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V4.2.3

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

For versions EV-200, EV-205, EV-200-PPD

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

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EMIS flowmeters manufacturer

The present manual intended for learning the device operation, operating rules, maintenance and calibration of the vortex flow transducers “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 meter.

The design of the transducer 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 ***Appendix*** A.

EMIS CJSC has the right to update the product and documents without prior notice if it does not affect product performance.

CONTENTS

1 DESCRIPTION AND OPERATION

1.1. Intended use of the flow meter

1.1.1 Flow transducer 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 and can be applied in different manufacturing spheres and as a part of heat, gas, steam metering systems.

Flow transducer of PPD version shall be used as part of reservoir pressure maintenance systems, for measuring of Senomanian water or other liquids under high pressure.

Flow transducers 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 transducers are divided into full bore (EV-200) and submersible (EV-205). There are two types of installation on the pipe:

- non-flange, wafer type, code C or C1, for 15mm to 300mm pipe size;
- flange, code F or F1, for 15mm to 300mm pipe size;
- flange with integrated reducer, code FR or FR1, for 25mm to 100mm pipe size;
- clamp connection, code T, for 50mm to 80mm pipe size;
- for reservoir pressure maintenance systems, code PPD, for 50mm, 80mm, 100mm and 150mm pipe size.

Submersible transducer EV-205 has installation code PR for 300mm to 2000mm pipe size.

Measuring method of EV-205 corresponds to GOST 8.361.

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

1) temperature range from -60 to +450ºC; temperature ranges and corresponding flow meter types are given in table 1.1.

Table 1.1 Temperature versions

Version	*Code*	*Medium temperature, °C*	
		min	*max*
EV-200	«70»	- 40 (- 60*)	+ 70
EV-200	«100»	- 40 (- 60*)	+ 100
EV-200	«250»	- 40 (- 60*)	+ 250
EV-200	«320»	- 40 (- 60*)	+ 320
EV-200	«450»	- 40 (- 60*)	+ 450
PPD	«100»	0	+ 100
EV-205	«100»	-40	+ 100
EV-205	«250»	-40	+ 250

Note: * As special order, the minimal temperature can be decreased to -60 ºC, except for ex-proof versions RV, RVI, RO.

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;
- max 4.0 MPa for T version;
- max 4.0 MPa for PR version;
- max 25 MPa for PPD and X versions (special version).

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%;

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 transducers shall be used in explosion proof environment.

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

Flow transducer 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" and 1Ex ia IIC(T1-T6)Gb X marking.

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

Flow transducer of explosion proof configuration PBI intended for underground use in mines, pits and related overground facilities hazardous with mine gas and combustible dust. Is provided with combined explosion protection "intrinsically safe circuit" and "explosion proof enclosure", masked as PB Ex d ib I Mb X.

Flow transducer of explosion proof configuration PO 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" and PO Ex ia I Ma X marking.

Explosion proof configurations PB, PBI and PO are supplied with ex-proof boxes.

Explosion proof safety aspects are described in 1.3. Explosion protection

1.1.5 Flow transducer has IP67 protection under GOST 14254, and conform with standard configuration underGOST P 52931.

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

1.1.7 Transducers in the range from Qp to Qmax (see table 1.7) are resistant to 10-100 Hz vibration with acceleration not exceeding 4,9 m/s2 and refers to NX group underGOST P 52931.

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

1.1.9 Flow meters can be operated in boreal climates location class 1 under GOST 15150.

Ambient temperature for all transducers (not include mine configuration) shall be in the range of -40°C to +70°C (for special configurations of -50°C to +70°C or -60°C to +70°C), humidity 95±3% non-condensing at +35°C.

For mine configurations PB, PBI and PO ambient temperature shall be 0 to +70°C.

For ExB, ExC, ExiaB, ExiaC configurations LCD display works at temperature not lower than -20ºC.

For Вн configuration LCD display works at temperature not lower than -40ºC.

For T version transducer with 2-wire connection type the LCD display works at temperature not lower than -20ºC.

1.1.10 To place the order correctly please see symbols as listed in the table 1.2.1 and table 1.2.2.

Table 1.1.1 - EV-200 and EV-205 symbols

Code	0	Item name				
	EMIS-VIHR 200	Full-bore				
	EMIS-VIHR 205	Insertion type				
Code	1	Explosion protection				
	–	No ex-proof				
	ExB	1Ex ib IIB (T1-T6) Gb X ***				
	ExC	1Ex ib IIC (T1-T6) Gb X ***				
	ExiaB	1Ex ia IIB (T1-T6) Gb X ***				
	ExiaC	1Ex ia IIC (T1-T6) Gb X ***				
	Вн	1Ex d IIC (T1-T6) Gb X				
	PB	PB Ex d I Mb X				
	PBI	PB Ex d ib I Mb X ***				
	PO	PO Ex ia I Ma X ***				
Code	2	Flow meter size (Pipe DN)				
	015	15 mm	100	100 mm	350	350 (fro EV-205 only)
	025	25 mm	125	125 mm	400	400 (fro EV-205 only)
	032	32 mm	150	150 mm	….	…. (for EV-205 only)
	040	40 mm	200	200 mm		
	050*	50 mm	250	250 mm		
	065	65 mm	300	300 mm	2000	2000 (fro EV-205 only)
	080	80 mm			X	special order
Code	3	Accuracy class (see table 1.7)				
	A	Accuracy class A				
	B	Accuracy class B				
	C	Accuracy class C				
Code	4	Flow range				
	–	standard				
	X	special order				
Code	5	Medium				
	L	liquid				
	G	gas/ saturated vapour/ superheated vapour				
	C	oxygen (for EV-200 only)				
Code	6	Flow tube material				
	H	stainless steel by default (see table 1.10)				
	HH	steel 12X18H10T				
	X	special order				
Code	7	Pipeline connection (for EV-200 only)				
	C	wafer (Dn 15-300mm)				
	C1	wafer (Dn 15-100mm) male-female under GOST 33259				
	F	flanged				
	F1	flanged 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				
	T	clamp (Dn50 and Dn80)				
	X	special order				
Code	8	Flow meter mounting				
	–	integrated with sensor				
	R	remote installation (3m cable length) ****				
	RXX	specify cable length for remote installation (up to 50m)				

Code	9	Max pressure of medium
	1.6	up to 1.6MPa
	2.5	up to 2.5MPa
	4.0	up to 4.0MPa
	6.3	up to 6.3MPa (for EV-200 only)
	10	up to 10MPa (for EV-200 only)
	16	up to 16MPa (for EV-200 only)
	20	up to 20MPa (for EV-200 only)
	25	up to 25MPa (for EV-200 only)
	X	special order
Code	**10**	Max medium temperature
	70	up to +70ºC
	100	up to +100ºC
	250	up to +250ºC
	320	up to 320ºC (for EV-200 only) ****
	450	up to 450ºC (for EV-200 DN≥40mm flanged version only) ****
	X	special order
Code	**11**	**Display**
	–	n/a
	SIM	integrated display with mechanical keyboard ****
	SIO	integrated display with optical keyboard ****
	SI	integrated display without keyboard ****
	X	special order
Code	**12**	**Flow meter mounting**
	C	base
	BB	extended (with computer) (for EV-200 only)
	C	special low temperature application
	T	2-wire connection (current loop)
Code	**13**	**Output signals**
	–	pulse-frequency, digital ModBus
	A	analog, pulse, digital ModBUS ***
	A1	analog, pulse, ModBUS ***
	H	analog, pulse, digital ModBUS, HART™ v6 ***
	H1	analog w/o additional error, pulse, digital ModBUS, HART™ v6 ***
	H2	analog w/o additional error, digital HART™ v7, 1st pulse-frequency with NAMUR, 2nd pulse-frequency *****
	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**
	–	with two cable glands
	У	with four cable glands (except for ex-proof versions PB, PBI, PO)
Code	**15**	**Calibration**
	–	manufacturer calibration at 5 points, pressure test
	ГП	state calibration
Code	**16**	**Min ambient temperature**
	–	-40 и -50 ºC
	60	-60 ºC ****

Code	*17*	*Min medium temperature;*
	–	-40 ºC
	И60	-60 ºC (for E-200 only)
Code	*18*	*Industrial versions*
	–	standard version
	AST	for hydrogen sulfide mediums

Note: «–» means standard configuration;
* - for clamp connection «T» Dn50 connected to the pipe of Dn65;
** - for 10-25 MPa connected with oval gasket;
*** - except for special version of transmitter;
**** - except for version with 2-wire connection;
***** - for version with 2-wire connection only;

Full-bore EV-200 symbolic specification

Code	*0*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	*17*	*18*
Order	**EMIS-VIHR 200**	**ExB**	**050**	**A**	**–**	**L**	**H**	**F1**	**R**	**2.5**	**250**	**SIO**	**C**	**H**	**–**	**ГП**	**–**	**И60**	**–**

Full-bore EV-205 symbolic specification

Code	*0*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	*17*	*18*
Order	**EMIS-VIHR 205**	**–**	**400**	**B**	**–**	**L**	**H**	**–**	**–**	**2.5**	**100**	**SIO**	**C**	**A**	**–**	**ГП**	**–**	**–**	**–**

Table 1.2.2 - PPD version symbolic specification

0	*Item name*	
EMIS-VIHR 200-PPD	PPD version	
1	*Size (pipe diameter/flow range code)*	*Configuration*
50/10	Pipe Dn 50mm, flow range 10	**–**
50/20	Pipe Dn 50mm, flow range 20	**–**
50/25	Pipe Dn 50mm, flow range 25	**–**, 1
50/50	Pipe Dn 50mm, flow range 50	**–**
50/60	Pipe Dn 50mm, flow range 60	**–**
80/20	Pipe Dn 80mm, flow range 20	**–**
80/25	Pipe Dn 80mm, flow range 25	1
80/35	Pipe Dn 80mm, flow range 35	**–**
80/50	Pipe Dn 50mm, flow range 80	**–**, 1
80/100	Pipe Dn 80mm, flow range 100	1
80/150	Pipe Dn 80mm, flow range 150	**–**
100/25	Pipe Dn 100mm, flow range 25	**–**
100/50	Pipe Dn 50mm, flow range 100	**–**
100/120	Pipe Dn 100mm, flow range 120	**–**
100/200	Pipe Dn 100mm, flow range 200	**–**, 1
100/300	Pipe Dn 100mm, flow range 300	**–**
150/500	Pipe Dn 150mm, flow range 500	1
X	special order	
2	*Accuracy class (see table 1.7)*	
–	Accuracy class C (standard version)	
A	Accuracy class A	
B	Accuracy class B	

3	***Max pressure of medium***
–	up to 25 MPa (standard version)
20	up to 20 MPa
4	***Display***
–	n/a
SIM	integrated display with mechanical keyboard
SIO	integrated display with optical keyboard
5	***Configuration***
-	standard version
1	version 1
X	special order
6	***Output signals***
–	pulse-frequency, digital ModBus
A	analog, pulse, digital ModBUS ***
A1	analog w/o additional error, pulse, ModBUS
H	analog, pulse, digital ModBUS, HART™ v6
H1	analog w/o additional error, pulse, digital ModBUS, HART™ v6
X	special order
7	***Calibration***
–	manufacturer calibration at 5 points, pressure test
ГП	state calibration
8	***Min ambient temperature***
–	-40 и -50 ºС
60	-60 ºС
9	***Flow tube material***
–	steel 20Х13 - standard version
НН	steel 12Х18Н10Т
X	special order
10	***Industrial versions***
–	standard version
AST	for hydrogen sulfide mediums

PPD version symbolic specification

Code	***0***	***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***	***9***	***10***
Order	**EMIS-VIHR 200-PPD**	**100/50**	**–**	**–**	**SIO**	**–**	**A**	**ГП**	**–**	**–**	**–**

1.1.11 PPD configuration has the following parameters:
- 1Ex d IIC T5 Gb X ex-proof marking for EV-200Вн
- measuring medium - liquid;
- measuring medium temperature from 0 to 100 °C;
- flangless version;
- integrated with sensor

1.1.12 AST version 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.

1.1.13 To place the order for mounting kit correctly please see symbols as listed in table 1.2.3 and table 1.2.4.

Table 1.2.3 - EV-200 and EV-205 mounting kit symbols

Code	0	Item name				
	EMIS-VIHR 200	Full-bore type mounting kit				
	EMIS-VIHR 205	Insertion type mounting kit				
Code	***1***	***Flow meter size (Pipe DN)***				
	015	15 mm	**100**	100 mm	**350**	350 (fro EV-205 only)
	025	25 mm	**125**	125 mm	**400**	400 (fro EV-205 only)
	032	32 mm	**150**	150 mm	**….**	…. (for EV-205 only)
	040	40 mm	**200**	200 mm		
	050	50 mm	**250**	250 mm		
	065	65 mm	**300**	300 mm	**2000**	2000 (fro EV-205 only)
	080	80 mm			**X**	special order
Code	***2***	***Pipeline connection (for EV-200 only)***				
	C	wafer (Dn 15-300mm)				
	C1	wafer (Dn 15-100mm) male-female under GOST 33259				
	F	flanged				
	F1	flanged 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				
	T	clamp (Dn 50 and Dn 80)				
	X	special order				
Code	***3***	***Max pressure of medium***				
	1.6	up to 1.6MPa			**10**	up to 10MPa (for EV-200 only)
	2.5	up to 2.5MPa			**16**	up to 16MPa (for EV-200 only)
	4.0	up to 4.0MPa			**20**	up to 20MPa (for EV-200 only)
	6.3	up to 6.3MPa (for EV-200 only)			**25**	up to 25MPa (for EV-200 only)
					X	special order
Code	***4***	Max medium temperature (for EV-200 only)				
	70	up to +70ºC				
	100	up to +100ºC				
	250	up to +250ºC				
	320	up to +320ºC				
	450	up to +450ºC				
	X	special order				
Code	***5***	***Flange material***				
	–	Steel 09Г2С				
	St20	Steel 20				
	H	stainless steel				
	13ХФА	Steel 13ХФА				
	X	special order				
Code	***6***	***Flange standard (for EV-200 only)***				
	–	version according to the Manual				
	ASME	ANSI / ASME standard				
	EN	EN1092-1 standard				
	X	special order				
Code	***7***	***Ball valve (for EV-200 only)***				
	–	None				
	C	with ball valve				

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

Full-bore EV-200 symbolic specification

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

Insertion type EV-205 mounting kit symbolic specification

Code	0	1	3	5	7
Order	Mounting kit EMIS-VIHR 200	800	1.6	H	–

Table 1.2.4 - Mounting kit symbols for PPD version

0	Item name	
EMIS-VIHR 200-PPD	PPD version mounting kit	
1	Size (pipe diameter/flow range code)	
50/10	80/20	100/25
50/20	80/25	100/50
50/25	80/35	100/120
50/50	80/50	100/200
50/60	80/100	100/300
	80/150	150/500
2	Configuration	
-	standard version	
1	version 1	
X	special order	
3	Flange material	
–	Steel 09Г2С	
St20	Steel 20	
H	stainless steel	
13ХФА	Steel 13ХФА	
X	special order	

PPD version mounting kit symbolic specification

Code	0	1	2	3
Order	Mounting kit EMIS-VIHR 200-PPD	100/50	-	H

1.2 Parameters

1.2.1 EV-200 and EV-205 minimum (Qmin) and maximum (Qmax) volume flow rate of water and air measured at 20°C and zero pressure are shown in table 1.3 and 1.4 accordingly.

Table 1.3 - EV-200 flow ranges

Flow meter size (DN), mm	Pipeline connection code	Temperature code for medium	Flow volume*, cbm/h			
			Water		Air	
			Qmin	Qmax	Qmin	Qmax
15	C, F, C1, F1	70, 100	0.5	5	4.5	32
		250.320	0.5	5	7	32
25	FR, FR1	70, 100	0.5	5	4.5	32
		250.320	0.5	5	7	32
25	C, F, C1, F1	70, 100	0,6 (0,4)	16	8	120
		250.320	0.6	16	12.5	120
32	FR, FR1	70, 100	0,6 (0,4)	16	8	120
		250.320	0.6	16	12.5	120
32	C, F, C1, F1	70, 100	0,8 (0,6)	26	10	200
		250.320	0.8	26	13	200
40	C, F, C1, F1	70, 100	1,4 (1)	41	12	310
		250.320	1.4	41	20	310
		450	3.4	41	31	310
50	FR, FR1	70, 100	0,8 (0,6)	26	10	200
		250.320	0.8	26	13	200
50	C, F, C1, F1	70, 100	2 (1,4)	64	18 (14)	480
		250.320	2	64	30	480
		450	5.3	64	48	480
65	C, F, C1, F1	70, 100	3 (2,6)	107	33 (24)	810
		250.320	3	107	55	810
		450	9	108	81	810
80	FR, FR1	70, 100	2 (1,4)	64	18 (14)	480
		250.320	2	64	30	480
80	C, F, C1, F1	70, 100	4,6 (4)	160	53 (36)	1230
		250.320	4.6	160	60	1230
		450	13	160	123	1230
100	FR, FR1	70, 100	4,6 (4)	160	53 (45)	1230
		250.320	4.6	160	60	1230

Table 1.3: continued

Flow meter size (DN), mm	Pipeline connection code	Temperature code for medium	Flow volume*, cbm/h			
			Water		Air	
			Qmin	Qmax	Qmin	Qmax
100	C, F, C1, F1	70, 100	8 (6)	250	80 (60)	1920
		250.320	8	250	90	1920
		450	21	250	192	1920
125	C, F, F1	70, 100	13 (10)	400	130 (90)	3000
		250.320	13	400	130	3000
		450	33	390	290	2900
150	C, F, F1	70, 100	18 (14)	575	190 (130)	4325
		250.320	18	575	190	4325
		450	47	560	420	4200
200	C, F, F1	70, 100	34 (26)	1060	320 (235)	8000
		250.320	34	1060	330	8000
		450	90	1080	810	8100
250	C, F, F1	70, 100	60 (42)	1700	470 (380)	12900
		250.320	60	1700	500	12900
		450	142	1670	1260	12600
300	C, F, F1	70, 100	95 (60)	2460	680 (550)	18600
		250.320	95	2460	800	18600
		450	200	2400	1820	18200
50, 80 **	T	70, 100	3	107	33	810
		250	3	107	55	810

Note:

1. As special order for temperature configurations under +100°C, we can produce transducer with extended flow range, the lower limit of extended range is indicated in brackets next to the main range lower limit. It shall be specified in order sheet by placing X after Dn and accuracy class (e.g. 080-Б-X means transducer of Dn80mm with Б accuracy class and extended flow range). In this case the accuracy for flow range lower than standard is not specified.*

*2.** For T configuration the flow range can be other than standard which is specified in transducer passport. It shall be specified in order sheet by placing X after Dn and accuracy class.*

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

Table 1.4 - EV-205 flow ranges

Flow meter size (DN), mm	Pipeline connection code	Temperature code for medium	Flow volume*, cbm/h			
			Water		Air	
			Qmin	Qmax	Qmin	Qmax
40	**Flow sensor PR**	70, 100, 250	1.4	18	23	144
300	**PR**	70, 100, 250	75	2030	1670	15230
350	**PR**	70, 100, 250	100	2770	2280	20770
400	**PR**	70, 100, 250	130	3630	2980	27240
450	**PR**	70, 100, 250	165	4600	3780	34550
500	**PR**	70, 100, 250	200	5700	4680	42750
600	**PR**	70, 100, 250	300	8200	6770	61800
700	**PR**	70, 100, 250	400	11300	9260	84500
800	**PR**	70, 100, 250	530	14800	12140	110800
900	**PR**	70, 100, 250	690	19200	15810	144300
1000	**PR**	70, 100, 250	850	23900	19600	178900
1100	**PR**	70, 100, 250	1030	29000	23790	217200
1200	**PR**	70, 100, 250	1240	34600	28420	259500
1300	**PR**	70, 100, 250	1460	40700	33460	305500
1400	**PR**	70, 100, 250	1700	47400	38930	355400
1500	**PR**	70, 100, 250	1950	54600	44830	409300
1600	**PR**	70, 100, 250	2200	62200	51100	466600
1800	**PR**	70, 100, 250	2800	79000	64880	592400
2000	**PR**	70, 100, 250	3500	98000	80430	734300

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

Qmin = max (Qmin * $\sqrt{K1/\rho}$ *or* ***Vmin * π * d²* / *4 * 0,0036)***), cbm/h (1.1)

Qmin = min (Qmax * $\sqrt{K2/\rho}$ *or* **Qmax*)***), cbm/h**,** (1.2)

where

Qmin and Qmax are the max and min flow according to the tables 1.3 and 1.4;

ρ - air density under working conditions kg/cbm;

d - inner diameter of flow body (at the point of sensor installation), mm (see fig.C.3 - C.13 Appendix C);

Vmin - min flow velocity, m/s (see table 1.5);

K1, K2 - empirical coefficients (see table 1.5).

Table 1.5 - 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		
			70, 100	200,250,320	450
15 или 25-ФР1	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.*

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 Min and max value of full and operating flow of water for PPD version are shown in table 1.6.

Table 1.6 - PPD version flow ranges

Flow meter size (DN/max flow)	Configuration	Flow volume, cbm/h			
		Operating range		Full range	
		Qmin'	Qmax'	Qmin	Qmax
50/10	–	0.5	8	0.3	10
50/20	–	0.7	20	0.5	25
50/25	–, 1	0.8	25	0.6	32
50/50	–	1,5	50	1.1	55
50/60	–	1.8	60	1.3	65
80/20	–	0.9	20	0.6	25
80/25	1	1	25	0.8	32
80/35	–	1.2	35	0.8	40
80/50	–	1,6	50	1.1	60
80/50	1	2	50	1.2	55
80/100	1	3	100	2.5	110
80/150	–	5	150	3.5	160
100/25	–	1	25	0.8	32
100/50	–	2	50	1.2	55
100/120	–	5	120	4	132
100/200	–	8	200	5	220
100/200	1	5	200	4	200
100/300	–	12	300	8.2	330
150/500	1	15	500	12.5	520

1.2.5 Working pressure for PPD configuration shall not be less than:
0,3 MPa – for Q ≤ Qmin';
0,4 MPa – for Qmin' < Q ≤ 0,5•Qmax';
0,8 MPa – for Q > 0,5•Qmax'.

1.2.6 Relative accuracy for volume and volume flow rate measured at frequency, pulse and digital signals and current signal for version A1, H1, H2, H3 depending on flow meter accuracy class is shown in Table 1.7.

Table 1.7 – Accuracy limits

Flow meter type	***Medium***	***Accuracy limits for A,B,C accuracy classes, %***						***Transition flow Qt***
		Qt≤ Q ≤ Qmax			***Qmin ≤ Q ≤ Qt***			
		A	***B***	***C***	***A***	***B***	***C***	
Full-bore	*Liquid*	**± 0,5**	**± 1,0**	**± 1,5**	**± 1,0**	**± 1,5**	**± 2,5**	***0,06·Qmax *****
	Gas and vapour	**± 1,0**	**± 1,5**	**± 2,0**	**± 2,0**	**± 2,5**	**± 3,5**	***0,1·Qmax *****
Full-bore PPD	*Liquid*	**± 0,5**	**± 1,0**	**± 1,5**	**± 1,0**	**± 1,5**	**± 2,5**	***Qmin'***
Insetion type	*Liquid*	**± 1,5**	**± 2,0**	**–**	**± 3,0**	**± 3,5**	**–**	***0,125·Qmax***
	Gas and vapour	**± 2,5**	**± 3,0**	**–**	**± 4,0**	**± 4,5**	**–**	***0,15·Qmax***
Flow sensor of insertion type flow meter	*Liquid*	**± 0,5**	**± 1,0**	**–**	**± 1,0**	**± 1,5**	**–**	***0,125·Qmax***
	Gas and vapour	**± 1,0**	**± 1,5**	**–**	**± 2,0**	**± 2,5**	**–**	***0,15·Qmax***

Note:
1. Qt – transition flow,
Qmax - max measuring flow according to the tables 1.3, 1.4 and 1.6
Qmin' - lower limit of operation flow for PPD version according to the table 1.6.
*2. ** Transition flow for full-bore flow meters of DN-15mm or Dn25FR(FR1) Qt = 0,6 cbm/h for liquid and 8 cbm/h for gas and vapour. Transition flow for DN=25mm or Dn32FR(FR1) Qt = 15 cbm/h for gas and vapour.*
*3. Transition flow for 450 temperature version Qt = 0,1·**Qmax** for liquid and 0.15·Qmax for gas and vapour.*

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

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

where δ – accuracy limit according to ***Table 1.7***, %;
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.

1.2.8 Flow meter can be equipped with the following outputs:
- pulse or digital output signal;
- analog (current) output signal (except for special version of flow meter);
- digital signals, see Table 1.8.

Table 1.8 - Digital signals

Protocol	***Physical interface***
Modbus RTU	*RS-485, USB*
HART	*Current loop 4-20 mA*

Note:
1. *When USB is connected, RS-485 is disabled.*
2. *HART is not available for special version flow meters.*

1.2.9 Pulse or digital output signal.

An output can work in different modes: frequency, pulse or digital. Output signal can be in two logical states: "closed"/"opened". It is passive output of open collector type.

There are two pulse outputs for T version with 2-wire connection type. One of them corresponds to NAMUR standard.

For "Frequency output" mode signal frequency is proportional to currently used variable. The following values can be used as variables: volume flow rate, volume flow rate under normal conditions, mass flow rate, absolute pressure, temperature.

Note: Hereinafter referred to as N.C.): - normal conditions (atmospheric pressure is 101325 Pa = 760 mm Hg. and air temperature 273,15 K = 20° C).

Minimum and maximum values comply with:

FMIN = 0 Hz - minimum value of current variable;

FMAX = 1000 Hz - maximum value of current variable:

Typical pulse values m for gas and liquid measuring at maximum frequency of 1000Hz are specified in Table.2.2.

Pulse value m can be calculated as follows:

$$m = Q'max / (3,6 * 1000\ Hz),\ L \qquad (1.4)$$

where Q'max is maximum possible flow rate (see table 2.2) for this size of flow meter, m3/h.

For "Pulse output" mode every output pulse means exact value of currently used variable which is called pulse value. Volume, volume under normal conditions or mass can be used as currently used variable. Pulse value and minimum pulse length can be specified according to customer needs. Signal frequency for pulse mode shall not exceed 500Hz.

For "Digital output" mode an output switches between "closed/opened" when instantaneous flow ("flow switch" mode) or total volume/mass ("dosing" mode) reach specified limit value.

Dosing mode operating procedure.

1) resettable totalizer set to zero, digital output set to initial state. This state is taken as normal (basic). Flow meter is ready to accumulate flow.

2) External automatic control device will turn the valve or pump upon output signal change. Flow meter counts amount of medium. External automatic device can stop flow counting if there is no technological need.

3) digital output change the state once the specified limit is reached. External automatic device stops the flow according to output state, switch the flow or change tare, if required.

4) Simultaneously with the step 3, the timeout timer is started in milliseconds (from 1 to 65535) specified in register 40011. At the end of the timeout, go to step 1 of the algorithm.

In any mode allowed external voltage for pulse (digital) output shall be 5V to 27V. Maximum current shall be 50 mA. Recommended resistance of load resistor Rload shall comply with:

$$(U-1)/0,04 < R_{load} < (U-1)/0,02,\ Ohm, \qquad (1.5)$$

where U – external voltage, V.

Connection diagrams for recorder are shown in Appendix B.

All modes 0...11 are implemented on the same terminals so that only one mode can be applied at a time.

Modes and maximum/minimum values can be adjusted via Modbus or flow meter keyboard. For more details see Appendix G.

1.2.10 Analog (current) output signal.

Current in the circuit lies within 4-20 mA range and varies linearly with currently used variable. The following values can be used as variables: volume flow rate, volume flow rate under normal conditions, mass flow rate, absolute pressure, temperature. Modes can be adjusted via Modbus or flow meter keyboard. Values for 4 mA and 20 mA can be adjusted via HART. For more details see Appendix I.

Analog signal is not available for transmitter of C version.

For T version with 2-wire connection the output signal lies in the 4-20mA range and corresponds to NAMUR standard.

By default for EV-200 and EV-200-PPD 20mA corresponds to the max flow Qmax for the DN as specified in the tables 1.3 and 1.4.

For EV-205 the current value of 20mA corresponds to 28 cbm/h for liquid and 210 cbm/h for gas and vapour.

4mA corresponds ot zero flow. Values for 4 mA and 20 mA can be adjusted according to specific needs.

For guaranteed operation of the current output, the total resistance of the current output circuit R1 must correlate to the following:

$$R1 \le (Uп - Ui) / 0,024,\ Ohm, \qquad (1.6)$$

where Up – power supply unit voltage, V.

Ui = 12 V for standard and extended versions of the transmitter,

Ui = 15,5 V for version with 2-wire connection scheme;

For general industrial version and for explosion-proof versions **Вн, PB** the voltage at the terminals of the current output should be in the range from 12 to 27 V.

For explosion-proof versions **ExB, ExC, ExiaB, ExiaC, PBI, PO** the voltage at the terminals of the current output should be in the range from 12 to 25,3 V.

1.2.11 Digital output signals.

Modbus is the main digital output signal. It complies with EIA/TIA-422-B and ITU V.11 requirements, provides data transfer through Modbus RTU (Modicon Modbus Protocol Reference Guide P1-MBUS-300 Rev. G) and provides network connection and measured data transfer.

ModBUS transfers the following data to Windows PC with installed EMIS-Integrator software (supplied with flow meter upon request and available on our web-sitewww.emis-kip.ru):

- flow tube diameter, mm;
- flow range, m³/h;
- flow meter serial number;
- instantaneous flow during damping time, m³/h;
- total volume of measured medium, m³;
- total and instantaneous mass flow, total and instantaneous volume flow under N.C. (if the function is activated);
- low signal cut-off, units;
- damping rate (shall be chosen from integer values from 0 to 10);
- medium type: liquid, gas, steam;
- specified temperature range for medium, C°;
- K-factor (medium volume per one vortex), l/pulse;
- piezoelectric cell signal amplitude, units;
- temperature and pressure from connected sensors;
- adjustable parameters of flow meter.

Wiring diagram is shown in Appendix B.

ModBUS is not available the transmitter with a two-wire connection scheme.

Additional digital output signal complies with HART TM standard.

Adjustment of the first, second, third and fourth variables for HART output is made via separate Modbus protocol. Adjustment of any other parameters for 4-20 mA output is made through modem or communicator.

1.2.12 Display

Types of display:

- display with mechanical keyboard, «SIM» configuration,
- display with optical keyboard, «SIO» configuration.
- display without keyboard - SI configuration (for the transmitter with 2-wire connection scheme only).

SIM and SIO configuration display shows the following information:

- volume flow rate and total volume under normal conditions;
- volume flow rate and total volume under working conditions; Measuring units m³ and m³ / h blink on the display *;
- for EV-205 it also shows total volume of the DN40 sensor and current flow along the pipeline/ Measuring units m³ and m³ / h blink while the current flow is displayed *;
- mass flow and total mass;
- transducer and medium temperature*;
- medium pressure;*
- instantaneous flow as a percent of maximum flow rate;
- signal values on current(*) and pulse outputs;
- control totals and metrological data;
- current access level;
- service messages.

* - except for special version of transmitter;

Display appearance and operation guide are shown in fig.B.4 and B.5 of the Appendix B.

SI configuration display shows the following information:

- volume flow (under W.C.), and the flow disregarding the temperature, etc.;
- total flow (under W.C.), and the flow disregarding the temperature, etc.;
- resettable volume totalizer (under W.C.);
- for EV-205 it also shows volume flow and total flow via DN40 sensor and current flow along the pipeline;
- sensor temperature;
- vortex shedding frequency;

signal amplitude in specified units;

- instantaneous flow as a percent of maximum flow rate;
- sensor temperature;

- signal values on current and pulse outputs;
- pulse value and length;
- flow value corresponding to 4 and 20 mA at the current output and to 1000Hz at the frequency output;
- cut-off value corresponding to the specified signal amplitude;
- other parameters.

1.2.13 Electrical insulation between electrical circuits and transmitter body at ambient temperature of 23±5°C and relative humidity 30 to 80% withstands 45 to 65 Hz AC sine wave with 500V r.m.s. during 1 minute.

1.2.14 Power supply and consumption

Transmitters of general purpose industrial versions and ex-proof versions shall be connected to separate 12-27 VDC supply unit. T version with 2-wire connection scheme the power is supplied from the current loop 4-20mA (see 1.2.10)

Power consumption in steady operation state is shown in the table 1.9.

Table 1.9 - Power consumption

Display version	***Ex-proof version***	***Power consumption, W***			
		Flow meter mounting			
		Basic and extended	***special***		***2-wire***
			No preheating	***Preheating***	
without display	*no explosion protection, Вн, PB*	*0.9*	*1.5*	*6.1*	*0.5*
SIM display		*3.4*	*4.0*	*8.7*	*-*
SIO display		*3.5*	*5.3*	*9.9*	*-*
SI display		*-*	*-*	*-*	*0.5*
without display	*ExB, ExC, ExiaB, ExiaC, PBI, PO*	*0.9*	*-*	*-*	*0,5*
SIM display		*0.9*	*-*	*-*	*-*
SIO display		*1.0*	*-*	*-*	*-*
SI display		*-*	*-*	*-*	*0,5*

Power supply parameters for ex-proof configurations are shown in 1.3 "Explosion protection".

1.2.15 Transducer 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 ***Appendix B***.

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 Transducer 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 not exceeds 3 hours;
- service life 15 years.

Transmitter failure means its non-compliance with 1.2.2. requirements

1.2.19. Materials for process-wetted elements of the flow meter are specified in the table 1.10.

Table 1.10 - List of materials

Version	Dn, mm	Pressure, Mpa	Tmeass., °C	Material code	Material			
					Flow tube	Bluff body	Sensor	Sensor gasket*
EV-200 C, F, FR	All	1,6-6,3	≤ 320	H	AISI 304	AISI 304	AISI 304	Fluorine plastic, graflex
EV-200 C	15-50	10-25	≤ 320	H	20X13	12X18H10T	titanium BT1-0	Copper, titanium
EV-200 C	65-300	10-25	≤ 320	H	20X13	20X13	titanium BT1-0	Copper, titanium
EV-200 F, F1	40-300	1,6-6,3	450	H	12X18H10T	12X18H10T	EP202	Titanium
EV-200 C1, F1, FR1	15-50	1,6-6,3	≤ 320	H	20X13	12X18H10T	titanium BT1-0	Copper, titanium
EV-200 C1, F1, FR1	65-100	1,6-6,3	≤ 320	H	20X13	20X13	titanium BT1-0	Copper, titanium
EV-200 F1	125-300	1,6-6,3	≤ 320	H	12X18H10T	12X18H10T	titanium BT1-0	Copper, titanium
EV-200 F1	15-100	10-16	≤ 320	H	20X13	12X18H10T	titanium BT1-0	Copper, titanium
EV-200 F1	125-300	10-16	≤ 320	H	12X18H10T	12X18H10T	titanium BT1-0	Copper, titanium
EV200-PPD	All	All	All	–	20X13	12X18H10T	titanium BT1-0	Copper
EV-205	All	All	All	H	AISI 304	AISI 304	AISI 304	Fluorine plastic, graflex
EV-200	All	All	All	HH	12X18H10T	12X18H10T	titanium BT1-0	Copper, titanium
EV200-PPD	All	All	All	HH	12X18H10T	12X18H10T	titanium BT1-0	Copper

Note:
1 Fluorine gaskets used for Tmed up to +100°C, graflex gaskets for +250 and +320°C, copper gaskets up to +250°C, titanium gaskets for +320 and +450°C;*
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 sensor gasket is made of titanium, electronic boards are additionally coated with AK-113 varnish.

1.3 Explosion protection

1.3.1. Ex-proof transmitters Вн have "explosion proof enclosure" under GOST IEC 60079-1-2011, used for explosive mixtures of IIC group, executed as "explosion proof" and marked as "1ExdIIC(T1-T6)X".

