PWF-TF Target Flowmeter

USER MANUAL

Pokcenser Automation Technology Company Limited

Contents

I. General

1) Types of products and applicable domain:

TF series target flowmeter with digital display is a completely new force induction target flowmeter developed based on measurement principle of traditional target flowmeter, making full use of most excellent features of the same, and in combination with new transducer technology and modern digital technology. This product not only features the characteristic of no movable part as in traditional flowmeters such as target flowmeter, orifice flowmeter and vortex flowmeter, but also a measurement accuracy matching that of volumetric flowmeter. In addition, this product has the performance against interference and impurities, and is light and reliable, hence is widely used in petroleum industry, chemical engineering, energy industry, food industry, environmental protection and water conservancy etc. In terms of operation effect, TF flowmeter has extremely wide applicability, i.e.:

· applicable to various pipe diameters: from Φ15 to Φ2000mm and larger;

· applicable to high and low temperature media: from -196℃ to +450℃;

· applicable to high pressure operating conditions: from 0 to 42Mpa (gauge).

2) Product features:

· Accurate measurement of flow of fluid media such as liquid, gas, steam and viscous media etc. under various normal temperature, high temperature and low temperature operating conditions;

· Extremely high sensitivity capable of measurement of ultra small flow (minimum flow that can be measured is 0.08m/s;

· No movable part, hence high safety and reliability;

· High measurement accuracy and precision (reaching 0.2% for measurement of total quantity);

· Wide measurement range (reaching 1:30);

· Good repeatability (normally 0.1～0.08%) and fast measurement;

· Small pressure loss, only about 1/2△P of standard orifice;

· Dry calibration can be used, i.e. poise hanging method;

· Target plate can be replaced as required to change flow measurement range;

· Capable of online direct reading and remote transmission/signaling;

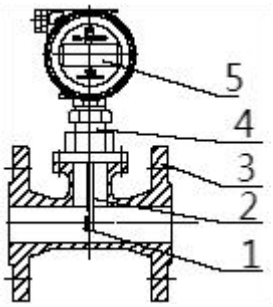
· Easy installation and very easy maintenance.

II. Structure and operating principle

1) Structure

TF flowmeter mainly consists of measurement tube (casing), stress element (target plate),

sensing elements (force transducer, pressure transducer and temperature transducer), transition part (adjusted according to temperature and pressure), and accumulation calculation, display and output part. Refer to the following figure for the structure:



1. Stress element (target plate)

2. Sensing elements (including temperature and pressure sensing elements)

3. Measurement tube

4. Transition part

5. Accumulation calculation, display and output part

2) Operating principle

Refer to Fig.1 for operation schematic of model TF target flowmeter with digital display. The stress element (target plate) is placed at center of measurement tube (instrument body) coaxially, with rigid connection with transducers. When measured medium flows at certain velocity (m/s), this medium has certain momentum that directly acts on the stress element (target plate). Due to rigid connection between stress element and transducer, the transducer is subject to direct force F generated by fluid momentum. This force is related to flow velocity V, medium density ρ and area of target subject A to force as follows:

$$F = C_D \frac{\rho V^2}{2} A$$

In which:

F——force on target plate

C_D——resistance coefficient

P——fluid density, kg/m^3

V——fluid velocity, m/s

A——area of target plate subject to force, m^2

Through derivation and conversion, the flow is calculated as follows:

$$Q_m = 4.512\alpha D(\frac{1}{\beta} - \beta)\sqrt{\rho F} \quad \text{kg/h}$$

$$Q_V = 4.512\alpha D(\frac{1}{\beta} - \beta)\sqrt{\frac{F}{\rho}} \quad \text{m}^3\text{/h}$$

In which

Q_m, Q_V—mass flow and volume flow respectively (kg/h, m^3/h)

α----flow coefficient

D----inner diameter of measurement tube, mm

β----diameter ratio, β=d/D

d----target plate diameter, mm

Other symbols are the same before.

Force on target plate is converted to electric signal by the force transducer. This signal is amplified by pre-amplification and processed by AD conversion and computer, to provide corresponding flow and total quantity. Operating principle is shown as follows:

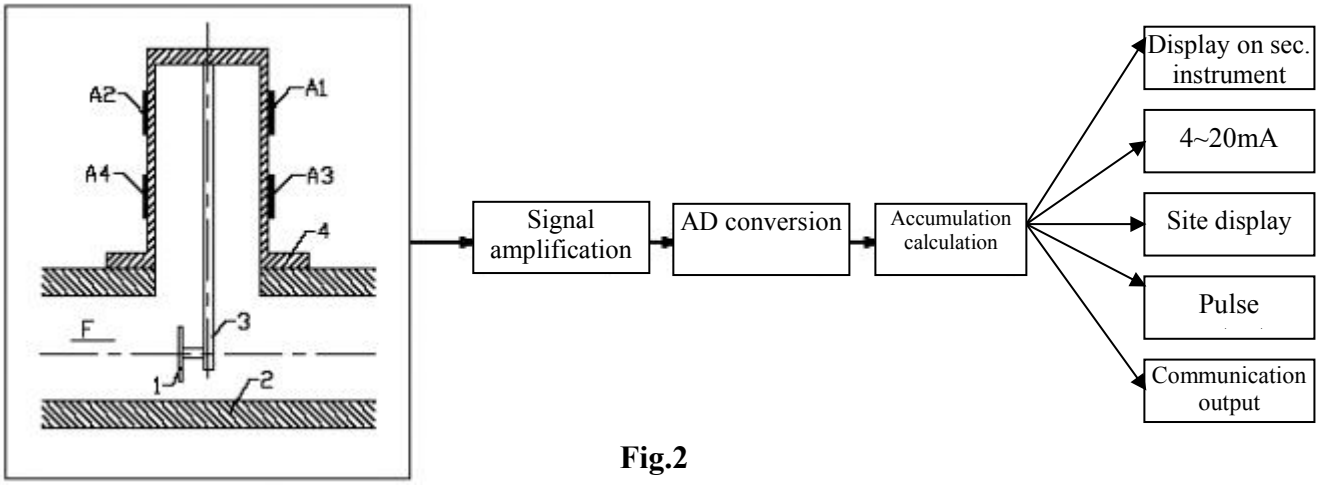


Fig.2

1. Measurement tube; 2. Target plate; 3. Target rod; 4. Transducer; A. Strain-meter

III. Technical parameters and indices

1) Table of main technical indices

Table 1

Measured media	Liquid, gas, steam				
Nominal diameter	Pipeline type 15~300mm	Clamped mounting type 15~600mm		Inserted type 100~2000mm	
Nominal pressure	0.6~42MPa	0.6~42MPa		0.6~42MPa	
Media temperature	-20℃~70℃ (normal temperature type) -196℃~+450℃ (high/low temperature type)				
Accuracy	±0.2%	±0.5%	±1.0%	±1.5%	±2.5%
Range degree	1:3	1:5	1:10	1:10 (gas)	1:10 (steam)
Compensation type	Temperature compensation; pressure compensation				
Repeatability	0.1%~0.08%				
Power supply	Built-in 3.6V Li batter; external power supply of 24VDC; 220VAC (only for separate digitron)				
Output forms	Site display reading; 4~20mA (2-wire system); pulse; 0~10V; RS232/RS485 (optional)				
Material of measurement tube	Carbon steel; 304; 316L; also supplied to user requirement				
Explosion-proof sign	Intrinsically safe type (ExiallCT$_4$); Explosion isolating type (ExiallBT$_4$)				
Protection class	IP65; IP67				

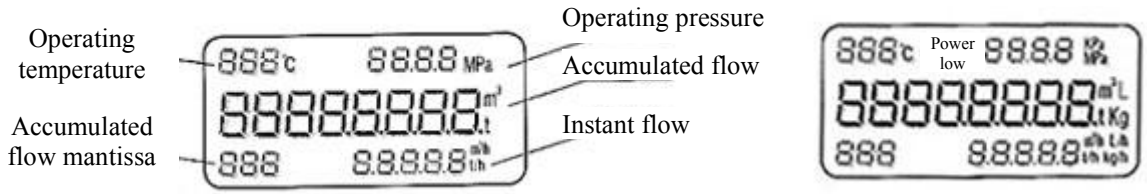
Note: Size of flowmeter flange shall execute GB/T9115.1~9115.4-2000 series standard. For

pipeline type, small diameter flowmeter of DN6, DN8, DN10 etc. can be manufactured to user requirements.

2) Contents displayed on screen during flowmeter operation

(version updating shall be governed by ex-factory products; no notice or modification will be provided):

The flowmeter adopts LCD display screen. Displayed contents and positions are shown below:



2000 version 2005 version

Fig.3

a. Flowmeter display units:

Operating temperature——degrees ℃ (optional)

Operating pressure——relative gauge pressure MPa or KPa (optional)

Instantaneous flow——m^3/h; L/h (volume flow); or t/h; kg/h (mass flow)

Accumulated flow——m^3; L (volume flow) or t; kg (mass flow)

b. Flowmeter indications

Operating temperature resolution——1; full scale——999

Operating pressure resolution——0.01; full scale——99.99

Accumulated flow resolution——0.00001 (m^3; L; t; kg); full scale——99999999 (m^3; L; t; kg)

Instantaneous flow resolution——0.0001 (m^3; L; t; kg); full scale——99999 (m^3; L; t; kg)

3) Displayed contents during flowmeter calibration

During calibration of flowmeter, operation parameters and system parameters can be displayed. For particular displayed contents and meanings thereof, refer to “Instructions manual” supplied along with product.

IV. Description of product types and models

TF target flowmeter with digital display has the following main types and forms:

1) Types:

· Liquid flowmeter: normal temperature and high temperature

· Gas flowmeter: normal temperature and high temperature

· Steam flowmeter: saturated steam and superheated steam.

2) Forms and corresponding sizes

· Pipeline type: Threaded pipeline type: size of DN15～DN80 (mm)

Flanged pipeline type: size of DN15～DN300 (mm)

· Clamped mounting type: size of DN15～DN600 (mm)

· Inserted type: size of DN100～DN2000 (mm)

