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12.11.2021
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LIQUID QUANTITY COUNTER
EMIS-MERA 300
Operation manual

EMIS
Russia,
Chelyabinsk

EMIS flowmeters manufacturer

GENERAL INFORMATION

This operation manual contains general technical parameters, directions for usage, transportation and storage, and other information for accurate operation of EMIS-MERA 300 flow meters (hereinafter referred to as the flow meter or EM-300)

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

Attention!

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

Contact your local dealer or our technical service:

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

e-mail: support@emis-kip.ru

Attention!

This instruction manual applies only to the EM-300 liquid meters. This document is not applicable to other equipment of EMIS or other companies.

Contents

1 DESCRIPTION AND OPERATION

1.1. Application

The flow meter is designed to measure the mass (mass flow rate) of liquids, oil and gas mixtures, crude oil under GOST R 8.615-2005 and oil products (hereinafter referred to as the measured medium), and to use the information obtained for technological purposes and accounting.

The flow meter is used in automated metering installations,

in stationary technological installations, ground mobile refueling and pumping facilities, in commercial metering systems.

Meters can be used for both safe and explosive environments. Pulse sensor (pulse sensor with integrated computer) located inside the flow meter is equipped with explosion-proof enclosure under GOST IEC 60079-1.1 or intrinsic safety of "ia" protection level under GOST 31610.0. The electric heating device located on the flower meter body has protection of type “e” according to GOST R 60079-7 and explosion protection of “increased reliability against explosion”.

Flow meters are divided into the following modifications:

EMIS-MERA 300-030, EMIS-MERA 300-030 B1 (EM-300-030) - flow meters with measuring range of 0.3 to 30 t/day;

EMIS-MERA 300-060, EMIS-MERA 300-060 B1 (EM-300-060) - flow meters with measuring range of 0.3 to 60 t/day;

EMIS-MERA 300-120, EMIS-MERA 300-120 B1 (EM-300-120) - flow meters with measuring range of 0.3 to120 t/day;

EMIS-MERA 300-210, EMIS-MERA 300-210 B1 (EM-300-030) - flow meters with measuring range of 0.3 to 210 t/day;

EMIS-MERA 300-480, EMIS-MERA 300-480 B1 (EM-300-480) - flow meters with measuring range of 0.3 to 480 t/day;

The flow meter configurations are as follows:

integral - pulse sensor with output signal, for EMIS-MERA 300-030, EMIS-MERA 300-060, EMIS-MERA 300-120, EMIS-MERA 300-210 and EMIS-MERA 300-480;

remote - pulse sensor is connected to the flow meter with a cable, for EMIS-MERA 300-030 B1, EMIS-MRA 300-060 B1, EMIS-MERA 300-120 B1, EMIS-MERA 300-210 B1 and EMIS-MERA 300-480 B1.

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

1.2. Structure and Operation Principle

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

- flow meter body (9);
- metering converter (3);
- pulse sensor [pulse sensor with rated output signal] (4);
- electric heating device (8).

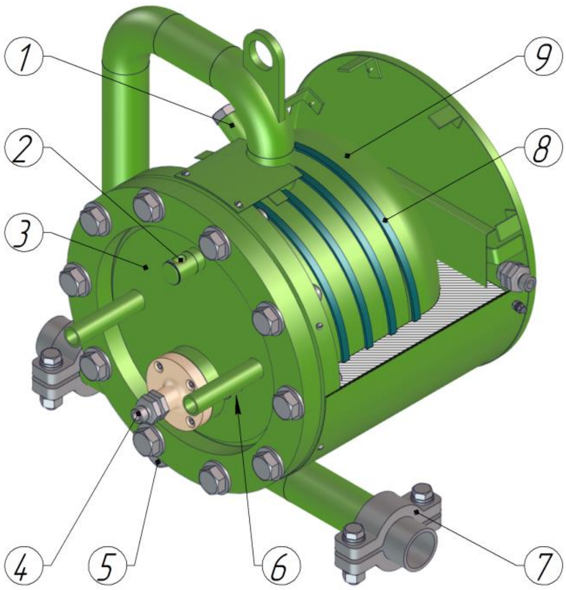


Fig. 1.1 – Liquid quantity counter

Table 1.1 - Description for fig.1.1

NO in fig.	Description
1	Manometer connection socket
2	Slope indicator
3	Transmitter
4	Pulse sensor (pulse sensor with rated output signal)
5	Drain outlet
6	Grounding point
7	Hub joint
8	Electric heating device
9	Flow meter body

The flow meter consists of the sealed body (9) and detachable transmitter (3). A collector is designed for oil and gas-water mixture input and discharge. There is a hub joint (7) on the collector for connection to the pipeline.

Medium enters the input collector of the flow meter body, then through the nozzle goes to the flow tube which consists of the two chambers. Once one of the chambers is filled with the medium it breaks the balance conditions depended on the position of the center of mass, which leads to its rotation and further discharge of the liquid out of the chamber. During the rotation another chamber is placed under the nozzle and the process of filling repeats, while the discharged medium goes to the discharge collector in the lower part of the flow meter body. The displacement of the measured medium occurs due to the excess pressure of the gas pumped into the meter body or released from the oil and water mixture due to the effect of gravitational separation.

Excessive gas is also released through the discharge collector. Prerequisite for operation in a closed collection system (under overpressure) is the presence of gas in the meter body.

The conversion of the number of turns of the sensor into electrical impulses is carried out by the action of a magnet attached to the measuring chamber on a reed switch or a Hall sensor installed in the housing of the pulse sensor.

The signal from the reed switch or the Hall sensor is converted to normalized according to the established algorithm.

If using an external transmitter the readings of the mass and flow rate are indicated on the display, as well as recorded and put in the archive. It is possible to transmit the normalized impulse into the upper level system.

1.3. Order sheet

EMIS-MERA 300 versions are shown in Table 1.2.

Order sheet completion is shown below.

	1		2		3		4		5		6		7		8		9		10		11		12		13
EMIS-MERA 300	-	-	030	-	-	-	-	-	-	-	-	-	-	-	S	-	E1	-	T	-	V1	-	SC	-	-

EMIS-MERA 300-030-S-E1-T-V1-SC

Table 1.2 - Flow meter configurations

1	Explosion protection
-	1Ex d e IIB+H_2 T4 Gb X - flow meters with electrical heating (standard configuration)
1ExdT4	1Ex d IIC T4 Gb X– without electrical heating unit and medium temp. up to 130ºC
1ExdT5	1Ex d IIC T5 Gb X– without electrical heating unit and medium temp. up to 95ºC
1ExdT6	1Ex d IIC T6 Gb X– without electrical heating unit and medium temp. up to 80ºC
0ExiaT4	0 Ex ia IIC T4 Ga X – without electrical heating unit and medium temp. up to 130ºC
0ExiaT5	0 Ex ia IIC T5 Ga X– without electrical heating unit and medium temp. up to 95ºC
0ExiaT6	0 Ex ia IIC T6 Ga X– without electrical heating unit and medium temp. up to 80ºC
X	by order
2	**Upper limit of the flow measurement, t/day**
030	30
060	60
120	120
210	210
480	480
X	by order
3	**Accuracy**
–	accuracy class 2.0 (standard version)
2.5	Accuracy class 2.5
1.75	Accuracy class 1.75
1.5	Accuracy class 1.5
1.0	Accuracy class 1.0
X	by order

4	**Connection to the pipeline**
–	hub joint (standard version)
F	Flanged
X	by order
5	**Location of the inlet and discharge pipe**
–	at the bottom on the same axis (standard version)
B	at the top on the same axis
C	at the center on the same axis (standard versions of EMIS-MERA 300-210 and EMIS-MERA 300-480)
BT	inlet at the top, discharge at the bottom
CB	inlet at the center, discharge at the bottom
X	by order
6	**Discharge pipe size**
–	equal to the inlet (standard version)
I	increased
X	by order
7	**Meter versions**
–	standard version
F	on the frame paired with piping set
X	by order
8	**Environmental class**
–	standard config., ambient temperature: - configuration with electrical heating from -50ºC up to +55ºC;
S	special version, ambient temperature: - from -50ºC up to +80ºC for configuration without electrical heating;
X	by order
9	**Electrical heating unit code**
-	without heating unit
E1	65ºC, 184 VA (for EMIS-MERA 300030, EMIS-MERA 300-060)
E2	65ºC, 230 VA (for EMIS-MERA 300-120, EMIS-MERA 300-210)
E3	65ºC, 460 VA (for EMIS-MERA 300-480)
E4	120ºC, 480 VA (for EMIS-MERA 300-030, EMIS-MERA 300-060)
E5	120ºC, 600 VA (for EMIS-MERA 300-120, EMIS-MERA 300-210)
E6	120ºC, 960 VA (for EMIS-MERA 300-480)
X	by order
10	**Heat insulating cover**
–	no cover
T	with the cover
X	by order
11	**Corrosion-resistant coat**
–	standard version (measuring chamber - steel **12X18N10T**)

C	with corrosion-resistant coat (inner surface of the meter and transmitter cover are coated with polymer of low adhesion to paraffin, measuring chamber is made of the steel 12X18N10T)
12	**Cabinet**
–	standard version
S	with transmitter mounting cabinet
13	**Output signals**
-	Rated pulse (standard version)
S	Rated pulse, digital RS-485 (Modbus RTU)
14	**Gas factor**
–	standard version (gas factor form 2 to 50%)
G*	Gas factor from 2 to 95%
15	**Remote data transmission**
-	Without remote data transfer (standard version)
B1	Remote data transmission (LoRa)
16	**Calibration**
–	manufacturer calibration
SC	state calibration
17	**Industrial versions**
–	standard version
AST	for hydrogen sulfide mediums

* Special version upon agreement with the manufacturer

EMIS-MERA 300 spare parts kit versions are shown in Table 1.2.1.

Standard supply scope of spare arts kit is presented in the clause 1.10 Supply scope

Order sheet completion is shown below.

	1		2		3		4		5
EMIS-MERA 300	-	-	K5	-	E5	-	S	-	-

Table 1.2.1 - Spare parts kit versions

1	**Spare parts kit**
Stand	Standard content
-	Select content
2	**Cable gland sets**
-	Without cable glands
K1	1 cable gland
K2	2 cable glands
K3	3 cable glands
K4	4 cable glands
K5	5 cable glands
3	**Number of electronic units**
–	Without electronics
E1	1 set of electronics

E2	2 sets of electronics
E3	3 sets of electronics
E4	4 sets of electronics
E5	5 sets of electronics
4	**Output signals**
-	Pulse output signal
S	Digital Modbus (RS-485)+Pulse
5	**General requirements**
-	Without special requirements
X	Special requirements (upon request)

1.4. Measuring unit

Measuring unit (fig.1.2) consists of the measuring chamber (6). There are two weights (8) located on the chamber to change (adjust) the center of mass of the measuring chamber. The measuring chamber is mounted on the cover (2) and the back support (7) on the bushings. The back support is fixed to the cover with studs (4). The measuring unit also includes a shock absorber (9), a damper (for EM-300-210 and EM-300-480), a pulse sensor [pulse sensor with a normalized output signal] (3), a slope indicator (1) for adjusting the position. Measuring units differ in the size of the measuring chamber.

