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EMIS-META

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METAL ROTAMETER

EMIS-META 215

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-META 215 rotameters.

Attention!

Present Manual EMIS-META 215 can be applied only for EMIS-META 215 rotameters. This document is not applicable to other equipment of EMIS or other companies.

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, 729-99-13, 729-99-16

e-mail: support@emis-kip.ru

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1. DESCRIPTION AND OPERATION

1.1 Application

EMIS-META 215 rotameters (hereinafter referred to as rotameters) are designed for measuring of volume of smoothly changing flow of liquids and gases, including chemically corrosive mediums at fuel and energy plants and other enterprises. Rotameters equipped with LED display can also calculate and show total accumulated volume, % of the maximum flow, actual current value at current output.

Rotameters are installed in automatic control, adjustment and operation systems and used at variable industries, stationary plants and pump stations.

This equipment has the following features:

- broad range of medium temperature;
- remote control of readings;
- application for chemically corrosive mediums.

Rotameters can be used for both safe and explosive environments.

Ex-proof rotameters EMIS-META 215-Ex have explosion protection called "intrinsically safe circuit" of "i" level under GOST 31610.11-2014 (IEC 60079-11:2014) and ex-proof marking 1Ex ib IIB/IIC T4/T2/T1 Gb X for explosive gas mediums and Ex ib IIIB/IIIC T100°C/T250°C/T420°C Db X for explosive dust mediums.

Ex-proof rotameters EMIS-META 215-Vn have explosion protection called "ex-proof enclosure" of "d" level under GOST IEC 60079-1-2013 and ex-proof marking 1Ex d IIB/IIC T4/T2/T1 Gb X for explosive gas mediums and Ex tb IIIB/IIIC T100°C/T250°C/T420°C Db X for explosive dust mediums.

Rotameters without outputs and LED display belongs to non-electrical equipment and have explosion protection called "design safety" of "c" level under GOST 31441.5-2011 and ex-proof marking II Gb c T4/T2/T1 X for explosive gas mediums and III Db c T100°C/T250°C/T420°C X for explosive dust mediums.

Rotameter of K version (oxygen application) has separate sign "Oxygen. Dangerous!". Indicator cover is painted blue.

1.2 Structure and Operation Principle

Rotameters of general application with vertical installation on the pipeline (see. fig.1.1).

Fig.1.1 - Measuring assembly of standard version rotameter

Rotameter consists of two main assemblies - measuring and indication parts. Indication assembly can be equipped with current output signal or digital HART for remote control of readings.

Liquid or gas inside the flow tube 7 pushes the float 3 with some force (see fig.1.2 - 1.3). Pushed by this force the float starts to move along the flow tube. While the area between the float and the tapered tube 8 through which the medium flows increases, the drag force decreases.

At a certain position the drag force and gravity (for version G- the spring force) reaches mechanical equilibrium and the float stops. The distance that the float passed depends on the flow speed and is submitted to the display through the electromagnetic device. Indicator hand shows current flow speed, the LED display shows current flow speed and total flow volume.

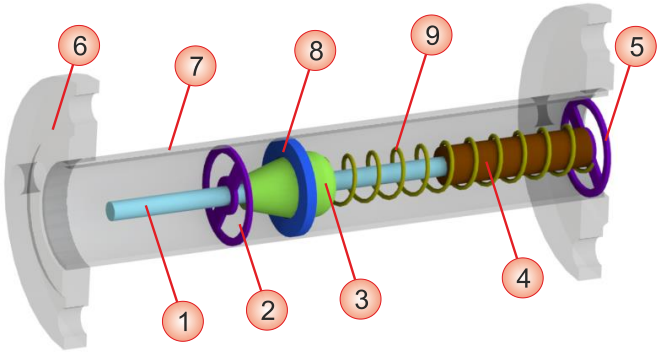


Fig.1.2 - Measuring assembly of standard version rotameter

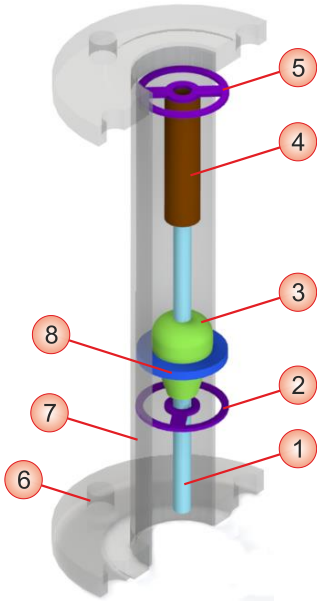


Fig.1.3 - Measuring assembly of standard version rotameter

Table 1.1 - Measuring assembly

NO in fig.	Description
1	Float axis
2	Lower stop
3	Float
4	Damper (for gas rotameters)
5	Upper stop
6	Flanges
7	Flow tube
8	Tapered tube
9	Spring

1.3 Specification

1.3.1 Brief description of technical parameters

Brief description of technical parameters is shown in Table 1.2.

Table 1.2 - Technical parameters of rotameter

Name	Description
Flow tube diameter	15; 25; 40; 50; 80; 100; 150
Tolerance limits - for accuracy class 1.0. - for accuracy class 1.5. - for accuracy class 2.5. - for accuracy class 4.0.	 ±1 % ±1.5 % ±2.5 %

Name		Description
		±4 %
Absolute pressure of medium, MPa;		0.101-32.0 0.15 - 32.0[1)]
Medium temperature, °C - standard configuration 100 -high-temperature configuration 250 -high-temperature configuration 420		From -40 to +100ºC From -80 to +250ºC From -40 to +420ºC
Max density of medium	for Dn 15mm	5 MPa-s
	for other versions	250 MPa-s
Output signals and indication		- indicator
		- current 4-20 mA,
		- digital HART™,
		- up to 2 limit switches
Input voltage		From 14V to 30V DC
Explosion protection: EMIS-META 215-Ex EMIS-META 215-Vn EMIS-META 215-Gbc[2)]		1Ex ib IIC T4/T2/T1 Gb X; Ex ib IIIC T100°C/T250°C/T420°C Db X. 1Ex d IIC T4/T2/T1 Gb X; Ex tb IIIC T100°C/T250°C/T420°C Db X. II Gb c T4/T2/T1 X; III Db c T100°C/T250°C/T420°C X.
Atmospheric pressure		84 to 106.7 kPa
Ambient temperature:		From -60 - +70[3)]
Relative humidity of environment		not more than 98% (under 35º C)
Climate version (under GOST 15150-69)		NF climate, device category 1, but for operation temperature from -60 up to +70°C under 90±3% humidity, non-condensing
Category of storage and transportation (under GOST 15150-69)		Category 4 (at -60 up to +70°C); Category 1 if without package
Dust and water protection		IP66, IP67
Magnetic field intensity		less than 250 A/m
Vibration		group V1 under GOST R 52931 group V1 under GOST R 52931
Flow range	water	2,5 to 100000 l/h

Name		Description
	gas	0,07 to 3000 cbm/h
Calibration interval		5 years
Average time between failure ATBF		over 100 000 hours
Service life		over 10 years
Dimensions and weight		see Appendix A
Content of precious metals		do not contain

[1] - for horizontal version of rotameter;

[2] - configuration without output signals and display;

[3] - as per order sheet (for this range of operating temperature, display indication before -30ºC);

[4] - Upon prior agreement with EMIS engineering service.

Attention!
Table data refers to standard version of rotameter. Customized order is available to provide any special requirements.

1.3.2 Measuring range

Standard flow ranges under normal conditions for liquid are presented in the table 1.3. Water at 20° C, density of 1000 kg/cbm is taken as standard medium.

Please contact EMIS engineers if any non-standard version or Dn is required for your special purpose.

Table 1.3 - Standard measurement ranges for volume flow of liquid (water) under normal conditions

Size	Flow range, m3/h	
	Flow tube material	
	H, H2**	FT**
015A	0.0025 to 0.025	-
015B	0.004 to 0.04	0.0025 to 0.025
015C	0.0063 to 0.063	0.004 to 0.04
015D	0.01 to 0.1	0.0063 to 0.063
015E	0.016 to 0.16	0.01 to 0.1
015F	0.025 to 0.25	0.016 to 0.16
015G	0.04 to 0.4	0.025 to 0.25
015H	0.063 to 0.63	0.04 to 0.4

025A	0.1 to 1.0	0.063 to 0.63
025B	0.16 to 1.6	0.1 to 1.0
025C	0.25 to 2.5	0.16 to 1.6
015D	0.4 to 4.0	0.25 to 2.5
040A	0.5 to 5.0	0.4 to 4.0
040B	0.6 to 6.0	0.5 to 5.0
050A	0.63 to 6.3	0.6 to 6.0
050B	1.0 to 10	0.63 to 6.3
050C	1.6 to 16	1.0 to 10
080A	2.5 to 25	1.6 to 16
080B	4.0 to 40	2.5 to 25
100	6.3 to 63	4.0 to 40
150	20 to 100	-

Standard flow ranges under normal conditions for gases are presented in the table 1.4. Oxygen of 1.204 kg/nm3 density at 20°C and 0.1013 Mpa is taken as standard.

Please contact EMIS engineers if any non-standard version or Dn is required for your special purpose.

Table 1.4 - Standard measurement ranges for gas (oxygen) under normal conditions

Size	Flow range, m3/h
	Flow tube material H, H2, FT
015A	0.07 to 0.7
015B	0.11 to 1.1
015C	0.18 to 1.8
015D	0.28 to 2.8
015E	0.48 to 4.8
015F	0.7 to 7.0
015G	1.0 to 10
015H	1.6 to 16
025A	3.0 to 30
025B	4.5 to 45
025C	7.0 to 70
015D	11 to 110

040A	12 to 120
040B	16 to 160
050A	18 to 180
050B	25 to 250
050B	40 to 400
080A	60 to 600
080B	80 to 800
100	100 to 1000
150	600 to 3000

1.3.3 Accuracy

Accuracy limits are presented below:

± 1,0 % for 1,0 accuracy class;

± 1,5 % for 1,5 accuracy class;

± 2,5 % for 2,5 accuracy class;

± 4.0 % for 4.0 accuracy class.

Accuracy class shall be stated when placing the order (see clause 1.7 of the Order sheet)

1.3.4 Output signals

Rotameters have the following output signals:

- indicator;
- LED display (optionally)
- analog current signal (optionally);
- digital HART™ (optionally);
- up to 2 limit switches (optionally; if no output signal and LED display are installed).

1.3.4.1 Analog current output signal

Current in the range of 4 to 20 mA has linear dependence with flow volume. Current of 4mA is taken as "zero" flow. Current of 20mA is taken as upper limit of range.

Parameters of current signal are shown in the Table 1.5.

Table 1.5 - Output current signal parameters

Analog current signal	
Range limits, mA	4..20
Load resistance, Ohm	not more than 750
Power supply voltage, V	14 to 30
Nominal output, W	Less than 1

1.3.4.2 Digital signal

Digital signal transmits data by frequency modulation at 4-20 mA output under Bell 202 standard. HART™ protocol version 5

Rotameter can be connected as point-to-point or multislot.

In point-to-point it is directly connected to master device.

In multislot it is connected to common bus along with other slave devices (up to 15 devices). Only digital connection is available and current is set as 4 mA.

The following parameters transmitted with digital signal:

rotameter serial number;

total volume

current flow

network address

All HART™ commands are listed in the Appendix F.

1.3.4.3 Indicator

Built-in indicating arrow shows current flow of measuring medium. Additional LED display can be installed (see fig.1.4). Displays have 2 lines to show current flow and total volume.

Fig. 1.4 - LED Display

1.3.4.4 Limit switch

Rotameters can be equipped with one or two limit switches.

Fig. 1.5 shows front panel of a rotameter with installed limit switches. When the arrow reaches the upper (1) or lower (2) limit switch activates. Limit switch signals can be used for light/sound alarm or other purposes.

Loosen the screw to move the limit switch to another position, then tighten it again to fix it.

