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Part 1
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V1.0.5

Vortex Flow meters EMIS-VIHR 200 (EV-200)

EV-200 Modification

Operation manual

High accuracy

Accuracy does not depends on process parameters

Working under high pressure and temperature

Protection against water hammer

Simulation test

LED display with optical buttons

In-built self-check

USB connection

www.emis-meter.com

EMIS
Russia,
Chelyabinsk

EMIS flowmeters manufacturer

The present manual intended for learning the device operation, operating rules, maintenance and calibration of the vortex flow meters “EMIS-VORTEX 200 (EV-200)” (hereinafter referred to as “transducer, “flow meter”).

This operation manual contains general technical parameters, directions for usage, calibration, transportation and storage, and other information for accurate operation of the flow meterflow meter.

The design of the flow meterflow meter is constantly being improved, so the device you purchased may have minor differences from the descriptions in this document that do not affect the performance, technical characteristics and usability.

The list of documents referenced in this manual is given in the Appendix A.

CONTENTS

1 Description and operation

1.1 Intended use of the flow meter

1.1.1 Flow meter is designed for measuring flow and volume of liquids, gases (natural, associated petroleum gas, air, oxygen, etc), saturated and superheated vapour, corrosive mediums under working pressure and temperature, gas volume flow under N.C., and can be applied in different manufacturing spheres and as a part of heat, gas, steam metering systems.

Flow meters can be used as part of automatic control and monitoring systems and local automation schemes using a pulse frequency signal under GOST 26.010, current signal under GOST 26.011 and digital signal ModBus (RS485, USB) and HART.

1.1.2 By the measurement method, the flow meters are full bore. There are the following installation types:

- non-flanged, wafer type, code C (for Dn from 15 to 300mm) or C1 (for Dn from 15mm to 100mm)
- flanged, code F or F1, for 15mm to 300mm pipe size;
- flanged with integrated reducer, code FR or FR1, for 25mm to 100mm pipe size;

1.1.3 flow meter is designed for measuring flow and volume of medium corresponding the below parameters:

1) temperature range from -60ºC to +450ºC; temperature ranges and corresponding flow meter types are given in table 1.1 1.1**.** Medium temperature for version RV, RVI, RO, RO-RV from -40ºC to +450ºC.

Table1.1 – Temperature versions

Code	***Medium temperature, °C***	
	min	***max***
«85»	-60	+85
«100»	-60	+100
«135»	-60	+135
«200»	-60	+200
«250»	-60	+250
«300»	-60	+300
«320»	-60	+320
«350»	-60	+350
«450»	-60	+450

Flow meters of temperature versions 135-200 withstand short exposure to media up to 250ºC, temperature version 300 - up to 320ºC.

2) exessive pressure:

- max 25 MPa for C version;
- max 16 MPa for F1 version;
- max 6,3 MPa for C1, F, FR, FR1 versions;

3) solid particles shall not exceed 250 mg/m3 for gases and 1g/l for liquids;

4) gas inclusions in liquid shall not exceed 2,5% of the volume for 0,5% accuracy version and 4% for 1,5% and 1% accuracy flow meters. When the content of gas inclusions is up to 10% by volume, the total relative error does not exceed ± 5%; Full-bore flow meters can measure liquids with gas inclusions up to 15% by volume with ±6,5% error.

5) dynamic viscosity for liquids shall not exceed 7mPa*s;

6) measuring liquid shall not be corrosive to flow tubes.

1.1.4 General purpose flow meters shall be used in explosion proof environment.

Flow meter of explosion proof configuration Vn is intended for use in explosive environment with explosive mixtures of IIC type, and has explosion safety called "explosion proof enclosure" and 1Ex d IIC(T1-T6)Gb X marking.

Flow meter of explosion proof configuration ExV intended for use in explosive environment with explosive mixtures of IIB type, and has explosion protection called "intrinsically safe circuit" and 1Ex ib IIB(T1-T6) Gb X marking.

Flow meter of explosion proof configuration ExC intended for use in explosive environment with explosive mixtures of IIC type, and has explosion protection called "intrinsically safe circuit" and 1Ex ib IIC(T1-T6)Gb X marking.

Flow meter of explosion proof configuration ExiaV intended for use in explosive environment with explosive mixtures of IIB subtype, and has explosion protection called "intrinsically safe circuit", **1 Ex ia IIB (T1-T6) GbX** and **0 Ex ia IIB (T1-T6) GbX** marking.

Flow meter of explosion proof configuration ExiaC intended for use in explosive environment with explosive mixtures of IIC type, and has explosion protection called "intrinsically safe circuit", **1 Ex ia IIC (T1-T6) GbX** and **0 Ex ia IIC (T1-T6) GbX** marking.

Ex-proof flow meters RV are equipped with ex-proof casing and can be used in underground mines, pits and its gas- and dust-hazardous overground facilities.

Flow meter of explosion proof configuration RVI and RO-RV intended for underground use in mines, pits and related overground facilities hazardous with mine gas and combustible dust and is equipped with combined explosion protection "intrinsically safe circuit" and "explosion proof enclosure".

Flow meter of explosion proof configuration RO intended for underground use in mines, pits and related overground facilities hazardous with mine gas and combustible dust. This configuration has explosion protection called "intrinsically safe circuit".

Explosion proof configurations RV, RVI and RO-RV are supplied with ex-proof boxes. Marking of RV, RVI and RO-RV configurations are presented in 1.6 table 1.9.

Explosion proof safety aspects are described in the clause 1.3 Explosion protection.

1.1.5 Flow meter has IP66 protection (configurations RV, RVI, RO-RV) and IP66/68 under GOST 14254, and by protection conforms with standard configuration under GOST R 52931.

1.1.6 Flow meter is resistant to external magnetic field up to 400 A/m under GOST P 50648.

1.1.7 meters in the range from Qp to Qmax ***table 1.5***)are resistant to 10 -100 Hz vibration with acceleration not exceeding 4.9 m/s2 and refers to NX group underGOST R 52931.

meters in the range from Qp to Qmax resistant to 10 - 500 Hz vibration with acceleration up to 2G referring to F1 and F2 groups under GOST R 52931.can be produced by special order.

1.1.8 Flow meter refers to P1 type as classified in GOST R 52931 by air pressure resistance class in the range of 84 to 106,7 kPa.

1.1.9 By resistance to environmental factors the flow meters comply with NF, N, F climatic conditions and 1-4 device categories under GOST 15150.

Ambient temperature for all flow meters (except for mine configuration and two-wire connection “T” configuration) shall be in the range of -60°C to +70°C, humidity 95±3% non-condensing at +35°C.

For mine configurations RV, RVI and RO-RV ambient temperature shall be 0 to 55°C.

For two-wire connection “T” configuration ambient temperature shall be -40 to +70°C.

1.1.10 To place the order for EV-200 correctly please see symbols as listed in the table 1.2.***1***.

1.1.11 AST version flow meters are designed for operation when the content of hydrogen sulfide in the environment in normal mode does not exceed 10 mg / m3, in an emergency mode- up to 100 mg / m3 during 1 hour. The content of dissolved hydrogen sulfide in the liquid is up to 6% by volume.

1.1.12 Vd configuration include flow meters for hydrogen and hydrogen-bearing gases with hydrogen content from 4% of the volume.

Table 1.2.1 – EV-200 symbols

Code	***0***	***Item name***				
	EMIS-VIHR 200	Full-bore				
Code	***1***	***Explosion protection***				
	–	No ex-proof			**Vn**	1ExdIIC(T1-T6) Gb X
	ExB	1ExibIIB(T1-T6)Gb X[1]			**RV[1]**	tab.1.9
	ExC	1ExibIIC(T1-T6)GbX[1]			**RVI[1]**	tab.1.9
	ExiaB	1ExiaIIB(T1-T6)GbX[1] или 0ExiaIIB(T1-T6)GbX[1]			**RO[1]**	tab.1.9
	ExiaC	1ExiaIIC(T1-T6)GbX[1] или 0ExiaIIC(T1-T6)GbX[1]			**RO-RV[1]**	tab.1.9
Code	***2***	***Flow meter size (Pipe DN)***				
	015	15 mm	**065**	65 mm	**200**	200 mm
	025	25 mm	**080**	80 mm	**250**	250 mm
	032	32 mm	**100**	100 mm	**300**	300 mm
	040	40 mm	**125**	125 mm	**X**	special order
	050	50 mm	**150**	150 mm		
Code	***3***	Accuracy class ***(see. table 1.5)***				
	A0	Accuracy class A0			**B**	Accuracy class B
	AA	Accuracy class AA			**C**	Accuracy class C
	A	Accuracy class A				

Code	4	Flow range *(see. table 1.3)*				
	–	standard				
	L	Lower extended limit of flow range				
	H	Higher extended limit of flow range				
	HL	Higher and lower extended limits of flow range				
	X	special order				
Code	**5**	***Medium type***				
	L	liquid				
	G	gas/ saturated vapour/ superheated vapour				
	O	oxygen[6]				
	Hyd	Hydrogen/hydrogen-bearing gases[6]				
Code	**6**	***Flow tube material***				
	H	stainless steel by default (see table 1.6)				
	HH	steel 12X18H10T				
	X	special order				
Code	**7**	***Connection to pipeline***				
	C	wafer (Dn15-300mm))				
	C1	wafer (Dn 15-100mm) male-female connection under GOST 33259[2]				
	F	Flanged				
	F1	flanges with male-female connection under GOST 33259[2]				
	FR	flanged connection with reducers (Dn 25-100mm)				
	FR1	flanged connection with integrated reducers (Dn 25-100mm) male-female connection type under GOST 33259				
	X	special order				
Code	**8**	***Elctronic unit mounting***				
	–	integrated with sensor				
	R	nondetachable remote installation (3m cable length)				
	RD	Disconnectable remote installation (3m cable length)				
	Rxx (RDxx)	specify cable length for remote installation (up to 50m)				
Code	**9**	***Max pressure of medium***				
	1.6	up to 1.6 MPa	6.3	up to 6.3 MPa	20	up to 20 MPa
	2.5	up to 2.5 MPa	10	up to 10 MPa	25	up to 25 MPa
	4.0	up to 4.0 MPa	16	up to 16 MPa	X	special order
Code	**10**	***Max medium temperature***				
	85	Up to +85ºC	300	Up to +300ºC[3]		
	100	Up to +100ºC	320	Up to +320ºC[3]		
	135	Up to +135ºC	350	Up to +350ºC (for F, F1, FR versions with Dn≥40mm)[3]		
	200	Up to +200ºC	450	Up to +450ºC (for F, F1, FR versions with Dn≥40mm)[3]		
	250	Up to +250ºC	X	special order		
Code	**11**	***Display***				
	–	n/a				
	SIM	integrated display with mechanical keyboard[3]				
	SIO	integrated display with optical keyboard (except for ExiaV) [3]				
	SI	integrated display with magnet keyboard[4]				
	X	special order				
Code	**12**	***Electronic unit version (see table 1.7)***				
	B	extended				
	BB	With transmitter (except for ExV, ExC, ExiaV, ExiaC)				
	C	basic				
	T	2-wire connection (current loop)				

Code	13	Output signals[5]		
	–	pulse-frequency, digital ModBus		
	A	analog, pulse, digital ModBUS ***		
	A1	analog w/o additional error, pulse, ModBUS		
	A-H	analog, pulse, digital ModBUS, HART™ v6		
	A1-H1	analog w/o additional error, pulse, digital ModBUS, HART™ v6		
	A1-H2	analog w/o additional error, digital HART™ v7, 1st pulse-frequency with NAMUR, 2nd pulse-frequency		
	A1-H3	analog with NAMUR w/o additional error, digital HART™ v7, 1st pulse-frequency with NAMUR, 2nd pulse-frequency		
	X	special order		
Code	**14**	**Transmitter version**		
	–	Electronic unit with two cable glands		
	y	electronic unit with four cable glands (except for ex-proof versions RV, RVI, RO, RO-RV)		
Code	**15**	**Calibration**		
	–	manufacturer calibration at 5 points, pressure test		
	SC	state calibration		
Code	**16**	**Industrial versions**		
	–	standard version	**AST**	Containing hydrogen sulfide

Note: «–» for standard configuration;
[1] - except for special version of electronic unit;
[2] - for 10-25 MPa connected with oval gasket;
[3] - except for version with 2-wire connection;
[4] - for version with 2-wire connection only;
[5] - output signals application:
"-" - for version with 2-wire connection scheme;
A, A1, A-H, A1-H1 - except for standard version and version with 2-wire connection scheme;
A1-H2, A1-H3 - for version with 2-wire connection only;
[6] - special versions with the following parameters:
- Dn over 250 and higher;
- medium temperature higher than 100 °C;
- excessive pressure of medium higher than 2.5 MPa;

Example of EV-200 symbolic specification:

Code	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Order	EMIS-VIHR 200	ExB	050	A	–	L	H	F1	D2	2.5	250	SIO	C	A	–	SC	–

1.1.12 To place the order for mounting kit correctly please see symbols as listed in table 1.2.2

Table 1.2.2 - EV-200 mounting kit symbols

Code	0	Item name				
	EMIS-VIHR 200	Full-bore type mounting kit				
Code	**1**	**Flow meter size (Pipe DN)**				
	015	15 mm	**065**	65 mm	**200**	200 mm
	025	25 mm	**080**	80 mm	**250**	250 mm
	032	32 mm	**100**	100 mm	**300**	300 mm
	040	40 mm	**125**	125 mm		
	050	50 mm	**150**	150 mm		

Code	2	Connection to pipeline				
	C	wafer (Dn 15-300mm)				
	C1	wafer (Dn 15-100mm) connection male-female under GOST 33259 *				
	F	Flange				
	F1	flanges with male-female connection under GOST 33259*				
	FR	flanged connection with reducers (Dn 25-100mm)				
	FR1	flanged connection with integrated reducers (Dn 25-100mm) male-female connection type under GOST 33259				
	X	special order				
Code	**3**	**Max pressure of medium**				
	1.6	up to 1.6 MPa	6.3	up to 6.3 MPa	20	up to 20 MPa
	2.5	up to 2.5 MPa	10	up to 10 MPa	25	up to 25 MPa
	4.0	up to 4.0 MPa	16	up to 16 MPa	X	special order
Code	**4**	**Max medium temperature**				
	85	Up to +85ºC		300	Up to +300ºC	
	100	Up to +100ºC		320	Up to +320ºC	
	135	Up to +135ºC		350	Up to +350ºC	
	200	Up to +200ºC		450	Up to +450ºC	
	250	Up to +250ºC		X	special order	
Code	**5**	**Flange type**				
	01	flat welding				
	11	butt welding				
Code	**6**	**Flange material**				
	–	Steel 09Г2С		13ХФА	Steel 13ХФА	
	Ст20	Steel 20		X	special order	
	H	steel 12Х18Н10Т				
Code	**7**	**Flange standards**				
	–	version according to the Manual				
	ASME	ANSI / ASME standard				
	EN	EN1092-1 standard				
	X	special order				

Note: * - for 10-25 MPa connected with oval gasket

EV-200 symbolic specification

Code	0	1	2	3	4	5	6	7
Order	Mounting kit EMIS-VIHR 200	050	C1	2.5	100	11	H	–

1.2 Parameters

1.2.1 EV-200 minimum (Qmin) and maximum (Qmax) calibration flow rate of water and air are shown in the table 1.3. Calibration is performed at 20°C and zero pressure.

Table 1.3 – EV-200 flow measuring ranges

Flow meter size (DN), mm	Pipeline connection code	Temperature code for medium	Flow volume*, m3/h			
			Water		Air	
			Qmin	Qmax	Qmin	Qmax
15	C, F, C1, F1	85-250	0.5	5	4.5	32
		300, 320	0.5	5	7	32
25	FR, FR1	85-250	0.5	5	4.5	32
		300, 320	0.5	5	7	32
25	C, F, C1, F1	85-250	0,6 (0,4)	16	8	120
		300, 320	0.6	16	12.5	120
32	FR, FR1	85-250	0,6 (0,4)	16	8	120
		300, 320	0.6	16	12.5	120
32	C, F, C1, F1	85-250	0,8 (0,6)	26	10	200
		300, 320	0.8	26	13	200
40	C, F, C1, F1	85-250	1,4 (1)	41	12	310
		300, 320	1.4	41	20	310
		350, 450	3.4	41	31	310
50	FR, FR1	85-250	0,8 (0,6)	26	10	200
		300, 320	0.8	26	13	200
50	C, F, C1, F1	85-250	2 (1,4)	64	18 (14)	480
		300, 320	2	64	30	480
		350, 450	5.3	64	48	480
65	C, F, C1, F1	85-250	3 (2,6)	107	33 (24)	810
		300, 320	3	107	55	810
		350, 450	9	108	81	810
80	FR, FR1	85-250	2 (1,4)	64	18 (14)	480
		300, 320	2	64	30	480
80	C, F, C1, F1	85-250	4,6 (4)	160	53 (36)	1230 (1600)
		300, 320	4.6	160	60	1230
		350, 450	13	160	123	1230
100	FR, FR1	85-250	4,6 (4)	160	53 (45)	1230
		300, 320	4.6	160	60	1230

1.3 continued

Flow meter size (DN), mm	Pipeline connection code	Temperature code for medium	Flow volume*, m3/h			
			Water		Air	
			Qmin	Qmax	Qmin	Qmax
100	**C, F, C1, F1**	85-250	8 (6)	250	80 (60)	1920 (2500)
		300, 320	8	250	90	1920
		350, 450	21	250	192	1920
125	**S, F, F1**	85-250	13 (10)	400	130 (90)	3000
		300, 320	13	400	130	3000
		350, 450	33	390	290	2900
150	**S, F, F1**	85-250	18 (14)	575	190 (130)	4325 (5000)
		300, 320	18	575	190	4325
		350, 450	47	560	420	4200
200	**S, F, F1**	85-250	34 (26)	1060	320 (235)	8000
		300, 320	34	1060	330	8000
		350, 450	90	1080	810	8100
250	**S, F, F1**	85-250	60 (42)	1700	470 (380)	12900
		300, 320	60	1700	500	12900
		350, 450	142	1670	1260	12600
300	**S, F, F1**	85-250	95 (60)	2460	680 (550)	18600
		300, 320	95	2460	800	18600
		350, 450	200	2400	1820	18200

Note:

*1. * As special order for temperature configurations under +250°C, we can produce flow meter with extended flow range. Both lower and upper limits can be extended. Extended range is indicated in brackets. It shall be specified in order sheet by placing H for extended higher limit or L for extended lower limit after Dn and accuracy class (e.g. 080-Б-Н means flow meter of Dn80mm with B accuracy class and extended higher limit of flow range).*

2. Flow ranges for other mediums depend on medium density, viscosity, pressure, temperature and can be defined based on data sheet filled in by a customer.

1.2.2 Qmin and Qmax for gas mediums under working conditions are calculated as follows:

$$\mathbf{Qmin = max\ (Qmin * \sqrt{K1/\rho}\ } \textit{or}\ \mathbf{Vmin * \pi * d^2 / 4*0{,}0036)},\ m^3/h \qquad (1.1)$$

$$\mathbf{Qmin = min\ (Qmax * \sqrt{K2/\rho}\ } \textit{or}\ \mathbf{Qmsx)},\ m^3/h, \qquad (1.2)$$

Where Qmin and Qmax are the max and min flow according to the table 1.3*;*
ρ – air density under working conditions kg/cbm;
d - inner diameter of flow body (at the point of flow meter installation), mm (see fig.C.1 - C.10 ***Appendix B***);
Vmin - min flow velocity, m/s (see table1.4);
K1, K2 - empirical coefficients (see table 1.4).

Table 1.4 - Coefficients for gas flow range calculation under working conditions

Flow meter size (DN), mm	Coefficient K1	Coefficient K2	Min velocity Vmin, m/s		
			Medium temperature code		
			85-250	300, 320	350, 450
15 or 25-FR1	1.2	47.4	2	3	-
other	1.2	26	1,5 (1,3*)	2	3

*Note: * Min velocity for extended range is shown in brackets.*

Measurement error for the flows over stated range as shown in the table 1.3 is not rated.

1.2.3 Flow meter shall be selected according to the flow under working conditions. If gas flow is given under N.C. Nm3 / h in order sheet then it shall be recalculated for operating conditions.

1.2.4 Relative accuracy for volume and volume flow rate measured at frequency, pulse and digital outputs and current signal for versions A1, H1, H2, H3 depending on flow meter accuracy class is shown in Table 1.5.

Table 1.7 1.5 – Accuracy limits

Medium type	Accuracy limits for accuracy classes, %										Transition flow Qt
	Qt ≤ Q ≤ Qmax					Qmin ≤ Q ≤ Qt					
	AA	A0	A	B	B	AA	A0	A	B	B	
Liquid	–	± 0,5	± 0,5	± 1,0	± 1,5	–	± 0,5	± 1,0	± 1,5	± 2,5	0,06·Qmax *
Gas and vapour	± 0,7	± 1,0	± 1,0	± 1,5	± 2,0	± 1,0	± 1,0	± 2,0	± 2,5	± 3,5	0,1·Qmax *

*Note: * Transition flow for flow meters of DN-15mm or Dn25FR(FR1) Qt = 0,6 cbm/h for liquid and 8 cbm/h for gas and vapour. For DN=25mm or Dn32FR(FR1) Qt = 15 cbm/h for gas and vapour.*

1.2.5 Relative accuracy limits of the flow measured at current output for version A and A-H does not exceed

$$\delta_{QI} = \pm [|\delta| + 0{,}2 * Imax/(4+16 * Q/Qmax)], \% \quad (1.3)$$

where δ – permissible error according to ***table*** 1.5, %;
Imax - 20mA - max current value in the loop;
Q - flow, cbm/h;
Qmax - max flow referring to 20mA at current output as specified in flow meter data sheet, cbm/h.

