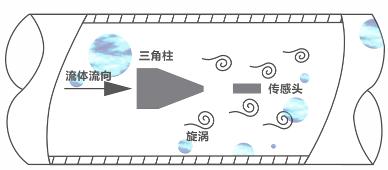
The selection is detailed on page 9

FV70
Vortex Flowmeter

Working principle

The FV70 vortex flow sensor measures the flow rate of steam, gas, and low viscosity liquids based on the theories of Carmen and Strouhal regarding the generation of vortices and the relationship between vortices and flow rate.As shown in the figure, insert a Triangular prism vertically into the meter body, that is, the vortex generator. When there is medium flowing through the meter body, regular Karman vortex in the opposite direction will be generated alternately behind the Triangular prism. The separation frequency F of the vortex is proportional to the flow speed V of the medium. By detecting the number of vortices through the sensing head, the fluid flow rate can be calculated, and then the volumetric flow rate of the measured medium can be calculated based on the gauge diameter.



Product description

The principle of measurement is based on the existence of regular vortex downstream of the retaining body, that is, "vortex street phenomenon", for example, in the gap between piers. Therefore, the baffle in each vortex flowmeter is located in the center of the pipeline. When the flow velocity reaches the specified value, a vortex is formed behind the baffle, which is separated from the fluid and transmitted to the downstream pipeline.

The vortex frequency is proportional to the average flow rate, that is, to the volume flow rate. Vortex separated from both sides of the gear body alternately generates positive pressure and negative pressure, and the capacitance sensor detects the pressure, generates an electrical signal and converts it into a digital linear signal for transmission to electronic components.

functional performance

Two-wire instrument with integrated pressure and temperature compensation
Wear-free, fully welded stainless steel structure, with high corrosion resistance, pressure resistance and temperature resistance.
plug and play
The measuring element adopts maintenance-free design.
Communication protocol, FF bus /Profibus
Integrated internal diameter reduction
Pressure and temperature signals can be read by HART.

Product application

Monitoring of electricity, gas and water treatment
Oil and gas industry
Power industry, chemical industry, metallurgical industry
Pulp and paper industry
Food and pharmaceutical industry
Environmental protection engineering

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Technical parameter

specifications	
Measuring medium	Gas, liquid, steam
Caliber specification	
Flange clamping type	DN15mm~DN150mm
Flange welding type	DN15mm~DN300mm
plug-type	DN200mm and above
measuring range	
Measuring velocity range	4~40m/s for gas and 0.5~5m/s for liquid.
Measuring flow range	See Table 1 for the measuring range of liquid and gas flow, Table 2 for the saturated steam flow and Table 3 for the plug-in flow.
measurement accuracy	Falanca-mounted and flange-mounted are Grade 1 and Grade 1.5.
	The accuracy of plug-in measuring head is Grade 1, and that of plug-in industrial pipe is Grade 2.5.
Temperature of measured medium	Normal temperature: -25℃~100℃
	High temperature: -25℃~150℃ or -25℃~300℃
nominal pressure	1.6Mpa, 2.5Mpa, 4.0Mpa (can be supplied according to the order requirements)
Output signal (signal line interface is M20×1.5 internal thread)	
impulse voltage	High voltage 8~10V, low voltage 0.7V~1.3V (explosion-proof: high voltage 4~5V, low voltage 0.7~1.3V)
output signal	The pulse duty ratio is about 50% and the transmission distance is 100m m.
Standard voltage	DC 4~20mA allows external load resistance to be less than 6000 (24V power supply).
output signal	
Instrument use environment	Temperature: -25℃~+25℃
	Humidity: 5~90% RH (50℃)
texture of wood	The watch body is made of 304 stainless steel, and the converter shell is made of aluminum alloy.
	The watch body is made of 316 stainless steel and needs to be customized.
Power Supply	Dc12v 10% DC 24v 10% lithium battery 3.6V 7.5Ah 2 section.
explosive-proof grade	Ex ia IIC T3... T6, Ex db IIC T6... T1 Gb
the protection grades	IP65，IP66，IP67 Selectable

Determination of Flowmeter Diameter and Available Flow Range

Gas, liquid

The upper limit flow rate of vortex flowmeter is generally not affected by medium pressure and temperature, while the lower limit flow rate depends on the working density and viscosity of the medium. Therefore, determining the flow range is actually determining the actually available lower limit flow. The optimal working flow is at 1/2-2/3 of the sensor range.

