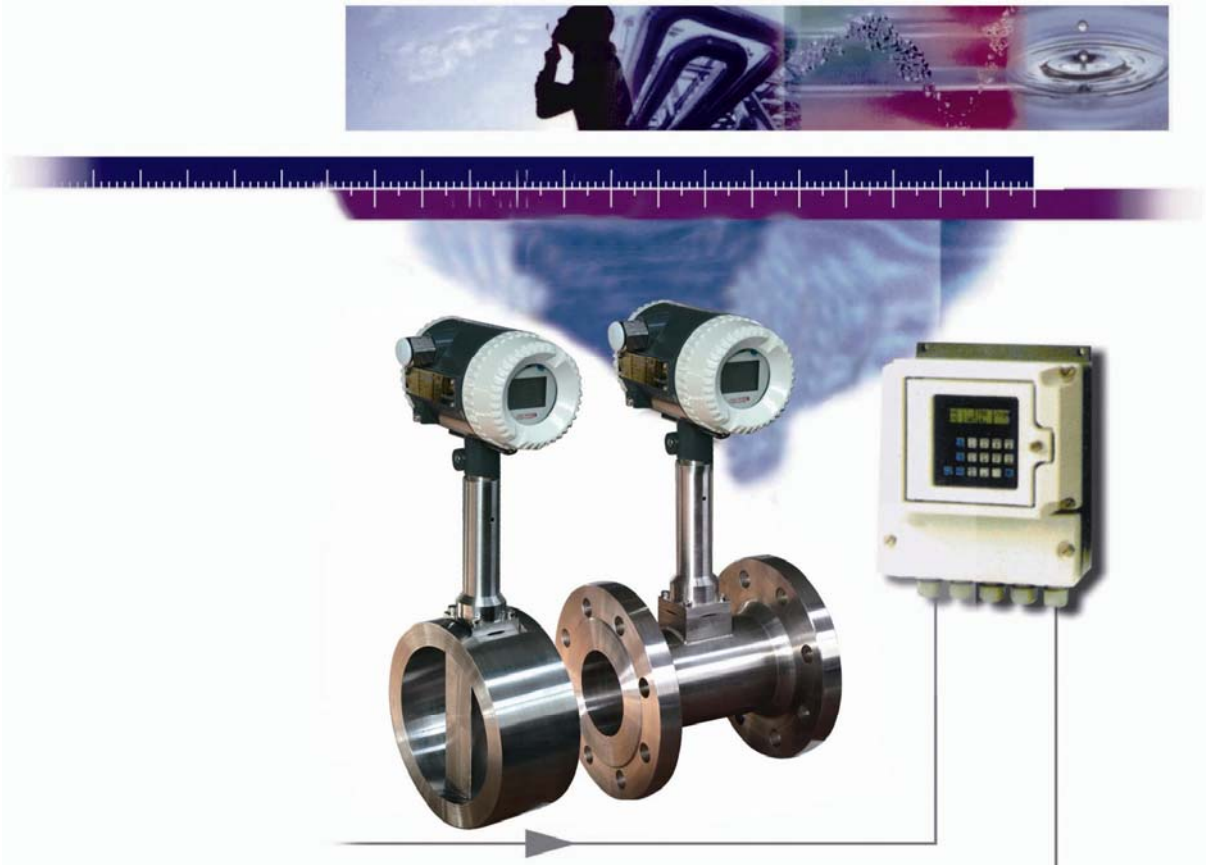
VT 8000 Specification

Intelligent Vortex Flowmeter



- Fluid temperatures up to 350°C
- High accuracy
- Short inlet sections
- Precise digital signal processing(DSP) technology
- Suitable for hazardous area applications

instrumentation

understanding measurement analysis control integration optimization

FISCHER & PORTER

Contents

Pipe design Vortex Flowmeter

1. Brief Introduction

Fischer&Porter Corporation has the most advanced vortex flowmeter in the world. It may carry out the flow measuring, detecting and controlling for various liquids, gases, high/low temperature superheated steam and saturated steam. It is widely used in the industry department, municipal construction and environmental protection engineering, such as petroleum, chemical industry, metallurgy, electric power, paper making, drug making, food and so on.

2. Characteristics

● Shock resistance type: the vortex flowmeter of Fischer & Porter Corporation adopts 4- piece piezoelectric crystals for measuring. Two of them are used to detect the flow of fluid. The other two are used to detect the vibration signal of pipe. 4–piece piezoelectric crystals adopt parallel connection mode to counteract the vibration signal detected by piezoelectric crystal detecting flow signal, thus the influence of external vibration on detecting flow is eliminated fundamentally.

● Temperature and pressure compensation: VT/VR transducer may receive temperature sensor PT100 signal directly ,temperature compensation ,output 4-20mA current signal ; Or receive temperature sensor PT100 signal and pressure converter 4-20mA signal , temperature and pressure compensation, output RS485 signal, displays the fluid flow after temperature and pressure compensation.