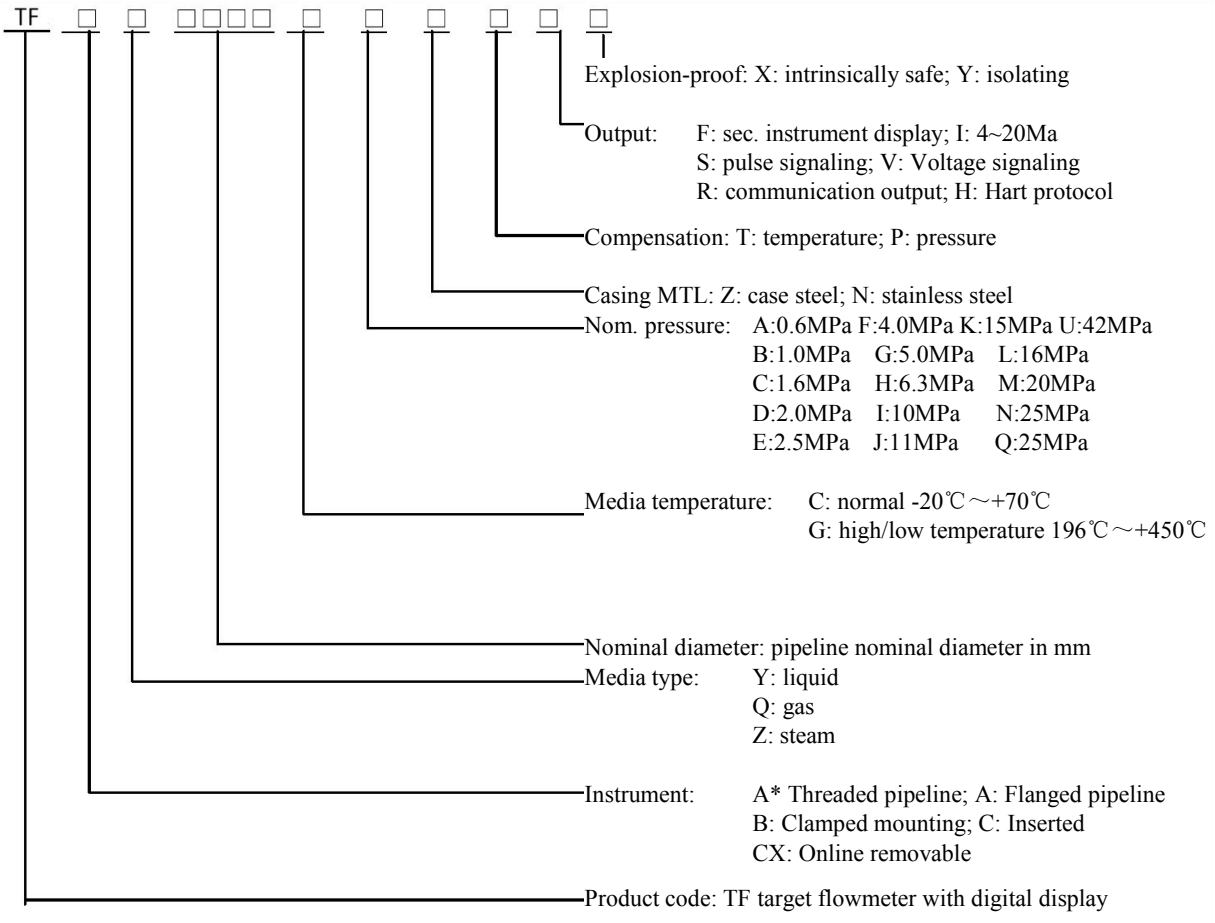
Inserted type includes fixed type and telescopic online removable type.

3) Description of flowmeter models

(fir upgrading of graphic or model, no notice or modification will be provided. For product model, confirmed type selection during ordering shall govern).

3.3 Product models

3.3.1 Meanings of model



Notes:

· Size of flowmeter flange shall execute relevant technical parameters specified in state standards GB/T9115.1~9115.4 —2000 and GB/T. Technical conditions and types can execute American and European system standards as required by user.

· For flowmeter type selection, user shall specify various requirements on flowmeter according to format of model

· In case user requires diameter, nominal pressure and output form not provided in this description of models, a corresponding description shall be provided.

· When selecting high temperature type flowmeter, in addition to filling the described format, especially note highest operating temperature of measured medium.

· For flowmeter with temperature or pressure compensation, in addition to filling the described format, especially note ranges of operating temperature and pressure that require compensation.

· In case user requires special material of measurement tube and/or internal lining, this shall be noted.

4) Example of type selection

TF—AY250CCNTIX means: flanged pipeline type target flowmeter with digital display, liquid measured media, nominal diameter of 250mm, normal temperature of media, nominal pressure of 1.6Mpa (flange size), stainless steel measurement tube, temperature compensation, 4～20mA current output, and intrinsically safe explosion-proof sign.

V. Selection of flowmeter flow measurement range

1) Selection of flowmeter accuracy and flow measurement range degree

a. Meanings of accuracy and measurement range degree

Accuracy: percentage % of measurement error of flowmeter in certain flow range.

Range degree: measurement range of flowmeter for which a definite accuracy condition applies.

Flowmeter of the same nominal diameter can be applicable to very wide measurement range. However, when certain accuracy is required, measurement range will be limited accordingly, i.e. the range between maximum measured flow and minimum measured flow will be limited. In short, one accuracy condition corresponds to one measurement range degree. Therefore, accuracy of measurement by flowmeter can only be ensured by one-to-one correspondence. The table below shows correspondence between measurement range degree and measurement accuracy for different types of measured media.

Table 2

Accuracy / Range degree / Type of media	±0.2%	±0.5%	±1.0%	±1.5%	±2.5%
Liquid	$Q_{max}=3Q_{min}$	$Q_{max}=5Q_{min}$	$Q_{max}=10Q_{min}$		
Gas			$Q_{max}=5Q_{min}$	$Q_{max}=10Q_{min}$	$Q_{max}=20Q_{min}$
Steam				$Q_{max}=5Q_{min}$	$Q_{max}=10Q_{min}$

Note: In the table, Qmax——maximum flow of measured media under operating conditions;

Qmin——minimum flow of measured media under operating conditions.

b. Example of selection of accuracy and measurement range:

Applicable measurement range of DN25 flow meter is 0.2m^3/h～9m^3/h. This range spans 45 times. Apparently, it is very difficult to ensure certain accuracy in such a large span. For a given accuracy, corresponding range degree shall be selected from the applicable measurement range. For example, when required accuracy is ±0.2%, measurement range degree shall be selected from applicable flow range 0.2 m^3/h～9m^3/h according to Qmax=3 Qmin, i.e. the range degree can be 0.2 m^3/h～0.6m^3/h, 0.5 m^3/h～1.5 m^3/h and 3m^3/h～9m^3/h etc. Similarly, if required accuracy is ±0.5% or ±1.0%, corresponding flow range degrees can be selected. It shall be pointed out that when Reynolds number of measured media is ＜ 1500, under certain accuracy condition, range degree will be narrower. Amplitude of narrowing depends on flow velocity and viscosity of measured media.

