SMALL-FLOWS REGULATOR
type R503

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1. SECURITY INSTRUCTION

1.1. Application

Small-flows regulator type R503 is used for constant maintain setting value of protected medium – air or water – in tubes of measuring systems not depend from pressure fluctuation. The size of flow is setting by a hand using handwheel. Small-flows regulators are used in pressure measuring systems when the separation of measuring system and aggressive measuring medium are necessary and when it is possible to get condensate or bears the measuring medium, sludge and other impurities might upset the measurement in the tubes.

The regulator type: A503-A010; A020 … A022 in connection with flow indicator type R504-A052 or R504-A051... A053 is used as regulator A503-A030 … A033 or R503-A040… A047 in case, when we need flow indicator with throttle valve separated from regulator.

1.2. Instructions and warnings

Body damage and/or serious material damages might be formed if user doesn't keep of instructions and warnings. Servicing staff have to be instructed and acquaint with whole safety instructions and warnings.

For well and safe rgulator's working there has to be assured right transport, storage, assembly, starting and conservation's instruction.

Main attentions of safety in mentioned operation and maintenance manual were marked as pictograms:

	**This sign means: Pointer.** „Pointer" indicates on action or any process important for well-working of product. Material damages might be formed if user doesn't keep of instructions.
	**This sign means: Warning.** „Warning " indicates on action or any process, which might be danger for staff or makes material damages if those aren't made correctly.

2. TECHNICAL DESCRIPTION

2.1. Product's description

Construction details of small-flows regulators are shown on drawings no. 6 – 10. Main functional units for all types of regulator are the same. Construction discrepancies are in assembly method and that regulators type: R503-A007; A008; A017; A018; A009; A019; A010; A020 ... A022 don't have out-build flow indicator.

Regulators type R503-A007; A008; A017; A019 have out-built setting throttle valve and regulators type R503-A010 and A020 ... A022 have plate with connectors using for connect the regulator by tubes with cooperating flow indicators which make possible to separate the assembly of flow indicator with throttle valve and the regulator.

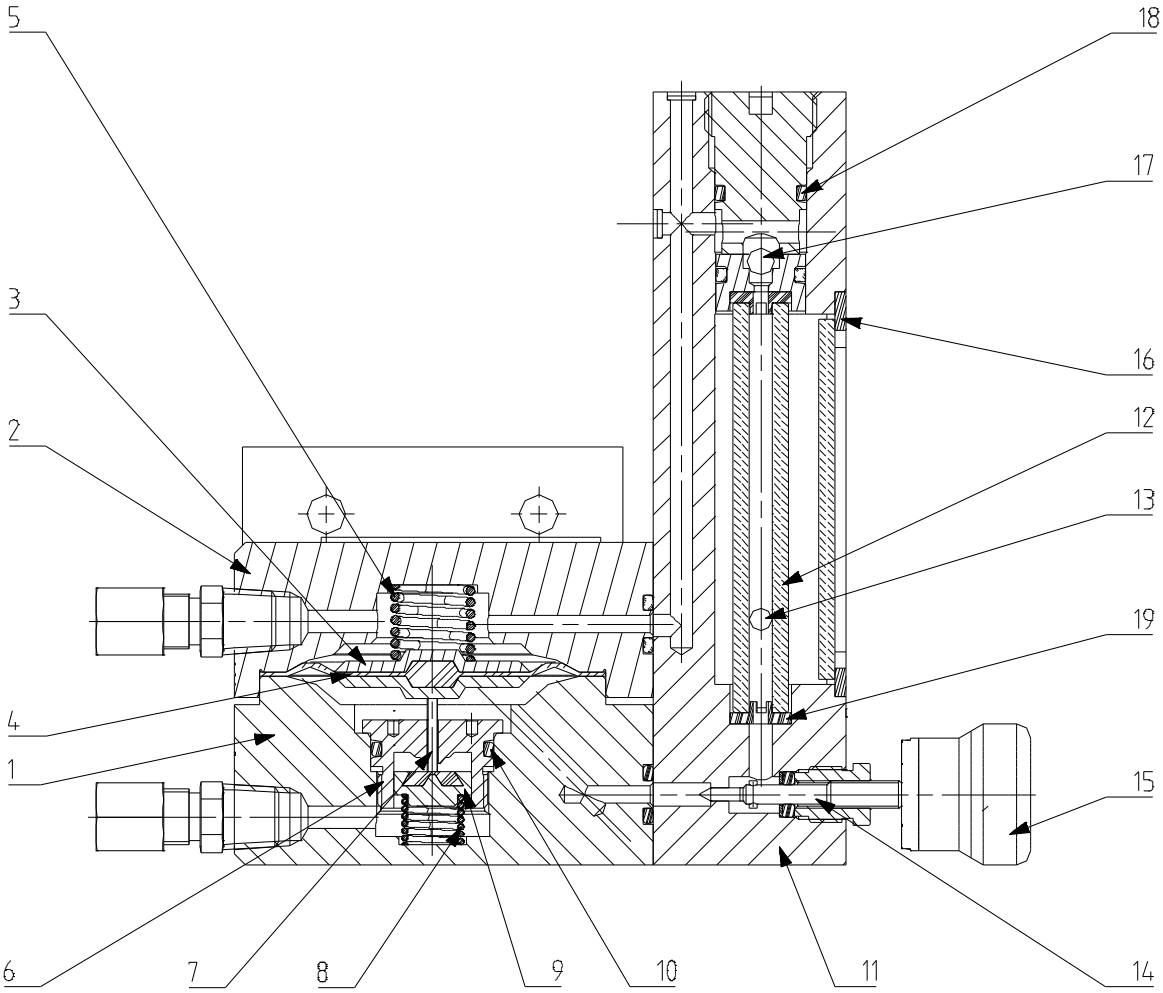
Description of main functional units:

REGULATOR'S UNIT

The regulator's unit consists of lower body (1), which includes control valve unit, membrane unit (4), pusher (7), spring (5) and upper body (2). Upper and lower body have special configurated faces using as membrane beds in case one-side overloading. Stiffener (3) limits the down movement of membrane. The control valve's seat (6)in screw in lower body (1) and it is sealing of sealing rubber ring (10). The mushroom (9) is pressed down to the seat by spring (8). The connectors type R903 and R916 for smooth pipes 6 dia. x 1 are used for connection of pressure supply tubes and output pressure.

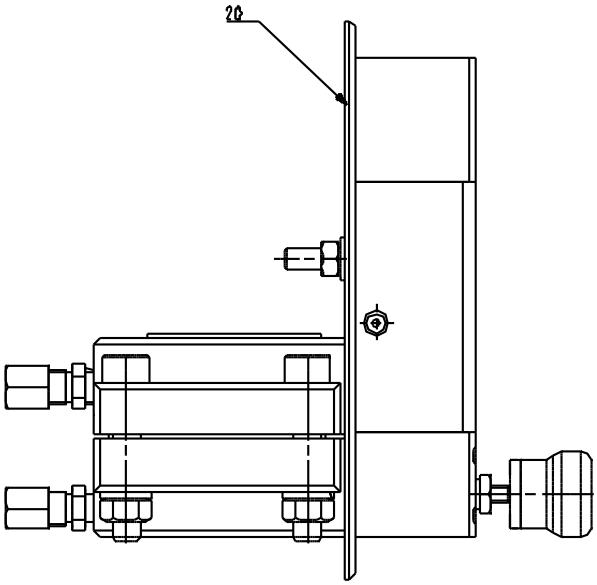
FLOW INDICATOR UNIT

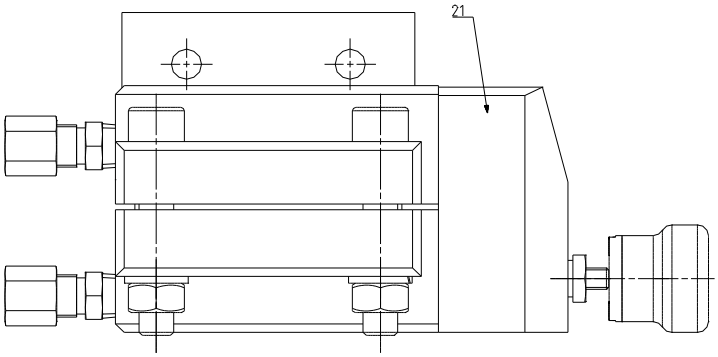
The flow indicator unit is in regulators type R503-A030 ... A033; A040 ... A043 and consists of the body (11), tapered tube (12) with float (13), needle valve (14), check Valle (17) and casing (16).



