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CORIOLIS FLOW METER EMIS-MASS 260

Operation manual

Direct mass flow measurement

High accuracy

Digital processing of signals

No straight run required

Applicable for high viscous liquids

www.emis-meter.com

EMIS

Russia, Chelyabinsk

EMIS flowmeters manufacturer

General information

This operation manual contains general technical parameters, directions for usage, transportation and storage, and other information for accurate operation of EMIS-MASS 260 Coriolis mass flow meters (hereinafter referred to as the flow meter or EM-260)

EMIS CJSC has the right to update the product and documents without prior notice if it does not affect product performance. For any information about present Operation Manual or other EMIS equipment please contact your local dealer or EMIS head office.

Attention!

Carefully study this Manual before starting operation. Please make sure that you have carefully read and learned the present manual before installation, operation or maintenance of the equipment. The above is strictly required to provide safety operation and equipment efficiency.

Contact your local dealer or our technical service: Company profile

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e-mail: support@emis-kip.ru

Attention!

Present Manual can be applied only for EMIS-MASS 260 flow meters. This document is not applicable to other equipment of EMIS or other companies.

Contents

1 Description and operation

1.1 Application

The flow meter EMIS-MASS 260 is designed to measure the mass flow rate, weight, temperature, density, volume flow, volume of liquids and gas.

The flow meter is used as a meter for gasoline, liquefied gas, kerosene, diesel fuel, oil, oil with water, fuel oil, other liquids and corrosive media under operating pressure and working temperature at chemical, petrochemical, oil, food, pharmaceutical and other industries and public utilities.

Flow meters are installed in automatic control, adjustment and operation systems and used at variable industries, stationary plants and

ground-based mobile refueling and transfer facilities, commercial accounting systems.

Flow meters can be used for both standard and explosive environments. Ex-proof flow meters EMIS-MASS 260-Ex are equipped with ex-proof enclosure under GOST IEC 60079-1-2013, intrinsically safe circuit of "ib" protection level under GOST 31610.11-2014.

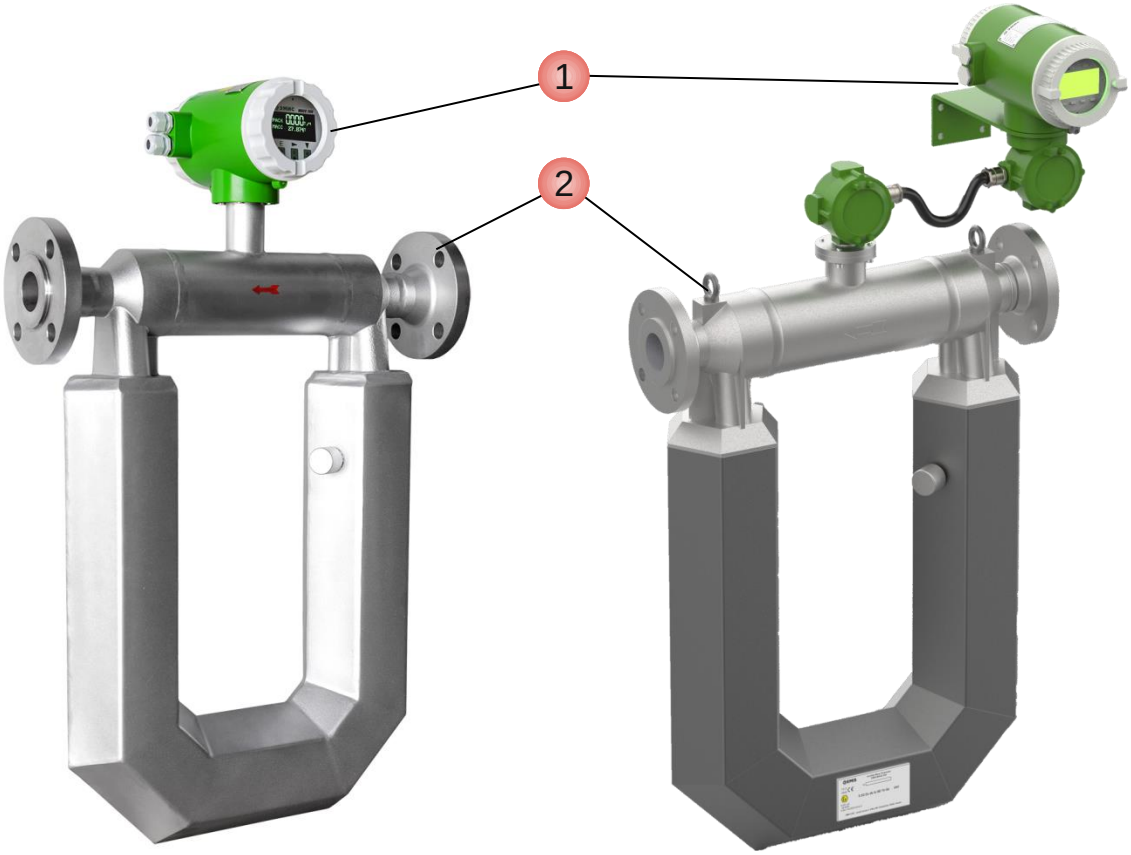
The flow meter EMIS-MASS 260 is an indicating device operating under excessive pressure, categories 1 and 2, in accordance with the requirements of TR TS 032/2013 “On safety of equipment operating under excessive pressure”.

Attention!
The flow meter is not intended for operation at nuclear facilities.

1.2 Structure and Operation Principle

Flow meter consists of the following assemblies (fig.1.1):

- Electronic unit (1).
- Sensor (primary transducer) (2).



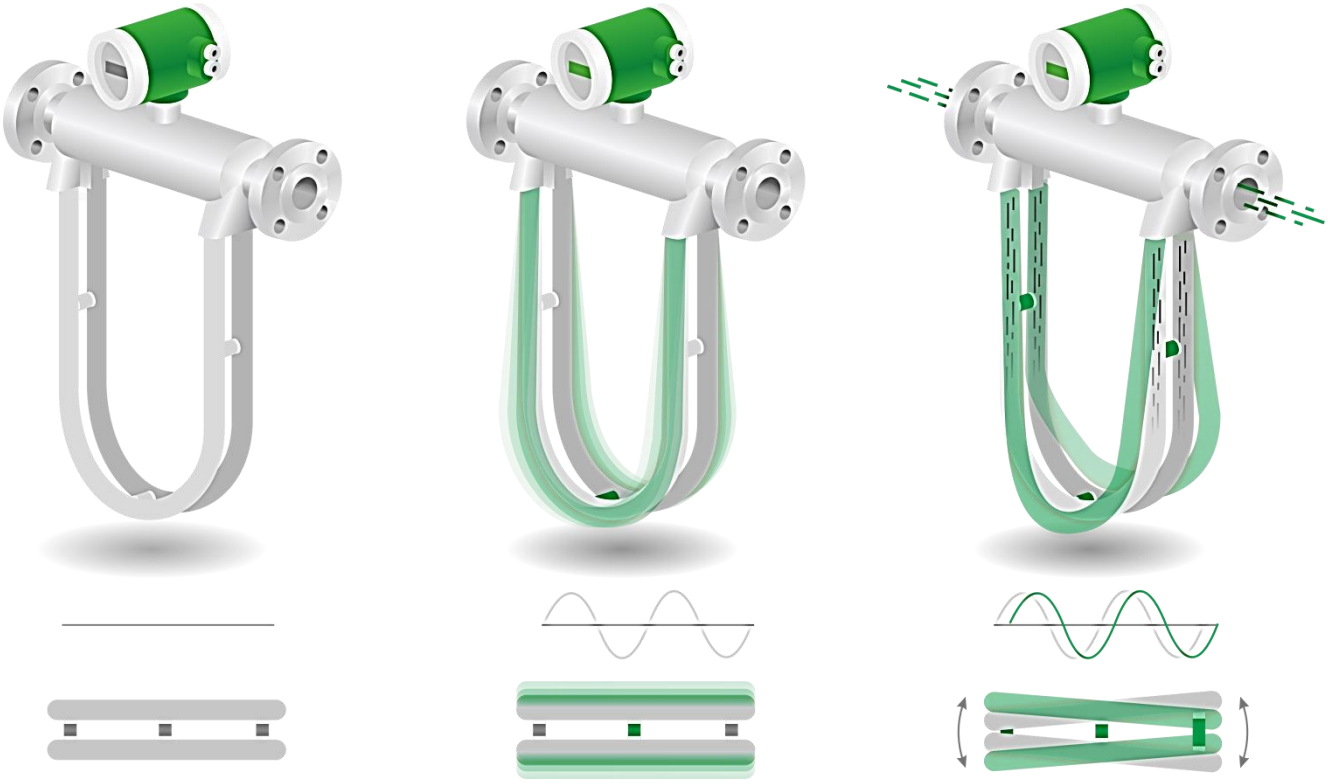
a) ***b)***

Fig.1.1 - External view of flow meter

Electronic unit can be mounted integrally with the flow meter (integral version, fig.1.1 a) and separately from the flow meter (remote version, fig.1.1 b).

The sensor is a measuring chamber with inlet and outlet pipes and flanges for pipeline connection. The magnetic coil and the magnet induce vibrations on the two U-shaped parallel flow tubes. Electromagnetic coils with magnets, called detectors, are installed on the flow tubes.

When a measured medium moves through a measuring chamber, a physical phenomenon appears, known as the Coriolis effect (Figure 1.2). The progressive movement of the medium in the oscillating flow tube leads to the occurrence of Coriolis acceleration, which, in turn, leads to the appearance of Coriolis force. This force is directed against the motion of the tube imparted to it by the driver coil, i.e. when the tube moves up during the half of its own cycle, the Coriolis force is directed downward for the fluid flowing inward. As the fluid passes through the bend of the tube, the direction of the force changes to the opposite Having been forced upward, the liquid flowing out of the sensor resists having its vertical motion decreased by pushing up on the tube. This action causes the tube to twist. When the tube is moving downward during the second half of its vibration cycle, it twists in the opposite direction.



a) ***b)*** ***b)***

Fig.1.2 - The forces affecting the tube during the vertical movement

Fig.1.2: a) flow meter without power supply; b) power supplied, the coil cause the vibration in the measuring tubes; c) flow supply, generation of Coriolis effect.

Coriolis force and the amount of twist is directly proportional to the mass flow rate. The detectors measure the phase shift when the opposite sides of the flow tubes move, and as a result, out of phase signals are generated. Mass flow rate Q is proportional to time delay Δt .

$$Q = 3{,}6 \times K \times \Delta t, \text{ kg/h} \qquad (1.1)$$

where K is a calibration coefficient g/s/μs

Δt - time delay between the signals from the coils, μs

The density of the medium being measured is determined by measuring the period of oscillation of the flow tubes, which is proportional to the density of the medium. While calibrating the density measuring channel for two different fluids with known (measured with density meter) density (air and water) the period of oscillation of the flow tubes corresponding to this density shall be measured. Medium density and oscillation period shall be specified via the transmitter display or digital interface. Due to the linear dependence based on the period of oscillation of the flow tubes we can calculate the density of the medium.

The integrated platinum sensor Pt100 measures the temperature. Measured temperature is used for automatic correction of the flow rate and density related to the temperature changes. Temperature correction coefficients for the flow rate and density are set as default at the plant and can be adjusted through the display menu.

The flow rate can be manually corrected depending on the pressure changes. In correction mode the electronic unit adjust the current flow of medium according to the working pressure inside the pipe. Pressure can be adjusted by inputting directly in the electronic unit or connecting to pressure gauge. Communication with external pressure gauge is performed via Modbus.

The sensor forms the primary signal containing the data on the time delay between the sensors. The primary signal is transmitted to the electronic unit mounted integrally with the flow meter or remotely.

The electronic unit processes the primary signal, calculates mass and volume flow, temperature compensation, forms output signals and show these info on the display. There are two version of the electronic unit: standard and extended. Detailed description of each type is presented in the Operation manuals EM-260.000.000.002.01 or EM-260.000.000.000.01. Operation manuals can be found in the website www.emis-kip.ru/ru/books1 in the related section EMIS-MASS 260.

Measurement advantages:

- direct measurement of mass flow rate in the pipeline without changes in parameters leading to further inaccuracy.
- high precision and stability for a long time;
- measurement of highly viscous fluids, non Newtonian fluids, fluids with solid and gas inclusions;
- no moving parts (small oscillation amplitude can be ignored) and wearing parts which extend the service life of the flow meter;
- no barrier for the flow path inside the tubes;
- temperature and density measurement;
- no straight pipes before/after the flow meter or the flow conditioner are required.
- Vertical and horizontal installation at different angles to the flow body.

1.3 Order Sheet

EMIS-MASS 260 order sheet is presented in the Table 1.1.

Example of the completed order sheet:

EMIS-МАСС-260 – Ex – 050К – И – Ж – 2,5 – 100 – 24 – А1 – 0,25 – 1,0 – 1,0 – У – SC – Е – GOST

Table 1.1 - Flow meter configurations

1	***Explosion protection***		
–	No explosion protection (standard version)		
Ex	Ex-proof marking: Flow meter: 1Ex ib IIC T6…T1 Gb X; 0Ex ia IIC T6…T1 Ga X[1)]; Electronic unit: 1Ex db [ib] IIC T6 Gb X; 1Ex db [ia Ga] IIC T6 Gb X[1)]; Amplifier: 1Ex db [ib] IIC T6 Gb X (amplifier is used for Dn≥100 with electronic unit of standard and extended versions).		
ExBB[2)]	Ex-proof marking: Flow meter: 0Ex ia IIC T6…T1 Ga X; Electronic unit: 1Ex db [ia Ga] IIC T6 Gb X.		
RV[3)]	Ex-proof marking: Flow meter: RV Ex d ia I Mb X; Electronic unit: RV Ex db [ib] I Mb X; Terminal block: PB Ex db I Mb X[4)]; Additional terminal box: PB Ex ib I Mb X[4)].		
RO-RV[5)]	Ex-proof marking: Flow meter: PO Ex ia I Ma X; Electronic unit: PB Ex db [ia Ma] I Mb X; Terminal block: PB Ex db I Mb X; Additional terminal box: PO Ex ia I Ma X.		
RO-RVBB[2)5)]	Ex-proof marking: Flow meter: PO Ex ia I Ma X; Electronic unit: PB Ex db [ia Ma] I Mb X; Terminal block: PB Ex db I Mb X; Additional terminal box: PO Ex ia I Ma X.		
[1)] – Marking is applied to flow meter with extended electronic unit; [2)] – Consider electrical parameters for this configuration, which are described in the clause 1.6 Explosion protection, it is equipped with special version of electronic unit only. [3)] – Configuration is equipped with electronic unit of standard or extended version. [4)] – Terminal box and additional terminal boxes applied to the remote type flow meters; [5)] – Available with special version electronic unit only.			
2	***Flow tube diameter***		
010	Dn 10	080	Dn 80
015	Dn 15	100	Dn 100
025	Dn 25	150	Dn 150
040	Dn 40	200	Dn 200
050	Dn 50		
3	***Body type***		
–	Standard U-shaped		
C	Compact		

X	Special config.
4	***Flow meter mounting***
I	Integral version - sensor and transmitter as integral assembly
R	remote installation with cable length of 3m
RXX	Remote version with cable length of XXm. Max length - 100m[1)]
[1)] – for ex-proof configuration - 50m	
5	***Calibration***
L	Liquid calibration
G	Gas calibration, additional liquid calibration
6	***Flow tube material***
–	Stainless steel (standard configuration)
X	by order
7	***Medium pressure***
1.6[1]	max pressure - 1.6 MPa
2.5[1]	max pressure - 2.5 MPa
4.0	max pressure - 4.0 MPa
6.3	max pressure - 6.3 MPa
10	max pressure - 10 MPa
16	max pressure - 16 MPa
25	max pressure - 25 MPa
[1)] Flow meters for 1.6 and 2.5 pressure are equipped with 4.0Mpa flanges.	
8	***Medium temperature***
75	measuring medium temperature from -60 to +75 °C
95	measuring medium temperature from -60 to +95 °C
100	measuring medium temperature from -60 to +100 °C
135	measuring medium temperature from -60 to +135 °C (remote type only)
200	measuring medium temperature from -60 to +200 °C (remote type only)
9	***Power supply***
24	24V DC
220	220V AC

10	***Output signals***
Standard electronic unit	
–	digital RS-485 + pulse output signal (active)
A	digital RS-485 + pulse output signal (active)+ current output signal 4-20mA (active)
A1	digital RS-485 + pulse output signal (active)+ current output signal 4-20mA (passive)

A2	digital RS-485 + pulse output signal (passive)+ current output signal 4-20mA (active)
A3	digital RS-485 + pulse output signal (passive)+ current output signal 4-20mA (passive)
TA	digital RS-485 + pulse output signal (active)+ current output signal 4-20mA with digital HART (passive)
H	digital RS-485 + pulse output signal (active)+ current output signal 4-20mA with digital HART (passive)
H1	digital RS-485 + pulse output signal (passive)+ current output signal 4-20mA with digital HART (active)
H2	digital RS-485 + pulse output signal (passive)+ current output signal 4-20mA with digital HART (active)
H3	digital RS-485 + pulse output signal (passive)+ current output signal 4-20mA with digital HART (active)
TH	RS-485 + current output signal 4-20mA with digital HART (active) + current output 4-20mA (active)
TH1	RS-485 + current output signal 4-20mA with digital HART (passive) + current output 4-20mA (passive)
F	digital RS-485 + pulse output signal (active) + pulse output signal (active)
F1	digital RS-485 + pulse output signal (passive) + pulse output signal (passive)
F2	digital RS-485 + pulse output signal (passive)
Extended electronic unit	
–	digital RS-485 + pulse output signal (active)
A1	digital RS-485 + pulse output signal (active)+ current output signal 4-20mA (passive)
A3	digital RS-485 + pulse output signal (passive)+ current output signal 4-20mA (passive)
TA	digital RS-485 + pulse output signal (active)+ current output signal 4-20mA with digital HART (passive) without additional error
THF	digital RS-485 + current output signal 4-20mA (passive) with digital HART + current output signal 4-20mA (passive) + pulse output signal (switchable active/passive)
TTF	digital RS-485 + current output signal 4-20mA (passive)+ current output signal 4-20mA (passive) + current output signal (switchable active/passive)
Special version electronic unit	
F2	digital RS-485 + pulse output signal (passive)
11	***Accuracy***
0.1	Accuracy class 0.1
0.15	Accuracy class 0.15
0.2	Accuracy class 0.2
0.25	Accuracy class 0.25
0.5	Accuracy class 0.5
12	***Density measuring error[1)]***
1.0	Error for liquid and gas ±1,0 kg/m^3
0,3[2)]	Error for liquid ±0,3 kg/m^3
0,5[2)]	Error for liquid ±0,5 kg/m^3
2.0	Error for liquid and gas ±2,0 kg/m^3

5.0	Error for liquid and gas ±5,0 kg/m^3
10.0	Error for liquid and gas ±10,0 kg/m^3
[1] After simulation test density measurement error is ±20,0 kg/m^3. [2] Upon prior agreement, for liquid only.	
13	***Temperature error***
1.0	Standard error ±1,0°C
0,5[1]	Error ±0,5°C
[1] Upon prior agreement.	
14	***Electronic unit version[1]***
–	Standard version
U	Extended version[2]
UIP	Extended version, simulation test function[2]
S	Special version
SIP	Special version, simulation test function2)
[1] – For flow meters with electronic unit of "-", "У" and "С" versions only flow calibration is available for periodical testing. For flow meters with electronic unit of "УИП" and "СИП" versions flow calibration and simulation test are available for periodical testing. [2] – Amount of output pulse signals can be increased to 3 upon special request.	
15	***Display***
-	LED display
ND	No LED display
[1] Version without display is available for electronic unit of "С" and "СИП" versions.	
16	***Configuration[1]***
-	Standard version
FR	Flanged connection with reducers
[1] – Use table 1.4 and 1.5 to choose the configuration.	