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 transducer 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 F.

"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;
- the LCD display operates at a temperature not lower than minus 40 ºC;

Transmitters of Вн configuration shall be equipped with certified ex-proof cable glands and ex-proof plugs complying with "d" explosion protection type of IIC subgroup, temperature range and ingress protection not less than IP67. 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;
- close transmitter cover before switch it on;
- use heat-resistant cables to connect flow meter body with distant type transmitter;
- the explosion protection is valid for the medium pressure below the maximum level permitted for that type of flow meter.

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 "1Ex ib IIB (T1-T6) Gb X", "1Ex ib IIC (T1-T6) Gb X", "1Ex ia IIB (T1-T6) Gb X", "1Ex 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 IP67 enclosure complying with GOST 14254.

For ExB, ExC, ExiaB, ExiaC configurations input parameters of supply circuit and output signal circuits are shown in table 1.11.

Table 1.11 - ExB, ExC, ExiaB, ExiaC versions input parameters of supply circuit

Parameter	***Description***				
	supply circuit		***current signal***	***frequency signal***	***digital signal RS485***
	ExB, ExiaB	ExC, ExiaC			
Max input voltage Ui, B	25.6	25.6	25.3	25.6	8.5
Max input current Ii, mA	0.41	0.18	0.11	0.11	0.9
Max input power Pi, W	2.5	2.5	0.8	0.8	1.8
Max input capacity Ci, pF	0.01	0.01	0.01	0.01	0.1
Max input inductance Li, µH	0.01	0.01	0.01	0.01	0.01

"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;

- the LCD display operates at a temperature not lower than minus 20 ºC;

- **ExB, ExC, ExiaB, ExiaC** power supply shall be provided from intrinsically safe unit with output circuits of "ib" or "ia" levels and electrical parameters complying with GOST 31610.11-2014 for intrinsically safe electrical equipment of "IIB/IIC" subgroups;

- **ExB, ExC, ExiaB, ExiaC** power supply shall be provided from intrinsically safe unit with output circuits of "ib" or "ia" levels and electrical parameters complying with GOST 31610.11-2014 for intrinsically safe electrical equipment of "IIB/IIC" subgroups;

- transmitters of Вн configuration shall be equipped with certified ex-proof cable glands and ex-proof plugs complying with operation temperature range and ingress protection not less than IP67. 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;

- close transmitter cover before switch it on;

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

- the explosion protection is valid for the medium pressure below the maximum level permitted for that type of flow meter.

1.3.3 Explosion proof flow meters of PB, PBI, PO configurations have "intrinsically safe circuit" of "ib" / "ia" level under GOST 31610.11-2014 (IEC 60079-11:2014) and "explosion proof enclosure" under GOSTT IEC 60079-1-2011 marked as «PB Ex d I Mb X», «PB Ex d ib I Mb X», «PO Ex ia I Ma X» accordingly.

Explosion protection of PB, PBI, PO types is provided by using explosion-proof boxes manufactured by LLC “Plant GORELTECH”, while the electronic unit of the flow meter is placed in this box of the corresponding execution.

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

- ensure that transmitter cover withstands heat more than 150 ºC transferred from the measuring medium;

- flow meters are supplied with permanent cable, all connections from flow meter shall be executed using certified terminal box with electronic block complying with ex-proof requirements as defined in GOST 31610.0-2014 (IEC 60079-0:2011) for a specific type of exlosion protection. Creepage path and clearance in terminal box shall comply with requirements as specified in GOST 31610.11-2014 and GOST IEC 60079-1-2013 accordingly.

- the explosion protection is valid for the medium pressure below the maximum level permitted for that type of flow meter.

- use shielded cables to connect flow meter body with distant type transmitter.

1.3.4 **ExB, ExC, ExiaB, ExiaC, PBI, PO** ex-proof flow meters shall be powered from 18 to 25,6 VDC power unit, **Вн** and **PB** version form 12 to 27VDC power unit.

Electric power supply of converters of versions ExB, ExC, ExiaB, ExiaC, PBI, PO should be provided from intrinsically safe barriers (blocks) having the “intrinsically safe electrical circuit” type of explosion protection with explosive intrusion safe levels for explosive mixtures of subgroups IIB or IIC according to the version of the transmitter.

Ex-proof cables shall be used for power supply and output signals connections of PB, PBI, PO configurations.

1.3.5 It is recommended to use BIS-A-111 or BIS-A-113 spark protection barriers for power supply circuits (there is a separate channel for RS-485 output), and BIS-A-110 barriers for frequency-pulse and current output circuits.

1.3.6 "Intrinsically safe circuit" is not available for special configurations of flow meter.

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

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

1.4 Flow meter parts

1.4.1 Flow meter consists of flow meter itself and mounting kit. Scope of supply is specified in Table 1.12.

1.4.2 Mounting kit is supplied upon request. Installation kit depends on transmitter version and shown in Appendix D.

Table 1.12 - Standard supply scope

No	Name	Number	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	Data sheet ЭВ-205.000.000.000.00 PS	1	For EV-205 versions
4	Operation manual ЭВ-200.000.000.000.00 ОМ	1	
5	Calibration method ЭВ-200.000.000.000.00 СМ	1	
6	Mounting kit with data sheet	1	Upon request
7	Adapter RS485/RS232 EMIS-System	1	Upon request
8	Testing cables	1	Upon request
9	Power unit EMIS-BRIZ 90	1	Upon request
10	Packing case	1	Upon request
11	Installation fitting	1	Upon request
12	Flow conditioner EMIS-VECTA 1200 with flanges	1	Upon request
13	Ball valve for insertion type flow meter	1	Upon request
14	Spare parts kit, tools and accessories	1	Upon request
15	Certificate for flanges, fixtures, gaskets	1	Upon request
16	HART protocol description for version with 2-wire connection scheme	1	Upon request
17	Ex-proof case of PB type.	1*	PB, PO, PBI version
18	Flow meter certificates	**	Upon request

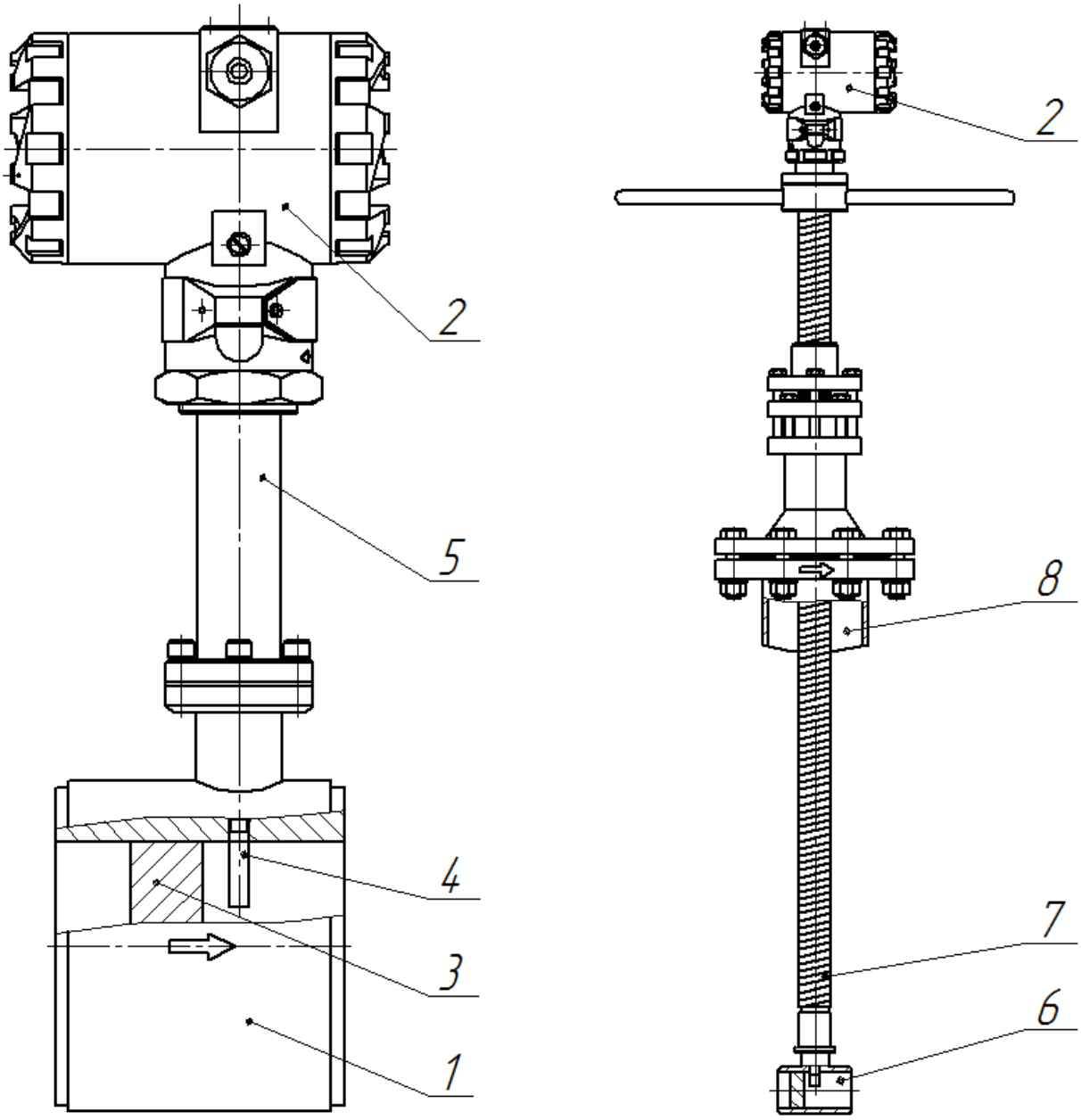
Note:
1. Installation kit contains two flanges, two gaskets (except for EV200-PPD) and fasteners. Flanges are not included in the orders supplied with run sections.
*2. * Amount of PB ex-proof boxes shall be specified while placing the order.*
3. List of certificates (supplied upon request):
Measuring 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"

1.4.3 Spare parts kit, tools and accessories is supplied upon request. Spare parts kit, tools and accessories contain cable glands, flange gaskets and fixtures for flange installation (depends on transmitter version) and thermal packed graphite packing for EV-205 1,6MPa pressure version. 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.1.2) consists of flow tube (1) and electronic transmitter unit(2). Flow tube is a hollow cylinder with bluff body installed in cross-sectional area (3). Sensor (4) is installed behind the bluff body.



Full-bore Insertion type

Figure1.2 - Flow meter structure

Transmitter (2) is installed on 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 sensor. Pressure fluctuation is transmitted to piezoelectric cell. Piezoelectric cell transforms fluctuation into electrical signals. Transducer forms output signals after amplification, filtration, transformation and digital processing of the signal.

In transmitters of "450" temperature configuration two pressure pulsation detectors are installed behind the bluff body with no extension into the flow tube. These detectors are equipped with piezoelectric cells which transform pressure pulsation into electrical signals.

Full-bore transmitter (see fig.1.2) consists of transmitter (6), support bar (7), weldneck (8) and transmitter (2). Sensor structure of insertion type flow meter is the same as of the full-bore and measures flow velocity at a single point.

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. 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. 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 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

Marking plate placed on transducer 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 (IP67);
- pulse value for insertion type flow meter.

For PB, PBI, PO flow meters with four cable glands the plate also contains ex-proof marking and electrical circuit parameters:

- PB Ex d I Mb X, $0 \le t_a \le + 70\ ^0C$ for EV-200 of PB version;
- PB Ex d ib I Mb X, $0 \le t_a \le + 70\ ^0C$ for EV-200 of PBI version;
- PO Ex ia I Ma X, $0 \le t_a \le + 70\ ^0C$ for EV-200 of PO version;

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.

For EV-200-PPD of Вн configuration:

- 1ExdIICT5GbX, $-40 \le t_a \le + 70\ ^0C$ for "100" temperature class.

For EV-200 and EV-205 of Вн configuration

- 1ExdIICT6GbX, $-40 \le t_a \le + 70\ ^0C$ for "70" temperature class.
- 1ExdIICT5GbX, $-40 \le t_a \le + 70\ ^0C$ for "100" temperature class.
- 1ExdIICT2GbX, $-40 \le t_a \le + 70\ ^0C$ for "250" temperature class.
- 1ExdIICT1GbX, $-40 \le t_a \le + 70\ ^0C$ for "320" and "450" temperature class.

For EV-200 and EV-205 of ExB configuration:

- 1ExibIIBT6GbX, $-40 \le t_a \le + 70\ ^0C$ for "70" temperature class.
- 1ExibIIBT5GbX, $-40 \le t_a \le + 70\ ^0C$ for "100" temperature class.
- 1ExibIIBT2GbX, $-40 \le t_a \le + 70\ ^0C$ for "250" temperature class.
- 1ExibIIBT1GbX, $-40 \le t_a \le + 70\ ^0C$ for "320" and "450" temperature class.

For EV-200 and EV-205 of ExC configuration:

- 1ExibIICT6GbX, $-40 \le t_a \le + 70\ ^0C$ for "70" temperature class.
- 1ExibIICT5GbX, $-40 \le t_a \le + 70\ ^0C$ for "100" temperature class.
- 1ExibIICT2GbX, $-40 \le t_a \le + 70\ ^0C$ for "250" temperature class.
- 1ExibIICT1GbX, $-40 \le t_a \le + 70\ ^0C$ for "320" and "450" temperature class.

For EV-200 and EV-205 of ExiaB version:

- 1ExiaIIBT6GbX, $-40 \le t_a \le + 70\ ^0C$ for "70" temperature class.
- 1ExiaIIBT5GbX, $-40 \le t_a \le + 70\ ^0C$ for "100" temperature class.
- 1ExiaIIBT2GbX, $-40 \le t_a \le + 70\ ^0C$ for "250" temperature class.
- 1ExiaIIBT1GbX, $-40 \le t_a \le + 70\ ^0C$ for "320" and "450" temperature class.

For EV-200 and EV-205 of ExiaC version:

- 1ExiaIICT6GbX, $-40 \le t_a \le + 70\ ^0C$ for "70" temperature class.
- 1ExiaIICT5GbX, $-40 \le t_a \le + 70\ ^0C$ for "100" temperature class.
- 1ExiaIICT2GbX, $-40 \le t_a \le + 70\ ^0C$ for "250" temperature class.
- 1ExiaIICT1GbX, $-40 \le t_a \le + 70\ ^0C$ for "320" and "450" temperature class.

Special temperature range $-50 \le t_a \le +70\ ^0C$ or $-60 \le t_a \le +70\ ^0C$ can be provided upon request.

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 transducer. Sealing is executed using the seal and the wire running through the special hole in the cover of transmitter.

Warranty stickers attached to the flow meter body: 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. APPLICATION

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. In this case send us current configuration data file compiled with EMIS-Integrator (see Appendix E) 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 meter can be installed indoors and outdoors.

2.1.3 Maximum amplitude of pipeline vibrations in flow meter installation section shall not exceed 0,5mm within 10 to 100Hz range. Vibration acceleration shall not exceed 0,5g.

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 sensor up to 90° around pipeline axis to match working direction of sensor with vibration amplitude.
- fill flow tube with measured medium.
- use bandpass filters. See help tab in EMIS-Integrator.

If above mentioned measures do not help, try to adjust low flow cut-off value via EMIS-Integrator. Set low flow cut-off value VS as:

$$VS = 2 \cdot A_B \quad (2.1)$$

where A_B is amplitude of signal for zero flow indicated by EMIS-Integrator in units.

In some cases this could change min flow. Thus, to select a flow meter it is necessary to compare the minimum possible flow rate with the minimum flow rate measured by the converter.

2.1.4 Possible pressure drop ΔP can be calculated as follows:

$$\Delta p = A \cdot \rho \cdot (Q)^2 / D^4, \text{ кPa} \quad (2.2)$$

where ρ - density of the measured medium under operating conditions, кг/м^3;

Q - volume flow under operating conditions, m3/h;

D - inner diameter of flow meter body, mm (see Appendix C);

A - coefficient as specified in table 2.1 (kPa•h2•mm4)/(kg•m3).

Table 2.1 - A coefficient

Version code	*Dn*	*A*
C, F, 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
PR	***300..2000***	30
PPD	***50/10, 50/20***	190
	50/25, 80/50, 80/100	105
	50/50, 50/60	160
	80/150, 100/120, 100/200, 100/300, 150/500	90
	80/20, 80/25, 80/35, 100/25, 100/50	150

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 mesuring medium.

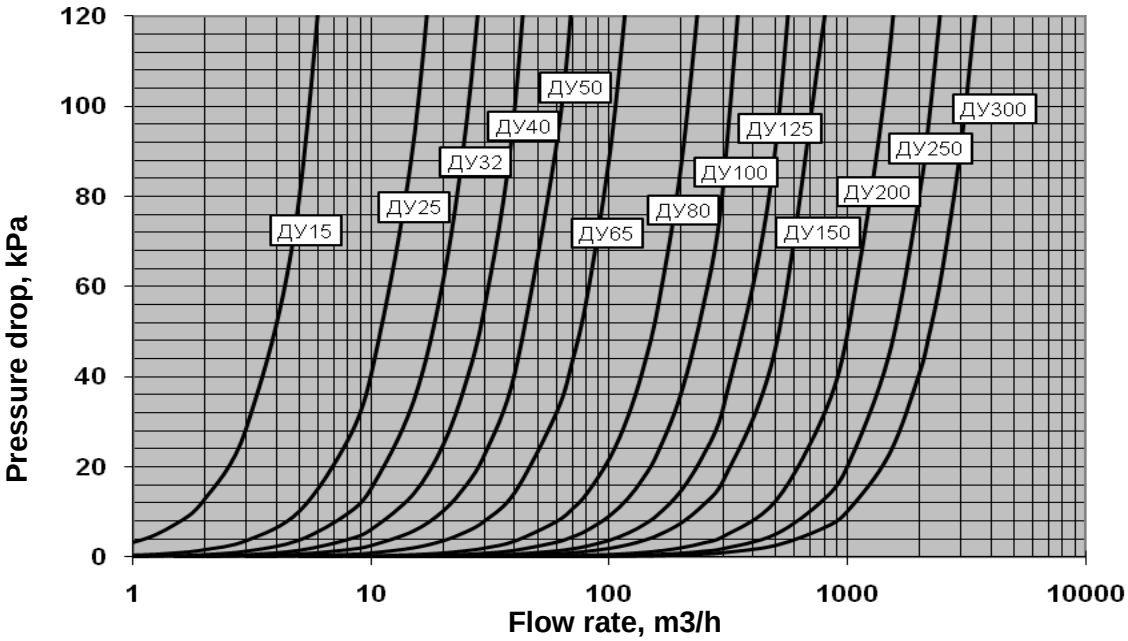


Figure 2.1 - Pressure drop diagram for water

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

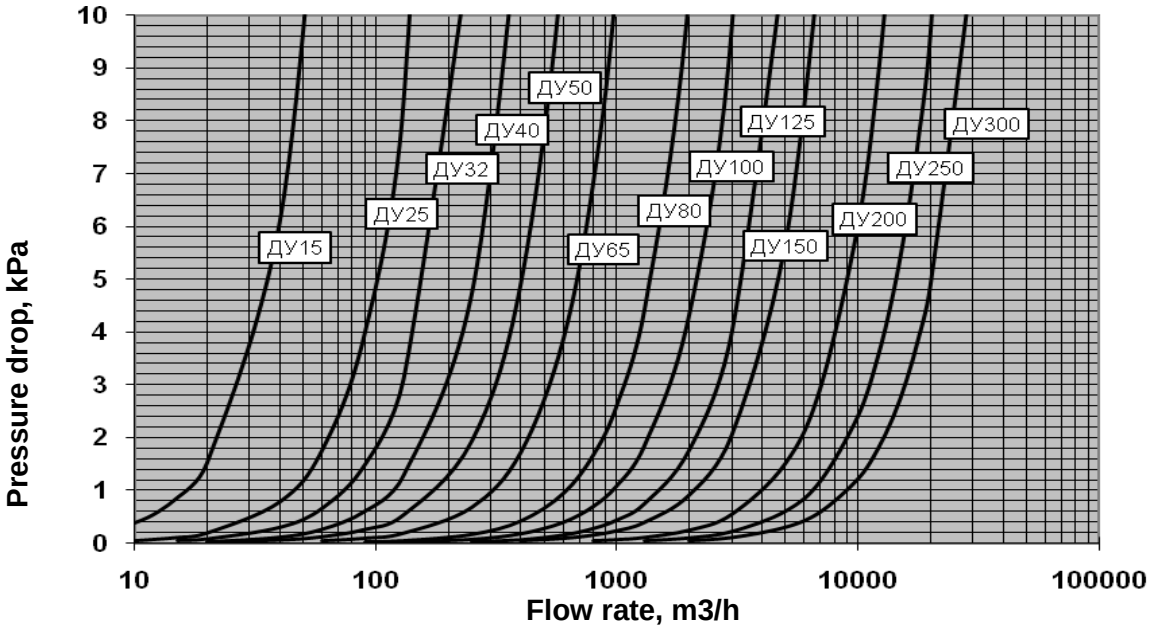


Figure 2.2 - Pressure drop diagram for air under normal conditions

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:

$$P = 2{,}9\ \Delta P + 1{,}3\ p_v, \qquad (2.3)$$

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 are specified in section 2.2.2.

2.1.7 Full-bore flow meters can measure liquids with gas inclusions up to 15% by volume with ±6,5% accuracy.

2.1.8 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 sensor and installing its software.

2.1.9 Pulse value m on pulse output (pulse and frequency modes) and relevant volume flow rate Q'max at maximum output signal frequency for each flow meter size depending on medium are shown in table 2.2. (by default).

Table 2.2 - Default pulse values m on pulse output

Size (version)	Liquid				Gas			
	Qmax cbm/h	Pulse value m, l			Qmax cbm/h	Pulse value m, l		
		Freq. mode	Pulse mode			Freq. mode	Pulse mode	
			standard	min			standard	min
EV-200								
15	9	0.0025	0.1	0.005	54	0.015	0.1	0.03
25	18	0.005	0.1	0.01	144	0.04	0.1	0.08
32	36	0.01	0.1	0.02	288	0.08	0.5	0.16
40	54	0.015	0.1	0.03	360	0.10	0.5	0.2
50	72	0.02	0.1	0.04	576	0.16	0.5	0.32
65	126	0.035	0.1	0.07	828	0.23	1	0.46
80	180	0.05	0.5	0.1	1368	0.38	1	0.76
100	288	0.08	0.5	0.16	2376	0.66	5	1.32
125	432	0.12	0.5	0.24	3240	0.90	5	1.8
150	648	0.18	1	0.36	5400	1.50	5	3.0
200	1080	0.30	1	0.6	9000	2.50	10	5.0
250	1800	0.50	5	1.0	14400	4.00	10	8.0
300	2520	0.70	5	1.4	20160	5.60	50	11.2
EV-205 (sensor DN40)	36	0.01	0.1	0.02	216	0.06	1	0.12
EV-200-T	108	–	50	0.06	900	–	50	0.5
EV-200-PPD	1800	–	1	1	–	–	–	–

Note:

1. Pulse value for insertion type flow meter shall be calculated as defined in Appendix J depending on actual size of a pipeline.
2. Effective pulse value is specified for frequency mode.
3. By default, EV-200, EV-205 are adjusted to the frequency mode, EV200-PPD and EV200-T - to the pulse mode of the output.

2.1.10 As agreed with the customer (or by the customer using ModBUS or the keyboard), the pulse-frequency output can be reconfigured to other modes and pulse value according to tables 2.3 - 2.5.

Table 2.3 - Frequency modes

Mode (register 40007)	Current variable	Measuring units	Min value (register 40033)	Max value (register 40035)
0	Volume flow	*cbm/h*	*0*	see Data sheet or table 2.2
*1**	Volume flow under N.C.	*cbm/h*	*0*	see Data sheet
*2**	Mass flow	*t/h*	*0*	
*3**	Absolute pressure	*MPa*	see Data sheet	
*4**	Temp.	*°C*		

Signal frequency for pulse mode shall not exceed 1200Hz.
** - n/a for special version of transmitter;*

Table 2.4 - Pulse modes

Mode	Current variable	Measuring units
5	Volume	*l*
*6**	Volume under N.C.	*l*
*7**	Weight	*kg*

Pulse value from data sheet or register 40039/
Signal frequency for pulse mode shall not exceed 500Hz.
** - n/a for special version of transmitter;*

*Table 2.5 - Discrete modes**

Mode	Current variable	Cut-off units (register 40903)
8	Flow switch (normally open contact)	*cbm/h*
9	Flow switch (normally closed contact)	*cbm/h*
10	Volume dosing unit	*ml*
11	Mass dosing unit	*g*

Cut-off value (dose weight) see in flow meter data sheet.
Signal frequency for discrete mode shall not exceed 50Hz.
** - n/a for special version of transmitter;*

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

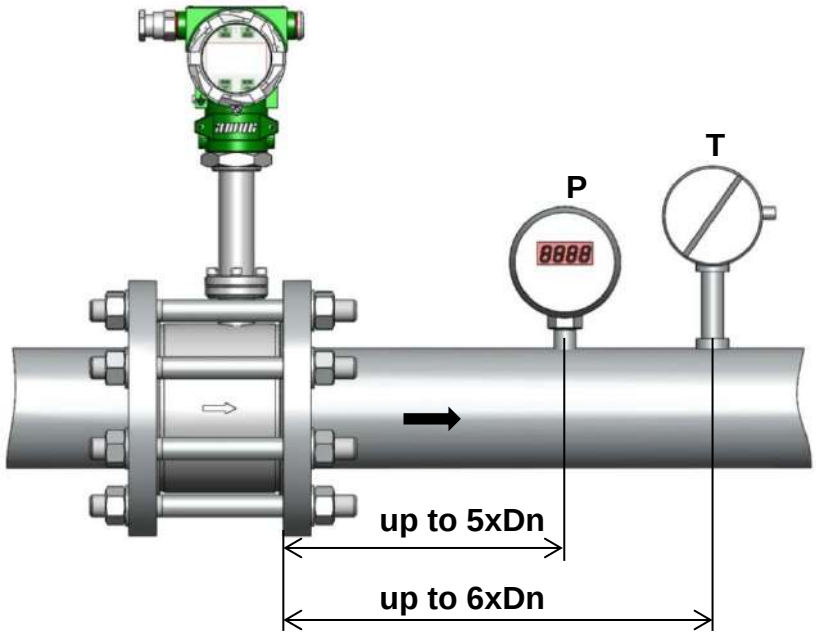


Figure 2.3 - Installation scheme for full-bore flow meter, pressure and temperature gauges

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 comply with GOST P 8.740-2011.

2.1.12 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).

When using a flow meter to measure the flow rate of saturated vapour, the degree of steam dryness should be at least 0.8.

2.1.13 Insertion type flow meter measures flow velocity. To reach required accuracy, measure actual inner diameter of a pipeline and input this value in the device memory via EMIS-Integrator.

Measuring section shall be selected in the straight run not closer than 5 Dn before the end of this straight section.

Square of measuring section shall be calculated as arithmetic average of four diameters equally spaced in cross section. Use bore micrometer as specified in GOST 10. If impossible to measure inner diameter of the pipe it is allowed to determine the measuring section area by measuring the external perimeter and the wall thickness of the pipe. Outer surface of a pipe shall be protected and has no dimples and bumps. Use steel tape-measure as specified in GOST 7502. Side thickness shall be measured with dial thickness gauge as defined by GOST 11358, slide gauge as defined by GOST 166 or ultrasonic thickness gauge.

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

2.1.16 EV-200-PPD can be operated under the pressure up to 30 MPa in short-term mode.

2.2 Mounting requirements

2.2.1 General rules of mounting

Mounting (dismantling), electric connection, adjustment, operation shall be performed 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. The recommended direction of flow (liquid, gas, steam) when installing the flow meter on a vertical or inclined section - from the bottom to top;

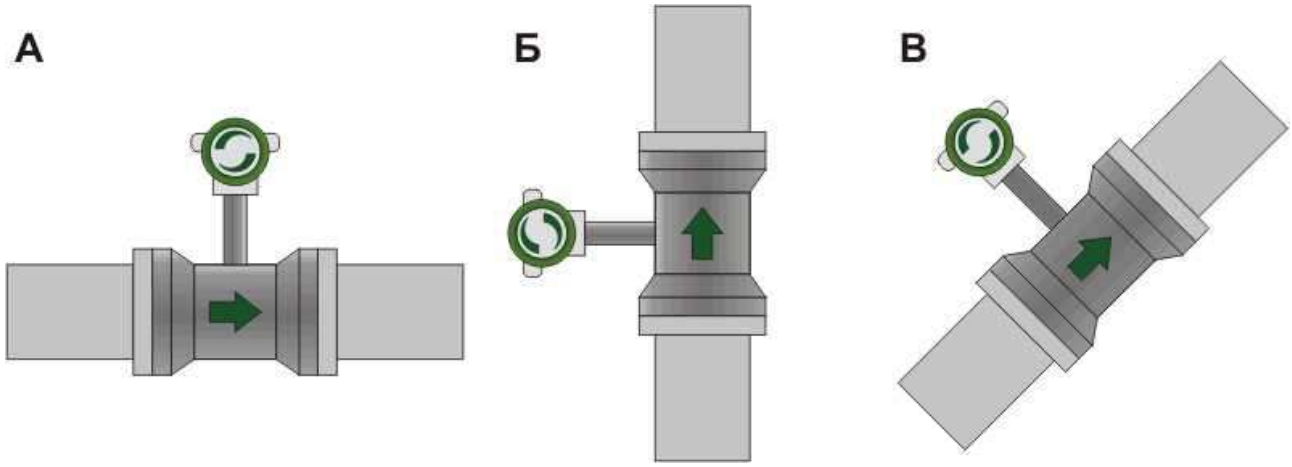


Figure 2.4

- 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 EV-200 and EV-205 of ex-proof configuration are supplied with two cable glands of 6mm and 9mm outside diameter. Ex-proof plugs shall be used to plug cable glands. Flow meters EV-200 and EV-205 of other configurations are supplied with two plastic cable glands of 6mm and 13mm outside diameter. Flow meters of PPD type are supplied with one metal cable gland for 6mm to 9mm cables and one ex-proof plug.

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 Mounting requirements

To provide declared accuracy follow installation requirements below:

1) Pipe inner diameter 2xDN before the flow meter shall comply with the formula below:

$$0{,}98Di \le Dp \le 1{,}05Di, \quad (2.4)$$

where Di - inner diameter of the flow tube, mm. (see size C in fig.C.3 - C.12).
Recommended tube size is specified in table D.15 (see Appendix D).

2) Provide required length of straight sections. Length of straight sections before and after the flow meter shall be not less than specified in table.2.6 for full-bore and 2.7 for insertion type flow meters depending on pipe reducers, extensions, bends along the pipeline, control gears and devices installed upstream from the flow meter. Failure to comply with the requirements leads to an increase in measurement error at low flow rates.

Table 2.6 - EV-200 straight pipes length

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

Table 2.7 - EV-205 straight pipes length for insertion type flow meters

Name	***Straight section before flow meter (X*DN)***		***Straight section after flow meter (X*DN)***
	Measurement at 0,242R point	***Measurement on pipe axis***	
Elbow or Tee	55 x Dn	25 x Dn	5 x Dn
Two or more coplanar elbows	50 x Dn	25 x Dn	5 x Dn
Two or more non-coplanar elbows	80 x Dn	50 x Dn	5 x Dn
Reducer (confusor)	30 x Dn	10 x Dn	5 x Dn
Expander (diffusor)	55 x Dn	22 x Dn	5 x Dn
Valve wide-open	45 x Dn	22 x Dn	5 x Dn
Gate valve wide-open	30 x Dn	15 x Dn	5 x Dn

Note: DN - nominal diameter of the pipeline.

For flow meters of PPD type straight section shall be not less than 5xDn before flow meter and 2xDn after flow meter regardless of pipeline configuration.

3) Misalignment between flow meter body and pipeline shall not exceed 0,5mm for **Dn** from 15 to 65 mm, 0,7mm for **Dn** from 80 to 125 mm and 1mm for **Dn** from 150 to 300 mm.

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

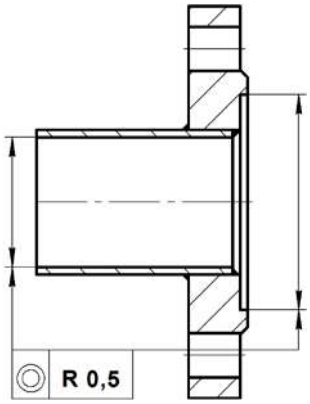


Figure 2.5 - Installation scheme for Dn65 and less using straight sections mounting kit

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

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

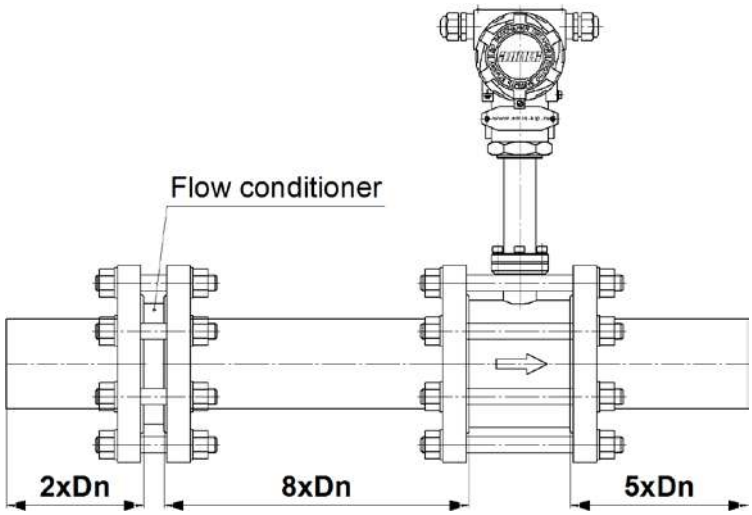


Figure 2.6 - Flow conditioner mounting

Flow conditioner develops flow profile with some pressure loss. Flow conditioner size is shown in figure 2.7 and table 2.8. Flow conditioner shall be installed between two flanges (F type under GOST 33259-2015 or 3 type under GOST 12815-80) and fastened with bolts and studs.

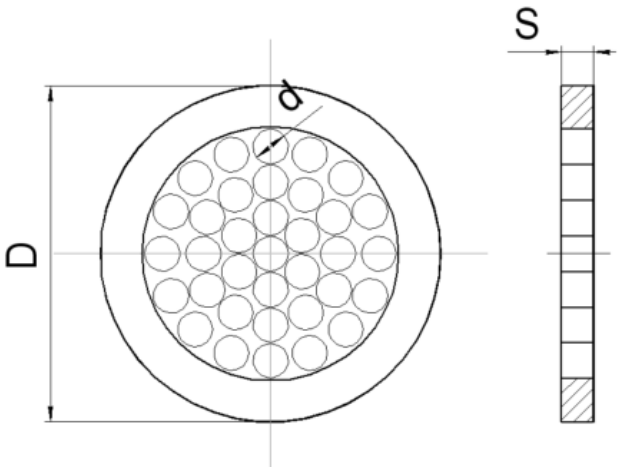


Figure 2.7 - Flow conditioner

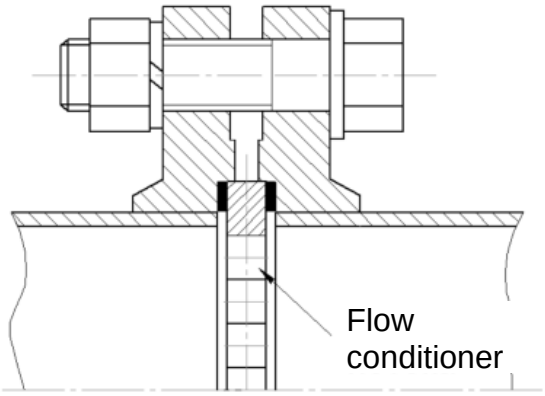


Figure 2.8 - Flow conditioner mounting

Table 2.8 - Flow conditioner size

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 under GOST 8.586.2.

