Vortex Flow Meter
User Manual

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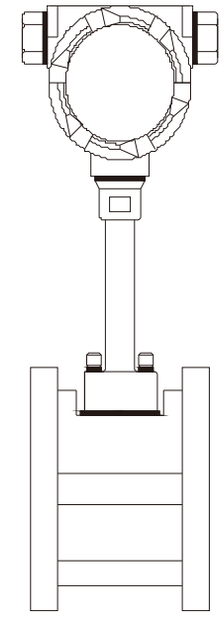

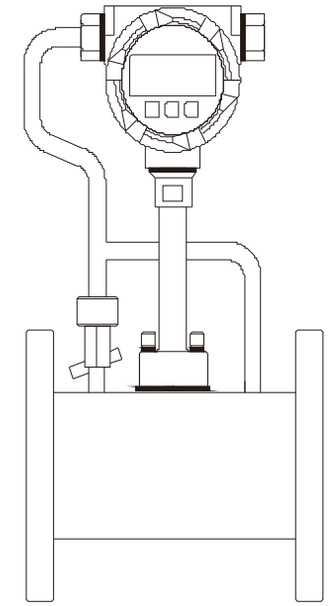

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Version Number: M-LUGB-SUV001-4

Contents

1. Introduction

Vortex Flowmeter is on the principle of Karman street, to measure liquid, gas and vapours even turbid liquid including micro grain and impurity. Applications: petroleum, chemical industry, paper making, metallurgy, electric force, environmental protection, food industry and etc.

2. Working principle

LUGB & LUCB Vortex flowmeter work on the principle of generated vortex and relation between vortex and flow by theory of Karman and Strouhal, which specialize in measurement of steam, gas and liquid of lower viscosity. As shown in below illustration, medium flows through bluff body and then vortex is generated, vortices are alternately formed on both sides with opposite directions of rotation, Vortices frequency is directly proportional to medium velocity. Through numbers of vortices that is measured by sensor head, medium velocity is calculated, plus flowmeter diameter, final volume flow come out.

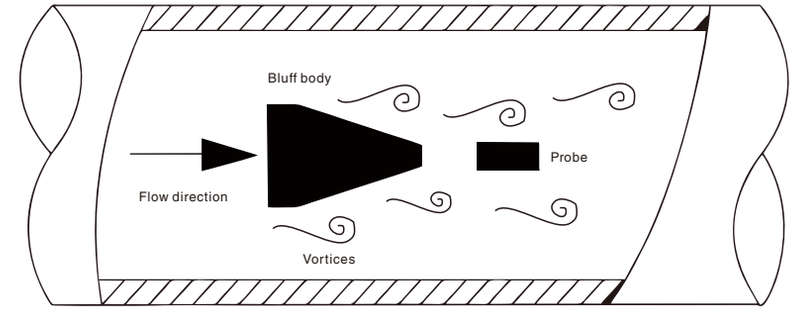


Fig-1

Computational formula as follows:

F=St*V/md ..... Formula 1
Q=3600*F/K ..... Formula 2
M=Q*ρ ..... Formula 3

Among Formula:

F: Fluid flow through bluff body generate frequency of vortex (Unit : Hz)
St: Strouhal constant (zero dimension)
V: Mean velocity of fluid inside the pipeline (Unit : m/s)
m: The ratio between Lune Circulation area of bluff body at both sides and cross-sectional area (Unit: zero dimension)
d: Upstream face width of bluff body inside vortex flowmeter (Unit : m)
D: Inside diameter (ID) of vortex flowmeter (Unit : m)
Q: Instantaneous volume flow (Unit : m3 / h)
K: Instrument coefficient of vortex flowmeter (Unit : pulses / m^3)
M: Instantaneous mass flow (Unit : kg/ h)
ρ: Fluid density (Unit : kg/ m^3)

Note: vortex flowmeter "K" coefficient is corresponding with a unique diameter, the exact "K" value should be calibrated in practice. Viz. one cubic meter fluid through sensor output numbers of pulse under working condition.

3. Technical Parameter

Medium	Liquid , Gas (including natural gas)
	Steam (saturated steam and superheated steam)
Normal Diameter	LUGB Pipeline-version: DN10-DN500
	LUCB Insertion-version: DN200-DN2000
Accurate:	LUGB Pipeline-version: 1.0% 1.5% (0.2% & 0.5% supply by negotiation)
	LUCB Insertion-version: 2.5% (1.0%&1.5% supply by negotiation)
Velocity	Liquid: 0.30 m/s...10 m/s
	Gas/steam: 3.0 m/s...90 m/s
Normal Pressure	LUGB pipeline-version wafer connection: DN10-DN500 (priority PN2.5MPa)
	LUGB pipeline-version flange connection: DN10-DN80 (priority PN2.5MPa) DN100-DN200 (priority PN1.6MPa) DN250-DN500 (priority PN1.0MPa)
	LUCB Insertion-version attachment flange: DN200-DN2000 (priority PN1.6MPa)
	Note: Wafer- version vortex flowmeter assemble made-to- order flanges, when flowmeter leave factory including companion flanges. We are able to provide GB/ T9119- 2000, ANSI/ ASME, DIN. JIS. KS.... Standard flanges (GB-China standard priority), pressure class recommend priority level.
Medium Temp.	LUGB pipeline-version: -40°C ~ +160°C -40°C ~ +280°C -40°C ~ +350°C -40°C~ +420°C
	LUCB insertion-version: -40°C ~ +160°C -40°C~ +200°C
Ambient	Ambient temperature: -20°C~+60°C(normal); -20°C~ +40°C(explosion-proof)
	Relative humidity (RH): 5% - 95%RH
	Atmospheric Pressure: 86kPa -106kPa
Electrical Interface	M20*1.5 internal thread (priority).
Protection	IP65 (IP67, IP68 supply by option)
Explosion-proof	Intrinsic safety Exia II CT4
	Exib II CT4
	Flame-proof Exd II CT6
Boday Material	Stainless steel (other material supply by negotiation)
Pressure Lose	$\triangle P \leq 1.2\rho_s V^2$ ($\triangle$P unit is Pa, ρ_s unit is kg/m^3, V unit is m /s)
Calibration Method	All flowmeters should be calibrated in the way of lower reaches taking pressure before flowmeters leave factory.

