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v.1.0.52

Electromagnetic flowmeter EMIS-MAG 270

Operation manual

High accuracy

Short straight run

Corrosive medium measurement

Built-up indicator

Wide range of DN

Measurement of direct and reverse flow

www.emis-kip.ru

EMIS CJSC
Russia, Chelyabinsk

ЭМИС
производство расходомеров

General information

This operation manual contains general technical parameters, directions for usage, transportation and storage, and other information for accurate operation of EMIS-MAG 270 electromagnetic flowmeters (hereinafter referred to as the flowmeter or EM-270)

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INFORMATION!

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:

tel/fax: +7 (351) 729-99-12, 729-99-13, 729-99-16

e-mail: support@emis-kip.ru

INFORMATION!

Present Manual can be applied only for EMIS-MAG 270 electromagnetic flowmeters. This document is not applicable to other equipment of EMIS or other companies.

CONTENTS

1 Description and operation

1.1 Application

EMIS-MAG 270 flowmeters are designed for measuring of conducting liquids of direct and reverse flow, including corrosive liquids, two-phase and contaminated liquids (containing solid particles and impurities) with low electrical conductivity $5 \cdot 10^{-4}$ Sm/m.

EM-270 can be used for technological and fiscal metering as part of technological process automated control systems in energy, chemical, paper industries, etc.

Flowmeters can used for reverse flow metering and indicate flow direction.

Flowmeters can be used for both safe and explosive environments. Ex-proof flowmeters EMIS-MAG 270-Ex are equipped with explosion-proof enclosure under GOST 30852.1, intrinsic safety of "ia" protection level under GOST 30852.10 for internal circuits.
Ex-proof flowmeters are equipped with ex-proof casing marked as PB ExdI X and can be used in underground mines, pits and its gas- and dust-hazardous overground facilities.

Flowmeters can be operated in boreal climates location class 3.1 OM1 (if supplied to ocean vessels) according to GOST 15150 under environment temperature from -40 up to 50°C and non-condensing humidity of 90±3 %.

1.2 Structure and Operation Principle

Flowmeter consists of the following assemblies (fig.1.1):

- flow tube (sensor) (1);
- transmitter (2).

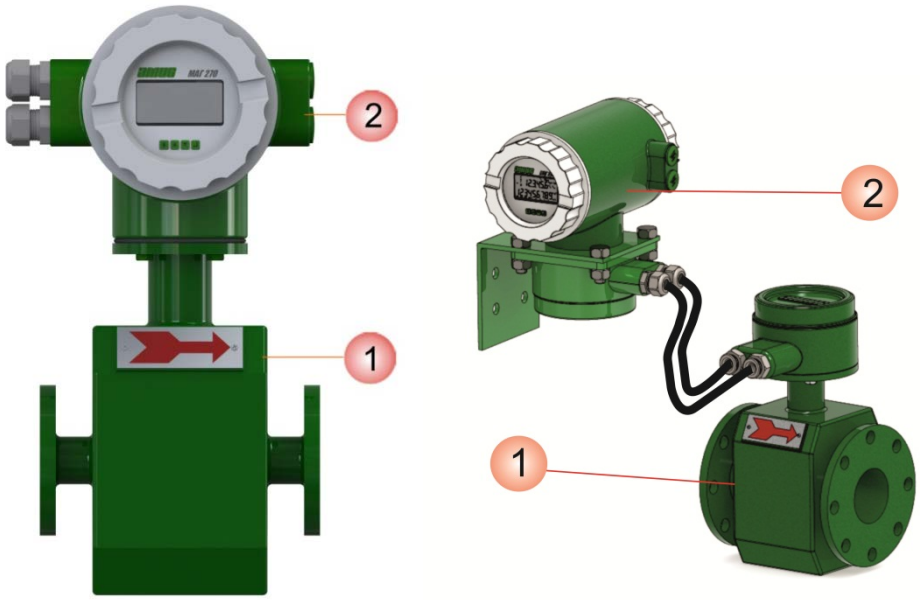

Fig.1.1 - external view of flowmeter

Sensor is a steel tube with corrosion resistant lining which is installed inside the measuring pipe and has welded flanges. Exciting coil and two isolated electrodes are installed on the pipe. Transmitter is mounted as integral part of sensor.

Transmitter can be mounted integrally with sensor (integral version) and separately from sensor (remote version).

Working principle is based on Faraday's law of electromagnetic induction. Electromotive force is induced when the flow pass through the magnetic field from exciting coil. Electromotive force is measured between a pair of electrodes located perpendicular to the flow direction. Measured electromotive force is carried to the transmitter, where it is processed to calculate flow speed and volume flow and then send putput signals to display.

1.2.1 Volume flow calculation

Fig.1.2 shows magnetic flowmeter working principle The induced voltage ***E*** is directly proportional to the velocity ***v*** of the fluid, pipe inner diameter and magnet induction ***B.***

$$E \sim v \cdot B \cdot D \qquad (1)$$

Use B and D to calculate volume flow Q:

$$Q = \frac{v \cdot \pi \cdot D^2}{4} = \frac{k \cdot \pi \cdot D \cdot E}{4 \cdot B} \qquad (2)$$

where k - calibration factor (table 2.13, parameter No33), input during calibration.

Electromotive force value does not depends on medium temperature, viscosity and conductivity provided that conductivity exceeds the value specified in technical parameters.

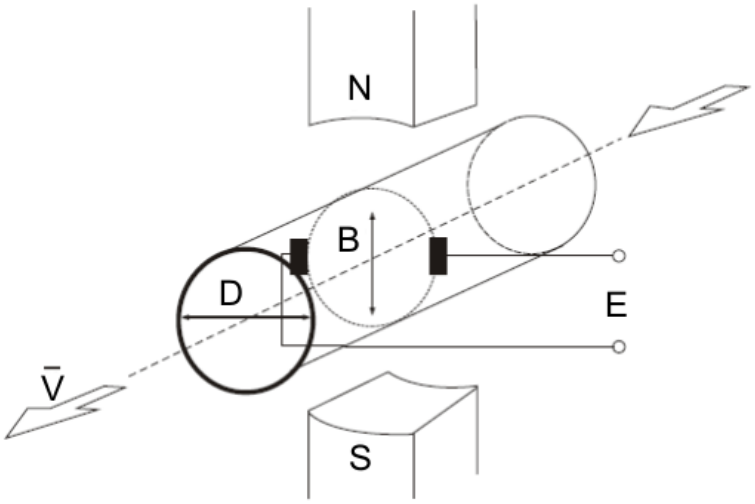

Fig.1.2 - Principal scheme of electromotive force generation

1.2.2 Calculation of approximate flow velocity

Approx. flow velocity ***v*** is calculated by dividing flow volume ***Q*** to flow tube cross-section:

$$v = \frac{Q \cdot 4}{\pi \cdot D^2} \qquad (3)$$

where ***D*** – sensor inner diameter (Table 2.13, No7).

1.2.3 Calculation of accumulated flow volume

Accumulated volume flow ***V*** is calculated by multiplying flow volume ***Q*** by time gap ***T*** between measurements:

$$V = Q \cdot T \qquad (4)$$

where ***T*** – time gap between measurements (Table 2.13, No10).

1.2.4 Conductivity indicator

Flowmeter is equipped with conductivity sensor which can define conductivity coefficient proportional to medium conductivity.

1.3 Technical parameters

1.3.1 Parameters

Brief description of technical parameters is shown in Table 1.1

Table 1.1 - Technical parameters of flowmeter

Name	Description			
Size	15 – 1000 mm			
Dynamic range	1:100			
Error	0,5 %			
Working pressure of medium:	up to 32 MPa			
Medium temperature	-40 ºC up to 130ºC (for Ex** up to 120ºC)			
Min electric conductivity of medium	5•10-4 Sm/m			
Output signals	pulse; frequency; current 4-20 mA Modbus RTU digital signal; HART digital signal			
Input voltage	24V DC, 220V AC			
Explosion protection	1Exd[ia]IIC(T4-T6)X, PB ExdI X			
Atmospheric pressure	84.0 to 106.7 kPa			
Ambient temperature		Integral type	Remote type	
			Flow tube	Transmitter
	-	-40…+50ºC	-40…+70ºC	-40…+60ºC
	Ex**	-40…+50ºC	-40…+50ºC	-40…+50ºC
	PB		-20…+50ºC	-20…+50ºC
Relative humidity of environment less than	90% (non-condensing under 35ºC)			
Magnetic field resistance	up to 400 A/m, 55Hz			
Vibration resistance	version V3 under GOST 52931 (shift amplitude 0,35mm, acceleration amplitude 49 m/s^2)			
Dust and water protection	IP65			
Calibration interval	4 years			
Service life	over 15 years			
Average time between failure ATBF	over 80 000 hours			
Dimensions and weight	see annex A			
Content of precious metals	does not contain			

Note: *You can customize flowmeter parameters according your specific demands.*

** - LED display working temp. shall be higher than -20ºC.*

*** - Ex-proof version*

1.3.2 Measuring range

Tables 1.2.1 and 1.2.2 shows min and max flow values Qmin and Qmax to define flow range with different accuracy. Measurement error is specified in 1.3.3.

Table 1.2.1 - Flow range up to 6,3MPa pressure versions.

Size, mm	Inner diameter, mm	Qmin, cbm/h	Qmax, cbm/h
15	15	0.06	6.40
20	20	0.11	11.30
25	25	0.18	17.70
32	32	0.30	28.90
40	40	0.45	45.00
50	50	0.71	71.00
65	65	1.20	119
80	80	1.80	181
100	100	2.80	283
125	125	4.40	442
150	150	6.40	636
200	200	11.30	1130
250	250	17.70	1770
300	300	25.50	2540
350	350	34.60	3460
400	400	45.00	4520
450	450	57.00	5720
500	500	70.50	7070
600	600	100	10200
700	700	140	13850
800	800	180	18100
900	900	230	22900
1000	1000	280	28300

Note: *Flow ranges for Dn> 1000 mm are specified upon request. Flow ranges for pressure more than 6,3MPa are specified upon request.*

1.3.3 Accuracy

Max relative error of flow and accumulated volume measurement via pulse, frequency signals, Modbus RTU and HART protocols depends on flow velocity and specified in Table1.3.

Table 1.3 - Relative error of flow and accumulated volume measurement

Max relative error, %		
Qmax ≥ Q > 0,1·Qmax	0,1·Qmax ≥ Q > 0,03·Qmax	0,03·Qmax ≥ Q > Qmin
± 0,5	± 1,0	± 5

Max relative errors via analogue current signal are specified in table 1.4.

Table 1.4 - Max relative error of volume flow measurement

Max relative error, %		
Qmax ≥ Q > 0,1·Qmax	0,1·Qmax ≥ Q > 0,03·Qmax	0,03·Qmax ≥ Q > Qmin
± (0,2·Qmax/Q + 0,5)	± (0,2·Qmax/Q + 1,0)	± (0,2·Qmax/Q + 5)

1.3.4 Pressure ranges

Pressure standards depending on pipe size are shown in table 1.5

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Non-standard pressure versions shall be discussed with EMIS engineers based on overall operation conditions.

Table 1.5 - Design version based on working pressure

Size, mm	Max working pressure of medium, MPa				
	1.6	2.5	4.0	6,3-10	15-32
15	●	●	●	C	C
20	●	●	●	C	C
25	●	●	●	C	C
32	●	●	●	C	C
40	●	●	●	C	C
50	●	●	●	C	C
65	●	●	●	C	C
80	●	●	●	C	C
100	●	●	●	C	C
125	●	●	●	C	C
150	●	●	●	C	C
200	●	C	C	C	C
250	●	C	C	X	X
300	●	C	C	X	X
350	C	C	C	X	X
400	C	C	C	X	X
450	C	C	C	X	X
500	C	C	C	X	X
600	C	C	C	X	X
700	C	C	C	X	X
800	C	C	C	X	X
900	C	C	C	X	X
1000	C	C	C	X	X

● - standard version
C – subject to approval
X – n/a

1.3.5 Parameters of electrical supply

Power supply shall be provided from external power source 24V DC or 220V AC, 50± 1 Hz. Power supply parameters are specified in table 1.6.

Table 1.6 - Power supply parameters

Rated voltage	Voltage range, V	Power consumption, not eceeding
24V DC	20 to 36	20W
220V AC	85 to 250	20 VA

For 24V supply cable length is 100m.

For 36V supply cable length is 300m.

1.3.6 Output signals

Flowmeters support the following output signals:

- pulse/requency signal;
- analog current signal (4-20mA);
- Modbus RTU digital signal;
- HART digital signal;
- emergency signal.

Display is installed to show volume flow and accumulated flow.

1.3.6.1 Pulse / frequency output signal

To switch between pulse and frequency signals go to Menu-Parameters (menu line 19, table 2.13).

Squarewave signal is generated at pulse/frequency output. Pulse/frequency signal is active.

At pulse output number of pulses correspond to measured volume from measurement start.

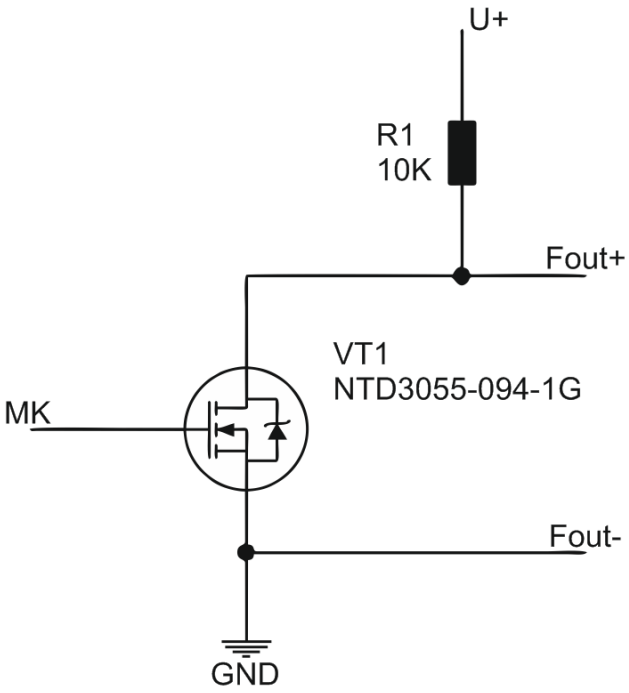
At frequency output pulse frequency corresponds to measured volume flow. Max flow value can be adjusted in menu line 9, table 2.13.

Main parameters of pulse/frequency outputs are presented in table 1.7.

Table 1.7 - Pulse/frequency output parameters

Parameter	Description
Voltage of unit, V, higher than	22
Voltage of zero point, V, not exceeding	0.6
Max current, mA	250
Max frequency, Hz (for frequency output)	5000*
Pulse value (for pulse output)	see menu line 20 ***table 2.13***

* - max frequency can be set up in Parameter menu, line 21 (table 2.13)



Fir.1.2.1 - Frequency output

EMIS-MAG 270

1.3.6.2 Analog current output signal

Current range for output signal is 4 -to 20 mA. Current signal is active. Current of 4mA is taken as "zero" flow. Flow value for 20mA can be set up in Parameters (menu line 9, table 2.13) and equal to Qmax by default.

Parameters of current signal are shown in Table 1.8.

Table 1.8 - Current signal parameters

Parameter	Description
Signal range, mA	4…20
Load resistance, Ohm	up to 750

1.3.6.3 Modbus digital signal

Modbus digital signal comlies with EIA/TIA-422-B and ITU V.11, providing transmission of measured values within the network. Parameters of digital signal are shown in Table 1.9.

Table 1.9 - Digital signal parameters

Parameter	Description
Physical level	RS-485
Communication protocol	Modbus RTU
Data transmission rate, bit/sec	1200, 2400, 4800, 9600,19200
Max length, m	300
Data format	8 bit, 1 start bit, non-parity, 1 stop bit
Read time	250 ms

Digital signal transmit the following parameters:

- approx. flow velocity;
- current volume flow;
- accumulated direct flow;
- accumulated reverse flow;
- measuring units.

Digital signal circuit parameters of ex-proof flowmeters are presented in clause 1.4.

1.3.6.4 HART digital signal

The HART data is superimposed on the 4-20 mA current loop.

1.3.6.5 Emergency signal

Emergency signal is a open collector output.

Max flow signal activates when current flow is higher than specified maximum value.

Min flow signal activates when current flow is lower than specified minimum value.

Max and min values can be set up in Parameters menu, line 25 and 27 (table 2.13)

Parameters of emergency signal are shown in Table 1.10.

Table 1.10 - Emergency signal parameters

Parameter	Description
Voltage in circuit, V, not exceeding	35
Commutated current, mA, not exceeding	250

1.3.7 Indicator

Flowmeter is equipped with matrix 3-line LED display. There are 14 character spaces in one line.

The following data can be displayed:

- current volume flow, l/h or cbm/h;
- accumulated direct flow, l or cbm;
- accumulated reverse flow, l or cbm;
- Difference between accumulated direct and reverse flow, l and cbm;
- flow direction;
- approx. flow velocity;
- service messages.

Update interval can be set up by parameter No11, table 2.13.

Control buttons are located above the display. Control directions are presented in clause 2.5 Operation and maintenance.

1.3.8 Used materials

Materials used in flowmeter construction are listed in table 1.11

Table 1.11 - Materials of flowmeter parts and elements

Version	Material				
	Sensor casing/ flanges	Flange sealing	Transmitter casing	Electrode	Lining
-	Steel 20	PET	Aluminum alloy; Modified aluminum-silicon alloy (for PB version only)	According to order, see table 1.12	According to order, see table 1.13
H1	Stainless steel 08X18H10 (equivalent SS304)	PET			
H2	Stainless steel 03X17H14M2 (equivalent SS316L)	PET			

INFORMATION

Flowmeter materials which contact with the medium shall be resistant to its corrosive influence.

Electrode material (table 1.12) selection depends on medium type.

Table 1.12 - Electrode material

Electrode material	Symbols for order sheet	Medium resistance
Stainless steel 03X17H14M2	-	Resistant to organic and not-organic acids, phosphorus acid, formylic acid, sulphurous acid and acetic acid, alkali water, sea water, sewage water, mineral water, ammonia, paper stock, diary products
Hastelloy alloy	HS	Resistant to the following acids: 10% nitric acid, salycilic, acetic, boric, butyric, cresylic, phosphorus, fatty, formylic (including formiates); Fe and Cu acid salt, sea water, propanetriol, methyl alcohol, caustic soda
Hastelloy alloy B	HB	Resistant to hydrochloric acid of any strength until boiling temperature, phosphorus and sulphuric acids up to 60%.
Tungsten carbide	**B**	Resistant to acids under room temperature, highly resistant to corrosive mediums which cause wearing and pitting of surfaces.
Titanium	Ti	Resistant to chlorides and hypochlorites, acid gases (including fuming nitric acid), organic acids, sea water and mineral water, corrosion-resistant to majority of mediums (not including alkaline mediums).
Tantalum	TA	Resistant to corrosive chemical mediums, fuming hydrochloric acid, nitric acid, sulphuric acid (t = 175 °C). Excluding fluric acid, fuming sulphuric acid and caustic soda.
Platinum-iridium alloy	PT	Resistant to most acidic solutions (including hydrochloric acid (at certain concentrations) with fuming sulfuric and fuming nitric acid), , alkalis, and salt solutions. Excluding nitrohydrochloric acid.

Inner surface of sensor is lined with corrosion-resistant material also performing as heat insulation.

Lining material shall be selected depending on diameter Dn, type and temperature of medium. Possible lining material are listed in table 1.13

Table 1.13 - Lining materials

Lining materials	Symbols for order sheet	Dn, mm	Medium type and material characteristics	Medium temperature, °C		Max pressure of medium, MPa
				Integral version	Remote version	
Polyurethane rubber	PR	15-1000	Resistant to wear, but not resistant to acids and alkalis.	0…+70°C	0…70°C	4.0
Chlorophrene rubber	CR	40-1000	Highly resistant to wear Resistant to coal-water slurry and contaminated mediums, weak acids and alkalis, oil.	0…+80°C	0…+80°C	4.0

Lining materials	Symbols for order sheet	Dn, mm	Medium type and material characteristics	Medium temperature, °C		Max pressure of medium, MPa
				Integral version	Remote version	
Polypropylene	PP	15-1000	Low heat conductivity and surface tension. Resistant to weak acids and alkalis, mineral oils.	0..+60	0..+60	32.0
Fluorinated ethylene propylene*	FEP	15-250	Resistant to hydrochloric sulfuric, nitric and nitrohydrochloric acids.	-40…+80	-40…+120	32.0
Polytetrafluoroethylene*	PET	40-1000	High heat resistance	-20…+80	-20…+120°C	4.0

(fluorine plastic-4)			and resilience, low surface tension. Resistant to concentrated acids and alkalis.			
Perfluoroalkoxy (fluorine plastic-50)	PFA	15-300	Resistant to hydrochloric, sulfuric, nitric and nitrohydrochloric acids. Properties very similar to PET.	-40…+80	-40..+130 -40…+120**	10.0
Ceramic	C	15-350	High resistance to caustic, corrosive and abrasive mediums. Used in pharmacy and cosmetic industry. Resistant to temperature changes and high mechanical impact. High resistance to vacuum.	-20..+100	-20..+180 -20…+120**	4.0

* - Flowmeters are equipped with protection rings installed at the ends of sensor to prevent lining from damages during transportation and installetion.

** - for ex-proof version

Attention!

Content of tables 1.11 and 1.12 presented for reference use only and does not guarantee correct electrode and lining material selection.

1.4 Explosion protection

Ex-proof flowmeters EMIS-MAG 270-Ex are equipped with explosion-proof enclosure under GOST 30852.1, intrinsic safety of "ia" protection level under GOST 30852.10 for internal circuits. Ex-proof marking is presented in table 1.14.

Table 1.14 - Ex-proof marking

medium temperature range, °C	Marking
-40 to +120	1Exd[ia]IICT4X
-40 to +80	1Exd[ia]IICT5X
-20 to +65	1Exd[ia]IICT6X

Ex-proof plates are presented in clause 1.5 Marking

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

- excessive pressure of medium shall not exceed specified values;
- unused cable gland shall be plugged with supplied plug.

