ERRE DI

VR-080 Smart Vortex Flowmeter

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FLOW INSTRUMENT

✔ Factory Price ✔ OEM Service ✔ Professional Technical Team ✔ Fast Delivery time

Size	DN15-DN300	Temperature (°C)	-25 +250°C
Cable Entry	1/2NPT, M20x1.5	Output signal	4-20 mA electric signal
Material	SS. Aluminum Alloy	Accuracy	1%
Power supply	With Li battery and can be used for three years /24VDC		
Working environment	-10 +55°C, RH 5% 90%		

INTRODUCTION

I. APPLICATION & FEATURES

VR-080 series smart vortex flowmeter is mainly used for measuring flow of industrial pipeline fluid, such as gas, liquid and steam, etc. It has little pressure loss, broad span range and high accuracy. It is not under influence of density, pressure, temperature and viscosity when measuring volumetric flow. It has no movable mechanical parts with high reliability and little maintenance.

II. OPERATION PRINCIPLES

Setting vortex generation body (bluff body) in fluid, regular vortex will alternately generate from two sides of vortex generation body. This kind of vortex is called Karman vortex. See picture 1. Vortex is at downstream of vortex generation body, unsymmetrical array. Set occurrence to be f, avarage flow speed of measured medium U, face width d and diameter D. According to Karman principle, exsiting following relation:

f = StU1/d = StU/md

U1 - avarage flow speed at two sides of vortex generation body, m/s St - Strouhal number

m – ratio of segment area and pipeline cross sectional area

$$m = 1 - \frac{2}{\pi}[d/D\sqrt{1-(d-D)^2} + \sin^{-1}\frac{d}{D}]$$

Instantaneous volumetric flow q_v:

$$q_v = \pi D^2 U/4 = \pi D^2 mdf/4St$$

$$K = f/q_v = [\pi D^2 mdf/4St]^{-1}$$

In the formula K --- Instrument Coefficient, pulse number/m3 (P/m3)

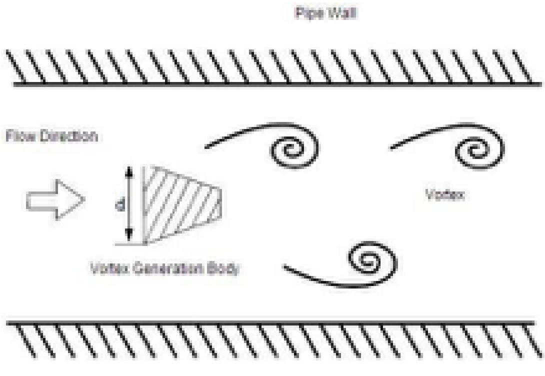


Diagram 1 Karman Vortex

K has relation with vortex generation body, pipeline dimension and Strouhal nember. Strouhal nember is a parameter without dimension. It has something to do with shape of vortex generation body and reynolds number. Seeing from the picture, in the range of Re
= 2 * 104 ~ 7 * 106, St can be seen to be a constant. When measuring gas flow, flow calculation formula of VR-080 is

$$Q_{vn} = Q_v \frac{PT_nZ_n}{P_nTZ} = \frac{f}{K}\frac{PT_nZ_n}{P_nTZ}$$

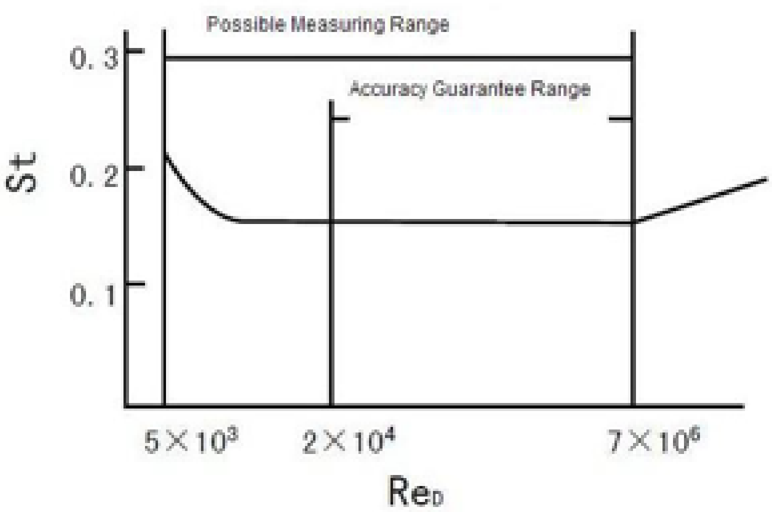


Diagram 2 Relation Curve of Strouhal number and reynold number

In the formula, Qvn, Q --- volumetric flow under standard conditions and working conditions, m3/h
Pn, P --- absolute pressure under standard conditions and working conditions, Pa.