1.2.6 Permissible relative error limits for medium temperature measurement of flow meter with BB version transmitter.

$$\delta_B(t) = \pm\left(\frac{1+0{,}0025\cdot|t_{изм}|}{t_{изм}+273{,}15}\right)100\%, \quad (1.4)$$

Where t_m - current value of medium temperature, °C.

1.2.7 Permissible relative error limits for medium temperature measuring channel of flow meter with BB version transmitter.

$$\delta(t) = \pm\sqrt{\delta_П(t)^2 + \delta_B(t)^2}, \quad (1.5)$$

where $\delta_П(t)$ – relative error of external temperature gauge of AA, A and B classes under GOST 6651-2009, %

1.2.8 Permissible relative error limits for medium pressure measurement of flow meter with BB version transmitter under ambient temperature of 20°C

$$\delta_B(P) = \pm 0{,}05\frac{P_{max}}{P_{min}}, \quad (1.6)$$

Where Pmax - upper stated limit of pressure measurement, MPa;
Pmin - lower limit of pressure measuring channel, MPa.

Additional reduced error related to ambient temperature deviation from 20°C: ±0,1 % for each 10°C.

1.2.9 Permissible relative error limits for medium pressure measuring channel of flow meter with BB version transmitter.

$$\delta(P) = \pm\sqrt{\delta_П(P)^2 + \delta_B(P)^2}, \quad (1.7)$$

where $\delta_П(P)$ – relative error of external pressure sensor, %

1.2.10 Relative permissible error of gas volume flow under NC, mass flow of gas, liquid, saturated and superheated vapour for flow meter with BB transmitter version.

$$\delta_B(V, M) = \pm 0{,}2\ \%.$$

1.2.11 Relative permissible error of measuring channel for gas volume flow under NC and adjusted for compressibility factor, mass flow of gas and vapour for flow meter with BB transmitter version.

$$\delta(V,M) = \pm\sqrt{\delta_B(V,M)^2 + \delta(t)^2 + \delta(P)^2 + \delta^2}, \quad (1.8)$$

where δ – relative accuracy for volume and volume flow rate measured at frequency, pulse and digital outputs (presented in the table 1.7), %

1.2.12 Permissible relative error limits for saturated vapour mass flow measuring channel of flow meter with BB version transmitter, $\delta(V,M)$, %:

- saturated vapour pressure measurement

$$\delta(V,M) = \pm\sqrt{\delta_B(V,M)^2 + \delta(P)^2 + \delta^2}, \quad (1.9)$$

- saturated vapour temperature measurement

$$\delta(V,M) = \pm\sqrt{\delta_B(V,M)^2 + \delta(t)^2 + \delta^2}. \quad (1.10)$$

1.2.14 Permissible relative error limits for mass flow measuring channel of flow meter with BB version transmitter

$$\delta(V,M) = \pm\sqrt{\delta_B(V,M)^2 + \delta(t)^2 + \delta^2}. \quad (1.11)$$

1.2.15 Flow meter refers to repairable, single-order devices of II group I type as defined in GOST 27.003.

1.2.16 Dimensions, connection sizes and weight of flow meter are shown in в ***Appendix*** C.

1.2.17 Pressure drop depends on measuring medium, flow meter size and flow speed. Calculation formula is shown in 2.1.4.

1.2.18 Flow meter reliability parameters:

- mean time before failure shall not be less than 75000 hours and depends on maintenance as specified in the manual;
- standard deviation of failures not less than 0.15;
- failure rate is normal (Gaussian law)
- mean time to recover for repaired transmitter shall not exceeds 3 hours;
- service life is 15 years.

Transmitter failure means its non-compliance with 1.2.4 requirements.

1.2.19. Materials for process-wetted elements of the flow meter are specified in the table 1.6.

1.2.20 Detailed information about work, operation, mounting, connection and adjustment of the electronic unit is presented in the “Vortex flow meter electronic unit” manual in compliance with the table 1.7.

Table 1.6 - List of materials

Version	Dn, mm	Pressure, MPa	Tmeas., °C	Material code	Material			
					Flow tube	Bluff body	Sensing element	Gasket of sensing element*
C, F, FR	All	1.6-6.3	≤ 320	H	AISI 304	AISI 304	AISI 304	Fluorine plastic, graflex
C	15-50	10-25	≤ 320	H	20X13	12X18H10T	Titanium BT1-0	Copper, titanium
C	65-300	10-25	≤ 320	H	20X13	20X13	Titanium BT1-0	Copper, titanium
F, F1	40-300	1.6-6.3	350, 450	H	12X18H10T	12X18H10T	EP202	Titanium
C1, F1, FR1	15-50	1.6-6.3	≤ 320	H	20X13	12X18H10T	Titanium BT1-0	Copper, titanium
C1, F1, FR1	65-100	1.6-6.3	≤ 320	H	20X13	20X13	Titanium BT1-0	Copper, titanium
F1	125-300	1.6-6.3	≤ 320	H	12X18H10T	12X18H10T	Titanium BT1-0	Copper, titanium
F1	15-100	10-16	≤ 320	H	20X13	12X18H10T	Titanium BT1-0	Copper, titanium

F1	125-300	10-16	≤ 320	H	12X18H10T	12X18H10T	Titanium BT1-0	Copper, titanium
All	All	All	All	HH	12X18H10T	12X18H10T	Titanium BT1-0	Copper, titanium

Note:
1 Graphite gaskets used for Tmeas up to +320°C, copper gaskets up to +250°C, titanium gaskets up to +320°C and +higher;*
2 Paronite,TEG or steel gaskets are used to seal the flow meter and pipeline flanges.
3 flow meter parts can be made of other materials upon the agreement with the customer;
4 The flow tube and the bluff body of the AST version are made of 12X18H10T steel, the gasket of sensing element is made of titanium, electronic boards are additionally coated with AK-113 varnish.

Таблица 1.7 – List of Operation manuals for electronic units

Document code	***Name***
EV-200.000.000.002.01OM	Electronic unit of vortex flow meter EMIS-VIHR 200 (EV-200) (extended version, version with computer)
EV-200.000.000.002.02OM	Electronic unit of vortex flow meter EMIS-VIHR 200 (EV-200) (standard version)
EV-200.000.000.002.03OM	Electronic unit of vortex flow meter EMIS-VIHR 200 (EV-200) (extended version, 2-wire version)

1.3 Explosion protection

1.3.1. Ex-proof transmitters Vn have "explosion proof enclosure" under GOST IEC 60079-1-2011, used for explosive environments of IIC group and marked as 1 Ex d IIC (T1-T6) Gb X.

Vn versions can be equipped with combined explosion protection upon the agreement with the customer.

Electrical parts of the flow meter are enclosed into explosion-proof casing which bears explosion pressure and help to avoid explosion transfer into the flammable environment. The explosion resistance and explosion-proofness of the flow meter enclosure comply with the requirements for electrical equipment of Group I and IIC subgroup according to GOST IEC 60079-1-2011.

Explosion safety of ex-proof enclosure is ensured by the following:

- axial length of the thread and the number of complete turns in the engagement of the threaded flameproof joints shall comply with the requirement of GOST IEC 60079-1-2013;
- tolerances and length of the planar and cylindrical explosion-proof joints comply with the GOST IEC 60079-1-2013;
- mechanical rigidity of transmitter casing comply with GOST 31610.0-2014 requirements for electrical equipment of group I and II with high risk of mechanical damage.
- inspection window is sealed inside the metal rim of the casing cover to provide integrity;
- max temperature of surface heating under operating conditions shall not exceed the values specified in GOST 31610.0-2014 (IEC 60079-0:2011).for specific temperature classes.

Explosion protection elements drawing is shown in ***Appendix E***.

"X" mark of ex-proof indicates specific operation conditions as described below:

- medium temperature shall not exceed specified value as marked in the ex-proof marking for this specific temperature class;
- max excessive pressure of the measuring medium shall not exceed the limit rated in the datasheet;

Transmitters of Vn configuration shall be equipped with certified ex-proof cable glands and ex-proof plugs complying with "d" explosion protection type of IIC subgroup, ambient temperature range and ingress protection IP66/IP68. Selection of cable glands shall be according to GOST IEC 60079-1-2011.

- painted transmitters can be the source of ESD. Wipe only with wet or antistatic cloth;
- disconnect before open;
- use shielded cables to connect flow meter body with distant type transmitter;

1.3.2 Ex-proof flow meters of ExB, ExC, ExiaB, ExiaC types are equipped with "intrinsically safe circuit"'of "ib" / "ia" level under GOST 31610.11-2014 (IEC 60079-11:2014), intended for environments with ignitable mixtures of IIC and IIB groups and designed as ex-proof with “1 Ex ib IIB (T1-T6) Gb X”, “1 Ex ib IIC (T1-T6) Gb X”, “1 Ex ia IIB (T1-T6) Gb X”, “0 Ex ia IIB (T1-T6) Gb X”, “1 Ex ia IIC (T1-T6) Gb X”, “0 Ex ia IIC (T1-T6) Gb X” marking.

Intrinsic safety of "ib" protection level is provided by the following;

- electric load of intrinsic circuit elements shall not exceed 2/3 of specified values under normal and emergency operation.
- clearance, leakage path and electrical endurance of isolation comply with GOST 31610.11-2014;

- three diodes are installed in series in the supply circuit to prevent the input capacitance from discharging into the supply line and to protect against polarity reversal. Three bypass Zener diodes are installed in the power supply circuit;

internal capacity and inductance of the flow meter circuit do not accumulate energy, explosive gas mixtures of IIB or IIC groups;

- current- carrying connections and electronic components are protected against environmental exposure with IP66/IP68 enclosure complying with GOST 14254.

"X" mark of ex-proof indicates specific operation conditions for version s**ExB, ExC, ExiaB, ExiaC** as described below:

- medium temperature shall not exceed specified value as marked in the ex-proof marking for this specific temperature class;

- max excessive pressure of the measuring medium shall not exceed the limit rated in the datasheet;

- for ExB, ExC, ExiaB, ExiaC flow meters, connection of external devices to digital, pulse, current outputs shall be provided via intrinsically safe Zener barrier complying with parameters under GOST 31610.11-2014 (IEC 60079-11:2014) for ignitable gas mixtures of IIB or IIC classes and certified under TR TS 012/2011. Parameters of Zener barriers shall comply with safety parameters of the flow meter.

- painted transmitters can be the source of ESD. Wipe only with wet or antistatic cloth;

- disconnect before open the cover lid;

- use heat-resistant cables to connect flow meter body with distant type transmitter;

- avoid friction and hits on the electronic unit made of aluminum alloy if flow meters located in 0 zone.

1.3.3 Ex-proof flow meters of RV version have ex-proof enclosure under GOST IEC 60079-1-2011. Ex-proof flow meters of RO version have intrinsically safe circuit of ib/ia level under GOST 31610.11-2014 (IEC 60079-11:2014). Explosion proof flow meters of RVI, RO-RV configurations have "intrinsically safe circuit" of "ib" / "ia" level under GOST 31610.11-2014 (IEC 60079-11:2014) and ex-proof enclosure under GOST IEC 60079-1-2011.

Explosion protection of RV, RVI, RO types is provided by using explosion-proof boxes, while the electronic unit of the flow meter is placed in the box of the corresponding configuration. Ex-proof configuration RV is consisted of electronic unit, main terminal box and flow meter body. Ex-proof configuration RVI, RO is consisted of electronic unit, additional terminal box and flow meter body. Ex-proof configuration RO-RV is consisted of electronic unit, main and additional terminal boxes and flow meter body.

"X" mark of ex-proof marking indicates specific operation conditions (mine version):

- during operation it is necessary to take measures of protection against overheating of the electronic unit (due to heat transfer from the medium) above 150°C;

- use certified ex-proof terminal boxes to connect the cable to the electronic unit;

- the explosion protection is valid for the medium pressure below the maximum level rated in the datasheet;

- use shielded cables to connect the flow meter body with the electronic unit;

- RV, RVI, RO, RO-RV flow meters can be operated in underground mines, pits while there is no coal dust;

- RV, RVI, RO, RO-RV with medium temperature code “100” can be operated in mines, pits hazardous with coal dust;

- connection of external devices to intrinsically safe circuits of RVI, RO, RO-RV configuration flow meters shall be provided via certified Zener barrier complying with parameters under GOST 31610.11-2014 (IEC 60079-11:2014) and certified under TR TS 012/2011. Parameters of Zener barriers shall comply with safety parameters of the flow meter.

1.3.4 Main ex-proof terminal box for connection of intrinsically safe circuits - supply circuit; signal circuit of pressure Gauge; signal circuit of resistance thermal converter; circuit of primary flow meter (for RV configuration).

Additional ex-proof terminal box for connection of intrinsically safe circuits - input circuit of EV200 flow meter; output circuit of RS485.

General view of the terminal boxes is presented in Appendix C.

1.3.5 Description of protection elements for intrinsically safe circuit protection type is presented in the Vortex flow meter Operation Manual (see table 1.7).

1.3.6 Ground terminal is marked with engraved earth sign. Removable cover of flow meter has the following warning sign: "Disconnect before open".

1.3.7 Ex-proof configuration has ex-proof marking plate. Plate description is shown in 1.6 Marking and sealing

1.4 Flow meter parts

1.4.1 Supply scope is presented in the table 1.8.

Table 1.8 – Standard supply scope

No	Name	Amount	Note
1	Vortex flow meter EMIS-VIHR 200	1	As ordered
2	Data sheet ЭВ-200.000.000.000.00 PS	1	For EV-200 versions
3	Operation manual EV-200.000.000.000.000OM	1	For flow meter
4	Operation manual EV-200.000.000.000.002OM	1	For electronic unit (special order)*
5	Calibration method ЭВ-200.000.000.000.00 СМ	1	For batch**
6	Mounting kit with data sheet	1	Upon request
7	Magnet handle	1	For 2-wire configuration “T” with indicator
8	Interface converter EMIS-SYSTEMA 750 RS-485/USB	1	Upon request
9	Testing cables	1	Upon request
10	Power supply unit	1	Upon request
11	Packing case	1	
12	Installation fitting	1	Upon request
13	Flow conditioner EMIS-VECTA 1200 with flanges	1	Upon request
14	Spare parts kit, tools and accessories	1	Upon request
15	Certificate for flanges, fixtures, gaskets	1	Upon request
16	Ex-proof case of PB type.	1	RV, RO, RVI version
17	Pressure and/or temperature gauges	1	As special order with “VV” computer
18	flow meter certificates	***	Upon request

Note:
1. Installation kit contains 2 flanges, 2 gaskets and fasteners. Flanges are not included in the orders supplied with run sections.
2. * Depends on Electronic unit version *(see. table 1.7).*
*3. ** If other amount is not specified in the supply agreement.*
*4. ***List of certificates (supplied upon request):*
Measuring instruments type approval certificate with type description;
- TR TS certificate 012/2011 on "The safety of equipment in explosion hazardous environments" with EX-proof enclosure;
- Declaration of Conformity TR TS 032/2013 on "The Safety of equipment working under excessive pressure"
- TR TS certificate 032/2013 on "The Safety of equipment working under excessive pressure"
- TR TS certificate 020/2011 on "Electromagnetic compatibility"

1.4.2 Mounting kit is supplied upon request. Mounting kit is shown in the Appendix D.

1.4.3 Spare parts kit, tools and accessories is supplied upon request. Spare parts kit includes cable glands, flange gaskets and fasteners for flanges mounting (depends on flow meter configuration). Other accessories can be included according to customer needs.

1.5 Configuration and operation

1.5.1 Structure and Operation Principle

Full-bore transmitter (see fig.1.1) consists of the flow tube (1) and electronic transmitter unit (2). Flow tube is a hollow cylinder with bluff body installed in cross-sectional area. Sensor (3) is installed behind the bluff body (4). Electronic unit (2) is installed on the flow meter body using support bar (5). Electronic boards are installed inside the transmitter.

flow meter measures the flow by detecting vortices frequency. Bluff body installed inside the flow tube which causes the formation of vortices in the incoming flow of the medium. Vortices spread along and behind

each side of the bluff body. The frequency of vortex shedding is proportional to flow velocity, and consequently proportional to volume flow of measured medium.

Vortices cause pressure fluctuation along each side of the sensing element. Pressure fluctuation is transmitted to piezoelectric cell. Piezoelectric cell transforms fluctuation into electrical signals. Transmitter forms output signals after amplification, filtration, transformation and digital processing of the signal.

In transmitters of “350” and "450" temperature configurations, two pressure pulsation detectors are installed behind the bluff body with no interruption into the flow tube. These detectors are equipped with piezoelectric cells which transform pressure pulsation into electrical signals.

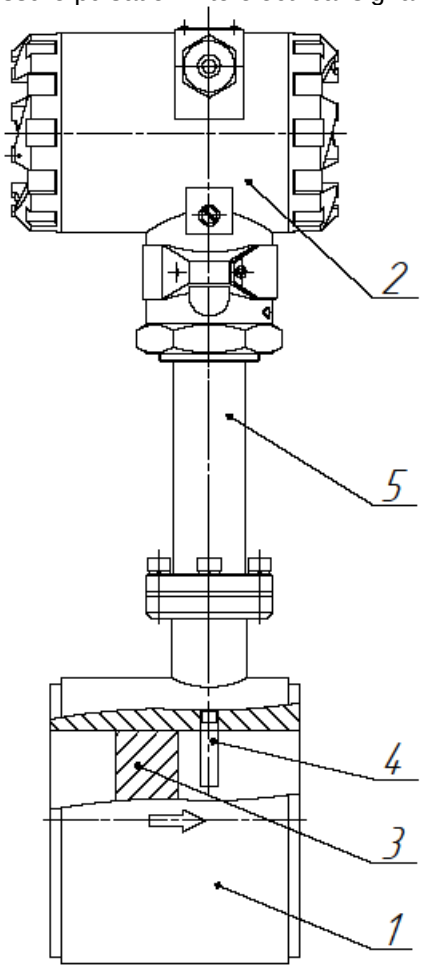


Fig.1.1 - flow meter structure

1.5.2 Flow meter size selection Flow meter selection is performed using specially designed calculator "EMIS Selector" based on the data provided by a customer. Please consider the following when choosing the flow meter:

1. 1. Inner diameter of flow meter (nominal diameter) shall be selected depending on flow velocity which causes vortices shedding of necessary power. If flow tubes diameter of selected flow meter does not match pipeline diameter use pipe reducer or FR configuration.

2. 2. Medium flow parameters specified by a customer shall comply with real operation parameters. Pressure, temperature, density, viscosity, operational flow ranges are essential for flow meter selection. If customer sheet is filled in according to real operational medium parameters the flow meter selection based on manufacturer calculation will provide permanent measurement accuracy for the whole flow range.

3. Pipeline diameter and straight run length before and after the flow meter shall comply with recommendation specified in 2.2.2.

4. Hydraulic pressure losses occurred in the flow meter shall be taken into account when calculating general hydraulic losses for the pipeline (equation is shown in 2.1.4). Flow velocity increase leads to greater pressure losses in quadratic dependence and may lead to cavitation under specific parameters. The size of the flow meter shall be selected so that the real flow rate is in the second third of the full range to provide necessary accuracy, eliminate pressure losses and avoid cavitation.

5. Provide counter pressure after the flow meter to avoid cavitation of liquids which leads to severe errors in measurement (calculation formula for counter pressure is shown in. 2.1.5).

1.6 Marks and seals

1.6.1 Marking

1.6.1.1 Marking plate placed on the electronic unit contains the following signs and notes according to GOST 12971:

- Instrument approval mark as per PR 50.2.104.
- serial number and date of manufacture;
- flow meter code;
- nominal diameter;
- max working pressure, MPa;
- medium temperature, °C;
- max. flow;
- output signals;
- ingress protection.

For RV, RVI, RO configurations and flow meters with four cable glands, the plate also contains ex-proof marking and electrical circuit parameters.

Marking of RV, RVI and RO-RV configurations are presented in the table 1.9.

Table 1.9 - Explosion protection marks for RV, RVI, RO, RO-RV configurations

Version	Ex-proof marking	Ambient temperature range, °C
Main terminal box		
RV	RV Ex d I Mb X	$0 \le t_a \le +55$ºC
RVI	RV Ex ib I Mb X	$0 \le t_a \le +55$ºC
RO	RO Ex ia I Ma X	$0 \le t_a \le +55$ºC
RO-RV	RV Ex d I Mb X	$0 \le t_a \le +55$ºC
Additional terminal box		
RV	-	-
RVI	-	-
RO	-	-
RO-RV	RO Ex ia I Ma X	$0 \le t_a \le +55$ºC
Flow tube		
PB	RV Ex d I Mb X	$0 \le t_a \le +70$ºC
RVI	RV Ex ib I Mb X	$0 \le t_a \le +70$ºC
PO	RO Ex ia I Ma X	$0 \le t_a \le +70$ºC
RO-RV	RV Ex d I Mb X[1] RO Ex ia I Ma X[2]	$0 \le t_a \le +70$ºC
Transmitter		
RV	RV Ex d I Mb X	$0 \le t_a \le +55$ºC
RVI	RV Ex d [ib] I Mb X	$0 \le t_a \le +55$ºC
RO	RO Ex ia I Ma X	$0 \le t_a \le +55$ºC
RO-RV	RV Ex d[ia] I Mb X	$0 \le t_a \le +55$ºC

Note:
[1] connection to main terminal box;
[2] connection to additional terminal box;

1.6.1.2 General purpose industrial versions, except for oxygen applications, have separate plate with indicated ambient temperature ranges and caution sign: "Do not use in explosive environments".

1.6.1.3 Ex-proof configurations with two cable glands have separate plate with ex-proof marking and electrical circuit parameters.