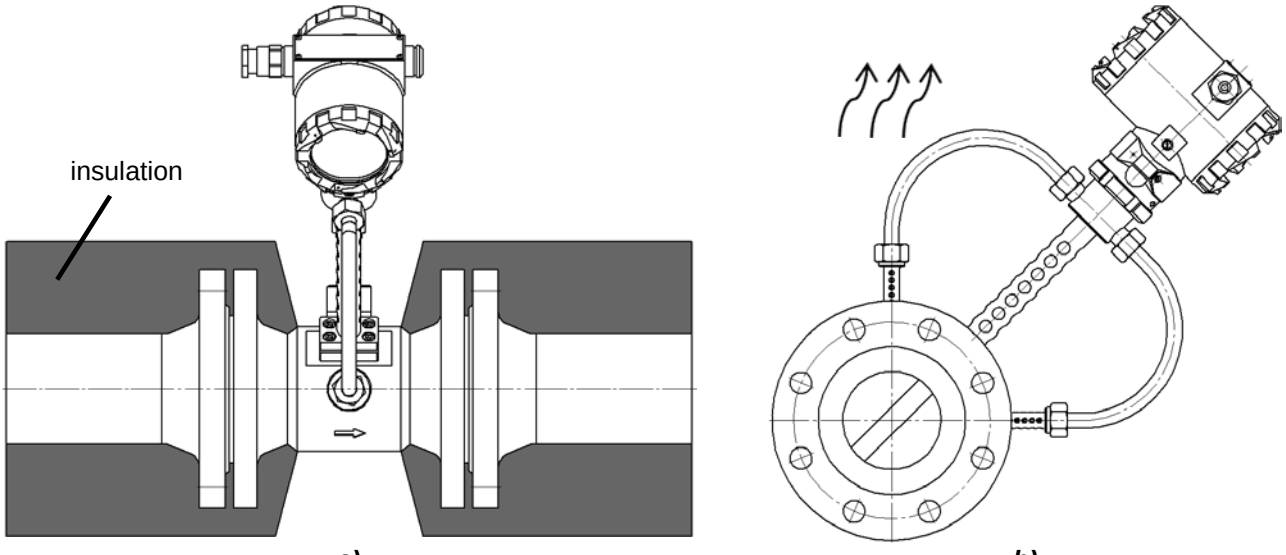
5) If gas inclusions in liquid exceed 5% we recommend the following installation options:
- support bar is located in the horizontal plane;
- support bar is located in the vertical plane with electronic unit downwards;
- installation in vertical section of the pipeline.

2.2.3 Installation in the pipeline with high temperature medium inside

To install flow meter in the pipeline with high temperature medium inside (more 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 with heat insulation 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). Transducer bar of high-temperature configuration "450" shall be inclined at 45 degrees to vertical as shown in fig.2.9b.



a) ***b)***

Figure 2.2.9 - Installation of flow meter for high-temperature mediums

2.2.4 Mounting

Mounting shall be performed as follows:

1) Prepare straight run as an assembly with flanges (see Appendix F) and coupling according to the drawings in Appendix C.

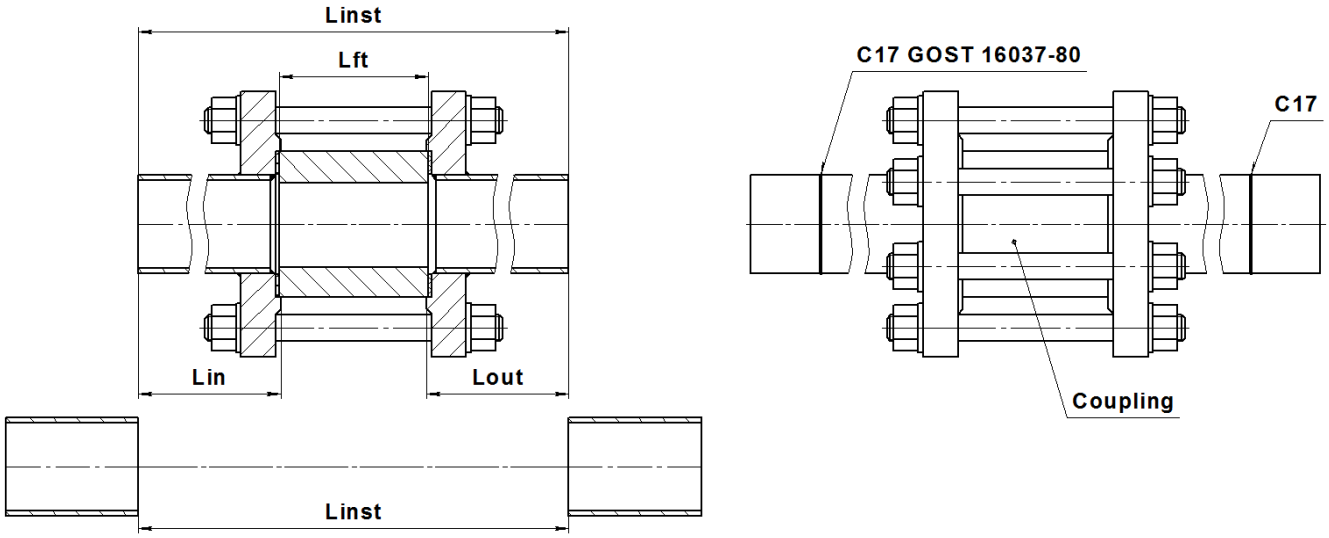


Figure 2.10 - Installation of coupling with straight sections

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

$$Linst = Lin + Lout + Lft - \Delta L, \quad (2.5)$$

where Lin + Lout are length of straight sections before and after the flow meter,

Lft - length of fitting which is equal to installation length L of the flow meter,

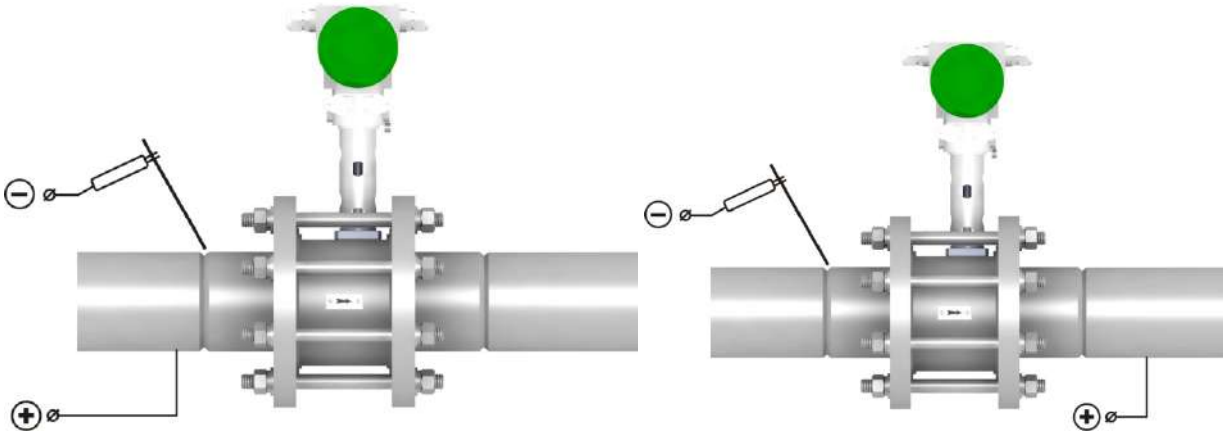
ΔL = 3mm for EV200 pressure ≤ 6,3MPa, ΔL = 13mm for EV200-PPD and ΔL = -14mm for EV200 pressure ≥ 10MPa.

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:

- gas welding is used for mounting;

- for arc-welding power source is connected so that current does not flow through the flow meter - see fig.2.11.



Right Wrong

Figure 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 steam measurement shall be placed horizontally in the same plane with steam line to avoid transducer overheat.

PPD type flow meters shall be installed without gaskets.
Tightening force for each stud shall be not less than:

- 40 kN for DN 50mm pipeline;
- 82 kN for DN 80mm pipeline;
- 107 kN for DN 100mm pipeline
- 160 kN for DN 150mm pipeline

2.2.5 Flow meter rotation

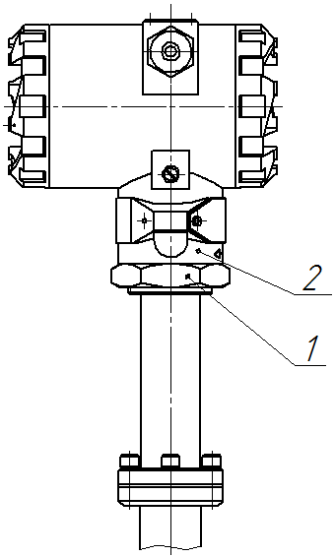


Figure 2.12 - Transmitter rotation

For the convenience of electrical installation and reading, it is allowed to rotate the electronic unit of the flow meter at an angle of no more than 90° relative to its initial position set at the factory. This is necessary in order to prevent twisting of the wires and to maintain the position of the sealing ring inside the electronic unit.

Loosen the lock nut 1 (see Fig. 2.12), turn the electronic unit 2 in the desired direction at an angle of no more than 90°, then firmly tighten the lock nut to ensure tightness.

2.2.6 Electrical installation

For electrical installation please follow recommendations below:

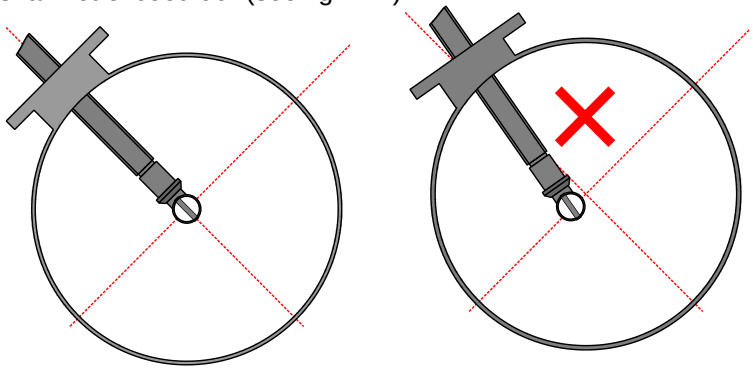
- do not place transmitter communication lines near power cables;
- we recommend to place cables and wires between transmitter and control gauges inside metal hoses or metal pipes;
- for wire laying we recommend to use control cables coated with rubber or plastic insulation, signal cables coated with PVC insulation;
- it is allowed to put transducer supply wire and output signal wires in the same cable;
- we recommend to use shielded cable to lay near 0,5kVA electric units communication lines.
- insulated wires of the same cable can be used as signal and supply wires, provided that insulation resistance shall be not less than 10 MOhm. No shielding required between output signal circuit and transmitter supply circuit;
- see wiring diagrams in **Appendix B** to do wiring between transmitter and secondary equipment provided that supply voltage and resistance of load resistor for frequency output shall comply with 1.2.9 hereof;
- use four- or seven-core cable for electrical installation (when using RS-485);
- test cable for continuity and mark each end, than connect them to terminal box of the transmitter. Perform visual inspection to check if all wires connected to the right gland;
- flow meter grounding shall be made using not less than 2,5mm^2 wire installed between earth bus and earth gland of the transmitter.

Attention! Securely fix a cable between sensor and electronic unit when connecting remote type flow meter. Otherwise cable vibration will lead to false signal occurrence and transducer failures.

2.2.7 Mounting requirements for insertion type

To provide declared accuracy follow installation requirements below:

- arrow on sensor shall match flow direction in the pipe; direction of bar handles shall be aligned with pipeline axis;
- In the case of removing the handle holes must be plugged with M14 bolts
- weldneck and insertion bar shall be installed perpendicular to the pipe in the place of installation (see fig.2.13);
- angle of deviation shall not exceed 90º (see fig.2.14).



Right wrong

Figure 2.13 – Flow meter positioning

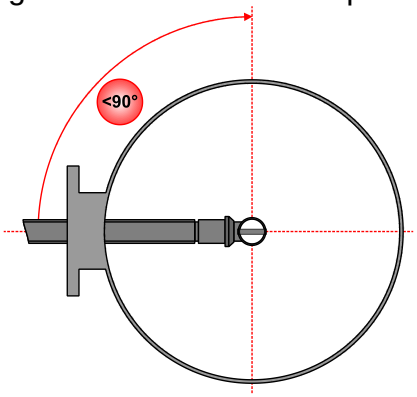


Figure 2.14 - Installation angle

Sensor of insertion type flow meter can be installed in the center of the pipe (R) (recommended for DN300...800mm) or in the point of average velocity (H) (recommended for over DN800mm). Flow meters are configured for installation at specified locations when they are released from production.

In pipelines with a diameter of more than 800 to 1200 mm, the sensor may also be installed in the center of the pipe. Sensor location is shown in fig.2.15.

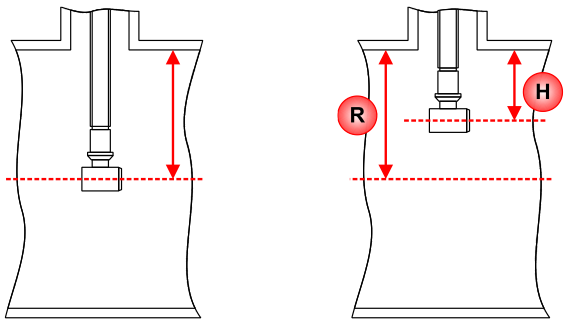


Figure 2.15 - Sensor location

Accuracy of insertion type flow meters is provided due to installation quality and qualified measurement of pipe diameter. Sensor detects flow velocity and to calculate flow rate you should measure inner diameter of the pipe and input this value into device memory using EMIS-Integrator.

To ensure accuracy, provide straight run as required (see table 2.7).

When measuring flow velocity in the middle of the flow you need to know pipe friction coefficient λ. In general it is 0,02. It shall not exceed 0,06. This number depends on viscosity and pipe wall roughness. The number will be selected automatically after you input medium and its temperature into the memory.

Sensor location accuracy shall comply with ±0,05R if placed in the core of the flow.

Attention! To ensure tightness when installing a insertion type flow meter and adjusting the immersion depth of the flow sensor, please follow the installation recommendations given in Appendix L.

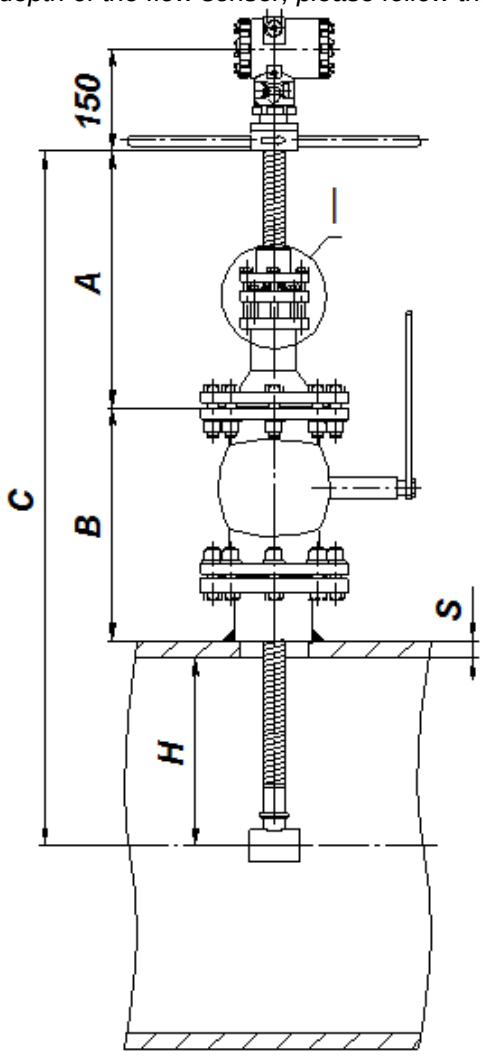


Figure 2.16 - Immersion depth calculation

When measuring flow velocity in 0,242R point, provide depth of insertion of±0,013R. In this point actual average velocity will be measured.

For flow meters of 1,6MPa configuration: to place sensor accurately inside the pipe you need to calculate and maintain A size (see fig.2.16), which corresponds with required insertion depth:

$$\mathbf{A = C - B - H - S,}\ \text{mm} \qquad (2.6)$$

where: A is a distance between ball valve flange face and bushing face (corresponds with insertion depth);

B - distance between velocity sensor axis and bushing face;

C - distance between external face of the pipe and ball valve flange or sleeve flange.

H - sensor insertion depth (R or 0,242R);

S - pipe thickness.

Installation of 1,6MPa insertion type flow meter can be performed without flow interruption (hot tapping). Hot tapping is presented in Appendix L.

For 2,5MPa and 4MPa configurations flow meter the flange shall be securely fitted in the insertion bar to avoid rotation and change of immersion depth. There is no ball valve and hot tapping is not available. Please specify inner diameter of the pipe and its thickness when placing the order for 2.5 and 4MPa insertion type flow meters so that we can select immersion depth.

2.2.8 Mounting of ex-proof flow meter

Carefully check the flow meter before installation. Pay attention to ex-proof marks, warning signs, check for damages of ex-proof enclosure and sensor, check for ground clamp, seals for cables and covers, supply cable condition.

Examine all ex-proof surfaces which will be unmounted. No scratches, indention, shears on the surfaces marked as ex-proof on the drawing in ***Appendix D*** are allowed.

Wiring shall be carried out in accordance with the wiring diagrams given in ***Appendix B***.

Connections can be made using any type of cable not less than 0,35 mm2 according to the chapter 7 of the Rules of electrical installation design.

It is not allowed to ground any circuits when using intrinsically safe power supply sources galvanically coupled with earth or load.

Flow meter body shall be grounded using 2,5mm^2 cable. Check ground resistance after installation, it shall not exceed 4 Ohm.

If only one cable gland is used, another one shall be plugged. Use the plugs provided by the manufacturer for ex-proof flow meters.

After electrical installation make sure that all covers of the transmitter case are tightened and locked according to the drawing in Appendix F.

Installation, operation and maintenance of flow meters shall comply with requirements of the "Rules of electrical installation design", GOST 31610.17-2012 «, "Rules of operation of consumer electrical installations" and Order of the Ministry of Labor of Russia of July 24,2013 No328n», ВСН332-74, "Safety rules for coal mines" and Federal regulations and rules for industrial safety "Safety rules for mining and solid minerals processing" and present manual.

PB, PBI, PO versions flow meters installation shall be executed according to the requirements of the present Manual and ex-proof enclosure installation instruction supplied in kit.

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 Flow meter parameters according to customer requirements are specified in data sheet:

- 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);
- process medium: liquid, gas, steam;
- medium and ambient temperature range;
- accuracy class;
- output signals: flow rate specified for 100Hz of the frequency signal, pulse value for pulse signal, flow rate for 20mA of the current signal;
- K-factor (for insertion type flow meters K-factor is specified for flow sensor).

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.

2.3.3 Operation via RS-485 or USB

RS-485 / USB allow to adjust and read the flow meter using PC, integrate several flow meters into one network or connect to existing networks via RS-485 and Modbus RTU.

EMIS-Integrator is designed to read and adjust flow meter via PC. Software functions and operation are specified in software QA.

When calibrating the flow meter it may require to adjust parameters that influence accuracy. The flow meter has mechanical write protection. Protection is ensured by switch SW1:1 located on the processor board. To deactivate protection and adjust protected parameters switch it to ON, after that you will receive the maximum access level (2 for standard and extended version and 6 level for special versions of the flow meter). To activate protection put the switch to OFF. Other parameters are protected with a password of access level 1 for the standard and extended version flow meters and levels 1-5 for a special version of the flow meter. Passwords can be changed by user with higher access level. See Appendix G for parameters division.

If total length of digital line exceeds 100 meters we recommend to include impedance matching unit R on the ends (resistor 0,125 W, 150 Ohm±10%).

When programming the converter via the RS485 / USB interface, data is exchanged in accordance with the Modbus RTU protocol (“Modicon Modbus Protocol Reference Guide P1-MBUS-300 Rev. G”).

Baud rate is selected from the list below: 4800; 9600; 19200; 38400 bit/s, data format: 8 bit, 1 stop bit, non-parity. 38400 bit/s is set by default.

Modbus RTU commands:

- 03 (read holding registers);
- 04 (read input registers);
- 06 (write holding registers);
- 08 (diagnostics);
- 16 (write multiple holding register);
- 17 (read device ID).

See Appendix G for Modbus Map (addresses).

2.3.4 Converter adjustment

2.3.4.1 Flow meter with extended transmitter version can calculate mass flow and medium mass, converting volume flow to normal conditions.

To use this function you need to connect pressure and temperature gauges as shown in fig.B.1. Cables from pressure and temperature gauges shall be connected to the flow meter through distribution box of KP-B-100D type or directly to the "U" version transmitter with 4 cable glands.

If no gauges are available you need to input pressure and temperature values under normal conditions via EMIS-Integrator.

2.3.4.2 Mass flow is calculated as volume flow multiplied by medium density.

If density tables are activated, water and saturated vapour density are calculated using equations as specified in measuring technique GSSD MP 147-2008, natural gas as specified in GOST P 8.662. If density tables are deactivated, density is calculated based on preset values.

The calculation of the density of other liquids, except water, is carried out using the appropriate temperature-density tables by linear interpolation. Input several temperature-density value pairs for such mediums. Apply extreme values of density for temperatures lying outside the table values.

Air and gas density is calculated as follows (except for natural gas):

$$\rho = (\rho 0 * Pa * T0) / (Kcom * Ta * P0), \text{ where} \quad (2.7)$$

ρ0 is medium density under normal conditions, input while adjustment;
Pa - absolute pressure of medium, MPa;
Ta - absolute temperature of medium, K;
P0 - absolute pressure under normal conditions, MPa;
T0 - absolute temperature under normal conditions, K;
Kcom - compressibility factor under normal conditions, input while adjustment.

2.3.4.3 Converter is adjusted according to the data provided in the order sheet. If some parameters are not specified in the data sheet they will be set by default as below:

- for liquids:
  - measuring medium - liquid;
  - density tables are activated for automatic density calculation;
  - static parameter of temperature sensor Pt100;
  - absolute pressure gauge is connected, MPa;
  - upper limit of pressure gauge 2,5MPa;
  - compressibility factor is 1;
  - air pressure 0,101325 MPa;
  - temperature under normal conditions 20 °C;
  - preset pressure (if pressure gauge is not installed or broken) 0,101325 MPa;
  - preset temperature (if temperature gauge is not installed or broken):
    - for 70, 100 and +25 temperature configurations;
    - for 250, +125 temperature configurations;

- for gas mediums:
  - measuring medium -air;
  - static parameter of temperature sensor Pt100;
  - absolute pressure gauge is connected, MPa;
  - upper limit of pressure gauge 2,5MPa;
  - compressibility factor is 1;
  - air pressure 0,101325 MPa;
  - temperature under normal conditions 0 °C;
  - preset pressure (if pressure gauge is not installed or broken) 0,101325 MPa;
  - preset temperature (if temperature gauge is not installed or broken):
    - for 70, 100 and +25 temperature configurations;
    - for 250, +125 temperature configurations;
    - for 320, +275 temperature configurations;

- for vapour:
  - measuring medium -saturated vapour;
  - static parameter of temperature sensor Pt100;
  - absolute pressure gauge is connected, MPa;
  - upper limit of pressure gauge 2,5MPa;
  - compressibility factor is 1;
  - air pressure 0,101325 MPa;
  - temperature under normal conditions 0 °C;
  - preset pressure (if pressure gauge is not installed or broken) 0,101325 MPa;
  - preset temperature (if temperature gauge is not installed or broken):
    - for 250, +125 temperature configurations;
    - for 320, +275 temperature configurations;
    - for 450, +425 temperature configurations;

2.3.4.4 If process parameters are different from above, select type of installed temperature and pressure gauges via EMIS-Integrator, input medium temperature and pressure for cases if sensor is not installed or broken, and adjust other parameters. We recommend to indicate process parameters in order sheet so that we can adjust the flow meter for you.

2.3.5 Preheating

Preheating is available only for special version flow meters. It is switched on using the switch on the process board. It is used to preheat electronics when ambient temperature falls below -20 °C. Specify it in the order sheet if necessary.

Preheating power does not exceed 4,7W under power supply of 24V.

2.3.6 Troubleshooting

2.3.6.1 There are 3 types of failures: failures that can be revealed by outward signs, by LED indication located near terminal box or in the front panel, by service messages.

2.3.6.2 Possible failures that can be revealed by outward signs are shown in table 2.9.

Table 2.9 - Troubleshooting

Failure	*Possible cause*	*Remedy*
1 Sensor or EMIS-Integrator show zero flow. when power is on and there is actual flow in the pipe. No signals on frequency or digital outputs.	Wrong connection of supply and signal cables.	Check cable or supply wires connection according to connection diagram
	Supply or signal cables break.	Check and replace supply and signal cable or wires, if they are broken.
	Supply voltage does not comply with required.	Check power supply unit and adjust voltage according to the manual.
	The flow volume is under specified minimum level for this Dn.	Open control adn gate valves.
	Low signal cut-off value is incorrect.	Adjust vibration resistance using EMIS-Integrator by reducing cutoff value in % according to signal strength.
	Wrong port selected for digital output connection.	Go to System and identify port number which the flow meter is connected to, select respective port in EMIS-Integrator.
	Electronics failure due to external disturbance.	Replace the set of electronic boards. Use EMIS-Integrator to recover coefficients and adjust the flow meter. Digital file containing flow meter settings shall be requested form manufacturer. All parameters specified in the data sheet are maintained.
2. Unstable indication of momentary flow. Unstable frequency output signal from flow meter.	Wrong installation of flow meter: - big difference between pipeline and flow meter diameters; - straight run does not comply with requirements; - gaskets extend.	Install flow meter according to 2.1 hereof.
	Gas bubbles in liquid.	Remove all gas inclusions.
	Piezoelectric cell is broken.	Replace it.
	Actual flow does not comply with declared flow for that flow meter diameter.	Replace flow meter to match actual flow and declared flow rates.
3. There is no actual flow in the pipe but some flow is detected on the outputs.	High level of vibrations along the pipeline which exceeds stated vibration resistance.	Follow the recommendations below: - fill the pipe with medium; - turn flow meter body to 90º ; - increase low signal cut-off value via EMIS-Integrator; - reveal vibration source (e.g. pump) and decrease vibration level by fixing vibration source and the pipeline in the point of flow meter installation; - Adjust sensor signal filtration.

2.3.6.3 If fail to repair or meet declared accuracy during scheduled calibration, please contact manufacturer or service center.

Claim sample for replacement or warranty repair is provided as the enclosure to the data sheet.

2.3.6.4 Failures detected by LED indication mode shall be identified in the table 2.10. Faults are analyzed in order of priority, indicated in column No. When the first fault is detected, further analysis is terminated and the LED indicate respective error.

Table 2.10 - LED indication in case of failure

No	Background lighting	Number of flashes per cycle (cycle length 3,2 seconds)	Failure
1	Yes	1	Wire break after amplifier
2	Yes	2	Electronics failure
3*	Yes	3	Temperature gauge failure or problem with its wiring
4*	Yes	4	Pressure gauge failure or problem with its wiring
5*	None	2	Current or current loop voltage do not comply with standard
6	None	3	Cavitation or chaotic vortex shedding
7*	None	4	Vibration acceleration amplitude exceeds stated limit

** - n/a for special version of transmitter;*

There is no background lighting if no failure detected, LED flashes every 3,2 sec to indicate power supply.

In the version of the electronic converter with a two-wire connection scheme, there is a “Power” LED, which lights up when there is power, and a “Status” LED, which lights up at a critical error.

2.3.6.5 Failures revealed by service messages.

Indication board with mechanical buttons (SIM configuration) will indicate a failure by flashing “E0001” if there is no connection with main processor. Board with optical buttons (SIO configuration) will indicate a failure “E0002” if the glass is dirty, wept or frost. Clean and wipe the glass, than switch off and switch on again. It is required to readjust initial level of glass reflection (zero level). Flow meter will indicate current parameters without restart but buttons control may continue unstable.

2.3.6.6 Flow meter repair shall be performed using spare parts and accessories produced by EMIS. The manufacturer is not responsible for any repair fullfilled using other manufacturer's spare parts and accessories.

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 flow meter becomes lower than stated critical minimum (approximately equal to saturated vapor pressure under given temperature). See 2.15 for 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. Drawing of maintenance insertion 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.

Insertion type flow meters with flow tubes of DN 40mm shall also be calibrated.

Calibration shall be performed according to Calibration method EV-200.000.000.000.00 CM Rev.1.

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 table 1.7.

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;
- sensor failure;
- violation of the geometry of body parts above the maximum permissible deviations;

4.2 Personell 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 rotameter;
- do electrical connection according to the diagrams not provided in the present manual
- operate the rotameter 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 does 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 of the body and fasteners.

9 PRECIOUS MATERIALS CONTENT

Does not contain precious metals.

Appendix A
(informative)

Reference documents

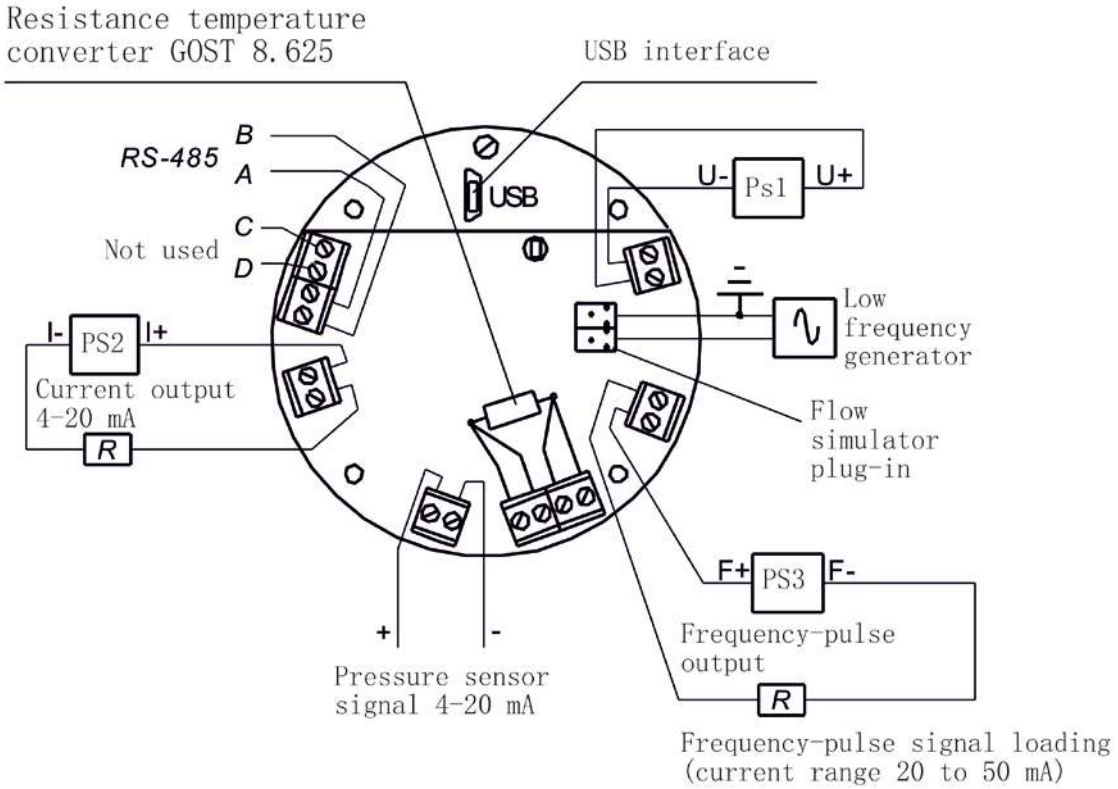
Table 1

Document code	*Name*	*Item No*
BCH 332-74	Instructions for Installation of electrical equipment, power and lighting systems in explosive environment	2.2.7
GOST 10-88	Tubular inside micrometers. Technical conditions	2.1.14
GOST 166-89	Calipers. Technical conditions	2.1.14. Appendix I
GOST 215-73	Mercury glass laboratory thermometers. Technical conditions	***Appendix I***
GOST 27.003-2016	Technical reliability General rules for reliability requirements	1.2.14
GOST 5915-70	Hex nuts of accuracy class B. Design and dimensions	***Appendix D***
GOST 6651-2009	State System for Ensuring Uniform Measurement. Thermal converters resistance made of platinum, copper and nickel. General technical requirements and test methods	***Appendix B***
GOST 7502-98	Metal measure tapes. Technical conditions	2.1.14. Appendix J
GOST 7798-70	Hex nuts of accuracy class B. Design and dimensions	***Appendix D***
GOST 8.361-79	State System for Ensuring Uniform Measurement. Liquid and gas flow. Technique of measuring by the velocity at a single point of a pipe cross-section.	1.1.1; Appendix J
GOST 8.586.1-2005	State System for Ensuring Uniform Measurement. Measure of flow and quantity of liquids and gases using standard reducers. Part 1. Principle of measurement method and general requirements	***Appendix J***
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	2.2.2
GOST 8732-78	Hot-rolled seamless steel pipes. Assortment	***Appendix D***
GOST P 8.662-2009	State System for Ensuring Uniform Measurement. Natural gas Thermodynamic properties of the gas phase Calculation methods for gas transportation and distribution based on the AGA8 fundamental equation of state	2.3.4.2
GOST 8734-75	Cold worked seamless steel pipes. Assortment	***Appendix D***
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	2.1.11
GOST 11358-89	Thickness and pipe wall thickness gauges with a scale value of 0.01 and 0.1 mm. Technical conditions	2.1.14
GOST 12820-80	Socket weld flange Pn 0,1 to 2,5 MPa.	***Appendix D***
GOST 12821-80	Weld-neck flange for Pn 0,1 to 20,0 MPa.	***Appendix D***
GOST 12971-67	Rectangular plates for machines and equipment. Sizes	1.6.1.1
GOST 14254-2015	Enclosure protection level (IP)	1.1.5, 1.3.2

Document code	Name	Item No
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.	1.1.9; 5; 6
GOST 16037-80	Welded connections of pipes Main types, structural elements and dimensions	***Appendix L***
GOST 22042-76	Studs for parts with smooth holes. Accuracy class B. Design and dimensions	***Appendix D***
GOST 22261-94	Means of measurement of electrical and magnetic values. General specifications	***Appendix J***
GOST 31610.0-2014 (IEC 60079-0:2011)	Explosive mediums Part 0. Equipment. General requirements	1.3.1, 1.3.3
GOST IEC 60079-1-2011	Explosive mediums Part 1. Protection by "d" flameproof enclosures	1.3.1, 1.3.2, 1.3.3
GOST 31610.11-2014 (IEC 60079-11:2014)	Explosive mediums Part 11. Protection by "i" intrinsic safety circuit	1.3.2, 1.3.2, 1.3.3
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)	2.2.8, 3
GOST 33259-2015	Flanges for valves, fittings and pipelines for pressure to PN 250.	***Appendix D***
ГСССД МР 147-2008	Method. Calculation of thermodynamic characteristics of water and water vapour	2.3.4.2
GOST 37.001.031-72	Threaded connection tightening	***Appendix L***
ПБ 05-618-03	Coal Mine Safety Regulations	2.2.7
ПР 50.2.104-09	State system for ensuring the uniformity of measurements. Test Procedure for Standard Samples or Measuring Instruments for Type Approval	1.6.1.1
Order of the Ministry of Energy of January 13, 2003. № 6	Rules of technical operation of electrical installations of consumers	2.2.7
Order of the Ministry of Labor of Russia of July 24,2013 №328н	Order of the Ministry of Labor of Russia dated of July 24, 2014 №328н “On approval of the Rules on labor protection in the operation of electrical installations”	2.2.7
Order Rostekhnadzor from of December 11, 2013. № 599	Mining and Solid Minerals Processing Safety Regulations	2.2.7
Order of FSETAN of March 25, 2014. № 116	Federal rules and regulations in the field of industrial safety	2.2.7
Russian Electrical	Electrical installation code	2.2.7

Appendix B
(normative)

Connection disgrams



1. PS1 - power supply unit 12 to 27 V DC
2. PS2 - DC power supply unit see 1.2.10
3. PS3 - power supply unit 5 to 27 V DC
4. PS4 - power supply unit up to 27 V DC

Figure B.1 - Order of terminal clamps for standard and extended version transmitters.