Tn, T --- thermodynamics temperature under standard conditions and working conditions, K
Zn, Z --- gas compression coefficient under standard conditions and working conditions Seeing from the above formula, pulse frequency signal output by VR-080 is not influenced by fluid physical properties and component changes, that is, instrument coefficient only has relation with vortex generation body and dimension of pipeline in a certain range of reynold number. But the flowmeter must measure mass flow in material balance and energy measurment, here output signal of flowmeter should monitor volumetric flow and fluid density, therefore, fluid physical properties and component have direct influence on flow measurement.

III. MAIN TECHNICAL PARAMETERS

1. Main Technical Data

Standard		Q/320831AHH003-2004 JB/T6807-93
Medium		Gas, liquid, steam
Sizes	Flange holding (clamp-on) type	25, 32, 50, 80, 100, 150, 200, 250, 300
	Flange connection type	100, 150, 200, 250, 300
Measuring Range	Normal range of flow speed	Reynold number 1.5 * 104 ~ 4 * 106; gas 5~50m/s; liquid 0.5~7m/s
	Normal range of flow rate	Liquid, gas flow range-sheet2; steam flow range-sheet 3
Accuracy		Class 1.5
Temperature		Normal temperature -25°~100° High temperature -25°~150° -25°~250°
Output Signal	Pulse voltage output signal	Square wave pulse
	Current remote signal	4 ~ 20 mA, transmission distance 100m
Environmental Conditions		Temperature: -25°~+55° humidity: 5~90%
Material		SS, Aluminum Alloy
Power		24 V DC or lithium battery 3.6V

Protection Class	IP65
Requirements to front & back straight tube section	See Diagram 14

2. Flow range of liquid, gas under working conditions

Nominal Diameter (mm)	25	32	50	65	80	100	150	200
Liquid (m3/h)	1~10	1.5~18	4~55	6.3~72	9~135	14~200	32~480	56~800
Gas (m3/h)	25~60	15~150	35~350	60~390	90~900	140~1400	300~3000	550~5500

3. Mass flow range of saturated steam

Absolute Pressure P/Mpa Temperature T/° Density ρ (kg/m3)	0.2 120.23 1.129	0.3 133.54 1.651	0.4 143.62 2.163	0.5 151.84 2.669	0.6 158.94 3.170	0.7 164.96 3.667	0.8 170.41 4.162
DN25 Qmin Qmax Extendable Max Upper	14 140 140	17 170 204	19 190 267	22 220 330	23 230 391	25 250 453	27 270 541
DN32 Qmin Qmax Extendable Max Upper	31 310 357	38 380 522	44 440 684	48 480 844	53 530 1003	57 570 1160	60 600 1317
DN50 Qmin Qmax Extendable Max Upper	52 520 558	63 630 816	73 730 1069	81 810 1320	88 880 1568	95 950 1813	101 1010 2058
DN65 Qmin Qmax Extendable Max Upper	67.8 678 900	99 990 1326	131 1310 1741	160 1600 2134	180 1800 2535	200 2000 2733	215 2150 3330
DN80 Qmin Qmax Extendable Max Upper	122 1220 1429	148 1480 2090	170 1700 2738	188 1880 3379	205 2050 4013	221 2210 4642	235 2350 5269
DN100 Qmin Qmax Extendable Max Upper	175 1750 2233	212 2120 3266	242 2420 4278	269 2690 5279	293 2930 6270	315 3150 7254	336 3360 8233
DN150 Qmin Qmax Extendable Max Upper	350 3500 5025	423 4230 7348	484 4840 9627	538 5380 11879	586 5860 14019	631 6310 16321	672 6720 15824
DN200 Qmin Qmax Extendable Max Upper	700 7000 8933	846 8460 13064	969 9690 17115	1076 10760 21119	1176 11730 25083	1261 12610 29016	1344 13440 32993
Absolute Pressure P/Mpa Temperature T/° Density ρ (kg/m3)	0.9 175.36 4.655	1.0 179.88 5.147	1.2 187.96 6.127	1.4 195.04 7.106	1.6 201.37 8.085	1.8 207.11 9.065	2.0 212.37 10.05
DN25 Qmin Qmax Extendable Max Upper	28 280 575	30 300 636	33 330 757	35 350 878	37 370 999	40 400 1120	42 420 1242
DN32 Qmin Qmax Extendable Max Upper	64 640 1473	67 670 1629	73 730 1939	79 790 2249	84 840 2559	89 890 2869	94 940 3180
DN50 Qmin Qmax Extendable Max Upper	107 1070 2302	112 1120 2545	122 1220 3030	132 1320 3514	140 1400 3998	149 1490 4483	157 1570 4970