● Explosion proof design: Exia II CT6
Exd II CT6

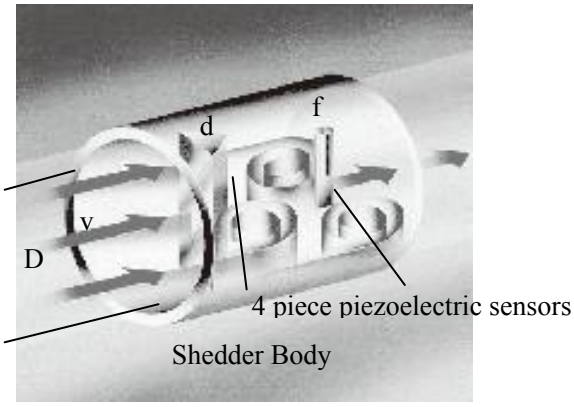
● Intelligent type: The meter parameters and meter range may be changed by three manual buttons or manual controller to modify instrument parameters and range on site.

● Output mode: 4-20mA current signal output ， pulse signal and RS485 port.

● Display mode: LCD multi-function screen can display the frequency, instantaneous flow and accumulated flow and so on, the type of temperature and pressure compensation can also display temperature, pressure, density, mass flow and so on.

● Communication mode: HART-communication protocol
RS485 Modbus port

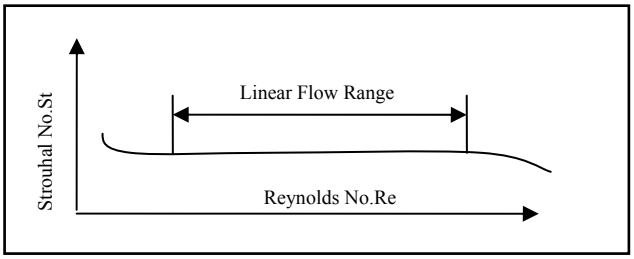
3. Priniple of Operation



The operation of the Vortex Flowmeter is based on the Karman Vortex Street principle. Vortices are formed alternately on both of its sides as a fluid flows around the shedder body.The flow causes these vortices to be shed forming a vortex street(Karman Vortex Street).
The frequency **f** of the vortex shedding in proportional to the flow velocity **v** and inversely proportional to the width of the shedder body **d**:

$$f = St \cdot v/d$$

St, the Strouhal Number, a dimensionless number, defines the quality of the vortex flowrate measurements.
(See the formula and chart)



As a result, the vortex shedding frequency to be evaluated, is a function only of the flow velocity and is independent of the fluid density and viscosity.

4. Technical Parameter Table

				
Meter Model			VT 8000	VR 8000
Accuracy	Liquids		1.0%, 0.75%	1.0%, 0.75%
	Gases/steam		1.0%	1.0%
Reproducibility			≤±0.2% of rate	≤±0.2% of rate
Allowable viscosity of measured medium			≤7.5mPa s	≤7.5mPa s
Typical flow Range			1:20	1:20
Sensor	Flange connection DIN		DN15-DN600	DN15-DN600
	Clamp connection DIN		DN15-DN300	DN15-DN300
	Fluid Temperature	Normal Temperature	-20°C--150°C	-20°C--150°C
		Medium Temperature	-20°C--250°C	-20°C--250°C
		High Temperature	-20°C--350°C	-20°C--350°C
	Pressure range	Standard	≤16MPa/900 lb	≤16MPa/900 lb
		Special	According to demands of users	According to demands of users
	Materials		0Cr18Ni9 /316/316L/Hast.C/Ti According to demands of users	0Cr18Ni9 /316/316L/Hast.C/Ti According to demands of users
Conve-rter	Supply Power		12-42 VDC / Battery power	12-42 VDC / Battery power
	Cable Connection		M20x1.5、1/2″NPT	M20x1.5、1/2″NPT
	Display		LC-Display	LC-Display
	Communication		HART-Protocol RS485 Modbus	HART-Protocol RS485 Modbus
	Ex-Design	Exia	Exia ll CT6	Exia ll CT6
		Exd	Exd ll CT6	Exd ll CT6
	Protection class	Standard	IP67	IP67
		Diving	-	Sensor IP68 / Transmitter IP67
	Ambient temperature		-40°C-+80℃	-40°C-+80℃
	Materials		Cast aluminum	Cast aluminum
	Power consumption		＜0.5 W	＜0.5 W

5. Flowrate

5.1 Flowrate（liquids）

Size				
DN	Inch	$Q_V$min[m^3/h]	$Q_V$max[m^3/h]	Frequency[Hz] at $Q_V$max
15	1/2″	0.5	5	370
25	1″	1.2	12	240
40	1.1/2″	2.5	25	190
50	2″	3.5	35	140
80	3″	13	130	100
100	4″	20	200	70
125	5″	30	300	60
150	6″	45	450	50
200	8″	90	900	45
250	10″	120	1200	29
300	12″	180	1800	26
350	14″	400	3200	22
400	16″	500	4000	20
500	20″	600	5000	17
600	24″	800	7000	14