Step 1: Look up Table 3 according to the actual flow, and initially determine the flowmeter caliber. Common flow should be selected at 50%-70% of the upper limit of flow. Note that gas refers to the working condition flow rate. If it is standard temperature and pressure flow rate, please use Formula (3) to convert it into working condition flow rate.

Formula: $Q=Q_N X (P_N P) X (T/T_N)$ ....(3)

Q -Working condition flow;

Q_N -Standard temperature and pressure flow;

P_N -standard atmospheric pressure (0. 101325MPa) ;

P -Absolute pressure of medium under working condition (gauge pressure+atmospheric pressure) ;

T -Absolute temperature of medium under working condition[<273.15+t) K]

t -Medium temperature under working condition(℃);

T_n -Standard temperature and pressure absolute temperature(273. 15K) 。

Step 2: Calculate the lower limit flow determined by the working density of the medium according to Formula (4)Q^{P}。

Formula: $Q_p=Q_O\times\sqrt{P_O/\rho}$..(4)

Q_P -Measurable lower limit flow of medium under working condition density;

Q_O -The lower limit flow rate of water or air listed in the table (liquid check water, gas check air),

P_O -Density of reference medium, Water is1000kg/m^3,and air is 1. 205kg/m^3;

ρ -Working condition density of measured medium Working condition density of measured medium

When the medium density is high, the measurable lower limit flow is low.

Step 3: Calculate the lower limit flow rate determined by the kinematic viscosity of the medium working condition according to Formula (5)$Q_{V.}$

Formula: $Q_v=Q_O\times u/u_O$.. (5)

Q_V -The measurable lower limit flow rate of the medium under the working condition kinematic viscosity.

Q_O -The lower limit flow rate of water or air listed in Table 3 (liquid check water, gas check air),

u -Kinematic viscosity of measured medium under working conditions,

Y_O -Kinematic viscosity of reference medium, Water is 1 x10-6 m²/s, and air is15x10-6m^2/s。

The conversion formula of kinematic viscosity and dynamic viscosity is as follows:

Formula: $u=\eta/\rho$..(6)

u -Kinematic viscosity(m^2/s)

η -Force viscosity[kg/ (m·s)]

ρ -Density(kg/m^3)

When the kinematic viscosity of the medium is small, the measurable lower limit flow rate is low.

Step 4: Compare Q_P and Q_V to determine the available lower limit flow and the linear lower limit flow.

If $Q_P < Q_V$, the measurable flow range is $Q_P \sim Q_{max}$, and the linear flow range is $Q_P \sim Q_{max}$;

If $Q_P \ge Q_V$, both the measurable flow range and the linear flow range are $Q_P \sim Q_{max}$.

Q_{max} refers to the upper limit flow specified in Table 3. The maximum flow rate of liquid should generally be less than 10m/s, and the maximum flow rate of gas should generally be less than 70m/s. The linear lower limit flow rate of high viscosity liquid is much higher than that of water. If the lower limit flow rate is required, it is not suitable to use vortex flowmeter.

Steam

When the user's measuring medium is steam, mass flowmeter units, such as t/h or kg/h, are commonly used. Because the density of steam is different at different temperatures and pressures. Therefore, the steam flow area can be calculated by Formula (7).

Step 1: Find out the maximum air flow range of the corresponding caliber flow from Table 3.

Step 2: According to the pressure and temperature parameters of steam, check the relevant data to get the density of steam.