DN65 Qmin Qmax Extendable Max Upper	220 2200 3724	225 2250 4117	235 2350 4902	245 2450 5685	255 2550 6470	265 2650 7252	275 2750 8038
DN80 Qmin Qmax Extendable Max Upper	249 2490 5893	261 2610 6515	285 2850 7757	307 3070 8996	328 3280 10235	347 3470 11476	365 3650 12723
DN100 Qmin Qmax Extendable Max Upper	355 3550 9208	374 3740 10181	408 4080 12120	439 4390 14057	468 4680 15993	496 4960 17932	522 5220 19880
DN150 Qmin Qmax Extendable Max Upper	711 7110 20719	747 7470 22909	815 8150 27270	878 8780 31628	936 9360 35985	992 9920 40347	1044 10440 44732
DN200 Qmin Qmax Extendable Max Upper	1421 14210 36834	1494 14940 40727	1630 16300 48481	1756 17560 56228	1873 18730 63794	1983 19830 71729	2088 20880 79523

IV. STRUCTURE & DIMENSION

A. This series vortex flowmeter has two types of connection forms and dimension

1. Wafer (Clamp-on) Type

2. Flange Connection Type

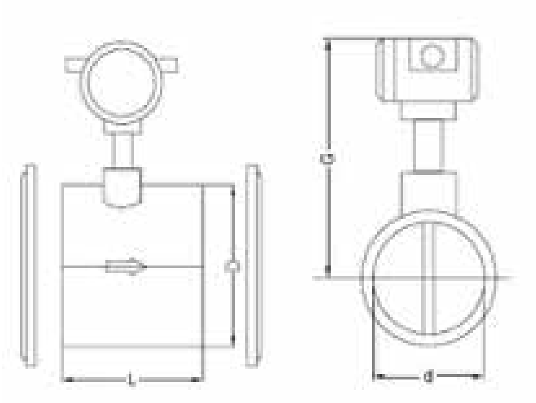


Diagram 3

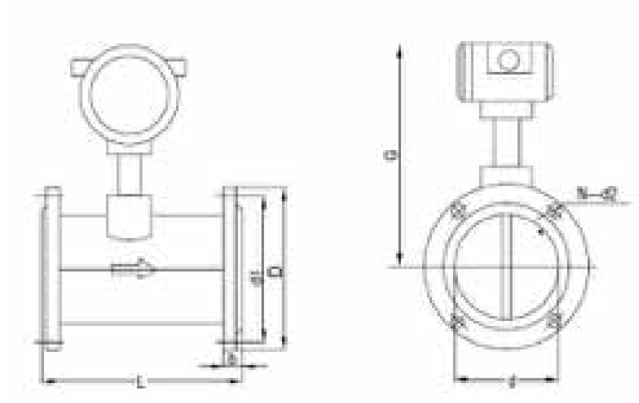
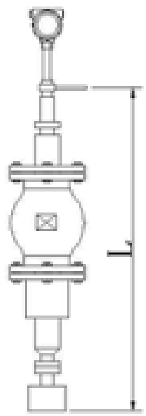