Explosion protection is provided by the following means:

1. Transmitter outputs and power supply are galvanically isolated from each other by transformer under GOST 30852.10.

Sensor power supply circuit and other circuits are galvanically isolated from each other by transformer under GOST 30852.10.

Zener diode protects circuit from overvoltage and overcurrent.

Clearance, leakage path and electrical endurance of isolation comply with GOST 30852.10;

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

2. Electrical elements of transmitter are covered with ex-proof enclosure to prevent from explosion pressure and transfer of fire to the explosive environment. Enclosure blast resistance and explosion protection comply with the GOST 30852.1 requirements for IIC class electrical equipment. Enclosure is tested for blast resistance under hydraulic pressure of 1,5MPa.

Explosion protection of connections comply with the GOST 30852.1 requirements for IIC class electrical equipment. Min axis length of the thread and full turns of thread comply with GOST 30852.1;

Inspection window is sealed inside the metal rim of the casing cover to provide integrity;

Cable gland provides reliable connection of cable. Sealing elements comply with GOST 30852.1;

3. Maximum heating temperature of transmitter cover and electrical elements shall not exceed the values specified for this temperature class under GOST 30852.0.

4. Transmitter cover and enclosure parts are executed under general requirements of GOST 30852.0 for electrical equipment located in explosive environment. Sealing and connection parts comply with IP65 under GOST14254. Mechanical rigidity of transmitter casing comply with GOST 30852.0 requirements for electrical equipment of group II with high risk of mechanical damage. EDS protection and friction spark protection are provided by construction materials properties.

5. Mine version of flowmeter EMIS-MAG 270 designed with transmitter enclosed in certified ex-proof box of PB protection class and has certified Ex cable glands.

Mine version EMIS-MAG 270 complies with TR TS012/2011.

PB protection class is provided by the following:

- electrical elements are covered with ex-proof enclosure to prevent from explosion pressure and transfer of fire to the explosive environment. Blast resistance and explosion protection comply with the GOST 30852.1 (IEC 60079-1:1998) requirements.
- each element of ex-proof enclosure is tested under hydraulic pressure of 0,8MPa during specified testing time not less than 10sec.
- min axis length of the thread and full turns of thread comply with GOST 30852.1; (IEC 60079-1:1998);
- cable glands provide reliable connection of cable. Sealing elements comply with GOST 30852.1 (IEC 60079-1:1998) requirement for explosion protection;
- flowmeter body and enclosure parts are executed under general requirements of GOST 30852.0 (IEC 60079-1:1998) for electrical equipment located in explosive environment. Sealing and connection parts comply with IP65 under GOST14254. Mechanical performance of

enclosure complies with the GOST 30852.1 (IEC 60079-1:1998) requirements.

- EDS protection and friction spark protection are provided by construction materials properties. Enclosure surface is covered with corrosion resistant paint coat of 250µm;
- maximum heating temperature of enclosure shall not exceed the values specified for this temperature class under GOST 30852.0 (IEC 60079-0:1998).

Explosion protection elements drawing is shown in Annex D.

Ex-proff marking, warning signs and X mark are attached to the flowmeter body. Ex-proof plates are presented in clause 1.5.1 Marking

"X" mark after ex-proof marking means:

- electrical connection to external circuits shall be executed using cable glands certified under GOST 30851.1;
- cable connection between sensor, transmitter and flow tube shall be executed using terminal block complying to any of the explosion protection standards listed in GOST30852.0 (IEC 60079-0:1998), clause 1 and ex-proof marking. Leakage path and clearance, insulation, CTI of temical block shall comply with GOST 30852.20.
- excessive pressure of medium shall not exceed the values specified for this version;
- use hest-resistant cable to connect sensor and ex-proof box with transmitter.
- unused cable glands shall be plugged with the plugs certified under GOST 30852.0;
- sensor shall be installed in places safe from friction sparks coused by friction or collision of parts.

Strictly follow direction of the present Manual for safe operation of the equipment.

1.5 Marking

Flowmeter marking is applied under GOST 12971 on the plate attached to the flowmeter body. Flowmeter has main and secondary plates.

1. For integral version, there is only one main plate, no secondary plates are available.
2. For remote version, the main plate is attached to flowmeter body, the secondary plate is attached to transmitter.

The plate is show in fig.1.3 and contain the data as listed in table 1.18.

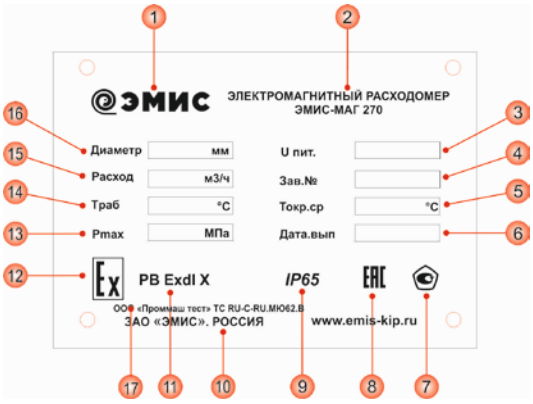


Fig.1.3 - Flowmeter plate

Table 1.18 - Marking on the name plate

NO in fig.	Description
1	Manufacturer trade mark
2	Name
3	Input voltage
4	Serial number
5	Ambient temperature*
6	Date of manufacturing
7	Measuring tool approval mark
8	TR TS sign
9	IP
10	Manufacturer information
11	Ex-proof marking
12	Ex-proof sign
13	Medium pressure
14	Medium temperature
15	Full range of meaurement
16	Size
-	Power consumption (Pcons)*[2]
-	Power voltage (Upow)[*2]
-	Weight (m)*[2]
17	Certification authority (for EX and PB version)

*[1] – *Main plate shows environment temperature*

[*2] – if supplied to ocean vessels

1.6 Scope of Supply

Standard supply scope is presented in fig.1.4 and table 1.20.

Fig.1.4 - Scope of supply

Table 1.20 - Standard supply scope

No	Description
1	Flowmeter EMIS-MAG 270
2	Operation manual
3	Data sheet
4	Calibration method

Additional supply kit is presented in fig.1.5 and table 1.21.

Fig. 1.5 - Additional supply kit

Table 1.21 - Additional supply kit

No	Description
1	Mounting kit (flanges, gaskets, bolts, nuts, washers, clamps) EMIS-MAG 270 - MK
2	Mounting sleeve EMIS-VECTA VT270 (according to order sheet)
3	Ground ring (according to order sheet)
4	Power supply unit (according to order sheet)
5	Certificates (on demand)
6	Spare parts kit includes cable glands, flange gaskets and fasteners for flanges mounting (depends on flowmeter version). Other accessories can be included according to customer needs.

INFORMATION

Please follow the steps below after receiving the flowmeter:

- check package for damages;
- check supply kit;
- compare flowmeter parameters to ones specified in order sheet

In case of any damages, supply kit or parameters mismatch, make a report.

1.7 Order sheet

EMIS-MAG 270 flowmeter versions are shown in Table 1.22.
Order sheet completion is shown below.

	1		2		3		4		5		6		7		8		9		10		11		12	
EMIS-MAG 270-	Ex	-	080	-	-	-	-	-	PP	-	Ti	-	-	-	-	-	6.3	-	-	-	-	-	-	-

13		14		15		16
24	-	S	-	ГП	-	GOST

Data as shown in order sheet: EMIS-MAG 270-Ex-080-ПП-ТИ-6,3-24-М-ГП-ГОСТ

Table 1.22 - Flowmeter versions

1	Explosion protection
–	No ex-proof
Ex	1Exd[ia]IIC(T4-T6)X (intrunsic circuit, ex-proof casing)
PB*	PB ExdI X (mining version)
X	special order

* - only for remote version R

2	Size				
015	Dn15	250	Dn250		
020	Dn20	300	Dn300		
025	Dn25	350	Dn350		
032	Dn32	400	Dn400		
040	Dn40	450	Dn450		
050	Dn50	500	Dn500		
065	Dn65	600	Dn600		
080	Dn80	700	Dn700		
100	Dn100	800	Dn800		
125	Dn125	900	Dn900		
150	Dn150	1000	Dn1000		
200	Dn200	X	special order		

3	Flow range
–	Standard, according to table 1.2
X	special order

4	Sensor body material
–	Steel 20
H1*	Stainless steel 08X18H10 (eqv. SS304)
H2*	Stainless steel 03X17H14M2 (eqv. SS316L)
X	special order

* - prior approval

5	Lining materials
PET	PTFE (fluorine plastic-4)
CR	Chlorophrene rubber
FEP	Fluorinated ethylene propylene
PP*	Polypropylene
PFA	Perfluoroalkoxy (fluorine plastic-50)
PK*	Polyurethane rubber
K	Ceramic
X	special order

* - prior approval

6	Electrode material
-	Stainless steel 03X17H14M2 (eqv. SS316L)
HS	Hastelloy C alloy
HB	Hastelloy B alloy
B	Tungsten carbide
Ti	Titanium
TA*	Tantalum (upon request for Dn 15-32)
PT	Platinum-iridium alloy
MN*	Monel alloy (for all Dn)
X	special order

* - prior approval

7	Connection to pipeline
–	Flange
S	Aseptic nut din11851 (upon agreement)
X	special order

8	Flowmeter mounting
-	Integral version - sensor and transmitter as integral assembly
RXX	Remote version with cable length of XXm. Max length - 50m

* - for non-ex version

9	Medium pressure
1.6	max pressure - 1,6 MPa
2.5	max pressure - 2,5 MPa
4.0	max pressure - 4,0 MPa
6.3	max pressure - 6,3 MPa
10	max pressure - 10 MPa
15	max pressure - 15 MPa
25	max pressure - 25 MPa
32	max pressure - 32 MPa
X	special order

10	Medium temperature
–	Standard, according to table 1.13
X	special order

11	Error
-	Standard, according to table 1.3
X	special order

12	Metering indicator
–	Standard indicator
X	special order

13	Power supply
24	24V DC
220*	220V AC
X	special order

* - for non-ex version

14	Output signals

–	Pulse/frequency signal + analogue current 4-20mA
S*	Additional Modbus RTU digital signal;
H*	Additional HART digital signal
X	special order

* - version with both Modbus and HART is not available.

15	Calibration
–	Manufacturer calibration, pressure test (according to technological process)
GP	State calilbration (for fiscal metering)
16	**Flange standards**
-	According to Manual, Annex A
GOST	GOST 33259
EN	EN 1092-1
ASME	ASME (ANSI) B16.5
17	**Spec. Plant version**
-	standard version
AST	for application at Gazprom-Dobycha Astrakhan

EMIS-MAG 270 mounting kit versions are shown in Table 1.23.
Order sheet completion is shown below.

		1		2		3		4		5		6
Mounting kit EMIS-MAG 270	-	015	-	1.6	-	-	-	Stn	-	УИ	-	GOST
Mounting kit EMIS-MAG 270-015-1,6-Стн-УИ-GOST												

Table 1.23 - Mounting kit symbols for EMIS-MAG 270

1	Size				
015	Dn15	100	Dn100	450	Dn450
020	Dn20	125	Dn125	500	Dn500
025	Dn25	150	Dn150	600	Dn600
032	Dn32	200	Dn200	700	Dn700
040	Dn40	250	Dn250	800	Dn800
050	Dn50	300	Dn300	900	Dn900
065	Dn65	350	Dn350	1000	Dn1000
080	Dn80	400	Dn400	X	special order

2	Medium pressure		
1,6	max pressure - 1,6 MPa	15	max pressure - 15 MPa
2,5	max pressure - 2,5 MPa	25	max pressure - 25 MPa
4,0	max pressure - 4,0 MPa	32	max pressure - 32 MPa
6,3	max pressure - 6,3 MPa	X	special order
10	max pressure - 10 MPa		

3	Connection to pipeline
–	Flange
X	special order

4	Material of counter flange		
Ст	Steel 20	13ХФА	Steel 13ХФА
Stn	Steel 09Г2С	X	special order
H1	Stainless steel 12Х18Н10Т		

5	Meter run
-	No
Y	Yes

6	Flange standards
-	According to Manual, Annex A
GOST	GOST 33259
EN	EN 1092-1
ASME	ASME (ANSI) B16.5

2 Intended Use

2.1 General recommendations for selection and use

2.1.1 Version selection

To provide reliable work and accuracy of the flowmeter 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 flowmeter 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	Error
9	Medium temperature at meter run
10	Pipeline pressure
11	Availability of automatic control and regulation systems
12	Pipeline diameter
13	Pipeline inclination at meter run
14	Ambient temperature
15	Ex-proof requirements (ex-proof marking)

INFORMATION

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

Flowmeter size shall be selected according to real flow volume in the pipe which can be different from calculated. Flowmeter 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 and smaller than size of the pipeline.

Use concentric reducer in case of pipeline size and flowmeter size mismatch. Concentric reducer can be made by customer, herewith to minimize pressure loss the central angle of the cone shall not exceed 15º.

2.1.2 Measurement of liquids with low electric conductivity

Flowmeter can measure volume flow of liquids with low electric conductivity$5 \cdot 10^{-4}$ Sm/m

To keep specified accuracy the low conductive medium shall not exceed 20% of the measuring volume.

2.1.3 Electrode and lining material selection

Lining and electrode material shall be selected based on medium corrosive properties. PET lining and electrodes made of stainless steel 03X17H14M2 are suitable for most corrosive mediums. Lining materials are limited by Dn and medium temperature.
Use table 1.11 and 1.12 for electrode and lining material selection.

2.1.4 Reverse flow measurement

Flowmeter can measure reverse flow. Accumulated flow for both directions of flow is stored in different registers. You can switch off reverse flow metering in menu line 17 reverse flow (table 2.13).

Frequency, pulse and current signals indicate absolute flow. Flow direction is not taken into account.

2.2 Safety requirements

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

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 temperature of medium;

While mounting, pre-commissioning and maintenance it is prohibited:

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

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.

Flowmeter installation and de-installation shall be executed under zero excessive pressure and disconnected power supply. Electrical installation shall be executed under disconnected power supply.

Attention!

It is prohibited to operate flowmeter with unlocked covers and no ground connection.

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 flowmeter near transformers. power units and other vibrating equipment.
- Flowmeter shall not be installed in piping stress part and be the support of the pipeline.
- Flowmeter shall be installed in easily accessible places. Appropriate space shall be provided for installation and maintenance.
- Equipment indicator shall be reachable for reading control.
- Installation place shall ensure minimal possible temperature in this environments. Under direct sun light the temperature of the flowmeter body can exceed environment temperature up to 30 degrees. Sun shield shall be installed if no shade is available.

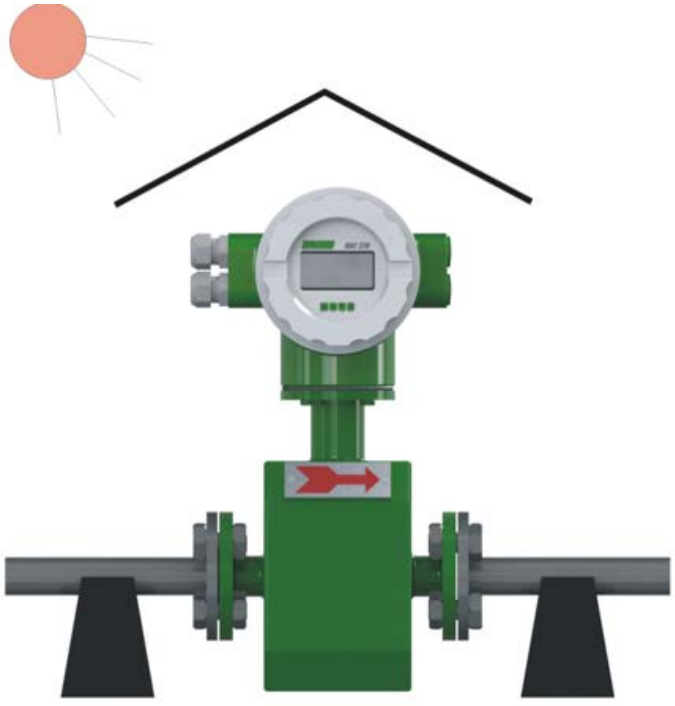


Fig. 2.1 - General requirements to installation place

Provide additional pipeline support legs before and after the flowmeter if it is installed in the places of strong vibration or flowmeter itself is the pipeline support. Support legs foundation sahll be rigid.

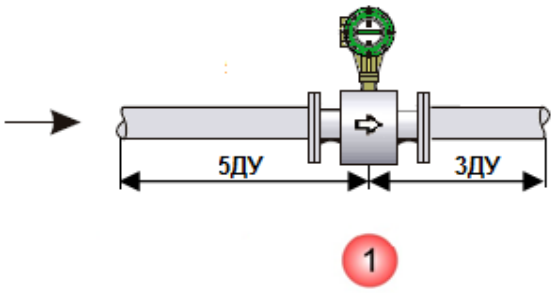
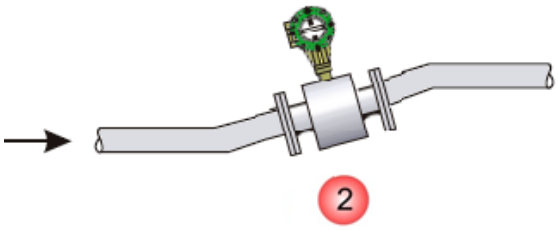
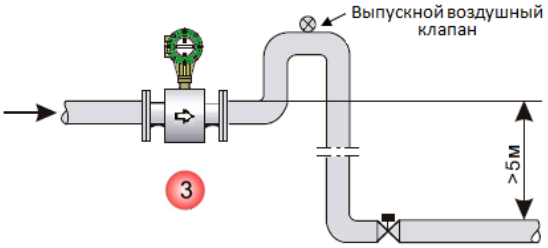
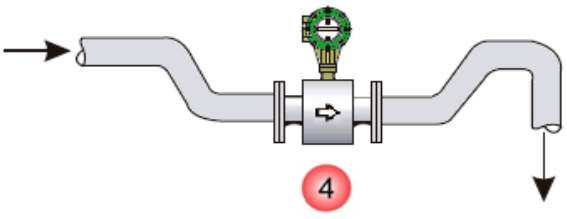
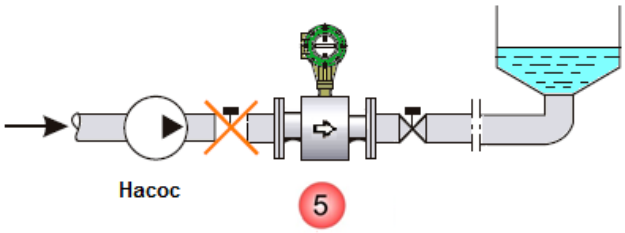
2.3.2 Pipeline inclination and straight run

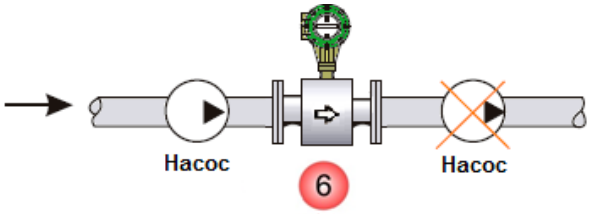
Flowmeter can be mounted on horizontal, vertical and inclined parts of the pipeline. Horizontal installation is the best option.

Flowmeter shall be installed so that flow tube is filled with medium and indicator arrow match flow direction. Installation recommendation are presented in table 2.2

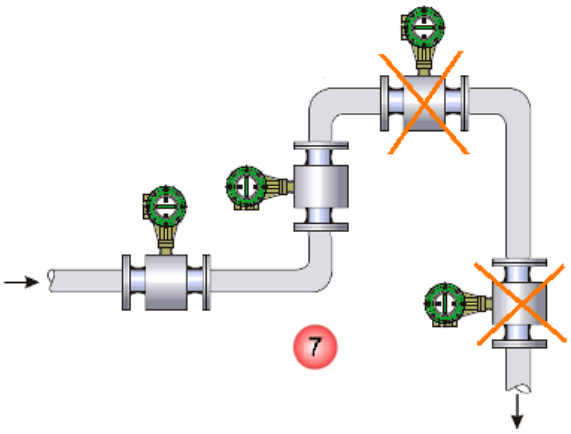
Table 2.2 - Installation recommendations

EMIS-MAG 270

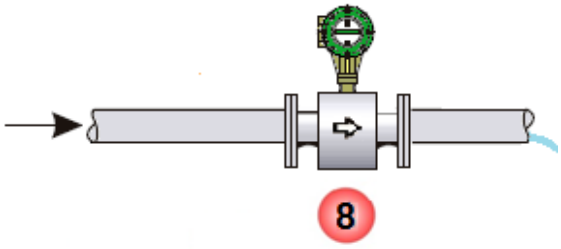
Name	Description
	1) Straight run requirements: not less than 5Dn before and 3Dn after place of installation
	2) for vertical or inclined installation, choose upstream part for better filling of the flow tube
	3) if discharge pipe is located 5 meters lower than the flowmeter, install exhaust valve at the highest position of the downstream.
	4) for bending pipes, choose lower part for installation
	5) It is not recommended to install the flowmeter near the pump after which the gate valve is installed.



6) It is not recommended to install the flowmeter near the pump inlet.



7) It is recommended to install flowmeter at the horizontal or vertical upstream parts of the pipeline. It is not recommended to install flowmeter at the highest point of the pipeline (to avoid gas accumulation inside the flow body) or vertically in downstream pipe.



8) It is prohibited to install the flowmeter in the horizontal pipe prior to freely falling of the stream, otherwise the measuring pipe will not be filled enough.

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 Annex A);
- remove protection rings, if any (see table 1.13)

Attention!

It is prohibited to install spiral wound gaskets without protective rings to avoid lining damage.

Installation of spiral wound gaskets allowed upon agreement with manufacturer provided that protective rings installed.

- cut the pipeline of L length

$$Linst = Lflm + 2*Lgas + 2*Lcfl, \quad (6)$$

where Linst - installation length of flowmeter (see protection ***Annex A***);

Lgas - gasket width;

Lfl- counter flange width after deduction of installation length;

- use mounting coupling to align flanges, them weld them to the pipeline.

Attention!

Flowmeter can be used as mounting coupling only if it is welded by gas welding.

Installation place shall look as it shown in fig.2.2, where L is the sum of the flowmeter length and gaskets width.