Step 3: Calculate the lower limit flow of the flowmeter by Formula (7).。

Formula: $Q=1.5Q_O x\sqrt{p_O/\rho}\ x\ \rho$ (kg/h)..(7)

Q, ρ -Flow rate and density of measured steam;

Q_O, P_O -Flow and density of reference air(1.205kg/m^3)。

Step 4: Determine the upper limit flow. The upper limit velocity of steam should be less than 70m/s.

Users can also look up Table 4 to know the flow range of saturated steam measured by different caliber flowmeters, or substitute the density of superheated steam into Table 5 to calculate the flow range of superheated steam measured by different caliber flowmeters.

When measuring the mass flow of steam, the sensor must form a mass flow measurement system together with temperature and pressure measuring elements. Platinum thermal resistance or pressure transmitter should be added to measure saturated steam, and platinum thermal resistance and pressure transmitter should be added to measure superheated steam at the same time.

Working principle calculation formula

The calculation formula is as follows:

F=Sr*V/(1-1. 27*d/D).............................formula 1
Q=3600*F/K ....formula 2
M=Q*ρ ....formula 3

F.....Vortex frequency (Hz) generated by liquid flowing through vortex street triangle column.
Sr......Stern Rohal number (unit: dimensionless)
V......Fluid velocity in the pipeline (unit: m/s)
d......Width of triangular column in vortex street surface (unit: m)
D.....Inside diameter of vortex street surface (unit: m)
Q.....Instantaneous volume flow (unit: m^3/h)
K.....Instrument coefficient of vortex street (unit: number of pulses/m^3)
M....Instantaneous mass flow (unit: kg/h)
ρ.....Fluid density (unitkg/m^3)

The instrument coefficient k of vortex street flow sensors with different calibers is different, and its specific value is actually calibrated by the flow calibration device. Meaning is the number of pulses per cubic meter.
That is, the number of vortices generated by flowing through one side of a cubic meter of fluid triangular column.

Measuring diameter and flow range

Flow range of liquid and working gas

Table 1

latus rectum **(mm)**	**liquid**	**Normal temperature and pressure air**
	Standard measuring range (m^3/h)	**Standard measuring range (m^3/h)**
15	0.8~6	6~40
20	1~8	8~50
25	1.5~12	10~80
32	1.6~16	15~150
40	2.5~30	25~200
50	3~50	30~300
65	5~80	50~500
80	8~120	80~800
100	12~200	120~1200
125	20~300	160~1600
150	30~400	250~2500
200	50~800	400~4000
250	80~1200	600~6000
300	100~1600	1000~10000
400	200~3000	1600~16000
500	300~5000	2500~25000
600	500~8000	4000~40000

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Mass flow range of superheated steam（kg/h）

