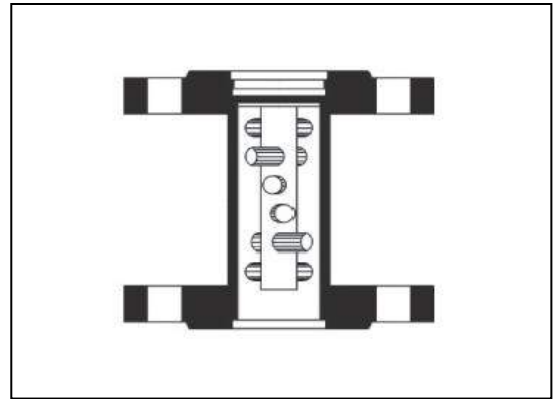


Fig. 6-5

Magnetic filters mounting height dimensions (length):

Flange standard is same as flowmeter's, selecting concave-convex sealing face: Sealing face of flange is convex up / concave down.

(1) Mounting height: 100mm

Nominal size: DN15, DN20, DN25, DN32, DN40, DN50, DN65, DN80, DN100

Pressure: PN1.6MPa~4.0MPa

(4.0MPa doesn't include DN80 and DN100)

(2) Mounting height: 120mm

Nominal size: DN80, DN100

Pressure: PN2.5MPa~4.0MPa

(3) Mounting height: 150mm

Nominal size: DN125, DN150, DN200, DN250

Pressure: PN1.0MPa~2.5MPa

If measuring gases, a valve must be mounted in outlet of flowmeters so as to set desired flow value. When calibration pressure is kept above float, gases will expansion at valve. Flowmeters may not be subjected to tensile or compressive stresses through the pipeline. So support frame is to be set up in inlet and outlet of flow meters. thus flowmeters are in minimum stress state.

6.2.2 Matters need attention during mounting :

Since the switching mechanism of variable area flowmeters adopts magnetic transmission, the ferromagnetic substances are not allowed to exist at least in 200 mm periphery so as to ensure accuracy of flowmeters. Otherwise, a measuring error will be easily appeared even out of commission.

Please be careful while flowmeter with PTFE liner is mounted. Because PTFE is easily deformed under low-temperature and bolt-on pressure condition, the flange nut should not be optionally fastened but shifting angle slightly fixed according to diagonal way in order to avoid damaging PTFE liner. For the relevant maximum torque refer to table 6-1.

6.2.3 Start up for the first time

Measurement of liquids:

During start up, in order to avoid damaging flowmeters from water hammer, open valves slowly!

Measurement of gases:

Before opening the valve, do not press the pipeline, or else , the float will run up to upper limit even probably damaging flowmeters if valve (example: magnetic valve) is suddenly turned on. Must slowly open valve!

The flowmeters of measuring gases may be equipped an air damper for the sake of decreasing float vibration as far as possible. To further ensuring the stability of float, a throttle or proper orifice can be mounted in the outlet of flowmeters.

Regarding intelligent-type and hart indicator, first of all the electrical wiring should be ensured correctly, then power on .

Program debugging asks for operating instructions.

Table 6-1

Nominal size (mm)	Maximum torque kgf	Stud
DN15	0.93	4 x M12
DN 20	1.50	4 x M12
DN 25	2.20	4 x M12
DN 32	3.00	4 x M16
DN 40	3.80	4 x M16
DN 50	5.50	4 x M16
DN 65	6.10	4 x M16
DN 80	4.70	8 x M16
DN 100	4.90	8 x M16
DN 125	5.30	8 x M18
DN 150	6.80	8 x M20