Vn configurations with explosion protection “ex-proof enclosure”:
- 1 Ex d IIC T6 Gb X, - 60 ≤ t_a ≤ + 70ºC for temperature configuration “85”;
- 1 Ex d IIC T5 Gb X, - 60 ≤ t_a ≤ + 70ºC for temperature configuration “100”;
- 1 Ex d IIC T4 Gb X, - 60 ≤ t_a ≤ + 70ºC for temperature configuration “135”;
- 1 Ex d IIC T3 Gb X, - 60 ≤ t_a ≤ + 70ºC for temperature configuration “200”;
- 1 Ex d IIC T2 Gb X, - 60 ≤ t_a ≤ + 70ºC for temperature configurations “250” ,“350”;
- 1 Ex d IIC T1 Gb X, - 60 ≤ t_a ≤ + 70ºC for temperature configuration ”320” , “350”, “450”;

ExV configuration:
- 1 Ex ib IIB T6 Gb X, - 60 ≤ t_a ≤ + 70ºC for temperature configuration “85”;
- 1 Ex ib IIB T5 Gb X, - 60 ≤ t_a ≤ + 70ºC for temperature configuration “100”;
- 1 Ex ib IIB T4 Gb X, - 60 ≤ t_a ≤ + 70ºC for temperature configuration “135”;
- 1 Ex ib IIB T3 Gb X, - 60 ≤ t_a ≤ + 70ºC for temperature configuration “200”;
- 1 Ex ib IIB T2 Gb X, - 60 ≤ t_a ≤ + 70ºC for temperature configurations “250” ,“300”;
- 1 Ex ib IIB T1 Gb X, - 60 ≤ t_a ≤ + 70ºC for temperature configuration ”320” , “350”, “450”;

ExC configuration:
- 1 Ex ib IIC T6 Gb X, - 60 ≤ t_a ≤ + 70ºC for temperature configuration “85”;
- 1 Ex ib IIC T5 Gb X, - 60 ≤ t_a ≤ + 70ºC for temperature configuration “100”;
- 1 Ex ib IIC T4 Gb X, - 60 ≤ t_a ≤ + 70ºC for temperature configuration “135”;
- 1 Ex ib IIC T3 Gb X, - 60 ≤ t_a ≤ + 70ºC for temperature configuration “200”;
- 1 Ex ib IIC T2 Gb X, - 60 ≤ t_a ≤ + 70ºC for temperature configurations “250” ,“300”;
- 1 Ex ib IIC T1 Gb X, - 60 ≤ t_a ≤ + 70ºC for temperature configuration ”320” , “350”, “450”;

ExiaB configuration:
- 1 Ex ia IIB T6 Gb X, - 60 ≤ t_a ≤ + 70ºC for temperature configuration “85”;
- 1 Ex ia IIB T5 Gb X, - 60 ≤ t_a ≤ + 70ºC for temperature configuration “100”;
- 1 Ex ia IIB T4 Gb X, - 60 ≤ t_a ≤ + 70ºC for temperature configuration “135”;
- 1 Ex ia IIB T3 Gb X, - 60 ≤ t_a ≤ + 70ºC for temperature configuration “200”;
- 1 Ex ia IIB T2 Gb X, - 60 ≤ t_a ≤ + 70ºC for temperature configurations “250” ,“300”;
- 1 Ex ia IIB T1 Gb X, - 60 ≤ t_a ≤ + 70ºC for temperature configuration ”320” , “350”, “450”;

- 0 Ex ia IIB T6 Gb X, - 60 ≤ t_a ≤ + 70ºC for temperature configuration “85”;
- 0 Ex ia IIB T5 Gb X, - 60 ≤ t_a ≤ + 70ºC for temperature configuration “100”;
- 0 Ex ia IIB T4 Gb X, - 60 ≤ t_a ≤ + 70ºC for temperature configuration “135”;
- 0 Ex ia IIB T3 Gb X, - 60 ≤ t_a ≤ + 70ºC for temperature configuration “200”;
- 0 Ex ia IIB T2 Gb X, - 60 ≤ t_a ≤ + 70ºC for temperature configurations “250” ,“300”;
- 0 Ex ia IIB T1 Gb X, - 60 ≤ t_a ≤ + 70ºC for temperature configuration ”320” , “350”, “450”;

ExiaC configuration:
- 1 Ex ia IIC T6 Gb X, - 60 ≤ t_a ≤ + 70ºC for temperature configuration “85”;
- 1 Ex ia IIC T5 Gb X, - 60 ≤ t_a ≤ + 70ºC for temperature configuration “100”;
- 1 Ex ia IIC T4 Gb X, - 60 ≤ t_a ≤ + 70ºC for temperature configuration “135”;
- 1 Ex ia IIC T3 Gb X, - 60 ≤ t_a ≤ + 70ºC for temperature configuration “200”;
- 1 Ex ia IIC T2 Gb X, - 60 ≤ t_a ≤ + 70ºC for temperature configurations “250” ,“300”;
- 1 Ex ia IIC T1 Gb X, - 60 ≤ t_a ≤ + 70ºC for temperature configuration ”320” , “350”, “450”;

- 0 Ex ia IIC T6 Gb X, - 60 ≤ t_a ≤ + 70ºC for temperature configuration “85”;
- 0 Ex ia IIC T5 Gb X, - 60 ≤ t_a ≤ + 70ºC for temperature configuration “100”;
- 0 Ex ia IIC T4 Gb X, - 60 ≤ t_a ≤ + 70ºC for temperature configuration “135”;
- 0 Ex ia IIC T3 Gb X, - 60 ≤ t_a ≤ + 70ºC for temperature configuration “200”;
- 0 Ex ia IIC T2 Gb X, - 60 ≤ t_a ≤ + 70ºC for temperature configurations “250” ,“300”;
- 0 Ex ia IIC T1 Gb X, - 60 ≤ t_a ≤ + 70ºC for temperature configuration ”320” , “350”, “450”;

For 2-wire connection “T” configuration ambient temperature shall be “-40 ≤ t_a ≤ +70 ^{0}C”.

1.6.1.4 "K" configurations (for oxygen) have separate plate with "Oxygen. Dangerous!" marking. flow meter body is painted blue.

1.6.2 Sealing

Sealing shall be done to prevent from unauthorized access to flow meter. Sealing is executed using the seal and the wire running through the special hole in the cover of transmitter.

Warranty stickers are located on the joint between support bar and flow meter body, protective switch of processor board, detachable connections of remote type flow meter. Warranty is not valid for the devices with damaged or detached stickers.

2 Intended Use

2.1 Operating features

2.1.1 flow meter is customized by manufacturer according to customer sheet and his technological process (medium density, temperature, pressure, viscosity, flow range).

To apply the device for another technological process it needs reconfiguration. Send us current configuration data file compiled with EMIS-Integrator and new order sheet. Manufacturer will send you new configuration file with adjusted parameters. For technological measurement additional calibration is not necessary.

2.1.2 flow meters can be installed in the premises and outdoors (install sun hood to protect electronic unit from overheating).

2.1.3 Pipe vibration can cause false indication of flow with no real flow in the pipe which means that vibration parameters exceed allowed values.

To avoid false signals and self-running:

- turn flow meter up to 90° around pipeline axis to match working direction of sensing element with vibration amplitude.
- fill flow tube with measured medium.

False indication can be caused bu other reasons. This condition is described in the Vortex flow meter Operation Manual (*see* ***table 1.7*****).**

2.1.4 Possible pressure drop ΔP can be calculated as follows:

$$\Delta p = A \cdot \rho \cdot (Q)^2 / D^4, \text{ kPa} \qquad (2.1)$$

where ρ - is medium density under working conditions, kg/m3;
Q - volume flow under operating conditions, m3/h;
D - inner diameter of flow meter body, mm (см. Appendix C);
A- coefficient as specified in table 2.1 (kPa•h2•mm4)/(kg•m3).

Table 2.1 - A coefficient

Version code	Dn	A
S, F, S1, F1	**15, 25, 32, 40, 50, 65**	160
	80, 100, 125, 150, 200, 250, 300	90
FR, FR1	**25, 32, 50**	190
	80, 100, 150, 200, 250, 300	105

For flow meters with no reducers you can estimate pressure drop using diagrams 2.1 and 2.2 It is necessary to draw a straight line on the graph of the corresponding medium from the point corresponding to the measured flow rate on the X axis to the pressure loss curve corresponding to DN. Then from intersection of vertical line and pressure drop curve, draw a horizontal line to Y axis. The point of intersection with the Y axis will correspond to the hydraulic pressure loss at an operating flow rate of the measuring medium.

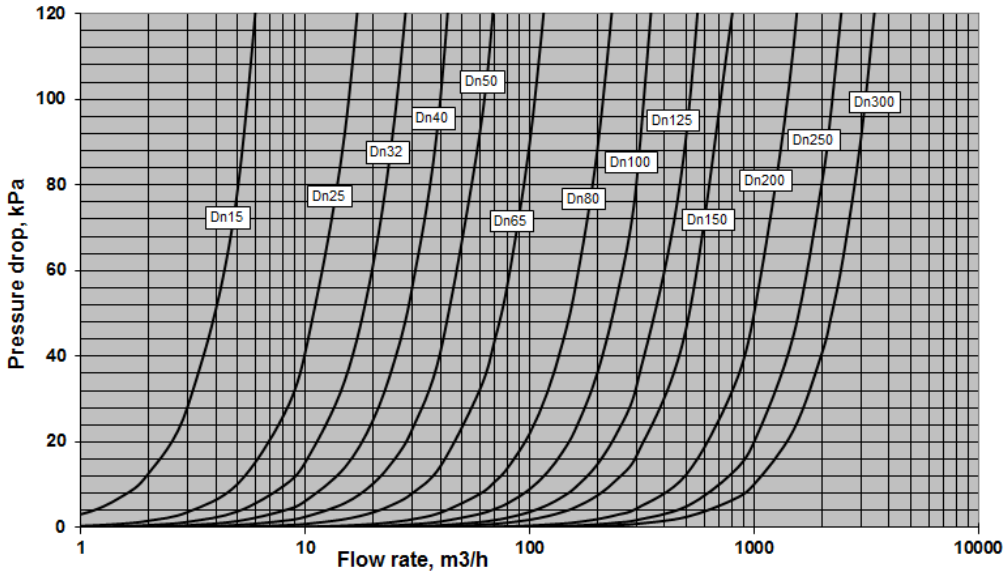


Figure 2.1 - Pressure drop diagram for water

Note: To calculate pressure drop for any other liquid multiply pressure drop value for water and ration of medium density to water density.

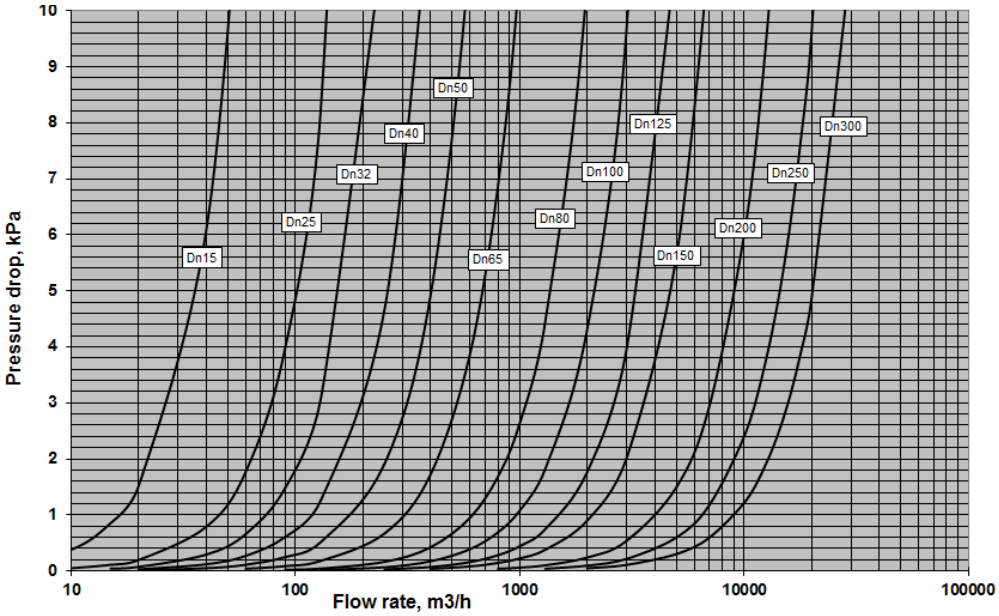


Figure 2.2- Pressure drop diagram for air under normal conditions
Note: To calculate pressure drop for any other gas medium multiply pressure drop value for air and ratio of medium density to air density.

2.1.5 Consider potential for cavitation (boiling) in some flow modes when measuring the flow rate of liquids. Cavitation makes the measurement impossible. To avoid this there should be extra pressure (P) for as long as 5 pipe diameters after the flow meter at the rate higher than calculated as follows:

$$P = 2{,}9\ \Delta P + 1{,}3\ p_v, \qquad (2.2)$$

where ΔP - is pressure loss, kPa;

P_v - pressure of saturated vapour under operating conditions (reference data), kPa.
If the calculated pressure is higher than the actual pressure in the pipeline, a safety valve shall be installed to increase the pressure.

2.1.6 Inner diameter of straight run shall match inner diameter of flow meter. Recommended diameters of straight pipe sections are specified in clause 2.2.2.

2.1.7 flow meter is supplied with compensated temperature error. Manufacturer adjusts a device according to the temperature range specified in customer order sheet using EMIS-Integrator. Temperature can be re-adjusted by the customer. Temperature error is compensated automatically after connecting thermal gauge and installing its software (for “VV” configuration only).

2.1.8 If flow meter is used as part of the metering assembly, pressure and temperature gauges shall be installed downstream as shown in the fig. 2.3. It is allowed to install pressure gauge 5xDn before the flow meter.

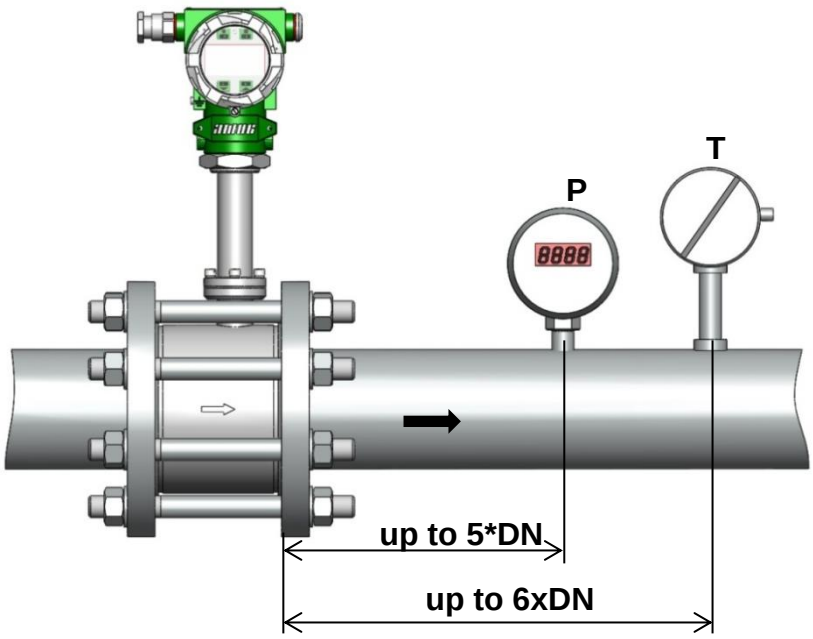


Fig. 2.3 - Installation scheme for full-bore flow meter, pressure and temperature gauges

For flow meters of DN<50mm, pressure and temperature gauges shall be installed up to 10xDN after the flow meter in the pipeline expansion, pressure gauge can be installed 5...10xDN before the flow meter.

Temperature and pressure gauge installation shall comply with normative documents.

Gas measuring methods complies with GOST P 8.740-

2.1.9 When using a flow meter to account hot water and steam, please follow the recommendations of the Methodology for the commercial accounting of coolants (Order of the RF Ministry of Construction No. 99 / pr dated March 17, 2014).

2.1.10 When using a flow meter to measure the flow rate of saturated vapour, the degree of vapour dryness should be higher than 0.8.

2.1.11 We do not recommend to use the flow meter for drastically changing flow, for example in dosing systems. To reduce response time after the flow change we recommend to reduce damping rate or switch off damping by setting its rate to 0 (see Operation Manual (table 1.7).

2.2 Mounting requirements

2.2.1 General rules of mounting

Mounting (dismantling), electric connection, adjustment, operation shall be performed by by duly authorized and electrically trained personnel who carefully read present manual.

Please follow mandatory rules when proceeding flow meter installation:

- provide free access to the flow meter;
- the installation site of the flow meter should ensure its operation without possible mechanical damage;
- it is not allowed to install flow meter in flooded underground heating facilities;
- straight sections of the pipeline and flow tubes shall be fully flooded with medium while measuring;
- connection between the pipeline and flow meter shall be designed so as to avoid air aggregation along the pipeline;
- gaskets between the flow meter body and flanges shall be installed precisely. Gaskets shall not extend inside the pipeline;
- the flow meter can installed in vertical, horizontal or inclined sections of the pipeline (fig.2.4) The recommended direction of flow (liquid, gas, steam) is from the bottom to top if the flow meter is installed on a vertical or inclined sections;

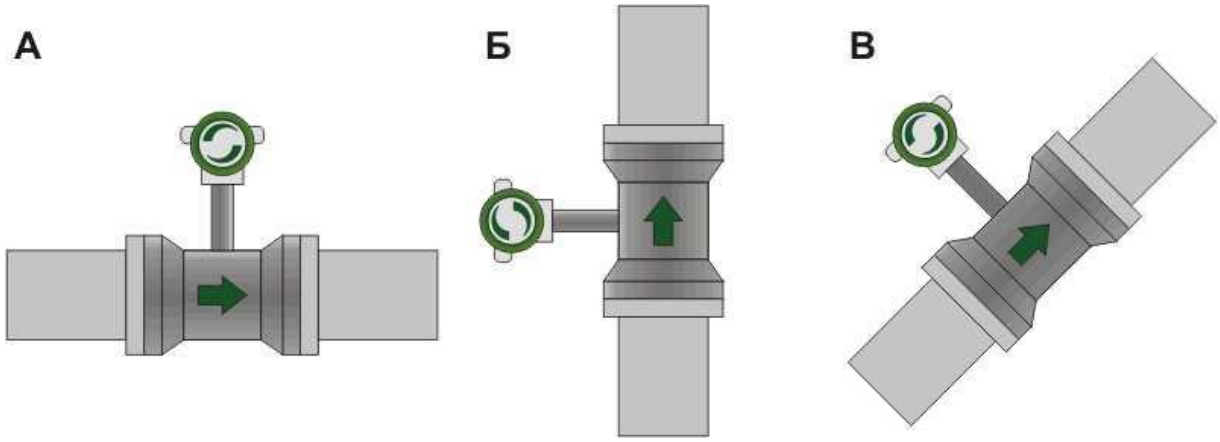


Fig.2.14 - Mounting options

- do not use the flow meter for measuring when the pipe is not fully flooded;
- for gas and vapour measurement the flow meter shall be installed so as to avoid condensed water aggregation inside the flow tube and straight run of the pipeline;
- it is prohibited to install the flow meter on the pipeline with inside pressure exceeding data sheet value;
- if transported under temperature below zero, leave the flow meter in normal conditions for 3 hours before installation;
- installation in areas with strong magnetic interference (e.g. near supply transformer) is not permitted.
- switch off the flow meter before performing any works;
- it is not allowed to work with not grounded devices and electrical tools;
- unused cable glands shall be securely plugged;
- connection of external circuits shall be performed after installation in the pipeline is done, disconnection shall be done before dismantling;
- grounding shall be performed by connecting grounding cable to the gland marked with earth sign. Counter flanges in the pipeline shall be interconnected with grounding cable.

By default, the flow meters of ex-proof configurations are supplied with two cable glands for connection of 6mm to 9mm non-shielded cables. Ex-proof plugs shall be used to plug cable glands. By default, the flow meters of standard configurations are supplied with two plastic cable glands for connection of 6mm to 13mm non-shielded cables.

Cable glands of different diameter or armored cables can be installed as special order (size shall be specified in order sheet).

Cable gland for cables hose of 9.4 to 14 mm size can be supplied.

When installing flow meter with an optical indicator (SIO version), it is recommended to install an electronic unit under the sun visor to prevent false triggering of optical buttons from direct sunlight.

2.2.2 Mounting requirements

To provide declared accuracy follow installation requirements below:

1) Pipe inner diameter Dp at 2xDN before and right after the flow meter shall comply with the below:

$$0{,}98Дi \le Дp \le 1{,}05Дi, \quad (2.4)$$

where Di - inner diameter of the flow tube, mm. (see size ***C*** on ***fig. C.1-C.9*** ***Appendix C).***

Recommended tube size is specified in table D.16 ***Appendix D).***

2) Provide required length of inlet an outlet straight sections. Length of straight sections before and after the flow meter shall not be shorter than specified in the table. 2.2.depending on pipe reducers, extensions, bends along the pipeline, control units and devices installed upstream from the flow meter location. Failure to comply with the requirements leads to an increase in measurement error at low flow rates.

Table 2.2 – Length of EV-200 straight sections

Name	***Straight section before flow meter (X*DN)***	***Straight section after flow meter (X*DN)***
Elbow or tee	12 x Dn	5 x Dn
Two or more coplanar elbows	20 x Dn	5 x Dn
Two or more non-coplanar elbows	30 x Dn	5 x Dn
Reducer (confusor)	10 x Dn	5 x Dn
Expander (diffusor)	12 x Dn	5 x Dn
Control valve	30 x Dn	5 x Dn
Gate valve wide-open	12 x Dn	5 x Dn

3) Misalignment between the flow meter body and the pipeline inner diameter shall not exceed:

- 0.5mm for Dn from 15mm to 65mm;
- 0.7mm for Dn from 80mm to 125mm;
- 1mm for Dn from 150mm to 300mm;

To provide alignment during installation follow the instruction as shown in figure 2.5 while welding.