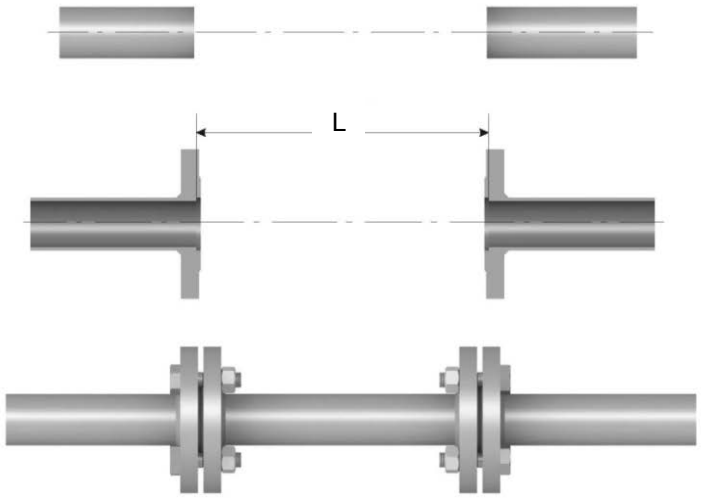


Fig.2.2 - Pipeline preparation

2.3.4 Pipe body preparation and flowmeter mounting

Please follows the steps below before installation:

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

To install the flowmeter proceed the following steps (fig.2.3):

- rotate the flowmeter so that the arrow on the body match normal flow direction;
- insert the screws into the counter flange of the pipeline and flowmeter flange, put the washers and turn the nuts. Do not tighten them.
- install gasket between counter flange and flowmeter flange, align it. It is recommended to avoid gasket protrusion inside the pipeline;
- put the gasket at another flange,insert the screws into the counter flange of the pipeline and flowmeter flange, put the washers and screw the nuts. Do not tighten the nuts;
- Tighten the nuts in sequence as shown in fig.2.4. Tightening force for flange bolts is presented in table 2.3;

Table 2.3 - Max tightening torque for flange bolts

Size, mm	Max pressure of medium, MPa	Max tightening torque, N-m
15	1,6-4	5,7
20	1,6-4	9,6
25	1,6-4	11
32	1,6-4	19
40	1,6-4	25
50	1,6-4	31
65	1,6-4	21
80	1,6-4	25
100	1,6-4	30
125	1,6-4	40
150	1,6-4	47
200	1,6	45
250	1,6	78
300	1,6	105
350	1,6	115
400	1,6	120
450	1,6	125
500	1,6	130
600	1,6	145
700	1,0	163
800	1,0	219
900	1,0	205
1000	1,0	261

- for remote version, transmitter can be mounted to the mounting stand, pipe or wall (see Annex B)

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

Fig.2.3 - Installation of EMIS-MAG 270 in the pipeline

Table 2.4 - Legend for fig.2.3

NO in fig.	Description
1	Flowmeter flanges
2	Counter flange
3	Gaskets
4	Bolts
5	Nuts

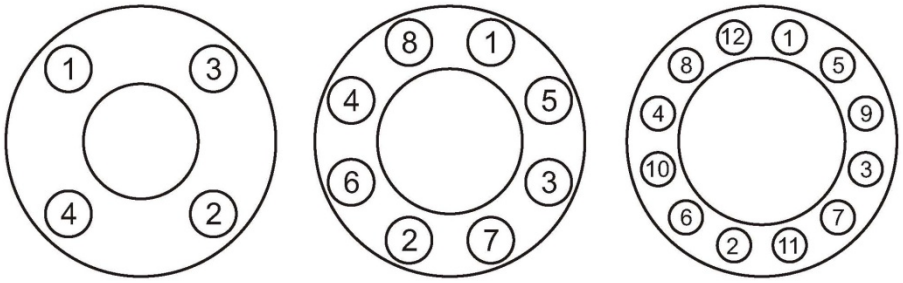


Fig.2.4 - Tightening sequence for flange bolts

2.3.5 Flowmeter rotation

If reading is impossible due to display turned out of the operator, you can rotate it to 90° or 180° until so that the display is facing the operator. Release 4 bolts (1) (see fig.2.5) Rotate transmitter (2) to 90° or 180° in necessary direction, tighten the 4 bolts to secure connection.

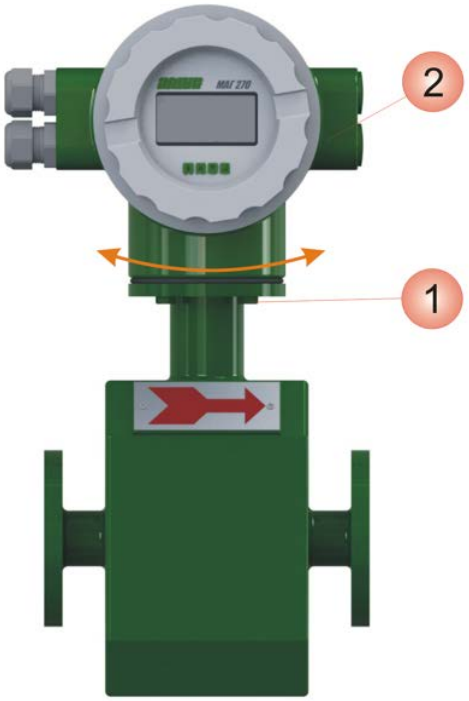


Fig.2.5 - Transmitter rotation

Attention!

To avoid wires twisting inside the transmitter, do not rotate more than 180° from initial position.

2.3.6. Heat insulation

If heat insulation shall be installed in the place of flowmeter mounting, follow the steps below:

- Heat insulation shall not stretch over the mark (see fig.2.6);
- Transmitter shall not be enclosed in boxes otherwise it can lead to overheat of electronic components.

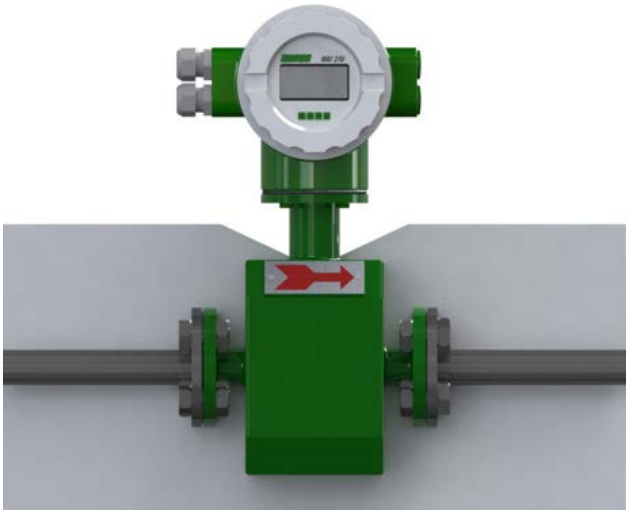


Fig.2.6 - Flowmeter heat insulation

2.4 Electrical connection

2.4.1 General directions

Electrical connection shall be executed in the sequence below (see fig.2.7):

- release cover (1) of the transmitter on the transmnitter back;
- carry the signal cable (2) and power cable (7) through the cable glands (3);
- release screws of the terminal block 4;
- arrange connection according to connection diagram **in Annex** C.
- 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 transmitter cover.

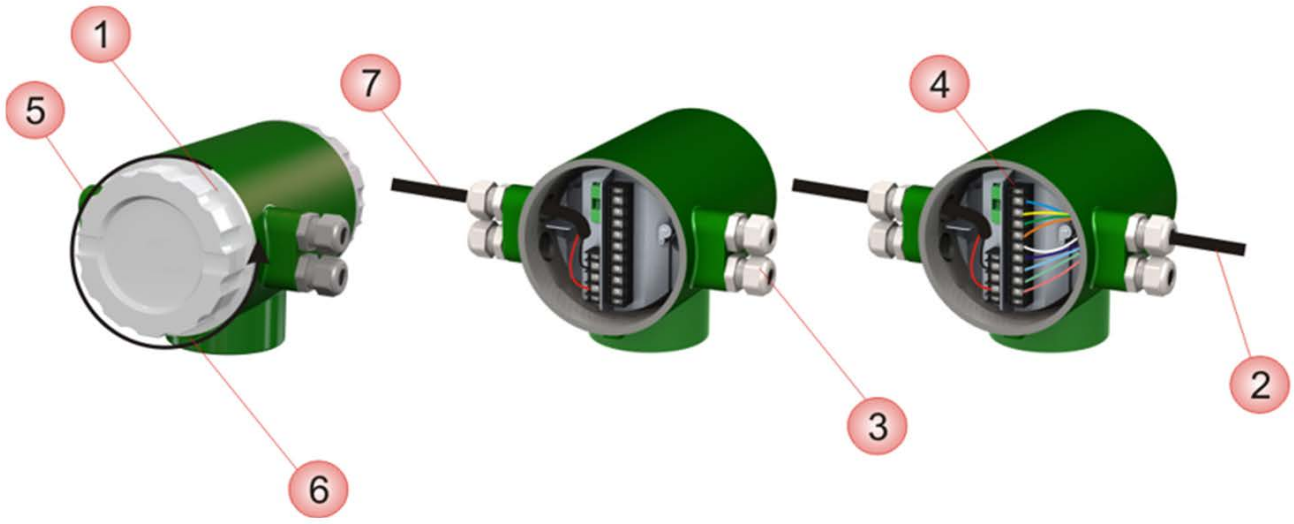


Fig.2.7 - Transmitter connection

Table 2.5 - Legend for fig.2.7

NO in fig.	Description
1	Transmitter cover
2	Signal cable
3	Cable glands
4	Terminal block
5	Cable glnad plug
6	Ground clamp
7	Power cable

INFORMATION
Flowmeter is supplied with cable gland of 7 to 14 mm size as standard. Cable gland for cables hose of 9.4 to 14 mm size can be supplied. Metal hose types: РЗЦП, РЗЦХ, МРПИ.

Power cable length shall not exceed 100m with wire size not less than 0,8mm^2.
Use twisted wire cable for connection to current and pulse outputs. Cable length shall not exceed 100m with wire size not less than 0,5mm^2.
For remote version, transmitter and sensor are connected with 9-wire shielded cable (or 2 cables of 2 and 3 wires) of max 50m length/

Connection diagrams are shown in ***Annex* C**.

Attention!

For installetion in explosive enironment strictly follow the rules listed in clause 2.4.2 Explosion protection while mounting.

INFORMATION

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

You can request for the library of connection schemes including standard cases and equipment in your region.

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 30852.0;
- GOST 30852.1;
- GOST 30852.10;
- instructions BCH332-74/MMCC (Installation of electrical equipment, power and lighting systems in explosive environment);
- any other corporate normative documents.
- Coal Mine Safety Regulations
- Mining and Solid Minerals Processing Safety Regulations

Pay attention to special rules listed in clause 1.4 Explosion protection.

Carefully check flowmeter 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.

Plug unused cable glands with the plug supplied or any other plug certified under GOST 30852.1.

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

PB version flowmeters installation shall be executed according to the requirements of the present Manual and ex-proof enclosure installation instruction supplied in kit.

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 fault between cables and to the frame;
- use different power suppliers for flowmeter and its output signals or multichannel supplier wiht galvanically separated 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 body is grounded to the sensor body.

2.4.4 Ingress protection

Flowmeter protection level complies with IP65 under GOST 14254.

After electrical mounting or maintenance is finished, follow the steps below to ensure required protection level:

- 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 it from moisture.
- Do not install the flowmeter in such a way that the cable entries are arranged vertically upwards.

Fig.2.8 - 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 flowmeter. To protect equipment from such phenomena connect grounding terminal of the terminal block to the earth using heavy-current wires.

Use the grounding wire not less than 2,5mm^2 size. Grounding wires shall be as short as possible and have a resistance of no more than 1 Ohm.

Transmitter can be grounded to the pipeline if the pipeline is also grounded.

Check for grounding wire before installation. In the presence of adverse external factors, it is necessary to ground the device according to fig. 2.9.

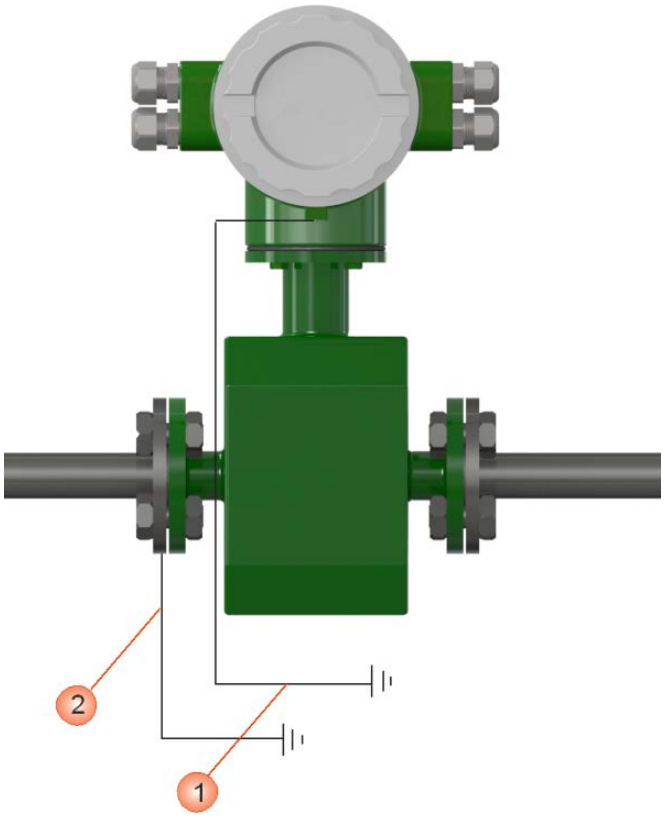


Fig.2.9 - Flowmeter grounding

Table 2.6 - Legend for fig.2.9

NO in fig.	Description
1	Transmitter grounding wire
2	Sensor grounding wire (wire size not less than 2,5mm^2, wire installation depth not less than 5m)

If the flowmeter is installed on the metal pipeline, check pipeline internal surface for rust, oxidation, paint or any other foreign matters.

Grounding of the flowmeters installed in PVC or any other plastic pipelines, painted pipeline or the pipelines with lined internal surface, shall be executed as shown in fig.2.10 by connecting two flowmeter flanges with grounding ring.

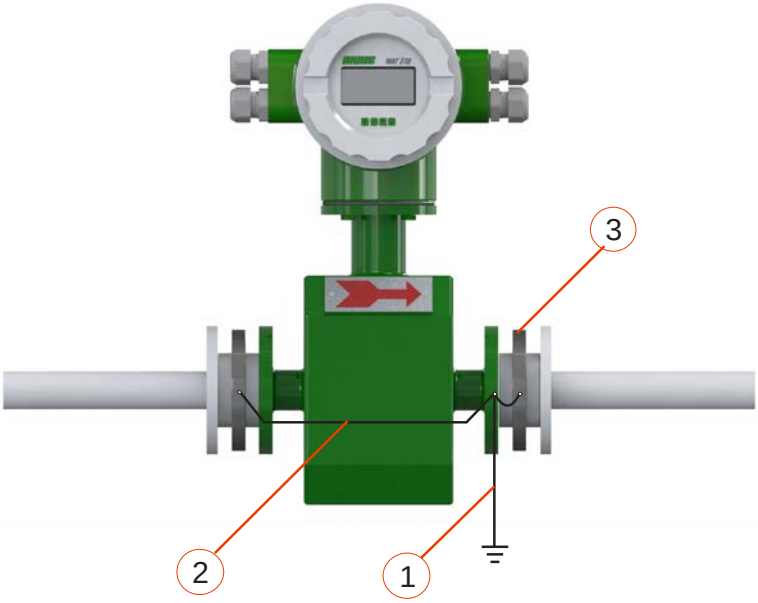


Fig.2.10 - Flowmeter grounding

Table 2.7 - Legend for fig.2.10

NO in fig.	Description
1	Sensor grounding wire (resistance R<10Ohm)
2	Flowmeter grounding wire
3	Grounding ring

If the flowmeter is installed in the pipeline with cathode protection, flowmeter flanges shall be wrapped with grounding wire as shown in
fig.2.11 provided that the flowmeter is isolated from the pipeline. Does not execute flowmeter grounding.

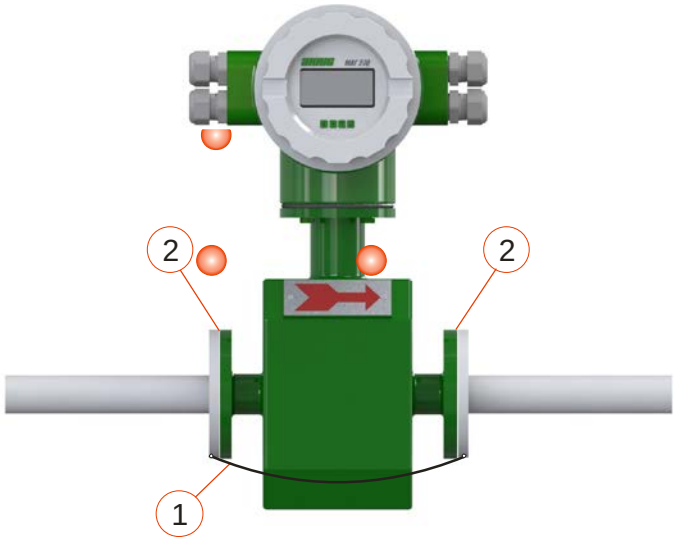


Fig.2.11 - Flowmeter grounding

Table 2.8 - Legend for fig.2.11

NO in fig.	Description
1	Grounding wire
2	Insulation (includes insulating washers, bushings and flange gaskets)

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 Flowmeter start/stop

After power is ON, the flowmeter starts diagnostics and, if successfully done, goes to measuring mode: measures flow, volume flow, generates signals and display metered values.

2.5.2 Measurement mode

Display is shown in fig.2.12.

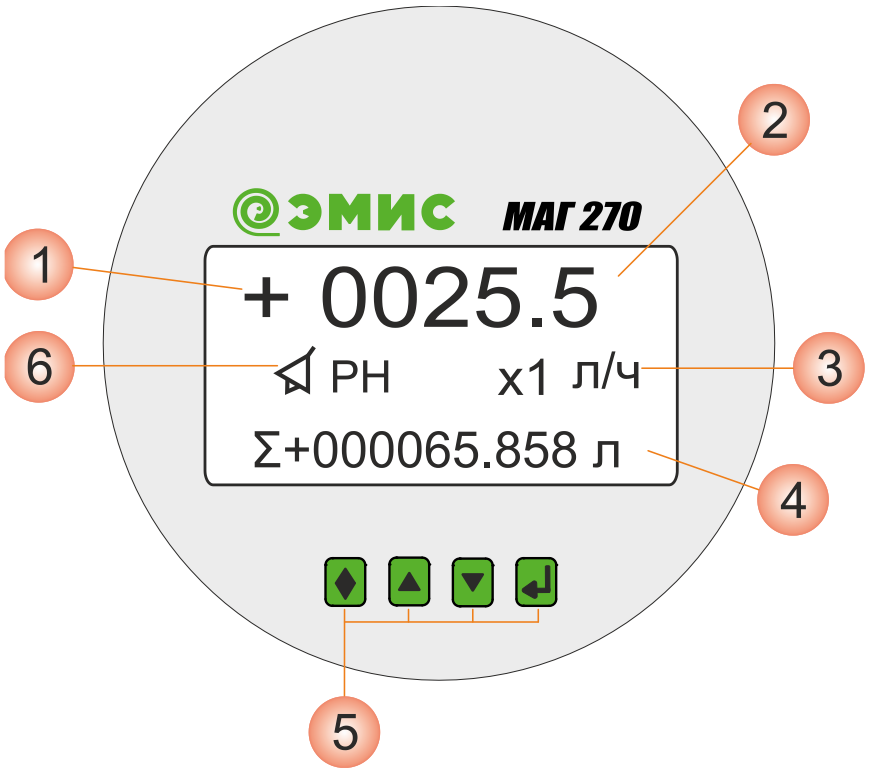


Fig.2.12 - Display view

Table 2.9 - Legend for fig.2.12

NO in fig.	Description
1	Flow direction mark "+" direct flow "-" reverse flow
2	Current flow
3	Measuring unit
4	Service line (see table 2.10)
5	Buttons (see table 2.12)
6	Service messages (see table 2.11)

Press ▼ button to go between service line parameters. Service line elements are listed in table 2.10.

Press buttons ↟ and ↲ simultaneously to go to adjustment mode. Adjustment mode menu is described in clause 2.5.3 Adjustment mode

Service messages are shown in table 2.11

Table 2.10 - Service line parameters

Parameter	Indication		Description
Approx. flow velocity	Velocity	XX.XXX m/s	Approx flow velocity value, m/s
Current flow in %	Flow	XXX.XXX %	Current flow value as % of the full range Upper limit defined as 100%
Conductivity coefficient	C conductivity	XXXXX	Medium conductivity coefficient
Max flow alarm	Flow is higher		Max flow alarm is On (menu line 24, table 2.13)
Min flow alarm	Flow is lower		Min flow alarm is On (menu line 26, table 2.13)
Empty pipe detection	Empty pipe is On		Empty pipe alarm is activated (menu line 22 table 2.13)
	Empty pipe is Off		Empty pipe alarm is off (menu line 22 table 2.13)
Sensor power supply	Sensor power is Off		Sensor POWER OFF
	Sensor power OK		Sensor power supply is standard
Pipe filling	Pipe filled		Pipe is filled with medium
Direct flow totalizer;	∑+	XXXXXXX.XX units	Accumulated direct flow since power is On not considering totalizer factor .*[2]
Reverse flow totalizer;	∑-	XXXXXXX.XX units*	Accumulated reverse flow since power is On not considering totalizer factor .*[2]
Total difference	∑D	XXXXXXX.XX units*	Difference between accumulated direct and reverse flow since power is On not considering totalizer factor .*[2]

* - unit is set up in menu line 16, table 2.13

*[2] - total flow volume ***Vt calculated as follows:***

$$V_t = V_d \times k_V \quad (7)$$

where

V_d ***- displayed value***

k_V - totalizer factor (see menu line 16, table 2.13)

Table 2.11 - Service messages

Indication	Description
PB	Current flow is higher than max limit
PH	Current flow is lower than min limit
PT	Empty pipe alarm
НП	Sensor POWER OFF

2.5.3 Adjustment mode

Fig.2.13 shows adjustment mode menu structure Description is presented in table 2.13.