4. LUGB and LUCB Configuration & Size

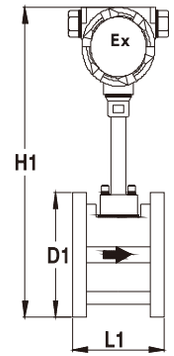
1. LUGB wafer connection vortex flowmeter: special companion flanges.
2. LUGB flange connection vortex flowmeter: see appendix 3 & 4 flanges size of configuration. we are able to provide GB (China); ANSI; DIN; JIS and etc.
3. LUCB insertion-version vortex flowmeter: flanges choose DN100 standard flange (reference GB9119-2000)

Dimensions of vortex flowmeter as per fig2 and fig1

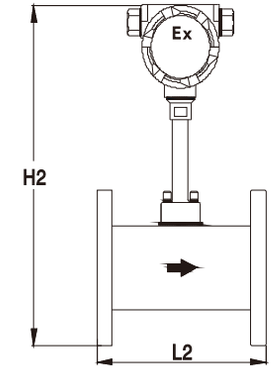
4.1 Dimension of LUGB & LUCB

Fig1

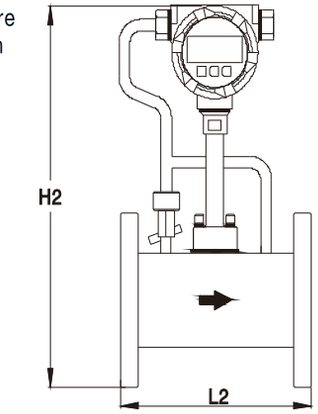
1. Wafer connection



2. Flange type



3. Flange type with temperature and pressure compensation



4.2 LUGB and LUCB max configuration size

This product is structurally supported by three primary pillars designated as 'a', 'b', and 'c', each with distinct lengths. The overall height of the assembly can be ascertained by consulting the daily angle index.

Utilize pillar 'c' for the 150°C sensor head without vortex street compensation, pillar 'b' for the 150°C sensor head with vortex street compensation, pillar 'b' for the 260°C sensor head with vortex streets, and pillar 'a' for the 300°C sensor head with vortex streets.

fig 1 (unit: mm)

Items	H1[a]	H1[b]	H1[c]	D1	L1	H2[a]	H2[b]	H2[c]	L2
DN15	525	445	355	45	65	540	460	370	170
DN20	531	451	361	58	65	545	465	375	170
DN25	531	451	361	58	65	550	470	380	250
DN32	531	451	361	58	65	563	483	393	250
DN40	529	449	359	85	70	578	498	408	250
DN50	541	461	371	99	70	590	510	420	250
DN65	558	478	388	118	70	612	532	442	250
DN80	573	493	403	132	70	625	545	455	280
DN100	595	515	425	156	70	644	564	474	300
DN125	621	541	451	184	70	674	594	504	350
DN150	647	567	477	211	70	703	623	533	350
DN200	705	625	535	266	98	757	677	587	400
DN250	757	677	587	319	114	810	730	640	450
DN300	808	728	638	370	130	860	780	690	500

P. LUCB Insetion- Vortex Flowmeter's Connection between amplifier and sensor.

1. Stop medium flow to dismantle
2. Keep medium flow to dismantle

Q. The mode of wave filtering

1. Common mode
2. Intelligent digital filtering mode

R. LUCB Insertion- version Vortex flanges pressure class

1. PN 1.6 Mpa (priority)
2. PN 2.5 Mpa (pressure class > 2.5 Mpa supply by negotiation)

Attention: Integrated P/ T compensation compact vortex apply in steam measurement, if designing drainage receiver configuration. Then horizontal installation is required. If vertical installation or learning installation condensing drainage loop receiver is required.

Note: Each function see appendix one.

5. Flow Range and Density

5.1 LUGB pipe-version vortex flowmeter measurable flow range.

Note: When choose vortex flowmeter that keep medium flow with dismountable sensor head or vortex flowmeter with accuracy is ± 0.5%, the lower limit of flow range is 0.5 times of corresponding value from fig2-4, upper limit multiplied by 0.8.

LUGB vortex flowmeter measurable liquid of different density corresponding with flow range under working condition.

fig2

Liquid Flow Range											
Density	500	600	700	800	900	1000	1200	1400	1600	1800	Qmax
DW	Different density fluid, the mini flow rate Qmin(Unit:m^3/h)										(Unit:m^3/h)
DN15	0.66	0.55	0.52	0.41	0.4	0.39	0.33	0.31	0.29	0.26	4.5
DN20	1.27	1.1	1.08	0.99	0.88	0.66	0.64	0.62	0.59	0.57	8
DN25	1.43	1.32	1.21	1.16	1.1	0.99	0.9	0.84	0.78	0.75	12
DN32	2.09	1.98	1.87	1.78	1.72	1.65	1.6	1.49	1.32	1.1	20
DN40	3.85	3.52	3.3	3.08	2.86	2.51	2.42	2.31	2.2	2.09	32
DN50	5.17	4.73	4.29	4.07	3.96	3.85	3.3	3.08	2.86	2.75	50
DN65	7.81	7.15	6.93	6.82	6.71	6.6	5.5	4.95	4.62	4.4	84
DN80	12.1	11	10.56	10.12	10.01	9.9	8.8	8.36	7.7	6.6	127
DN100	22	19.8	18.7	17.6	16.5	15.4	14.3	13.2	11	9.9	198
DN125	30.8	28.6	27.5	26.4	25.3	24.2	23.1	22	19.8	15.4	310
DN150	57.2	55	49.5	46.2	39.6	35.2	33	30.8	28.6	22	445
DN200	108.9	96.8	85.8	77	68.2	62.7	58.3	55	47.3	38.5	791
DN250	202.4	181.5	165	143	121	97.9	88	79.2	74.8	60.5	1237
DN300	275	242	220	198	176	140.8	132	121	107.8	84.7	1780

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LUGB vortex flowmeter measure gas of different density corresponding with flow range under standard condition .

fig3

Gas Flow Range													
Density (kg/m³)	0.5	0.8	1.2	2.4	3.6	4.8	6	7.2	8.4	9.6	12	20	Qmax
DW	Different density fluid, the mini flow rate Qmin (Unit:m³/h)												(Unit: m³/h)
DN15	5.28	3.85	3.52	3.08	2.97	2.86	2.75	2.64	2.53	2.42	2.31	2.2	38
DN20	9.02	7.26	5.5	5.28	5.17	4.95	4.73	4.4	4.29	4.18	4.07	3.3	67
DN25	11	9.9	8.69	8.36	7.92	7.59	7.26	6.82	6.49	5.94	5.5	4.95	100
DN32	28.6	19.8	15.4	14.52	14.08	13.42	13.2	12.87	12.32	11.99	11.11	9.9	170
DN40	41.8	27.5	22	20.9	19.8	18.7	17.6	16.5	15.4	14.3	13.2	11	300
DN50	52.8	44	34.1	31.9	30.8	28.6	25.3	24.2	23.1	22	19.8	13.2	500
DN65	88	72.6	58.3	49.5	48.4	46.2	44	41.8	38.5	33	28.6	19.8	780
DN80	143	110	88	83.6	77	72.6	68.2	63.8	55	50.6	41.8	30.8	1200
DN100	198	176	132	121	110	99	88	77	68.2	61.6	52.8	38.5	2000
DN125	308	275	209	187	171.6	159.5	148.5	132	110	99	83.6	60.5	2900
DN150	418	341	308	286	264	242	220	198	176	154	121	93.5	4100
DN200	880	660	550	528	473	440	418	396	363	330	297	220	7500
DN250	1100	968	869	803	748	682	649	572	528	462	440	330	12500
DN300	1430	1309	1254	1166	1078	990	902	836	770	682	638	440	16500

Conversion formula of gas volume flow under working condition& volume flow under standard condition:

Q (Ambient) = Q (Standard)* P (Standard)* Z* (273.15 + T (Ambient))/ [(p (Ambient)+ P(Ambient) * (273.15+ T (Standard))]-------- FORMULA 4

