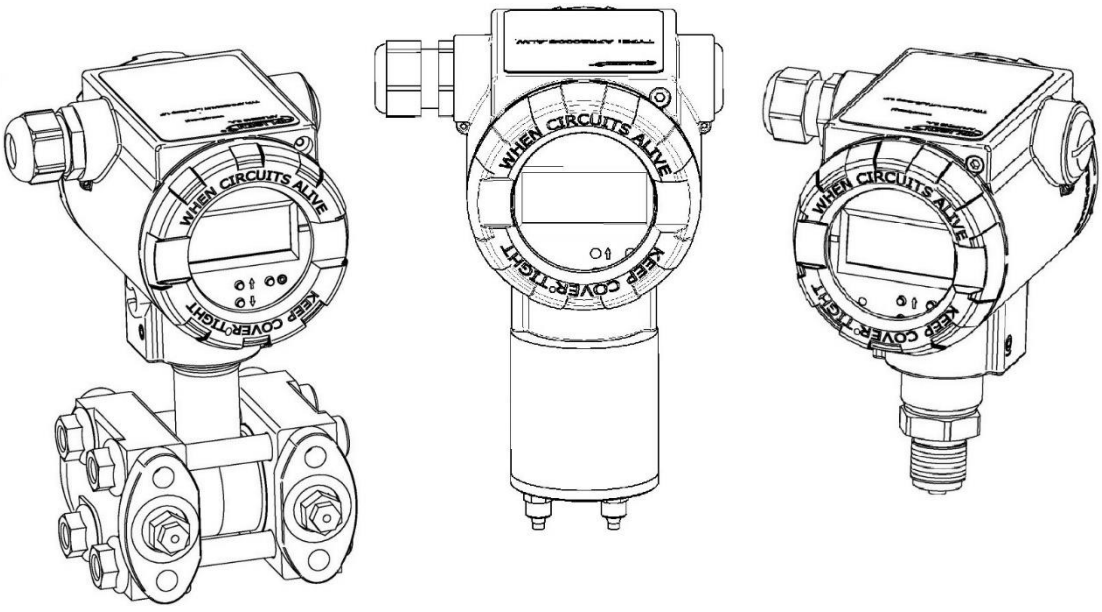
TECHNICAL INFORMATION

PRESSURE AND DIFFERENTIAL PRESSURE TRANSMITTERS

APC-2000ALW, APR-2000ALW, APR-2000ALW/G, APR-2000ALW with diaphragm seals



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www.aplisens.com, e-mail: export@aplisens.com

The QR code enables to identify a product and quickly access the user documentation.

APC-2000ALW

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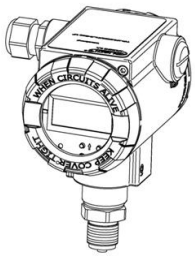

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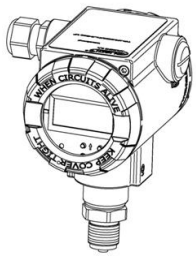

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(For sea uses)

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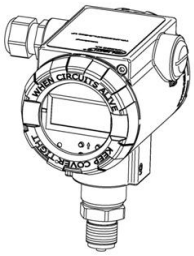

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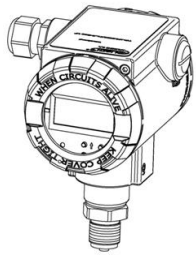

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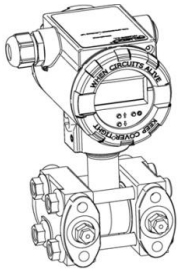

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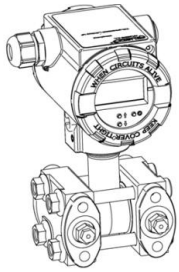

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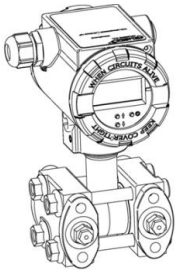

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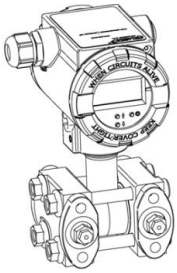

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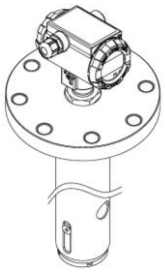

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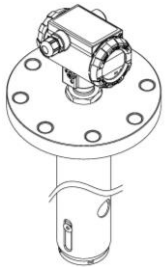

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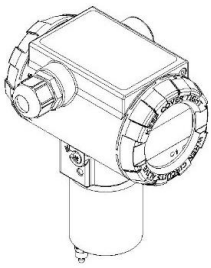

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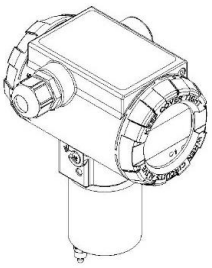

APR-2000ALW

with diaphragm seals

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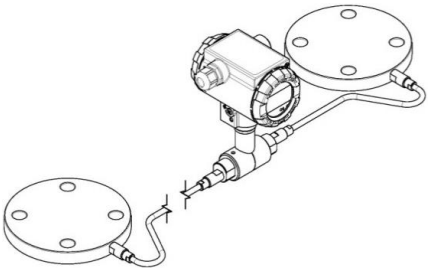

APR-2000ALW (Exi)

with diaphragm seals

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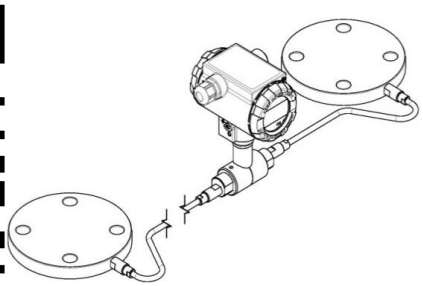


Table of contents

List of drawings

List of tables

1. Document information

1.1. Purpose of the document

The purpose of the Technical Information is to provide broader knowledge of the design, application, installation and parameterisation of pressure and differential pressure transmitters. All versions of the transmitters with the ID numbers listed on pages 2–3 of this document shall continue to appear under the common name APC(R)-2000ALW, unless it is intentional to distinguish the specific characteristics of a given type.

1.2. Symbols used

Symbol	Description
	Warning to proceed strictly in accordance with the information contained in the documentation in order to ensure the safety and full functionality of the device.
	Information particularly useful during installation and operation of the device.
	Information particularly useful during installation and operation of an Ex type device.

Table 1. Symbols used.

1.3. Trademarks

HART® is a registered trademark of FieldComm Group.
Windows® is a registered trademark of Microsoft Corporation.
Google Play® is a service registered and managed by Google® Inc.
Varivent® is a registered trademark of GEA Tuchenhagen Gmbh.
Tri-Clamp® is a registered trademark of Alfa Laval Corporate AB.
Teflon® is a registered trademark of E. I. du Pont de Nemours and Company.
Monel® is a registered trademark of Alloys International, Inc.
Hastelloy® is a registered trademark of Haynes International, Inc.

1.4. Definitions and abbreviations

APC(R)-2000ALW. Definitions and abbreviations.		
ITEM NO	Abbreviation	Meaning
1	**LRV**	"Lower Range Value" – the value of the set range expressed in physical units corresponding to the current of 4.000 mA, i.e. 0% of the output setpoint. The set range cannot exceed the set range limits. The minimum width of the set range **|(URV-LRV)|** is limited to 10% of the base range **(URL-LRL).**
2	**URV**	"Upper Range Value" — the value of the set range expressed in physical units corresponding to the current of 20.000 mA, i.e. 100% of the output setpoint. The set range cannot exceed the set range limits. The minimum width of the set range **|(URV-LRV)|** is limited to 10% of the base range **(URL-LRL).**
3	**LRL** **LSL**	"Lower Range Limit" or "Lower Sensor Limit" – lower limit of set range expressed in physical units. Value **(URL-LRL)** or **(USL-LSL)** is referred to as the base transmitter range. When the process value falls below the limit, status PV_UNDER_RLV in the Transducer Block will be set, which can be read out in the diagnostic tab via HART communication. If the transmitter operates with MID mode activated, message "undEr" will be shown on the display and diagnostic alarm mode will be enabled depending on the settings I_AL < 3.650 mA or I_AL > 21.500 mA.
4	**URL** **USL**	"Upper Range Limit" or "Upper Sensor Limit" – upper limit of set range expressed in physical units. Value **(URL-LRL)** or **(USL-LSL)** is referred to as the base transmitter range. When the process value exceeds the limit, status PV_OVER_RLV in the Transducer Block will be set, which can be read out in the diagnostic tab via HART communication. If the transmitter operates with MID mode activated, message "ovEr" will be shown on the display and diagnostic alarm mode will be enabled depending on the settings I_AL < 3.650 mA or I_AL > 21.500 mA.
5	**LPL**	"Lower Processing Limit" – lower limit of digital processing of measured value. The transmitter processes a digital measurement up to 50% of the base range width below the lower limit of set range **LRL (LSL).** After reaching the **LPL** and when below this value up to **LSAL**, the transmitter freezes the refreshing of digital value of the measurement. In this situation, message "UndEr" will be displayed on the display and diagnostic alarm mode will be activated depending on the settings I_AL < 3.650 mA or I_AL > 21.500 mA. Additionally, collective status PV_OUT_OF LIMITS and status PV_LOW_LIMITED in the Sensor Block will be set, which can be read out in the diagnostic tab via HART communication.
6	**UPL**	"Upper Processing Limit" – upper limit of digital processing of measured value. The transmitter processes a digital measurement up to 50% of the base range width above the upper limit of set range **URL (USL).** After reaching the **UPL** and when above this value up to **USAL**, the transmitter freezes the refreshing of digital value of the measurement. In this situation, message "OvEr" will be displayed on the display and diagnostic alarm mode will be activated depending on the settings I_AL< 3.650 mA or I_AL > 21.500 mA. Additionally, collective status PV_OUT_OF LIMITS and status PV_HIGH_LIMITED in the Sensor Block will be set, which can be read out in the diagnostic tab via HART communication.
7	**LSAL**	"Lower Saturation Limit" – lower limit of the A/D transmitter processing range. The lower limit of the A/D transmitter saturation is on the pressure/differential pressure scale below the **LPL** point and is associated with the minimum pressure, at which the analogue-digital pressure measurement transmitter reaches the lower limit of the processing capacity. The exact determination of this pressure is not possible, however usually the pressure does not exceed the pressure corresponding to 200% of the base range width **(URL-LRL)** below the lower limit of the digital processing of measured **LPL** value. After reaching **LSAL** and when below this value, error number E0256 will be displayed and the diagnostic alarm mode will be activated depending on the settings I_AL < 3.650 mA or I_AL > 21.500 mA. Additionally, collective status SENSOR_FAULT, PV_OUT_OF LIMITS and status NOREF+ERR@AIN1_AD7794 in the Sensor Block will be

		set, which can be read out in the diagnostic tab via HART communication.
8	**USAL**	"Upper Saturation Limit" – upper limit of the A/D transmitter processing range. The upper limit saturation point of A/D transmitter is on the pressure/differential pressure scale above the **UPL** point and is associated with the maximum pressure at which the analogue-digital pressure measurement transmitter reaches the upper limit of the processing capacity. The exact determination of this pressure is not possible, however usually the pressure does not exceed the pressure corresponding to 200% of the base range width **(URL-LRL)** above the upper limit of the digital processing of measured **UPL** value. After reaching **USAL** and when above this value, error number E0256 will be displayed and the diagnostic alarm mode will be activated depending on the settings I_AL < 3.650 mA or I_AL > 21.500 mA. Additionally, collective status SENSOR_FAULT, PV_OUT_OF LIMITS and status NOREF+ERR@AIN1_AD7794 in the Sensor Block will be set, which can be read out in the diagnostic tab via HART communication.
9	**AL_L**	Low current alarm (I < 3.650 mA).
10	**AL_H**	High current alarm (I > 21.500 mA).
11	**MSV**	"Minimum Span Value" – a value of the minimum set range width **[URV - LRV]** that possible to be set in the transmitter. This value is entered into the transmitter at the manufacturing stage and cannot be changed by the user. It is used to limit the application of the scaling of the **MSF** set range.
12	**MSF**	"Minimum Span Factor" – scaling coefficient of set range. Specifies the ratio of the base range to the minimum set range that can be set in the transmitter. This coefficient is usually x 10. The parameter defining the minimum set range width can be read-out using HART communications.
13	**FSO**	"Full Scale Output" – this term refers to full scale of setpoints (range of setpoints). For setpoints expressed as percentage values, it corresponds to 100% of the range value.
14	**ADC**	"Analog to Digital Converter", an analog-digital transmitter used to change the analog value of voltage or current to a digital value.
15	**DAC**	"Digital to Analog Converter", a digital-analog transmitter used to change the digital value to an analog value of voltage or current.
16	**LCD1, LCD2, LCD3**	LCD information fields. The exact description is included in (➔13.2.1).
17	**I_AL**	Alarm current. For non-critical safe diagnosable failures, the diagnostic alarm current, depending on the settings, is: I_AL < 3.650 mA (rated 3.600 mA) or I_AL > 21.500 mA (rated 22.000 mA). For critical safe diagnosable failures, the diagnostic alarm current, depending on the settings, is: I_AL << 3.650 mA (rated 0.150 mA). For safe non-diagnosed failures, the assumed alarm current value may be I_AL < 3.650 mA or I_AL > 21.500 mA.
18	**PV** **SV** **TV** **FV**	First process variable (pressure or differential pressure). Second process variable (pressure sensor temperature). Third process variable (temperature of main CPU microcontroller). Fourth process variable (ADC transmitter temperature).

Table 2. Definitions and abbreviations.

2. Selection of transmitter version depending on application

2.1. Principle of pressure and differential pressure measurement

The measurement principle is based on the measurement of the output voltage from the piezoelectric bridge proportional to the process pressure acting on the sensor diaphragm. The external pressure is fed through the flexible diaphragm of the sensor and the gauge fluid filling the sensor to the piezoresistive diaphragm of the measuring bridge, causing its deflection and changing the resistance of the bridge piezoresistors. Depending on the purpose, the measuring sensor may be installed in simple pressure heads or in more complex differential pressure heads. Additionally, pressure or differential pressure heads may be equipped with hydraulic separators. The electrical signal from the pressure sensor is transmitted to the ADC analog-digital transmitter where it is converted to a digital value. The digital value of the measurement signal with diagnostic measurements and the temperature measurement of the structure and the ADC transmitter via an optoelectrical galvanic barrier is transmitted to the main CPU microcontroller that manages the calculations and control of the transmitter modules. Here the analysis of the correctness of measurements, normalization of measurements to physical pressure values, compensation of temperature impacts on measurements, conversion of units, conversion of the characteristics and output setpoint ranges are performed depending on the client's settings. As a result, the standardized, calibrated and configured measurement controls the output current controller 4 ... 20 mA, ensuring that a user will obtain a precise and stable read-out of the measured input value of the process variable.

2.2. Selection of the transmitter version

Transmitter APC(R)-2000ALW is manufactured in standard version and in an intrinsically safe Exi version.
The following versions are available:

- low pressure measurement with an ultra-stable HS header;
- measurement of medium and high pressures;
- measurement of low pressure differences with the ultra-stable HS head;
- measurement of medium and high differential pressure.

The transmitters are available with several types of process connections and various versions of separators. The list of parameters is presented in the table below.

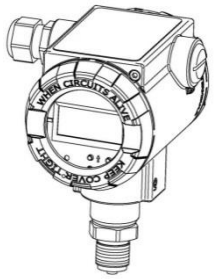
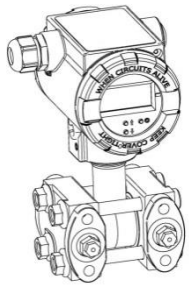
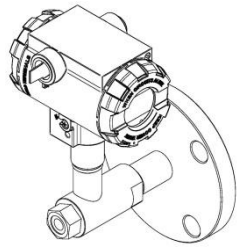
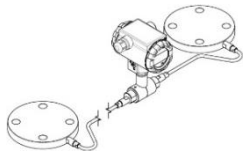
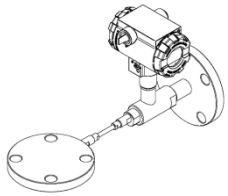
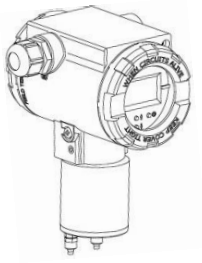
Smart transmitters						
	Pressure	**Differential pressure**				
	APC-2000ALW	**APR-2000ALW**		**APR-2000ALW with diaphragm seals**		**APR-2000ALW/G**
Version						
Application in measurements	- Level measurement - Pressure measurement - Negative pressure measurement - Absolute pressure measurement	- Level measurement - Differential pressure measurement - Flow measurement	- Level measurement	- Level measurement in closed tanks - Density measurement - Phase limit measurement - Differential pressure measurement	- Level measurement - Density measurement - Phase limit measurement - Differential pressure measurement (at varied height of pulse collection points)	- Pressure measurement - Negative pressure measurement - Differential pressure measurement
Housing	**Standard version:** - high pressure aluminium alloy casting, varnished or acid resistant steel 1.4401 (316)					
	Special version (Exi): - high pressure aluminium alloy casting, varnished or acid resistant steel 1.4401 (316)					

Table 3. Transmitter versions, used in measurements.

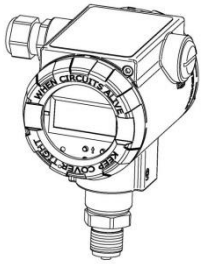
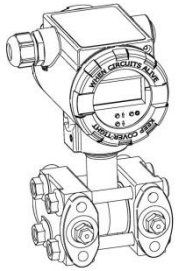
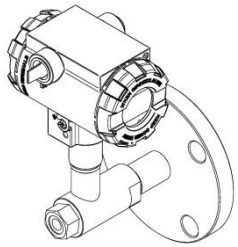
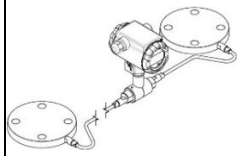
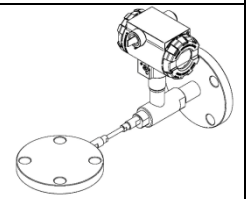
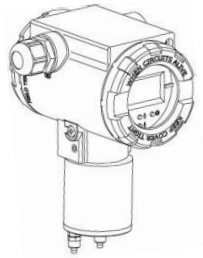
	APC-2000ALW	APR-2000ALW	APR-2000ALW	APR-2000ALW with diaphragm seals		APR-2000ALW/G
						
Process connections	- **M** (M20x1.5, Ø4) - **P** (M20x1.5, Ø12) - **1/2NPT**(ext. 1/2" NPT, inner G1/4") - **G1/2** (G1/2, Ø4) - **GP** (G1/2, Ø12) - **CM30x2**(M30x2) - **CG1**(G1") - **G1/4** (G1/4" Ø4) - **CG1/2**(G1/2") - **RM**(M20x1.5 Ø4) - **RG** radiator with G1/2 stub Specification of process connections for APC-2000ALW	- **P**(M20x1.5, Ø9) - **C** - **CR** Specification of process connections for APR-2000ALW	**For APR-2000ALW:** - **1/4 NPT** (for impulse tube welding) **For APC(R)-2000ALW:** - Flanged flat **S-P** - Flanged tubular **S-T** - Separator **S-TK-P** with built-in diaphragm flushing unit - Chemical resistant flanged **S-Ch** - Compact **S-Comp** - Compact distance separators **S-Comp10MPa, S-Comp25MPa, S-Comp60MPa** - Compact chemical resistant **S-CompCh** - **Hygiene** - **S-Mazut** - **S-RC**	**For APR-2000ALW with diaphragm seals:** - Flanged flat **S-P** - Flanged tubular **S-T** - Separator **S-TK-P** with built-in diaphragm flushing unit - Chemical resistant flanged **S-Ch** - Compact **S-Comp** - Compact distance separators **S-Comp10MPa, S-Comp25MPa, S-Comp60MPa** - Compact chemical resistant **S-CompCh** - **Hygiene** - **S-Mazut** - **S-RC**		- **PCV** (stubs with clamping end for Ø6 tube) - **P** (M20 x 1.5) - **GP** (G1/2" Ø12) - **Block valve adapter** (1/4NPT) Process connections for measuring low gas pressure
			Separators and their application			

Table 4. Transmitter versions, process connections.

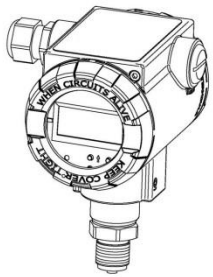
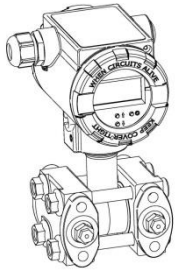
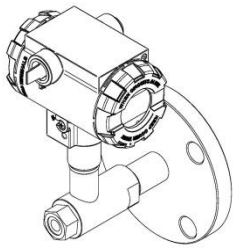
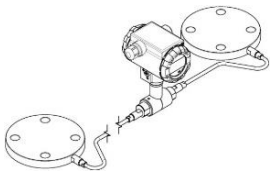
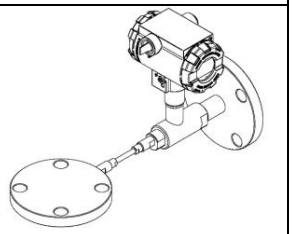
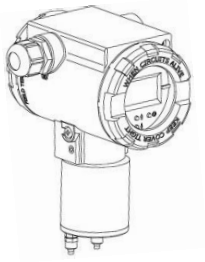
	APC-2000ALW	APR-2000ALW	APR-2000ALW	APR-2000ALW with diaphragm seals		APR-2000ALW/G
						
Measuring ranges [1]	**-100 kPa to 100 MPa**	**-50 kPa to 7 MPa Static pressure up to 41.3 MPa**	**According to the relevant separator data sheet[2].**	**-160 kPa to 1600 kPa**		**-10 kPa to 10 kPa Static pressure up to 100 kPa**
Overload*	**Up to 120 MPa**	With type **C** connection: **25 MPa** – standard version. **41.3 MPa** – special version. With type **P** connection: **7 MPa**	According to the relevant separator data sheet[2].			Overload depending on the measurement range and the head used.
Operating temperature (Ambient temperature)	**-40°C … 85°C (standard version) -40°C … 80°C (Exi version)**	**-25°C … 85°C (standard version) -25°C … 80°C (Exi version)**	**-25°C … 85°C (standard version) -25°C … 80°C (Exi version)**			**-25°C … 85°C (standard version) -25°C … 80°C (Exi version)**
Measurement error [5]	Basic error **0.05%... 0.1%**	Basic error **≤ ±0.075%**	Basic error ≤ **±0.1%** **Please note!** Measurement errors depending on the effect of separation			Basic error from **±0.075% to ±1,6%** **Please note!** Measurement errors depending on the measurement range.

Table 5. Transmitter versions, measurement ranges, overload, operating temperature, measurement error.

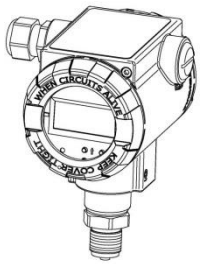
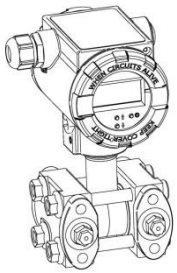
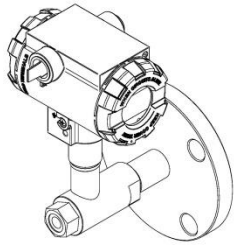
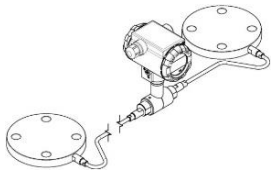
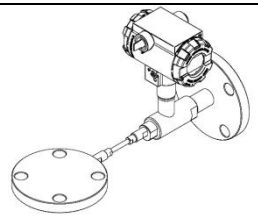
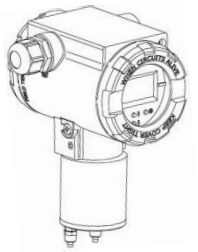
	APC-2000ALW	APR-2000ALW	APR-2000ALW	APR-2000ALW with diaphragm seals		APR-2000ALW/G
						
Power supply voltage	For **standard** version: **10.0 V – 55 V DC** For **Exi** version: **10.5 V – 30 V DC** Transmitters are manufactured with LCD backlight.					
Output	**4 … 20 mA** with HART protocol					
Options [4]	• **KAL** – factory calibration certificate; • **WZ** — calibration certificate issued by Accredited Laboratory; • **AU** – gold-plated diaphragm; • **2.1, 3.1** – material certificate acc. to PN-EN10204: 2006 (wetted parts); • **NACE** – material certificate NACE MR0175/ISO 15156 (wetted parts); • **PZH** – Certificate of the National Institute of Hygiene; • **TH** – hydrostatic test; • filling with edible oil, silicone oil, chemically neutral liquid for oxygen measurement versions and clean gases.					
Special versions	• **IP67** — housing protection rating — special version; • **MR** – version for marine applications; • **Hastelloy** – diaphragm made of Hastelloy C 276 (not for HS version;) • **Oxygen** – transmitter adapted for measurement of oxygen and pure gases[3]; • **SS** – housing made of steel 316 (stainless steel – maximum vibrations up to 1g); • **HS** — Ultra stable measuring element; • **Other** – to be agreed with Aplisens consultants.					

Table 6. Transmitter versions, supply voltages, output, options, special versions.

***** Limit value of the device pressure depends on the measuring system component with the lowest rated pressure.

[1] Measurement ranges of pressure and differential pressure transmitters and transmitters with the connection for low gas pressure measurement are shown in:
➔ **Table 14**, ➔ **Table 15**, ➔ **Table 16**, ➔ **Table 17** of Technical Information.

[2] Scope of applicability according to the relevant separator data sheet. The data are included in section (➔ **Separators and their application**).

[3] For selected ranges.

[4] Special versions with regard to separators according to the relevant separator data sheet.

[5] Measurement error depending on the measurement range.

[6] Range of storage temperatue and operating temperature is depends on the measuring system components see ➔ **Table 23,** ➔ **Table 24.**

2.3. Flow measurement, methods of mounting and mechanical connection of transmitters

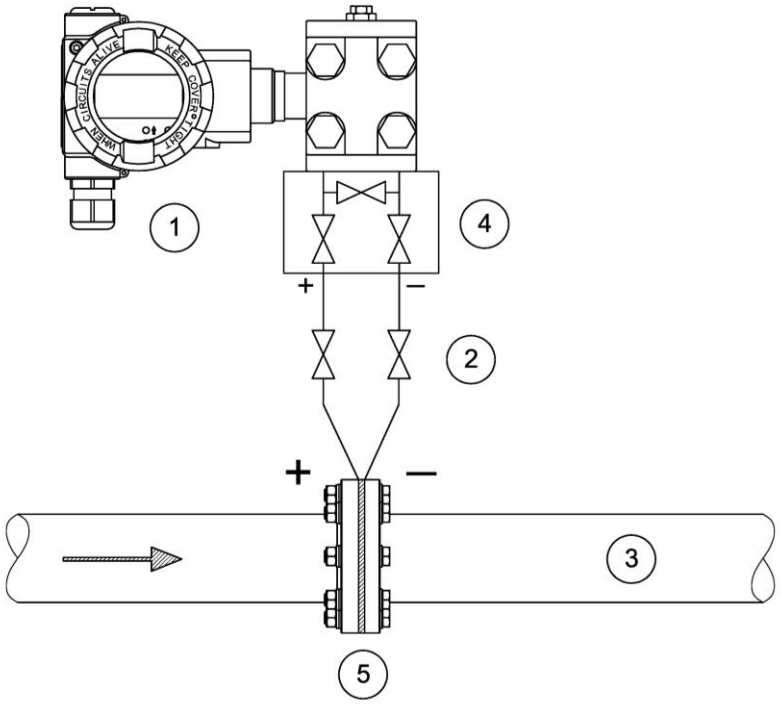
Transmitter APR-2000ALW enables to perform the measurement of gas, steam and liquid flow. In order to obtain the output current proportional to the flow, the transmitter should be set to the output setpoint root characteristics mode (➔ 4.4). The transmitter configuration allows for selection of one of 3 types of root characteristics. These characteristics differ from each other in the method of controlling the current output below the root dead band. The selection of characteristics is possible via HART communication and the corresponding software, e.g. Raport 2 manufactured by Aplisens S.A. or other using DD or DTM libraries.

In transmitters APR-2000ALW the following characteristics are available:

- second-stage root characteristics with relay characteristics and 0.2% hysteresis in the dead band (➔ 4.5);
- manufacturer's dual linear characteristics No 1 + second-stage root characteristics for constant dead band = 0.6% ... 0.8% of setpoints (➔ 4.6);
- manufacturer's single linear characteristics No 2 + second-stage root characteristics and 0.2% hysteresis in the dead band (➔ 4.7);
- square characteristics;
- special characteristics based on user-modified table.

2.3.1. Measurement of gas flow rate

Transmitter APR-2000ALW must be installed above the measuring point so that the condensate can flow from the capillaries to the process pipe.

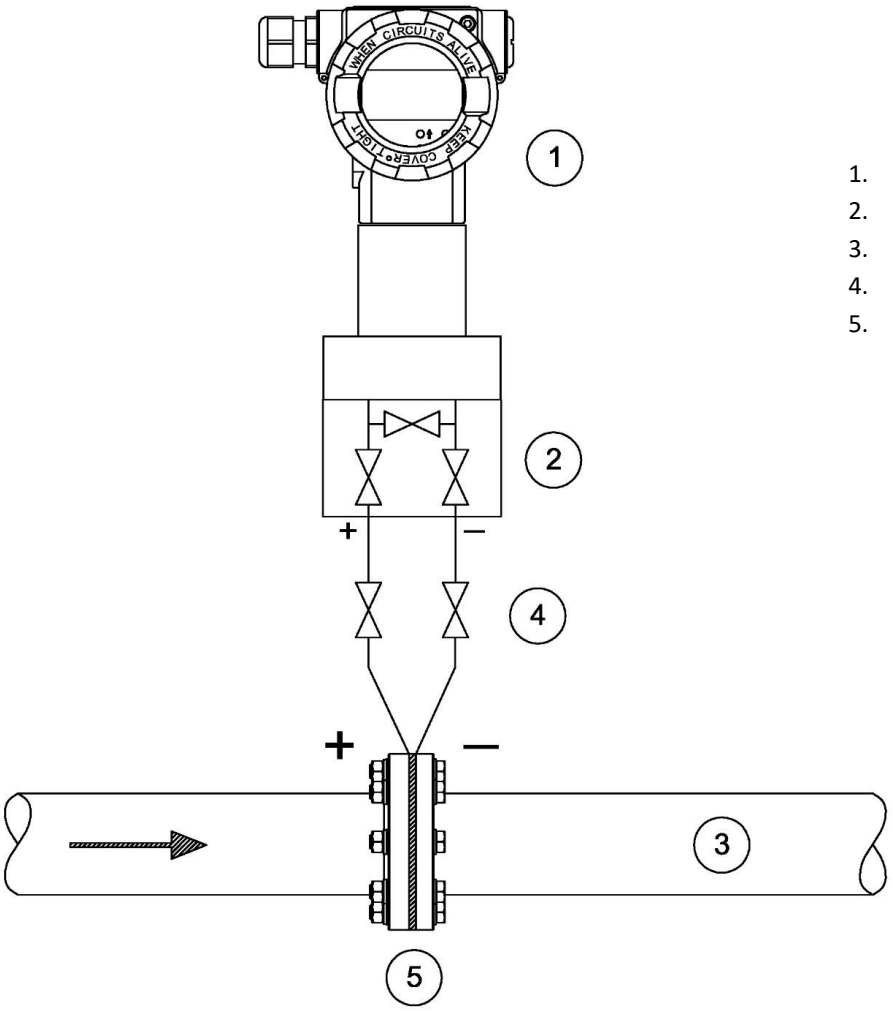


1. APR-2000ALW.
2. Shut-off valves.
3. Pipeline.
4. Three-way valve.
5. Orifice or Pitot tube.

Figure 1. Gas flow rate measurement system using APR-2000ALW.

Measurement of gas flow rate of low pressure

Transmitter APR-2000ALW/G must be installed above the measuring point so that the condensate can flow into the piping.

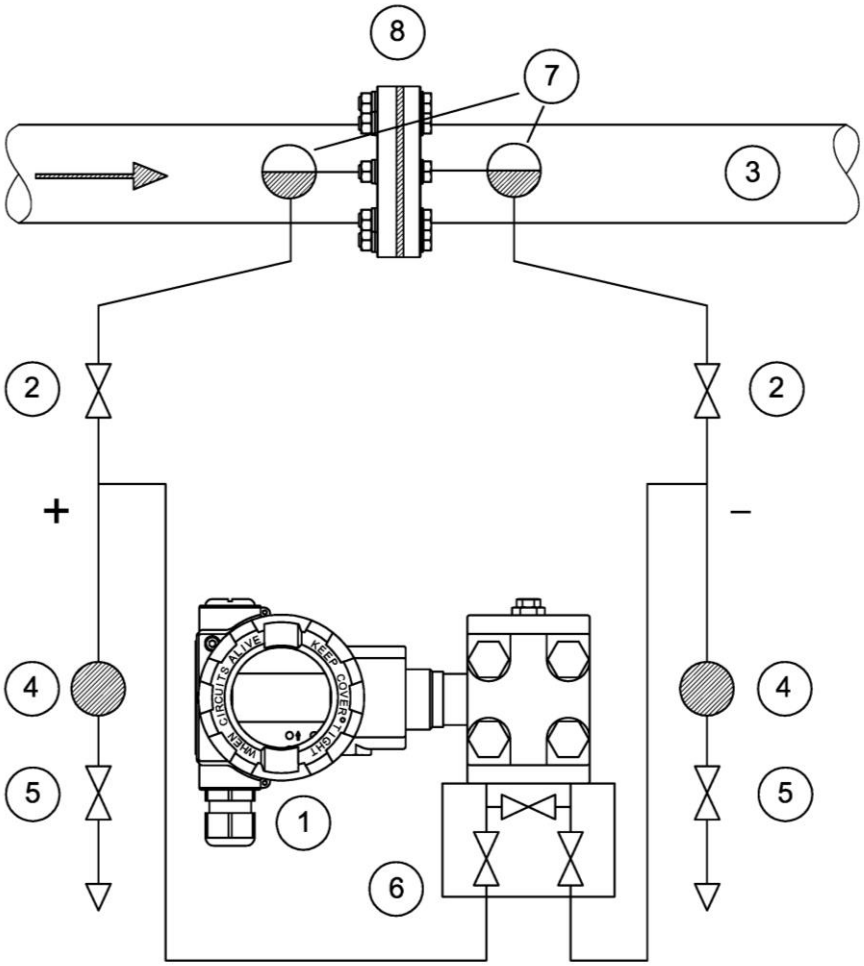


1. APR-2000ALW/G.
2. Three-way valve.
3. Pipeline.
4. Shut-off valve.
5. Orifice or Pitot tube.

Figure 2. Gas flow rate measurement system using APR-2000ALW/G.

2.3.2. **Measurement of steam flow rate**

Transmitter APR-2000ALW must be installed below the measuring point.
Traps (siphons) should be located at the same level as the sampling points and at the same distance from the transmitter.
Before turning the device on fill the impulse tubes up to the height of condensate traps.

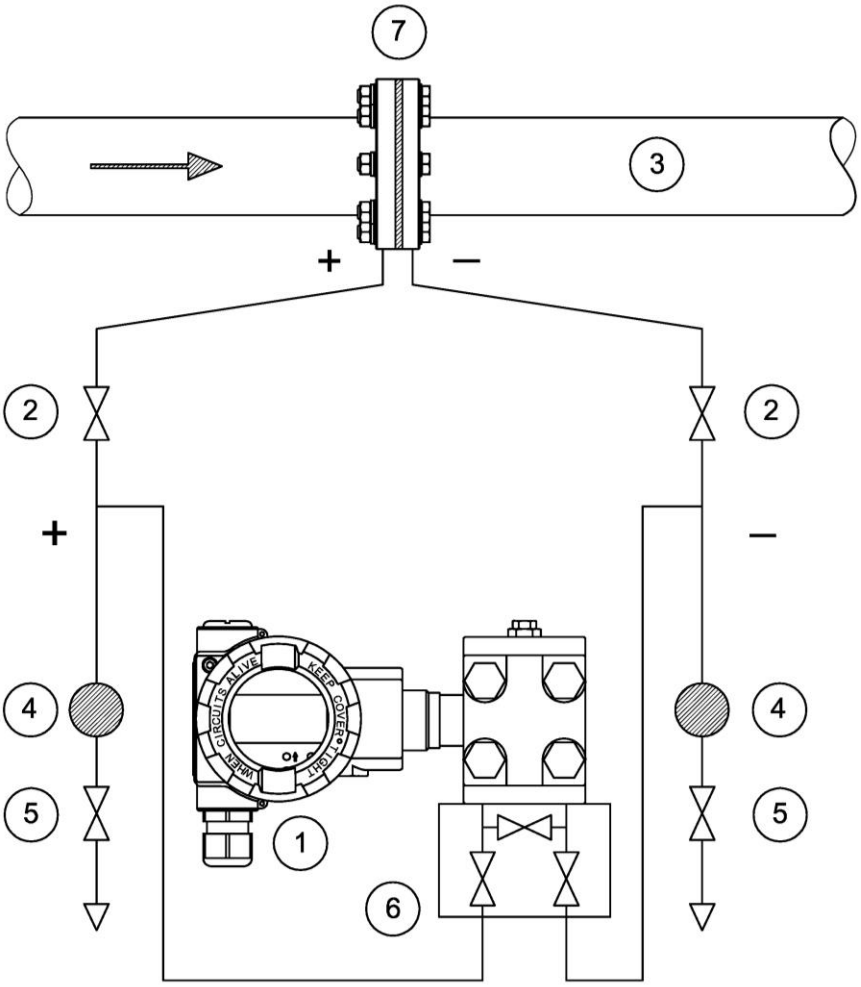


1. APR-2000ALW.
2. Shut-off valves.
3. Pipeline.
4. Separators.
5. Drain valves.
6. Three-way valve.
7. Traps (condensate traps).
8. Orifice or Pitot tube.

Figure 3. Steam flow rate measurement system using APR-2000ALW.

2.3.3. **Liquid flow measurement**

Transmitter APR-2000ALW must be mounted below the measuring point so that the impulse tubes are always filled with liquid and the gas bubbles can freely escape to the process pipe.
If the measured medium contains particles, it is useful to install separators and drain valves to remove deposits.



1. APR-2000ALW.
2. Shut-off valves.
3. Pipeline.
4. Separators.
5. Drain valves.
6. Three-way valve.
7. Orifice or Pitot tube.

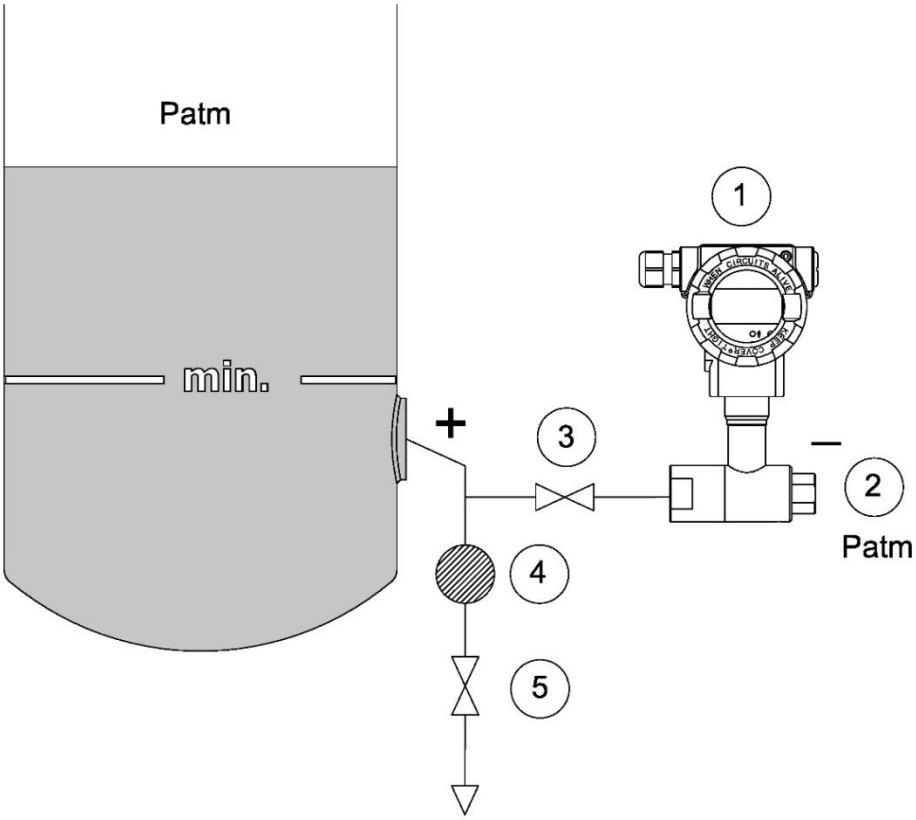
Figure 4. Liquid flow rate measurement system using APR-2000ALW.

2.4. Level measurement

Transmitter APC-2000ALW or APR-2000ALW enables to measure the level of liquids. In order to obtain the output current proportional to the liquid column, the transmitter should be set to the linear output setpoint characteristics mode (➔ 4.4). The transmitter configuration also enables to select a 21-point user characteristics and define the user's own unit and scaling the output setpoint. In this way, it is possible, for example, to measure the volume/weight of liquid in the tanks with irregular shapes.

2.4.1. **Liquid level measurement system in open tanks**

Transmitter APR-2000ALW must be mounted below the measuring point so that the impulse tubes are always filled with liquid.
The negative side of pressure connection is open to the atmosphere.
If the measured medium contains particles, it is useful to install separators and drain valves to remove deposits.

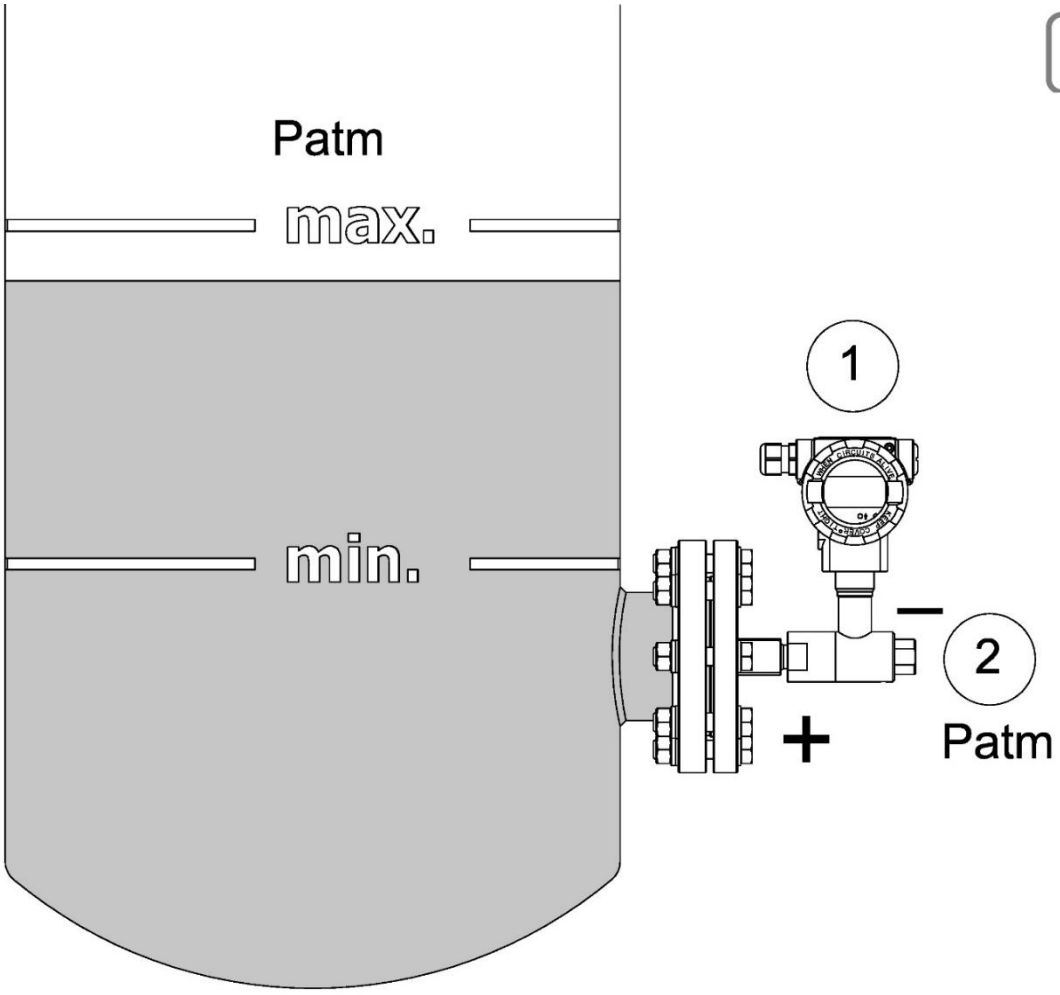


1. APR-2000ALW.
2. The negative side of pressure connection is open to atmosphere.
3. Shut-off valve.
4. Separators.
5. Drain valves.

Figure 5. System of liquid level measurement in open tanks using APR-2000ALW.

2.4.2. **Liquid level measurement system in open tanks with the use of direct separator and differential pressure transmitter APR-2000ALW**

Transmitter APR-2000ALW shall be mounted directly into the tank using an integrated separator always below the minimum liquid level.

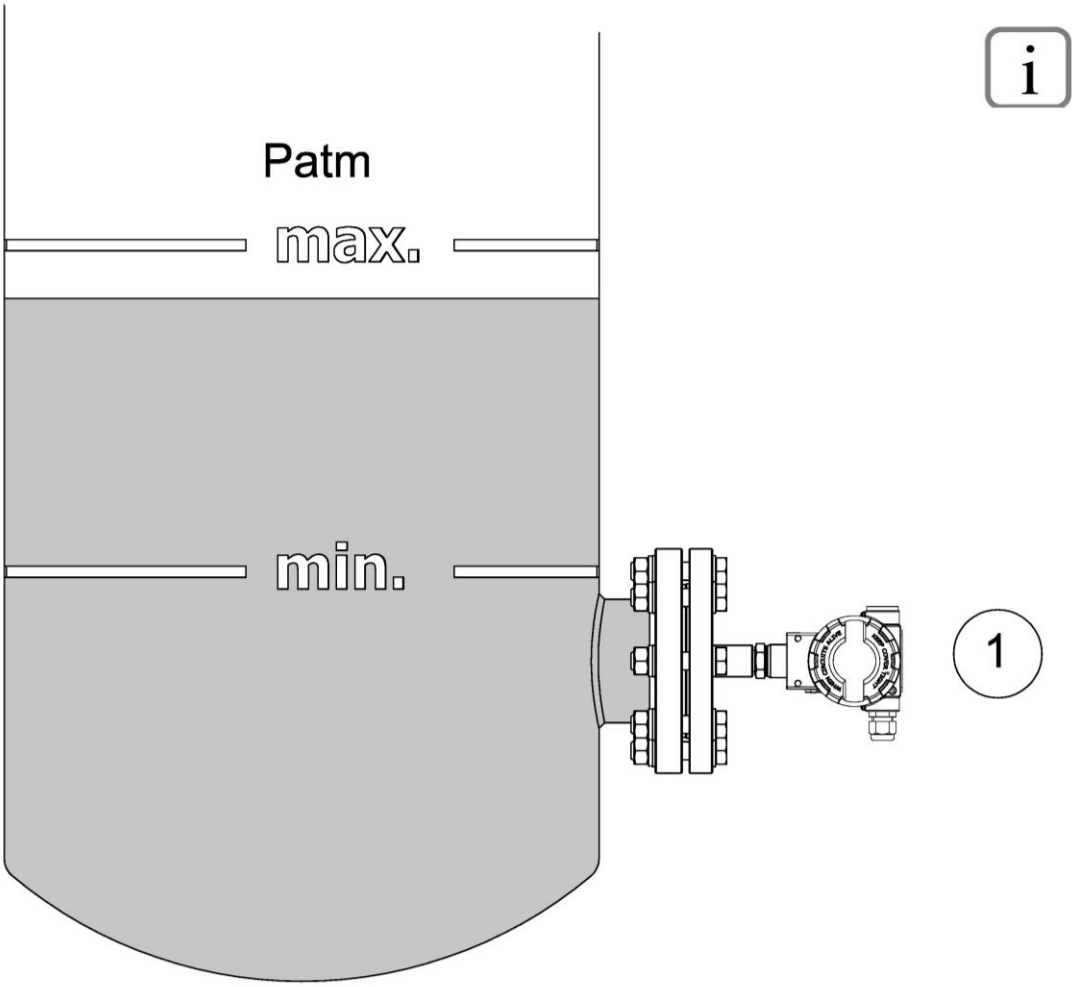


1. APR-2000ALW.
2. The negative side of pressure connection is open to the atmosphere.

Figure 6. Liquid level measurement system in open tanks using APR-2000ALW with direct separator.

2.4.3. **Liquid level measurement system in open tanks with the use of direct separator and pressure transmitter APC-2000ALW**

Transmitter APC-2000ALW shall be mounted directly into the tank using an integrated separator always below the minimum liquid level.