Reference medium: water（20℃，1.103bar,ρ_0=998kg/m^3）

5.2 Flowrate（gases/superheated steam）

Size				
DN	Inch	$Q_V$min[m^3/h]	$Q_V$max[m^3/h]	Frequency[Hz] at $Q_V$max
15	1/2″	8	18	1700
25	1″	10	50	2040
40	1-1/2″	18	180	1550
50	2″	30	300	1030
80	3″	70	700	700
100	4″	100	1000	500
125	5″	150	1500	360
150	6″	200	2000	285
200	8″	400	4000	260
250	10″	600	6000	220
300	12″	1000	10000	210
350	14″	1500	12000	170
400	16″	1800	14400	140
500	20″	2600	21000	110
600	24″	3300	29000	94

Reference medium: air（20℃，1.103bar, ρ_0=1.2kg/m^3）

5.3 Flowrate（saturated steam）[kg/h]

P[bar a] / DN/inch	0.5	1	1.5	2	3	4	5	6	7	8	9	10	12	15	25	30	35	40
15 min	3	4	5	6	7	8	9	10	10	11	12	12	14	15	21	25	30	34
1/2 max	7	14	21	27	40	52	64	76	88	100	112	124	147	182	300	360	420	480
25 min	9	13	15	17	21	24	27	29	31	33	35	37	41	45	58	69	81	92
1 max	45	89	129	169	248	324	401	476	551	624	699	773	920	1140	1875	2250	2625	3000
40 min	18	25	30	35	42	48	54	59	63	67	71	75	81	91	131	158	184	210
1-1/2 max	117	230	335	440	644	842	1041	1236	1431	1622	1817	2009	2391	2964	4875	5850	6825	7800
50 min	24	34	41	47	56	64	72	78	84	89	95	95	109	128	210	252	294	336
2 max	150	295	430	565	825	1080	1335	1585	1835	2080	2330	2575	3065	3800	6250	7500	8750	10000
80 min	60	84	102	116	141	161	179	195	210	223	236	249	270	302	481	578	674	770
3 max	360	708	1032	1355	1980	2592	3204	3804	4404	4992	5592	6180	7356	9120	15000	18000	21000	24000
100 min	90	126	152	175	211	241	269	293	315	335	355	373	407	493	811	974	1136	1298
4 min	570	1121	1634	2145	3135	4104	5073	6023	6973	7904	8854	9785	11647	14440	23750	28500	33250	38000
150 min	180	252	305	349	422	483	577	685	793	899	1007	1112	1324	1642	2700	3240	3780	4320
6 max	1350	2655	3870	5081	7425	9720	12015	14265	16515	18720	20970	23175	27585	34200	56250	67500	78750	90000
200 min	150	213	311	408	597	781	966	1147	1327	1505	1685	1863	2217	2749	4521	5425	6330	7234
8 man	2400	4720	6880	9032	13200	17280	21360	25360	29360	33280	37280	41200	49040	60800	100000	120000	140000	160000
250 min	480	673	813	931	1126	1288	1517	1801	2086	2363	2647	2926	3482	4318	7101	8622	9942	11362
10 max	4200	8260	12040	15806	23100	30240	37380	44380	51380	58240	65240	72100	85820	106400	175000	210000	245000	280000
300 min	840	1178	1422	1630	1970	2254	2506	2731	2951	3345	3747	4141	4929	6111	100051	12062	14072	16082
12 max	6000	11800	17200	22580	33000	43200	53400	63400	73400	83200	93200	103000	122600	152000	250000	300000	350000	400000
Densit ρ_{sat} [kg/m^3]	0.30	0.59	0.86	1.13	1.65	2.16	2.67	3.17	3.67	4.16	4.66	5.15	6.13	7.60	12.50	15.00	17.50	20.00
Temp. T_{sat}[℃]	81.3	99.6	111.4	120.0	133.0	144.0	152.0	159.0	165.0	170.0	175.0	180.0	188.0	198.0	224.0	234.0	242.0	250.0

5.4 Standard Density For Selected Gases

Gas	Normal Density[kg/m^3]
Acetylene	1.172
Air	1.290
Ammonia	0.771
Argon	1.780
Butane	2.700
Carbon dioxide	1.970
Carbon monoxide	1.250
Ethane	1.350
Ethylen	1.260
Hydrogen	0.0899
Methane	0.717
Natural gas	0.828
Neon	0.890
Nitrogen	1.250
Oxygen	1.430
Propane	2.020
Propylene	1.915

6. Selection of Size

The measuring ranges of vortex flometerers with different calibres are different. Even if it is the flowmeter with the same caliber, as it is used for different mediums, its measuring range is also different. The actual usable flow measurement range is determined through calculation. Fischer&Porter Corporation has the advanced lectotype software. The user may also carries out the optimum selection by use of the software of the corporation.

6.1 Determination of flow range of gas

6.1.1 Flow range of gas under reference condition

Reference condition（namely calibration condition:the medium is the air at normal temperature and in normal pressure,t_0=20℃, p_0=0.1MPa (absolute pressure), ρ_0=1.2kg/m^3）, for the flow range of gas under such condition fee the flow table 5.2.