We recommend to use specially designed straight sections and flanges supplied upon request for mounting flow meters of Dn65 and smaller. Straight sections and flanges in the kit have specially treated surfaces to provide precise alignment while welding.

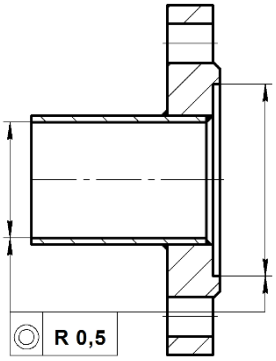


Fig.2.5 - Installation scheme (for Dn65 and smaller).

4) If you are limited in space and handle big pipe diameter it is hard to comply with all requirements for straight sections. In this case we recommend to use flow conditioner to reduce inlet length down to 8DN for all pipeline configurations.

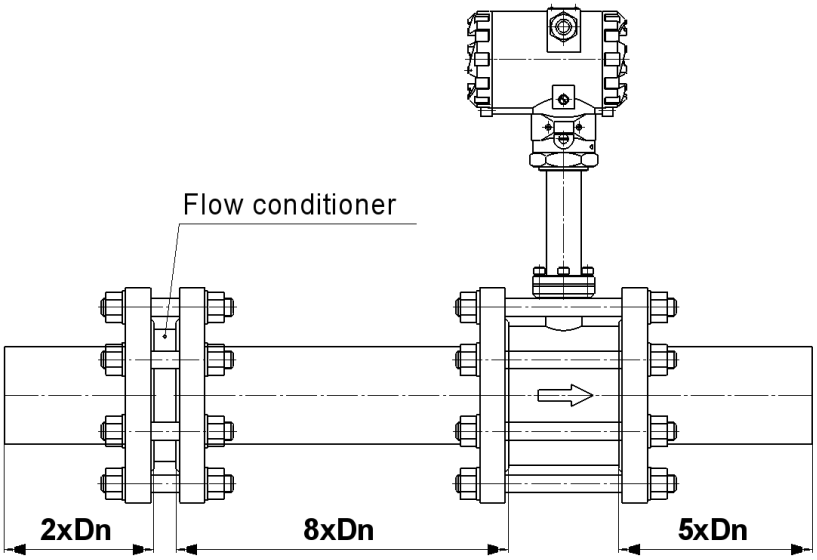


Fig.2.6 - Flow conditioner mounting

Flow conditioner develops flow profile with some pressure loss.. Flow conditioner sizes are shown in the figure 2.7 and the table 2.9. Flow conditioner shall be installed between two flanges (F type under GOST 33259 or type 3 under GOST 12815) and fastened with bolts and studs (fig.2.8).

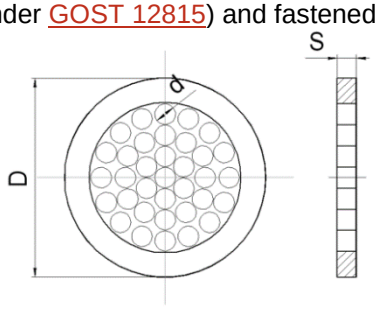


Fig.2.7 - Flow conditioner

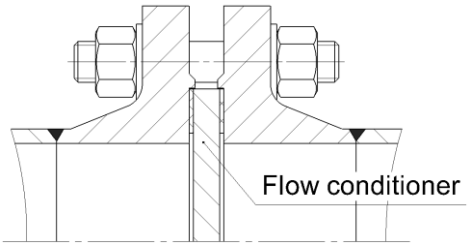


Fig.2.8 - Flow conditioner mounting

Fig.2.9 - Flow conditioner sizes

Nominal diameter, mm	*D, mm*	*d(min), mm*	*S, mm*
15	39	1.16	4.8
25	57	1.9	4.8
32	65	2.5	4.8
40	75	3.1	5
50	87	3.9	7
65	109	5	8
80	120	6.2	10
100	149	7.7	13
125	175	9.6	16
150	203	11.5	20
200	259	15.4	26
250	312	19.3	33
300	363	21.1	39

Note: Number of holes - 32 Flow conditioner holes size and location comply with Zanker plate configuration

5) If gas inclusions in liquid exceed 5% we recommend the following installation options:
- support bar is located in the horizontal plane;

- support bar is located in the vertical plane with electronic unit downwards;
- installation in vertical section of the pipeline.

2.2.3 Installation in the pipeline with high temperature medium inside

To install flow meter in the pipeline with high temperature medium inside (higher than 85°C) follow the recommendations below:

1) It is not allowed to cover support bar and perforated parts of high-temperature configuration flow meter if the pipeline and flow meter body are already covered with heat insulation (see fig.2.9a)! Otherwise, it may lead to electronic unit overheating even if ambient temperature does not exceed +70°C.

2) To decrease convection heating of electronic unit we recommend to install the flow meter so that it is located below or on the side of the pipeline, not above it (support bar placed horizontally or vertically downward). Flow meter bar of high-temperature configurations “350” and "450" shall be inclined at 45 degrees to vertical as shown in the fig.2.9b.

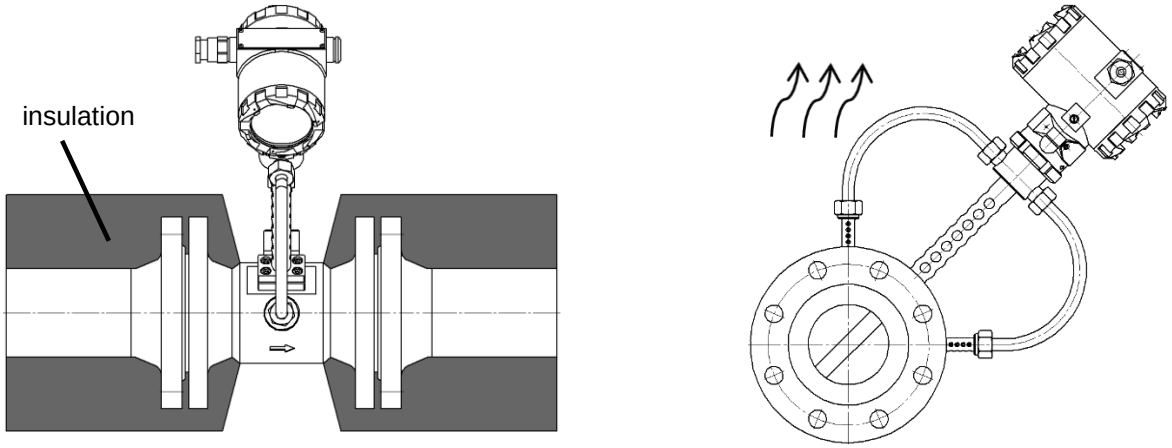


Fig.2.9 - Installation of flow meter for high-temperature mediums

2.2.4 Mounting

Mounting shall be performed as follows:

1) Prepare straight sections as an assembly with flanges and mounting coupling according to the drawings ***Appendix C***.

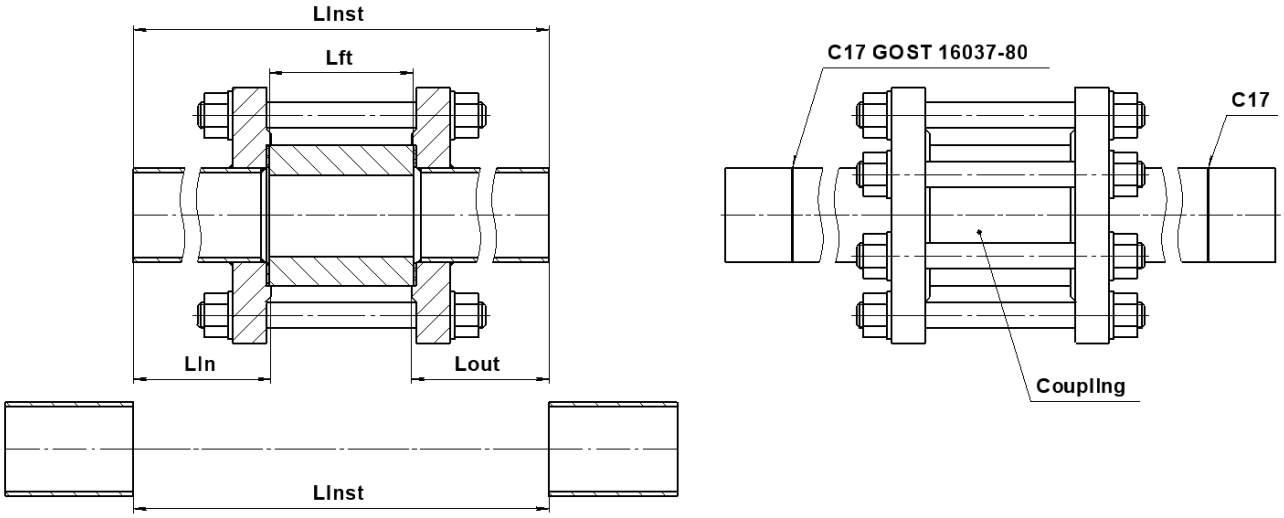


Fig.2.10 - Installation of coupling with straight sections

2) cut off pipeline section = Linst length (figure 2.10).

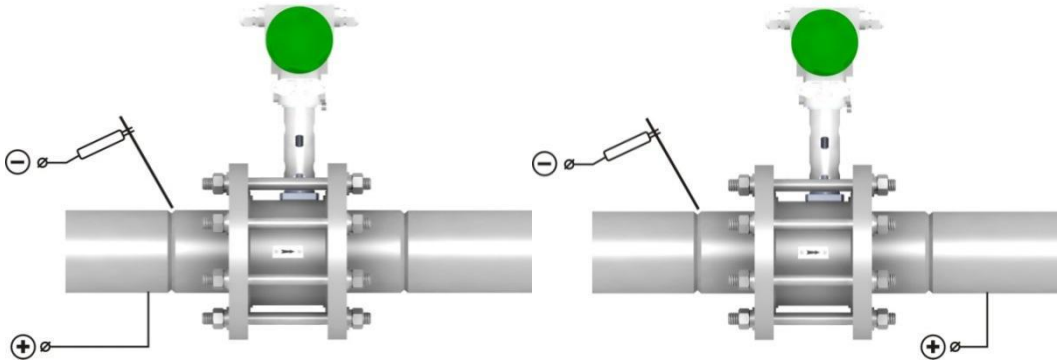
$$Linst = Lin + Lout + Lcpl - \Delta L, \quad (2.4)$$

where Lin + Lout are length of straight sections before and after the flow meter,
Lcpl - length of coupling which is equal to installation length L of the flow meter,
ΔL = 3mm for EV200 pressure ≤ 6,3Mpa and ΔL = -14mm for EV200 pressure ≥ 10MPa.

3) use studs and nuts to assemble straight sections and coupling and weld them to the pipeline as shown in figure 2.10.

Attention! Attention! flow meter can be used as a coupling only if:

- cables are disconnected from the electronic unit;
- gas welding shall be used for mounting;
- for arc-welding power unit shall connected so that current does not flow through the flow meter - see fig.2.11.



Right Wrong

Fig.2.11 - Power supply connection for arc-welding

4) put off the fitting and locate the flow meter between flanges so that the arrow on the body matches flow direction. Bolt tightening shall be done in an X-sequence.
Attention! Attention! Welding seam shall not extend inside the pipeline to avoid increased measuring error.
5) flow meters for vapour measurement shall be placed horizontally in the same plane with steam line to avoid electronic unit overheat.

2.2.5 Electrical installation
Electronic unit rotation, detailed description of electrical connection, description of remote detachable configuration, mounting of ex-proof flow meters are presented in the Vortex flow meter Electronic Unit operation manual (*see* ***table 1.7***).

2.3 Operation

2.3.1 Preparation

Before the first launch do the following:
- check whether pipeline installation is done correctly;
- check power supply parameters;
- check whether flow meter body grounding is done correctly;
- check whether external sources are connected correctly.

2.3.1.2 Datasheet parameters:
- flow meter size;
- flow range;
- serial number;
- network address of flow meter for Modbus or HART;
- type of explosion protection;
- damping rate for volume flow, selected from integer values from 0 to 10 (4 by default);
- Measuring medium: liquid, gas, vapour;
- medium and ambient temperature range;
- accuracy class;
- Output signals parameters: flow rate specified for 1000Hz of the frequency signal, pulse value for pulse signal, flow rate for 20mA of the current signal;
- K-factor;
- Software version;

2.3.2 Putting into service

It shall be accepted for operation by making acceptance act.
Acceptance date should be specified in data sheet and approved by authorized person.

3 Maintenance

Maintenance of ex-proof type flow meters shall be performed according to GOST 31610.17-2012 (IEC 60079-17:2002).

The flow meter put into operation does not require special maintenance other than periodic inspection to verify operation conditions.

Inspection interval depends on the operating conditions and shall be scheduled by the service party.

Pay special attention to technological parameters of measuring medium, including pipeline pressure, and avoid operating conditions that may lead to cavitation, i.e. formation of gas/steam/mixture bubbles in liquid. Cavitation bubbles appear when liquid pressure after the flow meter becomes lower than stated critical minimum (approximately equal to saturated vapour pressure under the given temperature). See 2.1.5 or breakdown pressure formula.

Violation of operating conditions may cause flow meter failure or severe measuring errors.

In case of flow meter breakdown, when there is no possibility of on-site repair, the flow meter shall be dismantled and replaced with insertion of the same size. Drawings of maintenance insertions is shown in Appendix C.

4 Calibration

The first calibration is executed when the flow meter leaves the factory after acceptance testing and quality control approval for TU 4213-017-14145564-2009.

Calibration to the extent of first calibration shall be performed::

- - if flow meter was stored for more than 36 month before operation;
- - after dismantling for repair;

Periodical calibration shall be performed for flow meters in operation and after repair.

Calibration interval is 4 years.

Calibration shall be performed according to Calibration method EV-200.000.000.000.00 CM Rev.2.

Note: unscheduled calibration can be performed during operation when it is necessary to check flow meter operating conditions, after seal removal or loss of calibration worksheet.

5 List of possible failures

List of possible failures (including critical)

- Seal failure of the body caused by destruction;
- Seal failure of the gaskets;
- Loss of tightness in plug connections;
- Non-compliance with the requirements of the table1.5.

Flow meter limit state criteria:

- reach of stated values
- first stage of body sealing damage (seepage, leakage);
- irreversible damage of elements caused by corrosion, erosion and ageing.
- exceeding the maximum allowable metal defects of body parts and welding seams;
- change (decrease) of the wall thickness of body parts to the minimum allowed by the strength calculation;
- change (decrease) of the bluff body size to the minimum allowed by the error value calculation;
- sensing element failure;
- violation of the geometry of body parts above the maximum permissible deviations;

4.2 Personnel mistakes leading to failure, emergency or accidents To provide safety operation, it is prohibited to:

- use fittings under conditions different from specified in data sheet;
- use wrenches of the size bigger than fasteners;
- do installation, de-installation, service works or repair under working pressure inside the flow meter;
- do electrical connection according to the diagrams not provided in the present manual
- operate the flow meter without operation data sheets.

Stop medium supply in case of failure or breakdown. Disconnect flow meter from electrical circuit.

6 Storage

Keep flow meter indoor on the shelve after unpacking. Storage conditions after unpacking shall comply with GOST 15150 under ambient temperature of -50 to +40°C and relative humidity of 95% non-condensing at 25°C.

Do stack flow meter on top of each other.

In winter time keep for 3 hours in heated premises before unpacking.

Long-term storage shall be provided in the manufacturer's package.

7 Transportation

flow meter can be transported in manufacturer's packaging by any means of transport according to GOST 15150 under ambient temperature of -50 to 50°C and relative humidity of 100 % non-condensing at 25°C.

Transit time shall not exceed 1 month;

Follow the requirements of handling marks while loading, transporting and unloading.

Protect equipment from precipitations;

8 Recycling

Flow meters do not contain hazardous materials or components dangerous to people health or the environment during service life and recycling.

Recycling shall be done divided by groups of materials: plastic elements, metal elements and fasteners.

9 Precious materials content

Does not contain precious metals.

Appendix A
(informative)

List of reference documents

Document code	*Name*
GOST166-89	Calipers. Technical conditions
GOST 28498-90	Liquid glass laboratory thermometers. General specifications. Test procedure
GOST 27.003-2016	Technical reliability General rules for reliability requirements
GOST 9064-75	Nuts of flanged connections for medium temperatures from 0 to 650°C.
GOST 6651-2009	State System for Ensuring Uniform Measurement. Thermal converters resistance made of platinum, copper and nickel. General technical requirements and test methods
GOST 8.586.2-2005	State System for Ensuring Uniform Measurement. Measure of flow and quantity of liquids and gases using standard reducers. Part 2. Membranes. Technical requirements
GOST 8732-78	Hot-rolled seamless steel pipes. Assortment
GOST 8734-75	Cold worked seamless steel pipes. Assortment
GOST P 8.740-2011	State System for Ensuring Uniform Measurement. Gas flow and amount. Measurement technique using turbine, rotary and vortex flow meters and counters
GOST 12820-80	Socket weld flange Pn 0,1 to 2,5 MPa.
GOST 12821-80	Weld-neck flange for Pn 0,1 to 20,0 MPa.
GOST 12971-67	Rectangular plates for machines and equipment. Sizes
GOST 14254-2015	Enclosure protection level (IP)
GOST P 52931-2008	Instruments for process monitoring and control. General specifications
GOST P 50648-94	Electromagnetic Compatibility of technical equipment. Resistant to external magnetic field. General technical requirements and test methods
GOST 22261-94	Means of measurement of electrical and magnetic values. General specifications
GOST 26.011-80	Measuring and automation devices Input and output current and voltage continuous signals
GOST 26.010-80	Measuring and automation devices Input and output frequenc continuous signals
GOST 15150-69	Machines, instruments and other industrial products Modifications for different climatic regions. Categories, operating, storage and transportation conditions as to environment climatic aspects influence.
GOST 31610.0-2014 (IEC 60079-0:2011)	Explosive mediums Part 0. Equipment. General requirements
GOST IEC 60079-1-2011	Explosive mediums Part 1. Protection by "d" flameproof enclosures
GOST 31610.11-2014 (IEC 60079-11:2014)	Explosive mediums Part 11. Protection by "i" intrinsic safety circuit
GOST 31610.17-2012 (IEC 60079-17:2002)	Equipment for explosive environments Part 17. Inspection and maintenance of electrical installations in hazardous areas (except for underground mines)
GOST 33259-2015	Flanges for valves, fittings and pipelines for pressure to PN 250.