2) Selection of size and flow measurement range

Flow measurement range of flowmeter is related to a number of factors, e.g. structural form, process requirements, operating pressure and status flow etc. After determination of process flow, since there are a number of flowmeter sizes applicable to this process flow, a flowmeter of size most suitable for this process flow shall be selected, normally according to the following two points:

a. Flowmeter size is normally determined according to process dimensions of configured pipeline;

b. Determination shall be carried out according to velocity of measured media in measurement tube, i.e.

Liquid $V_{average}$=5m/s

Gas $V_{average}$=30m/s

Steam $V_{average}$=50m/s

Above media velocities are status flow velocities. Normally, average status flow velocity of media is taken as maximum flow velocity of measured media flowing through the flowmeter. Maximum flow velocity that can be measured by the flowmeter can normally exceed maximum flow velocity under normal conditions by 1~1.5 times.

Following are flow measurement ranges of flowmeter of various sizes for standard water, saturated steam and standard dry air under operating conditions.

3) Table of flow measurement range for standard water under operating conditions

Table 3

Structural form			Flowmeter inside diameter (mm)	Flowmeter measurement range (m^3/h)	Target diameter ratio range		Maximum pressure drop△ P_{max} (Kps)
					β_{max}	β_{min}	
Clamped mounting type	Integral flange type	55 taper pipe thread type	15(1/2″)	0.1~3	0.8	0.6	96.4
			20(3/4″)	0.17~5	0.8	0.6	55.12
			25(1″)	0.3~9	0.8	0.6	34.45
			32(11/2″)	0.5~14	0.8	0.6	24.12
			40(13/4″)	1.0~24	0.8	0.5	17.23
			50(2″)	1.5~40	0.8	0.5	6.89
			65	2.5~60	0.7	0.4	5.51
			80	3.5~90	0.7	0.4	4.31
			100	5~140	0.7	0.4	2.76
			125	6~200	0.7	0.4	2.07
			150	10~300	0.6	0.3	1.38
			200	18~560	0.6	0.3	0.89
			250	25~800	0.5	0.3	0.56
			300	40~1200	0.5	0.25	0.35
			350	50~1500	0.5	0.25	0.10
			400	65~2000	0.5	0.25	0.07
			450	90~2600	0.4	0.25	0.06
			500	110~3300	0.4	0.2	0.05
			550	140~4100	0.35	0.2	0.04
			600	170~5000	0.3	0.2	0.03
Inserted type			700	230~6800	0.3	0.2	0.011
			800	300~9000	0.3	0.2	0.0083
			900	370~11000	0.3	0.2	0.0062
			1000	470~14000	0.2	0.1	0.0055
			1100	560~16000	0.2	0.1	0.0041
			1200	670~20000	0.2	0.1	0.0034
			1300	780~23000	0.2	0.1	0.0028
			1400	900~27000	0.2	0.1	0.0028
			1500	1050~31000	0.2	0.1	0.0021

Note: Actual flowmeter pressure drop △P=(actual flow/max. flow)^2×max. pressure drop P_{max}

△P_{max}---pressure loss caused by the flowmeter during maximum flow Q_{max} and under corresponding target diameter ratio βmax

β=d/D d----target plate diameter; D----flowmeter inside diameter

In case of special user requirements on flow and size, please contact the company.