7 Flow table, scale conversion and accuracy class

7.1 Flow table

Nominal size	Float number	Flow range: H ₂ O (water)		Flow range: Air		pressure loss (kPa) lower pressure loss need connect to manufacturer for order	
		Materiel: 1 CrNiSteel	Materiel: 2 PTFE	Materiel: 1 CrNiSteel		Materiel: 1	Materiel: 2
DN15	F15.00	10 l/h	25 l/h	0.30 Nm ³ /h		1.5	1.5
	F15.01	15 l/h	30 l/h	0.45 Nm ³ /h		1.5	1.5
	F15.02	20 l/h	35 l/h	0.60 Nm ³ /h		1.5	1.5
	F15.03	25 l/h	40 l/h	0.75 Nm ³ /h		1.5	1.5
	F15.04	30 l/h	45 l/h	0.90 Nm ³ /h		1.5	1.5
	F15.05	35 l/h	50 l/h	1.05 Nm ³ /h		1.5	1.5
	F15.06	40 l/h	55 l/h	1.20 Nm ³ /h		1.5	1.5
	F15.07	45 l/h	60 l/h	1.35 Nm ³ /h		1.5	1.5
	F15.08	50 l/h	70 l/h	1.50 Nm ³ /h		1.5	1.5
	F15.09	55 l/h	80 l/h	1.65 Nm ³ /h		1.5	1.5
	F15.10	60 l/h	90 l/h	1.80 Nm ³ /h		1.5	1.5
	F15.11	70 l/h	100 l/h	2.10 Nm ³ /h		1.5	1.5
	F15.12	80 l/h	120 l/h	2.40 Nm ³ /h		1.5	1.5
	F15.13	90 l/h	160 l/h	2.70 Nm ³ /h		1.5	1.5
	F15.14	100 l/h	200 l/h	3.00 Nm ³ /h		1.5	1.5
	F15.15	120 l/h	220 l/h	3.60 Nm ³ /h		1.5	3.0
	F15.16	160 l/h	250 l/h	4.80 Nm ³ /h		1.5	3.0
	F15.17	200 l/h	280 l/h	6.00 Nm ³ /h		1.5	3.0
	F15.18	220 l/h	300 l/h	6.60 Nm ³ /h		3.0	3.0
	F15.19	250 l/h	350 l/h	7.50 Nm ³ /h		3.0	3.0
	F15.20	280 l/h	400 l/h	8.40 Nm ³ /h		3.0	3.0
	F15.21	300 l/h	450 l/h	9.00 Nm ³ /h		3.0	3.5
	F15.22	350 l/h	500 l/h	10.50 Nm ³ /h		3.0	3.5
	F15.23	400 l/h		12.00 Nm ³ /h		3.0	
	F15.24	450 l/h		13.50 Nm ³ /h		3.5	
	F15.25	500 l/h		15.00 Nm ³ /h		3.5	
	F15.26	600 l/h		18.00 Nm ³ /h		3.5	
	F15.27	700 l/h		21.00 Nm ³ /h		3.5	
	F15.28	800 l/h		24.00 Nm ³ /h		3.5	
	F15.29	900 l/h		27.00 Nm ³ /h		3.5	
F15.30	1000 l/h		30.00 Nm ³ /h		3.5		
DN20	F20.00	800 l/h	400 l/h	24.0 Nm ³ /h		1.5	1.5
	F20.01	1000 l/h	600 l/h	30.0 Nm ³ /h		1.5	1.5
	F20.02	1200 l/h	800 l/h	36.0 Nm ³ /h		2.0	2.0
	F20.03	1600 l/h	1000 l/h	48.0 Nm ³ /h		2.0	2.0
	F20.04	2000 l/h	1200 l/h	60.0 Nm ³ /h		3.5	3.0
	F20.05	2500 l/h	1600 l/h	75.0 Nm ³ /h		4.0	3.0
DN25	F25.00	1000 l/h	600 l/h	30.0 Nm ³ /h		1.5	1.5
	F25.01	1200 l/h	800 l/h	36.0 Nm ³ /h		1.5	1.5
	F25.02	1600 l/h	1000 l/h	48.0 Nm ³ /h		3.0	1.5
	F25.03	2000 l/h	1200 l/h	60.0 Nm ³ /h		3.0	1.5
	F25.04	2500 l/h	1600 l/h	75.0 Nm ³ /h		3.5	3.0
	F25.05	3000 l/h	2000 l/h	90.0 Nm ³ /h		3.5	3.0
	F25.06	3500 l/h	2500 l/h	105.0 Nm ³ /h		8.0	3.5
	F25.07	4000 l/h	3000 l/h	120.0 Nm ³ /h		8.0	3.5
	F25.08	4500 l/h	3500 l/h	135.0 Nm ³ /h		8.0	8.0
	F25.09	5000 l/h	4000 l/h	150.0 Nm ³ /h		16.0	10.0
	F25.10	5500 l/h		165.0 Nm ³ /h		16.0	
F25.11	6000 l/h		180.0 Nm ³ /h		16.0		
DN32	F32.00	4000 l/h	4000 l/h	120.0 Nm ³ /h		8.0	8.0
	F32.01	5000 l/h	5000 l/h	150.0 Nm ³ /h		10.0	10.0
	F32.02	6000 l/h		180.0 Nm ³ /h		12.0	
	F32.03	8000 l/h		240.0 Nm ³ /h		16.0	
DN40	F40.00	5000 l/h	5000 l/h	150.0 Nm ³ /h		8.0	6.0
	F40.01	6000 l/h	6000 l/h	180.0 Nm ³ /h		10.0	10.0
	F40.02	8000 l/h		240.0 Nm ³ /h		12.0	
	F40.03	10000 l/h		300.0 Nm ³ /h		14.0	
DN50	F50.00	6000 l/h	6000 l/h	180.0 Nm ³ /h		3.0	3.0
	F50.01	8000 l/h	8000 l/h	240.0 Nm ³ /h		3.0	3.0
	F50.02	10000 l/h	10000 l/h	300.0 Nm ³ /h		4.0	4.0
	F50.03	12000 l/h	12000 l/h	360.0 Nm ³ /h		4.0	4.0
	F50.04	14000 l/h	14000 l/h	420.0 Nm ³ /h		4.0	6.0
	F50.05	16000 l/h	16000 l/h	480.0 Nm ³ /h		8.0	6.0
	F50.06	18000 l/h		540.0 Nm ³ /h		8.0	
	F50.07	20000 l/h		600.0 Nm ³ /h		16.0	
F50.08	25000 l/h		750.0 Nm ³ /h		16.0		
DN65	F65.00	12000 l/h	12000 l/h	360.0 Nm ³ /h		6.0	6.0
	F65.01	16000 l/h	16000 l/h	480.0 Nm ³ /h		8.0	8.0
	F65.02	20000 l/h	20000 l/h	600.0 Nm ³ /h		10.0	12.0
	F65.03	25000 l/h		750.0 Nm ³ /h		14.0	
	F65.04	30000 l/h		900.0 Nm ³ /h		20.0	
DN80	F80.01	25000 l/h	25000 l/h	750.0 Nm ³ /h		14.0	14.0
	F80.02	30000 l/h	30000 l/h	900.0 Nm ³ /h		14.0	14.0
	F80.03	35000 l/h	35000 l/h	1,050.0 Nm ³ /h		14.0	20.0
	F80.04	40000 l/h	40000 l/h	1,200.0 Nm ³ /h		22.0	25.0
	F80.05	50000 l/h		1,500.0 Nm ³ /h		22.0	
	F80.06	60000 l/h		1,800.0 Nm ³ /h		25.0	
	F80.07	65000 l/h		1,950.0 Nm ³ /h		25.0	
DN100	F100.0	50000 l/h	50000 l/h	1,500.0 Nm ³ /h		30.0	25.0
	F100.1	60000 l/h	60000 l/h	1,800.0 Nm ³ /h		30.0	25.0
	F100.2	70000 l/h		2,100.0 Nm ³ /h		30.0	
	F100.3	80000 l/h		2,400.0 Nm ³ /h		30.0	
	F100.4	90000 l/h		2,700.0 Nm ³ /h		40.0	
F100.5	100000 l/h		3,000.0 Nm ³ /h		40.0		
DN125	F125.0	100000 l/h	100000 l/h	3,000.0 Nm ³ /h		45.0	35.0
	F125.1	125000 l/h	125000 l/h	3,800.0 Nm ³ /h		45.0	40.0
	F125.2	150000 l/h				48.0	
DN150	F150.0	125000 l/h	125000 l/h	3,800.0 Nm ³ /h		45.0	42.0
	F150.1	150000 l/h	150000 l/h	4,500.0 Nm ³ /h		50.0	50.0
	F150.2	160000 l/h				50.0	
	F150.3	180000 l/h				60.0	
F150.4	200000 l/h				60.0		
DN200	F200.0	160000 l/h	160000 l/h			60.0	60.0
	F200.1	180000 l/h	180000 l/h			60.0	70.0
	F200.2	200000 l/h				65.0	
	F200.3	250000 l/h				65.0	
DN250	F250.0	220000 l/h	220000 l/h			65.0	60.0
	F250.1	250000 l/h				75.0	
	F250.2	300000 l/h				75.0	