Appendix B
(normative)

Installation schemes

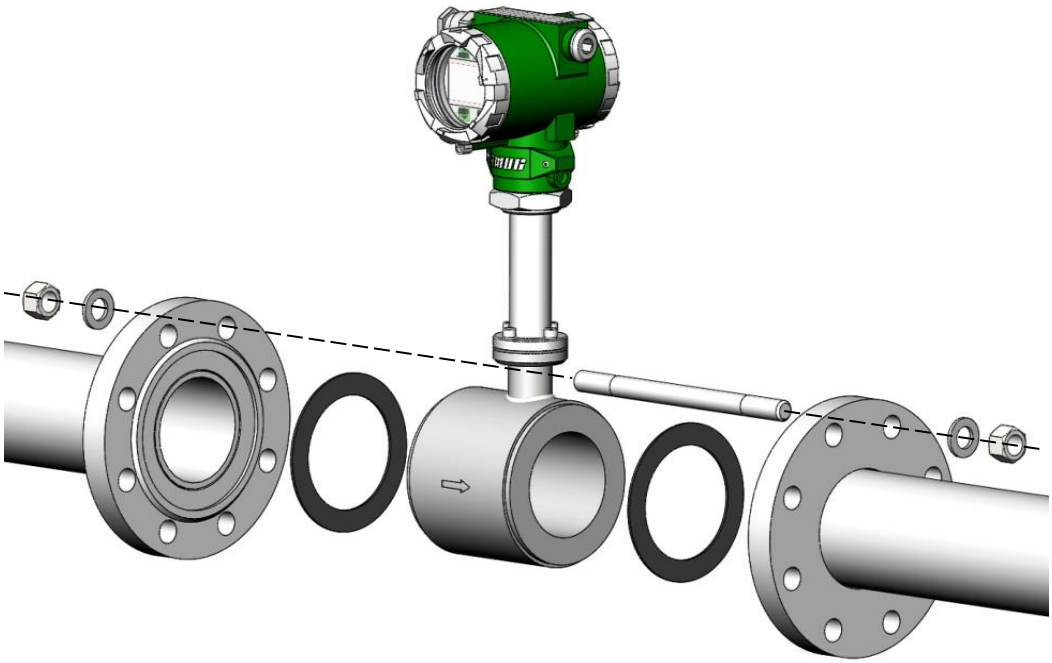


Figure B.1 - Installation scheme for flow meters without flanges

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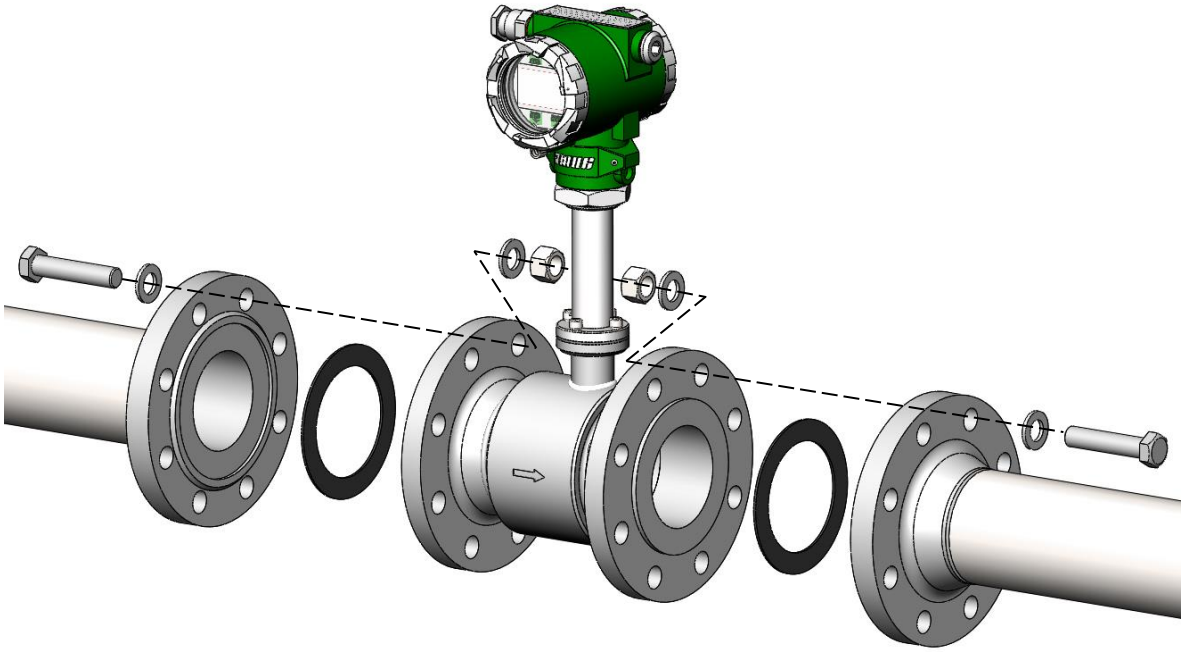
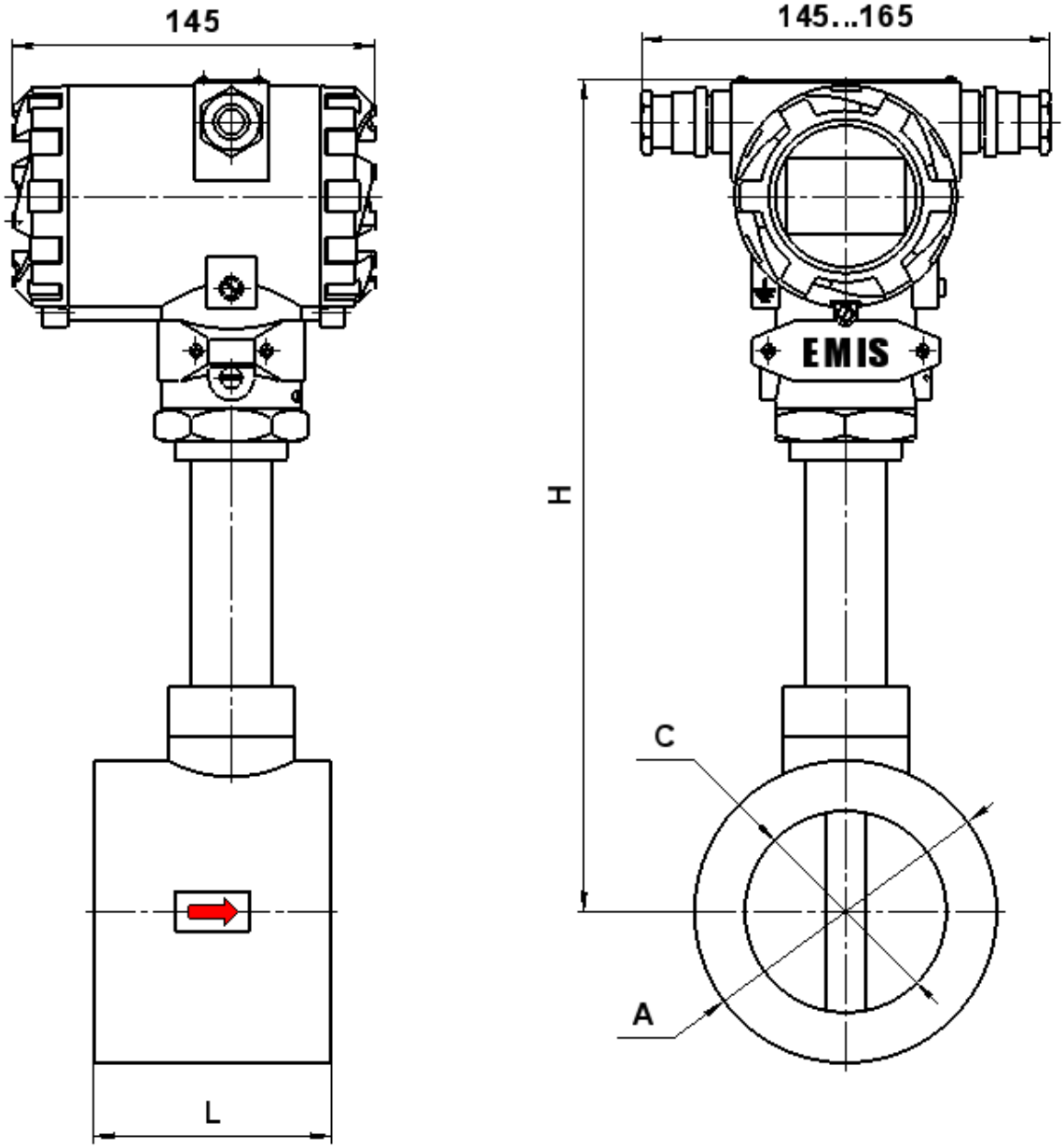


Figure B.2 - Installation scheme for flow meters with flanges

Appendix C

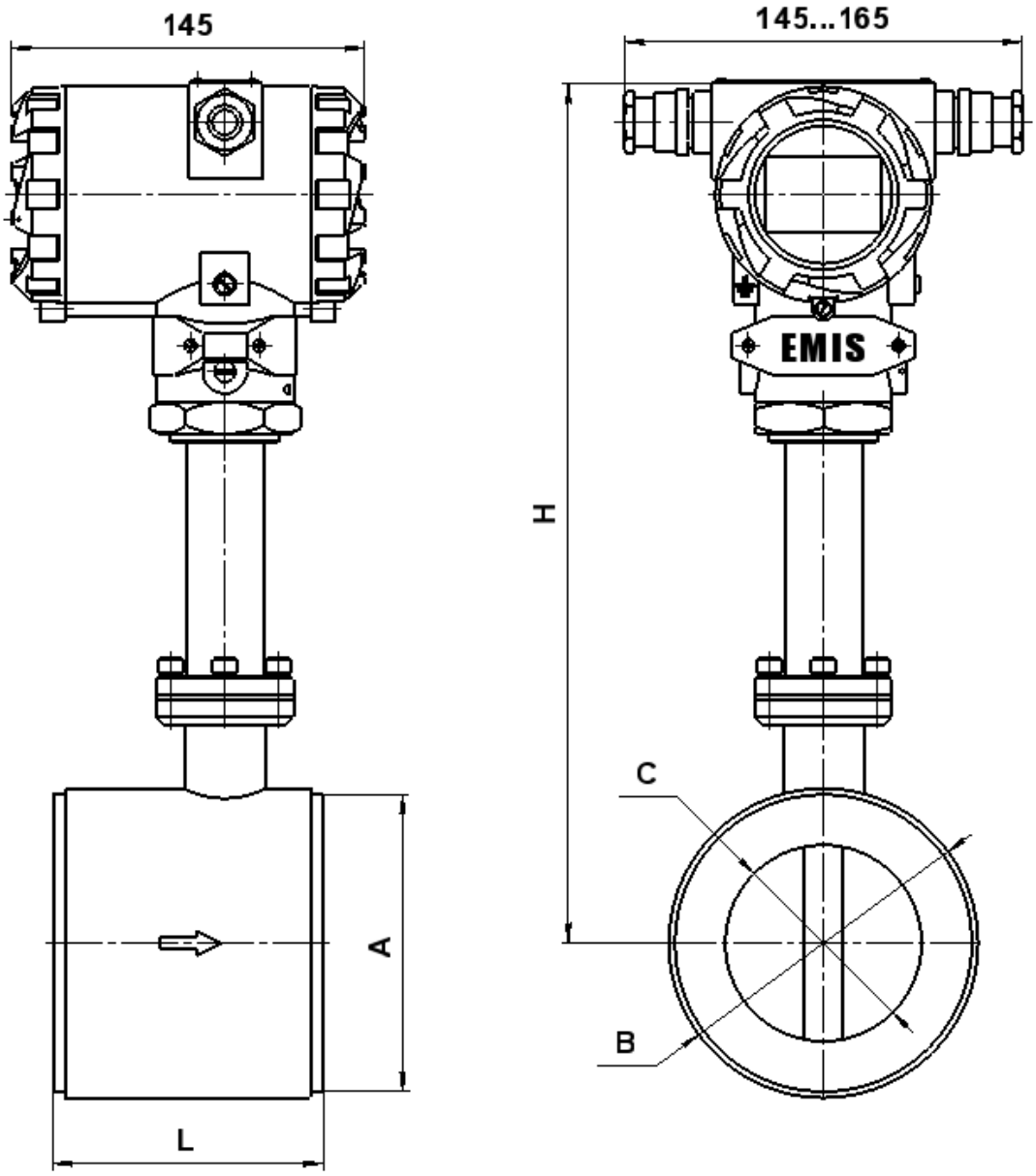
Dimensions, connection sizes and weight of flow meters



Version	A, mm	L, mm	H, mm		C, mm	Weight, kg	
			up to 100°C	135-320°C		up to 100°C	135-320°C
015	65	66	315	482	15	4.3	4.7
025	65	66	315	482	25	4.2	4.6
032	72	66	320	487	32	4.4	4.8
040	80	70	325	492	40	4.8	5.2
050	90	85	330	497	50	5.7	6.1
065	105	98	345	512	65	6.9	7.3
080	120	110	355	522	80	8.3	8.7
100	140	110	360	527	100	9.6	10.0

Fig.B.3 - C type flow meter sizes
Configuration "C1" pressure up to 6,3 MPa

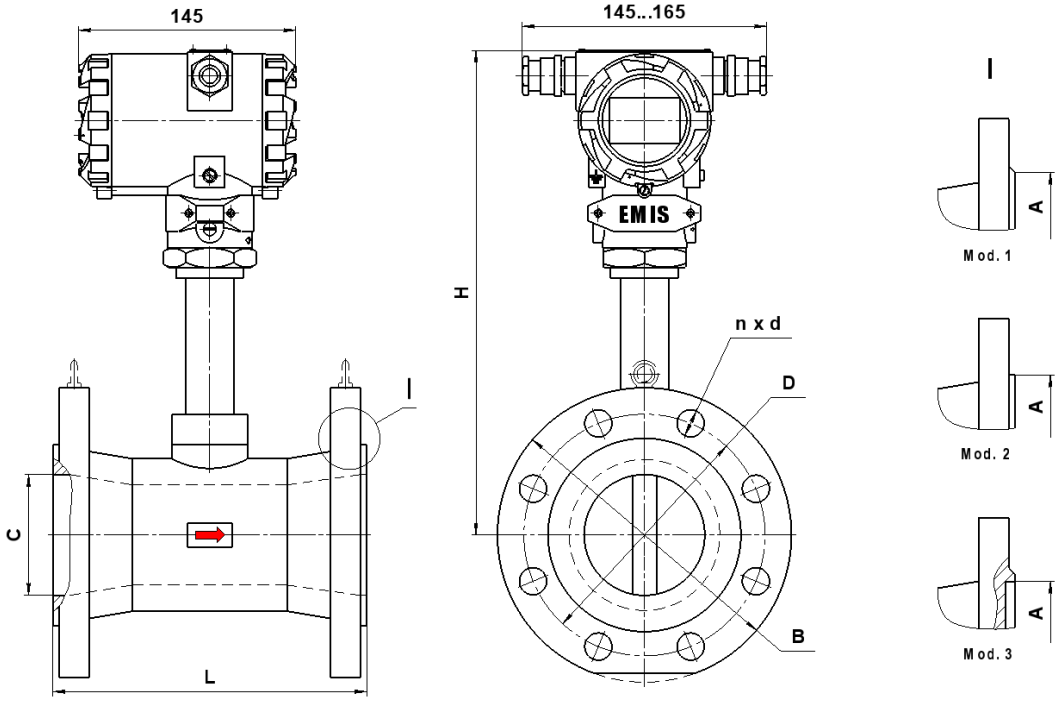
Appendix C



Version	A, mm	B, mm	L, mm	H, mm		C, mm	Weight, kg	
				up to 100°C	135-320°C		up to 100°C	135-320°C
015	58	64	75	325	485	15	4.0	4.4
025	58	74	75	330	490	25	4.5	4.9
032	66	79	80	335	495	32	4.8	5.2
040	76	86	80	340	500	40	5.1	5.5
050	88	96	85	345	505	50	5.8	6.2
065	110	112	100	350	510	65	7.5	7.9
080	121	126	110	360	520	80	8.9	9.3
100	150	152	110	370	530	100	11.5	11.9

Fig.C4 - C1 type flow meter sizes, without flanges
Configuration "C1" pressure up to 6,3 MPa

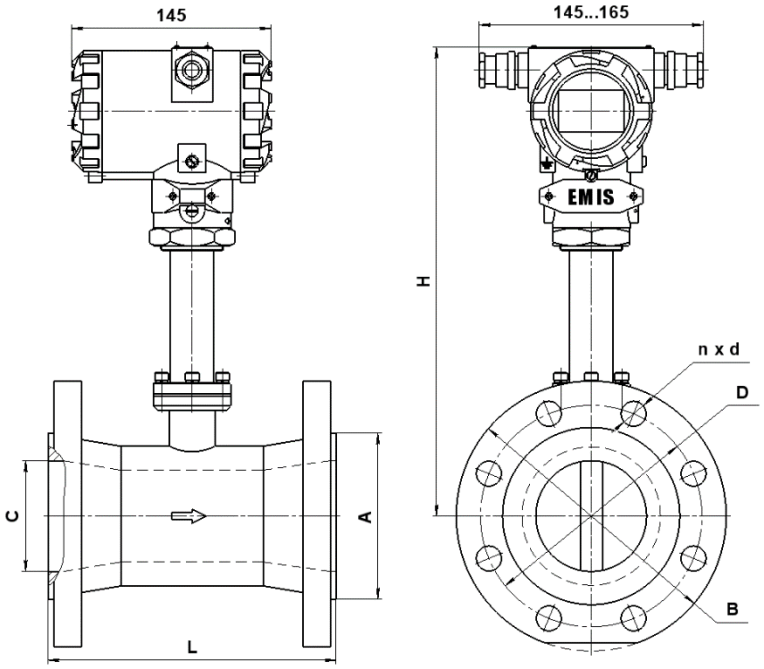
Appendix C



Dn, mm	Pressure, MPa	D, mm	Mod.	A, mm	B, mm	L, mm		C, mm	H, mm				d, mm	n, pcs	Weight , kg
									up to 100ºC		135-320ºC				
						F	FR		F	FR	F	FR			
015	1.6-4	65	2	39	95	150	–	15	315	–	–	–	14	4	5.4
	6.3	100	2	65	140								18	4	8
025	1.6-4	85	2	65	115	150	150	25	315	315	482	–	14	4	6
	6.3	100	2		135								18	4	8
032	1.6-4	100	2	72	135	150	150	32	320	315	487	482	18	4	7
	6.3	110	2		150								22	4	9
040	1.6-4	110	2	80	145	150	–	40	325	–	492	–	18	4	8
	6.3	125	2		165								22	4	11
050	1.6-4	125	2	90	160	167	167	50	330	320	497	487	18	4	9
	6.3	135	2		175								22	4	13
065	1.6-4	145	2	105	180	160	–	65	345	–	512	–	18	8	11
	6.3	160	2		200								22	8	16
080	1.6-4	160	2	120	195	196	196	80	355	330	522	497	18	8	13
	6.3	170	2		210								22	8	18
100	1.6-4	190	2	140	230	260	260	100	360	355	527	522	22	8	15
	6.3	200	2		250								26	8	23
125	1.6-2.5	220	1	184	270	260	–	123	360	–	527	–	26	8	22
	4	220	3	176	270	260		123	360		527		26	8	22
	6.3	240	3	176	295	260		123	365		532		30	8	23
150	1.6-2.5	250	1	212	300	300	–	148	370	–	537	–	26	8	29
	4	250	3	204	300	270		145	375		542		26	8	25
	6.3	280	3	204	340	270		150	375		542		33	8	30
200	1.6-2.5	310	1	278	360	320	–	206	405	–	572	–	26	12	42
	4	320	3	260	375	310		185	405		572		30	12	35
	6.3	345	3	260	405	320		200	405		572		33	12	59
250	1.6-2.5	370	1	335	425	320	–	256	425	–	592	–	30	12	63
	4	385	3	313	445	370		252	430		597		33	12	70
	6.3	400	3	313	470	370		246	430		597		39	12	75
300	1.6-2.5	430	1	390	485	320	–	308	435	–	602	–	30	16	77
	4	450	3	364	510	370		300	440		607		33	16	90
	6.3	460	3	364	530	370		280	440		607		39	16	125

Figure C.3 - Dimensions for F and FR configurations, temperature up to +320°C.

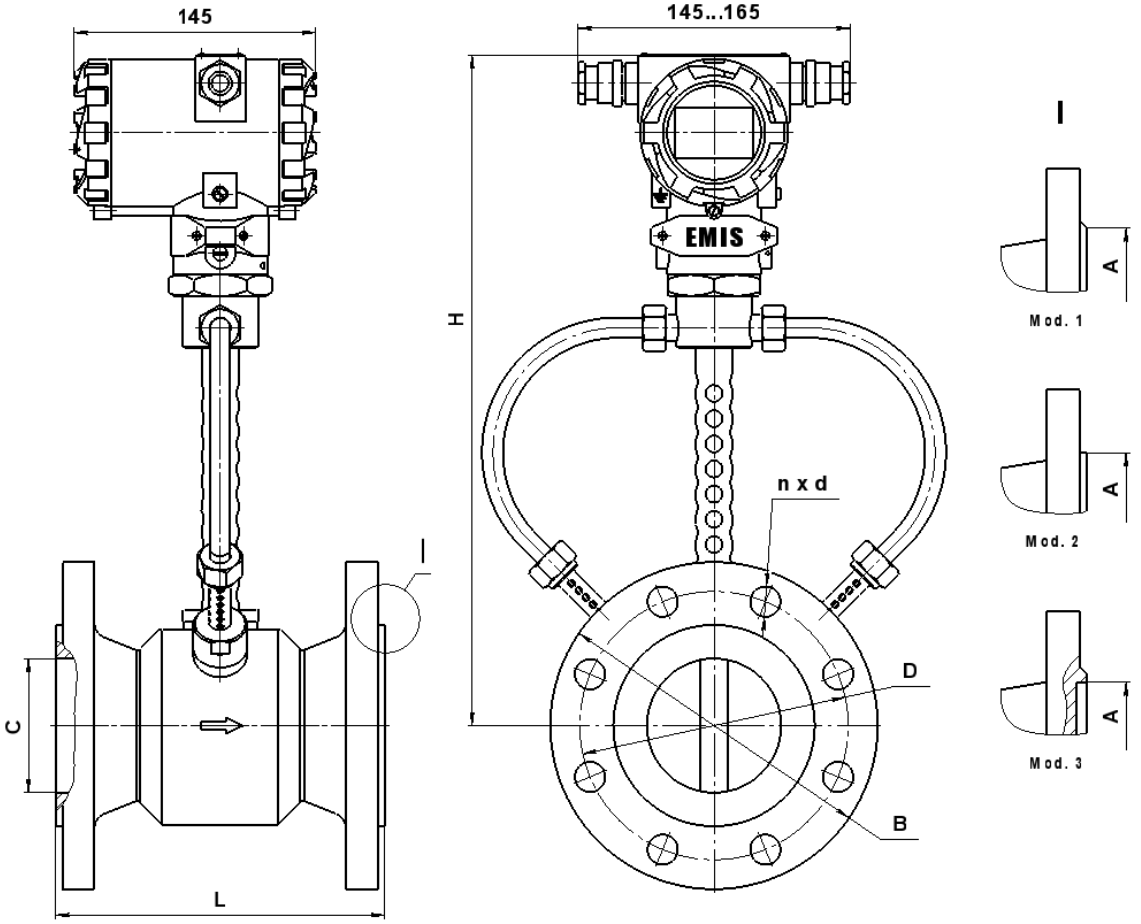
Appendix C



Dn, mm	Pressure, MPa	D, mm	A, mm	B, mm	L, mm		C, mm	H, mm				d, mm	n, pcs	Weight, kg
								up to 100°C		135-320°C				
					F1	FR1		F1	FR1	F1	FR1			
015	1.6-4	85	58	115	130	–	15	325	–	485	–	14	4	5.8
	6.3	100		135	160							18	4	7.4
025	1.6-4	85	58	115	130	130	25	330	325	490	485	14	4	6.1
	6.3	100		135	160	160						18	4	8.3
032	1.6-4	100	66	135	140	140	32	335	330	495	490	18	4	7.6
	6.3	110		150	165	165						22	4	10
040	1.6-4	110	76	145	150	–	40	345	–	505	–	18	4	8.5
	6.3	125		165	180							22	4	11.5
050	1.6-4	125	88	160	160	160	50	345	335	505	495	18	4	10
	6.3	135		175	190	190						22	4	14
065	1.6-4	145	110	180	180	–	65	350	–	510	–	18	8	14
	6.3	160		200	210							22	8	19
080	1.6-4	160	121	195	200	200	80	360	345	520	505	18	8	16
	6.3	170		210	220	220						22	8	21
100	1.6-4	190	150	230	200	200	100	370	360	530	520	22	8	22
	6.3	200		250	220	220						26	8	29
125	1.6-2.5	220	176	270	260	–	120	362	–	522	–	26	8	25
	4	220		270	260			362		522		26	8	26
	6.3	240		295	270		118	361		521		30	8	39
150	1.6-2.5	250	204	300	270	–	145	375	–	535	–	26	8	30
	4	250		300	270			375		535		26	8	35
	6.3	280		340	300		142	373		533		33	8	55
200	1.6-2.5	310	260	360	320	–	202	403	–	563	–	26	12	46
	4	320		375	320			403		563		30	12	59
	6.3	345		405	350		198	401		561		33	12	83
250	1.6-2.5	370	313	425	320	–	252	428	–	588	–	30	12	66
	4	385		445	390			428		588		33	12	94
	6.3	400		470	400		246	425		585		39	12	120
300	1.6-2.5	430	364	485	370	–	301	453	–	613	–	30	16	93
	4	450		510	440			453		613		33	16	135
	6.3	460		530	450		294	449		609		39	16	167