Comments to power supply units:

- Power supply PS1 is used for general power supply of flow meter (display, digital output ModBUS. etc.) and is obligatory unit.
- Power supply unit PS2 is used for HART and/or current output.
- Power supply PS3 is used for current or discrete output power supply.
- PS3 and PS2 are not obligatory (if relevant outputs are not used) or can be combined with PS1 (if galvanic isolation is not required).
- PS4 is used for pressure gauge connection. Internal resistance less than 150 Ohm.
- It is not recommended to use PS1 with secondary circuit grounding for flow simulation.
- The resistance of the resistor R1 in the current output circuit - see Section 1.2.10.
- The resistance of the resistor R2 in the circuit of the frequency-pulse output - see Section 1.2.9.

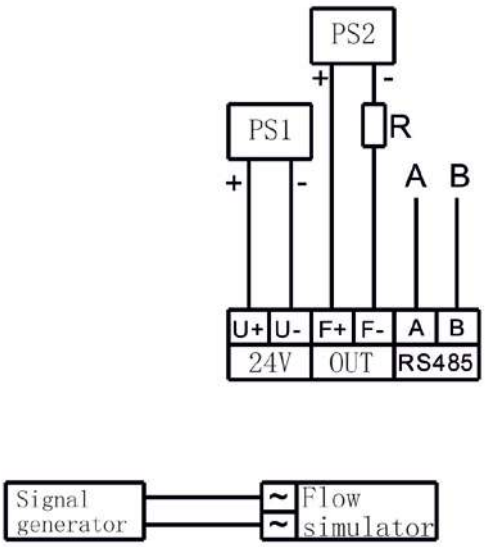
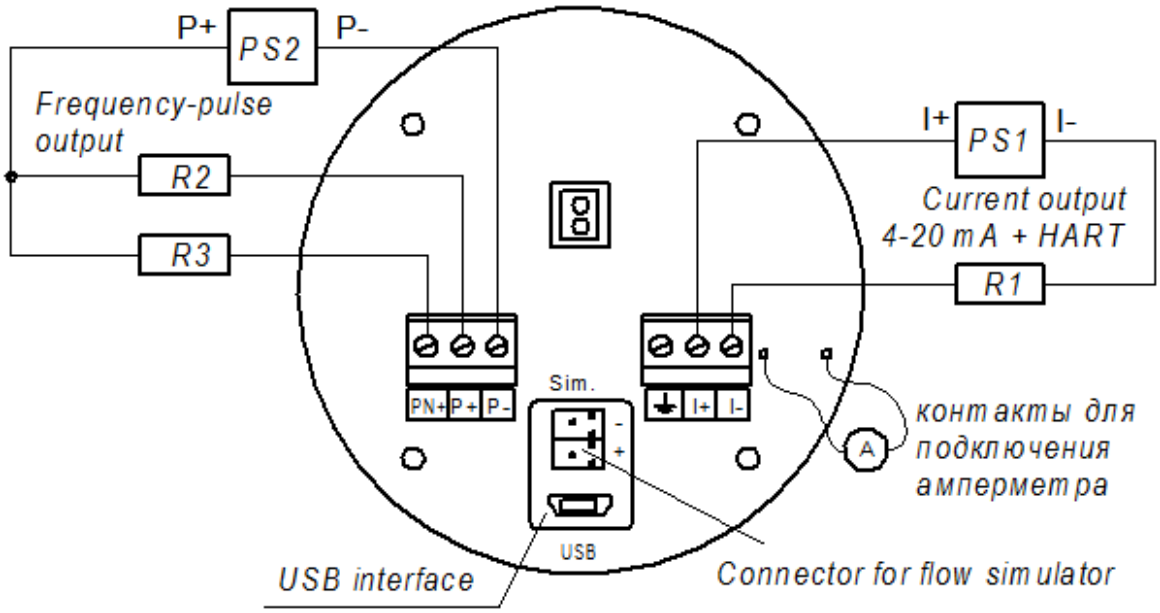


Figure B.1 - Order of terminal clamps for special version transmitters.

Comments to power supply units:

- Power supply PS1 is used for general power supply of flow meter (display, digital output ModBUS. etc.) and is obligatory unit. Power supply 12 to 27 V
- Power supply PS2 is used for frequency-pulse output power supply. Power supply 12 to 27 V. PS2 is not obligatory (if relevant outputs are not used) or can be combined with PS1 (if galvanic isolation is not required). PS2 can be integrated in secondary equipment.
- It is not recommended to use PS1 with secondary circuit grounding for flow simulation.
- Signal source shall form sine signal of max 1 V amplitude.
- The resistance of the resistor R in the circuit of the frequency-pulse output - see 1.2.9.



1. PS1 - power supply unit 16 to 30 V DC
2. PS2 - power supply unit 5 to 30 V DC

Figure B.3 - Order of terminal clamps for version transmitters with 2-wire connection scheme

Comments to power supply units:

www.emis-kip.ru/ru/prod/ev200

- Power supply PS1 is used for flow meter power supply.
- Power supply PS2 is used for frequency-pulse output power supply.
- PS2 is not obligatory (if corresponding outputs are not used).
- It is not recommended to use PS1 with secondary circuit grounding for flow simulation.
- The resistance of the resistor R1 in the current output circuit - see Section 1.2.10.
- The resistance of the resistor R2 in the circuit of the frequency-pulse output - see Section 1.2.9.
- The resistance of the resistor R3 in the circuit of the frequency-pulse output complies with the NAMUR specification.

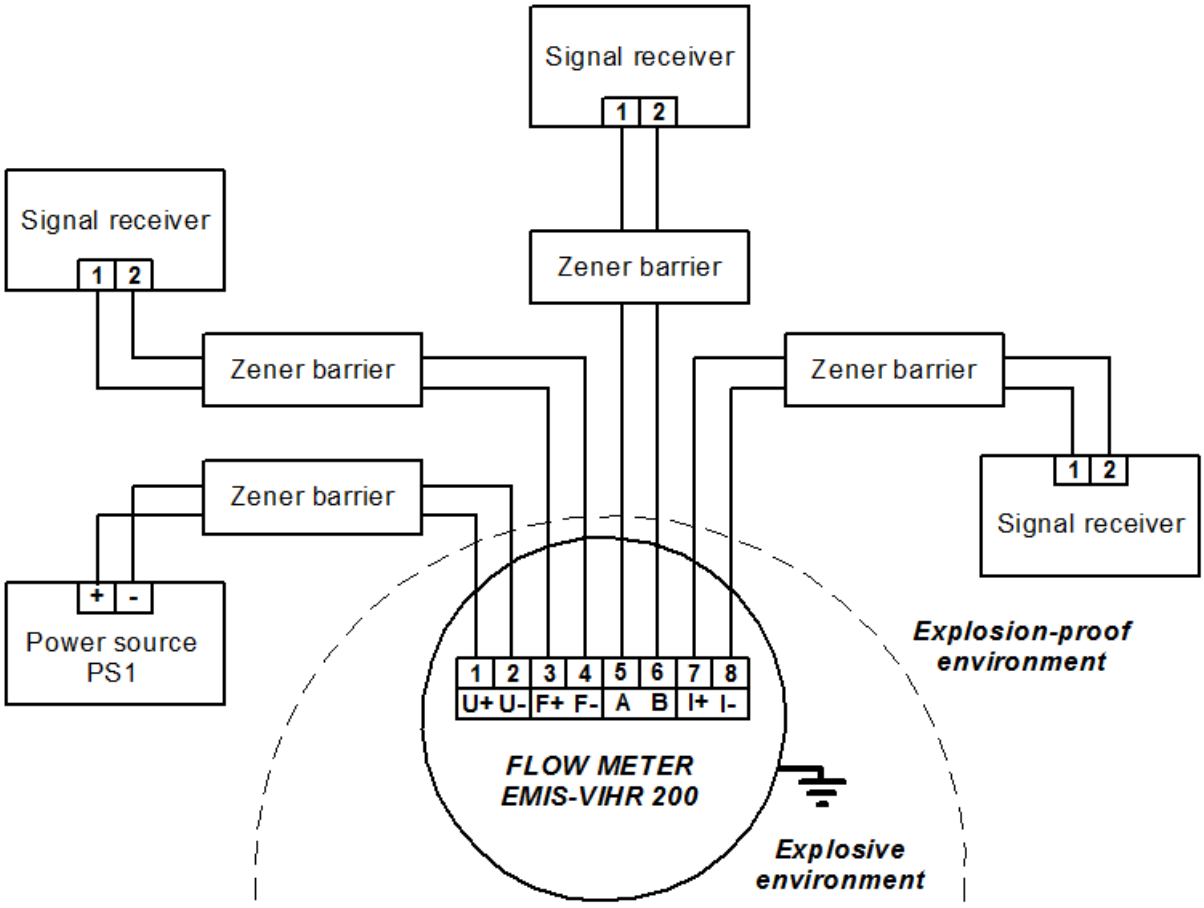
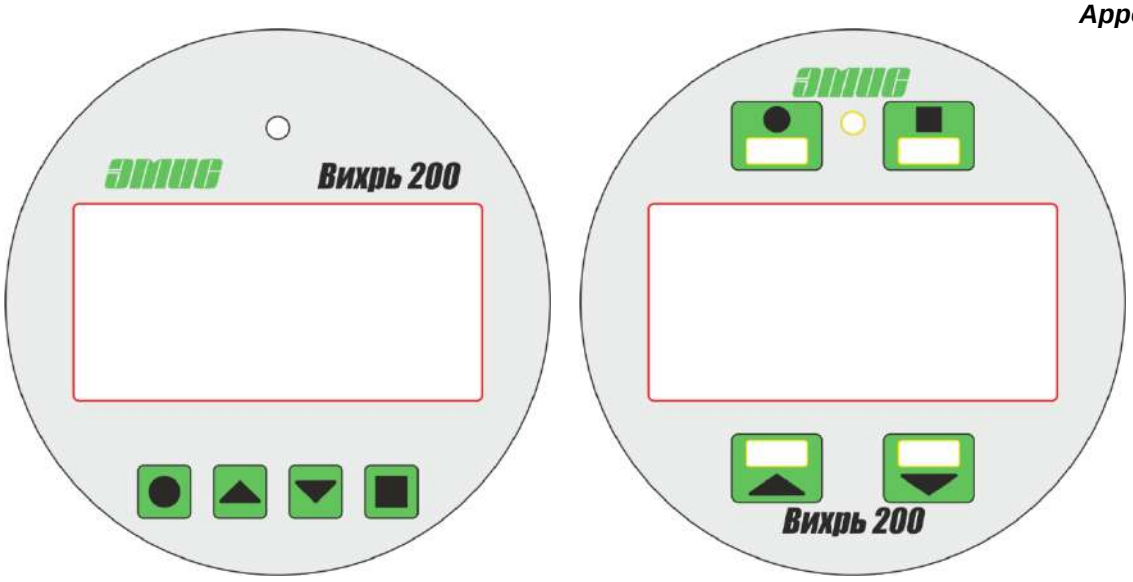


Figure B.4 - Connection diagram for ex-proof versions ExB, ExC, ExiaB, ExiaC, PBI, PO with with Zener barrier



SIM SIO

Figure B.5 - Front panel view

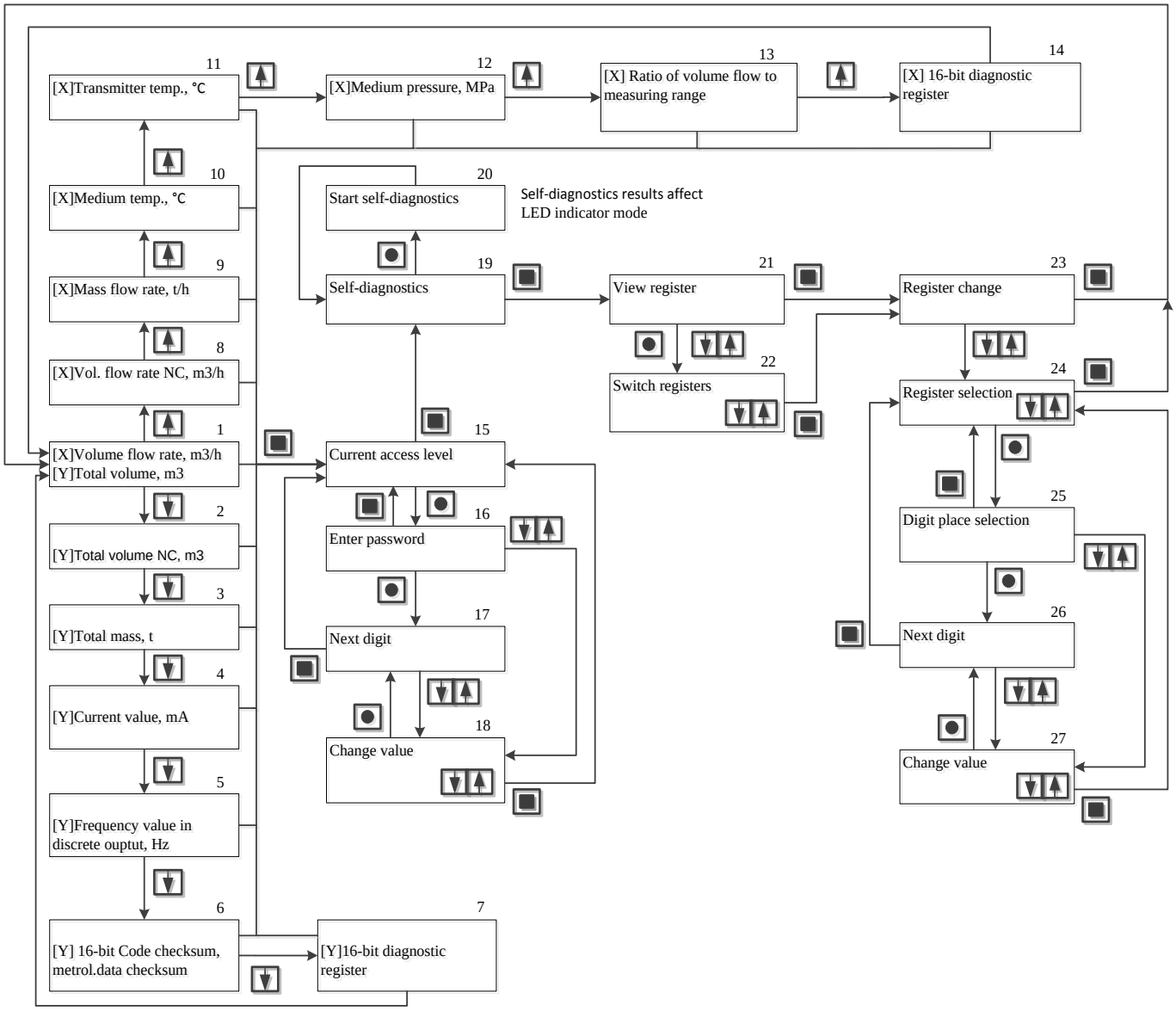


Figure B.6 - Menu structure of SIM and SIO config.

Appendix B

Fig.B.1 - Display of parameters for SIM and SIO config.

Menu line	*Indication*	*Navigation buttons*	*Menu description*
1	Volume flow rate, m3/h Total volume, m3		Current and total volume flow
2	(value in upper line) Total volume under NC m3	▼1	Total volume flow rate under normal conditions*
3	(value in upper line) Total mass, t	▼2	Total mass value*
4	(value in upper line) Current value in the loop, mA	▼3	Current value in the loop, mA *
5	(value in upper line) Frequency value in discrete output, Hz	▼4	Frequency value in discrete output
6	(value in upper line) 16-bit Code checksum, metrol.data checksum	▼5	16-bit checksum for source code, minus symbol and metrological data checksum
7	(value in upper line) 16-bit diagnostic register	▼6	16-bit content of diagnostic register
8	Vol.flow rate under NC, m3/h (value in lower line)	▲1	Current volume flow under normal conditions*
9	Mass flow rate, t/h (value in lower line)	▲2	Current mass flow *
10	Med. temperature, °C (value in lower line)	▲3	Medium temperature*
11	Transm. temperature, °C (value in lower line)	▲4	Transmitter temperature*
12	Max pressure of medium, MPa (value in lower line)	▲5	Medium pressure*
13	Ratio of volume flow to measuring range (value in lower line)	▲6	Ratio of volume flow to nominal measuring range
14	16-bit diagnostic register (value in lower line)	▲7	16-bit content of diagnostic register
15	Current access level	■1	Access level menu
16	Enter password	■1●1	Password menu
17	Next digit	■1●2	Digit place selection menu
18	Change value	■1●1▼▲1	Change value
19	Self-diagnostics	■2	Self-diagnostics
20	Start self-diagnostics	■2●1	Start self-diagnostics
21	View register	■3	Register menu
22	Switch register	■3●1	Register view menu
23	Register change	■4	Register change menu
24	Register selection	■4▼▲1	Register selection menu
25	Digit place selection	■4▼▲1●1	Digit place selection menu
26	Next digit	■4▼▲1●2	Digit place selection menu
27	Change value	■4▼▲1●1▼▲1	Change value menu

* - n/a for special version of transmitter

Appendix C
(informative)

Installation scheme, dimensions, connections sizes and weight

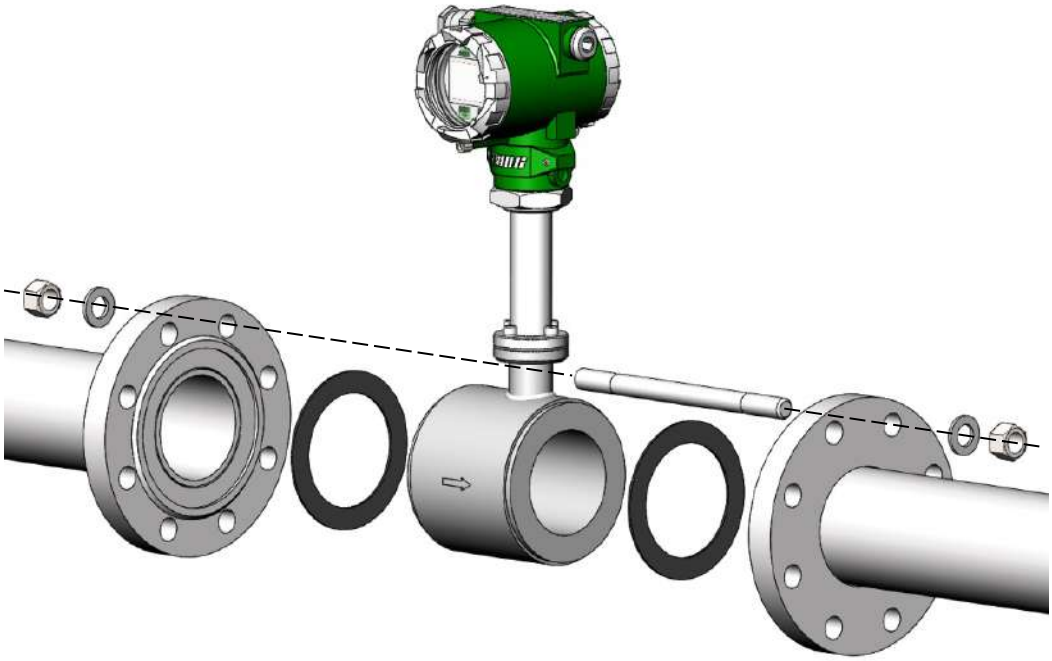


Figure C.1 - Installation scheme for flow meters of “wafer” type without flanges

.

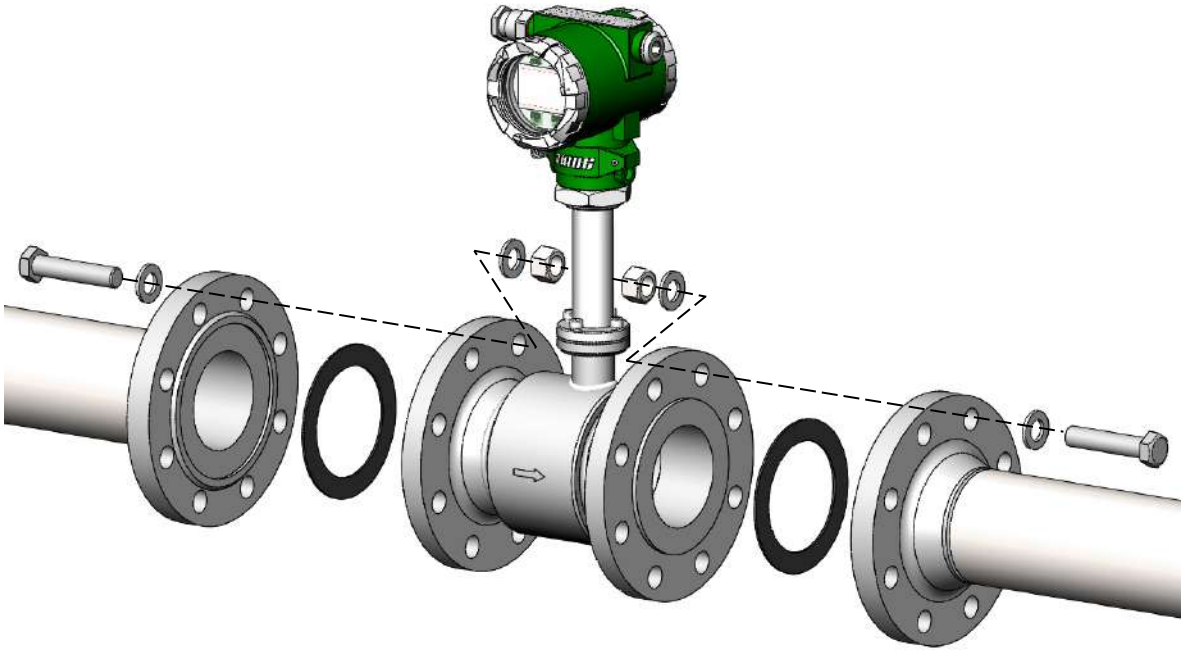
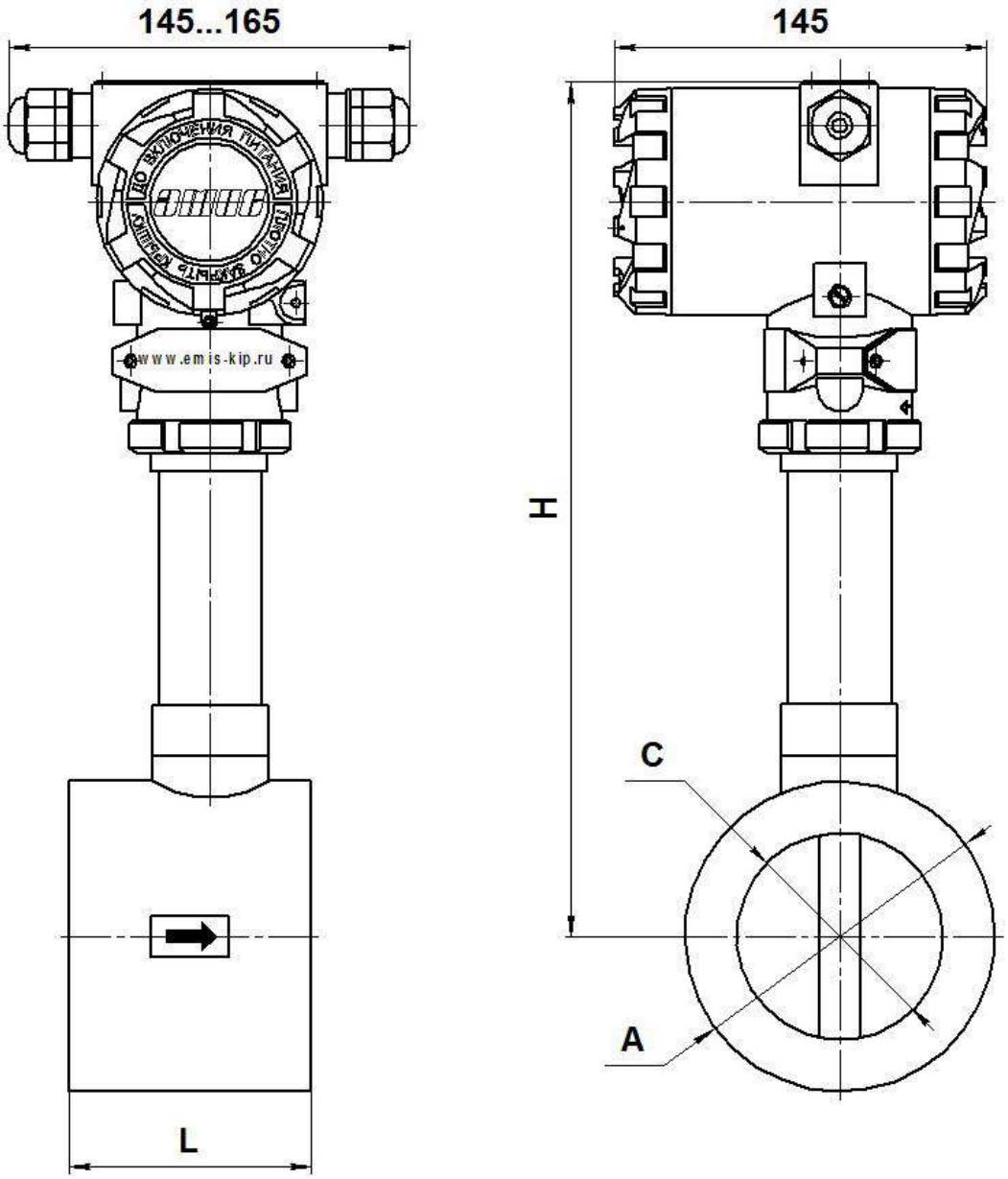


Figure C.2 - Installation scheme for flow meters with flanges

Appendix C

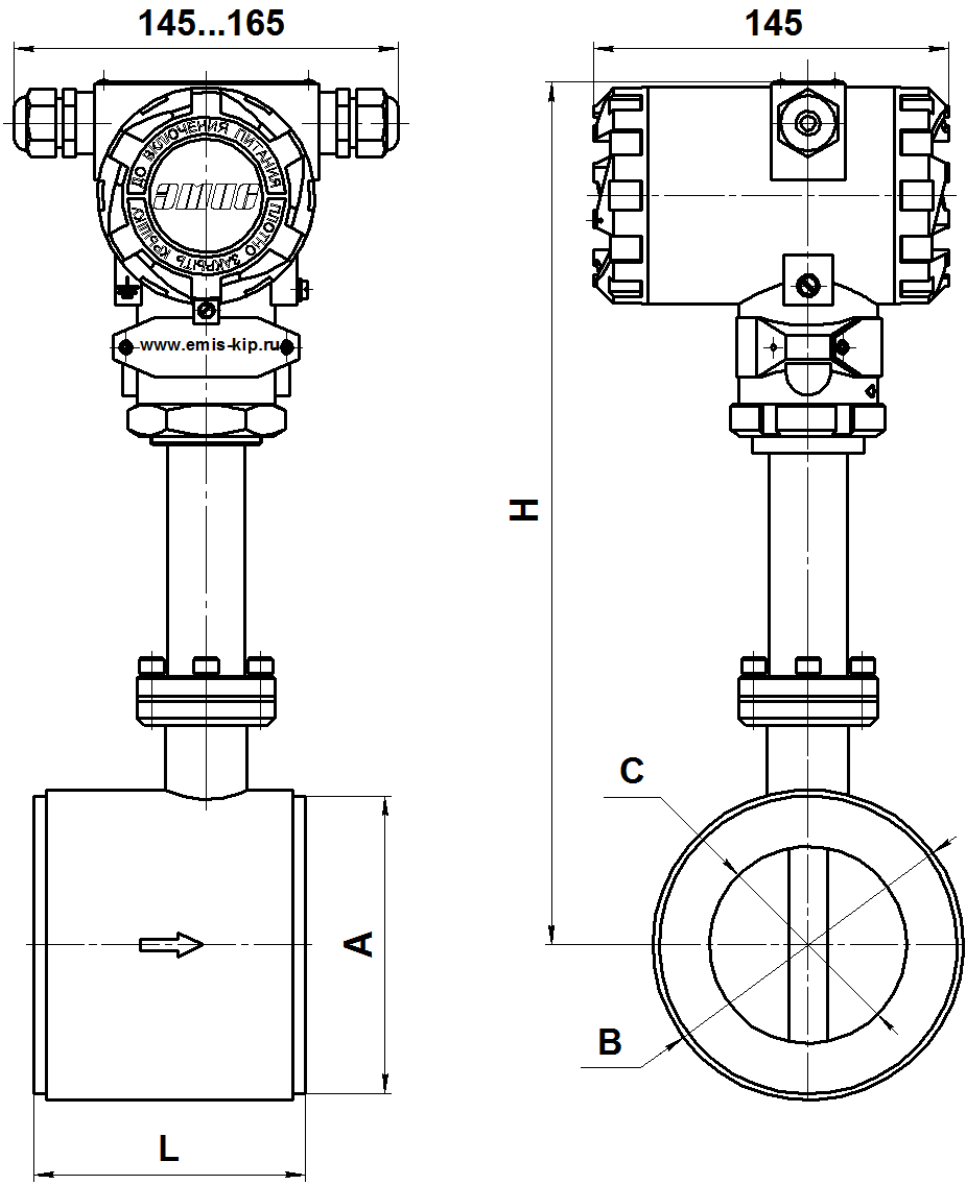


Version	A, mm	L, mm	H, mm		C, mm	Weight, kg	
			up to 100ºC	250,320ºC		up to 100ºC	250,320ºC
015	65	66	315	482	15	4.3	4.7
025	65	66	315	482	25	4.2	4.6
032	72	66	320	487	32	4.4	4.8
040	80	70	325	492	40	4.8	5.2
050	90	85	330	497	50	5.7	6.1
065	105	98	345	512	65	6.9	7.3
080	120	110	355	522	80	8.3	8.7
100	140	110	360	527	100	9.6	10.0

Figure C.3 - Flangless flow meter size

Configuration “C” pressure up to 6,3 MPa

Appendix C

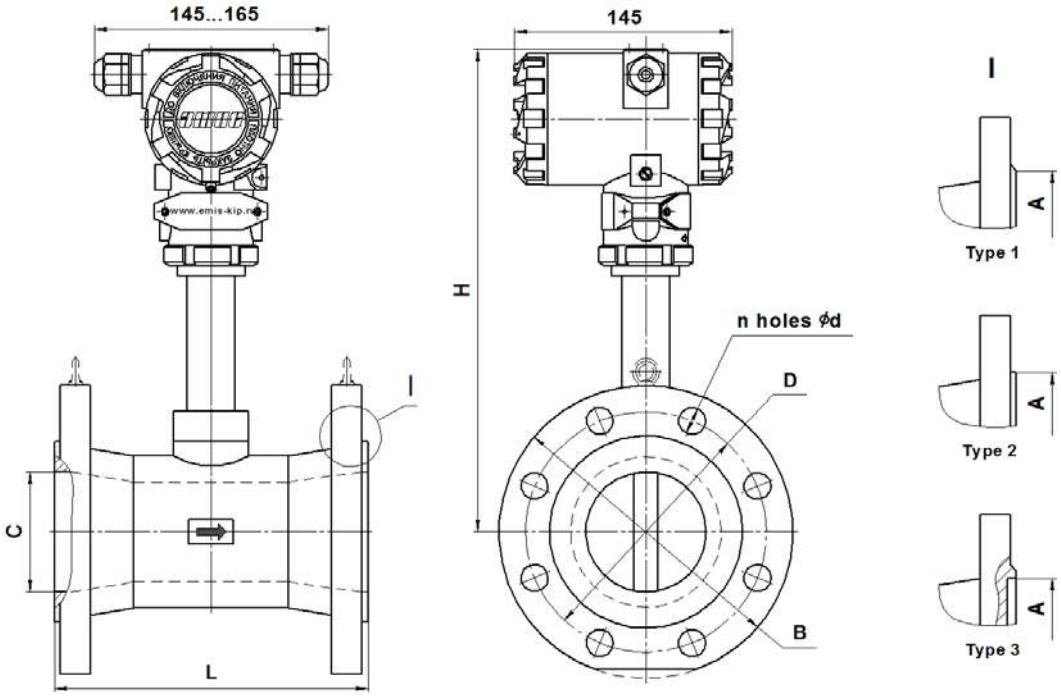


Version	A, mm	B, mm	L, mm	H, mm		C, mm	Weight, kg	
				up to 100°C	250,320°C		up to 100°C	250,320°C
015	58	64	75	325	485	15	4.0	4.4
025	58	74	75	330	490	25	4.5	4.9
032	66	79	80	335	495	32	4.8	5.2
040	76	86	80	340	500	40	5.1	5.5
050	88	96	85	345	505	50	5.8	6.2
065	110	112	100	350	510	65	7.5	7.9
080	121	126	110	360	520	80	8.9	9.3
100	150	152	110	370	530	100	11.5	11.9

Figure C.4 - Flangless flow meter size

Configuration “C1” pressure up to 6,3 MPa

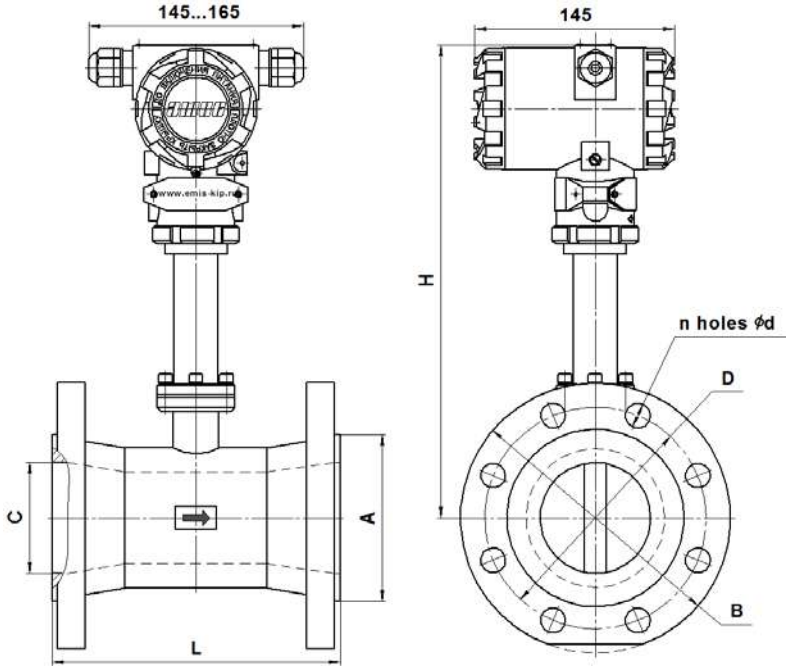
Appendix C



Dn, mm	Pressure, Mpa	D, mm	Type	A, mm	B, mm	L, mm		C, mm	H, mm				d, mm	n, pcs	Weight, kg
									up to 100ºC		250,320ºC				
						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	160	160	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.5 - Dimensions for F and FR configurations, temperature up to +320°C.