17	***Calibration***
–	manufacturer calibration
SC	state calibration
18	***Register map***
–	ЭМИС register map
P	ProLink registry map
19	***Sealing surface***
B	Flange connection, flange face - type B "Raised face" under GOST 33259
B1	Flange connection, flange face - type B1 Raised face under EN 1092-1
C	Flange connection, flange face - type C Male under GOST 33259 or EN 1092-1
D	Flange connection, flange face - type D Female under GOST 33259 or EN 1092-1
E	Flange connection, flange face - type E Raised face under GOST 33259 (standard) or EN 1092-1

F	Flange connection, flange face - type F Female under GOST 33259 or EN 1092-1
J	Flange connection, flange face - J type Oval gasket under GOST 33259 (standard version 10-25 MPa)
RF	Flange connection, flange face - RF type Raised face under ASME B16.5
RTJ	Flange connection, flange face - RTJ type Oval gasket under ASME B16.5
S	socket (for flow meters up to 4MPa connection according to DIN11851)
X	customized (various connection types under GOST, EN, ASME; please specify)
20	***Flange standards***
GOST	GOST 33259
EN	EN 1092-1
ASME	ASME (ANSI) B16.5
DIN	GOST 11851
21	***Industrial versions***
-	standard version
AST	for environments containing hydrogen sulfide
Hyd	for hydrogen, hydrogen-containing gases
22	***Installation length***
-	Standard version (length according to the Appendix A)
X	Upon request (installation length shall not be shorter than specified in the Appendix A)
23	***Heating jacket***
-	standard version
J	With heating jacket (for compact versions)

Mounting kit parts are listed in the table 1.2.

Example of the completed order sheet:

Mounting kit EMIS - MASS 260 050 - 2.5 - 11 - F - GOST - 09G2S

Table 1.2 - Mounting kit versions

1	***Flow tube diameter***		
010	Dn 10	080	Dn 80
015	Dn 15	100	Dn 100
025	Dn 25	150	Dn 150
040	Dn 40	200	Dn 200
050	Dn 50	X	by order
2	***Medium pressure***		
1.6	max pressure - 1,6 MPa	10	max pressure - 10 MPa

2.5	max pressure - 2,5 MPa	16	max pressure - 16 MPa
4.0	max pressure - 4,0 MPa	25	max pressure - 25 MPa
6.3	max pressure - 6,3 MPa		
3	***Flange type***		
01	Flat flange		
11	Weld neck flange		
4	***Sealing surface***		
B	Flange connection, flange face - type B “Raised face” under GOST 33259		
B1	Flange connection, flange face - type B1 Raised face under EN 1092-1		
C	Flange connection, flange face - type C Male under GOST 33259 or EN 1092-1		
D	Flange connection, flange face - type D Female under GOST 33259 or EN 1092-1		
E	Flange connection, flange face - type E Male under GOST 33259 or EN 1092-1-2007		
F	Flange connection, flange face - type F Female under GOST 33259 or EN 1092-1		
J	Flange connection, flange face - type J Oval gasket under GOST 33259		
RF	Flange connection, flange face - RF type Raised face under ASME B16.5		
RTJ	Flange connection, flange face - RTJ type Oval gasket under ASME B16.5		
S	socket (for flow meters up to 4MPa connection according to DIN11851)		
X	customized (various connection types under GOST, EN, ASME; please specify)		
5	***Flange standards***		
GOST	GOST 33259		
EN	EN 1092-1		
ASME	ASME (ANSI) B16.5		
X	by order		
6	***Flange material***		

09G2C	Steel 09G2S
Ст20	Steel 20
H	Stainless steel 12X18H10T
13XFA	Steel 13XFA
X	by order

1.4 Technical Parameters

1.4.1 Brief description of technical parameters

Brief description of technical parameters is shown in Table 1.3

Table 1.3 - Technical parameters of flow meter

Name	***Description***	
Dn, mm	10; 15; 25; 40; 50; 80; 100; 150; 200	
Accuracy	0,1; 0,15; 0,2; 0,25; 0,5	
Excessive pressure of medium, MPa	1,6; 2,5; 4,0; 6,3; 10; 16; 25 (see table 1.6 and 1.7)	
Temperature range, ºC	From -60 to +200ºC	
Explosion protection	Version	Marking
	Ex	Ex-proof marking: Flow meter: 1Ex ib IIC T6…T1 Gb X; 0Ex ia IIC T6…T1 Ga X; Electronic unit: 1Ex db [ib] IIC T6 Gb X; 1Ex db [ia Ga] IIC T6 Gb X; Amplifier: 1Ex db [ib] IIC T6 Gb X.
	ExBB	Ex-proof marking: Flow meter: 0Ex ia IIC T6…T1 Ga X; Electronic unit: 1Ex db [ia Ga] IIC T6 Gb X.
	RV	Ex-proof marking: Flow meter: RV Ex d ia I Mb X; Electronic unit: RV Ex db [ib] I Mb X; Terminal block: RV Ex db I Mb X; Additional terminal box: RV Ex ib I Mb X.
	RO-RV	Ex-proof marking: Flow meter: PO Ex ia I Ma X; Electronic unit: RV Ex db [ia Ma] I Mb X; Terminal block: RV Ex db I Mb X; Additional terminal box: PO Ex ia I Ma X.
	RO-RVBB	Ex-proof marking: Flow meter: PO Ex ia I Ma X; Electronic unit: RV Ex db [ia Ma] I Mb X; Terminal block: RV Ex db I Mb X; Additional terminal box: PO Ex ia I Ma X.
Atmospheric pressure, kPa	84.0 to 106.7	
Ambient temperature, °C	From -60 to +70ºC	
Relative humidity, % less than	90 ± 3 % (non-condensing under 25ºC)	
Magnetic field resistance	up to 40 A/m, 50Hz	
Vibration resistance	From 10 to 150Hz with acceleration not exceeding 9.8 m/s2, V1 group under GOST 52931-2008. From 5 to 2000Hz with acceleration not exceeding 49 m/s2, G1 group	

	under GOST R 52931-2008 upon prior agreement.
Dust and water protection	IP66 / IP67
Calibration interval	5 years
Temperature gauge	Pt100
Service life	over 20 years
Dimensions and weight	see Appendix A
Materials	Flow meter body - stainless steel AISI 304. Flow meter casing - stainless steel AISI 304. Sensor tubes - stainless steel AISI 316L. Electronic unit - aluminum alloy Does not contain precious metals.
* Upon prior agreement with EMIS engineering service.	

Note: You can customize flow meter parameters according your specific demands.

1.4.2 Measuring ranges

Flow meter provides mass flow measurement with accuracy of δ_{ml}, which is numerically equal to the accuracy class in the flow range from Qmin to Qmax according to the table 1.4.

When measuring flow of liquid, flow meter performance is provided within the flow ranges from Qmin to Qmax according to the table 1.4.1.

In the range from Qmin to Qmax as specified in the table 1.5, flow meter provides gas measurement accuracy of δ_{mg}, %:

$$\delta_{mg} = K_t + 0.25, \quad (1.2)$$

Where Kt - flow meter accuracy class according to the order sheet.

When measuring gas flow, flow meter performance is provided within the flow ranges from Qmin to Qmax according to the table 1.5.

Flow meter is designed for measure of single-phase mediums (liquid or gas).

Qmin depends on the medium parameters and shall be specified in the order sheer.

Table 1.4.1 - Mass flow rate measuring ranges for liquid

Dn	***Configuration***	***Qmin, kg/h***	***Qmin, kg/h***		*****Q_{max}, kg/h***	***Zero stability, kg/h***
			Accuracy class			
			0.1; 0.15; 0.2;	***0,25 u 0,5***		
10	-	10	–	50*	1,100	0.04
15	FR	10	–	50*	1,100	0.04
15C	-	10	200	150	3,000	0.2

25C	FR	10	200	150	3,000	0.2
25C	-	30	600	400	9,000	0.6
25	-	40	600	300	10,000	0.4
40C	FR	30	600	400	9,000	0.6
40	FR	40	600	300	10,000	0.4
40C	-	180	3,600	2,400	25,000	3.6
40	-	160	2,200	1,500	35,000	1.28
50	FR	160	2,200	1,500	35,000	1.28
50C	FR	180	3,600	2,400	25,000	3.6
50K	-	250	5,000	3,500	50,000	5
50	-	250	3,500	2,500	55,000	2
80	FR	250	3,500	2,500	55,000	2
80C	FR	250	5,000	3,500	50,000	5
80K	-	600	12,000	8,000	140,000	12
80	-	700	9,500	6,000	200,000	6
100	FR	700	9,500	6,000	200,000	6
100C	FR	600	12,000	8,000	140,000	12
100C	-	1,000	20,000	15,000	240,000	20
100	-	1,000	15,000	10,000	430,000	8
150	FR	1,000	15,000	10,000	430,000	8
150C	FR	1,000	20,000	15,000	240,000	20
150C	-	2,500	50,000	35,000	430,000	50
150	-	2,500	35,000	25,000	500,000	20
200C	-	5,000	100,000	70,000	1,000,000	100

* For flow meters of Dn10 0.5 accuracy can be provided.

** Qmax - flow complies with the pressure drop of 1bar when measuring flow of liquid at 20°C.

Table 1.4.2 - Extended liquid flow ranges

Dn	Configuration	Qmin, kg/h	Qmin, kg/h Accuracy class		**Q_{max}, kg/h	Zero stability, kg/h
			0.1; 0.15; 0.2;	0,25 u 0,5		
10	-	10	–	50*	1,600	0.04
15	FR	10	–	50*	1,600	0.04
15C	-	10	200	150	4,600	0.2
25C	FR	10	200	150	4,600	0.2
25C	-	30	600	400	14,000	0.6
25	-	40	600	300	14,000	0.4
40C	FR	30	600	400	14,000	0.6
40	FR	40	600	300	14,000	0.4
40C	-	180	3,600	2,400	34,000	3.6
40	-	160	2,200	1,500	51,000	1.28
50	FR	160	2,200	1,500	51,000	1.28
50C	FR	180	3,600	2,400	34,000	3.6
50C	-	250	5,000	3,500	64,000	5
50	-	250	3,500	2,500	77,000	2
80	FR	250	3,500	2,500	77,000	2
80C	FR	250	5,000	3,500	64,000	5
80C	-	600	12,000	8,000	188,000	12
80	-	700	9,500	6,000	288,000	6
100	FR	700	9,500	6,000	288,000	6
100C	FR	600	12,000	8,000	188,000	12
100C	-	1,000	20,000	15,000	375,000	20
100	-	1,000	15,000	10,000	550,000	8
150	FR	1,000	15,000	10,000	550,000	8
150C	FR	1,000	20,000	15,000	375,000	20
150C	-	2,500	50,000	35,000	574,000	50
150	-	2,500	35,000	25,000	900,000	20
200C	-	5,000	100,000	70,000	1,000,000	100

* For flow meters of Dn10 0.5 accuracy can be provided.

** Qmax - flow complies with the pressure drop of 2bars when measuring flow of liquid at 20°C.

Table 1.5 - Mass flow rate measuring ranges for gas

Dn	Configuration	Qmin, kg/h	Qmin, kg/h Accuracy class		**$Q_{(mg)max}$, kg/h	Zero stability, kg/h
			0.1, 0.15, 0.2	0,25 u 0,5		
10	-	10	–	50*	$15.7 \cdot \rho_g$	0.04
15	FR	10	–	50*	$15.7 \cdot \rho_g$	0.04
15C	-	10	200	150	$42.9 \cdot \rho_g$	0.2
25C	FR	10	200	150	$42.9 \cdot \rho_g$	0.2
25C	-	30	600	400	$128.6 \cdot \rho_g$	0.6
25	-	40	600	300	$142.8 \cdot \rho_g$	0.4
40C	FR	30	600	400	$128.6 \cdot \rho_g$	0.6
40	FR	40	600	300	$142.8 \cdot \rho_g$	0.4
40C	-	180	3,600	2,400	$357.1 \cdot \rho_g$	3.6
40	-	160	2,200	1,500	$500 \cdot \rho_g$	1.28
50	FR	160	2,200	1,500	$500 \cdot \rho_g$	1.28
50C	FR	180	3,600	2,400	$357.1 \cdot \rho_g$	3.6
50C	-	250	5,000	3,500	$714.3 \cdot \rho_g$	5
50	-	250	3,500	2,500	$785.7 \cdot \rho_g$	2
80	FR	250	3,500	2,500	$785.7 \cdot \rho_g$	2
80C	FR	250	5,000	3,500	$714.3 \cdot \rho_g$	5
80C	-	600	12,000	8,000	$2,000 \cdot \rho_g$	12
80	-	700	9,500	6,000	$2,857.1 \cdot \rho_g$	6
100	FR	700	9,500	6,000	$2,857.1 \cdot \rho_g$	6
100C	FR	600	12,000	8,000	$2,000 \cdot \rho_g$	12
100C	-	1,000	20,000	15,000	$3,428.6 \cdot \rho_g$	20
100	-	1,000	15,000	10,000	$6,142.9 \cdot \rho_g$	8
150	FR	1,000	15,000	10,000	$6,142.9 \cdot \rho_g$	8
150C	FR	1,000	20,000	15,000	$3,428.6 \cdot \rho_g$	20
150C	-	2,500	50,000	35,000	$6,142.9 \cdot \rho_g$	50
150	-	2,500	35,000	25,000	$7,142.9 \cdot \rho_g$	20
200C	-	5,000	100,000	70,000	$14,285.7 \cdot \rho_g$	100

* For flow meters of Dn10 0.5 accuracy can be provided.

Maximum gas flow can be calculated using the formula $Q_{(mg)max} = (Qmax \cdot \rho_g) / \kappa_g$

Where ρ_g – gas density under working conditions, kg/cbm;

K_g - empirical coefficient, K_g = 70 kg/cbm;

Maximum mass flow of gas $Q_{(mg)}$ shall not exceed maximum mass flow of liquid Q_{max} as specified in the table 1.4.1.

Reduce mass flow to volume flow using the formula below:

$$Q_v = Q/\rho, \quad (1.3)$$

Where Q – upper or lower limit of the full range, kg/h.

ρ – is medium density under working conditions, kg/m3;

Manufacturer set up low flow cut-off value as 1% of the maximum value to avoid self running. If required, it can be decreased locally at the installation site. The low flow cut off value can be changed through the menu or Modbus.

Flow density range from 1 to 3000 m3/h.

Maximum dynamic viscosity of the medium 1500 mPa * s.

Gas inclusions in liquid shall not exceed 1% of the volume for 0.1%, 0.15%, 0.2%, 0,25% and 3% for 0,5% accuracy flow meters.

It is not allowed to operate the flow meter at flow rates higher than stated maximum value.

1.4.3 Pressure configurations

Table 1.6 shows versions of the EMIS-MASS 260 flange flow meter depending on the type of the casing, nominal diameter and the maximum pressure of the measured medium.

Table 1.6 - Versions of flow meters by maximum pressure of the medium (flange connection).

Dn, mm	*Medium pressure*				
	1,6-4 MPa	*6.3 MPa*	*10 MPa*	*16 MPa*	*25 MPa*
010	✓	✓	✓	✓	✓
015-FR	✓	✓	✓	✓	✓
015C	✓	✓	✓	✓	✓
025K-FR	✓	✓	✓	✓	✓
025	✓	✓	✓	–	–
025C	✓	✓	✓	✓	–
040-FR	✓	✓	✓	–	–
040	✓	✓	✓	–	–
040K-FR	✓	✓	✓	✓	–
040C	✓	✓	✓	✓	–
050-FR	✓	✓	✓	–	–
050	✓	✓	✓	–	–
050K-FR	✓	✓	✓	✓	–
050C	✓	✓	✓	✓	–
080-FR	✓	✓	✓	–	–
080	✓	✓	–	–	–
080K-FR	✓	✓	✓	✓	–
080K	✓	✓	✓	✓	–
100-FR	✓	✓	–	–	–
100	✓	✓	–	–	–
100K-FR	✓	✓	✓	✓	–
100C	✓	✓	✓	–	–
150-FR	✓	✓	–	–	–
150	✓	✓	–	–	–
150K-FR	✓	✓	✓	–	–
150C	✓	✓	–	–	–
200C	✓	✓	–	–	–

✓ - available version;

Table 1.7 shows versions of the EMIS-MASS 260 socket flow meter depending on the type of the casing, nominal diameter and the maximum pressure of the medium. Socket connection in accordance with DIN 11851.

Table 1.7 - Versions of flow meter by maximum pressure of the medium (socket connection).

Dn, mm	*Medium pressure*		
	1.6 MPa	*2.5 MPa*	*4 MPa*

10	✓	✓	✓
15C	✓	✓	✓
25C	✓	✓	✓
40C	✓	✓	✓
50C	✓	✓	-
80C	✓	✓	-

✓ - available version;

1.4.4 Accuracy

Relative error limits for mass flow measurement of liquid δ_{ml} on pulse, frequency, current TA and digital output signals shall not exceed the values stated for the specific flow meter configuration (equal to accuracy class):

±0.1%; ±0.15%; ±0.2%; ±0.25%; ±0.5%.

Relative error limits for mass flow measurement of gas δ_{mg} on pulse, frequency, current TA and digital output signals shall not exceed the values calculated using below formula:

$$\delta_{\text{мж}} + 0{,}25\%. \quad (1.4)$$

$Q<Q_{min}$ relative error for liquid and gas is calculated using below formula:

$$\pm[\delta_{\text{мж}} + (Z/Q) \cdot 100\%], \quad (1.5)$$

$$\pm[\delta_{\text{мг}} + (Z/Q) \cdot 100\%], \quad (1.6)$$

Where Z - zero stability (table ***1.4, table 1.5***);

Q - measured flow rate, kg/h.

After simulation test, relative error limits for mass flow measurement on pulse, frequency, current TA and digital output signals shall not exceed the values calculated using the formula 1.7 for liquid and 1.8 for gas.

$$\delta_{\text{мж}} + 0{,}2\%. \quad (1.7)$$

$$\delta_{\text{мг}} + 0{,}2\%. \quad (1.8)$$

Relative error limits for measurement of liquid volume δ_{vl} on pulse, frequency, current TA and digital output signals shall not exceed the values calculated using below formula:

$$\pm\sqrt{(\delta_{\text{мж}})^2 + ((\Delta\rho_{\text{ж}}/\rho) \times 100\%)^2}\ , \quad (1.9)$$

Where ρ – measuring density, kg/cbm

Relative error limits for measurement of gas volume δ_{vg} on pulse, frequency, current TA and digital output signals shall not exceed the values calculated using below formula:

$$\pm\sqrt{(\delta_{\text{мг}})^2 + ((\Delta\rho_{\text{г}}/\rho) \times 100\%)^2}, \quad (1.10)$$

After simulation test, relative error limits for measurement of volume on pulse, frequency, current TA and digital output signals shall not exceed the values calculated using formula 1.1 for liquid and 1.12 for gas.

$$\delta_{V\text{ж}} + 0{,}2\%. \quad (1.11)$$

$$\delta_{V\text{г}} + 0{,}2\%. \quad (1.12)$$

Absolute error limits for measurement of liquid density $\Delta\rho_l$ on frequency and digital output signals shall not exceed the values specified for flow meter configuration as below:

±0.3 kg/m^3*; ±0.5 kg/m^3; ±1.0 kg/m^3; ±2.0 kg/m^3; ±5.0 kg/m^3; ±10.0 kg/m^3.

*Error is ±0.3 kg/m^3 after calibration under normal conditions.