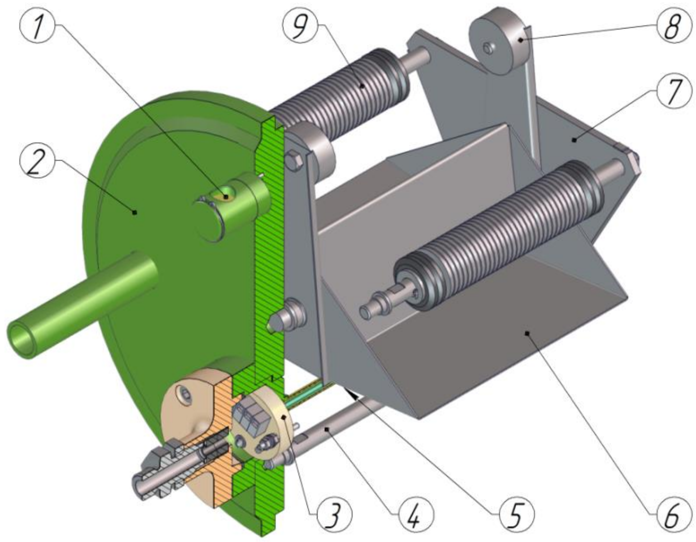


Fig.1.2 - Sensor

Table 1.3 - Description for fig.1.2

NO in fig.	Description
1	Slope indicator
2	Cover
3	Pulse sensor (pulse sensor with rated output signal)
4	Lower stud
5	Magnet
6	Measuring chamber
7	Back support

8	Weights
9	Shock absorber

The principle of operation of the measuring chamber is as follows. One part of the measuring chamber is filled with the medium until equilibrium is disturbed. After that, the chamber rotates to discharge the medium. Simultaneously another chamber is filled up with the medium. When the measuring chamber is tipped over, the edge of its unfilled part bumps the shock absorber (9) (see Figure 1.2).

1.5. Transmitter

Transmitter is an assemble of computer and pulse sensor (equipped with reed switch or Hall sensor). The computer works with one or two pulse sensors depending on Dn.

In the working position, pulse sensor is located under the measuring chamber on which the magnet is fixed. The chamber oscillates during the operation. When the magnet passes near the pulse sensor, the logical level changes, which is recorded by the computer. Computer calculates the accumulated mass and transfer the data to the outputs.

1.6. Electric heating device

External view of electrical heating device is shown in the fig.1.3.

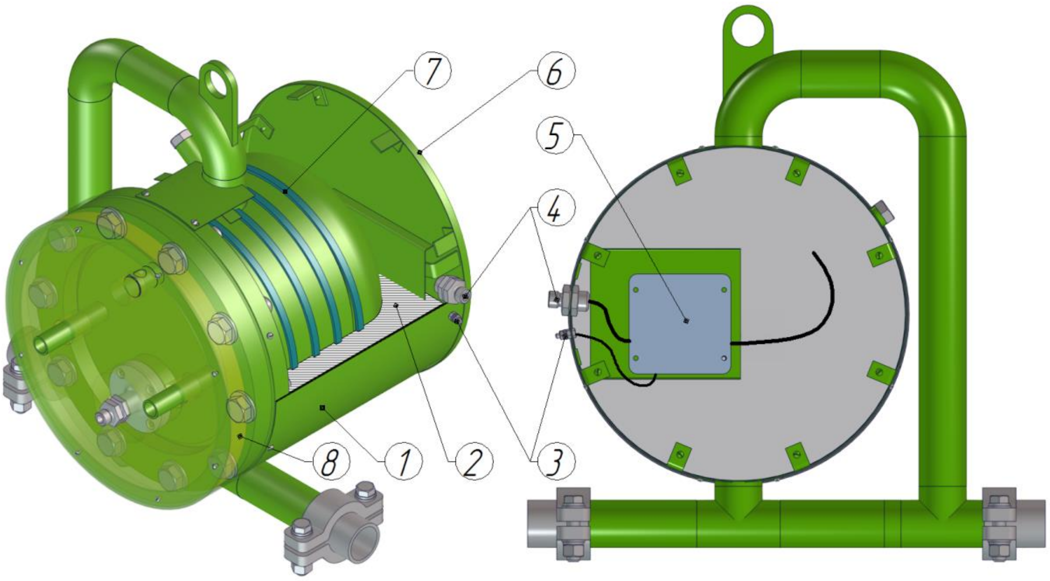


Fig.1.3 - Electrical heating device

Table 1.4 - Description for fig.1.3

NO in fig.	Description
1	Protection cover
2	Heat insulation
3	Grounding
4	Power supply input
5	Terminal box
6	Cover
7	Cable heating section
8	Transmitter heat-insulated cover

Heating unit is installed on the flow meter body. Heating is provided by the cable heating section.

Heating unit consist of the protection case (1) with the cover (6), heating cable section (7), terminal box (5), circuit breaker with combined protection, grounding (3), insulation (2), heat-insulated cover (8) (as per order).

Section (7) is laid in winds and fixed to the meter body with metal bend. The section is covered with the protection shell (1) filled with heat insulation (2) and cover (6). Installation outputs are put inside the terminal box (5).

The cable shall be connected to the terminal (4) of the terminal box (5).

The heating temperature is automatically adjusted according to the meter body temperature and ambient temperature. Max heating temperature shall not exceed the value as specified in the table 1.5. Heating temperature decreases accordingly with increasing temperature of the meter body and the environment, heating temperature increases with temperature decreasing.

Table 1.5 - Heating unit parameters

Version	Max temperature, ºC	Max initial current Imax, A, less then	Nominal output, VA
E1	65	10	184

E2	65	10	230
E3	65	10	460
E4	120	16	480
E5	120	16	600
E6	120	16	960

1.7. Specification

1.7.1. Description of technical parameters

Description of technical parameters is shown in Table 1.6

Table 1.6 - Technical parameters of the flow meter

Name	Description
Measuring medium	liquid, oil and gas mixture, crude oil and oil products
Accuracy	1,0; 1,5; 1,75; 2,0; 2,5
Medium temperature	From 0 to +130ºC
Upper limit of kinematic viscosity - EM-300-030, EM-300-060 - EM-300-120, EM-300-210, EM-300-480	up to $5 \cdot 10^{-4}$ m^2/s up to $1.5 \cdot 10^{-4}$ m^2/s
Density (820 kg/cbm by default)	500 – 1500 kg/cbm
Excessive pressure of medium	up to 6,3 MPa
The minimum permissible content of the volume fraction of free gas in the oil and gas mixture	2 %
The maximum permissible content of the volume fraction of free gas in the oil and gas mixture	50/95 %*
The content of hydrogen sulfide in free oil gas by volume, not more than - under pressure up to 1,7 MPa - under pressure higher than 1,7 up to 4,0MPa and partial pressure of hydrogen sulfide up to 345 Pa	4 % 0,002 %
Connection size, mm	see Appendix A
Limits of relative error for mass (mass flow), %, for meters of the following classes: - 1.0 - 1.5 - 1.75 - 2.0 - 2.5	± 1,00 ± 1,50 ± 1,75 ± 2,00 ± 2,50
Explosion protection: - with electrical heating unit - without heating unit	1Ex d e IIB+H_2 T4 Gb X 1Ex d IIC T4…T6 Gb X, 0Ex ia IIC T4...T6 Ga X
Atmospheric pressure	84.0 to 106.7 kPa

Ambient temperature:	from -50ºC up to +80ºC
Relative humidity, %, less than: - flow meter - external transmitter	95 % (condensing under 35ºC) 80% (non-condensing)
Magnetic field resistance	Up to 40A/m, 50Hz
Vibration resistance	group V1 under GOST P 52931
Ingress protection	IP66 / IP67
Electrical heating unit ingress protection	IP54
Pressure loss, not more than	0.01 MPa
Mean time before failure, not less than	52 000 hours
Service life	over 10 years
Dimensions and weight	see Appendix A

* special version

1.7.2. Measuring ranges

Table 1.8 shows flow meter measuring ranges. Stable work of the flow meter is secured for the full range as specified in the table 1.7.

The maximum achievable flow rate shall be within the approved range.

Table 1.7 - Flow range depending on the medium density

Flow meter code	Flow range depending on the density (ρ, kg/cbm)			
	500 ≤ ρ < 600	600 ≤ ρ < 700	700 ≤ ρ < 820	820 ≤ ρ < 1500
EM-300-030	0.3...18	0.3...22	0.3...26	0.3...30
EM-300-060	0.3...37	0.3...44	0.3...51	0.3...60
EM-300-120	0.3...73	0.3...88	0.3...102	0.3...120
EM-300-210	0.3...128	0.3...154	0.3...179	0.3...210
EM-300-480	0.3...256	0.3...307	0.3...359	0.3...480

* Full range corresponds to the values at the maximum density of the measured fluid.

** Max flow rate for the channel for all version of the flow meter EMIS-MERA 300 is 1·10-3 t/day.

1.7.3. Power supply parameters

The sensor with rated output signal shall be connected to 24VDC, the heating unit to 220 VAC (50±2) of Hz. Circuit characteristics are shown in the Table 1.8.

Table 1.8 - Flow meter assemblies power supply parameters

Flow meter part	Current type	Voltage, V	Power consumption, VA, not more than
Pulse sensor with rated output signal	direct	24±2	1

External transmitter	direct	24^{+4}_{-3}	4
Electric heating device	alternative	220^{+22}_{-33}	184..960 (see table 1.6)

1.7.4. Output signals

1.7.4.1 Pulse output signal

Table 1.9 - Pulse output signal parameters

Name		Description
Pulse output signal parameters	output circuit type	"open collector"
	pulse duration, s	0,25±0,05
	rated voltage, V, not exceeding	27
	rated current, mA, not exceeding	50
	output channels	1
	pulse weight, kg	adjustable
	current type	direct
Pulse output signal supply	voltage, V	24±2
	current, not higher, mA	50
	Power consumption, VA, not exceeding	1

Table 1.9.1 - Possible pulse values

Flow meter size, t/day	Bucket max weight, kg	Recommended pulse value, kg
30	0.8	2
60	0.96	2
120	1.92	3
210	3.3	5
480	6.6	10

Note: after changing pulse value, calibrate the measuring unit according to updated pulse value

1.7.4.2 Digital signal Modbus RTU

Computer with “M” output signal is equipped with output signal Modbus RTU according to the table 1.2.

Digital output signal Modbus RTU is based on RS-485 and complies with EIA/TIA-485-A standard. Main parameters of RS-485 are presented in the table 1.10.

Table 1.10 - Digital output signal parameters

Parameter	Name

Data transmission rate	115200 baud/s
Max length of segment	1200 m (If using terminator)
Max number of hosts in the segment	31
Signal	is differential

1.7.4.3. USB interface

Computer with “M” output signal is equipped with USB according to the table 1.2.

USB is a service interface and shall not be used as main communication interface. It is used for transmitter adjustment and calibration.

Transmitter is equipped with miniUSB output. Install the driver to access to the device. You can download the driver from the EMIS official web-site. After connecting the device, a virtual COM port will be created for communication with the device. Use EMIS software EMIS-Integrator of version 3.1.17 and higher for diagnostics and adjustment.

1.7.5. Data filing

Computer with “M” output signal is equipped with data filing function according to the table 1.2.