Note: special orders for user

7.2 Scale conversion

7.2.1 Liquids conversion

◆ Volumetric flow of measured liquids Q_t (l/h)

In accordance with density and maximum flow of measured liquid, the flow of water is obtained by substituting them into Formula 1, then, look up the corresponding Nominal size and float number in flow table, thus flow value measured is obtained by substituting flow value of water corresponding standard float No. finally, the scale range of liquid measured is obtained by rounding number.

$$Q_s = \sqrt{\frac{(\rho_f - \rho_s)\rho_t}{(\rho_f - \rho_t)\rho_s}} \times Q_t \quad \dots\dots\dots(1)$$

◆ Mass flow of measured liquids Q_m (kg/h)

According to Formula 2, the method is same as above.

$$Q_s = \sqrt{\frac{(\rho_f - \rho_s)}{(\rho_f - \rho_t)\rho_f\rho_s}} \times Q_m \times 1000 \quad \dots\dots\dots(2)$$

Note:

Q_t = Max. Volumetric flow of measured liquid (l/h)

Q_m = Max. Mass flow of measured liquid (kg/h)

Q_s = Flow of water-standard medium (l/h)

ρ_f = Density of float (kg/m³)

ρ_t = Density of measured liquid (kg/m³)

ρ_s = Density of water (kg/m³)

Float densities of various materials see table 7-1

7.2.2 Gases conversion

Because gas is easily affected by temperature and pressure other than liquid at the time of calculating flow, not only the density is regarded, but also it is regarded for the influences from temperature and pressure. so it is extremely important to provide exact temperature and pressure value of measured gas under operating condition.

◆ Standard flow of measured gases Q_N (Nm³/h)

$$Q_s = \sqrt{\frac{\rho_{st} \times P_s \times T_t}{\rho_s \times P_t \times T_s}} \times Q_N \quad \dots\dots\dots(3)$$

◆ Operating flow of measured gases: Q_t (m³/h)

$$Q_s = \sqrt{\frac{\rho_{st} \times P_t \times T_s}{\rho_s \times P_s \times T_t}} \times Q_t \quad \dots\dots\dots(4)$$

◆ Mass flow of gases to be measured Q_m (kg/h)

$$Q_s = \sqrt{\frac{1}{\rho_t \times \rho_s}} \times Q_m \quad \dots\dots\dots(5)$$

Note:

Q_N = Max. Volumetric flow (Nm³/h) of gases in calibrating condition

Q_t = Max. Volumetric flow of gases in operating condition (m³/h)

Q_m =Max. Mass flow of gas in operating condition (kg/h)