Absolute error limits for measurement of gas density $\Delta\rho_l$ on frequency and digital output signals shall not exceed the values specified for flow meter configuration as below:

±1.0 kg/m^3; ±2.0 kg/m^3; ±5.0 kg/m^3; ±10.0 kg/m^3.

After simulation test, absolute error limits for density on pulse and digital output signals shall not exceed 20kg/m$^{3.}$

Absolute error limits for measurement of medium temperature ΔT up to +200°C on frequency and digital output signals shall not exceed the values specified for flow meter configuration as below:

±0.5 ºC; ±1.0 ºC.

Reduced permissible error limits of conversion of measured value into current output signal for standard configuration shall not exceed 0.05%.

Relative permissible error limits for measurement of weight and volume of the first component of the two-component medium shall not exceed the values calculated by the formulas 1.13 and 1.14.

$$\pm[|\delta_{МЖ}| + (\rho_2 \cdot \Delta\rho_Ж/(\rho^2 - \rho_2 \cdot \rho)) \cdot 100\%], \quad (1.13)$$

$$\pm[|\delta_{МЖ}| + (\Delta\rho_Ж/(\rho - \rho_2)) \cdot 100\%], \quad (1.14)$$

Where ρ - two-component medium density;

ρ_2 – second component density;

ΔPl_l - mixture measurement error.

Error value is specified without reference to the inaccuracy of entered values of medium components density

Difference between mixture density and the second component density shall not be less than mixture density measurement inaccuracy $\Delta\rho l < |\rho - \rho_2|$. The function is available for liquids only.

1.4.5 Parameters of electrical power supply

The flow meter shall be supplied from 24VDC or 220 220^{+22}_{-33} VAC (50±1) Hz depending on the configuration.

The flow meter of DN≥100mm are equipped with integrated amplifier for drive coil power supply. The amplifier is supplied with the connection cable. Amplifier supply voltage complies with the transmitter supply voltage.

Circuit characteristics are shown in the Table 1.8.

Table 1.8 - Power supply parameters

Rated voltage	*Voltage range, V*	*Power consumption, not eceeding*
24V DC	18 to 30	24 W
220V AC	187 to 242	24 V-A

Main technical parameters of electronic units of standard configuration and U/UIP versions, along with operation directions, connection diagrams are presented in the operation manuals EM-260.000.000.002.01 OM or EM-260.000.000.000.01 OM

1.4.6 Output signals

Flow meters have the following output signals:

Analog output signals:

- frequency/pulse;
- current 4-20 mA;

- discrete.

Digital output signals:

- Modbus (RTU, ASCII) with RS-485;
- HART v7 on current loop 4-20 mA;
- Modbus TCP with Ethernet;
- Modbus (RTU, ASCII) with USB-485;*

*Service interface. Used for flow meter adjustment.

Analog input signals:

- Current output 4-20mA for external pressure gauge.

Integrated indicator is used to display mass flow, volume flow and other measured parameters.

1.4.7 Flow meter reliability parameters:

Transducer reliability parameters:

- mean time before failure, not less than 100 000 hours;
- mean time to recover not exceeds 8 hours;
- Average service life is not less than 20 years.

Flow meters can be operated in tepmerate, frigid climates device category 1 under GOST 15150. Flow meter shall comply with MU (marine universal) standard, device category 1 under GOST 15150, if supplied to ocean and inland water vessels.

1.5 Pressure loss

Flow meter pressure loss (ΔP) at maximum flow, pressure and temperature for water shall not exceed 0.13 MPa.

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

$$P = 2{,}9\ \Delta P + 1{,}3\ p_v, \qquad (1.15)$$

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.

Minimum medium pressure after the flow meter shall be not less than 0.1 MPa.

1.6 Explosion protection

Ex-proof flow meters EMIS-MASS 260-Ex, ExBB, RV, RO-RV, RO-RVBB are equipped with ex-proof enclosure “d” under GOST IEC 60079-1-2013, intrinsically safe circuit of “ia” or "ib" protection level under GOST 31610.11-2014 (IEC 60079-11:2011). Temperature marking according to the flow meter configuration is presented in the table 1.9.

Table 1.9 - Temperature marking

Configuration code	*Temperature class*
“75”	T6
”95”	T5
”100”	T4
”135”	
”200”	T3

Explosion protection marking is presented on the name plates.

Ex-proof name plates are presented in clause 1.7 Marking

Electronic unit enclosures, terminal boxes of RV, RO-RV, RO-RVBB configurations are certified with TR TS 012/2011.

Electrical elements of electrical unit of Ex and ExBB configurations are covered with ex-proof enclosures, which withstand internal explosion without transferring the ignition to the external gas air environment. Enclosure blast resistance and explosion protection comply with the GOST IEC 60079-1-2013 requirements for IIC class electrical equipment. Enclosures are tested for explosion stability according to GOST

IEC 60079-1-2013. Ex-proof connections parameters: axial length of the thread and the number of full turns in the engagement shall comply with the requirement of GOST IEC 60079-1-2013 for II group electrical equipment; Inspection window is sealed inside the metal rim of the casing cover to provide integrity;

Flow meter outputs and power supply unit are galvanically isolated from each other by transformer or DC/DC converter providing insulation strength of 1500 V.

Output current and voltage of electronic units and amplifier are limited to ensure safety factor of 1.5 for electrical equipment of I group, IIA, IIB or IIC subgroups under GOST 31610.11 2014 (IEC 60079 11:2011). Circuit redundancy of “ia” or “ib” level intrinsic circuits is executed according to GOST 31610.11 2014 (IEC 60079 11:2011).

Electric load of intrinsic circuit elements shall not exceed 2/3 of specified values under normal and emergency operation.

Flow meter power supply is provided from intrinsically safe circuits of “ia” or “ib” level of supply units and amplifier (optionally) with electrical parameters complying with electrical equipment of I group, IIA, IIB or IIC subgroups under GOST 31610.11 2014 (IEC 60079 11:2011).

Diode is installed in the electrical circuit to protect from polarity inversion.

Electrical circuits does not contain elements accumulating energy hazardous for ignition of gases of categories I, IIA, IIB, IIC.

For remote version cable L/R shall not exceed 25 μH/Ohm provided that cable length for IIC gas shall not exceed 50m (cable capacitance less than 10nF), cable length for IIB gas shall not exceed 200m (cable capacitance less than 40nF), cable length for IIA gas shall not exceed 800m (cable capacitance less than 160nF), cable length for I category gas shall not exceed 100m (cable capacitance less than 20nF).

Maximum temperature of casing and electrical elements heating under stated working conditions shall not exceed the value specified for that temperature class under GOST31610.0 2014 (IEC 60079 0:2011).

Flow meter body and parts of electronic unit, amplifier and sensor are executed under general requirements of GOST 30852.0 (IEC 60079-0:2011) for electrical equipment located in explosive environment. Sealing and connections provides safety level of IP66/67 under GOST 14254 2015 (IEC 60529:2013) (safety level provided by the enclosures (IP code)). Mechanical rigidity of flow meter casing complies with GOST 31610.0 2014 (IEC 60079 0:2011) requirements for electrical equipment of group II with high risk of mechanical damage. Materials provide friction spark protection under GOST31610.0 2014 (IEC 60079 0:2011). Enclosure surface is covered with corrosion resistant paint coat.

Ex-proof marking, warning signs and X mark are attached to the flow meter body.

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

- max temperature of surface and temperature class of the flow meter depend on medium temperature specified in the Manual;

- intrinsic safety of transducer is provided by connection to the intrinsically safe outputs of the electronic unit and coil amplifier (optionally) included in the flow meter assembly using the cable from the supply kit;

- electronic unit of ExBB and RO-RVBB configurations shall be operated with power supply unit and recorder with intrinsically safe circuits under GOST 31610.11 2014 (IEC 60079 11:2011) and intrinsic safety parameters (circuit level and electrical equipment subgroup) complying with operating conditions in hazardous environment.

- protect aluminum parts of flow meter body from hits when operating in 0 Zone to avoid friction sparks;

- flow meters with steel body shall be used in underground mines, pits and its overground facilities hazardous with mine gas;

- use certified cable glands and plugs to provide required type and level of explosion protection under GOST 14254 2015 (IEC 60529:2013). O-rings material shall withstand ambient temperature of operating environment. Unused cable glands shall be securely plugged.

Power supply parameters of electronic unit and amplifier of “Ex” configuration:

- DC voltage, V, not higher than 30
- power consumption, W, not higher than 24

or

- AC voltage, V, not higher than 250
- power consumption, VA, not higher than 24

Power supply parameters of electronic unit of RV, RO-RV configurations:

- DC voltage, V, not higher than 30
- power consumption, W, not higher than 24

Electrical parameters of intrinsically safe electronic unit of “EXBB” configuration:

Power supply circuit:

- max input voltage Ui, V. 27
- max input current Ii, mA 400
- max input power Pi, W 2.5
- max internal capacity Ci, μF 0.01
- max internal inductance L_i, μH 0.01

RS-485 circuit:

- max input voltage Ui, V. 17
- max input current Ii, mA 900
- max input power Pi, W 1.8
- max internal capacity Ci, μF 0.01
- max internal inductance L_i, μH 0.01
- max input voltage U_o, V. 5.9
- max input current I_o, mA 540
- max output power P_o, W 1.1
- max internal capacity C_o, μF 0.365
- max output inductance L_o, μH. 0.07

Frequency-pulse output:

- max input voltage Ui, V. 30
- max input current Ii, mA 100
- max input power Pi, W 0.7
- max internal capacity Ci, μF 0.01
- max internal inductance L_i, μH 0.01
- max input voltage U_o, V. 5.9
- max input current I_o, mA 540
- max output power P_o, W 1.1
- permissible external capacity C_o, μF 0.056

- permissible external inductance L_o, μH. 0.002

Electrical parameters of intrinsically safe electronic unit of “RO-RVBB” configuration:

Power supply circuit:

- max input voltage Ui, V. 27
- max input current Ii, mA 824
- max input power Pi, W 14.8
- max internal capacity Ci, μF 0.01
- max internal inductance L_i, μH 0.01

RS-485 circuit:

- max input voltage Ui, V. 17
- max input current Ii, mA 900
- max input power Pi, W 1.8
- max internal capacity Ci, μF 0.01
- max internal inductance L_i, μH 0.01
- max input voltage U_o, V. 5.9
- max input current I_o, mA 540
- max output power P_o, W 1.1
- permissible external capacity C_o, μF 12.64
- permissible external inductance L_o, μH. 1.4

Frequency-pulse output:

- max input voltage Ui, V. 30
- max input current Ii, mA 100
- max input power Pi, W 0.7
- max internal capacity Ci, μF 0.01
- max internal inductance L_i, μH 0.01
- max input voltage U_o, V. 5.9
- max input current I_o, mA 540
- max output power P_o, W 1.1
- permissible external capacity C_o, μF 3.05
- permissible external inductance L_o, μH. 0.5

1.7 Marking

Marking is applied on the plates attached to the flow meter body. The flow meter has the following plates:

1. Nameplate with technical parameters.
2. For ex-proof flow meters - plate with explosion protection parameters.

The nameplate is shown in fig.1.3 and contain the data as listed in the table 1.10.

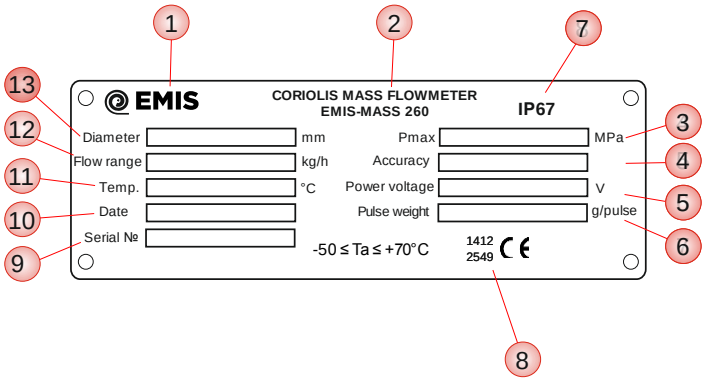


Fig.1.3 - Flow meter nameplate

Table 1.9 - Marking on the nameplate

NO in fig.	Description
1	Manufacturer trade mark
2	Name
3	Max pressure of environment (Pmax)
4	Accuracy
5	Pulse value (for pulse output)
6	Input voltage
7	IP
8	Ex-proof sign*
9	Serial number
10	Date of manufacturing
11	Medium temperature range T_{work}
12	Full range of measurement (Q)
13	Dn, mm
-	TR TS sign*
-	Power consumption (P_{cons})**
-	Weight**

* – for ex-proof configurations only;

** – if supplied to ocean and inland water vessels

Marking plate of flow meter with protection type “intrinsically safe circuit” of “ib” level under GOST 31610.11-2014 (IEC 60079-11:2011) is shown in ***fig 1.4***.

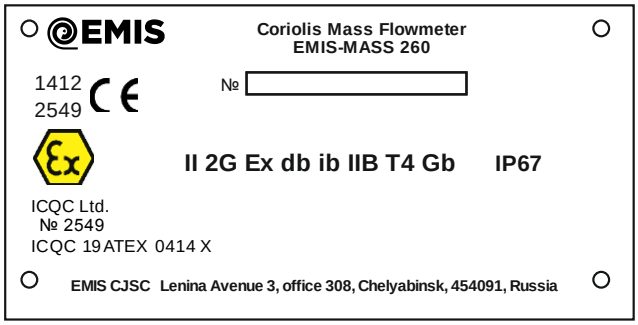


Fig.1.4 - Marking plate

The plate contains:

- manufacturer trade mark;
- flow meter name;
- ex-proof sign for ex-proof configurations;
- ex-proof level for ex-proof configurations;
- Amplifier ex-proof level sign, if any;
- ambient temperature requirement;
- ingress protection;
- ex-proof certificate No;
- TR compliance sign if supplied to ocean and inland water vessels.

Attention!
Please make sure that all information applied on the plates conform with your order sheet.

Flow meter is sealed after checking. Sealing is executed using sealing sticker attached to the switch unit or uwing sealing wire as shown in the fig.1.5

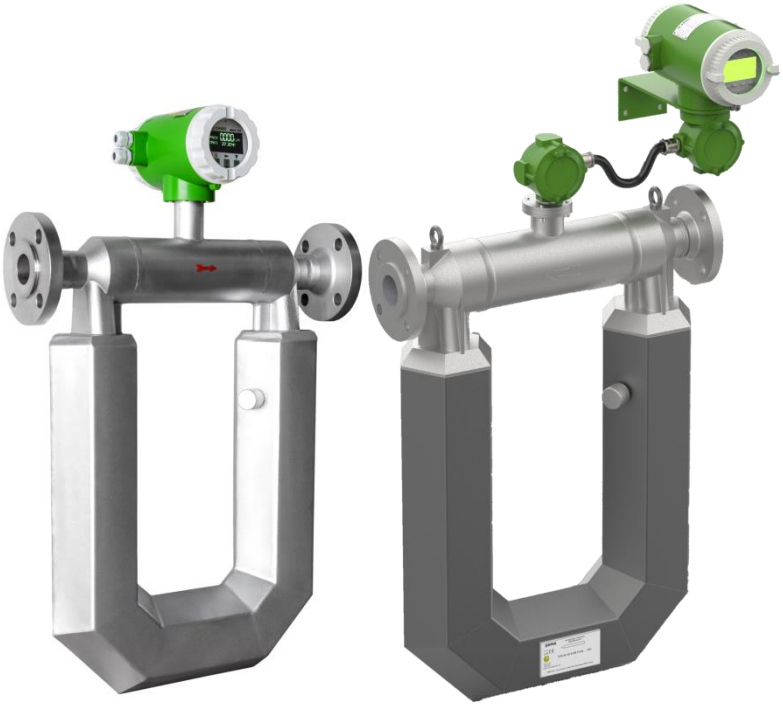
Flow meter general view for different configurations

Point of sealing

Fig.1.5 Sealing types of EMIS-MASS 260 depending on electronic unit configuration.

1.8 Scope of Supply

Standard supply scope is presented in the fig.1.6 and described in the table 1.11. Additional supply kit is presented in the fig.1.7 and described in the table 1.12.



1 2

3 4 5 6

Fig.1.6 - Standard scope of supply

Table 1.11 - Standard scope of supply

NO in fig.	*Description*	*Kit content*	*Upon request*
1	Integral version CORIOLIS FLOW METER EMIS-MASS 260	+	
2	Remote version CORIOLIS FLOW METER EMIS-MASS 260	+	Cable length
3	Operation manual EM-260.000.000.000.00 OM	+	
4	Operation manual for standard version of electronic unit EM--260.000.000.002.01 OM or Operation manual for extended version of electronic unit “U/UIP” EM--260.000.000.002.01 OM EM-260.000.000.000.01 OM	+	
5	Data sheet EM-260.000.000.000.00 DS;	+	
6	Package	+	
7	Calibration method MP- 208-043-2019		+
8	EMIS-Integrator	Software is available on the web-site of EMIS, CJSC	
9	Certificates*		+
Notes: *List of certificates is presented in the table 1.15; ** Manuals for different types of electronic unit are available on the web-site of EMIS, CJSC. Printed version provided upon request.			

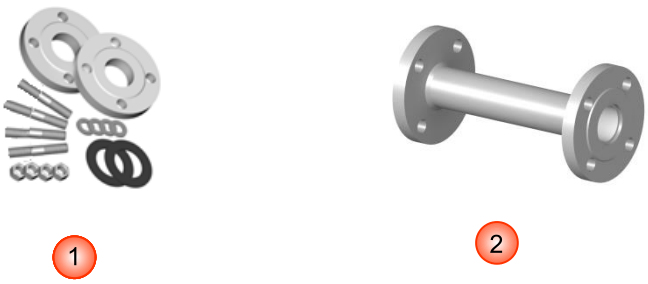


Fig. 1.7 - Additional supply kit

Table 1.12 - Additional supply kit

NO in fig.	*Description*
1	Mounting kit (flanges, gaskets, nuts, washers, studs) EMIS-MASS 260 -MK
2	Mounting sleeve EMIS-VECTA VT300
-	Mounting kit for remote type flow meter* (Support bar mounting bracket Ø50-100mm; clamps, nuts, washers)
-	Spare parts kit, tools and accessories**
Notes: *Mounting kit for remote type flow meter is presented in the Appendix A; ** Standard spare parts kit includes cable glands with plugs, fasteners and flange gaskets.	

Table 1.13 - List of certificates and declarations

No	*Certificate*
1	Measuring instruments type approval certificate with enclosure;
2	TR TS certificate 012/2011 on "The safety of equipment in explosion hazardous environments" with enclosure.
3	TR TS certificate 032/2013 on "The Safety of equipment working under excessive pressure"
4	TR TS declaration 020/2011 on "Electromagnetic compatibility"
5	TR TS 004/2011 “On the safety of low-voltage equipment”

2 Intended Use

2.1 Configuration selection

To provide reliable work and accuracy of the flow meter it is important to match equipment version with your technological process. Process information needed for equipment selection is listed in table 2.1.

Table 2.1 - Information for flow meter version selection

NO	Process information
1	Full name of medium
2	Content and percentage of liquids
3	Content and percentage of gases
4	Content and percentage of gas inclusions
5	Medium density
6	Medium viscosity
7	Flow range
8	Required accuracy
9	Medium temperature at meter run
10	Pipeline pressure
11	Pressure loss tolerance
12	Availability of automatic control and regulation systems
13	Pipeline diameter
14	Pipeline inclination at meter run
15	Environment temperature anear the pipeline
16	Ex-proof requirements (ex-proof marking)

Attention!

To avoid selection mistakes please fill in the order sheet and send to your nearest EMIS representative.