Drawing no. 1. Small-flow regulator type R503-A030 ... A033

Drawing no. 2.
Small-flow regulator
type R503-A040 ... A043





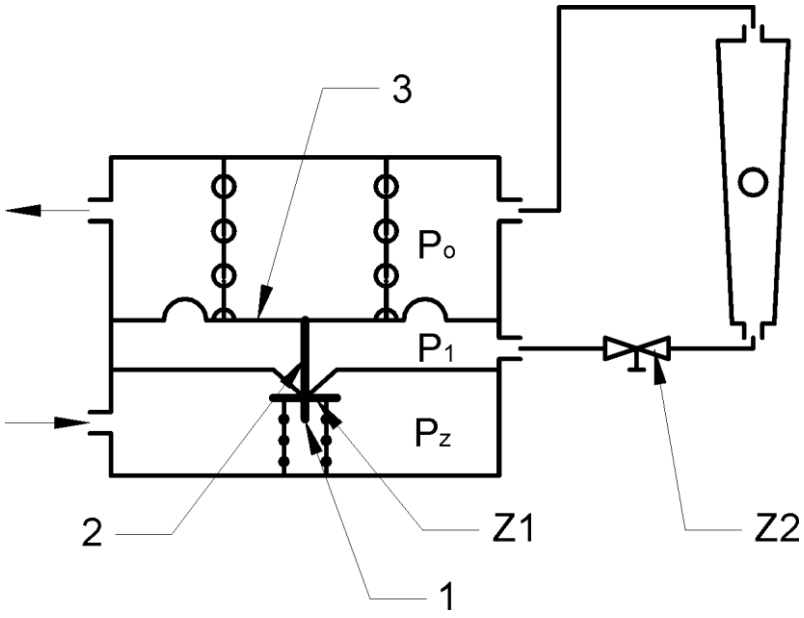
Drawing no. 3.
Small-flow regulator
type R503-A007, A008, A0107, A018

The throttle valve (14) is put into lower part of body and it is using for flow setting of bathing medium. The throttle valve has handwheel (15) and the handwheel is equipped with coupling protecting before wrong using. In case to set needed flow one should be pull the handwheel of the regulator and next turningwheel pull off from the regulator and after turning around. The indicator's pipe (12) is put into the body and it is sealed by sealing rings; the float fenders (19) are in upper and lower ends of pipe. Check valve (17) is used as protection in case the output pressure goes up more than expect or the decrease of pressure supply. The indicator is connected with regulator's unit by screws M5x45. The leak-proofness of connection is provided by sealing rings (18). Regulators type R503-A040 ... A043 are equipped with additional parts using for table fixing (20).

GLANDS UNIT

The glands unit is only in regulators type R503-A007; A008; A017; A018 and consists of the body (21) where closing valve and needle valve are.

2.2. Operation's description



Drawing no. 4
Functional diagram of small-flows regulator

Working medium is transmitted under the control valve Z1 mushroom (1) under the pressure Pz. The mushroom (1) is controlled by membrane (3) at pusher (2) help. The system will be in balance if:

P1 – Po = ΔP – K

K – constant value depends of the elastic force influence on membrane.

In case change of output pressure Δp and disturb the balance, the membrane will open or close the valve Z1, which makes change the pressure P1 by the value Δp1 = ΔPo. This constant difference makes constant flow of working medium by needle valve Z2. The rate of the flow depends on opening rate of the valve Z2.

3. TECHNICAL DATA

Working medium	air or water
Supply pressure Pz	2.5 or 0.6 MPa
Output pressure Po	0…24 MPa
Keeping up the pressure differences ΔP	20kPa
Accuracy working: pressure differences ΔP under the change of supply pressure and output pressure are not higher than: • for air • for water when	 2 kPa 3 kPa 50 kPa ≤ (Pp-Po) ≤ 600 kPa
Setting flow rangers for: • for air • for water	 4 ... 20 dm^3/h 4 ... 40 dm^3/h
Accurate of indications: • for air	 ± 1.5 dm^3/h up to 4 dm^3/h ± 2 dm^3/h over 4 ... 8 dm^3/h ± 2,5 dm^3/h over 8 ... 12 dm^3/h ± 3 dm^3/h over 12 ... 20 dm^3/h

• for water	± 2 dm³/h up to 10 dm³/h ± 3 dm³/h over 10 ... 20 dm³/h ± 4 dm³/h over 20 ... 40 dm³/h
Max. acceptable pressure	4 MPa
Mass:	
R503-A030...A033 and A040-A047	2 kg
R503-A007, A008, A017 and A018	1,4 kg
R503-A009, A010, A019 and A020	1,3 kg

The overall dimensions of regulators are shown on the drawings no. 5…7.