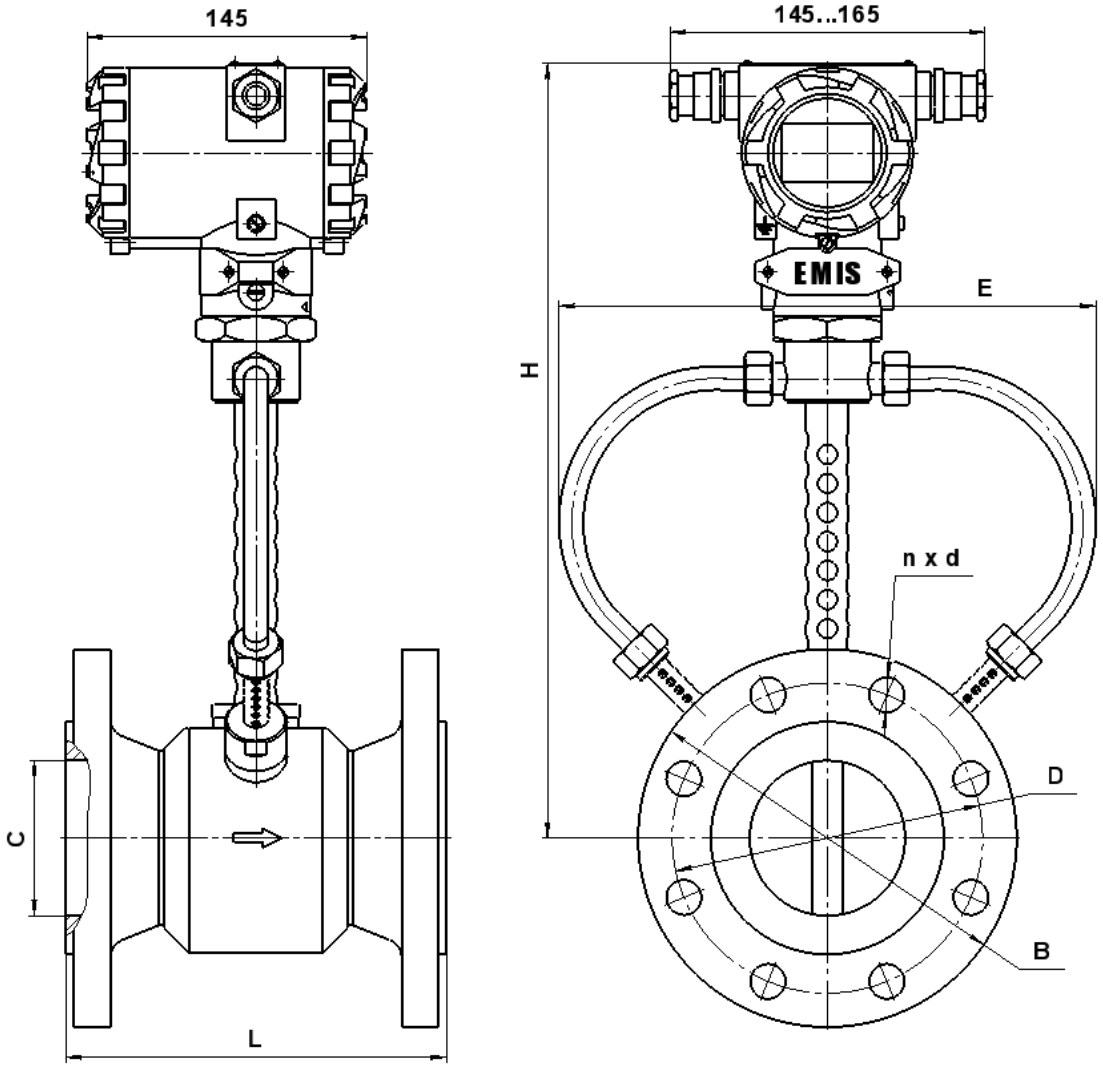
Figure C.4 - Dimensions for F1 and FR configurations, temperature up to +320°C, pressure up to 6,3MPa

Appendix C



Dn, mm	*Pressure, MPa*	*D, mm*	*Ver.*	*A, mm*	*B, mm*	*L, mm*	*C, mm*	*H, mm*	*d, mm*	*n, pcs*	*Weight, kg*
040	1.6-4	110	2	80	145	150	40	380	18	4	9
	6.3	125	2		165	180			22	4	12
050	1.6-4	125	2	90	160	167	50	380	18	4	10
	6.3	135	2		175	190			22	4	14
065	1.6-4	145	2	105	180	160	65	388	18	8	13
	6.3	160	2		200	180			22	8	18
080	1.6-4	160	2	120	195	196	80	395	18	8	14
	6.3	170	2		210	220			22	8	19
100	1.6-4	190	2	140	230	196	100	405	22	8	18
	6.3	200	2		250	220			26	8	25
125	1.6-2.5	220	1	184	270	260	123	505	26	8	26
	4	220	3	176	270	260	123		26	8	26
	6.3	240	3	176	295	260	123		30	8	40
150	1.6-2.5	250	1	212	300	300	148	517	26	8	33
	4	250	3	204	300	300	138		26	8	36
	6.3	280	3	204	340	300	138		33	8	59
200	1.6-2.5	310	1	278	360	320	200	545	26	12	49
	4	320	3	260	375	320	185		30	12	63
	6.3	345	3	260	405	320	185		33	12	88
250	1.6-2.5	370	1	335	425	320	256	575	30	12	65
	4	385	3	313	445	370	231		33	12	92
	6.3	400	3	313	470	370	231		39	12	120
300	1.6-2.5	430	1	390	485	370	304	600	30	16	90
	4	450	3	364	510	370	280		33	16	127
	6.3	460	3	364	530	370	280		39	16	163

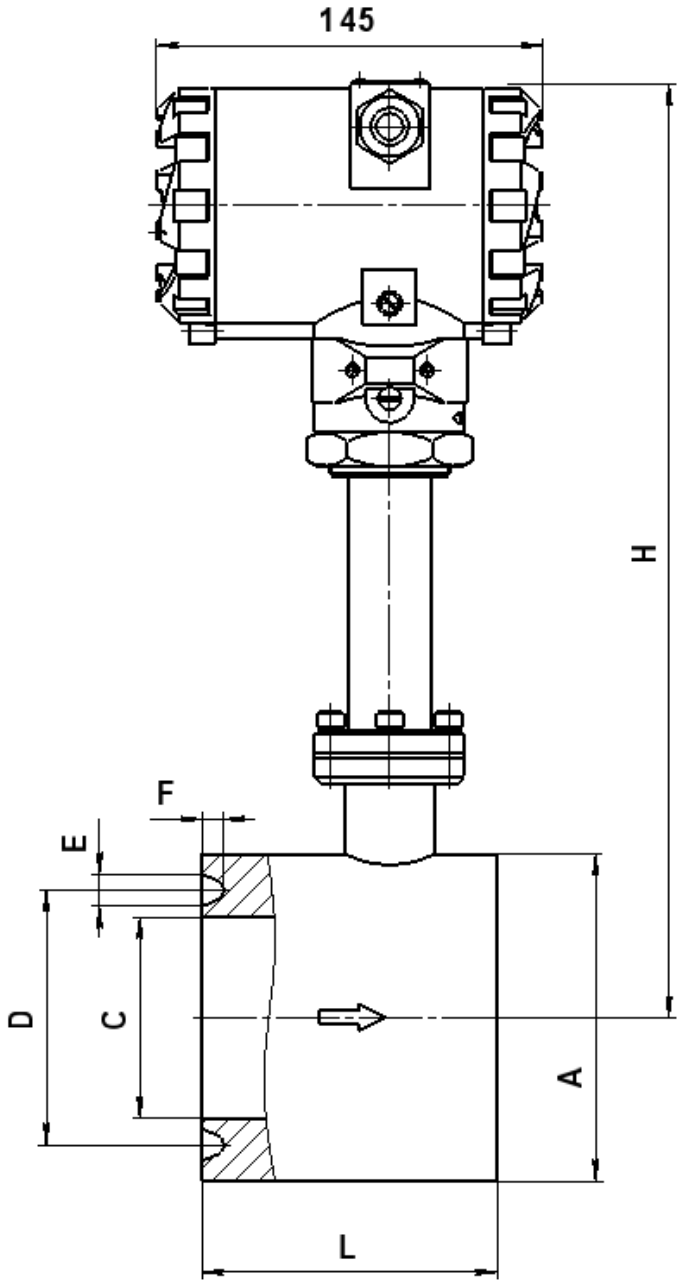
Figure C.5 - Dimensions for F configuration, temperature up to +450°C.



Dn, mm	*Pressure, MPa*	*D, mm*	*A, mm*	*B, mm*	*L, mm*	*C, mm*	*H, mm*	*d, mm*	*n, pcs*	*Weight, kg*
040	1.6-4	125	76	160	160	40	380	22	4	12
	6.3	125		160	160	40		22	4	12
050	1.6-4	135	88	170	160	48	380	22	4	14
	6.3	145		190	190	46		26	4	17
065	1.6-4	160	110	195	180	65	380	22	8	18
	6.3	170		215	210	63		26	8	23
080	1.6-4	170	121	205	200	80	400	22	8	19
	6.3	180		225	220	78		26	8	25
100	1.6-4	200	150	245	200	97	420	26	8	25
	6.3	210		260	220	95		30	8	33
125	1.6-4	240	176	290	260	120	510	30	8	40
	6.3	250		305	300	115		33	8	53
150	1.6-4	280	204	335	270	145	520	33	8	60
	6.3	290		345	330	140		33	12	74
200	1.6-4	345	260	400	270	200	550	33	12	92
	6.3	360		425	330	195		39	12	120
250	1.6-4	400	313	465	310	250	580	39	12	125
	6.3	430		495	400	240		39	12	183
300	1.6-4	460	364	525	330	300	600	39	16	175
	6.3	500		580	450	290		45	16	270

Figure C.6 - Dimensions for F1 configuration, temperature +350°C and +450°C.

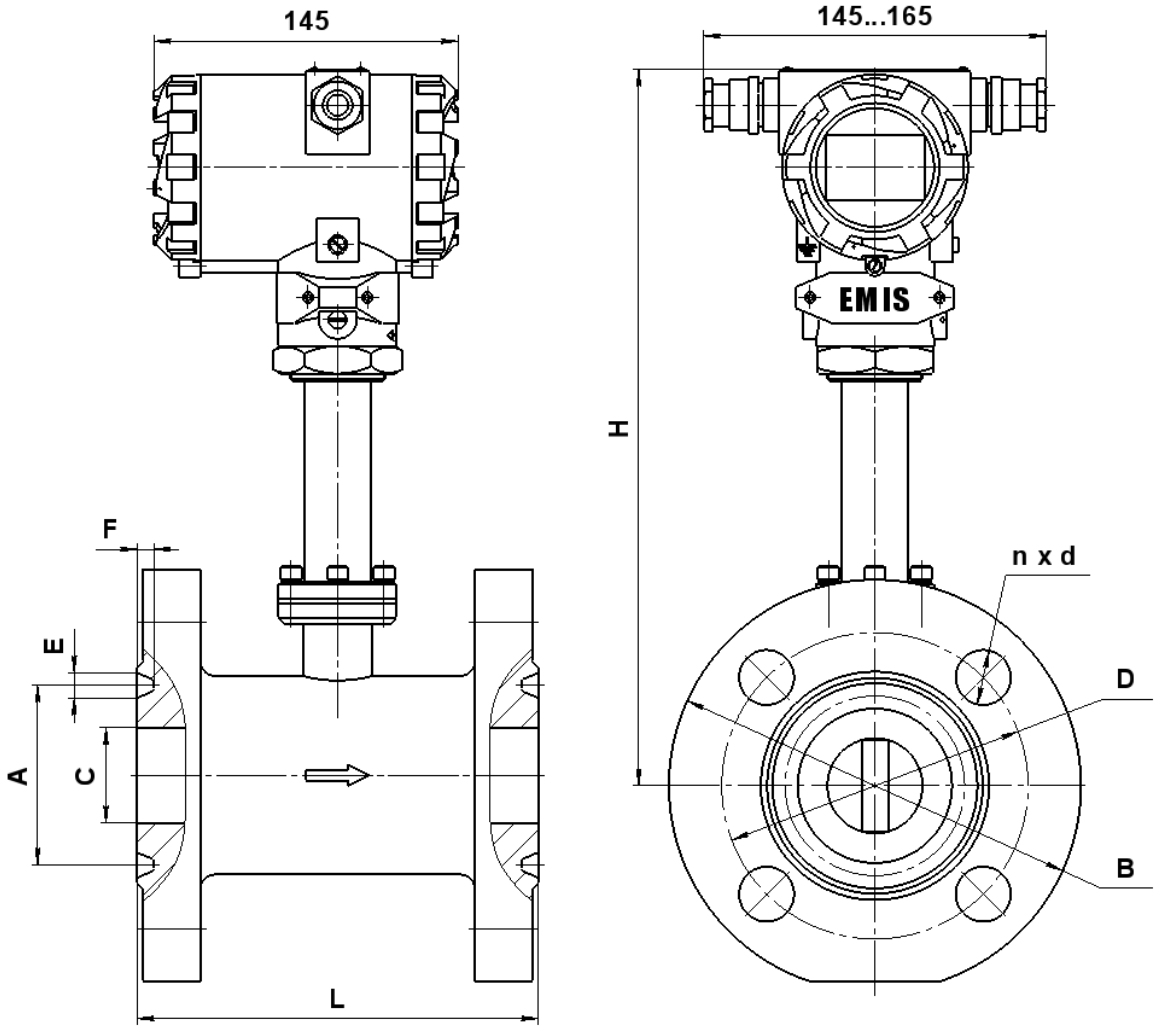
Appendix C



Dn, mm	A, mm	C, mm	D, mm	E, mm	F, mm	L, mm	H, mm		Weight, kg
							up to 100°C	135-320°C	
15	68	14	50	9	6.5	75	318	478	4.5
25	72	25	50	9	6.5	75	324	484	4.6
32	82	32	65	9	6.5	80	327	487	5.2
40	87	37	65	9	6.5	80	330	490	5.5
50	115	45	95	12	8	100	354	514	9.1
65	115	62	95	12	8	100	367	527	8.2
80	122	75	95	12	8	110	374	534	8.8
100	138	92	115	12	8	110	382	542	9.8
150	228	136	205	14	10	140	415	575	31
200	268	192	240	17	11	170	423	583	40
250	316	236	275	17	11	200	445	605	60
300	418	284	380	23	14	250	489	649	151

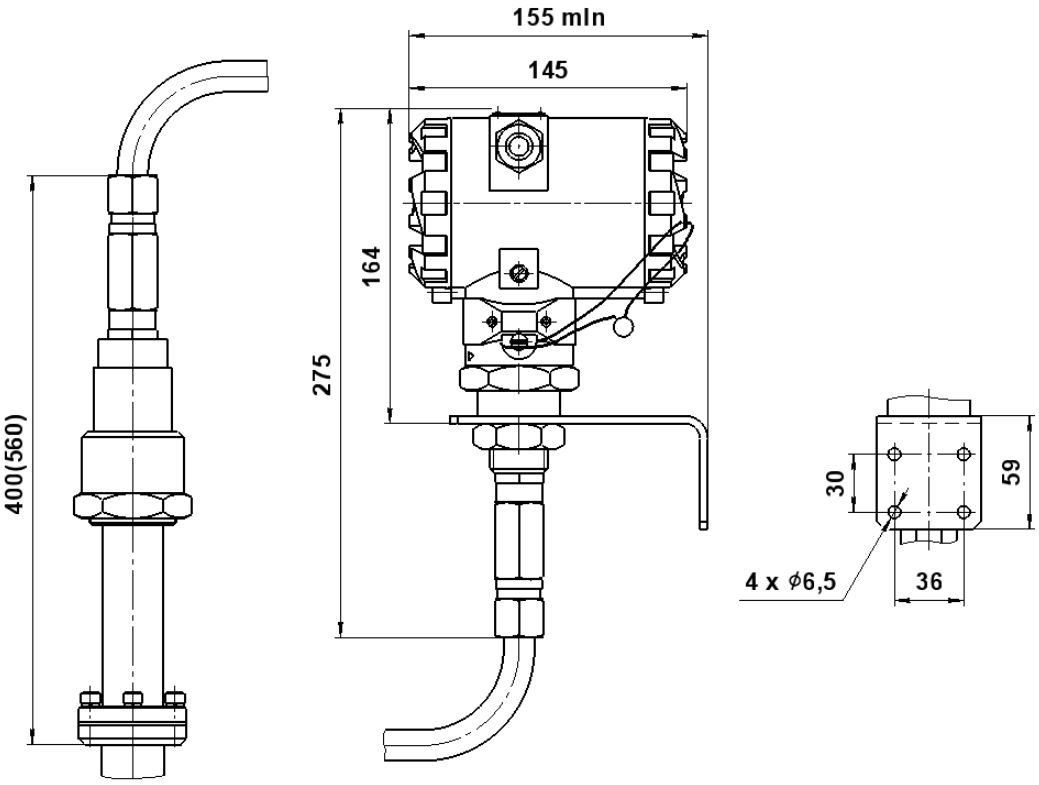
Fig.C.7 - Dimensions for C configuration 16-25 MPa

Appendix C



Dn, mm	Pressure, MPa	A, mm	B, mm	C, mm	D, mm	E, mm	F, mm	L, mm	H, mm		d, mm	n, pcs	Weight, kg
									up to 100°C	135-320°C			
15	10-16	35	105	14	75	9	6.5	160	319	479	14	4	6.8
25	10-16	50	135	25	100	9	6.5	160	324	484	18	4	9.6
32	10-16	65	150	32	110	9	6.5	170	328	488	22	4	11
40	10-16	75	165	37	125	9	6.5	180	330	490	22	4	14
50	10	85	195	45	145	12	8	190	335	495	26	4	19
	16	95											17
65	10-16	110	220	62	170	12	8	210	343	503	26	8	25
80	10	115	230	75	180	12	8	220	350	510	26	8	28
	16	130											26
100	10-16	145	265	92	210	12	8	220	360	520	30	8	37
125	10	175	310	115	250	12	8	300	360	520	33	8	45
	16	190											46
150	10	205	350	140	290	12	8	330	372	532	33	12	62
	16					14	10						67
200	10	265	430	195	360	12	8	380	400	560	39	12	104
	16	275				17	11						117
250	10	320	500	240	430	12	8	450	422	582	39	12	168
	16	330				17	11						188
300	10	375	585	290	500	12	8	530	447	607	45	16	257
	16	380				23	14						290

Fig.C.8 - Dimensions for F1 configuration 16-25 MPa



Size in brackets - for version +135ºC... +320ºC

Fig.C10 - Remote type flow meter sizes
Other sizes see fig.C.1...C.9

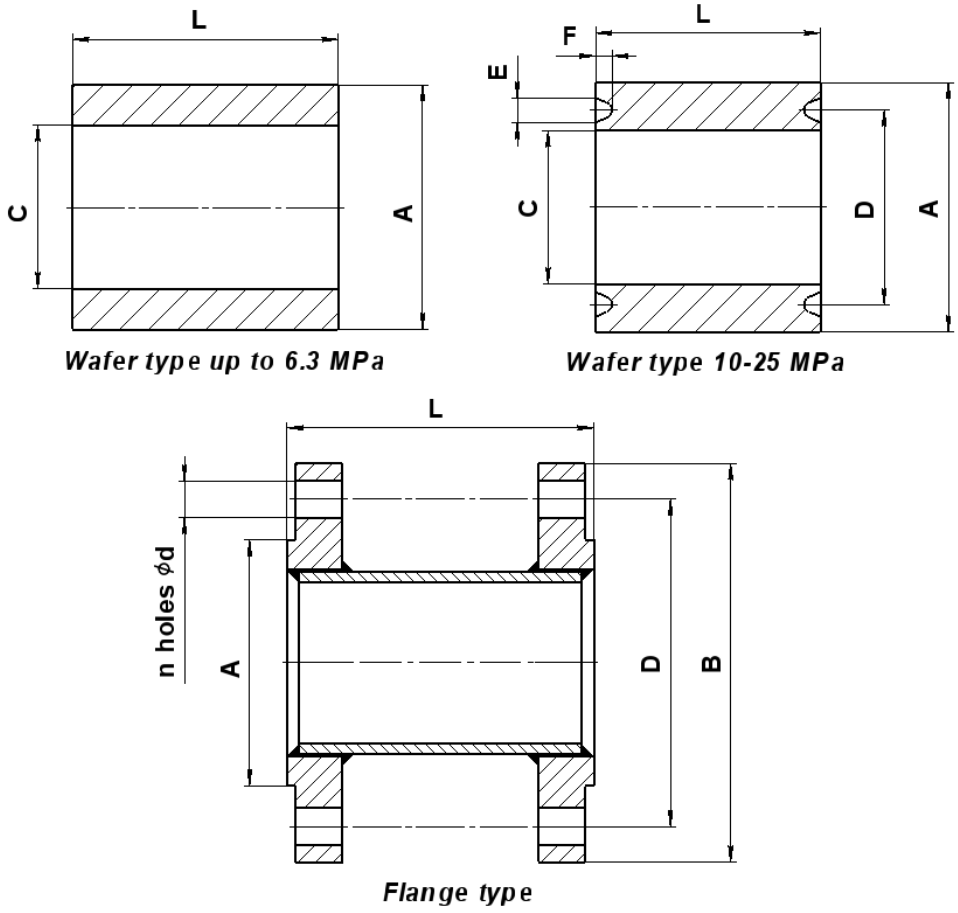


Fig.C11 - Mounting coupling sizes
fig.C.3...C.9

Appendix D
(informative)

Mounting kit

Mounting kit includes 2 flanges, 2 gaskets, fasteners - studs, nuts and washers, the sizes are specifies in the tables below.