Among formula:

Q (Ambient): volume flow under working condition (unit: m^3/h)

P (Ambient): gas pressure under working condition (unit: Mpa)

T (Ambient): gas temperature under working condition (unit: °C)

Z: gas relative compressibility $Z= Z_s/ Z_n$ (zero dimension)

Q (Standard): volume flow under standard condition (unit: m^3/ h)

P (Standard): Atm press under standard condition (take absolute pressure= 0.101325 Mpa)

T (Standard): temperature under standard condition (0°C or 20°C)

P (Local): local Atm press (unit: Mpa)

LUGB vortex flowmeter measure saturated steam of different density corresponding with flow range under working condition

fig. 4

Mpa		0.1	0.2	0.3	0.4	0.5	0.6	0.8	0.9	1	1.2	1.6	2	unit
°C		120	134	144	152	159	165	175	180	184	192	204	215	
Kg/m³		1.12	1.67	2.19	2.68	3.18	3.67	4.62	5.16	5.63	6.67	8.52	10.57	
DW mm		Different steam density corresponding with flow range												
15	Qmin	3.85	5.67	7.41	9.12	11	12.54	15.95	17.93	19.36	22.55	29.37	36.19	kg/h
	Qmax	35	51.5	67.4	83	100	115	146	163	176	205	268	329	
20	Qmin	6.84	10.07	13.09	16.17	19.58	22.44	28.49	32.01	34.43	40.04	52.25	64.35	
	Qmax	62.2	91.6	120	147	178	204	259	291	313	365	476	586	
25	Qmin	10.68	15.73	20.46	25.3	30.69	34.98	44.55	49.94	53.79	62.59	81.73	100.54	
	Qmax	97.1	143	187	230	279	318	405	454	489	569	743	914	
32	Qmin	17.49	25.63	33.66	41.47	50.27	57.42	72.93	81.95	88.11	102.63	133.1	163.9	
	Qmax	159	234	306	378	457	522	664	745	802	933	1218	1499	
40	Qmin	25.3	36.3	47.3	58.3	70.4	80.3	102.3	110	121	143	187	231	
	Qmax	300	440	575	710	860	980	1250	1400	1500	1750	2280	2810	
50	Qmin	38.5	38.5	57.2	69.3	83.6	96.8	122.1	137.5	143	165	220	275	
	Qmax	550	460	680	845	1020	1170	1480	1670	1800	2100	2730	3360	
65	Qmin	64.9	95.7	125.4	150.7	182.6	209	264	303.6	326.7	379.5	495	605	
	Qmax	790	1160	1520	1835	2222	2540	3230	3620	3970	4620	6030	7422	
80	Qmin	98.45	144.1	189.2	233.2	282.7	319	407	451	495	572	748	924	
	Qmax	1195	1760	2300	2800	3400	3900	4900	5580	6000	6999	9100	11000	
100	Qmin	0.15	0.22	0.3	0.36	0.44	0.51	0.64	0.72	0.77	0.9	1.1	1.43	t/h
	Qmax	1.87	2.75	3.6	4.43	5.36	6.12	7.78	8.73	9.4	11	14.3	17.6	
125	Qmin	0.24	0.35	0.46	0.56	0.68	0.78	1	1.1	1.21	1.41	1.84	2.2	
	Qmax	2.91	4.29	5.62	6.91	8.37	9.56	12	13.6	14.7	17	22.3	27.4	

150	Qmin	0.35	0.51	0.66	0.81	0.99	1.13	1.44	1.62	1.74	2.02	2.64	3.26	t/h
	Qmax	4.2	6.18	8.09	9.96	12	13.8	17.5	19.6	21.1	24.6	32.1	39.5	
200	Qmin	0.62	0.9	1.19	1.45	1.76	2.01	2.56	2.87	3.09	3.61	4.71	5.8	
	Qmax	7.5	11	14.4	17.7	21.4	24.5	31.1	35	37.6	43.7	57.1	70.3	
250	Qmin	0.96	1.41	1.85	2.2	2.76	3.16	4	4.5	4.84	5.61	7.36	9.02	
	Qmax	11.6	17	22	27.6	33	38	48	54	58.7	68	89	110	
300	Qmin	1.38	2.04	2.66	3.28	3.97	4.54	5.78	6.48	6.97	8.12	10.56	12.98	
	Qmax	16.7	24.7	32	39	48	55	70	78	84	98	128	158	

Superheated Steam.

fig.5 (unit: kg/m^3)

ITEM	130° C	140° C	150° C	160° C	170° C	180° C	190° C	210° C	220° C	250° C	300° C	360° C	420° C
0.10MPa	1.1	1.07	1.04	1.02	0.99	0.97	0.95	0.91	0.89	0.83	0.76	0.69	0.63
0.15MPa	1.38	1.34	1.34	1.28	1.24	1.21	1.19	1.13	1.11	1.04	0.95	0.86	0.78
0.26MPa		1.96	1.9	1.85	1.81	1.76	1.72	1.64	1.61	1.51	1.37	1.24	1.13
0.30MPa			2.12	2.067	2.01	1.96	1.92	1.83	1.79	1.68	1.53	1.38	1.26
0.36MPa			2.46	2.39	2.33	2.27	2.21	2.11	2.06	1.94	1.76	1.59	1.45
0.40MPa				2.61	2.54	2.47	2.41	2.3	2.25	2.11	1.91	1.73	1.57
0.50MPa				3.16	3.07	2.99	2.91	2.77	2.71	2.54	2.3	2.07	1.89
0.60MPa					3.61	3.51	3.42	3.25	3.18	2.97	2.69	2.42	2.21
0.70MPa						4.05	3.94	3.74	3.65	3.41	3.09	2.78	2.53
0.80MPa						4.59	4.46	4.23	4.13	3.85	3.48	3.13	2.84
0.90MPa						5.15	4.99	4.73	4.61	4.3	3.88	3.48	3.16
1.00MPa							5.54	5.23	5.09	4.75	4.28	3.84	3.48
1.15MPa							6.37	6	5.84	5.43	4.88	4.37	3.97
1.50MPa								7.87	7.64	7.05	6.3	5.63	5.1
1.65MPa								8.7	8.43	7.76	6.92	6.17	5.59
1.80MPa								9.55	9.24	8.48	7.55	6.72	6.08
2.00MPa									10.36	9.47	8.39	7.45	6.74
2.20MPa									11.51	10.47	9.24	8.2	7.4
2.50MPa										12.02	10.55	9.32	8.39

Several normal gas of density under standard condition.

fig.6 (unit: kg/m^3)

Tag Density	Air	Hydrogen	Oxygen	Nitrogen	Chlorine	Ammonia gas	Semi-watergas
	1.293	0.0889	1.43	1.251	3.214	0.77	0.836
Tag Density	Argon	Acetylene	Methane	Ethane	Propane	Butane	Coke-oven gas
	1.79	1.017	0.717	1.357	2.005	2.703	0.4849
Tag Density	Ethylene	Propylene	Natural gas	Coal gas	CO	Co2	
	1.264	1.914	0.828	0.802	1.25	1.977	

Note: standard state is absolute pressure 0.101325Mpa and temperature is 0°C.