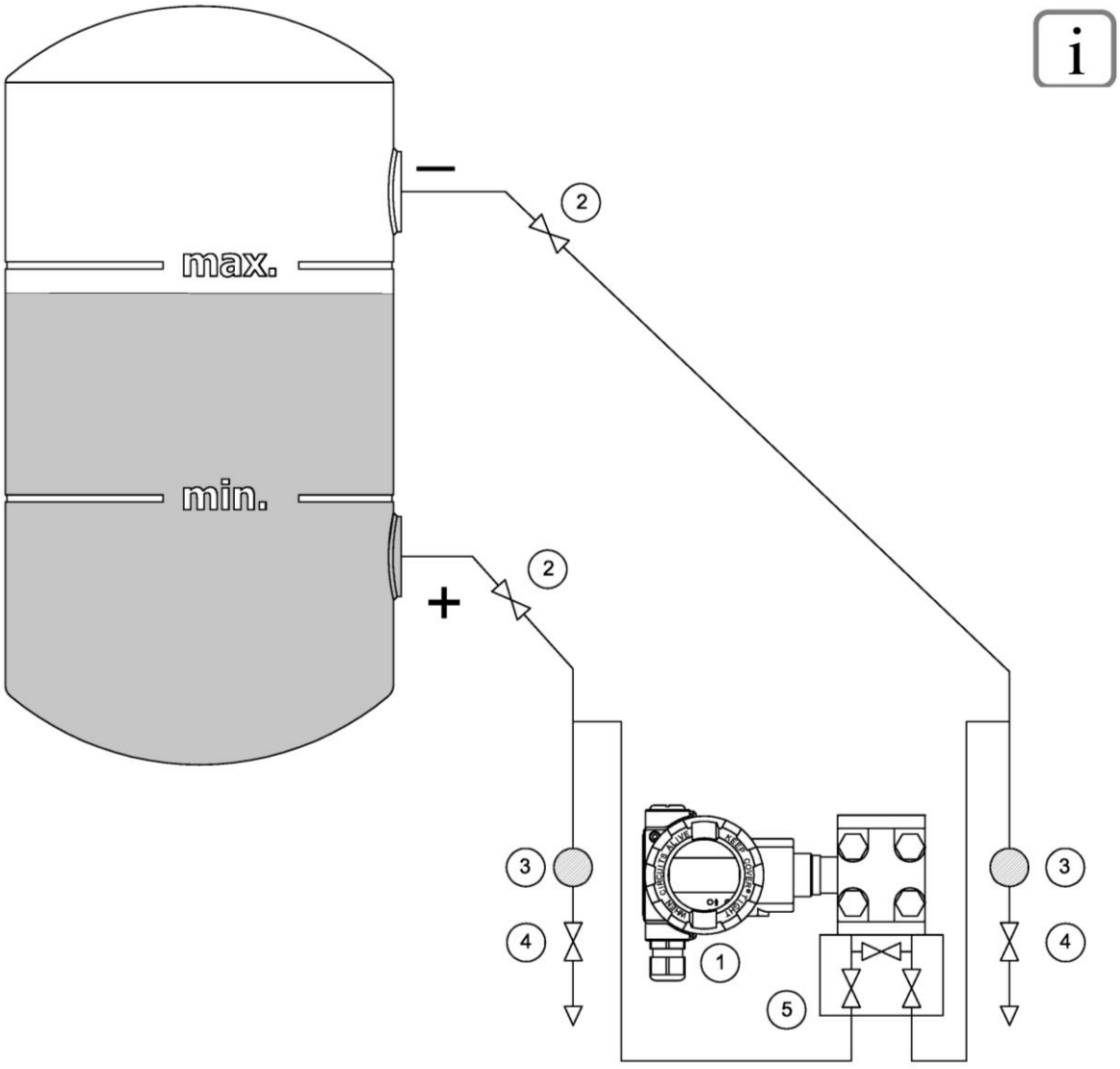


1. APC-2000ALW.

Figure 7. Liquid level measurement system in open tanks using APC-2000ALW with direct separator.

2.4.4. **Liquid level measurement system in closed tanks**

Transmitter APR-2000ALW must be mounted below the measuring point so that the impulse tubes are always filled with liquid.
The negative side of pressure connection must be connected through a capillary tube always above the maximum liquid level.
If the measured medium contains particles, it is useful to install separators and drain valves to remove deposits.

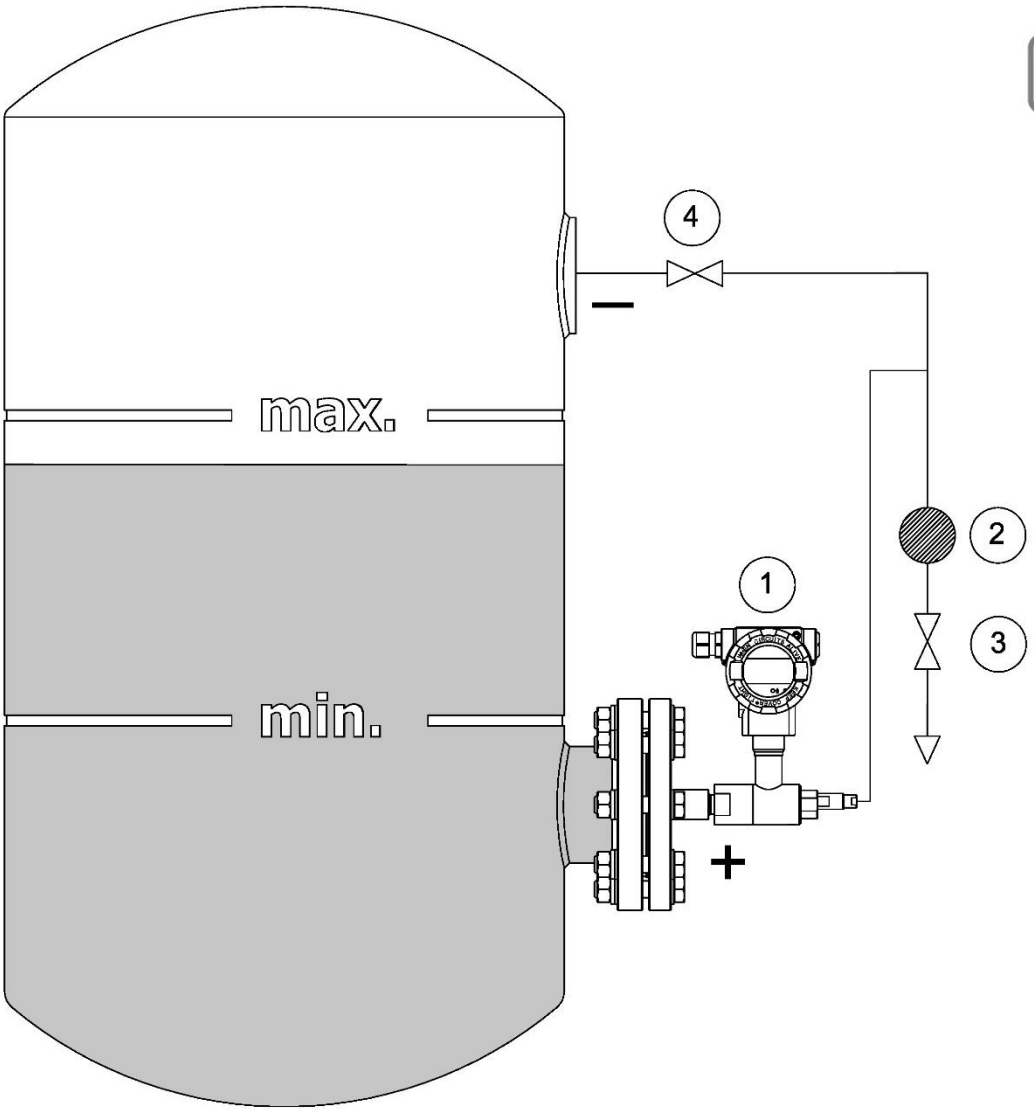


1. APR-2000ALW.
2. Shut-off valves.
3. Solids separators.
4. Drain valves.
5. Three-way valve.

Figure 8. Liquid level measurement system in closed tanks using APR-2000ALW.

2.4.5. **Liquid level measurement system in closed tanks with the use of direct separator**

Transmitter APR-2000ALW must be mounted directly into the tank using an integrated separator.
The negative side of pressure connection must be connected through a capillary tube always above the maximum liquid level.
If the measured medium contains particles, it is useful to install separators and drain valves to remove deposits.

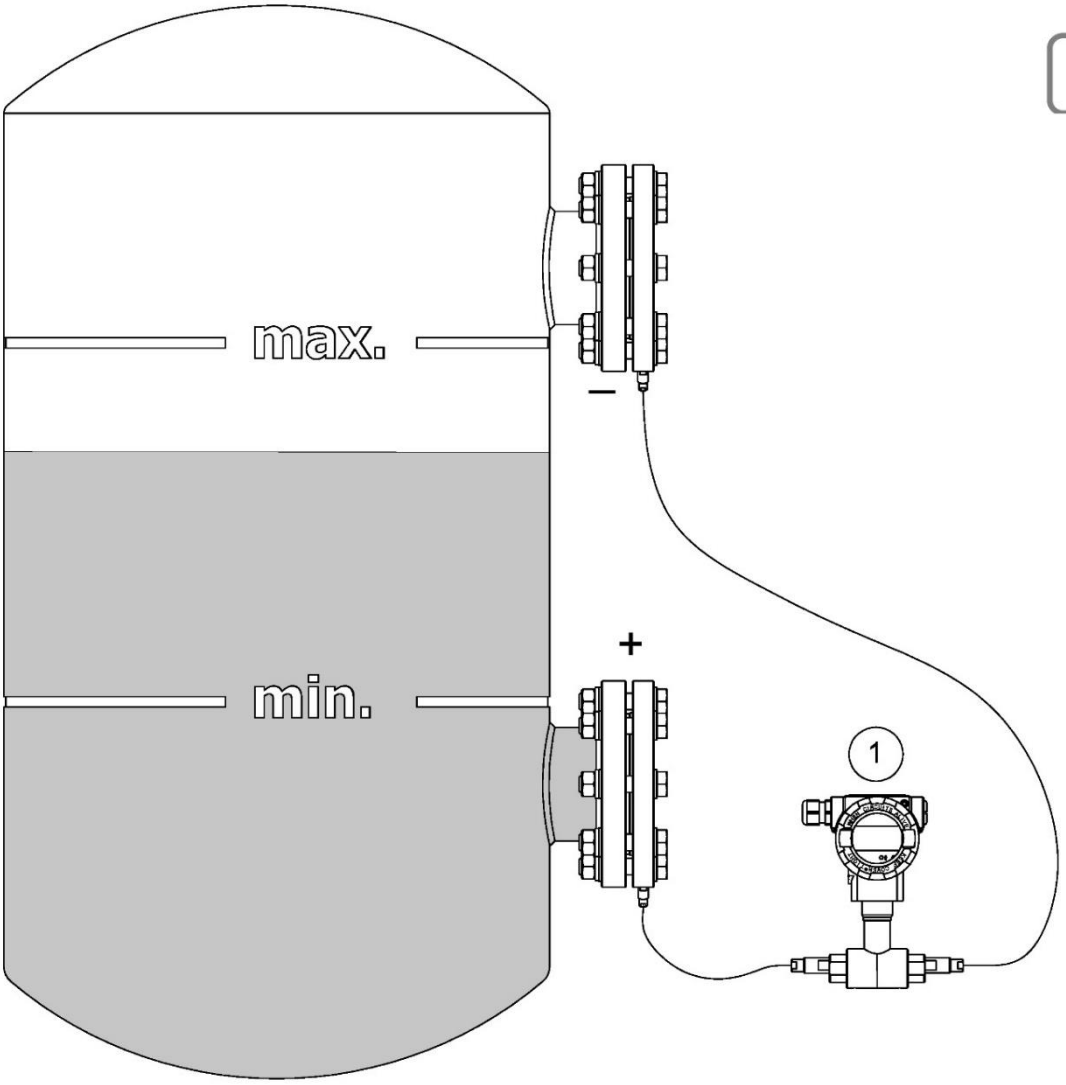


1. APR-2000ALW.
2. Solids separators.
3. Drain valve.
4. Shut-off valve.

Figure 9. Liquid level measurement in closed tanks using APR-2000ALW and direct separator.

2.4.6. **Liquid level measurement system in closed tanks with the use of distance separators**

Transmitter APR-2000ALW with diaphragm seals must be installed below the mounting points of distance separators. Approximate ambient temperature in both capillaries connecting the transmitter with separators must be ensured. The correct measurement is ensured only between the upper edge of the lower separator and the lower edge of the upper separator.

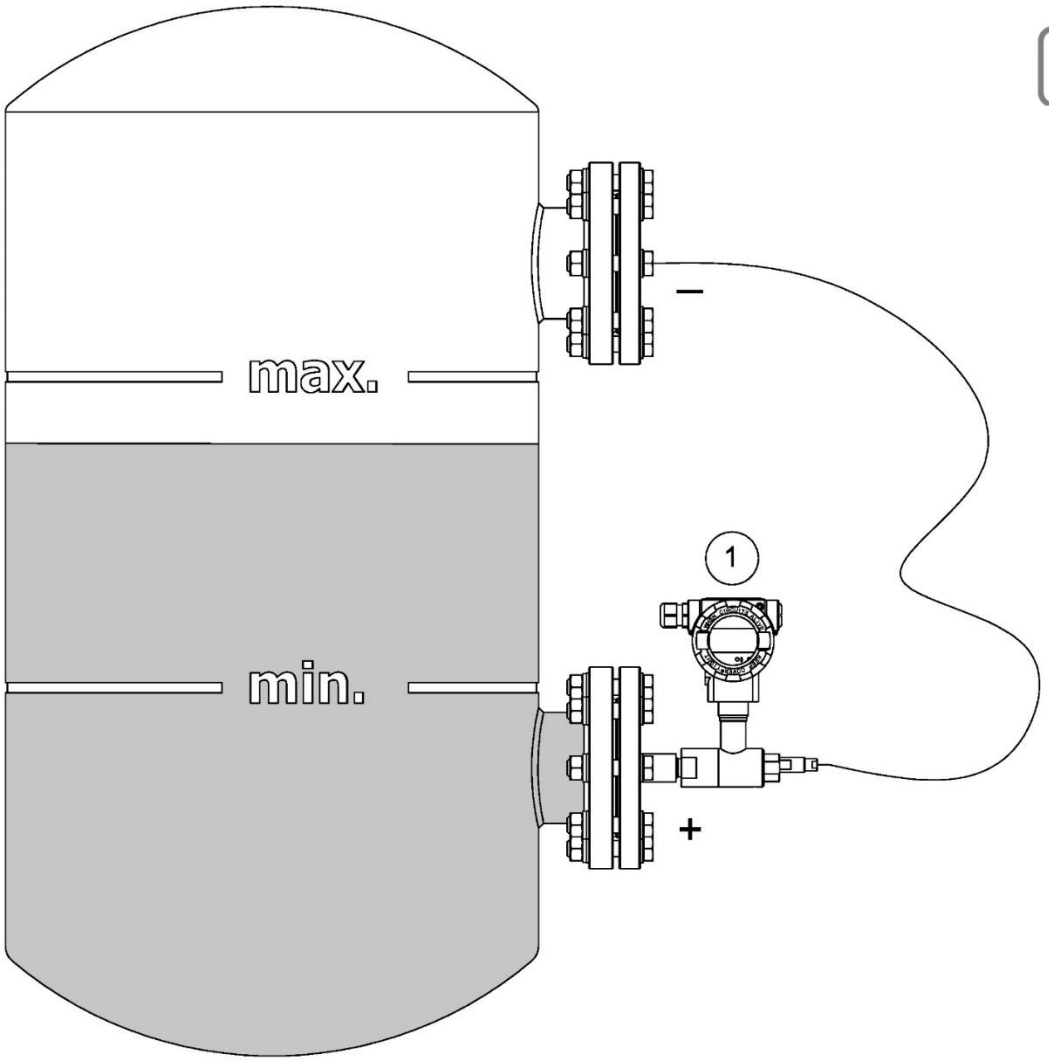


1. APR-2000ALW with distance separators.

Figure 10. Liquid level measurement in closed tanks using APR-2000ALW with distance separators.

2.4.7. **Liquid level measurement system in closed tanks with the use of direct and distance separator**

Transmitter APR-2000ALW with diaphragm seals must be mounted directly into the tank using an integrated separator.
The negative side of pressure connection must be connected through a distance separator always above the maximum liquid level.

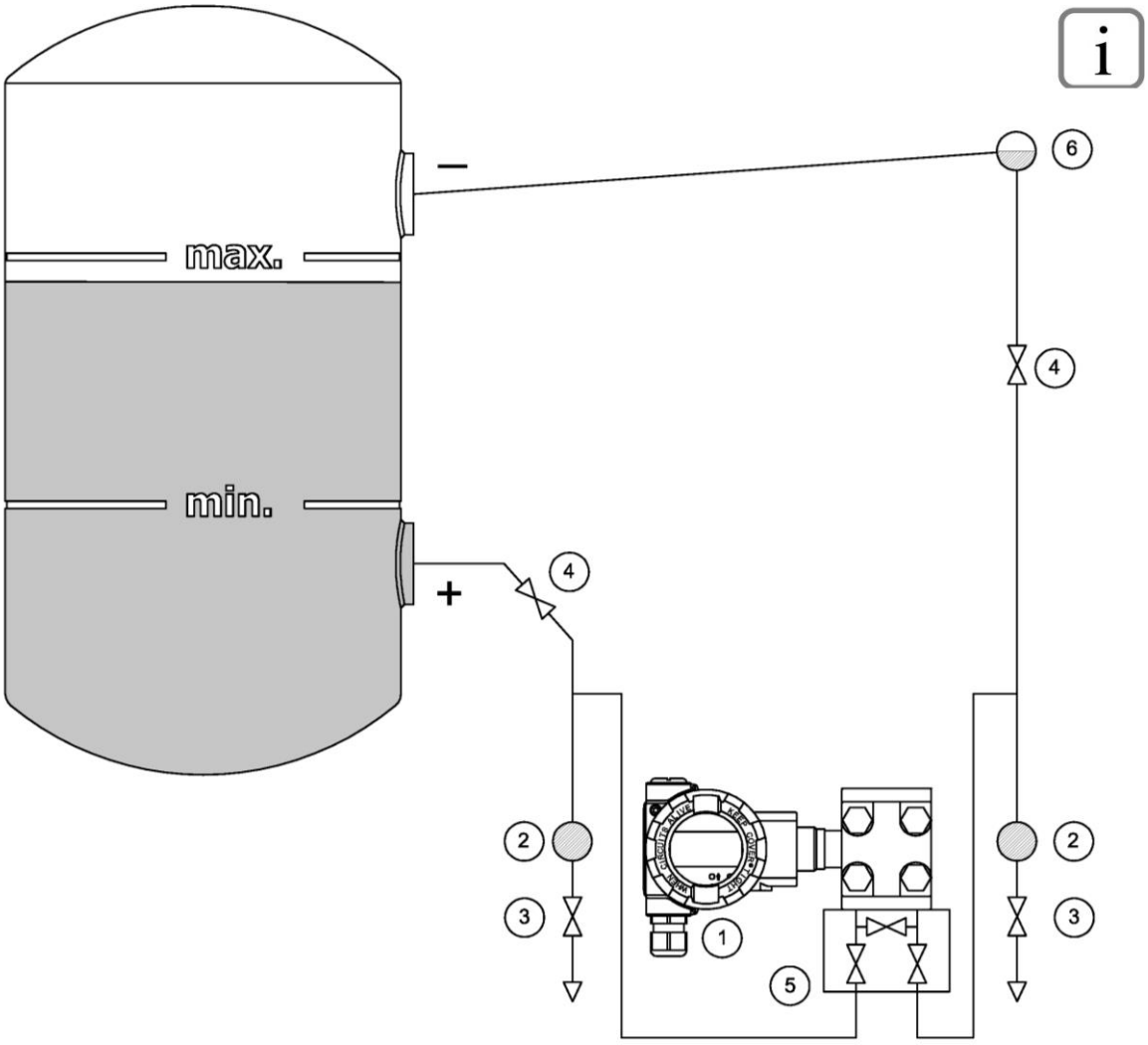


1. APR-2000ALW with direct and distance separators.

Figure 11. Liquid level measurement in closed tanks using APR-2000ALW with direct and distance separators.

2.4.8. **Liquid level measurement system in closed tanks with steam pillow**

Transmitter APR-2000ALW must be mounted below the measuring point so that the impulse tubes are always filled with liquid.
The negative side of pressure connection must be connected through a capillary tube always above the maximum liquid level.
If the measured medium contains particles, it is useful to install separators and drain valves to remove deposits.

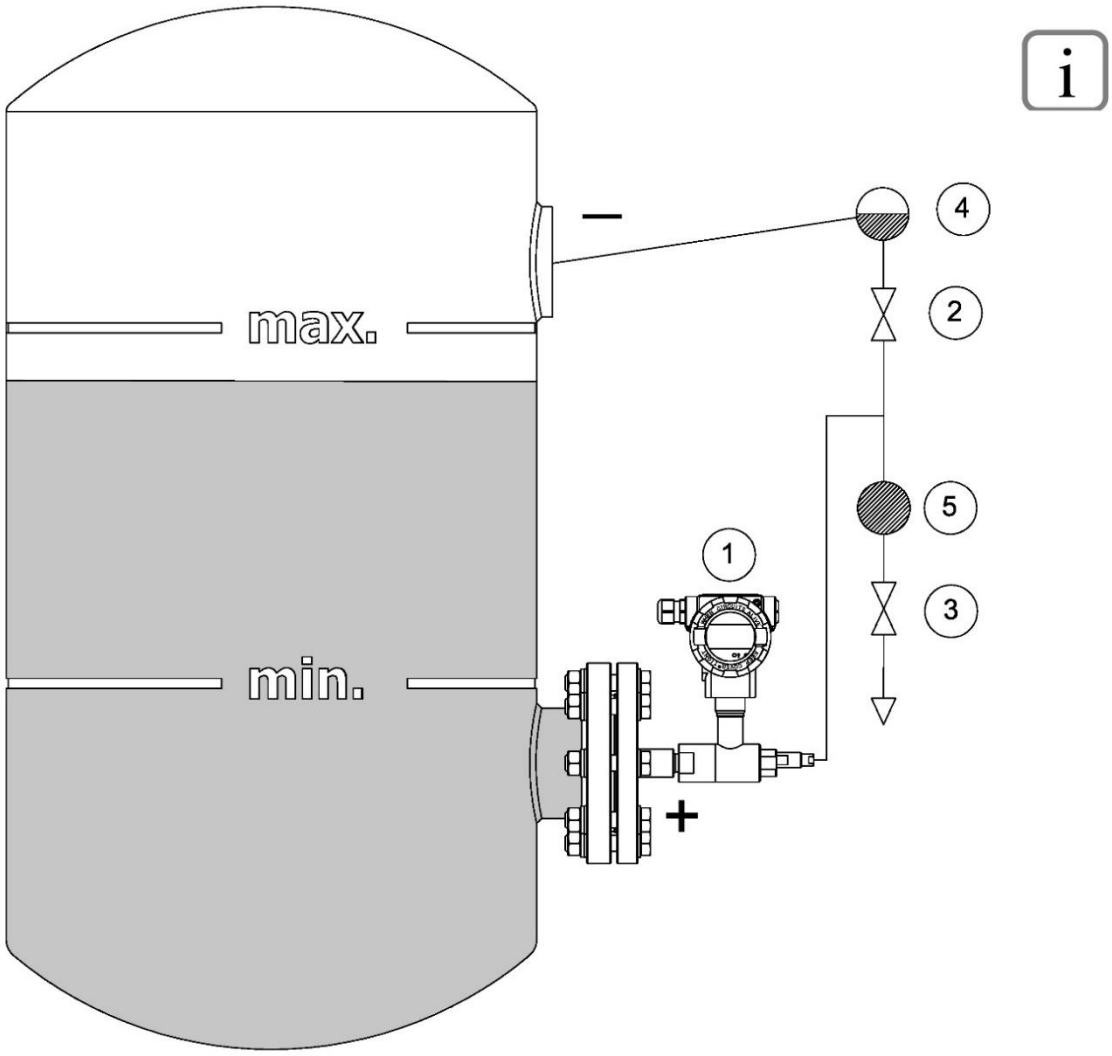


1. APR-2000ALW.
2. Solids separators.
3. Drain valves.
4. Shut-off valves.
5. Three-way valve.
6. Condensate trap.

Figure 12. Liquid level measurement system in closed tanks with steam cushion using APR-2000ALW.

2.4.9. **Liquid level measurement system in closed tanks with steam cushion with the use of direct separator**

Transmitter APR-2000ALW must be mounted directly into the tank using a direct separator.
The negative side of pressure connection must be connected through a capillary tube always above the maximum liquid level.
Condensate trap ensures constant pressure from the negative process pressure side.
When measuring medium contains solid particles, it is useful to install a separator and drain valve to remove deposits.



1. APR-2000ALW with direct separator.
2. Shut-off valve.
3. Drain valve.
4. Condensate trap.
5. Solids separator.

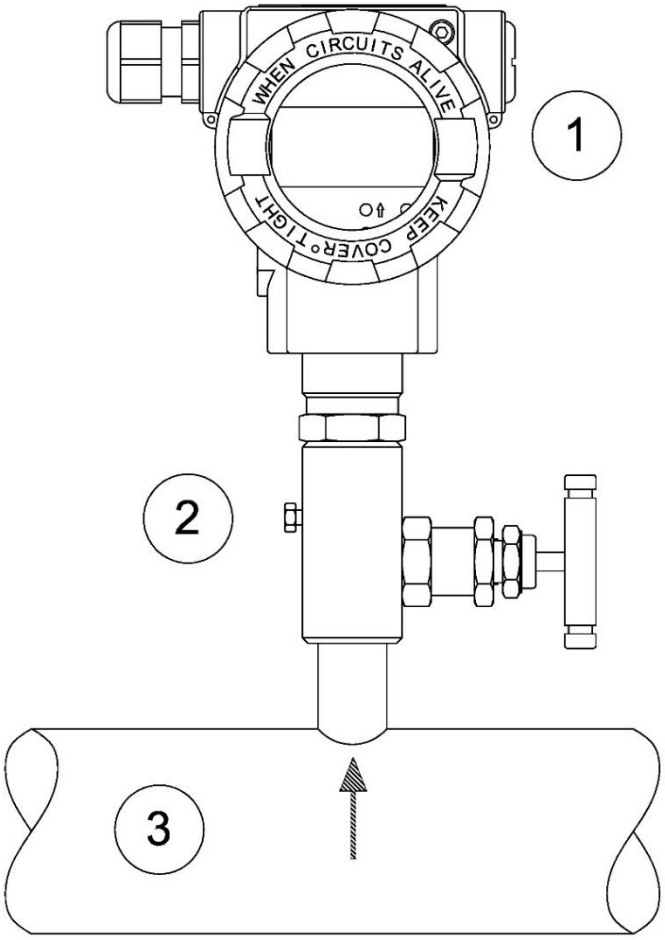
Figure 13. Liquid level measurement system in closed tanks with steam cushion using APR-2000ALW with direct separator.

2.5. Pressure measurement

Transmitter APC-2000ALW or APR-2000ALW enables to measure pressure. A range of process connections with separators and a large number of standard process ranges of the measured pressures are available. The transmitter configuration also allows for pressure presentation in many physical units (➔ 13.2.2) or the user's own units (➔ 13.2.6).

2.5.1. **Gas pressure measurement system**

Transmitter APC-2000ALW must be installed above the measuring point so that the condensate can flow into the piping.

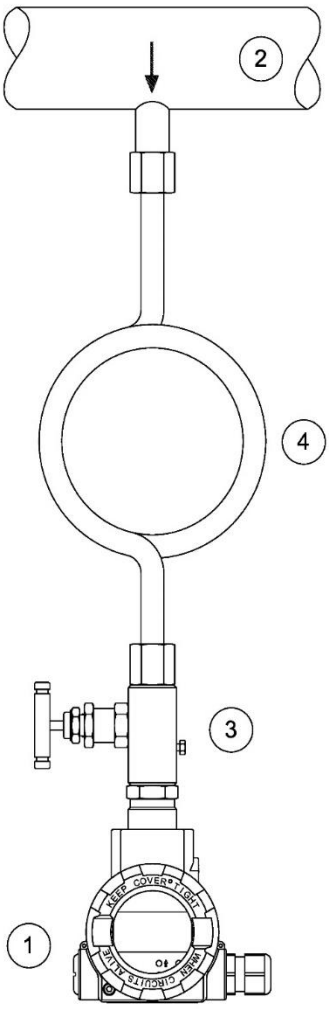


1. APC-2000ALW.
2. Pressure gauge valve.
3. Pipeline.

Figure 14. Gas pressure measurement system using APC-2000ALW.

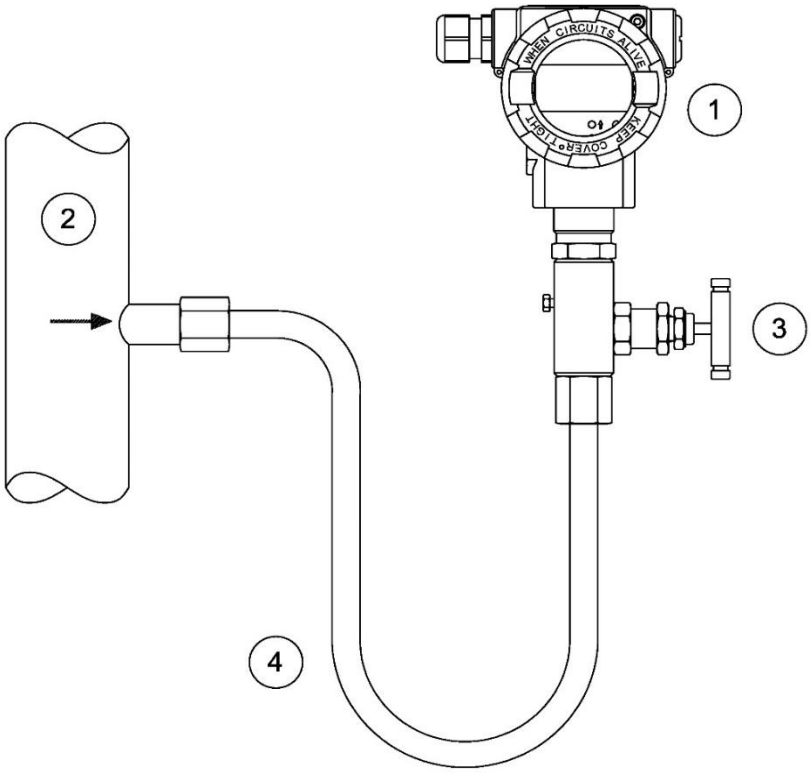
2.5.2. **Steam pressure measurement system**

Steam temperature reducing water-seal tubes should be used to measure the steam pressure.
Preferably transmitter APC-2000ALW should be installed below the measuring point.
Before starting the water-seal tubes must be filled with liquid.



1. APC-2000ALW.
2. Pipeline.
3. Pressure gauge valve.
4. Loop water-seal tube.

Figure 15. Steam pressure measurement system on horizontal pipeline using APC-2000ALW.



1. APC-2000ALW.
2. Pipeline.
3. Pressure gauge valve.
4. Water-seal tube.

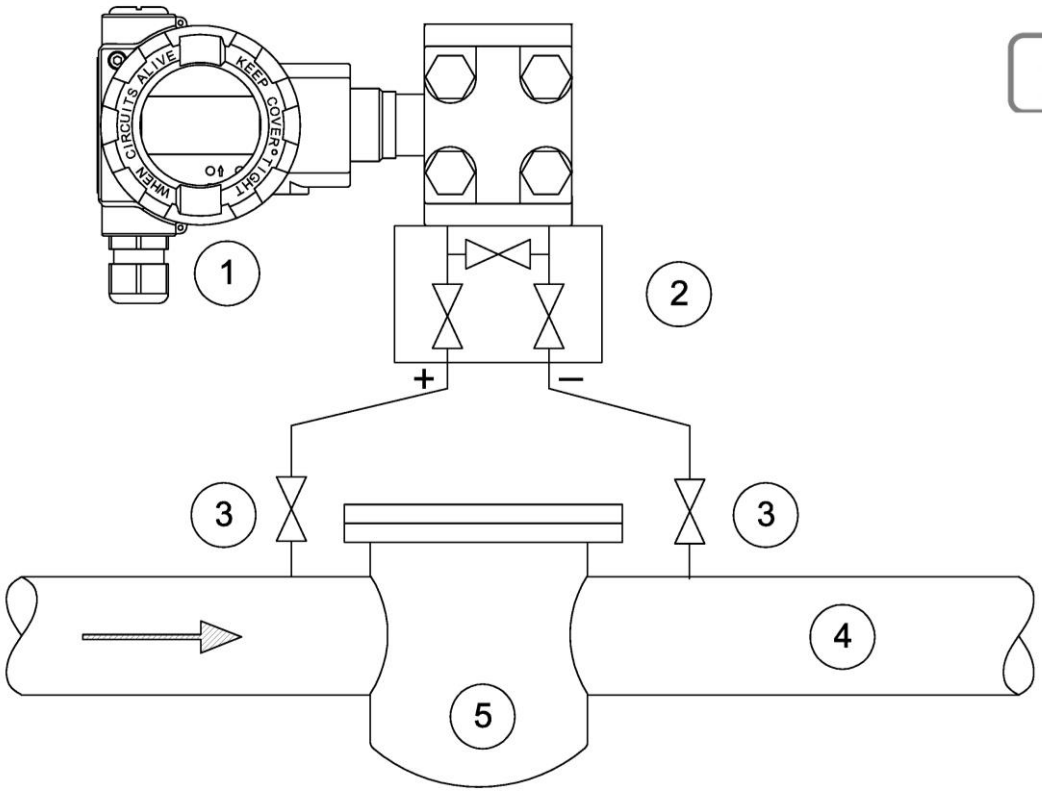
Figure 16. Steam pressure measurement system on vertical pipeline using APC-2000ALW.

2.6. Differential pressure measurement

Transmitter APR-2000ALW makes it possible to measure differential pressure at high static pressures. A range of valve manifolds with separators and a large number of standard process ranges of the measured differential pressures are available. The transmitter configuration also allows for differential pressure presentation in many physical units (➔ 13.2.2) or the user's own units (➔ 13.2.6).

2.6.1. **Gas and steam differential pressure measurement system**

Transmitter APR-2000ALW must be installed above the measuring point so that the condensate can flow through impulse tubes into the process pipes.

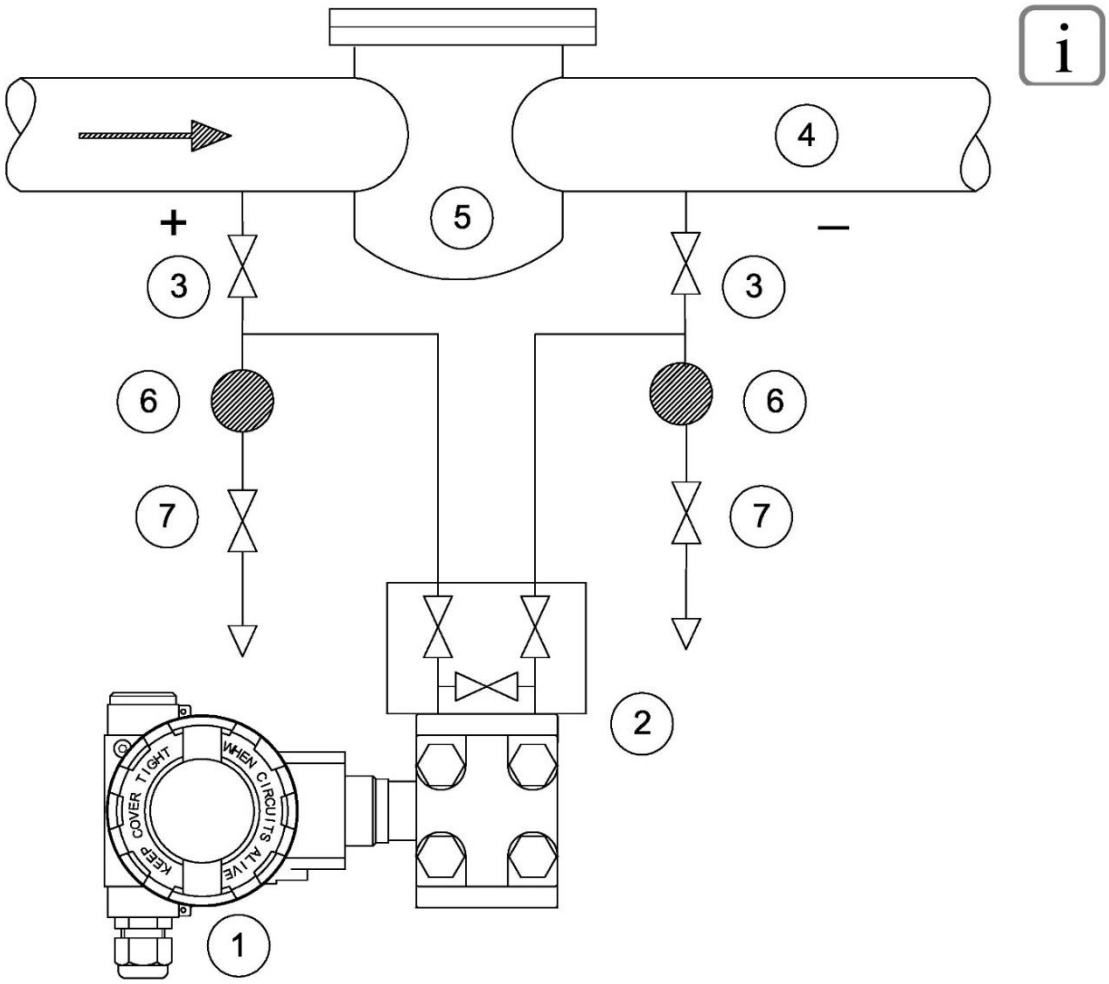


1. APR-2000ALW.
2. Three-way valve.
3. Shut-off valves.
4. Pipeline.
5. Filter or other element.

Figure 17. Gas and steam differential pressure measurement system using APR-2000ALW.

2.6.2. **Liquid differential pressure measurement system**

Transmitter APR-2000ALW must be mounted below the measuring point so that the impulse tubes are always filled with liquid and the gas bubbles can freely escape to the process pipe.
If the measured medium contains particles, it is useful to install separators and drain valves to remove deposits.

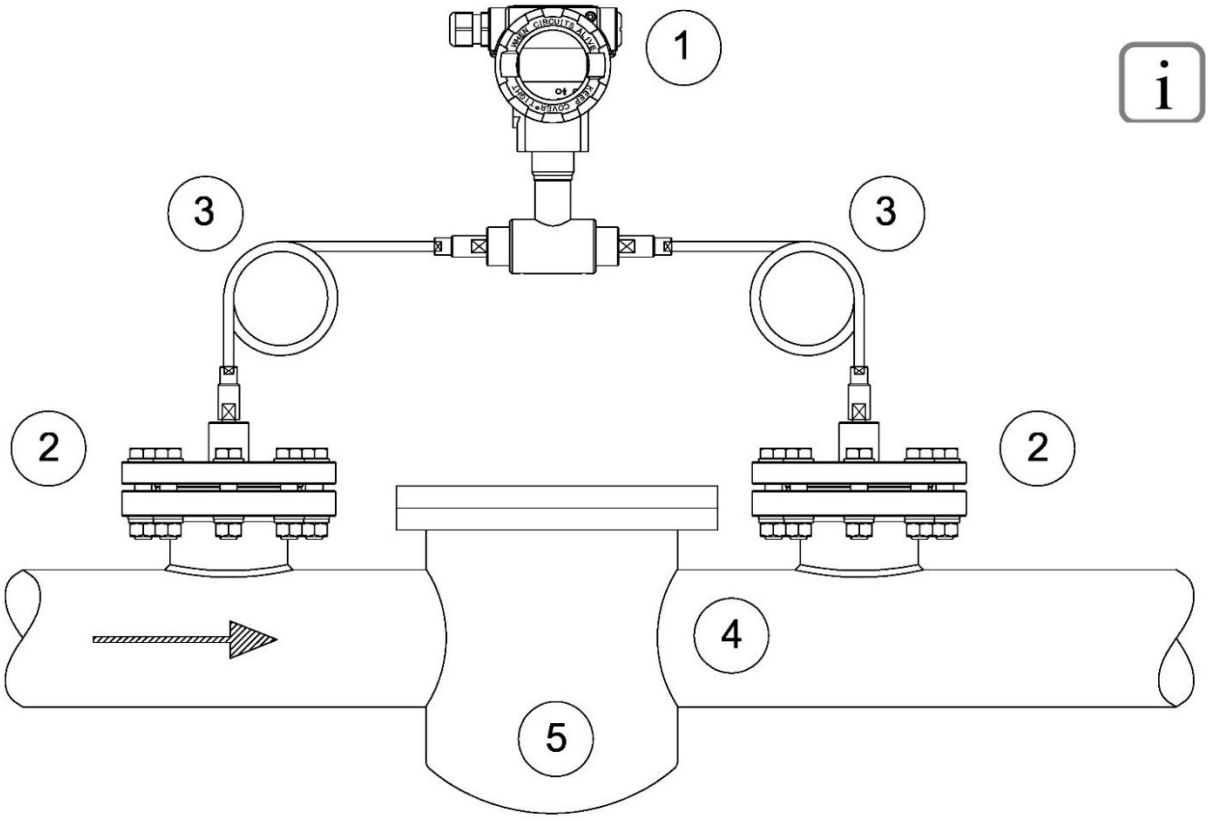


1. APR-2000ALW.
2. Three-way valve.
3. Shut-off valves.
4. Pipeline.
5. Filter or other element.
6. Solids separators.
7. Drain valves.

Figure 18. Liquid differential pressure measurement system using APR-2000ALW.

2.6.3. **Gas, steam and liquid differential pressure measurement system with the use of distance separators**

The separators must be mounted on the top or side of the pipeline.
For vacuum measurements, transmitter APR-2000ALW must be installed below the measuring point.
Approximate ambient temperature in both capillaries connecting the transmitter with separators must be ensured.



1. APR-2000ALW with diaphragm seals.
2. Separators.
3. Capillary tubes.
4. Pipeline.
5. Filter or other element.

Figure 19. Gas, steam and liquid differential pressure measurement system using APR-2000ALW with distance separators.

3. Characteristics of process measurement input

3.1. Measurement process variables

The basic input variable of the measuring process is pressure or differential pressure (PV). They are used to measure derivative values such as level (liquid column, volume, weight) or flow. Additionally, further process variables related to temperature are measured. These are:

- temperature of the pressure measuring module in the measuring head (SV);
- temperature of the main microcontroller CPU (FV);
- temperature of the structure of an ADC analog-digital transmitter used to perform pressure measurements (TV).

Temperature measurement process variables are used to adjust the temperature impact on the transmitter measuring elements to ensure high measurement accuracy. Process variables can be read out through Raport 2, Aplisens Mobile Configurator or other software using DD or DTM library – example below.

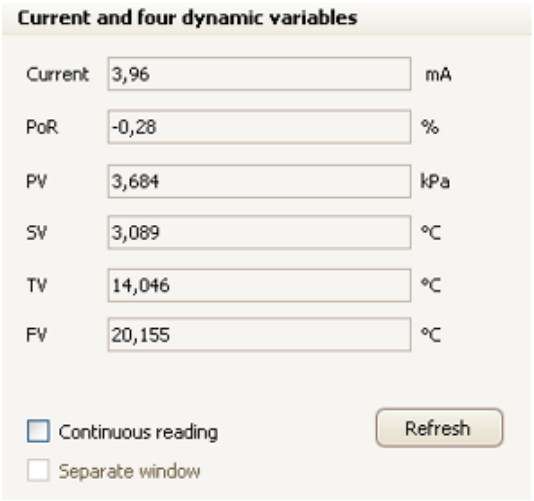


Figure 20. Example of process variables read-out window in Raport 2.

3.2. Measurement input diagnostics

The input measurement circuits are subject to continuous diagnostics, providing the CPU with data on the correctness of the measurement process. The monitoring covers, inter alia, the sensor measuring bridge, ADC transmitter, EEPROM of sensor parameters, sensor power supply systems, connections between sensor components, digital data transfer via sensor galvanic insulation barrier. The detected failures are analysed by the software and in the event of a threat to the safety function, the current output is set to alarm mode (➔ 4.8), (➔ 4.9).

4. Characteristics of process measurement output

4.1. Basic unit and user's unit

The transmitter allows for setting one of many available physical units of pressure, level or force (➔ 13.2.2). After changing the physical unit, the conversion to a newly selected unit occurs automatically. Using HART communication, the user can configure his/her own 6-character description of the unit displayed on LCD3 (➔ 13.2.6). It is possible to display ASCII characters from the range (32 ... 96 dec) or (20 ... 60 hex), i.e.:
!"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`
Lowercase letters are exchanged automatically to uppercase ones; other unsupported characters are displayed as *.
When a user-defined unit is used, it is required to enter its name and scaling parameters. The scaling of the user's unit involves entry of a digital value for 0% setpoint of the set range width and 100% setpoint of set range width. The user's unit is used to visualize the value displayed on LCD and does not affect the process variable of the measurement expressed in the basic unit and the process value of the current setpoint in the current loop.

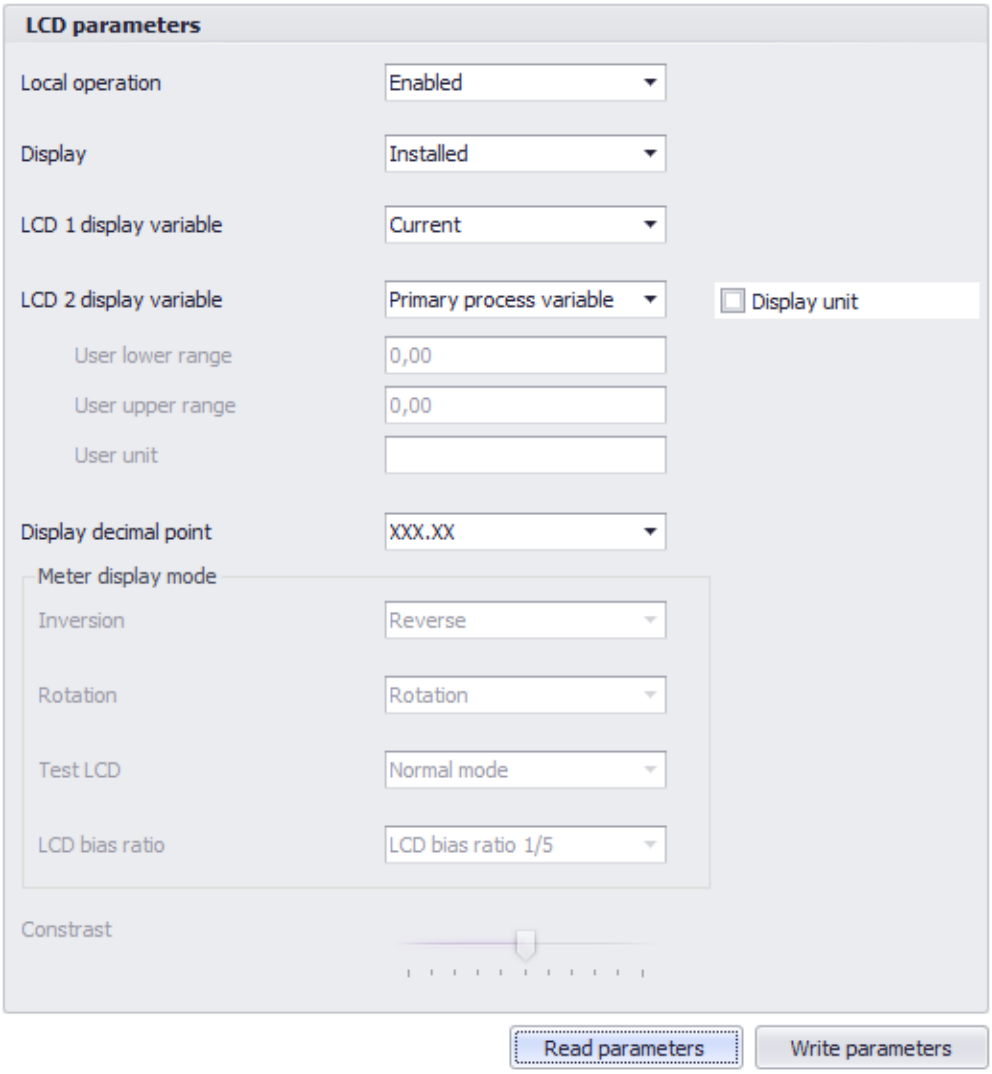


Figure 21. Exemplary settings of the start of range, end of range and user's unit name in Raport 2.

4.2. Set range

The set range refers to the setpoints of the process current output. The setpoint of the process output can be presented in percent or in milliamperes. The LRV point of the set range corresponds to the current of 4.000 mA, whereas the URV point corresponds to the current of 20.000 mA. The LRV and URV points can be assigned to different pressures from the transmitter's base range while maintaining the condition for minimum range width of the set MSV. The reversal characteristics can also be set where the LRV point is assigned to the pressure higher than the URV point, while maintaining the minimum MSV set range width.
The figure below shows the transmitter set range and limits related to the permissible set range, digital processing range and saturation limits of A/D pressure measurement transmitter. As standard, values of 4 mA/20 mA currents are assigned to LRV/URV points. In order to obtain reverse characteristics, it is possible to reverse the assignment so that the LRV/URV points are assigned to 20 mA/4 mA currents.