Table 1.6 - technical parameters of limit switches

Name	Description
Function	Open contact
Commutation voltage, V DC	1... 30
Commutation frequency, Hz, not higher than	500
Commutation current I, mA	0... 100
Idling current I, mA	≤ 15

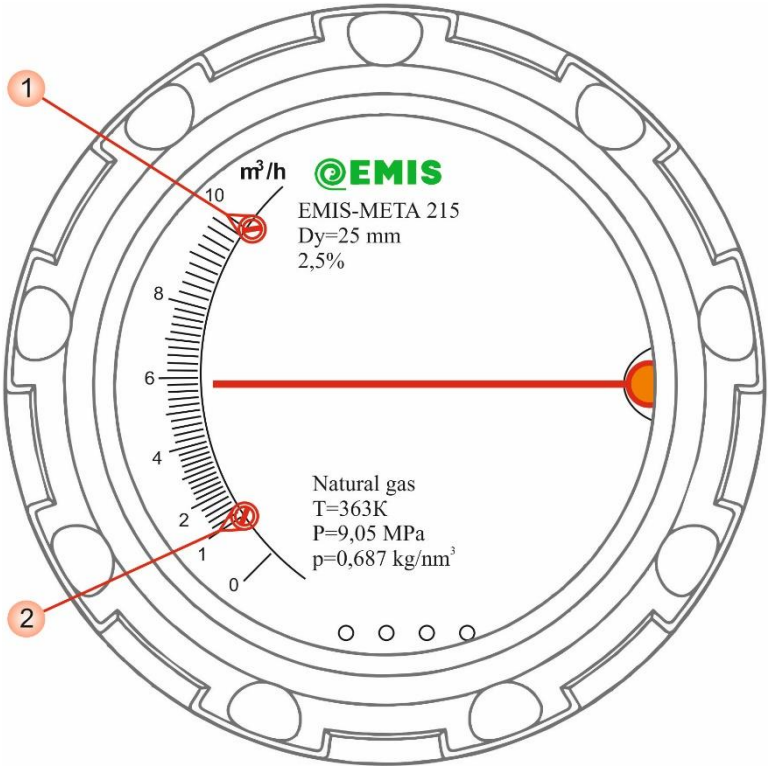


Fig. 1.5 - Limit switches

Hysteresis of limit switch is rated as ±10% from the specified set-up value.

Attention!
Version with limit switch can be manufactured if no output signal and LED display are installed.

1.3.5 Used materials

Materials used in rotameter construction are listed in table 1.7

Table 1.7 - Materials of rotameter parts and elements

Details and assemble units	Material
Indication unit body and lid	Aluminum alloy
Flanges	stainless steel 304 (12X18H10T) (application H)
	stainless steel 316 (08X17H13M2) (application H2)
Flow tube	stainless steel 304 (12X18H10T) (application H)
	stainless steel 316 (08X17H13M2) (application H2)
	PTFE-teflon for pressure up to 6,3 MPa, fluorine plastic F46 for pressure 10MPa (application Ft)
Float	stainless steel 304 (12X18H10T), magnet steel (application H)
	stainless steel 316 (08X17H13M2), magnet steel (application H2)
	fluorine plastic F46; magnet steel (application Ft)
Flange seal (for socket and	As per order sheet line (for flange version)

Details and assemble units	Material
clamp connections)	silicone rubber (for socket and clamp versions)
Magnet filter	stainless steel 304 (12X18H10T), magnet steel (standard application H)
	Lining: PTFE-teflon (F4/F46); stainless steel 304; magnet steel (application Ft)

1.4 Explosion protection

Electrical elements of ex-proof transmitter are covered with ex-proof enclosures, which withstand internal explosion without transferring the ignition to the external gas air environment. The explosion resistance and explosion protection of the transmitter enclosure comply with the requirements for electrical equipment of Group IIC subgroup according to GOST IEC 60079-1-2013. The enclosure is tested for explosion proofness under GOST IEC 60079-1-2013. Ex-proof connections: axial length of the thread and the number of full turns in the engagement shall comply with the requirement of GOST IEC 60079-1-2013 for IIC group electrical equipment; Inspection window is sealed inside the metal rim of the casing cover to provide integrity;

- EMIS-META 215-Ex configurations shall be operated with power supply unit and recorder with intrinsically safe circuits under GOST 31610.11-2014 (IEC 60079-11:2011) and intrinsic safety parameters (circuit level and electrical equipment subgroup) complying with operating conditions in hazardous environment.

Capacity and inductance of circuits are adjusted according to intrinsic safety requirements for electrical equipment of Group IIC subgroup under GOST 31610.0-2014 (IEC 60079-0:2011).

Circuit redundancy of “ib” level intrinsic circuits is executed according to GOST 31610.11-2014 (IEC 60079-11:2011).

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

Clearance, leakage path and electrical endurance of isolation comply with GOST 31610.0-2014 (IEC 60079-0:2011).

Protection from flammable dust ignition is provided using “t” type enclosures under GOST IEC 60079-31-2013 and explosion protection “c” according to GOST 31441.5-2011 (EN13463-5:2003).

Max temperature of surface heating under operating conditions shall not exceed the values specified in GOST 31610.0-2014 (IEC 60079-0:2011) for specific temperature classes.

Rotameters are executed under general requirements of GOST 31610.0-2014 (IEC 60079-0:2011) for electrical equipment located in explosive environment. Mechanical rigidity of transmitter casing complies with GOST 31610.0-2014 (IEC 60079-0:2011) requirements for electrical equipment of group II with high risk of mechanical damage. Materials provide friction spark protection under GOST 31610.0-2014 (IEC 60079-0:2011).

Table 1.8 - Input parameters of circuits

Parameter	Parameter value
Max input voltage Ui, B	30

Max input current Ii, mA	160
Max input power Pi, W	1
Max input capacity Ci, pF	0.01
Max input inductance Li, μH	0.01

There is a marking sign for explosion-proof rotameters. The plate is shown in the fig.1.6

1.5 Marking and sealing

1.5.1 Marking

Marking is applied on the plate attached to the rotameter body as shown in the fig.1.6. Marks are shown in the table 1.9.

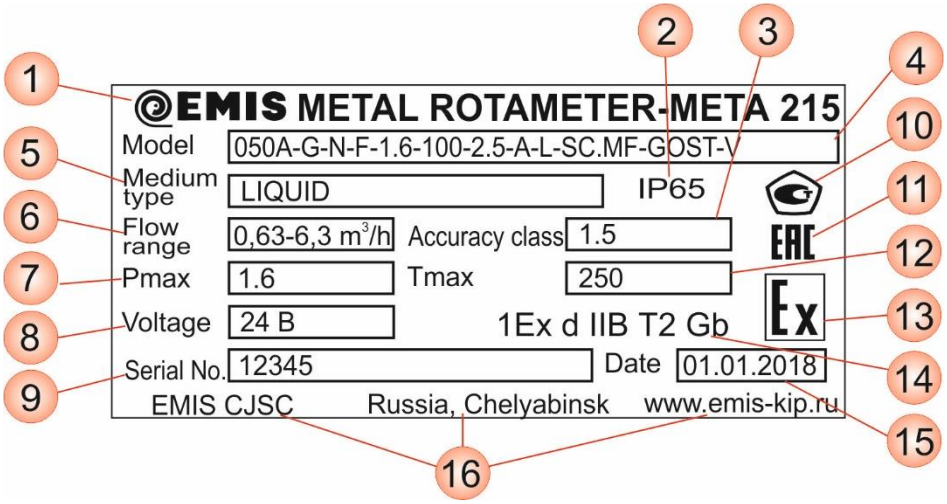


Fig.1.6 - Name plate of rotameter

Table 1.9 - Marking on the name plate

NO in fig.	Description
1	Manufacturer trade mark
2	Ingress protection
3	Accuracy class
4	Model
5	Medium type
6	Flow range
7	Max pressure of environment (Pmax)

8	Output signal supply
9	Serial number
10	Equipment mark
11	EAC sign
12	Max temperature of medium (Tmax)
13	Ex-proof sign
14	Ex-proof marking
15	Date of manufacturing
16	Manufacturer information
17	Certification authority and certificate number.

Scale of the rotameter contains the following info (see the fig.1.7-1.9, the table 1.10):

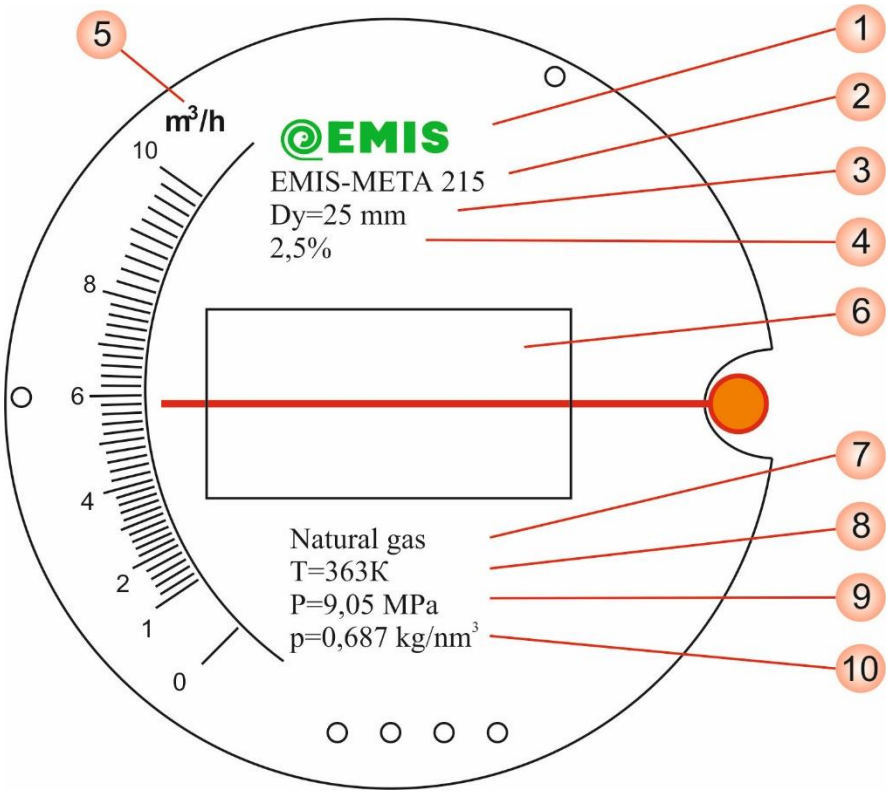


Fig. 1.7 - Scale of rotameter without LED display

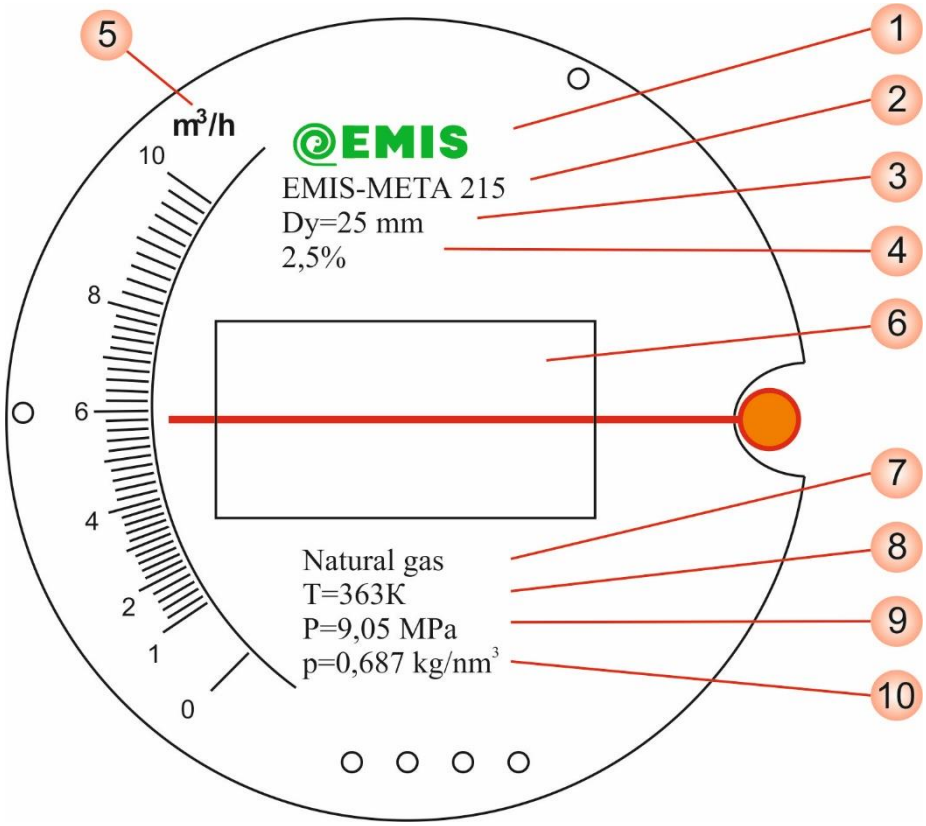


Fig. 1.8 - Scale of rotameter with LED display

Table 1.10 - Scale signs

NO in fig.	Description
1	Logo
2	Rotameter model
3	Flow tube diameter
4	Accuracy class
5	Scale units
6	LED display*
7	Measuring medium
8	Medium temperature (for gases)
9	Medium pressure (for gases)
10	Density of measuring medium
*Optionally	

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

1.5.2 Sealing

Sealing shall be done to avoid unauthorized access to indicator and parameters change.