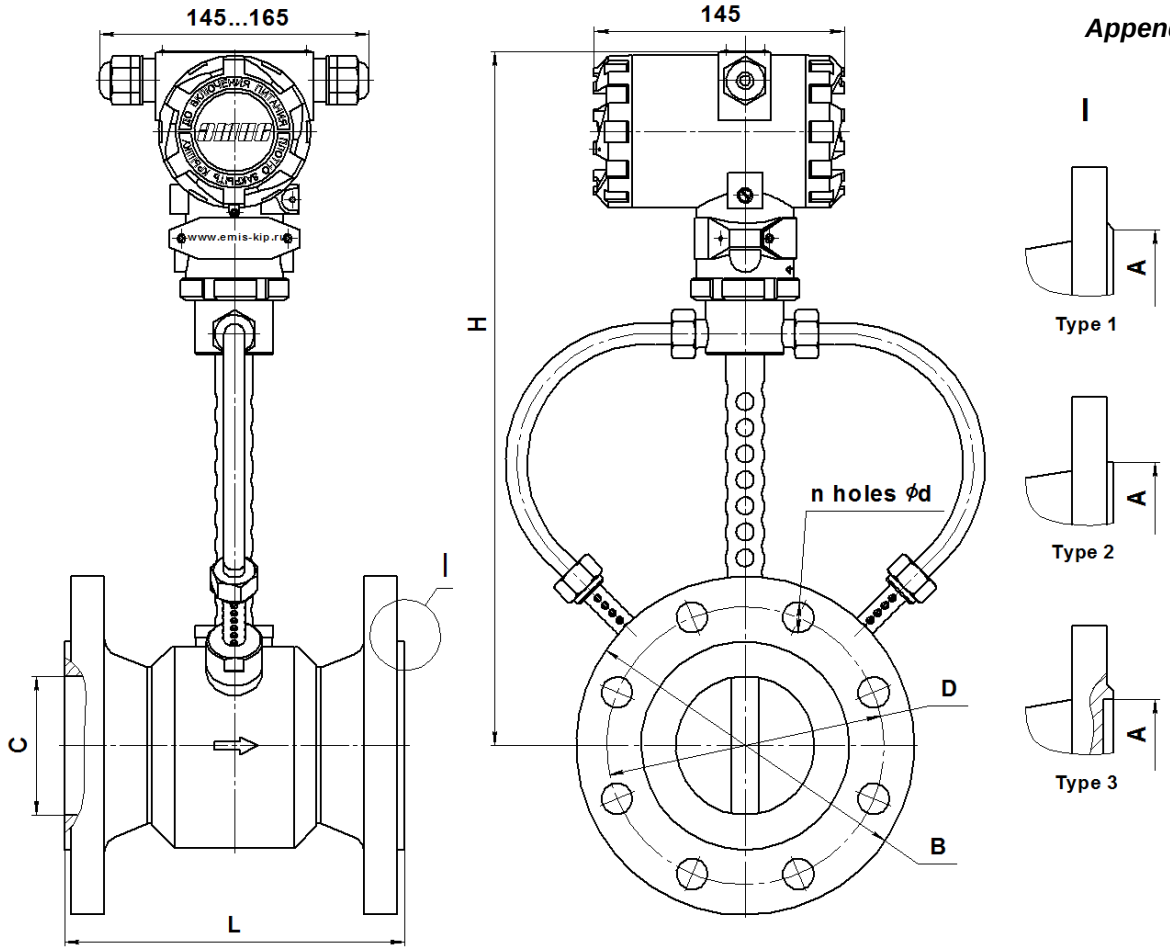
Appendix C



Dn, mm	Pressure, MPa	D, mm	A, mm	B, mm	L, mm		C, mm	H, mm				d, mm	n, pcs	Weight, kg
								up to 100ºC		250,320ºC				
					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.6 - Dimensions for F1 and FR1 configurations, temperature up to +320°C, pressure up to 6,3MPa

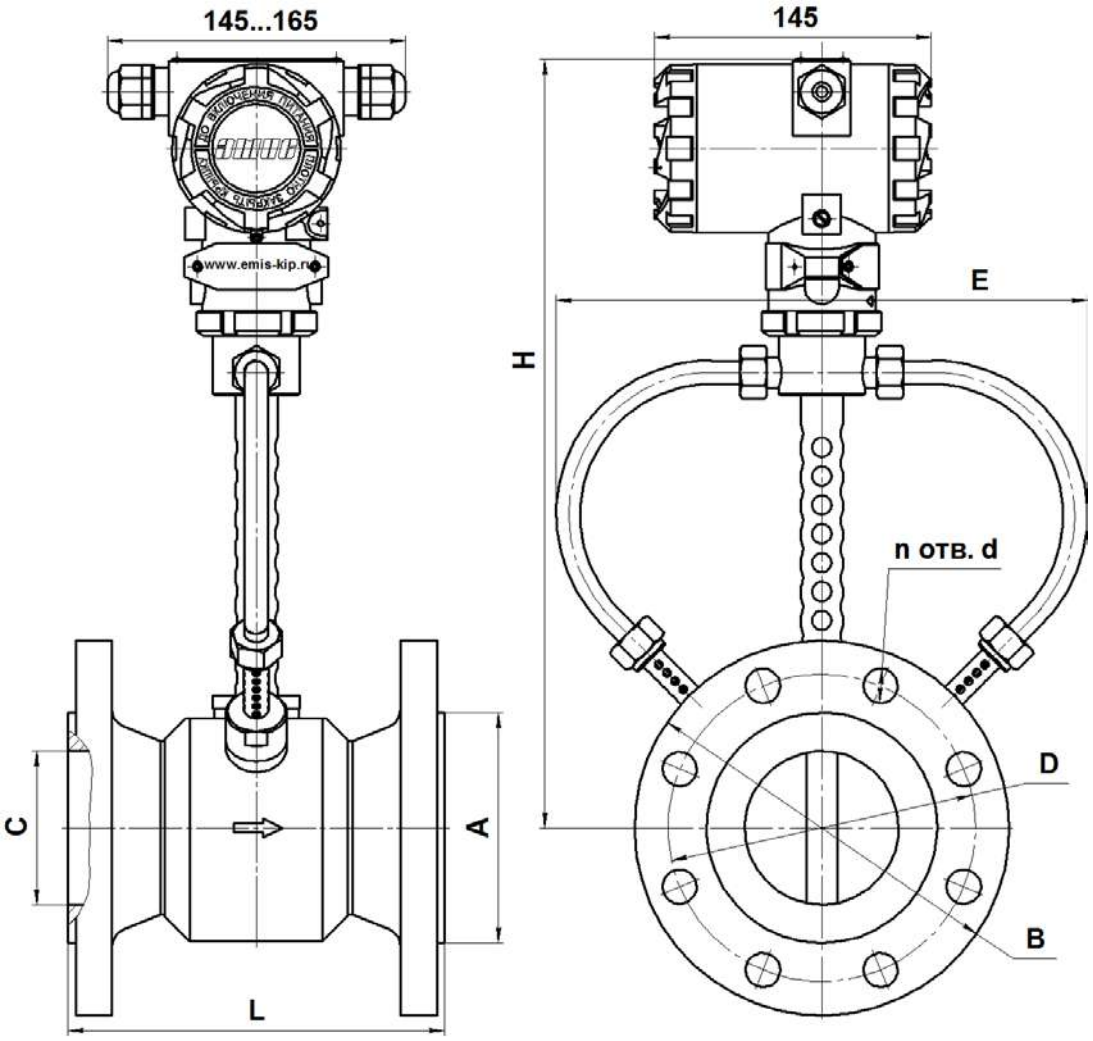
Appendix C



Dn, mm	*Pressure, MPa*	*D, mm*	*Type*	*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

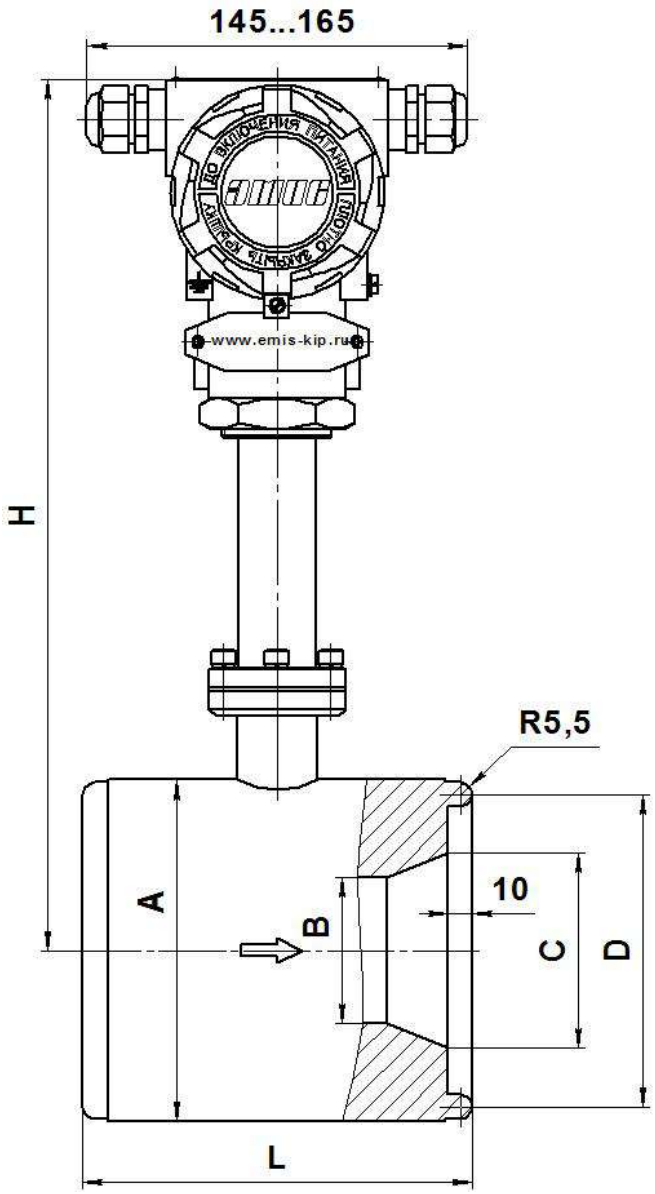
Figure C.7 - Dimensions for F configuration, temperature up to +450°C.

Appendix C



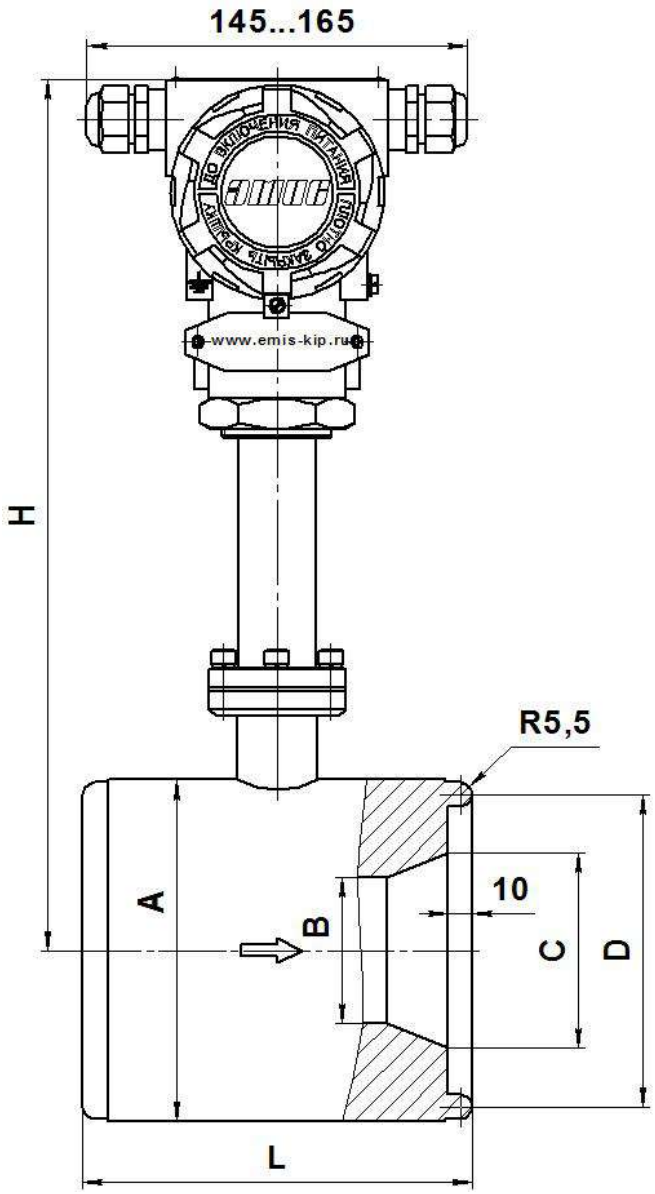
Dn, mm	*Pressure, MPa*	*D, mm*	*A, mm*	*B, mm*	*L, mm*	*C, mm*	*H, mm*	*d, mm*	*n, pcs*	*Weight, kg*
040	1,6-4	125	76	160	160	40	380	22	4	12
	6.3	125		160	160	40		22	4	12
050	1,6-4	135	88	170	160	48	380	22	4	14
	6.3	145		190	190	46		26	4	17
065	1,6-4	160	110	195	180	65	380	22	8	18
	6.3	170		215	210	63		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.8 - Dimensions for F1 configuration, temperature up to +450°C.



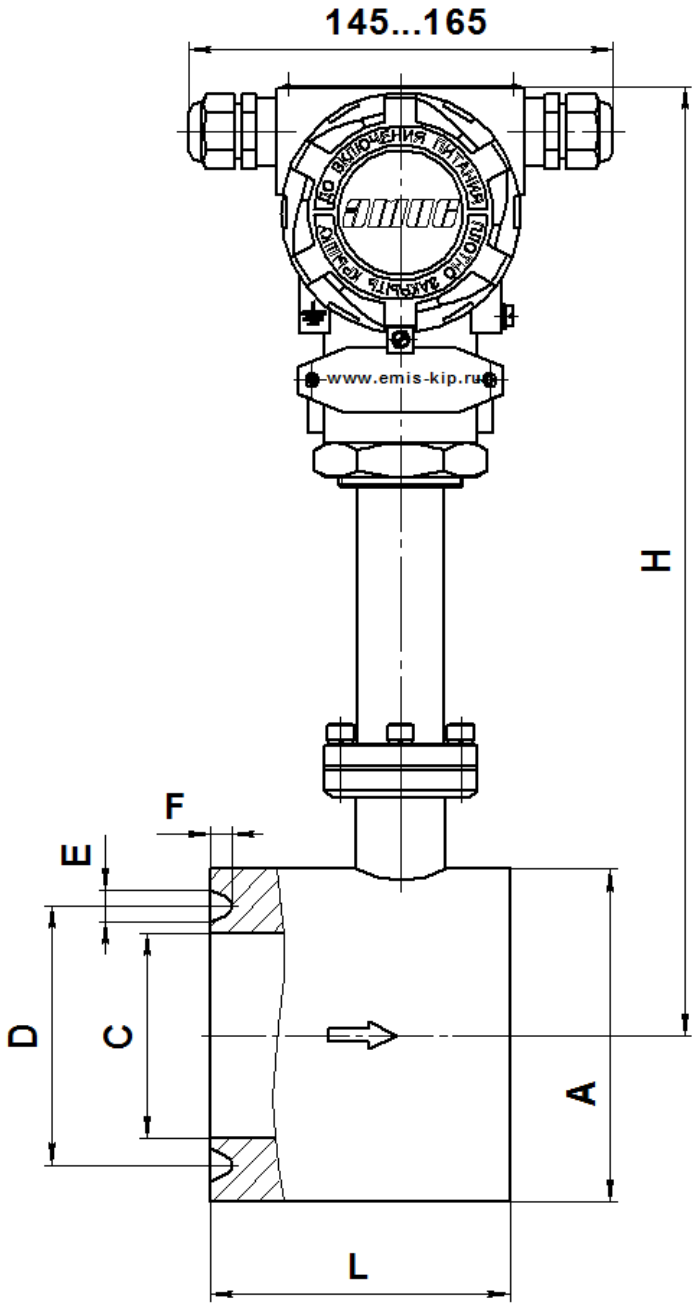
Size	*Version*	*A, mm*	*B, mm*	*C, mm*	*D, mm*	*L, mm*	*H, mm*	*Weight, kg*
50/10	PPD	92	20	50	80	140	346	8.5
50/20			32				346	8
50/25			35				348	8
50/50			45				348	7.6
50/60			50				346	7.8
80/20	PPD	140	32	71	128	160	312	17.8
80/35			40				316	17.5
80/50			45				317	17.7
80/150			80	80			361	14.7
100/25	PPD	140	35	90	128	160	312	17
100/50			45				316	16.6
100/120			80				366	14.4
100/200			90				366	13.4
100/300			102	102			362	12.8

Figure C.9 - Dimensions for PPD configuration of standard flow meter



Size	*A, mm*	*B, mm*	*C, mm*	*D, mm*	*L, mm*	*H, mm*	*Weight, kg*
50/25	84	35	46	64	139	348	6.9
80/25	118	35	71	102	139	354	11.7
80/50	118	45	71	102	139	354	11.2
80/100	118	72	72	102	139	352	9.5
100/200	138	86	90	121	139	364	11.4
150/500	182	136	142	167	149	365	16.1

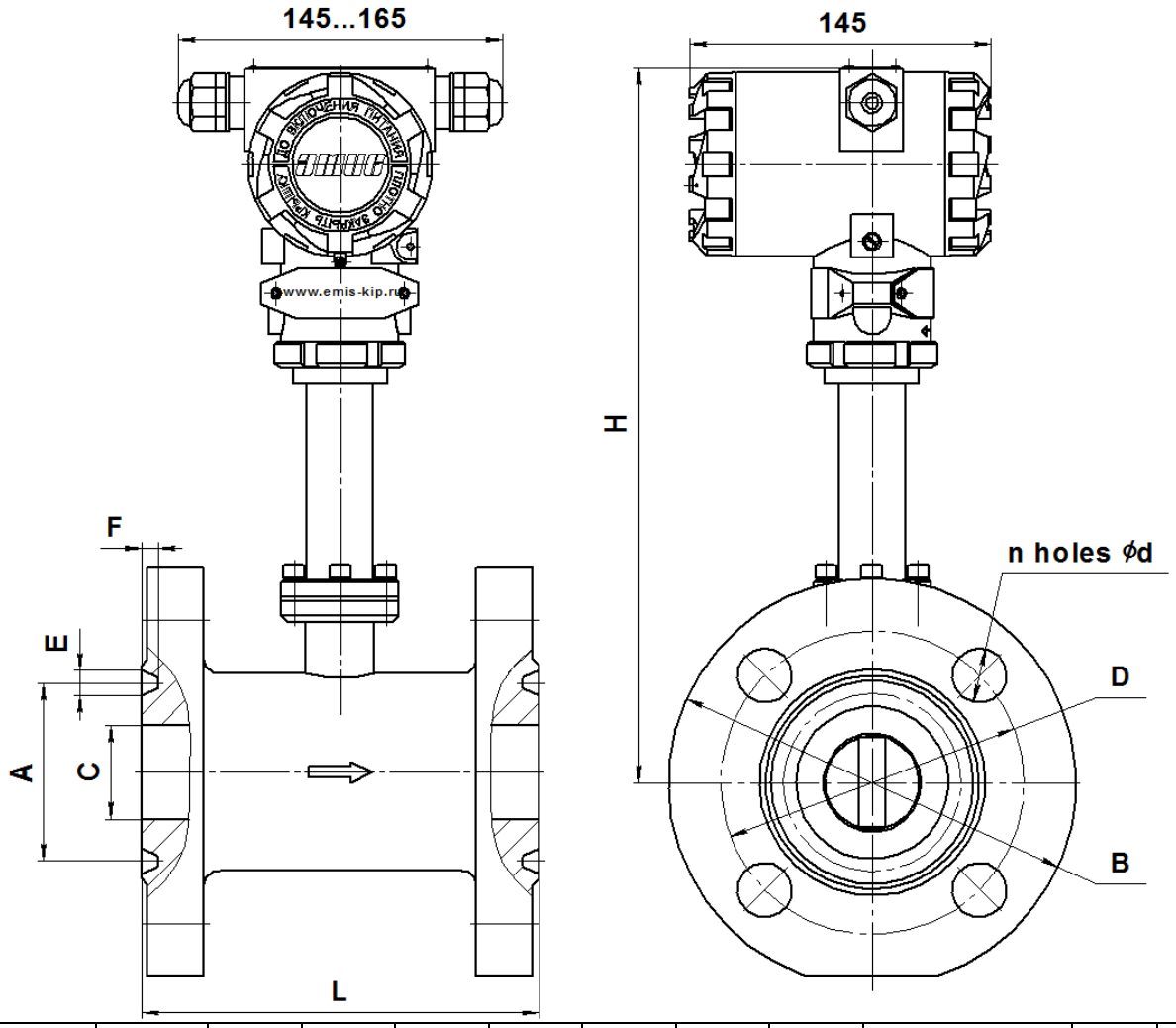
Figure C.10 - Dimensions for PPD configuration of 1 type configuration flow meter



Dn, mm	*A, mm*	*C, mm*	*D, mm*	*E, mm*	*F, mm*	*L, mm*	*H, mm*		*Weight, kg*
							up to 100°C	*250,320°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

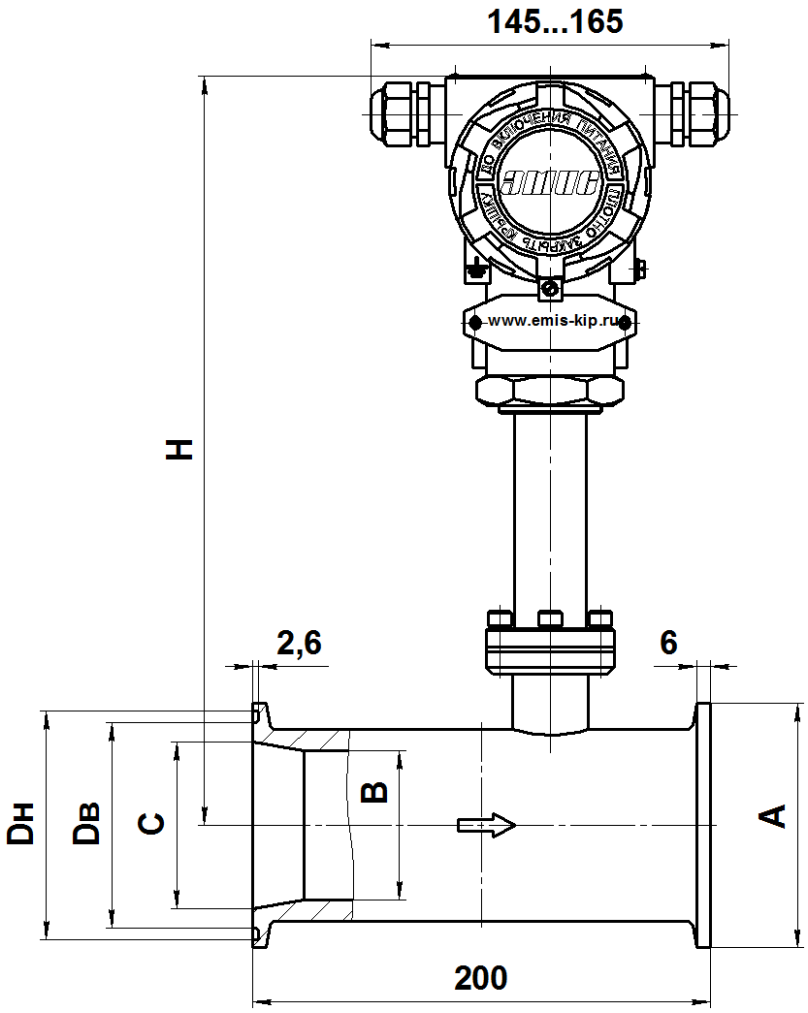
Figure C.11 - Dimensions for C configuration 16-25 MPa

Appendix C



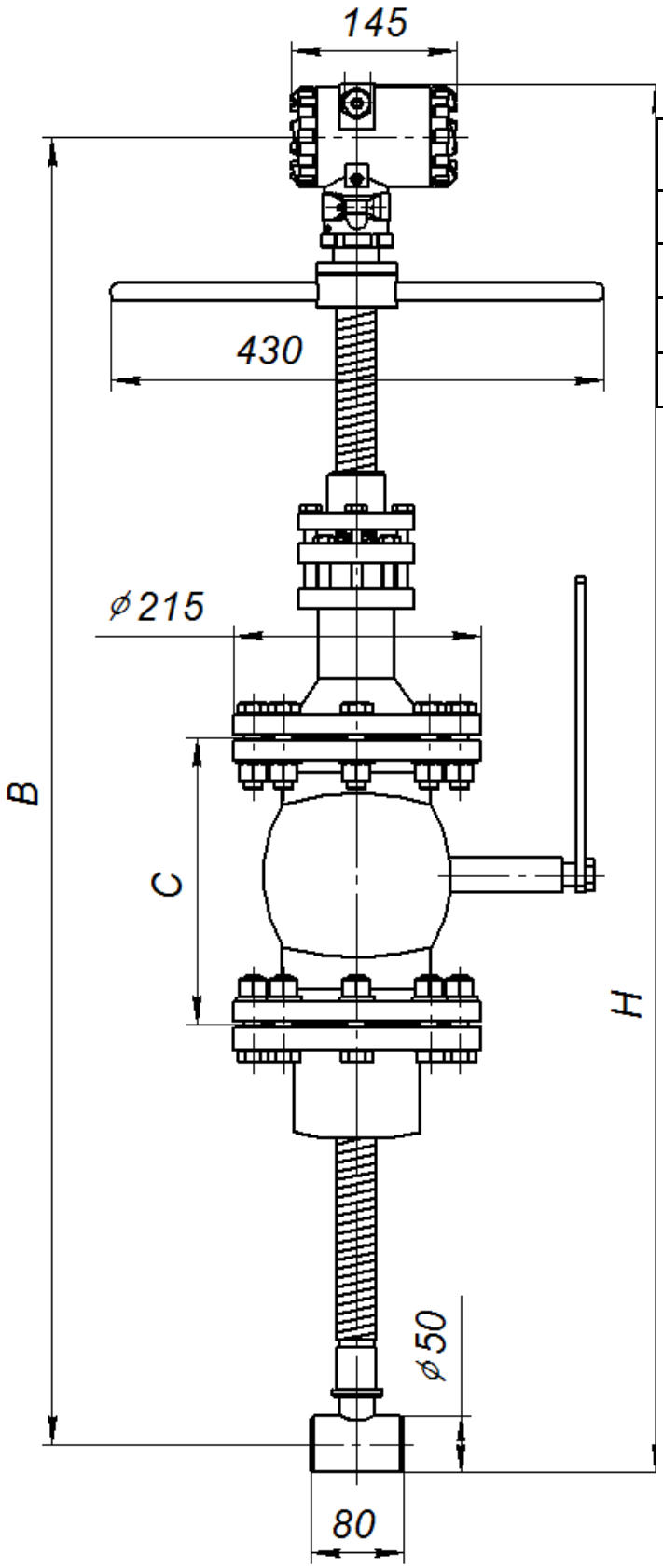
Dn, mm	Pressure, MPa	A, mm	B, mm	C, mm	D, mm	E, mm	F, mm	L, mm	H, mm		d, mm	n, pcs	Weight, kg
									up to 100°C	250, 320°C			
15	10-16	35	105	14	75	9	6.5	160	319	479	14	4	6.8
25	10-16	50	135	25	100	9	6.5	160	324	484	18	4	9.6
32	10-16	65	150	32	110	9	6.5	170	328	488	22	4	11
40	10-16	75	165	37	125	9	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

Figure C.12 - Dimensions for F1 configuration 16-25 MPa

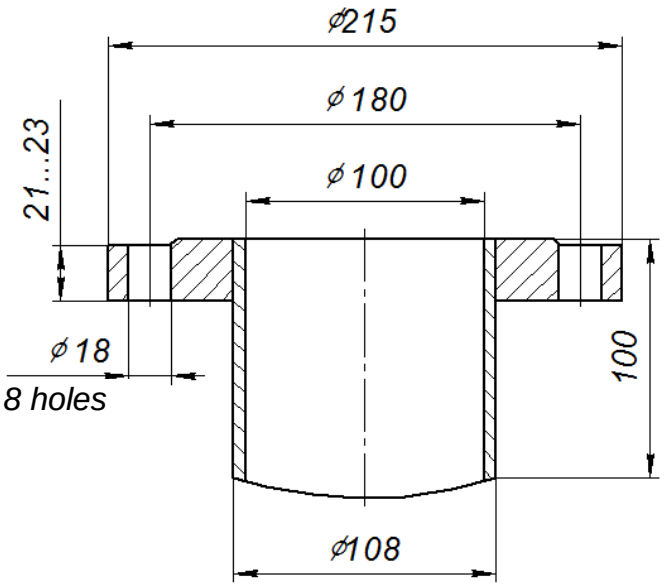


Dn, mm	*A, mm*	*B, mm*	*C, mm*	*DB, mm*	*DH, mm*	*H, mm*		*Weight, kg*
						up to 100°C	*250, 320°C*	
50	94	65	65	75	85	328	468	5.7
80	107	65	73	90	100	328	468	6.1

Figure C.13 - Dimensions for T configuration

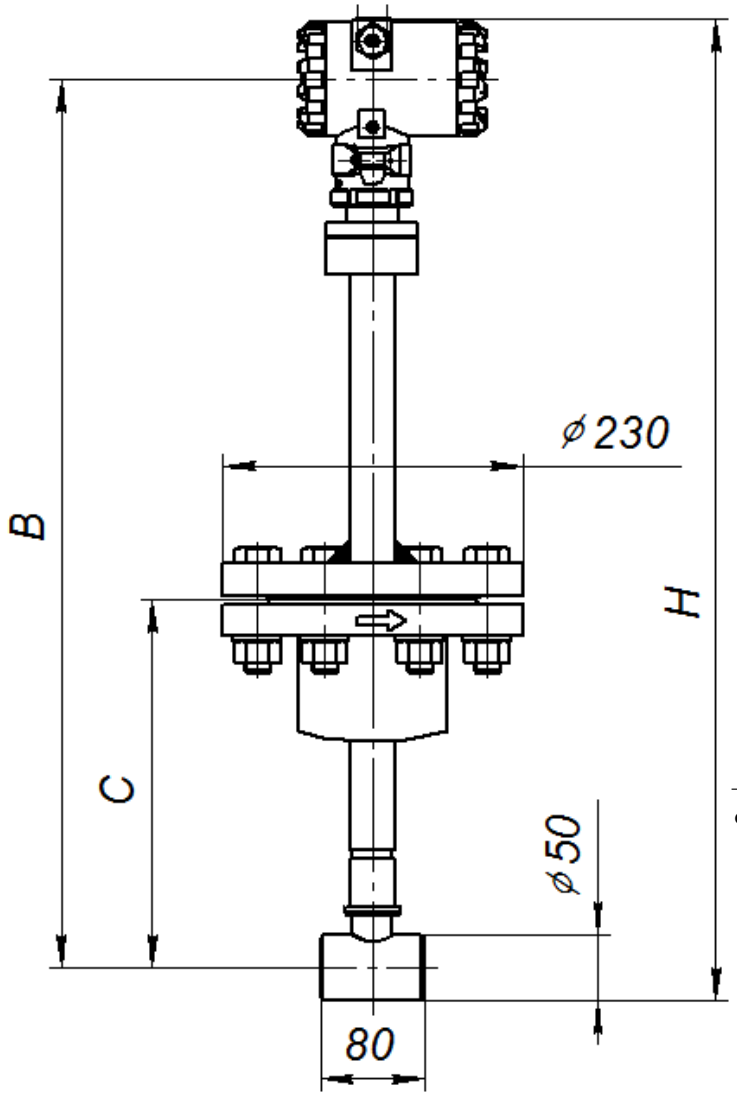


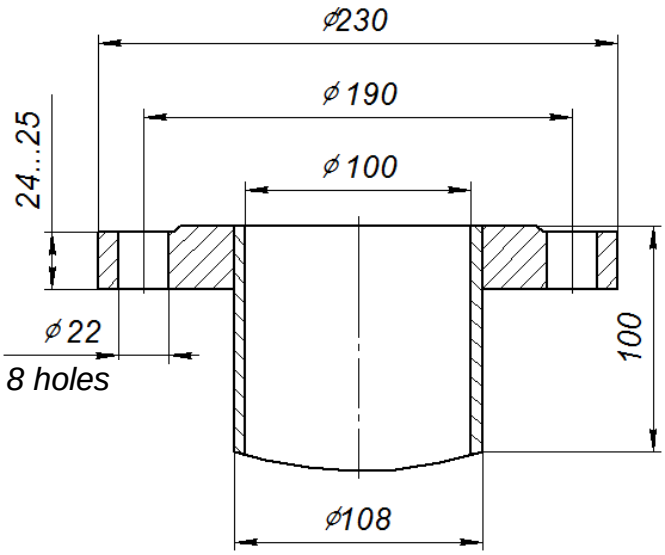
Dn, mm	*B, mm*	*H, mm*	*C, mm*	*Weight, kg*
300 – 500	1160	1230	230	21
600 – 1100	1460	1530	230	22
1200 – 1600	1160	1230	230	21
1800 – 2000	1460	1530	230	22



Weldneck size for 1.6 MPa

Figure C.14 - Insertion type flow meter size for 1.6 MPa

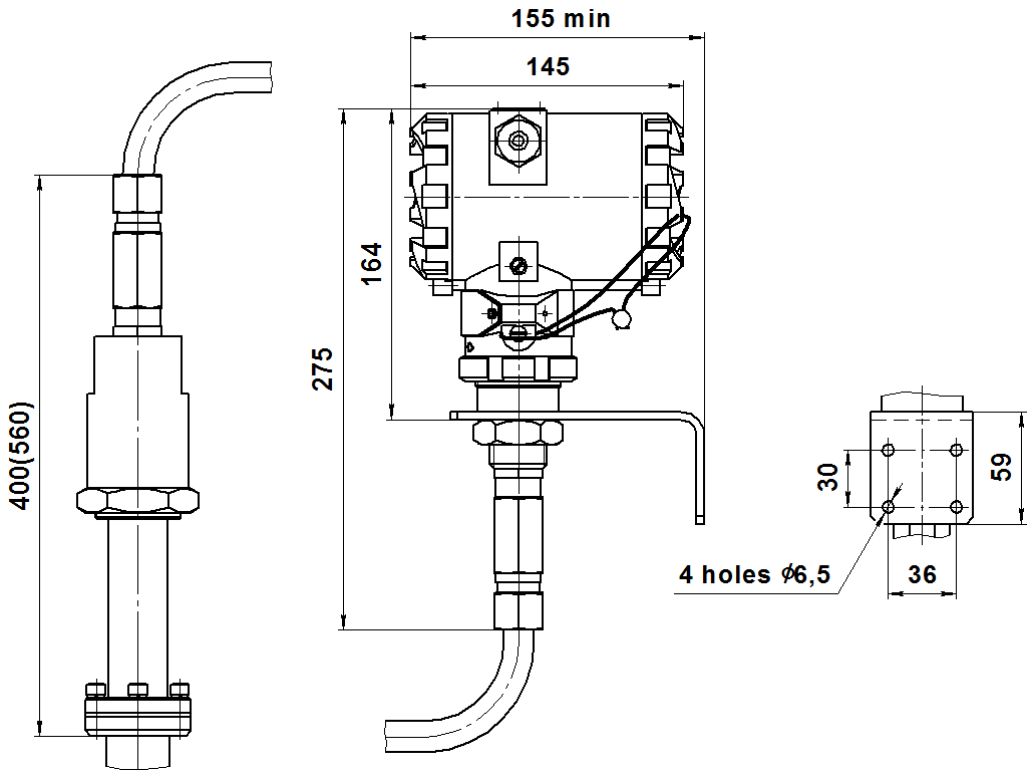




Weldneck size for 2.5 and 4.0 MPa

Dn mm	B, mm	C mm	H, mm	Weight, kg	Dn mm	B, mm	C mm	H, mm	Weight, kg	Dn mm	B, mm	C mm	H, mm	Weight, kg
300	740	265	810	19	600	1040	415	1110	20	1200	740	250	810	19
350		290			700		460			1400		270		
400		315			800		510			1600		300		
450		340			900		560			1800		320		
500		365			1000		610			2000		345		