Q_s = Flow of air-standard medium (m³/h)

ρ_s = Density of air in calibrating condition (kg/m³)

ρ_{st} =Density of gas in calibrating condition (kg/m³)

ρ_t = Density of air in operating condition (kg/m³)

P_s = Absolute pressure of air in calibrating condition (0.1MPa)

P_t = Absolute pressure of gas in operating condition (MPa)

T_s = Absolute Temp. of air in calibrating condition (293.15K)

7.3 Accuracy class

See table 7-2 :

Table 7-1

Float densities of various materials	
Materials	Densities (g/m ³)
CrNi Steel	7.85
PTFE	3.40
PVDF	3.80
PV	1.38~1.43
PP	0.90~0.91
Nickel-base alloy	8.89
Ti	4.50
Al	2.70
Cu	8.90

Table 7-2

Standard		VDI / VDE 3513		
Accuracy class	1.0	1.5	2.0	2.5
Error %	Relative to full scale	Relative to full scale	Relative to full scale	Relative to full scale
Flow %	100	90	80	70
	1.000	0.925	0.850	0.775
	1.500	1.387	1.275	1.162
	2.000	1.850	1.700	1.550
	2.500	2.312	2.125	1.937
		2.750	2.500	2.250
		3.125	2.875	2.625
		3.500	3.250	2.937
		3.875	3.625	3.250
		4.250	4.000	3.562
		4.625	4.375	3.875
		5.000	4.750	4.187
		5.375	5.125	4.500
		5.750	5.500	4.812
		6.125	5.875	5.125
		6.500	6.250	5.437
		6.875	6.625	5.750
		7.250	7.000	6.062
		7.625	7.375	6.375
		8.000	7.750	6.687
		8.375	8.125	7.000
		8.750	8.500	7.312
		9.125	8.875	7.625
		9.500	9.250	7.937
		9.875	9.625	8.250
		10.250	10.000	8.562
		10.625	10.375	8.875
		11.000	10.750	9.187
		11.375	11.125	9.500
		11.750	11.500	9.812
		12.125	11.875	10.125
		12.500	12.250	10.437
		12.875	12.625	10.750
		13.250	13.000	11.062
		13.625	13.375	11.375
		14.000	13.750	11.687
		14.375	14.125	12.000
		14.750	14.500	12.312
		15.125	14.875	12.625
		15.500	15.250	12.937
		15.875	15.625	13.250
		16.250	16.000	13.562
		16.625	16.375	13.875
		17.000	16.750	14.187
		17.375	17.125	14.500
		17.750	17.500	14.812
		18.125	17.875	15.125
		18.500	18.250	15.437
		18.875	18.625	15.750
		19.250	19.000	16.062
		19.625	19.375	16.375
		20.000	19.750	16.687
		20.375	20.125	17.000
		20.750	20.500	17.312
		21.125	20.875	17.625
		21.500	21.250	17.937
		21.875	21.625	18.250
		22.250	22.000	18.562
		22.625	22.375	18.875
		23.000	22.750	19.187
		23.375	23.125	19.500
		23.750	23.500	19.812
		24.125	23.875	20.125
		24.500	24.250	20.437
		24.875	24.625	20.750
		25.250	25.000	21.062
		25.625	25.375	21.375
		26.000	25.750	21.687
		26.375	26.125	22.000
		26.750	26.500	22.312
		27.125	26.875	22.625
		27.500	27.250	22.937
		27.875	27.625	23.250
		28.250	28.000	23.562
		28.625	28.375	23.875
		29.000	28.750	24.187
		29.375	29.125	24.500
		29.750	29.500	24.812
		30.125	29.875	25.125
		30.500	30.250	25.437
		30.875	30.625	25.750
		31.250	31.000	26.062
		31.625	31.375	26.375
		32.000	31.750	26.687
		32.375	32.125	27.000
		32.750	32.500	27.312
		33.125	32.875	27.625
		33.500	33.250	27.937
		33.875	33.625	28.250
		34.250	34.000	28.562
		34.625	34.375	28.875
		35.000	34.750	29.187
		35.375	35.125	29.500
		35.750	35.500	29.812
		36.125	35.875	30.125
		36.500	36.250	30.437
		36.875	36.625	30.750
		37.250	37.000	31.062
		37.625	37.375	31.375
		38.000	37.750	31.687
		38.375	38.125	32.000
		38.750	38.500	32.312
		39.125	38.875	32.625
		39.500	39.250	32.937
		39.875	39.625	33.250
		40.250	40.000	33.562
		40.625	40.375	33.875
		41.000	40.750	34.187
		41.375	41.125	34.500
		41.750	41.500	34.812
		42.125	41.875	35.125
		42.500	42.250	35.437
		42.875	42.625	35.750
		43.250	43.000	36.062
		43.625	43.375	36.375
		44.000	43.750	36.687
		44.375	44.125	37.000
		44.750	44.500	37.312
		45.125	44.875	37.625
		45.500	45.250	37.937
		45.875	45.625	38.250
		46.250	46.000	38.562
		46.625	46.375	38.875
		47.000	46.750	39.187
		47.375	47.125	39.500
		47.750	47.500	39.812
		48.125	47.875	40.125
		48.500	48.250	40.437
		48.875	48.625	40.750
		49.250	49.000	41.062
		49.625	49.375	41.375
		50.000	49.750	41.687

8 Indicator

8.1 P8 type

- ◆ Mechanical indicator with stainless steel housing;
- ◆ Lightly and beautiful appearance;
- ◆ May connect to hygeian type.