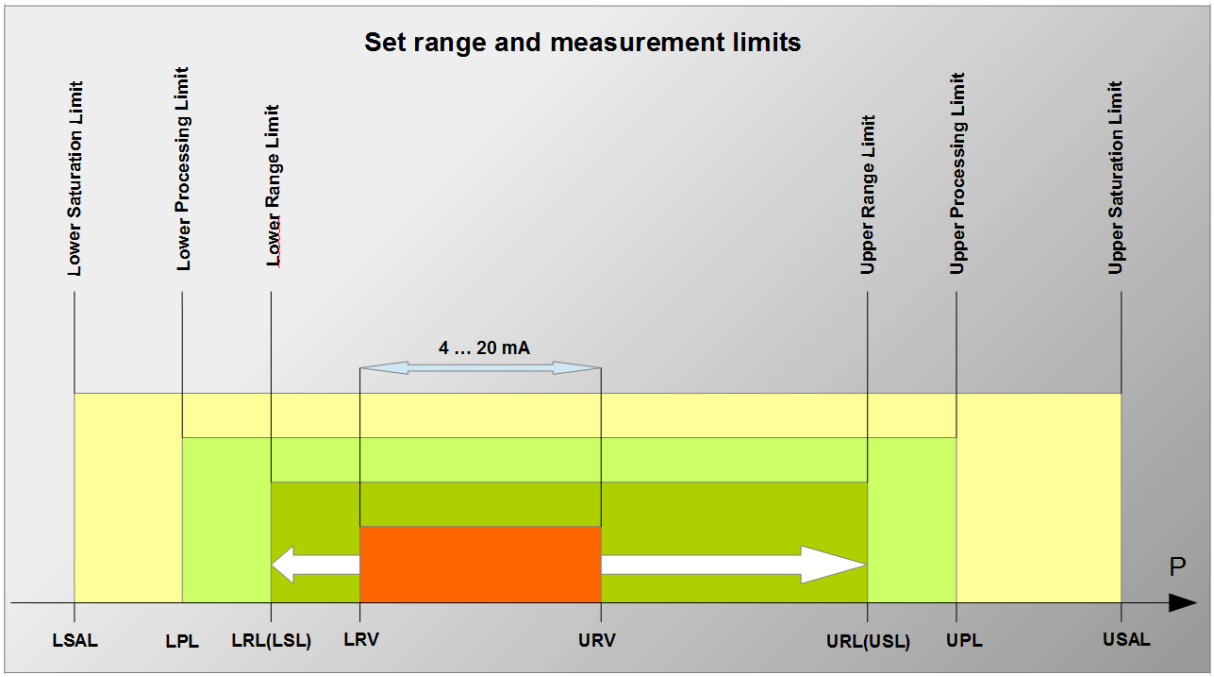


Figure 22. Set range and measurement limits.

4.3. Digital damping time constant

The transmitter allows for adjusting the damping of the measurement process value. The standardized measurement process variable can be suppressed by a digital inertial element of the first order for time constant parameterised in the range of τ = 0 ... 30 s. Entry of a parameter in a floating-point format is available via software using HART communication (➔ 6), e.g. Raport 2 by Aplisens S.A. It is also possible to set in the local MENU (➔ 13.2.11) one of the six predefined fixed damping time constants τ = 0, 2, 5, 10, 30, 60 s. The pressure process variable subjected to damping in the inerting unit is:

- converted to the selected unit and presented on the display (➔ 13.2.1) or available for reading via HART communication (➔ 13.1);
- converted according to the set range and presented as output setpoint percentage (0 ... 100%) or output current setpoint (4 ... 20 mA).

4.4. Linear characteristics transfer functions

In some applications it is recommended to convert the linear process variable of the output control setpoint with a specific function. The following mathematical control signal transformation functions are available:

- linear, i.e. no transformation;
- second-stage root characteristics with relay characteristics and 0.2% hysteresis of the setpoint value in the dead band;
- manufacturer's dual linear characteristics No 1 + second-stage root characteristics for constant dead band = 0.6% of setpoint value;
- manufacturer's single linear characteristics No 2 + second-stage root characteristics and 0.2% hysteresis of the setpoint value in the dead band;
- square characteristics;
- special multi-point linearization based on user-modified table.

In addition to the linear characteristics used in the measurements of level, force, pressure and differential pressure, the root characteristics is often used for flow measurements. Therefore, transmitter APC(R)-2000ALW allows the user to select 3 types of root characteristics as described below.

4.5. Basic root characteristics

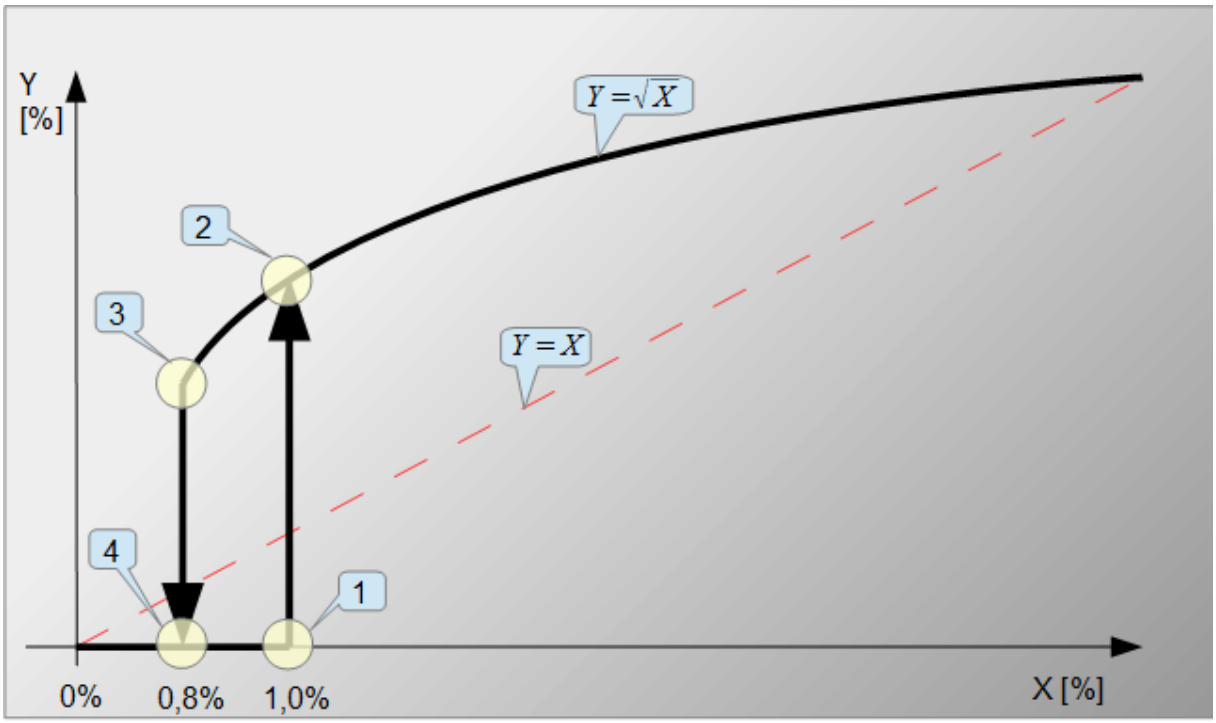


Figure 23. Root characteristics with adjustable dead band.

"Relay" characteristics below the dead band. The figure shows exemplary values for the set dead band of 1%.
① – ② In the case of pressure/flow increase in point [1]–[2], the hysteresis of 0.2% is activated and function Y = 0 is converted to root function Y = $\sqrt{X}$. The pressure measured above point [3] will be converted to the root function.
③ – ④ In the case of pressure/flow drop in point [3]–[4], root function Y=$\sqrt{X}$ is converted to function Y=0. The pressure below point [1] will be converted to Y= 0. The dead band of the root characteristics is configurable in the full range of 0-100% using HART communication or in a limited range of pre-defined values using the local MENU. In on-site applications the values are typically set to approx. 1% of the output setpoint.

4.6. Manufacturer's root characteristics 1

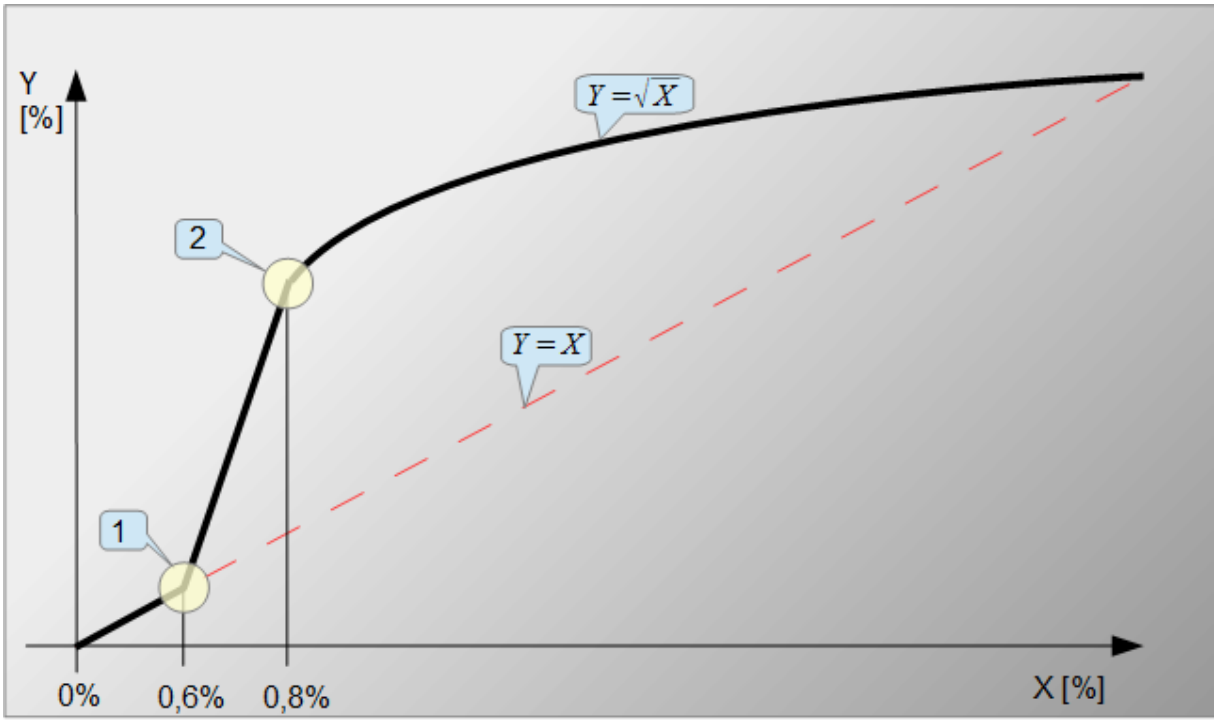


Figure 24. The manufacturer's root characteristics 1 with fixed points of the characteristic change at points 0.6% and 0.8%.

① – Point [1] of the 0.6% setpoint of the X output (4.096 mA on linear characteristic) in which linear function Y = X is converted to linear function with a larger slope Y = Xn.

② – In point [2] of the 0.8% setpoint of the X output (4.128 mA on linear characteristics), linear function Y= Xn is converted to root function $\sqrt{X}$. Unlike the base root characteristics, this characteristics allows for monitoring of small flows below the dead band, e.g. when the valve closes or is unscrewed. The "stroke" effect of the measurement at the limit of the function concatenation is also significantly smaller. The values of concatenation points are fixed and cannot be modified.

4.7. Manufacturer's root characteristics 2

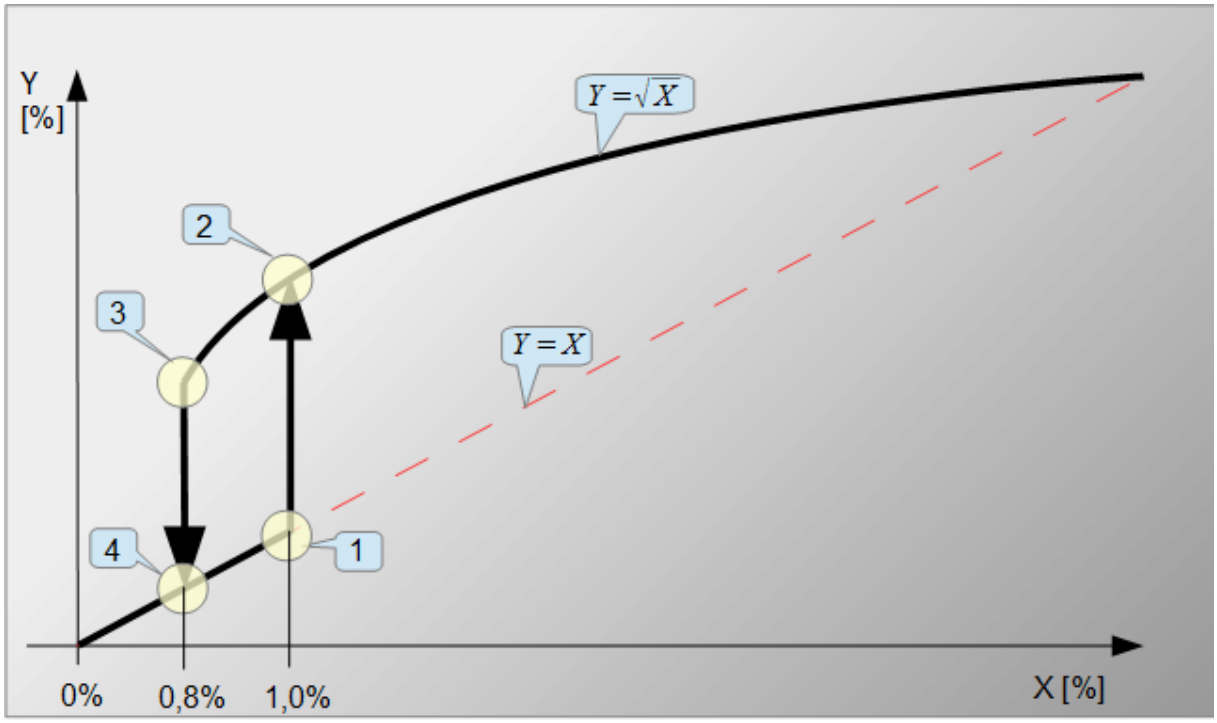


Figure 25. Manufacturer's root characteristics 2 with adjustable dead band and hysteresis 0.2%.

The figure shows exemplary values for the set dead band of 1%.
① – ② In the case of pressure/flow increase in point [1]–[2], the hysteresis of 0.2% is activated and linear function Y = X is converted to root function $\sqrt{X}$. The pressure measured above point [1]-[2] will be converted to the root function.

③ – ④ In the case of pressure/flow drop in point [3]–[4], root function Y=$\sqrt{X}$ is converted to linear function Y=X. The pressure below point [3]-[4] will be converted to linear function. The dead band of the root characteristics can be configured in a limited range of pre-defined values using the local MENU or in the full range of 0-100% using HART communications. In on-site applications the values are typically set to approx. 1% of the output setpoint. Unlike the base root characteristics, this characteristics allows for monitoring of small flows, e.g. when the valve closes or is unscrewed, simultaneously reducing the "ringing" of the input signal on the limits when the linear function concatenates with the root function.

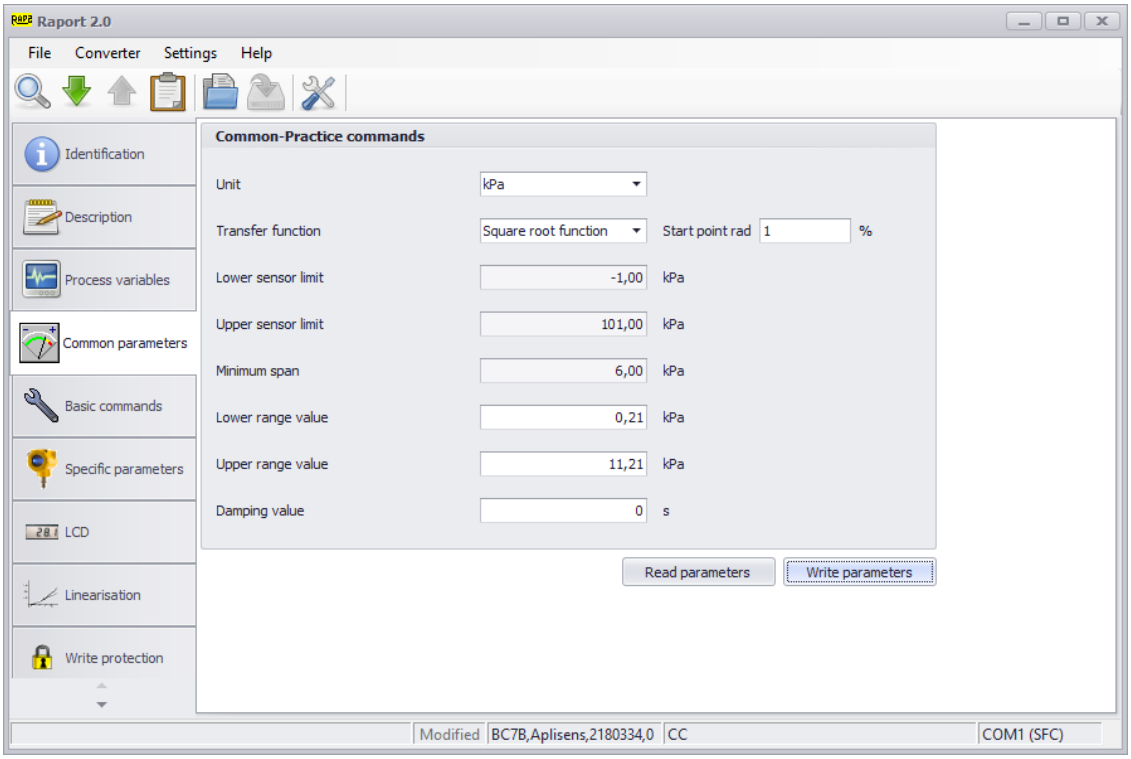


Figure 26. Example of a tab in Raport 2, in which the type of processing characteristics and the dead band of the root characteristics are configured.

4.8. Output signal 4 ... 20 mA HART

Transmitter APC(R)-2000ALW provides a process variable of the measurement referenced to the set range of pressure via the value of current in current loop 4 ... 20 mA. For practical reasons, the transmitter's current controller lower saturation point is below the 0% setpoint and is -0.64% (3.900 mA) for the NORMAL mode and -1.25% (3.800 mA) for the NAMUR mode. For the same reasons, the upper saturation point of the setpoint is 103.13% (20.500 mA).

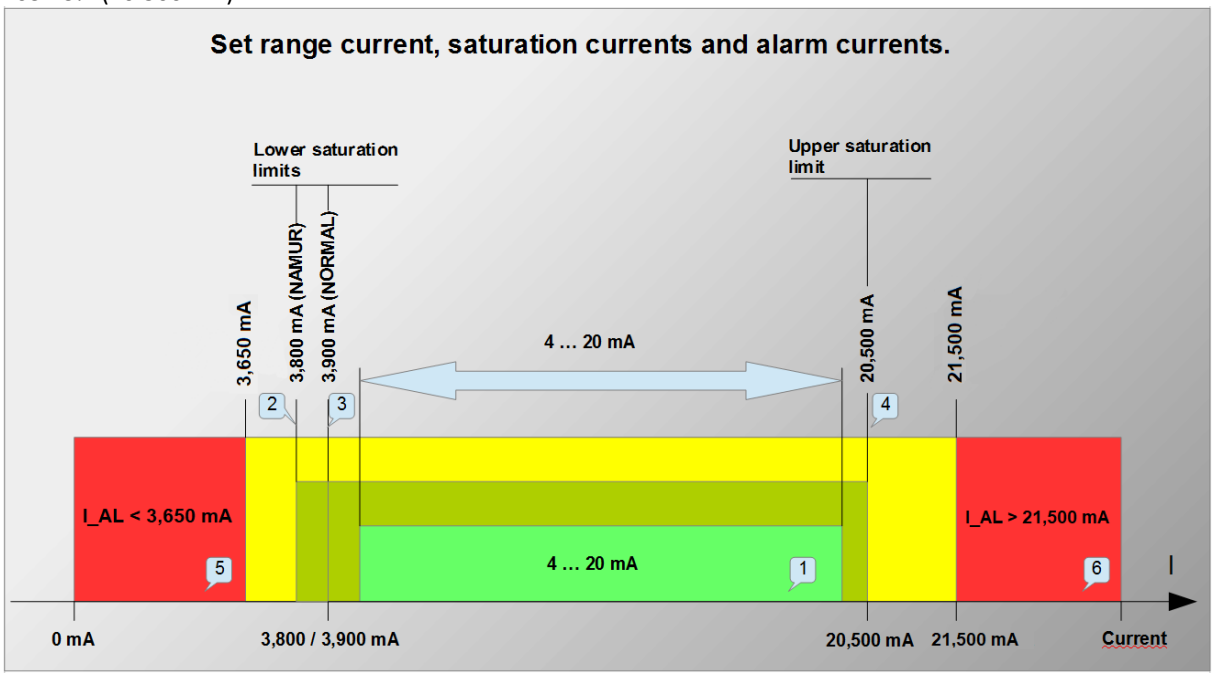


Figure 27. Set range current, saturation currents, alarm currents.

① – Area of current set to 4 ... 20 mA corresponding to the 0 ... 100% setpoint of the process output.
② – Lower saturation current of 3.800 mA for NAMUR mode.
③ – Lower saturation current of 3.900 mA for NORMAL mode.
④ – Upper saturation current of 20.500 mA for NAMUR and NORMAL mode.
⑤ – Alarm current area I_AL < 3.650 mA for internal diagnostic alarms or alarms related to dangers failures with external diagnostics.
⑥ – Alarm current area I_AL > 21.500 mA for alarms related to dangers failures with external diagnostics.

The measurement process variable expressed in the basic unit of pressure, force or level is also available via HART communication using a current loop as a physical layer. Digital HART communication is based on FSK modulation of BELL202 type with frequencies of 2200 Hz and 1200 Hz respectively for "0" and "1". Transmitter APC(R)-2000ALW has an implemented communication stack with an application layer consistent with HART 5.1 and HART 7 (➔ 13.1).

4.9. Alarm signal levels

Below lower saturation thresholds (3.900 mA or 3.800 mA), there is an alarm current setting area covering the range < 3.650 mA. Rated low alarm current value AL_L is 3.600 mA.
Above upper saturation thresholds (20.500 mA), there is an alarm current setting area covering the range > 21.500 mA. Rated high alarm current value AL_H is 22.000 mA.
In addition to the diagnostic alarm supported by the transmitter current controller, there is also a critical diagnostic alarm. This is an alarm mode supported by an additional independent watchdog system. It is triggered in the following cases:

- error of floating-point mathematical calculations;
- error in RAM dynamic memory;
- error in the coefficient memory or FLASH memory;
- error in main CPU logs;
- inconsistency of 8 successive values of the current setpoint with the measured current value in the current loop;
- disturbance of the programme automatic system resulting in exceeding the watchdog refresh time window of the critical alarm mode WDT_SIL.

The critical alarm mode is used due to the need of immediate disconnection of the transmitter from the current loop (associated process current drop below the alarm threshold). The specified causes of the errors are critical due to the inability to guarantee in such conditions the correct course of numerical calculations and consequently the reliability of the output process variable.

Occurrence of a critical alarm usually indicates a serious damage to the transmitter and the necessity to repair it at the manufacturer's plant.

However, there are two exceptions.
The first one is too low power voltage inconsistent with the technical conditions, causing shortage of supply voltage on the transmitter terminals when the output current is high.
The other one is a very high excessive interruption level in the current loop line supplying the transmitter. Excessive interference may destabilize the operation of the transducer systems responsible for the control measurement of current flowing in the current loop. The difference between the value of the set current for the controller and the measured value, which lasts for a longer period of time may also cause the critical alarm to be set. In the case of a critical alarm, the transmitter display goes out, and the alarm current is approximately 0.150 mA. After approx. 10 s in the critical alarm status, the transmitter restarts its software and automatically attempts to restore operation. In the case of a permanent fault, the transmitter again triggers a critical alarm.

APC(R)-2000ALW. Types of diagnostic alarms with comment		
Alarm type	Alarm current [mA]	Comment
Diagnostic alarm	< 3,650 or < 21,500, depending on the settings	Rated alarm current = 3.650 mA or 22.000 mA, depending on the settings. This is an alarm current caused by non-critical events or failures in terms of the process and operation of the transmitter. In the case of a hazardous event the transmitter internal diagnostics always applies alarm current < 3.650 mA or > 21.500 mA, depending on the settings.
Critical alarm	<< 3,650	Rated alarm current is approximately 0.150 mA. This is an alarm current caused by critical events or failures in terms of the process and operation of the transmitter. The critical alarm lasts for approx. 10 s, then the transmitter automatically attempts to restore operation.

Table 7. Types of diagnostic alarms with comment.

4.10. Loading of current loop 4 ... 20 mA with serial resistance

The power line resistance, power source resistance and other additional serial resistances increase the voltage drops between the power source and the transmitter terminals. The maximum transmitter current under normal operation conditions is defined as I_max = 22,000 mA

The maximum resistance value in the power circuit (along with the power cables resistance) is defined by the formula:

R_{L_MAX} [Ω] ≤= $\frac{(U-10)[V]}{0{,}022[A]}$ for standard version

R_{L_MAX} [Ω] ≤= $\frac{(U-10{,}5)[V]}{0{,}022[A]}$ for intrinsically safe (Exi)

where:

U – voltage of 4 … 20 mA current loop power supply unit in [V];

R_{L_MAX} – maximum power supply line resistance in [Ω].

The above formula may be used to describe the indicative dependency of the maximum load resistance on the power supply voltage.

In applications where the supply voltage is lower than the nominal supply voltage (24 V DC), it is necessary to pay particular attention to the voltage drop on the resistance incorporated in series into the power supply line in order to use the local HART communication (➔ Figure 32). After removing the jumper mounted on the electrical connection terminals, the resistor 240 [Ω] shunted by the jumper and integrated with the transmitter is switched in series to the current line, causing additional voltage drop. It can be up to approx. 5.3 V DC, increasing the minimum supply voltage by this value.

After performing configuration or local HART read-outs, it is recommended to reassemble the jumpers (➔ Figure 32).

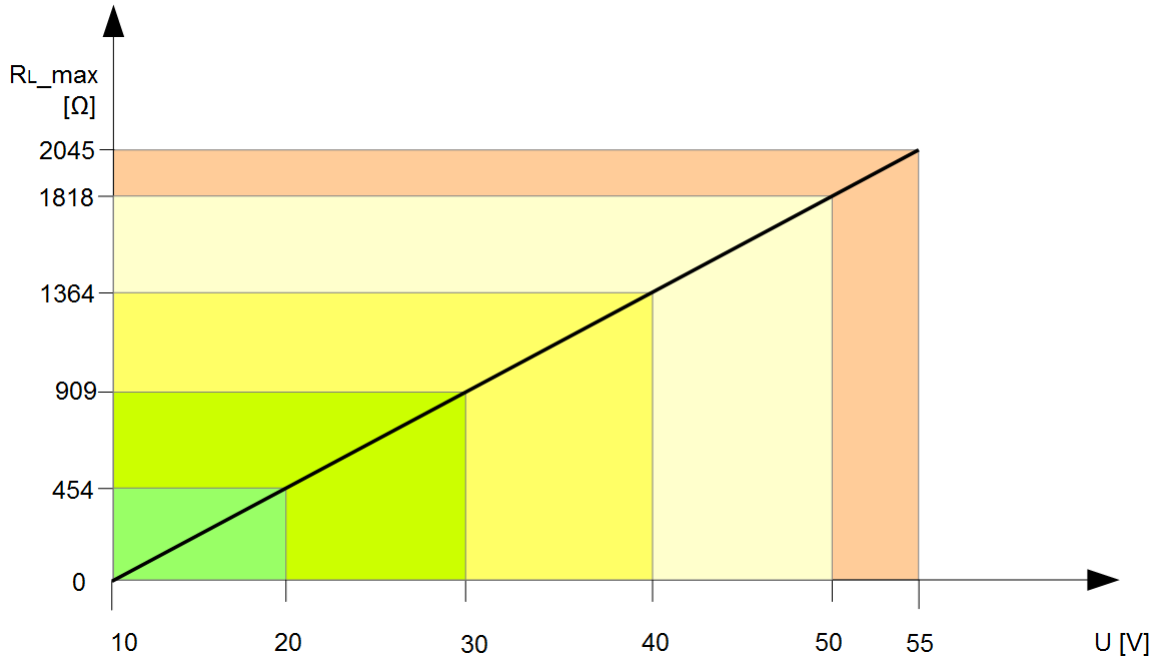


Figure 28. The maximum load resistance R_{L_MAX} [Ω] in the supply line of transmitter APC(R)-2000ALW (standard version) depending on the power supply voltage U [V].

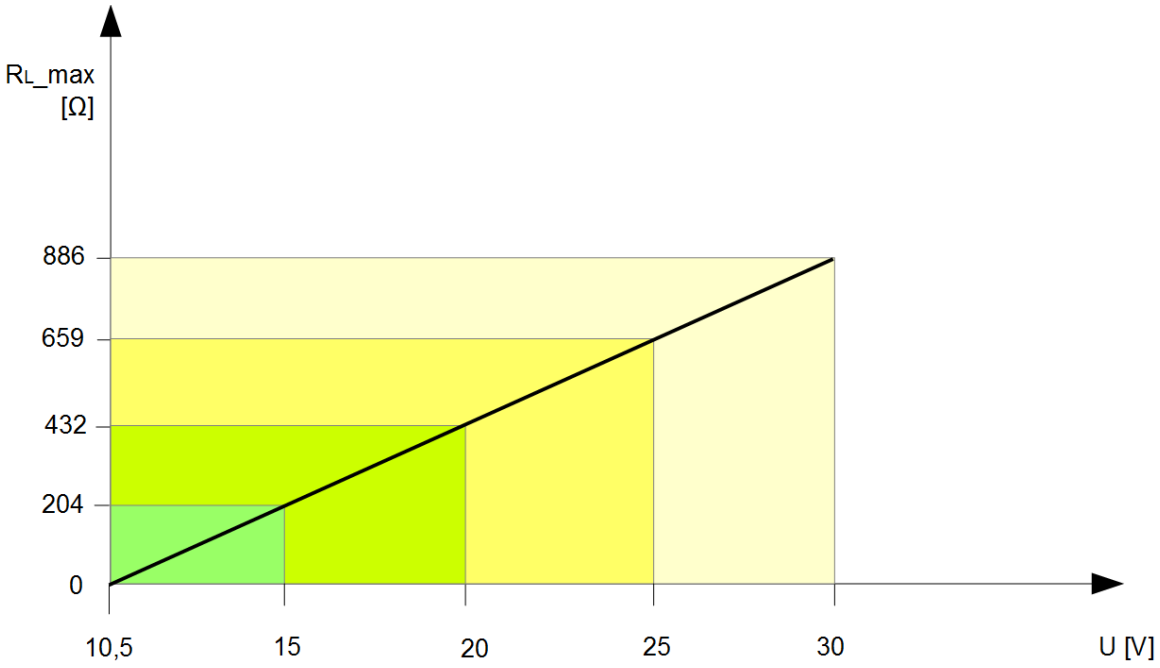


Figure 29. The maximum load resistance R_{L_MAX} [Ω] in the supply line of transmitter APC(R)-2000ALW (Exi version) depending on the power supply voltage U [V].

HART local communication jumper (➔ Figure 31) mounted.

4.11. Current controller resolution 4 ... 20 mA

The current controller used to control the output current of the transmitter operates on the basis of a 16-bit DAC digital-analog transmitter. Effective controller current resolution is approximately 1.0 µA (➔ 8.3).

4.12. Dynamic parameters of digital measurement

In the full measurement cycle, the transmitter performs the measurements of basic input pressure and temperature values and measurements of additional diagnostics-related variables. Time of full measurement cycle pertaining to successive refreshment of the process output by a given value may be configured. It can be adjusted in 12 steps from 32 to 480 ms (from approx. 30 to 2 measurement cycles per second). The parameter can be modified e.g. via Raport 2 or other software using DD or DTM library.
Note that the measurement accuracy decreases with the increase of processing rate (i.e. the decrease of measurement time). This is a physical phenomenon associated with the increase of noise contribution to the measured digital signal.
The figure below presents a screenshot from Raport 2 with slider window for changing of ADC/DAC processing time.

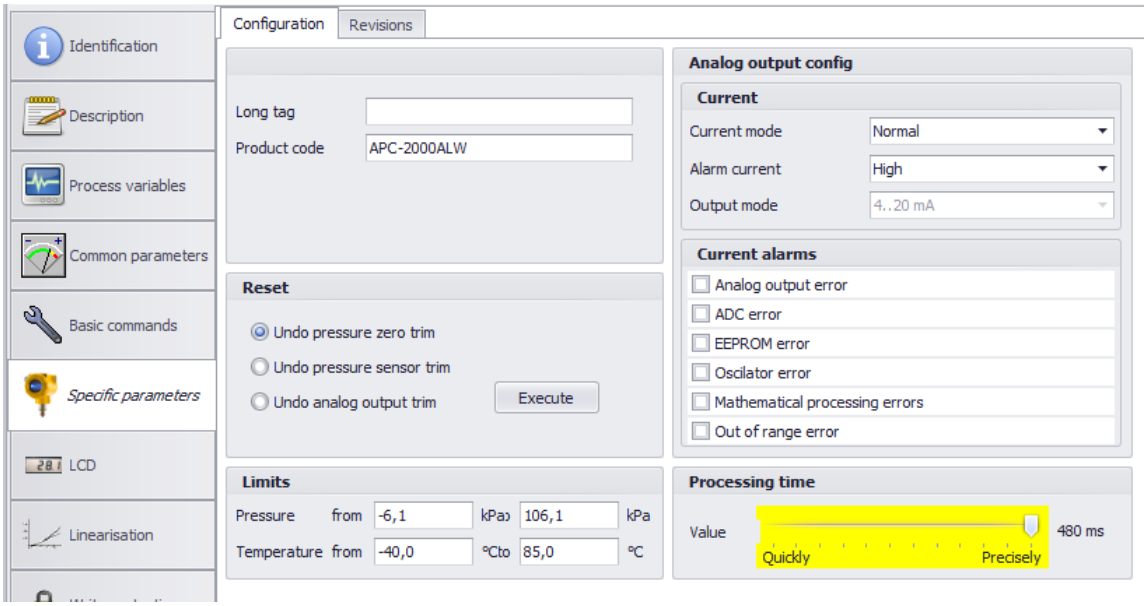


Figure 30. Example screenshot from Raport 2 with a visible slider for changing the processing time.

4.13. Dynamic parameters of current output

The process current output is refreshed according to the set processing time. Time constant τ of analog output path damping entered by the hardware low-pass filter is approx. 5 ms.

4.14. Process measurement output diagnostics

The transmitter diagnostic systems control the process variable of the current measurement output for compliance with the calculated current set value. If the measured value of current in the current loop is different by more than 1% of the set range (160 µA) than the set value, the transmitter diagnostics will activate alarm I_AL < 3.650 mA. If the alarm current is also affected by the error greater than 1% of the set range (160 µA), the diagnostic system will activate the critical alarm by enabling an additional protection module WDT_SIL. In this case the alarm current will be approximately 0.150 mA. Critical alarm will be enabled for approx. 10 s. Then the transmitter will restart the software and attempt to restore operation. For more information on diagnostic alarms, see (➔ 4.9).

5. Software version of the main microcontroller CPU

APC(R)-2000ALW. Software version of the main microcontroller CPU		
Major/minor version number	Date of entry	Comments
3.7	09-2019	Software version introducing HART 7 support

Table 8. Software version of the main microcontroller CPU.

6. HART – specific data related to the protocol application layer

Universal commands and general-purpose commands are implemented in the transmitter according to the requirements of HART standard rev. 5.1 and HART 7. The manufacturer's specific commands meet the requirements of the HART standard, but have a structure not described in the standard. Data with the structure of the manufacturer's specific commands are not available in this documentation. However, they may be made available in specific cases. The following commands and associated parameters and methods are available:

APC(R)-2000ALW. Specific data related to the HART Rev. 5.1 protocol application layer		
HART Command No	Type	Function
Universal commands		
0	READ	Read unique identifier
1	READ	Read primary variable
2	READ	Read current and percent of range
3	READ	Read current and four dynamics variables
6	WRITE	Write pooling address
11	READ	Read unique identifier associated with TAG
12	READ	Read message
13	READ	Read TAG, DESCRIPTOR, DATE
14	READ	Read PV sensor information
15	READ	Read output information
16	READ	Read final Assembly Number
17	WRITE	Write message
18	WRITE	Write tag, descriptor, date
19	WRITE	Write final assembly number
General-purpose commands		
34	WRITE	Write PV damping value
35	WRITE	Write PV unit code and upper and lower range values
36	WRITE	Set PV upper range value URV by PV value
37	WRITE	Set PV lower range value LRV by PV value
38	WRITE	Reset “configuration changed” flag
40	WRITE	Enter/exit PV current mode
42	WRITE	Perform master reset
43	WRITE	Set PV zero
44	WRITE	Write PV unit
45	WRITE	Trim PV current DAC zero
46	WRITE	Trim PV current DAC gain
47	WRITE	Write PV transfer function
48	READ	Read additional transmitter status
59	WRITE	Set numbers of response preambles
Manufacturer’s specific commands		
128	READ	Read static data materials
129	READ	Read device variable trim points
130	WRITE	Trim upper sensor calibration
131	WRITE	Trim lower sensor calibration
132	WRITE	LCD1 variable, LCD2 variable, decimal points, LCD operation, keyboards operation – set local control modes

133	READ	Read local control modes
135	WRITE	Write user's characteristic coefficients
136	READ	Read user's characteristic coefficients
138	WRITE	Return to factory settings
141	WRITE	Write Analog Input function block configurations
142	READ	Read Analog Input function block configurations
230	READ	Read CPU, Master, Slave, HART firmware revision
231	READ	Read product codes
233	READ	Read separator codes
235	READ	Read manifold codes
237	READ	Read operational limits
240	WRITE	Write long TAG
241	READ	Read long TAG
242	WRITE	Write sqrt start point coefficient
243	READ	Read sqrt start point coefficient
244	WRITE	Write User's unit name and rearrange coefficients
245	READ	Read User's unit name and rearrange coefficients
246	WRITE	Write customer’s security code
247	WRITE	Set write protect code

Table 9. Specific data related to the HART application layer HART Rev. 5.1.

APC(R)-2000ALW. Specific data related to the HART Rev. 7 protocol application layer		
HART Com-mand No	Type	Function
Universal commands		
0	READ	Read unique identifier
1	READ	Read primary variable
2	READ	Read current and percent of range
3	READ	Read current and four dynamics variables
6	WRITE	Write pooling address
7	WRITE	Read Loop Configuration
8	READ	Read Dynamic Variable Classifications
9	READ	Read Device Variables with Status
11	READ	Read unique identifier associated with TAG
12	READ	Read message
13	READ	Read TAG, DESCRIPTOR, DATE
14	READ	Read PV sensor information
15	READ	Read output information
16	READ	Read final Assembly Number
17	WRITE	Write message
18	WRITE	Write tag, descriptor, date
19	WRITE	Write final assembly number
20	READ	Read Long Tag
21	READ	Read Unique Identifier Associated With Long Tag
22	WRITE	Write Long Tag
38	WRITE	Reset Configuration Changed Flag
48	READ	Read Additional Device Status
General-purpose commands		
31	READ/WRITE	Extended Command Numbers
34	WRITE	Write Primary Variable Damping Value
35	WRITE	Write Primary Variable Range Values
36	WRITE	Set Primary Variable Upper Range Value

37	WRITE	Set Primary Variable Lower Range Value
38	WRITE	Reset Configuration Changed Flag
40	WRITE	Enter/Exit Fixed Current Mode
42	WRITE	Perform Device Reset
43	WRITE	Set Primary Variable Zero
44	WRITE	Write Primary Variable Units
45	WRITE	Trim Loop Current Zero
46	WRITE	Trim Loop Current Gain
47	WRITE	Write Primary Variable Transfer Function
50	READ	Read Dynamic Variable Assignments
54	READ	Read Device Variable Information
59	WRITE	Write Number Of Response Preambles
80	READ	Read Device Variable Trim Points
81	READ	Read Device Variable Trim Guidelines
82	WRITE	Write Device Variable Trim Point
83	WRITE	Reset Device Variable Trim
1280	READ	Read Pressure Status
1281	READ	Read Capabilities
1282	READ	Read Supported Status Mask
1283	READ	Read Pressure Sensor Information
1284	READ	Read Process Connection
1285	READ	Read Associated Device Variables
Manufacturer’s specific commands		
128	READ	Read static data materials
129	READ	Read device variable trim points
130	WRITE	Trim upper sensor calibration
131	WRITE	Trim lower sensor calibration
132	WRITE	LCD1 variable, LCD2 variable, decimal points, LCD operation, key-boards operation - set local control modes
133	READ	Read local control modes
134	WRITE	Write HART5/HART7 mode
135	WRITE	Write user's characteristic coefficients
136	READ	Read user's characteristic coefficients
138	WRITE	Return to factory settings
141	WRITE	Write Analog Input function block configurations
142	READ	Read Analog Input function block configurations
230	READ	Read CPU, Master, Slave, HART firmware revision
231	READ	Read product codes
233	READ	Read separator codes
235	READ	Read manifold codes
237	READ	Read operational limits
240	WRITE	Write long TAG
241	READ	Read long TAG
242	WRITE	Write sqrt start point coefficient
243	READ	Read sqrt start point coefficient
244	WRITE	Write User's unit name and rearrange coefficients
245	READ	Read User's unit name and rearrange coefficients
246	WRITE	Write customer’s security code
247	WRITE	Set write protect code

Table 10. Specific data related to the HART application layer HART Rev. 7.

7. Power supply

7.1. Cabling specification

Aplisens S.A. recommends using two-wire screened twisted pair cable. The recommended external diameter of the cable for the glands sold with the product is from 5 to 10 mm. In the case of using glands purchased by the customer, the outer diameter of the conductor shall be selected according to the gland specifications so as to ensure tightness of the cable gland.

7.2. Electric connection terminals functions

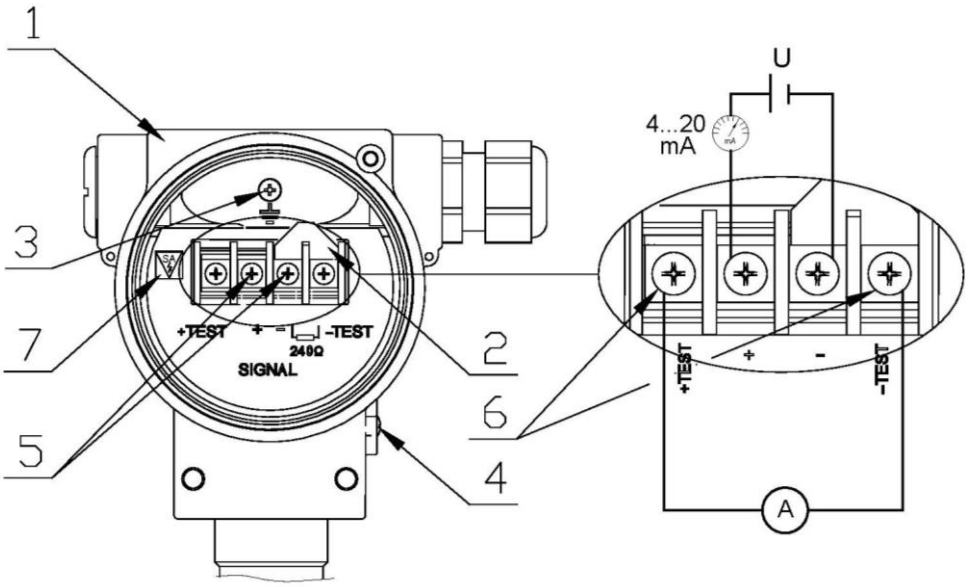


Figure 31. APC(R)-2000ALW. Electrical connection compartment, electrical terminals and their functions.

1 - Housing.
2 – Local HART communication jumper.
3 – Internal ground terminal.
4 – External ground terminal.
5 – Transmitter power terminals, current loop 4 ... 20 mA.
6 – Ammeter connection terminals for uninterruptible current measurement.
7 – Designation of a transmitter version (SA) with integrated overvoltage protection applies to Exi version.

Internal electrical switching terminals are suitable for conductors with the cross-section from 0.5 to 2.5 mm^2. The internal and external electrical ground terminal of the body is suitable for conductors with cross-section from 0.5 to 5 mm^2.

7.3. Electrical connection of power supply

Warning!

Power cables may be live!
There is a risk of electric shock and/or explosion!

- When using the transmitter in explosion-risk atmospheres, the system must comply with local national standards and regulations, with intrinsic safety instructions and installation drawings.
- All explosion protection data is given in separate documentation which is available on request (➔ 16.2). The Ex documentation is typically supplied with all transmitters approved for use in explosion-risk atmospheres.

Power supply from cable line 4 ... 20 mA should be connected to terminals **[SIGNAL +] and [SIGNAL -]** according to the figure (➔ Figure 31).

7.4. Shielding, equipotential bonding

Optimal protection against interference is provided by the earthing of the screen on both sides (in the cabinet and equipment). In case of potential difference between earthing points of devices which may result in the flow of equipotential currents, the screen shall be earthed on one side – preferably at the transmitter.
When used in potentially explosive environments, the applicable regulations must be observed. Separate Ex documentation with additional technical data and instructions is attached to all Ex transmitters.

7.5. Electrical connection of uninterruptible current measurement in the current loop

The transmitter enables uninterruptible current measurement in the current loop using a milliammeter. In order to maintain the measurement error ≤ 0.05%, the internal resistance of the milliammeter shall be ≤ 10 Ω. The milliammeter must be connected to terminals **[+ Test] and [- Test].** The milliammeter connection diagram is shown in Figure (➔ Figure 31).

7.6. Electrical connection of local and remote HART communication

7.6.1. **Connection of transmitter with the option of using local HART communication.**

Transmitter APC(R)-2000ALW allows to use the local HART communication. To do this you can use a HART communicator unit or modem interoperating with a computer or a smartphone.
In order to establish the local communication, it is necessary to:

- unscrew the transmitter's electrical connection cover;
- remove HART communication jumper ②;
- connect the communicator or modem to terminals and carry out the planned operations;
- after completing the communication, install the HART communication jumper ② on the correct position according to (➔ Figure 32);
- close the cover of the transmitter electrical connection, paying attention to its correct tightening.

Please note!

Opening of the HART jumper results in applying resistance of 240 Ω in series in line 4 ... 20 mA. This resistance reduces voltage on transmitter supply terminals by approximately 5 V DC for the maximum current, which can be set by the transmitter. Therefore, when the jumper is removed, the minimum power supply voltage increases by 5,3 V DC. When using power supplies with supply voltages below 17 V DC, to avoid the supply voltage deficit on the transmitter terminals during operation, the HART jumper must be dismantled only for the time of performing the HART local communication. Connection diagram of the communicator or modem to energized transmitter APC(R)-2000ALW is shown in the figure below.

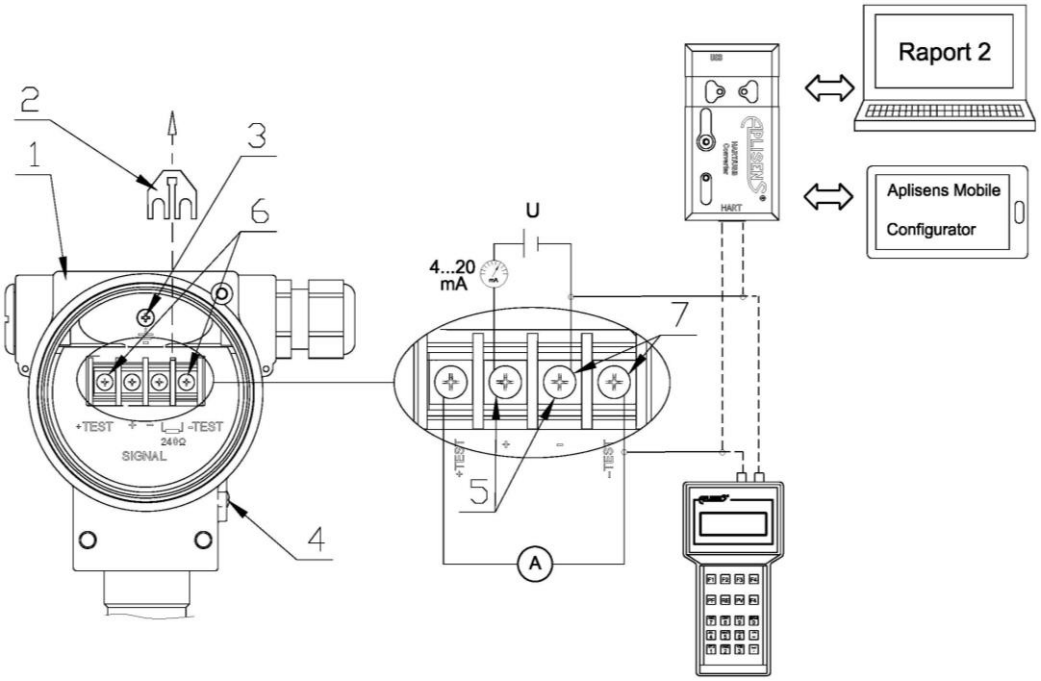


Figure 32. Electrical connection 4…20 mA of HART to transmitter in standard version.

1 - Housing.
2 – Removed local HART communication jumper.
3 – Internal ground terminal.
4 – External ground terminal.
5 – Transmitter power terminals, current loop 4 … 20 mA.
6 – Ammeter connection terminals for uninterruptible current measurement.
7 – Terminals – point of connection of the communicator or HART modem.

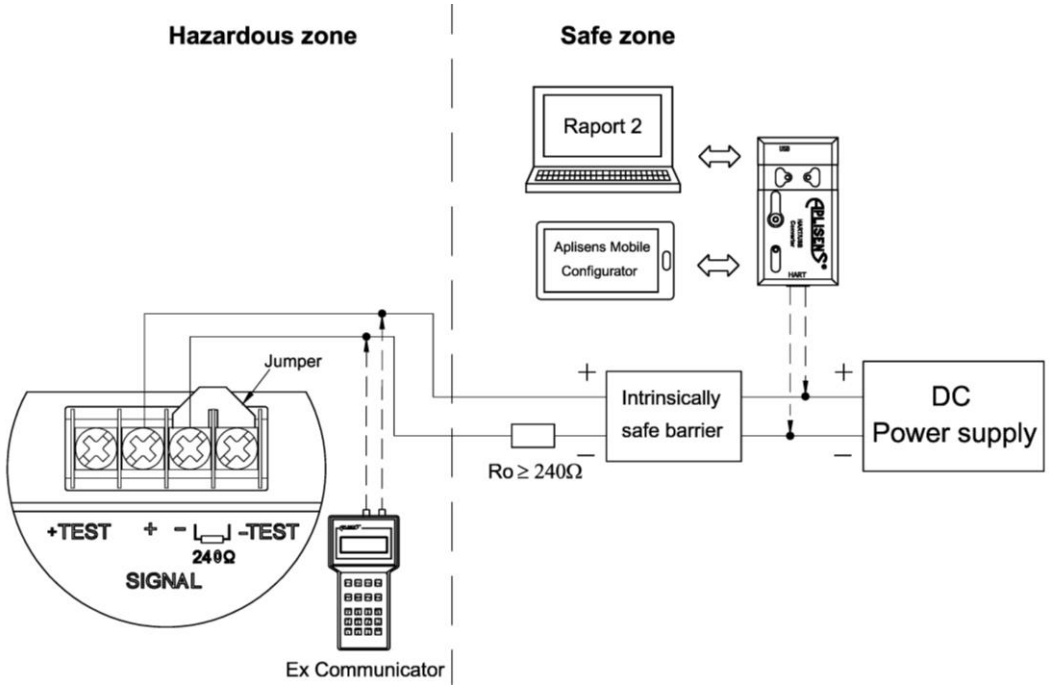


Figure 33. Electrical connection 4…20 mA of HART to transmitter in Exi version.