Use buttons as shown in table 2.12 to go between menu lines and for changes.

Table 2.12 - Buttons description and hot keys

Action	Description
▼	• Move between service line parameters in adjustment mode. • Move down between menu lines in adjustment mode. • Decrease parameter value by unit.
▲	• Move up between menu lines in adjustment mode. • Increase parameter value by unit.
↵	• Enter any menu line or save parameter change.
▼ + ▼	• Move cursor to the right for parameter change or for password entry.
▼ + ▲	• Move cursor to the left for parameter change or for password entry.
▼ + ↵	• Enter adjustment mode • Password confirmation
Long press ↵	• Exit to measurement mode

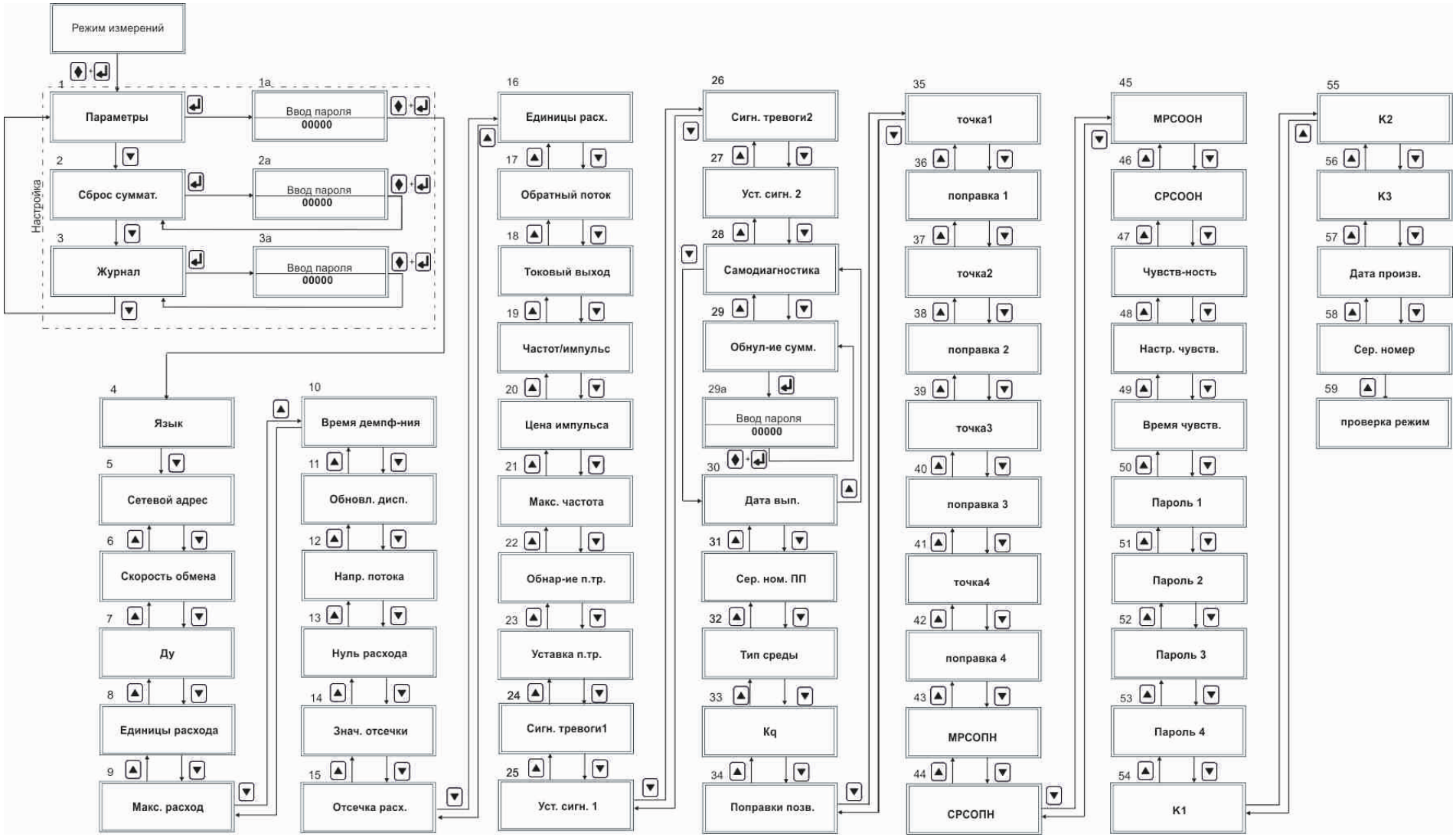


Fig.2.13 - Adjustment mode menu structure

Table 2.13 - Menu description

Menu line	Parameter	Indication	Move buttons	Menu description
Sub-menu in adjustment mode				
Long press of ↵ (around 10sec) for exit from adjustment mode to measuremtn mode.				
1	Parameter	Parameter	▼2 ↵1a	Press ▼ or▲ to move between Adjustment menu lines. Press ↵ and enter the password to move to Parameters menu.
1a	Enter password	XXXXX	‹ + ↵ password confirmation	See clause ***2.5.3.5 Passwords.***
2	Totalizer zeroing mode	Totalizer zeroing	▼3, ↵4	See clause ***2.5.3.1 Totalizer zeroing***
2a	Enter password	XXXXX	‹ + ↵ password confirmation	See clause ***2.5.3.5 Passwords.***
3	Change log	Log	▼1 , ↵enter	Check coefficient change history see clause 2.5.3.2 Change log

Line line	Parameter	Indication		Move buttons	Menu description	Password level
Parameters sub-menus						
Long press of ↵ (around 10sec) for exit from Parameters menu to adjustment mode.						
4	Language	Language	Russian	▼5, ↵- change	Selected language- Russian	2
5	Network address	Network address	XX	▼6, ▲ 4 ↵- change	Enter flowmeter address in the data bus. *Range:0-99*	2
6	Data speed	Data speed	300; 600; 1200; 2400; 4800; 9600; 19200; 38400	▼7, ▲ 5 ↵- change	Modbus data speed (bit/s). Press ↵ to change selected parameter. Press ▼ or▲ to move to the next speed value. Press ↵ to confirm selection.	2
7	Flowmeter diameter (mm).	Dn	XXXX	▼8, ▲ 6 ↵- change	Adjust flowmeter diameter. *Range: 3-3000 mm*	2
8	Measuring units	Meas.units	m^3/h, l/s, l/min, l/h, m^3/s, m^3/min	▼9, ▲ 7 ↵- change	Select measuring units. *Range: m3/h, l/s, l/min, l/h, m3/s, m3/min*	2
9	Upper limit of flow range	Max flow	XXXXX	▼10, ▲ 8 ↵- change	Set up upper limit of the flow range for current and frequency signals. Lower limit is taken as 0. Press ▼ or▲ to change selected value. Each press changes the value by one unit. Press ↤ + ▼ to move to the right to next digit. Press ↤ + ▲ to move to the left to next digit. Press ↵ to confirm.	2
10	Interval between measurements.	Damping	XX	▼11, ▲ 9 ↵- change	Set up time between measurements. The higher the value, the more stable the signal, but data processing is low. *Range: 1-50 s*	2
11	Display update interval	Disp.update	0; 10; 15; 30; 60; 90; 120; 150; 180; 240	▼ 12, ▲ 10 ↵- change	Change display info update interval Select "0" to deactivate. *Range:0−240c*	2
12	Flow direction;	Flow dir.	Direct	▼ 13, ▲ 11	Select flow direction Flow direction- Direct	2

Line line	Parameter	Indication		Move buttons	Menu description	Password level
			Reverse	↵- change	Flow direction- Reverse	
13	Zero point adjustment	Zero flow	XXXXX	▼ 14, ▲ 12 ↵- change	Zero adjustment see ***2.5.3.3 Zero point adjustment*** Range:±*9999*	2
14	Flow cut-off	Cut-off value	XXX.XX%	▼ 15, ▲13 ↵- change	Cut-off value is set as % of upper range limit. If cut-off is active (see line 15) and flow value is lower than specified, the outputs does not indicate the flow, totalizers does not work. It is taken as empty pipe. *Range:0–99.99%*	2
15	Flow cut-off (on/off)	Flow cut-off	On Off	▼ 16, ▲ 14 ↵- change	Activates (On) or deactivates (Off) flow cut-off.	2
16	Measuring units and totalizer factor	Meas.units	0.001_l 0.01_l 0.1_l 1.0_l 0.001_m^3 0.01_m^3 0.1_m^3 1.0_m^3	▼ 17, ▲ 15 ↵- change	Select measuring units and totalizer factor k_v: • 0.001_l measuring unit l, k_v= 0,001; • 0.01_l measuring unit l, k_v= 0,01; • 0.1_l measuring unit l, k_v= 0,1; • 1.0_l measuring unit l, k_v= 1; • 0.001_m^3 measuring unit m^3, k_v= 0,001; • 0.01_m^3 measuring unit m^3, k_v= 0,01; • 0.1_$m^{3:}$ measuring unit m^3, k_v= 0,1; • 1.0_$m^{3:}$ measuring unit m^3, kv= 0,001;	2
17	Reverse flow	Reverse flow	On Off	▼ 18, ▲ 16 ↵- change	When this function is active (On), both direct and reverse flow are measured. When this function is deactivated (Off), reverse flow is not measured.	2
18	Current output	Current output	X—XX мА	▼ 19, ▲ 17 ↵- change	Select 4-20 mA or 0-10mA signal range	2
19	Frequency or pulse output	Frequency/pulse	Frequency	▼ 20, ▲ 18	Select current or pulse output signal	2

Line line	Parameter	Indication		Move buttons	Menu description	Password level
			Pulse	↵- change		
20	Pulse value	Pulse value	0.001_l 0.01_l 0.1_l 1.0_l 0.001_m^3 0.01_m^3 0.1_m^3 1.0_m^3	▼ 21, ▲ 19 ↵- change	Go to "pulse" mode in menu line 19 to set up the pulse value from the specified range *Range:* • *0.001 l/pul;* • *0.01 l/pul;* • *0.1 l/pul;* • *1.0 l/pul;* • *0.001 m^3/pul;* • *0.01 m^3/pul;* • *0.1 m^3/pul;* • *1.0 m^3/pul;*	2
21	Max frequency	Max.freq.	XXXX	▼ 22, ▲ 20 ↵- change	Select upper limit for frequency output. *Range:1–5000 Hz*	2
22	Empty pipe detection	Empty pipe det.	On Off	▼ 23, ▲ 21 ↵- change	Activate (On) or deactivate (Off) empty pipe detection. If empty pipe is detected, the service message will come out in the display.	2
23	Empty pipe value	Emp.pipe.val.	XXXXX	▼ 24, ▲ 22 ↵- change	Select empty pipe alarm value. Empty pipe value adjustment is described in ***2.5.3.4***. *Range:0–59999*	2
24	Alarm (max)	Alarm 1	On Off	▼ 25, ▲ 23 ↵- change	Activate/deactivate max alarm value	2
25	Max value of emergency signal.	Alarm val. 1	XXX.XX%	▼ 26, ▲ 24 ↵- change	Max alarm value is defined as % of the flow range upper limit. Alarm signal is generated when the flow reaches the level higher than specified. *Range:0–99.99 %*	2
26	Alarm (min)	Alarm 2	On	▼ 27, ▲ 25	Activate/deactivate min alarm value	2

Line line	Parameter	Indication		Move buttons	Menu description	Password level
			Off	↵- change		
27	Min alarm value	Alarm val. 2	XXX.XX%	▼ 28, ▲ 26 ↵- change	Min alarm value is defined as % of the flow range upper limit. Alarm signal is generated when the flow reaches the level lower than specified. *Range:0–99.99 %*	2
28	Diagnostics	Diagnostics	On Off	▼ 29, ▲ 27 ↵- change	Activate (On) or deactivate (Off) system diagnostics (active by default). If activated, the service message will come out of the display, if any damage in supply circuit is detected.	2
29	Totalizer zeroing	Tot.zer.	XXXXX	▼ 30, ▲ 28 ↵29a	Reset totalizer Re-enter the password in the menuTotalizer zero	3
29a	Enter password	XXXXX		-	See clause ***2.5.3.5 Passwords***	3
30	Date of manufacturing	DOM	XXXXX	▼ 31, ▲ 29 ↵- change	Service parameter	4
31	Serial number	Ser.No PP	XXXXX	▼ 32, ▲ 30 ↵- change	Service parameter	4
32	Medium type	Medium type	Type X	▼ 33, ▲ 31 ↵- change	The flowmeter has three modes with different excitation frequency. Type 1 - common and suitable for most cases. Type 2 and type 3 - with low excitation frequency, suitable for bigger Dn for water measurement. Use type 2 or type 3 for zero flotation cases. Measure the same medium as the flowmeter was calibrated to. *Range:1–4*	4

Line line	Parameter	Indication		Move buttons	Menu description	Password level
33	Calibration factor	Kq	X.XXXX	▼ 34, ▲ 32 ↵- change	Calibration factor is set by the manufacturer This factor shall not be changed without calibration. *Range:0–5.9999*	4
34	Activate Correction mode	to	On Off	▼ 35, ▲ 33 ↵- change	Activate Correction mode . This factor shall not be changed without calibration.	5
35	Correction point 1	Corr.point 1	XX.XXX	▼ 36, ▲ 34 ↵- change	Set correction point in m/s. This factor shall not be changed without calibration.	5
36	Correction factor 1	Correction value 2	X.XXX	▼ 37, ▲ 35 ↵- change	Activate Correction mode . This factor shall not be changed without calibration.	5
37	Correction point 2	Correction point 2	XX.XXX	▼ 38, ▲ 36 ↵- change	Set correction point in m/s. This factor shall not be changed without calibration.	5
38	Correction factor 2	Correction value 2	X.XXX	▼ 39, ▲ 37 ↵- change	Activate Correction mode . This factor shall not be changed without calibration.	5
39	Correction point 3	Correction point 3	XX.XXX	▼ 40, ▲ 38 ↵- change	Set correction point in m/s. This factor shall not be changed without calibration.	5
40	Correction factor 3	Correction value 3	X.XXX	▼ 41, ▲ 39 ↵- change	Activate Correction mode . This factor shall not be changed without calibration.	5
41	Correction point 4	Correction point 3	XX.XXX	▼ 42, ▲ 40 ↵- change	Set correction point in m/s. This factor shall not be changed without calibration.	5
42	Correction factor 4	Correction value 3	X.XXX	▼ 43, ▲ 41 ↵- change	Activate Correction mode . This factor shall not be changed without calibration.	5
43	Least significant digit of	LSDDFT	XXXXX	▼ 44, ▲ 42	Allows to change least significant digits of direct flow	4

Line line	Parameter	Indication		Move buttons	Menu description	Password level
	direct flow totalizer			↵- change	totalizer. Least significant digits are the last 5 digits of the totalizer. *Range:00000–99999* *Enter the password.*	
44	High order digits of direct flow totalizer	HODDFT	XXXX	▼ 45, ▲ 43 ↵- change	Allows to change high order digits of direct flow totalizer. High order digits are the first 4 digits of the totalizer. *Range:00000–9999* *Enter the password.*	4
45	Least significant digits of reverse flow totalizer	LSDRFT	XXXXX	▼ 46, ▲ 44 ↵- change	Allows to change least significant digits of reverse flow totalizer. Least significant digits are the last 5 digits of the totalizer. *Range:00000–99999* *Enter the password.*	4
46	High order digits of reverse flow totalizer	HODRFT	XXXX	▼ 47, ▲ 45 ↵- change	Allows to change high order digits of reverse flow totalizer. High order digits are the first 4 digits of the totalizer. *Range:00000–9999* *Enter the password.*	4
47	Inclusions sensitivity	Sen-ty	On Off	▼ 48, ▲ 46 ↵- change	Activate (On) or deactivate (Off) inclusion sensitivity adjustment for slurries and mediums with significant volume of solid particles. If activated, it helps to compensate for the effect of inclusions on the measurement, by recalculating.	4
48	Sensitivity adjustment	Sens.adj.	X.XXXm/s	▼ 49, ▲ 47 ↵- change	Using ten coefficients of velocity, you can set up inclusion sensitivity for mediums with significant inclusions. Smaller coefficient provides higher accuracy. Optimal value is set up by default. *Range:0.010–0.800м/с*	4

Line line	Parameter	Indication		Move buttons	Menu description	Password level
49	Sensitivity period	Sens.period	XXXXms	▼ 50, ▲ 48 ↵- change	Optimal time for reliable output signal from electrodes. Optimal value is set up by default. *Range:400–2500ms*	4
50	Password of the 1st level	Password 1	XXXXX	▼ 51, ▲ 49 ↵- change	Allow to change password of the 1st level. Available after entering the password of the 5th level. *Range:00000–99999*	5
51	Password of the 2nd level	Password 2	XXXXX	▼ 52, ▲ 50 ↵- change	Allow to change password of the 2nd level. Available after entering the password of the 5th level. *Range:00000–99999*	5
52	Password of the 3rd level	Password 3	XXXXX	▼ 53, ▲ 51 ↵- change	Allow to change password of the 3rd level. Available after entering the password of the 5th level. *Range:00000–99999*	5
53	Password of the 4th level	Password 4	XXXXX	▼ 54, ▲ 52 ↵- change	Allow to change password of the 4th level. Availble after entering the password of the 5th level. *Range:00000–99999*	5
54	K1	K1	X.XXXX	▼ 55, ▲ 53 ↵- change	Zero flow current adjustment factor for current output. If zero flow current I_o if different from 4mA then update K1 factor. Updated value$K1_{нов}$ is calculated as follows: $$K1_{нов} = K1_{ст} \cdot (4/I_o)$$ where $K1_{ст}$ - present value of K1.	5
55	K2	K2	X.XXXX	▼ 56, ▲ 54 ↵- change	Max flow current valuefor current output (max flowe can be adjusted in Menu line 9). If max flow current I_{max} if different from 20mA then update K2 factor. Updated value$K2_{нов}$ is calculated as follows: $$K2_{нов} = K2_{ст} \cdot (20/I_{max})$$ where $K2_{ст}$ - present value of K2.	5

Line line	Parameter	Indication		Move buttons	Menu description	Password level
56	K3	K3	X.XXXX	▼ 57, ▲ 55 ↵- change	Service parameter	5
57	Date of manufacture	DOM	XXXXX	▼ 58, ▲ 56 ↵- change	Service parameter	5
58	Serial number	Ser.No	XXXXX	▼ 59, ▲ 57 ↵- change	Service parameter	5
59	Check mode	Check mode	No parity Add parity Even parity	▲ 58 ↵- change	Service parameter	5

2.5.3.1 Totalizer zeroing

For totalizer zeroing proceed the following:

- Move from measurement mode to adjustment mode by pressing ◖ + ↵;
- Go to Parameters (see line 1, table 2.13);
- Enter 3rd level password in line 29 (see table 2.13);
- Exit Parameters to measurement mode by long pressing (around 10sec) of ↵;
- Enter to totalizer zeroing mode (Tot.zer.) (see line 2, table 2.13);
- Enter 3rd level password in line 2a (see table 2.13);

2.5.3.2 Change log

Change log writes the history of coefficient changes. Log view is shown in fig.2.14. Figure description is presented in table 2.14.

Press ▼ и ▲ to move between log (5) pages.

To view previous coefficients move to earlier pages.

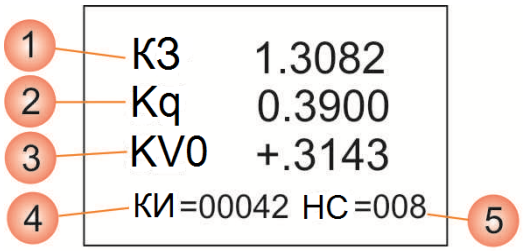


Fig.2.14 - Change log

Table 2.14 - Change log

NO in fig.	Description
1	Service parameter
2	Calibration factor
3	Zero point adjustment
4	Number of coefficient changes
5	Page No

Change log writes updated values of coefficients (1) and (2), zero flow adjustment factor entered by an operator.

Number of changes (4) shows how many times the coefficient was changed. Once one coefficient is changed, number of changes decreases by one.

In fig.2.14 the number of changes is 42.

2.5.3.3 Zero point adjustment

Zero flow is set up at the calibration unit by the manufacturer.

Zero flow defines the flow velocity when there is no flow inside the flow tube.

To adjust the zero flow proceed the following:

- switch on the flowmeter and idle it during 30min to preheat;
- fill it with medium;
- close the gate valve located downstream in the direction of the flow;
- make sure that the flow tube is full with medium;
- close the gate valve located upstream in the direction of the flow;
- make sure that there is no flow inside;
- move to line 13 (see table 2.13);

Adjustment menu is shown in fiig.2.15.

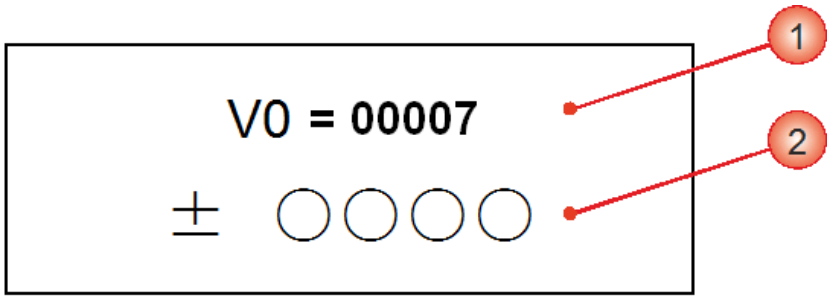


Fig.2.15 - Zero flow adjustment menu

Table 2.16 - Legend for fig.2.15

NO in fig.	Description
1	Zero flow, mm/s
2	Zero point adjustment

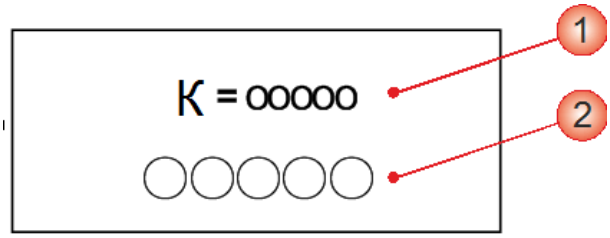
- change zero point adjustment value to adjust zero flow within the specified range. Press display buttons to change zero flow. Press ⊦+▼ to move to the next digit to the right. Press ⊦+▲ to move to the next digit to the lefft. Press ▼ or▲ to change selected value. The same way you can choose the adjustment sign: «+» or «-».
- Press ↵ to exit adjustment mode after zero point correction is done.