6.1.2 The gas operating condition flow range under actual use condition

As the measured medium is not the normal temperature and pressure air, the actual measured flow range in operation condition needs to be calculated. The upper limit flow of the vortex flowmeter is not generally influenced by the temperature and pressure of medium. The lower limit flow depends on the operating condition density of medium. Therefore, the determination of the actual flow range of the vortex flowmeter is to determine the actual usable lower limit flow. The methods are as follows:

The first step: calculate the volume flow rate of medium in operating condition Q_V[m^3/h];

The second step: Look up the table 5.2 to determine the caliber of the meter according to the range Q_V;

The third step: calculate the actual usable lower limit flow according to the medium density and the measured lower limit value corresponding to the meter calibre; according to the following formula:

$$Q_{V\,min} = Q_O \times \sqrt{\rho_0/\rho}$$

In which:

$Q_{V\,min}$: actual usable lower limit flow [m^3/h]

Q_O: the measured lower limit value corresponding to caliber [m^3/h]

ρ_0: reference medium density ρ_0=1.2kg/m^3

ρ: medium operating condition density [kg/m^3]

The fourth step: determine the upper limit flow range of the meter: the selection of gas flow upper limit takes the upper limit flow in flow table 5.2 as the standard. Generally, the flow velocity of gas should be smaller than 70m/s.

6.2 Determination of liquid flow range

6.2.1 The flow range of liquid under reference Condition

Reference condition（namely calibration condition:the medium is water，t_0=20℃,ρ_0=1000kg/m^3） Under such condition, for the flow range of liquid see the flow table 5.1.

6.2.2 The liquid operating condition flow range under actual use condition

As the measured medium is not water, the actual measured flow range in operation condition needs to be calculated. The upper limit flow of the vortex flowmeter is not generally influenced by the temperature and pressure of medium. The lower limit flow depends on the operating condition density of medium. Therefore, the determination of the actual flow range of the vortex flowmeter is to determine the actual usable lower limit flow. The methods are as follows:

The first step: calculate the volume flow rate of medium in operating condition Q_V[m^3/h];

The second step: Look up the table 5.1 to determine the calibre of the meter according to the range Q_V;

The third step: calculate the actual usable lower limit flow according to the medium density and the measured lower limit value corresponding to the meter calibre; according to the following formula:

$$Q_{V\,min} = Q_O \times \sqrt{\rho_0/\rho}$$

In which:

$Q_{V\,min}$: actual usable lower limit flow [m^3/h]

Q_O: measured lower limit value corresponding to caliber [m^3/h]

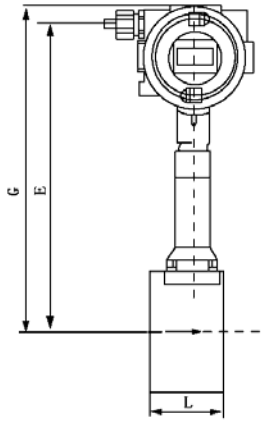
ρ_0: reference medium density ρ_0=1000kg/m^3

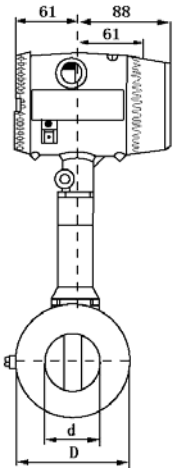
ρ: medium operating condition density [kg/m^3]

The fourth step: determine the upper limit flow range of the meter: the selection of liquid flow upper limit takes the upper limit flow in flow table 5.1 as the standard. Generally, the liquid velocity of gas should be smaller than 7m/s.

7. Dimensions and Connections

7.1 Wafer Design VT/VR8030, DIN2501/ANSI RF/ GB





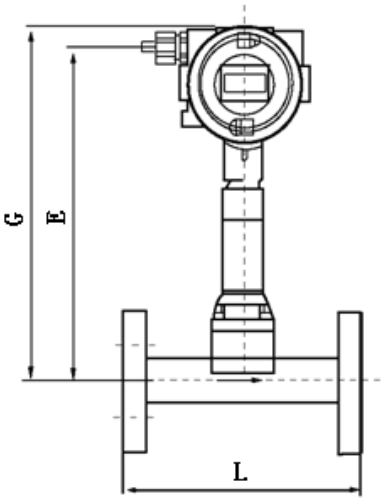
Wafer Design DIN2501/GB

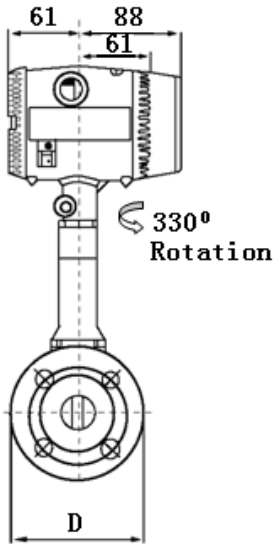
Size DN	PN [kg]	L	E	G	D	d	Weight[kg]
15	10-40	65	278	297	55	15	4.2
25	10-40	65	284	303	55	25	4.1
32	10-40	65	290	309	85	32	5.2
40	10-40	65	290	309	85	40	4.8
50	10-40	65	298	317	95	50	5.6
65	10-40	70	305	324	115	65	6.5
80	10-40	65	312	331	125	80	7.6
100	10-40	65	320	339	145	100	8.5
125	10-40	85	340	359	170	125	11
150	10-40	85	352	371	195	150	13
200	10-40	120	377	396	250	200	18
250	10-40	120	402	421	300	250	24.5
300	10-40	135	427	446	350	300	29