5.2 LUCB insertion- version vortex flowmeter measurable flow range under working condition and its calculation. (See fig.7)

LUCB insertion- version vortex flowmeter measure liquid of different density corresponding with flow range under working condition.

fig.7

Gas	Density ρ(kg/ m3)	1	1.2	2	3	4	6	8	10	15	20	Vmax (m/s)
	Vmin(m/s)	5.5	5.2	5	4.8	4.6	4.2	4	3.8	3.6	3.5	55
Liquid	Density ρkg/m	500	600	700	800	900	1000	1200	1400	1600	1800	Vmax (m/s)
	Vmin(m/s)	0.96	0.8	0.7	0.66	0.62	0.6	0.56	0.52	0.5	0.45	6

Notes: fig.7 that is accuracy ± 2.5% of insertion- version vortex flowmeter flow range. When accuracy is better than ± 2.5%, velocity of flow = lower limit of velocity multiplied by coefficient R(R = 2-3), the upper limit multiplied by 0.8.

LUCB insertion- version vortex flowmeter measurable medium flow range calculation under working condition

►Gas & liquid : min volume flow formula under working condition

$Qmin=3600*Vmin*(\pi*D2/4)$ ---------- Formula 5

►Gas & liquid : max volume flow formula under working condition

$Qmax=3600*Vmax*(\pi*D2/4)$ ----------Formula 6

►Gas : min volume flow formula under standard condition

$QNmin=Qmin*[(P_L+P_S)*(273.15+T_N)]/[P_N*Z*(273.15+T_S)]$ ----Formula 7

►Gas : max volume flow formula under standard condition

$QNmax=Qmax*[(P_L+P_工)*(273.15+T_N)]/[P_N*Z*(273.15+T_S)]$---------Formula 8

►Gas : density formula under working condition

$\rho=\rho n[(P_L+P_S)*(273.15+T_N)]/[P_N*Z*(273.15+T_S)]$ ---------- Formula 9

Among Fomular

Qmin: min volume flow under working condition (unit : m^3/h)
Qmax: max volume flow under working condition (unit : m^3/h)
Vmin: min velocity under working condition (unit : m/s refer to fig.7)
Vmax: max velocity under working condition (unit : m/s refer to fig.7)
D: nominal diameter of insertion-version vortex flowmeter (unit : m)
π: circumference ratio 3.1415926535898
Qnmin: gas min volume flow under standard condition (unit : m^3/h)
Qnmax: gas max volume flow under standard condition (unit : m^3/h)
T_N: temperature under standard condition, general is 0℃ or 20℃. (unit:℃)
T_S: measurable gas temperature under working condition (unit:℃)
P_N: normal atmospheric pressure (=0.101325MPa)
P_S: measurable gas pressure under working condition (unit : MPa)
Z : measurable fluid relative compressibility $Z=Z_S/Z_N$
ρ: gas density under working condition (unit : kg/m^3)
ρ_n: gas density under standard state (unit: kg/m^3 ; temp is 0℃ or 20℃, absolute pressure is 0.101325MPa , among formula 9 the temperature is the same between T_N and ρ_n corresponding temp. Several normal gas density under standard state see fig. 6)
P_L: local atmospheric pressure (unit : MPa)

LUCB insertion- version vortex flowmeter Numerical methods of flow range matching steam measurement:
According to steam temperature and pressure refer to fig.4 & fig. 5 then gain exact density " p" under working condition.

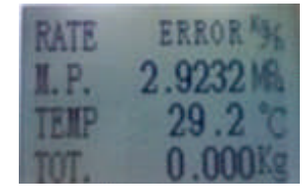
According to steam density"p" under working condition, refer to fig.7 then gain max/ min velocity to pipe diameter of insertion- version vortex flowmeter, through Formula 5 and Formula 6 calculate min volume under working condition or max volume.
The final density "p" under working condition x Qmin or Qmax = mass flow range.

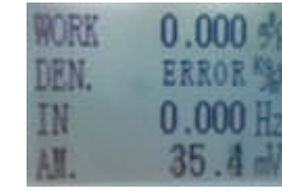
1. Instantaneous flow under working condition corresponding voltage- frequency- pulse output (lower PWL ≤ 1V, higher PWL ≥ 6V)
2. Instantaneous flow under standard condition corresponding voltage- frequency- pulse output (lower PWL ≤ 1V, higher PWL ≥ 6V)
3. Instantaneous flow under standard condition pulse equivalent output (lower PWL≤ 1V, higher PWL ≥ 6V)
4. Instantaneous flow under working condition corresponding two- wire or three- wire 4-20mA output (load resistance ≤ 300 Ω)
5. Instantaneous flow under standard condition corresponding two- wire or three- wire 4-20mA output (load resistance ≤ 300 Ω)

Communication interface: RS 485; HART Display mode:
Intellient numeric alphabetic display type: twin- row numeric alphabetic LCD (instantaneous flow rate and totalizer)
Intelligent dot matrix LCD: English 128* 64 do matrix LCD (instantaneous flow rate, totalizer, temperature and pressure under working condition, battery voltage or density under working condition, instantaneous flow rate under working condition, send- out, time, menu, modify records, power- off records, etc.)

6. Menu Display

Turn on the 24VDC power supply and display the main screen. The main screen is divided into 5 pages, which can be displayed & switched by the key .





Connect the hand operator to flowmeter, and press button for several seconds, then the operator starts receiving data and displaying the main menu.

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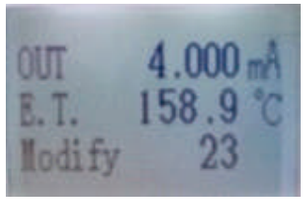

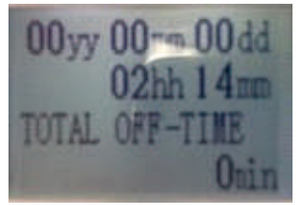

6.1 Menu Instruction

Instantaneous flow: display range 0.000-99999999
Total flow: display Range 0.000-999999999
Remarks: When the total flow is accumulated to 1000000000, it is all cleared and re-accumulated. When the flow unit changes, the total flow value remains at the original value. In this case, please record down the original total flow, then clear it and re-accumulate.
Temperature: display range -50.0...430.0℃
Gauge pressure/Absolute pressure: Under unit of Mpa, indication range is -0.1000…20.0000Mpa
Working Condition: Display instantaneous volume flow under working condition, indication range is 0.000-99999999m^3/h.
Density: indication range is 0.000-99999999kg/m^3
K-factor: When the flow unit is standard condition (such as Nm^3/h), display compression factor of medium under working condition, indication range is 0.000000-9.999999
Input: Display the frequency value that actually measured by the sensor, indication range is 0.000-9000.0Hz.
Output: Display the corresponding frequency or current output value according to the "output type" setting in the menu.
Instrument Temperature: Display inside temperature of pick up sensor, indication range is -99.9-+99.9℃.
Upper-limit: when the measurement limitation function open, transmitter will show the cumulative flow over the upper limit, indication range is 0.000-999999999.