2.5.3.4 Empty pipe detection adjustment

To set up the empty pipe detection value proceed the following:

- switch on the flowmeter and idle it during 30min to preheat;
- fill it with medium;
- move to line 23 (see table 2.13);
- enter conductivity factor for full pipe;
- enter the value provided that it 3 times smaller than full pipe conductivity factor.

Adjustment menu is shown in fig.2.16.



Flg.2.16 - Empty pipe detection value

Table 2.17 - Legend for fig.2.16

NO in fig.	Description
1	Medium conductivity coefficient
2	Empty pipe value

Once conductivity factor reaches the value smaller than specified value, the service message ПТ. is displayed.

Press ▼ or▲ to change selected value. Each press changes the value by one unit. Press + ▼ to move to the next digit to the right. Press +▲ to move to the next digit to the left.

2.5.3.5 Passwords

Flowmeter parameters are protected from change by passwords of different levels.

Table 2.18 - Passwords

Password level	Description	Description
1	00521	Allows to change menu line 4 only.
2	03210	Allows to change menu lines 4-28.
3	06108	Allows to reset totalizer
4	07206	Allows to change 4-40 menu lines.
5	09454	Allows to change menu lines 4-49.

For password change, press ▼ or▲ to change selected value. Each press increase the value by one unit. Press + ▼ to move to the right to next digit. Press +▲ to move to the left to next digit. After password is changed, press +↵.

2.5.4 Maintenance

Flowmeters in service require periodical inspection:

- observation of operating conditions;
- power supply and its compatibility with parameters specified in thge clause Power supply and output signals ;
- visibility of plates and other marking signs;
- absence of dirt on the external surfaces;
- connections sealing;
- visible damages.

Inspection interval depends on the operating conditions and shall be scheduled by the service party upon the agreement with operating party. In case of failure follow the instructions in Diagnostics and troubleshooting.

Periodic inspection of the sensor internal channel for dirt and rust shall be provided at least once a year. Light brown residue is allowed if it can be easily removed with wet cloth.

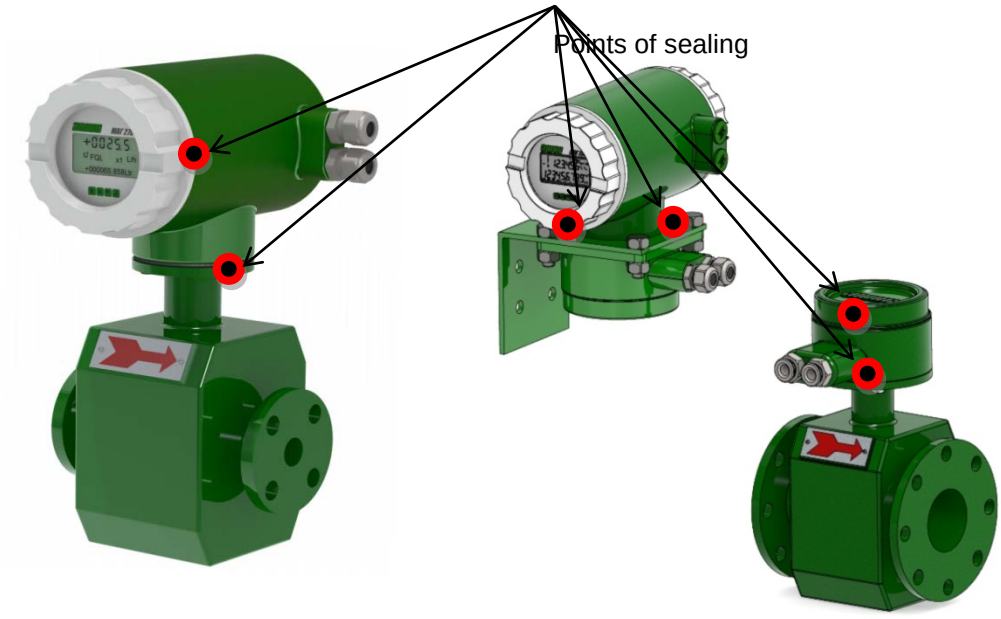
In the presence of contamination and / or debris of another type or their substantial thickness, it is necessary to clean the surface with water, clean cloth and non-abrasive detergents immediately after removing the flowmeter from the pipeline.

Attention!

Violation of operating conditions may cause flowmeter failure or measuring errors.

2.5.5 Sealing

Sealing shall be done to avoid unauthorized access to transmitter and parameters change. Points of sealing are shown in fig.2.17.



Integral version Remote version

Fig.2.17 - Flowmeter sealing

2.5.6 Diagnostics and troubleshooting

Possible failures and troubleshooting are presented in table 2.19.

Table 2.19 - Troubleshooting

Failure	*Possible cause*	*Remedy*
1 Flowmeter is On, but display is not active, no signals at pulse/frequency, digital, current outputs.	Wrong connection of supply cable.	Check cable or supply wires connection according to connection diagram (***Annex C***).
	Supply cable break	Check and replace supply cable or wires, if they are broken.
	Supply voltage does not comply with the manual.	Check power supply unit and adjust voltage according to the manual.
2 With real flow in the pipe, the state of the flowmeter output signals corresponds to zero flow.	The flow volume is under specified minimum level for this Dn.	Open valves at full until the flow reaches the specified flow range.
3 When the flow is zero, the flowmeter detects some flow value.	Zero flow is not set.	Adjust zero flow value according to caluse 2.5.3.3.
4 NP Alarm is displayed	No power supply to the sensor	Check sensor power supply connection.
5 EP Alarm is displayed	Flow tube is not filled with medium.	Fully open the gate valve until flow tube if filled.

Claim report example is presented in datasheet supplied with the flowmeter.

3 Transportation and Storage

3.1 Transportation

Please follow the transportation requirements:

- flowmeter shall be packed in such package to avoid mechanical damages during transportation;
- line the inner part of transportation package with water-resistant paper;
- environment temperature shall be 40 to 70°C and relative humidity up to 100 % under 35°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 flowmeters 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 flowmeter transported without package.

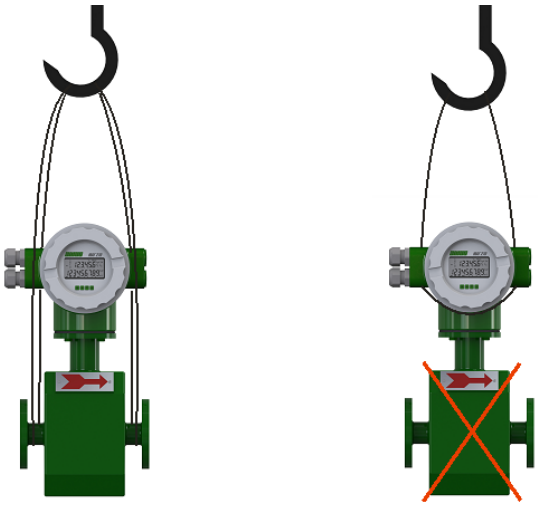


Fig.3.1 - Flowmeter transportation without package

Attention!

Usually, the center of gravity of the flowmeter is higher than the bearing points. Make sure that the flowmeter will not slide from the straps or move around the axis.

3.2 STORAGE

Flowmeter can be stored in unheated rooms with air temperature from minus 40 to plus 75 ° C and relative humidity of air up to 95% at 25 ° C without moisture condensation.

Flowmeters 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

Flowmeters does not contain hazardous materials or components dangerous to people health or the environment during service life and recycling.

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

4. LIST OF POSSIBLE FAILURES

4.1 List of possible failures (including critical)

The possible failure are:

- seal failure of the body caused by destruction;
- seal failure of the gaskets;
- loss of tightness in plug connections;
- does no comply with the requirements of the table 2-3

Flowmeter limit state criteria:

- first stage of body sealing damage (seepage, leakage);
- exceeding the maximum allowable metal defects of body parts and welding seams;
- change (decrease) of the wall thickness of body parts to the minimum allowed by the strength calculation;
- change (decrease) of the bluff body size to the minimum allowed by the error value calculation;
- failure of electrodes, flowmeter coils;
- violation of the geometry of body parts above the maximum permissible deviations;

flow tube lining damage.

4.2 Personell mistakes leading to failure, emergency or accidents

To provide safety operation, it is prohibited to:

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

5. PERSONNEL EMERGENCY RESPONSE

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

6. LIMIT STATE CRITERIA

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

7 Calibration

Calibration shall be provided according to the Instruction. State system for ensuring the uniformity of measurements. Magnetic flowmeter EMIS-MAG 270 Calibration method".

ANNEX A
(normative)

Dimensions and connection sizes

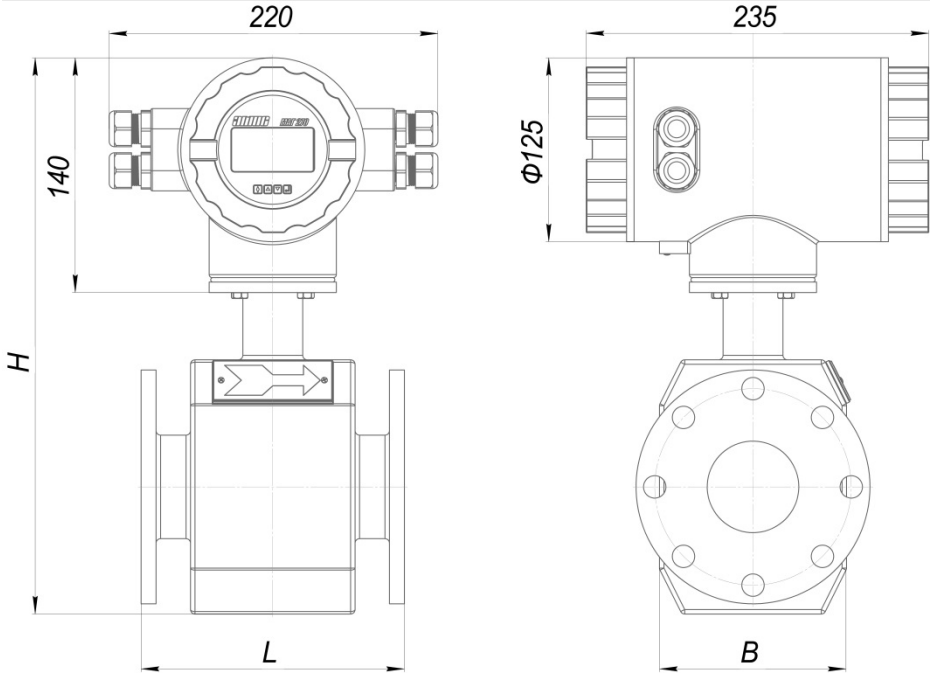


Fig.A.1 - Dimensions and connection sizes of the flowmeter (Dn 15-80mm)

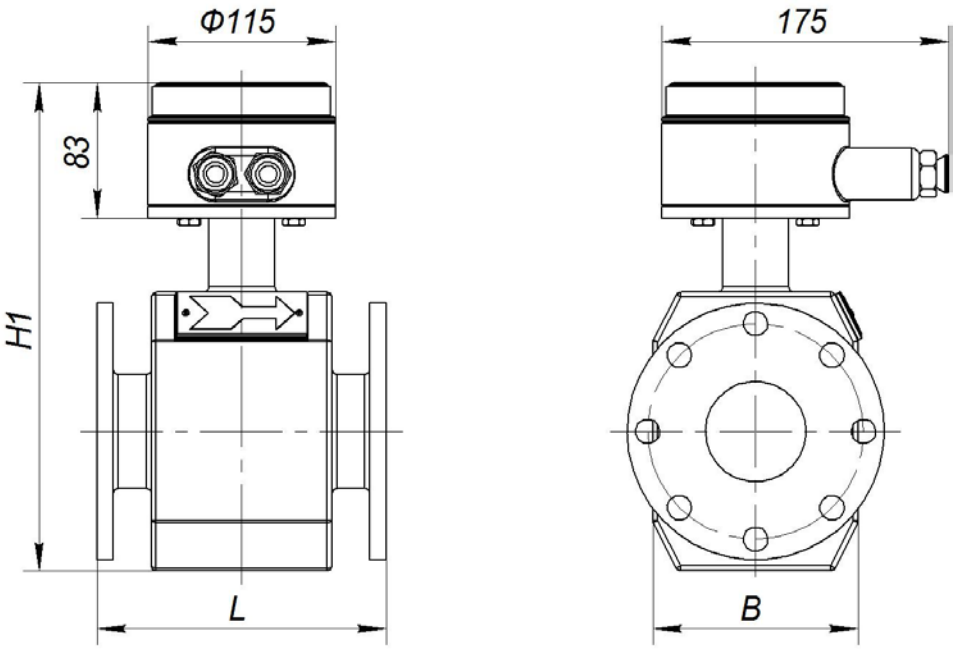


Fig.A.2 - Dimensions and connection sizes of the remote type flowmeter (Dn 15-80mm)

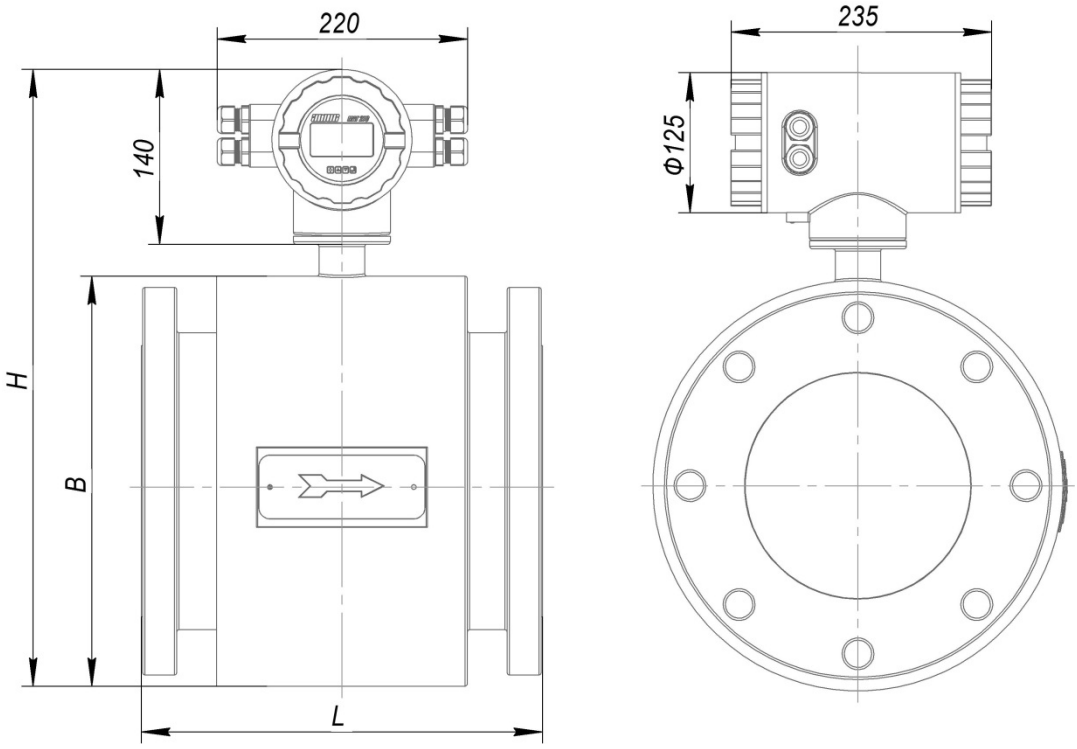


Fig.A.3 - Dimensions and connection sizes of the flowmeter (Dn ≥ 100 mm)

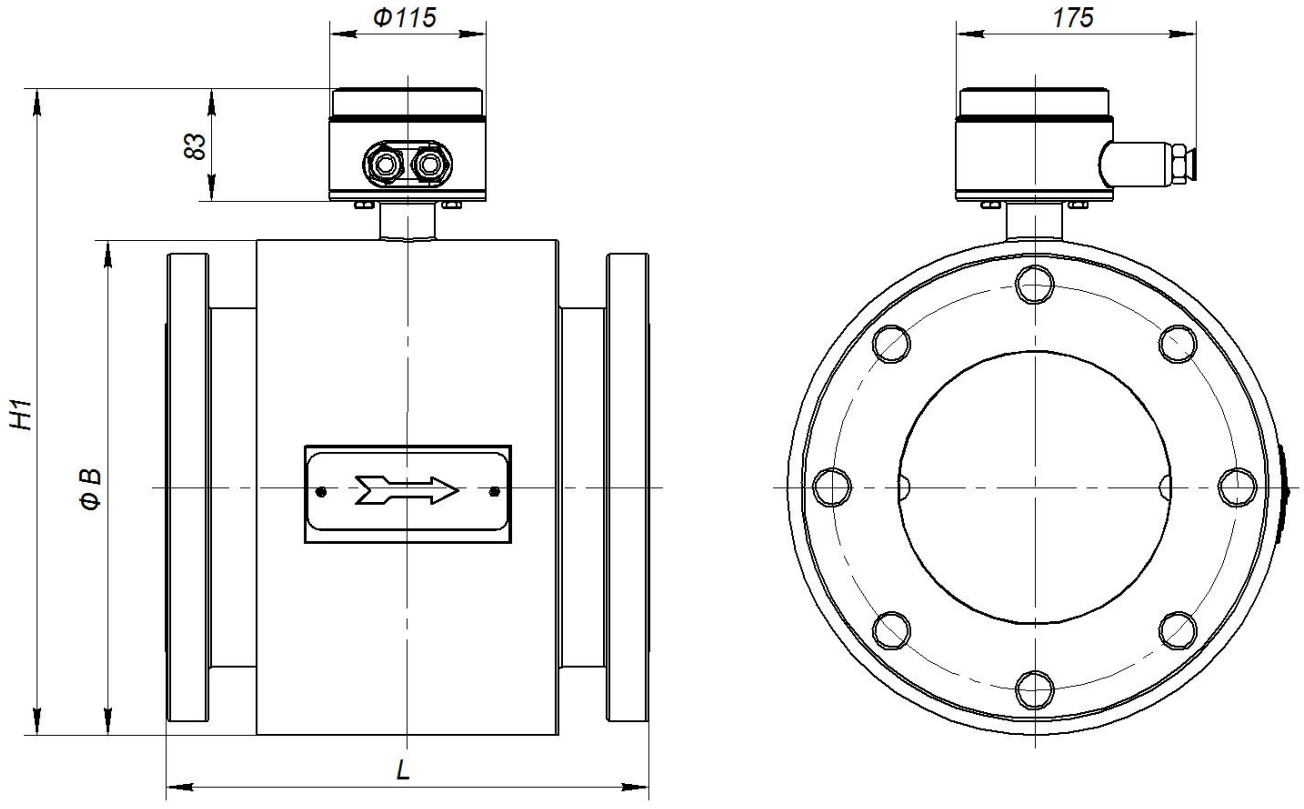


Fig.A.4 - Dimensions and connection sizes of the remote type flowmeter (Dn ≥ 100 mm)

Table A.1 - Dimensions, connections sizes and weight

Dn, mm	P, MPa	L, mm	B, mm	H, mm	H1, mm	Weight, kg
15	1,6 – 4,0	200	142	390	315	12
20		200	142	390	315	12,4
25		200	142	390	315	12,5
32		200	142	390	315	13
40		200	158	412	340	13,8
50		200	170	418	345	17
65		200	185	432	360	19,1
80		200	200	442	370	21,5
100		250	235	432	360	25
125		250	270	465	390	25,5
150		300	300	495	420	39,3
200	2,5	350	360	545	470	59
250		450	425	605	530	92
300		500	485	660	590	127
350		550	555	725	650	141
400		600	620	780	710	184

Note: Dimensions, connections sizes and weight for Dn> 450mm provided upon request.

Lining size is not included. Lining size is 2-5mm.