It is mandatory to read EN.IX.APC.APR.ALW Explosion-proof Device User Manual, containing important information related to the installation of intrinsically safe and flameproof versions of the transmitter.

7.6.2. **Connection of transmitter with the option of using remote HART communication**

For remote communication, where the connection point of Master HART is not local as for the transmitter, it is necessary to ensure the resistance of ≥ 240 Ω between the power supply and the communicator/modem connection point. In the case when the transmitter is supplied from smart cards of measuring systems equipped with HART communication, such resistance is usually not required. Its function is fulfilled by the active impedance on the system measurement card provided with HART communications module. In case of measurement cards with HART communication, the manufacturer's recommendations shall be adhered to.

7.7. Overvoltage protections (optional)

Transmitters comply with EMC standards for safety-related products used in general industrial environment.
Transmitters in standard version is fitted with overvoltage protection.
In intrinsically safe transmitters, in order to increase the resistance to excessive surge, it is possible to use the overvoltage protection **SA** version. Transmitters with integrated overvoltage protection **SA** should be grounded.
Overvoltage protection parameters in transmitters in standard and Exi versions:

- discharge threshold voltage: 230 V DC;
- discharge threshold impulse voltage: 450 V (pulse 100 V/µs);
- discharge threshold impulse voltage: 600 V (pulse 1000 V/µs);
- discharge current for 1 surge: 20 kA, 8/20 µs;
- discharge current for 10 surges: 10 kA, 8/20 µs;
- discharge current for 300 surges: 200 A, 10/1000 µs.

Transmitter APC(R)-2000ALW has an internal and external earthing terminal. The method of earthing and the type of conductors used are defined by local regulations.

7.8. Supply voltages

APC(R)-2000ALW. Minimum and maximum supply voltage		
Electronics version	Minimum supply voltage	Maximum supply voltage
4 ... 20 mA HART, standard version (to be used in non-explosive environments)	10.0 V DC	55 V DC
4 ... 20 mA HART, Exi version *	10.5 V DC	30 V DC
* For details on intrinsically safe version see Exi documentation (➔ 16.2).		

Table 11. Minimum and maximum supply voltage.

Check that for the maximum possible current setpoint (22.000 mA) the voltage on the transmitter's supply terminals complies with the requirements set out in the table and on the transmitter nameplate.

7.9. Impact of supply voltage on ADC transmitter (supply voltage range from minimum to maximum under reference conditions)

Any noticeable impact of voltage change within the range from the minimum to maximum on digital readings of the process variable value of the measurement was not found.

7.10. Impact of supply voltage on DAC transmitter

It was found that the supply voltage variation has negligible impact on the value of process current. This effect results from the flow of the shunt current of overvoltage elements used in the transmitter input power supply system. The maximum impact of the supply voltage referenced to the current range width of 16 mA does not exceed 0.0005%/V.

7.11. Total impact of supply voltage on measurement (ADC + DAC)

The total impact of the supply voltage covering the impact on ADC +DAC referenced to the current range width of 16 mA does not exceed 0.0005%/V.

7.12. Permissible levels of ripple and differential interruptions in power supply line

Transmitter APC(R)-2000ALW complies with the requirements of PN-EN 61326-1, PN-EN 61326-2-1, PN-EN 61326-2-3, PN-EN 61326-3-1 and PN-EN 61000 referenced therein.

With regard to voltages dips and failures for the I/O control connections, the standards do not determine the levels and duration of the tests. However, using the approach where loop 4 ... 20 mA is regarded as DC supply port, resistance measurements were performed.

Maximum permissible duration of supply voltage failure < 1 ms when the DS criterion is met in terms of continuous performance of the safety function.

Maximum permissible duration of voltage dip up to 40% of the rated voltage of 24 V DC on the transmitter terminals < 3 ms, when the DS criterion is met in terms of continuous performance of the safety function.

Maximum permissible duration of voltage dip up to 70% of the rated voltage of 24 V DC on the transmitter terminals < 3 ms, when the DS criterion is met in terms of continuous performance of the safety function.

A separate issue is the permissible interruption level required to ensure the correct HART communication. In order to ensure a low error rate, it is required to provide the power supply that meets the following criteria:

APC(R)-2000ALW. Permissible supply interruption level required for correct HART communication		
Item No	Maximum interruption voltage	Voltage value, characteristics
1	Maximum interruption voltage in band 0 ... 63 Hz	138 mV RMS
2	Maximum interruption voltage in band 63 ... 500 Hz	138 mV ... 2.2 mV RMS with decrement of 40 dB/decade
3	Maximum interruption voltage in band 500 ... 10 kHz	2.2 mV RMS
4	Maximum interruption voltage in band 10 kHz ... 3.2 MHz	2.2 mV ... 707 mV RMS with increment of 20 dB/decade

Table 12. Permissible supply interruption level required for correct HART communication.

The above-mentioned conditions are illustrated in the following figure:

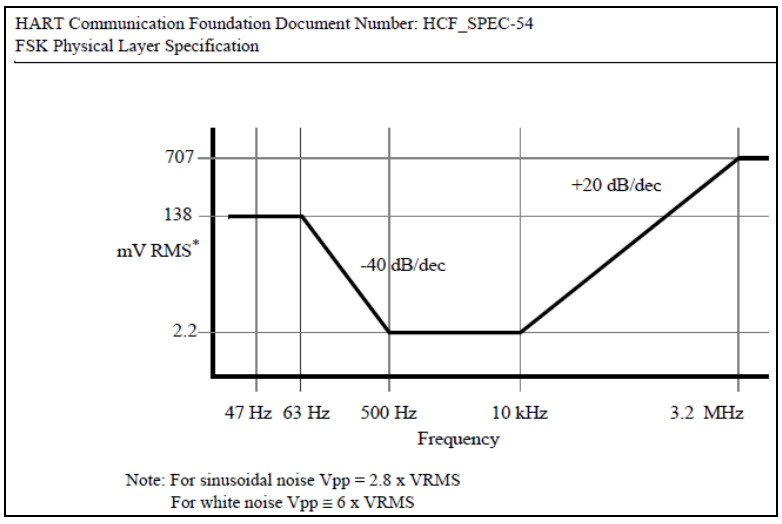


Figure 34. Requirements for the maximum interruption level in the transmitter power supply approved for correct HART communication.

8. Transmitter parameters related to process measurement

8.1. Reference climatic conditions

Constant reference temperature of 22°C (±5)°C.
Constant relative humidity in the range of: 10 ... 80% rH.

8.2. Impact of mounting position on measurement

During installation of the transmitter on site it may be required to correct the effect of the position on the measurement. This impact applies to the transmitter "zero" offset, which is connected to the gravitational impact on the silicon measuring diaphragm and is greater, the lower base measurement range of the transmitter is. To perform the pressure resetting after installation, use the local MENU (➔ 13.2.11) and perform a **PVZERO** function in it or perform this operation using HART communication using a communicator, PC or smartphone. It should be noted that the transmitters with ABS ranges do not enable resetting operations. However, ABS ranges due to the use of higher pressure ranges are less sensitive to the impact of the mounting position.

8.3. Measurement resolution

The resolution of the digital measurement value depends on the measuring range of the transmitter and is slightly different for each base range. A 24-bit ADC analog-digital transmitter is used for pressure/differential pressure measurements. Approximately 25% of the range is used out of the transmitter full range of processing voltage, which reduces the theoretical resolution to about 22 bits. Therefore, the theoretical resolution of the digital measurement is approximately 0.000024% of the base range. The effective resolution of digital measurement taking into account the stable number of measurement bits is however lower and amount to approximately 0.0015% of the base range. Since, simply speaking the entire pressure process variable processing path basically consists of a serial connection of the ADC stage and the DAC stage, the final resolution will be determined by the module with the smallest processing resolution. It is an analog-digital DAC transmitter module based on a 16-bit transmitter. The measurement resolution referenced to the process current output is therefore approx. 1.0 µA.

APC(R)-2000ALW. Pressure measurement resolution		
Type of measurement	Measurement resolution	Comments
ADC	0.000024%	Refers to the total resolution of the analog-digital module for the base range.
ADC	0.0015%	Refers to the effective resolution of the analog-digital module for the base range.
DAC	0.005% ≈1 µA	Refers to total resolution of the analog-digital and digital-analog module referenced to the current output.

Table 13. Pressure measurement resolution.

8.4. Impact of vibration on measurement

During the tests of transmitters APC(R)-2000ALW in aluminium housing (➔ 10.5) vibrations have slight impact on the process variable measurement. The maximum impact of vibrations was observed in resonance frequencies, the variation amplitude of the current process variable for the transmitter's base range did not exceed 0.032% of the measurement range (5 µA). Tests were performed in 3 transducer axes in accordance with PN-EN 60068-2-6: 2008 for the range of 10 Hz ... 60 Hz with displacement amplitude of ±0.35 mm, and for a range of 60 Hz … 1000 Hz with constant acceleration of 50 m/s^2. During the tests of transmitters APC(R)-2000ALW in the stainless steel housing (➔ 10.5) vibrations have slight impact on the process variable measurement. The maximum impact of vibrations was observed in resonance frequencies, the variation amplitude of the current process variable for the transmitter's base range did not exceed 0.032% of the measurement range (5 µA). The

tests were performed in 3 transmitter axes in accordance with PN-EN 60068-2-6:20 08 for the range 10 Hz ... 60 Hz with displacement amplitude of ± 0.15 mm, and for a range of 60 Hz … 1000 Hz with constant acceleration of 20 m/s^2.

8.5. Measuring ranges

8.5.1. **APC-2000ALW**

APC-2000ALW. Measuring ranges.				
No.	Base range	Minimum adjustable width of the measuring range	Option of changing the start of the measuring range	Permissible overload (without hysteresis)
1	0 ... 100 MPa	1 MPa	0 ... 99 MPa	120 MPa
2	0 … 60 MPa	600 kPa	0 … 59,4 MPa	120 MPa
3	0 ... 30 MPa **	300 kPa	0 ... 29,7 MPa	45 MPa
4	0 … 16 MPa **	160 kPa	0 … 15,84 MPa	45 MPa
5	0 ... 7 MPa **	70 kPa	0 ... 6,93 MPa	14 MPa
6	-0,1 … 7 MPa **	71 kPa	-0,1 … 6,929 MPa	14 MPa
7	0 ... 2,5 MPa **	25 kPa	0 ... 2,475 MPa	5 MPa
8	-0,1 …2,5 MPa **	26 kPa	0 … 2,474 MPa	5 MPa
9	0 ... 0,7 MPa **	7 kPa	0 ... 693 kPa	1,4 MPa
10	-100 … 700 kPa**	8 kPa	0 … 692 kPa	1,4 MPa
11	-100 ... 150 kPa **	12 kPa	-100 ... 138 kPa	400 kPa
12	0 ... 200 kPa **	10 kPa	0 ... 190 kPa	400 kPa
13	0 ... 100 kPa **	5 kPa	0 ... 95 kPa	200 kPa
14	-50 ... 50 kPa **	5 kPa	-50 ... 45 kPa	200 kPa
15	0 ... 25 kPa **	2,5 kPa	0 ... 22,5 kPa	100 kPa
16	-10 ... 10 kPa **	2 kPa	-10 ... 8 kPa	100 kPa
17	-1,5 ... 7 kPa */**	0,5 kPa	-1,5 ... 6,5 kPa	50 kPa
18	-2,5 ... 2,5 kPa * (only for HS)	0,2 kPa	-2,5 ... 2,3 kPa	50 kPa
19	-0,7 ... 0,7 kPa * (only for HS)	0,1 kPa	-0,7 ... 0,6 kPa	50 kPa
20	0 ... 130 kPa (ABS)	10 kPa	0 ... 120 kPa (ABS)	200 kPa
21	0 ... 700 kPa (ABS)	10 kPa	0 ... 690 kPa (ABS)	1,4 MPa
22	0 ... 2,5 MPa (ABS)	25 kPa	0 ... 2,475 MPa (ABS)	5 MPa
23	0 ... 7 MPa (ABS)	70 kPa	0 ... 6,93 MPa (ABS)	14 MPa
24	0 … 30 MPa (ABS)	300 kPa	0 … 29,7 MPa (ABS)	45 MPa
25	0 … 10 MPa **	100 kPa	0 … 9,90 MPa	45 MPa
26	0 … 10 MPa (ABS)	100 kPa	0 … 9,90 MPa (ABS)	45 MPa
* – only for transmitters without separator. ** – range available in standard and HS versions. HS — Ultra stable measuring element. ABS- absolute pressure				

Table 14. APC-2000ALW. Measuring ranges.

8.5.2. **APR-2000ALW**

APR-2000ALW. Measuring ranges				
No.	Base range	Minimum adjustable width of the measuring range	Option of changing the start of the measuring range	Permissible overload / Permissible static pressure.
1	0 … 7 MPa	700 kPa	0 … 6300 kPa	C type connection: 25 MPa 32 MPa – special execution 41,3 MPa – special execution P type connection: 4 MPa 7 MPa (for the first range)
2	0 ... 1,6 MPa **	160 kPa	0 ... 1440 kPa	
3	0 ... 250 kPa **	20 kPa	0 ... 230 kPa	
4	0 ... 100 kPa **	5 kPa	0 ... 93 kPa	
5	0 ... 25 kPa **	1 kPa	0 ... 24 kPa	
6	-50 ... 50 kPa */**	10 kPa	-50 ... 40 kPa	
7	-10 ... 10 kPa	0,4 kPa	-10 ... 9,6 kPa	
8	-0,5 ... 7 kPa **	0,4 kPa	-0,5 ... 6,6 kPa	
9	-2,5 ... 2,5 kPa (only for HS)	0,2 kPa	-2,5 ... 1,8 kPa	20 MPa 4 MPa for P type connection.
10	-0,7 ... 0,7 MPa (only for HS)	0,1 kPa	-0,7 … 0,6 kPa	2 MPa
* – recommended for level measurement with direct separator and flooded (or empty) impulse tube. ** – range available in standard and HS versions. HS — Ultra stable measuring element.				

Table 15. APR-2000ALW. Measuring ranges.

APR-2000ALW with diaphragm seals. Measuring ranges with distance separators or with distance and direct separators.					
No.	Base range	Minimum adjustable width of the measuring range	Distance between vertical separators	The maximum adjustable measuring range (taking into account actual spacing of sep., vertically	Permissible static pressure.
1	-16 … 16 kPa	0,1 m H_2O	≤ 1,7 m	[1,6 + (distance between sep. vertical x 0,94)]m H_2O	4 MPa
2	-50 ... 50 kPa	0,5 m H_2O	≤ 6 m	[5 + (distance between sep. vertical x 1,04)]m H_2O	4 MPa
3	-160 ... 200 kPa	1,5 m H_2O	≤ 15 m	[20 + (distance between sep. vertical x 1,04)]m H_2O	4 MPa
4	-160 ... 1600 kPa	100 kPa	≤ 15 m	1600 kPa	4 MPa
Please note! Presented in the table maximum spacing of vertical separators applies to level measuring, the ability to reset the transmitter with an empty tank. For measuring the density or the phase boundary (sugar industry, chemical industry, refineries) spacing of vertical separators can be larger.					

Table 16. APR-2000ALW with diaphragm seals. Measuring ranges with distance separators or distance and direct separators.

APR-2000ALW/G. Measurement ranges of the version with the connection for low pressure measurement gases.					
No.	Base range	Minimum adjustable width of the measuring range	Option of changing the start of the measuring range	Permissible overload	Permissible static pressure.
1	0 ... 2500 Pa	100 Pa	0 ... 2400 Pa	100 kPa	35 kPa
2	-250 ... 250 Pa	20 Pa	-250 ... 230 Pa	35 kPa	35 kPa
3	-700 ... 70 Pa	100 Pa	-700 ... 600 Pa	35 kPa	35 kPa
4	-2500 ... 2500 Pa	500 Pa	-2500 ... 2000 Pa	100 kPa	100 kPa
5	-10 ... 10 kPa	2 kPa	-10 ... 8 kPa	100 kPa	100 kPa

Table 17. APR-2000ALW/G. Measurement ranges of the version with the connection for low pressure gases measurement.

8.6. Basic measurement error

8.6.1. Basic measurement error of pressure transmitter APC(R)-2000ALW

The basic measurement error of APC(R)-2000ALW	
Transmitter	**Declared error**
APC-2000ALW	≤ ±0,075%; ≤ ±0,1% (for the range 19); ≤ ±0,05% (special execution).
APR-2000ALW	≤ ±0,075%;
APR-2000ALW with diaphragm seals	≤ ±0,1%

Table 18. Basic measurement error of APC(R)-2000ALW.

8.6.2. Basic measurement error of differential pressure transmitter APR-2000ALW/G with connection for low pressure gases measurement.

Basic measurement error of APR-2000ALW/G with connection for low pressure gases measurement					
Basic range	0 … 2500 Pa	-250 … 250 Pa	-700 … 700 Pa	-2500 … 2500 Pa	-10 … 10 kPa
Basic error	**≤ ±0,075%**	**≤ ±0,25%**	**≤ ±0,1%**	**≤ ±0,1%**	**≤ ±0,075%**
Basic range	0 … 250 Pa	-50 … 50 Pa	-50 … 50 Pa	-250 … 250 Pa	-1 … 1 kPa
Basic error	**≤ ±0,4%**	**≤ ±1,6%**	**≤ ±1,6%**	**≤ ±0,4%**	**≤ ±0,4%**

Table 19. Basic measurement error of APR-2000ALW with connection for low pressure gases measurement.

8.7. Temperature error

Temperature error	
Transmitter	Declared error
APC-2000ALW	– < ±0,05% (FSO)/10°C (0,1% for ranges: 16, 17, 18, 19); – Max ± 0,25% (FSO) entire range of compensation (0,4% for ranges: 16, 17, 18, 19).
APR-2000ALW	– < ±0,05% (FSO)/10°C (for ranges: 1, 2, 3, 4, 5, 6, 7, 8, 9); – < ±0,08% (FSO)/10°C (for range 10); – Max ±0,25% (FSO) entire range of compensation.
APR-2000ALW/G	– ±0,1% (FSO)/10°C; – Max ±0,4% (FSO) entire range of temperature compensation.

Table 20. Temperature error of pressure and differential pressure transmitter.

8.8. Static pressure error

8.8.1. Measurement error due to static pressure of differential pressure transmitter APR-2000ALW

APR-2000ALW. Measurement error due to static pressure		
Base range No. (FSO)	Maximum declared measurement error referenced to the base range	Comments
3, 4, 5, 6, 7, 9;	±0,01% (FSO) / 1 MPa	
8	±0,03% (FSO) / 1 MPa	
1, 2	±0,06% (FSO) / 1 MPa	
2, 8 (HS)	±0,01% (FSO) / 1 MPa	Version HS
10	±0,02% (FSO) / 1 MPa	
HS - Ultra stable measuring element.		

Table 21. Measurement error due to static pressure of differential pressure transmitter APR-2000ALW.

8.9. Total measurement error

When calculating the total measurement error, the square average of the sum of errors shall be assumed, taking into account the conditions such as the base range, set range, range of ambient temperature variations, range of static pressure variations, long-term stability. Other parameters, such as supply voltage variation or humidity, have a negligible impact on the measurement and may be omitted in calculations.

8.10. Long-term stability

APC(R)-2000ALW. Long-term stability	
Transmitter type.	Maximum declared measurement error referenced to the base range
APC-2000ALW	- for base range ≤ base error for 3 years (FSO) or ≤ 2 x base error for 5 years (FSO); - special execution HS ≤ (ranges 3 … 15) base error for 6 years (FSO) ≤ 2 x base error for 10 years (FSO).
APR-2000ALW	- for base range ≤ base error for 3 years (FSO) ≤ 2 x base error for 5 years (FSO); - special execution HS ≤ (ranges 2, 4, 5, 8, 9) base error for 10 years (FSO).
HS — Ultra stable measuring element.	

Table 22. Long-term stability.

8.11. Time from switch-on to first measurement

The start-up of the transmitter from the activation to the end of the first measurement lasts approx. 0,8 seconds. It is the time of performing basic programme tests and pressure and temperature measurements which constitute a complete process variable measurement chain.

8.12. Measurement thermal stabilization time

Thermal stabilization of the measurement is related to the determination of thermal equilibrium of measurement elements warmed with power supply energy. The transmitter is equipped with mechanisms compensating the impact of temperature on the measurement. After the transmitter is energized, the measurements performed are within the tolerance limits of the errors described in the Technical Information, but in order to perform calibration or adjustment it is recommended to stabilize the temperature conditions. If the transmitter has already been located in a stable temperature, the recommended stabilization time of the transmitter to perform these operations is approximately 15 minutes. When in the transmitter there is a significant difference between the body temperature and the ambient temperature, at which the measurement is to be performed, the temperature stabilization time shall be at least 2 hours.

9. Installation

9.1. General mounting instructions

During installation of transmitter APC(R)-2000ALW on site it may be required to correct the effect of the position on the measurement. This impact applies to the transmitter zero offset (➔ 8.2).
Pressure resetting can be performed by the following methods:

- in the transmitter's local **MENU**, select and accept the **PV ZERO** function with the buttons (➔ 13.2.12);
- using the KAP03 communicator manufactured by Aplisens S.A. or other communicator using DD and DTM libraries;
- using a PC, Raport 2 and HART/USB communicator.

The transmitter with ABS ranges is not capable of performing a pressure resetting operation.
The ABS ranges due to the use of larger pressure ranges are less sensitive to the influence of the mounting position.

The body of transmitter APC(R)-2000ALW can be rotated by max. 330° (➔ 9.5).

Transmitter APC(R)-2000ALW gives the possibility of adjusting the display position to the mounting position of the body. The display may be rotated in total by an angle of 345° with a step of 15° (➔ 9.6).

Transmitters APC(R)-2000ALW may be mounted on a pipe or wall using special brackets and clamps. Exact mounting method is described in (➔ 9.3). Specification of mounting brackets is included in (➔ 12.3).

The method of mounting the transmitter and the configuration of impulse tubes used to feed pressure shall be based on the following conditions:

- impulse tubes should be as short as possible and with a sufficiently large cross section, run without sharp bends;
- impulse tubes must have a constant slope, e.g. 10 cm/m, unless they are looped;
- if the impulse pipes are installed in open air, they must be adequately protected against freezing;
- in the case of gaseous medium, the transmitter must be installed above the measuring point so that the condensate can flow from capillary tubes to the process pipe;
- for liquid and steam, the transmitter must be installed below the measuring point;
- if the measured medium contains particles, it is useful to install separators and drain valves to remove deposits;
- keep the same liquid level or constant level difference in the impulse tubes. It is necessary to ensure the same temperature of both tubes and correct the error due to the impact of the position and filling of impulse tubes by pressure resetting;
- avoid installation of a measuring orifice at high points of a process system for liquids and at low points for gases;
- the configuration of impulse tubes and three- or five-way valve connection system shall be selected taking into account the measurement conditions and such functions as "pressure resetting" of transmitters on site. In addition, it is necessary to take into account the impulse routes during degassing, dewatering and flushing.

The transmitter parts must be selected according to chemical (corrosive) properties of the process medium. Pay particular attention to the diaphragm material. For more information on wetted parts materials in item (➔ 12.5).

9.2. Measuring system

Flow measurement.

Transmitter **APR-2000ALW** enables to perform the measurement of gas, steam and liquid flow (➔ 2.3).
In case of gas flow measurement, the transmitter must be installed above the measuring point (➔ 2.3.1).
For measurement of steam and liquid flow, the transmitter should be installed below the measuring point (➔ 2.3.2; ➔ 2.3.3). Additionally, when measuring the steam flow, condensate traps must be installed at the level of the measuring point and at the same distance from transmitter **APR-2000ALW.**

Level measurement.

Transmitters APC(R)-2000ALW enable the liquid level measurement in open and closed tanks (➔ 2.4).

- *Level measurement system in open tanks*
  APR-2000ALW: install the transmitter below the measuring point; the negative side of the pressure connection remains open to the atmosphere (➔ 2.4.1).
  APR-2000ALW: install the transmitter directly on the tank; the negative side of the pressure connection remains open to the atmosphere (➔ 2.4.2).
  Install transmitter **APC-2000ALW** directly into the tank below the minimum liquid level (➔ 2.4.3).

- *Level measurement system in closed tanks, also with steam pillow*
  APR-2000ALW : install the transmitter below the measuring point; the negative side of the pressure connection should be connected via capillary tube to the tank above the maximum liquid level (➔ 2.4.4).
  APR-2000ALW: install the transmitter directly on the tank using an integrated separator; the negative side of the pressure connection must be connected via the capillary tube to the tank above the maximum liquid level (➔ 2.4.5).
  APR-2000ALW with diaphragm seals: install the transmitter below the mounting points of distance separators (➔ 2.4.6).
  APR-2000ALW with diaphragm seals: install the transmitter directly on the tank using an integrated separator; the negative side of the pressure connection must be connected via the distance separator above the maximum liquid level (➔2.4.7).
  APR-2000ALW: install the transmitter below the measuring point; the negative side of the pressure connection must be connected via the capillary tube above the maximum liquid level (➔ 2.4.8).
  APR-2000ALW: install the transmitter directly on the tank using a direct separator; the negative side of the pressure connection must be connected via the capillary tube above the maximum liquid level (➔ 2.4.9).

Pressure measurement.

Transmitters APC(R)-2000ALW enable to measure pressure and differential pressure of gases, steam and liquids (➔ 2.5; ➔ 2.6).

- Gas pressure measurement:

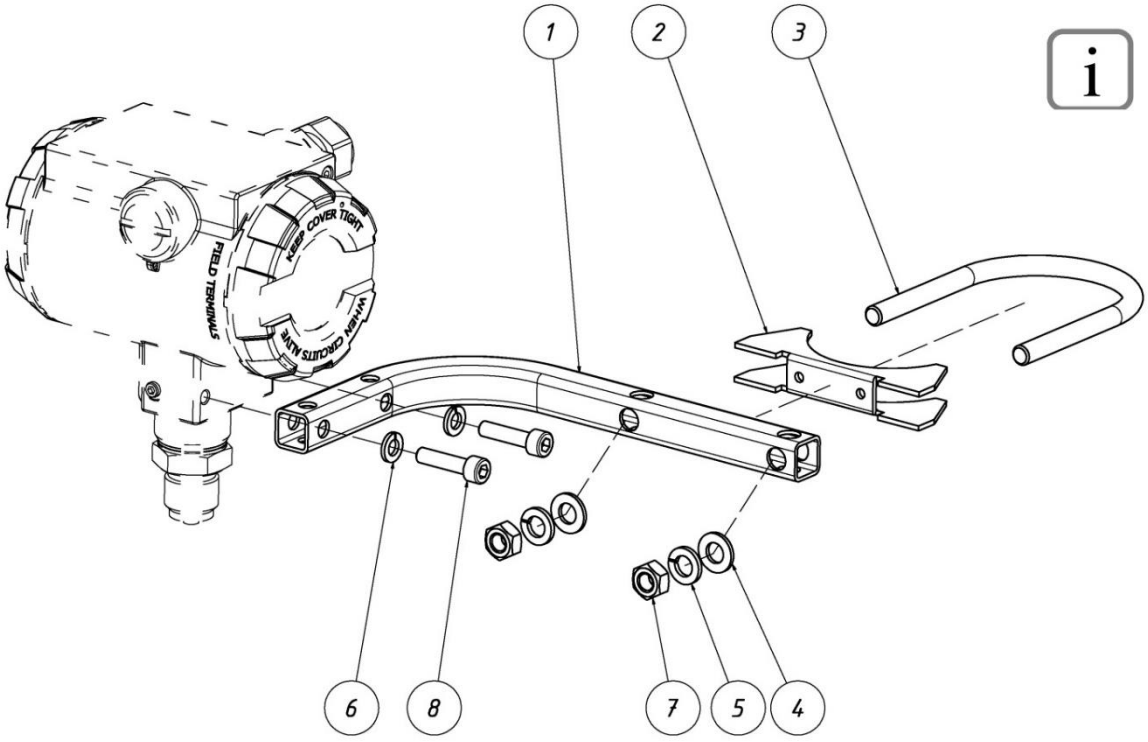
APC-2000ALW: install the transmitter above the measuring point (➔ 2.5.1).
Steam pressure measurement:
APC-2000ALW: install the transmitter below the measuring point (➔ 2.5.2).

Differential pressure measurement

Gas and steam differential pressure measurement:
Transmitter **APC-2000ALW** must be installed above the measuring point (➔ 2.6.1).
Liquid differential pressure measurement:
Transmitter **APC-2000ALW** must be installed below the measuring point (➔ 2.6.2).
Gas, steam and liquid differential pressure measurement with the use of distance separators:
Transmitter **APR-2000ALW with diaphragm seals** must be installed below the measuring point (➔ 2.6.3).

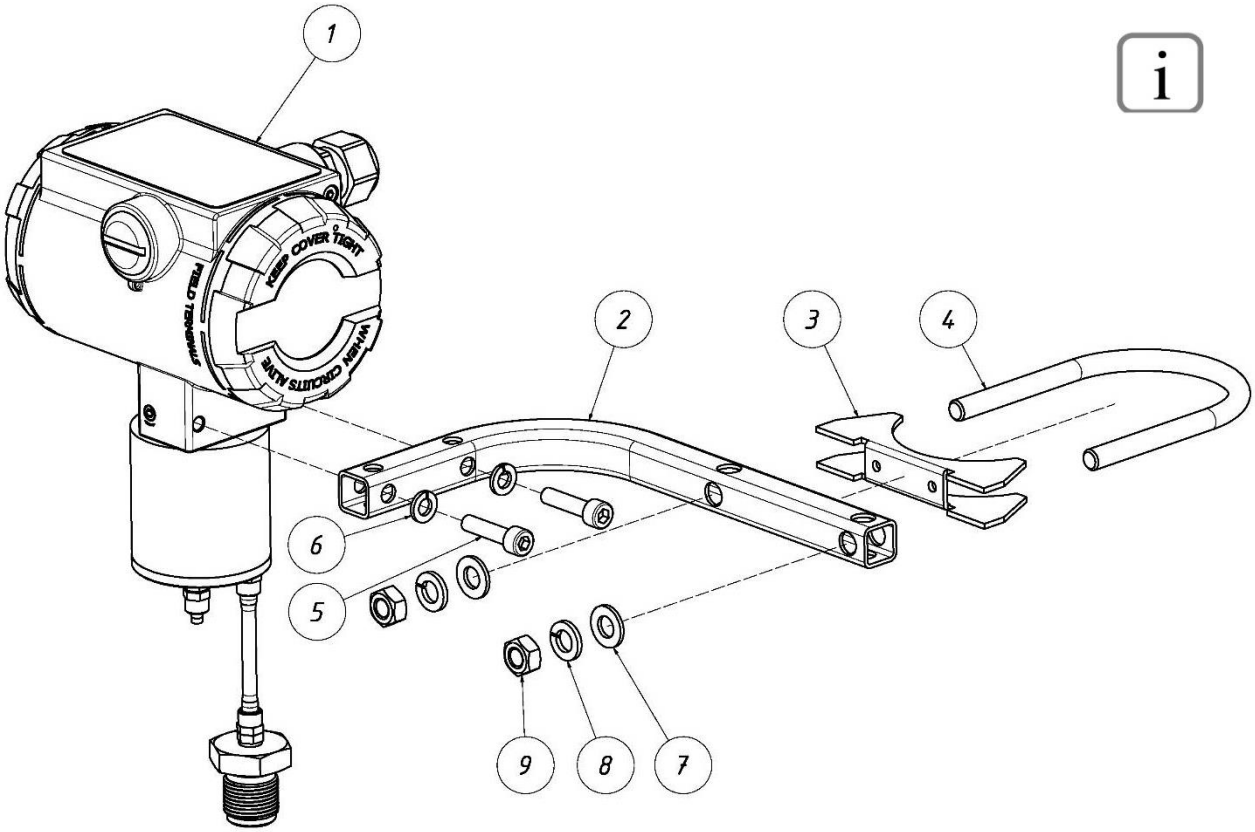
9.3. Pipe and wall mounting

Transmitter APC(R)-2000ALW can be mounted on the wall by means of an AL mounting arm (item 1) or to the pipe using the components as shown below:



1. AL mounting arm.
2. C2 clamp V-block.
3. Pipe mounting lug.
4. Flat washer Ø 8.4 acc. to DIN 125 (2 pcs).
5. Spring washer Ø 8.1 acc. to DIN 127 (2 pcs).
6. Spring washer Ø 6.1 acc. to DIN 127 (2 pcs).
7. M8 nut acc. to DIN 934 (2 pcs).
8. Hex socket head cap screw M6x25 acc. to DIN 912 (2 pcs).

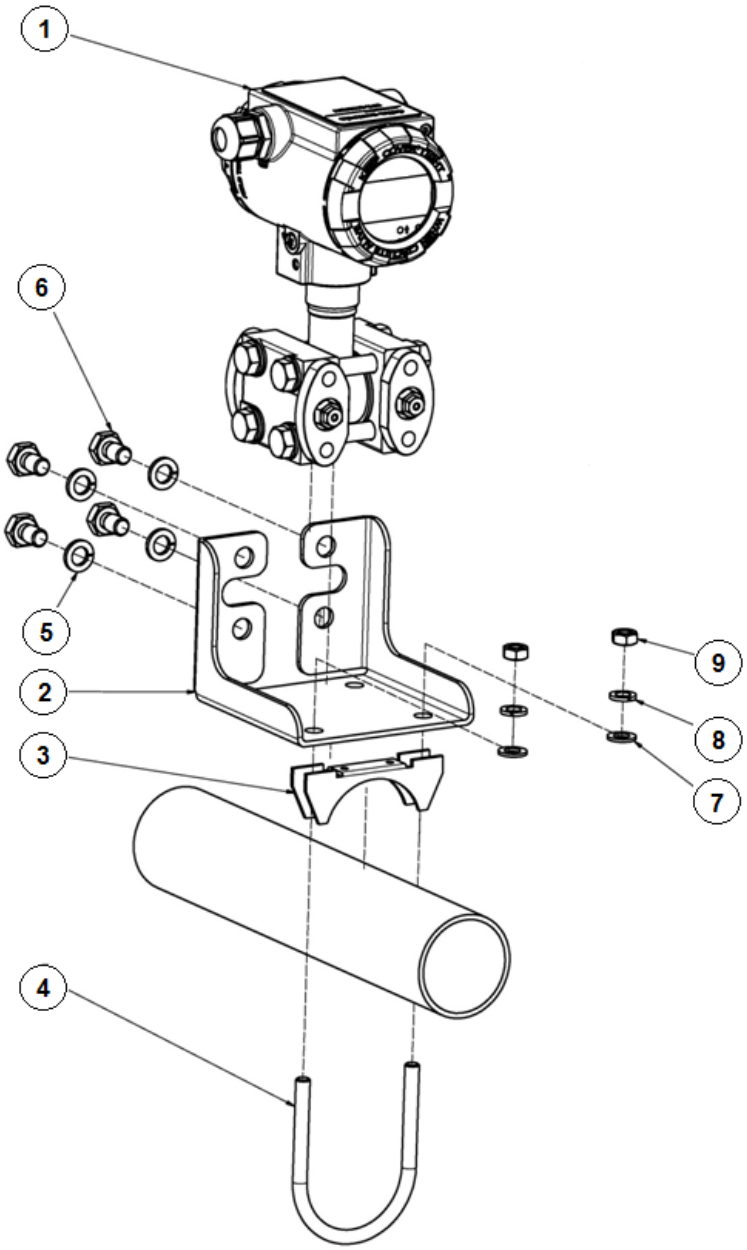
Figure 35. Transmitter APC-2000ALW. Wall and pipe mounting.



1. APR-2000ALW/G.
2. AL mounting arm.
3. C2 clamp V-block.
4. Pipe mounting lug.
5. Hex socket head cap screw M6x25 acc. to DIN 912 (2 szt.).
6. Spring washerØ6,1 acc. to DIN 127 (2 pcs.).
7. Flat washer Ø8,4 acc. to DIN 125 (2 pcs.).
8. Spring washer Ø8,1 acc. to DIN 127 (2 pcs.).
9. M8 nut acc. to DIN 934 (2 pcs.).

Figure 36. Transmitter APR-2000ALW/G. Wall and pipe mounting using AL mounting arm.

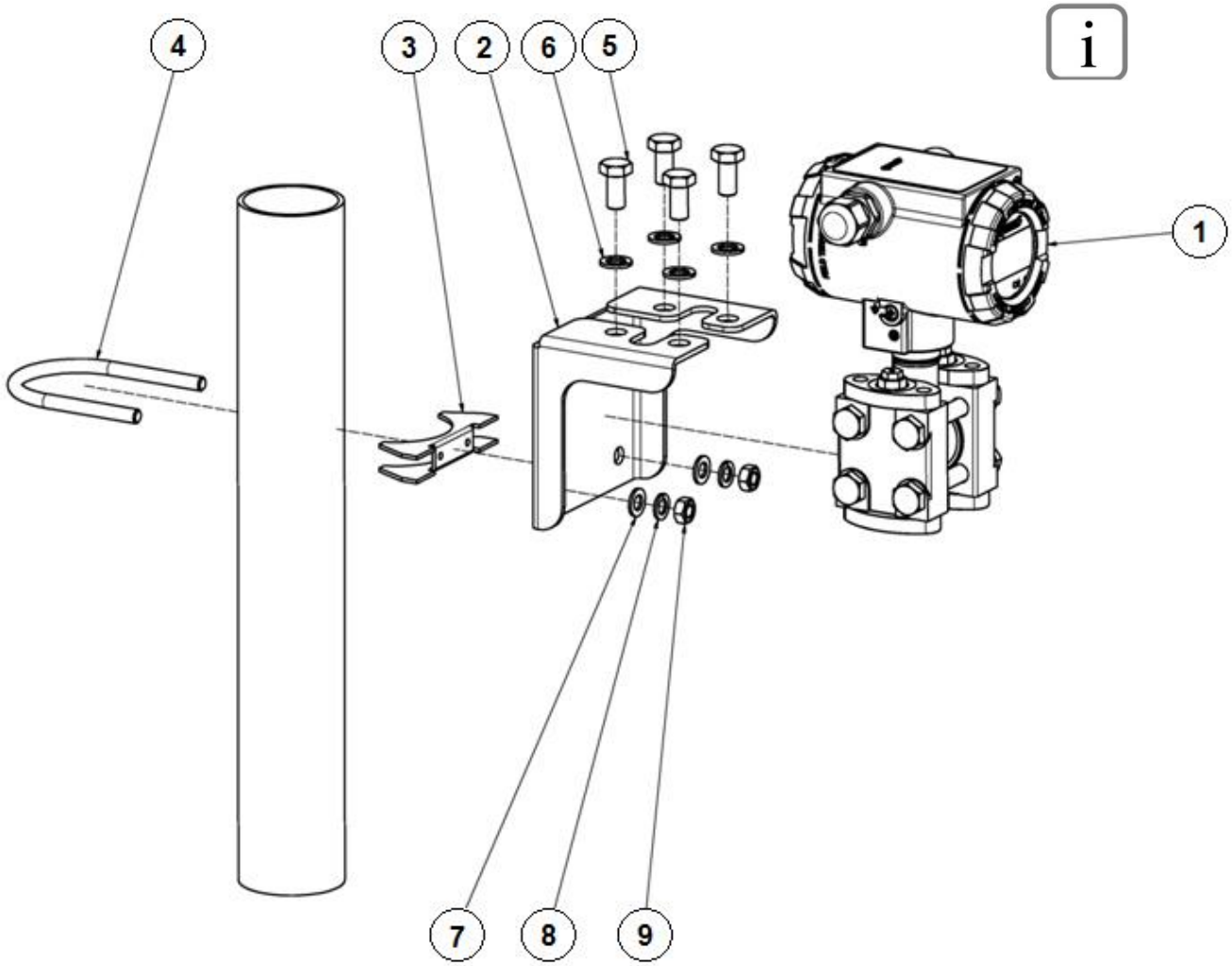
Differential pressure transmitters APR-2000ALW with process connection of C type can be mounted to the pipe using the mounting bracket C2 in the following way:



1. APR-2000ALW with process connection C.
2. C2 bracket.
3. V-block.
4. Pipe mounting lug.
5. Spring washer Ø 10.2 acc. to DIN 127A (4 pcs).
6. Screw M10x16 acc. to DIN 933 (4 pcs).
7. Flat washer Ø 8.4 acc. to DIN 125 (2 pcs).
8. Spring washer Ø 8.1 acc. to DIN 127 (2 pcs).
9. M8 nut acc. to DIN 934 (2 pcs).

Figure 37. Transmitter APR-2000ALW with C type process connection. Mounting on pipe.

Differential pressure transmitters APR-2000ALW with process connection of CR type can be mounted to the pipe using the mounting bracket C2 in the following way:



1. APR-2000ALW with process connection CR.
2. C2 bracket.
3. V-block.
4. Pipe mounting lug.
5. Screw M10x16 acc. to DIN 933.
6. Spring washer Ø10.2 acc. to DIN 127A (4 pcs).
7. Flat washer Ø 8.4 acc. to DIN 125 (2 pcs).
8. Spring washer Ø 8.1 acc. to DIN 127 (2 pcs).
9. M8 nut acc. to DIN 934 (2 pcs).

Figure 38. Transmitter APR-2000ALW with CR process connection. Mounting on pipe.

9.4. Version with distance separator

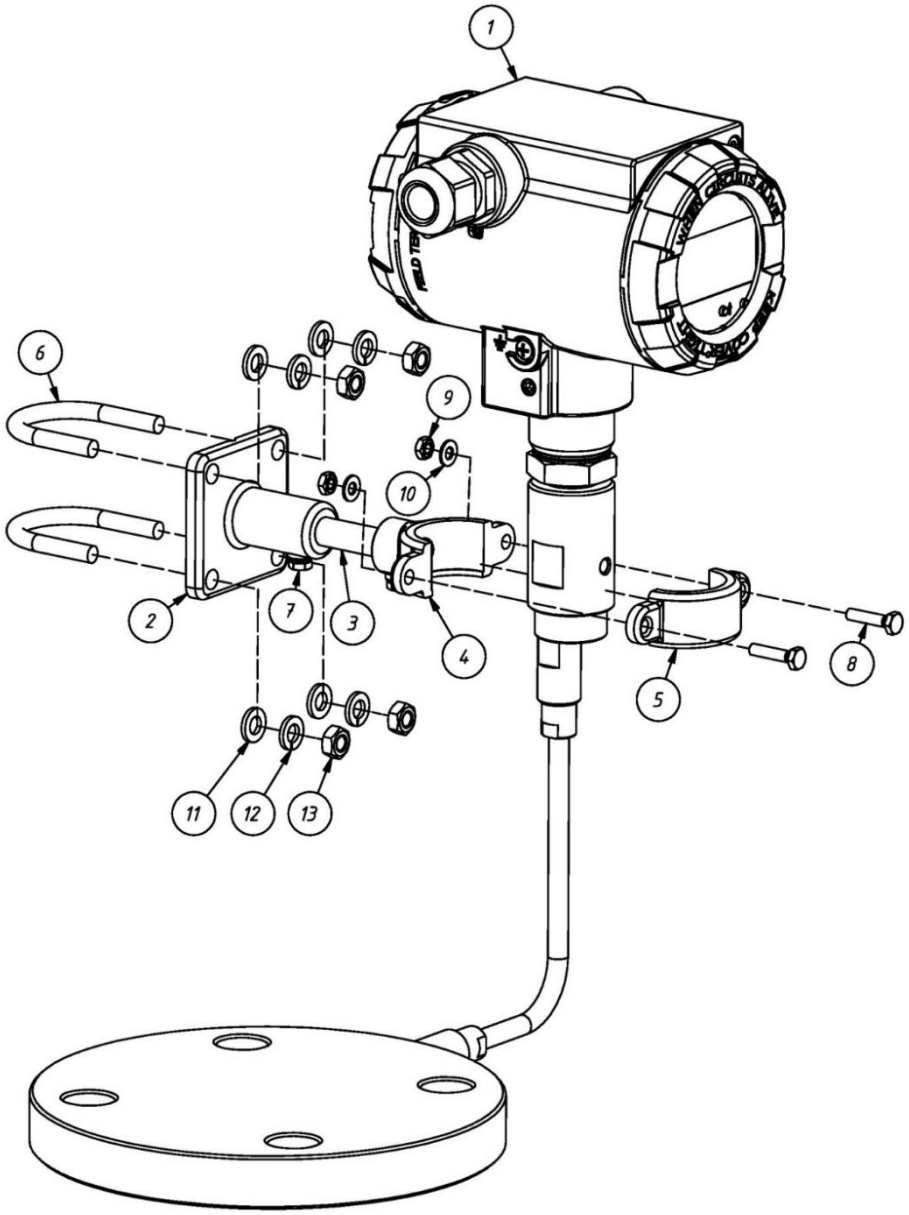


Figure 39. Assembly and mounting of the variant with distance separator.

List of parts for the PCR version bracket (pipe mounting):

1. APC-2000ALW with distance separator.
2. Bracket body.
3. Bracket pin.
4. Bracket clamp (bottom).
5. Bracket clamp (top).
6. Pipe mounting lug (2 pcs).
7. Screw M5x10 acc. to DIN 933 (2 pcs).
8. Screw M5x18 acc. to DIN 933 (2 pcs).
9. M5 nut acc. to DIN 934 (2 pcs).
10. Flat washer ø5.3 acc. to DIN 433 (2 pcs).
11. Flat washer Ø 6.4 acc. to DIN 125 (4 pcs).
12. Spring washer Ø 6.1 acc. to DIN 127 (4 pcs).
13. M6 nut acc. to DIN 934 (4 pcs).

List of parts for the PC version bracket (wall mounting):

1. APC-2000ALW with distance separator.
2. Bracket body.
3. Bracket pin.
4. Bracket clamp (bottom).
5. Bracket clamp (top).
7. Screw M5x10 acc. to DIN 933 (2 pcs).
8. Screw M5x18 acc. to DIN 933 (2 pcs).
9. M5 nut acc. to DIN 934 (2 pcs).
10. Flat washer ø5.3 acc. to DIN 433 (2 pcs).

9.5. Rotation of transmitter body

Transmitters APC(R)-2000ALW can be rotated by 330°.
In order to do so:

- loosen the screw (item 1) to allow the housing to be rotated;
- position the transmitter housing as required (item 2);
- tighten the screw (item 1).

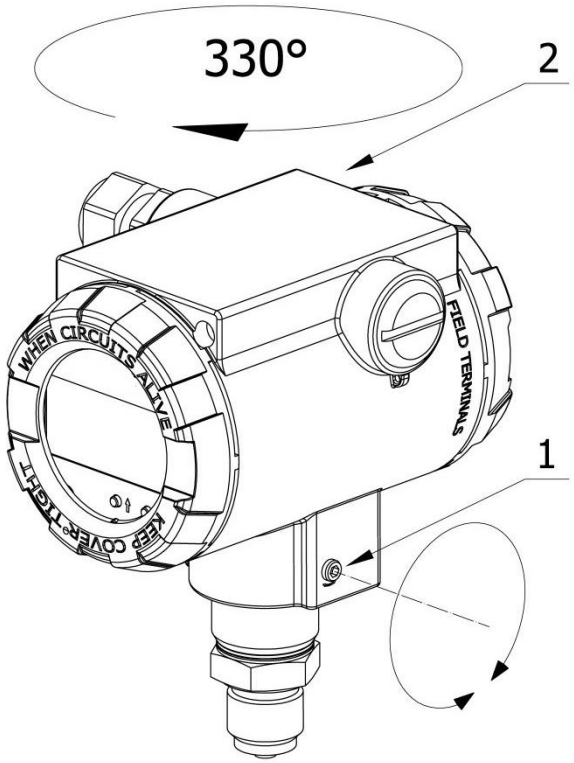
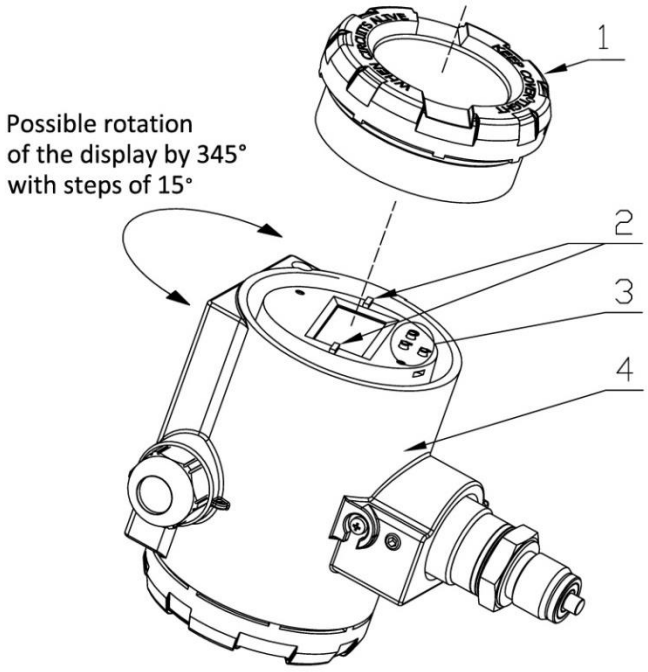


Figure 40. Rotation of APC(R)-2000ALW transmitter housing.

9.6. Rotation of display

The transmitter gives the possibility of adjusting the display position to the mounting position of the body. Access to the extensions (item 2) used to rotate the display is provided after opening the front cover (item 1). The display may be rotated by an angle of 345° with a step of 15°.