Rotameter sealing scheme and marking location are presented in the fig.1.9.

Fig.1.9 - Sealing scheme

1.6 Supply scope

The standard supply scope and additional supply kit are shown in the fig.1.10, 1.11 and tables 1.11, 1.12.

Fig.1.10 - Scope of supply

Table 1.11 - Standard supply scope

NO in fig.	Description
1	Rotameter
2	Operation manual
3	Data sheet
4	TR TS certificate 012/2011 on "The safety of equipment in explosion hazardous environments" with enclosure.
5	TR TS certificate 032/2013 on "The Safety of equipment working under excessive pressure"*

* –Provided upon request

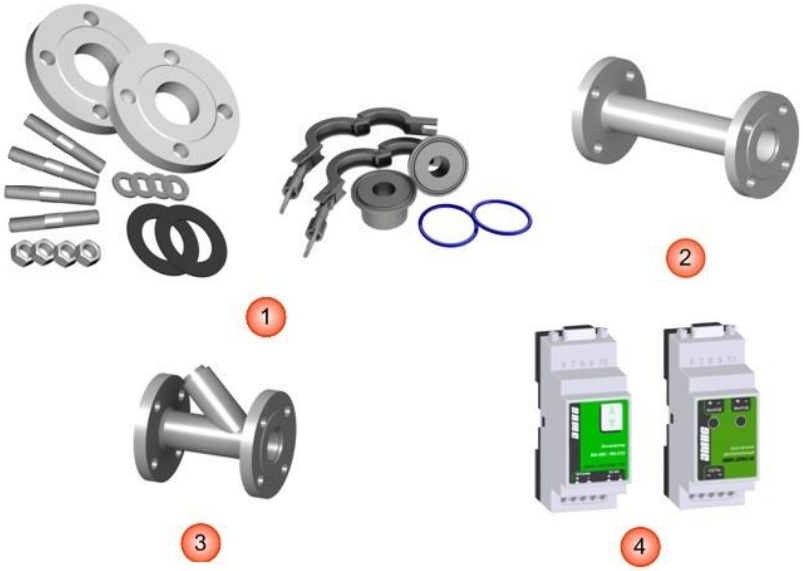


Fig. 1.11 - Additional supply kit

Table 1.12 - Additional supply kit

No	Description
1	Mounting kit (flanges, gaskets, studs, nuts, washers, clamps)*
2	Mounting sleeve EMIS-META 215-BT
3	Filter and/or gas separator EMIS-VECTA
4	Power adapter EMIS-BREEZE
5	Magnet filter
6	HART modem
7	Spare parts kit, tools and accessories. It includes cable glands, flange gaskets and fixing accessories for flanges mounting. Other accessories can be included according to customer needs.
8	Other certificates (on demand)

Depends on the type of connection to the pipeline;

** - Additional kit to mount magnet filter.

Attention!
Please follow the steps below after receiving the rotameter: • check package for damages. • check supply kit. • compare rotameter 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-META 215 Rotameter configurations are shown in the table 1.13. Order sheet completion is shown below.

EMIS-META 215-

1		2		3	4		5		6		7		8		9		10		11		12		13		14
-	-	-	-	050	A	-	G	-	N	-	F	-	1.6	-	100	-	2.5	-	-	-	A	-	L	-	-

	15		16		17		18		19
-	SC	.	MF	-	GOST	-	V	-	-

Data as shown in order sheet: EMIS-META 215-050A-G-N-F-1.6-100-2.5-A-L-SC.MF-GOST-V

Table 1.13 - Rotameter versions

1	Explosion protection		
–	n/a		
Ex	Intrinsically safe electrical circuit Equipment for explosive environments: 1Ex ib IIB/IIC T1/T2/T4 Gb X. For dust hazardous environments: Ex ib IIIB/IIIC T100°C/T250°C/T420°C Db X.		
Vn	Ex-proof enclosure Marking of explosion protection for explosive gas environments: 1Ex db IIB/IIC T1/T2/T4 Gb X. Marking of explosion protection for dust hazardous environments: Ex tb IIIB/IIIC T100°C/T250°C/T420°C Db X.		
Gbc*	Structural safety Marking of explosion protection for explosive gas environments: II Gb c T1/T2/T4 X. Marking of explosion protection for dust hazardous environments: III Db c T100°C/T250°C/T420°C Db X IP65/IP67.		
X	special order		
* - configuration without output signals and no display;			
2	Rotameter version		
–	vertical installation on pipeline (standard)		
Г	horizontal installation on pipeline		
3	Size		
015	Dn = 15 mm	080	Dn = 80 mm
025	Dn = 25 mm	100	Dn = 100 mm
040	Dn = 40 mm	150	Dn = 150 mm
050	Dn = 50 mm	X	special order

4	Flow range*		
A	flow range A	F	flow range F
B	flow range B	G	flow range G
C	flow range C	H	flow range H
D	flow range D	X	customized flow range
E	flow range E		

* - Rotameters flow range can be customized, in this case you put X after flow range (see order sheet example)

5	Medium type*
L	Liquid
G	gas
O	Oxygen

* - initially rotameters are calibrated for standard conditions Standard conditions are as follows:
liquid - water under 20° C, density 1000 kg/cbm
gas - air under 20° C pressure of 0,1013 MPa, density 1,204 kg/cbm.
To measure other medium please specify it in the order sheet.

6	Flow tube material
N	stainless steel (SS304)
N2	stainless steel (SS316)
Ft*	PTFE-teflon **
X	customized flow tube material

* - Ft version is not applicable for horizontally mounted rotameters (application Г);
** - fluorine plastic for application up to 4,0 MPa.

7	Connection type
F	flange connection
S*	socket connection
C*	clamp connection
X	customized (various connection types under GOST, EN, ASME; please specify)

- configurations with connection S and C are not available for rotameters with flow tubes made of Ft. If you choose S or C connection, add mounting kit MK symbol after the magnet filter.
For example: EMIS-META 215-050A-G-N-F-1.6-100-2.5-A-L-SC.MF-MK

8	Working 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 - 10,0 MPa
16	max pressure - 16,0 MPa
25	max pressure - 25,0 MPa
32	max pressure - 32,0 MPa

X	special order
* - customized pressure options, see table 2.3	
9	Medium temperature
100	measuring medium temperature -40 to +100 °C
250*	measuring medium temperature -80 to +250 °C
420*	measuring medium temperature -40 to +420 °C
X	special order
* - not applicable for rotameters with flow tube made of Ft and S and C connection types.	
10	Accuracy
4	Accuracy class 4
2.5	Accuracy class 2.5
1.5*	Accuracy class 1.5
1*	Accuracy class 1
X	special order
* Applicable for liquid medium only	
11	Heating jacket
–	without heating jacket
T	with jacket for case heating using steam or oil
12	Output interface
–	n/a
A	- analog 4-20 mA,
H	HART ™ + analog 4-20mA
LS1	upper limit switch
LS2	lower limit switch
LS3	Upper and lower limit switches
X	special order
13	Additional LED display
–	n/a
L	Additional LED display
14	Scale adjusted for working conditions
–	Standard
X	Special
15	Calibration
–	manufacturer calibration, pressure test (according to technological process)
SC	state calibration

16	Magnet filter
–	n/a
MF	with magnet filter

17	Flange standards
GOST	GOST 33259
ASME	ASME (ANSI) B16.5
EN	EN 1092-1
–	Under TU, Appendix A
18	Sealing surface
B	Raised face (V1 and V2)
C	Male
D	Slot
E	Male
F	Female
G	Raised face for O-ring
H	Groove for O-ring
J	For oval gasket
K	For lens gasket
L	Tongue for fluorine plastic gaskets
LF	Large female face
LG	Large groove face
LM	Large male face
LT	Large tongue face
M	Male for fluorine plastic gaskets
RF	Raised face
RTJ	Ring type joint
SF	Small female face
SG	Small groove face
SM	Small male face
ST	Small tongue face
–*	Under TU, Appendix A
* for TU flanges, Appendix A	
19	Spec. Version
-	standard version
AST	for environments containing hydrogen sulfide

Mounting kit symbols

Mounting kit EMIS-META 215-

https://emis-meter.com/

1		2		3		4		5		6		7		8		9		10
015	-	1.6	-	F	-	H	-	-	-	GOST	-	01	-	V	-	09G2S	-	St35

Table 1.14 - Mounting kit symbols

1	Size				
015	Dn15	040	Dn32	100	Dn50
025	Dn25	050	Dn40	150	Dn65
032	Dn32	080	Dn80	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				
F	Flange				
X	special order				
4	Flow tube				
N	stainless steel (SS304)				
N2	stainless steel (SS316)				
Fp	fluorine plastic (PTFE-teflon)				
X	customized flow tube material				
5	Meter run				
-	No				
MR	Yes				
6	Flange standards				
GOST	GOST 33259				
EN	EN 1092-1				
ASME	ASME (ANSI) B16.5				
-	Under TU, Appendix A				

7	Flange type
01*	Steel flat welding flange
11*	Steel weld neck flange
SO**	Slip-ON welding flange
WN**	Welding neck flange
--***	Standard flange according to OM
X	Special version of flange

* for flanges under GOST and EN.

** for flanges under ASME.

** for TU flanges, Appendix A.

8	Sealing surface
B	Raised face (V1 and V2)
C	Male
D	Slot
E	Male
F	Female
G	Raised face for O-ring
H	Groove for O-ring
J	For oval gasket
K	For lens gasket
L	Tongue for fluorine plastic gaskets
LF	Large female face
LG	Large groove face
LM	Large male face
LT	Large tongue face
M	Male for fluorine plastic gaskets
RF	Raised face
RTJ	Ring type joint for oval gasket
SF	Small female face
SG	Small groove face

SM	Small male face
ST	Small tongue face
–	Under TU, Appendix A
9	Flange material
09G2S	Steel 09G2S
N	Steel 12X18H10T
St20	Steel 20
X	Special material
10	Fasteners materials
St35	Steel 35
20XN3A	Steel 20XN3A
30XMA	Steel 30XMA
N	Steel 12X18N10T
St35	Steel 35
X	Special material

2. INTENDED USE

2.1 Selection recommendations

2.1.1 Version selection

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

Table 2.1 - Information for version selection

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

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

By default the scale is adjusted for volume flow of water or air under standard conditions, if other is not specified in order sheet.

Use the formulas in the Appendix D to adjust the scale according to specific medium.

Rotameter size shall be selected according to real flow volume in the pipe which can be different from calculated. Rotameter 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 nominal size of the pipeline.

If rotameter size is smaller than pipe size we recommend to use cone shaped couplings. Cone shaped couplings can be made by customer, herewith to minimize pressure loss the central angle of the cone shall not exceed 30º.

Rotameters of Dn 15,25,40,50,80mm have some standard versions with different flow ranges.

Take into account automatic and regulating units that can be the cause of water hammer (pressure jump) and lead to rotameter damage.

For horizontal version of EMIS-META 215 minimal absolute pressure of measured medium is 0.15 MPa.

2.1.2 Material selection

Rotameter material which contacts the medium shall be resistant to its corrosive influence. It is recommended to use versions with float and measuring tube made of stainless steel 304 (version H), stainless steel 316 (version H2). Use rotameter with float and PTFE flow tube to measure corrosive mediums (version Ft).

2.1.3 Heating jacket application

Provide rotameter heating to maintain the temperature of medium while it flows through the rotameter. For that purpose heating jacket (version T) is used. It has nozzles for hot oil or steam connection. Connection sizes of heating jacket are described in the Appendix A, fig.A.7.

2.1.4 Mechanical and gas inclusions

Solid mechanical inclusions and gas inclusions can lead to measurement errors. EMIS engineers will help you to choose appropriate rotameter for mediums with mechanical and gas inclusions. We recommend to use EMIS-VECTA 1210 or EMIS-VECTA 1215 filters.