4. TABLE OF VERSIONS

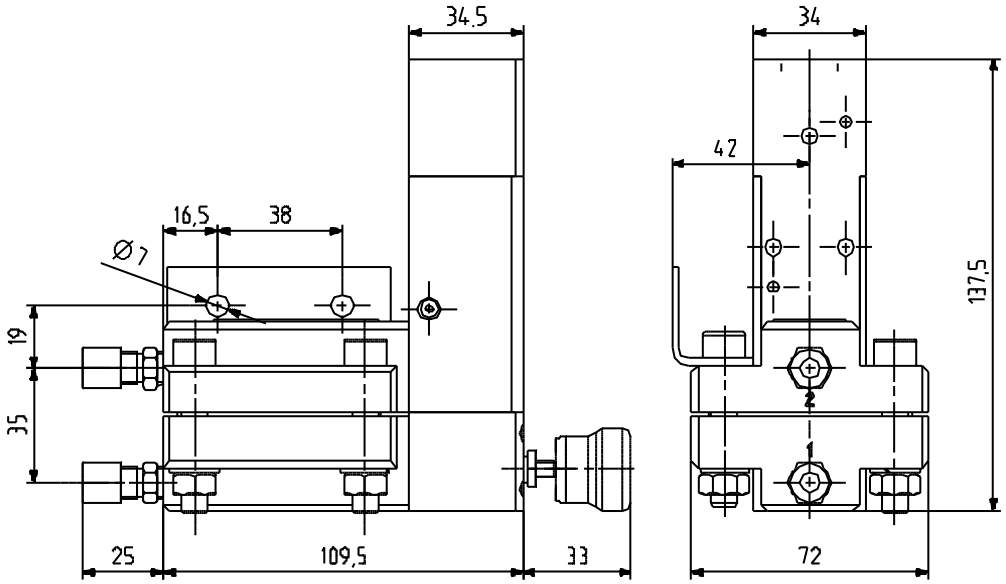
Small-flows regulators are made in versions as follows:

Working medium	Assembly	Using	Version	
			2,5MPa	0,6MPa
Air	On the wall	Pointing and flow regulationi	**A030**	**A032**
		Flow regulation (to cooperation with R503 indicator)	**A007**	**A017**
	On the table	Pointing and flow regulationi	**A040**	**A042**
Water	On the wall	Pointing and flow regulationi	**A031**	**A033**
		Flow regulation (to cooperation with R503 indicator)	**A008**	**A018**
	On the table	Pointing and flow regulationi	**A041**	**A043**

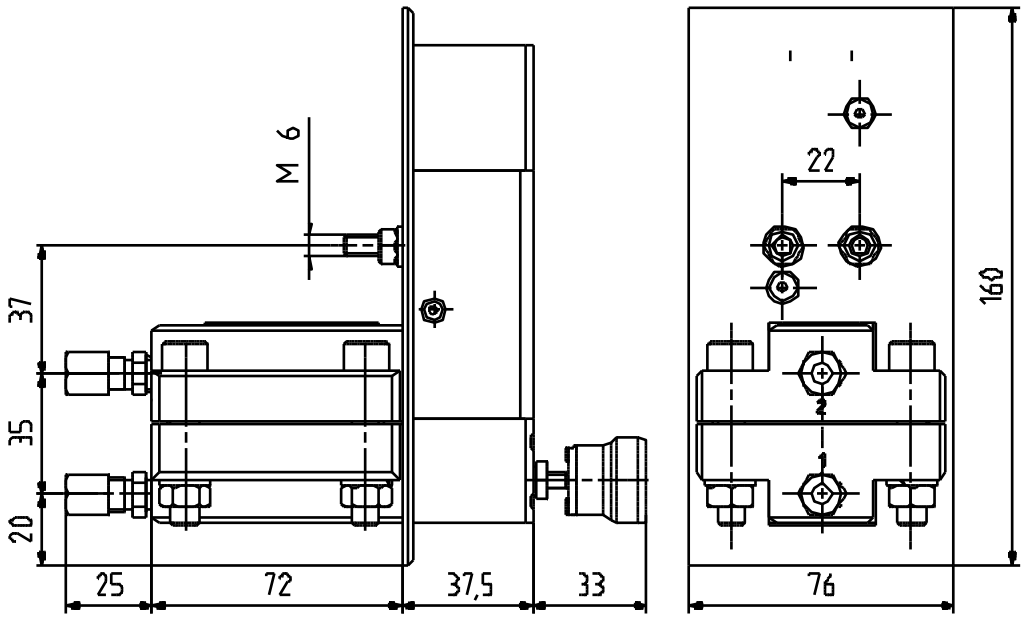
The letter "K" on the end of type the regulator means acid-proof version

Regulators are delivered with connectors as follows:

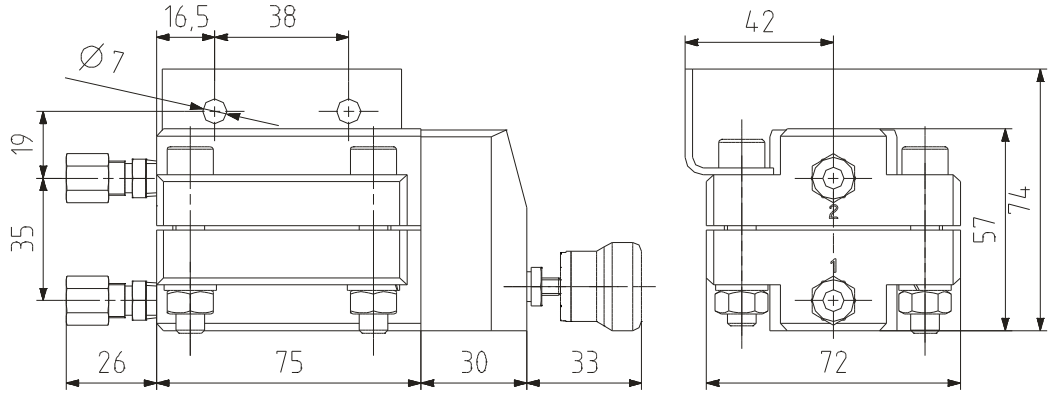
Type of connectors	Marking
For copper pipe 6 dia.x1 or acid-proof	R903