1. Front cover.
2. Extensions for display rotation.
3. Local keypad buttons.
4. Housing.

Figure 41. Change of display position and access to buttons.

9.7. Oxygen applications

Oxygen and some other gases are highly explosive when they come into contact with oil, any fats and plastics, therefore it is necessary to take the following measures:

- all components of the measuring system must be cleaned and degreased.

Transmitters APC(R)-2000ALW are available in the version suitable for oxygen measurements. At the user's request, a washing certificate (➔ 16.7.7) may be issued to confirm the possibility of using pressure and differential pressure transmitters in oxygen systems, and the interior of the measurement heads is filled with a chemically inert liquid.

9.8. Hydrogen applications

For applications where the process medium contains hydrogen, there is a risk that the hydrogen atoms will penetrate through the metal and diaphragm into the sensor chamber. This phenomenon causes false measurement results and, in some cases, it may result in the damage to the sensor.
For this type of application, Aplisens S.A. offers diaphragms coated with gold (Au) layer, designed for pressure measurement of the hydrogen-containing media.
More information in item (➔ 12.5) “Specification of materials coming into contact with the process”.

10. Environment

10.1. Operating temperature range

APC(R)-2000ALW. Operating temperature range	
Transmitter type	Operating temperatures
APC-2000ALW	-40°C ... +85°C
APR-2000ALW	-40°C ... +85°C
APC(R)-2000ALW with diaphragm seals	-25°C ... +85°C
APR-2000ALW/G	-25°C ... +85°C
APC-2000ALW Exi	-40°C ... +80°C
APR-2000ALW Exi	-40°C ... +80°C
APC(R)-2000ALW Exi with diaphragm seals	-25°C ... +80°C
APR-2000ALW/G Exi	-25°C ... +80°C
Special version	From -50°C

Table 23. Operating temperature range.

10.2. Storage temperature range

APC(R)-2000ALW. Storage temperature range	
Transmitter type	Storage temperatures
APC-2000ALW	-40°C ... +85°C
APR-2000ALW	-40°C ... +85°C
APC(R)-2000ALW with diaphragm seals	-25°C ... +85°C
APR-2000ALW/G	-25°C ... +85°C
APC-2000ALW Exi	-40°C ... +80°C
APR-2000ALW Exi	-40°C ... +80°C
APC(R)-2000ALW Exi with diaphragm seals	-25°C ... +80°C
APR-2000ALW/G Exi	-25°C ... +80°C
Special version	From -50°C

Table 24. Storage temperature range.

10.3. IP protection rating

APC(R)-2000ALW. IP protection rating	
Transmitter type	IP
APC-2000ALW	IP66 IP67 special version
APR-2000ALW	IP66 IP67 special version
APC(R)-2000ALW with diaphragm seals	IP66 IP67 special version
APR-2000ALW/G	IP66

Table 25. IP protection rating.

10.4. Climatic class

APC(R)-2000ALW. Climatic class	
Test basis, standard title	Conditions
EN 60068-2-2:2007, item 3.7 DNV, Dry heat	Test B, T = +70°C, RH = max 55%
EN 60068-2-1:2007, item 3.9 DNV, Cold	Test A, T = -25°C
EN 60068-2-30:2008, item 3.8 DNV, Damp heat, cyclic	Db test, (T = +55°C, RH = min. 95%, 24 h) x 2 cycles
EN 60068-2-52:2001, item 3.10 DNV, Salt mist, cyclic (sodium chloride solution)	Kb test (spraying for 2 h, T = +25°C, storage for 7 days, T = +40°C, RH = 93%) x 4 cycles, together 28 days

Table 26. Climatic class.

10.5. Vibration and surge resistance

APC(R)-2000ALW. Vibration and surge resistance.			
Type of disturbance	Standard	Type of housing	Exposure parameters
Surges	EN 60068-2-27	Stainless steel	20 g/10 ms; 18 surges (3 per each direction of axle)
		AL	50 g/10 ms; 600 surges (100 per each axle direction)
Sinusoidal vibrations	EN 60068-2-6, Fc test	Stainless steel	±15 mm, 10 … 60Hz ±20 m/s^2, 60 … 1000Hz
		AL	±35 mm, 10 … 60Hz ±50 m/s^2, 60 … 1000Hz

Table 27. Vibration and surge resistance.

10.6. Electromagnetic compatibility

Electromagnetic compatibility acc. to EN 61326-1, EN 61326-2-3 for industrial applications		
Type of disturbance	Standard	Level
Electrostatic discharge (ESD)	EN 61000-4-2	contact ±6 kV air ±8 kV
Radiated electromagnetic field	EN 61000-4-3	80 … 1000 MHz – 10 V/m 1.4 … 2 GHz – 3 V/m 2 … 2.7 GHz – 1 V/m
Fast electrical transients (burst)	EN 61000-4-4	± 2 kV, I/O
Surges	EN 61000-4-5	± 2 kV, line – earthing
Conducted interruptions induced by radio-frequency fields:	EN 61000-4-6	0.15 … 80 MHz, 3 V
Emission	EN 55011	30 … 1000 MHz (group 1, class A)

Table 28. Electromagnetic compatibility.

11. Process

11.1. Process temperature limits (applies to the temperature of transmitter components)

Components of transmitter APC(R)-2000ALW		Temperature limits of	
		Process	Medium
Separators	1.4404 (316L) Hastelloy C 276 Teflon® Nickel Titanium Tantalum Monel	from -40°C to +85°C from -25°C to +85°C[2)]	from -40°C to +120°C in direct measurements. Above 120°C in distance measurements.
Diaphragms	1.4404/1.4435 (316L) Hastelloy C 276 Nickel Titanium Tantalum Monel Teflon[1)] Gold[1)]		
Process connections	1.4404 (316L) Hastelloy C 276		
1) Layer sprayed on 316L steel diaphragm. 2) APR-2000ALW/G			

Table 29. Temperature limit for individual transmitter components.

- The temperature of the measured medium cannot cause an increase in the temperature of the transmitter housing above the temperatures specified in the table;
- measurement of the medium with temperature above 85°C is possible only with the use of a separator, stub with a radiator or impulse tube;
- the temperature ranges of the measured medium should be observed due to the applied gauge fluid in the process connection. Information on gauge fluids is given in section (➔ 14.2);
- for oxygen measurement applications, the guidelines given in item (➔ 9.7) “Oxygen application” shall be observed;
- observe the permissible temperature range for gaskets, given in item (➔ 11.2) “Operating temperature ranges of gaskets”.

11.2. Operating temperature ranges of the used gaskets

Sealing material	Permissible ranges of operating temperatures*
NBR	from -40°C to +85°C
HNBR	from -40°C to +85°C
PTFE	from -40°C to +85°C
EPDM	from -40°C to +85°C
Silicone	from -40°C to +85°C
FPM	from -20°C to +85°C
Copper	from -30°C to +85°C
* The permissible operating temperature range depends on the transmitter configuration.	

Table 30. Temperature ranges for the transmitter sealing elements.

11.3. Specification of allowable pressures

The maximum pressure value for transmitters APC(R)-2000ALW is dependent on the measuring system component with the lowest nominal pressure. The relevant data are included in section (➔ 8.5) “Measurement ranges”.
The maximum static pressure is specified on the transmitter nameplate APR-2000ALW / APR-2000ALW (with diaphragm seals) / APR-2000ALW/G.
For oxygen measurement applications, it shall be necessary to follow the instructions and the values provided in section (➔ 9.7) “Oxygen applications”.

12. Mechanical design

Housing:

standard version:

- varnished housing of AL 164 type made of high pressure casting of aluminium alloy ZLD 102;
- stainless steel housing: acid resistant steel 1.4401 (316).

Special version:

- high pressure aluminium alloy casting, varnished;
- stainless steel 1.4401 (316).

Housing protection rating (acc. to PN-EN60529:2003):

- IP66;
- IP67.

The main component of the transmitter and the probe is a measuring head with the silicon diaphragm installed. The measuring heads may be equipped with different pressure connections. Inside the head there is a "pressure chamber" filled with gauge fluid. On the side of the measured medium, it is limited by a separating diaphragm welded tightly to the head body (differential pressure transmitters have two separating diaphragms for inputs: "+" and "-").

12.1. Dimensions of body with pressure process connection

The transmitter height is calculated as a sum of heights of the following elements:

Housing. + Optionally mounted parts such as separators, capillary tubes etc. + Heights of process connection.

Please note!

If necessary, the mounting distances essential for installation of the transmitter must be considered.

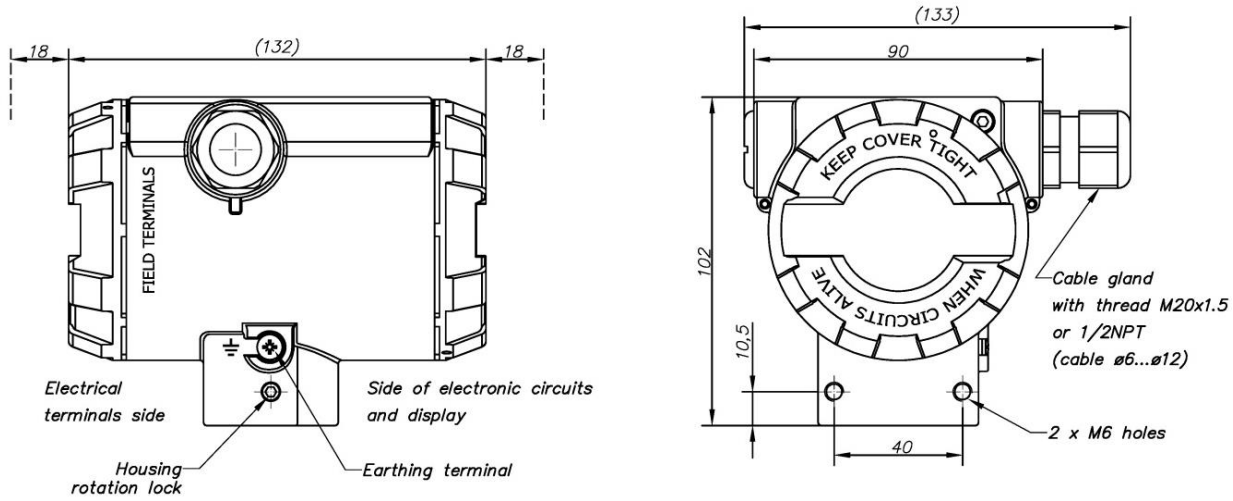


Figure 42. Overall dimensions of APC(R)-2000ALW.

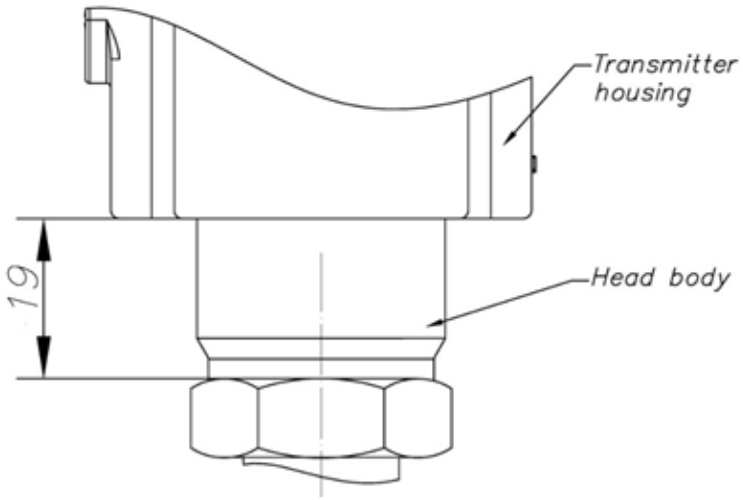


Figure 43. Overall dimensions of a measuring head for transmitter APC(R)-2000ALW.

12.2. Process connections

12.2.1. **Specification of process connections for APC-2000ALW**

Type M (M20x1.5, Ø4)

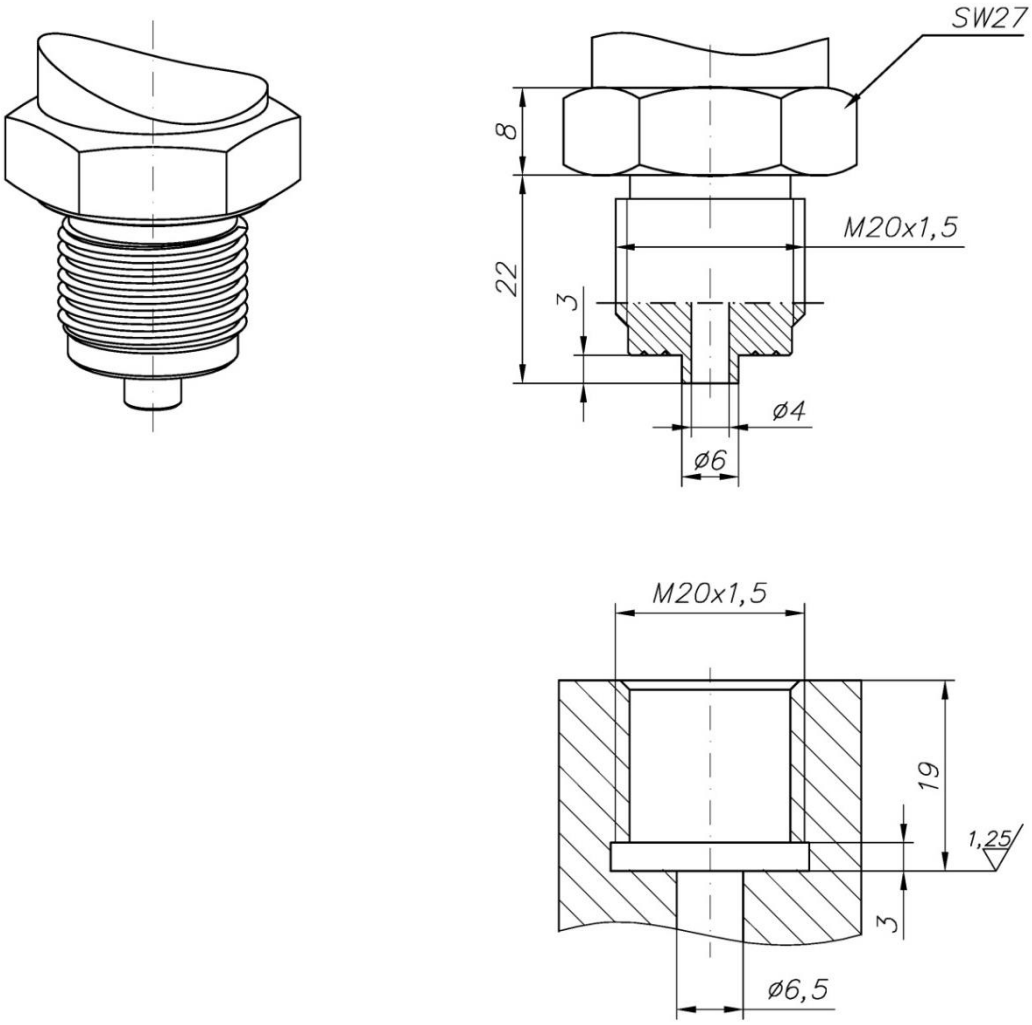


Figure 44. Type M connection (M20x1.5, Ø4) with socket.

Material:

- standard version: steel 316L;
- special version: **Au** – gold-plated diaphragm; **Oxygen** – head suitable for oxygen measurement.

Return ➔ Table 4. Transmitter versions, process connections.

Type P (M20x1.5, Ø12)

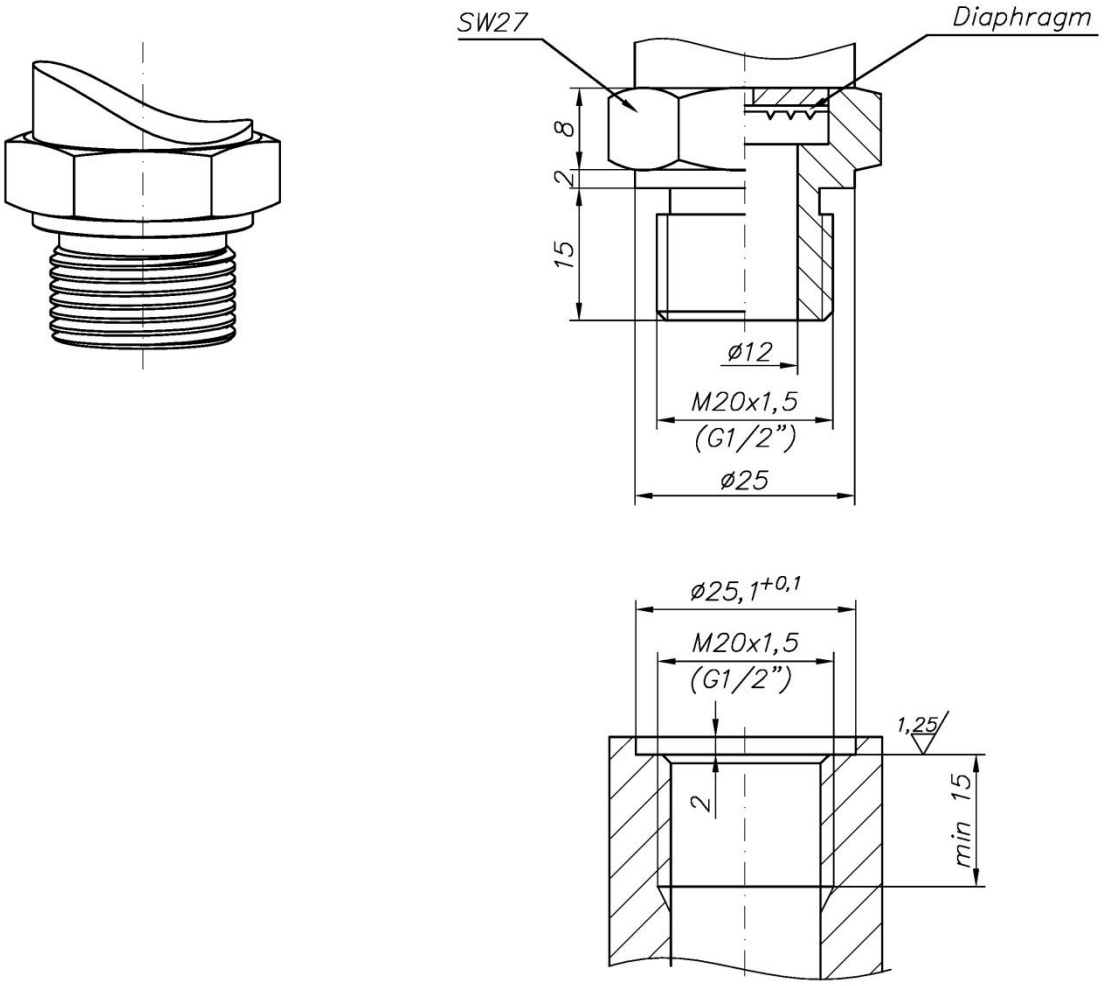


Figure 45. Type P connection (M20x1.5, Ø12) with socket.

Material:

- standard version: steel 316L;
- special version: **Hastelloy** C 276; **Oxygen** – head suitable for oxygen measurement.

Type ½ NPT (ext. ½ NPT, inner G ¼")

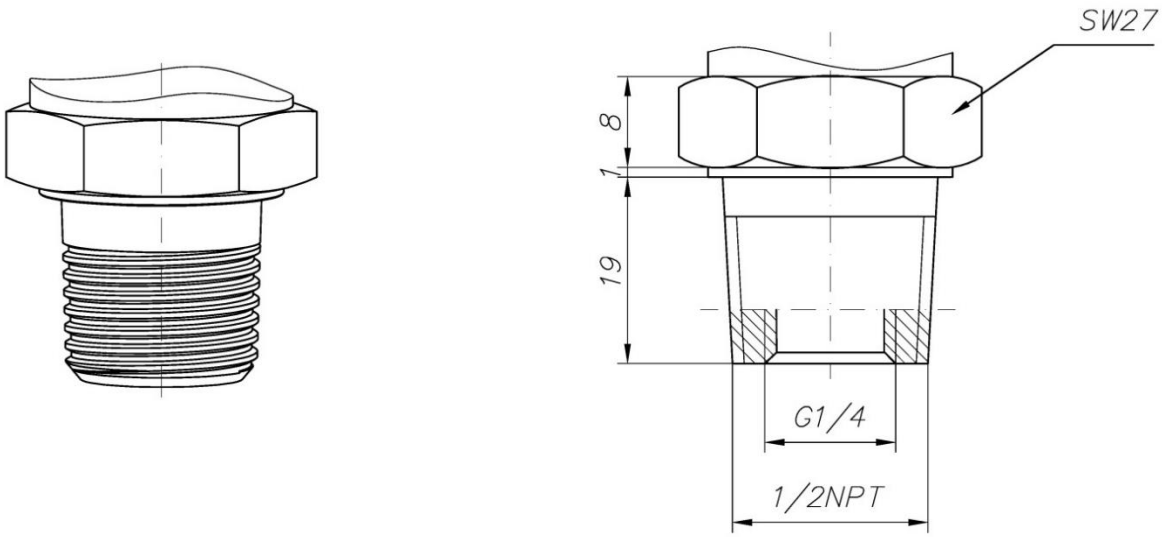


Figure 46. Type ½ NPT connection (ext. ½ NPT, inner G ¼").

Material:

- standard version: steel 316L;
- special version: **Hastelloy** C 276.

Type G ½“ (G ½’’, Ø4)

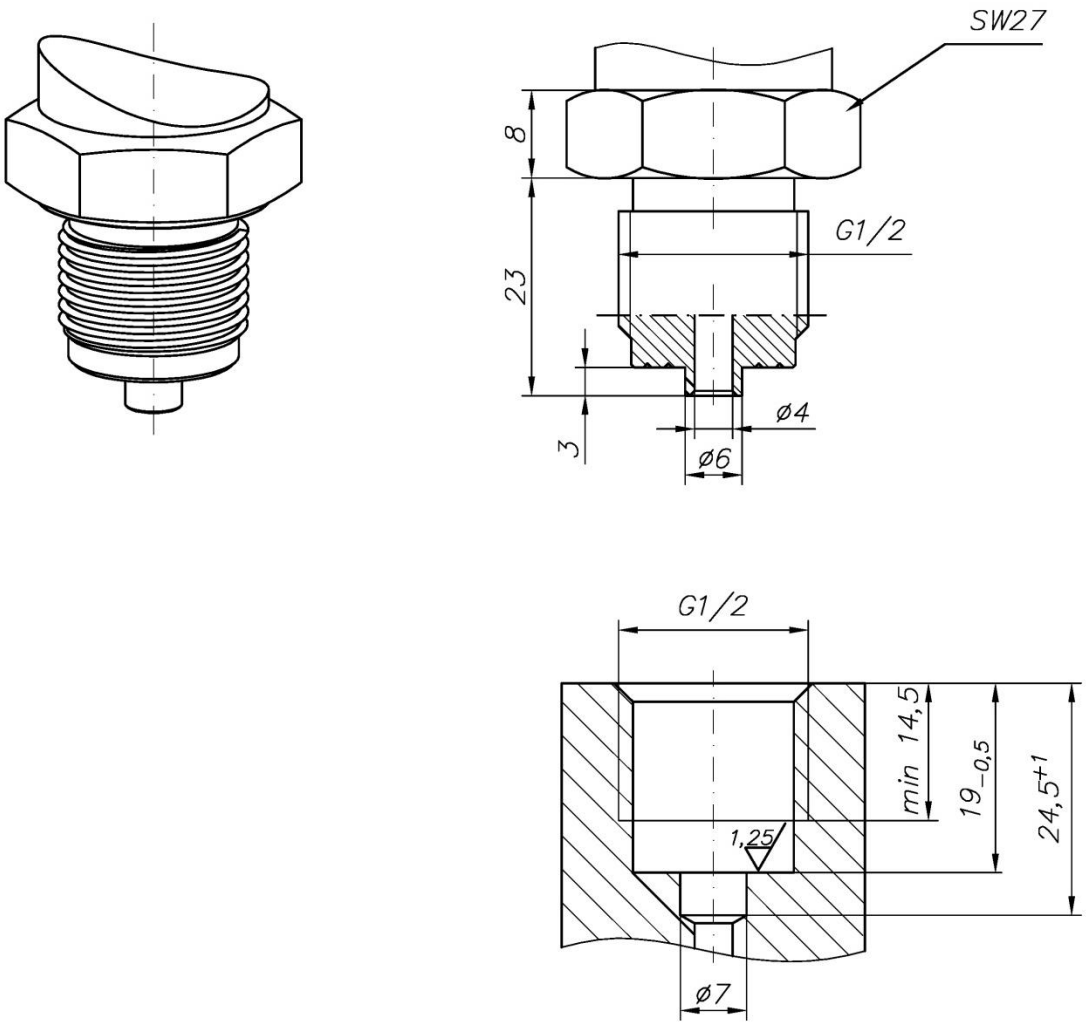


Figure 47. Type G ½" connection,(G ½”, Ø4) with socket.

Material:

- standard version: steel 316L;
- special version: **Au** – gold-plated diaphragm; **Oxygen** – head suitable for oxygen measurement.

Type GP (G ½, Ø12)

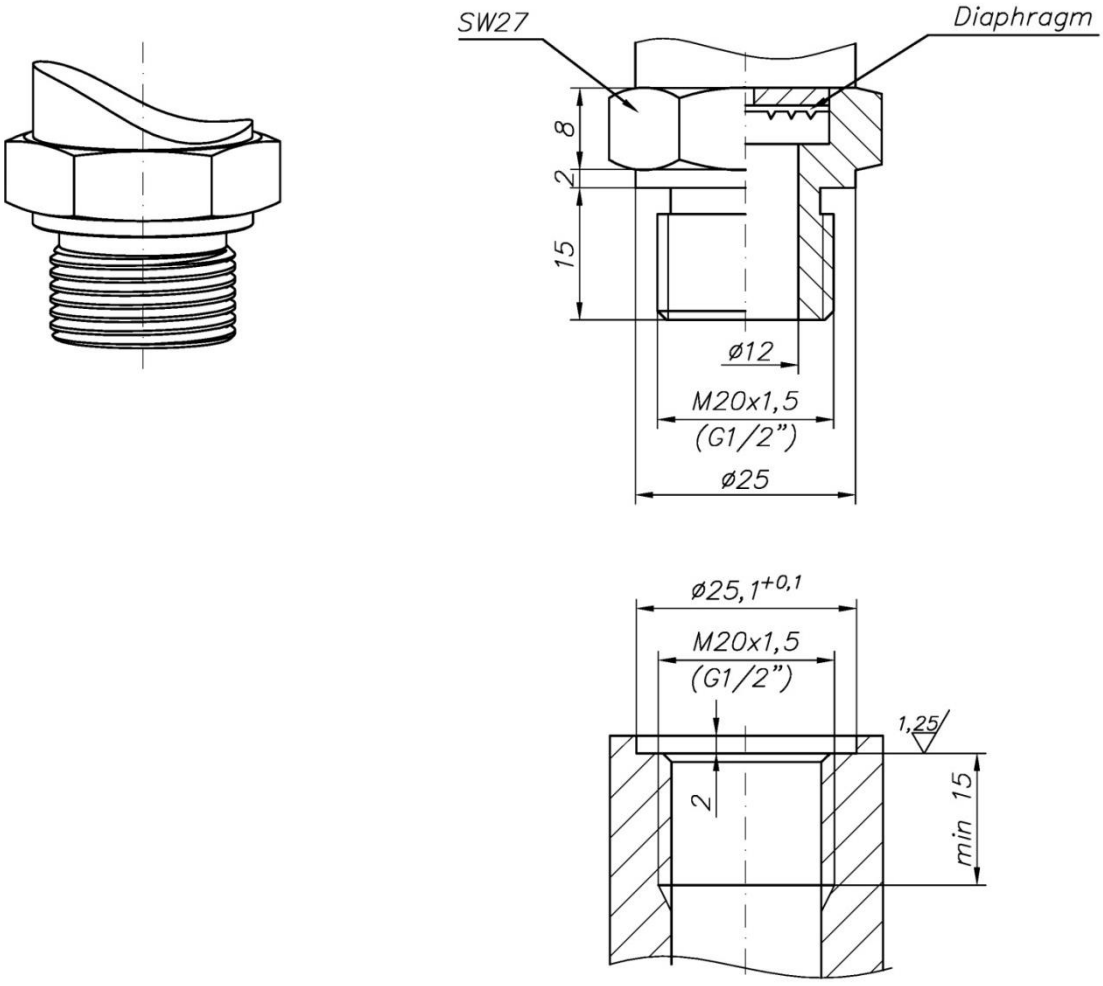


Figure 48. Type GP connection (G ½, Ø12) with socket.

Material:

- standard version: steel 316L;
- special version: **Hastelloy** C 276; **Oxygen** – head suitable for oxygen measurement.

Type CM30x2 (M30x2)

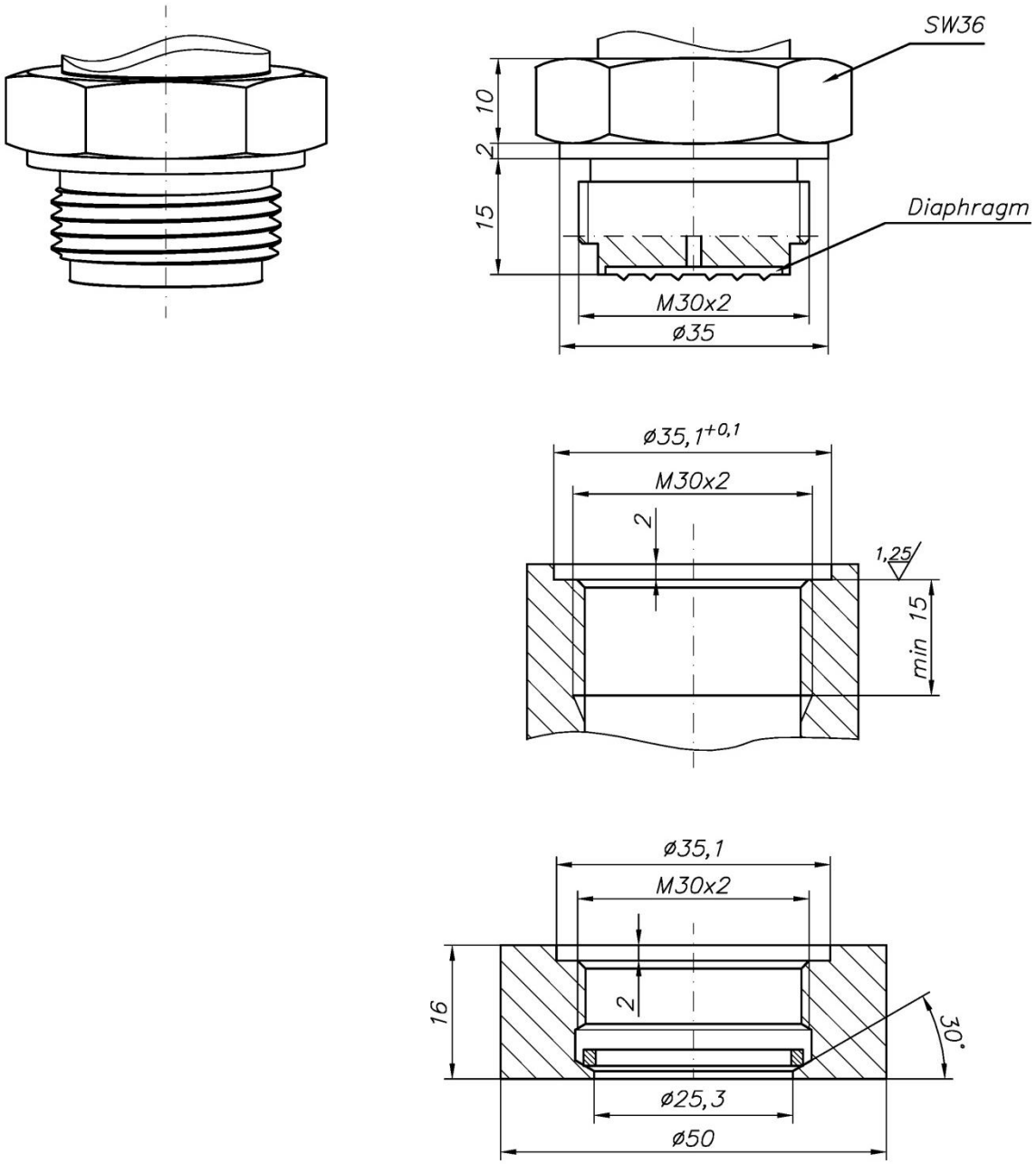


Figure 49. Type CM30x2 connection (M30x2) with socket and ring.

Material:

- standard version: steel 316L;
- special version: **Hastelloy** C 276; **Au** – gold-plated diaphragm;
- sealing: PTFE.

Type CG1 (G1”)

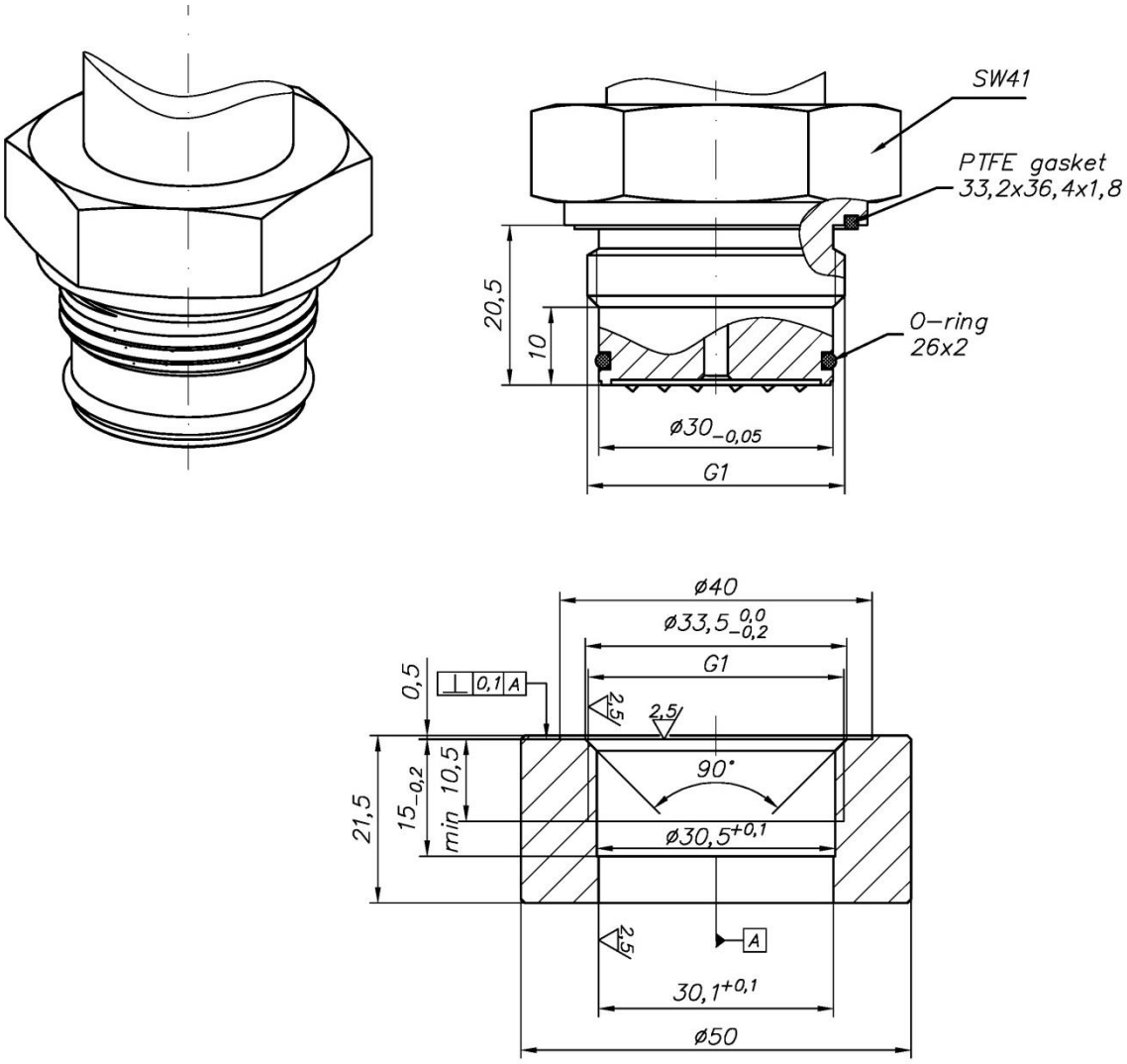
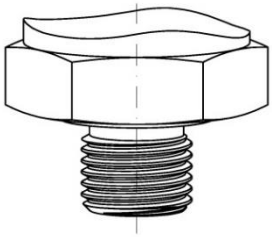


Figure 50. Type CG1 connection (G1”) with socket.

Material:

- standard version: steel 316L;
- special version: **Au** – gold-plated diaphragm.

Type G ¼ (G ¼", Ø4)



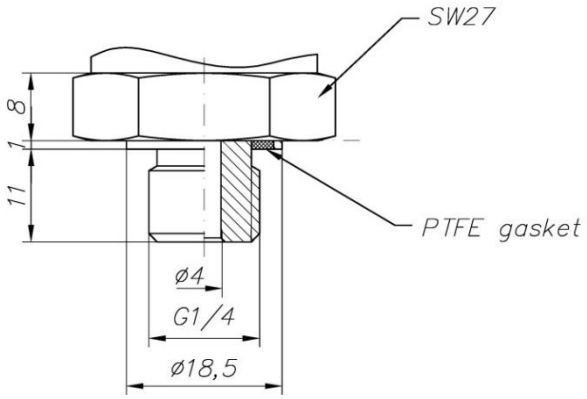
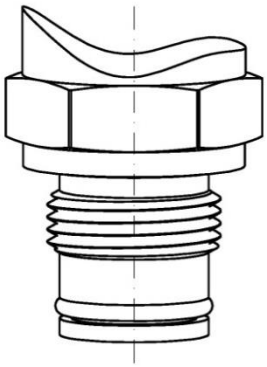
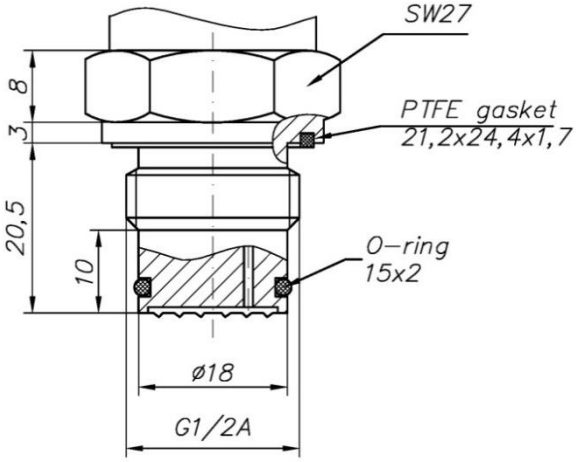


Figure 51. Type G ¼ connection (G ¼", Ø4).

Material – standard version: steel 316L.

Type CG ½ (G ½")





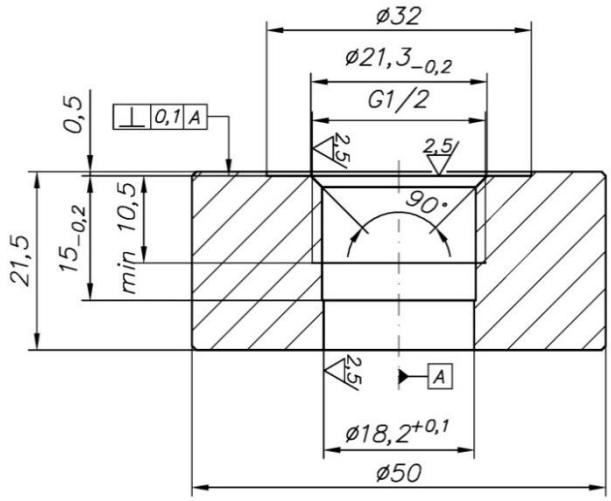


Figure 52. Type CG ½ connection with socket.

Material:

- standard version: steel 316L;
- special version: **Au** – gold-plated diaphragm.

Type: RM radiator with M stub M20x1,5 / RG radiator with G ½ stub

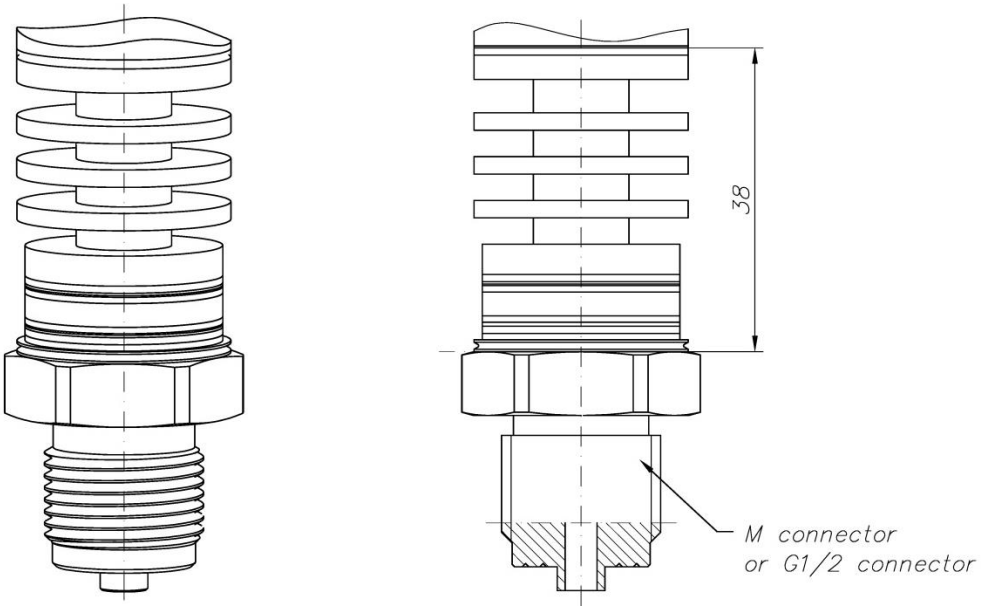


Figure 53. Radiator with M20x1,5 or G ½ stub.

Material – standard version: steel 316L.

12.2.2. **Adapters**

Material:
- Steel 316L
- Brass

- **G ½ “**

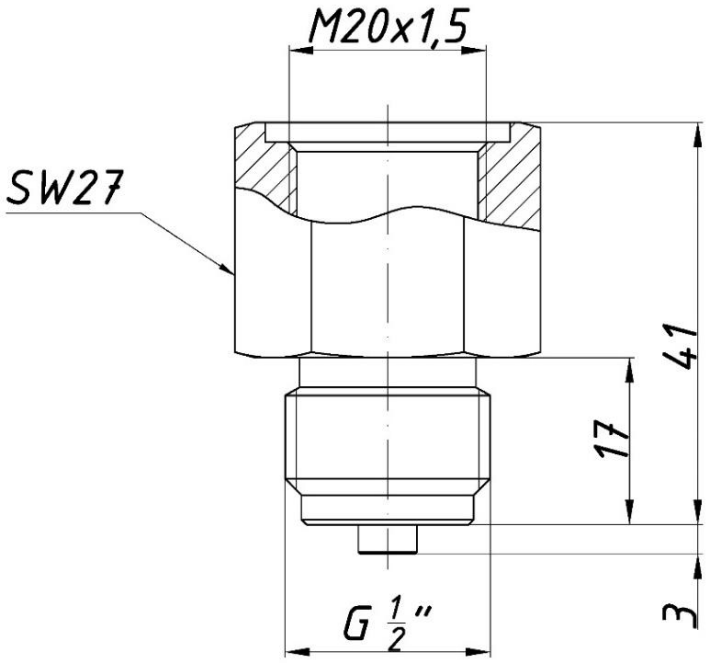


Figure 54. Adapter G ½”.

- **R ½“**

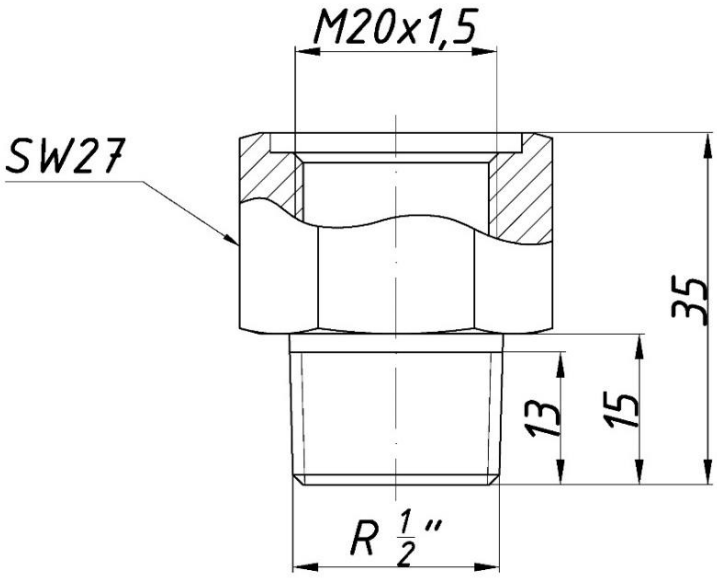


Figure 55. Adapter R ½”.

- **¼ NPT**

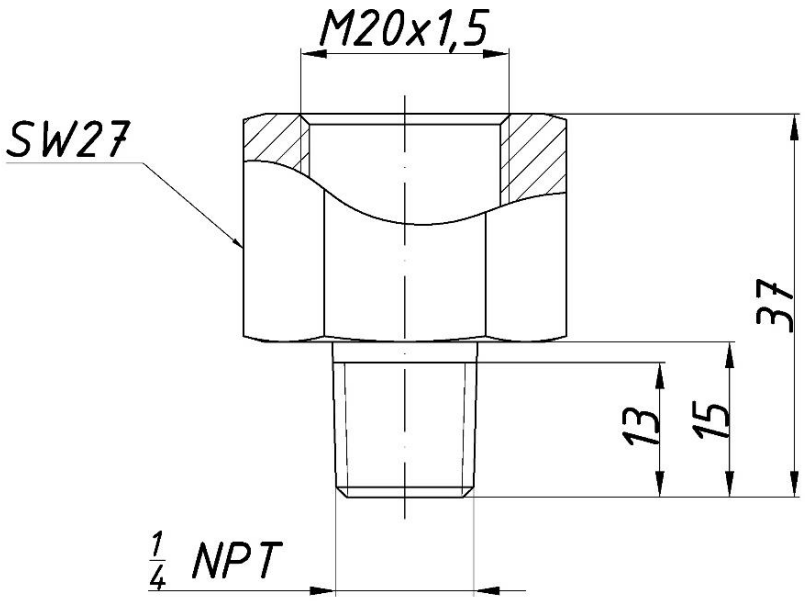


Figure 56. Adapter ¼ NPT.

- **G ¼ "**

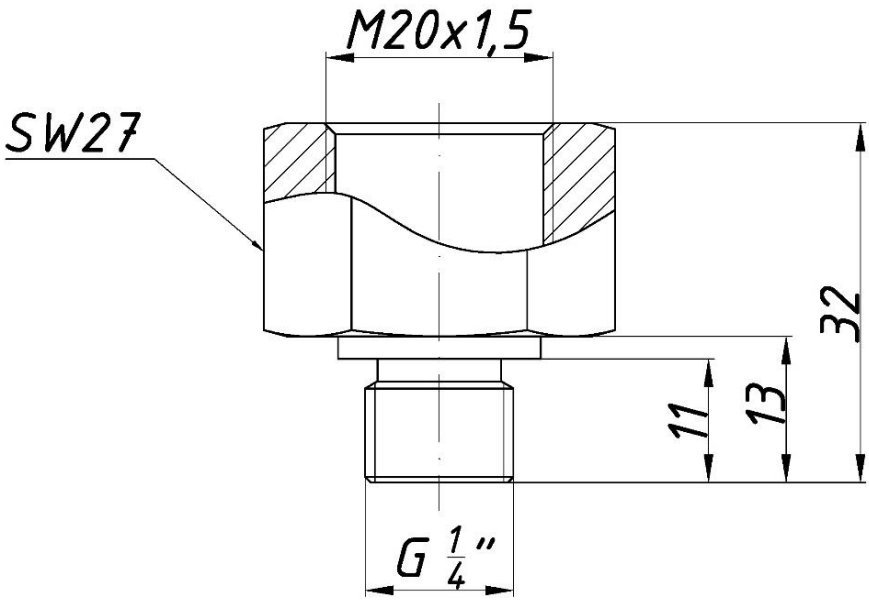


Figure 57. Adapter G ¼".

- **½ NPT F**

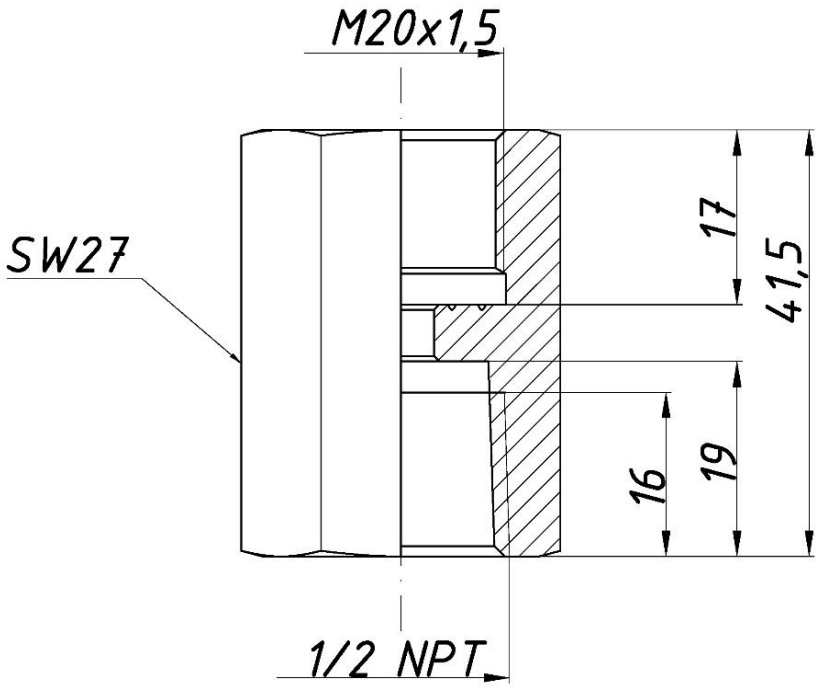


Figure 58. Adapter ½ NPT F.