Figure C.15 - Insertion type flow meter size for 2.5 and 4.0 MPa



Size in brackets - for version +200ºC, +250ºC and +320ºC

Figure C.16 - Remote flow meter sizes
Other dimensions see Fig.C.3...C.13

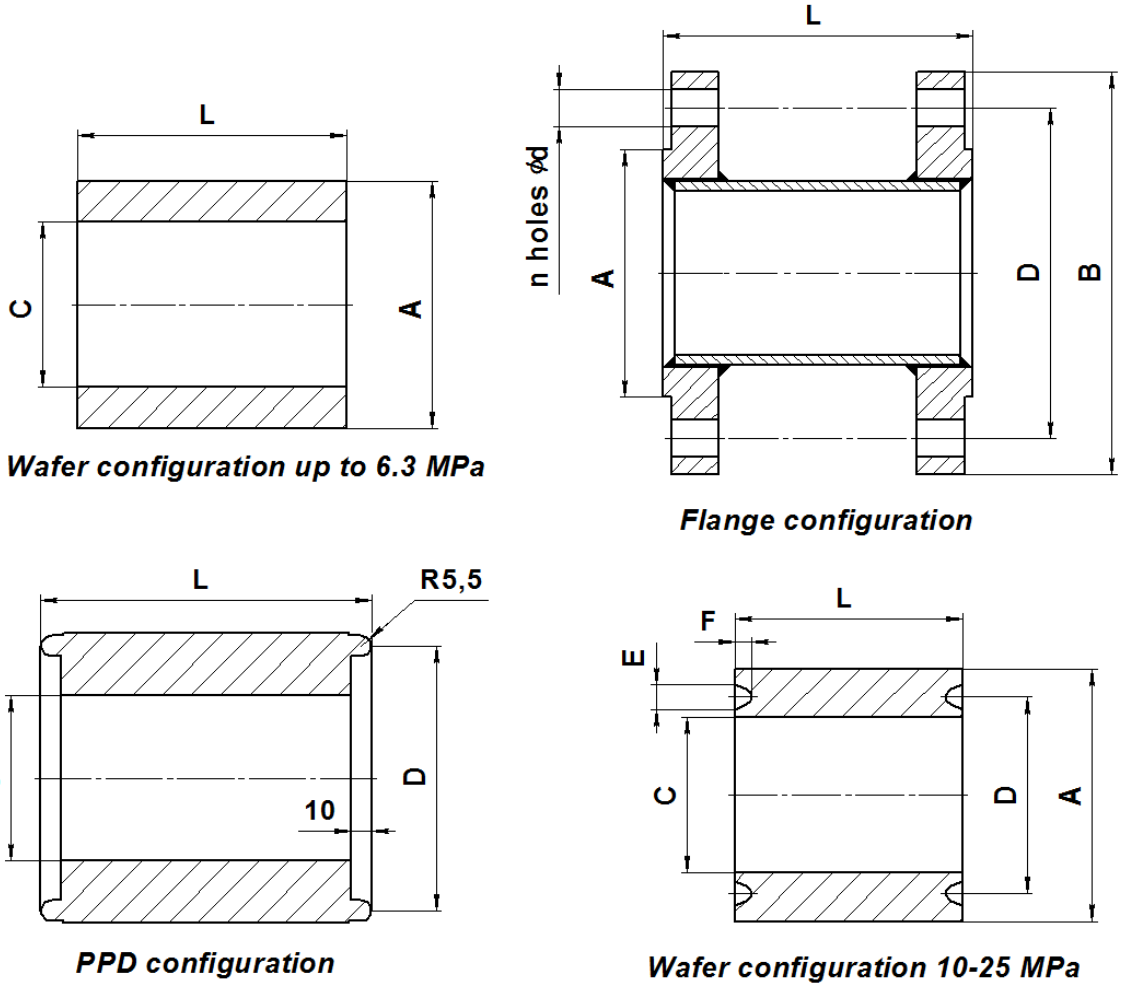


Figure C.17 - Mounting coupling sizes
see Fig.C.3...C.9

Appendix C

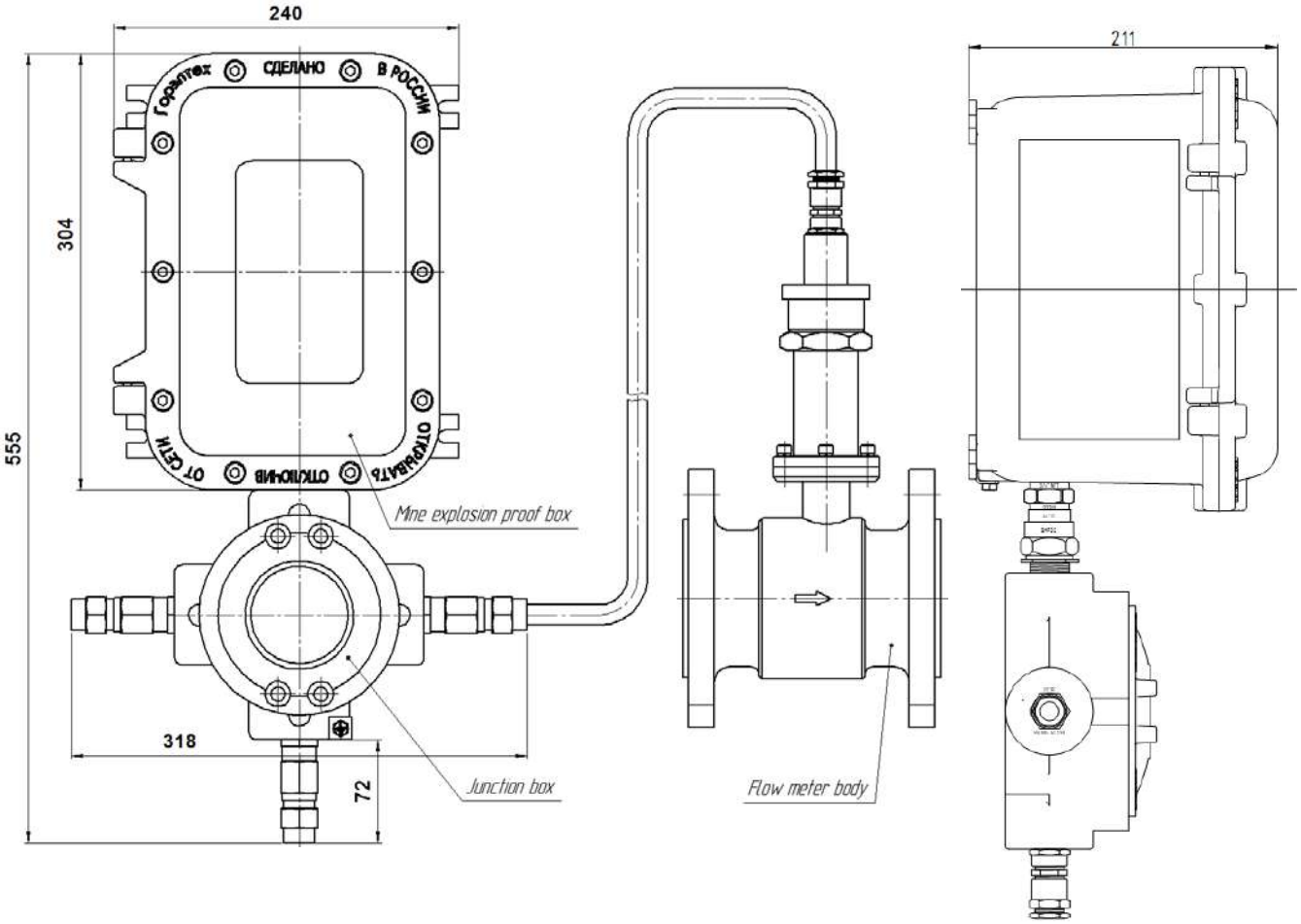


Figure C.18 - Mine version flow meter sizes

Appendix D
(informative)

Mounting kit

Table D.5 Fasteners for EV-200 with connection type “C” pressure up to 6,3 MPa

Dn, mm	Stud *GOST 9066*				Nut *GOST 9064*		
	1.6–2.5 MPa	***4 MPa***	***6.3 MPa***	***Number***	***1.6-4 MPa***	***6.3 MPa***	***Number***
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	БМ16x220	БМ16x220	БМ20x230		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 5915may be used

Table D.2 Fasteners for EV-200 with connection type “C1” pressure up to 6,3 MPa

Dn, mm	Pin *GOST 9066*				Nut *GOST 9064*		
	1.6–2.5 MPa	***4 MPa***	***6.3 MPa***	***Number***	***1.6-4 MPa***	***6.3 MPa***	***Number***
15	AM12x150	AM12x150	AM16x170	4	AM12 (S18)	AM16 (S24)	8
25	БМ12x150	БМ12x150	AM16x170				
32	AM16x170	AM16x170	AM20x190		AM16 (S24)	AM20 (S30)	
40							
50	AM16x180						
65	AM16x200	AM16x200	БМ20x220	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 converters EV-200 with connection type "F", "FR" and the temperature of the measured medium up to + 320 °C

Dn, mm	Pin *GOST 9066*				Nut *GOST 9064*			
	1.6–2.5 MPa	***4 MPa***	***6.3 MPa***	***Number***	***1.6–2.5 МПа***	***4 MPa***	***6.3 MPa***	***Number***
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.

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Table D.4 Fasteners for converters EV-200 with connection type "F1", "FR1" and the temperature of the measured medium up to + 320 °C

Dn, mm	Pin GOST 9066				Nut GOST 9064			
	1.6–2.5 MPa	4 MPa	6.3 MPa	Number	1.6–2.5 МПа	4 MPa	6.3 MPa	Number
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 EV-200 with connection type “F” and the temperature of the measured medium + 450 °C

Dn, mm	Pin GOST 9066				Nut GOST 9064			
	1.6–2.5 MPa	4 MPa	6.3 MPa	Number	1.6–2.5 МПа	4 MPa	6.3 MPa	Number
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 EV-200 with connection type “F1” and the temperature of the measured medium + 450 °C

Dn, mm	Pin GOST 9066			Nut GOST 9064		
	1.6-4 MPa	6.3 MPa	Number	1.6-4 MPa	6.3 MPa	Number
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

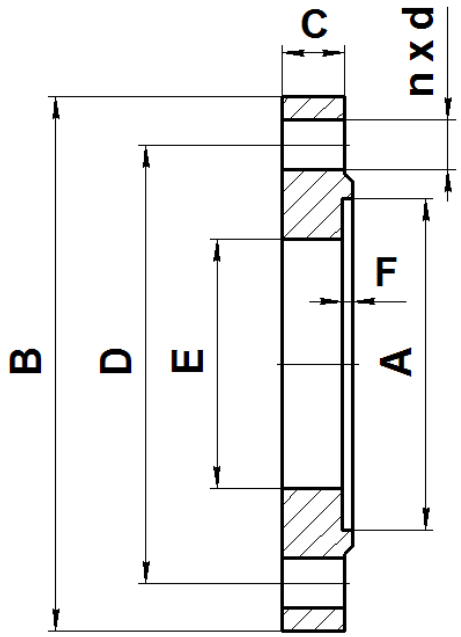


Fig. D.1.1

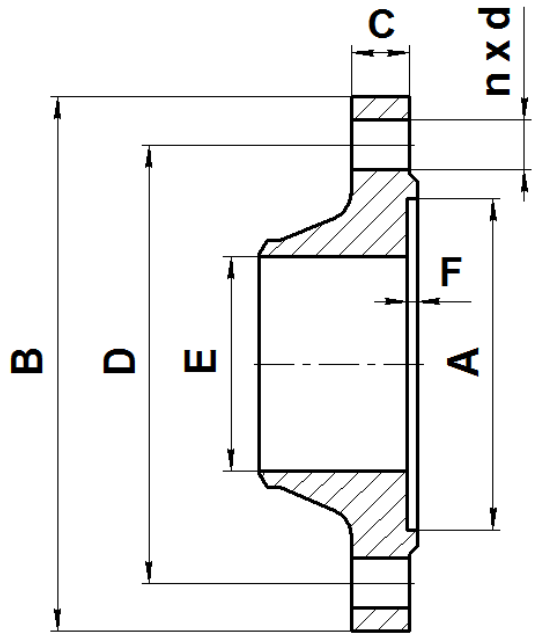


Fig. D.1.2

Figure D.1 - Flange size for EV-200 configuration ≤ 6,3 MPa

Table D.7 Fasteners for EV-200 with connection type “F1”, pressure ≤ 6,3 and the temperature of the measured medium + 450 °C

Dn, mm	*Connection 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 ГОСТ 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 EV-200 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	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	+450	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	4	18	2.7
		≤ 2.5	+450	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	+450	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	+450	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	+450	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

Table D.9 Flange size for EV-200 with connection type "C1,“F1”, "FR1", pressure ≤ 6,3 and the temperature of the measured medium + 320 °C

Dn, mm	*Connection 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	D.1.1	58	115	16	85	19	3	4	14	1.0
		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	D.1.1	58	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	C1, F1, FR1	≤ 2.5	D.1.1	66	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	C1, F1	≤ 2.5	D.1.1	76	145	19	110	46		4	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	D.1.1	88	160	21	125	59		4	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	D.1.1	110	180	21	145	78		8	18	3.1
		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	D.1.1	121	195	23	160	91		8	18	4.0
		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	D.1.1	150	230	25	190	110		8	22	5.7
		4	D.1.2		230	23	190	96			22	6.8
		6.3			250	29	200	94			26	10.5
125	F1	≤ 2.5	D.1.1	176	270	27	220	135		8	26	8.2
		4	D.1.2		270	25	220	120			26	9.5
		6.3			295	33	240	118			30	16.6
150	F1	≤ 2.5	D.1.1	204	300	27	250	161		8	26	9.8
		4	D.1.2		300	27	250	145			26	12.6
		6.3			340	35	280	142			33	24.1
200	F1	≤ 2.5	D.1.1	260	360	29	310	222		12	26	13.0
		4	D.1.2		375	35	320	200			30	23.5
		6.3			405	41	345	198			33	36.1
250	F1	≤ 2.5	D.1.1	313	425	31	370	273		12	30	18.5
		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 ГОСТ 12820.
2. Flanges for pressure 4 and 6,3 MPa, except for Dn15, comply with GOST 33259 type 11 ГОСТ 12821.
3. The sealing surfaces of the flanges correspond to version F according to GOST 33259 or version 3 according to GOST 12815.

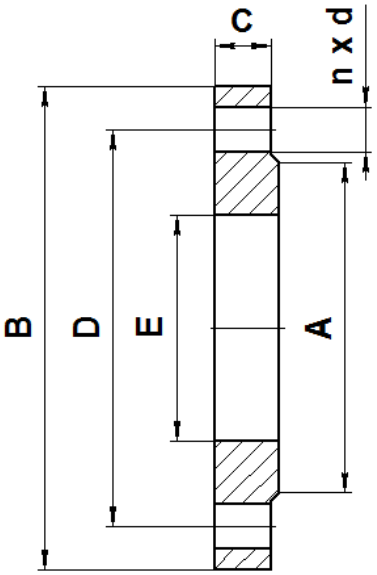


Fig. D.2.1

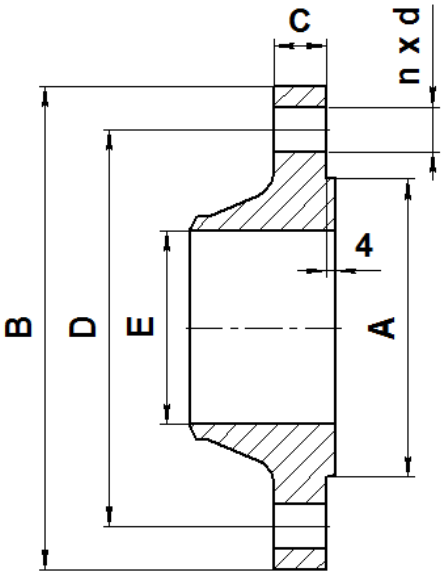


Fig. D.2.2

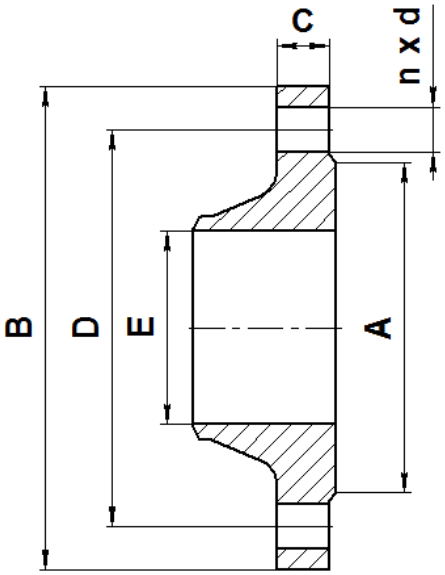


Fig. D.2.3

Figure D.2 - Flange size for EV-200 "F"configuration pressure ≤ 6,3 MPa, Dn > 100mm

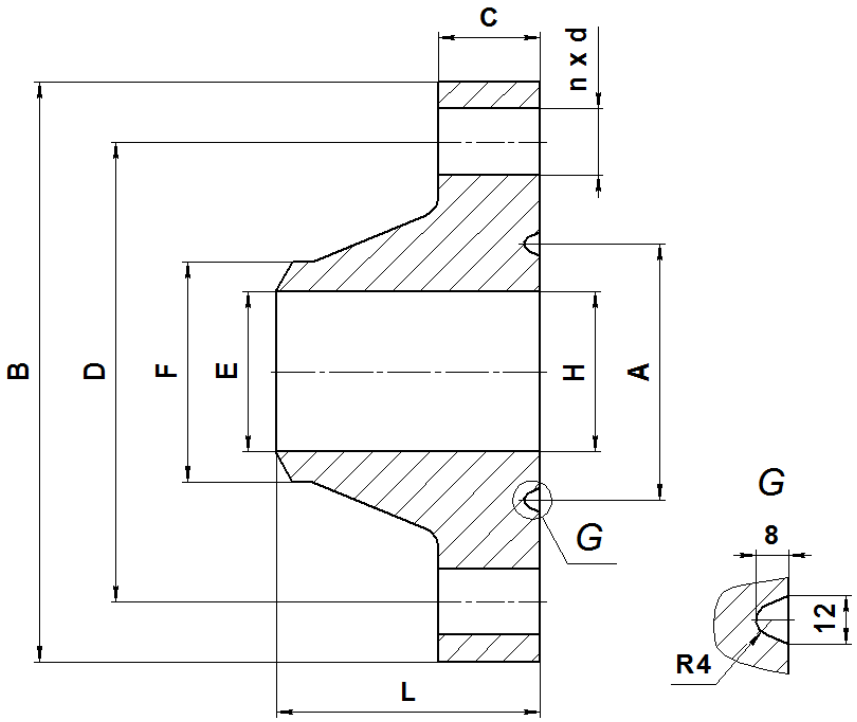
Table D.10 Flange size for EV-200 with connection type "F" pressure ≤ 6,3 Dn > 100mm

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	+450	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	+450	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	+450	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	+450	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	+450	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

Table 1.11 - PPD version fasteners

Size	*Config.*	Pin *GOST 9066*	Nut *GOST 9064*	*Pcs.*		
				Flanges	*Studs**	*Nuts*
50/10, 50/20, 50/25, 50/50, 50/60	-	AM24x260	AM24 (S36)	2	8	20
80/20, 80/35, 80/50, 80/150	-	AM30x340	AM30 (S46)	2	8	20
100/25, 100/50, 100/120, 100/200, 100/300	-	AM30x340	AM30 (S46)	2	8	20
50/25	1	AM24x260	AM24 (S36)	2	8	20
80/25, 80/50, 80/100	1	AM30x340	AM30 (S46)	2	8	20
100/200	1	AM30x340	AM30 (S46)	2	8	20
150/500	1	1-M30x360*	AM30 (S46)	2	12	28

Note: 1. Two studs are full-length threaded 2. * Stud GOST 26-2040-96.



Size	*Config.*	*A, mm*	*B, mm*	*C, mm*	*D, mm*	*E, mm*	*F, mm*	*H, mm*	*L, mm*	*n, pcs*	*d, mm*	*Weight , kg*
50/10, 50/20, 50/25, 50/50, 50/60	-	80	210	37	160	46	61	-	95	8	26	11
80/20, 80/35, 80/50	-	128	290	51	230	71	90	-	132	8	33	27
80/150	-	128	290	51	230	71	90	80	132	8	33	26
100/25, 100/50, 100/120, 100/200	-	128	300	54	235	90	114	-	120	8	33	28
100/300	-	128	300	54	235	90	114	102	120	8	33	27
50/25	1	64	210	37	160	46	61	-	95	8	26	11
80/25, 80/50, 80/100	1	102	290	51	230	71	90	-	132	8	33	27
100/200	1	121	300	54	235	90	114	-	120	8	33	28
150/500	1	167	390	68	320	142	178	-	160	12	36	56

Figure D.3 - Flange size for EV-200 PPD

Fig.D12 - Flange size for "C" configuration 10-25 MPa pressure

Size	*Pressure, Mpa*	Pin *GOST 9066*	Nut *GOST 9064*	*Gasket GOST P 53561*	*Pcs.*		
					*Studs**	*Nuts*	*Gaskets*
15	10, 16	AM16x180 *	AM16 (S24)	1-1-25-200	4	12	2
	20, 25	AM24x220	AM24 (S36)			8	
25	10, 16	AM16x180 *	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	AM20x200 *	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	AM24x260 *	AM24 (S36)		8	20	
65	10, 16	AM24x260 *	AM24 (S36)	1-1-50-200	8	20	2
	20, 25	AM27x280 *	AM27 (S41)				
80	10, 16	AM24x260 *	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

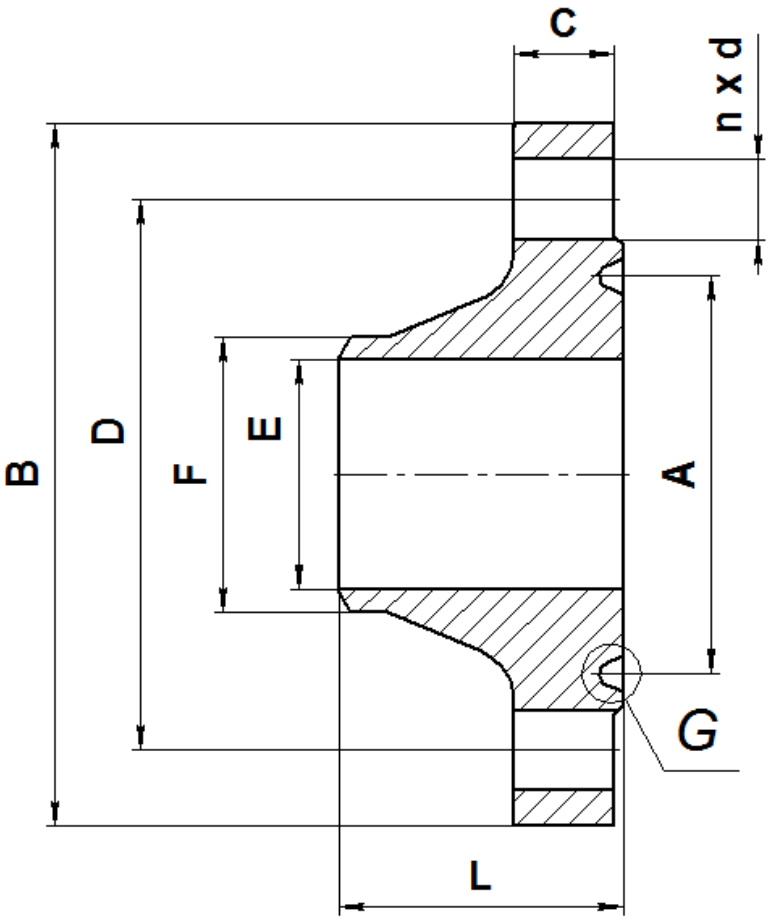
Note:

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

Fig.D13 - Fasteners for "F1" configuration 10-16 MPa pressure

Size	Pin *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



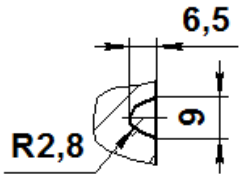


Fig. D.4.1

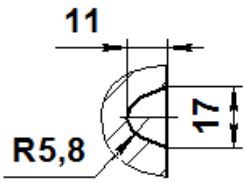


Fig. D.4.4

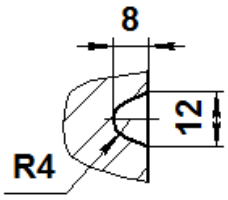


Fig. D.4.2

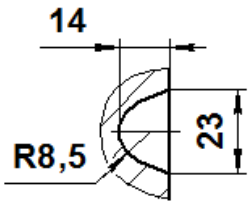


Fig. D.4.5

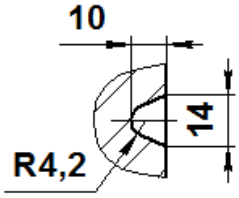
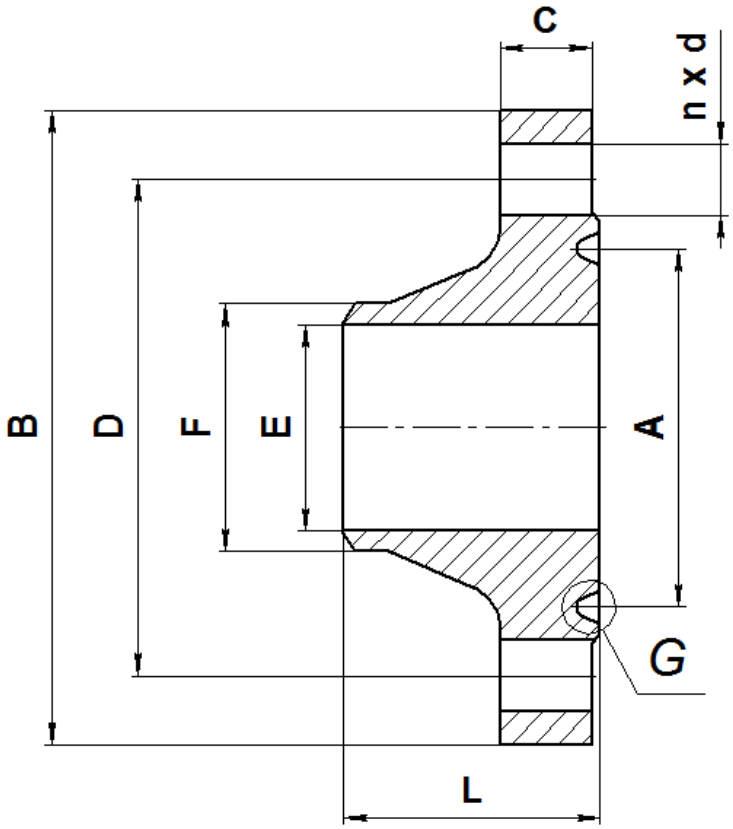


Fig. D.4.3

Size	*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

Figure D.15 - Flange size for "C" configuration 10-25 MPa



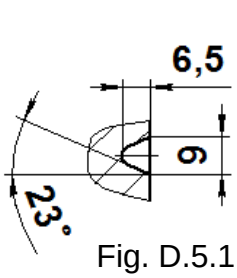


Fig. D.5.1

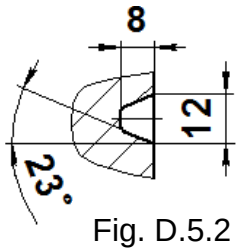


Fig. D.5.2

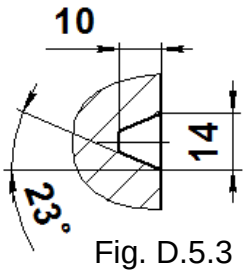


Fig. D.5.3

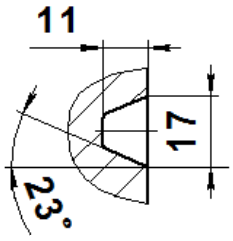


Fig. D.5.4

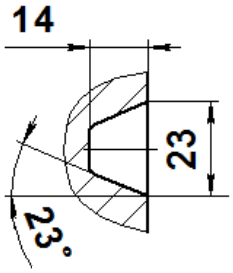


Fig. D.5.5

Size	*Pressure, MPa*	*A, mm*	*B, mm*	*C, mm*	*D, mm*	*E, mm*	*F, mm*	*L, mm*	*n, count*	*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.

Figure D.5 - Flange size for "F1" configuration 10-16 MPa

Table D.14 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 = +450 °C	Graflex, Spiral wound Gasket	

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

Table D.15 Insertion type EV-205 mounting kit

Pressure, Mpa	*Ball valve*	Bolt *GOST 7798*	Nut *GOST 9064*	*Pcs.*		
				Bolts	*Nuts*	*Gaskets*
1.6	None	M16x75	AM16 (S24)	8	8	1
	yes			16	16	2
2,5; 4	None	M20x90	AM20 (S30)	8	8	1

Note: The number of washers is equal to 2x nuts.

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

EV 200 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	--	--

EV200-PPD Size	*Line 1*	*Line 2*
50/*	60x7	57x5
80/*	89x9	89x8
100/*	114x12	108x9
150/500	168x13	178x18

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

Appendix E
(informative)

EMIS-Integrator guide

EMIS-Integrator is designed to read and adjust flow meter via PC. You can download EMIS-Integrator here **http://www.emis-kip.ru.**

For more details see software Help

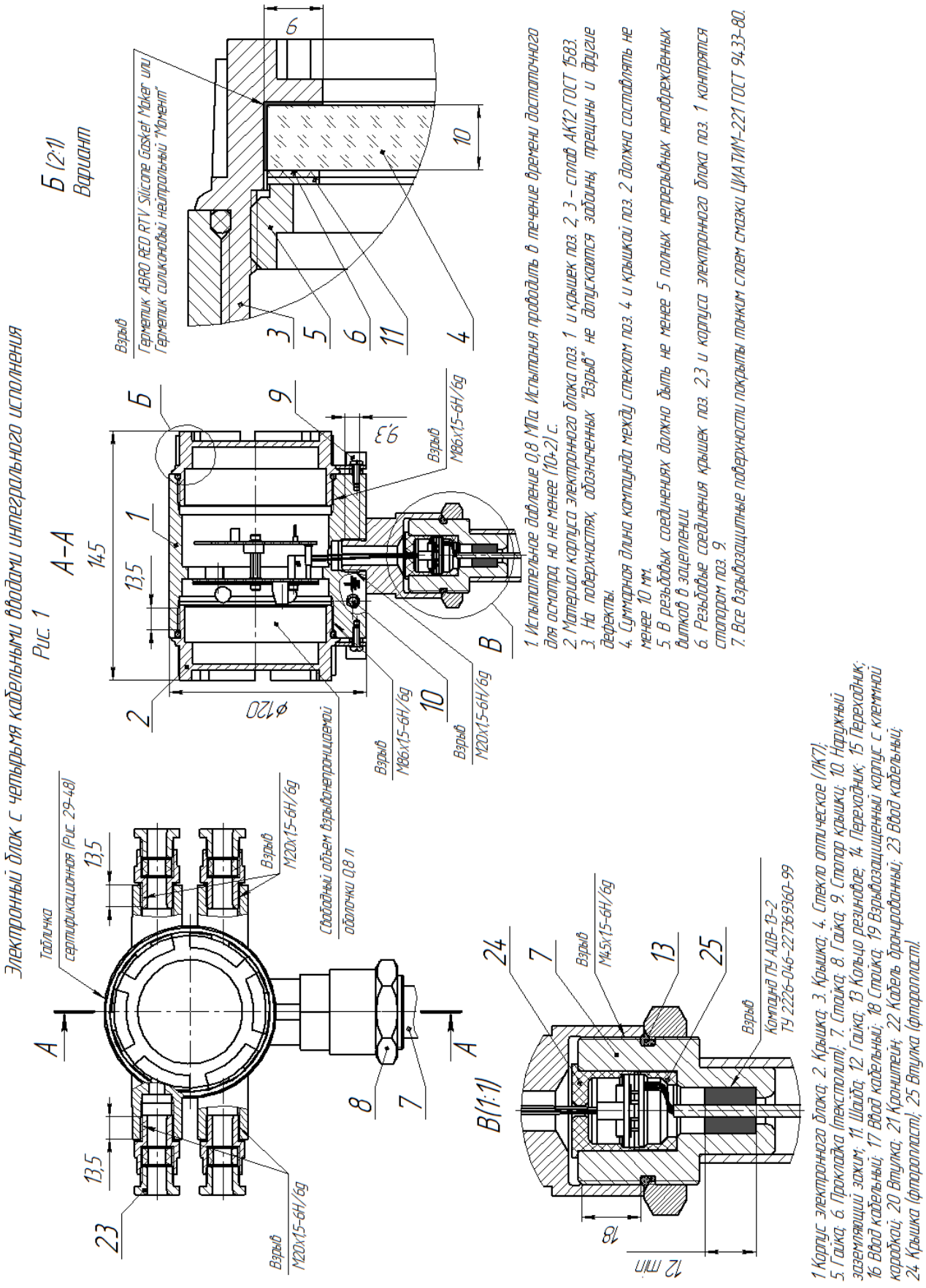
To install the EMIS-Integrator, launch «EMISSoftware_X_X_X.exe», where X.X.X -stands for the software version (3.0.0 and older). Setup wizard will appear after launching. Follow the setup wizard to install the program.

To launch the program select Start-Programs-EMISSoftware> Integrator X.X.X».