Flow meter size shall be selected according to real flow volume in the pipe which can be different from calculated. Flow meter size shall be selected so that the real flow volume falls at the second third of nominal flow range. Therefore, flow tube diameter (Dn) can be equal, bigger or smaller than size of the pipeline.

Use concentric reducer in case of pipeline size and flow meter size mismatch. They can be made by customer, herewith to minimize pressure loss the central angle of the cone shall not exceed 30º.

2.2 Safety requirements

Mounting, operation, maintenance shall be provided by authorized personnel who have carefully read the Manual and get through electrical safety instruction.

Operation and maintenance shall be executed providing electro-static safety.

Flow meter installation and de-installation shall be executed under zero flow and excessive pressure and disconnected from power supply. Electrical installation shall be executed under disconnected power supply.

While mounting, commissioning and maintenance, it is prohibited:

- to replace radio components if power is connected;
- connect to power supply source with output voltage different from specified in the Manual;
- use electrical units without grounding or in case of malfunction.

The factors below can be dangerous:

- AC power supply of 220V and higher, 50Hz (if power supply is located near equipment installation);
- excessive pressure of medium inside the pipeline;
- high medium temperature;

Ex-proof flow meters operation conditions shall comply with clause 7.3 of Russian Electrical Code and other normative documents for explosive environments.

Attention!
It is prohibited to mount and operate flow meter under medium pressure and temperature higher than limited. It is prohibited to operate flow meter with unlocked covers and no ground connection.

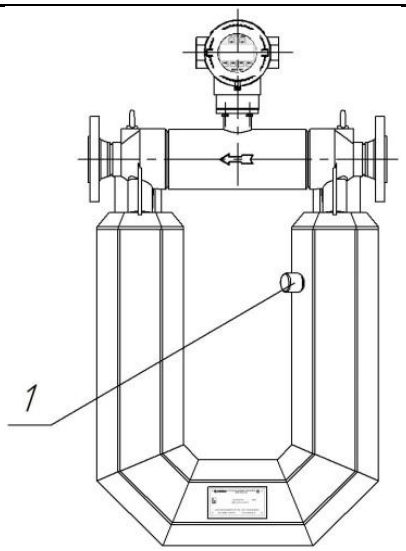


Fig.2.1 - Cover lid location

It is prohibited to open cover lid 1 showed in the fig.2.1 to avoid gas leakage from inner cavity of flow meter cover.

2.3 Mounting on the pipeline

2.3.1 Installation options

Follow the rules below to select installation type:

- The place of installation shall be protected from strong vibration, high temperature and magnetic field. It is not recommended to install flow meter near transformers. power units and other vibrating equipment.
- Flow meter shall not be installed in piping stress part and not bear the pipeline.
- It is recommended to protect casing from moisture.
- Flow meter shall be installed in easily accessible places. Appropriate space shall be provided for installation.
- Equipment indicator shall be reachable for reading control.

Ambient temperature of installation point shall be in the range from -60 to +70°C. Under direct sun light the temperature of the flow meter body can exceed environment temperature up to 30 degrees. Sun shield shall be installed if no shade is available.

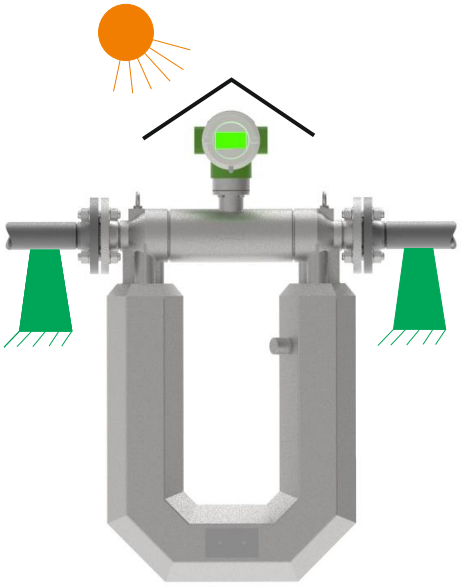


Fig. 2.2 - General requirements to installation point

Attention!
Provide additional pipeline support legs before and after the flow meter if it is installed in the places of strong vibration or flow meter itself is the pipeline support. Support legs foundation sahll be rigid. Installation of the meter in places where vibration is present, including on moving units, is allowed. It is allowed to install the flow meter along with stress and/or vibration compensation devices.

2.3.2 Pipeline direction

Flow meter can be mounted on horizontal, vertical and inclined parts of the pipeline. Horizontal installation is the best option.

The flow meter should be installed so that it is always filled with the measured medium. Flow meter works properly in any position.

Flow meter shall be installed so that indicator arrow match flow direction. Otherwise adjust the flow direction in the electronic unit menu.

No straight section is required before and after installation, as well as installation of additional flow conditioners. If two or more flow meters are installed on the same pipe provide distance between them not less than 2 m for Dn<100mm and 3m for Dn≥100mm.

Installation guide see fig.2.3.

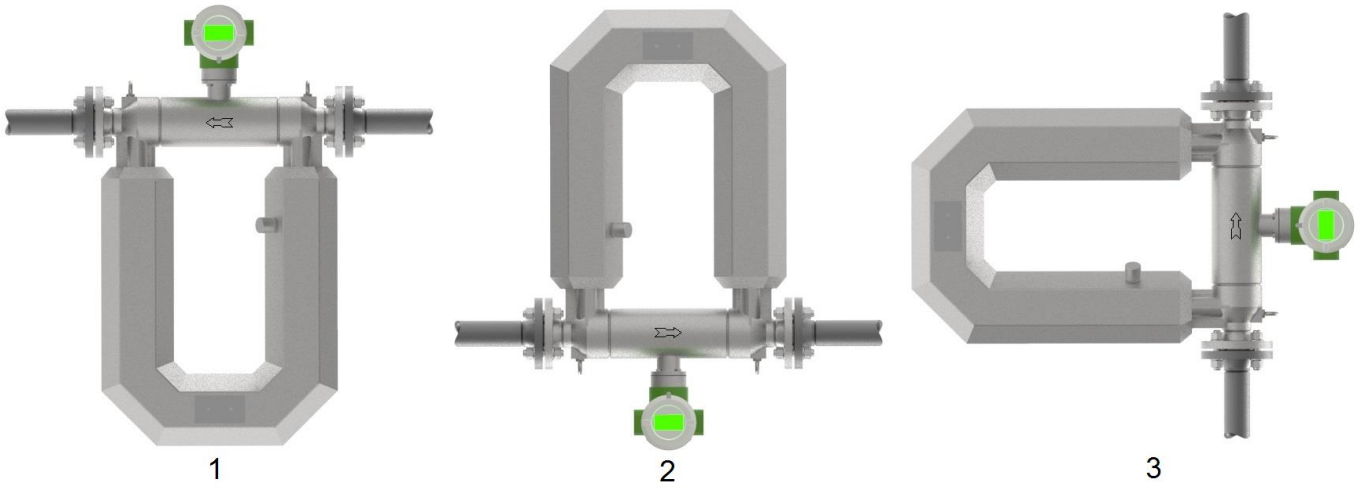


Fig.2.3 - Installation guide for EMIS-MASS 260

Table 2.3 - Description for fig.2.3

NO in fig.2.2	*Recommendations*
1	Install flow meter with measuring chamber downward to provide filling with liquid and avoid gas accumulation in tubes.
2	Install flow meter with measuring chamber upward for gas measurement to avoid moisture condensation.
3	In the case of vertical or inclined orientation of the pipeline, it is recommended to install the device in the area with the upward flow direction. Vertical installation is recommended for mediums with gas inclusions.

Recommendations
Choose remote type flow meter for installation with measuring chamber upward to provide convenient reading of indicator. Flow meters with electronic unit of U/UIP version have display rotation function up to 180 degrees.

Install the flow meter in the lower part of the pipeline of the pipeline is bent.

It is prohibited to install the flow meter in the horizontal section of the pipe prior to the free falling of the stream, otherwise the measuring pipe will not be filled enough and excessive pressure not less than 0.1 MPa will not be provided after the flow meter.

Attention!
Remember the rule of complete filling of measuring chamber with measuring medium when choosing or designing the place of flow meter installation. Otherwise, we do not guarantee working efficiency of the flow meter.

2.3.3 Preparation of pipeline

To prepare for installation please follow the steps below:

- check for flanges, fasteners, clamps, couplings and its parameters (see Appendix A);
- cut the pipeline of L_{inst} length:

$$L_{\text{уст}} = L_{\text{расх}} + 2 \cdot L_{\text{пр}} + 2 \cdot L_{\text{фл}}, \quad (2.1)$$

where L_{inst} - installation length of flow meter (see protection Appendix A);

Lgas - gasket width;

Lfl- counter flange width after deduction of installation length;

- mount counter flanges in the pipeline;
- use mounting coupling to align flanges, them weld them to the pipeline.

Attention!

It is allowed to use flow meter as mounting coupling in cases listed below:

- gas welding is used for mounting;

- arc-welding power source is connected so that current does not flow through the flow meter - see fig.2.4.

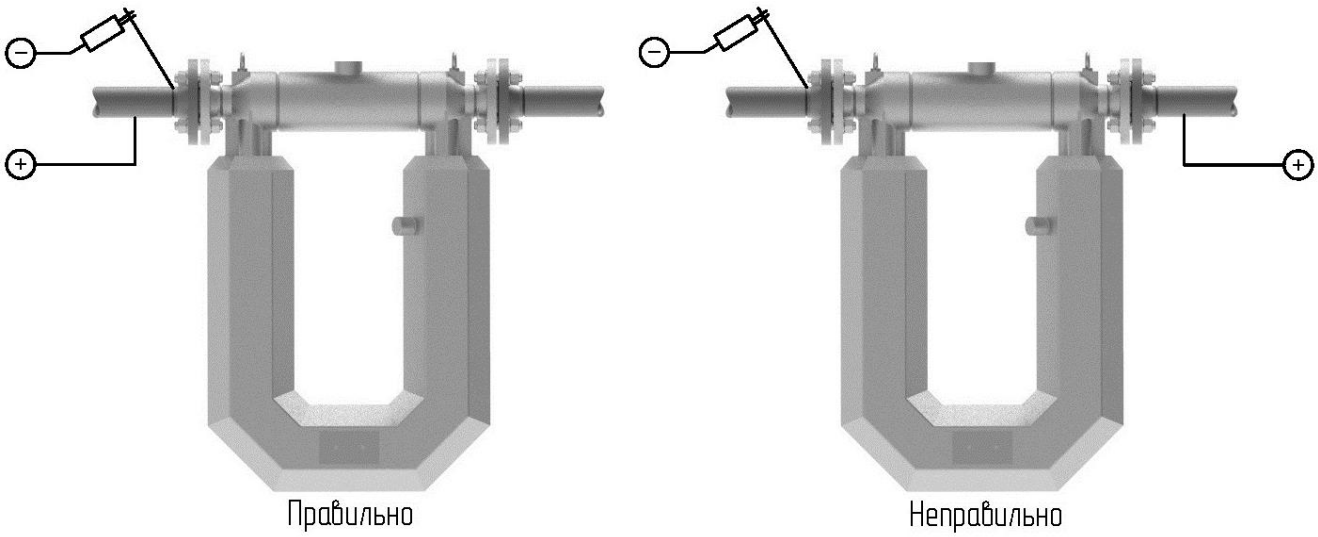


Fig.2.4 - Power supply connection for arc-welding

Installation place shall look as it shown in fig.2.5, where L is sum of flow meter length and two gaskets width.

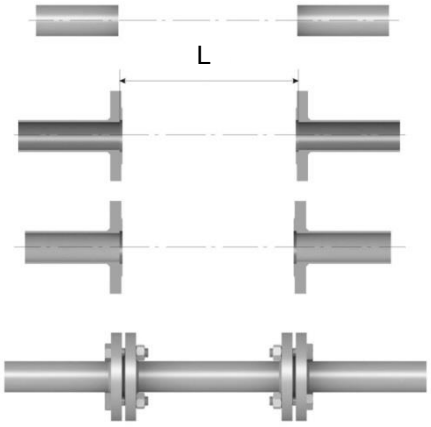


Fig.2.5 - Pipeline preparation

Attention!

When using filters and gas separators, the length of the pipeline section should include their installation.

2.3.4 Pipe body preparation and flow meter mounting

Please follows the steps below before installation:

- clean the pipeline from rust, sand and other solid particles;
- check inside surface of the flow meter and remove solid particles and other inclusions;

To install the flow meter, proceed the following steps (fig.2.6):

- Rotate the flow meter so that the arrow on the flow meter body match the normal directio of flow (in case of reverse flow, adjust the direction in the menu of the electronic unit);
- install the gasket between counter flange and flow meter flange, align it. It is recommended to avoid gasket protrusion inside the pipeline;
- insert the screws into the counter flange of the pipeline and flow meter flange, put the washers and tough the nuts. Do not tighten the nuts;
- put the gasket at another flange,insert the screws into the counter flange of the pipeline and flow meter flange, put the washers and screw the nuts. Do not tighten the nuts;
- tighten the nuts in the sequence shown in fig.2.7

Attention!
Avoid bending and twisting loads upon connection points, and mismatch of pipeline counter connections.

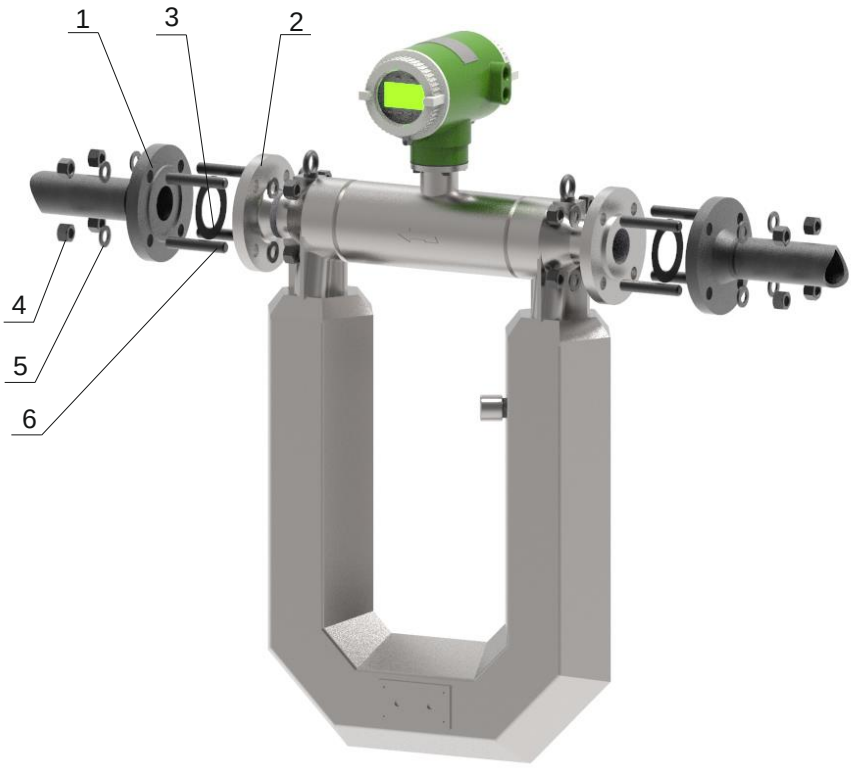


Fig.2.6 - Installation of EMIS-MASS 260 in the pipeline

Table 2.4 - Description for fig.2.6

NO in fig.	*Description*
1	Flow meter flanges
2	Counter flange

3	Gaskets
4	Nuts
5	Washers
6	Pins

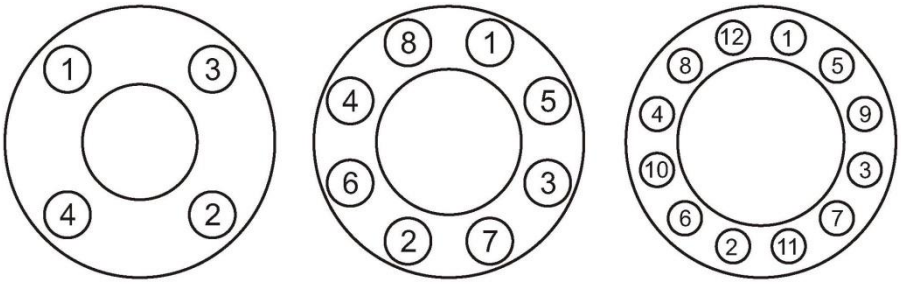


Fig.2.7 - Tightening sequence for flange bolts

Remote type flow meter is shown in the fig.2.8. Electronic unit can be fixed to the support bar using the mounting bracket or the wall using the additional mounting kit for remote type electronic unit (supplied upon request, see Appendix A)

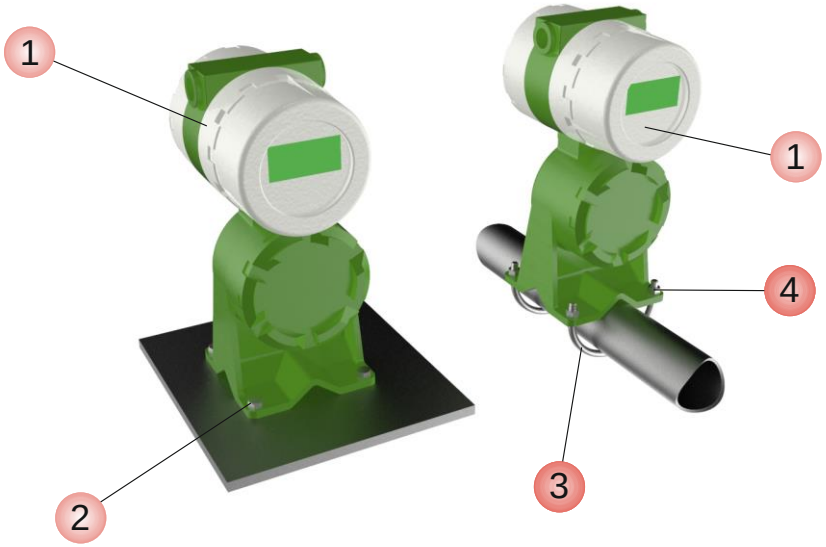


Fig.2.8.1 - Installation options for standard electronic unit of remote type flow meter

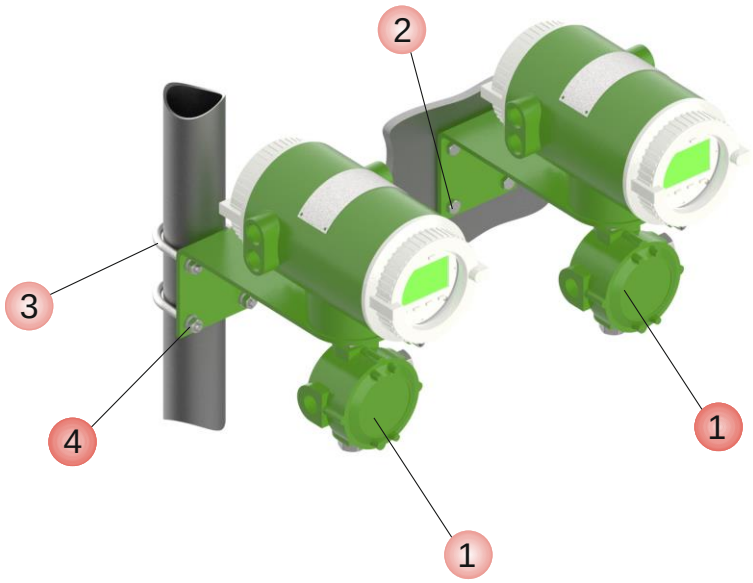


Fig.2.8.2 - Installation options for extended electronic unit of remote type flow meter

Table 2.5 - Description for fig.2.8

NO in fig.	*Description*
1	Remote type electronic unit
2	Bolts (not included in the standard supply kit)
3	Clamps (not included in the standard supply kit)
4	Nuts (not included in the standard supply kit)

Attention!
It is not allowed to install the electronic unit so that the cable inlet directed upward.