Table D.1 Fasteners for flow meters with connection type "C", pressure up to 6,3MPA

Dn, mm	Stud GOST 9066				Nut GOST 9064		
	1,6–2,5 MPa	4 MPa	6.3 MPa	Amount	1,6–4 MPa	6.3 MPa	Amount
15	AM12x140	AM12x140	AM16x160	4	AM12 (S18)	AM16 (S24)	8
25							
32	AM16x160	AM16x150	AM20x170		AM16 (S24)	AM20 (S30)	
40							
50	AM16x180	AM16x170	AM20x190				
65	AM20x220	AM20x220	AM24x240	8	AM20 (S30)	AM24 (S36)	16
80	BM16x220	BM16x220	BM20x230		AM16 (S24)	AM20 (S30)	
100	AM20x220	AM20x220	AM24x240		AM20 (S30)	AM24 (S36)	

Note: 1. The number of washers is equal to the number of nuts.
2. For pressures of 1.6 - 2.5 MPa, studs complying with GOST 5915 may be used

Table D.2 Fasteners for flow meter with connection type "C1", pressure up to 6,3MPa

Dn, mm	Stud GOST 9066				Nut GOST 9064		
	1,6–2,5 MPa	4 MPa	6.3 MPa	Amount	1,6–4 MPa	6.3 MPa	Amount
15	AM12x150	AM12x150	AM16x170	4	AM12 (S18)	AM16 (S24)	8
25	BM12x150	BM12x150	AM16x170				
32	AM16x170	AM16x170	AM20x190		AM16 (S24)	AM20 (S30)	
40							
50	AM16x180						
65	AM16x200	AM16x200	BM20x220	8	AM16 (S24)	AM20 (S30)	16
80	AM16x220	AM16x220	AM20x240				
100	AM20x220	AM20x220	AM24x240		AM20 (S30)	AM24 (S36)	

Note: 1. The number of washers is equal to the number of nuts.
2. For pressures of 1.6 - 2.5 MPa, studs complying with GOST 5915 may be used

Table D.3 Fasteners for flow meter with connection type "F", "FR" and the temperature of the measured medium up to + 320 ° C

Dn, mm	Stud GOST 9066				Nut GOST 9064			
	1,6–2,5 MPa	4 MPa	6.3 MPa	Amount	1,6–2,5 МПа	4 MPa	6.3 MPa	Amount
15	AM12x70	AM12x70	AM16x90	8	AM12 (S18)	AM12 (S18)	AM16 (S24)	16
25								
32	AM16x90	AM16x90	AM20x110		AM16 (S24)	AM16 (S24)	AM20 (S30)	
40	AM16x100							
50								
65	AM16x100	AM16x100	AM20x120	16				32
80								
100	AM20x110	AM20x110	AM24x130		AM20 (S30)	AM20 (S30)	AM24 (S36)	
125	AM24x130	AM24x130	AM27x150		AM24 (S36)	AM24 (S36)	AM27 (S41)	
150			AM30x170				AM30 (S46)	
200		AM27x150		24		AM27 (S41)		48
250	AM27x150	AM30x170	AM36x220		AM27 (S41)	AM30 (S46)	AM36 (S55)	
300				32				64

Note: 1. The number of washers is equal to the number of nuts.
2. For pressures of 1.6 - 2.5 MPa, studs may be replaced with bolts, and nuts are also allowed according to GOST 5915.

Appendix D

Table D.4 Fasteners for flow meter with connection type "F1", "FR1" and the temperature of the measured medium up to + 320 ° C

Dn, mm	Stud GOST 9066				Nut GOST 9064			
	1,6–2,5 MPa	4 MPa	6.3 MPa	Amount	1,6–2,5 МПа	4 MPa	6.3 MPa	Amount
15	AM12x70	AM12x70	AM16x90	8	AM12 (S18)	AM12 (S18)	AM16 (S24)	16
25								
32	AM16x90	AM16x90	AM20x110		AM16 (S24)	AM16 (S24)	AM20 (S30)	
40	AM16x100							
50								
65	AM16x100	AM16x100	AM20x120	16				32
80								
100	AM20x110	AM20x110	AM24x130		AM20 (S30)	AM20 (S30)	AM24 (S36)	
125	AM24x130	AM24x130	AM27x150		AM24 (S36)	AM24 (S36)	AM27 (S41)	
150			AM30x170				AM30 (S46)	
200	AM24x140	AM27x160	AM30x180	24		AM27 (S41)		48
250	AM27x150	AM30x180	AM36x220		AM27 (S41)	AM30 (S46)	AM36 (S55)	
300				32				64

Note: 1. The number of washers is equal to the number of nuts.
2. For pressures of 1.6 - 2.5 MPa, studs may be replaced with bolts, and nuts are also allowed according to GOST 5915.

Table D.5 Fasteners for flow meter with connection type “F” and the temperature of the measured medium +350 and + 450 ° C

Dn, mm	Stud GOST 9066				Nut GOST 9064			
	1,6–2,5 MPa	4 MPa	6.3 MPa	Amount	1,6–2,5 МПа	4 MPa	6.3 MPa	Amount
40	AM16x90		AM20x110	8	AM16 (S24)		AM20 (S30)	16
50								
65	AM16x100		AM20x120	16	AM16 (S24)		AM20 (S30)	32
80								
100	AM20x110		AM24x140		AM20 (S30)		AM24 (S36)	
125	AM24x130		AM27x150		AM24 (S36)		AM27 (S41)	
150	AM24x130		AM30x180		AM24 (S36)		AM30 (S46)	
200	AM24x130	AM27x150	AM30x180	24	AM24 (S36)	AM27 (S41)	AM30 (S46)	48
250	AM27x150	AM30x180	AM36x220		AM27 (S41)	AM30 (S46)	AM36 (S55)	
300				32				64

Note: 1. The number of washers is equal to the number of nuts.
2. For pressures of 1.6 - 2.5 MPa, studs complying with GOST 5915 may be used

Table D.6 Fasteners for flow meter with connection type “F1” and the temperature of the measured medium +350 and + 450 ° C

Dn, mm	Stud GOST 9066			Nut GOST 9064		
	1,6–4 MPa	6.3 MPa	Amount	1,6–4 MPa	6.3 MPa	Amount
40	AM20x110	AM20x110	8	AM20 (S30)	AM20 (S30)	16
50		AM24x130			AM24 (S36)	
65	AM20x120	AM24x140	16	AM20 (S30)	AM24 (S36)	32
80						
100	AM24x140	AM27x150		AM24 (S36)	AM27 (S41)	
125	AM27x150	AM30x180		AM27 (S41)	AM30 (S46)	
150	AM30x180	-		AM30 (S46)	-	
	-	AM30x180	24	-	AM30 (S46)	48
200	AM30x180	AM36x220		AM30 (S46)	AM36 (S55)	
250	AM36x220			AM36 (S55)		
300		AM42x260	32		AM42 (S65)	64

Note: 1. The number of washers is equal to the number of nuts.
2. For pressures of 1.6 - 2.5 MPa, studs complying with GOST 5915 may be used

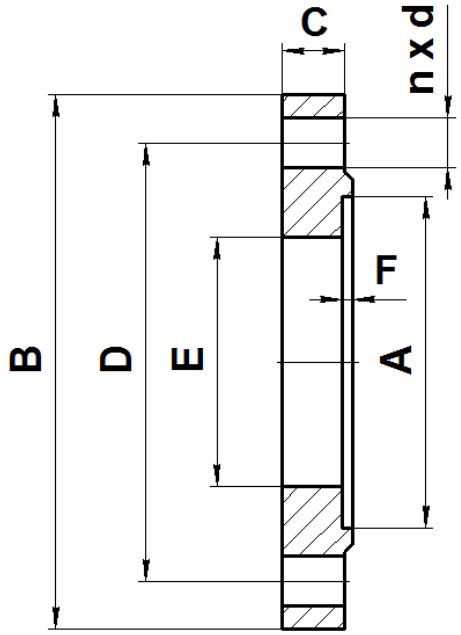


Fig.D.1.1

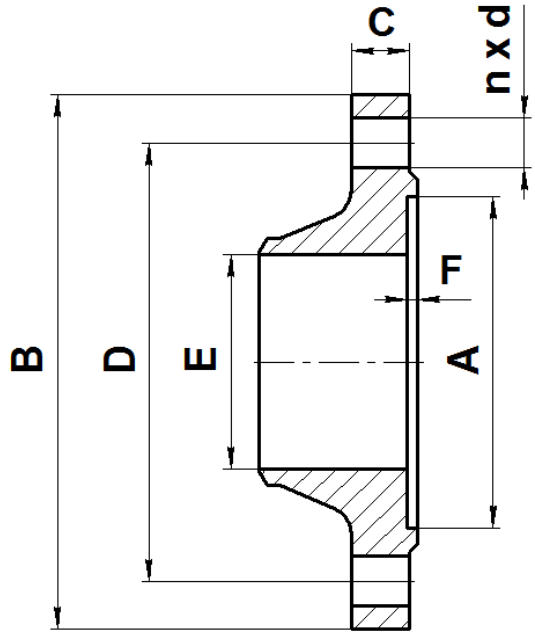


Fig.D.1.2

Fig.D.1 - Flange size for flow meter with pressure configuration ≤ 6,3MPa

Table D.7 Flange size for flow meter with connection type "F1", pressure ≤ 6,3 and the temperature of the measured medium +350°C and + 450°C

Dn, mm	*Connec-tion to pipeline*	*Pressure, MPa*	*Fig.*	*A, mm*	*B, mm*	*C, mm*	*D, mm*	*E, mm*	*F, mm*	*n, pcs*	*d, mm*	*Weight, kg*
040	F1	≤ 4	D.1.2	76	165	21	125	37	3	4	22	3.7
		6.3			165	23	125	37			22	4.0
050	F1	≤ 4		88	175	23	135	47		4	22	4.5
		6.3			195	25	145	45			26	5.6
065	F1	≤ 4		110	200	25	160	64		8	22	6.0
		6.3			220	29	170	62			26	8.5
080	F1	≤ 4		121	210	27	170	77		8	22	7.0
		6.3			230	31	180	75			26	9.9
100	F1	≤ 4		150	250	29	200	94		8	26	10.5
		6.3			265	35	210	92			30	14.4
125	F1	≤ 4		176	295	33	240	118		8	30	16.6
		6.3			310	39	250	112			33	19.3
150	F1	≤ 4		204	340	35	280	142		8	33	24.1
		6.3			350	43	290	136		12	33	37.9
200	F1	≤ 4		260	405	41	345	198		12	33	36.1
		6.3			430	51	360	190			39	54.0
250	F1	≤ 4		313	470	45	400	246		12	39	50.3
		6.3			500	57	430	236			39	85.1
300	F1	≤ 4		364	530	50	460	294	4	16	39	68.3
		6.3			585	66	500	284			45	127.7

Note:

1. Flanges comply with GOST 33259 type 11 GOST 12821.
2. The sealing surfaces of the flanges correspond to version F according to GOST 33259 or version 3 according to GOST 12815.

Table D.8 Flange size for flow meter with connection type "C", “F”, "FR" pressure ≤ 6,3 Dn ≤ 100mm

Dn, mm	Connection to pipeline	Pressure, MPa	Temp, °C	Fig.	A, mm	B, mm	C, mm	D, mm	E, mm	F, mm	n, pcs	d, mm	Weight, kg
015	C	≤ 2.5	<=320	D.1.1	65	115	16	85	19	4	4	14	1.0
		4		D.1.2		115	14	85	15			14	1.1
		6.3				135	18	100	15			18	2.2
015	F	≤ 2.5	<=320	D.1.1	39	95	14	65	19		4	14	0.7
		4		D.1.2		95	14	65	15			14	0.75
		6.3			65	135	18	100	15			18	2.2
025	C, F, FR	≤ 2.5	<=320	D.1.1	65	115	16	85	33		4	14	1.1
		4		D.1.2		115	14	85	25			14	1.1
		6.3				135	20	100	25			18	2.2
032	C, F, FR	≤ 2.5	<=320	D.1.1	72	135	18	100	39		4	18	1.7
		4		D.1.2		135	16	100	31			18	1.8
		6.3				150	21	110	31			22	2.9
040	C, F	≤ 2.5	<=320	D.1.1	80	145	19	110	46		4	18	2.1
		≤ 2.5	>=350	D.1.2		145	16	110	38			18	2.1
		4	all			145	16	110	38			18	2.1
		6.3				165	21	125	37			22	3.7
050	C, F, FR	≤ 2.5	<=320	D.1.1	90	160	21	125	59		4	18	2.7
		≤ 2.5	>=350	D.1.2		160	17	125	48			18	2.5
		4	all			160	17	125	48			18	2.7
		6.3				175	23	135	47			22	4.5
065	C	≤ 2.5	<=320	D.1.1	105	230	25	190	78		8	22	6.7
		4		D.1.2		230	23	190	66			22	8.6
		6.3				250	29	200	64			26	12.8
065	F	≤ 2.5	<=320	D.1.1	105	180	21	145	78		8	18	3.1
		≤ 2.5	>=350	D.1.2		180	19	145	66			18	3.6
		4	all			180	19	145	66			18	3.6
		6.3				200	25	160	64			22	6.0
080	C, F, FR	≤ 2.5	<=320	D.1.1	120	195	23	160	91		8	18	4.0
		≤ 2.5	>=350	D.1.2		195	19	160	78			18	4.3
		4	all			195	21	160	78			18	4.6
		6.3				210	27	170	77			22	7.0
100	C, F, FR	≤ 2.5	<=320	D.1.1	140	230	25	190	110		8	22	5.7
		≤ 2.5	>=350	D.1.2		230	21	190	96			22	6.3
		4	all			230	23	190	96			22	6.8
		6.3				250	29	200	94			26	10.5

Appendix D

Table D.9 Flange size for flow meter with connection type "C1,"F1", "FR1", pressure ≤ 6,3 and the temperature of the measured medium ≤ +320 ° C

Dn, mm	Connec-tion to pipeline	Pressure, MPa	Fig.	A, mm	B, mm	C, mm	D, mm	E, mm	F, mm	n, pcs	d, mm	Weight, kg
015	C1, F1	≤ 2,5 (type 01)	D.1.1	58	115	16	85	19	3	4	14	1.0
		≤ 2,5 (type 11)	D.1.2		115	14	85	25			14	1.1
		4	D.1.2		115	14	85	15			14	1.1
		6.3			135	20	100	15			18	2.2
025	C1, F1, FR1	≤ 2,5 (type 01)	D.1.1	58	115	16	85	33		4	14	1.1
		≤ 2,5 (type 11)	D.1.2		115	14	85	25			14	1.1
		4	D.1.2		115	14	85	25			14	1.1
		6.3			135	20	100	25			18	2.2
032	C1, F1, FR1	≤ 2,5 (type 01)	D.1.1	66	135	18	100	39		4	18	1.7
		≤ 2,5 (type 11)	D.1.2		135	16	100	31			18	1.8
		4	D.1.2		135	16	100	31			18	1.8
		6.3			150	21	110	31			22	2.9
040	C1, F1	≤ 2,5 (type 01)	D.1.1	76	145	19	110	46		4	18	2.1
		≤ 2,5 (type 11)	D.1.2		145	16	110	38			18	2.1
		4	D.1.2		145	16	110	38			18	2.1
		6.3			165	21	125	37			22	3.7
050	C1, F1, FR1	≤ 2,5 (type 01)	D.1.1	88	160	21	125	59		4	18	2.7
		≤ 2,5 (type 11)	D.1.2		160	17	125	49			18	2.7
		4	D.1.2		160	17	125	48			18	2.7
		6.3			175	23	135	47			22	4.5
065	C1, F1	≤ 2,5 (type 01)	D.1.1	110	180	21	145	78		8	18	3.1
		≤ 2,5 (type 11)	D.1.2		180	19	145	66			18	3.7
		4	D.1.2		180	19	145	66			18	3.6
		6.3			200	25	160	64			22	6.0
080	C1, F1, FR1	≤ 2,5 (type 01)	D.1.1	121	195	23	160	91		8	18	4.0
		≤ 2,5 (type 11)	D.1.2		195	19	160	78			18	4.5
		4	D.1.2		195	21	160	78			18	4.6
		6.3			210	27	170	77			22	7.0
100	C1, F1, FR1	≤ 2,5 (type 01)	D.1.1	150	230	25	190	110		8	22	5.7
		≤ 2,5 (type 11)	D.1.2		230	21	190	96			22	6.6
		4	D.1.2		230	23	190	96			22	6.8
		6.3			250	29	200	94			26	10.5
125	F1	≤ 2,5 (type 01)	D.1.1	176	270	27	220	135		8	26	8.2
		≤ 2,5 (type 11)	D.1.2		270	23	220	121			26	9.5
		4	D.1.2		270	25	220	120			26	9.5
		6.3			295	33	240	118			30	16.6
150	F1	≤ 2,5 (type 01)	D.1.1	204	300	27	250	161		8	26	9.8
		≤ 2,5 (type 11)	D.1.2		300	25	250	161			26	12.6
		4	D.1.2		300	27	250	145			26	12.6
		6.3			340	35	280	142			33	24.1

Table D.9: continued

Dn, mm	*Connec-tion to pipeline*	*Pressure, MPa*	*Fig.*	*A, mm*	*B, mm*	*C, mm*	*D, mm*	*E, mm*	*F, mm*	*n, pcs*	*d, mm*	*Weight, kg*
200	F1	≤ 2,5 (type 01)	D.1.1	260	360	29	310	222		12	26	13.0
		≤ 2,5 (type 11)	D.1.2		360	27	310	202			26	17.4
		4	D.1.2		375	35	320	200			30	23.5
		6.3			405	41	345	198			33	36.1
250	F1	≤ 2,5 (type 01)	D.1.1	313	425	31	370	273		12	30	18.5
		≤ 2,5 (type 11)	D.1.2		300	29	370	254			30	25.7
		4	D.1.2		445	39	385	252			33	36.5
		6.3			470	45	400	246			39	50.3
300	F1	≤ 2.5	D.1.1	364	485	32	430	325	4	16	30	23.3
		4	D.1.2		510	42	450	301			33	50.3
		6.3			530	50	460	294			39	68.3

Note:

1. Flanges for pressure ≤ 2,5 MPa, except for Dn15, comply with GOST 33259 type 01 (GOST 12820) or type 11 (GOST 12821).
2. Flanges for pressure 4 and 6,3 MPa, except for Dn15, comply with GOST 33259 type 11 (GOST12821).
3. The sealing surfaces of the flanges correspond to version F according to GOST 33259 or version 3 according to GOST 12815.