Table 2

Absolute pressure P (MPa)	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.2	1.5	2.0
Temperature (℃)	**120.23**	**133.54**	**143.62**	**151.84**	**158.94**	**164.96**	**170.41**	**175.36**	**179.88**	**189.96**	**198.41**	**212.37**
density ρ (kg/m³)	**1.129**	**1.651**	**2.163**	**2.669**	**3.170**	**3.667**	**4.162**	**4.655**	**5.147**	**6.127**	**7.602**	**10.05**
DN25 Lower limit of standard	14	17	19	22	23	25	27	28	30	33	36	42
DN25 standard upper limit	140	170	190	220	230	250	270	280	300	330	360	420
DN32 standard lower limit	26	30	34	38	41	44	47	50	52	57	63	73
DN32 standard upper limit	260	300	340	380	410	440	470	500	520	570	630	730
DN40 standard lower limit	31	38	44	48	53	57	60	64	67	73	82	94
DN40 standard upper limit	310	380	440	480	530	570	600	640	670	730	820	940
DN50 standard lower limit	52	63	73	81	88	95	101	107	112	122	136	157
DN50 standard upper limit	520	630	730	810	880	950	1010	1070	1120	1220	1360	1570
DN65 standard lower limit	90	106	121	134	146	158	168	178	187	204	227	261
DN65 standard upper limit	900	1060	1210	1340	1460	1580	1680	1780	1870	2040	2270	2610
DN80 standard lower limit	122	148	170	188	205	221	235	249	261	285	318	365
DN80 standard upper limit	1220	1480	1700	1880	2050	2210	2350	2490	2610	2850	3180	3650
DN100 standard lower limit	175	212	242	269	293	315	336	355	374	408	454	522
DN100 standard upper limit	1750	2120	2420	2690	2930	3150	3360	3550	3740	4080	4540	5220
DN125 standard lower limit	262	318	363	404	440	473	504	533	561	612	681	783
DN125 standard upper limit	2620	3180	3630	4040	4400	4730	5040	5330	5610	6120	6810	7830
DN150 standard lower limit	350	423	484	538	586	631	672	711	747	815	908	1044
DN150 standard upper limit	3500	4230	4840	5380	5860	6310	6720	7110	7470	8150	9080	10440
DN200 standard lower limit	700	846	969	1076	1173	1261	1344	1421	1494	1630	1815	2088
DN200 standard upper limit	7000	8460	9690	10760	11730	12610	13440	14210	14940	16300	18150	20880
DN250 standard lower limit	1050	1269	1453	1641	1759	1892	2016	2132	2241	2445	2722	3132
DN250 standard upper limit	10500	12690	14530	16410	17590	18920	20160	21320	22410	24450	27220	31320
DN300 standard lower limit	1750	2116	2422	2690	2932	3153	3359	3553	3736	4076	4536	5220
DN300 standard upper limit	17500	21160	24220	26900	29320	31530	33590	35530	37360	40760	45360	52200

Mass flow range of superheated steam（kg/h）

Table3

latus rectum (mm)	Unlimited flow (kg/h)	Upper limit flow (kg/h)
25	13.1	131
32	23.0	230
40	26.5	265
50	49.4	494
65	82.3	823
80	115.3	1150
100	164.7	1647
125	247.1	2471
150	329.4	3294
200	658.8	6588
250	988.2	9882
300	1647	16470

Note: 1. ρ is the working temperature of superheated steam. Generally, the upper limit velocity of superheated steam should not be greater than 70m/s.

2. The pressure loss of the sensor under different flow rates can be calculated as follows: ρ=1.2ρV2.

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Formula:

P -Pressure loss (Pa)

ρ -Measuring working density of medium(kg/m²)

V -Average velocity in pipe(m/s)。

Formula requirements: 3. When the medium to be measured is liquid, in order to prevent gasification or cavitation, the absolute pressure in the sensor under working condition should meet the following requirements.

$$P > 2.6\quad P + 1.25P_b$$

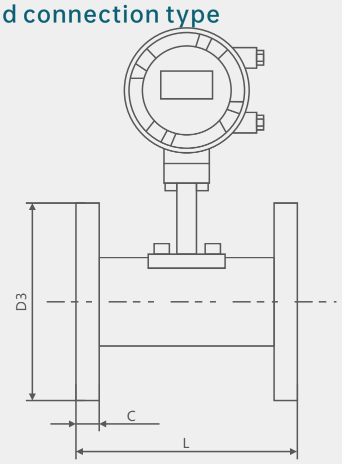
Formula:

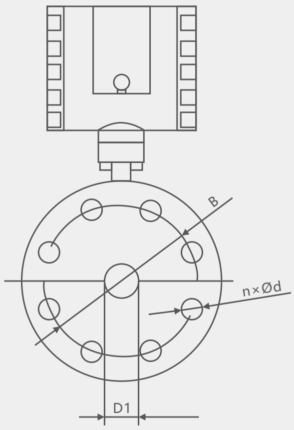
P -Absolute pressure of measured medium(Pa)