2.3.5. Heat insulation

Follow the recommendations shown in fig.2.9 if heat insulation is required.

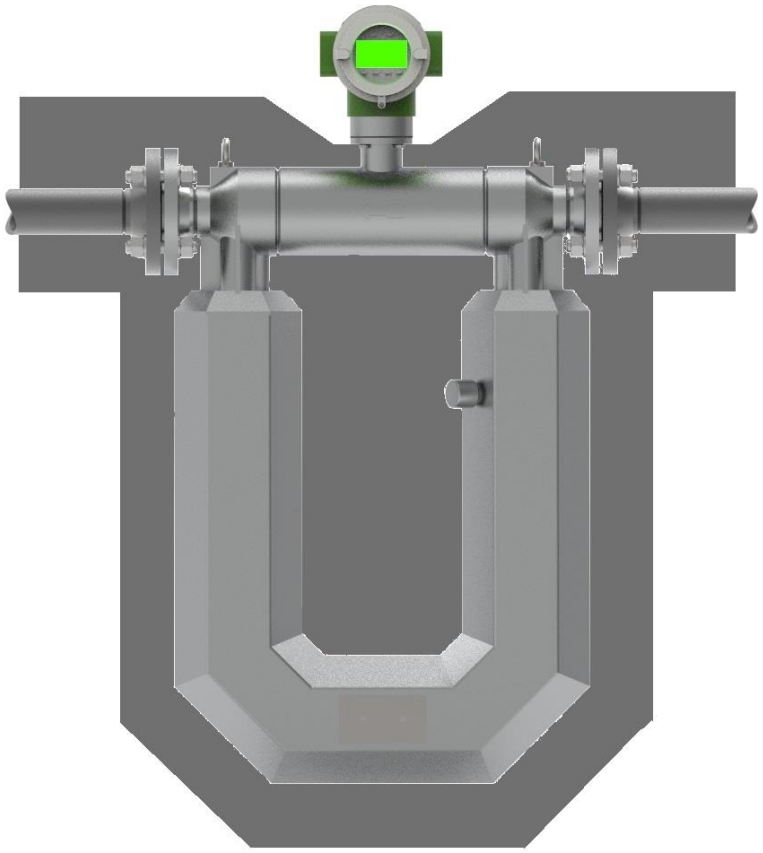


Fig.2.9 - Heat insulation recommendations

2.3.6 Preheating

The flow meter can be equipped with the inlet for connection of external heating (see fig.2.10) upon special request. Liquid or gas (vapour) at temperature less than 200˚C and pressure not less than 0.1 MPa can be used for heating. Connection of heating shall be provided using inlet and outlet nozzles with the thread of A=1/2NPT.

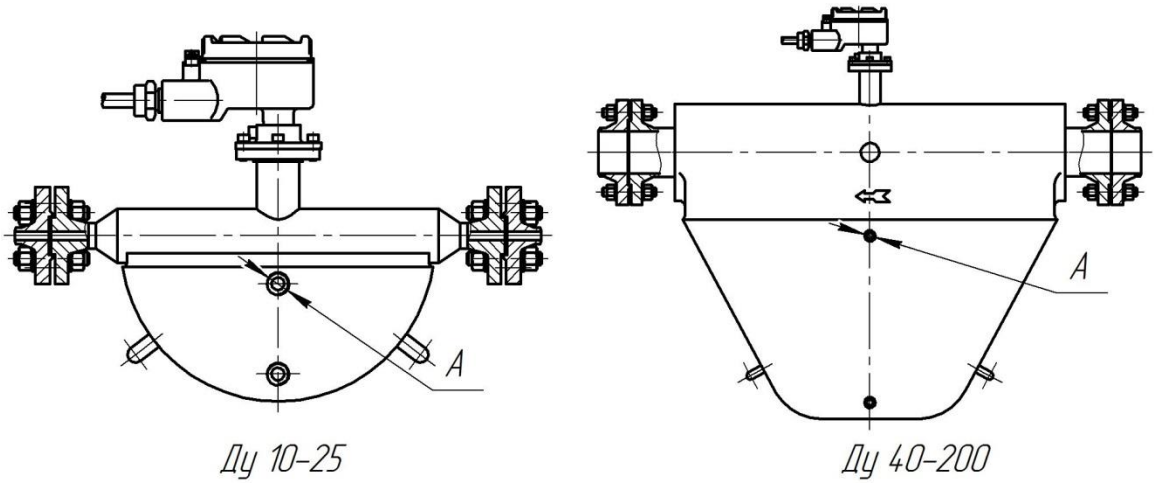


Fig.2.10 - Connection of external heating

2.3.7 Rotation of electronic unit

If electronic unit is out of viewer sight, rotate it to the angle of 90° or 180°. Release 4 bolts (1) (see fig.2.11) Rotate electronic unit (2) to 90° or 180° in necessary direction, tighten the 4 bolts to secure connection.

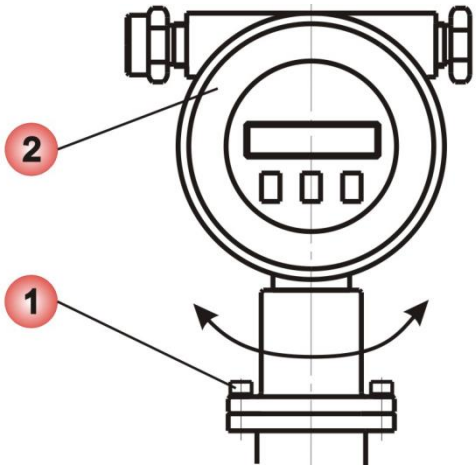


Fig.2.11 - Rotation of electronic unit

Attention!
To avoid wires twisting inside the flow meter, do not rotate more than 180° from initial position.

Notify EMIS maintenance service prior to the rotation of electronic unit to keep warranty.

2.4 Power connection

Attention!
1. All connections shall be executed when flow meter is not connected to power supply. 2. Electrical connection shall be performed by the certified specialists corresponding qualification and permission. 3. Electrical crew shall follow effective federal and national security regulations. 4. Electrical connection of ex-proof flow meter shall be executed according to the “Electrical connection” clause of the Manual (EM-260.000.000.002.01 OM or EM-260.000.000.000.01 OM) depending on configuration and effective regulations. Inlet and outlet parameters of intrinsically safe circuits are presented in the tables 1.10 and 1.11 of Operation manual EM-260. 5. Avoid ESD on the electronic unit. 6. Avoid wires squeeze under the cover when connecting amplifier of flow meter of Dn≥100.

2.4.1 General directions

Electrical mounting shall be executed in the sequence below (see fig.2.12):

- release cover (1) of the electronic unit on back side of indicator;
- carry the signal cable (2) and power cable (7) through the cable glands (3);
- release screws of the terminal block 4;
- Execute electrical connection according to the “Electrical connection” clause of the Manual (EM-260.000.000.002.01 OM or EM-260.000.000.000.01 OM) depending on configuration.
- tighten the screws of the terminal block;
- tighten cable gland;
- put the plug (5) to the unused gland, if necessary;
- connect ground wire to the ground terminal (6);
- screw the cover.

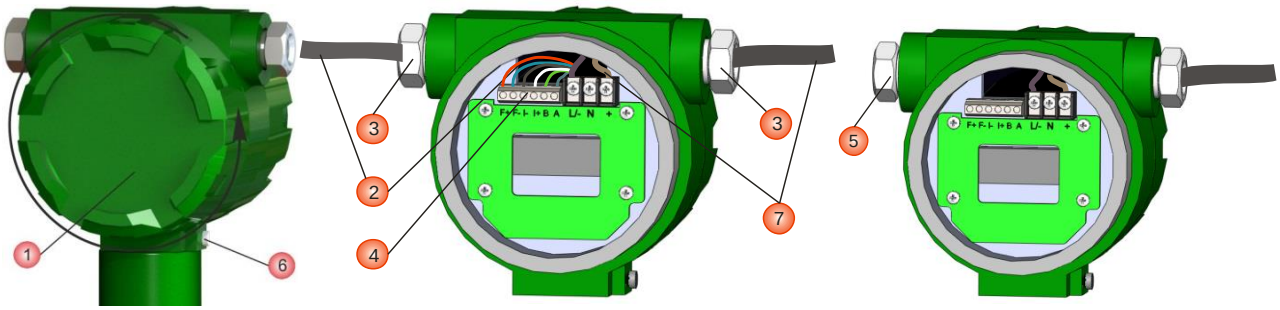


Fig.2.12 - General rules of electrical mounting

Table 2.6 - Description for fig.2.12

NO in fig.	*Description*
1	Electronic unit cover
2	Signal cable
3	Cable glands
4	Terminal block
5	Cable gland plug

6	Ground clamp
7	Power cable

Adjust flow meter 0 point after mounting and electrical connection.

Flow meter is supplied with cable gland of 6 to 9 mm size by default.

Flow meter can be equipped with the following cable glands upon special request (specify in the order sheet):

– for non-armored shielded cables with outer diameter of 6 to 18mm (diameter range can be different depending on the manufacturer);

– for armored cables with outer diameter of 6.7 to 25mm (diameter range can be different depending on the manufacturer);

– for non-armored shielded cables with outer diameter of 7.2 to 17mm (diameter range can be different depending on the manufacturer); Metal hose types: RZCP, RZCH, MRPI.

– for armored cables with outer diameter of 6 to 17mm with metal hose fasteners (diameter range can be different depending on the manufacturer). Metal hose types: RZCP, RZCH, MRPI.

Attention!

For installation in explosive environment strictly follow the rules listed in clause 2.4.2 “Explosion protection while mounting”.

Attention!

Contact your local EMIS dealer if any assistance for electrical mounting is required.

2.4.2 Explosion protection while mounting

Installation in explosive environment shall comply with the requirement listed below:

– present Manual;

– Operation Guide to Load-Side Electrical Installations (clause 3.4);

– Russian Electrical Code (clause 7.3);

– GOST 31610.0-2-2014 (IEC 60079-0:2011);

– GOST 31610.11-2014 (IEC 60079-11:2011);

– GOST IEC 60079-1-2013

– instructions BCH332-74/MMCC (Installation of electrical equipment, power and lighting systems in explosive environment);

– any other corporate normative documents.

Pay attention to special rules listed in clause 1.5 “Explosion protection”.

Carefully check 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.

Cable wires size shall be not less than 0.8mm^2 and length of not less than 300m.

When electrical mounting is finished, check ground line resistance shall not exceed 1 Ohm. Use the grounding wire not less than 2,5mm^2 size.

Plug unused cable glands with the plug supplied or any other plug certified under GOST IEC 60079-1-2013.

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 B are allowed.

After electrical mounting is done, close all covers of case and stop them with brackets according to the drawing in Appendix C.

2.4.3 Connection recommendations

Follow the directions below for electrical mounting:

- cable cores shall be protected and connected to terminals so that to avoid electric cross and fault to the meter body;

- use different power suppliers for flow meter and each of its output signals or multichannel supplier with galvanically isolated windings.

- to calculate load resistance calculate full resistance as the sum of the resistances of cable, external load, Zener barrier and auxiliary equipment.

- use shielded twisted pair to minimize disturbance of 4-20 mA signal; grounding shall be done at one end only (at supply unit end);

- it is not recommended to put signal cable in the same runway or cable rack with supply cable, or near electromagnetic sources; signal cable can be grounded at any place of the signal circuit, if required. For example, ground negative terminal of the power unit. Transmitter is grounded to the flow meter body.

2.4.4 Ingress protection

The flow meter complies with all IP requirements according to category specified in **Technical parameters.**

After electrical mounting or maintenance is finished, follow the steps below to ensure required protection level (see fig.2.13):

- Sealing shall not be dirty or damaged. Clean or replace sealing, if necessary. Use genuine sealing supplied by manufacturer.
- The size of electrical cables shall comply with cable gland size and not be damaged.
- Transmitter cover and threaded connections shall be securely tighten.
- Cable glands shall be securely tighten.
- Unused cable glands shall be securely plugged.
- Form a U-shaped drip before cable inlet to protect electronic unit from moisture.
- Do not install the flow meter in such a way that the cable entries are arranged vertically upwards.

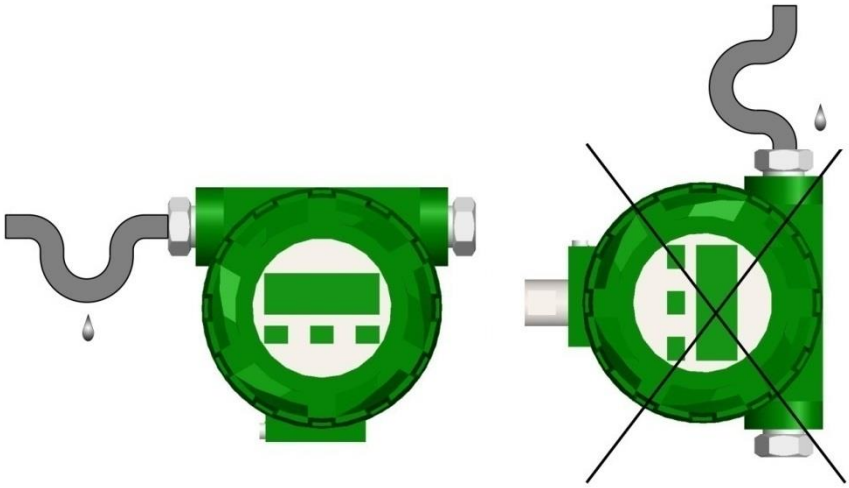


Fig.2.14 - Cables and cable glands arrangement

2.4.5 Grounding

Transient phenomena due to lightning, welding, powerful electrical units or distribution boards may cause readings mistakes or damage the flow meter. To protect from transient phenomena provide the flow meter grounding according to the clause “Electrical connection” of the EM-260 Operation manual (EM-260.000.000.002.01 OM or EM-260.000.000.000.01 OM) depending on the flow meter configuration.

Attention!
Potential shall not be induced at grounding wire. Do not use single grounding wire for two or more units.

2.5 Operation and maintenance

2.5.1 General directions

Follow the steps below to provide reliable work of the flow meter and ensure accuracy:

- Smoothly open/close pipeline valves to protect measuring unit from damages caused by water hammer.
- Provide complete filling of measuring tubes to ensure accurate work of flow meter.

2.5.2 Flow meter start/stop

After power is ON, the flow meter starts self-check and, if successfully done, goes to measuring mode, generates output signals and indicates measured values.

2.5.3 Zero point adjustment

Zero point adjustment defines point of zero flow. Zero point value is difference between signal phases from sensor coils corresponding to zero flow. Zero adjustment shall be executed at the site of installation when flow meter is completely filled with measuring medium. Medium pressure for zero adjustment shall be equal to operation pressure.

Zero adjustment is very important procedure. To ensure accurate adjustment, follow the steps below:

1. Make sure that the flow tube is filled with medium;
2. Provide at least 30 minutes of work on measuring medium after flow meter start.
3. Wait until heat balance between the flow meter and measuring medium is reached.
4. Close the gate valve located downstream in the direction of the flow;
5. Close the gate valve located upstream in the direction of the flow;
6. Make sure that there is no flow inside;
7. Start zero point adjustment.

Zero adjustment launch procedure is described in the Manual for a specific flow meter electronic unit version.

2.5.4 Flow meter cleaning

It is prohibited to clean or blow the inner cavity of the flow meter.

While cleaning it is prohibited:

- To exceed temperature of washing fluid as specified in the flow meter marking;
- To exceed pressure of washing fluid as specified in the flow meter marking;

- To use corrosive washing fluid;
- To exceed flow range specified for the flow meter. If washing is executed using the medium in physical form other than specified in the flow meter marking, use the values specified in the tables 1.4 and 1.5.

Adjust zero point after flow meter washing.

3 Transportation, Storage and Recycling

3.1 Transportation

Please follow the transportation requirements:

- flow meter shall be packed so to avoid mechanical damages during transportation;
- line the inner part of transportation package with water-resistant paper;
- Transportation temperature shall be in the range from -60 to +50°C and relative humidity up to 100 % under 25°C;
- protect equipment from precipitations;
- transportation can be done by every mean of enclosed transport, including air transportation in warm sealed sections according to specified rules of transportation.
- follow handling signs on the package;
- it is allowed to ship flow meters in containers;
- boxes shall be stuffed so that to avoid movement during transportation;
- avoid strong bumps during cargo stuffing;
- transit time shall not exceed 3 month;
- leave the boxes unpacked for at least 12 hours in warm premises if cargo was transported under 0°C.

Follow the recommendation in fig.3.1 if the flow meter transported without package.

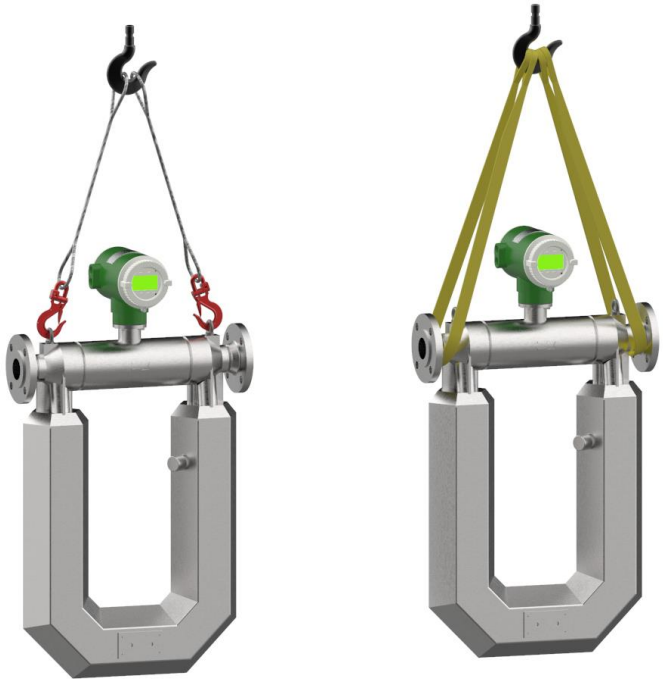


Fig.3.1 - Flow meter transportation without package

3.2 Storage

Flow meter can be stored in unheated premises with air temperature from -60 to +40°C and relative humidity of air up to 95% non-condensing at 25°C.

Flow meters can be stored in transportation boxes stacked up to 3 boxes in height or without package. Long-term storage shall be provided in manufacturer package.

3.3 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 and fasteners.

4 Calibration

Calibration shall be provided according to the CM 208-043-2019 “GSI. CORIOLIS FLOW METER EMIS-MASS 260”. Calibration method MI- 3272-2010 GSI. On-site calibration procedure using a compact prover in set with a turbine flow transducer and flow density transducer", "MI 3151-2008 GSI. Mass flow meters. On-site calibration using mechanical displacement meter prover in set with density converter”, MI 3313-2011 GSI. Coriolis mass flow meter. Calibration using benchmark mass flow meter”.

Calibration of flow meters used for measurements of only some measuring channels or in smaller ranges is allowed, based on the decision of the chief metrologist or the head of a legal entity, to be performed only according to those requirements of the calibration procedure and in those measurement ranges that determine the suitability of the flow meter for the application of the number of quantities and the applied measurement ranges ... Calibration shall be entered into the calibration certificate or flow meter data sheet.

There two types of calibration: wet and simulation.

Simulation is used for periodical calibration of mass,volume and density channels of flow meter with electronic unit of UIP version. For simulation calibration, remove measuring medium from the flow meter, provide absence of vibration and stress in the pipeline.

For first calibration use wet method.