Note: When the ultra-limit flow rate reach 1000000000, all the record will be reset and accumulate.

Menu modification: show the times of parameters setting, indication range is 0-9999, if reach 10000, will be reset & re-record.
Interface four: Display current time, total power-down minutes; "system time" will be shown when flow meter turn on.
Interface five: Display the power failure record, will save the last 10 times of power failure; "system time" will be shown when flow meter turn on.

Special display instructions.
A. NULL: No display.
B. ERROR: data mistakes, so please check parameter setting or flow meter operation is ok or not.
C. OVERRUN: Data overload indication range.

7. Parameter setting

Parameters setting will be achieved by button [SET] , button [>>] , button [^] , button [v] coordinate.

7.1 Button Setting

[SET] button: enter parameter setting and setting confirmation.
[>>] button: Move the cursor to the next position.
[^] button: Add 1 to the value of the cursor position or function selection.
[v] button: back to last menu level.

7.2 Main Menu

Under main interface, press K1 to enter main menu
Press K2 to select each menu, press K1 to enter

Parameters setting
Validation setting
Language
Return

7.3 Main menu of parameters setting

	Input password
Parameters setting	000 000
Total flow reset	123 000
Flow zero setting	000 000
Password setting	000 000

After selecting menu, press K1 to enter password checking Interface, input correct password; then can set each parameter.

Note: If there is no response in t he parameter setting menu over 30 seconds, the system will automatically exit the "Settings" state. Meanwhile, the setting parameter value is invalid. All the parameters setting will be workable by storage confirmation before existing.

7.4 Parameter Setting Menu

Initial password: 000000

Parameter Setting Menu

Menu	Menu Content	Explanation
Load default	YES or NO	Select "Yes", press the setting button long time, the LCD displays "Please wait…", then will show "Restore completed"; select "No", to enter the next menu. No is default setting
Application	LIQUID GAS GAS + P + T SAT. STEAM + T SAT. STEAM + P WATER + P + T LIQUID COMP OIL + P + T NATURAL GAS + P + T MIXED GAS + P + T HEAT STEAM + P + T	
Size	0000-9999mm	
Factor unit	1/m3; 1/L	
Flow curve	LINEAR 10POINT	POINT1…Hz K1…1/ M^3 … POINT10…Hz K1…1/ M^3
K factor	0000.000-9999.999 1/M3	
Flow unit	m^3/h, km^3/ h, L/min, kg/h, t/h, kg/min, (Nm^3/h, Nkm^3/h, NL/min, Nm^3/min, Nkm^3/min)	m^3/h, km^3/h, l/min are the volume flow unit under the working condition, kg/h, t/h, kg/min are mass flow unit, Nm^3/h, Nkm^3/h、Nl/min, Nm^3/min, Nkm^3/min are gas volume flow unit under standard condition

Output	4-20mA (wires) CURRENT PERCENT UNSCALE PULSE COMP. PULSE	Working frequency: only output the frequency pulse before compensation Scaled pulse output: Output the frequency after correction and compensation 4-20mA: Display and output the 4-20ma current at the upper and lower limit of output
Pulse output	0.000000-99999999	The scaled factor is only workable when output type is scaled factor Scaled factor should be selected according to the flow rate. For details method, please refer to appendix 3.
High flow	0.000000-99999999	It's workable under "4-20mA" output
Low flow	0.000000-99999999	
Damping	01-99	
Critical PRES.	0.000000-99999999 Mpa	"Liquid COMP." parameter setting
Critical TEMP.	0.000000-99999999 K	
COMP. FACTOR	0.000000-99999999	
TEMP1	-9999-99999 °C	
DENSITY1	0.000000-99999999 kg/m^3	
.....		
TEMP2	-9999-99999 °C	
DENSITY2	0.000000-99999999 kg/m^3	
CO2 mole fraction	0.000000-99999999	Parameter setting for "nature gas measurement with compensation function" Co2 mole fraction default value 0.006; H2 mole fraction default value is 0; Relative density default value is 0.581
H2 mole fraction	0.000000-99999999	
Relative density	0.000000-99999999	
QGR	0.000000-99999999 MJ/m^3	

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Temp H limit	-50-430 ℃	
Temp L limit	-50-430 ℃	
Pressure mode (GP/AP)	Meter pressure/ Absolutely pressure	It's workable when choose"Manual" in the pressure compensation model menu.
M. P. H limit/ A. P. H limit	-0.1- +20 Mpa	
M. P. L limit/ A. P. L limit	-0.1- +20 Mpa	
Gas pressure	0.000000-99999999 Mpa	Default value: 0.101325Mpa
STD.TEMP	00-99 ℃	Default value: 0 ℃
Fluid density	0.000000-99999999 kg/m^3	No compensation model: The density should be under working condition. Gas temperature compensation: The density should be under 0.101325Mpa and standard temp. Petroleum temperature compensation: The density should be under 0.101325Mpa and 20 ℃.
Flow cutoff unit	Hz; Flow unit	
Cutoff data	0.000000-99999999	
Time setting	00 year 00month 00date 00 hour 00 min	The time will not display when choose "No" in the time menu
Date	No/ YES	
Communication	NO RS 485	
Address	001-255	Default: 001
Baudrate	9600, 4800, 2400, 1200	Default: 9600
Parity mode	None Odd parity Even parity	Default: No
Blacklight	Off, On, Auto	
Stop bit	1 bit 2 bit	Default: 1 bit
Save	YES/ NO	

Note: 1. The above form list all the menus, but if use different password, some menus will be hidden.

2. When enter menu, some value maybe different with original value. The reason comes from non-flushed LCD screen, it's normal. You could press K2 to recover.

Total flow reset	YES	NO
Total flow reset when power fails	YES	NO
"Total flow reset" could clear the total flow and power failing records.		
Zero setting	Zero point value: 0053	
Setting method	Manual setting/ Auto zero setting	
Enter the menu and change the value and save it.		
Setting method	Auto zero setting	
One Key zero setting: On the main interface, press [↑] until the light is on to enter the auto setting status. When the light off, the setting is finished.		
Two key zero setting: Enter the auto setting status first. When the value becomes stable, press [SET], and save setting.		

Note: Non- professional people are forbidden to change the Zero point manually. When setting zero point, please make sure the flow is zero in the pipe.

8. Installation Instruction

8.1 How to select a perfect installation environment

1. To avoid strong power equipment, high-frequency equipment and strong power switchgear.
2. To avoid high-temp thermal source and source of radiant heating; outdoor installation should do some measures of sun-shading and rain shelter.
3. To avoid shock places and corrosion environment ; meanwhile, easy maintenance should be considered.

8.2 How to install the instrument on the pipeline

1. Installation position should avoid strong shock pipeline, or take some measures of shock absorption.
2. Horizontal, vertical and slanting installation. For liquid measurement, ensure flow direction from low to high. Gas measurement has not direction requirement. For measuring vapor or high-temp gas, flow meter body pillar should be at an angle of 45 Deg with vertical direction.