2.1.5 Magnet filter

If medium contains impurities affected by magnetic field, magnet filter can be installed before the rotameter. Magnet filter size and design are shown in the Appendix B.

2.1.6 Damping system

Gas version rotameters of Dn less than 80 mm (Dn≤ 50mm) are equipped with damper to ensure accuracy (see fig.2.1).

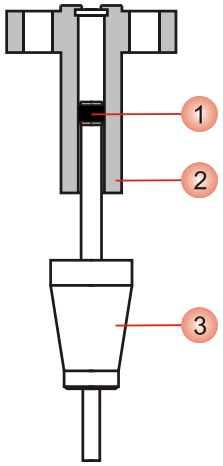


Figure 2.1. - Damping system

1 - piston; 2 - damper cylinder; 3 - float.

2.1.7 Pressure loss

Pressure loss is constant and does not depend on flow speed. Pressure loss is shown in the table 2.2.

Table 2.2 - Pressure loss

Dn	Pressure loss, kPa			Dn	Pressure loss, kPa		
	Water		Gas		Water		Gas
	Version				Version		
	H, H2	Ft			H, H2	Ft	
015A	6.8	-	7.1	015D	7.8	9.2	19.0
015B	6.8	5.5	7.2	040A	10.8	8.6	9.8
015C	7.0	5.5	7.3	040B	12.6	10.4	16.5
015D	7.2	5.6	7.5	050A	4.7	6.8	8.6
015E	7.8	5.6	8.0	050B	11.0	9.4	10.4
015F	9.0	5.8	10.8	050C	17.0	14.5	15.5
015H	12.0	6.1	10.0	080A	8.1	6.9	12.9
015J	13.0	7.3	14.0	080B	9.5	8.0	18.5
025A	4.2	5.9	7.7	100A	15.0	8.5	19.2
025B	5.7	6.0	8.8	150A	19.2	–	20.3
025C	6.0	6.8	12.0				

2.1.8 Connection to pipeline

Tables 2.3 - 2.5 show standard types of connection to pipeline depending on medium temperature, pressure and nominal diameter. Please contact EMIS engineers if any non-standard Dn pressure version is required for your special purpose.

Table 2.3 - Standard types of connection for medium temperature -40 to +100

Flow tube diameter	Max working pressure, MPa								
	1	1.6	2.5	4.0	6.3	10	16	25	35
15	F, C, S	F, C, S	F	F	F	F	F	F	F

25	F, C, S	F, C, S	F	F	F	F	F	F	-
40	F, C, S	F, C, S	F	F	F	F	F	F	-
50	F, C, S	F, C, S	F	F	F	F	F	F	-
80	F, C, S	F, C, S	F	F	F	F	F	-	-
100	F	F	F	F	F	F	-	-	-
150	F	F	F	F	F	-	-	-	-

Table 2.4 - Standard types of connection for medium temperature -80 to +250

Flow tube diameter	Max working pressure, MPa								
	1	1.6	2.5	4.0	6.3	10	16	25	35
15	F, C, S	F, C, S	F	F	F	F	F	F	-
25	F, C, S	F, C, S	F	F	F	F	F	-	-
40	F, C, S	F, C, S	F	F	F	F	F	-	-
50	F, C, S	F, C, S	F	F	F	F	F	-	-
80	F, C, S	F, C, S	F	F	F	F	F	-	-
100	F	F	F	F	F	F	-	-	-
150	F	F	F	F	-	-	-	-	-

Table 2.5 - Standard types of connection for medium temperature -40 to +420

Flow tube diameter	Max working pressure, MPa								
	1	1.6	2.5	4.0	6.3	10	16	25	35
15	F	F	F	F	F	F	F	-	-
25	F	F	F	F	F	F	-	-	-
40	F	F	F	F	F	F	-	-	-
50	F	F	F	F	F	F	-	-	-
80	F	F	F	F	F	F	-	-	-
100	F	F	F	F	F	-	-	-	-

150	F	F	F	F	-	-	-	-	-

Symbols “F” - flange, “C” - clamp, “S” - socket, “-” - special order as approved by the EMIS engineering service.

Other connection types for special pressure and temperature configurations can be executed upon prior agreement with the EMIS engineering service.

2.2 Safety requirements

2.2.1 General directions

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.

Rotameter 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;
- toxic level of medium.

Attention!
It is prohibited to mount and operate rotameter under medium pressure and temperature higher than limited. It is prohibited to operate rotameter 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:

- Rotameter shall be installed in the true-vertical part of the pipeline with upward flow direction (for standard version) or in the horizontal part of the pipeline with left-to-right flow direction (for G version).
- Minimal length of straight run before and after rotameter shall be 5x Dn size.
- The place of installation shall be protected from strong vibration, high temperature and magnetic field. That is why it is not recommended to install rotameter near transformers. power units and other vibrating equipment.
- Regulating devices shall be installed after rotameter.
- It is recommended to install circuit breakers after rotameter.

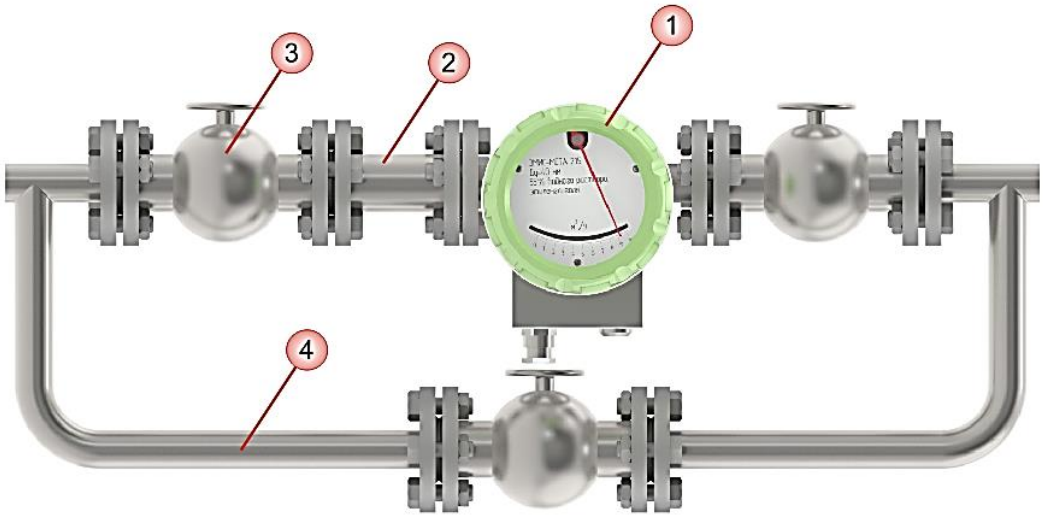
- Magnet filter shall be installed 5-10x Dn before rotameter (magnet filter is not included in the straight run length).
- Rotameter shall not be installed in piping stress part and not bear the pipeline.
- It is recommended to protect casing from moisture.
- Rotameter shall be installed in easily accessible places. Appropriate space shall be provided for installation and maintenance.

Equipment indicator shall be reachable for reading control.

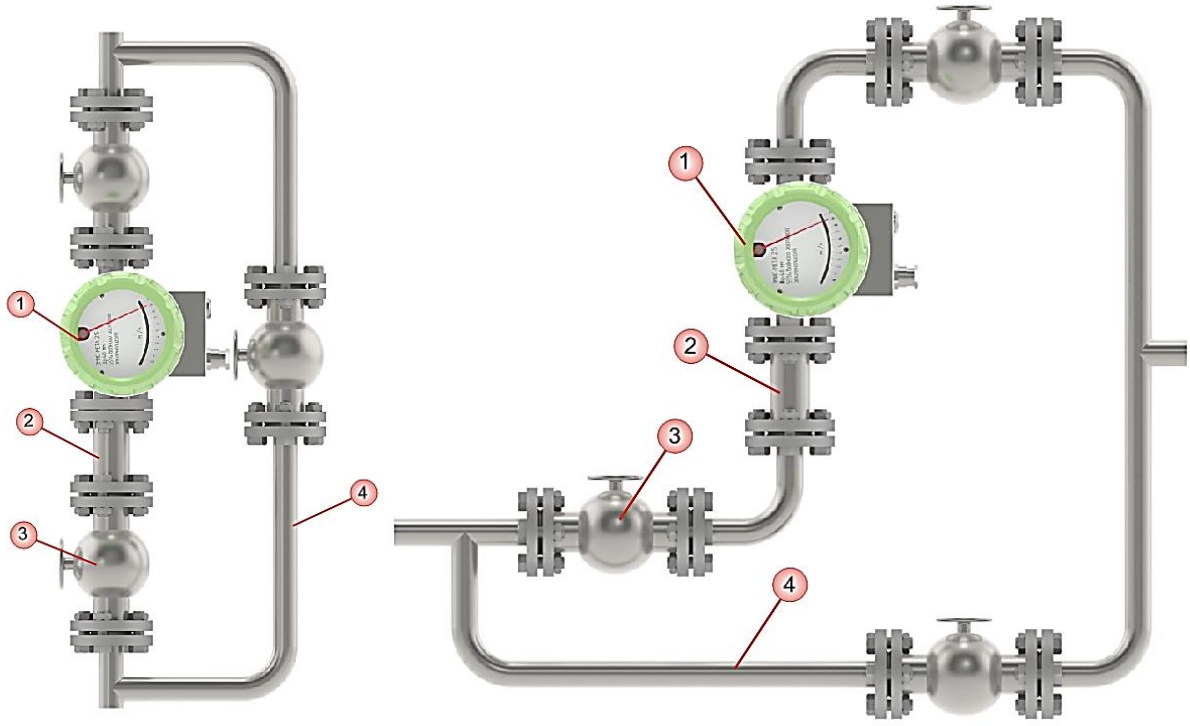
2.3.2 Installation scheme

Installation scheme shall provide upward flow direction for standard configuration or horizontal left-to-right flow direction for horizontal configuration of rotameter.

It is recommended to install by-pass pipe for maintenance and service procedure. Installation options are presented in the fig.2.2 (a,b,c).



a)



b) b)

Fig.2.2 - Rotameter mounting scheme

Fig.2.2 shows: a) mounting of horizontal configuration; b) mounting of standard configuration rotameter on the vertical pipeline; c) mounting of standard configuration rotameter on the horizontal pipeline.

Attention!
Straight sections are conventionally not shown in the fig.2.2, but shall be provided at 5Dn before and after the rotameter to ensure measurement and accuracy parameters. Magnet filter shall be installed so that does not affect straight sections requirements.

Table 2.6 - Legend for fig.2.2

NO in fig.	Description
1	Rotameter
2	Magnet filter
3	Control valve
4	By-pass line

2.3.3 Preparation to installation

To prepare for installation please follow the steps below:

- check equipment supply scope and completeness;
- check for flanges, fasteners, clamps, couplings and its parameters (see Appendix A);

For flange connection version:

- cut the pipeline of L length:

$$L = L_{rot} + 2 \cdot s_{gas} + 2 \cdot L_{fl}$$

where L_{rot} - installation length of rotameter (see Appendix A);

S_{gas} - gasket width;

L_{fl}- counter flange width after deduction of installation length;

- mount counter flanges in the pipeline;
- use mounting coupling or rotameter to align flanges, them weld them to the pipeline. Installation place shall look as it shown in the fig.2.3, where L is sum of rotameter length and two gaskets width.

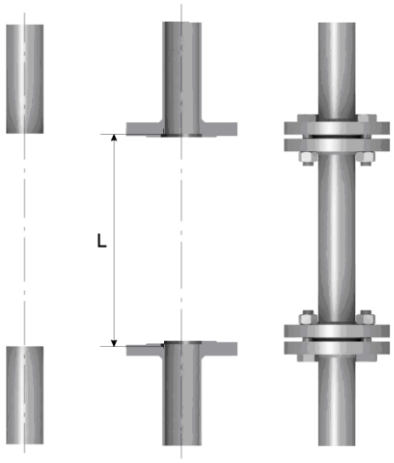


Fig. 2.3 - Pipeline preparation for flange connection

For socket and clamp connection version:

- cut the pipeline of L length:

$$L = L_{rot} + 2 \cdot L_{cp},$$

where L_{inst} - installation length of rotameter (see Appendix A);

L_n - width of counter pipe

- use mounting coupling or rotameter to align counter pipes, them weld them to the pipeline. Installation place shall look as it shown in fig.2.4, where L is sum of rotameter length and two counter pipes width.