P8 type

8.2 P10 type

(1) P10 / Exi type

(2) P10 / Exd type

- ◆ Mechanical indicator;
- ◆ LCD display (flow rate and flow total);
- ◆ 2-wire (4-20) mA current output with hart communication;
- ◆ Key setting , the hand operator or PC remote configuration;
- ◆ Exi / Exd;
- ◆ One or two limit switches selectable;
- ① Limit switch KG22 (K1, K2); ② Limit switch KG24 (KE1, KE2).



P10/Exi: intrinsically safe type

P10/Exd: explosion-proof type

8.3 P10I type

- ◆ Mechanical indicator with explosion protection housing;
- ◆ One or two limit switches selectable.
- ① KG22 limit switch (K1, K2); ② KG23 limit switch (KR1, KR2).



P10I type

8.4 P10B type

- ◆ Mechanical indicator;
- ◆ LCD display (flow rate and flow total);
- ◆ Powered supply by 3.6V Lithium battery (service life: 1 year).



P10B Type

9 Electrical data and connection

9.1 Limit switches

9.1.1 KG22

KG22 consists of two parts. One is inductance approach switch SJ3.5N and cutting discs on rotation axis (fig.9-1.Technical parameters see table 9-1), another is external isolated switching amplifier (WE77/Ex , it is selected by user see fig.9-2.Technical parameters see table 9-2).
Default set:

- K1: Low limit
- K2: High limit

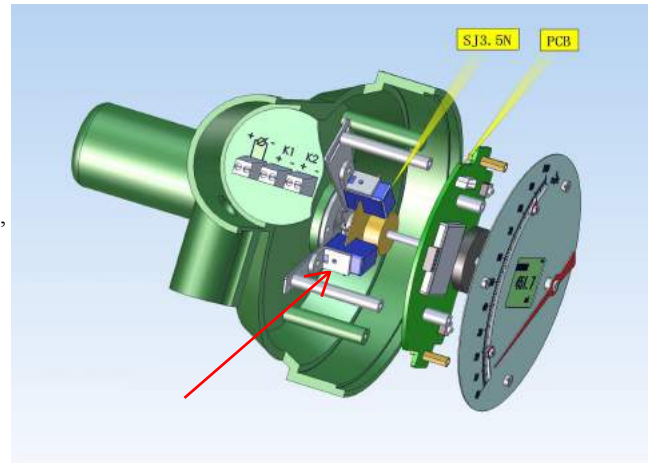


Fig.9-1

Table 9-1

Rated voltage	8 V DC	
Current loss	Active area open	Active area close
	≥3 mA	≤1 mA
Self-inductance	160μH relate to dangerous place	
Self capacitance	20μF relate to dangerous place	
Ambient temperature	-25°C~+100°C	
Degree of protection	IP65	



Table 9-2

Technical data	AC TYPE	DC TYPE
	WE77 / Ex-1	WE77 / Ex-1-G
	WE77 / Ex-2	WE77 / Ex-2-G
Power Supply Standard	220V AC/45-65Hz	-
Special type	24 ,42 ,110 ,127V AC	15-70V DC
Power Consumption	About 3.5VA	Max 6.3W
Input intrinsically safety	DIN19243 or NAMUR	DIN19243 or NAMUR
Explosion-proof type	[EExia]IIC or [EEExib]IIC	[EExia]IIC or [EEExib]IIC
Explosion-proof certificate number	Ex-79/2043 X	Ex-81/2146 X
Open-circuit voltage	8 V DC(13.5 V DC)	8 V DC(12.7 V DC)
Short-circuit current	8 mA (31 mA)	8 mA (21 mA)
Safe distributed inductance /Capacitance		
[EExia]IIC	3 mH/230ηF	2 mH/230ηF
[EEExib]IIC	31 mH/609ηF	70 mH/800ηF
Output non-intrinsically safety		
Model of switch	WE77/Ex-1: 1 transition terminal WE77/Ex-2: 2 transition terminal	WE77/Ex-1:1 transition terminal WE77/Ex-2:2 transition terminal
Contact capacity	AC:4A/250V/500A/cos=0.7	DC: 220V/0.1A:60V/0.6A:24V/4A
Display “relay operating”	LED	LED
Housing Materials	LY12	
Installation	Mount on 35mm standard bar according DIN46 227 by lapping , or mount based on DIN43 603	
Connection	Auto-opening fastening terminal , max. sectional area: 2×1.5mm ²	
Type of protection	IP20 , in accordance with DIN40 050 standard	
Ambient	Noise: according to DIN40 040 standard , ambient temp.: -20°C up to 60°C, maximum relative humidity: 75%	

KG22 and WE77 / Ex electrical connection see fig. 9-3:

fig. 9-4 Electrical connection of one transition terminal,
fig. 9-5 Electrical connection of two transition terminal.