4) Table flow measurement range for saturated steam under operating pressure

Table 4

Nominal diameter mm	Measurement range t/h									
	0.1MPa	0.2 MPa	0.3 MPa	0.4 MPa	0.5 MPa	0.6 MPa	0.8 MPa	1.0 MPa	1.5 MPa	2.0 MPa
15	0.002 ~0.02	0.003~ 0.03	0.005~ 0.05	0.007~ 0.07	0.008~ 0.08	0.009~ 0.09	0.012~ 0.12	0.015~ 0.15	0.023~ 0.23	0.03~0.3
20	0.003 ~0.03	0.006~ 0.06	0.009~ 0.09	0.012~ 0.12	0.015~ 0.15	0.017~ 0.17	0.022~ 0.22	0.0280~.2 8	0.04~0.4	0.055~ 0.55
25	0.005 ~0.05	0.009~ 0.09	0.014~ 0.14	0.019~ 0.19	0.02~0.2	0.027~ 0.27	0.035~ 0.35	0.044~0.4	0.065~ 0.65	0.085~ 0.85
32	0.008 ~0.08	0.016~ 0.16	0.023~ 0.23	0.032~ 0.32	0.036~ 0.36	0.044~ 0.44	0.056~ 0.56	0.072~ 0.72	0.1~1.0	0.14~1.4
40	0.012 ~0.12	0.026~ 0.25	0.036~ 0.36	0.045~ 0.45	0.058~ 0.58	0.069~ 0.69	0.09~0.9	0.11~1.1	0.16~1.6	0.22~2.2
50	0.02~ 0.2	0.038~ 0.38	0.057~ 0.57	0.075~ 0.75	0.09~0.9	0.1~1.0	0.14~1.4	0.171~.7	0.26~2.6	0.343~.4
65	0.035 ~0.35	0.065~ 0.65	0.1~1.0	0.13~1.3	0.15~1.5	0.18~1.8	0.24~2.4	0.29~2.9	0.44~4.4	0.58~5.8
80	0.05~ 0.5	0.1~1.0	0.15~1.5	0.18~1.8	0.23~2.3	0.27~2.7	0.36~3.6	0.45~4.5	0.66~6.6	0.88~8.8
100	0.08~ 0.8	0.15~ 1.5	0.23~2.3	0.28~2.8	0.36~3.6	0.42~4.2	0.56~5.6	0.7~7.0	1.0~10	1.3~13
125	0.12~ 1.2	0.24~ 2.4	0.35~3.5	0.48~4.8	0.56. ~5.6	0.68~6.8	0.89~8.9	1.1~11	1.6~16	2.1~21
150	0.18~ 1.8	0.35~ 3.5	0.5~5.0	0.7~7.0	0.82~8.2	0.96~9.6	1.2~12	1.5~15	2.3~23	3.1~31
200	0.32~ 3.2	0.6~6.0	0.9~9.0	1.2~12	1.4~14	1.7~17	2.2~22	2.8~28	4.1~41	5.5~55
250	0.5~ 5.0	1.0~10	1.4~14	1.9~19	2.2~22	2.7~27	3.5~35	4.4~44	6.5~65	8.6~86
300	0.7~ 7.0	0.14~ 1.4	2.0~20	2.5~25	3.3~33	3.9~39	5~50	6.2~62	9.2~92	12~120
350	1~1.0	1.9~19	2. ~828	3.5~35	4.4~44	5.2~52	7~70	8.5~85	12~210	27~270
400	1.3~ 13	2.5~25	3.63~6	4.7~47	5.8~58	6.8~68	9~90	11~110	16~160	22~220
450	1.6~ 16	3.1~31	4. 6~46	6.0~60	7.4~74	8.6~86	11~110	14~140	21~210	27~270
500	1.6~ 16	3.8~38	5.6~56	7.0~70	9.1~91	10~100	14~140	17~170	26~260	34~340
550	2.5~ 25	4.7~47	6.8~68	9.09~0	11~110	13~130	17~170	20~200	31~310	41~410
600	3~30	5.6~56	8.2~82	10~100	13~130	15~150	20~200	25~250	37~370	49~490

Note: Actual pressure drop △P=actual flow/max. flow×max. pressure drop △Pmax. For special user requirements, please contact the company.

5) Table of flow measurement range for standard dry air under operating conditions

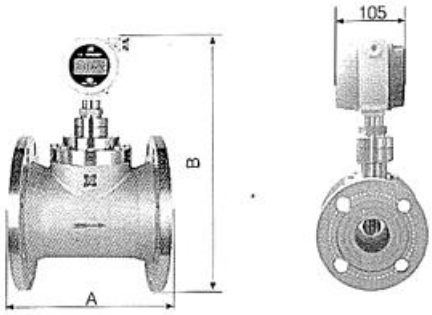
Table 5

Nominal diameter	Measurement range NM^3/h									
mm	0.01MPa	0.1 MPa	0.2 MPa	0.3 MPa	0.4 MPa	0.6 MPa	0.8 MPa	1.0 MPa	2.0 MPa	4.0 MPa
15	2～20	4～40	6～60	8～80	10～100	14～140	18～180	22～220	42～420	82～820
20	3～30	6～60	9～90	12～120	15～150	21～210	27～270	33～330	63～630	123～1230
25	5～50	10～100	15～150	20～200	25～250	35～350	45～450	55～550	105～1050	205～2050
32	8～80	16～160	24～240	32～320	40～400	56～560	72～720	88～880	168～1680	328～3280
40	13～130	26～260	39～390	42～420	65～650	91～910	117～1170	143～1430	273～2730	533～5330
50	13～130	40～400	60～600	80～800	100～1000	140～1400	180～1800	220～2200	420～4200	820～8200
65	35～350	70～700	105～1050	140～1400	175～1750	245～2450	315～3150	385～3850	735～7350	1435～14350
80	50～500	100～1000	150～1500	200～2000	250～2500	350～3500	450～4500	550～5500	1050～10500	2050～20500
100	80～800	160～1600	240～2400	320～3200	400～4000	560～5600	720～7200	880～8800	1680～16800	3280～38200
125	130～1300	260～2600	390～3900	420～4200	650～6500	910～9100	1170～11700	1430～14300	2730～27300	5330～53300
150	180～1800	360～3600	540～5400	720～7200	900～9000	1260～12600	1620～16200	1980～19800	3780～37800	7380～73800
200	300～3000	600～6000	900～9000	1200～12000	1500～15000	2100～21000	2700～27000	3300～33000	6300～63000	12300～12300
250	500～5000	1000～10000	1500～15000	2000～20000	2500～25000	3500～35000	4500～45000	5500～55000	10500～105000	20500～205000
300	750～7500	1500～15000	2250～22500	3000～30000	3750～37500	5250～52500	6750～67500	8250～82500	15750～157500	30750～30750
350	1000～10000	2000～20000	3000～30000	4000～40000	5000～50000	7000～70000	9000～90000	1000～11000	21000～210000	41000～410000
400	1300～13000	2600～26000	390039000	4200～4200～0	6500～65000	9100～91000	1700～11700	4300～143000	27300～273000	53300～533000
450	1700～17000	3400～34000	5100～51000	6800～68000	8500～85000	11900～11900	5300～15300	8700～18700	357003～57000	69700～697000
500	200020000	4000～40000	6000～60000	8000～80000	10000～10000	14000～140000	8000～18000	2000～22000	42000～420000	82000～820000
550	250025000	5000～50000	7500～75000	10000～10000	12500～12500	17500～17500	2500～22500	7500～27500	52500～525000	102500～1025000
600	300030000	6000～60000	9000～90000	12000～12000	15000～15000	21000～21000	2500～22500	3000～33000	63000～630000	123000～1230000
700	400040000	8000～80000	12000～12000	16000～16000	20000～20000	28000～28000	6000～36000	4000～44000	84000～840000	164000～1640000
800	5000～50000	10000～100000	15000～150000	20000～20000	25000～25000	35000～35000	5000～45000	5000～55000	05000～105000	205000～2050000
900	6500～65000	13000～130000	19500～195000	26000～26000	325000～325000	45500～45500	8500～58500	1500～71500	36500～136500	266500～265000
1000	8000～80000	16000～160000	24000～24000	32000～32000	40000～40000	56000～56000	2000～72000	8000～88000	68000～168000	32800～3280000

Note: Shown in the table is flow range of standard air at 20℃ and 0.101Mpa.