Drawing no. 5
Small-flows regulator type R503-A030 ...A033



Drawing no. 6
Small-flows regulator
type R503-A040 .. A043



Drawing no. 7
Small-flows regulator
type R503-A007; A008; A017; A018

5. WORKING CONDITIONS

The small-flows regulator is designed for work under the following conditions:

a) working medium – water or air free from dust, oil, aggressive impurities and mediums which have relative humidity to the temperature point of dew has to be lower not less than 10^0C relative to ambient temperature

b) ambient temperature: - for air -40…+50°C
- for water +5 … +50°C

c) permissible value of vibrations:
- amplitude 0.1 mm,
- frequency up to 50 Hz

d) working position – vertical

6. TRANSPORT INSTRUCTION

The regulator with declaration of conformity and hygroscopic medium is located in plastic bag and next is put into carton box, filled with shock absorbing insert; the carton box is the consumer package.

Temperature during transport should not exceed range -40°C...+60°C.

Packed regulators should be protected from damages and direct influence of rain and snow.

7. UNPACKING AND STORAGE INSTRUCTION

Customer should inspect packages state after receiving.

After taking the regulator out of box, without opening plastic bag, inspect it visually for damages.

Regulators should be stored in original boxes in closed rooms at ambient temperature 20 ±10 ^{0}C and relative humidity up to 80%.

Air in storage area should not contain aggressive vapours and gases making corrosion (not concern to acid-proof version).

8. ASSEMBLY

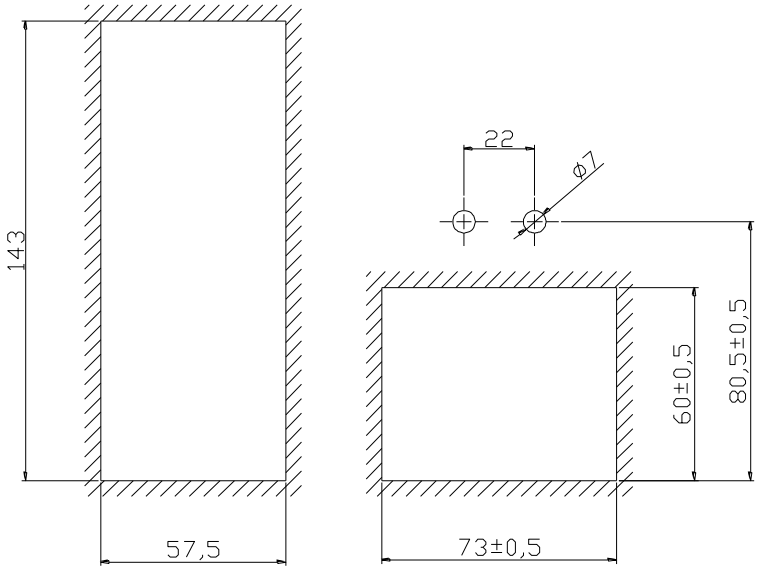
8.1. Fixing the product

Fixing of regulator type R503-A030; A033; A007

The bracket with two holes is using for fixing small-flows regulators as mentioned above. Dimensions and holes spacing are presented on drawings no. 5…7. The regulator should be assembled in working position as presented in mentioned drawings.

8.2. Place of assembly

The regulator should be assembled possible near of measuring place. The choice of pace and method of assembly should make possible to easy access to the regulator and protect before impurities and high fluctuation of ambient temperature. The regulator type R503-A040 …A043 is assembled into the table.



a) the hole in the table for assembly – for standard regulator

b) the hole in the table for assembly – for acid-proof regulator

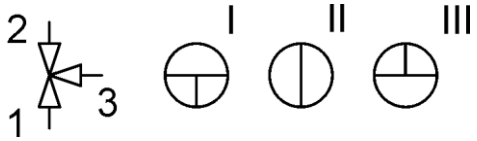
Drawing no. 12. Fixing regulators type R503-A040 ... A043 into the table

8.3. Measuring tubes and pressure supply

Tubes should be placed with protection before their damage and fixed carefully. Tubes and devices should be assembled in order to without influence of any mechanical loads. When tubes will be placed sharp curvings should be avoid. Before connect the tubes one should be cleaned by blowing to protect the device before pollution. Inside etched cooper pipe 6 dia. x 1 or 8 dia. x 1 outside covered protecting lacquer shell is the best as pressure supply tubes.