Wafer Design ANSI RF

Size Inch	PN[lb]	L	E	G	D	d	Weight[kg]
1/2″	150/300	65	278	297	55	15	4.2
1″	150/300	65	284	303	55	25	4.1
1-1/4″	150/300	65	290	309	85	32	5.2
1-1/2″	150/300	65	290	309	85	40	4.8
2″	150/300	65	298	317	95	50	5.6
2-1/2″	150/300	70	305	324	115	65	6.5
3″	150/300	65	312	331	125	80	7.6
4″	150/300	65	320	339	145	100	8.5
5″	150/300	85	340	359	170	125	11
6″	150/300	85	352	371	195	150	13
8″	150/300	120	377	396	250	200	18
10″	150/300	120	402	421	300	250	24.5
12″	150/300	135	427	446	350	300	29

7.2 Flange Design VT/VR8010, DIN2501/ANSI RF/GB





Flange Design DIN2501/ANSI RF/GB

Size DN	PN [kg]	Size Inch	PN [lb]	L	E	G	Weight[kg]
15	10-40	1/2″	150/300	200	296	315	5.1
25	10-40	1″	150/300	200	313	332	5.7
32	10-40	1-1/4″	150/300	200	287	306	6.0
40	10-40	1-1/2″	150/300	200	291	310	8.5
50	10-40	2″	150/300	200	298	317	10.1
65	10-40	2-1/2″	150/300	200	309	327	14.5
80	10-40	3″	150/300	200	316	335	17.6
100	10-40	4″	150/300	250	325	344	20.1
125	10-40	5″	150/300	250	340	359	25.1
150	10-40	6″	150/300	300	352	371	32.8
200	10-40	8″	150/300	350	414	433	44
250	10-40	10″	150/300	500	439	458	56.1
300	10-40	12″	150/300	500	464	483	78.2
350	10-25	14″	150	600	489	508	90
400	10-25	16″	150	600	514	533	102
500	10-25	20″	150	600	564	583	122
600	10-25	24″	150	600	614	633	145

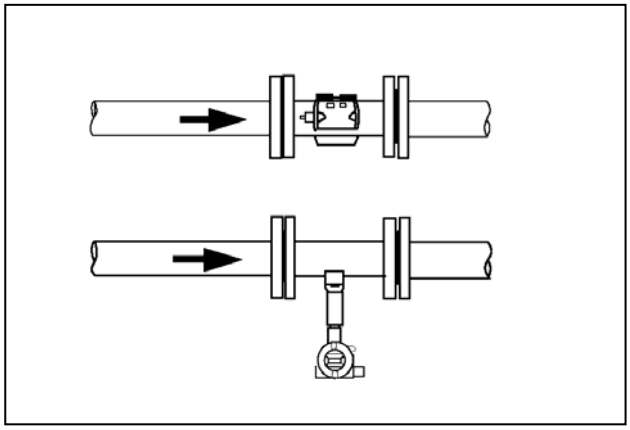
Note: The dimension D in the figure is equal to the inside diameter of the flange. It is determined according to corresponding flange standard.