- **¼ NPT F**

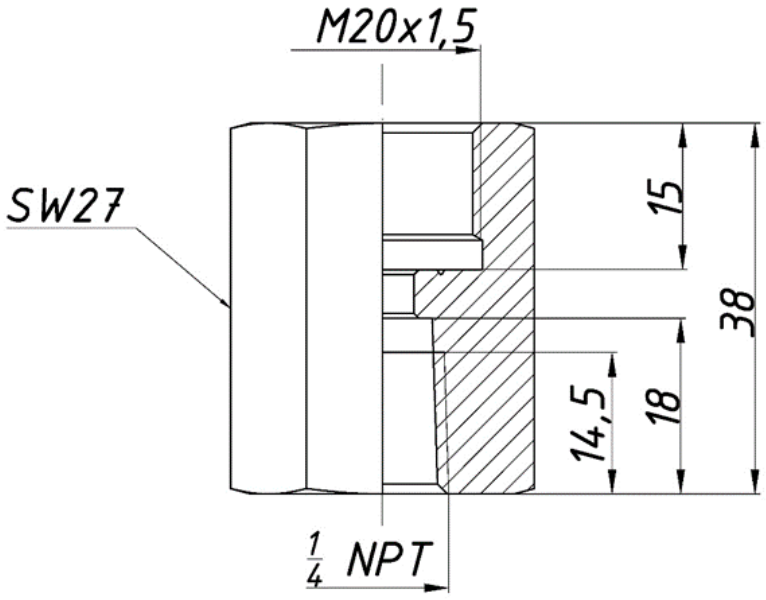


Figure 59. Adapter ¼ NPT F.

- **Elastic tube**

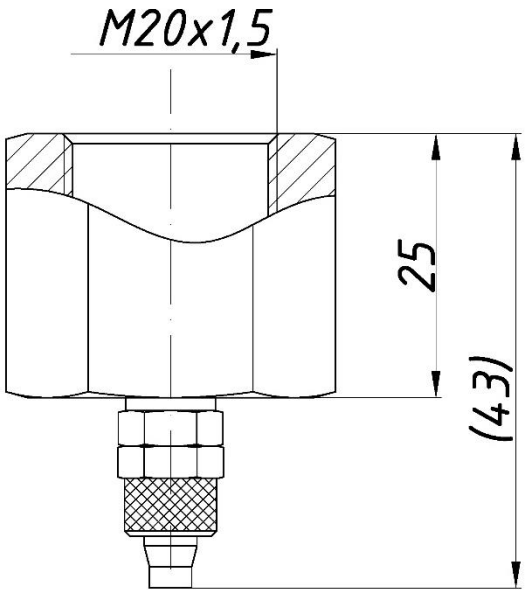


Figure 60. Elastic tube ø6 x 1.

12.2.3. **Specification of process connections for APR-2000ALW**

Type P

Process connector
with female thread 1/4 NPT

Process connector
with male thread M20x1.5

Process connector
with male thread G1/2

Process connector
with male thread 1/2 NPT

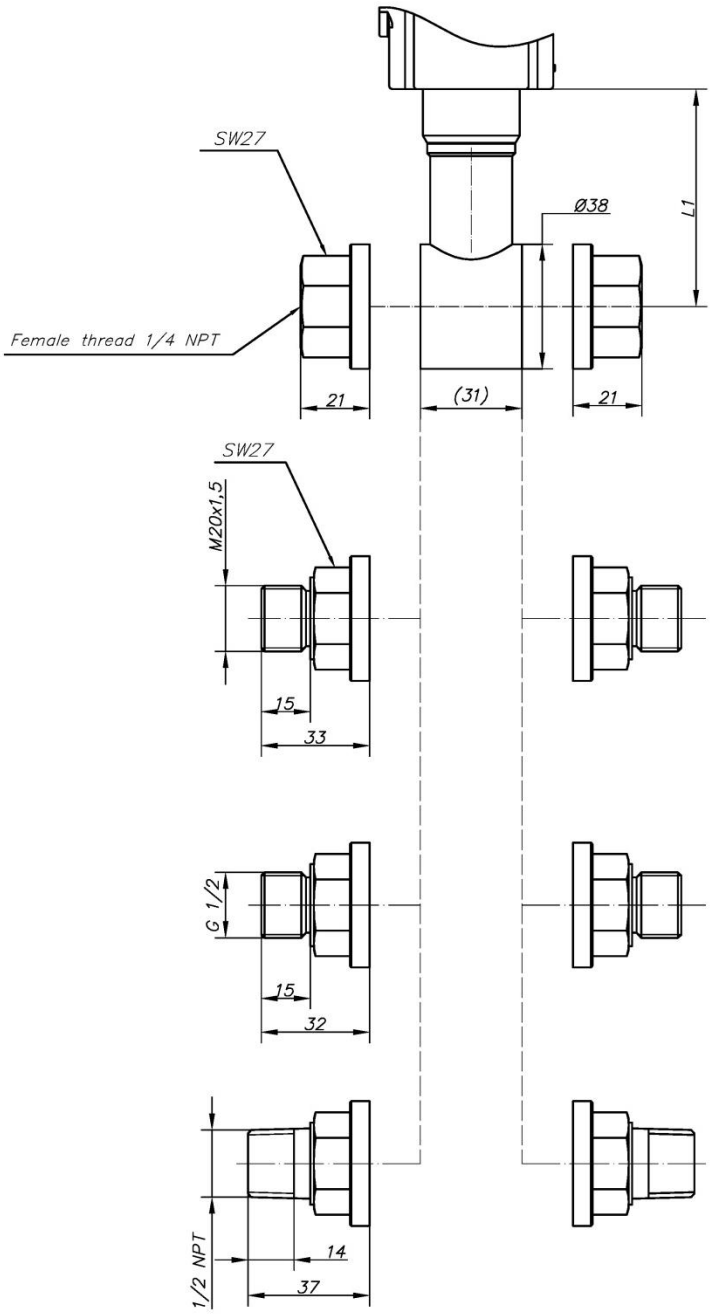


Figure 61. Type P connection for APR-2000ALW.

* L1 dimension due to different values depending on the version is shown in ➔ Table 31.

Material:

- standard version: steel 316L;
- special version: Au.

Return ➔ Table 4. Transmitter versions, process connections.

Type C

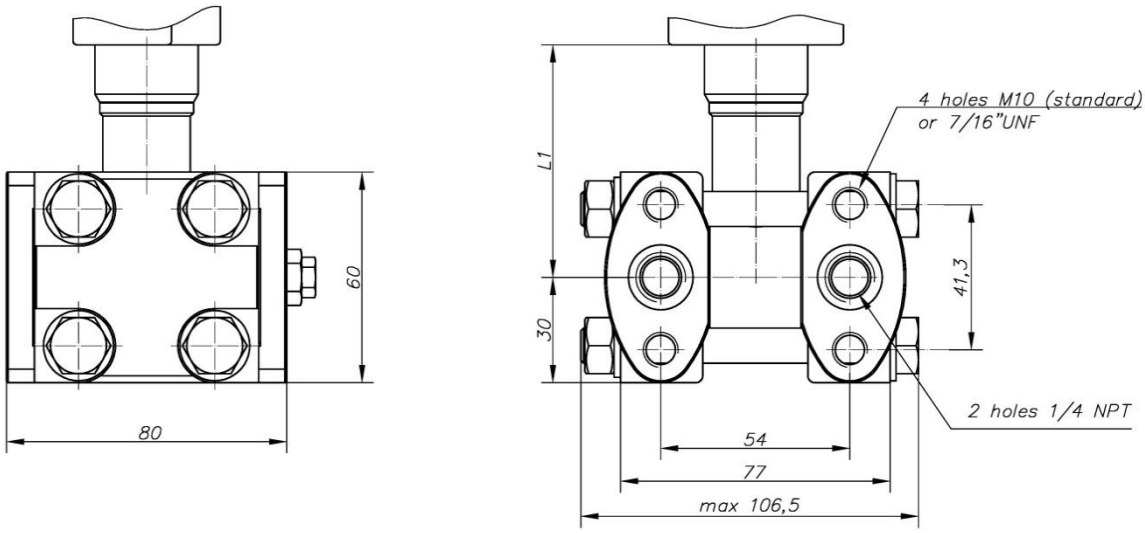


Figure 62. Overall dimensions of type C connection.

* L1 dimension due to different values depending on the version is shown in ➔ Table 31.

Material – standard version: steel 316L.

Type CR

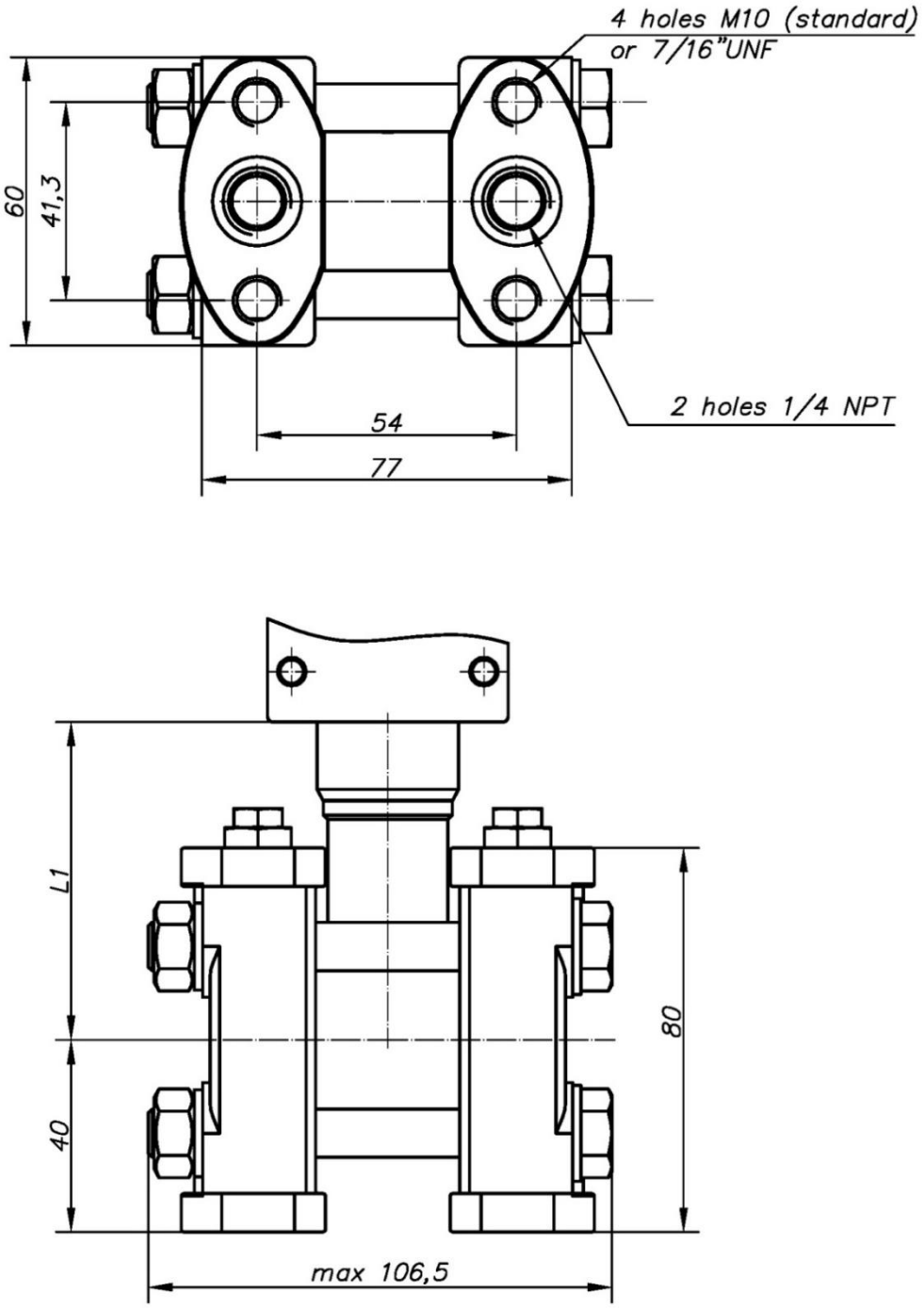


Figure 63. Overall dimensions of CR type connection.

* L1 dimension due to different values depending on the version is shown in ➔ Table 31.

Material – standard version: steel 316L.

Connection	Size	Standard version	Version HS
C	L1 [mm]	66.5	78.5
CR			
Two-side process connection: P (M20x1.5) G ½ ¼ NPT F ½ NPT M			

Table 31. Diversification of the head height depending on the type of connection and version.

12.2.4. **Process connections for measuring low gas pressure**

PCV

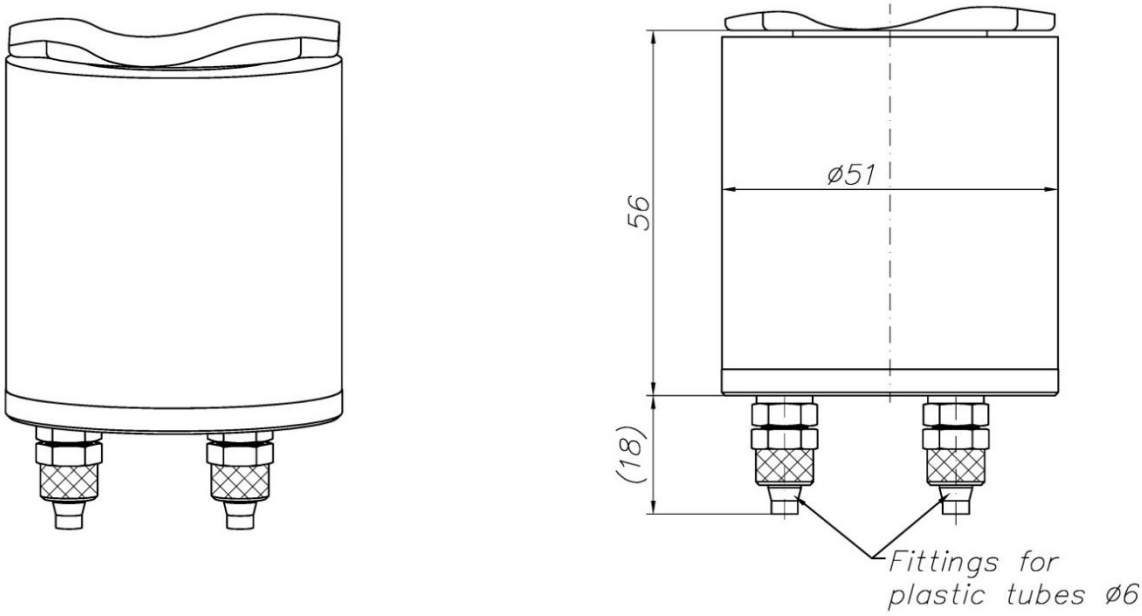


Figure 64. Process connection PCV type.

Return ➔ Table 4. Transmitter versions, process connections.

P GP

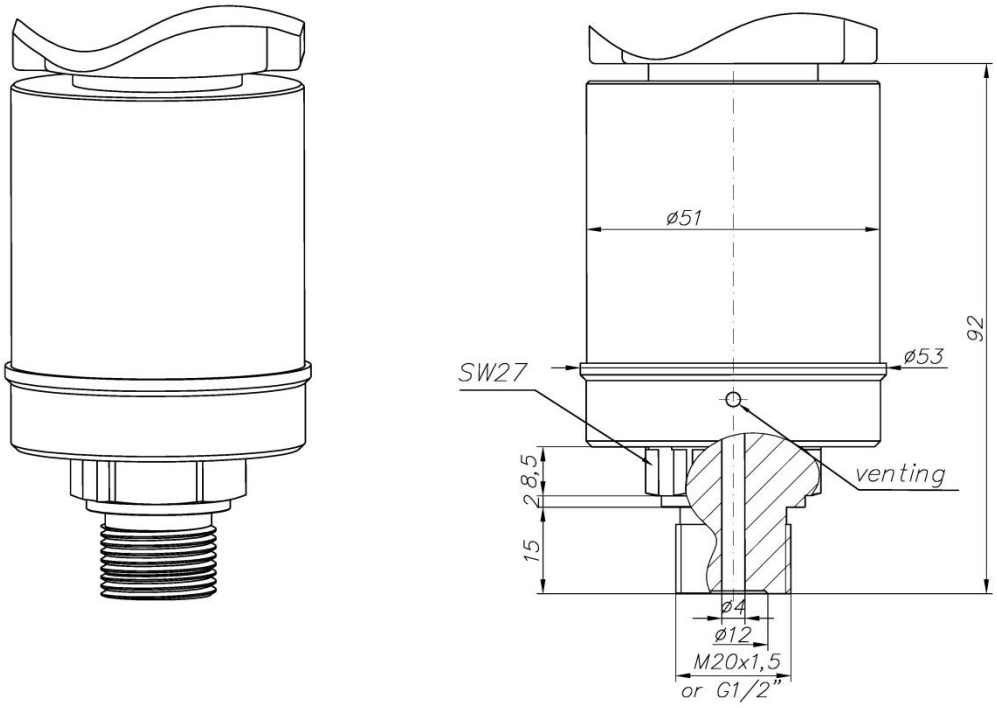


Figure 65. Process connection P or GP for low pressure gases measurement.

HS

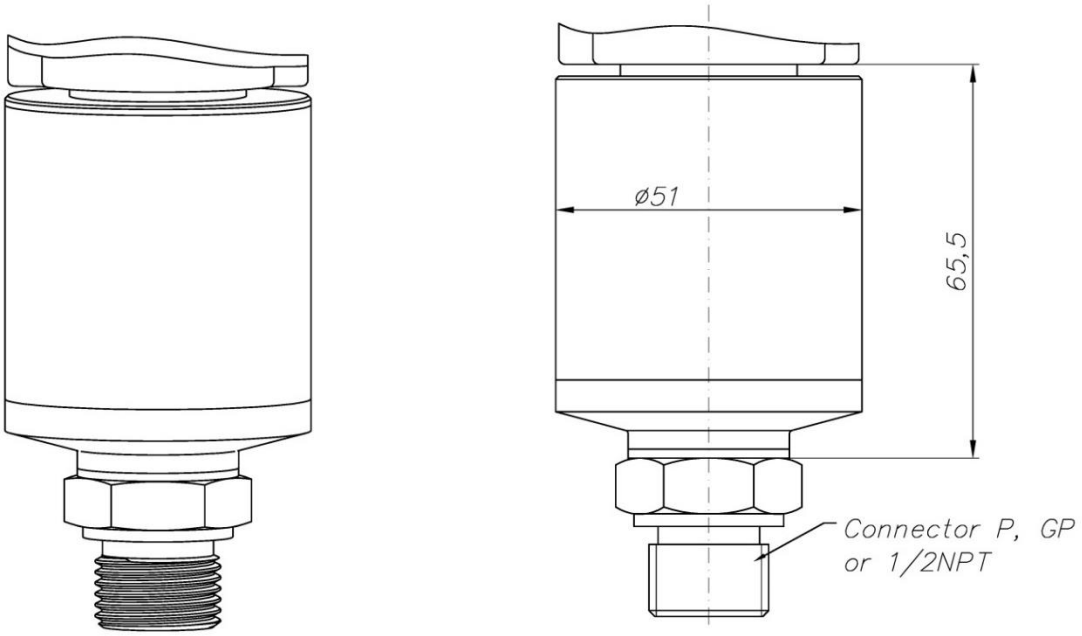


Figure 66. Process connection HS.

Adapter for block valve ¼ NPT

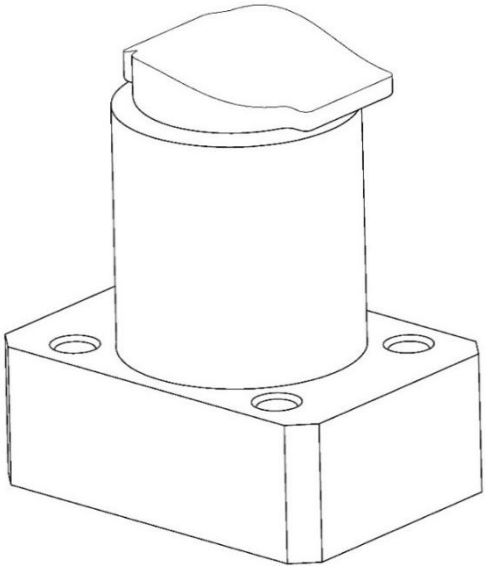


Figure 67. Block valve adapter ¼ NPT for low pressure gases measurement - view in isometry.

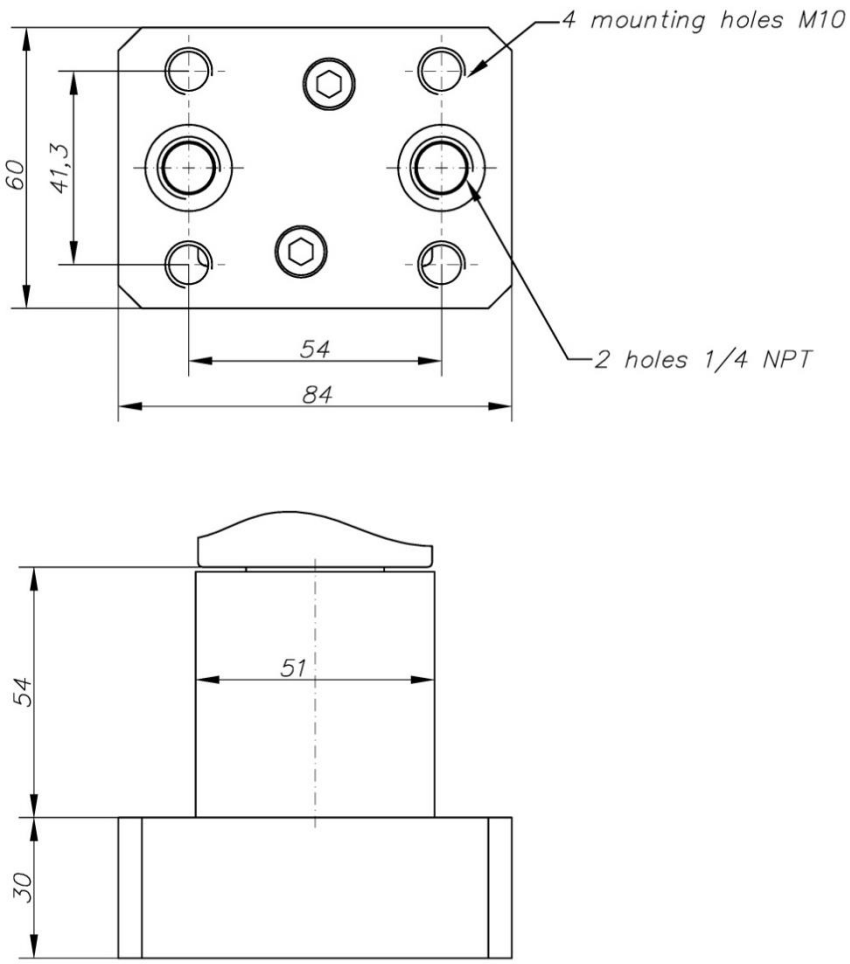


Figure 68. Overall dimension of block valve adapter ¼ NPT for low pressure gases measurement.

12.3. Specification of mounting brackets

“AL” bracket for transmitters APC-2000ALW.
A universal bracket for transmitters APC-2000ALW allows to mount them in any position on the construction and vertical or horizontal pipe 2”.

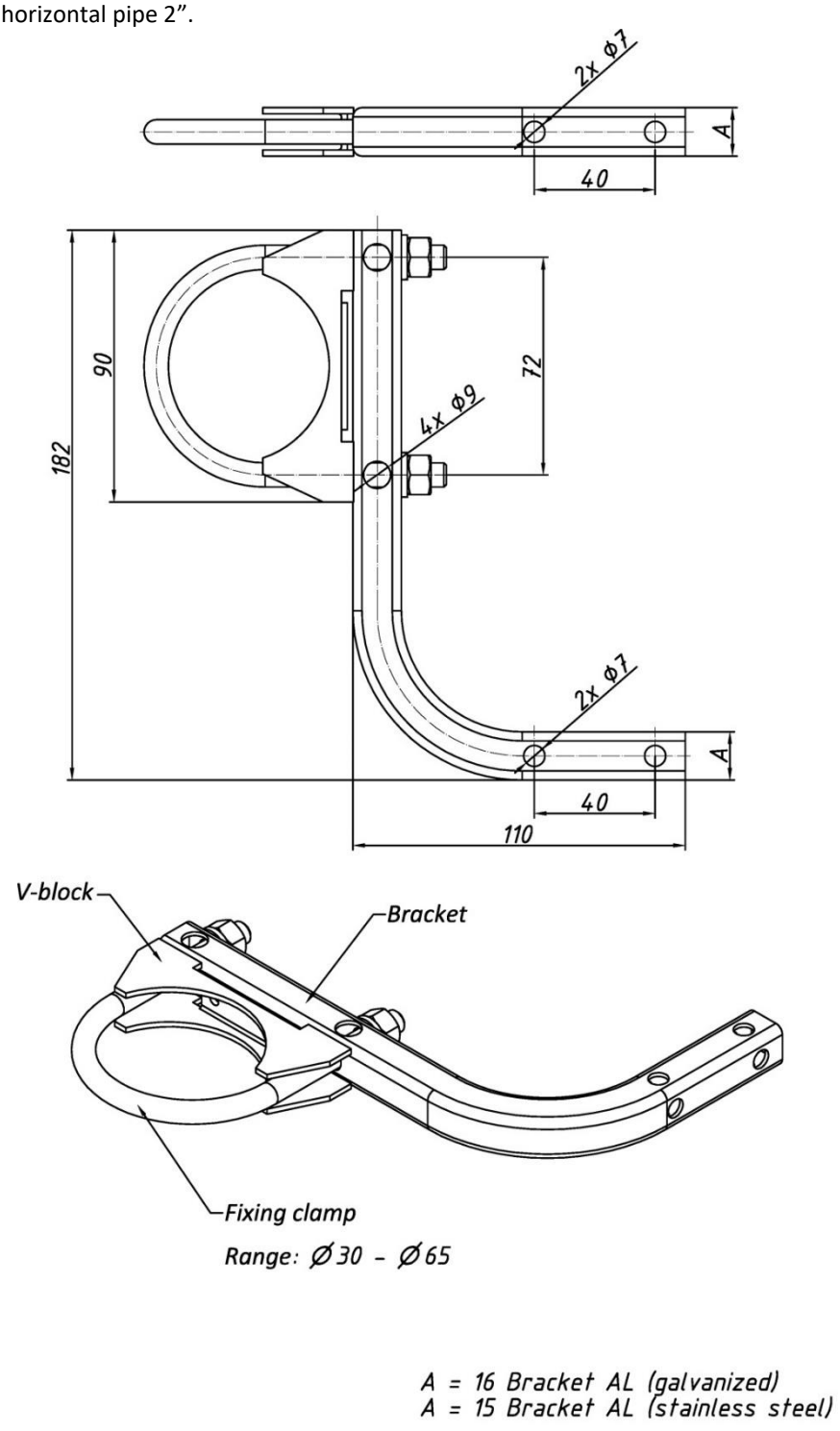


Figure 69. Overall dimensions of the “AL” mounting bracket in galvanized and stainless steel versions.

Bracket C-2 for transmitters APR-2000ALW

Bracket for fixing of differential pressure transmitters with type C connection to pipe 2” or walls.

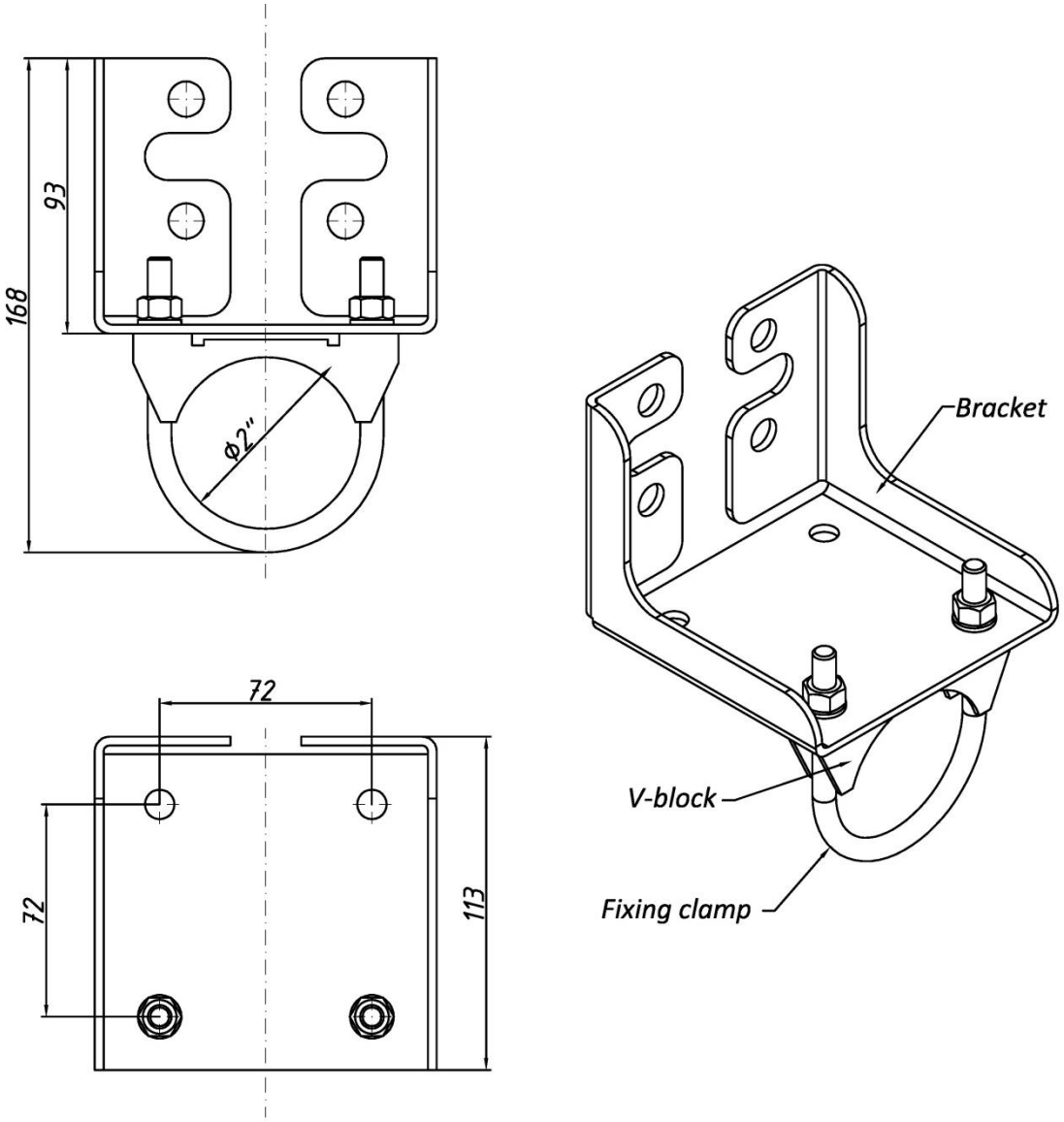


Figure 70. Mounting bracket C-2 for transmitters APR-2000ALW.

Bracket ø25 for transmitters APR-2000ALW and APR-2000ALW with diaphragm seals.
A set for fixing differential pressure transmitters APR-2000ALW with diaphragm seals and APR-2000ALW with type P stub on a vertical or horizontal pipe ø25.

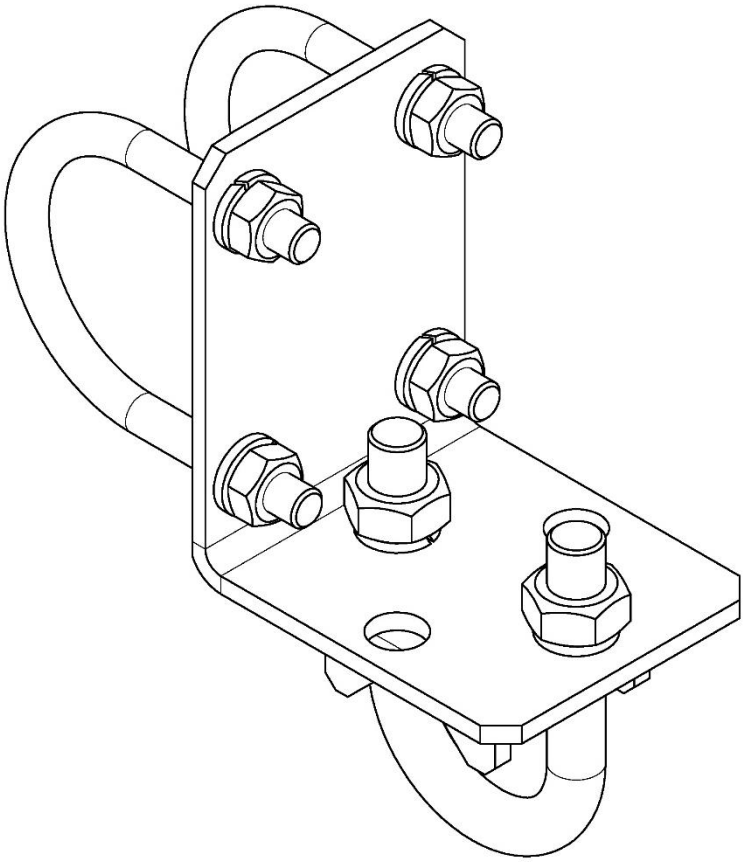


Figure 71. Mounting bracket ø25 – view in isometry.

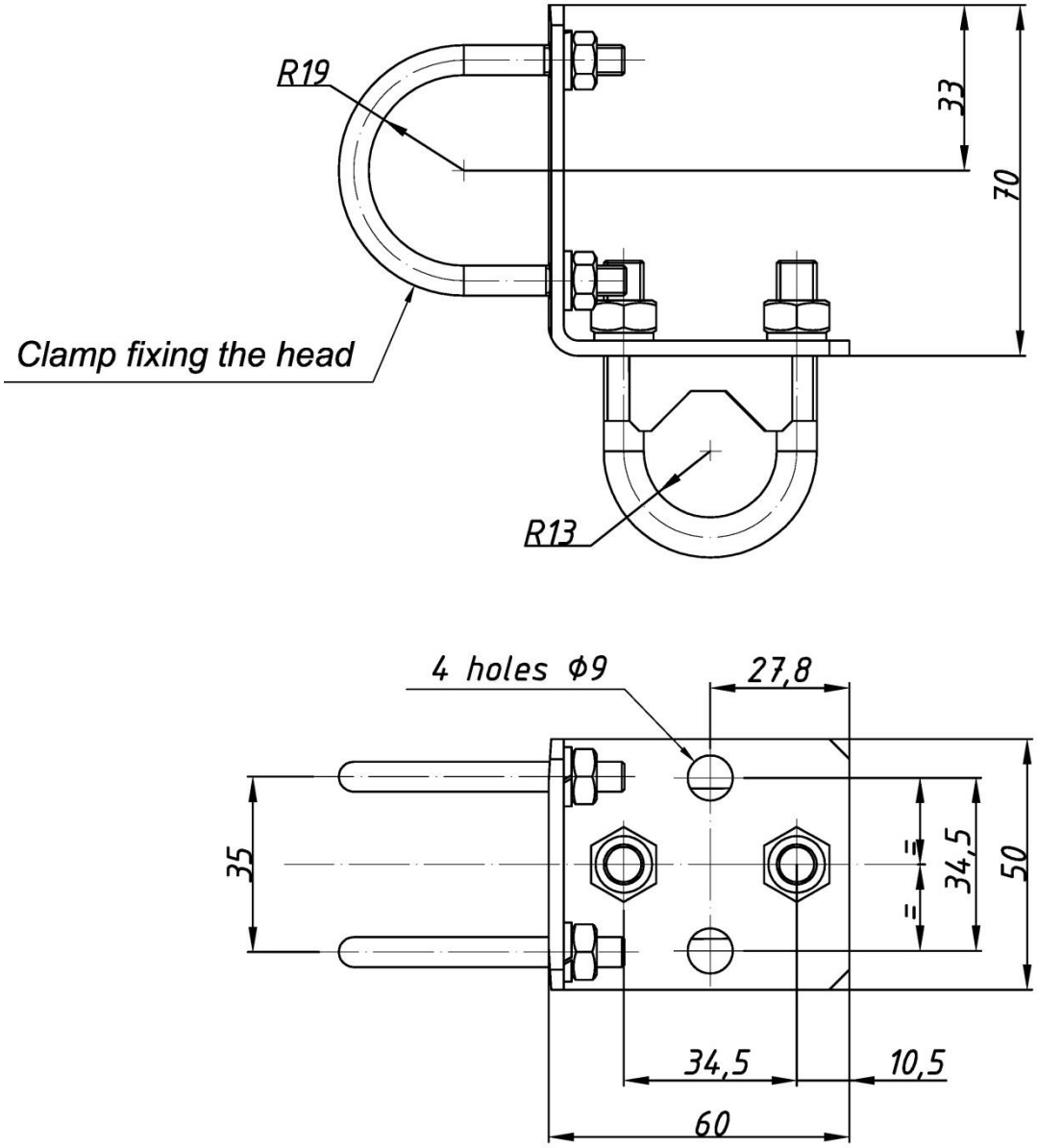


Figure 72. Overall dimensions of the mounting bracket ø25.

12.4. Specification of materials not coming into contact with the process

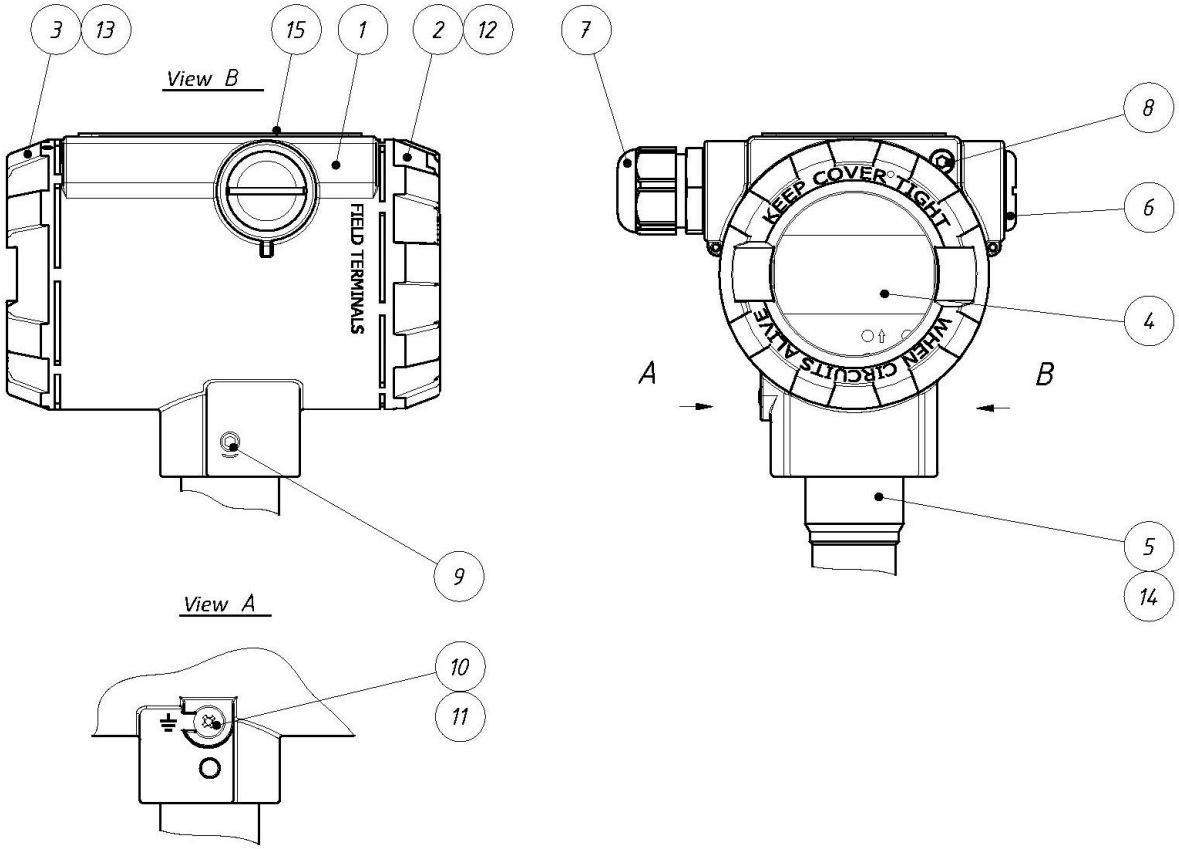


Figure 73. Specification of materials not coming into contact with the process.

1. Transmitter housing.
2. Full cover.
3. Cover with sight glass.
4. Glass window.
5. Head body.
6. Plug.
7. Gland.
8. Cover locking bolt.
9. Housing rotation locking screw.
10. Earthing bolt.
11. Earthing washer.
12. Full cover O-ring.
13. Sight glass cover O-ring.
14. Head body O-ring.
15. Nameplate.

12.5. Specification of materials coming into contact with the process

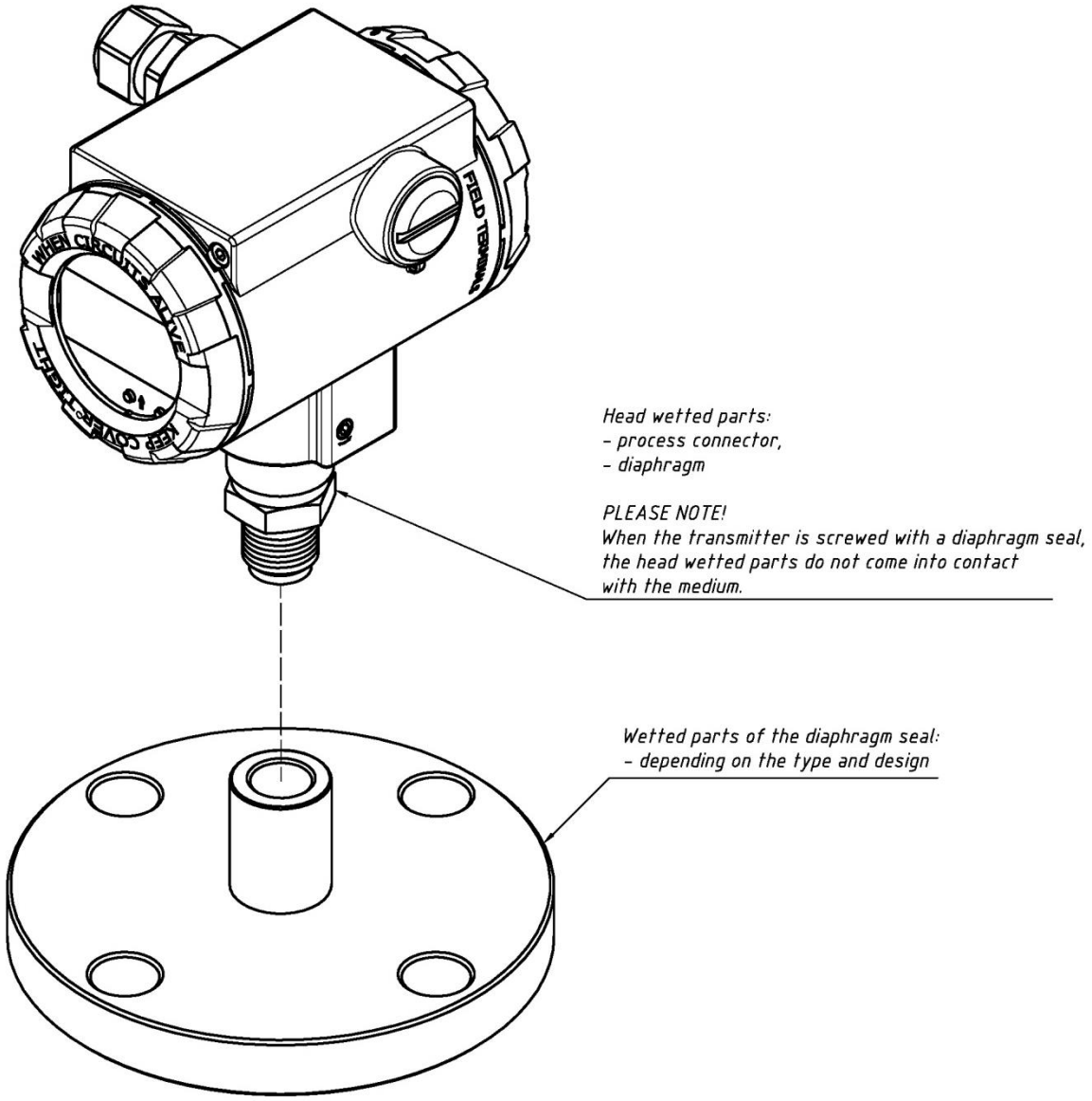


Figure 74. Specification of materials coming into contact with the process for APC-2000ALW.

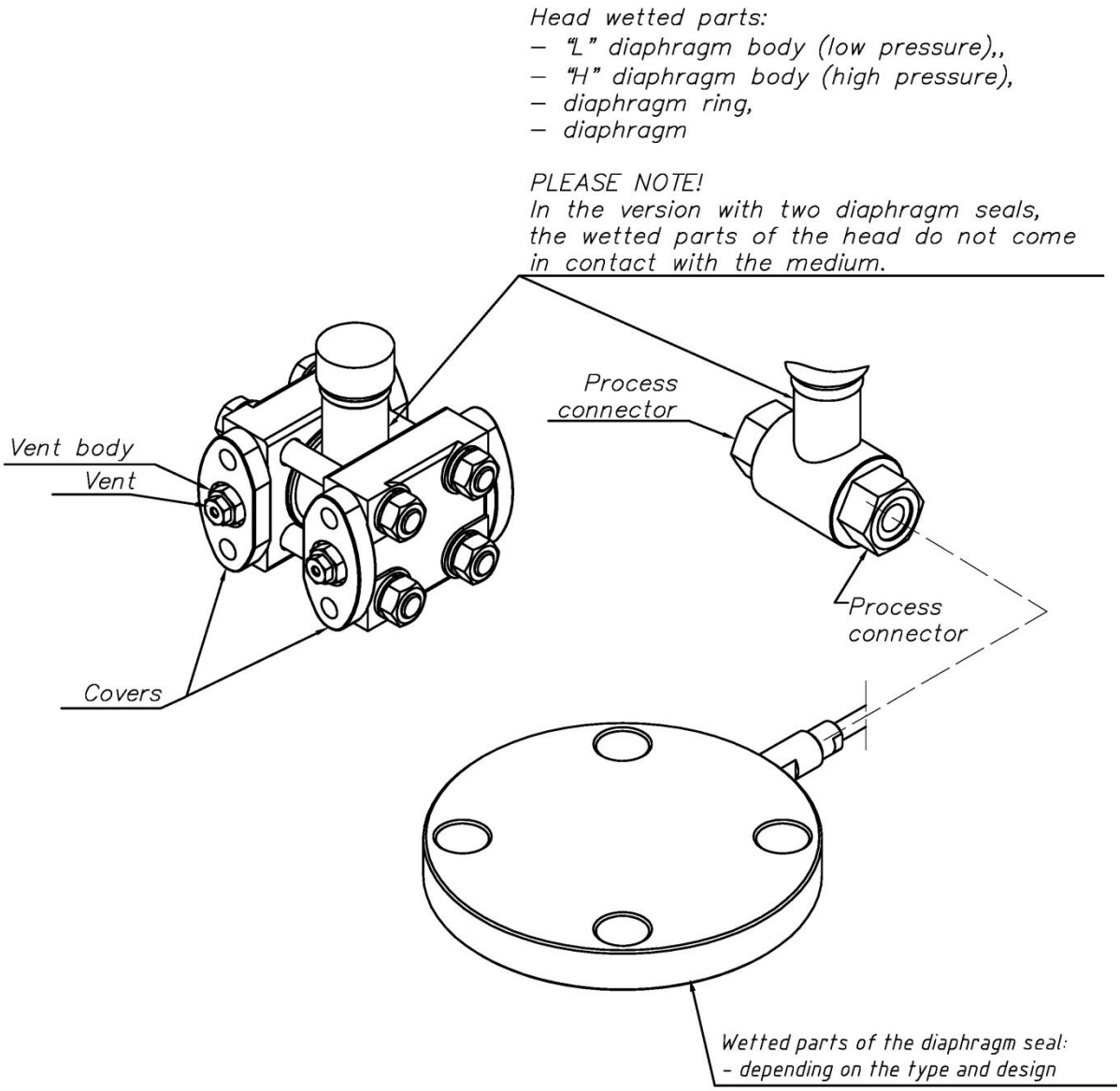


Figure 75. Specification of materials coming into contact with the process for APR-2000ALW.

13. Operation

13.1. Change of setpoints, parameterisation, read-out of variables, diagnostics

The scope of the transmitter's operations include read-out of the settings, change of the settings, diagnostic read-outs. Some of the setpoint change functions (parameterisation) are available in local MENU with the use of the local keyboard. Almost all the functions (except for activation and deactivation of the MID mode) are available via digital HART communications. The following table describes the functions available in local MENU supported by local keypad and functions available via digital HART communications.