8.4. Assembly rules

When small-flows regulator is assembled it is recommended to use on measuring tubes three way manifolds (look at drawing no. 9); the manifolds make possible to connect measuring tubes with atmosphere at starting.



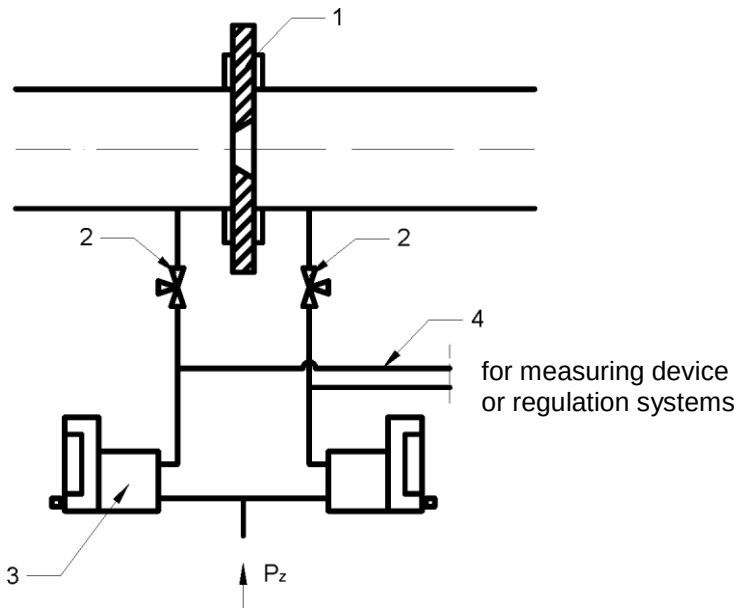
1 – measuring tube
2 – the tube connecting with measuring tube
3 – connection with atmosphere

Drawing no. 9. Three-way manifold

Assembly rules of regulators for some of cases meeting in automation systems will be described below. Designer and end user have to decided which system will be good for their requirements.

8.5. Assembly at measurements and flow's regulation

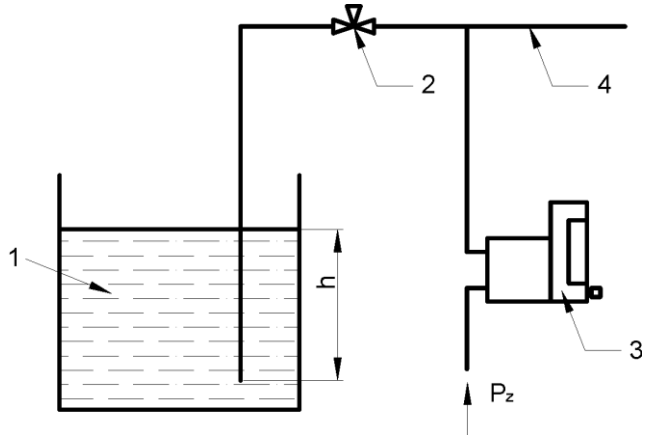
Small-flows regulator in systems presented on drawing no. 10 is used at measurements and flow's regulation of liquid or gases in cases we want to separate measuring medium from measuring device.



Drawing no. 10.
Assembly
at measurements
and flow's regulation

8.6. Assembly at measurements and liquid level regulation in opened tanks

Small-flows regulator in systems presented on drawing no. 11 is used at measurements and flow's regulation of liquid level in opened tanks.



Drawing no. 11.
Measurements and liquid level regulation
in opened tanks at small-flows regulator
type R503 using

1 – tank
2 – three-way manifold
3 – small-flows regulator
4 – measuring tubes

In this system value of measuring pressure Pm is determined as:

$$\mathbf{Pm + h \cdot \gamma + \Delta p}$$

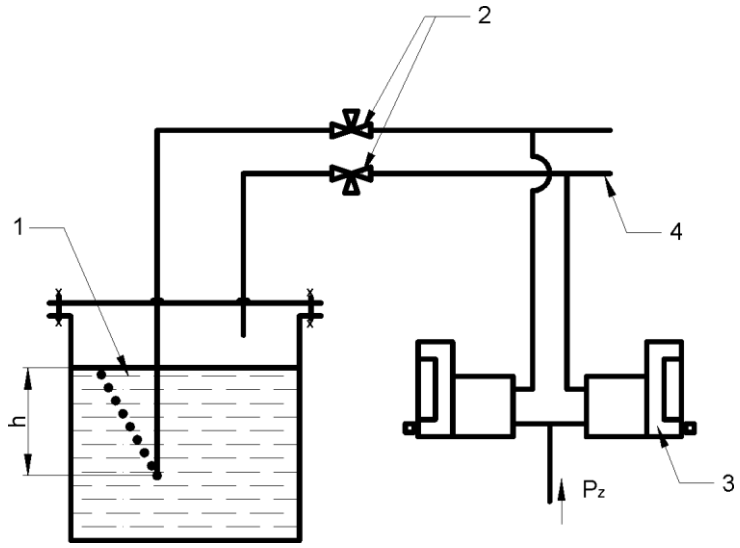
and:

h – high of column of liquid
γ – specific gravity of liquid
Δp – decrease of pressure in measuring system

When we use non-regulating gland for measuring liquid level ∆p changes depending on changes supply pressure and Pm pressure. When we use small-flows regulator decrease of pressure ∆p is constant and may be not take into consideration as value not essential. This value might be important when we need accurate measurements of level and when we have considerable length of measuring tubes.

8.7. Assembly at measurements and liquid level regulation in closed tanks

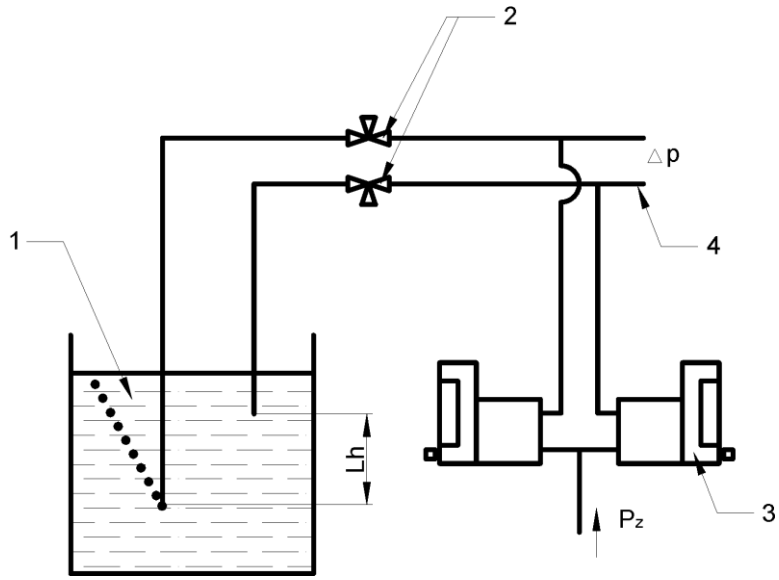
Small-flows regulator in systems presented on drawing no. 12 is used at measurements and flow's regulation of liquid level in closed tanks.



Drawing no. 12.
Measurements and liquid level regulation in opened tanks at small-flows regulator type R503 using

8.8. Assembly at measurements and liquid specific gravity regulation

Small-flows regulator in measuring systems presented on drawing no. 13 is used at measurements and liquid specific gravity regulation.



Drawing no. 13.
Measurements and liquid specific gravity regulation at small-flows regulator type R503 using

In this system specific gravity or measuring liquid is determined as:

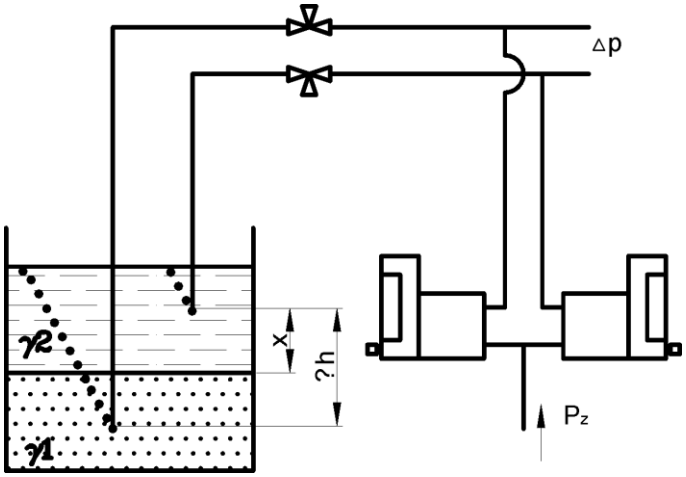
$$\gamma = \frac{\Delta p}{\Delta h}$$

and:
∆p – discrepancies of pressure in measuring system
∆h – discrepancies of depth submersion of instrument stalk
γ – specific gravity of liquid

Decreases of pressure on measuring tubes compensate reciprocally at using tubes at the same length and intersection. The same system might be used for measuring of liquid specific gravity in closed tanks, too, because the pressure in tanks has no influence of Δp. It is possible to measuring of liquid specific gravity using one instrument stalk (look at drawing no. 11), in this case constant high of column of liquid using for example overflow hole has to be done.