Symbols used on the figure:

- 1: SJ3.5N sensor
- 2: Isolated switching amplifier
- 3: LED on while relay works
- 4: Relay output
- 5: Power supply 220V AC

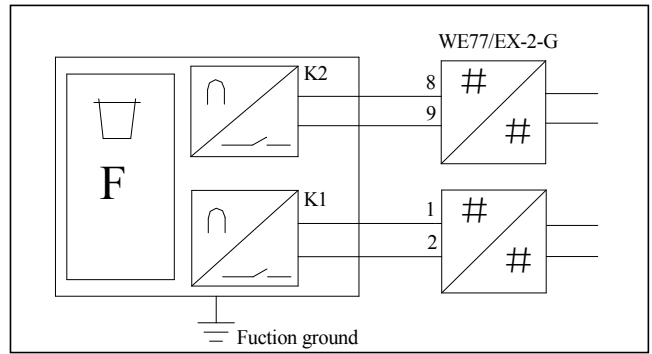


Fig. 9-3

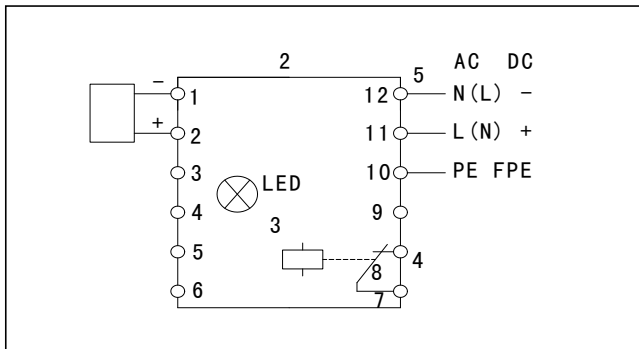


Fig. 9-4

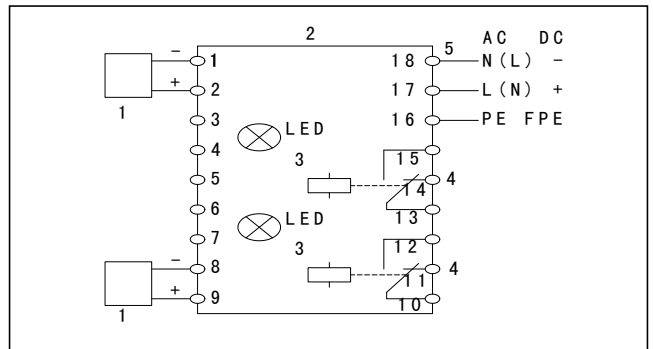


Fig. 9-5

9.1.2 KG23

Fig.9-6KG23 is reed switch,

- ◆ Compact and lightweight;
- ◆ Fast speed on-off time is 1~3ms;
- ◆ Connection point vermeidbar oxidation, Carbonization, Corrosion.

Table 9-3 KG23 Technical parameters,

Fig. 9-7 KG23 Electrical connection .

Default set:

- KR1: Low limit
- KR2: High limit

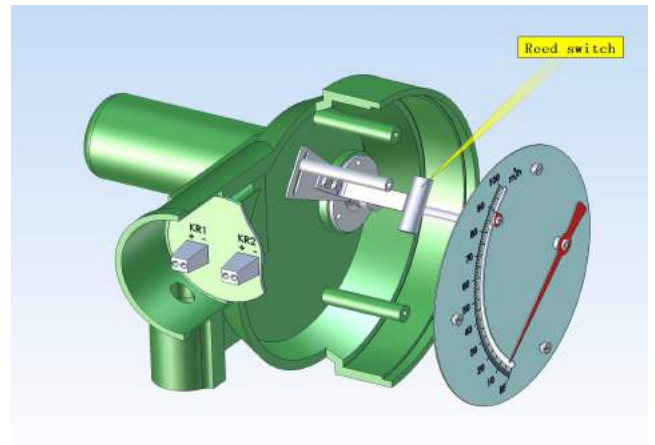


Fig. 9-6

Table 9-3

Contact form	SPST
Power rating	10W
Switching current (Max.)	1.0A
Load current (Max.)	1.5A
Switching voltage (Max.)	100V
Min. breakdown voltage	200V
Contact impedance	200 milliohms
Insulation impedance (min.)	10 ¹² ohms
Contact capacity (max.)	0.2pf

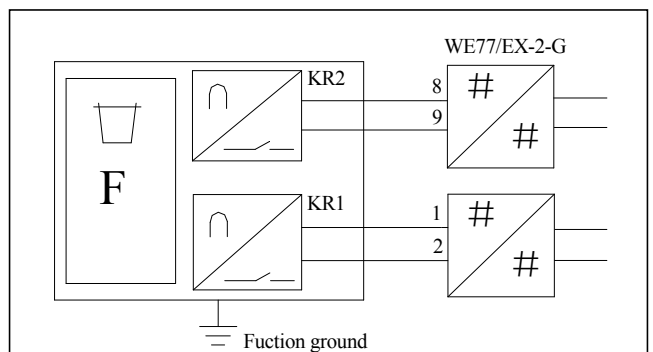


Fig. 9-7

9.1.3 KG24

KG24 is optical coupling switch which photoelectric relay is integrated on flow board card and set digital value. See fig. 9-8:

- ◆ Limit signal of output is better reliable, safe and precise;
- ◆ Limit setting is better convenient.