To switch on and off data filing use EMIS-Integrator of version 3.1.17 and higher or Modbus RTU RS-485 or USB. Data filing is switched on by default.

Minute/hour/day/month along with constant values archiving is processed to different sectors of memory.

Archive capacity for hours is 45 days, for days is 366 days, for month is 36 months, for minutes is 5.5 days. When the archive is out of memory, it starts to re-write over the early records.

The device is equipped with the real-time clock. Set up current date, time and reporting hour, by default it is set as 01.01.2020 00:00:00, reporting hour is 0. To set date, time and reporting hour use RS-485 or USB via EMIS-Integrator of version 3.1.17 and higher or Modbus RTU, see Appendix D for registry description. In the absence of battery supply, when the external power is turned off and on again, the time and date are set from the moment the power is turned off.

To read minute, hour, day and month archive use RS-485 or USB via EMIS-Integrator of version 3.1.17 and higher or Modbus RTU, see Appendix D for registry description. Read algorithm for Modbus RTU is presented in the table 1.11.

Table 1.11 - Read algorithm for Modbus RTU

No	Action	Register address
1	Set start read time	56
2	Set start read date	58
3	Set end read time	60
4	Set end read date	62
5	Request archive type: 0 - request pending/request canceled 1- hour 2 - day 3 - month 4 - minute.	64

6	Read status: 0 - no request 1 - data collecting 2 - data collected 3 - no data for requested period 4 - start time or date incorrect 5 - end time or date incorrect 6 - end date/time prior to start date/time 7 - requested period is too long	44
7	Count received data elements	46
8	Count array with response for archived data	62-1258

1.8. Explosion protection

All meter are ex-proof with the following protection levels:

With electrical heating 1Ex d e IIB+H_2 T4 Gb X;

Without electrical heating 1Ex d IIC T6…T4 Gb X, 0Ex ia IIC T4...T6 Ga X

Assemblies which influence the device explosion protection level:

- pulse sensor (pulse sensor with rated output signal) is equipped with explosion-proof enclosure under GOST IEC 60079-1.1 or intrinsically safe circuit of "ia" protection level under GOST 31610.0 (IEC 60079-0). Ex-proof marking 1Ex d IIC T6…T4 Gb X, or 0Ex ia IIC T4...T6 Ga X;

- heating unit of the "e" type protection under GOST R IEC 60079-7 and explosion protection called "advanced protection against explosion'. Ex-proof mark of the heating unit 2ExeIIT6…T4X.

Explosion protection marking is indicated on the plates attached to the cover of the transmitter and to the cover of the housing (casing) of the electric heating unit.

Ex-proof plates are presented in clause 1.9 Marking"

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

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

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

- electrical connection to external circuits shall be executed using cable glands certified under GOST IEC 60079-1.1;

- plug unused cable glands with the plug supplied with the device or any other plug certified under GOST IEC 60079-1.1;

- the external electric circuit (in the explosion-proof zone) shall be equipped with a switch with combined protection (VKZ) which disconnects the heating section of the device from the mains when the leakage current to earth exceeds 30 mA;

- connection of external devices to the pulse output and power of the meters should be carried out in accordance with GOST IEC 60079-1;

- ex-proof meters with protection type 0Ex ia IIC T4...T6 Ga X shall be powered to and operated with the devices with intrinsically safe circuit of "ia" level.

Explosion protection called "ex-proof enclosure" is provided by putting electrical parts into explosion-proof casing under GOST IEC 60079-1 to avoid explosion transfer into the flammable environment. Explosion safety is provided by the following:

- the enclosure withstands the four-time explosion pressure;

- axial length of the thread and the number of complete turns in the engagement of the threaded flameproof joints shall comply with the requirement of GOST IEC 60079-1;

- tolerances and length of the planar and cylindrical explosion-proof joints comply with the GOST IEC 60079-1;

- protection enclosure corresponds to a high degree of mechanical strength according to GOST 31610.0 (IEC 60079-0);

- max temperature of surface heating under operating conditions shall not exceed the values of T4, T5, T6 temperature classes as specified in GOST 31610.0 (IEC 60079-0) for temperature classes.

Explosion protection elements drawing is shown in the Appendix C.

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

- power supply and connection of external devices shall be performed under the requirements of GOST IEC 60079-1;

- electrical load of the intrinsically safe parts of the circuit shall not exceed 2/3 of the value as specified in the data sheet;

- pulse sensor circuit data values shall not exceed the values specified in GOST 31610.11;

- Zener barrier is installed;

- creepage path and clearance shall comply with the requirements as specified in GOST 31610.11, insulation between the meter body and the protection casing withstands AC test of 500V;

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

- current- carrying connections and electronic components are protected against environmental exposure with IP 66/ IP 67 enclosure complying with GOST 14254 (IEC 60529).

Parameters of intrinsically safe circuit:

- max input voltage Ui: 25.6 V;

- max input current Ii: 130мА

- max input power Pi: 0.8 W;

- max internal capacity Ci: 0.01 μF;

- max internal inductance Li; 0.01 mH.

Explosion protection of "e" type is provided by the following:

- the ends of the heating element are sealed with special termination kits;

- after installation one of the ends is fully covered inside the ex-proof enclosure;

- after sealing of the ends is done perform the break, short-circuit tests and measure resistance between the current-carrying wires and the shield. Insulation resistance shall be not less than 100 MΩ.

1.9. Marking

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

Main plate with technical parameters.

Pulse sensor ex-proof plate (pulse sensor with rated output signal).

Electrical heating unit plate with technical parameters.

The name plate is shown in fig.1.4 and contains the data as listed in the table 1.12.

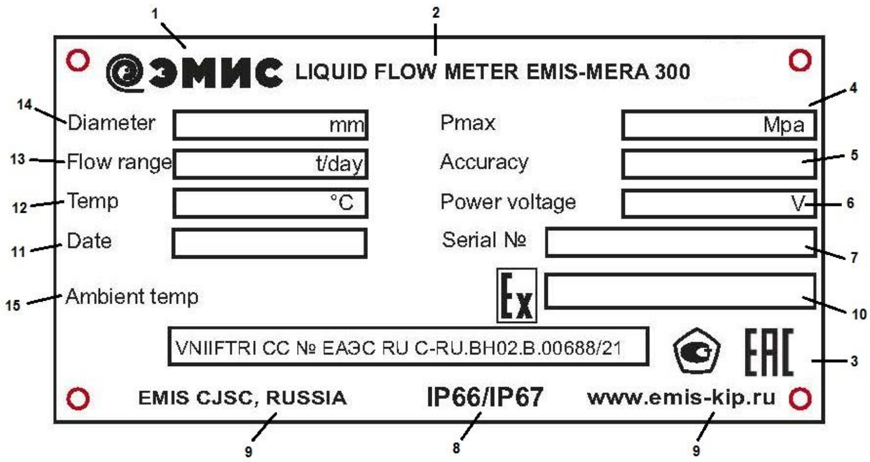


Fig.1.4 - Name plate

Table 1.12 - Marking on the name plate

NO in fig.	Description
1	Manufacturer trade mark
2	Name
3	Certification authority
4	Max pressure of environment (Pmax)
5	Accuracy
6	Input voltage
7	Serial number
8	Ingress protection of the transmitter and the pulse sensor
9	Manufacturer information
10	Ex-proof sign
11	Date of manufacturing
12	Medium temperature range Twork
13	Full range of measurement (Q)
14	Dn, mm
15	Ambient temperature range (Ta)

Pulse sensor ()pulse sensor with rated output signal) of transmitter has explosion protection called “ex=proof enclosure” under GOST IEC 60079-1 or “intrinsically safe circuit” of "ia" protection level under GOST 31610.11. Ex-proof marking 1Ex d IIC T6…T4 Gb X or 0Ex ia IIC T6…T4 Ga X;

- heating unit of the "e" type protection under GOST R IEC 60079-7 and explosion protection called "advanced protection against explosion'. Ex-proof mark of the heating unit 2ExeIIT6…T4X.

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

1.10. Supply scope

Basic supply kit includes:

- Flow meter EMIS-MERA 300;
- Data sheet EM-300.000.000.000.00 PS;
- Operation manual EM-300.000.000.000.00 OM;
- Calibration method EM-300.000.000.000.00 CM;
- Spare parts and accessories kit (studs - 4pcs., lock washers- 6pcs., rubber ring - 1pc., hex wrench - 1pc., cable gland);
- Switch with combined protection (for the meter with electrical heating unit);
- Package.

Additional kit:

- Certificates:

Measuring instruments type approval certificate with type description;

TR TS certificate 012/2011 on "The safety of equipment in explosion hazardous environments" with enclosure.

TR TS certificate 032/2013 on "The Safety of equipment working under excessive pressure"

- TR TS declaration 032/2013 on "The Safety of equipment working under excessive pressure "

- TR TS declaration 020/2011 on "Electromagnetic compatibility"

- TR TS 004/2011 “On the safety of low-voltage equipment”

- EMIS-MERA 300 Mounting kit (counter pipes of the hub joint - 2pcs., hub joints - 4pcs., gaskets - 2pcs., bolts/studs - 4pcs., pins - 4/8pcs., flat washers - 8pcs.)
- Mounting sleeve EMIS-VECTA VT300;

Attention!

Please follow the steps below after receiving the flow meter:

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

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

2 APPLICATION

2.1 *Configuration selection*

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

Table 2.1 - Information for flow meter version selection

NO	Process information
1	Oil viscosity under N.C.[1], kg/cbm
2	Water viscosity under N.C., kg/cbm
3	Gas viscosity under N.C., kg/cbm
4	Estimated oil-production rate, cbm/day
5	Estimated water-production rate, cbm/day
6	Estimated liquid-production rate, cbm/day
7	Estimated working pressure at the well production measurement point, cbm/cm^2
8	Gas factor under normal conditions, cbm/t of oil (cbm/cbm oil)
9	Gas injection volume under normal conditions, cbm/day
10	Bubble point pressure, kp/cm2
11	Kinematic viscosity of crude oil under 20 ºC, mm^2/s (cST)
12	The temperature of the measured oil and gas mixture, ºC
13	The presence of hydrogen sulfide (H_2S) and its volume fraction in the oil and gas mixture,%
14	The presence of acids and alkalis in the oil and gas mixture
15	The presence of mechanical impurities in the flow of oil and gas mixture, mg / l
16	The content of asphaltenes, paraffins and other substances prone to adhesion for steel grades: 09Г2С и 12Х18N10Т
17	Max ambient temperature, ºC
18	Min ambient temperature, ºC

Normal conditions is the measuring unit at ambient temperature of 20 ºC and atmospheric pressure of 101.3 kPa.

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

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

2.2 *Safety requirements*

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

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

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

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

- to replace radio components if power is connected;

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

The factors below can be dangerous:

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

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

Attention!
It is prohibited to mount and operate the meter under medium pressure and temperature higher than limited. It is prohibited to operate the meter 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 flow meter near transformers. power units and other vibrating equipment.
- Meter shall not be installed in piping stress part and be the support of the pipeline.
- Meter shall be installed in easily accessible places. Appropriate space shall be provided for installation and maintenance.
- Display shall be reachable for reading control.