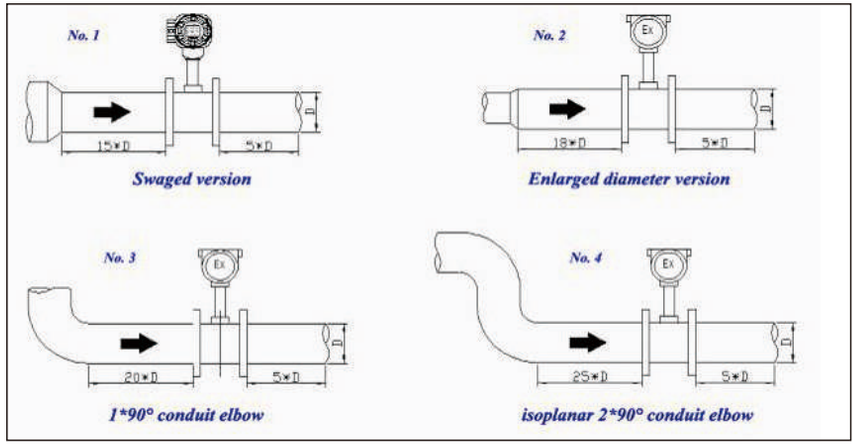
8.3 Grounding connection

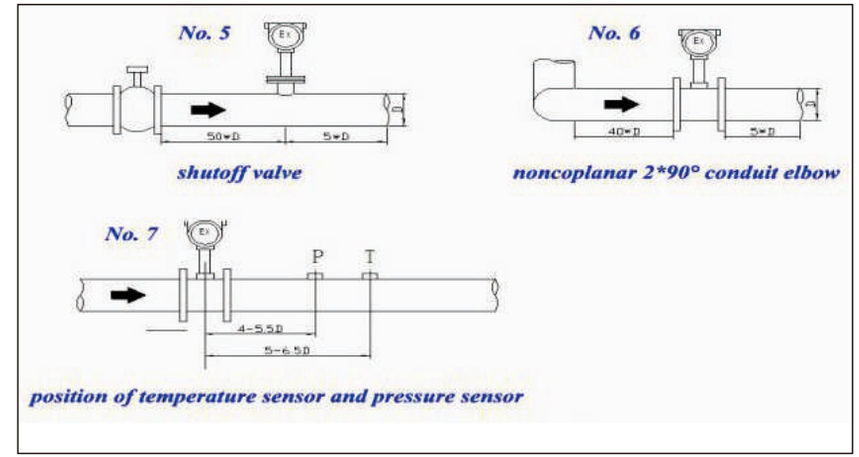
1. When pipelines without available grounding conditions, a ground-wire is essential between housing and earth.

8.4 Straight pipeline requirement

In order to correct measurement, upstream or downstream of flow meter should obligate enough straight length. No components to effect fluid velocity in upstream of flow meter. All types of straight length installation reference:

Fig2

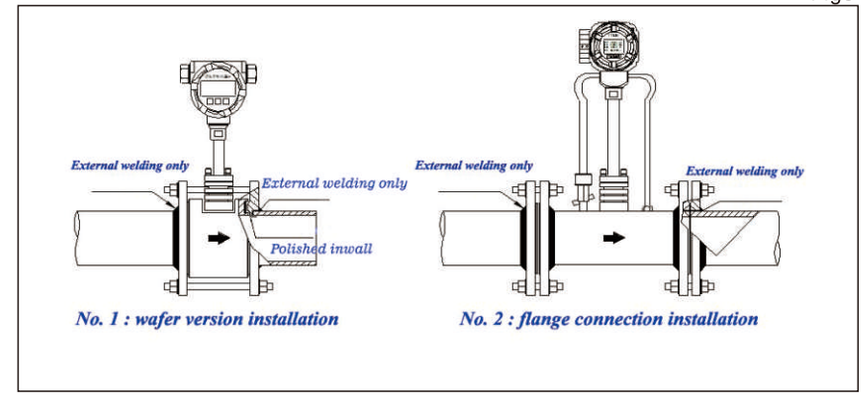


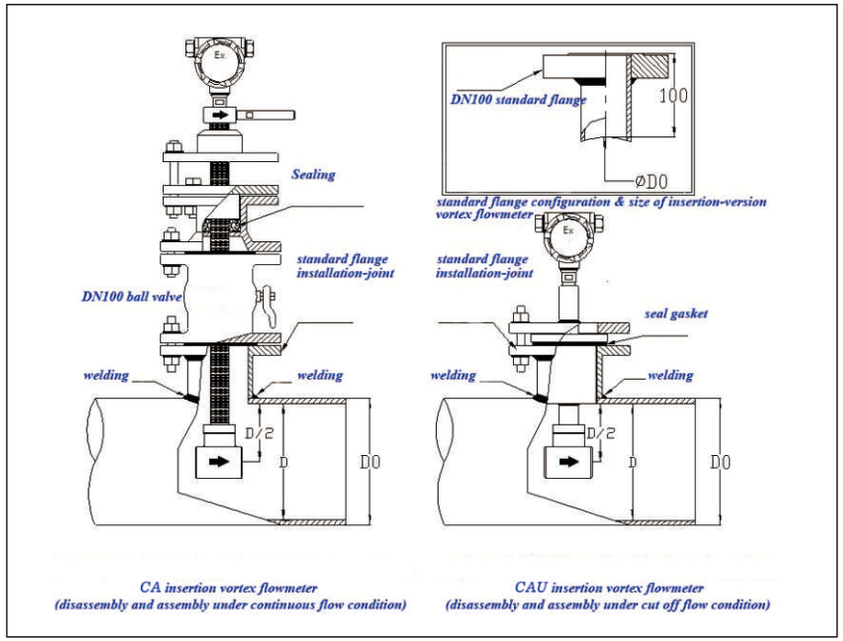


8.5 Installation and welding of flow meter

1. LUGB Vortex diameter is accordant to upstream and downstream tubing diameter at installation point; sensor is concentric with pipeline; prohibit gaskets between sensor and flanges bulge out into pipeline. Make sure that the connection end face of insertion-version vortex flowmeter parallel to the pipe axis. Details as per fig.3.
2. After initial installation, when medium is steam or other high-temp medium, flanges & bolts should be re-tightened when medium full of pipeline. Do heat reservation measures for pipeline in order to protect amplifier.

Fig3





Be attention: concerning P/T compensation integrated vortex flow meter, to avoid high-temp or liner shock damage pressure transmitter, Pressure control valve must be closed before medium is full of pipeline. When medium full of pipeline meanwhile approaching working temperature and pressure, slowly turn on control valve. Pressure tapping and pressure detector should be done heat reservation if flow meter outdoor installation.