Photoelectric relay technical parameters see table 9-4:

Default set:

- KE1: Low limit
- KE2: High limit

If Continuous load current is greater than absolute maximum ratings, KG24 need directly connect to WE77/E, also connect to other isolated switching amplifier which is offered or recommended by manufactory. KG24 electrical connect see fig. 9-9.

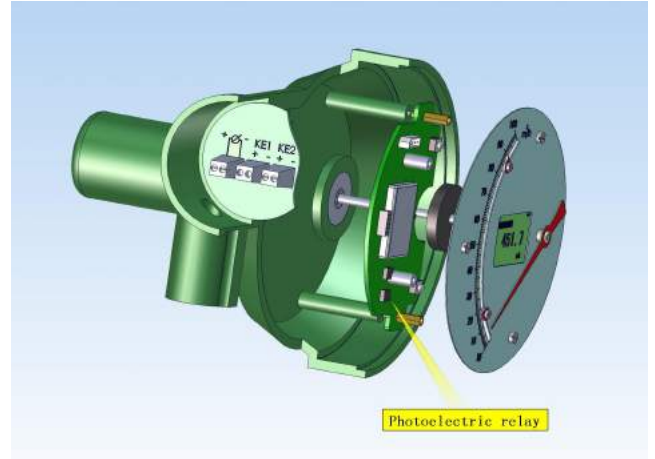


Fig.9-8

Table 9-4

Item		Absolute maximum ratings
Turn off	Load voltage (peak AC)	350V
	Off state leakage current	1μA
Turn on	On resistance (Max.)	25Ω
	Continuous load current	0.12A
Power dissipation		300mW
I/O isolation voltage		1500V AC
Turn on time (Max.)		5ms
Turn off time* (Max.)		2ms

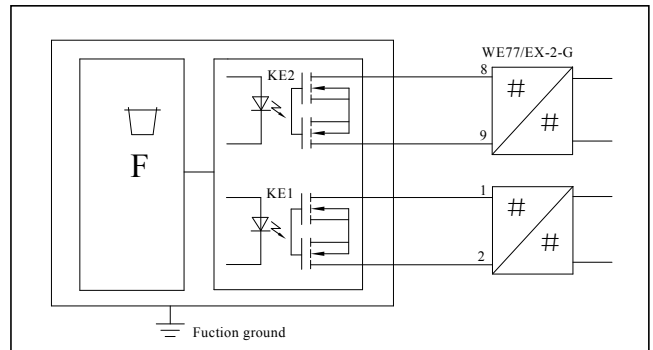


Fig. 9-9

9.2 (4-20)mA / HART communication protocol electronic signal output

See fig. 9-10:

9.2.1 Electrical data:

Power supply: (12~36)VDC;

Rated voltage: 24VDC.

9.2.2 Electrical connection:

Terminal wiring see fig. 9-11:

Fig. 9-12 electrical connection of Explosion-proof

R: recommended 250Ω.