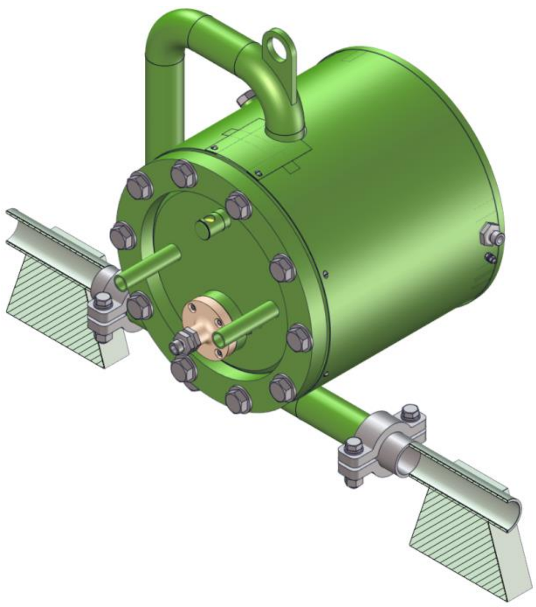


Fig. 2.1 - General requirements to installation place

Attention!
Provide additional pipeline support legs before and after the flow meter if it is installed in the places of strong vibration or flow meter itself is the pipeline support. Support legs foundation shall be rigid. Installation of the meter in places where vibration is present, including on moving units, is allowed.

2.3.2 Pipeline direction

Flow meter can be mounted on horizontal part of the pipeline.

No straight run is required before and after installation, as well as installation of additional flow conditioners.

To prepare for installation please follow the steps below:

- check for counter flanges of the hub joints, fasteners, technological joints and their match with the order sheet;
- cut the L1 segment of the pipeline (see **Appendix A**)

$$L1 = L + 2*Lhub, \qquad (2.1)$$

where L- installation length of flow meter (see **Appendix A**);

Lhub - the length of the hub=b joint;

- install the counter pipes using the hub joints;
- align the mounting insert assembled with the counter pipes, align, center and weld them to the pipeline.

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

- gas welding is used for mounting;

- for arc-welding power source is connected so that current does not flow through the meter - see fig.2.2.

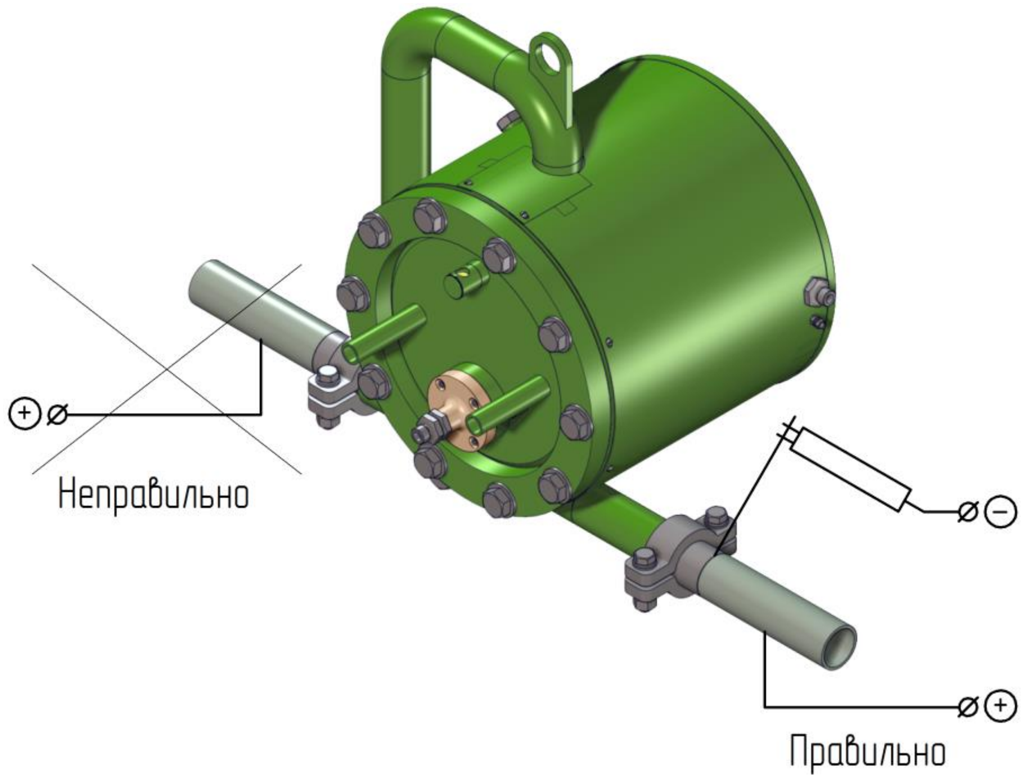


Fig.2.2 - Power supply connection for arc-welding

2.3.3 Preparation of the pipeline

As a result, the installation point should look in accordance with the figure 2.3.

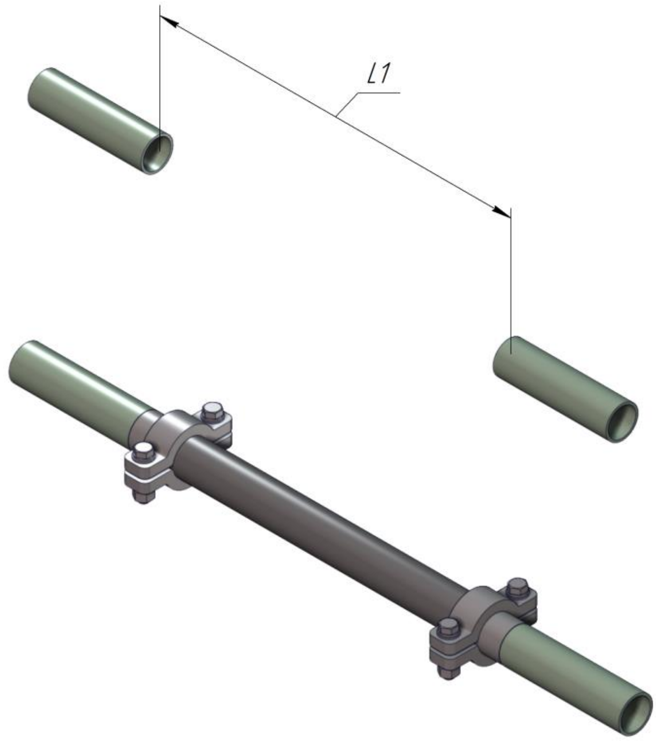


Fig.2.3 - Pipeline preparation

2.3.4 Pipeline cavity preparation and counter installation

Please follows the steps below before installation:

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

To install the flow meter proceed the following steps (fig.2.4):

- rotate the flow meter so that the arrow on the body match normal flow direction;
- place the gasket (2) between the hub pipes in the groove on the pipe;
- put two hub joints (7) covering the hub pipes;
- insert the bolts (8) (studs) through the holes of the hubs, put on the washers (4, 5) and tighten the nuts (3). Do not tighten the nuts;
- install a gasket between the other hub pipes, put on two hub joints, thread bolts (studs) through the hub holes, put on washers and tighten the nuts. Do not tighten the nuts;
- loosen the transmitter flange bolts;
- use the handles to align the transmitter (10). Align the transmitter so that the air bubble (9) is located at the center of the indicator.
- tighten the nuts (3) of the hub joint;
- tighten the flange bolts in the sequence as showed in the fig.2.5. Tightening torque is 250Nm;
- repeat the tightening for max tension;
- provide the flow in the meter;
- ensure that all joints are sealed.

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

2.4 *Electrical connection*

2.4.1 General directions

The electrical connections of the pulse sensor (pulse sensor with rated output signal) shall be made in the following sequence (see Figure 2.6):

- loosen the counter but (3), unscrew the socket (2);
- unscrew the bolts (1) of the cover (6) and remove it;
- remove the washer (4) and two o-rings (5) from the cover;
- put the cable through the insulated cover (if any), socket (2), washer (4), sealing rings (5) and cover (6);
- release screws of the terminal block 12;
- * remove the tip (11) fixed with the nut (9) and washer (10);
- * crimp the ground wire (11);
- arrange connection according to connection diagram **in Appendix** B
- tighten the screws of the terminal block (12);
- * put the tip (11), washers (10) and tighten the nut (9);
- put the cover (6), check for gasket (7) between the meter body (8) and the cover, tighten the bolts (1);
- put the sealing rings (5) and washer (4) into the cover (6);
- screw in the socket (2) and tighten the counter nut (3).

* The grounding contact can be implemented on the terminal block (12), if there are no tip (11) and the fasteners (9, 10).

For EMIS-MERA 300-120 and EMIS-MERA 300-480 electrical connection of the pulse sensor with integrated transmitter shall be carried inside the terminal box in a niche outside the housing. Wiring diagram is shown in Appendix B.

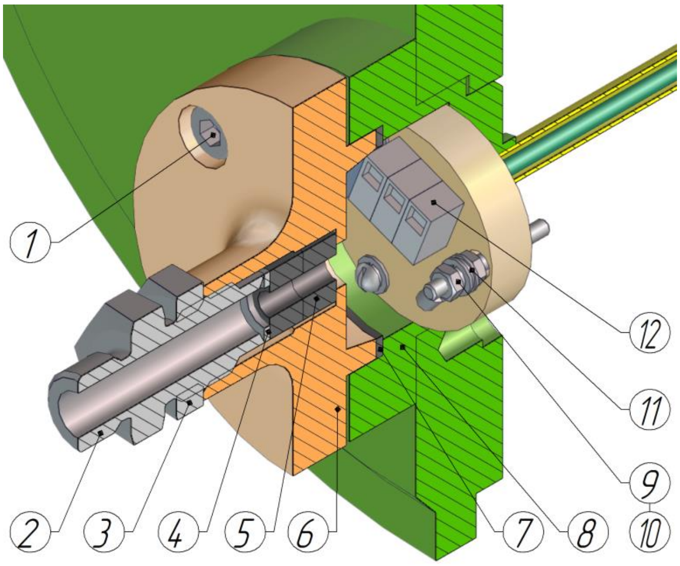


Fig. 2.6 - General rules for pulse sensor electrical connection (pulse sensor with integrated transmitter)

Table 2.3 - Description for fig.2.6

NO in fig.	Description
1	Fixing bolt
2	Socket
3	Lock nut

4	Washer
5	Sealing ring
6	Cover
7	Gasket
8	Body
9	Nut (if any)
10	Flat washer + lock washer (if any)
11	Tip (if any)
12	Terminal block

Power cable length shall not exceed 250m with wire size not less than 0,8mm^2.

The resistance of each conductor shall not exceed 50 Ohm. The size of each wire connected to the sensor shall not exceed 2.5mm^2.

Heating unit electrical mounting shall be executed in the sequence below (see fig.2.7):

- unscrew the bolts (2) of the cover (1) and remove it;
- remove the terminal box cover (3);
- arrange connection according to connection diagram **in Appendix** B
- remove the terminal box cover (3);
- put the cover (1), screw in the screws (2).