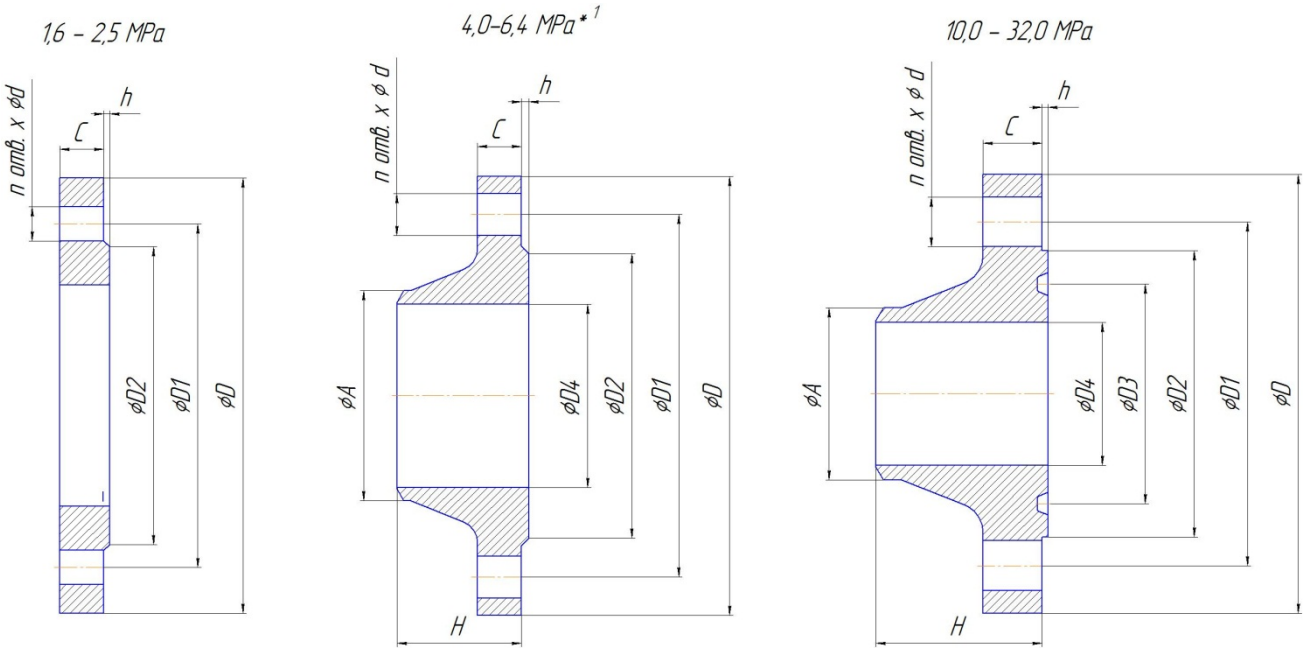


Fig. A.5 – Connection flange and mounting kit size

Table A.2 – Connection flange and mounting kit size

Dn, mm	P, MPa	A, mm	D, mm	D1, mm	D2, mm	D3, mm	D4*2, mm	C, mm	h, mm	n, count	d, mm	H, mm
15	1,6	-	95	65	45	-	19	12	2	4	14	-
	2,5	-	95	65	45	-	19	12	2	4	14	-
	4/0	19	95	65	45	-	11,5	12	2	4	14	33
	6,3	18	105	75	45	-	11,5	18	2	4	14	45
	10	21,3	95	66,7	50,5	34,14	*	14,3	5,54	4	16	52
20	1,6	-	105	75	58	-	26	14	2	4	14	-
	2,5	-	105	75	58	-	26	14	2	4	14	-
	4,0	26	105	75	58	-	18,5	14	2	4	14	34
	6,3	25	130	90	58	-	18,5	20	2	4	18	48
	10	26,9	115	82,6	63,5	42,88	*	15,9	6,35	4	19	57
25	1,6	-	115	85	68	-	33	14	2	4	14	-
	2,5	-	115	85	68	-	33	14	2	4	14	-
	4,0	33	115	85	68	-	25	14	2	4	14	36
	6,3	32	140	100	68	-	25	22	2	4	18	58
	10	33,7	125	88,9	69,5	50,8	*	17,5	6,35	4	19	62
	15	33,7	150	101,6	71,5	50,8	*	28,6	6,35	4	26	73
	25	33,7	150	101,6	71,5	50,8	*	28,6	6,35	4	26	73
	32	33,7	160	108	82,5	60,33	*	35	6,35	4	26	89

Table A.2 – Connection flange and mounting kit size (continue)

Dn, mm	P, MPa	A, mm	D, Mm	D1, Mm	D2, mm	D3,	D4*[2], mm	C, mm	h, mm	n, count	d, mm	H, mm
32	1,6	-	140	100	78	-	39	16	2	4	18	-
	2,5	-	140	100	78	-	39	16	2	4	18	-
	4,0	39	140	100	78	-	31	16	2	4	18	43
	6,3	38	155	110	78	-	31	22	2	4	22	60
	10	42,4	135	98,4	79	60,33	*	20,7	6,35	4	19	67
	15	42,4	160	111,1	81	60,33	*	28,6	6,35	4	26	73
	25	42,4	160	111,1	81	60,33	*	28,6	6,35	4	26	73
	32	42,4	185	130,2	101	72,23	*	38,1	7,92	4	29	95
40	1,6	-	150	110	88	-	46	15	3	4	18	-
	2,5	-	150	110	88	-	46	15	3	4	18	-
	4,0	46	150	110	88	-	38	15	3	4	18	45
	6,3	45	170	125	88	-	38	23	3	4	22	62
	10	48,3	155	114,3	90,5	68,27	*	22,3	6,35	4	22	70
	15	48,3	180	123,8	92	68,27	*	31,8	6,35	4	29	83
	25	48,3	180	123,8	92	68,27	*	31,8	6,35	4	29	83
	32	48,3	205	146	114	82,55	*	44,5	7,92	4	32	111
50	1,6	-	165	125	102	-	59	17	3	4	18	-
	2,5	-	165	125	102	-	59	17	3	4	18	-
	4,0	58	165	125	102	-	49	17	3	4	18	45
	6,3	57	180	135	102	-	49	23	3	4	22	62
	10	60,3	165	127	108	82,55	*	25,4	7,92	8	19	73
	15	60,3	215	165,1	124	95,25	*	38,1	7,92	8	26	102
	25	60,3	215	165,1	124	95,25	*	38,1	7,92	8	26	102
	32	60,3	235	171,4	133	101,6	*	50,9	7,92	8	29	127
65	1,6	-	185	145	122	-	78	19	3	4	18	-
	2,5	-	185	145	122	-	78	19	3	4	18	-
	4,0	77	185	145	122	-	68	19	3	4	18	50
	6,3	76	205	160	122	-	68	23	3	8	22	68
	10	76,1	190	149,2	127	101,6	*	28,5	7,92	8	22	79
	15	76,1	245	190/5	137	107,95	*	41,3	7,92	8	29	105
	25	76,1	245	190,5	137	107,95	*	41,3	7,92	8	29	105
	32	76,1	265	196,8	149	111,13	*	57,2	9,53	8	32	143
80	1,6	-	200	160	138	-	91	21	3	8	18	-
	2,5	-	200	160	138	-	91	21	3	8	18	-
	4,0	90	200	160	138	-	80	21	3	8	18	55
	6,3	89	215	170	138	-	80	25	3	8	22	72
	10	88,9	210	168,3	146	123,83	*	31,8	7,92	8	22	83
	15	88,9	240	190,5	156	123,83	*	38,1	7,92	8	26	102
	25	88,9	265	203,2	168	136,53	*	47,7	7,92	8	32	117
	32	88,9	305	228,6	168	127	*	66,7	9,53	8	35	168

Table A.2 – Connection flange and mounting kit size (continue)

Dn, mm	P, MPa	A, mm	D, mm	D1, Mm	D2, mm	D3,	D4*[2], mm	C, mm	h, mm	n, count	d, mm	H, mm
100	1,6	-	220	180	158	-	110	19	3	8	18	-
	2,5	-	235	190	162	-	110	23	3	8	22	-
	4,0	110	235	190	162	-	99	23	3	8	22	65
	6,3	108	250	200	162	-	99	27	3	8	26	78
	10	114,3	275	215,9	175	149,23	*	38,1	7,92	8	26	102
	15	114,3	290	235	181	149,23	*	44,5	7,92	8	32	114
	25	114,3	310	241,3	194	161,93	*	54	7,92	8	35	124
125	1,6	-	250	210	188	-	135	19	3	8	18	-
	2,5	-	270	220	188	-	135	25	3	8	26	-
	4,0	135	270	220	188	-	122	25	3	8	26	65
	6,3	133	295	240	188	-	122	31	3	8	30	88
	10	139,7	330	266,7	210	180,98	*	44,5	7,92	8	29	114
	15	139,7	350	279,4	216	180,98	*	50,8	7,92	8	35	127
150	1,6	-	285	240	212	-	161	21	3	8	22	-
	2,5	-	300	250	218	-	161	27	3	8	26	-
	4,0	161	300	250	218	-	146	27	3	8	26	68
	6,3	159	345	280	218	-	146	33	3	8	33	95
	10	168,3	355	292,1	241	211,12	*	47,7	7,92	12	29	117
200	1,6	-	340	295	268	-	222	23	3	12	22	-
	2,5	-	360	310	278	-	222	29	3	12	26	-
	4,0	222	375	320	285	-	205	33	3	12	30	85
	6,3	219	415	345	285	-	205	39	3	12	36	110
250	1,6	-	405	355	320	-	276	26	3	12	26	-
	2,5	-	425	370	335	-	276	32	3	12	30	-
	4,0	278	450	385	345	-	255	39	3	12	33	98
	6,3	273	470	400	345	-	255	43	3	12	36	125
300	1,6	-	460	410	378	-	328	28	4	12	26	-
	2,5	-	485	430	395	-	328	34	4	16	30	-
	4,0	330	515	450	410	-	303	48	4	16	33	112
	6,3	325	530	460	410	-	303	48	4	16	36	140

Note: Connection sizes for Dn> 350 mm are specified upon request.

** - D4 size for Pn≥10MPa indicates inner diameter of the flow tube, see table 1.2.2.*

*[1] - for pressure 4,0 flat flange is used

*[2] - size of the counter flanges

Table A.3 - Mounting kit weight, kg

Dn, mm	P, MPa			
	1,6	2,5	4	6,3
15	1,9	1,9	1,9	3,1
20	2,4	2,4	2,4	4,98
25	2,7	2,7	2,7	6,1
32	4,7	4,7	4,7	7,39
40	5,2	5,2	5,2	9,6
50	6,4	6,4	6,4	11,4
65	7,3	9,3	9,3	16,84
80	9,5	11,2	11,2	19,5
100	11,0	17,1	17,1	28,5
125	12,9	22,6	22,6	43,91
150	19,1	26,6	26,6	60,9
200	26,9	38,9	49,3	97,2
250	35,9	53,4	75,0	112
300	47,0	75,7	110	140
350	68,5	106	168	180
400	94,7	146	222	260
450	124	178	241	356
500	159	220	317	486
600	240	314	502	679

Note: Mounting kit for Dn > 600mm are provided upon request.

Table A.4 - Mounting kit parts

Parts	P, MPa	Pcs.						
		Dn, mm						
		15-40	50	65-150	200-250	300	350-400	450-600
Flanges	1,6-6.3	2	2	2	2	2	2	2
Pins*	1,6	8	8	16	24	24	32	40
	2,5	8	8	16	24	32	-	-
	4,0-6.3	8	8	16	24	32	32	40
Nuts	1,6	16	16	32	48	48	64	80
	2,5	16	16	32	48	64	-	-
	4,0-6.3	16	16	32	48	64	64	80
Washers	1,6	16	16	32	48	48	64	80
	2,5	16	16	32	48	64	-	-
	4,0-6.3	16	16	32	48	64	-	-

Note: Mounting kit parts for Dn > 600mm are provided upon request.

** - for pressure 1,6-2,5 can be supplied with bolts, number of nuts equal to the number of bolts.*

Table A.5 - Fasteners

Dn, mm	P, MPa	Pin*	Nut (wrench size)
15	1,6-4.0	M12x70	M12
	6,3	M12x80	M12
20	1,6-4.0	M12x70	M12
	6,3	M16x90	M16
25	1,6-4.0	M12x70	M12
	6,3	M16x100	M16
32	1,6-4.0	M16x90	M16
	6,3	M20x110	M20
40	1,6-4.0	M16x90	M16
	6,3	M20x110	M20
50	1,6-4.0	M16x90	M16
	6,3	M20x110	M20
65	1,6-4.0	M16x90	M16
	6,3	M20x110	M20
80	1,6-4.0	M16x100	M16
	6,3	M20x120	M20
100	1,6	M16x90	M16
	2,5-4.0	M20x110	M20
	6,3	M24x130	M24
125	1,6	M16x90	M16
	2,5-4.0	M24x120	M24
	6,3	M27x150	M27
150	1,6	M20x110	M20
	2,5-4.0	M24x130	M24
	6,3	M30x160	M30
200	1,6	M24x130	M24
	2,5	M24x130	M24
	4,0	M27x150	M27
	6,3	M33x180	M33
250	1,6	M24x130	M24
	2,5	M27x150	M27
	4,0	M30x170	M30
	6,3	M33x190	M33
300	1,6	M24x130	M24
	2,5	M27x160	M27
	4,0	M30x190	M30
	6,3	M33x210	M33

Note: Fasteners for Dn > 300mm are provided upon request.

** 1,6-2,5 MPa pressure versions are equipped with bolts.*

Table A.6 - Flange gaskets size

Dn, mm	P, MPa	Gasket GOST 15180
15	1,6-4.0	A-15-40-Фт
20	1,6-4.0	A-20-40-Фт
25	1,6-4.0	A-25-40-Фт
32	1,6-4.0	A-32-40-Фт
40	1,6-4.0	A-40-40-Фт
50	1,6-4.0	A-50-40-Фт
65	1,6-4.0	A-65-40-Фт
80	1,6-4.0	A-80-40-Фт
100	1,6	A-100-16-Фт
	2,5-4.0	A-100-40-Фт
125	1,6	A-125-16-Фт
	2,5-4.0	A-125-40-Фт
150	1,6	A-150-16-Фт
	2,5-4.0	A-150-40-Фт
200	1,6	A-200-25-Фт
	2,5	A-200-25-Фт
	4,0	A-200-40-Фт
250	1,6	A-250-16-Фт
	2,5	A-250-25-Фт
	4,0	A-250-40-Фт
300	1,6	A-300-16-Фт
	2,5	A-300-25-Фт
	4,0	A-300-40-Фт

Note: Flange gaskets size for Dn > 300mm are provided upon request.

ANNEX B
(normative)

Dimensions and connection sizes of remote type transmitter

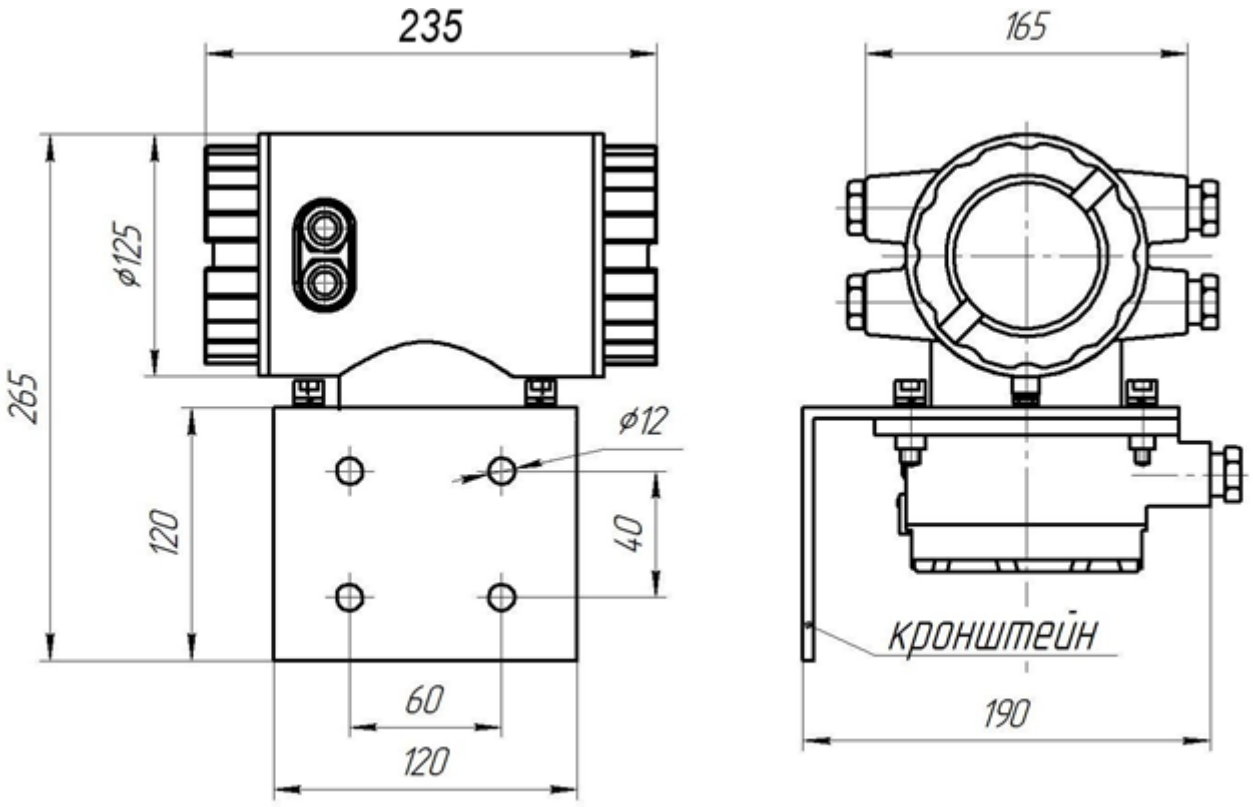


Fig.B.1 - Dimensions and connection sizes of remote type transmitter

ANNEX C
(normative)

Connection diagram

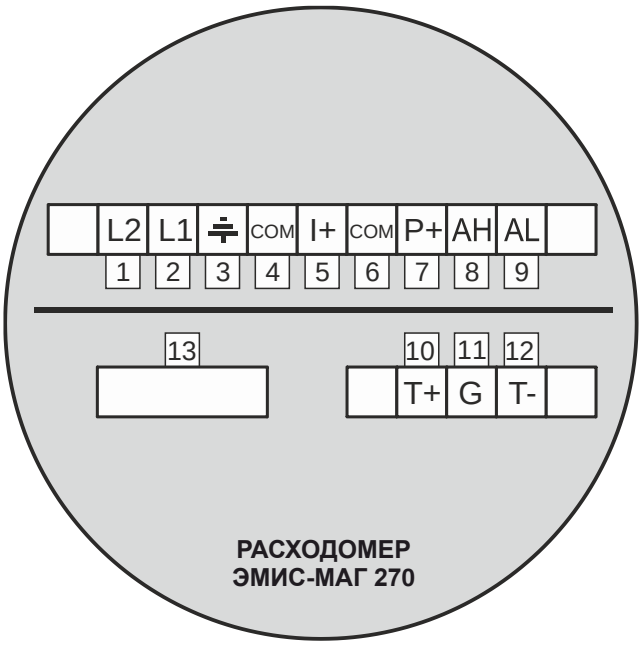


Fig.B.1 - Transmitter terminal block view

Table B.1 - Legend for fig.B.1

No	Name	Description
1	L2	Supply voltage 220V（−24V）
2	L1	Supply voltage 220V（+24V）
3	⏚	Ground clamp
4	COM	Current output (common)
5	I+	Current output(+)
6	COM	Frequency/pulse output (common)
7	P+	Frequency/pulse output (+)
8	AH	Max flow alarm (+)
9	AL	Min flow alarm (+)
10	T+	Digital output(+)
11	G	Common for RS485
12	T-	Digital output(-)
13		Fuse*

* - fuse parameters: for the flowmeter supplied from 24V DC: size 5x20mm, 4a, 250V; for the flowmeters with a supply voltage of 220V AC: size 5x20mm, 2A, 250V.