APC(R)-2000ALW. Change of setpoints, parameterisation, read-out of variables, diagnostics		
HART Command No / Function	**Local keypad**	**Communication HART 5 / HART 7**
CMD_0 Unique identifier read-out. *Read unique identifier.*	No.	Yes / Yes.
CMD_1 Read-out of basic process variable. *Read primary variable.*	Yes (LCD2).	Yes / Yes.
CMD_2 Read-out of current and control percentage. *Read current and percent of range.*	Yes (LCD1).	Yes / Yes.
CMD_3 Read-out of current and 4 variables: PV, SV, TV, FV. *Read current and four dynamics variables.*	Yes (LCD2). Except for ADC temperature.	Yes / Yes.
CMD_6 Call address entry. *Write pooling address.*	No.	Yes / Yes.
CMD_7 Read-out of current loop configuration. *Read Loop Configuration.*	No.	No / Yes.
CMD_8 Read-out of dynamic variable classifications. *Read Dynamic Variable Classifications.*	No.	No / Yes.
CMD_9 Read-out of process variables and statuses. *Read Device Variables with Status.*	No.	No / Yes.
CMD_11 Read-out of unique TAG-related identifier. *Read unique identifier associated with TAG.*	No.	Yes / Yes.
CMD_12 Message read-out. *Read message.*	No.	Yes / Yes.
CMD_13 Read-out of Tag, Descriptor, Date. *Read Tag, Descriptor, Date.*	No.	Yes / Yes.
CMD_14 Read-out of information related to the PV sensor. *Read PV sensor information.*	No.	Yes / Yes.
CMD_15 Read-out of output parameters. *CMD_15 Read output information.*	No.	Yes / Yes.

APC(R)-2000ALW. Change of setpoints, parameterisation, read-out of variables, diagnostics		
HART Command No / Function	**Local keypad**	**Communication HART 5 / HART 7**
CMD_16 Read-out of device installation number. *Read final Assembly Number.*	No.	Yes / Yes.
CMD_17 Message entry. *Write message.*	No.	Yes / Yes.
CMD_18 Entry of Tag, Descriptor, Date. *Write tag, descriptor, date.*	No.	Yes / Yes.
CMD_19 Entry of device installation number. *Write final assembly number.*	No.	Yes / Yes.
CMD_20 Read Long Tag. *Read Long Tag.*	No.	No / Yes.
CMD_21 Read-out of unique Long Tag identifier. *Read Unique Identifier Associated With Long Tag.*	No.	No / Yes.
CMD_22 Write Long Tag. *Write Long Tag.*	No.	No / Yes.
CMD_31 Extended command entry. *Extended Command Numbers.*	No.	No / Yes.
CMD_34 Damping value entry. *Write PV damping value.*	Yes (DAMPING). Predefined values: 0, 2, 5, 10, 30, 60 s.	Yes / Yes. Floating-point value from the range 0 ... 30 s.
CMD_35 Entry of PV unit for URV and LRV, and URV and LRV values via the value. *Set PV unit code for upper and lower range value. Set URV and LRV by value.*	Yes, (SETURV → BYVALU), (SETLRV → BYVALU).	Yes / Yes.
CMD_36 Entry of URV set range through the set pressure. *Set PV upper range value.*	Yes (SETURV → BYPRES).	Yes / Yes.
CMD_37 Entry of LRV set range through the set pressure. *Set PV lower range value.*	Yes (SETLRV → BYPRES).	Yes / Yes.
CMD_38 Resetting of configuration change flag. *Reset "configuration changed" flag.*	No.	Yes / Yes.
CMD_40 Forced current mode. *Enter/exit PV current mode.*	No.	Yes / Yes.
CMD_42 Program reset. *Perform master reset.*	Yes (RESET).	Yes / Yes.

APC(R)-2000ALW. Change of setpoints, parameterisation, read-out of variables, diagnostics		
HART Command No / Function	**Local keypad**	**Communication HART 5 / HART 7**
CMD_43 Pressure resetting. *Set PV zero.*	Yes (PVZERO).	Yes / Yes.
CMD_44 Basic unit entry. *Write PV unit.*	Yes (UNIT).	Yes / Yes.
CMD_45 4 mA DAC calibration. *Trim PV current DAC zero.*	No.	Yes / Yes.
CMD_46 20 mA DAC calibration. *Trim PV current DAC gain.*	No.	Yes / Yes.
CMD_47 Transfer function entry. *Write PV transfer function.*	Yes (TRANSF). Linear; root; ; ; square; special user-defined.	Yes / Yes. Linear; root; manufacturer's root 1; manufacturer's root 2; square; special user-defined.
CMD_48 Read-out of additional diagnostic statuses. *Read additional transmitter status.*	No.	Yes / Yes.
CMD_50 Read-out of dynamic variable assignment. *Read Dynamic Variable Assignments.*	No.	No / Yes.
CMD_54 Read-out of dynamic variable information. *Read Device Variable Information.*	No.	No / Yes.
CMD_59 Entry of the number of preambles in the response. *Set numbers of response preambles.*	No.	Yes / Yes.
CMD_80 Read-out of process variable calibration points. *Read Device Variable Trim Points.*	No.	No / Yes.
CMD_81 Read-out of process variable guidelines. *Read Device Variable Trim Guidelines.*	No.	No / Yes.
CMD_82 Process variable calibration point entry. Write Device Variable Trim Point.	No.	No / Yes.
CMD_83 Return to factory settings of process variable calibration. *Reset Device Variable Trim.*	No.	No / Yes.
CMD_1280 Pressure measurement read-out status. *Read Pressure Status.*	No.	No / Yes.
CMD_1281 Read-out of optional parameter capability. *Read Capabilities.*	No.	No / Yes.

APC(R)-2000ALW. Change of setpoints, parameterisation, read-out of variables, diagnostics		
HART Command No / Function	**Local keypad**	**Communication HART 5 / HART 7**
CMD_1282 Read-out of supported status mask. *Read Supported Status Mask.*	No.	No / Yes.
CMD_1283 Read-out of pressure sensor information. *Read Pressure Sensor Information.*	No.	No / Yes.
CMD_1284 Read-out of process connection information. *Read Process Connection.*	No.	No / Yes.
CMD_1285 Read-out of associated process variable information. *Read Associated Device Variables.*	No.	No / Yes.
CMD_128 Read-out of material data. *Read static data materials.*	No.	Yes / Yes.
CMD_129 Read-out of pressure calibration points. *Read device variable trim points.*	No.	Yes / Yes.
CMD_130 Calibration of upper pressure point. *Trim upper sensor calibration.*	No.	Yes / Yes.
CMD_131 Calibration of lower pressure point. *Trim lower sensor calibration.*	No.	Yes / Yes.
CMD_132 Selection of variable displayed on LCD2. *LCD2 variable, Set local control modes.*	Yes (LCD2VR).	Yes / Yes.
CMD_132 Selection of the decimal point position in LCD2. *LCD2 variable decimal point, Set local control modes.*	Yes (LCD2DP).	Yes / Yes.
CMD_132 Enabling/disabling of LCD display. *LCD operation, Set local control modes.*	No.	Yes / Yes.
CMD_132 Local keypad activation/interlock. *Keyboard operation, Set local control modes.*	No.	Yes / Yes.
CMD_132 Selection of variable displayed on LCD1. *LCD1 variable, Set local control modes.*	Yes (LCD1VR).	Yes / Yes.
CMD_133 Read-out of keypad and display operation mode configuration. *Read local control modes.*	No.	Yes / Yes.
CMD_134 HART 5 / HART 7 entry. *Write HART mode (HART5/HART7).*	No.	No / Yes.

APC(R)-2000ALW. Change of setpoints, parameterisation, read-out of variables, diagnostics		
HART Command No / Function	**Local keypad**	**Communication HART 5 / HART 7**
CMD_135 User's characteristics entry. *Write user's characteristic coefficients.*	No.	Yes / Yes.
CMD_136 User's characteristics read-out. *Read user's characteristic coefficients.*	No.	Yes / Yes.
CMD_138 Return to factory settings. *Return to factory settings.*	Yes (FACTOR).	Yes / Yes.
CMD_141 Entry of AI function block configuration. *Write AIFB Configuration.*	No.	Yes / Yes.
CMD_142 Read-out of AI function block configuration. *Read AIFB Configuration.*	No.	Yes / Yes.
CMD_230 Read-out of the CPU, Master, Slave, HART revisions. *Read CPU, Master, Slave, HART firmware revision.*	No.	Yes / Yes.
CMD_231 Product code read-out. *Read product codes.*	No.	Yes / Yes.
CMD_233 Separator code read-out. *Read separator codes.*	No.	Yes / Yes.
CMD_235 Manifold code read-out. *Read manifold codes.*	No.	Yes / Yes.
CMD_237 Read-out of limit parameters. *Read operational limits.*	No.	Yes / Yes.
CMD_240 Write long TAG. *Write long TAG.*	No.	Yes / Yes.
CMD_241 Read long TAG. *Read long TAG.*	No.	Yes / Yes.
CMD_242 Entry of the root characteristics start point. *Write sqrt start point.*	Yes (%SQRT). Predefined 0%, 0.2%; 0.4%; 0.6%; 0.8%; 1%.	Yes / Yes. Floating-point value from the range 0 ... 100%.
CMD_243 Read-out of the root characteristics start point. *Read sqrt start point.*	No.	Yes / Yes.
CMD_244 Entry of the user's unit and scaling coefficients. *Write User's unit name and rearrange coefficients.*	No.	Yes / Yes.

APC(R)-2000ALW. Change of setpoints, parameterisation, read-out of variables, diagnostics		
HART Command No / Function	**Local keypad**	**Communication HART 5 / HART 7**
CMD_245 Read-out of the user's unit and scaling coefficients. *Read User's unit name and rearrange coefficients.*	No.	Yes / Yes.
CMD_246 Access code entry. *Write customer's security code.*	No.	Yes / Yes.
CMD_247 Write (setpoint change) lock setting. *Set write protect code.*	No.	Yes / Yes.
MID Selection of MID interlock mode. *MID write protect.*	Yes (MID_WP).	No / No.

Table 32. APC(R)-2000ALW. Change of setpoints, parameterisation, read-out of variables, diagnostics.

13.2. Local setpoints selected with keypad

13.2.1. **Local LCD display**

The transmitter is equipped with a local LCD used to illustrate process variables, parameters during local configuration, error messages or failures.

The LCD has three primary information fields identified in the figure below as LCD1, LCD2, LCD3.

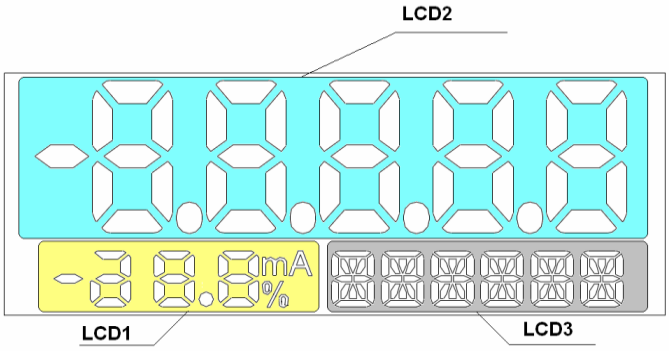


Figure 76. LCD display.

Depending on the configuration **LCD1** field is used to display:

- values of process variable for current in [**mA**] with 0.1 mA resolution;
- values of the set range of current output in percent [**%**] with 1% resolution.

[mA] – value (milliamperes) of process current in line 4 ... 20 mA, proportional to the measured pressure.
[%] – value (percentage) of the setpoint $Y(t)$ of current controller in current loop 4 ... 20 mA. This value is the ratio of the process current $Ip(t)$ to the current range width according to the following formula:

$$\%Y(t) = \frac{Ip(t) - 4\,[mA]}{16\,[mA]} * 100\,[\%]$$

Depending on the configuration **LCD2** field is used to display:

- values of pressure / differential pressure in physical units;
- values of pressure / differential pressure in the user's units and scaling;
- value of temperature of the pressure sensor body;
- value of CPU temperature;
- values of the set range when changing the range by entering a number;
- information on error or failure number;
- information on exceeding the range of displayed values;
- information about exceeding the set range limits (only in MID mode).

The LCD2 field is used mainly to display floating-point decimal values in the unit displayed on LCD3. In some cases, other messages may be displayed:

- **ERROR** - in the case of some operating errors or failure diagnosed in the transmitter, error/failure number **E**□□□□ will appear on LCD2; the **ERROR** message will be displayed on LCD3. The image will blink to attract the operator's attention. The transmitter will set the current output to alarm status depending on the configuration I_AL < 3.650 mA or I_AL > 21.500 mA.
- **undEr** - the message will appear when 50% of the base range below the lower limit range of the set **LRL (LSL)** is exceeded. After reaching the **LPL** and when below this value up to **LSAL**, the transmitter freezes the refreshing of digital value of the measurement. In this situation, message "undEr" will be displayed. The image will blink to attract the operator's attention. Diagnostic alarm mode will be enabled depending on the settings I_AL < 3.650 mA or I_AL > 21.500 mA. Additionally, common status PV_OUT_OF LIMITS and status PV_LOW_LIMITED in the Sensor Block will be set, which can be read out in the diagnostic tab via HART communication. If the transmitter is set to MID mode, when the limit below **LRV** of the set range is exceeded by the process, **undEr** (under) message will appear on LCD1. The image will blink to attract the operator's attention. The transmitter will set the current output to a given status depending on the configuration I_AL < 3.650 mA or I_AL > 21.500 mA.
- **ovEr** - the message will appear when 50% of the base range below the lower limit range of the set **URL (USL)** is exceeded. After reaching the **UPL** and when above this value up to **USAL**, the transmitter freezes the refreshing of digital value of the measurement. In this situation, the message "ovEr" will be displayed. The image will blink to attract the operator's attention. Diagnostic alarm mode will be enabled depending on the settings I_AL < 3.650 mA or I_AL > 21.500 mA. Additionally, collective status PV_OUT_OF LIMITS and status PV_HIGH_LIMITED in the Sensor Block will be set, which can be read out in the diagnostic tab via HART communication. If the transmitter is set to MID mode, when the limit above **URV** of the set range is exceeded by the process, **ovEr** (over) message will appear on LCD1. The image will blink to attract the operator's attention. The transmitter will set the current output to a given status depending on the configuration I_AL < 3.650 mA or I_AL > 21.500 mA.
- ● ● ● ● - when the set position of comma (point) on LCD2 does not allow for the correct display of the process variable, four dots ● ● ● ● will appear on LCD. The image will blink to draw the operator's attention. In this situation, change the decimal point position in the local setpoint change MENU or via HART communications.

Depending on the configuration, **LCD3** field is used to display:

- physical unit of pressure displayed on LCD2;
- user's unit when displaying values of pressure / differential pressure on LCD2 in user's units and scaling done by the user;
- option of selecting a setpoint using the local setpoint change MENU;
- numbers of errors related to the execution of commands of the local setpoint change MENU.

The display may be configured by means of a local keypad / local MENU or via HART communication.
The local LCD has a limited number of character fields. For this reason, the majority of the messages are given in an abbreviated form. Below you will find a list of abbreviations used for each character field.

Depending on the configuration **LCD3** field is used to display:

- physical unit of pressure displayed on LCD2;
- user's unit when displaying values of pressure/differential pressure on LCD2 in the units and scaling of the user;
- option of selecting a setpoint using the local setpoint change MENU;
- numbers of errors related to the execution of commands of the local setpoint change MENU.

The display configuration is possible by means of a local keypad/local MENU or via HART communication.
The local LCD has a limited number of character fields. For this reason, the majority of the messages are given in an abbreviated form. Below you will find a list of abbreviations used for each character field.

13.2.2. **Abbreviations of physical units of pressures and levels and their description**

INH2O	inch of water column.
INGH	inches of mercury column with temperature of 0°C.
FTH2O	feet of water column with temperature of 20°C (68°F).
MMH2O	millimeters of water column with temperature of 20°C (68°F).
MMHG	millimeters of mercury column with temperature of 0°C.
PSI	pounds per square inch.
BAR	bars.
MBAR	millibars.
GSQCM	grams per square centimeter.
KGSQCM	kilograms per square centimeter.
PA	pascals.
KPA	kilopascals.
TORR	torrs.
ATM	atmosphere.
MH2O4	metres of water column with temperature of 4°C.
MPA	megapascals.
INH2O4	inches of water column with temperature of 4°C.
MMH2O4	millimeters of water column with temperature of 4°C.
NOUNIT	the shortcut displayed when a unit not implemented in the transmitter is configured via HART communication.

13.2.3. **Abbreviations of temperature measurement point name**

SENS °C	temperature of pressure/differential pressure sensor measurement structure expressed in degrees Celsius.
CPU °C	temperature of the main CPU structure expressed in degrees Celsius. This temperature refers to temperature of the main electronic components and is similar to transmitter body temperature.

13.2.4. **Abbreviations displayed during configuration via local MENU and their descriptions**

<-BACK	return to one level above in local MENU.
EXIT	going out of the local MENU.
UNIT	pressure and level unit selection menu.
SENS_T	option of measuring the temperature of pressure or differential pressure sensor measurement structure.
CPU_T	option of measuring the main CPU structure temperature.
DAMPIN	menu of selecting damping time constant of process variable.

TRANSF	menu of selecting the current output transfer function.
%SQRT	menu of selecting the dead band percentage of the root characteristics of the current output transfer function.
PVZERO	pressure transmitter resetting menu and option.
SETURV	URV setting menu (upper pressure of the set range).
SETLRV	LRV setting menu (lower pressure of the set range).
BYPRES	option of setting the range according to pressure.
BYVALU	option of setting the set range by entering a value.
RESET	transmitter hot restart software menu.
LCD1VR	menu for selection of the type of measurement displayed on LCD1.
LCD2VR	menu for selection of the type of measurement displayed on LCD2.
LCD2DP	menu for selecting position of comma / decimal point.
FACTOR	return to factory values menu.
RECALL	option of return to factory settings. Factory pressure/differential pressure calibrations, zero setpoints of pressure and current will be restored.
LINEAR	option of linear function of current output setpoint transfer.
SQRT	option of root function of current output setpoint transfer.
SPECIA	option of the user's special characteristics of current output setpoint transfer.
SQUARE	option of square function of current output setpoint transfer.
CURREN	option of selecting the display of set current on LCD1.
PERCEN	option of selecting the display of set percentage on LCD1.
PRESS	option of selecting the display of pressure/differential pressure on LCD2.
USER	option of selecting user's units and scaling to be displayed on LCD3.
MID_WP	MID mode setting menu. In this mode, the option of changing the setpoints related to the transmitter metrology is disabled. Additionally, the exceeding of LRV and URV limits results in displaying the **undEr** or **ovEr** message, blinking of the display and setting of the process output to the current alarm mode I_AL<3,650 mA lub I_AL>21,500mA
ON	MID mode activation option.
OFF	MID mode deactivation option.
X.XXXX	option of selecting position of comma / decimal point.
XX.XXX	option of selecting position of comma / decimal point.
XXX.XX	option of selecting position of comma / decimal point.
XXXX.X	option of selecting position of comma / decimal point.
XXXXX.	option of selecting position of comma / decimal point.
0 [S]	option of selecting damping time constant.
2 [S]	option of selecting damping time constant.
5 [S]	option of selecting damping time constant.
10 [S]	option of selecting damping time constant.
30 [S]	option of selecting damping time constant.
60 [S]	option of selecting damping time constant. The 60-second damping constant is only available from the local keypad; the configuration via HART in Revision 5 does not allow a damping value greater than 30 seconds. Other damping values are possible to be set via HART communication.
0.0 %	option of selecting root characteristics dead band point.
0.2 %	option of selecting root characteristics dead band point.
0.4 %	option of selecting root characteristics dead band point.
0.6 %	option of selecting root characteristics dead band point.
0.8 %	option of selecting root characteristics dead band point.
1.0 %	option of selecting root characteristics dead band point. Other dead band values are possible to be set via HART communication.
DONE	message about the acceptance and implementation of the set-point change.

13.2.5. **Abbreviations of local configuration errors and description of abbreviations**

ER_L07	message displayed on LCD3. It is displayed if a user tries to change the setpoint in the transmitter protected against entry (change of setpoints) or in active MID mode.

ER_L09 message displayed on LCD3. It is displayed if:
- a user tries to change the set range by set pressure which is not within the allowable upper URL pressure.
- A user tries to reset pressure when the pressure exceeds the allowable upper limit.

ER_L10 message displayed on LCD3. It is displayed if:
- a user tries to change the set range by set pressure which is not within the allowable lower LRL pressure.
- A user tries to reset pressure when the pressure exceeds the allowable lower limit.

ER_L14 message displayed on LCD3. It is displayed if:
- the adopted URV value through the set pressure or entry of a value cannot be accepted because it causes a reduction of the set pressure range set below the allowable limit.

ER_L16 message displayed on LCD3. It is displayed if:
- A user tried to perform an operation that is disabled or unavailable. It may be caused by:
  - attempting to access the local setpoint change MENU when the access to the local MENU is disabled;
  - attempting to reset pressure in the absolute pressure measurement transmitter.

WG_L14 the message will appear if the assumed LRV value through the set pressure or entry of a value causes a decrease of the current set range. Entry of LRV automatically results in the transmitter's attempt to set URV in such a way that the current width of the set range is maintained. If this is not possible due to exceeded URL, the transmitter automatically adopts the URV = URL and a new LRV. Since the set range width and URV deviate from previous values, a message is displayed.

13.2.6. **ASCII characters displayed on LCD3 in user's unit**

Using HART communication, the user can configure its own 6-character unit displayed on LCD3. It is possible to display ASCII characters from the range (32 ... 96 dec) or (20 … 60 hex), i.e.:

!"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`

13.2.7. **Local keypad**

The local keypad is used to enable the configuration mode of some transmitter parameters and to navigate through MENU and accept MENU options. The MENU can be accessed by pressing and holding any of the keys for at least 4 seconds. After this time, the LCD3 field of the local display will show an **EXIT** message. This means entering into the MENU navigation mode.

13.2.8. **Local configuration of setpoints**

APC(R)-2000ALW transmitter enables local configuration of some of the most common setpoints via local keypad and local LCD.

13.2.9. **Navigation in local setpoints MENU**

The MENU can be accessed by pressing and holding any of the keys for at least 4 seconds. After this time, the LCD3 field of the local display will show an **EXIT** message. This means entry into the local configuration MENU. Pressing the buttons with arrows [↑] [↓] for at least 1 second you can move up or down MENU.

13.2.10. **Acceptance of local setpoints**

The key marked with symbol [●] is used to accept the selection. The acceptance of setpoint change is confirmed by a **DONE** message displayed on LCD3. After changing the setpoint, the transmitter leaves the local configuration change MENU. If in MENU mode, we do not make any choice, after 2 minutes the transmitter automatically returns to display of standard messages. The MENU can also be left by selecting and accepting the **EXIT** option.

13.2.11. **List of local setpoints MENU messages**

EXIT→	[↓][scroll down]	[↑][scroll up]	→	◙ [set]
PVZERO→	[↓][scroll down] ←BACK PVZERO	[↑][scroll up] ←BACK PVZERO	→	◙ [set]
SETLRV→	[↓][scroll down] ←BACK SETLRV	[↑][scroll up] ←BACK SETLRV	→	◙ [set]
SETURV→	[↓][scroll down] ←BACK SETURV	[↑][scroll up] ←BACK SETURV	→	◙ [set]
UNIT→	[↓][scroll down] ←BACK INH2O INHG FTH2O MMH2O MMHG PSI BAR MBAR GSQCM KGSQCM PA KPA TORR ATM MH2O4 MPA INH2O4 MMH2O4	[↑][scroll up] ←BACK MMH2O4 INH2O4 MPA MH2O4 ATM TORR KPA PA KGSQCM GSQCM MBAR BAR PSI MMHG MMH2O FTH2O INHG INH2O	→	◙ [set]
DAMPIN→	[↓][scroll down] ←BACK 60 [S] 30 [S] 10 [S] 5 [S] 2 [S] 0 [S]	[↑][scroll up] ←BACK 0 [S] 2 [S] 5 [S] 10 [S] 30 [S] 60 [S]	→	◙ [set]
TRANSF→	[↓][scroll down] ←BACK LINEAR SQRT SPECIA SQUARE	[↑][scroll up] ←BACK SQUARE SPECIA SQRT LINEAR	→	◙ [set]

%SQRT→	[↓][scroll down] ←BACK 1.0 % 0.8 % 0.6 % 0.4 % 0.2 % 0.0 %	[↑][scroll up] ←BACK 0.0 % 0.2 % 0.4 % 0.6 % 0.8 % 1.0 %	→	◙ [set]
LCD1VR→	[↓][scroll down] ←BACK CURREN PERCEN	[↑][scroll up] ←BACK PERCEN CURREN	→	◙ [set]
LCD2VR→	[↓][scroll down] ←BACK PRESS USER SENS_T CPU_T	[↑][scroll up] ←BACK CPU_T SENS_T USER PRESS	→	◙ [set]
LCD2DP→	[↓][scroll down] ←BACK XXXXX● XXXX●X XXX●XX XX●XXX X●XXXX	[↑][scroll up] ←BACK X●XXXX XX●XXX XXX●XX XXXX●X XXXXX●	→	◙ [set]
FACTOR→	[↓][scroll down] ←BACK RECALL	[↑][scroll up] ←BACK RECALL	→	◙ [set]
RESET→	[↓][scroll down] ←BACK RESET	[↑][scroll up] ←BACK RESET	→	◙ [set]
MID_WP→	[↓][scroll down] ←BACK ON OFF	[↑][scroll up] ←BACK OFF ON	→	◙ [set]

13.2.12. **Structure of local setpoints MENU**

(Press and hold any of 3 buttons for 4s.)
If you navigate through the active local MENU area, you should hold the button for at least 1 s to trigger the action. The pushing and holding of button ↑ or ↓ replaces single holding for min. 1 s. If you leave the Local Menu inactive for more than 2 minutes, the transmitter will automatically leave the Local Menu and begins displaying the process variable.

```
|
|
EXIT                    (The first message you will see when Local Menu is
|                       enabled. If you accept this option, you will leave the Local Menu
|                       and return to the process variable display.)
|
PVZERO_______
|          \
|          ←BACK       (Return to Local Menu. If you approve this option,
|          |            you will return to the main tree of the Local Menu.)
|          |
|          PVZERO      (Pressure resetting. If you approve this option,
```

| the transmitter will confirm that it received the command using
| “DONE” message or will display a relevant error number.)
|

SETLRV_____ (Setting of the beginning of set LRV range.)
| \
| ←**BACK** (Return to Local Menu. If you approve this option,
| | you will return to the main tree of the Local Menu.)
| |
| **BYPRES**sure (Setting of LRV through set pressure. After parameter acceptance
| | the transmitter will confirm that it received the command using
| | “DONE” message or will display a relevant error number.)
| |
| **BYVALU**e (Setting of LRV by entering a digit.)
| \
| (When approved, the current LRV value will be displayed before
| going to the edit mode.)
| ↓
| ↓
| **+/-** (Select and confirm the character of the parameter you entered.)
| ↓
| **00000** (Enter a 5-digit number, digit by digit, with or without a decimal point. After accepting the last 5th digit of the parameter, the transmitter will confirm that it received the command by displaying the following message “DONE” or will display a relevant error number. The parameter is entered in “UNITs”.)
|
SETURV_____ (Setting of the end of set URV range.)
| \
| ←**BACK** (Return to Local Menu. If you approve this option,
| | you will return to the main tree of the Local Menu.)
| |
| **BYPRES**sure (Setting of URV through set pressure. After parameter acceptance
| | the transmitter will confirm that it received the command using
| | “DONE” message or will display a relevant error number.)
| |
| **BYVALU**e (Setting of URV by entering a digit.)
| \
| (After accepting, the current URV value will be displayed before
| going to the edit mode.)
| ↓
| ↓
| **+/-** (Select and confirm the character of the parameter you entered.)
| ↓
| **00000** (Enter a 5-digit number, digit by digit,
| with or without a decimal point. After accepting the last 5th digit of the parameter the transmitter will confirm that it received the command by displaying the following message “DONE” or will display a relevant error number. The parameter is entered in “UNITs”.)
|
UNIT_____
| \
| ←**BACK** (Return to Local Menu. If you approve this option,
| | you will return to the main tree of the Local Menu.)
| |
| | (Accept one of the following units by
| | pressing ● button. After accepting the parameter,

	|	the transmitter will confirm that it received the command by displaying the
	|	following message „DONE”.)
	INH2O	
	INHG	
	FTH2O	
	MMH2O	
	MMHG	
	PSI	
	BAR	
	MBAR	
	GSQCM	
	KGSQCM	
	PA	
	KPA	
	TORR	
	ATM	
	MH2O4	
	MPA	
	INH2O4	
	MMH2O4	
|		
|DAMPINg_____		(Setting of damping time constant of process variable.)
	\	
	←BACK	(Return to Local Menu. If you approve this option,
	|	you will return to the main tree of the Local Menu.)
	|	
	|	(Accept one of the following values of time constant by
	|	pressing and holding ● button. After accepting the parameter,
	|	the transmitter will confirm that it received the command by displaying the
	|	following message „DONE”.)
	0 [s]	
	2 [s]	
	5 [s]	
	10 [s]	
	30 [s]	
	60 [s]	
|		
|		
TRANSFer____		(Setting of transfer type for current output characteristics.)
	\	
	←BACK	(Return to Local Menu. If you approve this option,
	|	you will return to the main tree of the Local Menu.)
	|	
	|	(Accept one of the following values of time by pressing and holding
	|	● button. After accepting the parameter,
	|	the transmitter will confirm that it received the command by displaying the
	|	following message „DONE”.)
	LINEAr	(Linear.)
	SQRT	(Square root.)
	SPECIAl	(Special user-defined.)
	SQUARE	(Square.)
|		
|		
% SQRT_____		(Setting of root characteristic cut-off point.)
|	\	

	←BACK	(Return to Local Menu. If you approve this option, you will return to the main tree of the Local Menu.)
		(Accept one of the following values by pressing and holding ● button. After accepting the parameter, the transmitter will confirm that it received the command by displaying the following message „DONE”.)
	0.0 %	
	0.2 %	
	0.4 %	
	0.6 %	
	0.8 %	
	1.0 %	
LCD1VaRiable__		(Type of process variable displayed on LCD1.)
	←BACK	(Return to Local Menu. If you approve this option, you will return to the main tree of the Local Menu.)
		(Accept one of the following options by pressing ● button. After accepting the parameter, the transmitter will confirm that it received the command by displaying the following message „DONE”.)
	CURRENt	(LCD1 display will display a value of current in the current loop.)
	PERCENt	(LCD1 display will display a percentage value of output setpoint.)
LCD2VaRiable__		(Type of variable displayed on LCD2.)
	←BACK	(Return to Local Menu. If you approve this option, you will return to the main tree of the Local Menu.)
		(Accept one of the following options by pressing ● button. After accepting the parameter, the transmitter will confirm that it received the command by displaying the following message „DONE”.)
	PRESSure	(LCD2 will display pressure.)
	USER	(LCD2 display will display the value scaled in user units.)
	SENS_T	(LCD2 display will display the current temperature of pressure sensor – head in °C.)
	CPU_T	(LCD2 display will not display the current temperature of transducer CPU – electronic elements in °C.)
LCD2DP_____		(Position of decimal point of the variable displayed on LCD2.)
	←BACK	(Return to Local Menu. If you approve this option,

		you will return to the main tree of the Local Menu.)
		(Accept one of the following options by
		pressing ● button. After accepting the parameter,
		the transmitter will confirm that it received the command by displaying the following message „DONE”.)
	XXXXX●	
	XXXX●X	
	XXX●XX	
	XX●XXX	
	X●XXXX	
FACTORy_____		(Removal of pressure and current sub-calibration. Return to factory settings.)
	\	
	\	
	🡐BACK	(Return to Local Menu. If you approve this option, you will return to the main tree of the Local Menu.)
		(Accept the following command by pressing and holding
		● button. After accepting the parameter, the transmitter
		will confirm that it has received the command with “DONE” message.)
	RECALL	
RESET_____		(Software forcing of transmitter reset.)
	\	
	🡐BACK	(Return to Local Menu. If you approve this option, you will return to the main tree of the Local Menu.)
		(Accept the following command by pressing and holding
		● button. After accepting the parameter, the transmitter
		will perform hot restart.)
	RESET	
MID_WP_____		(Locked modification of parameters related to MID metrology.)
	\	
	🡐BACK	(Return to Local Menu. If you approve this option, you will return to the main tree of the Local Menu.)
		(Accept one of the following options by
		pressing ● button. After accepting the parameter,
		the transmitter will confirm that it received the command by displaying the following message „DONE”.)
	ON	(Deactivation of the interlock of parameters affecting metrology.)
	OFF	(Deactivation of the interlock of parameters affecting metrology.)

13.3. Local or remote selection of setpoints via HART communication

The transmitter allows to read out and configure the parameters via HART rev5.1 or HART rev7 with the use of 4 ... 20 mA loop as a physical layer for BELL 202 FSK modulation. The transmitter allows to use the local HART communication. To do this you can use a HART communicator unit or modem interoperating with a computer or a smartphone. In order to establish communication, it is necessary to:

- remove HART communication jumper;
- connect the communicator or modem to electrical terminals (➔ 7.5).

In case of remote communication, HART modem should be incorporated in parallel to line 4 ... 20 mA as described in (➔ 7.5). It is required that resistance between the power supply and the modem connection point be greater than 240 Ω. The guidelines of the minimum load resistance R_{L_MAX} described in (➔ 4.10) must also be observed. When using measuring cards with built-in HART master, it shall be necessary to observe the regulations of the card manufacturer.

The following devices may be used to communicate with the transmitter:

- Aplisens S.A. KAP-03, KAP-03Ex communicator (Only HART 5);
- communicators from other companies, including those using DD and DTM libraries;
- PC computers equipped with HART modem (e.g. HART/USB converter manufactured by Aplisens S.A.) with WIN7, WIN10 operating system with the installed Raport 2;
- PC computers equipped with HART modem using software from other companies, accepting DD and DTM libraries;
- smartphones with Android system, using a converter providing wireless communications (e.g. HART/USB converter by Aplisens S.A.) with the use of Aplisens Mobile Configurator. The software is available on Google Play®.

13.4. Integration with DCS

The system integrator may provide the transmitter with a **TAG** consisting of 8 alphanumeric characters or a LONG TAG consisting of 32 alphanumeric characters (HART7). It is possible to identify the transmitter in the HART network on the basis of its tag. The system integrator can assign any bus address other than zero to the transmitter. The bus address other than zero is suitable for digital multidrop communication.

14. Separators and their application

The separator is a diaphragm pressure relay. The signal is transmitted to the associated pressure gauge, pressure transmitter, manometer via gauge fluid filling the space between the separator diaphragm and the pressure gauge. The function of the separator is to separate the pressure gauge from adverse parameters of the medium, such as:

- low or high temperature, increased viscosity, contamination;
- system vibrations (distance separation).

The basic metrological problem when using the separators is an absolute “zero” temperature error resulting from the effects of thermal expansion of gauge fluid, which must be compensated by the flexibility of the separating diaphragm.
In order to minimize this impact, it is recommended to:

- use of as short capillaries as possible, which reduces the volume of the gauge fluid in the system;
- use of larger DNs to maximize diaphragm flexibility;
- location of capillary tubes in such a way to minimize the changes of their temperatures.

14.1. Design and operation modes

The separator is a diaphragm device used in situations where the measuring medium or installation structure does not allow for direct connection of a pressure transmitter. This is the case when:

- the process temperature is outside the temperature range acceptable for the pressure gauge (and it is not possible to use an impulse tube);
- the medium is corrosive;
- the medium is characterised by increased viscosity, solidification or forms slurries;
- the application requires the use of hygienic connection;
- there are vibrations in the installation.

The separator transfers a pressure signal of the measured medium to the associated transmitter via a pressure gauge fluid that fills the space between the separator diaphragm and the transmitter.

The measuring sets of the separator and transmitter are available in the following configurations:

- pressure transmitter – direct separator;
- pressure transmitter – distance separator;
- differential pressure transmitter – direct separator;
- differential pressure transmitter – distance separator;
- differential pressure transmitter – two separators, including at least one distance separator.

The following drawings show possible separator configurations along with the application of process connections.

Return ➔ Table 4. Transmitter versions, process connections.

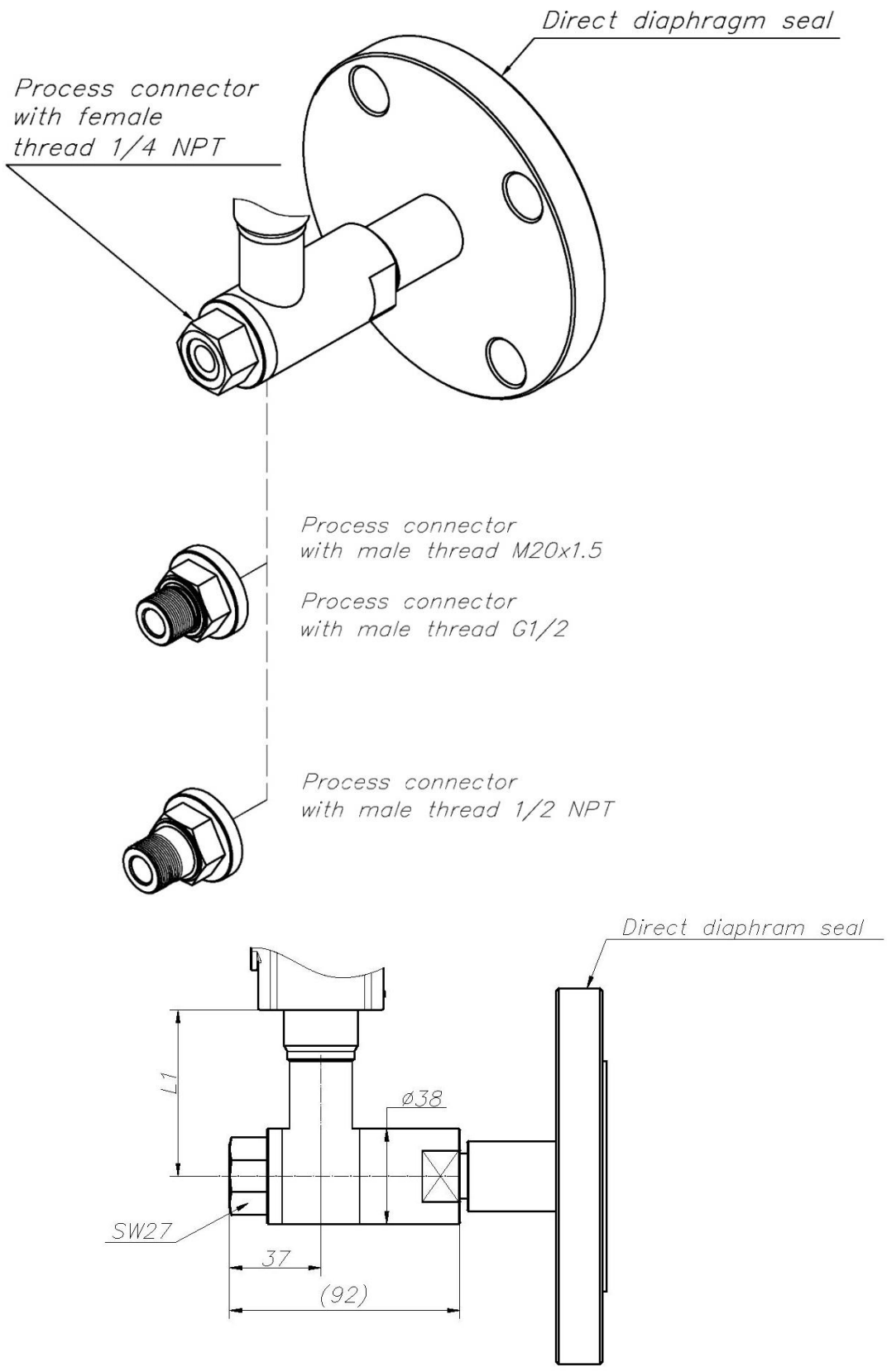


Figure 77. Direct separator and possible process connections.

Due to different values depending on the version, “L1” dimension is shown in ➔ Table 31.

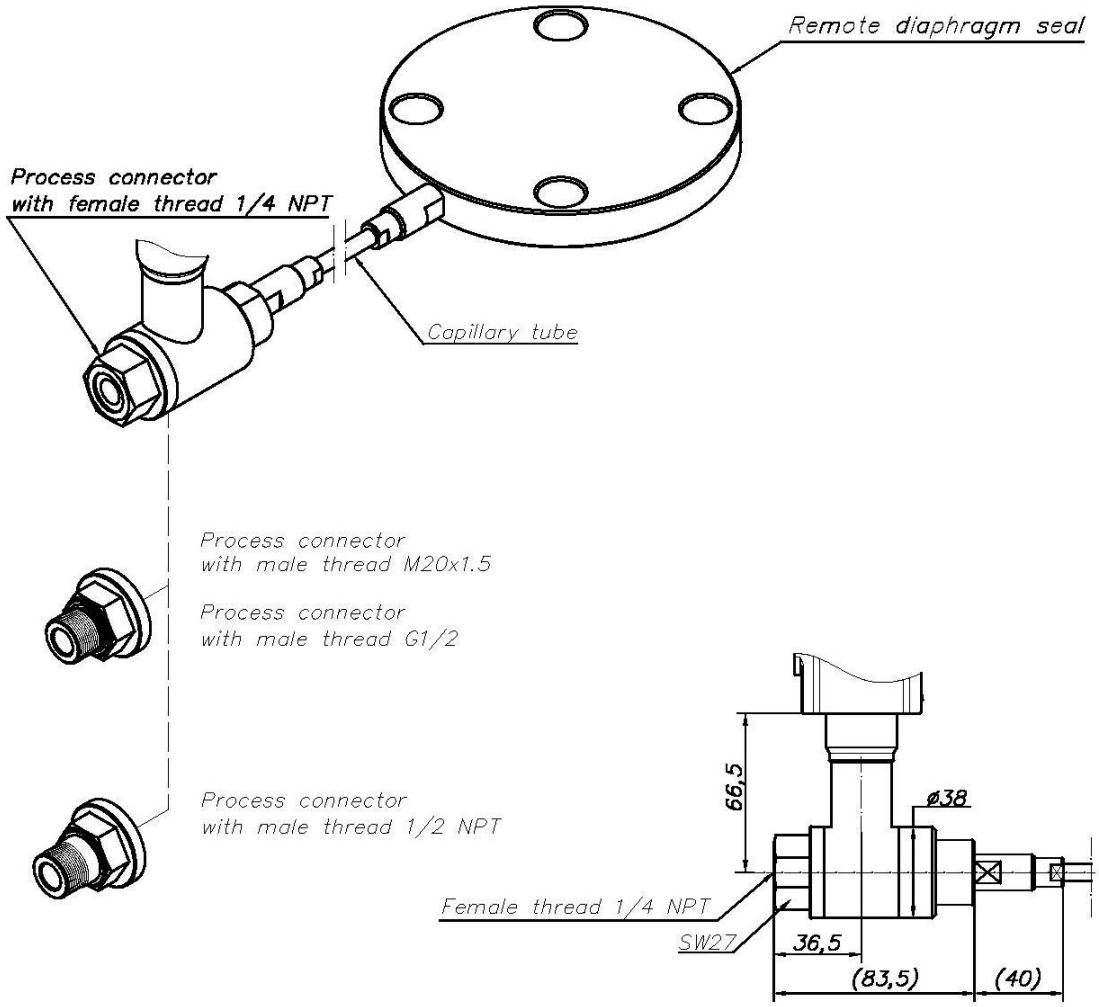


Figure 78. Distance separator and possible connections.

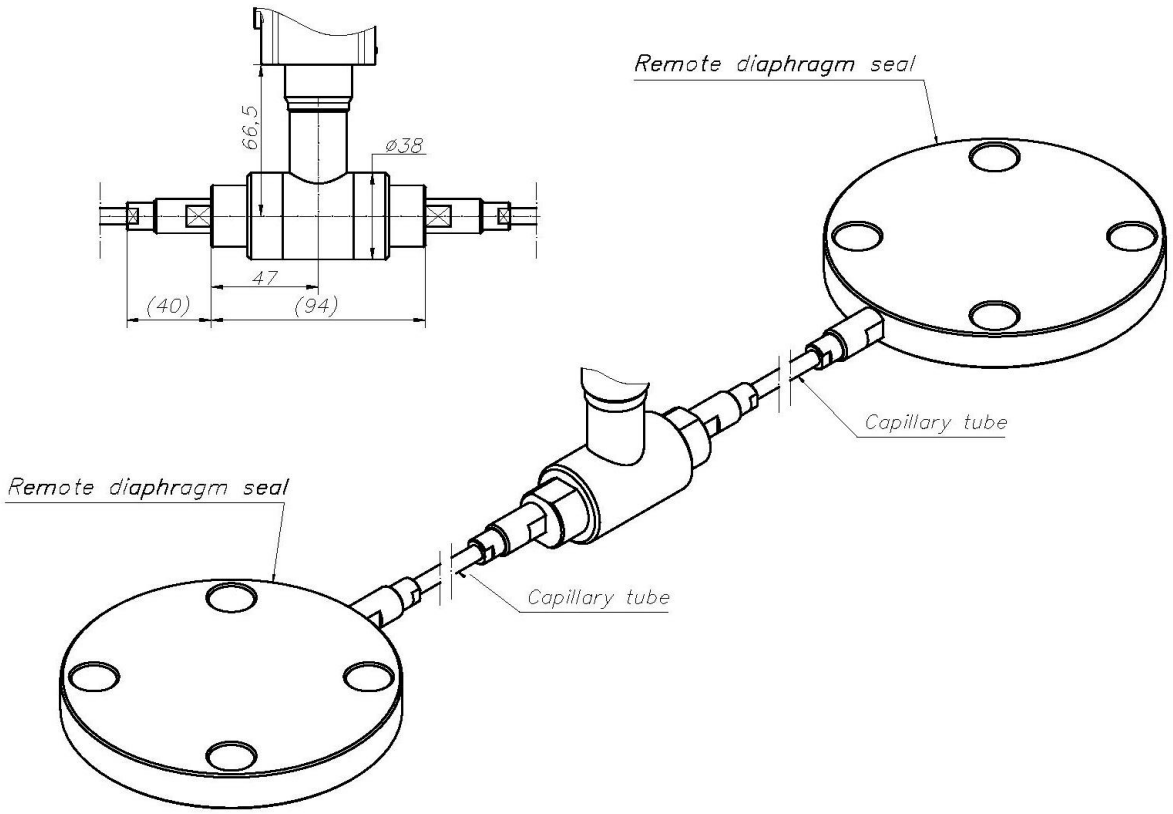


Figure 79. Example of connection using two distance separators.

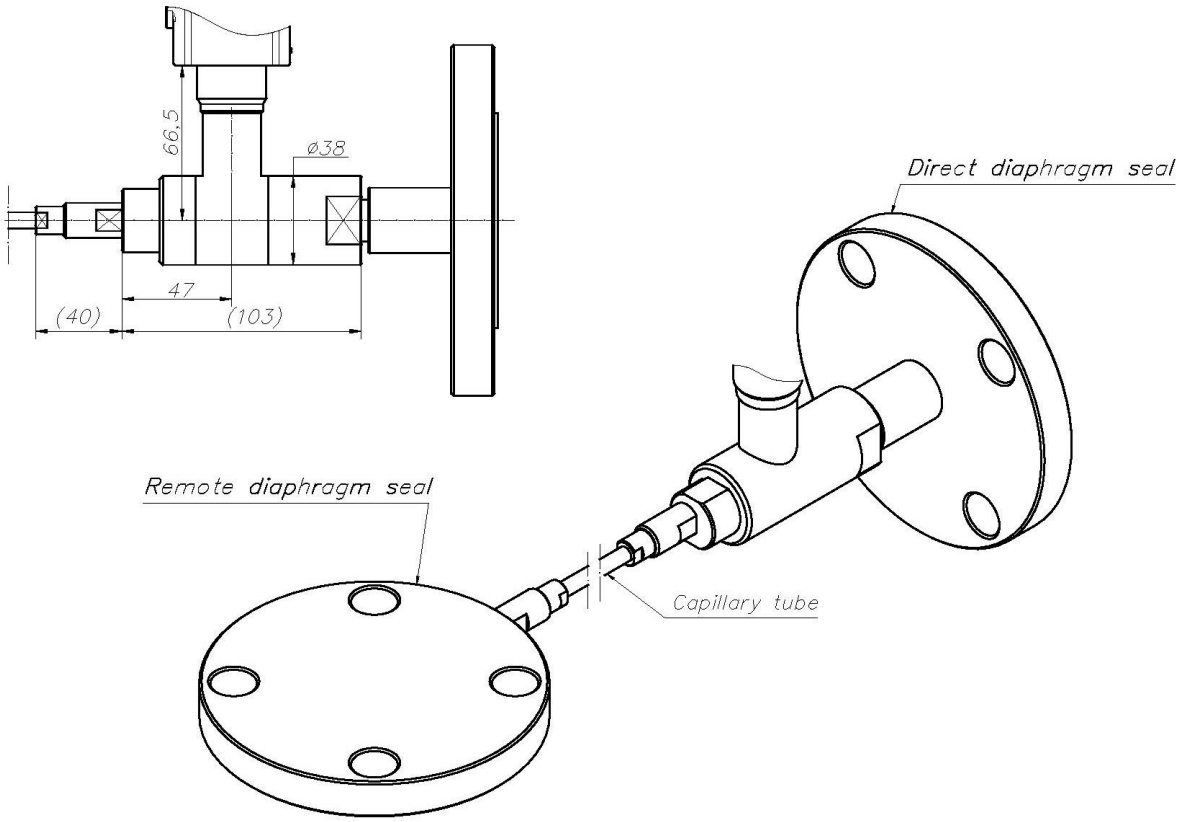


Figure 80. Example of connection using distance and direct separator.

Distance separators, unlike the direct separators, have a capillary tube that allows the transmitter to be moved from the pressure measuring point. This allows media measurements in the range from 150°C to 380°C.
Capillary tubes have an inner diameter of 1 mm and are made of material 316Ti. Capillary tubes are available in two versions:

- in flexible conduit 304;
- in flexible conduit 304 coated with white PVC.

Hygienic separators of S-DIN type; S-Clamp; S-Poziom are equipped with standard hygienic connections and enable to perform the measurements in the food and pharmaceutical industry.

The separators are also designed with flanged connections according to international flange standards: ASME B16.5; EN1092-1; JIS B2220.

The tubular flange separators have a protruded diaphragm, which may reach into a multi-shell container close to its inner wall.
Distance flange separators with acid-resistant steel diaphragm are made in a standard with a radial capillary tube. Whereas the version of these separators with diaphragm made of materials other than acid-resistant steel or with (Teflon®, gold) plated diaphragm typically has a capillary tube outgoing in the separator axis.