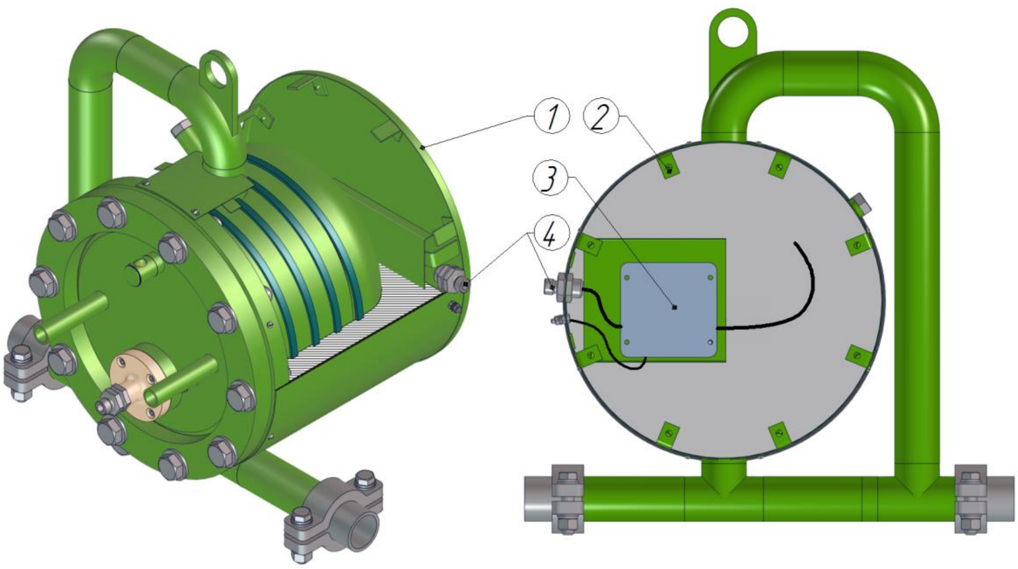


Fig.2.7 - General rules for heating unit connection

Table 2.4 - Description for fig.2.7

NO in fig.	Description
1	Cover
2	Screw
3	Terminal box
4	Cable gland

Attention!
It is prohibited to turn on the electric heating device in the supply network without circuit breaker.

Attention!
For installation in explosive environment strictly follow the rules listed in 2.4.2 Explosion protection while mounting.

Attention!
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:

- specified in the Operation Manual;
- Operation Guide to Load-Side Electrical Installations (clause 3.4);
- Russian Electrical Code (clause 7.3);
- GOST IEC 60079-1.0;
- GOST IEC 60079-1.1;
- GOST R IEC 60079-7;
- instructions VSN332-74/MMCC (Installation of electrical equipment, power and lighting systems in explosive environment);
- any other corporate normative documents.

Pay attention to special rules listed in clause 1.8 Explosion protection.

Inspect the pulse sensor before installation. Check for ex-proof marking, warning signs, damages of the sensor ex-proof housing, grounding clamp in the ex-proof housing, condition of the cable and sealing of the cable and the cover.

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

Pulse sensor installation shall be carried out using the round cable of (∩7 to 10mm size fully-filled and not longer than 250m.

After installation is done check that resistance between the electrical circuits and the pulse sensor housing is more than 20Mohm and ground line resistance does not exceed 4Ohm. Use the grounding wire not less than 2,5mm^2 size.

After completing the electrical installation, the cover and other parts of the pulse sensor that were removed during installation should be put in place, while paying attention to the presence of all fasteners and locking elements and the thoroughness of their tightening, according to the drawing of **Appendix B**.

Attention!
It is prohibited to use cable with PE insulation and coating. Cable Dn shall comply with the sealing ring marking.

Attention!
It is prohibited to open the pulse sensor cover in the hazardous environment.

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 flow meter and each of its output signals or multichannel supplier with galvanically isolated windings.

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

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

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

2.4.4 Ingress protection

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

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

- The seals of the pulse sensor and the electrical heating unit shall not be contaminated 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.
- Pulse sensor 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 (see fig.2.8)

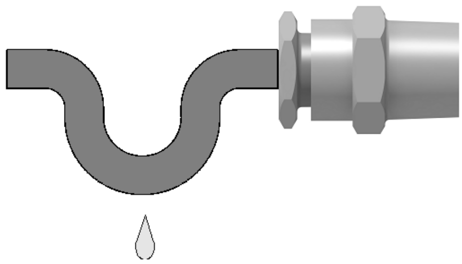


Fig.2.8 - Cable glands scheme

2.4.5 Grounding

Transient phenomena due to lightning, welding, powerful electrical units or distribution boards may cause readings mistakes or damage the flow meter. To protect equipment from such phenomena connect grounding terminal of the flow meter and heating unit (see fig.2.9) 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.

Pulse sensor and heating unit can be grounded through the pipeline if the pipeline provides the grounding.

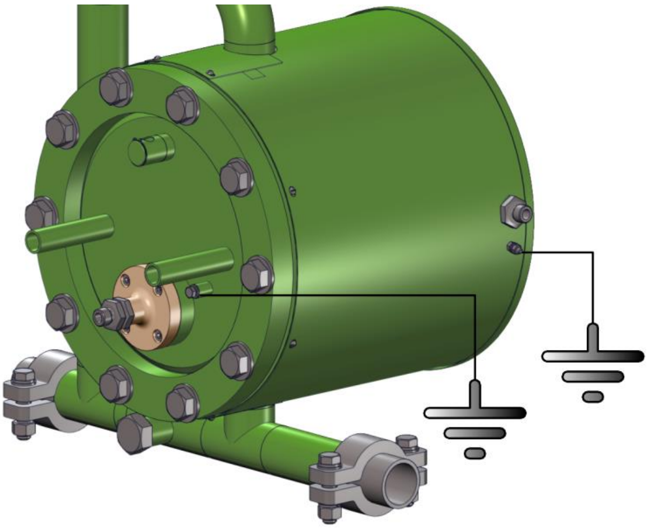


Fig.2.9 - Flow meter grounding

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

2.5 *Operation, measurement technique and maintenance*

2.5.1 General directions

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

- smoothly open/close pipeline valves to protect the meter from damages caused by water hammer.
- During the operation of the meter on the measured medium containing paraffins or mechanical impurities, deposits are possible on the inner surfaces of the measuring unit, which increase the error in measuring the liquid flow rate. It is allowed to use steam to remove paraffins form the inner parts of the meter. Steam can be supplied independently or along with the measuring medium.

Use meters with electrical heating to avoid deposits of paraffins inside the meter.

2.5.2 Measurement technique

Operation of meter shall comply with the requirements specified in the present Manual.

Working principle of the meter is based on measurement of number of rotations of sensor proportional to the medium weight passed through the meter.

Medium enters the input collector of the meter body, then through the nozzle goes to the flow tube which consists of the two chambers. Once one of the chambers is filled with the medium it breaks the balance conditions depended on the position of the center of mass, which leads to its rotation and further discharge of the liquid out of the chamber. During the rotation another chamber is placed under the nozzle and the process of filling repeats, while the discharged medium goes to the discharge collector in the lower part of the flow meter body. The displacement of the measured medium occurs due to the excess pressure of the gas pumped into the meter body or released from the oil and water mixture due to the effect of gravitational separation.

Pulse sensor transform transducer rotations into the electrical signals. Computer collect, transform, process pulse signals from the transducer and calculate medium weight, then transfer via interfaces to the transmitter indication unit.

Measuring conditions:

- Measuring mediums include liquids, oil and gas mixtures, crude oil under GOST R 8.615-2005 or oil products with the content of free gas from 2 to 95%;
- Measuring medium shall not be corrosive to meter materials.
- Flow meter operating conditions shall comply with the parameter requirements as below: pressure, temperature, density and flow velocity of gas; ambient temperature and humidity; electrical power supply; location class and explosion protection class.

Preparation to measurement:

- Prior to measurement, check permissible range as specified in the table 1.8 of the Manual.
- Follow the rules in the clause 2.3 of the Operation manual to select installation point and prepare the pipeline for installation.
- Check if measuring medium parameters (pressure, temperature, density) comply with operating parameters of the meter; check safety requirements specified in the clause 2.2 of the Manual; check installation requirements specified in the clause 2.3and electrical connection requirements specified in the clause 2.4 of the Manual.
- Check measuring pipeline integrity and sealing according to the normative documents.

Measurement procedure:

- The meter measures medium and transfer rated pulse signal (standard pulse value is 10kg/pulse).
- Meter readings can be taken from other devised such as controller, pulse counter etc. compatible with pulse sensor.

Calculation of medium weight:

When using pulse signal from pulse sensor, measured medium weight can be calculated as follows:

$$Q_{\text{M}} = m * n$$

where:

Q_M - weight, kg;

m - pulse value, kg/pulse.

n- number of pulses, pulse.

2.5.3 Maintenance

Maintenance include check of the technical parameters and periodical inspection.

Maintenance shall be provided by authorized personnel who have carefully read the Manual and get through electrical safety instruction.

Follow the Manual directions to perform the transmitter maintenance.

During operation, the meter must be inspected monthly for external damages and periodically for failure prevention.

During an external examination, it is necessary to check:

- observation of operating conditions;
- for breaks or damage to the cable insulation;
- power supply and its compatibility with parameters specified in the clause Power supply and output signals ;
- if the pulse sensor cover is tightened;
- visibility of marking plates;
- connections sealing;
- visible damages.

Inspection interval depends on the operating conditions and shall be scheduled by the service party as agreed with the operating side, but not less than twice a year.

In the process of preventive examination, the following should be performed:

- check cable sealing (it shall not rotates in the inlet);
- check wire connection and insulation integrity;
- check pulse sensor housing for damages.

In case of failure follow the instructions in Diagnostics and troubleshooting.

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

2.5.4 Diagnostics and troubleshooting

Possible failures and troubleshooting are presented in table 2.5.

Table 2.5 - Troubleshooting

Failure	Possible cause	Remedy
No indication in the transmitter display No periodic clicks in side the meter	No flow of oil and gas mixture	Check the flow with one of the available methods
	There is not enough gas in the meter	Ensure meter filling with gas
No indication in the transmitter display Periodic clicks in side the meter can be heard	Connection break	Find and repair a break
	Transmitter failure	Check transmitter operability according to the Operation manual
	Pulse sensor failure	replace reed switch or the Hall sensor
Drastic increase of pressure before the meter	Meter collector is clogged with paraffin or mechanical impurities	Clean the pipeline and the meter with the steam under 115ºC for 10-15 min. Clean the meter channels form mechanical impurities.
Significant decrease of the displayed total weight in the transmitter display	No flow of oil and gas mixture	Check the flow with one of the available methods

3 TRANSPORTATION, STORAGE AND RECYCLING

3.1 *Transportation*

Please follow the transportation requirements:

- flow meter shall be packed in such tare to avoid mechanical damages during transportation;
- line the inner part of transportation package with water-resistant paper;
- Flow meter can be transported according to GOST 15150 under ambient temperature of -50 to 50°C and relative humidity of 100 % at 35°C.
- protect the device from precipitations;
- transportation can be done by every mean of enclosed transport, including air transportation in warm sealed sections according to specified rules of transportation.
- follow handling signs on the package;
- it is allowed to ship flow meters in containers;
- boxes shall be stuffed so that to avoid movement during transportation;
- avoid strong bumps during cargo stuffing;
- transit time shall not exceed 3 month;
- leave the boxes unpacked for at least 12 hours in warm premises if cargo was transported at the temperature below 0°C.