Diagram 4

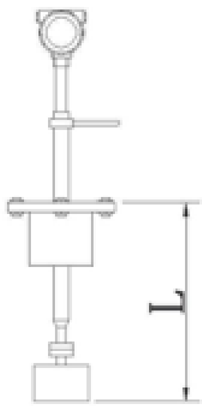
Dimension of Vortex Flowmeter—flange holding type & flange connection type

	DN (mm)	Pressure MPa	L mm	G Normal Temp.	G High Temp.	D mm	dl mm	N-d2	d mm	b mm	Weight Kg
Wafer Type	25	2.5~4.0	80	342	500	76	-	-	25	-	7
	32	2.5~4.0	80	342	505	76	-	-	32	-	10
	50	2.5~4.0	80	337	515	86	-	-	50	-	12.5
	65	-	80	345	530	102	-	-	65	-	28
	80	1.6~2.5	100	350	540	112	-	-	80	-	25
	100	1.6~2.5	110	330	550	132	-	-	100	-	35
	150	1.6	140	355	575	203	-	-	150	-	40
	200	1.6	150	380	600	259	-	-	200	-	46
Flange Connection Type	100	1.6	250	310	530	125	180	8-Ø18	100	26	30
	150	1.6	300	335	555	280	240	8-Ø23	150	28	34
	200	1.6	320	370	590	335	295	12-Ø23	200	30	41

B. Inserted Vortex flow meter



a. Inserted type with ball valve



b. Inserted vortex flow meter

	Size (mm)	DN250	DN300	DN400	DN500	DN600	DN800-2000
a	L	680	705	755	805	855	905-1555
b	L	255	280	330	380	430	530-1130

V. MODEL SELECTION & CALCULATION

1. Size of flowmeter should be chosen according to max working flow Qv; to get much wider working flow range, max working flow should be not less than 1/2 of rated max flow Qmax. Corresponding reynold number range of linear flow range is 2 * 104 ~ 7 8*106.

For liquid, please look up in sheet 2 according to picture 9; for gas please work out flow range under working conditions according to picture 10, looking up in sheet 2.

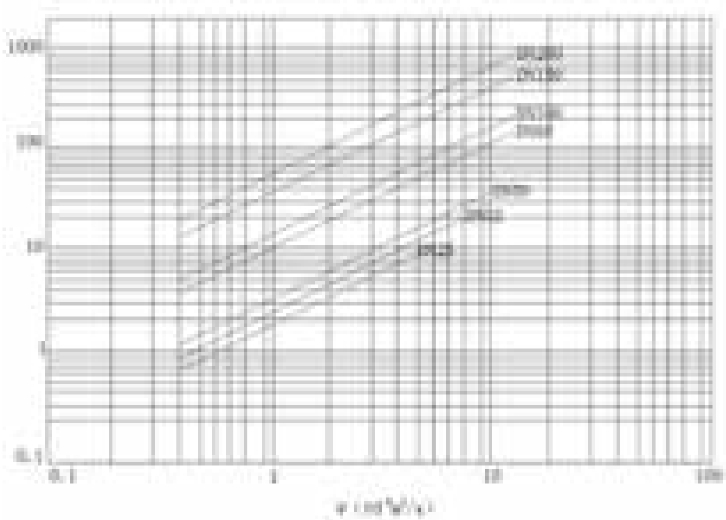


Diagram 5 Relation between Min flow of liquid and moving viscosity

2. Change flow under standard conditions into flow under working conditions

(1) Change density ρn under standard conditions into ρ under working conditions

$$\rho = \rho_n \times \frac{0.1013+P}{0.1013} \times \frac{273.15+20}{273.15+T}$$

(2) Calculate flow Q under working conditions

a. Find out Qv by Qn under standard conditions $Q_v = Q_n \times \frac{\rho_n}{\rho}$

b. Find out Qv by mass flow Qm $Q_v = Q_m / \rho$

3. Conversion between Dynamic viscosity μ and moving viscosity v $V = \frac{\mu}{\rho}$

ρ – density under working conditions (kg/m3)
ρn- density under standard conditions (kg/m3)
P – pressure under working conditions (MPa) T – temperature under working conditions (°C)
Qv – flow under working conditions (m3/h)
Qn – flow under standard conditions (m3/h)
Qm – mass flow (kg/h)
μ– dynamic viscosity (Pa · S) V – kinematic viscosity (m2/s)