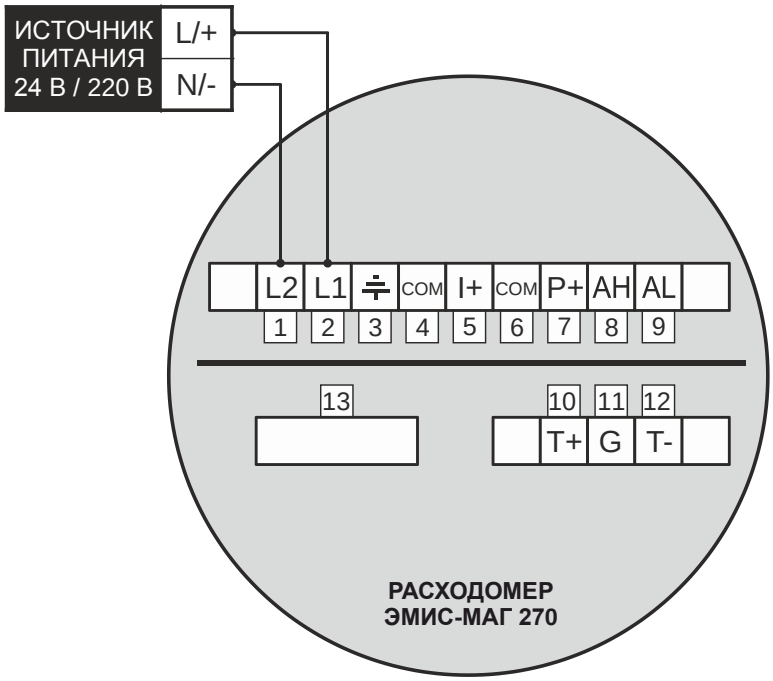


Fig.C.2 - Power connection diagram

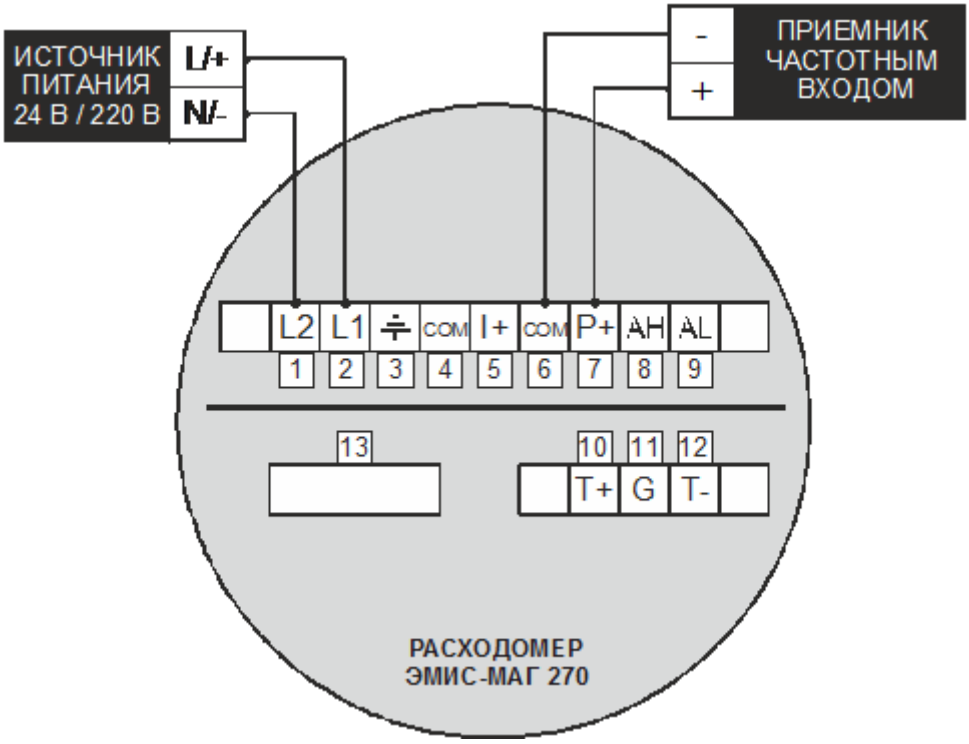


Fig.C.3 - Connection diagram for frequency and pulse output signals

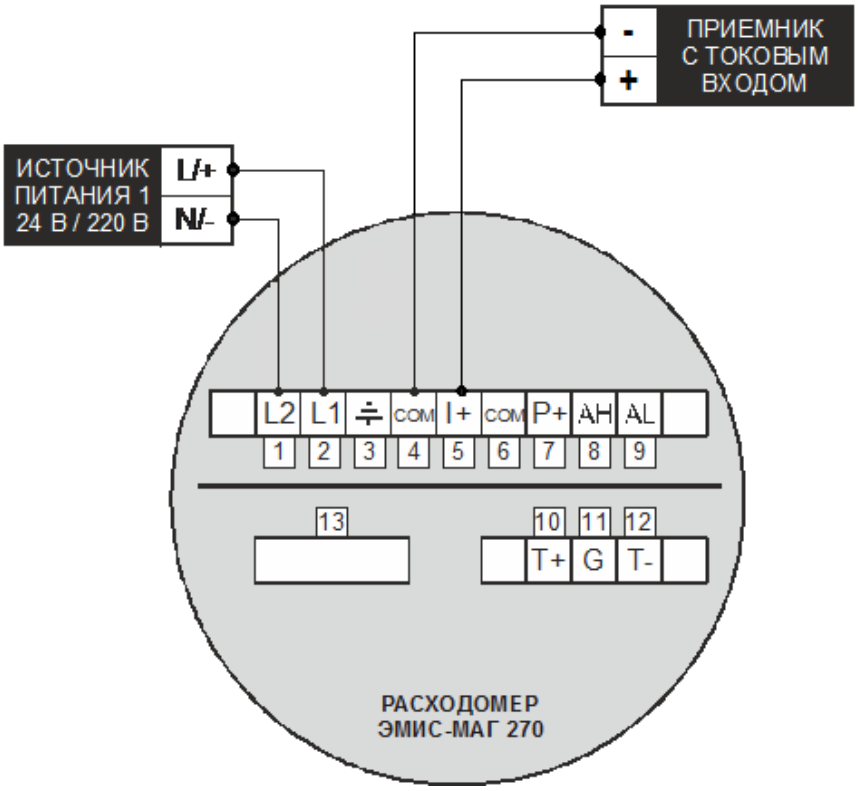


Fig.C.3 - Connection diagram for current output signals

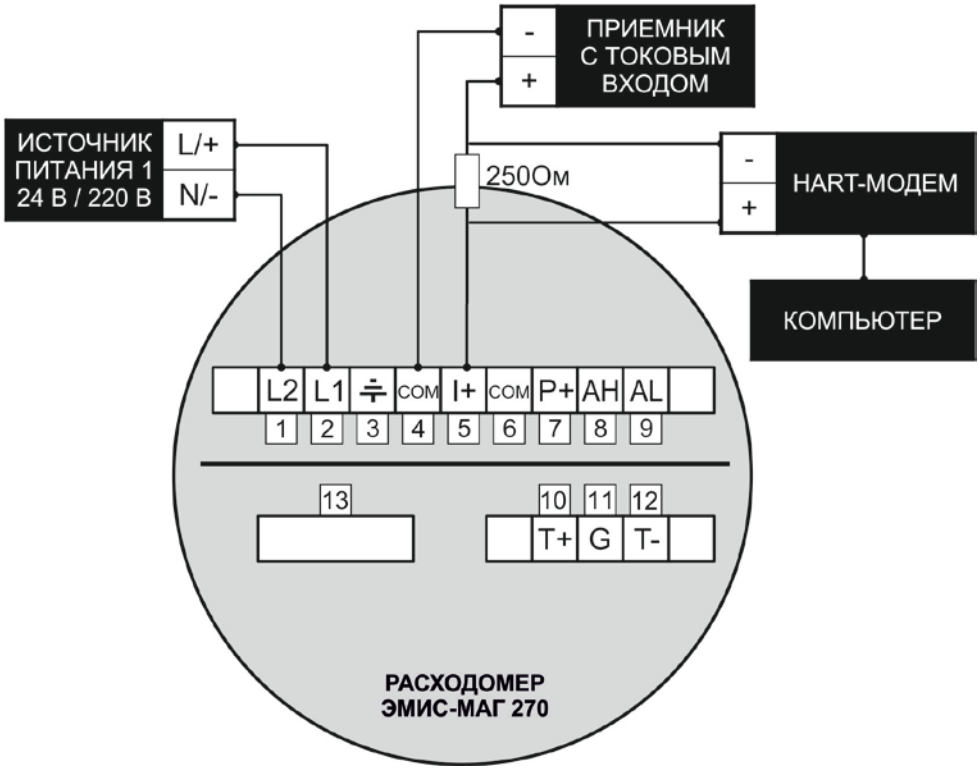


Fig.C.5 - Connection diagram fro current and HART digital signals*

* Resistors with a nominal value of 240 to 270 ohms are allowed. Max value of resistance can be increased according to operation conditions and under HART™ requirements.

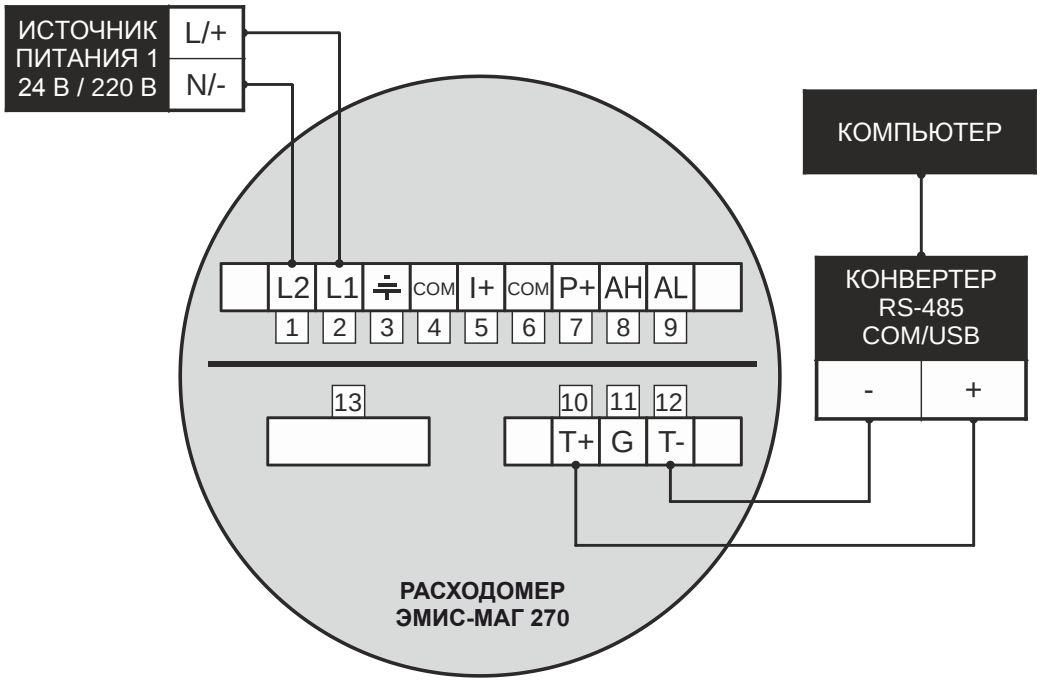


Fig.C.6 - Connection diagram for Modbus digital signal.

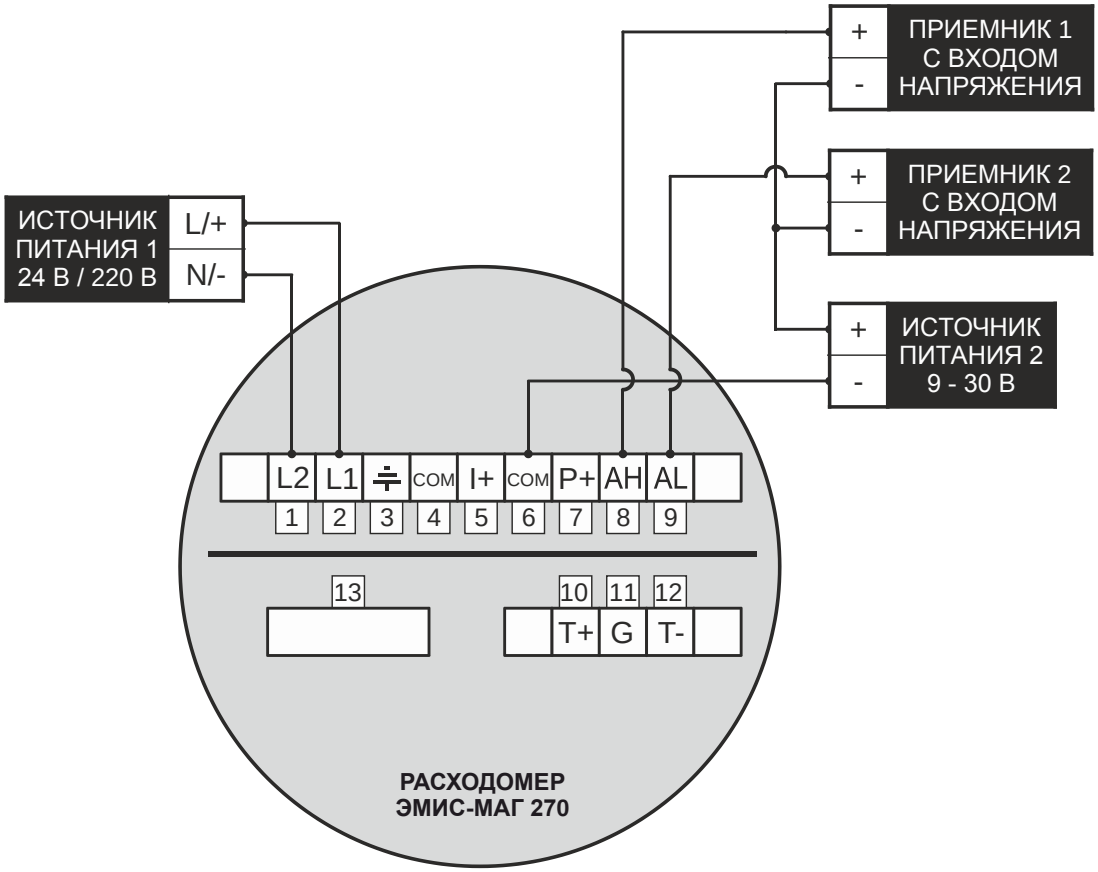


Fig.C.7 - Connection diagrma for emergency signal

PB version connection is executed through the terminal block according to the table C.2.

Table C.2 - PB version connection diagram

Terminal number	Description to fig.C.1 and table C.1.
1	Service terminals
2	
3	
4	
5	
6	L2 -
7	L1 +
8	Earth
9	COM
10	I+
11	COM
12	P+
13	AH
14	AL
15	T+
16	G
17	T-

For remote type flometer, toggle switches are located under the terminal block. Toggle switches are shown in fig.C.7, toggles intended use and description are presented in the table C.2.

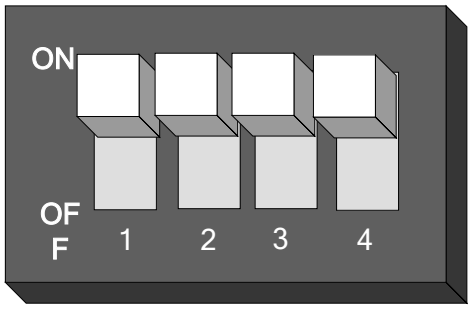


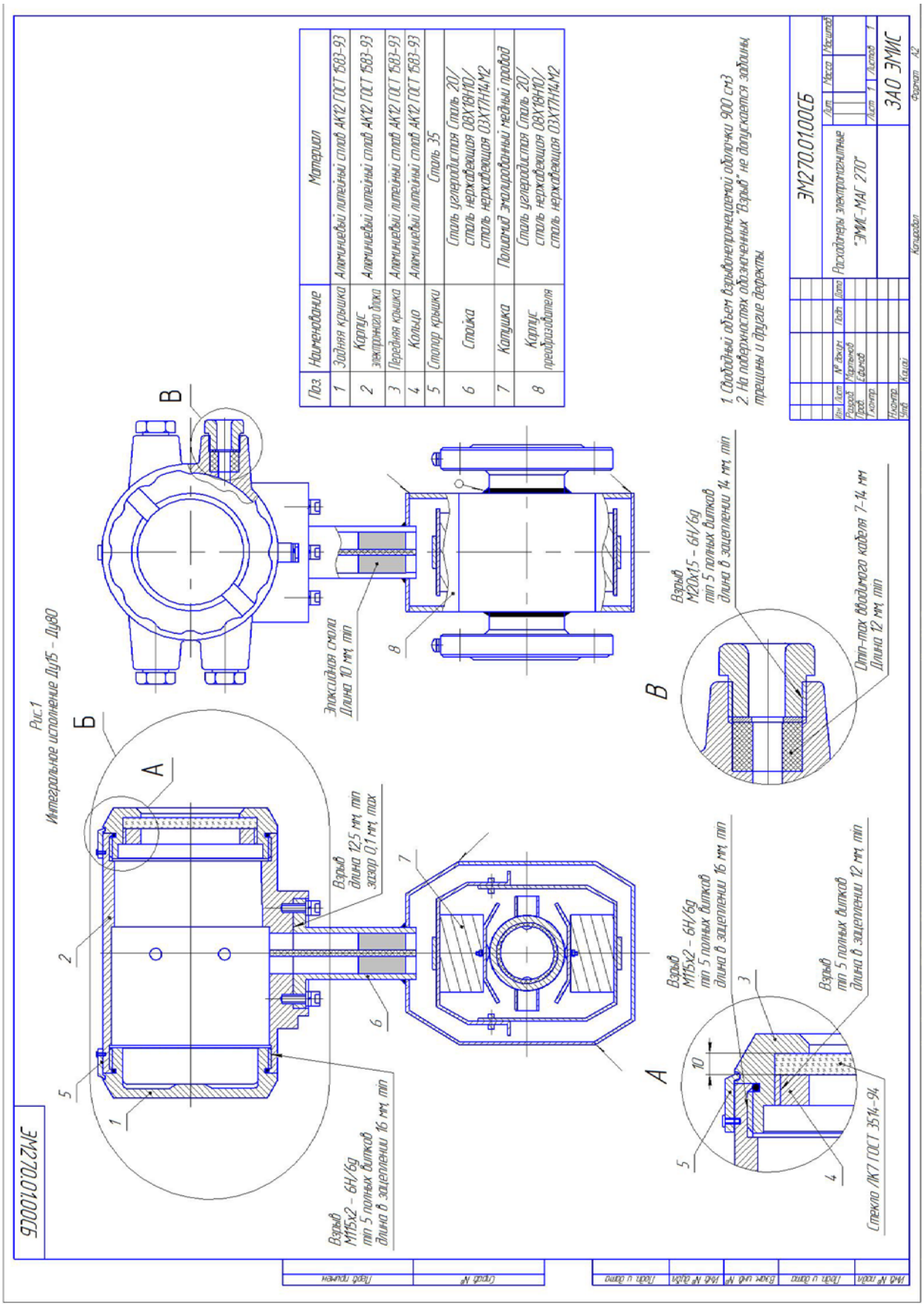
Fig.C.7 - Toggle switches

Table C.1 - Legend for fig.C.1

Toggle NO	State	Description
1	ON	24V supply voltage to the upper alarm set point
	OFF	Not connected
2	ON	Connection of pull-up resistor to check the connection between the pulse output and open collector transostor.
	OFF	Not connected
3	ON	24V supply voltage to the lower alarm set point
	OFF	Not connected
4	ON	Connection to RS485 through resistance.
	OFF	Not connected

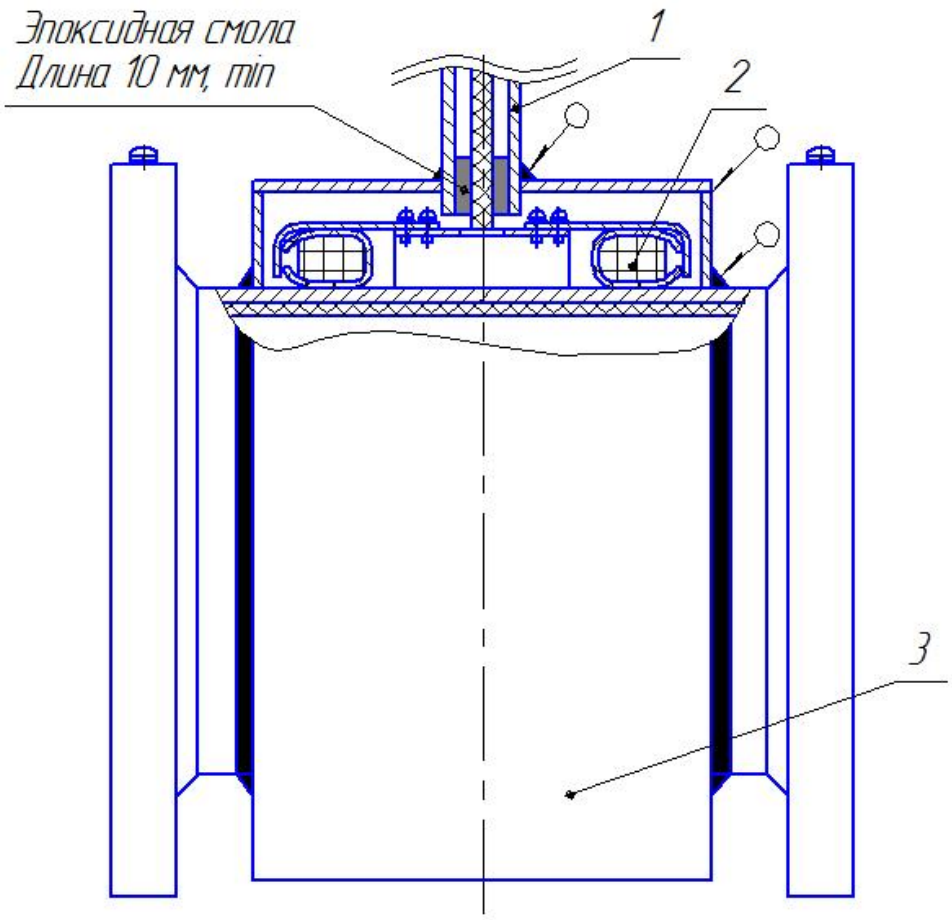
ANNEX D
(normative)

Ex-proof elements drawing



ЭМ270.01.00СБ

Рис.2
Ду100 и выше
Остальное см. Рис.1



Поз.	Наименование	Материал
1	Стойка	Сталь углеродистая Сталь 20/ сталь нержавеющая 08Х18Н10/ сталь нержавеющая 03Х17Н14М2
2	Катушка	Полиамид эмалированный медный провод
3	Корпус	Сталь углеродистая Сталь 20/ сталь нержавеющая 08Х18Н10/ сталь нержавеющая 03Х17Н14М2

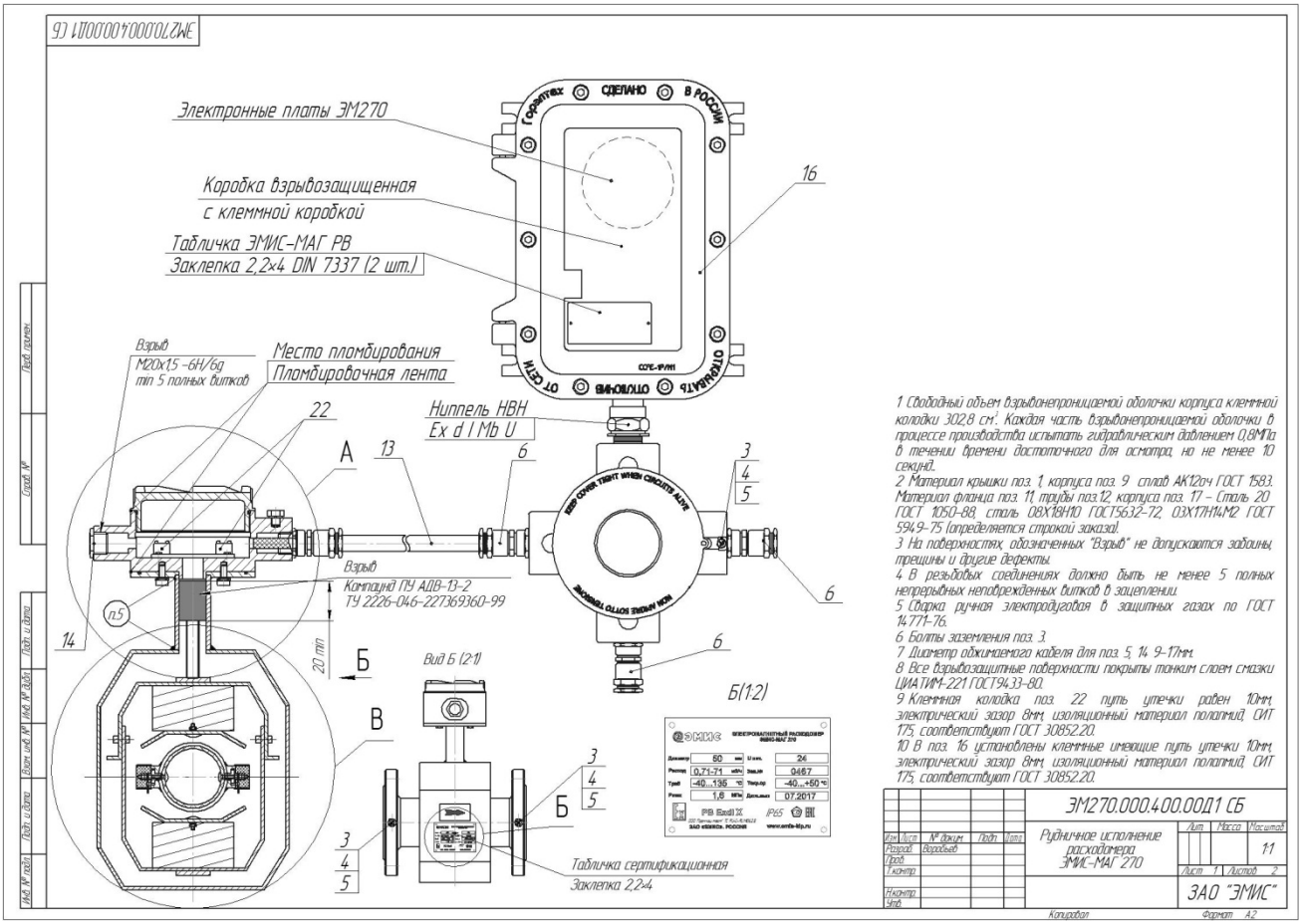
Подп. и дата | Инв. № дубл. | Взам. инв. № | Подп. и дата | Инв. № подл.