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

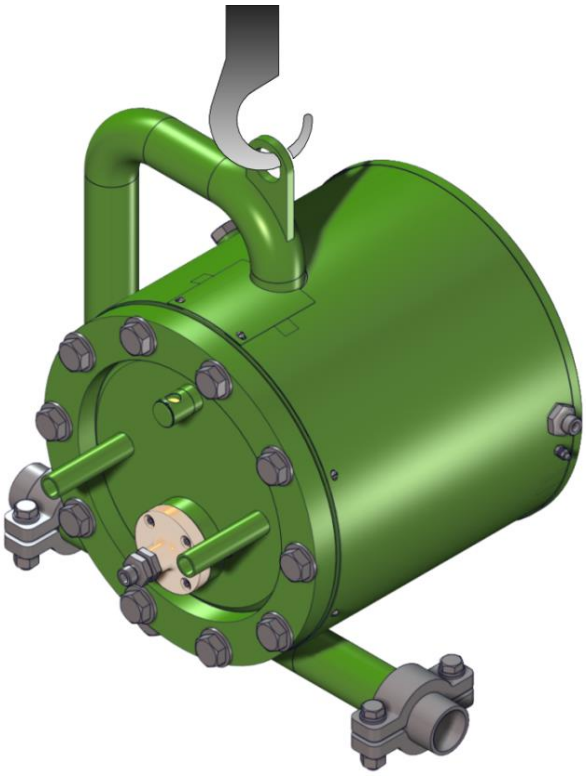


Fig.3.1 - Flow meter transportation without package

3.2 *Storage*

Storage of meters in accordance with storage conditions for products 4 (G2) according to GOST 15150. Flow meter can be stored in unheated rooms with air temperature from minus 50 to plus 50 ° C and relative humidity of air up to 95% non-condensing at 25 ° C.

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

3.3 *Recycling*

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

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

Does not contain precious metals.

4 CALIBRATION

Calibration is performed according to EM-300.000.000.000.00 CM for liquid quantity counters. Calibration method".

Calibration interval is 3 years.

APPENDIX A

(normative)

Dimensions and connection sizes

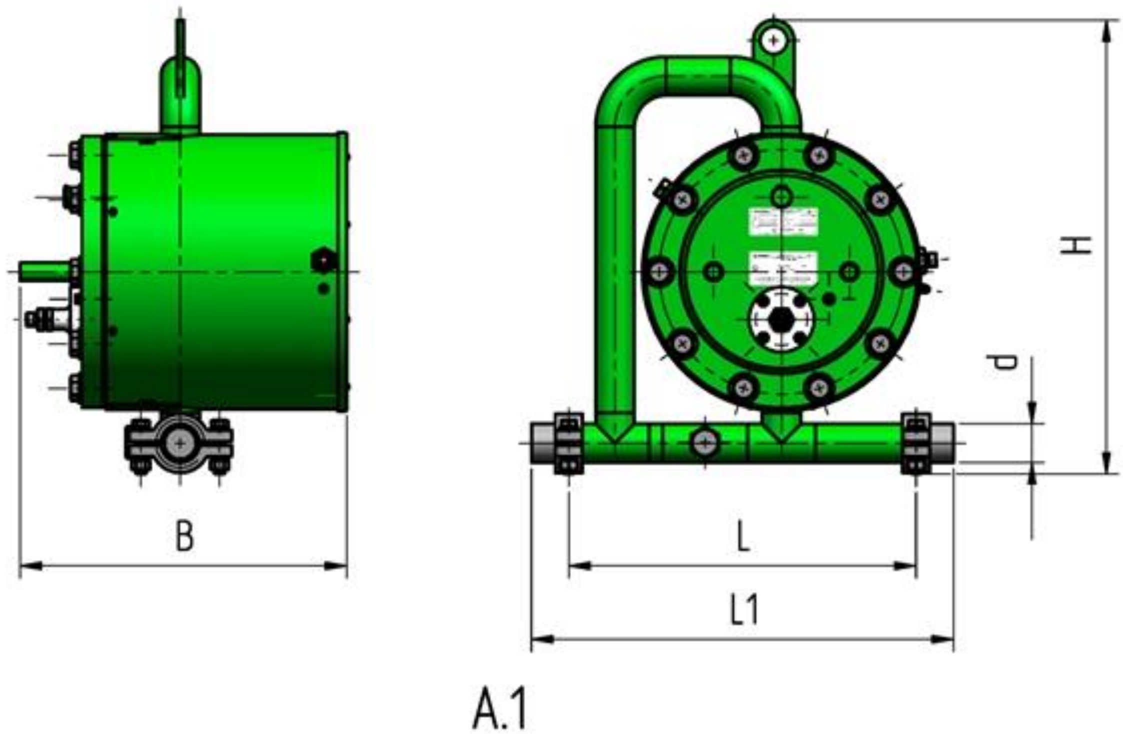
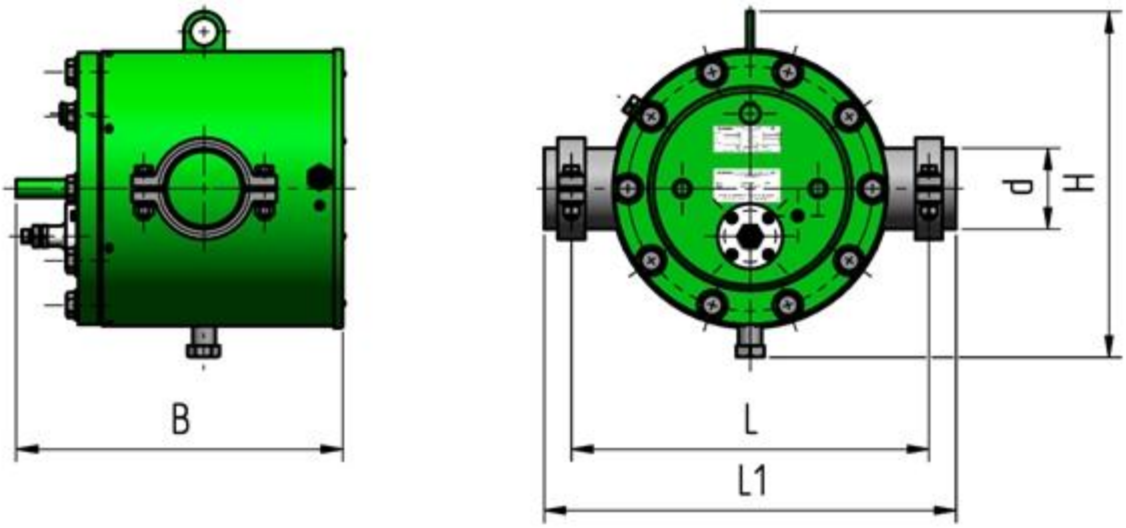
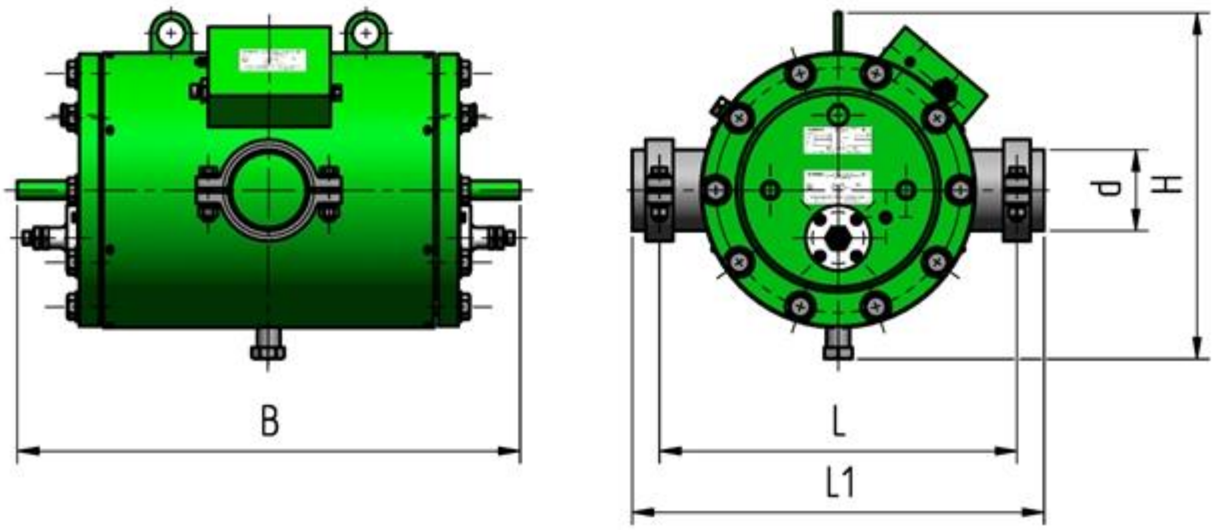


Fig.A.1. - Dimensions and connection sizes of the meter



A.2



A.3

Fig.A.2., A.3 - Dimensions and connection sizes of the meter

Table A.1 - Dimensions, connections sizes and weight

Meter code	Figure	Diameter d, mm	L, mm	L1, mm	H, mm	B, mm	Weight, kg
EM-300-030	A.1	50	500	610	700	500	100
EM-300-060	A.1	50	500	610	700	500	100
EM-300-120	A.2	80	600	680	570	800	200
EM-300-210	A.2	80	600	680	570	800	200
EM-300-480	A.3	80	600	700	627	1143	300

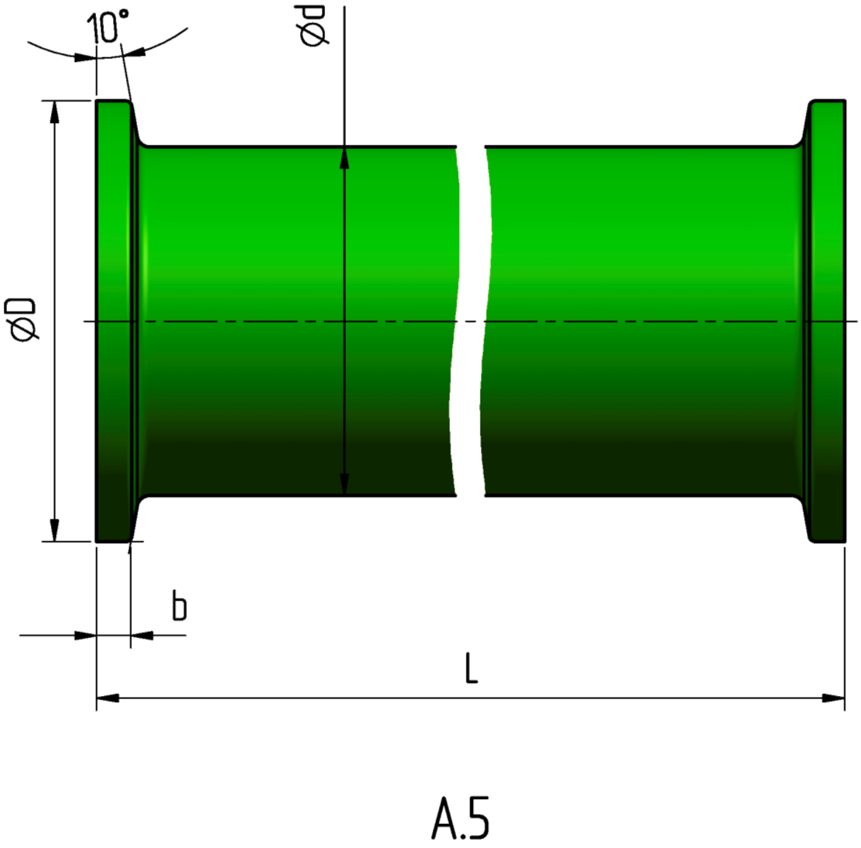


Fig.A.5 - Dimensions and connection sizes of the mounting coupling

Table A.2 - Dimensions, connections sizes and weight of the mounting coupling

Flow meter code	Diameter d, mm	d, mm	D, mm	b, mm	L, mm	Weight, kg
EM-300-030	50	57	72	5.6	500	3.1
EM-300-060	50	57	72	5.6	500	3.1
EM-300-120	80	57	72	5.6	600	7.7
EM-300-210	80	89	106	6.0	600	7.7
EM-300-480	80	108	131	6.5	600	9.6