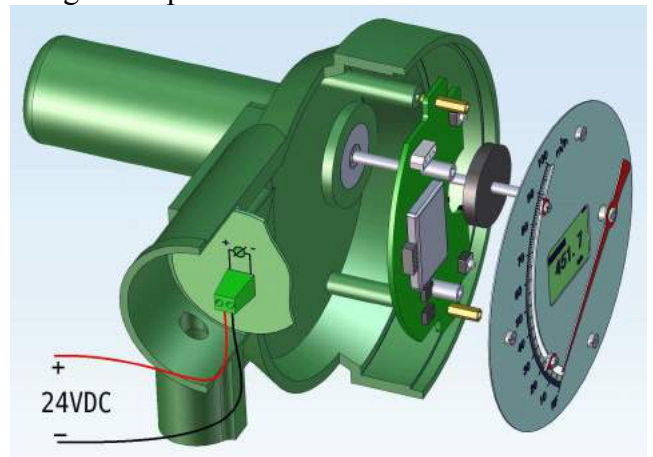


Fig. 9-10

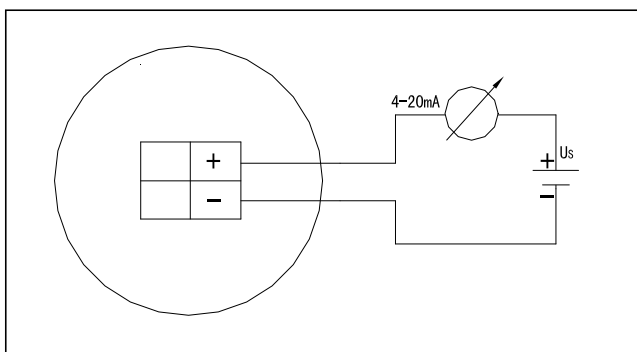


Fig. 9-11

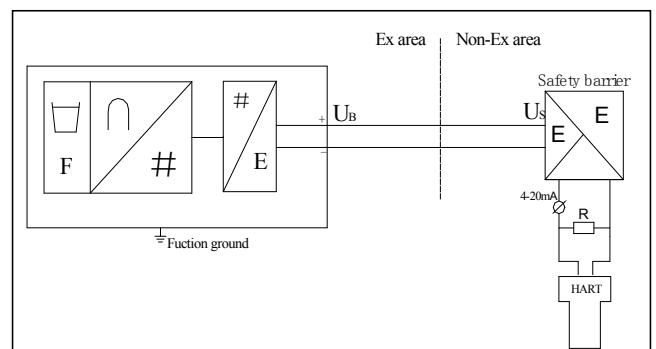


Fig. 9-12

10 LM57 order code

F56 order code			
1.Series type : LM57			
2.Installation form			
VL	Vertical (if select Vertical mounting , this column is ignored)		
HL	Horizontal		
BT	Bottom-in side-out		
ST	Side-in side-out		
UT	Up-in down-out		
3.Process connection			
F	Flange connection		
W	Screw thread connection		
H	Clamp connection / Hygienic		
C	Cutting sleeve connection		
4.Materials (other ones is optional also)			
IS	304/304SS		
AS	316/316SS		
SS,AA	304L/304LSS, 316L/316LSS		
SA,SI	317/317SS, 317L/317LSS		
C276,B2,B1,	Hastelloy alloy C276, Hastelloy alloy B2, Hastelloy alloy B1, N6		
PV	PV (Vertical, Max: DN100, normal atmospheric temperature)		
PP	PP (Vertical, Max: DN100)		
C4,B2,B1,N6	Hastelloy alloy C4, Hastelloy alloy B2, Hastelloy alloy B1, N6		
Ti	Titanium alloy		
Zr	Zirconium alloy		
Al	Aluminium alloy		
Cu	Copper alloy		
SP	1Cr18Ni9Ti with PTFE liner		
5.Indicators			
P8	Mechanical indicator with stainless steel housing		
P10	A	Mechanical indicator with two-wire signal output (4-20)mA,(K22 or K24)	
	H	Mechanical indicator with two-wire signal output (4-20)mA/HART,(K22 or K24)	
	I	Mechanical indicator,(K22 or K23)	
	B	Mechanical indicator with LCD display powered supply by lithium-ion battery	
6.Explosion protection type			
Exi	Intrinsic safety type		
Exd	Explosion-proof type		
7.Measuring medium			
L	Liquid		
G	Gas		
8.Jacket-type			
T	With Heating / cooling jacket		
9.Limit switches			
KG22	K1	Low limit	
	K2	High limit	
KG23	KR1	Low limit	
	KR2	High limit	
KG24	KE1	Low limit	
	KE2	High limit	
10.High temperature			
H1	Medium temperature : 120℃~160℃		
H2	Medium temperature : 160℃~250℃		
H3	Medium temperature : 250℃~400℃		

① ② ③ ④ ⑤

For example LM57/VL/F/ S4 / P10H / L (see above order code)

- ① Vertical (PI needn't fill in) ② Flange connection ③ Two-wire output signal (4-20)mA / Hart communication protocol
 ④ 304 ⑤ Measuring medium is liquid



Serial number
No:

Variable Area Flowmeters Technical Data Sheet

F.No.												
Tag No.												
MFG.No.												
Quantity												
Nominal Diameter	DN	PN		DN	PN		DN	PN				
Flange Standard												
Body Materials												
Lining Materials												
Float Materials												
Jacket type	<input type="checkbox"/> Heating	<input type="checkbox"/> Cooling		<input type="checkbox"/> Heating	<input type="checkbox"/> Cooling		<input type="checkbox"/> Heating	<input type="checkbox"/> Cooling				
Connection Standard	DN	PN		DN	PN		DN	PN				
Heating Medium												
Pres.MPa/Temp. °C		MPa	°C		MPa	°C		MPa	°C			
Overall Height			mm			mm			mm			
Accuracy Class												
Fluid Conditions	Liquid <input type="checkbox"/>		Gas <input type="checkbox"/>	Liquid <input type="checkbox"/>		Gas <input type="checkbox"/>	Liquid <input type="checkbox"/>		Gas <input type="checkbox"/>			
Flow Name												
Operating Conditions	Min	Normal	Max	Min	Normal	Max	Min	Normal	Max			
Flow Rate												
Temperature °C												
Pressure MPa												
Density kg/m ³												
Specific Gravity kgf/m ³												
Viscosity mPa.s(cp)												
Gas Molecular Weight												
Project Range	Standard Dial		%			%			%			
	Operating Dial		%			%			%			
	Float No.											
MFG.Range	Standard Dial		%			%			%			
	Operating Dial		%			%			%			
	Float No.											
Electrical Signal Output			mA						mA			
Power Supply			V DC			V DC			V DC			
Cable Connection		M	×	mm		M	×	mm		M	×	mm
Limit Switches	<input type="checkbox"/> High	%	<input type="checkbox"/> Low	%	<input type="checkbox"/> High	%	<input type="checkbox"/> Low	%	<input type="checkbox"/> High	%	<input type="checkbox"/> Low	%
Degree of protection												
Certificate Sign												

Fittings

Tag No.	Standard / Model	Name	Quantity