8.9. Assembly at measurements and regulation of boundary layer of two liquids at different specific gravities

Small-flows regulator in measuring systems presented on drawing no. 14 is used at measurements and regulation of boundary layer of two liquids at different specific gravities.



Drawing no. 14.
Measurements and regulation of boundary layer of two liquids at different specific gravities.

In this system the distance "X" of boundary layer measuring from the end of submerged instrument stalk to known depth of this one is determined as:

$$X = \frac{\Delta p - \Delta h \bullet \gamma 1}{\gamma 2 - \gamma 1}$$

and:

Δp – discrepancies of pressure in measuring system
Δh – discrepancies of depth submersion of instrument stalk
γ1 and γ2 – specific gravities of liquid

9. MAINTENANCE INSTRUCTION

9.1. Start-up

GENERAL INSTRUCTIONS

Before starting of regulator, the cut-off manifolds on measuring tubes should be closed. During making works connected with starting up of regulator first has to checked if measuring medium has bad influence for the staff who will servicing of the regulator and what kind of safety rules have to be used. The leakproofness of measuring tubes and connections have to checked before start-up. If any leaks are, they have to be eliminated.

START-UP IN MEASUREMENTS AND FLOW'S REGULATIONS OF LIQUID OR GASES:
In case of start-up one should be done:

- set the three-way manifolds at position "Atmosfera" (look at drawing no. 10),
- turn on the supply pressure
- set the requested flow value
- switch the manifolds at position "Praca"
- make works connected with starting-up of measuring instrument or regulation system

START-UP IN MEASUREMENTS AND LIQUID LEVEL REGULATION IN OPENED TANKS:
In case of start-up one should be done:

- set the three-way manifold at position "Atmosfera"
- turn on the supply pressure
- set the requested flow value
- switch the manifolds at position "Praca"
- make works connected with starting-up of measuring instrument or regulation system

START-UP IN MEASUREMENTS AND LIQUID LEVEL REGULATION IN CLOSED TANKS:
In case of start-up one should be done:

- set the three-way manifolds at position "Atmosfera"
- turn on the supply pressure
- set the requested flow value equal for both regulators
- switch the manifolds at position "Praca"
- make works connected with starting-up of measuring instrument or regulation system

START-UP IN MEASUREMENTS IN POINTS 8.8. AND 8.9. IS MADE BY THE SAME WAY.

9.2. Exploitation

The correct assembled and prepared for working regulator doesn't need more service except conservation and repairs.

9.3 . Disconnecting from the exploitation

In case of disconnect the regulator from the exploitation one should be done:

- set the three-way manifolds at position "Atmosfera"
- turn off the supply pressure
- switch the manifolds at position "Zamknięty"

9.4. Disassembly

In case of disassembly the regulator one should be done:

- make all thinks mentioned in point no. 9.3.
- turn off measuring instruments and protect them before pollution
- loos screws fixing the regulator
- protect connectors (connector and holes) before getting in the pollutions inside the device
- when the regulator is disassembled it should be stored acc. to requirements described in point 7 of this documentation (UNPACKING AND STORAGE INSTRUCTION)

10. CONSERVATION

The leak-proofness of measuring tubes and turned places should be done sometimes during operation of small-flows regulator. Any founded defects should be immediately removed.

Periodical checking of filtering devices which are in supply line of small-flows regulator has to be made to assure proper cleanness of measuring medium.

11. DAMAGES AND REPAIRS

11.1. Cleaning of measuring tubes

The regulator has to be disconnected from the circuit. Carefully blow up the measuring tubes by compressed air. Turn on tubes and check the leakproofness of connections.

11.2. Damages elimination

Damage	Cause of damage	Elimination method
The requested flow's value can't be set	The membrane is damaged or it is leaky.	Change the membrane
	The control or needle valve is polluted.	Clean valves.
The float of flow's indicator is blocked	Tube or ducts, by which working medium flows inside the regulator, are polluted.	Clean
The regulator doesn't keep constant flow's value at changing output	The ring sealing the seat of sealing valve is damaged.	Change the sealing ring.

12. SCOPE OF DELIVERY

- small-flows regulator with requested spare parts
- Technical Product Documentation
- Commissioning Certificate
- Package

ATTENTION: All repairs should be performed by producer or authorized service company. In case of repairs performed by unauthorized persons producer bears no responsibility for safety and proper product operation.

CONTROLMATICA ZAP-PNEFAL Sp. z o.o.
ul. Krotoszynska 35; PL-63-400 Ostrow Wlkp., Poland
tel.: +48627372250, fax: +48627372724, controlmatica@controlmatica.com.pl
www.controlmatica.com.pl