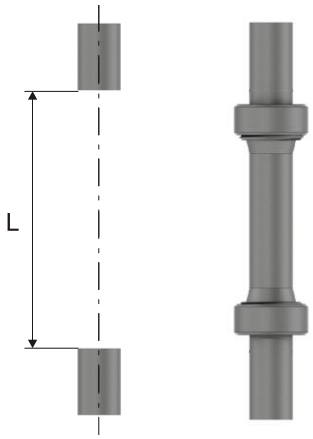


Fig.2.4 - Clamp and socket installation preparation

Attention!
Pipeline length shall be enough for installation of by-pass, block and regulating valves, magnet filter.

Attention!
Do not detach measuring tube form the indicator. Otherwise it will lead to float and indicator misalignment which cause accuracy mistakes and equipment failure.

2.3.4 Pipe body preparation and rotameter mounting

Please follows the steps below before installation:

- clean the pipeline from rust, sand and other solid particles;
- check inside surface of rotameter and remove solid particles and other inclusions;
- remove preservation grease, if any, by passing kerosene, gasoline or diesel fuel through it, then drain the degreasing liquid.
- Rotate the rotameter to reach upward flow direction for standard configuration of rotameter and left-to-right direction for horizontal configuration of rotameter.

Flange rotameter installation is shown in the fig.2.5 Nuts tightening scheme is shown in the fig.2.6

Fig.2.5 - Flange rotameter connection to the pipeline

Figure 2.5 shows: 1 - rotameter EMIS-META 215, 2 - counter flange; 3 - flange gasket; 4 - studs; 5 - nuts.

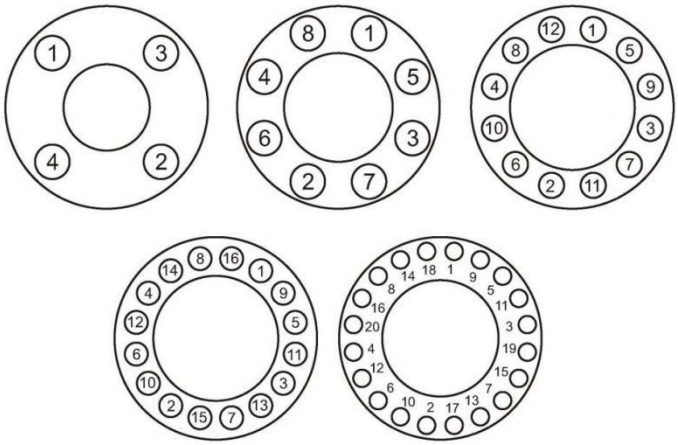


Fig.2.6 - Tightening sequence for flange bolts

Socket type rotameter installation is shown in the fig.2.7.

Fig.2.7 - Socket type rotameter connection to the pipeline

Figure 2.7 shows: 1 - rotameter EMIS-META 215, 2 - connector; 3 - flange gasket; 4 - coupling nut.

Clamp type rotameter connection to the pipeline is shown in the figure 2.8.

Fig.2.8 - Clamp type rotameter connection to the pipeline

Figure 2.8 shows: 1 - rotameter EMIS-META 215, 2 - clamp; 3 - gasket; 4 - connecting piece.

2.3.5. Heat insulation

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

Fig.2.9 - Heat insulation recommendations

Insulation shall not cover indication unit to provide access to the inner part of the unit. Avoid mechanical damage to the indication unit while cutting, tightening of insulation.

2.3.6. Installation of ex-proof rotameter

Carefully check rotameter before installation. Pay attention to ex-proof marks, warning signs, check for damages, ground clamp, seals for cables and covers, supply cable.

When mounting Vнн type rotameter, examine all ex-proof surfaces which will be unmounted in any way. No scratches, indention, shears allowed on the surfaces marked as ex-proof on the ex-proof elements drawing in the Appendix E.

Connection can be executed using any type of connection cable with copper wires and cross-section of 0,35 mm^2.

When electrical mounting is finished, check ground line resistance shall not exceed 4 Ohm.

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

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

2.4 Electrical connection

2.4.1 General directions

Electrical mounting shall be executed in the sequence below (see fig.2.11):

- Unscrew stop screws on the lid 1 of the transmitter;
- remove lid 1 of the transmitter;
- insert the cable through the cable gland 2;
- arrange connection according to connection diagram in the Appendix C.
- tighten cable gland 2;
- grounding wire;
- put the transmitter lid 1.
- screw stop screws.

Fig.2.11 - General rules of electrical connection

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

INFORMATION!
Rotameter is supplied with cable gland for non-armoured cable of 6 to 12 mm size as standard.

2.4.2 Limit switch connection

In standard version each switch has 3 terminals. Power supply and load connection diagrams are shown in the fig. 2.12. Power supply unit and load parameters are presented in the table 2.7.

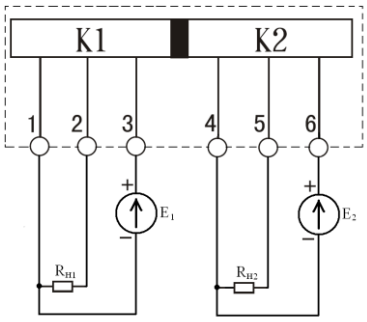


Fig.2.12 - Limit switch connection scheme

Table 2.7 - Power supply unit and load parameters

Parameter	Description
$R_{H1} = R_{H2}$	1…2 kOhm
$E_1 = E_2$	30 V

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;
- to calculate load resistance, first calculate full resistance as the sum of cable resistance, external resistance and auxiliary equipment resistance.
- use shielded twisted pair to minimize disturbance of 4-20 mA signal transmission; 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.

Recommendations for signal cable selection depending on the line length are presented in the table 2.8.

Table 2.8 - Cable type selection recommendations

Connection line length	Min size of core, mm
< 10 m	0.2
10 – 100 m	0.3
100 – 300 mm	0.4
> 300 m	0.5

2.4.5 Ingress protection

Rotameter complies with all IP requirements according to category specifies in the chapter **Specification.**

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

- Sealing shall not be dirty or damaged. Clean or replace sealing, if necessary. Use genuine sealing supplied by manufacturer.
- The size of electrical cables shall comply with cable gland size and not be damaged.
- Transmitter cover and threaded connections shall be securely tighten.
- Cable glands shall be securely tighten.
- Unused cable glands shall be securely plugged.
- Form a U-shaped drip before cable inlet to protect it from moisture.

Fig.2.13 U-shaped cable loop

2.4.6 Grounding

Transient phenomena due to lightning, welding, powerful electrical units or distribution boards may cause readings mistakes or damage the rotameter. To protect equipment from transient phenomena, connect grounding terminal of the terminal block to the earth using heavy-current wires.

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

2.5 Operation and maintenance

2.5.1 General directions

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

- Smoothly open/close pipeline valves to protect measuring unit from damages caused by water hammer.
- Use medium with appropriate viscosity as specifies in rotameter parameters;
- Use rotameter under conditions specified in the order sheet. Use formula from the Appendix D to re-adjust the measuring scale if initial working conditions have changed.

Irregular or inhomogeneous flow can cause indicator needle pulsation.

2.5.2 Commissioning and de-commissioning

Adjust the following parameters before operation start:

- Compare working pressure and temperature inside the system with technical data on the plate (temperature and pressure). Do not exceed specifies parameters;
- Check materials compatibility;
- Slowly open inlet valve until it is fully opened. Then adjust the flow with outlet regulating valve.
- Avoid float bumping because it may lead to float or rotameter damage.
- For de-commissioning slowly close inlet valve, then regulating valve.

2.5.3 Abnormal operation

External factors may cause abnormal operation of the equipment. Some failures can be repaired by the customer.

In case of gasket leakage, tighten all bolts and nuts or replace the gasket.

In case of medium contamination, immediately clean the pipeline and the float. For that purpose, de-install the rotameter and clean measuring tube from dirt, wash the pipeline and install it back.

2.5.4 Maintenance

Do periodical cleaning of magnet filter, if any, after commissioning. Interval of cleaning depends on operating conditions, primarily of medium contamination with magnetic particles, and shall be defined by the maintenance side and agreed with operator.

Do periodical inspection to check for:

- observation of operating conditions;
- power supply and its compatibility with parameters specified this manual;
- visibility of plates and other marking signs;
- cleanness of external surfaces;
- connections sealing;
- visible damages.

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

2.5.5 Diagnostics and troubleshooting

Possible failures and troubleshooting are presented in table 2.95.

Table 2.9 - Troubleshooting

Failure	Possible cause	Remedy
1. The power is on but LED display is off, no signals at current and digital outputs.	Wrong connection of supply cable.	Check supply cable or wires connection as shown in the scheme , see 2.4 Electrical connection.
	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. The power is on, measured data is displayed , but no signals at current and/or digital outputs.	Wrong connection of wires to the rotameter or auxiliary equipment.	Check output signals connection as shown in the scheme , see 2.4 Electrical connection. Check if correct port is selected for connection of rotameter ot the PC.
3. Output signal transmit zero flow, indicator needle at zero level when actual flow is present in the pipe.	The flow value is under specified minimum level for this Dn.	Open valves at full until the flow reaches the specified flow range.
4. Flow volume is stable, but indicator needle fluctuates, readings unstable and false.	Medium pressure is lower than pressure loss specifies for that size of rotameter.	Increase pressure head until pressure reaches the value higher than specified pressure loss value. (section 1.3.2 Flow ranges and pressure loss)
5. Indicator needle shows fixed flow volume and does not change position when the actual flow changes or stops.	Float is blocked because of flow tube clogging.	De-commission rotameter and clean the flow pipe. Re-commission rotameter.

Claim, return or warranty repair procedures are described in the data sheet.

2.6 Calibration

2.6.1 General information

First calibration is executed after manufacturing and successful approval test by QC department.

Calibration shall be done:

- before commissioning after more than 60 month of storage;
- after repair;
- every 5 years of operation;
- unscheduled calibration can be done to ensure equipment correct functioning or if calibration certificate was lost.
- after calibration is done insert a wire in the hole of fixing screw and seal it. Calibration mark is applied to the seal.

2.6.2 Calibration method

Calibration procedure, conditions, methods and result data handling are complied with GOST 8.122-99 "Rotameters. Calibration method".

3. TRANSPORTATION AND STORAGE

3.1 Transportation

Transportation requirements;

- rotameter shall be packed in such tare to avoid mechanical damages during transportation;
- line the inner part of transportation package with water-resistant paper;
- environment temperature shall be -60 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 rotameters in containers;
- boxes shall be stuffed so that to avoid movement during transportation;
- avoid strong bumps during cargo stuffing;
- transit period shall not exceed 3 month;
- leave the boxes unpacked for at least 12 hours in warm premises if cargo was transported under 0°C.
- Do not handle rotameter by transmitter.

3.2 Storage

Rotameters can be stored in unheated premises under -60 to +40°C.

Rotameters 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.

4. RECYCLING

Rotameters 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.

5. LIST OF POSSIBLE FAILURES

5.1 List of possible failures (including critical)

List of possible failures:

- Seal failure of body;
- seal failure of the gaskets;
- Welding seams damage;
- Accuracy failure.

5.2 Personell mistakes leading to failure, emergency or accidents

To provide safety operation, it is prohibited to:

- use fittings under conditions different from specified in data sheet;

- use wrenches of the size bigger than fasteners;
- - do installation, de-installation, service works or repair under working pressure inside the rotameter;
- operate the rotameter without operation data sheets.

6. PERSONELL ACTIONS IN CASE OF ACCIDENT, CRITICAL FAILURE OR BREAKDOWN

Stop medium supply in case of failure or breakdown.

7. LIMIT STATE CRITERIA

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.