Wet or simulation can be used for periodical calibration. Calibration method is selected by user based on economical factors and technological process in the production site.

5 List of possible failures

5.1 List of possible failures (including critical)

- Seal failure of body;

- Welding seams damage;

5.2 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 flow meter;
- operate the flow meter without operation data sheets.

Personnel emergency response

Stop medium supply in case of failure or breakdown.

5.4 KLimit state criteria

Flow meter limit state criteria are:

- reach of stated values
- violation of geometry and elements size preventing from normal operation;
- irreversible damage of elements caused by corrosion, erosion and ageing.

Appendix A

(normative)

Dimensions and connection sizes

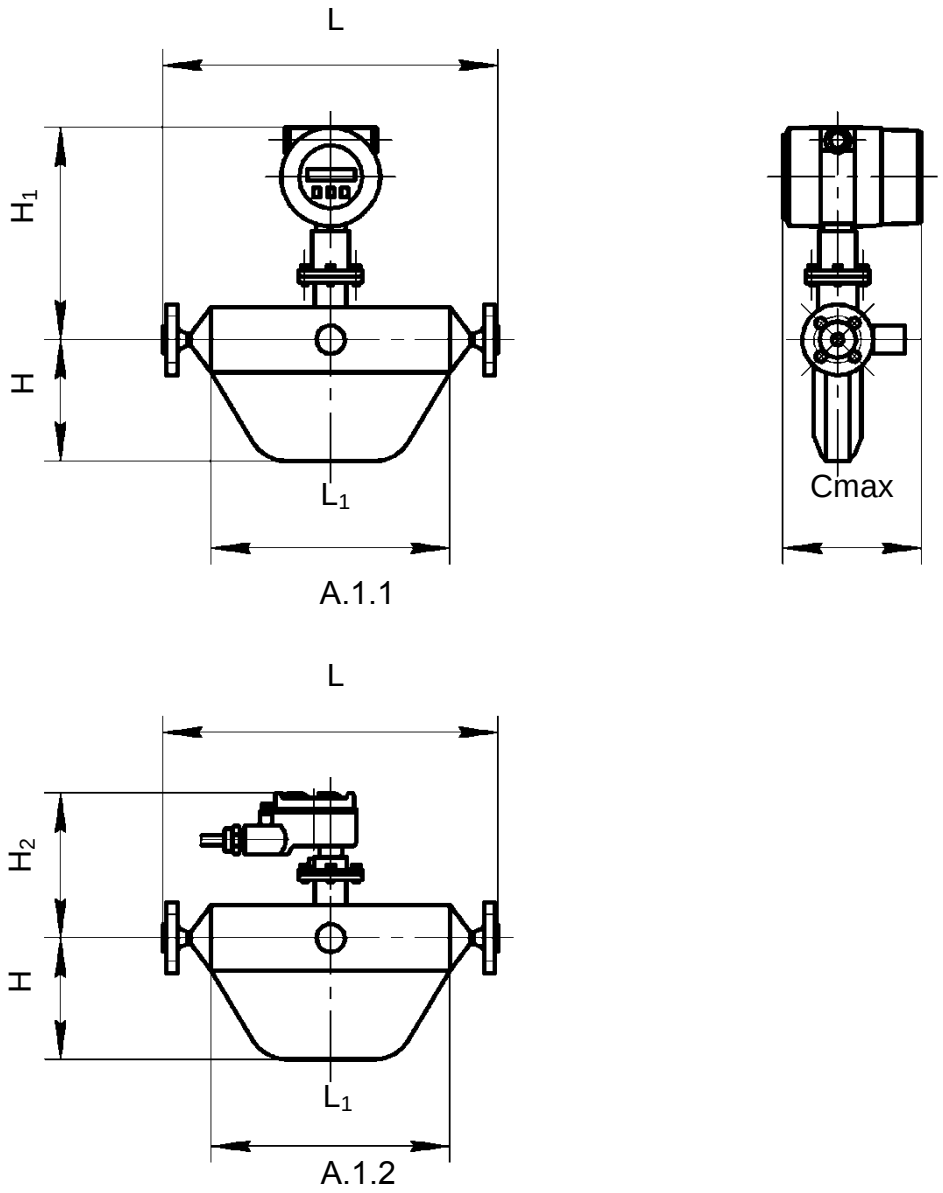


Figure A.1 - Dimensions and connection size of EMIS-MASS 260 Dn10 standard configuration and Dn15 FR version

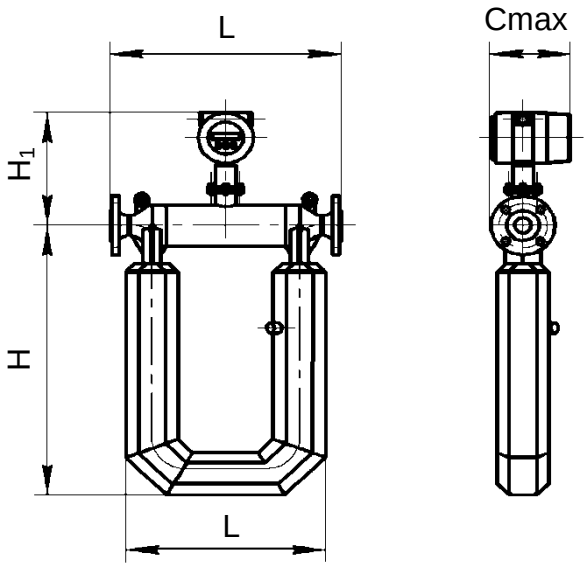
(1) A.1.1 - Integral version; A.1.2 - Remote version.

(2) Connection sizes of flow meter flanges are presented on the pages 48, 49.

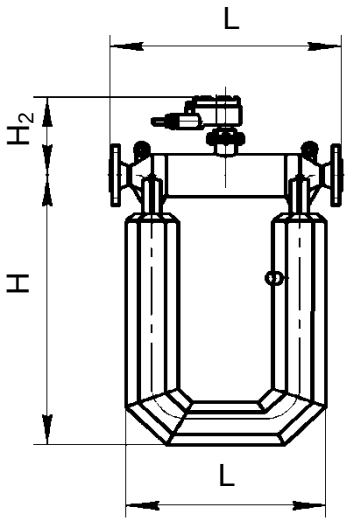
(3) Electronic unit dimensions are presented on the pages 53, 54

Table A.1

Size	L, mm		L_1, mm	H, mm	H_1, mm	H_2, mm	Cmax, mm	Weight, kg	
	1,6-4.0 MPa	6.3 MPa						A.1.1,	A.1.2
010	424±3	484±3	302	154	270	185	245	12	15
015FR									



A.2.1



A.2.2

Figure A.2 - Dimensions and connection size of EMIS-MASS 260 Dn25, Dn40 and Dn80 standard configuration

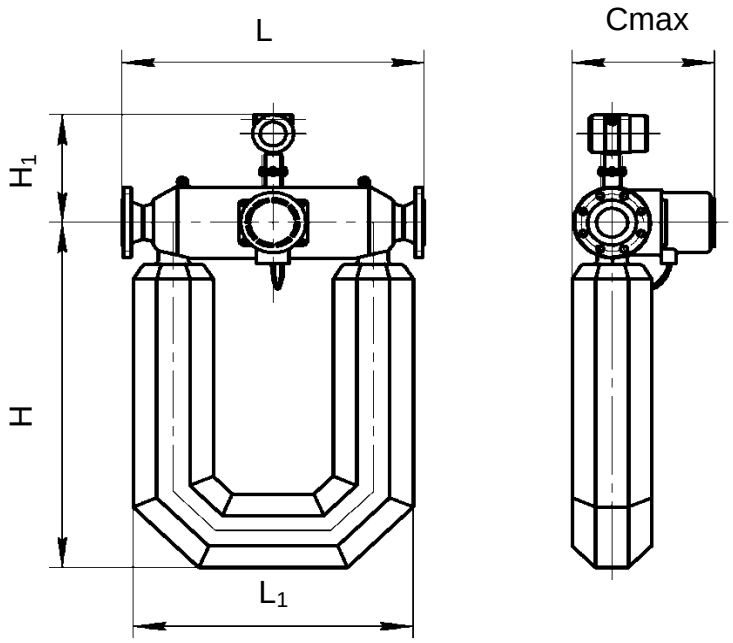
(1) A.2.1 - Integral version; A.2.2 - Remote version.

(2) Connection sizes of flow meter flanges are presented on the pages 48, 49.

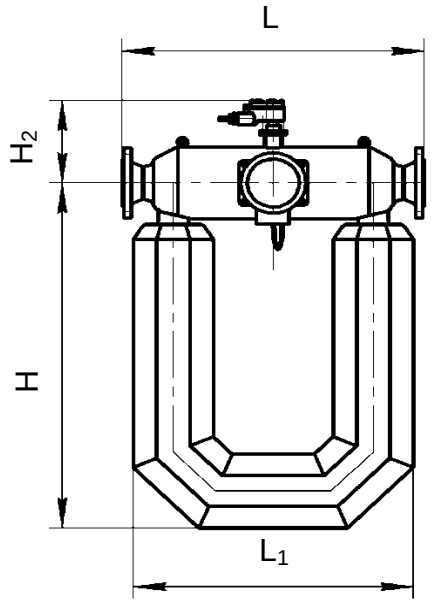
(3) Electronic unit dimensions are presented on the pages 53, 54.

Table A.2

Size	L, mm		L_1, mm	H, mm	H_1, mm	H_2, mm	Cmax, mm	Weight, kg	
	1,6-4.0 MPa	6.3 MPa						A.2.1	A.2.2
025	410±4	450±4	371	488	243	190	245	27	30
040FR									
040	520±4	547±4	450	660	277	192	245	34	37
050FR									
050	558±4	588±4	522	748	288	202	245	44	47
080FR	580±4	600±4							
080	780±4	808±4	705	1030	326	242	245	104	107



A.3.1



A.3.2

Dimensions and connection size of EMIS-MASS 260 Dn100, Dn150 and Dn200 standard configuration

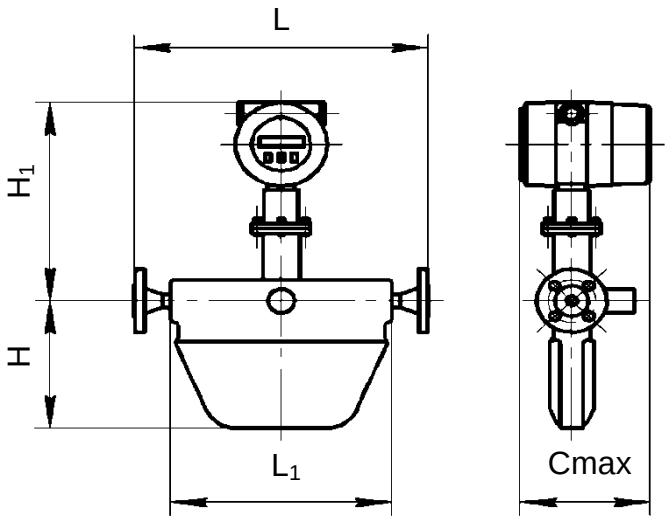
(1) A.3.1 - Integral version; A.32.2 - Remote version.

(2) Connection sizes of flow meter flanges are presented on the pages 48, 49.

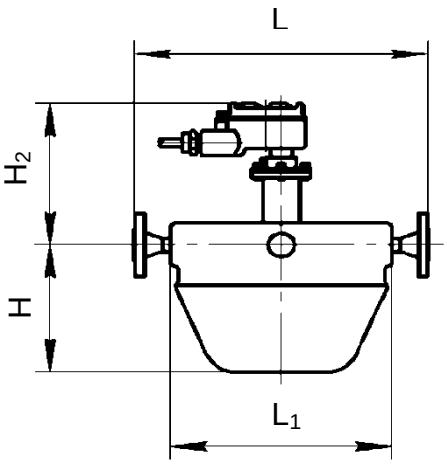
(3) Electronic unit dimensions are presented on the pages 53, 54.

Table A.3

Size	L, mm		L_1, mm	H, mm	H_1, mm	H_2, mm	Cmax, mm	Weight, kg	
	1,6-4.0 MPa	From 6.3 MPa						A.3.1	A.3.2
100FR	780±4	808±4	705	1030	326	242	245	104	107
100	920±4	948±4	853	1140	356	272	430	194	197
150FR	940±4	960±4							
150	1100±5	1140±5	1050	1526	386	302	580	329	332



A.4.1



A.4.2

Dimensions and connection size of EMIS-MASS 260 Dn15C, Dn25C, Dn40C, Dn50C and Dn80C compact configuration

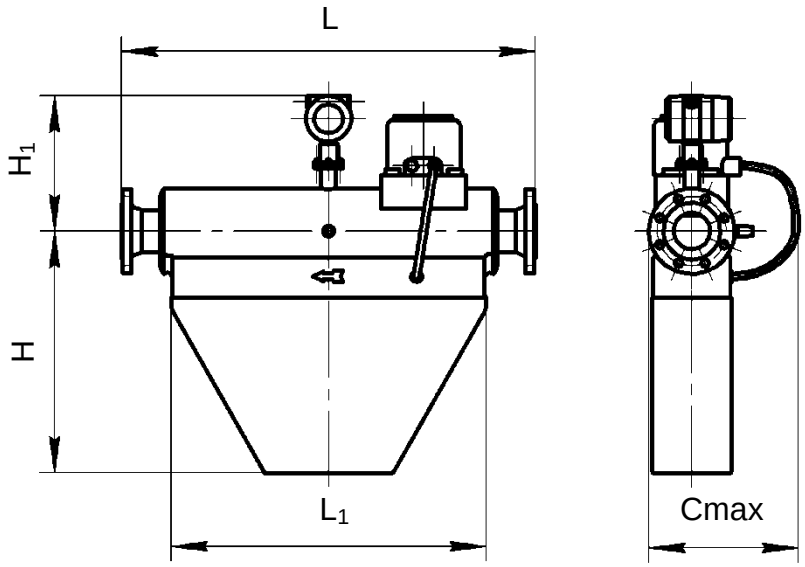
(1) A.4.1 - Integral version; A4.2 - Remote version.

(2) Connection sizes of flow meter flanges are presented on the pages 48, 49.

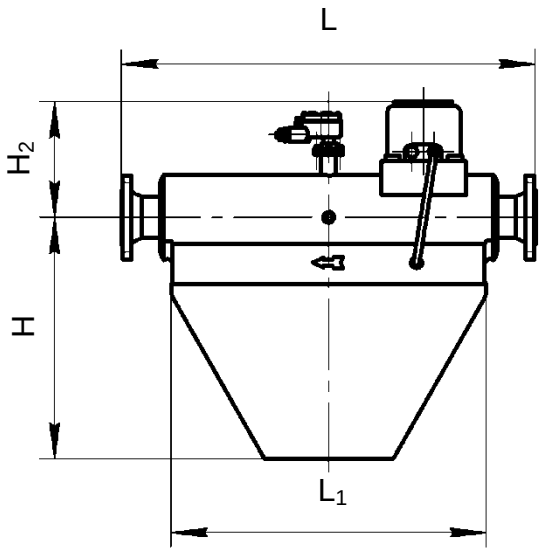
(3) Electronic unit dimensions are presented on the pages 53, 54.

Table A.4

Dn	L, mm		L_1, mm	H, mm	H_1, mm	H_2, mm	Cmax, mm	Weight, kg	
	1,6-4.0 MPa	6.3 MPa						A.4.1	A.4.2
015C 025C-FR	400±3	414±3	280	191	298	213	245	16	19
025C 040C-FR	500±4	536±4	360	258	302	218	245	19	22
040C 050C-FR	600±4	634±4	460	306	315	230	245	29	32
050C 080C-FR	800±4	828±4	640	410	325	240	245	42	45
080C	900±4	928±4	700	495	350	265	245	82	85



A.5.1



A.5.2

Dimensions and connection size of EMIS-MASS 260 Dn100C, Dn150C and Dn200C compact configuration

(1) A.5.1 - Integral version; A5.2 - Remote version.

(2) Connection sizes of flow meter flanges are presented on the pages 48, 49.

(3) Electronic unit dimensions are presented on the pages 53, 54

Table A.5

Dn	L, mm		L_1, mm	H, mm	H_1, mm	H_2, mm	Cmax, mm	Weight, kg	
	1,6-4.0 MPa	6.3 MPa						A.5.1	A.5.2
100C-FR	900±4	928±4	700	495	350	265	250	82	85
100C	1130±5	1156±5	860	663	370	285	470	139	142
150C-FR									
150C	1450±5	1490±5	1200	902	400	316	520	269	272
200C	1800±5	1844±5	1450	1170	426	342	570	434	437

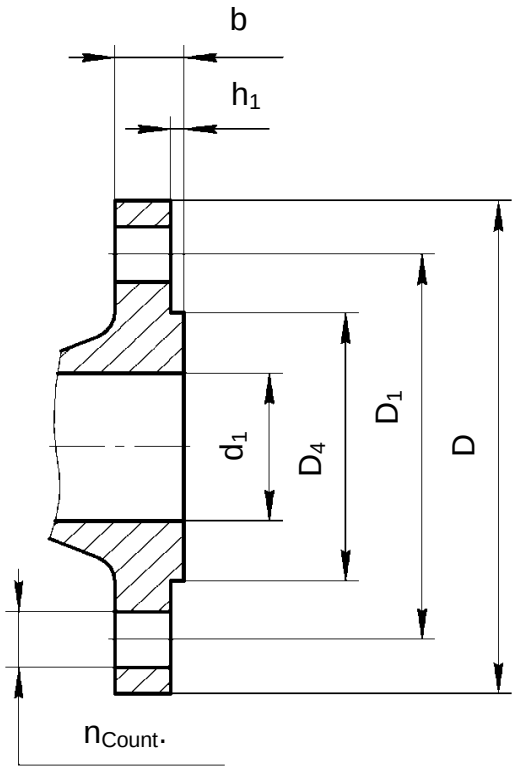


Fig. A.6 – Connection flange sizes of EMIS-MASS 260.

Main type of connection surface for 6.3 Mpa complies with E configuration under GOST 33259. Other connection sizes can be provided upon request.

Table A.6

Dn	Pu, MPa	d1, mm	D_4, mm	D1, mm	D, mm	b, mm	h_1, mm	n	d, mm
010	1,6; 2,5; 4	8	34	60	90	16	4	4	14
	6.3	8	34	70	100	18	4	4	14
015/015C	1,6; 2,5; 4	12	39	65	95	16	4	4	14
	6.3	12	39	75	105	18	4	4	14
025/025C	1,6; 2,5; 4	25	57	85	115	16	4	4	14
	6.3	25	57	100	135	22	4	4	18
040/040C	1,6; 2,5; 4	38	75	110	145	19	4	4	18
	6.3	37	75	125	165	24	4	4	22
050/050C	1,6; 2,5; 4	48	87	125	160	20	4	4	18
	6.3	47	87	135	175	26	4	4	22
080/080C	1,6; 2,5; 4	78	120	160	195	24	4	8	18
	6.3	77	120	170	210	30	4	8	22
100/100C	1,6; 2,5; 4	96	149	190	230	26	4	8	22
	6.3	94	149	200	250	32	4	8	26
150/150C	1,6; 2,5; 4	145	203	250	300	30	4	8	26
	6.3	142	203	280	340	38	4	8	33
200/200C	1,6; 2,5; 4	200	259	320	375	38	4	12	30
	6.3	198	259	345	405	44	4	12	33

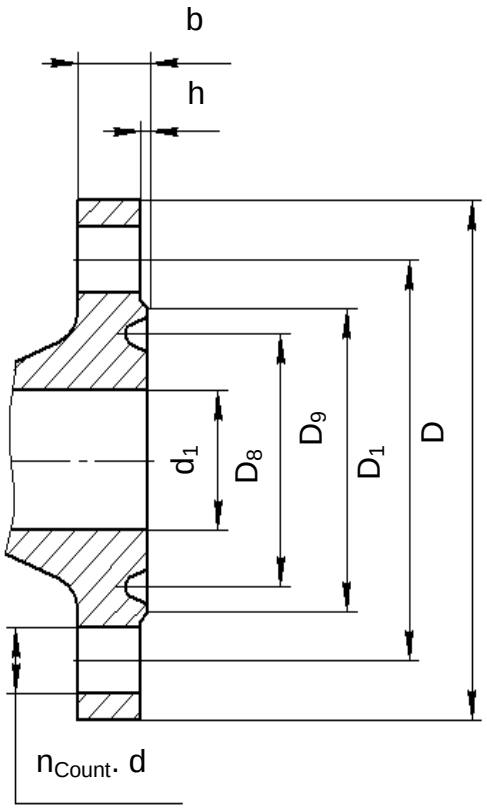


Fig. A.7 – Connection flange sizes

Main type of connection surface for 10 MPa complies with J configuration under GOST 33259. Other connection sizes can be provided upon request.