8. Installation of Meter

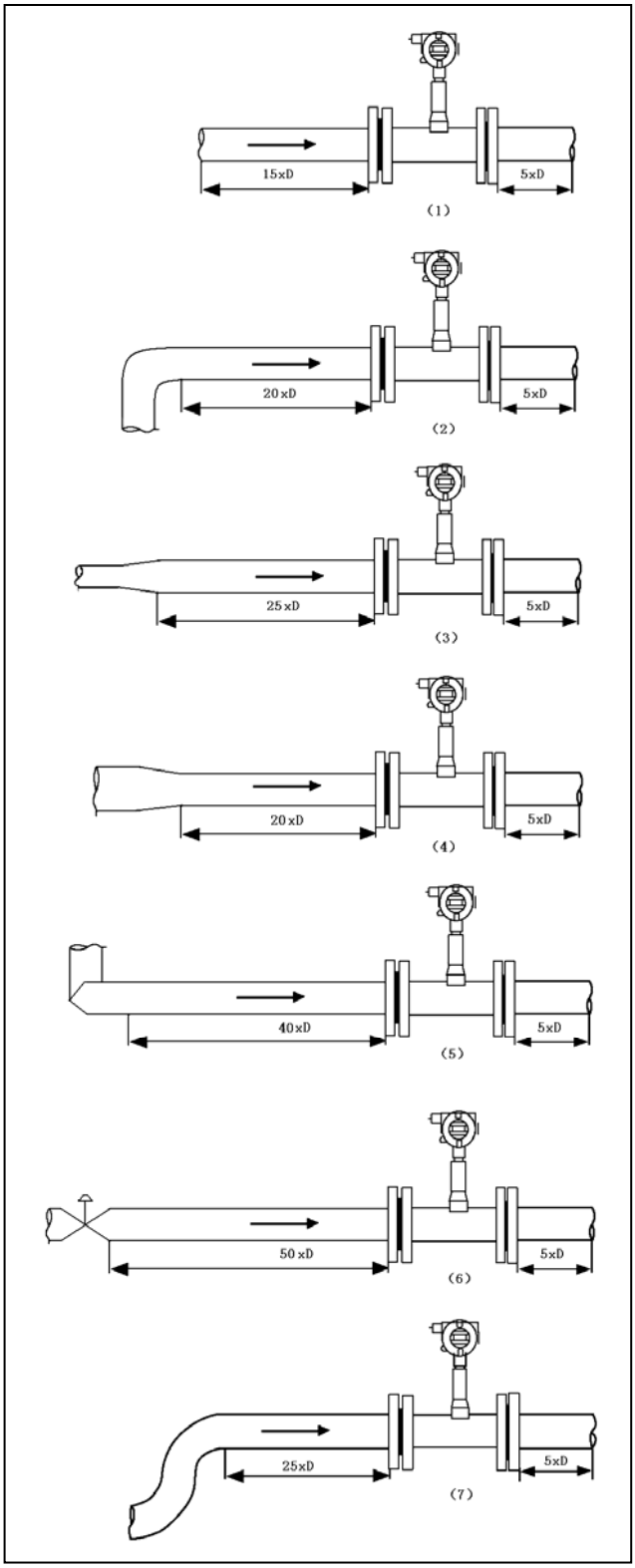
8.1 Installation instruction

In order to maintain the stable state as the medium enters the meter, the user should pay attention to the followings installation:

- ◆When metering liquids, the flowmeter primary is always completely filled with fluid and cannot drain.
- ◆Mechanical vibrations are to be eliminated, using supports if required.
- ◆Air bubbles in the pipe are to be eliminated, using air separator if required.
- ◆For high fluid temperatures ,the flowmeter primary should be installed so that the electronic assembly is mounted at the side or bottom of the flowmeter .The following figure shows the installations for High Fluid Temperatures >150 °.



◆ Recommended in- and outlet sections



8.2 Installation of accessories

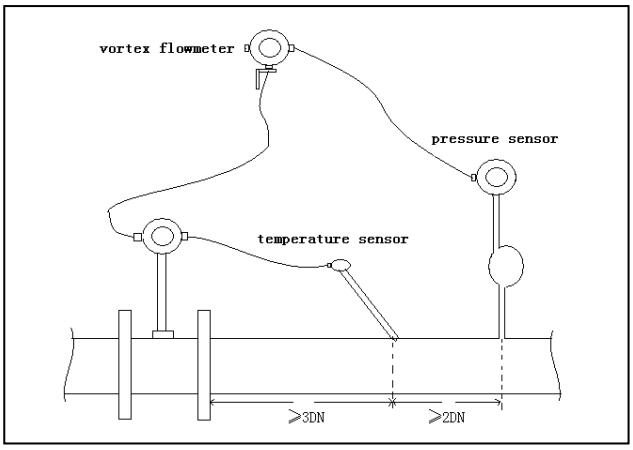
8.2.1 Temperature sensor

The circuit board of VT8000 type vortex flowmeter can receive the temperature sensor Pt 100 signal directly and realize the temperature compensation of the flow automatically. The temperature sensor adopts two-wire system Pt100, which is welded on the pipe directly to detect the medium temperature. The temperature sensor can also be provided by the manufacturer or is prepared by the user.

8.2.2 Pressure sensor

The circuit board of VT8000 type vortex flowmeter may receive 4-20mADC of the pressure converter signal (need to be independent power supply) directly and realize the temperature compensation of flow automatically. The pressure sensor can can be directly mounted on the pressure duct to inspect the fluid pressure.The pressure sensor may be provided by the manufacturer or is prepared by the user.

8.2.3 Installation of temperature and pressure sensor, pulse output/ RS485 modbus port



8.2.3.1 Installation of temperature sensor

The installation position of temperature sensor is shown as the above figure. Mounting hole with Φ12 is opened at an angle of 60 degrees to the pipe where is more than or equal to 3DN from the downstream of vortex flowmeter on the pipe .100mm of the temperature sensor sheath is inserted into the hole, and then it is welded firmly.

8.2.3.2 Installation of pressure sensor

The installation position of pressure sensor is shown as the above figure. Mounting hole with Φ12 is opened at an angle of 60 degrees to the pipe with where is more than or equal to 2DN from the downstream of vortex flowmeter on the pipe or use the pressure duct to connect the sensor with the pipe. If the heated fluid needs condensing processing, it is necessary to add sealingpot with spacer fluid in case of corrosion.

To

◆ Other accessories

Our company may provide other vortex flowmeter accessories: straight pipe section on the inlet/outlet, companion flange, bolt, nut, pad, etc.