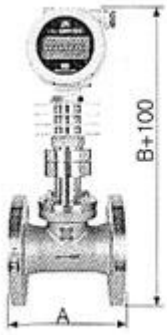
VI. Product main connection and outline dimensions

1) Flanged pipeline type



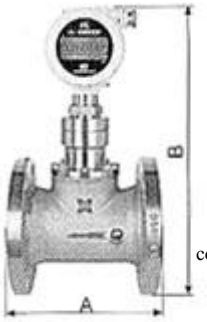
(Normal temperature)

Nominal inside diameter	Total width	Total height	Conventional product flange pressure	Remark
	A	B	Flange class	
DN15	200	305	1.6; 2.5; 4.0	A, B are for reference; ex-factory product shall govern
DN20	200	310		
DN25	205	315		
DN32	205	340		
DN40	210	345		
DN50	220	355	2.5; 4.0	
DN65	240	370		
DN80	250	390		
DN100	260	410		
DN125	305	445		
DN150	315	460		
DN200	324	530	2.5	
DN250	360	595		
DN300	400	655		

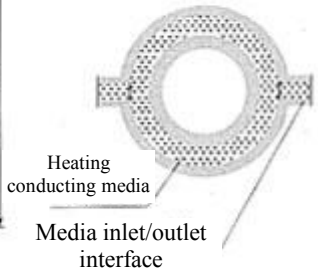


(High temperature type)

(Temperature/pressure compensation type)



Jacket insulation type (conducting sleeve)



Schematic of jacket structure

Notes:

a. Connection flange shall execute relevant technical requirements in state standard GB/T9115.1~9115.4-2000.

b. All standard flanges from other countries (Japanese standard, USA standard and German standard etc.) are special order.

c. For high temperature type and temperature/pressure compensation type, in addition to

pipeline flange, connection mode can be clamped mounting type, inserted type or threaded structure.

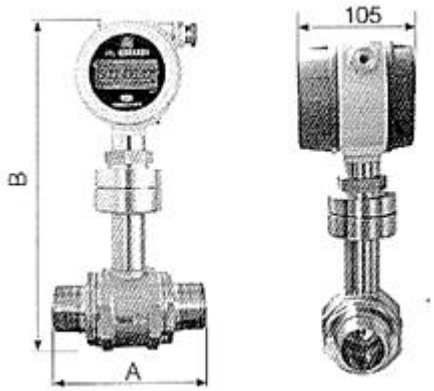
d. Jacket insulation type (heat conducting type) is suitable for applications in which preheating and thermal insulation, or process thermal insulation are required to eliminate media solidifying and crystallization during process flow. This type is normally used for viscous media such as modified asphalt and coal tar etc.

e. When media temperature in high temperature type flowmeter is >200℃, upside-down horizontal installation must be used for the instrument. For the purpose of design, sufficient installation space shall be considered.

f. In case media flow up-down or down-up, for ordering, please note: right view, left view (showing gauge head)

2) Pipe taper thread: connection thread system is 55°

Outline dimensions of pipe taper thread type



Nominal inside diameter		A	B
mm	in		
15	1/2″	120	240
20	3/4″	120	240
25	1″	120	240
32	11/2″	125	240
40	13/4″	125	255
50	2″	125	255
65		180	275
80	3	220	310

Notes:

a. Connection thread system can be made to user order;

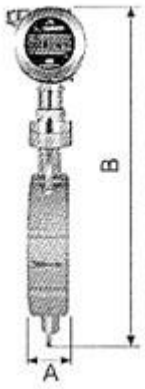
b. For dimensions A and B of high temperature type and temperature/pressure compensation type, ex-factory status (or order confirmation) shall govern;

c. For dimensions A and B of special order size, actual dimensions of instrument shall govern;

d. When media temperature of high temperature type flowmeter is >200℃, the instrument must be installed up-side-down and horizontal. The design shall consider sufficient mounting space;

f. When the media flow up-down or down-up, for the purpose of ordering, please note: right view, left view (showing gauge head).