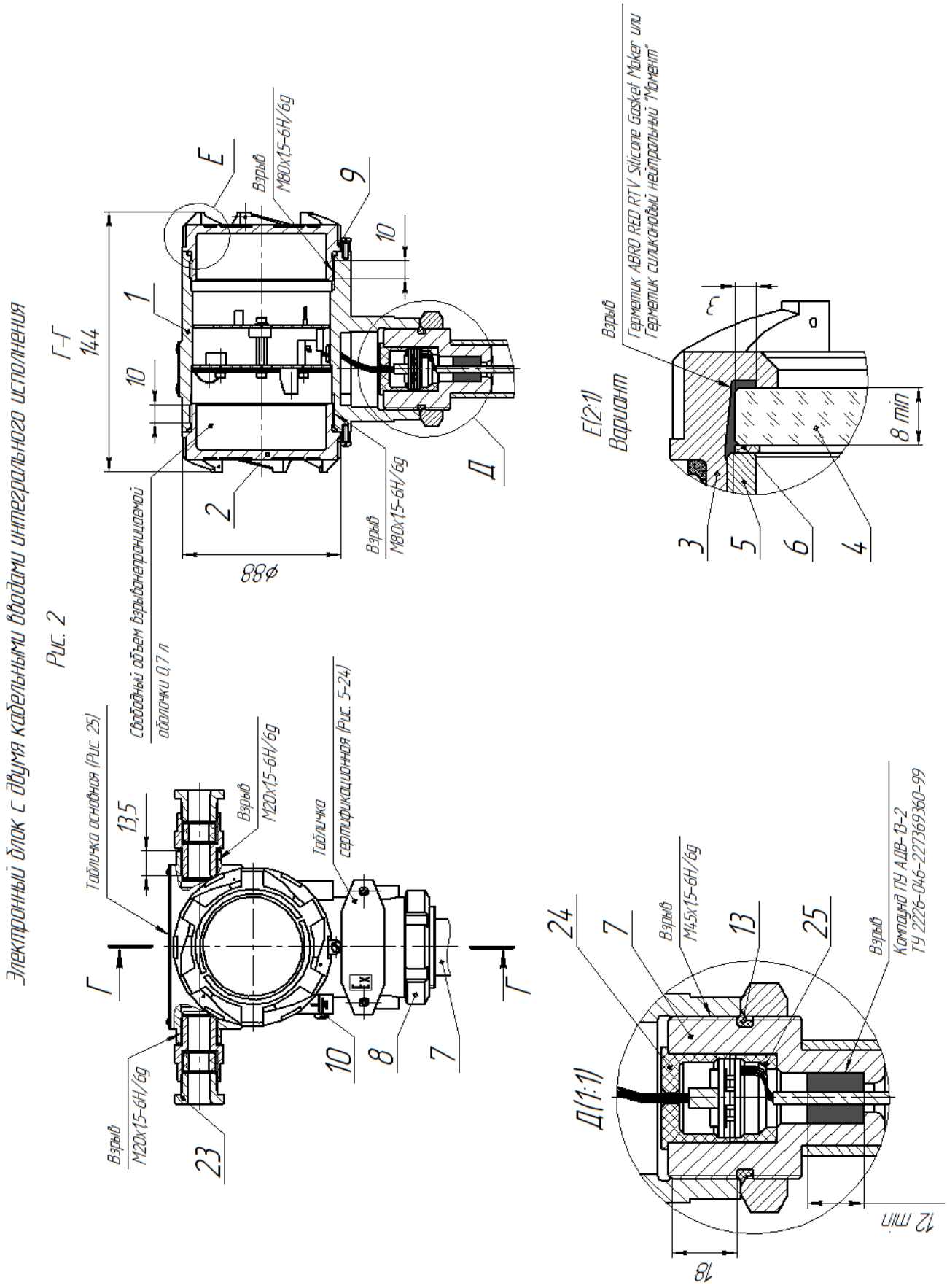
Appendix F
(normative)

Explosion protection scheme

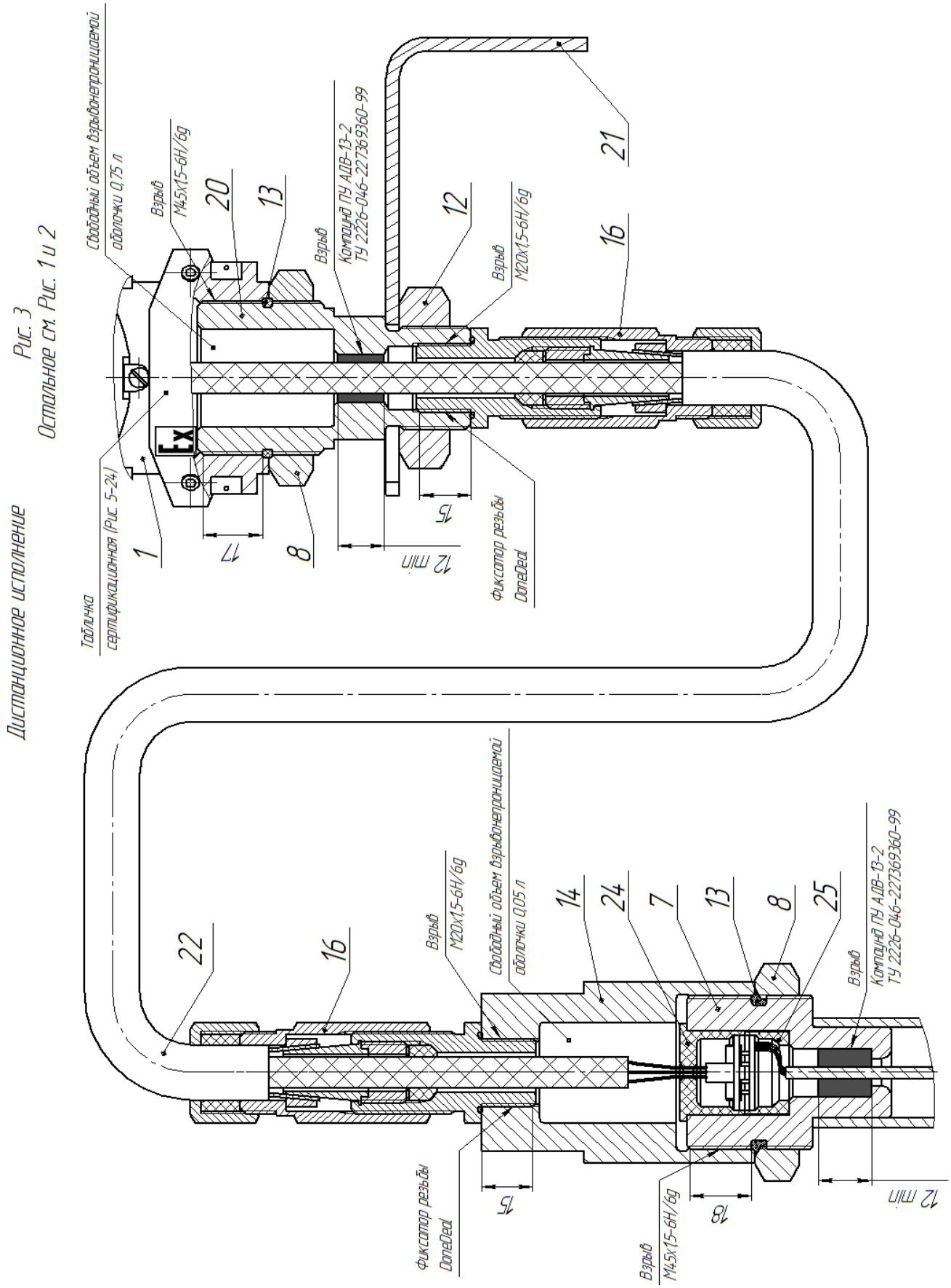
Drawings of explosion protection for Вн type flow meter with four cable inputs



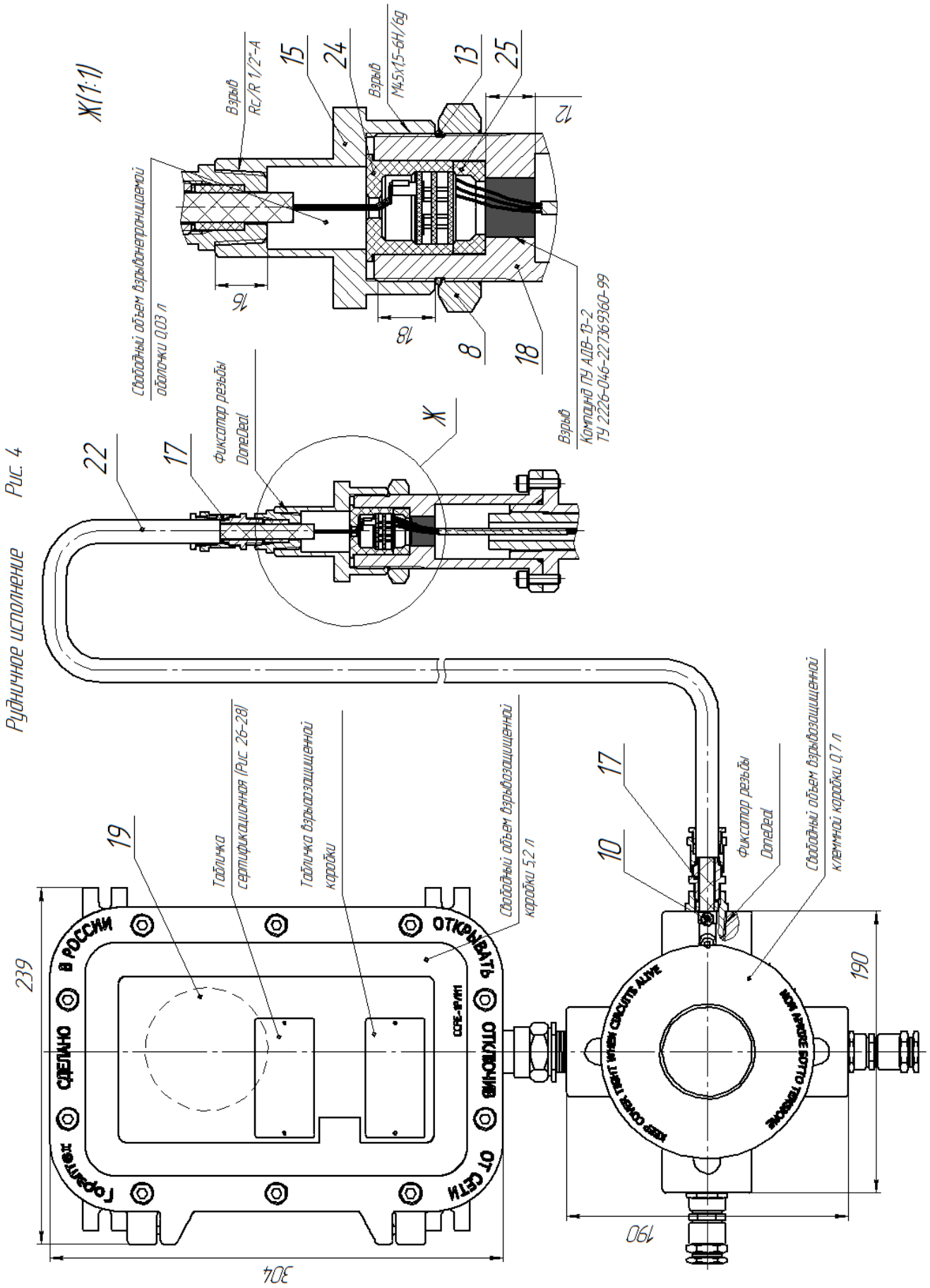
Drawings of explosion protection for Вн type flow meter with two cable inputs.



Drawings of explosions protection for Вн remote type flow meters.



Drawings of explosion protection for mining configuration flow meters.



Таблички сертификационные
Для электронного блока с двумя кабельными вводами

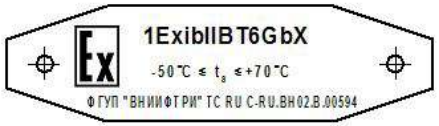
"Искробезопасная электрическая цепь" уровня ib для смеси подгруппы IIB

Рис.5

Рис.6

Рис.7

Рис.8



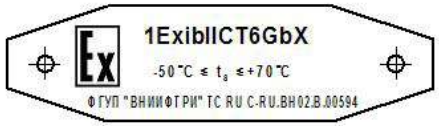
"Искробезопасная электрическая цепь" уровня ib для смеси подгруппы IIC

Рис.9

Рис.10

Рис.11

Рис.12



"Взрывонепроницаемая оболочка" для смеси подгруппы IIC

Рис.13

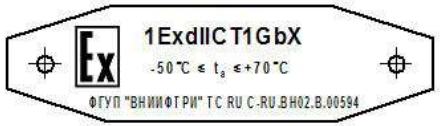


Рис.14

Рис.15

Рис.16

Рис.	Код температурного исполнения преобразователя расхода
5;9;13;17;21;29;33;37;41;45	"280", "320", "450"
6;10;14;18;22;30;34;38;42;46	"250"
7;11;15;19;23;31;35;39;43;47;26;27;28	"100"
8;12;16;20;24;32;36;40;44;48;26;27;28	"70"

"Искробезопасная электрическая цепь" уровня ia для смеси подгруппы IIB

Рис.17

Рис.18

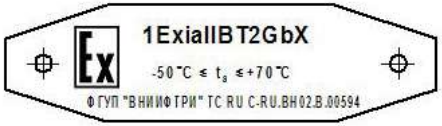
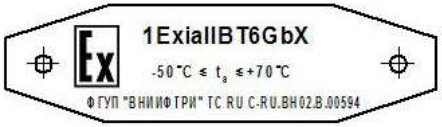


Рис.19

Рис.20



"Искробезопасная электрическая цепь" уровня ia для смеси подгруппы IIC

Рис.21

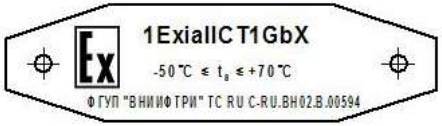


Рис.22

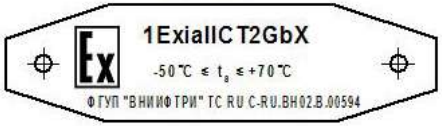


Рис.23

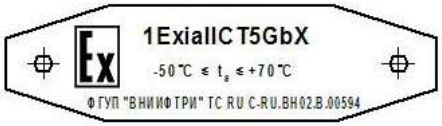
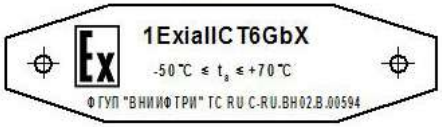


Рис.24



Табличка основная
Для электронного блока с двумя кабельными вводами

Рис.25

Таблички сертификационные
Для рудничного исполнения

Рудничное исполнение с взрывозащитой вида PB

Рис.26

Рудничное исполнение с взрывозащитой вида PB "искробезопасная электрическая цепь"

Рис.27

Рудничное исполнение с взрывозащитой вида PO

Рис.28

Таблички сертификационные
Для электронного блока с четырьмя кабельными вводами

"Искробезопасная электрическая цепь" уровня ib для смеси подгруппы IIB

Рис.29

Рис.30

Рис.31

Рис.32

"Искробезопасная электрическая цепь" уровня ib для смеси подгруппы IIC

Рис.33

Рис.34

Рис.35

Рис.36

"Взрывонепроницаемая оболочка" для смеси подгруппы IIC

Рис.37

Рис.38

Рис.39

Рис.40

"Искробезопасная электрическая цепь" уровня ia для смеси подгруппы IIB

Рис.41

Рис.42

Рис.43

Рис.44

"Искробезопасная электрическая цепь" уровня ia для смеси подгруппы IIC

Рис.45

Рис.46

Рис.47

Рис.48

Appendix G
(informative)

«Modbus» protocol description

Protocol interface have almost the same functions as Modbus RTU (Rev.G). The following functions are supported:

Table G.1 - Supported functions

Command (function)	Function code (HEX)	Sub-Function code (HEX)
Common commands:		
Read Input Registers	04	
Read Holding registers	03	
Report slave ID	11	
Write Single Coil	06	
Write Multiple Coilz	10	
Diagnostics	08	
Diagnostics sub-functions:		
Return query data		00
Restart Communications options		01
Restart Communications options		02
Force Listen Only Mode		04
Clear Counters and Diagnostic Register		0A
Return Bus Message Count		0B
Return Bus Communication Error Count		0C
Return Bus Exception Error Count		0D
Return Slave Message Count		0E
Return Slave No Response Count		0F
Return Slave NAK Count		10
Return Slave Busy Count		11
Return Bus Character Overrun Count		12
User commands:		
Test galvanic isolation and ADU sensor of vortex flow meter	41	
Enter password	43	
Set flow limits for current output*	45	

* - n/a for special version of transmitter

See description of special functions for detailed information.

Function 04h (read input registers)

This function can be used to read input registers. Further the following codes will be used for register format description:

Int 16 - 16-bit binary value without point

Float- 32-bit binary IEEE floating point number

Int 32 - 32-bit binary value without point

Registers of more than 16-bits are saved in two sequentially located logic addresses in low word-high word order. Standard request-response format

Float integers consist of 4 bytes, for example, in IEEE754 0,01 is represented as 3C23D70A. In this protocol version the byte transfer order is d7, 0a, 3c, 23.

In Int 32 registers digits consist of 4 bytes. In this protocol version the byte transfer order is 56, a0, 12, d7.

Request size is limited by Modbus RTU, although for diagnostics purposes there are several address and register combinations which provide requested information beyond the standard protocol.

Address	Registers quantity	Description
36145	512	Vortex sensor signal selection
37169	512	Acceleration sensor signal selection
33073	512	Power spectrum of vortex sensors
34097	512	Vortex sensor signal selection after all filters
38193	64	64-bit power spectrum of vibration sensor (acceleration gauge)

Power spectrum value can be ranged from 0 to 16383, signal selection values can be ranged from -32768 to 32767. Amount of requested values decrease along with decrease of Fourier transform pairs in use (defined in register 40928).

Note: Note: because of asynchronous message passing and use of one buffer for all internal processing (window function overlap), in the sensor signals, the appearance of "steps" and the visible effects of partial overlap of the window function are possible. This does not indicate any failure.

Function 03h (read holding registers)

This function can be used for holding register reading, request and response are standard. Maximum number of registers in one read transactions (by Modbus standard) is 126.

Function 11h (Read slave ID)

Standard Request

Response:

- Address
- Function code 11h
- Byte Count - 12
- Byte FFh
- ON/OFF indicator FFh
- - Additional data- ASCII-line «EV205 8.04»
- Checksum CRC16

Function 06h (Write Single Coil)

It takes some time to write to flash drive so when processing this request delayed write is used, the memory will not be able to response repeated requests until the writing is completed.

Function 10h (Write multiple Coils)

It takes some time to write to flash drive so when processing this request delayed write is used, the memory will not be able to response repeated requests until the writing is completed. Maximum number of registers in one read transactions (by Modbus standard) is 126.

Function 08h (diagnostic)

Standard Request

Response:

- Address
- Function code 08h
- Sub-Function code
- Additional data Содержимое зависит от выполняемой подфункции
- Checksum CRC16

Function code 41h (self-diagnostics). Self-diagnostics period is quite long so the result is not transferred in response. Instead, it is stored in relevant bit of 30001 diagnostics register, in case of A/D converter or charge amplifier failure it also influences LED indicator lighting.

Request contains:

- Address
- Function code 41h
- Checksum CRC16

Response is equal to request.

Function code 43h (password entry). Current access level (register 30046) can be read with "read input registers" function.

Request contains:

- Address
- Function code 43h
- Password (digit Int32) in high byte-low byte order (4 bytes in total)
- Checksum CRC16

Response:

- Address
- Function code 43h
- Checksum CRC16

Function code 45h (preset current output range). To set flow ranges at 4mA and 20 mA respectively (not available for special version of transmitter).

Request contains:

- Address
- Function code 45h
- Flow range at 4mA (float number)
- Flow range at 20mA (float number)
- Checksum CRC16

Response:

- Address
- Function code 45h
- Checksum CRC16

MODBUS REGISTRY MAP

Table description.

If no format specified for register the number is stored as 16-bit digit without point. Variables in numeric format with float point and 32-bit integer numbers without point stored in two consecutive registers. In this cases the address is defined as register with lower number.

Registers are read with function 03, modified with functions 06 and 16 (10Hex).

Input registers are read with function 04.

Access levels are encoded as follows:

- level 0 - can be modified by user,
- levels 1-5 - can be modified after entering current level or higher level password or switching on SW1:1 on the processor board,
- level 6 - can be modified when SW1:1 is switched on.

Address of tables containing floating point digits shall be the address of the first item of the table, for each consequent item the address shall be increased by two.

Abbreviations: WC - working conditions, NC - normal conditions.

Table G.2- Input registers

No, format	Variable description
30001	Diagnostics register. Bit values contain the following: 0 bit- read error (checksum error) bit 1- flow under WC during stated period bit 2- self-diagnostics error or charge amplifier error This is a stuck bit, can be reset after power off or after proceeding request 65 (self-diagnostics) * bit 3 no connection with HART * bit 4 low supply voltage in current loop * bit 5 loop current not comply with analog output * bit 6 temperature sensor failure * bit 7 temperature sensor short circuit * bit 8 pressure sensor failure (current lower 3,8 mA) * bit 9 pressure sensor overload (current higher 21 mA) bit 10 discrete output frequency higher than 1200 Hz bit 11 cavitation bit 12 chaotic vortex shedding * bit 13 out of stated temperature range * bit 14 out of stated temperature range * bit 15 Vibration acceleration amplitude exceeds 0,5g
30002 * float	Temperature in Celsius. In case of temperature sensor failure stated value from 40031 register is displayed
30004 * float	Electronic board temperature in Celsius. Measurement accuracy shall be defined as stated temperature sensor accuracy and approximately±is 5 °C. No standard rate applicable.
30006 * float	Medium pressure in MPa. In case of pressure sensor failure stated value from 40027 register is displayed
30008 * float	Calculated density in kg/m3. In case of temperature and/or pressure sensor failure stated value from 40023 register will be displayed
30010 float	Rms amplitude of signal after filters
30012 float	Volume flow rate, m^3/h
30014 * float	Mass flow, t/h
30016 float	Vortex shedding frequency, Hz
30018 float	Output frequency of discrete output, Hz when working in pulse mode
30020 * float	Output current of analog output, mA
30022 int32	Accumulated volume, mm under WC
30024 int32	Accumulated volume, m3 under WC
30026 * int32	Accumulated mass, g
30028 * int32	Accumulated mass, t
30030 int32	Resettable volume totalizer under WC, ml
30032 int32	Resettable volume totalizer under WC, m3
30034 * int32	Resettable mass totalizer, g
30036 * int32	Resettable mass totalizer, t
30038 int32	Resettable volume totalizer under WC for additional medium, ml
30040 int32	Resettable volume totalizer under WC for additional medium, m3
30042	Variables checksum
30043	Source code checksum

No, format	Variable description
30044*	Current code for analog-to-digital conversion of 4-20 mA signal from pressure gauge
30045	Spectrum dispersion (conditions of cavitation and chaotic vortex shedding)
30046	Current access level. May take the value from 0 (low) to6 (when SW1:1 is switched on)
30047 float	Vibration acceleration amplitude (g)
30049 float	Vibration frequency. Register contains spectral component with the highest amplitude. Frequency of acceleration gauge signal digitalizing is the same as vortex sensor signal digitalizing.
30051* float	Volume flow m3/h under NC
30053	Reserved
30054	Reserved
30055	Reserved
30056	Reserved
30057 float	Actual pulse value (does not match stated value in insertion mode)
30059 float	Flow rate at 1000 Hz (does not match stated value in insertion mode)
30061 float	Flow rate at 0 Hz (does not match stated value in insertion mode)
30063* float	Flow rate at 4mA
30065* float	Flow rate at 20mA
30067	HART source code checksum
30068	RS-485 diagnostics Total amount of messages received through system
30069	RS-485 diagnostics Amount of CRC errors
30070	RS-485 diagnostics Modbus exception response amount
30071 float	Vibratory displacement acceleration, g
30073 float	Volume flow rate m3/h, in insertion mode through inner diameter of the pipe
30075 int32	Accumulated volume in mm under WC, in insertion mode through inner diameter of the pipe Calculation based on 30022 register
30077 int32	Accumulated volume in mm under WC, in insertion mode through inner diameter of the pipe. Calculation based on 30022, 30024 registers

* - not available for special version of transducer

Table G.3 - Holding registers

No, format	Variable description	Access level
40001	Device IP in Modbus network shall be from 1 to 247 as stated in protocol.	3
40002	RS-485 data communication speed. Encoded as follows: 0 – 4800 bit/s, 1 – 9600 bit/s, 2 – 19200 bit/s, 3 – 38400 bit/s (by default)	3
40003	Serial number of flow meter	6
40004	Medium type: Encoded as follows: 0- water, 1- liquid No1, 2- liquid No2, 3- liquid No3, 4- liquid No4, 5- saturated water steam, 6- air, 7- gas No1, 8- gas No2, 9- gas No3,	6
40005	Nominal pipe diameter in mm; If the value does not match any specified in technical requirements, calculation of flow rate and related parameters shall be done using approximate equations.	6
40006*	Analog output modes configuration Low 4 bits encode primary variable which is used for output current statement: 0- output switched off 1- volume flow in m3/h 2- volume flow in m3/h under NC 3- mass flow in t/h 4- temperature in Celsius 5- pressure in MPa The following three groups of 4 bits encode the second, third and forth dynamic variable the same way as the primary including additional parameters: 6- volume in liters under WC: (0 to 1000) 7- volume in cubic meters under WC: Total measured volume is equal to sum of volume in m3 and volume in liters. 8- mass in kg (0 to 1000) 9- mass in tons. Total measured mass is equal to sum of mass in tons and mass in kg.	6
40007	Discrete(pulse) output modes configuration: 0- frequency output for volume flow within the range from 0 to a value stated in 40035 register. Frequency range always from 0 to 1000 Hz 1- frequency output of flow under NC within the range from 0 to a value stated in 40035 register. Frequency range always from 0 to 1000 Hz 2- frequency output for mass flow within the range from 0 to a value stated in 40035 register. Frequency range always from 0 to 1000 Hz 3- frequency output for absolute pressure within the range from a value stated in 40033 register to a value stated in 40035 register, Frequency range always from 0 to 1000 Hz 4- frequency output for temperature within the range from a value stated in 40033 register to a value stated in 40035 register, Frequency range always from 0 to 1000 Hz 5- pulse output with pulse value in liters stated in 40039 register * 6- pulse output with pulse value in liters under NC stated in 40039 register * 7- pulse output with pulse value in kg stated in 40039 register 8- flow switch (normally open contact), limit stated in 40039 register 9- flow switch (normally closed contact), limit stated in 40039 register 10- volume dosing unit with dose in ml stated in 40903 register Normally open contact *11- mass dosing unit with dose in g stated in 40903 register Normally open contact 12- volume dosing unit with dose in ml stated in 40903 register Normally closed contact	6

	*13- mass dosing unit with dose in g stated in 40903 register Normally closed contact Note: after selecting operation mode check bit 10 in diagnostics register. If it is stated as one then maxumum frequency of pulse output exceeds allowed value of 1200 Hz in frequency mode and 500 Hz in pulse mode. In this case input increased pulse value for modes 5-7 and reset mode parameters. Otherwise discrete output will not work in pulse mode, in frequency mode will be limited to 1200 Hz after that frequency stops increase.	
No, format	Variable description	Access level
40008	Write interval (in minutes) of totalizers, minimum and maximum measured flow rate, pressure and temperature. When value is set to 0 writing will not proceed.	3
40009*	ADC code corresponding to 6mA on pressure gauge input	4
40010*	ADC code corresponding to 14 mA on pressure gauge input	4
40011	Dosing unit counter reset timeout in ms (from 1 to 65535). Zero setting in dosing mode will lead to discrete output failure.	6
40012	Self-diagnostics interval in hours. Executed at zero after receiving the command via Modbus or HART The result is stored in diagnostics register.	3
40013	Configuration of band-stop filters. Bits have the following functions: bit 0 - switch on 50 Hz band-stop filter bit 1 - switch on the first band-stop filter bit 2 - switch on the second band-stop filter bit 3 - switch on the third band-stop filter bit 4 - switch on the forth band-stop filter	5
40014	Switch on amplitude filter. Bits have the following functions: bit 0 - switch on amplitude filter bit 1 - switch on adaptive filter bit 2 - switch on automatic medium component determination. Algorithm involves amplitude filter usage bit 3 - switch on viscosity tables bit 4 - switch on density tables bit 5 - switch on piezosensor signal automatic gain control bits 6-8 - switch on and adjust median filter length. median filter will switch on if adjusted to any value more than 0, buffer length is equal to a stated value. We recommend to choose odd values (3,5 or 7) bit 9 - switch off Reynolds number correction bit 10 - switch on insertion mode	5
40015*	Pressure gauge configuration. Encoded as follows: 0 - manually adjusted pressure (MPa abs.) applied 1 - absolute pressure gauge is connected, MPa 2 - absolute pressure gauge is connected, kgs/cm2 3 - extra pressure gauge is connected, MPa To calculate absolute pressure shall be added to a value stated in 40029 register 4 - extra pressure gauge is connected, kgs/cm2 To calculate absolute pressure shall be added to a value stated in 40029 register	4
40016*	Static parameter of temperature sensor. Encoded as follows: 0 - manually adjusted temperature (C^0) applied 1 - Pt100 (W100 = 1.3850) 2 - 100P (W100 = 1.3910) 3- 50M	4
40017	Cut-off values based on amplitude If fundamental harmonic amplitude is lower than stated value, flow is set to zero.	5
40018*	ADC code corresponding to 18 mA on pressure gauge	4
40019	Flow rate damping rate (from 0 to 10)	3
40020	Ghost vortex alert Compare with spectrum dispersion. If spectrum root mean square (RMS) within stated range, chaotic vortex shedding is detected, if RMS is higher than stated it is detected as cavitation. Corresponding status bits are adjusted in diagnostics register.	3
40021	Parameter indicated in the 1st line. Encoded as follows: 1 - all parameters listed for codes 2-9 are displayed with 2sec interval. 2- current volume flow in m3/h *3- current volume flow under NC in m3/h *4- current mass flow in t/h *5- medium temperature, °C *6- electronic board temperature, °C	1

	*7- medium pressure, MPa 8- ratio of volume flow to nominal measuring range 9- letter "E", space and diagnostics register data in hex format. Note- when insertion mode in ON (40014): *3- current volume flow in m3/h, insertion mode	
No, format	Variable description	Access level
40022	Parameter indicated in the 2nd line. Encoded as follows: 1 - all parameters listed for codes 2-8 are displayed with 2sec interval. 2- accumulated flow rate, m3 *3- accumulated flow rate under NC, m3 *4- accumulated mass flow, t *5- current in current loop, mA 6- frequency on discrete output, Hz checksum for source code in hex format, minus symbol and metrological data checksum 8- letter "E", space and diagnostics register data in hex format. Note- when insertion mode in ON (40014): *3- current volume flow in m3/h, insertion mode	1
40023* float	Calculated density under WC in kg/m3. Used in case of pressure gauge and/or temperature sensor failure or absence,and if "temperature-density" tables in register 40014 are disabled	4
40025 * float	Stated density under NC in kg/m3. Used in case of pressure gauge and/or temperature sensor failure or absence	4
40027 * float	Stated pressure. Used in case of pressure gauge failure or absence	4
40029 * float	Atmospheric pressure in MPa	4
40031 float	Stated temperature of measured medium Used in case of temperature sensor failure or absence	4
40033 float	Lower limit of measuring range for pulse output	6
40035 float	Upper limit of measuring range for pulse output	6
40037 float	Low flow cut-off in m3/h If measured flow rate is lower than stated minimum it is detected as zero.	6
40039 float	Pulse value in liters or kilograms. Used in volume or mass flow input mode for frequency output	6
40041 float	Ratio of flow rate to frequency of vortex shedding (main K-factor)	6
40043 float	Medium compressibility factor	6
40045 float	Compressibility factor under working conditions	4
40047 float	Correction factor based on straight run length	6
40049 float	K-factor conversion coefficient	6
40051 float	K-factor conversion coefficient	6
40053 * float	Correction coefficient for mass flow rate calculation	6
40055 * float	Minimum detected medium pressure in MPa	5
40057 * float	Maximum detected medium pressure in MPa	5
40059 float	Minimum detected volume flow rate in m3/h	5
40061 float	Maximum detected volume flow rate in m3/h	5
40063 * float	Maximum detected temperature in Celsius	5
40065 * float	Zero shift of temperature sensor in Celsius Used for flow meter static parameter correction	4

No, format	Variable description	Access level
40067 * float	Lower limit of pressure gauge in natural units defined in register 40015	4
40069 * float	Upper limit of pressure gauge in natural units	4
40071 float	dynamic viscosity in MPa·, input manually. Used for Reynolds number calculation if 40014 register disable viscosity tables.	4
40073*	ADC code corresponding to 20 mA on pressure gauge input	4
40074	Reserved	0
40075 float	Lower frequency of band-stop filter 1 Use Hz for all frequencies	5
40077 float	Lower frequency of band-stop filter 2	5
40079 float	Lower frequency of band-stop filter 3	5
40081 float	Lower frequency of band-stop filter 4	5
40083 float	Upper frequency of band-stop filter 1	5
40085 float	Upper frequency of band-stop filter 2	5
40087 float	Upper frequency of band-stop filter 3	5
40089 float	Upper frequency of band-stop filter 4	5
40091 float	Transmitting efficiency of band-stop filter 1 All software filters have U-shaped response curve. Transmission factors shall be specified in the range from 0 to 100. In case of frequency band overlap the overall coefficient in the overlapping part is calculated as the product of transmission coefficients multiplication divided by 100. Transmission coefficient is limited to 1% to avoid full block of signal.	5
40093 float	Transmitting efficiency of band-stop filter 2	5
40095 float	Transmitting efficiency of band-stop filter 3	5
40097 float	Transmitting efficiency of band-stop filter 4	5
40099 float	Coefficient C for liquid filter's quadratic equation- lower cut-off. Equation is as follows $y=Ax^2+Bx+C$, where x is measured frequency of vortex shedding, y is measured value of signal amplitude. Normally measured value of amplitude (register 30010) shall lie between lower and upper cut-off values.	5
40101 float	Coefficient B for liquid filter's quadratic equation- lower cut-off.	5
40103 float	Coefficient A for liquid filter's quadratic equation- lower cut-off.	5
40105 float	Coefficient C for liquid filter's quadratic equation- upper cut-off.	5
40107 float	Coefficient B for liquid filter's quadratic equation- upper cut-off.	5
40109 float	Coefficient A for liquid filter's quadratic equation- upper cut-off.	5
40111 float	Lower frequency for liquid filter	5
40113 float	Upper frequency for liquid filter	5
40115 float	Coefficient C for gas filter's quadratic equation- lower cut-off.	5
40117 float	Coefficient B for gas filter's quadratic equation- lower cut-off.	5
40119 float	Coefficient A for gas filter's quadratic equation- lower cut-off.	5
40121 float	Coefficient C for gas filter's quadratic equation- upper cut-off.	5

No, format	Variable description	Access level
40123 float	Coefficient B for gas filter's quadratic equation- upper cut-off.	5
40125 float	Coefficient A for gas filter's quadratic equation- upper cut-off.	5
40127 float	Lower frequency for gas filter	5
40129 float	Upper frequency for gas filter	5
40131	Connection adjustment Bits: 00- no parity 01- odd parity 10- even parity 0**-1 stop bit 1**-2 stop bits 0**- fixed bit off 1***- even fixed bit	4
40132	Reserved	0
40133 float	S insertion mode coefficient	4
40135 float	Dynamic viscosity table based on temperature for 0 code mediums Table shall contain "temperature-viscosity" pair of values. Viscosity shall be input in kg/m·. Temperature value shall monotonically increase along with register number increase. Viscosity value, corresponding to intermediate temperature value, calculated using linear interpolation.	4
40167 * float	Dynamic viscosity table based on temperature for 1 code mediums Viscosity unit is mPa·, temperature shall be specified in °**C.**	4
40198 * float	Dynamic viscosity table based on temperature for 2 code mediums	4
40231 * float	Dynamic viscosity table based on temperature for 3 code mediums	4
40263 * float	Dynamic viscosity table based on temperature for 4 code mediums	4
40295 * float	Dynamic viscosity table based on temperature for 5 code mediums	4
40327 * float	Dynamic viscosity table based on temperature for 6 code mediums	4
40359 * float	Dynamic viscosity table based on temperature for 7 code mediums	4
40391 * float	Dynamic viscosity table based on temperature for 8 code mediums	4
40423 * float	Dynamic viscosity table based on temperature for 9 code mediums	4
40455 * float	Density table based on temperature for 0 code mediums Has the same format as "temperature-viscosity" tables. Density shall be input in kg/m3. Note: 0 code- water This table is not used for water as water density is analytically tractable parameter.	4
40487 * float	Density table based on temperature for 1 code mediums	4
40519 * float	Density table based on temperature for 2 code mediums	4
40551 * float	Density table based on temperature for 3 code mediums	4
40583 * float	Density table based on temperature for 4 code mediums	4
40615 * float	Density table based on temperature for 5 code mediums This table is not used for water steam as water steam density is analytically tractable parameter.	4
40647 * float	Density table based on temperature for 6 code mediums Gas density is analytically tractable parameter so this address area is not used.	4
40679 * float	Density table based on temperature for 7 code mediums Gas density is analytically tractable parameter so this address area is not used.	4

No, format	Variable description	Access level
40711 * float	Density table based on temperature for 8 code mediums Gas density is analytically tractable parameter so this address area is not used.	4
40743 * float	Density table based on temperature for 9 code mediums Gas density is analytically tractable parameter so this address area is not used.	4
40775 * float	Correction table based on Reynolds number. The table consists of 8 pairs "Reynolds number- correction factor as %%". Correction factor for intermediate values is calculated using linear interpolation.	4
40807 * float	Correction table for liquids based on flow rate. The table consists of 10 pairs "normalized frequency- correction factor as %%". Correction factor for intermediate values is calculated using linear interpolation. Normalized frequency equals to ration of vortex shedding frequency to a value stored in register 40887. Normalized frequency value shall increase along with register number increase and be different from each other.	6
40847 * float	Correction table for gases based on flow rate. The table consists of 10 pairs "normalized frequency- correction factor as %%". Correction factor for intermediate values is calculated using linear interpolation. Normalized frequency equals to ration of vortex shedding frequency to a value stored in register 40887. Normalized frequency value shall increase along with register number increase and be different from each other.	6
40887 float	Upper limit of vortex shedding frequency range in Herz.	6
40889	Minimum pulse duration on pulse output in pulse mode, ms. Minimum value -of1 ms and maximum value as 50% of current duration are set automatically when the value is out of range.	4
40893 int32	Password of 1 level To provide manual password entry using keyboard the maximum length shall not exceed 999999999.	2
40895 int32	Password of 2 level To provide manual password entry using keyboard the maximum length shall not exceed 999999999.	3
40897 int32	Password of 3 level To provide manual password entry using keyboard the maximum length shall not exceed 999999999.	4
40899 int32	Password of 4 level To provide manual password entry using keyboard the maximum length shall not exceed 999999999.	5
40901 int32	Password of 5 level To provide manual password entry using keyboard the maximum length shall not exceed 999999999.	6
40903 int32	Dosing unit portion in grams or milligrams. Unit is adjusted by discrete output mode (register 40007).	6
40913 int32	Resettable volume counter in ml	1
40915 int32	Resettable volume counter in m3	1
40917 * int32	Resettable mass counter in grams	1
40919 * int32	Resettable mass counter in tons	1
40921 int32	Resettable volume counter for other medium in ml	1
40923 int32	Resettable volume counter for other medium in m3	1
40925	Disable functions using special register. Set bit as 1 to switch off the following functions: * bit 0 - switch off analog output (current output is set to 4mA) bit 1 - switch off frequency output (set to normally open) *bit 2 - switch off 4-20 mA output *bit 3 - switch off thermal sensor output * bit 4 - switch off density calculation under WC. Value specified in register 40023 is used. bit 5 - switch off flow conversion factor (register 400051) ** bit 6 - switch on simulation testing (measuring sensor will automatically switch off)	6
40926* float	Additive correction to board temperature sensor measurement. To calculate actual value of board temperature stated value value in the register shall be deducted from measured temperature value.	6

No, format	Variable description	Access level
40928	Number of Fast Fourier Transformation points is used for signal frequency calculation. Encoded with two bits as follows: D1 D0 0 0 1024 points, 0 1 512 points, 1 0 256 points, 1 1 128 points. Bits D2-D15 are not used.	6
40929* float	Maximum detected temperature of electronics in Celsius	5
40931* float	Minimum detected temperature of electronics in Celsius	5
40933 float	Amplitude limit for cavitation and ghost vortex shedding calculation	5
40935* float	Standard temperature used for gas density calculation	6
40937* float	Standard pressure used for gas density calculation	6
40939 int32	The register is not used in programm	6

* - not available for special version of transducer
** - available for special version of transducer

Appendix H
(informative)

«HART» protocol description

The protocol description and HART version 7 commands for an electronic converter with a two-wire connection scheme are available for download at http://www.emis-kip.ru.