Appendix 1: Functions of all Models

Table 7

Tag	Diameter	Medium	Medium temp	Function description
Wafer connection	DN10-500 (mm)	Gas Liquid Saturated steam Superheated steam	-40…+150°C -40…+280°C -40…+350°C	Flowmeter body material: stainless steel Wafer type companion flange: forged carbon steel Max working pressure: 2.5Mpa (over 2.5Mpa supply by negotiation)
Flange connection				
Wafer connection patent type	DN25-500 (mm)		-40…+150°C -40…+280°C -40…+350°C -40…+420°C	Flowmeter body material: stainless steel (other material supply by negotiation) Max working pressure: 2.5Mpa (over 2.5Mpa supply by negotiation) Features : replace sensor head without effect fluid flow inside pipeline.
Flange connection patent type				
Flange connection low flow version equipped dismountable sensor head				Flowmeter body material: stainless steel (other material supply by negotiation) Max working pressure: 2.5Mpa (over 2.5Mpa supply by negotiation) Features : 1. Compare same diameter vortex flowmeter its more lower limit. 2. Replace sensor head without effect fluid flow inside pipeline.
Flange connection low flow version				
Wafer version with temp compensation	DN25-500 (mm)	Saturated steam	+100..+220°C	Flowmeter body material: stainless steel (other material supply by negotiation) Flanges material: forged carbon steel Temperature gauge head: PT100 Max working pressure : 2.5Mpa Features : 1. Special for saturated steam. Integrated flow and temperature sensor in one. 2.Sensor is dismountable type, replace sensor head without effect fluid flow inside pipeline.
Wafer version with temperature compensation equipped dismountable sensor head				

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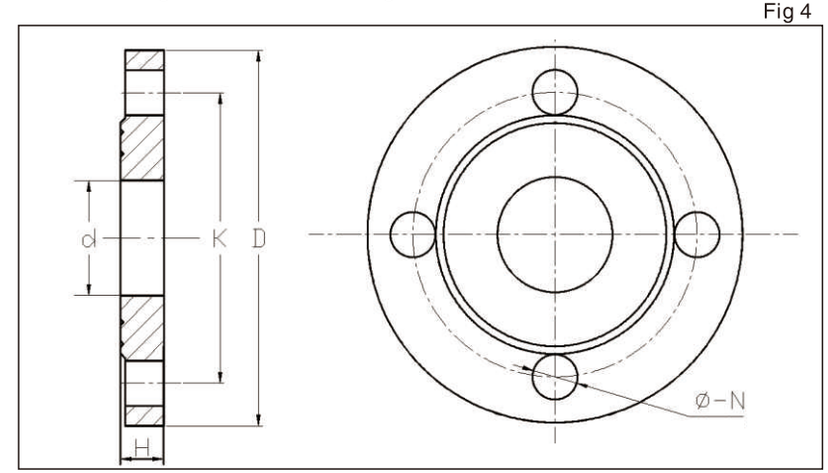
Flange connection Integrated temperature with pressure compensation	DN25-500 (mm)	Gas Saturated steam Superheated steam	-40…+150°C -40…+280°C -40…+350°C	Flowmeter body material: stainless steel (other material supply by negotiation) Temperature gauge head: PT100 Pressure gauge head: diffuse silicon pressure sensor. Max working pressure: 2.5Mpa (over 2.5Mpa supply by negotiation) Features : 1. Integrated temperature and pressure compensation in one. 2. Sensor is dismountable type, replace sensor head without effect fluid flow inside pipeline.
Flange connection Integrated temperature with pressure compensation equipped dismountable Sensor head			-40…+150°C -40…+280°C -40…+350°C -40…+420°C	
Insertion-version with dismountable body need stop medium flow	DN200-DN2000 (mm)	Gas Liquid Saturated steam Superheated steam	-40…+160°C -40…+200°C	Flowmeter body material: stainless steel Connection joint: carbon steel Max working pressure: 2.5Mpa (over 2.5Mpa supply by negotiation) Features: 1. Stop medium flow is the priority for insertion vortex flowmeter. Its compact conformation and good anti-vibration performance. 2. No need stop medium flow with dismountable flowmeter body is equipped DN100 glove valve. Do installation, maintenance and replacement without effect medium flow.
Insertion-version with dismountable body no need stop medium flow				

Submergible-version vortex flowmeter	Wafer-version	DN10-500 (mm)	Gas Liquid	-40…+150°C -40…+280°C	Flowmeter body and flange material: same Max working pressure: 2.5Mpa (over 2.5Mpa supply by negotiation) Features : 1. Flowmeter sensor is Submergible-version. Application: subsurface and Submergible pipeline. 2. Remote-version: transmitter and sensor is separated installation. (The biggest distance suggest ≤10m.
	Flange-version	DN25-500 (mm)			
	Insertion-version	DN200-DN2000 (mm)			

Appendix 2: Configuration Size of Flange Connection Models

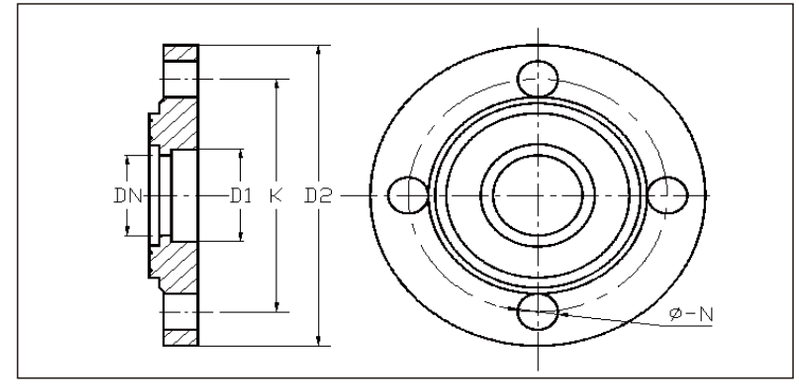
Fig 4



Flange diameter (mm)	Pressure class(MPa)	Flange standard of connection version					
		D(mm)	K(mm)	¢(mm)	N	H(mm)	D (mm)
DN10	PN1.0/PN1.6/PN2.5	90	60	14	4	14	17.2
DN15	PN1.0/PN1.6/PN2.5	95	65	14	4	14	21.3
DN20	PN1.0/PN1.6/PN2.5	105	75	14	4	16	26.9
DN25	PN1.0/PN1.6/PN2.5	115	85	14	4	16	33.7
DN32	PN1.0/PN1.6/PN2.5	140	100	18	4	18	42.4
DN40	PN1.0/PN1.6/PN2.5	150	110	18	4	18	48.3
DN50	PN1.0/PN1.6/PN2.5	165	125	18	4	20	60.3
DN65	PN1.0/PN1.6/PN2.5	185	145	18	4/4/8	20/20/22	76.1
DN80	PN1.0/PN1.6/PN2.5	200	160	18	8	20/20/24	88.9
DN100	PN1.0/PN1.6/PN2.5	220/220/235	180/180/190	18/18/22	8	22/22/26	114.3
DN125	PN1.0/PN1.6/PN2.5	250/250/270	210/210/220	18/18/26	8	22/22/28	139.7
DN150	PN1.0/PN1.6/PN2.5	285/285/300	240/240/250	22/22/26	8	24/24/30	168.3
DN200	PN1.0/PN1.6/PN2.5	340/340/360	295/295/310	22/22/26	8/12/12	24/26/32	219.1
DN250	PN1.0/PN1.6/PN2.5	395/405/425	350/355/370	22/26/30	12/12/12	26/29/35	273
DN300	PN1.0/PN1.6/PN2.5	445/460/485	400/410/430	22/26/30	12/12/16	28/32/38	323.9
DN350	PN1.0/PN1.6/PN2.5	505/520/555	460/470/490	22/26/33	16/16/16	30/35/42	355.6
DN400	PN1.0/PN1.6/PN2.5	565/580/620	515/525/550	26/30/36	16/16/16	32/38/46	406.4
DN450	PN1.0/PN1.6/PN2.5	615/640/670	565/585/600	26/30/36	20/20/20	35/42/50	457
DN500	PN1.0/PN1.6/PN2.5	670/715/730	620/650/660	26/33/36	20/20/20	38/46/56	508

Note: LUGB flange connection vortex flowmeter its flange pressure class: DN10-DN80 is PN2.5MPa; DN100-DN200 is PN1.6MPa; DN250-DN500 is PN1.0MPa; if over above pressure class, please mention clearly in purchasing order. GB (China flange standard follows GB9119-2000). International standard, such as ANSI/DIN/JIS... Please customer provide clear model number.