P_b -The corresponding absolute pressure of saturated gas at the working temperature of the measured medium.(Pa)

Size mm

Flanged connection type

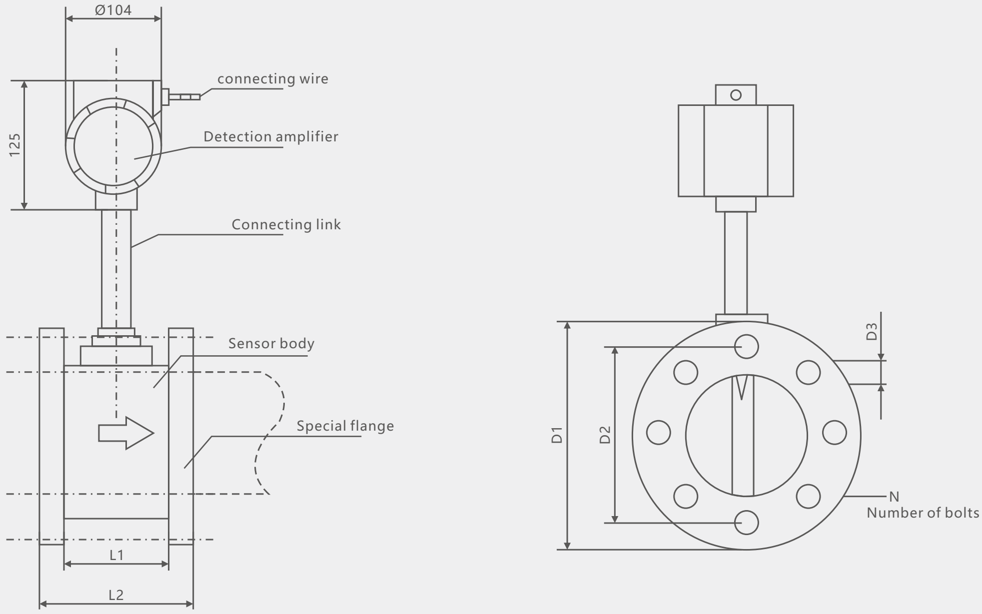




Nominal Diameter (mm)	Inner diameter of gauge body D1(mm)	Meter body lengthL (mm)	flange outer diameterD3 (mm)	Centre-to-centre distance of bolt holeB(mm)	flange thicknessC (mm)	Bolt hole diameterd (mm)	Number of bolts n
25	25	170	150	110	18	18	4
32	32	170	155	115	18	18	4
40	40	190	160	120	18	18	4
50	50	190	165	125	20	18	4
65	65	220	165	145	20	18	4
80	80	220	200	160	20	18	8
100	100	240	220	180	22	18	8
125	125	260	250	210	22	18	8
150	150	280	285	240	24	22	8
200	200	300	340	295	26	22	12
250	250	360	405	355	28	26	12
300	300	400	460	410	32	26	12

Size mm

Falanca style



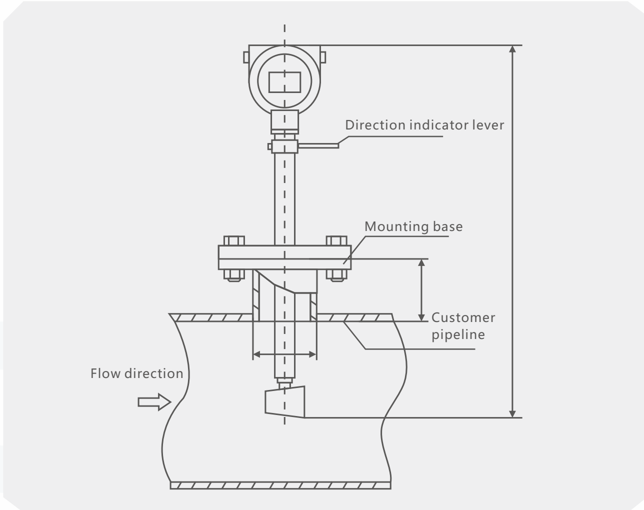
Bore	L1	L2	D1	D2	D3	N
15	65	95	125	100	13	4
20	65	95	125	100	13	4
25	65	95	125	100	13	4
32	66	96	140	100	13	4
40	80	114	145	110	13	4
50	80	114	160	125	17	4
65	93	135	180	145	17	6
80	100	142	195	160	17	6
100	126	168	230	190	17	8
125	146	192	245	210	17	8
150	166	216	280	240	21	8
200	196	246	335	295	21	12
250	114	168	405	355	21	12
300	130	184	460	410	21	12