Table A.7

Size	Pu, MPa	d1, mm	d1, mm	D8, mm	D9, mm	D, mm	b, mm	h, mm	n	d, mm
010	10	8	70	35	50	100	18	2	4	14
	16	12	75	35	55	105	20	2	4	14
	25	14	82	40	55	120	26	2	4	22
015C	10	12	75	35	55	105	20	2	4	14
	16	12	75	35	55	105	20	2	4	14
	25	14	82	40	55	120	26	2	4	22
025C	10	25	100	50	68	135	24	2	4	18
	16	25	100	50	68	135	24	2	4	18
040C	10	37	125	75	88	165	26	3	4	22
	16	37	125	75	88	165	28	3	4	22
050C	10	45	145	85	102	195	28	3	4	26
	16	45	145	95	115	195	30	3	4	26
080C	10	75	180	115	150	230	34	3	8	26
	16	75	180	130	150	230	36	3	8	26
100C	10	92	210	145	175	265	38	3	8	30

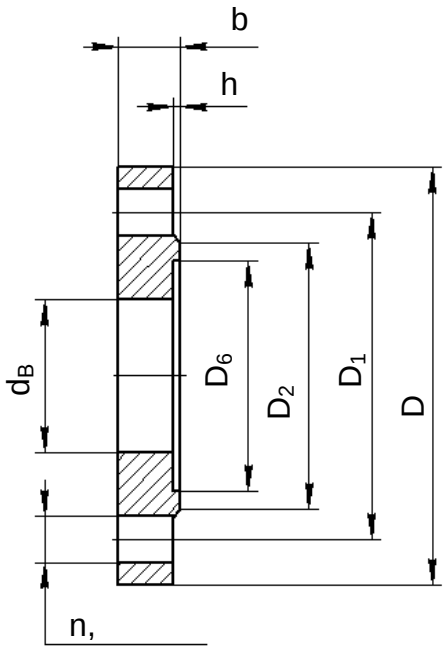


Fig. A.8 – Connection flange and counter flange size

Counter flange of type 01 “Flat welding flange” GOST 33259, flange type according to order sheet. Flange face complies with type F “Female” under GOST 33259. Other connection sizes can be provided upon request.

Table A.8

Size	Pn, MPa	Di, mm	D_6, mm	D_1, mm	D, mm	b, mm	h, mm	n, pcs	d, mm	Weight, kg
010	1,6; 2,5	15	35	60	90	16	2	4	14	0.64
015/015C	1,6; 2,5	19	40	65	95	16	2	4	14	0.71
025/025C	1,6; 2,5	33	58	85	115	18	2	4	18	1.17
040/040C	1,6; 2,5	46	76	110	145	22	3	4	18	2.18
050/050C	1,6; 2,5	59	88	125	160	24	3	4	18	2.8
080/080C	1,6; 2,5	91	121	160	195	26	3	8	18	4.06
100/100C	1,6; 2,5	110	150	190	230	28	3	8	22	5.92
150/150C	1,6; 2,5	161	204	250	300	30	3	8	26	10.5
200/200C	Only neck flanges are used (type 11)									

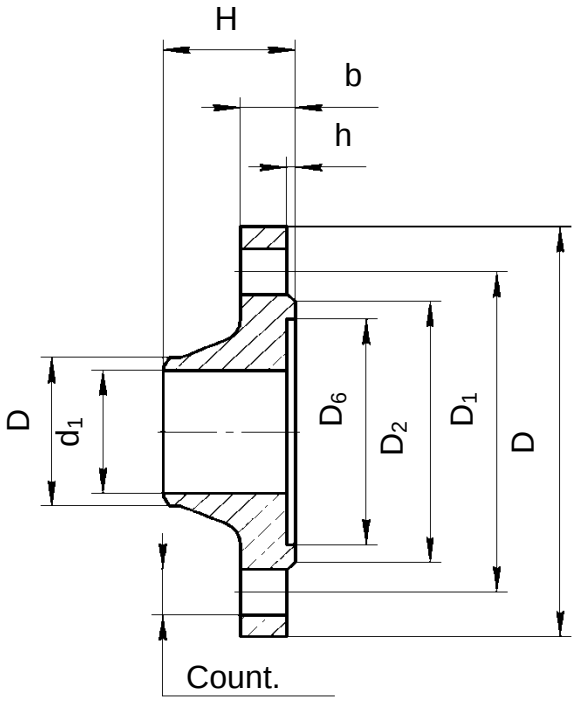


Fig. A.9 – Connection flange and counter flange weight

Counter flange of type 11 “Weld neck flange” GOST 33259, flange type according to order sheet. Flange face complies with type F Female under GOST 33259. Other connection sizes can be provided upon request.

Table A.9

Size	Pn, MPa	d1, mm	D_6, mm	D_1, mm	D, mm	H, mm	D_n, mm	b, mm	h, mm	n	d, mm	Weight, kg
010	1.6-4.0	8	35	60	90	35	15	16	2	4	14	0.69
	6.3	8	35	70	100	48	15	18	2	4	14	1.03
015/015C	1.6-4.0	12	40	65	95	35	19	16	2	4	14	0.8
	6.3	12	40	75	105	48	19	18	2	4	14	1.15
025/025C	1.6-4.0	25	58	85	115	38	33	16	2	4	14	1.19
	6.3	25	58	100	135	58	33	22	2	4	18	2.3
040/040C	1.6-4.0	38	76	110	145	48	46	19	3	4	18	2.19
	6.3	37	76	125	165	68	46	24	3	4	22	3.75
050/050C	1.6-4.0	48	88	125	160	48	58	20	3	4	18	2.81
	6.3	47	88	135	175	70	58	26	3	4	22	4.63
080/080C	1.6-4.0	78	121	160	195	58	90	24	3	8	18	4.81
	6.3	77	121	170	210	75	90	30	3	8	22	7.22
100/100C	1.6-4.0	96	150	190	230	68	110	26	3	8	22	7.4
	6.3	94	150	200	250	80	110	32	3	8	26	10.7
150/150C	1.6-4.0	145	204	250	300	71	161	30	3	8	26	13.2
	6.3	142	204	280	340	108	161	38	3	8	33	25.4
200/200C	1.6-4.0	200	260	320	375	88	222	38	3	12	30	24.4
	6.3	198	260	345	405	113	222	44	3	12	33	38.5

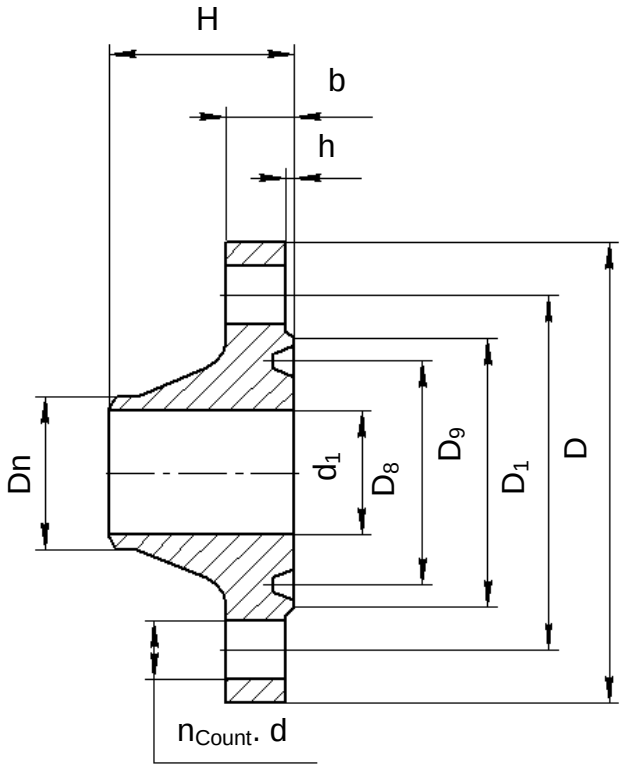


Fig. A.10 – Connection flange and counter flange weight

Counter flange of type 11 “Weld neck flange” GOST 33259. Flange face - complies with type J “Oval gasket” under GOST 33259.

Table A.10

Size	Pu, MPa	H, mm	d1, mm	d1, mm	D8, mm	D9, mm	D, mm	b, mm	h, mm	n, pcs	d, mm	Weight, kg
010	10	45	8	70	35	50	100	18	2	4	14	1.03
	16	52	12	75	35	55	105	20	2	4	14	1.27
	25	54	14	82	40	55	120	26	2	4	22	2.11
015C	10	48	12	75	35	55	105	20	2	4	14	1.27
	16	52	12	75	35	55	105	20	2	4	14	1.27
	25	54	14	82	40	55	120	26	2	4	22	2.11
025C	10	58	25	100	50	68	135	24	2	4	18	2.5
	16	58	25	100	50	68	135	24	2	4	18	2.5
040C	10	70	37	125	75	88	165	26	3	4	22	4.07
	16	75	37	125	75	88	165	28	3	4	22	4.28
050C	10	71	45	145	85	102	195	28	3	4	26	6.08
	16	78	45	145	95	115	195	30	3	4	26	6.49
080C	10	90	75	180	115	150	230	34	3	8	26	9.98
	16	93	75	180	130	150	230	36	3	8	26	10.5
100C	10	100	92	210	145	175	265	38	3	8	30	14.7

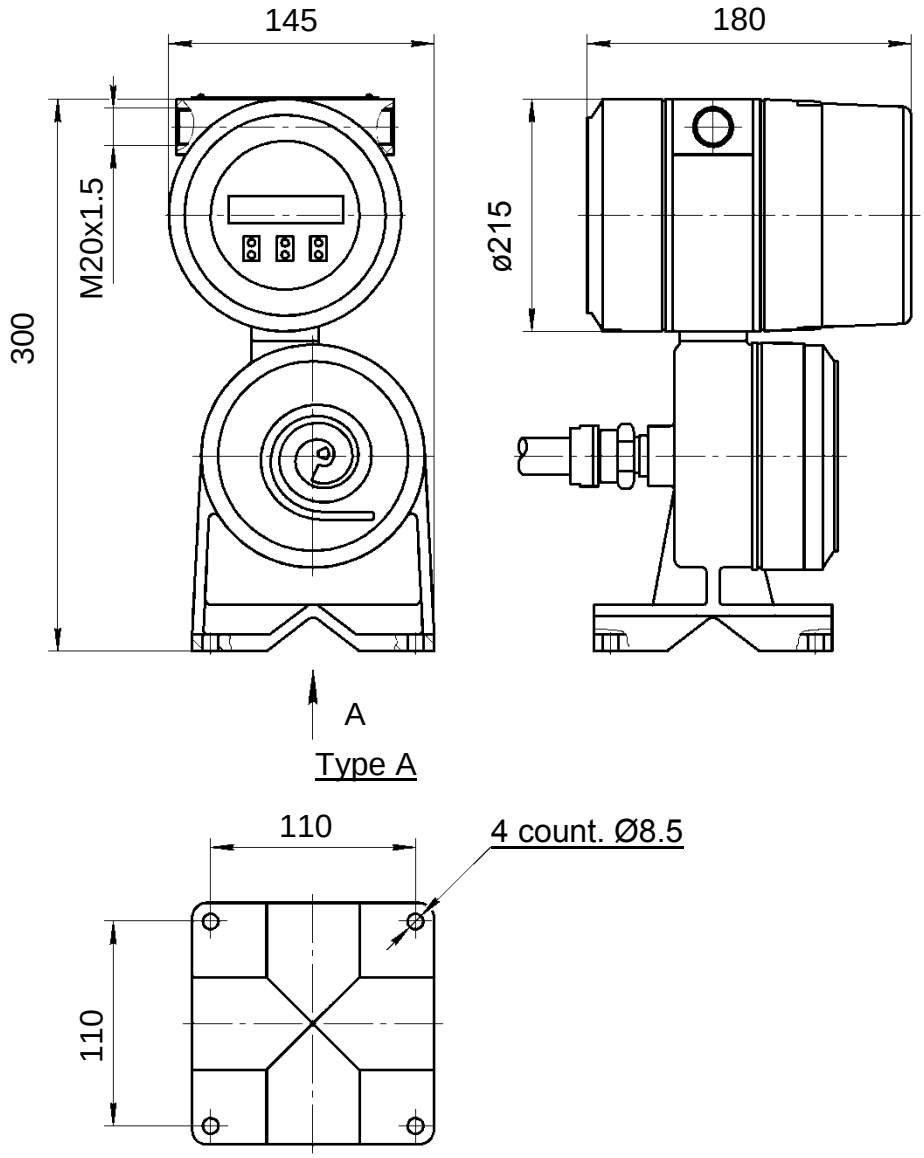


Figure A.11 - Dimensions and connection sizes of electronic unit of standard version, remote type flow meter EMIS-MASS 260.

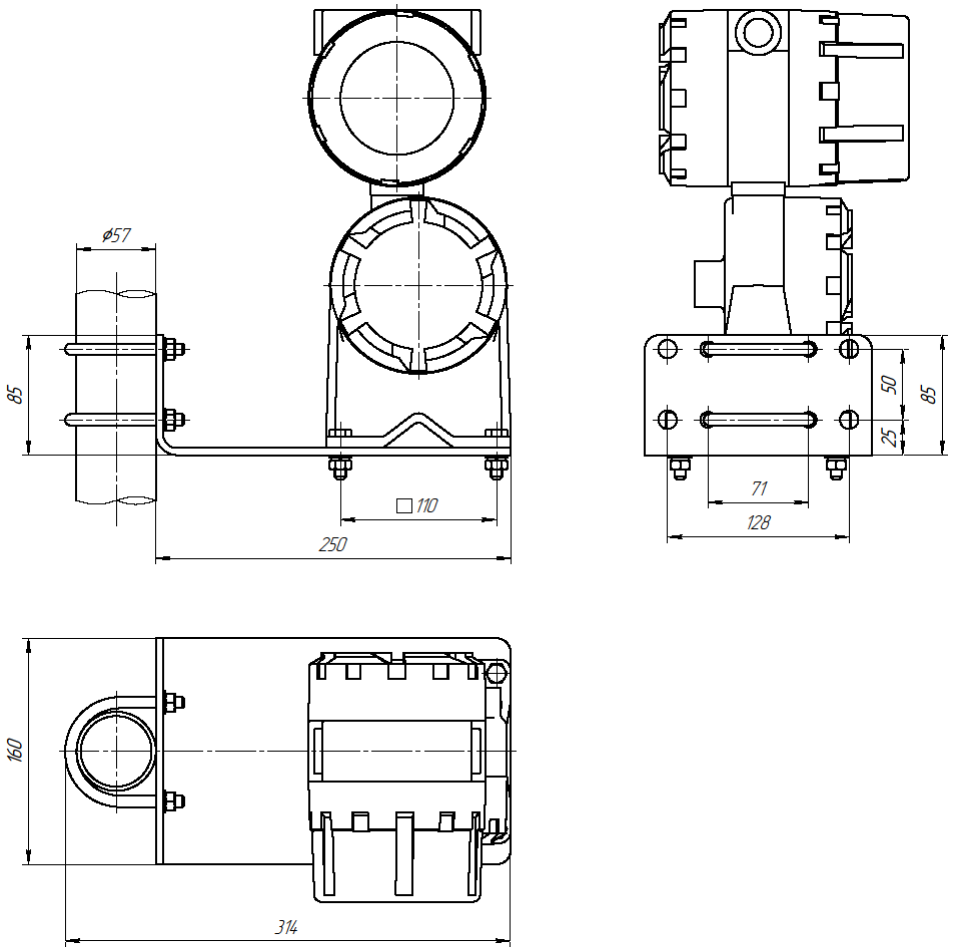


Figure A.12 Mounting bracket for standard electronic unit of remote type flow meter on the support bar.

Table A.12 - Mounting kit for standard electronic unit, remote type flow meter.

Part	Amount	Note
Bracket	1pc	
Clamp 50	2pcs	For mounting on support bar up to Ø60mm
Clamp 100	2pcs	For mounting on support bar up to Ø110mm
Bolt M8x30	4pcs	For mounting on the bracket
Nut M8	12 pcs	
Spring washer 8	12 pcs	
Washer 8	12 pcs	

Mounting kit for remote type electronic unit is supplied upon request.

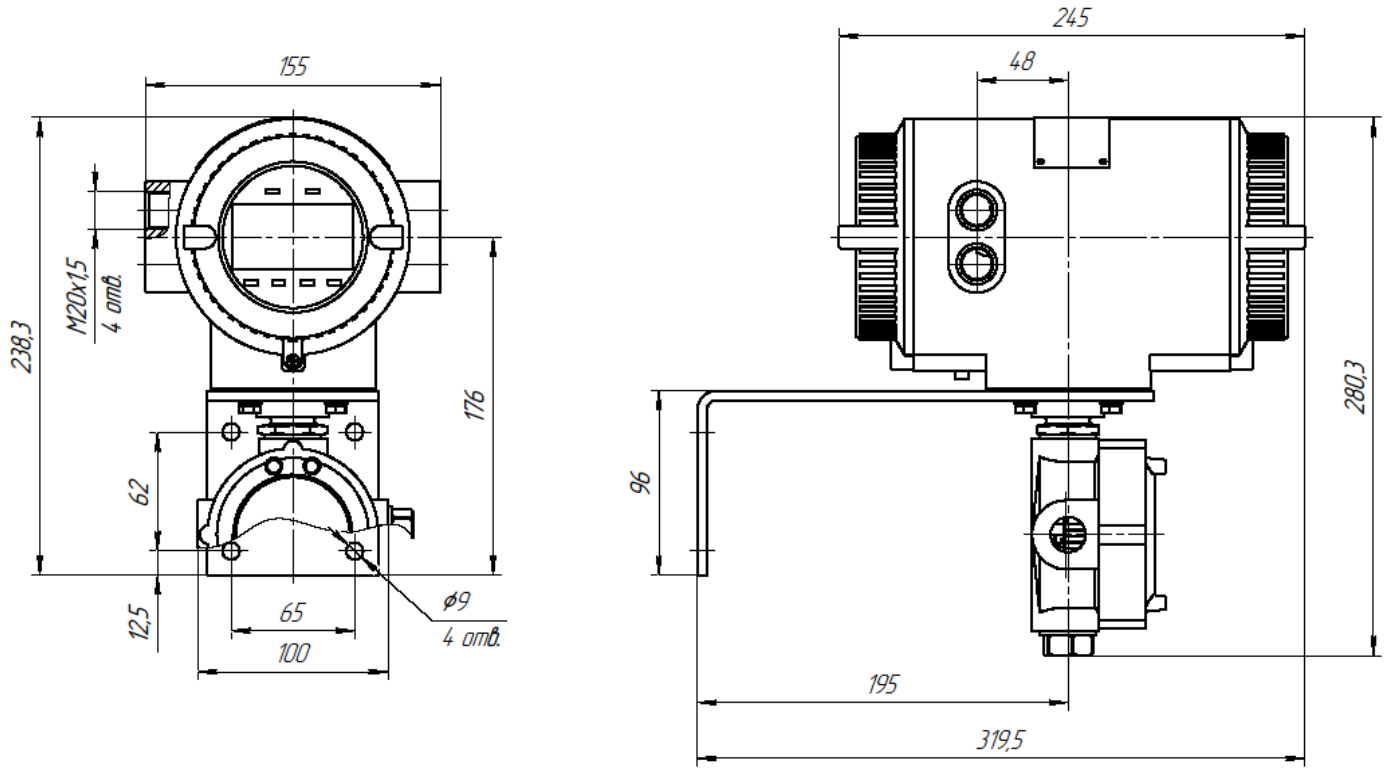


Figure A.13 - Dimensions and connection sizes of electronic unit of extended version, remote type flow meter EMIS-MASS 260.