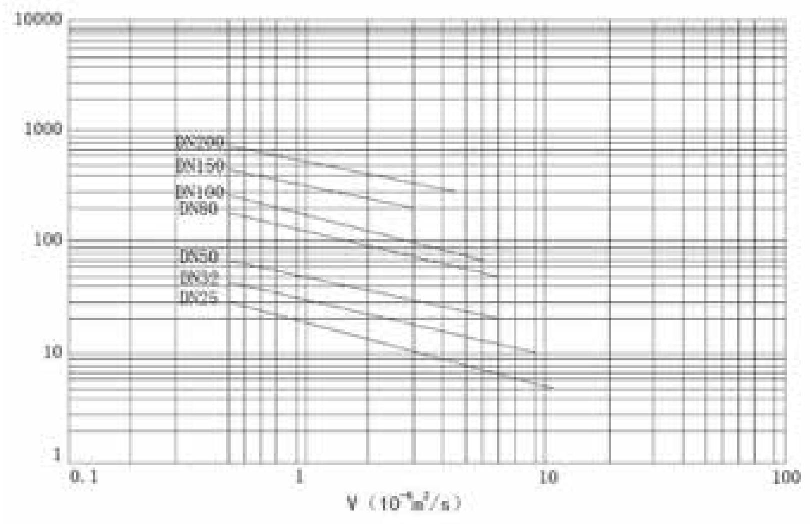


Diagram 6 Relation between Min flow of Gas/superheated steam and density

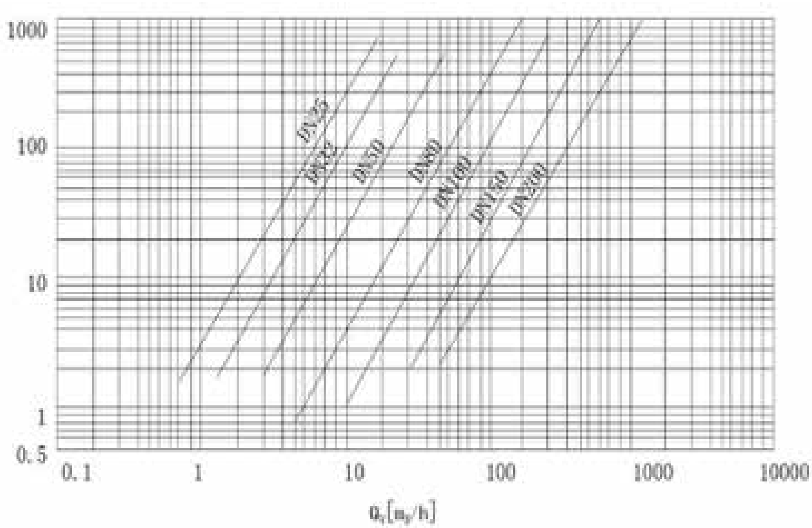


Diagram 7 Pressure loss for medium of water (20°C, 1013mbar, ρ=998kg/m3)

4. Density of commonly used gas under standard conditions (0.101325Mpa, 20°C)

Gas	Density (Kg/m3)	Gas	Density(Kg/m3)	Gas	Density (Kg/m3)
Acetylene	1.083	Normal Butane	2.4163	Ethane	1.2500
Ammonia	0.7080	Ethylene	1.1660	Methane	0.6669
Propane	1.8332	Neon	0.83914	Natural Gas	0.776
Air	1.2041	Argon	1.6605	Carbon Dioxide	1.829
Carbon Monoxide	1.165	Hydrogen	0.0838	Oxygen	1.3302
Propylene	1.7459	Nitrogen	1.1646		

5. Pressure Loss

i. Pressure loss at measuring liquid

Diagram 7 is the relation of pressure loss and flow at measuring flow of water (20°C, 1013mbar, ρ = 998kg/m3)

At measuring other liquid with density of ρs, calculating pressure loss according to following formula:

$$\Delta P' = \frac{\rho_s}{998} \times \Delta P$$

$\Delta P'$ —pressure loss of measured liquid (mbar)