3) Clamped mounting type:



Nominal inside diameter	Total width	Total height	Conventional product flange pressure	Remark
	A	B	Flange class (Mpa)	
DN15	54	245	1.6; 2.5; 4.0	Dimensions A and B are for reference. Ex-factory product shall govern.
DN20	54	255		
DN25	54	265		
DN32	54	290		
DN40	54	300		
DN50	54	315	2.5; 4.0	
DN65	85	335		
DN80	85	350		
DN100	85	385		
DN125	85	400		
DN150	85	450		
DN200	85	525	2.5	
DN250	85	600		
DN300	100	665		
DN350	100	730		
DN400	100	810		
DN450	100	835		
DN500	100	905		
DN550	100	955		
DN600	100	1040		

Notes:

a. Connection flange shall execute relevant technical requirements in state standard GB/T9115.1~9115.4-2000;

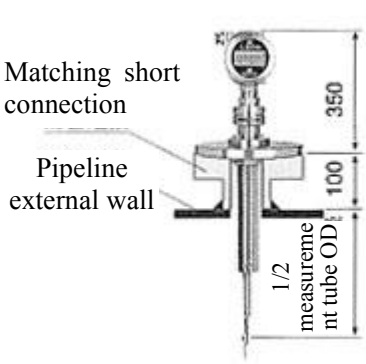
b. Dimensions A and B of special order and high/low temperature types, and temperature/pressure compensation types shall conform to dimensions of conventional products;

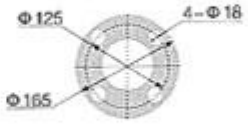
c. Standard flanges from other countries (Japanese standard, German standard and USA standard etc.) belong to special order;

d. When media temperature of high temperature type flowmeter is >200℃, the instrument must installed up-side-down and horizontally. The design shall consider sufficient mounting space;

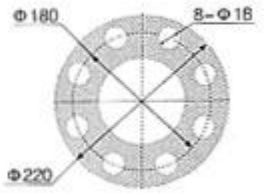
e. When media flow up-down or down-up, for ordering, please note: right view, left view (showing gauge head).

4) Inserted type





DN50 flanged short connection



DN100 flanged short connection

Description

(1) Description of flange

Short connection flange shall execute relevant technical requirements in state standard GB/T9115.1~9115.4-2000, or special standard such as American or European standard as required by user.

(2) Description of structure

a. For actual dimensions of high temperature or temperature/pressure compensation inserted type flowmeter, ex-factory (order) status shall govern.

b. When media temperature of high temperature type flowmeter is >200℃, the instrument must be installed up-side-down and horizontally. The design shall consider sufficient mounting space.

c. If the media flow up-down or down-up, for ordering, please note: right view, left view (showing gauge head).

In this design, only fixed inserted type is provided; if telescopic online removable type is required, particular size shall be determined with manufacturer.

5) Separate type

Separate type can be: flanged pipeline type, pipe taper thread type, clamped mounting type

and inserted type.

- In the separate type flowmeter, LCD display is changed to digitron display, instrument proper is separated from display part, and normal or screened multi-core cable is used for connection in between. Ex-factory standard configuration is 25m cable.
- Power supply normally directly adopts 220VAC or 24VDC power.
- This form of flowmeter is applicable to distance between instrument proper and display part not exceeding 100m and direct reading.
- For gauge head outline and dimensions, ex-factory products shall govern.
- Digitron instrument box of separate type flowmeter is of standard size. Refer to the figure below for its surface and mounting hole dimensions.

① Type I instrument box

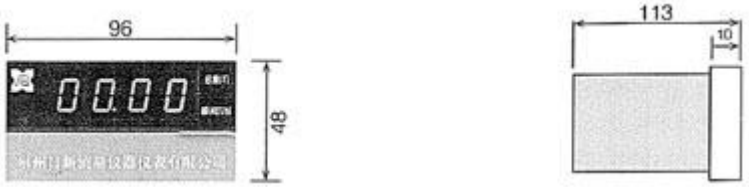


Fig.6.1 shows type I instrument box, which has single row 4-place digitron display. Display of instantaneous flow and total amount is alternate by pressing a button. For detailed method of operation, refer to product instructions manual supplied along with the instrument.

Instrument box mounting hole size is 91*45. Upon ex-factory, matching instrument box fixing screws are provided.

② Type II instrument box

Fig.6.2 shows type II instrument box, which has 2-row digitron display. The 8-place upper row shows accumulated total amount, while the 5-place lower row shows instantaneous flow. For detailed method of operation, refer to product instructions manual supplied along with the instrument.

Instrument box mounting hole size is 150*75. Upon ex-factory, matching instrument box fixing screws are provided.

VII. Instrument output and connection lines

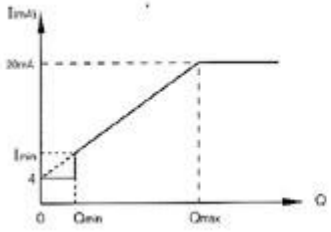
1) Instrument output form

- Current output: 4～20mA (2-wire system)
- Voltage output: 0～10V

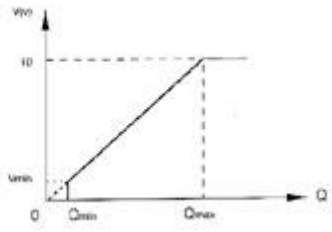
- Pulse input/voltage output: 0~2000HZ 1L/pulse 0.1L/pulse
- RS232/RS485 interface

When using RS232/RS485 interface, user can, according to command format provided by manufacturer, extract real time operating parameters (instantaneous flow, accumulated flow, operating pressure and operating temperature) as required.

2) Current and voltage output characteristics



4~20mA current output characteristics



0~10V voltage output characteristics

In above two figures, Imin and Vmin are output current and output voltage corresponding to minimum flow displayed by flowmeter respectively. Values of these outputs are:

a. 4~20mA output

$$I_D = \frac{FullRangeOutput - ZeroOutput}{FullRangeOutput} \cdot CurrentFlow + ZeroOutput$$

$$= \frac{20-4}{Q_m} \cdot Q_D + 4$$

Similarly, any output current in full range of output and corresponding flow can be calculated.