Appendix 3: Configuration Size of Wafer Connection Models



Flange DN (mm)	Pressure class (MPa)	Flange standard of wafer connection version				
		D1(mm)	D2(mm)	K(mm)	¢(mm)	N
DN10	PN1.0/PN1.6/PN2.5	14	90	60	14	4
DN15	PN1.0/PN1.6/PN2.5	19	95	65	14	4
DN20	PN1.0/PN1.6/PN2.5	26	100	70	14	4
DN25	PN1.0/PN1.6/PN2.5	33	100	75	14	4
DN32	PN1.0/PN1.6/PN2.5	39	105	80	14	4
DN40	PN1.0/PN1.6/PN2.5	49	150	116	18	4
DN50	PN1.0/PN1.6/PN2.5	60	160	124	18	4
DN65	PN1.0/PN1.6/PN2.5	76	175	138	18	4
DN80	PN1.0/PN1.6/PN2.5	90	204	164	20	4
DN100	PN1.0/PN1.6/PN2.5	109	234	192	22	6
DN125	PN1.0/PN1.6/PN2.5	134	250	205	22	6
DN150	PN1.0/PN1.6/PN2.5	163	280	232	22	6
DN200	PN1.0/PN1.6/PN2.5	220	340	286	24	8
DN250	PN1.0/PN1.6/PN2.5	274	390	338	24	8
DN300	PN1.0/PN1.6/PN2.5	327	450	393	26	12
DN350	PN1.0/PN1.6/PN2.5	377	510	460	26	16
DN400	PN1.0/PN1.6/PN2.5	426	565	510	26	16
DN450	PN1.0/PN1.6/PN2.5	482	620	565	30	16
DN500	PN1.0/PN1.6/PN2.5	534	685	620	33	20

Note: Companion flanges for wafer connection follows PN2.5MPa pressure class, when over 2.5MPa please make clearly mention.

Appendix 4 Calibration Method

1. When calibrating the instrument, the “output form” must be set to “frequency of working condition”, and “value of small signal cutting” is set to 0; after calibration, “K-factor” is set according to the actual calibration, and then change “output form” and “value of small signal cutting” back to the original setting.
2. Flow rate stabilization time of calibration point: ≥ 60s.

Appendix 5 Fundamental formula

1. Instantaneous volume flow rate of working condition.

$$Qv = 3600 \times \frac{F}{K}$$

Qv: volume flow rate of working condition (unit: m^3/ h)

F: current frequency of working condition (unit: Hz)

K: K factor (unit: number of pulse/ m^3)

2. Instantaneous mass flow rate of working condition.

$$Qm = 3600 \times \rho \times \frac{F}{K}$$

Q_m:Mass flow rate of working condition (unit:kg/h)

ρ: medium density under working condition(unit: kg/m^3)

3. Scaled coefficient calculation method.

$$\begin{cases} K_N = \dfrac{Q_{max}}{F_N \times 3600} & \text{Flow unit */h} \\ K_N = \dfrac{Q_{max}}{F_N \times 60} & \text{Flow unit */min} \end{cases}$$

K_N: Scaled coefficient (unit: cumulative flow rate/ pulse)

F_N: Maximum frequency output (unit: Hz; when K_N is selected, set FN< 5000, and general F_N should be 2000 Hz)

Q_{max}: The actual maximum instantaneous flow rate (unit: same as the setting flow rate unit)

Appendix 6 Communication Function

1. Relevant parameter

The instrument has RS485 communication interface, adopts standard MODBUS-RTU communication protocol, relevant parameters are as follows:

Start bit: 1 bit	Data bit: 8 digits	Parity bit: can be set
Termination bit: can be set	Baud rate: can be set	response time:0.05s

2. Data format

IEEE754 standard single float format

3. Data address

This flow meter can transmit 1-16 continuous data at the same time, and each data is stored by the corresponding address as follows:

1.0001H: Instantaneous flow value
2.0003H: Cumulative flow value
3.0005H: Working temperature (Non-compensation model, it displays 0.0000)
4.0007H: Gauge Pressure/ absolute pressure (Non-compensation model, it displays 0.0000)
5.0009H: Volume flow rate of working condition
6.000BH: Density under working condition
7.000DH: Compression coefficient (Non-standard condition volume unit, it displays 0.0000)
8.000FH: Input frequency
9.0011H: Frequency output under working condition (Not this output, it displays 0.0000)
10.0013H: Scaled pulse output (Not this output, it displays 0.0000)
11.0015H: Current output (Not this output, it displays 0.0000)
12.0017H: 0.0000(This address is reserved by system and unrelated to the instrument data displays on the interface.)
13.0019H: Gauge temperature
14.001BH: Exceed to limited cumulative flow rate (When close the Protocol measurement, it displays 0.0000)
15.001DH: Total power outage time (When the system clock is off, it displays 0.0000)

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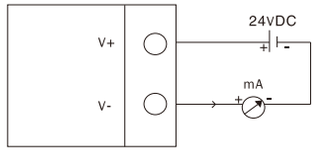
4. Data address

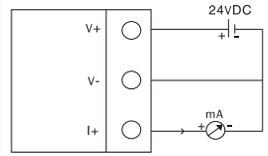
When the LCD screen displays the following data transmission information:

NULL	transmission data- 0
ERROR	transmission data- 1234
OVERRUN	transmission data- 8888

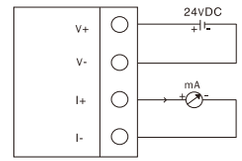
Appendix 7 Electrical wiring



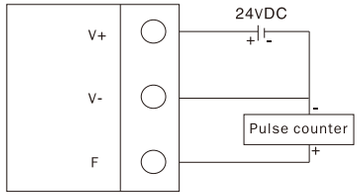
**Current output-
two wires connection**



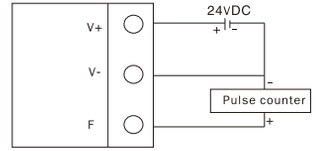
**Current output-
three wires connection**



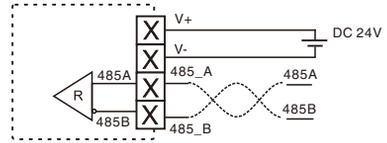
**Current output-
four wires connection**



Frequency output



Frequency output



RS485 Output

Vortex Flow Meter
User Manual