ΔP—pressure loss of water found from Diagram 7

ii. Pressure loss at measuring gas (overheated steam)

Diagram 8 is pressure loss at measuring air (20°C, 1013mbar, ρ = 1.2kg/m3). Using the following formula to calculate density ρs of other gas:

$$\Delta P' = \frac{\rho_s}{1.2} \times \Delta P$$

$\Delta P'$ —pressure loss of medium (mbar)

ΔP—pressure loss of air found from Diagram 8

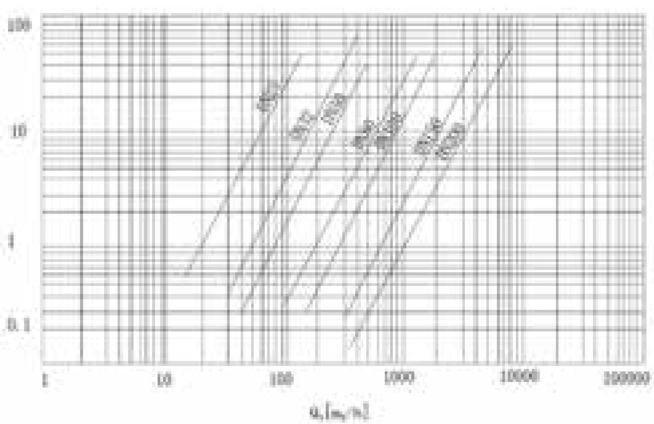


Diagram 8

VI. MODEL SELCETION

Code	Nominal Diameter (mm)	Flow Range (m3/h)		Remarks
VR-080-25	DN25	1~12(L)	10~100(G)	1. Make reference to sheet 3 for steam flow range
VR-080-32	DN32	1.5~23(L)	15~150(G)	2. DN250 ~ DN600 can be provided according to customers' requirements
VR-080-40	DN40	2.4~32(L)	23~230(G)	3. For DN300 and above, we recommend Insertion Type Vortex Flowmeter
VR-080-50	DN50	4~50(L)	35~350(G)	
VR-080-65	DN65	6.3~84(L)	60~600(G)	
VR-080-80	DN80	10~130(L)	90~900(G)	
VR-080-100	DN100	20~200(L)	140~1400(G)	
VR-080-125	DN125	31~310(L)	220~1450(G)	
VR-080-150	DN150	45~450(L)	300~3000(G)	
VR-080-200	DN200	80~800(L)	550~5500(G)	

Code	Function 1
N	No Temperature & Pressure compensation
Y	Temperature & Pressure compensation provided

Code	Output
F1	4 ~ 20 mA (two wires)
F2	4 ~ 20 mA (three wires)
F3	RS 485 communication interface
F4	Pulse / Frequency

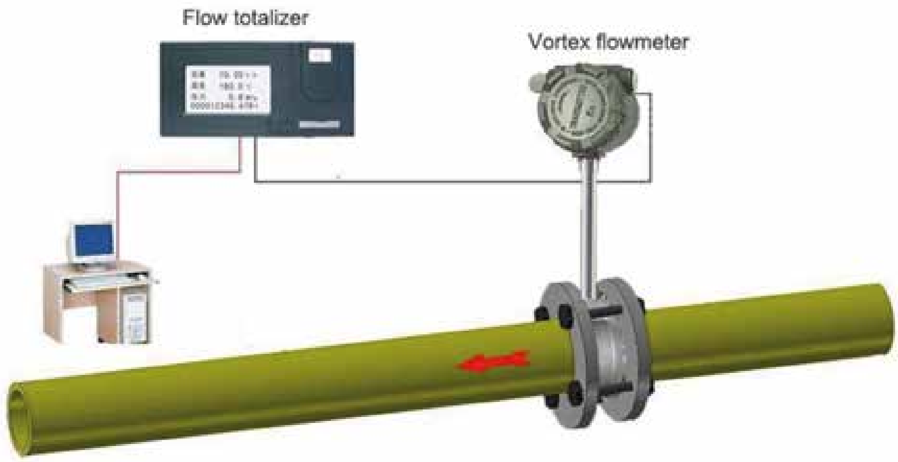
Code	Medium	Code	Medium
J1	Liquid	J3	Steam
J2	Gas		