9. Converter Parameters

9.1. Converters Technical Parameters

Converter buttons & display

The converter of VT8000 series vortex flowmeter completely adopts signal processing system（DSP technology），the digital circuit module can adapt to all pipe size and the conditions of gas and liquid fluid ,it can also adjust signal and deal with the specification; The wide LCD screen can display its fundamental configuration information which allow to beprogrammed and set casually, realizing multiple functions.

Based on spectral analysis with more frequency combfilter technology, based on the second float the uV levelsignal amplifiers and integrated design of power segregation, which effectively guarantee anti-interference ability and stability. Efficient power design makes powerdissipation extremely low, which greatly extend the battery life span.

Supply flexible input/output interface, can meet different complex needs of different users, the specific characteristics is as follow:

- The isolation electrical structure
- Excellent anti-interference ability
- Saturated and superheated steam temperature and pressure compensation
- IEEE754 double-precision loating-point alculations
- RamTron ferroelectric memory data stored permanently
- Compatible with HART6.0
- RS485 Modbus lightning protection interface

Flow Input Signal:

Sensor: 4 pieces piezoelectric sensors stress signals

Tempreture Input Signal(compensation signal):

Sensor: Pt resist

Signal Stype: Pt100

Pressure Input Signal(compensation signal):

Sensor:Pressure converter

Signal Stype: 4-20mADC

Output Signal:

a Three-wire system voltage pulse(V_{OL}<0.8V,V_{OH}>4.5V)

b Two-wire system current pulse

c Two-wire system current analog

d HART@4-20mA

e RS485 Modbus

Measure Accuracy:

Analog more over 0.2%,

Frequency more over 0.1%

Calculation Precision:

IEEE754 double-precision floating-point calculations

Communication Function::

a HART@4-20mA

b RS485 Modbus lightning protection interface

Display Function：

Double-line LC-Display,can display accumulate flow, instantaneous flow, frequency flow, temperature.

Date Protection Function:

Adopting the latest RamTron ferroelectric memory date stored technology, the converter can record the operation result and the data set by the users at any time, in case of lost when power off.

Supply Power:

12 - 42 VDC(voltage pulse output)

16.5 - 42VDC(4-20mA@HART)

Power consumption:

1.3mA(battery supply Indicator style)

4-20mA(4-20mA@HART interface style)

60-80mA(RS485 Modbus interface style)

Work Environment:

Humidity:-40 – 80℃

Temperature:5 -95%RH

Electromagnetic Compatibility:

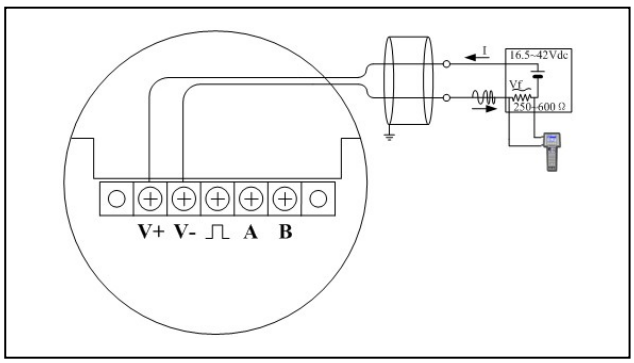
Accord with GB/T 17799.2-2003 "emc standards and industrial environment of the resistance to flexibility experiment".

Weight:

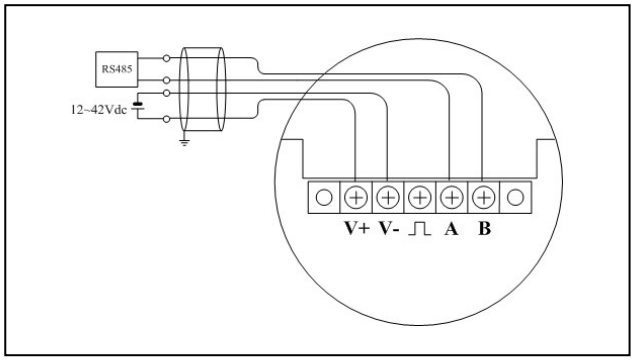
About 100g

9.2. Electrical Connection Diagram

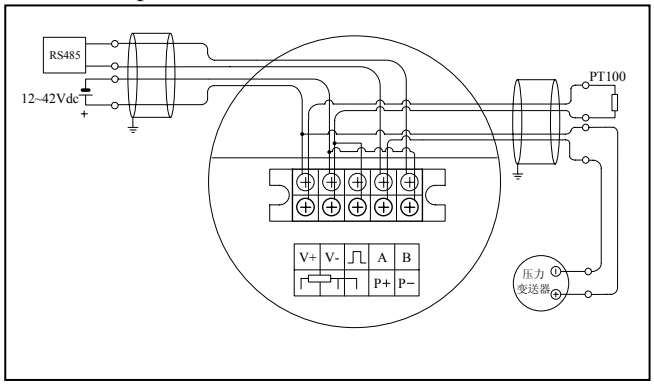
9.2.1 pulse output/4-20mA output/HART treaty