APPENDIX B

(normative)

Connection diagram

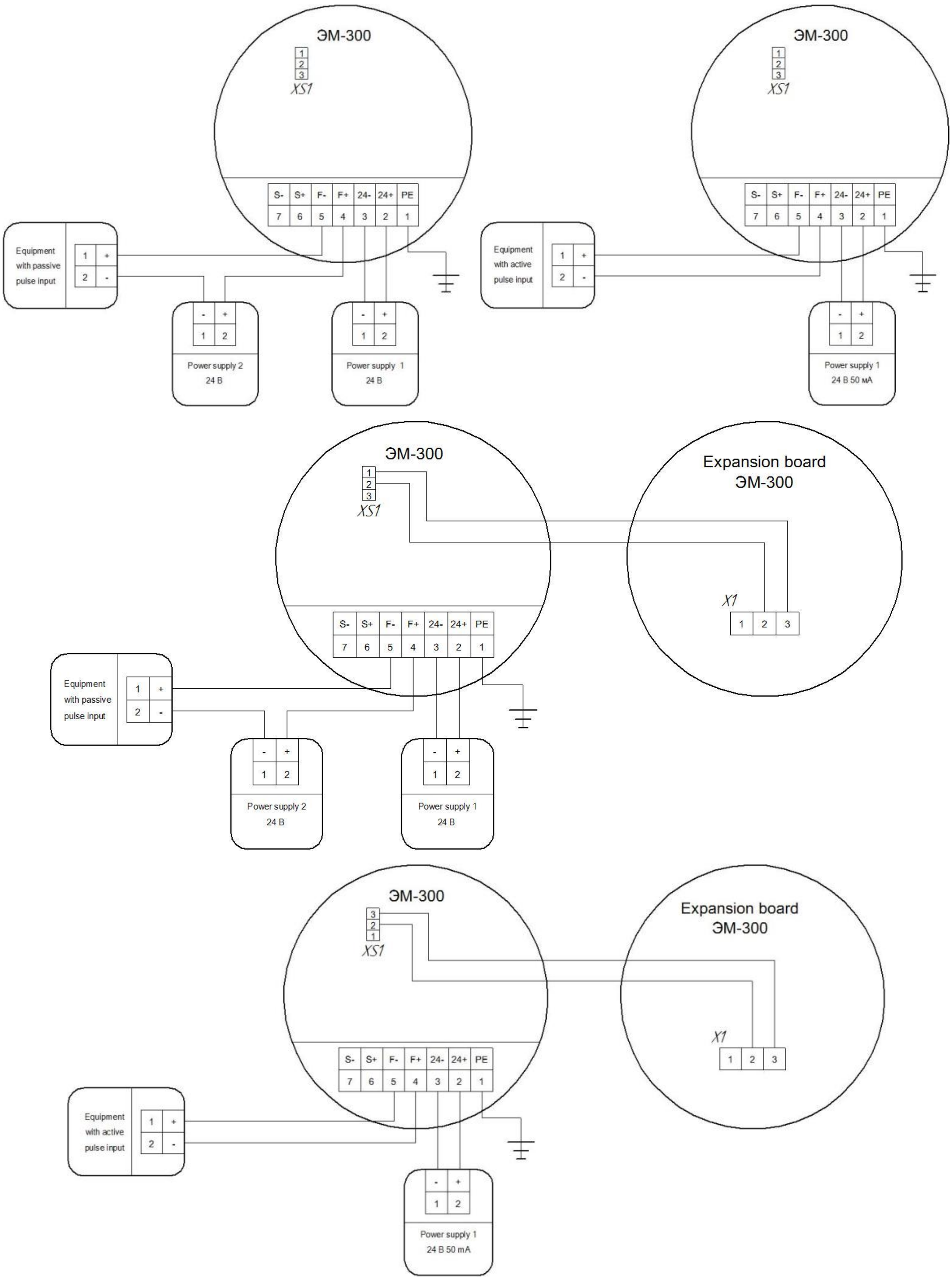


Fig.B.1 - Pulse sensor connection

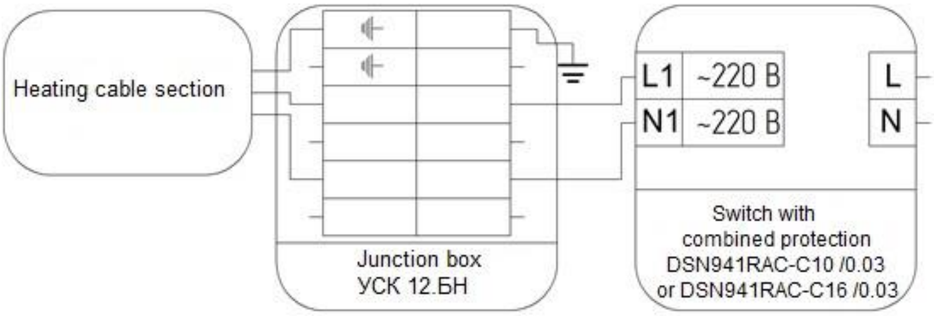


Fig.B.2 - Heating unit connection

APPENDIX D

(normative)

Modbus RTU register map

pulse sensor with digital output signal

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

Table C.1.

Command (function)	Function code (HEX)	Sub-Function code (HEX)
Common commands:		
Read Coils	01	
Read Holding Registers	03	
Read Input Registers	04	
Write Single Coil	05	
Write Multiple Coils	0F	
Write Multiple Registers	10	
Report Slave ID	11	

See description of special functions for detailed information.

Function 01h (read coils)

Standard request-response

Function 03h (read holding registers)

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

Function 04h (read input registers)

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

Float- 32-bit binary IEEE 754-2008

Uint 32 - 32-bit binary value without point

Registers of more than 32-bits are saved in two sequentially located logic addresses in low word-high word order. Standard request-response format Since both valid data types occupy two registers, the address of the requested data and the number of registers in all requests must always have even values.

Float integers consist of 4 bytes, for example, 0,01 of IEEE754 format is represented as 3c23d70a. In this protocol version the byte transfer order is d7, 0a, 3c, 23.

Uint32 digits consist of 4 bytes. In this protocol version the byte transfer order is 56, a0, 12, d7.

Request length is limited by Modbus RTU standard.

Function 05h (write single coil)

Standard request-response

Function 0Fh (write multiple coils)

Standard request-response

Function 10h (Write multiple registers)

Standard request-response Maximum number of registers in one read transactions (by Modbus standard) is 126.

Function 11h (Read slave ID)

Standard Request

Response contains:

Address

Function code 11h

Byte Count - 12

Byte FFh

ON/OFF indicator FFh

Additional data ASCII-line “EM300L v1.00” (sll letters are Latin)

Checksum CRC16

Two digits after the point stand for software sub-version and can be changed through the time.

Modbus register map

Description to the tables.

Variables in digits with float point and 32-bit integers without point (int32) occupy two following registers in a row. The register with smaller number is selected as address.

Function 01 to Read coils, functions 05 and 15 (0F Hex) for adjustment.

Function 03 to Read holding registers, function 16 (10 Hex) for adjustment

Function 04 to Read input registers.

Access level are coded as follows: 0 - free access to modification, level 1 - modification after password, level 2 - modification if witch SW1:1 is activated.

For tables containing numbers with floating point, the address of the first element of the table is indicated, the address of each subsequent element is incremented by 2. Due to each number with floating point occupies in two 16-bits registers of Modbus.

Part 1 - coil register (discrete output coils)

Register address	Register address (hex)	Action	Access level
0	0000	Calibration start	1
1	0001	Start self-diagnostics Bit is cleared after self-diagnostics	1
2	0002	Clear totalizers	2
3	0003	Start imitation mode	1
4	0004	Reload micro controller	1

Part 2 - holding registers

<table>
<tr><th>Address</th><th>Type</th><th colspan="2">Description of variable</th><th>Access level</th></tr>
<tr><td>0</td><td>UINT32</td><td colspan="2">Network address for Modbus RS485T. It can be in the range from 0 to 125 as per protocol.</td><td>1</td></tr>
<tr><td>2</td><td>UINT32</td><td colspan="2">Data transmission rate in Modbus RS485 network. Shall be from the range 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200</td><td>1</td></tr>
<tr><td>4</td><td>UINT32</td><td colspan="2">Number of stop-bits transferring via RS-485 (1 or 2 stop bits)</td><td>1</td></tr>
<tr><td>6</td><td>UINT32</td><td colspan="2">Parity check via RS-485. Coded a follows:
0 - non-parity
1 - parity check
2 - non-parity check</td><td>1 - imparity check</td></tr>
<tr><td>8</td><td>UINT32</td><td colspan="2">Device serial number</td><td>3</td></tr>
<tr><td>10</td><td>UINT32</td><td colspan="2">Meter type EM-300. Shall be from the range 30, 60, 120, 210, 480</td><td>3</td></tr>
<tr><td>12</td><td>FLOAT</td><td>E1</td><td rowspan="5">Polynomial multiplier determines the dependence of the input pulse weight on the pulse frequency for the first measuring transducer
p(f)=E1*f^4+D1*f^3+C1*f^2+B1*f+A1</td><td rowspan="5">3</td></tr>
<tr><td>14</td><td>FLOAT</td><td>D1</td></tr>
<tr><td>16</td><td>FLOAT</td><td>C1</td></tr>
<tr><td>18</td><td>FLOAT</td><td>B1</td></tr>
<tr><td>20</td><td>FLOAT</td><td>A1</td></tr>
<tr><td>22</td><td>FLOAT</td><td>E2</td><td rowspan="5">Polynomial multiplier determines the dependence of the input pulse weight on the pulse frequency for the second measuring transducer
p(f)=E2*f^4+D2*f^3+C2*f^2+B2*f+A2</td><td rowspan="5">3</td></tr>
<tr><td>24</td><td>FLOAT</td><td>D2</td></tr>
<tr><td>26</td><td>FLOAT</td><td>C2</td></tr>
<tr><td>28</td><td>FLOAT</td><td>B2</td></tr>
<tr><td>30</td><td>FLOAT</td><td>A2</td></tr>
<tr><td>32</td><td>FLOAT</td><td colspan="2">Min frequency of input pulse, Hz</td><td>3</td></tr>
<tr><td>34</td><td>FLOAT</td><td colspan="2">Max frequency of input pulse, Hz</td><td>3</td></tr>
<tr><td>36</td><td>FLOAT</td><td colspan="2">Input pulse value, kg</td><td>1</td></tr>
<tr><td>38</td><td>UINT32</td><td colspan="2">Output pulse duration, ms</td><td>1</td></tr>
<tr><td>40</td><td>UINT32</td><td colspan="2">Accumulated volume meter record interval, min If set to 0, no recording provided</td><td>2</td></tr>
<tr><td>42</td><td>UINT32</td><td colspan="2">Enter/change password for level 2 If enter 0, current access level is set to 0. If enter 1111 (standard password), current access level is set to 1. If enter password of level 2, current access level is set to 2.</td><td>Enter - 0
Change - 1</td></tr>
<tr><td>44</td><td>UINT32</td><td colspan="2">Accumulated weight, g (from 0 to 999999)</td><td>2</td></tr>
<tr><td>46</td><td>UINT32</td><td colspan="2">Accumulated weight, t (from 0 to 999999999, then the counter resets to zero)</td><td>2</td></tr>
<tr><td>48</td><td>FLOAT</td><td colspan="2">Resettable accumulated weight, kg</td><td>0</td></tr>
<tr><td>50</td><td>UINT32</td><td colspan="2">Current time
Coded as follows:
The third byte (high-order) - 0
The second byte - hours
The first byte - minutes
Zero byte (lower-order) - seconds
Each byte is separately converted to hex
For example, time 23-59-00 in hex format: 173B00h in decimal format 1522432(10)</td><td>1</td></tr>
</table>