Insert vortex street

Plug-in vortex flowmeter is mainly used to measure the flow of large-caliber gas, liquid and steam media in industrial pipelines of various industries. Its characteristics are simple structure, no moving mechanical parts, small pressure loss and wide range ratio. The range is 10 -15, and the cost performance is high.

Matters needing attention in installation:

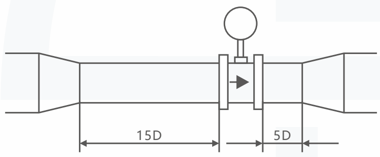
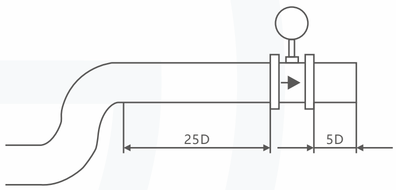
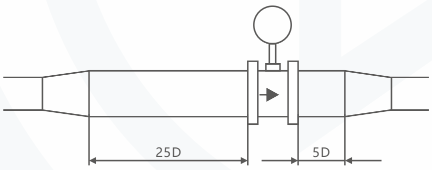
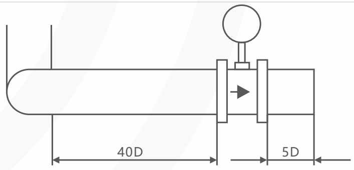
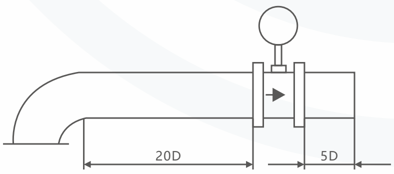
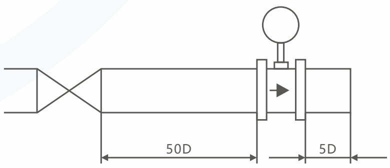
1. The installation base inserted into the pipeline shall not exceed the inner wall of the pipeline;
2. The position of the pedestal on the pipeline should be straight and not skewed.
3, deburring and welding slag removal;
4. The flange plane of the pedestal is parallel to the pipeline axis.
5, to ensure that the medium flow direction is consistent with the flow direction indicator, it is forbidden to pull the flow direction indicator.



Installation conditions

The sensor should be installed on the horizontal, vertical and inclined (liquid flows from bottom to top) pipeline corresponding to its diameter. The upstream and downstream of the sensor should be equipped with a certain length of straight pipe section, and its length should meet the following table:

Front and rear straight pipe section

Concentric contraction Fully open valve		The same plane Two 90 elbows	
Concentric tube expansion		Different planes Two 90 elbows	
A 90 elbow		control valve Half-open valve	

The pipeline near the installation of the liquid sensor should be filled with the measured liquid.

Sensors should be avoided to be installed on pipes with strong mechanical vibration.

The inner diameter of the straight pipe section should be consistent with the sensor diameter as much as possible. If it is not consistent, a pipe slightly larger than the sensor diameter should be used.

When the temperature and pressure of the measured medium need to be corrected, the pressure point should be 3~5DN behind the sensor, and the temperature point should be 5~8DN.

When the measured medium contains more impurities, a filter should be installed beyond the length required by the straight pipe section upstream of the sensor.