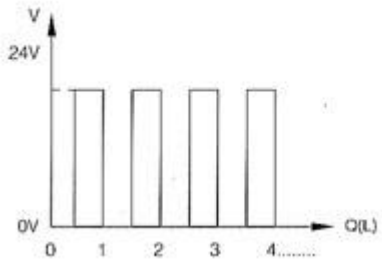
b. 0~10V output

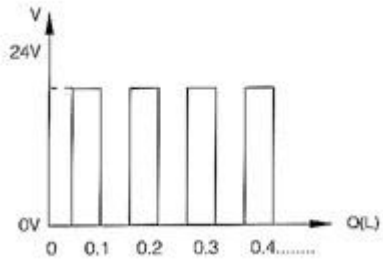
$$V_D = \frac{FullRangeOutput}{FullRangeFlow} \cdot CurrentFlow$$

$$= \frac{10}{Q_m} \cdot Q_D$$

Similarly, any output voltage in full range of output can corresponding flow can be calculated.

3) 0~2000Hz pulse output characteristics





1L/pulse output characteristics　　0.1L/pulse output characteristics

4) Power supply mode

- Online LCD display without output: built-in 3.6VDC Li battery
- Separate digitron display: external 220VAC or 24VDC power supply
- Online LCD with output: external 24VDC power supply

5) Output connection lines

- Flowmeter signal output line connection thread size is M20*15
- 4～20mA current output is of 2-wire system
- 0～10V voltage output is of 3-wire system
- Pulse output is of 3-wire system

For output line connection method and mode, refer to “Instruction manual” provided along with the product.

Signal output wire protection sheath and connection thread can be configured according to actual user requirement.

VIII. Flowmeter installation

1) Standard for flowmeter flange:

- Standard for flanges: GB/T9115.1~9115.4-2000 standard

Flanges meeting special requirements can be supplied to user demand.

2) Installation of normal temperature type flowmeter:

- Flowmeter is normally installed horizontally, with display part above pipeline. According to actual operating conditions, vertical and upside down installation can also be used.
- To ensure accurate metering by flowmeter, front and rear straight pipe segments are normally required. To ensure system operation not affected by inspection and replacement of flowmeter, bypass pipeline shall be provided as much as possible.

The installation is shown below:

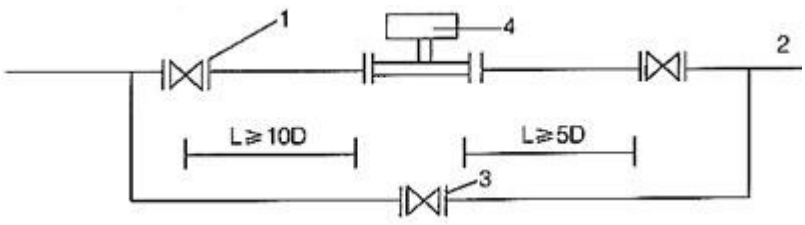


Fig.16

1·2·3 are front valve, rear valve and bypass valve respectively. 4 is the flowmeter. L≥10D and L≥5D are lengths of front and rear straight pipe segments respectively. If limited by installation conditions, these lengths can be reduced to L≥5D or L≥5D for front segment and L≥3D for rear segment, with D as pipeline nominal diameter.

3) Installation of high temperature type flowmeter

- For high temperature flowmeter of operating temperature lower than 200℃, the same installation mode as that of normal temperature flowmeter can be adopted.
- Flowmeter used for gas, liquid and steam etc. of operating temperature higher than 200℃ shall adopt upside-down installation.

Note: Upside-down means flowmeter display part (sensor part) below pipeline. This installation mode does not affect metering performance of flowmeter.

4) Other

- Vertical installation can be adopted due to need by process. Measured media can flow up-down or down-up, but this shall be described to supplier when ordering.
- Process dimensions of pipeline connected to flowmeter shall be the same as those of the flowmeter, so as to reduce resistance due to difference in this regard, resulting in interference to flow and error of metering.
- For installation of flange type and clamped mounting type flowmeter, note if inside diameter of sealing gasket between flanges is the same as that of flowmeter and process pipeline, and coaxial, so as to avoid interference affecting metering accuracy.
- For newly completed process pipeline, preliminary purging shall be carried out before flowmeter installation.
- The direction pointed by the arrow on external wall of measurement tube is the direction of flow of measured media.

5) Special warning

It is not permitted to directly install valve, elbow and other parts that will greatly change flow state at front or rear end of flowmeter measurement tube.

If it is required to install parts such as valve and elbow on pipeline before and after the flowmeter, lengths of front and rear straight segments of pipe.

IX. Flowmeter calibration

Two calibration forms can be adopted for TF flowmeter:

1) Actual flow calibration of standard device.

2) Dry calibration, i.e. poise hanging method.

When dry method is used for calibration, first use the following formula to calculate force F exerted on target plate at each flow point:

$$Q_V = a \bullet D(\frac{1}{\beta} - \beta) \bullet \sqrt{\frac{F}{\rho}}$$

In which: Q_V---instantaneous flow (m^3/h)

C---flow coefficient

D---flowmeter nominal diameter (mm)

F---force exerted by media on target (kg)

ρ---operating density of measured media (Kg/m^3)

In the above formula, coefficient C will be provided by manufacturer, and user can use formulae to calculate relation between instantaneous flow Q_V in instrument flow range and force F exerted by the media on the target, so as to calibrate the instrument. For detailed calibration method, refer to “Instructions manual” provided along with the product.

X. Precautions on type selection

TF target flowmeter with digital display is applicable to various situations and various media. In order to ensure satisfactory operation effect, the following are recommended for type selection:

1) Determine required normal flow and hence maximum flow as 1.5~2.5 times normal flow.

2) Clearly specify standard and sealing mode of mounting flanges, and especially special installation requirements.

3) When user places an order, describe measured media and provide media density.

4) If special media are measured, in addition to materials of measurement tube provided by us, you can directly recommend required measurement tube material.