HART verson 6 commands for standard and extended version are shown in the tables H.1 - H.2.

HART interface protocol complies with the protocol specification. Difference is described in "Response data" column. Quoted values are constants in decimal representation.

Access level can be adjusted by entering password corresponding to the access level using keyboard or SW1;1 on the processor board (inside the electronic block).

Request address can be adjusted by command 6 at any access level, command 39 is not proceeded.

Table H.1 - HART commands

Command No and function	Command data	Response data
0 Read unique identifier	—	Byte 0 Sensor code (“66”) Byte 1 number of preambles required (“5”) Byte 2 universal command revision Byte 3 device-specific command revision (“1”) Byte 4 software version Byte 5 hardware versions (“1”) Byte 6 device function flags Byte 7-9 manufacturer identification code (Modbus #40003)
1 Read primary variable	—	Byte 0 PV units code Byte 1-4 primary variable
2 Read current and percent of range	—	Byte 0-3 current (mA) Byte 4-7 percent of range
3 Read current and four (predefined) dynamic variables	—	Byte 0-3 current (mA) Byte 4 PV units code Byte 5-8 primary variable Byte 9 SV units code Byte 10-13 secondary variable Byte 14 TV units code Byte 15-18 third variable Byte 19 FV units code Byte 20-23 fourth variable All dynamic virables are adjusted in Modbus register #40006
4 Read common static data (block 0). Read message	Byte 0 block number (“0”)	Byte 0 Block number (“0”) Byte 1-24 Message
4 Read common static data (block 1): Read tag, descriptor, data	Byte 0 block number (“1”)	Byte 0 Block number (“1”) Byte 1-6 tag Byte 7-18 descriptor Byte 19-21 data Byte 22-24 “250”
4 Read common static data (block 2): Read sensor information	Byte 0 block number (“2”)	Byte 0 Block number (“2”) Byte 1-3 sensor serial number (“0”) Byte 4 units code for sensor (“252”) Byte 5-8 upper sensor limit Byte 9-12 lower sensor limit Byte 13-16 minimum range “0” Byte 17-24 “250” Values for upper and lower range limits are the same as for th e flow meter (see command 4, block 3)

Command No and function	Command data	Request
4 Read common static data (block 3): read output data.	Byte 0 block number (“3”)	Byte 0 Block number (“3”) Byte 1 alarm select code (“0”) Byte 2 transfer function code (“0”) Byte 3 PV/units code range Byte 4-7 upper range limit Byte 8-11 lower range limit Byte 12-15 damping value Byte 16 write-protect code (“1” - protected, "0" - not protected) Byte 17-24 “250” Write protection is enabled if current access level is less than 3.
5 Read common static data (block 0). Write message.	Byte 0 block number (“0”) Byte 1-24 Message	as in command
5 Read common static data (block 1): Read tag, descriptor, data	Byte 0 block number (“1”) Byte 1-6 tag Byte 7-18 descriptor Byte 19-21 data Byte 22-24 “250”	as in command
5 Read common static data (block 1): Write final assembly number.	Byte 0 block number (“4”) Byte 1-3 final assembly number Byte 4-24 “250”	as in command Serial number can be modified at 6 access level only. Serial number is stored in register 40003 and can be from 0 to 65535. If bigger value is entered higher binary positions will be lost and stored as zero.

Table H.2 - Common-practice commands

Command No and function	Command data	Request
33 Read sensor variables	Byte 0 transmitter variable code for slot 0 Byte 1 transmitter variable code for slot 1 Byte 2 transmitter variable code for slot 2 Byte 3 transmitter variable code for slot 3	Byte 0 transmitter variable code of slot 0 Byte 1 - units code for slot 0 Byte 2-5 variable code for slot 0 Byte 6 transmitter variable code of slot 1 Byte 7 - units code for slot 1 Byte 8-11 variable code for slot 1 Byte 12 transmitter variable code for slot 2 Byte 13 - units code for slot 2 Byte 14-17 variable code for slot 2 Byte 18 transmitter variable code for slot 3 Byte 19 - units code for slot 3 Byte 20-23 variable code for slot 3 Variable encoding- see Modbus description, register #40006
34 Write damping value	Byte 12-15 damping level	as in command
34 Configuration reset Change flag	-	-
39 EEPROM control	Byte 0 EEPROM Control code “0” – burn EEPROM “1” – copy EEPROM to RAM	as in command
40 Enter/exit fixed current mode	Byte 0-3 current (mA) If 0 – exit fixed current mode	as in command Current can be adjusted from 3,8 to 21 mA
41 Self-diagnostics	none	none Self-diagnostics data will be indicated with LED and related diagnostic bit
42 Master reset	none	none
45 Trim DAC zero	Byte 0-3 measured current (mA)	as in command
46 Trim DAC gain	Byte 0-3 measured current (mA)	as in command

Appendix I
(normative)

List of measuring instruments used for calibration

Table I.1 - List of measuring devices needed for calibration

Name	*Type*	*Specification*
1. Mercury glass laboratory thermometer	TL GOST 215	Measurement range 0 – 55 °C,, division 0,1 °C
2. DC power supply- 2 pcs.	Б5-45 ЕЭ3.233.219 ТУ	DC upper voltage limit 49,9 V, current up to 100 mA.
3. Digital frequency meter	Ч3-88 по ТУ BY 100039847.076-2006	Output signal frequency range from 0,1 Hz to 200 MHz
4. Stopwatch	СТЦ-1 ТУ25-07.1353-77	Accuracy ± 0,1 sec.
5. Personal computer		Personal computer with installed Windows 95/98/2000, EMIS-Integrator and reserved COM-port.
6. Calibration unit	УПСЖ 100/ВМ ТU 4381-001-55749794-2002	Flow range from 0,03 up to 100m3, relative error for comparison method not exceeds ±0,25 %, for indirect method not exceeds ±0,05 %.
7. Calibration units for gas meters	УПСГ	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 specified requirements. Measurement devices shall be calibrated and have approval marks in the data sheet.

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

Name	*Type*	*Specification*
1. Mercury glass laboratory thermometer	TL GOST 215	Measurement range 0 – 55 °C, division 0,1°C
2. DC power supply unit	Б5-44 ТU 3.233.219	DC upper voltage limit 49,9 V, current up to 100 mA.
3. Digital frequency meter	Ч3-88 по ТУ BY 100039847.076-2006	Output signal frequency range from 0,1 Hz to 200 MHz
4. Stopwatch	СТЦ-1 ТУ25-07.1353-77	Accuracy ± 0,1 sec.
Lever-type micrometer	0-25 и 25-50 ТU 2-034-227-87	Accuracy ± 0,01 %
6. Digital caliper	ЩЦЦ-150 ГОСТ 166	Accuracy ± 0,03 %
7 Signal generator	Г6-27 GOST 22261	Frequency range 0,3 Hz...3 MHz stability not less than 0,05 %
8 Digital voltmeter	В7-65/5	Measurement limits from (0-0,05) to 1000 V, accuracy 0,02 % + 5dgt
9 Resistance multiplier	Р4831	Resistance up to 1000Ohm, relative accuracy ± 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 pine output.
11. Oscilloscope	С1-117/1 ТГ2.044.016ТУ	Range not less than 100 kHz sensitivity not less than 10mV/div
12. Protocol converter RS485/USB	EMIS-SYSTEM 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. Measurement devices shall be calibrated and have approval marks in the data sheet.

Appendix J
(normative)

Insertion type flow meter adjustment according to application conditions

Use EMIS-Integrator (at-most-once operation) to adjust insertion type flow meter to use with a specific pipe diameter or recalculate pulse value on pulse output and maximum flow rate corresponding with upper limit of current output signal. Set bit 10 in register 40014 (enable insertion mode), calculate correction factor to readjust flow rate according to actual pipe diameter. Calculation can be done using EMIS-integrator without re-adjusting transducer.

Pulse value correction

Actual pulse value ma can be calculated as follows:

ma=m*S, (J.1)

where m - sensor pulse value as stated in the device passport, l/pulse;
S - correction factor according to formulation (J.3).

Adjust upper limit of current output signal

Actual flow rate **Qmax a** corresponding with current output signal upper limit can be calculated as follows:

Qmax a = Qmax * S , (J.2)

where **Qmax** is sensor flow rate corresponding with 20mA current output signal as stated in the device passport, m3/h;
S - correction factor according to formulation (J.3).

Calculate correction factor

Correction factor **S** for actual diameter of a pipe can be calculated as follows:

$$S = (D_a / d)^2 * Kv * Kt * Ks, \quad (J.3)$$

where D_a is actual pipe diameter, mm;

d – flow meter inner diameter in the installation point of bluff body, **d** = 40 mm;

Kv – coefficient depends on sensor immersion depth. Kv=1 if sensor is installed at the point of average speed (0,242R). To install sensor on the pipe axis Kv value can defined using interpolation based on **table J.4.** In general cases Kv can be defined as 0,84;

Kt is transition coefficient sensitive to K-factor changes when sensor is installed (insertion mode) with reference to K-factor defined with calibrating unit. Kt coefficient shall be selected from table J.1 (defined empirically);

Table J.1 - transition coefficient Kt

Measurement point	Transition coefficient Kt
Center	1.65
Point of average speed	1.42

Ks is coefficient of shadowing which depends on immersion depth. Ks coafficient shalol be defined using **table J.2.**

Table J.2 - Shadowing coefficient Ks

DN, mm	**200**	**250**	**300**	**350**	**400**	**450**	**500**	**600**	**700**	**800**
Ks	0,905	0,921	0,930	0,932	0,936	0,938	0,940	0,944	0,948	0,952
DN, mm	**900**	**1000**	**1100**	**1200**	**1300**	**1400**	**1500**	**1600**	**1800**	**2000**
Ks	0,956	0,960	0,963	0,967	0,970	0,973	0,976	0,978	0,981	0,985

Actual value of pipe inner diameter shall be calculated as follows :

$$D_a = L_H / 3.1416 - 2*s , \quad (J.4)$$

where L_H is perimeter of circle average over four measurements , mm;
s – pipe side width average over four measurements , mm

To measure pipe inner diameter use measuring instruments as specified in the **table J.3** or similar.

Table J.3 - List of measuring instruments used for pipe diameter measurement

Name	*Technical requirements*
1. Metal tape measure Р10Н2К, GOST 7502-98	Length 10m, division 0,5mm
2. ultrasonic thickness gauge УТ-93П, GOST 25863-83	Range 3...30mm, relative error 3 %

Kv coefficient can be defined as follows:

- define average speed of the flow $\mathbf{V_{av}}$, m/s using pipe section for average flow rate from flow meter range

$$\mathbf{Vav = 2000 * (Qmin + Qmax) / (D_a^2 * 3,6 * 3,1416)\ ,} \qquad \text{(J.5)}$$

where **Qmin (Qmax)** is minimum (maximum) value of flow rate according to **table 1.3**, m3/h;

where **Da** is actual pipe diameter, mm;

- calculate Reynolds number, **Re**

$$\mathbf{Re = 0,001 * Da * Vav / \nu}\ , \qquad \text{(J. 6)}$$

where **Da** is actual pipe diameter, mm;

Vav is average speed of the flow, m/s;

ν - kinematic viscosity of measuring medium for working temperature range, m2/s.

- calculate coefficient of flow friction λ using Althsul equation.

$$\lambda = 0{,}11 \cdot \left(\frac{R_\phi}{D_\phi} + \frac{68}{Re} \right)^{0{,}25}\ , \qquad \text{(J.7)}$$

where **Ra**- roughness of inner surface of the pipe, mm (defined experimentally or by GOST 8.563.1-97);

Da is actual pipe diameter, mm;

Re – Reynolds number.

Hydraulic friction λcan also be calculated using Colebrook-White equation.

Kv coefficient for calculated hydraulic friction λ can be defined by interpolation using table J.4 (GOST 8.361-79).

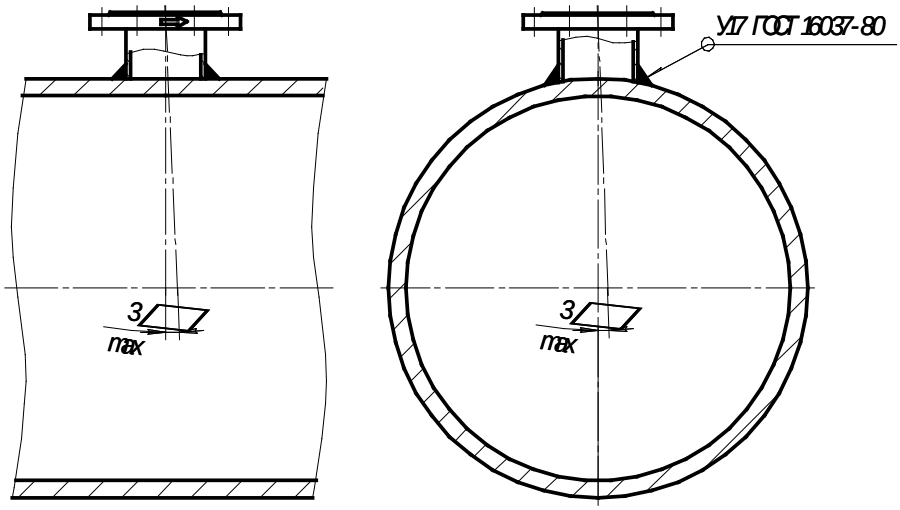
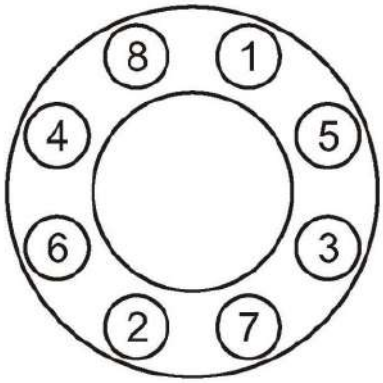
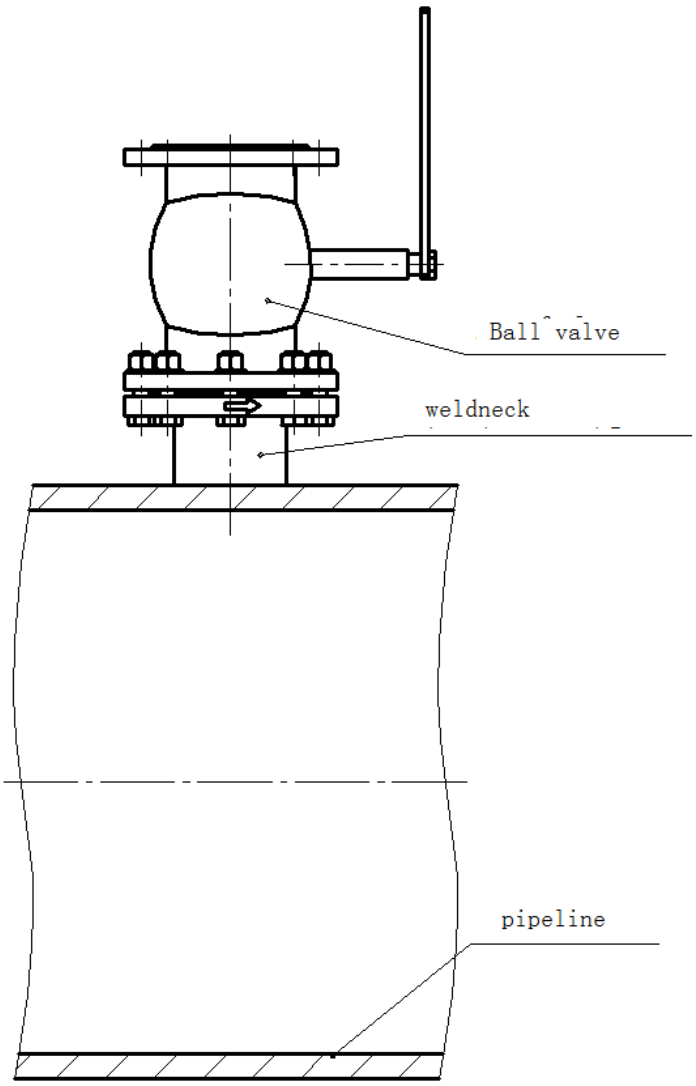
Table J.4 - Immersion coefficient **Kv**

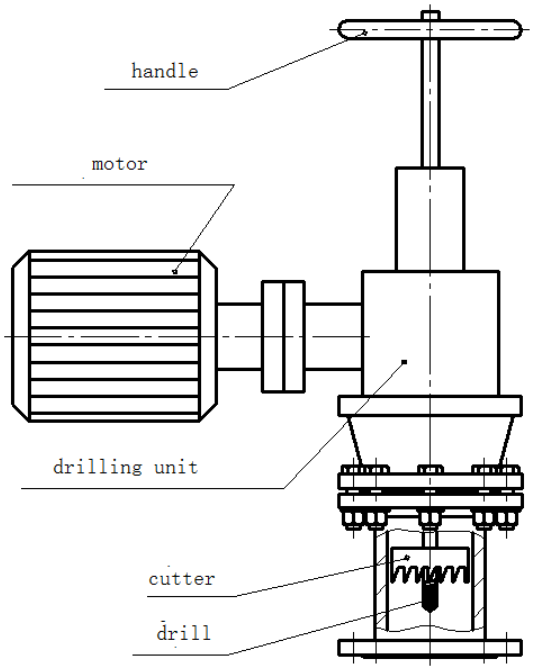
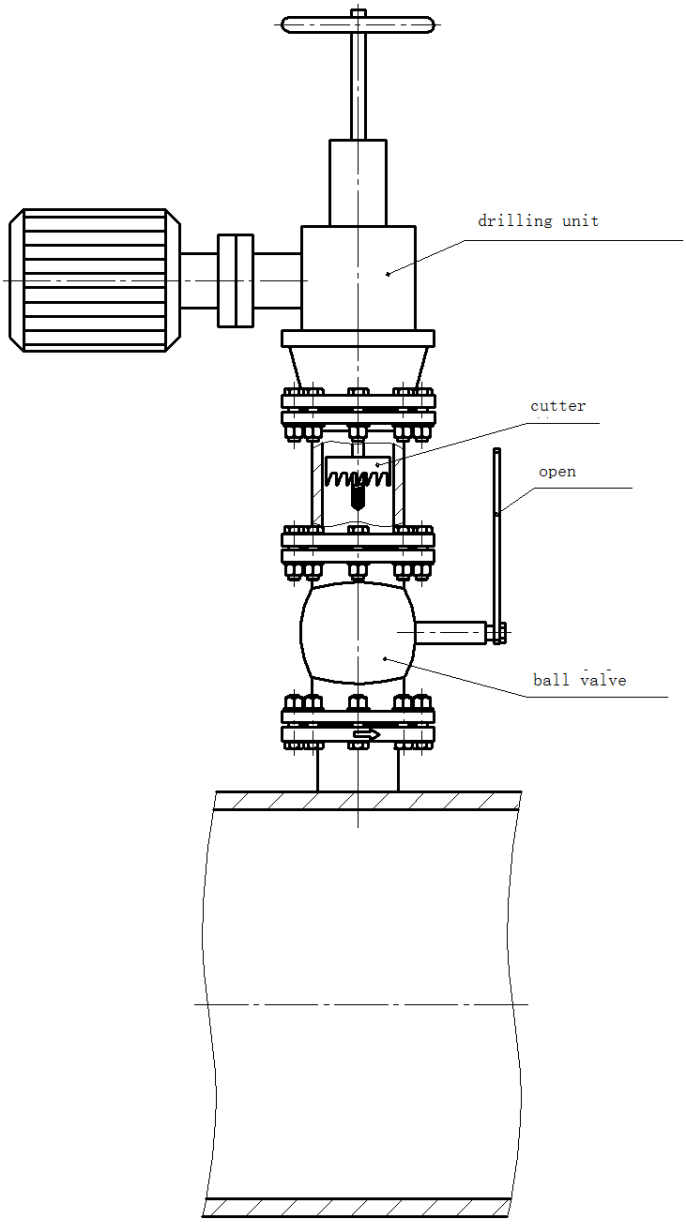
λ	0,01	0,02	0,03	0,04	0,05	0,06
Kv	0,875	0,840	0,800	0,770	0,740	0,713

Appendix K
(normative)

In-process installation of 1,6MPa insertion type flow meter without flow interruption

Table K.1 *Installation procedure without flow interruption*

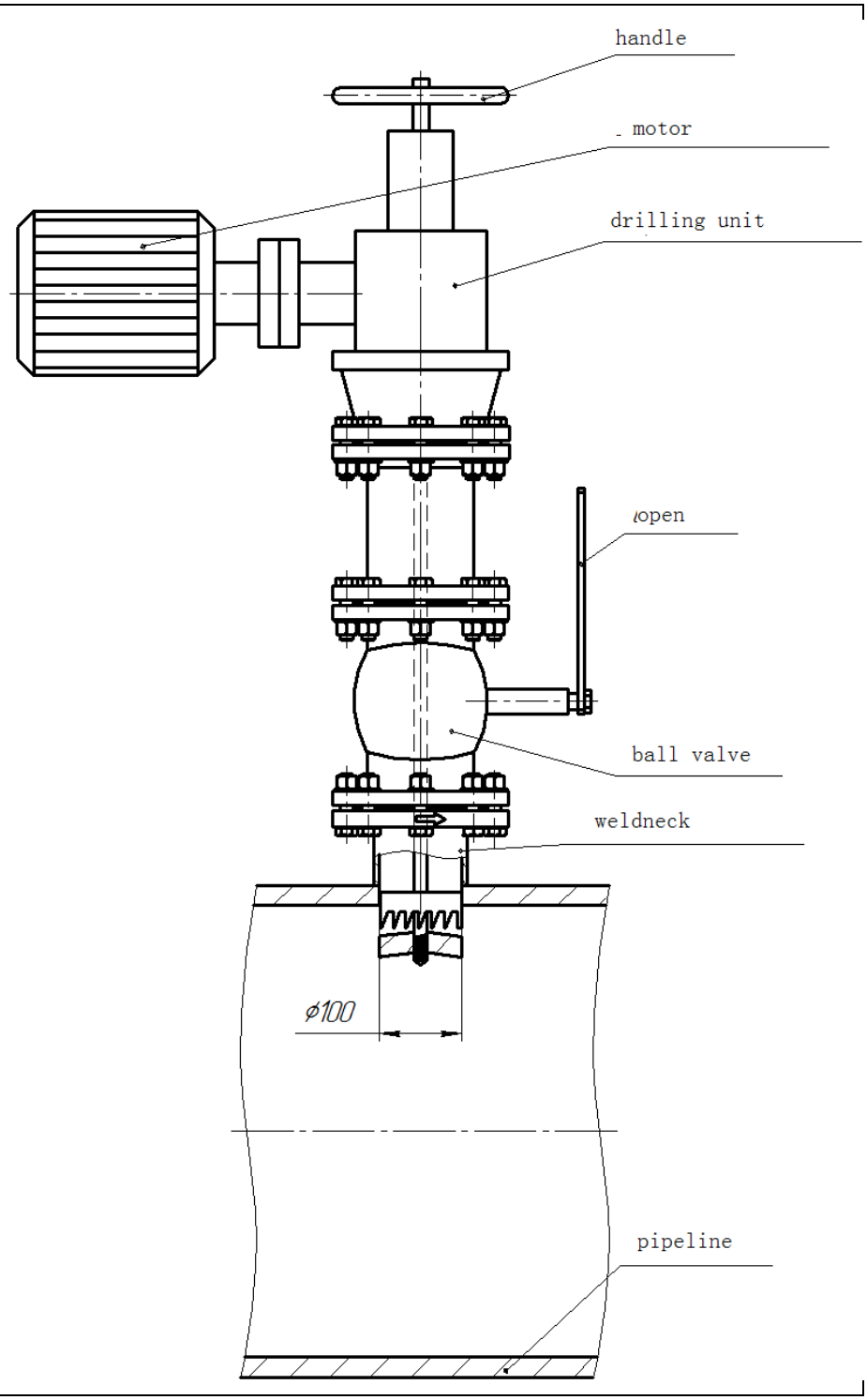
Operation	Figure
1. Weld insertion bar to the pipeline. Welding under GOST 16037-80. Bar axis shall be perpendicular and symmetric with pipe axis. Misalignment of flow meter bar in the point of connection shall not exceed 3º.	
2. Install a ball valve on the weldneck using bolts. Ball valve length shall not exceed 230mm. Place gasket between weldneck flanges and valve flanges. 8 bolts M16x70 shall be tightened according to the scheme, bolt torque shall be 88,25 N*m (9 kgs*m) up to 107,87 N*m (11 kgs*m). Technical requirement on tightening according to GOST 37.001.031-72.  **Bolt tightening scheme**	

3. Prepare hole drilling device.	
4. Put drilling unit on the ball valve, install the gasket between the flanges. Fix the unit with bolts and nuts. See item 2 on the tightening scheme. Open ball valve.	

5. Bring drill into the open valve close to the pipeline surface.

Switch on drilling unit.

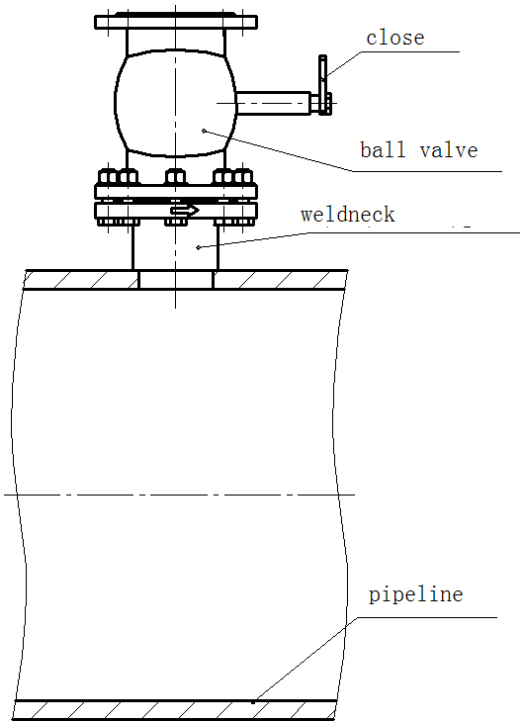
Drill a hole in the pipeline keeping vertical direction of the cutter.



6. Bring up cutter with the cut section of the pipeline.

Close ball valve.

Switch off driller and put it off from the ball valve.

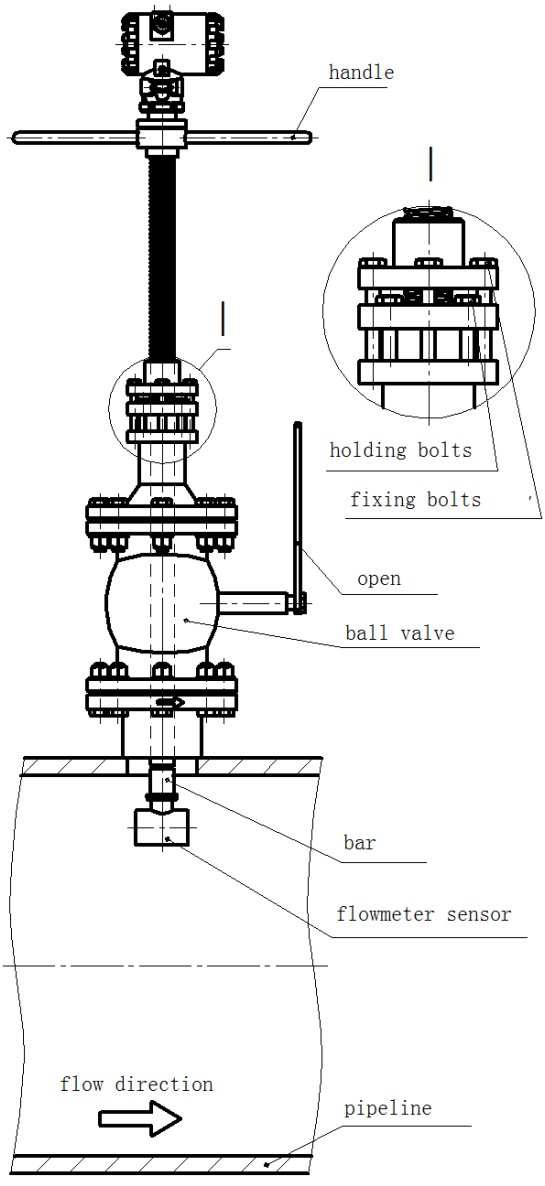


7. Fix flow meter to the ball valve using bolts and nuts. Place new gasket between ball valve flange and flow meter flange.

See item 2 on the tightening scheme.

Attach a handle to the flow meter bar and loosen fixing and holding bolts.

Smoothly open ball valve.



8. Turn the handle and put the sensor down into the pipe until required depth (until it reached the axis of the pipeline for the pipeline diameter not exceeding 800mm).

Calculate A size to ensure appropriate depth of immersion for sensor H as follows:

A = B – C – H – S,

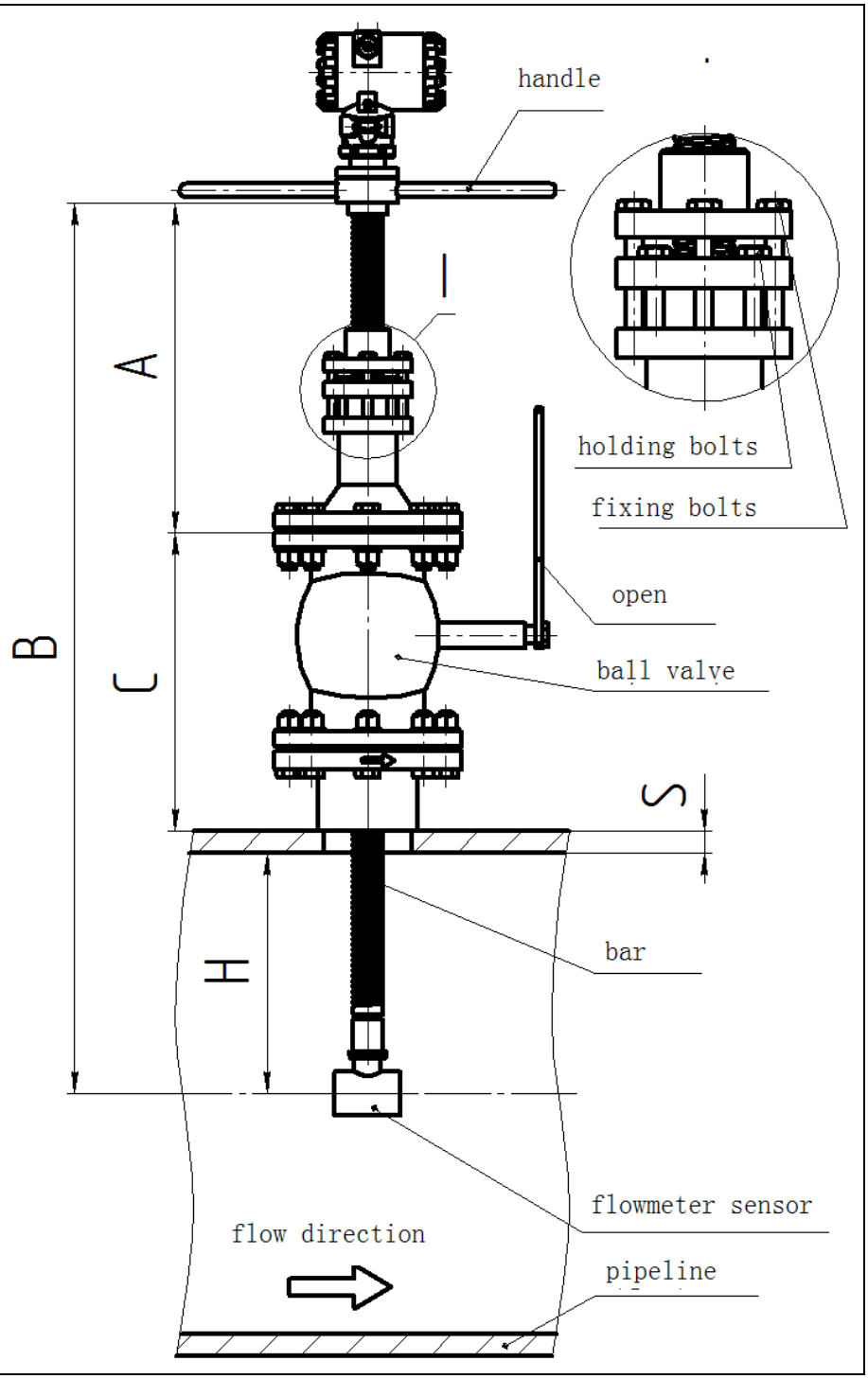
H = D/2 if D ≤ 800 mm,

H = 0,121*D if D > 800 mm,

where D is inner diameter of the pipe.

To provide correct alignment of the flow meter inside the pipe, ensure that handle direction is aligned with flow direction (sensor axis is parallel with pipeline axis).

Attention!
Tighten fixing and holding bolts.



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