APPENDIX A

Dimensions and connection sizes

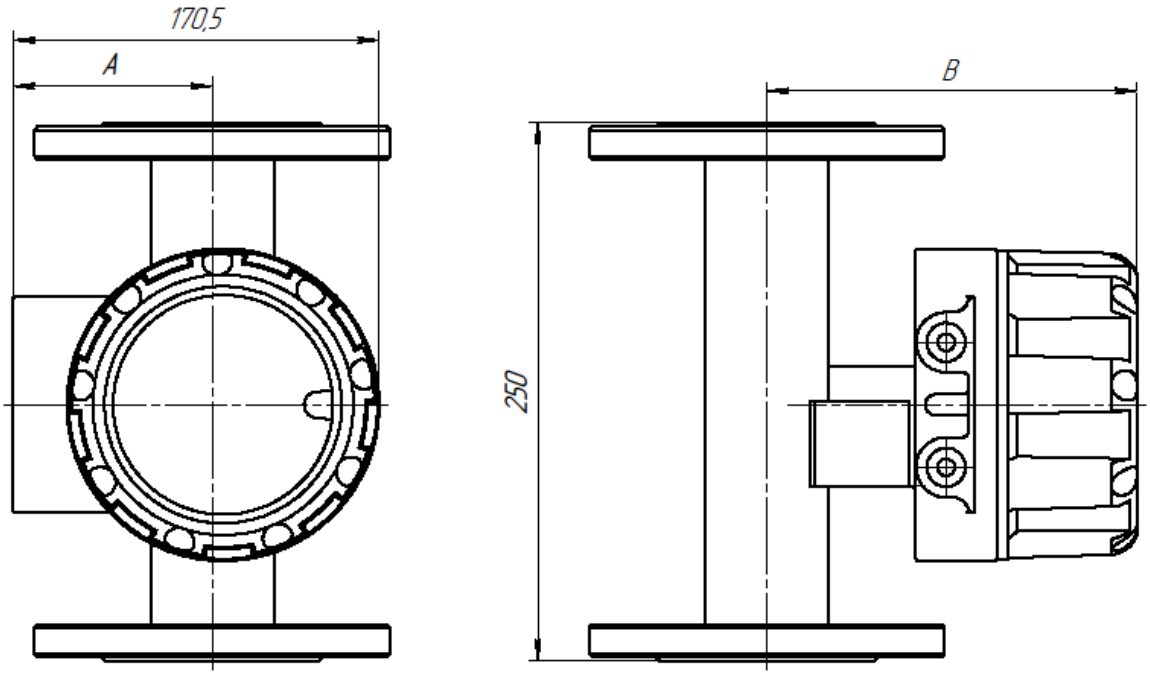


Table A.1 - Dimensions of flanged rotameters

Table A.1 - Dimensions of flanged rotameters

Dn, mm	P, MPa	A, mm	B, mm	W, kg
015	1.6-32	108	154	5.3
025	1.6-32	99	173	6.4
040	1.6-32	90	173	9.1
050	1.6-32	84	173	10.4
080	1.6-32	71	173	12.6
100	1.6-32	61	213	15
150	1.6-32	42	213	40

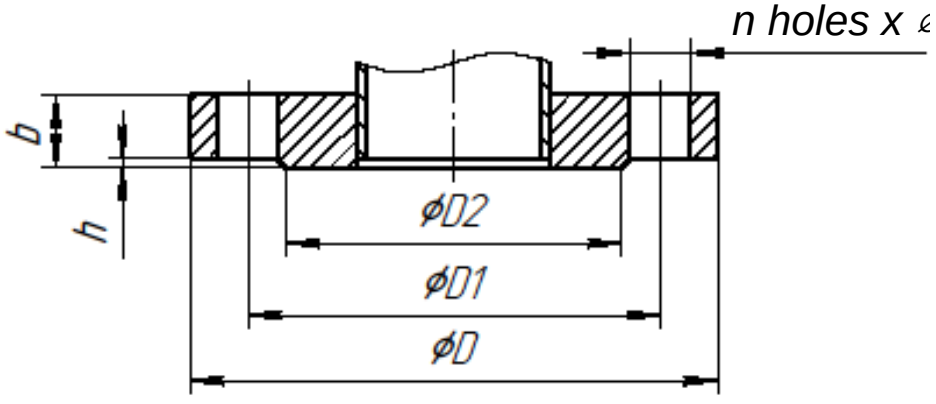


Fig. A.2 - Rotameter flange sizes under TU

Table A.2 - Rotameter flange sizes under TU

Dn, mm	P, MPa	D2, mm	d1, mm	D, mm	b, mm	h, mm	d, mm	n
015	1.6	46	65	95	15	2	14	4
	2.5							
	4.0							
	10.0		75	105	20			
025	1.6	65	85	115	15	2	14	4
	2.5							
	4.0							
	10		100	140	24		18	
040	1.6	84	110	150	17	2	18	4
	2.5							
	4.0							
	10		125	170	26		22	
050	1.6	99	125	165	17	2	18	4
	2.5							
	4.0							
	10		145	195	28		26	
080	1.6	132	160	200	20	2	18	8
	4.0				24	2		
100	1.6	156	180	220	22	2	18	8
	4.0		190	235	24	2	22	
150	1.6	211	240	285	24	2	22	8
	4.0		250	300	28	2	26	

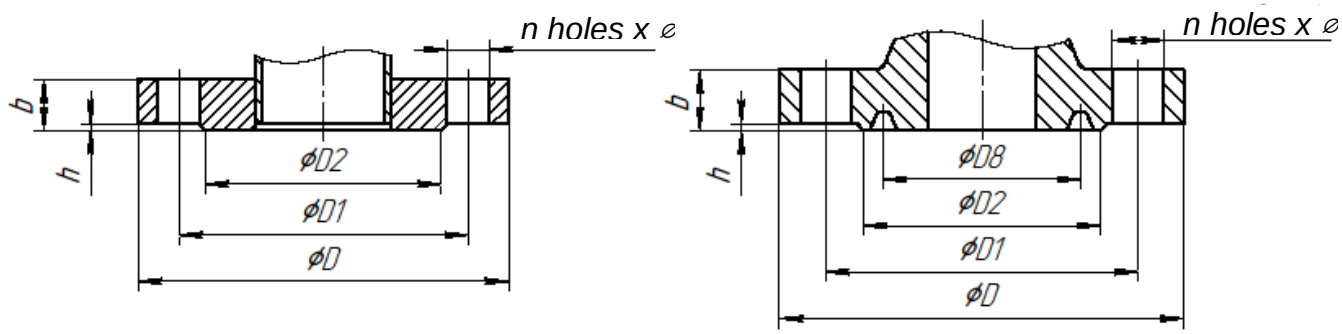


Fig.A.3 - Flange size under GOST 33259-2015 with sealing surfaces of B and J types.

Table A.3 - Flange size under GOST 33259-2015 with sealing surfaces of B and J types.

Dn	P, MPa	D2, mm	D8	d1, mm	D, mm	b, mm	h, mm	d, mm	n
015	1.6	47	-	65	95	14	2	14	4
	2.5					16			
	4.0								
	6.3	55	35	75	105	18			
	10					20			
	16								
025	1.6	68	-	85	115	18	2	14	4
	2.5								
	4.0					16			
	6.3		50	100	135	22		18	
	10					24			
	16								
040	1.6	88	-	110	145	20	3	18	4
	2.5					22			
	4.0					19			
	6.3		75	125	165	24		22	
	10					26			
	16					28			

Table A.3: continued

Dn	P, MPa	D2, mm	D8	d1, mm	D, mm	b, mm	h, mm	d, mm	n
050	1.6	102	-	125	160	22	3	18	4
	2.5					24			
	4.0					20			
	6.3		85	135	175	26		22	
	10			145	195	28		26	
	16	115	95			30			
080	1.6	133	-	160	195	24	3	18	4
	2.5					26			8
	4.0					24			
	6.3		115	170	210	30		22	
	10	150		180	230	34		26	
	16		130			36			
100	1.6	158	-	180	215	26	3	18	8
	2.5			190	230	28		22	
	4.0					26			
	6.3	170	145	200	250	32		26	
	10			210	265	38		30	
	16	175	145			40			
150	1.6	212	-	240	280	28	3	22	8
	2.5			250	300	30		26	
	4.0								
	6.3	240	205	280	340	38		33	8
	10	250		290	350	46			12
	16					50			

Note:

Connection sizes of flanges under ASME, EN, GOST with other sealing types can be provided upon request.

PN=1.6-2.5l PN=1.6-2.5l

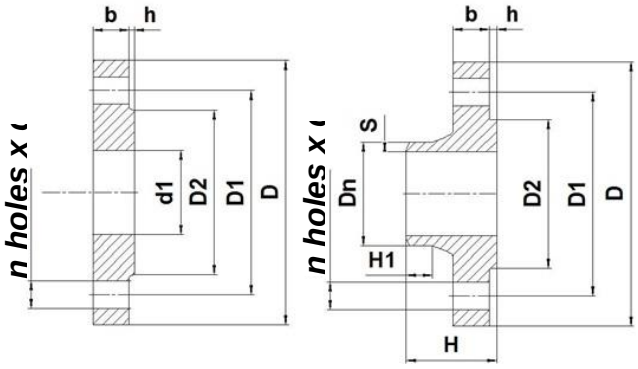
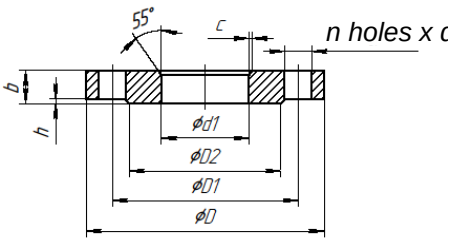


Fig.A.4 - Counter flanges dimensions and connections sizes under TU

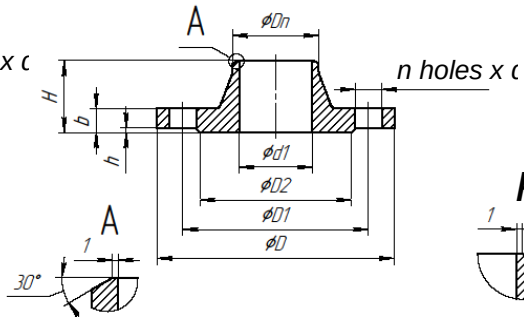
Table A.4 - Counter flanges dimensions and connections sizes under TU

Dn	P, MPa	d1, mm	D2, mm	d1, mm	D, mm	b, mm	h, mm	d, mm	n	H	H1	Dn, mm	S	W, kg
015	1.6	19	46	65	95	13	2	14	4	-	-	-	-	0.7
	2.5													
	4.0	-								35	5	19	3.5	0.8
	10			75	105	18				48	4.5			1.2
025	1.6	32	65	85	115	13	2	14	4	-	-	-	-	1.1
	2.5													
	4.0	-								38	7	33	4	1.2
	10			100	140	22		18		58	10			2.5
040	1.6	47	84	110	150	15	2	18	4	-	-	-	-	2.1
	2.5													
	4.0	-								47	6.5	46	4	2.2
	10	-		125	170	24		22		69				4.1
050	1.6	58	99	125	165	15	2	18	4	-	-	-	-	2.8
	2.5													
	4.0	-								47	5.5	58	5	2.8
	10			145	195	26		26		70	8			6
080	1.6	88	132	160	200	18	2	18	8	-	-	-	-	3.7
	4.0					22				57	6.5	90	6	4.8
100	1.6	108	156	180	220	20	2	18	8	-	-	-	-	4.5
	4.0			190	235	22		22		67	7	110	7	7.1
150	1.6	160	211	240	285	22	2	22	8	-	-	-	-	8.2
	4.0			250	300	26		26		70	10	161	8	13.2

1.6-2.5MPa



4.0MPa



6.3-16MPa

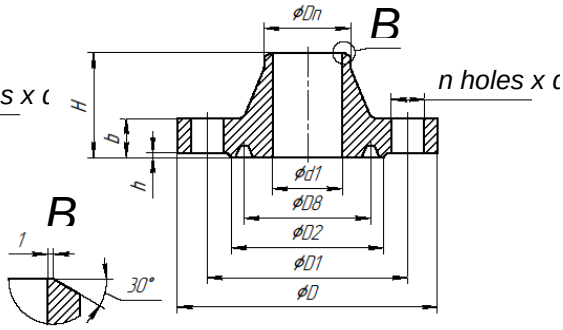


Table A.5 - Counter flanges dimensions and connections sizes under GOST 33259-2015

Dn	Pn, MPa	D2, mm	D8	d1, mm	D, mm	b, mm	h, mm	d, mm	n	c, mm	d1, mm	Dn, mm	H, mm	W, kg
015	1.6	47	-	65	95	14	2	14	4	2	19	-	-	0.61
	2.5					16								0.71
	4.0									-	12	19	35	0.8
	6.3	55	35	75	105	18							48	1.15
	10					20								1.27
	16												52	
025	1.6	68	-	85	115	18	2	14	4	3	33	-	-	1.17
	2.5													
	4.0					16				-	25	33	38	1.19
	6.3		50	100	135	22		18					58	2.3
	10					24								2.5
	16													
040	1.6	88	-	110	145	20	3	18	4	3	46	-	-	1.96
	2.5					22								2.18
	4.0					19				-	38	46	48	2.19
	6.3		75	125	165	24		22			37		68	3.75
	10					26							70	4.07
	16					28							75	4.28