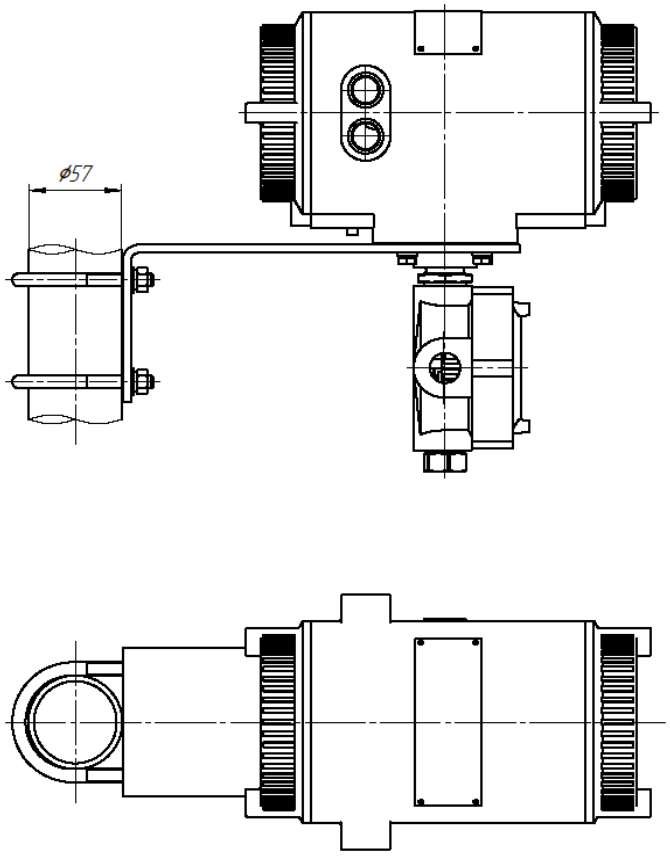


Figure A.14 - Dimensions and connection sizes of electronic unit of extended version, remote type flow meter EMIS-MASS 260.

Figure A.13 - Dimensions and connection sizes of electronic unit of extended version, remote type flow meter EMIS-MASS 260.

Part	Amount	Note
Clamp 1¾"	2 pcs	For mounting on support bar up to Ø57mm
Nut M8	4 pcs	
Spring washer 8	4 pcs	
Washer 8	4 pcs	

Mounting kit for remote type electronic unit is supplied upon request.

Table A.14 - Mounting kit parts for EM-260

Size	Pu, MPa	Size / Amount				
		Flanges	Pins GOST 9066[1]	Nuts GOST 9064	Washers GOST 9065	Gaskets under GOST 15180
010	1,6; 2,5; 4	2	M12x70 / 8 pcs.	M12 / 16 pcs.	12 / 16 pcs.	B-10-160-PON-B
	6.3	2	M12x80 / 8 pcs.	M12 / 16 pcs.	12 / 16 pcs.	
015	1,6; 2,5; 4	2	M12x70 / 8 pcs.	M12 / 16 pcs.	12 / 16 pcs.	B-15-160-PON-B
	6.3	2	M12x80 / 8 pcs.	M12 / 16 pcs.	12 / 16 pcs.	
025	1,6; 2,5; 4	2	M12x70 / 8 pcs.	M12 / 16 pcs.	12 / 16 pcs.	B-25-160-PON-B
	6.3	2	M16x100 / 8 pcs.	M16 / 16 pcs.	16 / 16 pcs.	
040	1,6; 2,5; 4	2	M16x90 / 8 pcs.	M16 / 16 pcs.	16 / 16 pcs.	B-40-160-PON-B
	6.3	2	M20x110 / 8 pcs.	M20 / 16 pcs.	20 / 16 pcs.	
050	1,6; 2,5; 4	2	M16x90 /8 pcs.	M16 / 16 pcs.	16 / 16 pcs.	B-50-160-PON-B
	6.3	2	M20x120 / 8 pcs.	M20 / 16 pcs.	20 / 16 pcs.	
080	1,6; 2,5; 4	2	M16x100 /16 pcs.	M16 / 32 pcs.	16 / 32 pcs.	B-80-160-PON-B
	6.3	2	M20x120 / 16 pcs.	M20 / 32 pcs.	20 / 32 pcs.	
100	1,6; 2,5; 4	2	M20x110 / 16 pcs.	M20 / 32 pcs.	20 / 32 pcs.	B-100-160-PON-B
	6.3	2	M24x140 / 16 pcs.	M24 / 32 pc.	24 / 32 pcs.	
150	1,6; 2,5; 4	2	M24x130 / 16 pcs.	M24 / 32 pcs.	24 / 32 pcs.	B-150-160-PON-B
	6.3	2	M30x170 / 16 pcs.	M30 / 32 pcs.	30 / 32 pcs.	
200	1,6; 2,5; 4	2	M27x160 / 24 pc.	M27 / 48 pc.	27 / 48 pcs.	B-200-160-PON-B
	6.3	2	M30x170 / 24 pcs.	M30 / 48 pcs.	30 / 48 pcs.	

1. Fasteners material is provided upon request, zinc plated fasteners made of 35 steel are used at ambient temperature to -40°C and/or medium pressure up to 6.3 MPa. Zinc plated fasteners made of 09G2S steel are used at ambient temperature to -40°C and/or medium pressure up to 10 MPa. Other materials not listed herein can be orovided upon request. Gaskets are made of paronite PON-B or 12X18H10T along with sealing type J under GOST 33259.

Appendix B

List of normative documents

Name	Name	Menu
GOST 31610.11-2014	Explosive mediums Part 11. Equipment with protection type "intrinsically safe circuit "i".	1.1, 1.5, 1.6, 2.4.2
GOST IEC 60079-1-2013	Explosive mediums Part 1. Equipment with protection type "flameproof enclosures "d".	1.1, 1.5, 2.4.2
TR TS 032/2013	"The Safety of equipment working under excessive pressure"	1.1
GOST R 52931-2008	Instruments for process monitoring and control. General specifications	1.3.1
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.	1.3.8
GOST 31610.0-2014	Explosive mediums Part 0. Equipment. General requirements	1.5, 2.4.2
GOST 14254-2015	Enclosure protection level (IP)	1.5
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
GOST 33259-2015	Flanges for valves, fittings and pipelines for pressure to PN 250. Design, dimensions and general technical requirements	1.8 Appendix A
PUE	Russian Electrical Code	2.2, 2.4.2
PEEP	Operational Code for Electrical Installations	2.4.2
MI 3272-2010	State system for ensuring the uniformity of measurements. Coriolis mass flow meter. On-site calibration procedure using a compact prover in set with a turbine flow transducer and flow density transducer	4
MI 3151-2008	State system for ensuring the uniformity of measurements. Mass flow meters. On-site calibration using turbo-piston prover in set with flow converter.	4
MI 3313-2011	State system for ensuring the uniformity of measurements. Coriolis mass flow meter. Calibration using benchmark mass flow meter”.	4

Appendix C

Measurement technique

1. Application:

Present manual describes EMIS-MASS 260 measuring technique of mass flow and mass, density, temperature, volume flow and volume of liquids, volume flow, volume, mass flow and temperature of gases.

This technique is applicable for flow meters installed at commercial and technological metering units.

2. Normative references

The following normative references are included in the present appendix:

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

GOST 15528-86 Instruments for measuring flow rate, volume or mass of flowing fluid and gas.

GOST R 8.563-2009 State System for Ensuring Uniform Measurement. Measurement technique

GOST R 8.763-2011 State System for Ensuring Uniform Measurement. Multiple direct measurements. Results processing. General provisions.

RMG 29-2013 State System for Ensuring Uniform Measurement. Metrology. General terms and definitions.

3. Terms and definitions

Present technique uses the terms according to GOST 15528, GOST 8.586.1, RMG 29-2013, as well as the following definitions:

3.1 Flow meter: Mass flow meter EMIS-MASS 260.

3.2 Flow sensor (primary transducer): Part of flow meter consisting of measuring chamber with measuring tubes and cover, inlet and outlet tube, flanges, electromagnetic system.

3.3 Electronic unit: Part of flow meter for control and processing of signals coming from electromagnetic system, display and transfer of measuring results.

3.4 Manufacturer: Entity that is responsible for design, production, sale and supply services is EMIS, CJSC.

3.5 User: Entity that operates flow meter.

3.6 Measuring pipeline (MP): Part of the pipeline with installed flow meter for gas and liquid metering.

3.7 Mounting coupling: Part of the pipeline including flanges and fasteners with the same connection sizes as flow meter, using for replacement of flow meter on the pipe if necessary.

3.8 Zero point shift: Flow indication other than zero when at zero flow.

3.9 Zero stability: The limits for zero shift during measurement.

3.10 Low flow cut-off: Specified flow value equal to zero and not metering by mass counter.

3.11 Operation conditions: Flow and medium parameters at the place of flow meter installation.

3.12 Measuring medium: liquid or gas in single-phase state, which flow through the measuring pipeline with installed flow meter.

3.13 Hydrocarbon medium: Complex multi-component system consisting of different hydrocarbons with broad physical and chemical composition.

3.14 Volume gas content: The ratio of the volumetric flow rate (volume) of the gas phase to the volumetric flow rate (volume) of the gas-liquid mixture.

3.15 Metering unit: Metering devices providing metering of medium flow and amount, as well as defining its quality parameters.

3.16 Commercial metering unit: Metering unit providing accounting for the purpose of seller and buyer.

3.17 Cost accounting unit: Metering unit for cost accounting of production within the operating entity.

3.18 Technological metering unit: Metering unit for flow rate and medium amount accounting within the operating entity.

3.19 Semi-fixed parameter value: The value of parameter fixed for a specific period of time (day, week, month).

3.20 Control over measurement units metrology parameters: Compare the indication of operating and benchmark devices to check operating condition of the measurement unit.

4. Symbols

List of used symbols are presented in the table D.1

Table D.1.

Code	*Value*	*Measuring units*
DN	Flow tube diameter	-
u'y	Relative standard indeterminacy of y value measurement result	%
U'y	Relative extended indeterminacy of y value	%
y	controlled value	value of parameter under check
Z	Zero stability	kg/h
δ	Relative error	%
Δy	Absolute error of y	value of parameter under check

5. Measurement method

5.1 Measurement is based on Coriolis effect applied to the medium which flows through the oscillating measuring tubes.

5.2 The flow meter measures volume flow, volume, mass flow, mass, temperature of liquids and gases, volume flow and volume of liquids.

5.3 It meters each component of the watery oil separately. Input density of each component of measuring medium (water and oil) before applying the function "Oil content".

6. Safety requirements.

6.1 Mounting and operation shall be provided by the duly trained personell who have studied the operation manual for the flow meter and auxiliary devices, approved for unsupervised work and tested for normative regulations.

6.2 Prior to start operation, check flow meter condition according to the operation manual for presence and integrity of ex-proof marks, fasteners, integrity of covers and enclosures.

6.3 Strictly follow the applicable rules of industrial, labour, sanitary and fire safety during mounting and operation.

6.4 Installation and de-installation of the devices in the pipeline, maintenance works shall be executed after the pipeline was relieved of pressure. Blow the pipe with hazardous and inert gases prior to the works.

6.5 Operation manual shall be available for the maintenance personell.

7. Gas and liquids measuring methods.

7.1 Measuring conditions.

7.1.1 Medium type

7.1.1.1 Measuring medium is gas or liquid in single-phase state during measurement.

7.1.1.2 Possibility of flow meter operation shall be agreed with the manufacturer in the following cases:

for liquids:

- The liquid is corrosive to the flow meter parts contacting with medium.
- Liquid is abrasive;
- Operating conditions are close to liquid boiling point;

For gases:

- Gas with high content of sulfur leading to corrosive processes;
- Gas with content of halogens (chlorine, bromine, etc.);
- Other components f gas corrosive to the flow meter parts contacting with measuring medium.
- Working conditions are close to the gas dew point.

7.1.2 Flow meter application conditions

7.1.2.1 Fow liquid measurement, ensure that process temperature is lower than boiling points of each medium component to avoid gas inclusions. Follow the recommendations in clause 1.4 to avoid cavitation. Volume gas content in liquid shall not exceed 3%. It is allowed to increase liquid pressure to decrease volume gas content.

7.1.2.2 Flow meter conditions shall comply with the parameter requirements as below: pressure, temperature, density and flow velocity of gas; ambient pressure, temperature and moisture; electrical power supply, permissible electromagnetic fields strength, industrial radio interference and vibrations.

7.2 Preparation to measurement.

7.2.1 Selection of flow meter configuration

7.2.1.1 Permissible flow range can be defined according to the table 1.4 or 1.5 of the Operation manual.

7.2.1.2 Follow the table 1.3.1 and 1.3.2 of the Operation manual to select the flow meter based on the maximum pressure.

7.2.1.3 Other requirements are presented in the clause 2.1 of the Operation manual.

7.2.2 Follow the rules in the clause 2.3 of the Operation manual to select installation point and prepare the pipeline for installation.

7.2.3 Check the following prior to start the measurement:

- Flow meter parameters shall comply with the real conditions of liquid and ga flow (temperature, pressure, velocity, content);
- Flow meter installation shall comply with the requirements in the clause 2.3 of the Operation manual.
- Electrical connections shall comply with the requirements in the clause 2.4 of the Operation manual.

7.2.4 Check measuring pipeline for integrity and sealing according to the normative documents.

7.2.5 Adjust zero point according to the clause 2.5.4.

7.2.6 Adjust flow meter parameters:

- Set the low flow cut-off value (if required);
- Adjust totalizers;
- Adjust output signals according to the input parameters of the auxiliary devices.
- Adjust digital interface (Modbus or HART) according to the auxiliary devices interface.
- Adjust indication parameters of the display.

7.3 Measurement procedure

7.3.1 The flow meter meters the following parameters of medium:

- Mass flow;
- density;
- temperature.
- volume flow;
- Total medium weight for the whole measurement period since the totalizer reset.
- Total medium volume for the whole measurement period since the totalizer reset.
- Mass flow, weight, volume flow and volume of one component of two-phase medium and % of the second component.

7.3.2 Readings are based on pulse, current output signals, digital interfaces Modbus RTU or HART, flow meter display.

7.4 Calculation of medium flow and amount

7.4.1 Calculation includes conversion of the output signals into the measured values of flow and medium amount;

7.4.2 Conversion of output signals of the flow meter into the measured values,

7.4.2.1 Conversion of pulse signal into display readings (herein after “measured value”, MV) executed using the below formula:

$$M = f \cdot w,$$

Where, M - measured value, kg/s;

f - output signal frequency , Hz;

w- pulse value, kg/pulse.

7.4.2.2 Conversion of pulse signal into the weight or volume (herein after measured value”, MV) executed using the below formula:

$$V = N \cdot w,$$

Where, V - measured value, MV units;

N - number of pulses in the output;

w - pulse value, MV units.

Value of w can be specified in the flow meter output signal settings.

7.4.2.3 Conversion of current output into the flow rate, density or temperature (herein after measured value”, MV) executed using the below formula:

$$V = \frac{(I - 4\text{мА}) * (Vmax - Vmin)}{16},$$

Where, V - measured value, MV units;

I - current value at the flow meter output, mA;

V_{max} - measured value at 20mA, MV units;

V_{min} - measured value at 4mA, MV units;

V_{max} and V_{min} can be specified in the flow meter current output signal settings.

7.4.2.4 RS-485 transfers measured values in the form of numeric values, units are specified in the registry map.

7.4.2.5 HART transfers measured values in the form numeric values with specific units.

7.5 Accuracy check

7.5.1 General provisions

7.5.1.1 The flow meter shall be calibrated according to CM 208-043-2019 under PR 50.2.006-94 procedure.

7.5.1.2 Accuracy check procedure is presented in the Operation manual.

7.5.1.3 Check the following parameters:

- absence of reading failure by comparing to the reading of benchmark flow meter installed in different measuring line or redundant metering system, if any.

- Flow meter metrological parameters

- medium flow through the measuring pipeline, working pressure and temperature which shall be within the specified range.

- fulfillment of the requirements of the measurement conditions;

- Zero point shift.

7.5.1.4 Check interval is defined according to flow meter operating conditions and accuracy requirements as agreed by the interested parties. Unscheduled check can be executed by the request of one of the parties.

7.5.1.5 Check procedure shall not interrupt regular measurement procedure.

7.5.2 Accuracy check

7.5.2.1 Check zero point shift

7.5.2.1.1 Zero point shift shall be checked:

- During the first operating month after flow meter commissioning;
- Each season during the first year of operation (further check interval is defined according to flow meter operating conditions and accuracy requirements, previous check results);
- If medium temperature and pressure, or ambient temperature go out of limits leading to the shift exceeding zero stability.
- Periodically, with a frequency defined by the previous check results considering flow meter operating conditions.

7.5.2.2 Check of flow meter metrological parameters

7.5.2.2.1 Executed according to the user regulations.

There are the following installation options for measurement control device:

A) in the working measuring pipeline before or after the flow meter for the period of check. After the check, control device shall be replaced with the mounting coupling.

B) in the control measuring pipeline connected to the working measuring pipeline using the additional piping set.

Control device can be installed permanently or temporarily for check period. In case of temporarily installation, control device shall be replaced with the mounting coupling.

7.5.2.2.2 For control purpose, check controlled parameters (weight, volume, density or temperature) not less than 3 times at stable medium flow. Accumulation time shall be not less than 30sec for each measurement.

7.5.2.2.3 Check result is positive if each measurement meets the following condition:

$$\left|\frac{m_{\text{К}} - m_{\text{СК}}}{m_{\text{ск}}}\right| \cdot 100\% \leq \sqrt{U'^2_{m\text{ск}} + U'^2_{m\text{к}}}$$

Where, m_c and m_{cb} are the value of process parameter from controlled device and benchmark device.

U'_{mcb} - limits of relative extended indeterminacy of benchmark device (including auxiliary device error) (specified in the benchmark device data sheet);

U'_{mc} - limits of relative extended indeterminacy of controlled device (including auxiliary device error) (numerically is equal to the main relative error of controlled device);

7.5.2.2.4 If one of the measurement does not comply with the condition, it shall be excluded from the check results and additional measurement shall be executed.

7.5.2.2.5 If two or more measurements do not meet the condition and in case of additional measurement failure to meet the condition, reveal and eliminate the cause of failure, then proceed another round of check.

7.5.2.2.6 If the second round of check results in failure, apply for flow meter repair or calibration.

8. Requirements to the personell

8.1 Preparation and measurement procedure shall be executed by adults of 18+ duly educated and trained at the site to be capable to maintain labour, industrial and fire safety, who proceeded first aid training and medical check.

8.2 Maintenance crew shall carefully study the present manual.