Appendix D

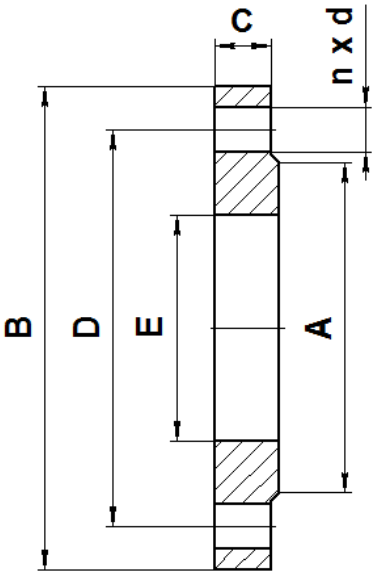


Fig.D.2.1

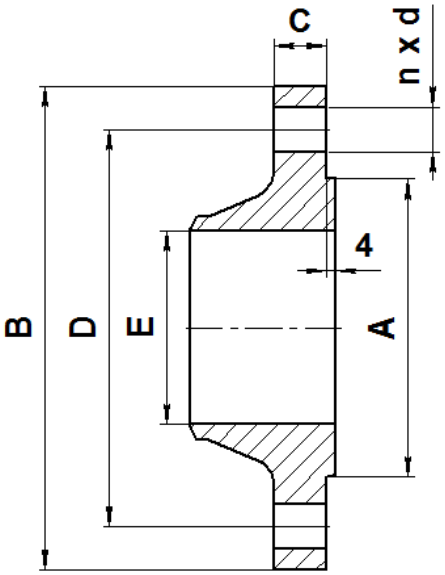


Fig.D.2.2

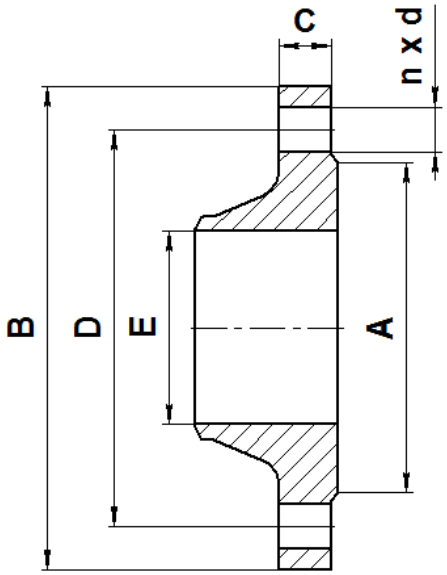


Fig.D.2.3

Fig.D.2 - Flange size for flow meter of "F" configuration pressure ≤ 6,3MPa, Dn > 100mm

Table D.10 Flange size for flow meter with connection type "F" pressure ≤ 6,3 Dn > 100mm

Dn, mm	Connection to pipeline	Pressure, MPa	Temp, °C	Fig.	A, mm	B, mm	C, mm	D, mm	E, mm	n, pcs	d, mm	Weight, kg
125	F	≤ 2.5	<=320	D.2.1	184	270	27	220	135	8	26	8.2
		≤ 2.5	>=350	D.2.3	184	270	23	220	121		26	9.4
		4	all	D.2.2	175	270	25	220	120		26	10,2
		6.3			175	295	32	240	118		30	17.0
150	F	≤ 2.5	<=320	D.2.1	212	300	27	250	161	8	26	10.1
		≤ 2.5	>=350	D.2.3	212	300	25	250	146		26	12.5
		4	all	D.2.2	203	300	27	250	145		26	13.2
		6.3			203	340	35	280	142		33	25.4
200	F	≤ 2.5	<=320	D.2.1	278	360	29	310	222	12	26	13.3
		≤ 2.5	>=350	D.2.3	278	360	27	310	202		26	17.4
		4	all	D.2.2	259	375	35	320	200		30	24.0
		6.3			259	405	41	345	200		33	38.5
250	F	≤ 2.5	<=320	D.2.1	335	425	31	370	273	12	30	18.9
		≤ 2.5	>=350	D.2.3	335	425	29	370	254		30	24.4
		4	all	D.2.2	312	445	39	385	252		33	37.3
		6.3			312	470	45	400	246		39	53.8
300	F	≤ 2.5	<=320	D.2.1	390	485	32	430	325	16	30	24.0
		≤ 2.5	>=350	D.2.3	390	485	32	430	303		30	33.3
		4	all	D.2.2	363	510	42	450	301		33	50.6
		6.3			363	530	50	460	294		39	74.6

Fig.D11 - Flange size for "C" configuration 10-25MPa

Dn	Pressure, MPa	Stud GOST 9066	Nut GOST 9064	Gasket GOST P 53561	Pcs.		
					Pins	Nuts	Gaskets
15	10, 16	Ам16х180 *	AM16 (S24)	1-1-25-200	4	12	2
	20, 25	AM24x220	AM24 (S36)			8	
25	10, 16	Ам16х180 *	AM16 (S24)	1-1-25-200	4	12	2
	20, 25	AM24x220	AM24 (S36)			8	
32	10, 16	AM20x200	AM20 (S30)	1-1-32-200	4	8	2
	20, 25	AM24x220	AM24 (S36)				
40	10, 16	Ам20х200 *	AM20 (S30)	1-1-32-200	4	12	2
	20, 25	AM24x220	AM24 (S36)			8	
50	10, 16	AM24x260	AM24 (S36)	1-1-50-200	4	8	2
	20, 25	Ам24х260 *	AM24 (S36)		8	20	
65	10, 16	Ам24х260 *	AM24 (S36)	1-1-50-200	8	20	2
	20, 25	AM27x280 *	AM27 (S41)				
80	10, 16	Ам24х260 *	AM24 (S36)	1-1-50-200	8	20	2
	20, 25	AM30x320 *	AM30 (S46)				
100	10, 16	AM27x280 *	AM27 (S41)	1-1-80-100	8	20	2
	20, 25	AM36x360 *	AM36 (S55)				
150	10, 16	AM30x320 *	AM30 (S46)	1-1-150-160	12	28	2
200	10, 16	AM36x400 *	AM36 (S55)	1-1-150-200	12	28	2
	20, 25	AM42x420 *	AM42 (S65)				
250	10, 16	AM36x450 *	AM36 (S55)	1-1-200-160	12	28	2
300	10, 16	AM42x540 *	AM42 (S65)	1-1-300-160	16	36	2

Note:

1. * Two studs are full-length threaded
2. Do not install washers.

Fig.D12 - Fasteners for "F1" configuration 10-16MPa

Dn	Stud GOST 9066	Nut GOST 9064	Gasket GOST P 53561		Pcs.		
			10 MPa	16 MPa	Studs	Nuts, washers	Gaskets
15	AM12x80	AM12 (S18)	1-1-15-160		8	16	2
25	AM16x100	AM16 (S24)	1-1-25-200		8	16	2
32	AM20x120	AM20 (S30)	1-1-32-200		8	16	2
40	AM20x120	AM20 (S30)	1-1-40-200		8	16	2
50	AM24x160	AM24 (S36)	1-1-50-100	1-1-50-200	8	16	2
65	AM24x160	AM24 (S36)	1-1-65-160		16	32	2
80	AM24x160	AM24 (S36)	1-1-80-100	1-1-80-160	16	32	2
100	AM27x160	AM27 (S41)	1-1-100-160		16	32	2
125	AM30x190	AM30 (S46)	1-1-125-100	1-1-125-160	16	32	2
150	AM30x190	AM30 (S46)	1-1-150-100	1-150-16 GOST 26.260.461-99	24	48	2
200	AM36x240	AM36 (S55)	1-1-200-100	1-1-200-160	24	48	2
250	AM36x240	AM36 (S55)	1-1-250-100	1-1-250-160	24	48	2
300	AM42x280	AM42 (S65)	1-1-300-100	1-1-300-160	32	64	2

Note: Washer are not applied for 1,6MPa versions

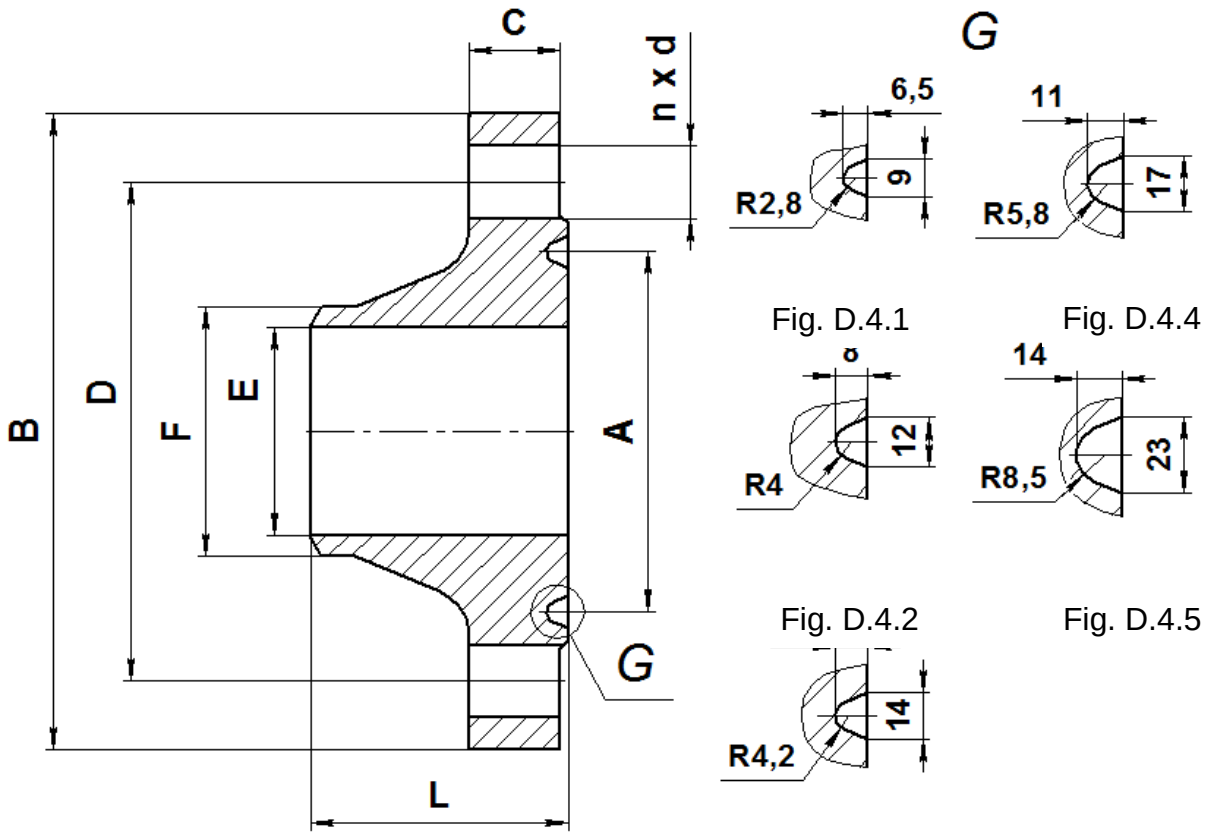
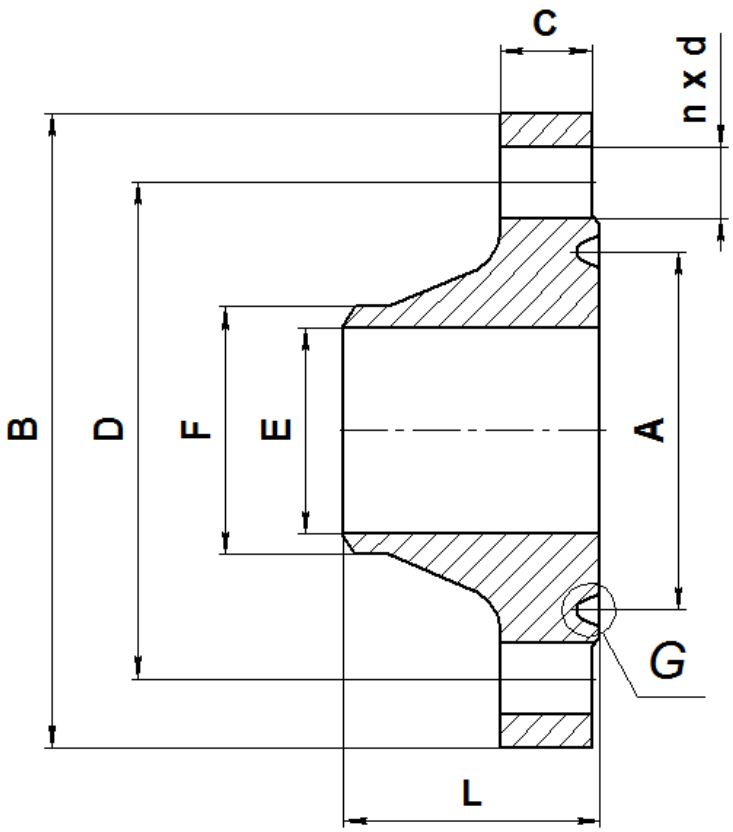


Fig.D3 - Flange size for "C" configuration 10-25MPa

Table.D13 - Flange size for "C" configuration 10-25MPa

Dn	*Pressure, MPa*	*A, mm*	*B, mm*	*C, mm*	*D, mm*	*E, mm*	*F, mm*	*L, mm*	*n, pcs*	*d, mm*	*Fig.*	*Weight, kg*
15	10, 16	50	135	22	100	14	22	52	4	18	D.4.1	2.3
	20, 25		150	28	102	14	22	62	4	26	D.4.1	3.5
25	10, 16	50	135	22	100	25	33	58	4	18	D.4.1	2.5
	20, 25		150	28	102	25	36	62	4	26	D.4.1	3.5
32	10, 16	65	150	22	110	31	39	67	4	22	D.4.1	3
	20, 25		160	30	115	31	43	67	4	26	D.4.1	4.3
40	10, 16	65	165	25	125	37	46	75	4	22	D.4.1	4
	20, 25		170	31	124	36	49	75	4	26	D.4.1	5.3
50	10, 16	95	195	27	145	45	58	78	4	26	D.4.2	6.3
	20, 25		210	37	160	46	61	98	8	26	D.4.2	9.8
65	10, 16	95	220	31	170	62	77	88	8	26	D.4.2	8.8
	20, 25		260	45	203	65	90	121	8	30	D.4.2	19
80	10, 16	95	230	33	180	75	90	93	8	26	D.4.2	10
	20, 25		290	51	230	75	110	135	8	33	D.4.2	28
100	10, 16	115	265	37	210	92	110	103	8	30	D.4.2	15
	20, 25		310	54	240	92	114	118	8	39	D.4.2	29
150	10, 16	205	350	47	290	136	161	133	12	33	D.4.3	34
200	10, 16	240	430	57	360	192	222	148	12	39	D.4.4	58
	20, 25	240	485	59	400	192	245	180	12	45	D.4.4	88
250	10, 16	275	500	65	430	236	278	168	12	39	D.4.4	92
300	10, 16	380	585	74	500	284	330	189	16	45	D.4.5	136



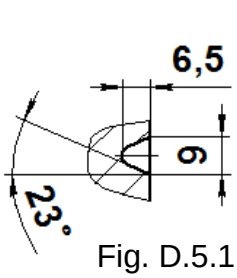


Fig. D.5.1

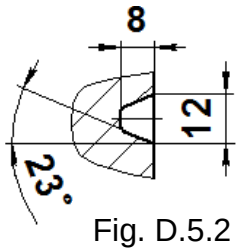


Fig. D.5.2

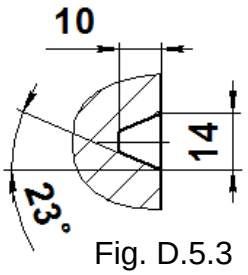


Fig. D.5.3

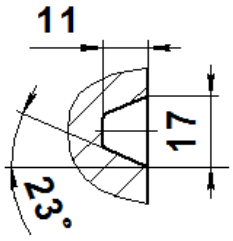


Fig. D.5.4

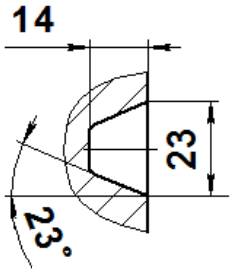


Fig. D.5.5

Fig.D.4 - Flange size for "F1" configuration 10-16MPa

Table.D.14 - Flange size for "F1" configuration 10-16MPa

Dn	*Pressure, MPa*	*A, mm*	*B, mm*	*C, mm*	*D, mm*	*E, mm*	*F, mm*	*L, mm*	*n, pcs*	*d, mm*	*Fig.*	*Weight , kg*
15	10-16	35	105	18	75	12	19	52	4	14	D.5.1	1.2
25	10-16	50	135	22	100	25	33	58	4	18	D.5.1	2.4
32	10-16	65	150	22	110	31	39	67	4	22	D.5.1	3
40	10-16	75	165	25	125	37	46	75	4	22	D.5.1	3.9
50	10	85	195	25	145	45	58	71	4	26	D.5.2	5.9
	16	95		27				78				6.3
65	10-16	110	220	31	170	62	77	88	8	26	D.5.2	8.8
80	10	115	230	31	180	75	90	90	8	26	D.5.2	9.8
	16	130		33				93				10,2
100	10-16	145	265	37	210	92	110	103	8	30	D.5.1	15
125	10	175	310	39	250	112	135	115	8	33	D.5.2	23
	16	190		41				118				23.8
150	10	205	350	43	290	136	161	128	12	33	D.5.2	31.8
	16	205		47				133			D.5.3	34
200	10	265	430	51	360	190	222	143	12	39	D.5.2	53
	16	275		57				148			D.5.4	57
250	10	320	500	57	430	236	278	163	12	39	D.5.2	85
	16	330		65				168			D.5.4	92
300	10	375	585	66	500	284	330	184	16	45	D.5.2	127
	16	380		74				189			D.5.5	136

Note: Flanges comply with GOST 33259 type 11 configuration J.

Table D.15 Fasteners material

Mounting kit content	Version	Standard version	Upon request*
Studs, bolts	All	Galvanized steel	12X18H10T, 30XMA
Nuts, washers	All	Galvanized steel	12X18H10T, 30XMA
Gaskets	Pressure up to 6.3 MPa	Paronite ПОН-Б	Graflex, Spiral wound Gasket, Paronite PMB
	Pressure 10-25 MPa	Steel 09Г2С	12X18H10T
	T =+350°C and +450°C	Graflex, Spiral wound Gasket	

Note: * Can be made of other materials upon the agreement with the customer

Table D.16 Recommended pipeline size (inner diameter x wall thickness)

Dn, mm	C, F, FR P = 1.6 - 2.5 MPa		C, F, FR P = 4 - 6.3 MPa		C1, F1, FR 1 P = 1.6 - 6.3 MPa		P = 10 - 25 MPa		EV200-T P = 1.6 - 4 MPa	
	Line 1	Line 2	Line 1	Line 2	Line 1	Line 2	Line 1	Line 2	Line 1	Line 2
15	18x1.5	20x2.5	18x1.5	20x2.5	18x1.5	20x2.5	20x3	22x4	--	--
25	32x3	30x2	32x3	30x2	32x3	30x2	32x3.5	35x5	--	--
32	38x2.5	38x3	38x2.5	38x3	38x2.5	38x3	38x3	42x5	--	--
40	45x2.5	48x3.5	45x2.5	48x3.5	45x2.5	48x3.5	45x4	48x5	--	--
50	57x3.5	57x4	57x3.5	57x4	57x3.5	57x4	57x6	60x7	76x5	76x6
65	76x5	76x6	76x5	76x6	76x5	76x6	76x7	89x13	--	--
80	89x4.5	89x5	89x4.5	89x5	89x4.5	89x5	89x7	108x16	89x8	89x7
100	108x4	108x5	108x4	108x5	108x4	108x5	108x8	114x11	--	--
125	133x5	133x4	133x5	133x4	133x5	133x4	133x9	140x12	--	--
150	159x5	159x6	152x7	159x8	159x5	159x6	159x9	165x12	--	--
200	219x6	219x8	203x8	219x14	219x8	219x9	219x12	219x11	--	--
250	273x6	273x8	245x7	273x16	273x8	273x10	273x16	273x14	--	--
300	325x6	325x10	299x9	325x16	325x10	325x12	325x16	325x14	--	--

Note: It is recommended to use pipes complying with GOST 8732, GOST 8734.

Appendix E
(normative)

List of measuring instruments used for calibration

Table F.1 - List of measuring and auxiliary devices needed for device error calculation

Name	***Type***	***Specification***
1. Mercury glass laboratory thermometer	TL GOST 28498	Measurement range 0 – 55 °C, division 0.1 °C
2. DC power supply - 2 pcs.	B5-45 ЕЭ3.233.219 TU	DC upper voltage limit 49.9 V, current up to 100 mA.
3. Digital frequency meter	Ч3-88 under TU BY 100039847.076-2006	Output signal frequency range from 0.1 Hz to 200 MHz
4. Stopwatch	STCT -1 TUУ25-07.1353-77	Accuracy ± 0,1 sec.
5. Personal computer		Personal computer with installed Windows 95/98/2000, EMIS-Integrator and reserved COM-port.
6. Calibration unit	UPSG 100/BM TU 4381-001-55749794-2002	Flow range from 0.03 up to 100m3/h, relative error for comparison method not exceeds ±0,25 %, for indirect method not exceeds ±0,05 %.
7. Calibration units for gas meters	UPSG	Flow range from 1 to 4000 m3/h. Relative error for air measurement not exceeds ± 0,35 %.

Note: Calibration units other than mentioned herein can be used if their technical and metrological parameters comply with the specified requirements. Measurement devices shall be calibrated and have approval marks in the data sheet.

Table F.2 - List of measuring and auxiliary devices needed for accuracy measurement with simulation method.

Name	*Type*	*Specification*
1. Mercury glass laboratory thermometer	TL GOST 28498	Measurement range 0 – 55 °C, division 0.1 °C
2. DC power supply unit	B5-44 TU 3.233.219	DC upper voltage limit 49.9 V, current up to 100 mA.
3. Digital frequency meter	Ч3-88 under TU BY 100039847.076-2006	Input signal frequency range from 0.1 Hz to 200 MHz
4. Stopwatch	STC -1 TU25-07.1353-77	Accuracy ± 0.1 sec.
5. Lever-type micrometers	0-25 and 25-50 TU 2-034-227-87	Accuracy ± 0.01 %
6. Digital caliper	ЩЦЦ-150 GOST 166	Accuracy ± 0.03 %
7 Signal generator	G6-27 GOST 22261	Frequency range 0,. Hz...3 MHz stability not less than 0.05 %
8 Digital voltmeter	B7-65/5	Measurement limits from (0-0,05) to 1000 V, accuracy 0.02 % + 5dgt
9 Resistance multiplier	R4831	Resistance up to 1000Ohm, relative accuracy not exceed ± 0,05 %.
10 Personal computer	Personal computer IBM compatible	Windows 95/98/2000/XP/Vista/7 with installed EMIS-Integrator and reserved COM or USB port or line output.
11. Oscilloscope	C1-117/1 tGTГ2.044.016TU	Range not less than 100 kHz sensitivity not less than 10mV/div
12. Protocol converter RS485/USB	EMIS-MASS 750	
13 Testing cables	EV200.KIP	

Note: Calibration units other than mentioned herein can be used if their technical and metrological parameters comply with specified requirements. Measurement devices shall be calibrated and have approval marks in the data sheet.

EMIS
454091 Russian Federation, Chelyabinsk bld.3, room 308 Lenina Ave

Sales department
+7 (351) 729-99-12 (multichannel)
+7 (351) 729-99-16
sales@emis-kip.ru

Maintenance department
+7 (351) 729-99-12
add. 741, 744, 756, 763
support@emis-kip.ru