Table A.5: continued

Dn	P, MPa	D2, mm	D8	d1, mm	D, mm	b, mm	h, mm	d, mm	n	c, mm	d1, mm	Dn, mm	H, mm	W, kg
050	1.6	102	-	125	160	22	3	18	4	3	59	-	-	2.58
	2.5					24								2.8
	4.0					20				-	48	58	48	2.81
	6.3		85	135	175	26		22			47		70	4.63
	10			145	195	28		26			45		71	6.08
	16	115	95			30							78	6.49
080	1.6	133	-	160	195	24	3	18	4	4	91	-	-	3,71
	2.5					26			8					4.06
	4.0					24				-	78	90	58	4.81
	6.3		115	170	210	30		22			77		75	7.22
	10	150		180	230	34		26			75		90	9.98
	16		130			36							93	10.5
100	1.6	158	-	180	215	26	3	18	8	4	110	-	-	4.73
	2.5			190	230	28		22						5.92
	4.0					26				-	96	110	68	7.4
	6.3	170	145	200	250	32		26			94		80	10.7
	10			210	265	38		30			92		100	14.7
	16	175	145			40							103	15.4
150	1.6	212	-	240	280	28	3	22	8	4	161	-	-	8.2
	2.5			250	300	30		26						10.5
	4.0									-	145	161	71	13.2
	6.3	240	205	280	340	38		33			142		108	25.4
	10	250		290	350	46			12		136		128	32.9
	16					50							133	35.0

Table A.4 - Mounting kit weight, kg

Dn	P, MPa					
	1.6	2.5	4.0	6.3	10	16
15	1.9	1.9	1.9	2.7	3.1	3.8
25	2.7	2.7	2.7	5.2	6.1	6.8
40	5.2	5.2	5.2	8.9	9.6	11.0
50	6.4	6.4	6.4	9.4	13.6	14.5
80	9.5	11.2	11.2	15.9	23.5	29.9
100	11.0	17.1	17.1	22.9	38.6	41.3
150	19.1	26.6	28.5	60.3	74.6	98.5

Table A.7 - Mounting kit

<table>
<tr><th rowspan="2">Kit content</th><th rowspan="2">Excessive pressure, MPa</th><th colspan="4">Pcs.</th></tr>
<tr><th>Dn 15-50</th><th>Dn 80</th><th>Dn100</th><th>Dn150</th></tr>
<tr><td>Flanges</td><td>1.6-16</td><td>2</td><td>2</td><td>2</td><td>2</td></tr>
<tr><td rowspan="3">Pins</td><td>1.6</td><td rowspan="3">8</td><td>8</td><td rowspan="3">16</td><td rowspan="2">16</td></tr>
<tr><td>2.5-6.3</td><td rowspan="2">16</td></tr>
<tr><td>10-16</td><td>24</td></tr>
<tr><td rowspan="3">Nuts</td><td>1.6</td><td rowspan="3">16</td><td>16</td><td rowspan="3">32</td><td rowspan="2">32</td></tr>
<tr><td>2.5-6.3</td><td rowspan="2">32</td></tr>
<tr><td>10-16</td><td>48</td></tr>
<tr><td rowspan="3">Washers</td><td>1.6</td><td rowspan="3">16</td><td>16</td><td rowspan="3">32</td><td rowspan="2">32</td></tr>
<tr><td>2.5-6.3</td><td rowspan="2">32</td></tr>
<tr><td>10-16</td><td>48</td></tr>
<tr><td>Gaskets</td><td>1.6-16</td><td>2</td><td>2</td><td>2</td><td>2</td></tr>
</table>

Note:

Mounting kit scope is specified for rotameters with flanges under GOST 33259-2015 as presented in this Manual.

Table A.8 - Flange gaskets size

Dn	Excessive pressure, MPa	Gasket under GOST 52376-2005 **	Gasket under GOST 15180-86*	Gasket under GOST 53561-2009***
015	1.6-4.0	SNP-G-1-1-15-40	A-15-40	-
	6.3-16	-	-	1-1-15-160
025	1.6-4.0	SNP-G -1-1-25-40	A-25-40	-
	6.3-16	-	-	1-1-25-160
040	1.6-2.5	SNP-G -1-1-40-40	A-40-40	-
	4.0-16	-	-	1-1-40-160
050	1.6-4.0	SNP-G -1-1-50-40	A-50-40	-
	6.3-10	-	-	1-1-50-100
	16	-	-	1-1-50-160
080	1.6-4.0	SNP-G -1-1-80-40	A-80-40	-
	6.3-10	-	-	1-1-80-100
	16	-	-	1-1-80-160
100	1.6	SNP-G -1-1-100-16	A-100-16	-
	2.5-4.0	SNP-G -1-1-100-40	A-100-40	-
	6.3-10	-	-	1-1-100-100
	16	-	-	1-1-100-160
150	1.6	SNP-G -1-1-150-16	A-150-16	-
	2.5-4.0	SNP-G -1-1-150-40	A-150-40	-
	6.3-10	-	-	1-1-150-100
	16	-	-	1-1-150-160

* - Ft gaskets are used for Ft version, PON-b for H and H2 versions

** - For 250°C tepmerature version

*** - Gasket material 12X18H10T steel

Note:

Gasket size is specified for rotameters with flanges under GOST 33259-2015 as presented in this Manual.

Table A.9 - Fasteners

Dn, mm	Pressure, Mpa	Pin	Nut (wrench size)
015	1.6-4.0	M12x70	M12 (S18)
	6.3-16	M12x80	
025	1.6-4.0	M12x70	M12 (S18)
	6.3-16	M16x100	M16 (S24)
040	1.6-4.0	M16x90	M16 (S24)
	6.3-16	M20x110	M20 (S30)
050	1.6-4.0	M16x100	M16 (S24)
	6.3	M20x120	M20 (S30)
	10-16	M24x130	M24 (S36)
080	1.6-4.0	M16x100	M16 (S24)
	6.3	M20x120	M20 (S30)
	10-16	M24x150	M24 (S36)
100	1.6	M16x110	M16 (S24)
	2.5-4.0	M20x120	M20 (S30)
	6.3	M24x130	M24 (S36)
	10-16	M27x160	M27 (S41)
150	1.6	M20x110	M20 (S30)
	2.5-4.0	M24x130	M24 (S32)
	6.3	M30x170	M30 (S46)
	10-16	M30x190	M30 (S46)

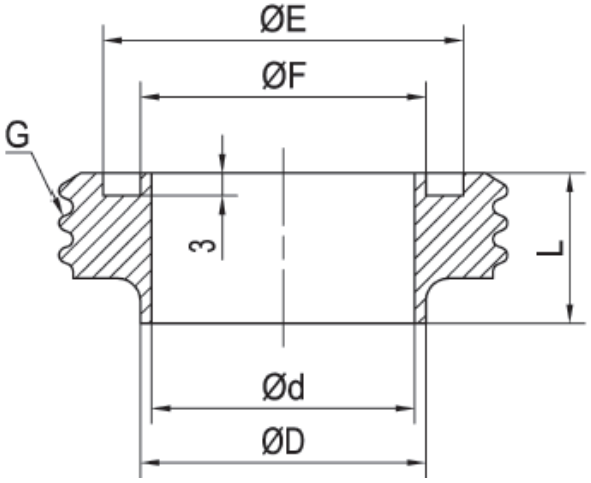


Fig.A.6 - Connection sizes of socket type rotameter

Table A.10 - Connection sizes of socket type rotameter

Dn	P, MPa	E	F	D	d	L	G
015, 025	2.5	32	25	25.4	22.4	18	RD40x1/6”
040	2.5	48	38	38	35	20	RD60x1/6”
050	2.5	61	51	51	48	20	RD70x1/6”
080	2.5	86	76	76.2	72.2	25	RD98x1/6”

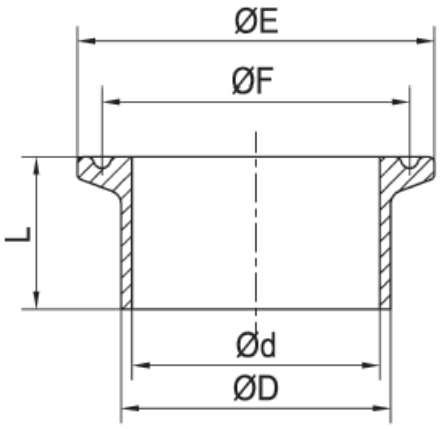


Fig.A.6- Connection sizes of clamp type rotameter

Table A.11 - Connection sizes of clamp type rotameter

Dn	P, MPa	E	F	D	d	L
025	2.5	50.5	43.5	25.4	22.4	21.5
040	2.5	50.5	43.5	38.1	35.1	21.5
050	2.5	64.0	56.5	50.8	47.8	21.5
080	1.6	91	83.5	76.2	72.2	21.5

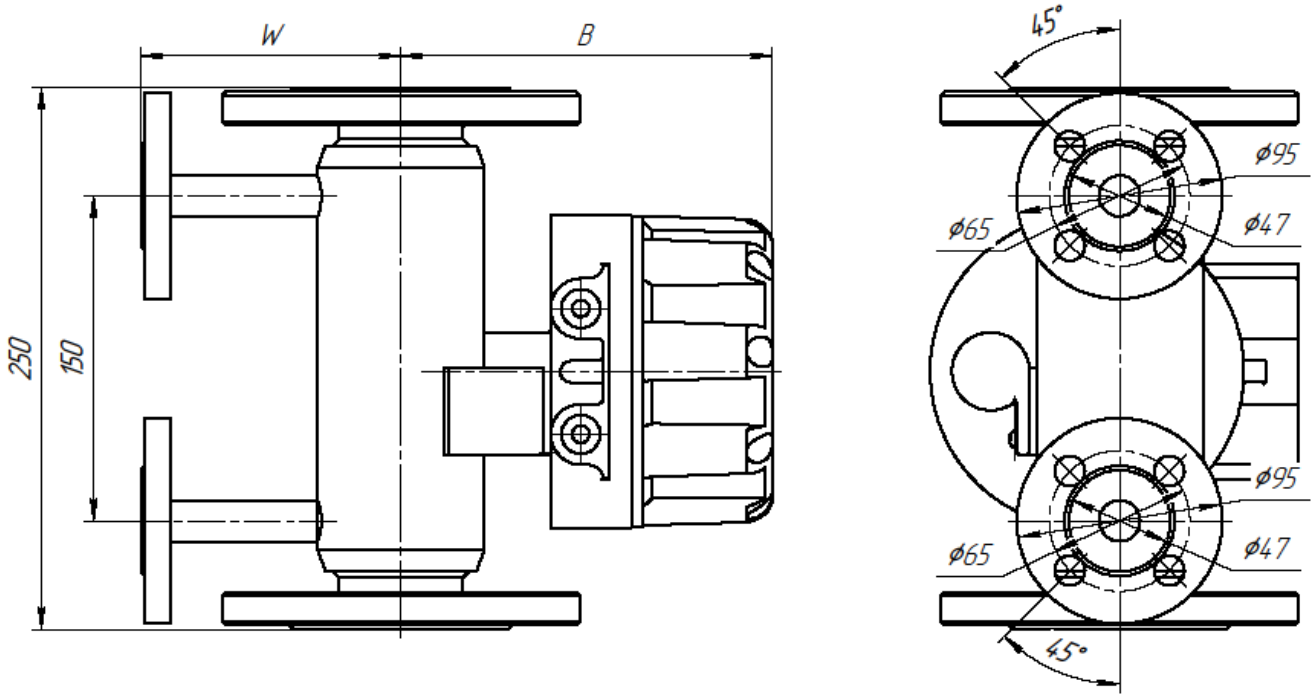


Table A.8 - Heating jacket connection size

Heating jacket is equipped with connection flanges under GOST 33259-2015, Dn15, PN16. Order additional mounting kit for heating jacket, if any: Mounting kit EMIS-META 215 015-1.6-F- N -GOST-01-V-09G2S-St35. Select material of flanges and fasteners according to installation conditions.