Sensors should be avoided to be installed in places with strong electromagnetic interference, small space and inconvenient maintenance.

FV70-Selection composition

Selection example FV70 B / G / 1-10 / O / Y / W / B / S / V / X / A
1 2 3 4 5 6 7 8 9 10 11

1.Process installation mode	A	Flange clamping type
	B	Flange tube type
	C	Plug-in
	D	Split type
2.Signal output type	G	4~20mA
	H	4~20mA, HART protocol signal
	I	4-20mA, switch output
	J	4~20mA+RS485
	K	4~20mA+FF bus
	L	4~20mA+PF bus
	M	4~20mA+MODBUS
	N	4~20mA+RS485+MODBUS
3.Range range	R( )	Range (Note Range)
4.Shell material	O	Stainless steel
	P	Aluminum
5.Liquid material	X	Anticorrosion ABS
	Y	304
	Z	316L
	T( )	Other materials
6.Precision class	V	1.0level
	W	1.5level
7.Pressure rating	A	PN10
	B	PN16
	C	PN25
	D	PN40
	E	PN63
	F	PN100
	G	Class150
	H	Class300
	I	Class400
	J	Class600
	T( )	Other pressure levels
8.Flange connection specification(Do not select this option for plug-in.)	N	DN15
	O	DN20
	P	DN25
	Q	DN32
	R	DN40
	S	DN50
	Z	DN65
	U	DN80
	V	DN100
	W	DN125
	X	DN150

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FV70-Selection composition

Selection example **FV70** | B | G | 1-10 | O | Y | W | B | S | V | X | A

B	G	1-10	O	Y	W	B	S	V	X	A
1	2	3	4	5	6	7	8	9	10	11

8.Flange connection specification(Do not select this option for plug-in.)	A	DN200
	B	DN250
	C	DN300
	D	3/8"
	E	1/2"
	F	3/4"
	G	1"
	H	1¼"
	I	1½"
	J	2"
	K	2½"
	L	3"
	Z	3½"
	M	4"
	N	5"
	O	6"
	P	8"
	Q	10"
	T( )	Other specifications

8-1.Insert flange connection(Flange connection is not selected)	W	DN200
	X	DN250
	Y	DN300
	Z	DN350
	A	DN400
	B	DN450
	C	DN500
	D	DN600
	E	DN700
	F	DN800
	G	DN900
	H	DN1000
	I	DN1400
	J	DN1600
	K	DN1800
	L	DN2000
	M	DN3000
	N	8"
	O	10"
	P	12"
	Q	14"
	R	16"
	S	18"
	T( )	Other specifications

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LUDWIG INSTRUMENT

FV70-Selection composition

Selection example FV70 / B / G / 1-10 / O / Y / W / B / S / V / X / A
1 2 3 4 5 6 7 8 9 10 11

8.2.Threaded connection	Y	G1"
	Z	2"
9.Power source	S	24VDC
	U	220VAC
10.Wire system	X	Two-wire system
	Y	Three-wire system
	Z	Four-wire system
12.Explosion-proof type	A	Intrinsically safe explosion protection
	B	flameproof
	N	Non-explosion proof

Instructions:

It means that FV70 vortex flowmeter is pipe section installation, signal output is 4-20mA, measuring range is 1-10t/h, body material is stainless steel, liquid material is 304 stainless steel, accuracy level 1.5, pressure level PN16, flange specification is DN50, (8,8.1,8.2) three choices, power supply 24V DC, 2-wire system, This is explosion-proof.

Product Certification

Compliance and approval; Rodwig flow meters meet key standards and certifications for process measurement technology;
To ensure the highest reliability in such settings;

CE Ex SIL

Ludwig China Representative Office
Ludwig Automation Instrument (Guangzhou) Co., Ltd | Ludwig International Trade (Shanghai) Co., Ltd
LUDWIG More product information is available www.ludwig-schneider.com.cn
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