Code	Connection
L1	Wafer Type
L2	Flange Connection Type

Code	Function 2
E1	1.0
E2	1.5
T1	Normal temperature
T2	High Temperature
T3	Steam
P1	1.6 MPa
P2	2.5 MPa
P3	4.0 MPa
P0	Special pressure
D1	Internal 3.6 V
D2	24V DC

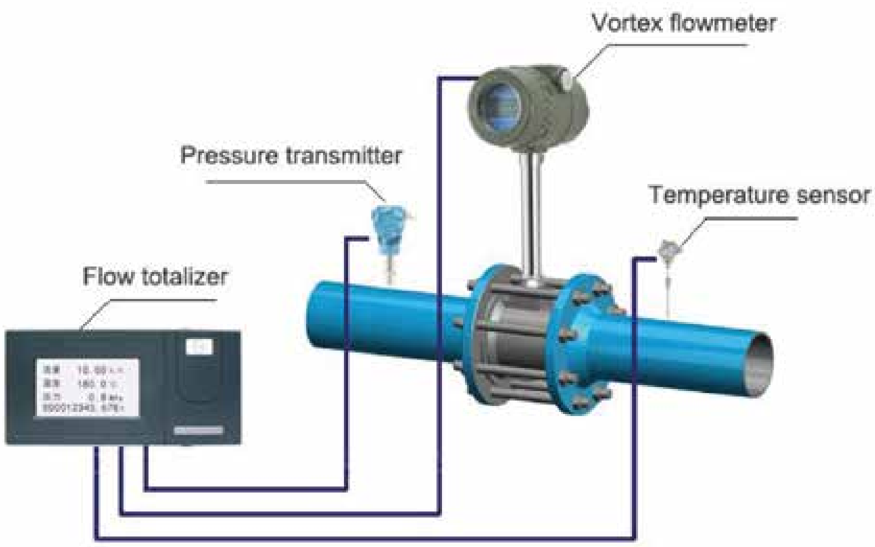
VR-080-25	Y	F1	J1	L1	E1T1P1D2

MEASUREMENT FOR CONDUCTION OIL



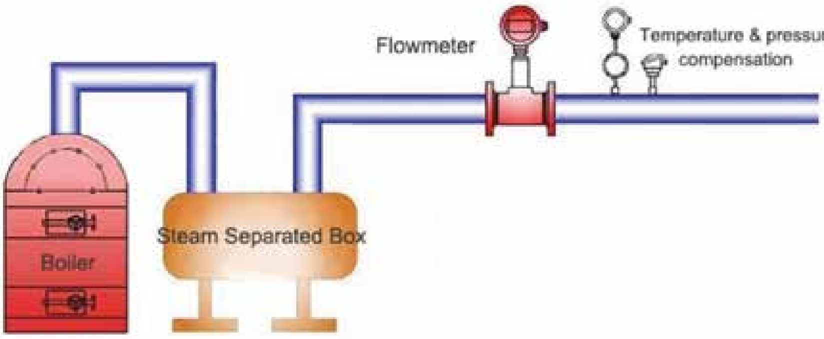
Heavy oil, light oil or flammable liquid is used in heat conduction boiler as fuel. As heat carrier, heat conduction oil of liquid type is circulated compulsively taking advantage of circulation oil pump. After passing the heat energy to heat user, it returns to straight-flow special industrial furnace for re-heating, which is widely used in petrochemical, textile, printing and dyeing, rubber, food processing, wood processing, pitch heating, carbon production, vegetable dehydration, pain baking etc. Its working temperature is below 350° C.

COMPRESSED AIR METERING



Compressed air, transferred from electric energy or thermal energy by air compressor, is important secondary power in industrial production and an essential economic index of cost accounting in enterprise and public institution, which can manage working medium transferred from large energy to save energy and improve equipment management level. That is the main purpose of compressed air flow rate metering.

STREAM MEASUREMENT



Steam is one of the mostly important source, also the main energy for city centrally heated system. It is a very important economical index for cost accounting for enterprise and public institution. The right measurement for steam flowmeter will directly affect the economic interest between steam supplier and end user. ERRE.DI. can supply perfect steam measurement system solution.