Table A.11 - Connection sizes of rotameter with heating jacket

Dn	W	B
015	100	154
025	110	173
040	120	173
050	120	173
080	140	173
100	150	213
150	185	213

APPENDIX B

Dimensions and connection sizes of magnet filter

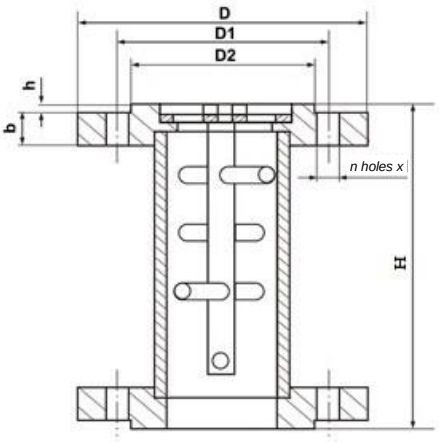


Fig.B.1 - Dimensions and connection size of magnet filter for flanged rotameters

Table B.1 - Dimensions of magnet filter

Dn, mm	P, MPa	H, mm
015, 025, 040, 050	1.6-4.0	100
	6.3-10	150
080, 100	1.6-2.5	100
	4.0	150
150	1.6-4.0	150

Magnet filter sizes not specified in the table B.1 can be provided upon request. Magnet filter is supplied with flanges of the same size as rotameter flanges.. Order additional mounting kit for magnet filter, if any.

APPENDIX C

(normative)

Connection scheme

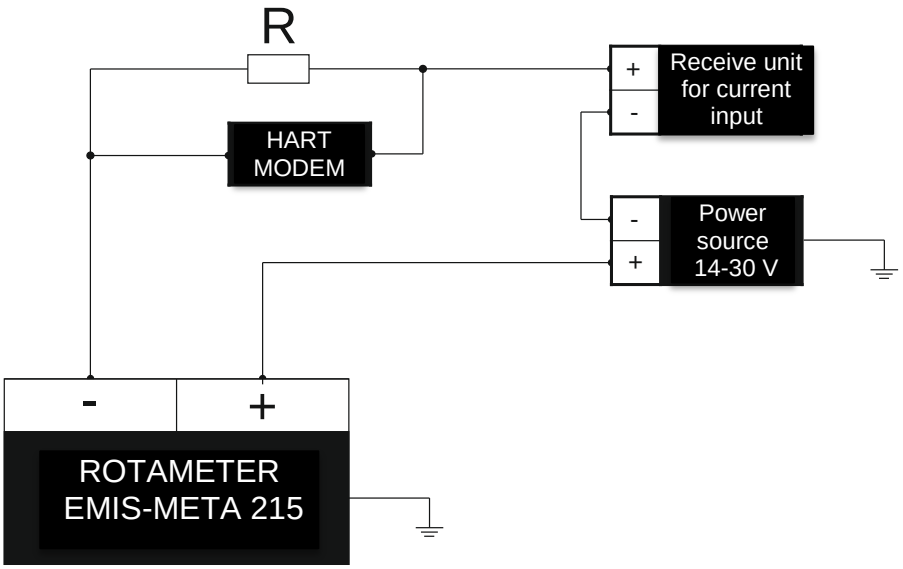


Fig.C.1 - Digital and current output connection

Resistors with a nominal value of 350 to 500 Ohms are allowed. Max value of resistance can be increased according to operation conditions and under HART™ requirements.

APPENDIX D

Measurement technique

1. Application:

Present Appendix describes the procedure of liquid and gas volume flow measurement using EMIS-META 215 rotameter.

2. Normative references.

GOST 8.618-2006. State system for ensuring the uniformity of measurements. State calibration for gas mass and volume flow measurement equipment.

GOST 8.510-2002. State system for ensuring the uniformity of measurements. State calibration for liquid mass and volume flow measurement equipment.

Technical conditions TU 4213-033-14145564-2011. Rotameters EMIS-META 210/210-R, EMIS-META 215.

3. Terms and definitions

Present technique uses the terms according to GOST 15528, GOST 8.586.1, RMG 29-99, as well as the following definitions:

3.1. Rotameter: Rotameter EMIS-META 215.

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

3.3. User: Entity that operates flow meter.

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

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

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

3.7. Standard conditions: liquid medium - water under 20° C, density 1000 kg/cbm

Gas medium - air under 20° C pressure of 0,1013 MPa, density of 1,204 kg/cbm.

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

4. Measurement method

Rotameter EMIS-META 215 consists of two main assemblies - measuring and indication parts.

Flow tube is a cone-shaped measuring tube where the float with magnet moves back and forth. Float magnet interacts with the counting device which transforms linear moves of the float into the angular rotation. Local or remote indication reading. Versions with angle scale with arrow or LED display are designed for local reading. Versions with 4-20mA output signal or digital output Modbus/HARTF are designed for remote reading.

5. Safety requirements.

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

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

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

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

5.5. Operation manual shall be available for the maintenance personell.

6. Flow meter application conditions

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

6.2. Rotameter shall be installed in the true-vertical part of the pipeline with upward flow direction (for standard version) or in the horizontal part of the pipeline with left-to-right flow direction (for G version).

6.3 Minimal length of straight run before and after rotameter shall be 5x Dn size.

7. Measuring scale division according to measuring medium.

* - initially rotameters are calibrated for standard conditions

The following formula is used to calculate current volume flow of liquids:

$$Q_S = Q_N \sqrt{\frac{(\rho_f - \rho_S)\rho_N}{(\rho_f - \rho_N)\rho_S}},$$

Where, Q_S – actual flow;

Q_N – readings;

ρ_s – liquid density;

ρ_f – float density (7930 kg/cbm – for H version; 3400 kg/cbm – for Ft version);

ρ_N – density of medium used for calibration (water density under 20° C is $1 \cdot 10^3$ kg/cbm).

To calculate current volume flow of gas medium use the formula below;

$$Q_S = Q_N \sqrt{\frac{\rho_N P_N T_S}{\rho_{SN} P_S T_N}},$$

where P_N – absolute pressure of calibration medium (air) $1.013 \cdot 10^5$ Pa (760 mm of mercury);

T_N – temperature in kelvin (293,15K);

ρ_N –air density under standard conditions (1,204 kg/cbm);

P_S – absolute pressure of measuring medium;

T_S –absolute temperature of measuring medium;

ρ_{SN} – density of measuring medium under standard conditions;

Q_S – actual gas flow;

Q_N – readings.

Use the formula below to calculate volume flow under standard conditions;

$$Q_S = Q_N \sqrt{\frac{\rho_N P_S T_N}{\rho_{SN} P_N T_S}}.$$

If mass indicator division is required, than adjust the scale using the following formula:

$$Q_{SM} = Q_{SN} \cdot \rho_{SN} = 1{,}293 \cdot Q_N \sqrt{\frac{\rho_{SN} P_S T_N}{\rho_N P_N T_S}},$$

where Q_{SN} – value under standard condition;

Q_{SM} – mass flow;

For liquefied gas measuring use the formula below;

$$Q_{SW} = Q_N \sqrt{\frac{\rho_N}{\rho_{SN} \frac{(P_S - \psi_s P_{DS}) T_N}{P_N \cdot T_S} + \psi_s \cdot \rho_{DS}}},$$

Where Q_{SW} – actual flow of liquefied gas;

ψ_S – relative humidity of gas medium;

P_{DS} – intense flow pressure;

ρ_{DS} – density of liquefied gas under temperature T_S;

APPENDIX E

HART ™ register map

The protocol is used for connection between master and slave devices. Rotameter can be connected to HART-devices in two modes. Standard mode - rotameter EMIS-META 215 is connected to master devices. Multichannel mode - parallel connection of 15 slave devices with master devices using one pair of wires. According to HART protocol there shall be not more than two master devices. In standard mode the devices shall have 0 address.

Table D1 - Data channel parameters

Name	Parameter
Standard data transmission	Bell 202
Data protocol	HART ™, version 5
Type of transmission	asynchronous
Number of devices	up to 15 (multichannel mode)
Connection type	half-duplex
Character encoding	start bit; 8 bit of data; parity bit; stop bit
Frame format	short frame
Error detection algorithm	byte parity control, control byte checksum
Data transmission rate	1,2 kbit/s (packet transfer time: 500ms - asynchronous, 200ms-synchronous)
Connection line length	- standard mode: 3 km (shielded twisted pair) - multichannel mode: 100 m

Table D.2 - HART commands

No	Function	Request	Response
Universal commands			
0	Read Unique Identifier Associated With Tag	No	Byte 0 "254" (extension) Byte 1 manufacturer code Byte 2 equipment type code Byte 3 number of code words Byte 4 universal commands version Byte 5 specific commands version Byte 6 software version Byte 7 hardware version Byte 8 function flags (H) Byte 9-11 device ID (B)
1	Read Primary Variable	No	Byte 0 primary variable unit of measure code Byte 1-4 primary variable (F)
2	Read Current and Range percentage	No	Byte 0-3 current (mA) (F) Byte 4-7 range percentage (F)
3	Read Current and Four Dynamic Variables	No	Byte 0-3 current (mA) (F) Byte 4 measuring unit code for primary parameter Byte 5-8 primary variable (F) Byte 9 measuring unit code for secondary variable Byte 10-13 secondary variable (F) Byte 14 measuring unit code for tertiary variable Byte 15-18 third variable (F) Byte 19 measuring unit code for fourth variable Byte 20-23 fourth variable (F)
6	Write Request Address	Byte 0 request address	as in command
12	Read Message	No	Byte 0-23 message (A)
13	Read Tag, Descriptor, Date	No	Byte 0-5 tag (A) Byte 6-17 descriptor (A) Byte 18-20 date (D)
14	Read Sensing Element Data	No	Byte 0-2 serial No of sensing element Byte 3 sensor measuring unit code, limits and min interval Byte 4-7 upper limit of sensing

No	Function	Request	Response
			element (F) Byte 8-11 lower limit of sensing element (F) Byte 12-15 min interval (F)
15	Read Primary Variable Output Information	No	Byte 0 alarm code Byte 1 transducer function code Byte 2 range unit code Byte 3-6 upper limit of range Byte 7-10 lower limit of range Byte 11-14 damping value Byte 15 write protection code Byte 16 selle mark code (F)
16	Read Final Assembly Number	No	Byte 0-2 serial number of equipment
17	Write Message	Byte 0-23 message (32 symbols)(A)	as in command
18	Write Tag, Descriptor, Date	Byte 0-5 tag (A) Byte 6-17 descriptor (16 symbols) (A) Byte 18-20 date (D)	as in command
19	Write Final Assembly Number	Byte 0-2 serial No of device	as in command
Common commands			
33	Read Sensor Variables	Byte 0 sensor variable code for slot 0 Byte 1 sensor variable code for slot 1 Byte 2 sensor variable code for slot 2 Byte 3 sensor variable code for slot 3	Byte 0 sensor variable code for slot 0 Byte 1 measuring unit code for slot 0 Byte 2-5 variable for slot 0 (F) Byte 6 sensor variable code for slot 1 Byte 7 measuring unit code for slot 1 (cut after last requested code) Byte 8-11 variable for slot 1 (F) Byte 12 sensor variable code for slot 2 Byte 13 measuring unit code for slot 2 Byte 14-17 variable for slot 2 (F) Byte 18 sensor variable code for slot 3 Byte 19 measuring unit code for slot 3 Byte 20-23 variable for slot 3 (F) (cut after last requested variable)

No	Function	Request	Response
34	Write Damping Value	Byte 0-3 damping value (sec) (F)	as in command
35	Write Range Value	Byte 0 range measuring unit code Byte 1-4 upper limit of range (F) Byte 5-8 lower limit of range (F)	as in command
36	Set Upper Limit of Range	None	None
37	Set Lower Limit of Range	None	None
39	EEPROM Control	Byte 0 EEPROM control code (0=burn EEPROM, 1=copy EEPROM to RAM)	as in command
40	In/Out of Fixed Current Mode	Byte 0-3 current (mA) (0=exit mode) (F)	as in command
43	Set Zero of Primary Variable	None	None
44	Write Primary Variable Measuring Units	Byte 0 primary variable unit of measure code	as in command

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 (day, month, year- 1900)

F: with floating point (4 bytes IEEE 754)

H: Integer xxxxx yyy (xxxxx=hardware version; yyy=code of generation of real-world signals) Non-marked data are 8-,16-,24-bit integers.

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