52	UINT32	Current date Coded as follows: The third byte (high-order) - 0 The second byte - day The first byte - month Zero byte (lower-order) - year (from 0 to 99) Each byte is separately converted to hex For example, date 01.01.2020 in hex format: 010114h in decimal format 65812(10)	1
54	UINT32	Reporting hour to record in day and month archive (from 0 to 23)	1
56	UINT32	Archive start read time Coded as follows: The third byte (high-order) - 0 The second byte - hours The first byte - minutes Zero byte (lower-order) - seconds Each byte is separately converted to hex For example, time 23-59-00 in hex format: 173B00h in decimal format 1522432(10)	1
58	UINT32	Archive start read date Coded as follows: The third byte (high-order) - 0 The second byte - day The first byte - month Zero byte (lower-order) - year (from 0 to 99) Each byte is separately converted to hex For example, date 01.01.2020 in hex format: 010114h in decimal format 65812(10)	1
60	UINT32	Archive end read time Coded as follows: The third byte (high-order) - 0 The second byte - hours The first byte - minutes Zero byte (lower-order) - seconds Each byte is separately converted to hex For example, time 23-59-00 in hex format: 173B00h in decimal format 1522432(10)	1
62	UINT32	Archive end read date Coded as follows: The third byte (high-order) - 0 The second byte - day The first byte - month Zero byte (lower-order) - year (from 0 to 99) Each byte is separately converted to hex For example, date 01.01.2020 in hex format: 010114h in decimal format 65812(10)	1
64	UINT32	Request archive type: 0 - request pending/request canceled 1- hour 2 - day 3 - month 4 - minute.	1

		Read archive from flash memory occurs when the value of this register is set, therefore, you must first enter the date and time for reading the registers, and then the type of the requested register	
66	FLOAT	Medium density, kg/m3	1
68	UINT32	Accumulated weight, ml (from 0 to 999999)	2
70	UINT32	Accumulated weight, cbm (from 0 to 999999999, then the counter resets to zero)	2
72	UINT32	Switch-off register for some functions 1 - Switch-off data filing	1

Part 2 - input registers

Address	Type	Description of variable	Note
0	UINT32	Diagnostics register. Single bit values encode the following situations: ------------- Noncritical states-------------------------- Bit 0 flow rate out of rated range Bit 1 no signal from the first transducer Bit 2 no signal from the second transducer Bit 3 the first transducer shorted on the meter body or transducer breakout Bit 4 the second transducer shorted on the meter body or transducer breakout	
2	UINT32	Current access level	
4	UINT32	Checksum of metrologically significant constants	
6	UINT32	Checksum CRC16	
8	FLOAT	Frequency at the first transducer input, Hz	
10	FLOAT	The first transducer input pulse value, kg	
12	FLOAT	The first transducer previous input pulse value, kg	
14	FLOAT	The first transducer input pulse average value, kg	
16	FLOAT	Mass flow rate at the first transducer, t/h	
18	FLOAT	Frequency at the second transducer input, Hz	
20	FLOAT	The second transducer input pulse value, kg	
22	FLOAT	The second transducer previous input pulse value, kg	
24	FLOAT	The second transducer input pulse average value, kg	
26	FLOAT	Mass flow rate at the second transducer, t/h	
28	UINT32	Accumulated weight, g (from 0 to 999999)	
30	UINT32	Accumulated weight, t (from 0 to 999999999, then the counter resets to zero)	
32	FLOAT	Resettable weight counter (resets to zero after reaching pulse value)	
34	UINT32	Battery voltage, mV	
36	FLOAT	Total mass flow for two buckles, t/h	
38	FLOAT	Resettable accumulated weight, kg	
40	UINT32	Current time Coded as follows: The third byte (high-order) - 0 The second byte - hours The first byte - minutes	

		Zero byte (lower-order) - seconds Each byte is separately converted to hex For example, time 23-59-00 in hex format: 173B00h in decimal format 1522432(10)	
42	UINT32	Current date Coded as follows: The third byte (high-order) - 0 The second byte - day The first byte - month Zero byte (lower-order) - year (from 0 to 99) Each byte is separately converted to hex For example, date 01.01.2020 in hex format: 010114h in decimal format 65812(10)	
44	UINT32	Request status: 0 - no request 1 - data collecting 2 - data collected 3 - no data for requested period 4 - start time or date incorrect 5 - end time or date incorrect 6 - end date/time prior to start date/time 7 - requested period is too long	
46	UINT32	The number of elements in the array with the response to the request for archived data	
48	UINT32	Accumulated weight, ml (from 0 to 999999)	
50	UINT32	Accumulated weight, cbm (from 0 to 999999999, then the counter resets to zero)	
52	FLOAT	Mass flow rate at the first transducer, cbm	
54	FLOAT	Volume flow rate at the second transducer, cbm	
56	FLOAT	Total mass flow for two buckles, cbm	
58	UINT32	Reserve	
60	UINT32	Reserve	
62-1258	UINT32	Array with the response to the request for archived data In format [Date/Time] - [Weight, g] - [Weight, t] For example 62,63 - Date/Time1; 64,65 - Weight g, 66,67 - Weight tons; 68,69 - Date/Time2. For minute archive date/time format: The third byte (high-order) - hours The second byte - minutes The first byte - day Zero byte (lower-order) - month For other archives date/time format: The third byte (high-order) - hour The second byte - day The first byte - month Zero byte (lower-order) - year (from 0 to 99) Use EMIS Arhiv software for archives reading.	

APPENDIX E

(upon request)

Ex-proof elements drawing

APPENDIX F

(normative)

GRADUATION LINES APPLICATION

Connect the meter to the input 4 (see fig.D.1). Turn switches 7 to ON (see fig.D.1) to got to the graduation mode. In graduation mode the pulse from the sensor is directly transmitted to the output without processing.

Calibrate the meter following the steps of the calibration method as specified in c.1-c.7 of the EM-300.000.000.000.00 CM but the determination of metrological characteristics should be made at the flow points and at the values of the spilled weight indicated in Table D.1. For each calibration point and each repetition the following parameters needed: measuring time, s; weight measured with benchmark device, kg; number of pulses received from the calibrated meter.

Enter the measured values into the EMIS-Integrator.

Table D.1 Calibration values of flow and mass

EMIS-MERA 300-030					
Q, t/day	0.15±0.005	0,4±0,02	0,65±0,03	0.95±0.04	1,2±0,05
Q*, t/day	3±0.15	9±0,45	15±0,75	22.5±1.1	28.5±1,4
M, kg	10	20	30	40	50
EMIS-MERA 300-060					
Q, t/day	0.25±0,01	0.75±0,03	1.25±0,05	1.9±0,09	2.4±0,1
Q*, t/day	6±0,3	18±0,9	30±1,5	45±2,25	57±2,8
M, kg	10	30	50	80	100
EMIS-MERA 300-120					
Q, t/day	0.5±0,025	1.5±0,07	2.5±0,1	3.75±0,18	4.75±0,2
Q*, t/day	12±0,6	36±1,8	60±3	90±4,5	114±5,7
M, kg	10	60	100	150	200
EMIS-MERA 300-210					
Q, t/day	0.9±0,045	2.65±0,13	4.4±0,2	6.6±0,33	8.35±0,4
Q*, t/day	21±1,05	63±3,15	105±5,2	157.5±7,85	199.5±9,9
M, kg	40	120	200	250	300
EMIS-MERA 300-480					
Q, t/day	2±0,1	6±0,3	10±0,5	15±0,7	19±0,9
Q*, t/day	48±2,4	144±7,2	240±12	360±18	456±22
M, kg	40	170	300	300	300

* Reference value

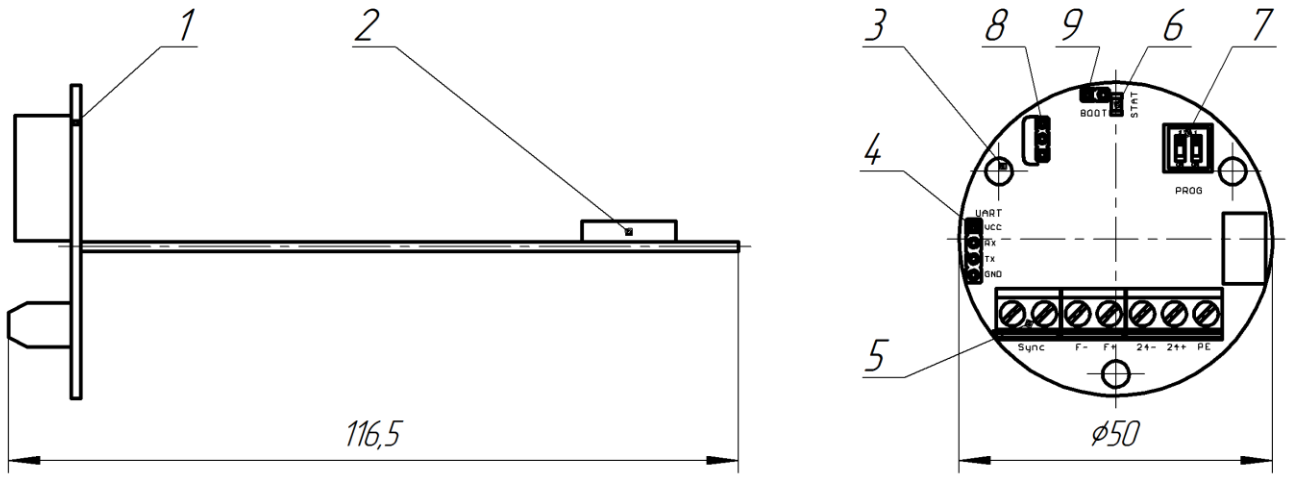


Fig. D.1 - Pulse sensor view and structure

1 - controller board; 2 - reed switch or Hall sensor; 3 - screw hole; 4 - PC output; 5 - WAGO spring terminals for external circuits; 6 - LED; 7 - switch; 8 - output for external reed switch; 9 - board operation mode switch.