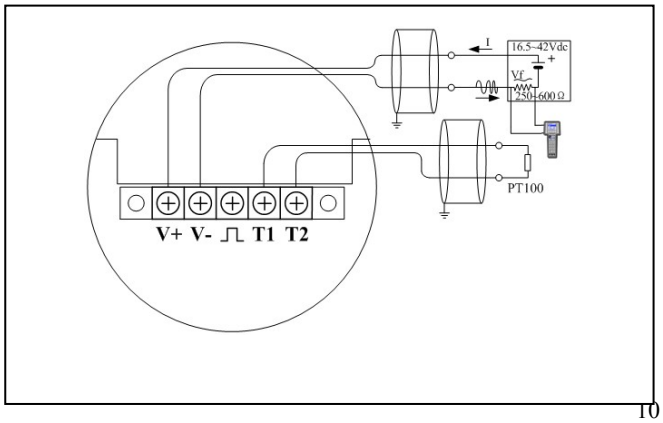
9.2.2 pulse output/RS485Modbus interface



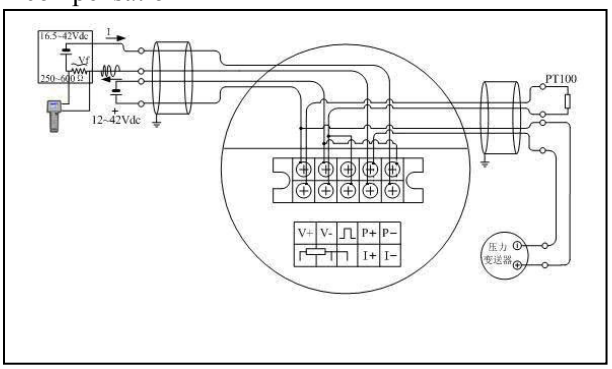
9.2.3 pulse output / temperature & pressure compensation / RS485Modbus interface



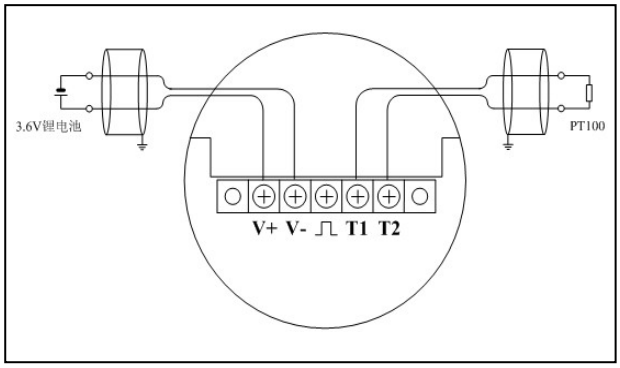
9.2.4 pulse output/temperature compensation/ 4-20mA output / HART treaty



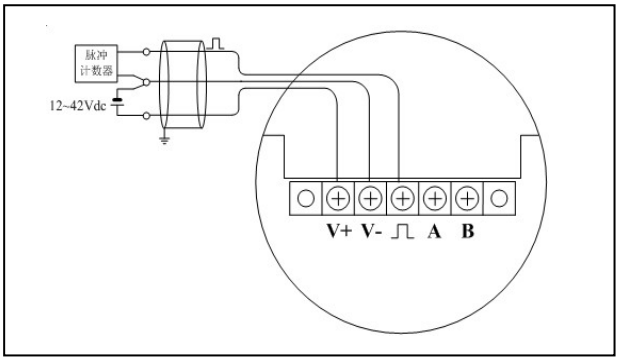
9.2.5 pulse output / temperature and pressure compensation



9.2.6 battery supply / pulse output / temperature compensation



9.2.7 three-wire system voltage pulse output



10. Specification Explanation

Vortex flowmeter V	X	X	X	X	X	X	X	X	X	X
Compact design	T									
Remote design	R									
Serial number		8								
None			0							
Exi			1							
Exd			2							
Process Connections										
Flange				1						
Wafer				3						
Fluid										
Liquid					1					
Gas					2					
Steam					3					

Materials

Housing	Shedder	Sensor	
0Cr18Ni9(304)	0Cr18Ni9(304)	0Cr18Ni9(304)	1
316	316	316	2
316L	316L	316L	3
Hc	Hc	Hc	H
Others			Q

Normal temperature（T≤150°C）							N			
Moderate temperature（T≤250°C）							S			
High temperature（T≤350°C）							H			
Converter										
Power supply / Locale display / Pulse output / 4-20mA signal output / HART								1		
Power supply / Locale display / Pulse output / RS 485 Modbus								2		
Power supply / Locale display / Temperature&pressure compensation / Pulse output								3		
Power supply / Locale display / Temp.&pre. Compensation / Pulse output / RS 485 Modbus								4		
Power supply / Locale display / Temp. compensation / Pulse output / 4-20mA output / HART								5		
Power supply / Locale display / Temp.&pre.compensation / Pulse output / 4-20mA output / HART								6		
Battery power / Locale display / External 24VDC with pulse output								7		
Battery power / Locale display / Temperature compensation / Pulse output								8		
Other								9		
Supply Power										
12-42V DC									A	
Battery power									B	
Cable Connection										
M20x1.5										M
1/2″NPT										N
Other										Q