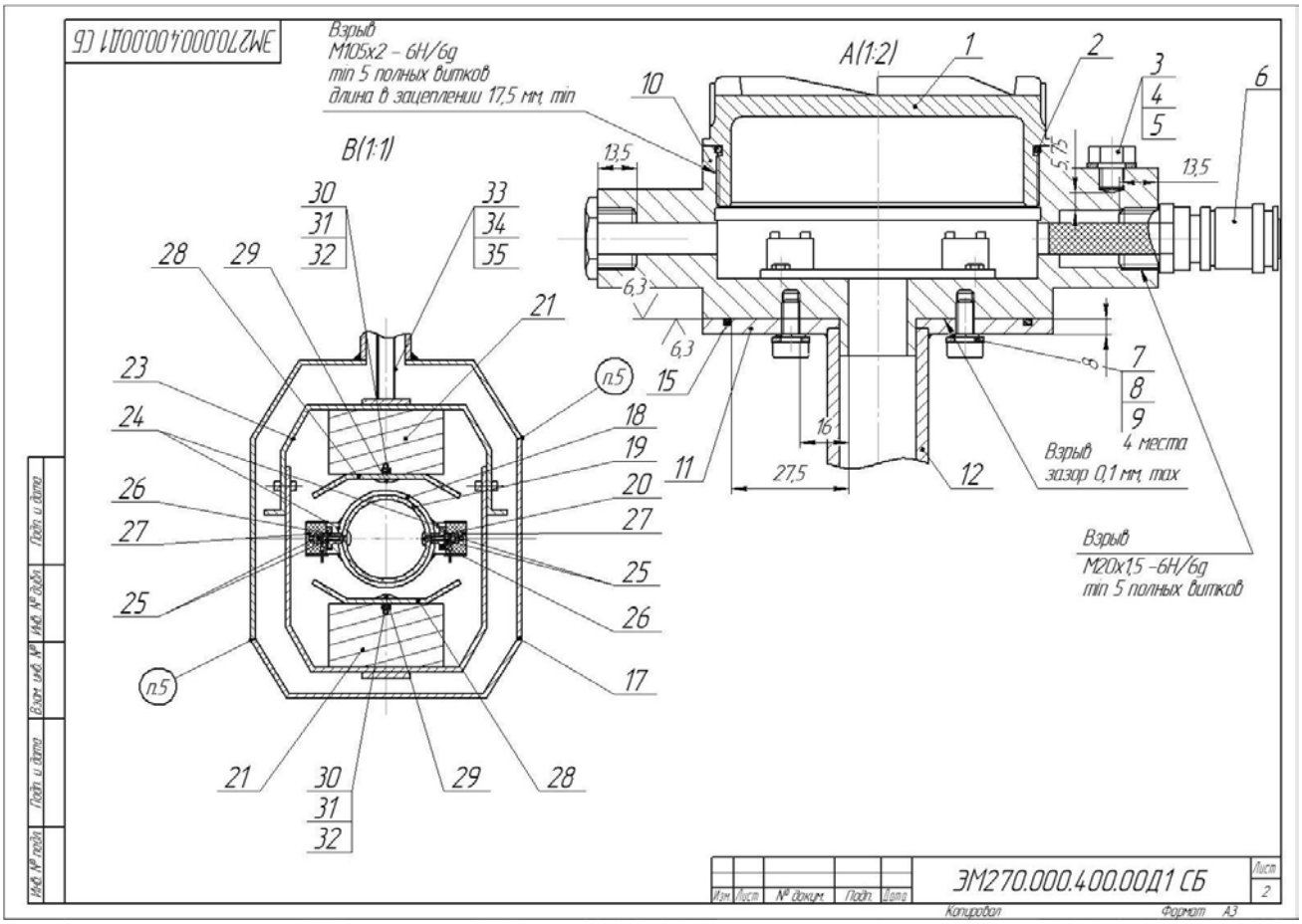
Изм. | Лист | № докум. | Подп. | Дата

ЭМ270.01.00СБ

Лист 2

Копировал Формат А4


ЭМ270.000.400.00Д1 СБ
Электронные платы ЭМ270
Коробка взрывозащищенная с клеммной коробкой
Табличка ЭМИС-МАГ РВ
Заклепка 2,2×4 DIN 7337 (2 шт.)
Взрыв М20х1,5 -6Н/6g min 5 полных витков
Место пломбирования
Пломбировочная лента
Ниппель НВН
Ex d I Mb U
Взрыв
Кампаунд ПУ АДВ-13-2
ТУ 2226-046-22736936О-99
20 min
Вид Б (2:1)
Б(1:2)
Табличка сертификационная
Заклепка 2,2×4
1 Свободный объем взрывонепроницаемой оболочки корпуса клеммной колодки 302,8 см³. Каждая часть взрывонепроницаемой оболочки в процессе производства испытать гидравлическим давлением 0,8МПа в течении времени достаточного для осмотра, но не менее 10 секунд.
2 Материал крышки поз. 1, корпуса поз. 9 сплав АК12оч ГОСТ 1583. Материал фланца поз. 11, трубы поз.12, корпуса поз. 17 – Сталь 20 ГОСТ 1050-88, сталь 08Х18Н10 ГОСТ5632-72, 03Х17Н14М2 ГОСТ 5949-75 (определяется строкой заказа).
3 На поверхностях, обозначенных "Взрыв" не допускаются забоины, трещины и другие дефекты.
4 В резьбовых соединениях должно быть не менее 5 полных непрерывных неповрежденных витков в зацеплении.
5 Сварка, ручная электродуговая в защитных газах по ГОСТ 14.771-76.
6 Болты заземления поз. 3.
7 Диаметр обжимаемого кабеля для поз. 5, 14: 9-17мм.
8 Все взрывозащитные поверхности покрыты тонким слоем смазки ЦИАТИМ-221 ГОСТ 9433-80.
9 Клеммная колодка поз. 22 путь утечки равен 10мм, электрический зазор 8мм, изоляционный материал полиамид, СИТ 175, соответствуют ГОСТ 30852.20.
10 В поз. 16 установлены клеммные имеющие путь утечки 10мм, электрический зазор 8мм, изоляционный материал полиамид, СИТ 175, соответствуют ГОСТ 30852.20.
ЭМ270.000.400.00Д1 СБ
Рудничное исполнение расходомера ЭМИС-МАГ 270
ЗАО "ЭМИС"


ЭМ270.000.400.00Д1 СБ
Взрыв М105х2 – 6Н/6g min 5 полных витков длина в зацеплении 17,5 мм, min
B(1:1)
A(1:2)
Взрыв зазор 0,1 мм, max
4 места
Взрыв М20х1,5 -6Н/6g min 5 полных витков
ЭМ270.000.400.00Д1 СБ

ANNEX E
(normative)

Modbus register map

The protocol supports one main device in a line, which can access several slave devices at a unique line address. It can be 1 to 99 devices in line.

Modbus RTU frame format is hexadecimal. Frame structure is presented in the tables E.1, E.2.

The frame starts with a silent interval equal to the transmission time of 3.5 characters at a given transmission rate. Message frames are separated by a silent interval of at least 3.5 character times. A new frame start after this interval.

Frame is transmitting as a continuous stream. If a silent interval of more than 1.5 character times occurs between two characters, the message frame is declared as incomplete and the next byte will be received as a new message frame.

If a new message starts earlier than 3,5 the receiver shall receive it as the continuation of the previous message. An error will be detected as the result of the checksum mismatch.

Table E.1 - Master device frame format

Start	Address	Function code	Register address	Register length	Checksum	End
T1-T2-T3-T4	8 bit	8 bit	16 bit	16 bit	16 bit	T1-T2-T3-T4

Table E.1 - Slave device frame format

Start	Address	Function	Data.	Checksum	End
T1-T2-T3-T4	8 bit	8 bit	n × 8 bit	16 bit	T1-T2-T3-T4

The device address immediately follows the beginning of the frame and consists of one 8-bit character. The bits show slave address which shall receive master request.

Each slave device shall have a unique address, so that only this device can reply to the request.

The function code indicates to the server what kind of action to perform.

Data field contains the request and response parameters.

Error checking field allows to check message for errors.

Table E.3 - Function codes

Code	Name	Action
03	Read holding registers	Receive current value of one or several holding registers
04	Read input register	Receive current value of one or several input registers
06	Preset single register	Write new value for holding register

Table E.4 - Register map

Counter number (dec)	Sub-functioncode (hex)	Data format	Description
Input registers			
4112	0x1010	32-bit floating point	Current flow
4114	0x1012	32-bit floating point	Current flow velocity
4116	0x1014	32-bit floating point	Current flow as % from max
4118	0x1016	32-bit floating point	Medium conductivity, Sm/m
4120	0x1018	long integer 32 bit	Integer part of accumulated direct flow
4122	0x101A	32-bit floating point	Decimal part of accumulated direct flow
4124	0x101C	long integer 32 bit	Integer part of accumulated reverse flow
4126	0x101E	32-bit floating point	Decimal part of accumulated reverse flow
4132	0x1024	integer 32 bit	Empty pipe alarm
4133	0x1025	integer 32 bit	Transmitter power off
Holding registers			
4128	0x1020	integer 16 bit	Current flow measuring units
4129	0x1021	integer 16 bit	Accumulated flow measuring units
4130	0x1022	integer 16 bit	Min alarm value
4131	0x1023	integer 16 bit	Min alarm value

Floating point format is shown below (see table E.5) for current flow.

Table E.5 - Floating point digit structure

0x1010		0x1011	
byte 1	byte 2	byte 3	byte 4
S EEEEEEE	E MMMMMMM	MMMMMMMM	MMMMMMMM

S - mantissa sign; 1 - negative; 0 - positive. High-order bit

E - Index Next 8 bit

M- mantissa. Low-order 23 bits and fraction.

Conversion from floating point to decimal format is carried out according to the following formula:

$V = (-1)^{S} \cdot 2^{(E-127)} \cdot (1+M)$

Master device message (see table E.6) and slave response (see table E.6) are shown below.

Table E.6 - Read current flow register

Slave address	Function	High-order address byte	Low-order address byte	High-order length byte	Low-order length byte	High-order check byte	Low-order check byte
01	04	10	10	00	02	74	CE

Table E.7 - Slave device response

Slave address	Function	Data length	4 bytes (current flow)				High-order check byte	Low-order check byte
01	04	04	C4	1C	60	00	2F	72

C41C6000 floating point:

C4	1C	60	00
1100 0100	0001 1100	0110 0000	0000 0000
byte 1	byte 2	byte 3	byte 4

S = 1; if mantissa = 1, the value is negative.

E = 10001000; Index is 136.

M = 001 1100 0110 0000 0000 0000

Current flow is:

$V = (-1)^{1} \cdot 2^{(136-127)} \cdot (1 + 1/8 + 1/16 + 1/32 + 1/512 + 1/1024) = -625{,}5.$

ANNEX F
(normative)

HART register map

The protocol is used for connection between master and slave devices. Two master devices are allowed. Flowmeter support standard mode with single slave and two master devices only. Several HART parameters are oresented in Table E.1.

Table E.1 - HART parameters

Name	Parameter
Standard data transmission	Bell 202
Data protocol	HART ™, version 5
Type of transmission	asynchronous
Number of devices	1 slave device
Connection type	half-duplex
Character encoding	start bit; 8 data bit; parity bit; stop bit
Frame format	short frame
Error detection algorithm	1 error for 10^5 bit, parity checking for each byte, check byte for each packet
Data transmission rate	1,2 kbit/s (packet transfer time: 500 ms)
Connection	up to 3 km

HART frame is presented in tables E.2 and E.3.

Table E.2 - Master device frame format

Preamble	Start byte	Address	Command	Number of data bytes	Data	Checksum
5...20 bytes	1 byte	1...5 bytes	1 byte	1 byte	0...25 bytes	1 byte

Table E.3 - Slave device frame format

Preamble	Start byte	Address	Command	Number of data bytes	Status	Data	Checksum
5...20 bytes	1 byte	1...5 bytes	1 byte	1 byte	2 bytes	0...25 bytes	1 byte

Table E.4 - HART universal commands

No	Function	Request data (Type)	Response data (Type)
0	Read Unique Identifier Associated With Tag	none	Byte 0 "254" (expansion) Byte 1 Manufacturer Identification Code Byte 2 Manufacturer Device Type Byte 3 Number of Request Preambles Byte 4 Revision Level of Universal Command Byte 5 Revision Level of Specific Command Byte 6 Software Revision Level Byte 7 Hardware Revision Level (H) Byte 8 Flags, none defined at this time (B) Byte 9-11 Device Identification Number
1	Read Primary Variable	none	Byte 0 Primary Variable Unit Code Byte 1-4 Primary Variable (F)
2	Read Current and Percent of Range (dependent on operational mode chosen)	none	Byte 0-3 Analog Output Current mA(F) Byte 4-7 Percent of Range (F)
3	Read four dynamic Variables and Current	none	Byte 0-3 Analog Output Current mA(F) Byte 4 Primary Variable Unit Code Byte 5-8 Primary Variable (F) Byte 9 Secondary Variable Unit Code Byte 10-13 Secondary Variable (F) Byte 14 Tertiary Variable Unit Code Byte 15-18 Tertiary Variable (F) Byte 19 4th Variable Unit Code Byte 20-23 4th Variable (F)
12	Read Message	none	Byte 0-23 Message (A)
13	Read Tag, Descriptor, Date	none	Byte 0-5 Tag (A) Byte 6-17 Descriptor (A) Byte 18-20 Date: Day, Month, Year (D)
14	Read Primary Variable Sensor Information	none	Byte 0-2 Sensor Serial Number Byte 3 Sensor Limits/Min Span Units Byte 4-7 Upper Sensor Limit (F) Byte 8-11 Lower Sensor Limit (F) Byte 12-15 Minimum Span (F)

Table E.4 - HART universal commands (continue)

No	Function	Request data (Type)	Response data (Type)
15	Read Primary Variable Output Information	None	Byte 0 Alarm Select Code Byte 1 Primary Variable Transfer Function Code Byte 2 Primary Variable Range Values Units Code Byte -6 Primary Variable Upper Range Value Byte -10 Primary Variable Lower Range Value Byte 11-14 Primary Variable Damping Value (F) Byte 15 Write Protect Code Byte 16 Private Label Distributor Code (F)
16	Read Final Assembly Number	None	Byte 0-2 Final Assembly Number
17	Write message	Byte 0-23 Message (32 symbols)(A)	as in command
18	Write Tag, Descriptor, Date	Byte 0-5 Tag (8 symbols) Byte 6-17 Descriptor (16 symbols) (A) Byte 18-20 Date: Day, Month, Year (D)	as in command
19	Write Final Assembly Number	Byte 0-2 Final Assembly Number	as in command

Table E.4 - HART Commom Practice Commands

No	Function	Command data	Response data (Type)
33	Read Sensor Variables	Byte 0 Sensor Variable Code slot 0 Byte 1 Sensor Variable Code slot 1 Byte 2 Sensor Variable Code slot 2 Byte 3 Sensor Variable Code slot 3	Byte 0 Sensor Variable Code slot 0 Byte 1 Units Code slot 0 Byte 2-5 Slot Variable 0 (F) Byte 6 Sensor Variable Code slot 1 Byte 7 Units Code slot 1 Byte 8-11 Slot Variable 1 (F) Byte 12 Sensor Variable Code slot 2 Byte 13 Units Code slot 2 Byte 14-17 Slot Variable 2 (F) Byte 18 Sensor Variable Code slot 3 Byte 19 Units Code slot 3 Byte 20-23 Slot Variable 3 (F)
34	Write Primary Variable Damping Value	Byte 0-3 Damping Value (F)	as in command

Table E.4 - HART Commom Practice Commands (continue)

No	Function	Command data	Response data (Type)
35	Write Primary Variable Range Values	Byte 0 PV Upper and Lower Range Values Units Code Byte -4 Primary Variable Upper Range Value Byte 5 -8 Primary Variable Lower Range Value	as in command
44	Write primary variable measuring units	Byte 0 primary variable unit of measure code	as in command
48	Read Sensor Additional Status	No	Byte 0-5 Device Status (B) Byte 6-7 Operating Mode Байт 8-10 Analog Outputs (B) Байт 11-13 Analog Outputs (B) Byte 14-24 Device Status (B)
50	Read Dynamic Variables Task	None	Byte 0 Sensor Variable Code, Primary Variable Byte 1 Sensor Variable Code, Secondary Variable Byte 2 Sensor Variable Code, Tertiary Variable Byte 3 Sensor Variable Code, 4th Variable
54	Read Sensor Variable Information	Byte 0 Sensor Variable Code	Byte 0 Sensor Variable Code Byte 1-3 Sensor Serial Number, Sensor Variable Byte 4 Sensor Units Code, Limits, Variable Byte 5-8 Upper Sensor Limit, Sensor variable (F) Byte 9-12 Lower Sensor Limit, Sensor variable (F) Byte 13-16 Damping Value, Sensor Variable (F) Byte 17-20 Min Span, Sensor Variable (F)
57	Read Tag, Descriptor, Date Units Code	None	Byte 0-5 Tag Units (8 symbols) (A) Byte 6-17 Descriptor Units (16 symbols) (A) Byte 18-20 Date units (D)
60	Read Analog Output and Percent of Range	Byte 0 Analog Output Code Number	Byte 0 Code Number, Analog Output Byte 1 Units Code, Analog Output Byte 2-5 Level, Analog Output (F) Byte 6-9 Percent of Range, analog Output (F)

Table E.4 - HART Commom Practice Commands (continue)

No	Function	Command data	Response data (Type)
61	Read Dynamic Variable and Primary Variable Analog Output	No	Byte 0 Units Code, Analog Output, Primary Variable Byte 1-4 Level, Analog Output, Primary Variable (F) Byte 5 Primary Variable Unit Code Byte 6-9 Primary Variable (F) Byte 10 Secondary Variable Unit Code Byte 11-14 Secondary Variable (F) Byte 15 Tertiary Variable Unit Code Byte 16-19 Tertiary Variable (F) Byte 20 4th Variable Unit Code Byte 21-24 4th Variable (F)
62	Read Analog Outputs	Byte 0 Code Number, Analog Output slot 0 Byte 1 Code Number, Analog Output slot 1 Byte 2 Code Number, Analog Output slot 2 Byte 3 Code Number, Analog Output slot 3	Byte 0 Slot 0, Analog output, Code Number Byte 1 Slot 0, Units Code Byte 2-5 Slot 0, Level (F) Byte 6 Slot 1, Analog output, Code Number Byte 7 Slot 1, Units Code Byte 8-11 Slot 1, Level (F) Byte 12 Slot 2, Analog output, Code Number Byte 13 Slot 2, Units Code Byte 14-17 Slot 2, Level (F) Byte 18 Slot 3, Analog output, Code Number Byte 19 Slot 3, Units Code Byte 20-23 Slot 3, Level (F)
63	Read Analog Outputs Information	Byte 0 Code Number, Analog Output	Byte 0 Analog Output, Code Number Byte 1 Analog Output, Alarm Select Code Byte 2 Analog Output, Transfer Function Code Byte 3 Analog Output, Range Units Code Byte 4-7 Analog Output, Upper Sensor Limit (F) Byte 8-11 Analog Output, Lower Sensor Limit (F) Byte 12-15 Analog Output, Damping Value

Table E.4 - HART Commom Practice Commands (continue)

No	Function	Command data	Response data (Type)
70	Read Exit Analog Output Value	Byte 0 Code Number, Analog Output Byte 1 Units Code,	Byte 0 Analog output, Code Number Byte 1 Analog Output Exit Value, Units Code Byte 2-5 Analog Output, Upper Sensor Limit (F) Byte 6-9 Analog Output, Lower Sensor Limit (F)
110	Read all dynamic Variables	None	Byte 0 Primary Variable Unit Code Byte 1-4 Primary Variable (F) Byte 5 Secondary Variable Unit Code Byte 6-9 Secondary Variable (F) Byte 10 Tertiary Variable Unit Code Byte 11-14 Tertiary Variable (F) Byte 15 4th Variable Unit Code Byte 16-19 4th Variable (F)

Note: Data type:

A: ASCII line (4 symbols for each 3 bytes)

B: bit-by-bit flags (but 0=multiparameter device; bit 1=control EEPROM)

D: Date (3 bytes: day, month, year - 1900)

F: with floating point (4 bytes IEEE 754)

H: Integer xxxxx yyy (xxxxx – hardware version; yyy – physical channel generation code).
Unmarked data are 8-, 16- or 24-bit integers.

ANNEX G
(normative)

Reference documents

Name	Name	Line
GOST 30852.10-2002	Ex-equipment Part 11. Intrinsically safe electrical circuit i	1.1, 1.4, 2.4.2
GOST 30852.1-2002	Ex-equipment Part 1. Flameproof enclosure.	1.1, 1.4, 2.4.2
GOST 15150-69	Machines, instruments and other industrial products Modifications for different climatic regions. Categories, operating, storage and transportation conditions as to environment climatic aspects influence.	1/1
GOST P 52931-2008	Instruments for process monitoring and control. General specifications	1.3.1
GOST 30852.0-2002	Ex-equipment Part 0. General requirements	1.4, 2.4.2
GOST 14254-2015	Enclosure protection level (IP)	1.4, 2.4.4
GOST 12971-67	Rectangular plates for machines and equipment. Sizes	1.5
GOST 33259-2015	Flanges for valves, fittings and pipelines for pressure to PN 250. Design, dimensions and general technical requirements	1.7
Russian Electrical	Code	2.2, 2.4.2
Operation Guide to Load-Side	Electrical Installations	2.4.2
BCH332-74/MMCC	Instructions for Installation of electrical equipment, power and lighting systems in explosive environment	2.4.2
GOST 15180-86	Flat elastic gaskets	Annex A

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