14.1.1. **Flanged seals with flush diaphragm S-P**

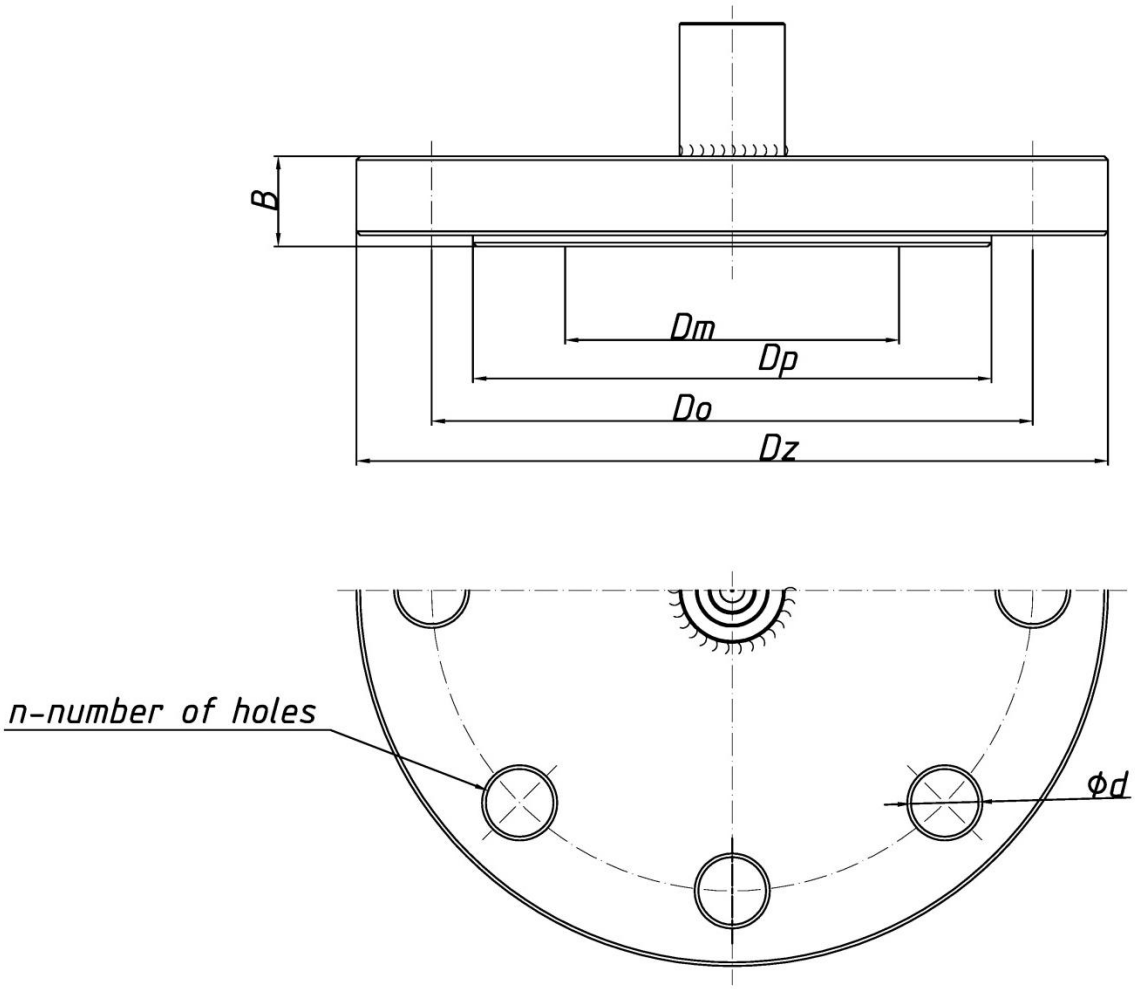
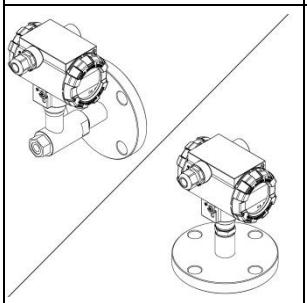
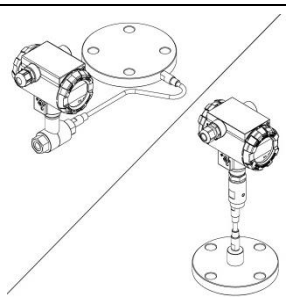
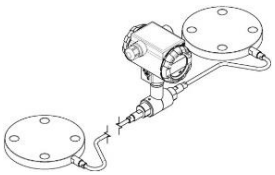
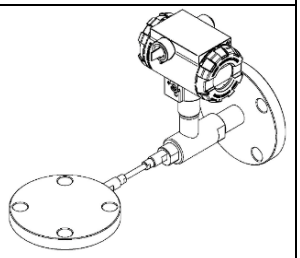


Figure 81. Flanged seals with flush diaphragm S-P.

	Using in each type of separation			
	Direct **(S-P)**	Distance **(S-PK)**	With distance separators **(S-PK)**	With direct and distance separators **(S-P/S-PK)**
Transmitter				
APC-2000ALW	✓	✓	✗	✗
APR-2000ALW	✓	✓	✗	✗
APR-2000ALW with diaphragm seals	✗	✗	✓	✓

Version	Diaphragm diameter **Dm**	Rabbet diameter **Dp**	Pitch diameter **Do**	Outer diameter **Dz**	Thickness **B**	Holes diameter **d**	Number of holes **n**
DN50 PN40	59	102	125	165	22	18	4
2” ANSI PN40	59	92	120.5	150	20	20	4
DN80 PN40	89	138	160	200	24	18	8
3” ANSI 150	89	127	152.5	190	24	20	4
DN100 PN40	89	162	190	235	24	22	8
4” ANSI 150	89	158	190.5	230	24	20	8

Table 33. Dimensions of S-P separators.

Pressure gauge	**Type of separation**	**Separator version**		
		DN50 / 2”	**DN80 / 3”**	**DN100 / 4”**
APC(R)-2000ALW*	Direct	10	2.5	2.5
	Distance	100	25	25
* The ranges listed in the table for the variable range transmitter APC(R)-2000ALW shall be understood as set ranges.				

Table 34. Recommended minimum measurement range width (kPa).

Maximum pressure for PN40 → 4 MPa.

Type of separation	**Absolute “zero” error per 10°C for the separator**		
	DN50 / 2”	**DN80 / 3”**	**DN100 / 4”**
Direct	0.05 kPa	0.04 kPa	0.04 kPa
Distance (capillary tube 2 m)	0.3 kPa	0.1 kPa	0.1 kPa

Table 35. Additional absolute “zero” error due to the ambient temperature changes.

Please note!
Additional “zero” error due to the changes of temperature in the oil separation system and in each case is considerably smaller than the errors given in the table.

Distance separation			Direct separation
Gauge fluid	**Negative pressure measurements**	**Overpressure measurements**	
High temperature (DC)	Max. 200°C - p≥ 5 kPa ABS	-10 … 315°C	-30 … 150°C
High temperature (DH)	Max. 250°C - p≥ 10 kPa ABS	+15 … 380°C	
Low temperature (AK)	Not recommended for pressure measurements < 20 kPa ABS	-60 … 200°C	

Table 36. Range of the measured medium temperature.

ABS- absolute pressure

Please note!

For ambient temperature < -15°C it is recommended to warm up the capillary tubes with DC fluid.

Diaphragm and separator flange material: 1.4404 (steel 316L).

Special versions:

- other standard ANSI or DIN;
- filled with edible oil (medium temp. -10 … 150°C);
- direct diaphragm seal for medium temp. over 150°C;
- other to be agreed with Aplisens consultants.

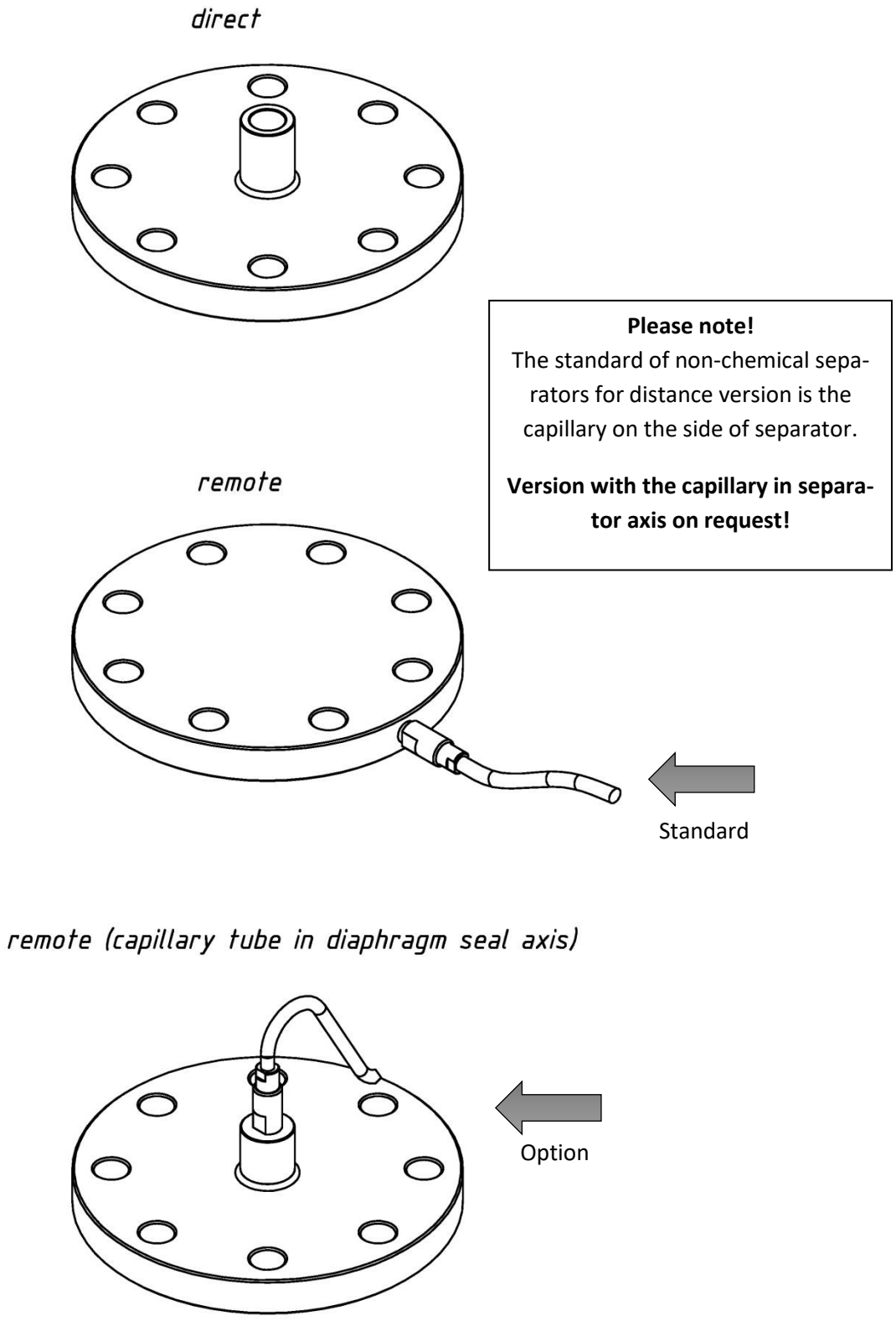


Figure 82. Types of flange separators S-P.

14.1.2. **Flanged seals with extended diaphragm S-T**

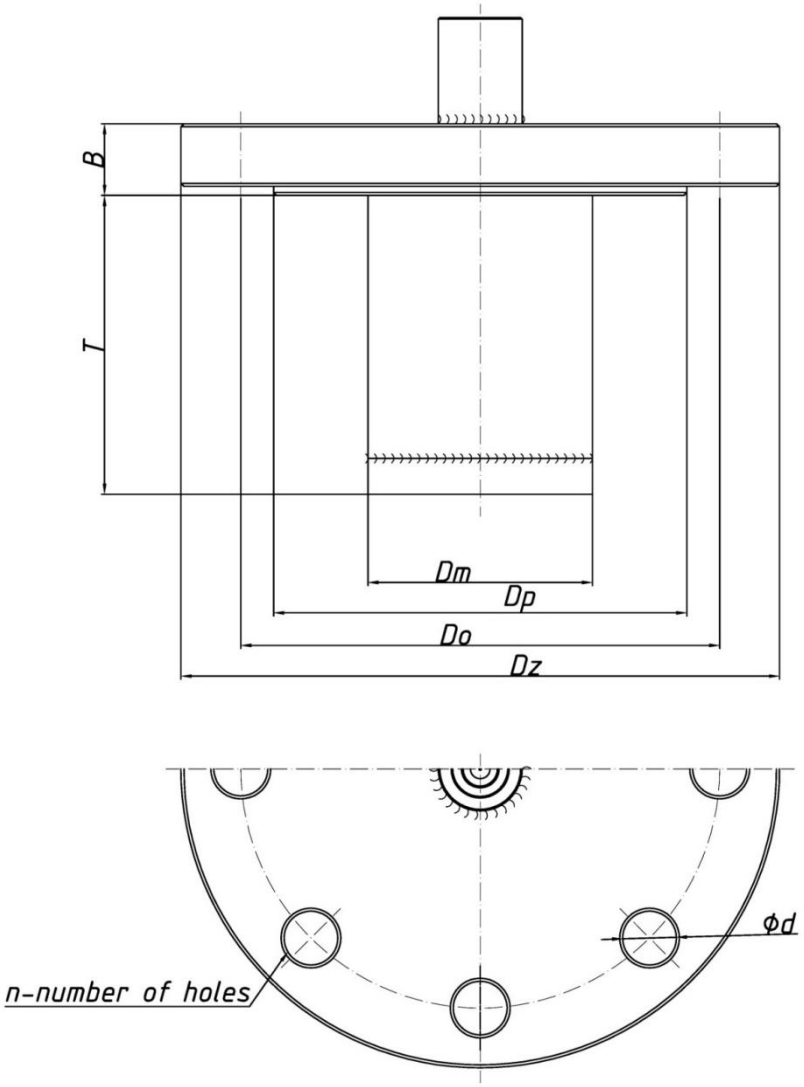
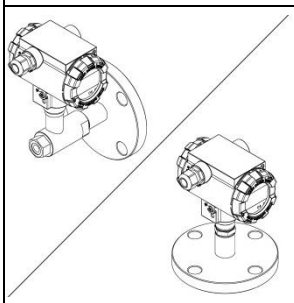
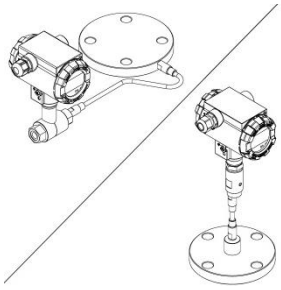
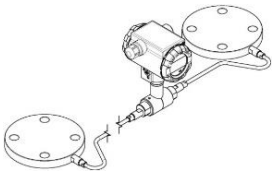
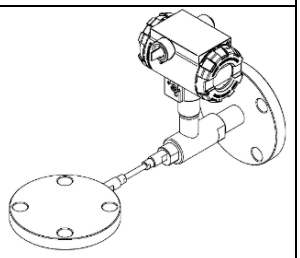


Figure 83. Flanged seals with extended diaphragm S-T.

A typical use of a tubular separator is a pressure or level measurement in a multi-shell tank where it is advisable that the diaphragm is located close to the inside of the tank.

Version	Diaphragm diameter **Dm**	Rabbet diameter **Dp**	Pitch diameter **Do**	Outer diameter **Dz**	Thickness **B**	Holes diameter **d**	Number of holes **n**	Tube length **T**
DN50 PN40	48	102	125	165	22	18	4	50, 100, 150, 200
2” ANSI PN40	48	92	120.5	150	20	20	4	
DN80 PN40	75	138	160	200	24	18	8	
3” ANSI 150	75	127	152.5	190	24	20	4	
DN100 PN40	89	162	190	235	24	22	8	50, 100, 150
4” ANSI 150	89	158	190.5	230	24	20	8	

Table 37. Dimensions of S-T separators.

	Using in each type of separation			
	Direct **(S-T)**	Distance **(S-TK)**	With distance separators **(S-TK)**	With direct and distance separators **(S-T/S-TK)**
Transmitter				
APC-2000ALW	✓	✓	✗	✗
APR-2000ALW	✓	✓	✗	✗
APR-2000ALW with diaphragm seals	✗	✗	✓	✓

Pressure gauge	**Type of separation**	**Separator version**		
		DN50 / 2”	**DN80 / 3”**	**DN100 / 4”**
APC(R)-2000ALW*	Direct	10	10	10
	Distance	600	50	25
* The ranges listed in the table for the variable range transmitter APC(R)-2000ALW shall be understood as set ranges.				

Table 38. Recommended minimum measurement range width (kPa).

Maximum pressure for PN40→ 4 MPa.

Type of separation	**Absolute “zero” error per 10°C for the separator**		
	DN50 / 2”	**DN80 / 3”**	**DN100 / 4”**
Direct	0.2 kPa	0.06 kPa	0.04 kPa
Distance (capillary tube 2 m)	1 kPa	0.2 kPa	0.1 kPa

Table 39. Additional absolute “zero” error due to the ambient temperature changes for separator with a 100mm of tube.

Please note!

Additional “zero” error due to changes of the temperature of the medium depends on the temperature gradient in the oil separation system and in any case it is significantly lower than the errors given in the table.

Distance separation			**Direct separation**
Gauge fluid	**Negative pressure measurements**	**Overpressure measurements**	
High temperature (DC)	Max. 200°C - p≥ 5 kPa ABS	-10 … 315°C	-30 … 150°C
High temperature (DH)	Max. 250°C - p≥ 10 kPa ABS	+15 … 380°C	
Low temperature (AK)	Not recommended for pressure measurements < 20 kPa ABS	-60 … 200°C	

Table 40. Range of the measured medium temperature.

ABS- Absolute pressure

Please note!
For ambient temperature < -15°C it is recommended to warm up the capillary tubes with DC fluid.

Special versions:

- other separators acc. to DIN or ANSI;
- direct diaphragm seal for medium temp. over 150°C;
- other to be agreed with Aplisens consultants.

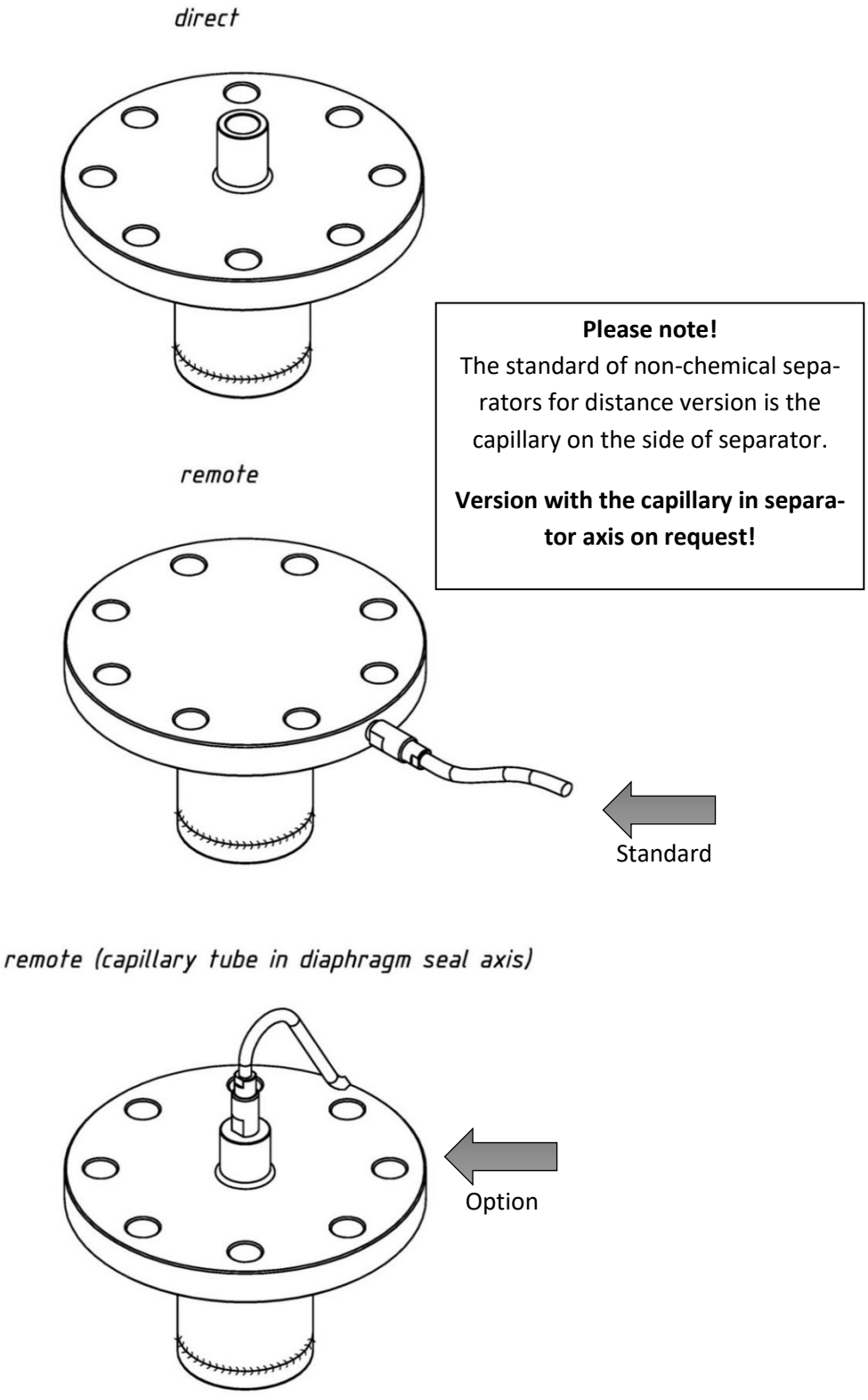


Figure 84. Types of flanged tubular separators S-T.

14.1.3. **Flanged seals with extended diaphragm and direct diaphragm cleaning system S-TK-P**

Separator S-TK-P is a special version of tubular distance separator S-TK-DN100/T=100 mm, which is equipped with a diaphragm flushing unit. It is used for the measurements of extremely dense and viscous media with tendency to cover the diaphragm. The user can clean the diaphragm without dismantling the separator. The cleaning medium, e.g. water is supplied through two ducts located inside the separator.
Flushing shall be carried out periodically, in intervals depending on the properties of the measured medium. Connection of water to the flushing ducts is possible via two ball valves G ½" located at the rear part of the separator.

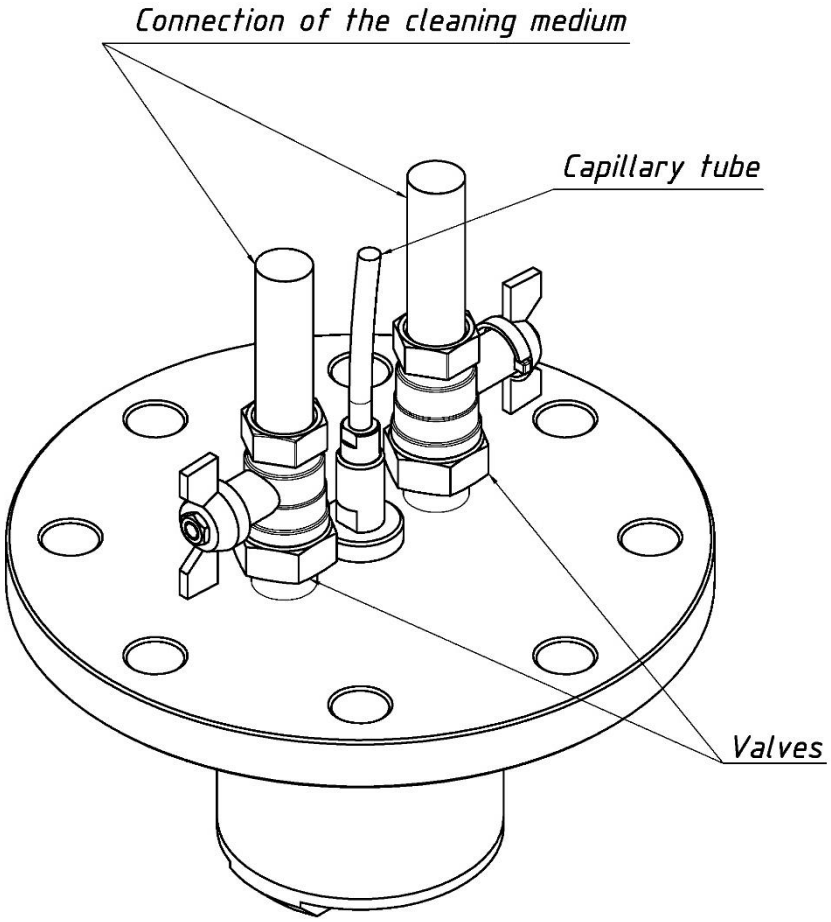


Figure 85. Separator S-TK-P with a built-in diaphragm rinsing unit, view in isometry.

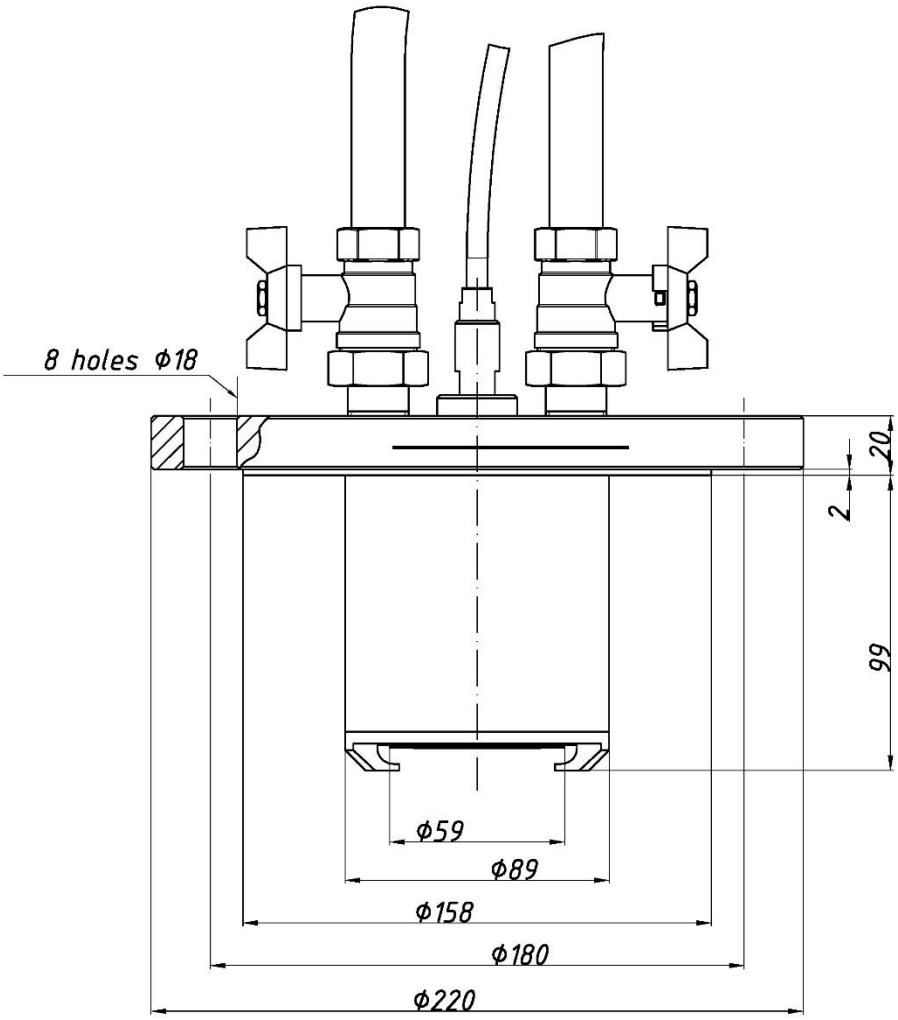
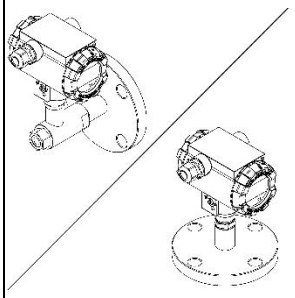
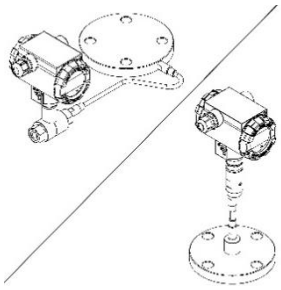
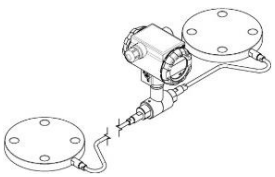
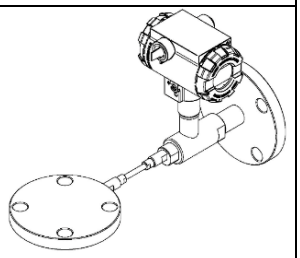


Figure 86. Overall dimensions of the separator S-TK-P with a built-in diaphragm rinsing unit.

	Using in each type of separation			
Transmitter	Direct	Distance **(S-TK-P)**	With distance separators **(S-TK-P)**	With direct and distance separators **(S-TK-P)**
				
APC-2000ALW	✗	✓	✗	✗
APR-2000ALW	✗	✓	✗	✗
APR-2000ALW with diaphragm seals	✗	✗	✓	✓
*S-TK-P separator is intended to distance mounting only.				

14.1.4. **Chemical flanged seals with flush diaphragm S-Ch**

Chemical flanged seals separate the transmitter from adverse parameters characterising the medium, such as:
- high corrosivity;
- low or high temperature, increased viscosity, contamination;
- system vibrations.

Diaphragms and rabbets of chemical-resistant separators are made of selected materials resistant to corrosive effect of the medium, taking into consideration the chemical composition, the expected range of concentrations and the range of temperatures.

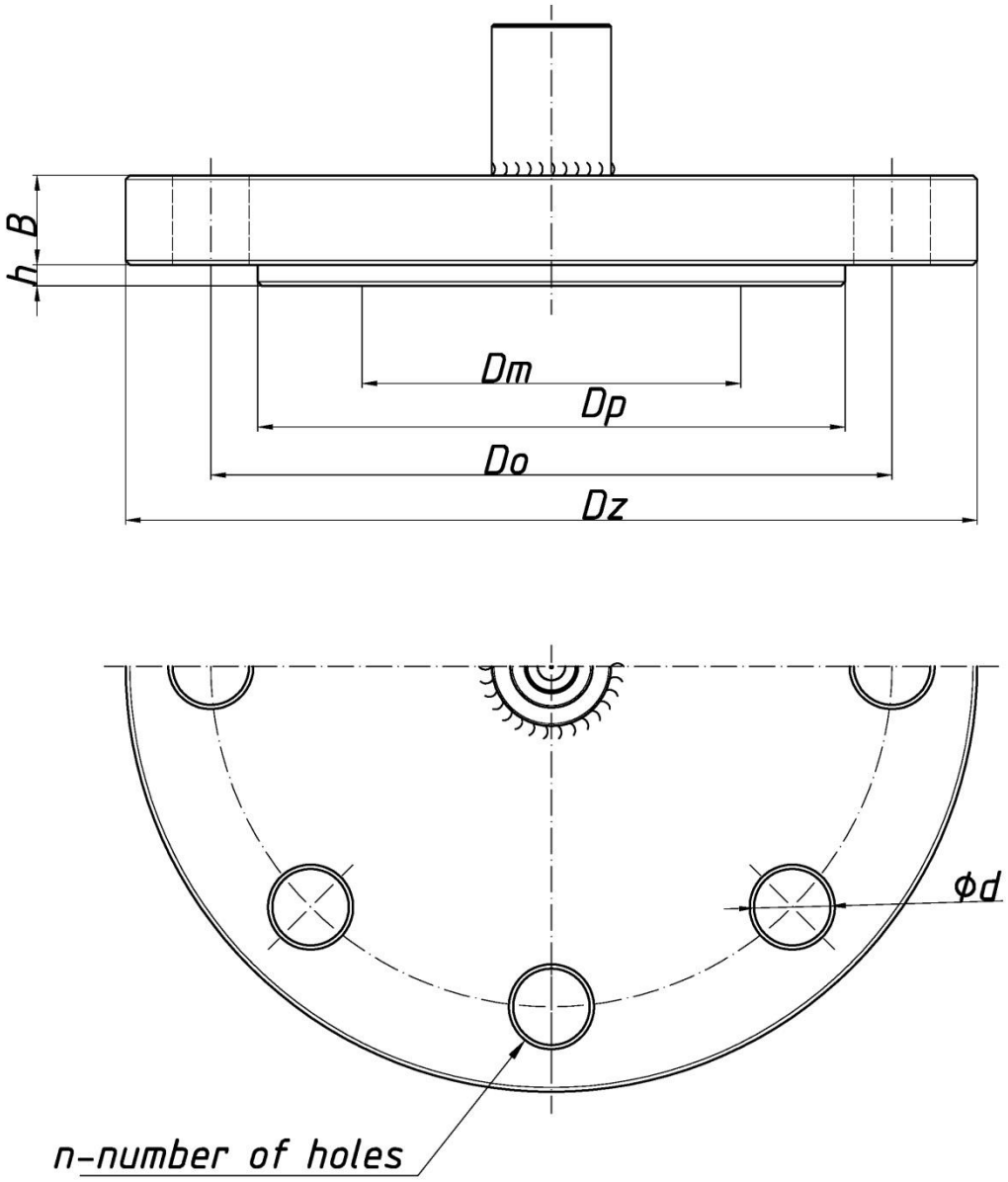
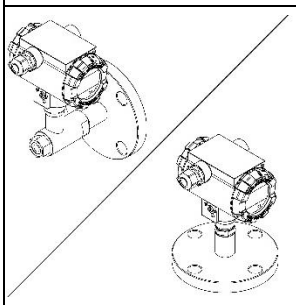
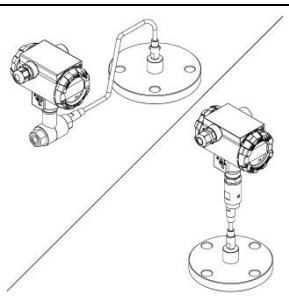
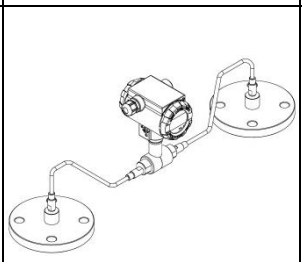
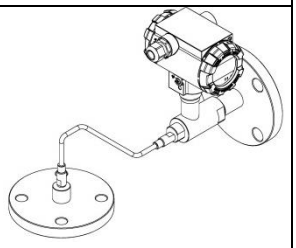


Figure 87. Overall dimensions of S-Ch separator with flush diaphragm.

	Using in each type of separation			
Transmitter	Direct **(S-Ch)**	Distance **(S-ChK)**	With distance separators **(S-ChK)**	With direct and distance separators **(S-Ch/S-ChK)**
				
APC-2000ALW	✓	✓	✗	✗
APR-2000ALW	✓	✓	✗	✗
APR-2000ALW with diaphragm seals	✗	✗	✓	✓

Material of wetted parts.	Version	Diaphragm diameter **Dm**	Rabbet diameter **Dp**	Pitch diameter **Do**	Outer diameter **Dz**	Thickness **B**	Thickness **h**	Holes diameter **d**	Number of holes **n**
Hastelloy, nickel, Monel	DN50 PN10/40	59	98	125	165	18	7	18	4
	DN80 PN25/40	89	132	160	200	22	7	18	8
Titanium	DN50 PN10/40	59	98	125	165	24	6	18	4
	DN80 PN25/40	89	138	160	200	22	6	18	8
Tantalum-Tantalum	DN50 PN10/40	59	102	125	165	18	3	18	4
	DN80 PN25/40	89	138	160	200	22	3	18	8
Tantalum-Teflon Titanium-Teflon	DN50 PN16	59	102	125	165	18	8	18	4
	DN80 PN10/16	89	138	160	200	22	8	18	8
Teflon	DN50 PN10/40	59	102	125	165	18	7	18	4
	DN80 PN25/40	89	138	160	200	22	7	18	8

Table 41. The dimensions of the Aplisens separators are similar to those specified in DIN EN1092-1.

Material of wetted parts.	Version	Diaphragm diameter **Dm**	Rabbet diameter **Dp**	Pitch diameter **Do**	Outer diameter **Dz**	Thickness **B**	Thickness **h**	Holes diameter **d**	Number of holes **n**
Hastelloy, nickel, Monel	2” ANSI 150	59	92	120.5	150	18	7	20	4
	3” ANSI 150	89	123	152.5	190	22	7	20	4
Tantalum-Tantalum	2” ANSI 150	59	92	120.5	150	18	2	20	4
	3” ANSI 150	89	127	152.5	190	22	2	20	4
Tantalum-Teflon Titanium-Teflon	2” ANSI 150	59	92	120.5	150	18	8	20	4
	3” ANSI 150	89	127	152.5	190	22	8	20	4
Teflon	2” ANSI 150	59	92	120.5	150	18	7	20	4
	3” ANSI 150	89	127	152.5	190	22	7	20	4

Table 42. The dimensions of the Aplisens separators are similar to those specified in ANSI ASME 16.5.

Pressure gauge	**Type of separation**	**Separator version**	
		DN50 PN16	**DN80 PN40**
APC(R)-2000ALW	Direct	40	10
	Distance	100	40

Table 43. Recommended minimum measurement range width (kPa).

Please note!

Diaphragms and rabbets of chemical-resistant separators are made of selected materials resistant to corrosive effect of the medium, taking into account the chemical composition, the expected range of concentrations and the temperature range.

Type of separation	Absolute “zero” error per 10°C for the separator	
	DN50	DN80
Direct	0.5 kPa	0.2 kPa
Distance (capillary tube 2 m)	1 kPa	0.4 kPa

Table 44. Additional absolute “zero” error due to the ambient temperature changes.

Diaphragm material	Rabbet material	Permissible pressure	Some restrictions for use
Hastelloy	Hastelloy	4 MPa	Measurement of hot concentrated hydrochloric acid
Monel	Monel	4 MPa	Acid measurement
Nickel	Nickel	4 MPa	Acid measurement
Tantalum	Tantalum	1.6 MPa	Hydrofluoric acid measurement, soda lye measurement
Tantalum	Tantalum	1.6 MPa	Presence of gaseous chlorine or fluorine; temperature of medium greater than 95°C
Titanium	Titanium	4 MPa	Presence of dry chlorine, measurements in Ex zones
Teflon*	Teflon*	4 MPa	Measurements of negative pressure, measurements of abrasive media, additionally limitation of Teflon application

Table 45. Offered chemical-resistant materials with the major application limits.

* Diaphragm material — Hastelloy with sprayed-on Teflon layer, rabbet material – steel 316L with sprayed-on Teflon layer.

Medium temperature range:

- -30 ... 180°C for distance separation;
- -30 ... 150°C for direct separation.

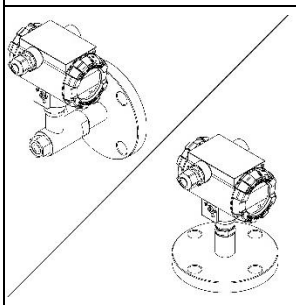
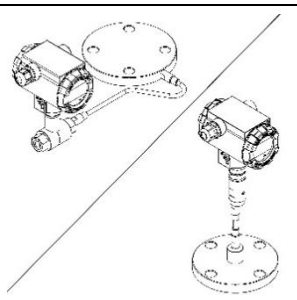
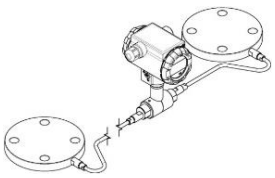
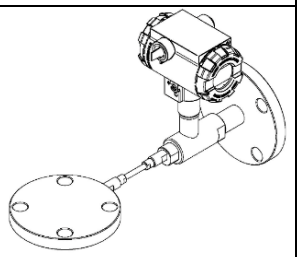
Special versions:

- filling with FLUOROLUBE fluid;
- direct diaphragm seal for medium temp. over 150°C;
- gold plated wetted parts material- after consulting with Aplisens.

14.1.5. **Threaded seals with large diaphragm S-Comp**

Separators S-Comp are equipped with a large separating diaphragm (ø70) while maintaining an economic, compact design of the unit. Advantages of S-Comp type separators:

- possibility of performing measurements with low range width;
- ease of assembly.

	Using in each type of separation			
Transmitter	Direct **(S-Comp)**	Distance **(S-CompK)**	With distance separators **(S-CompK)**	With direct and distance separators **(S-Comp/S-CompK)**
				
APC-2000ALW	✓	✓	✗	✗
APR-2000ALW	✓	✓	✗	✗
APR-2000ALW with diaphragm seals	✗	✗	✓	✓

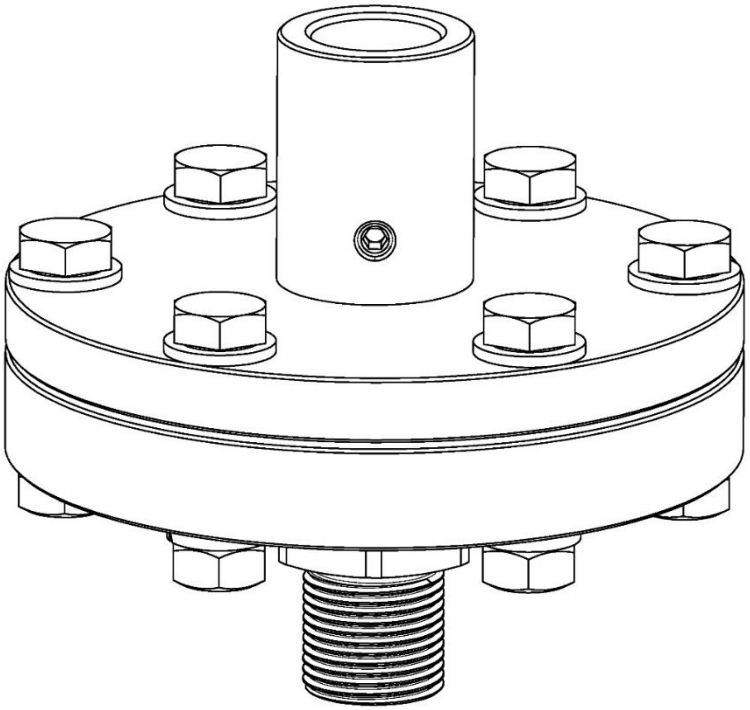


Figure 88. S-Comp separator - view in isometry.

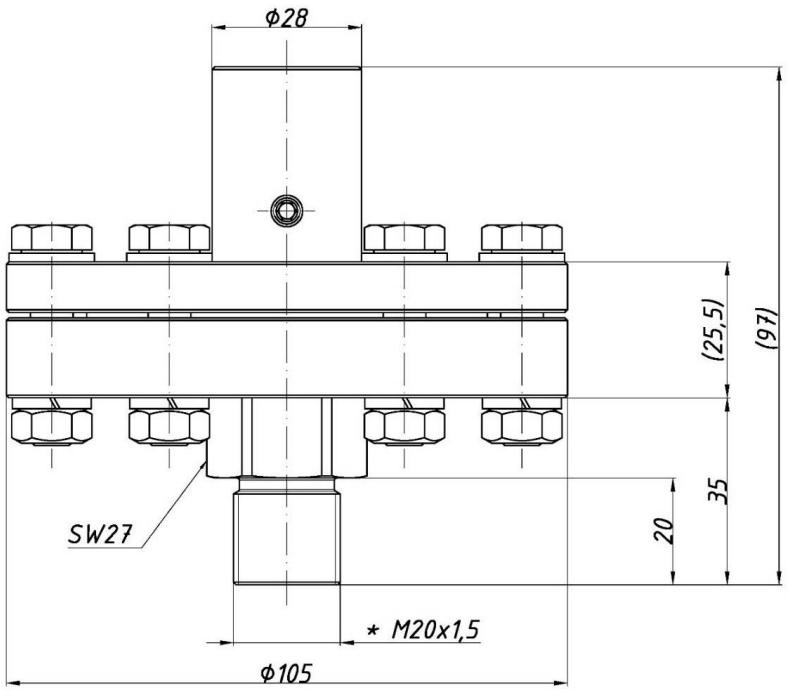


Figure 89. S-Comp separator - overall dimensions.

***Optionally G ½**

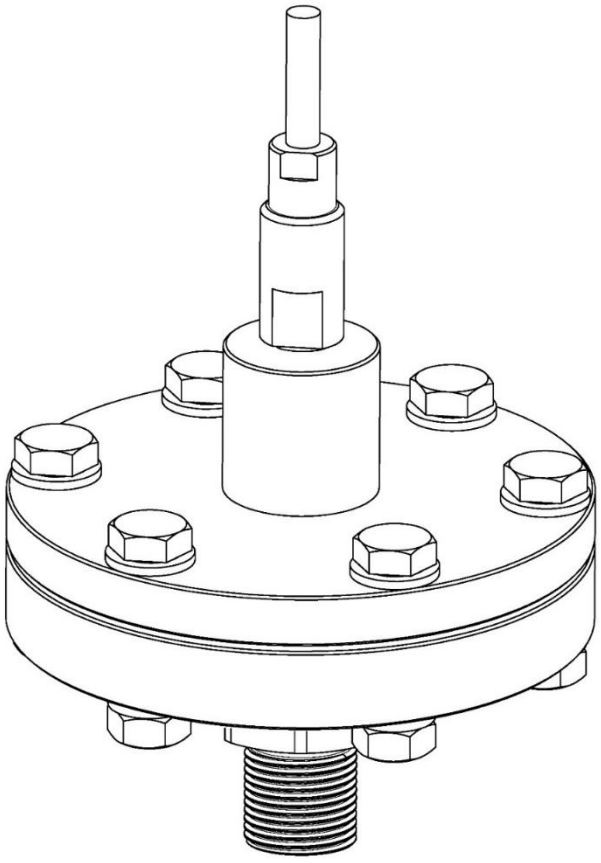


Figure 90. S-CompK distance separator with capillary in axis.

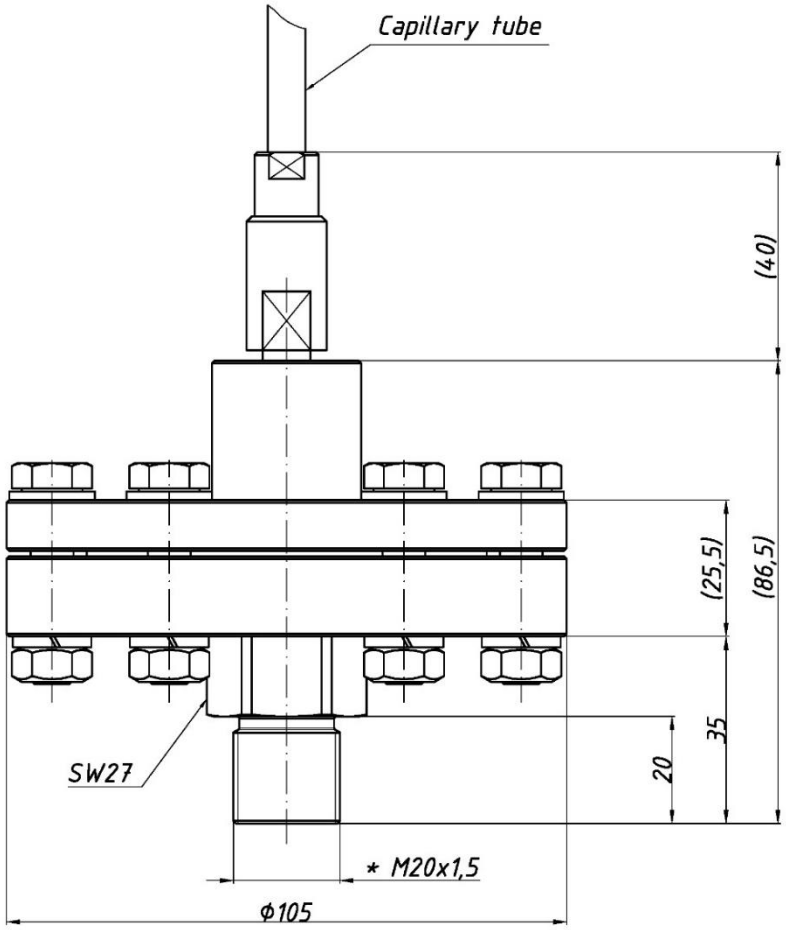


Figure 91. S-CompK separator - overall dimensions.

***Optionally G ½**

S-Comp ø51 separator

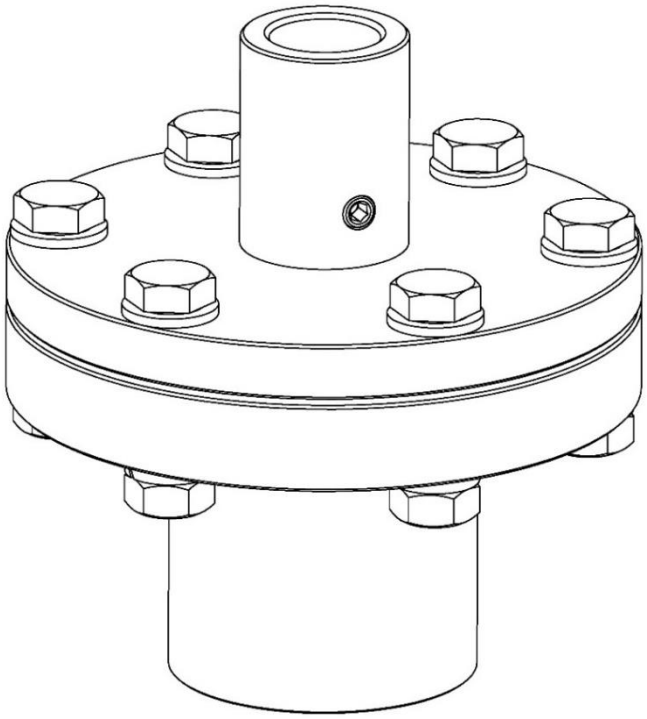


Figure 92. S-Comp ø51 separator - view in isometry.

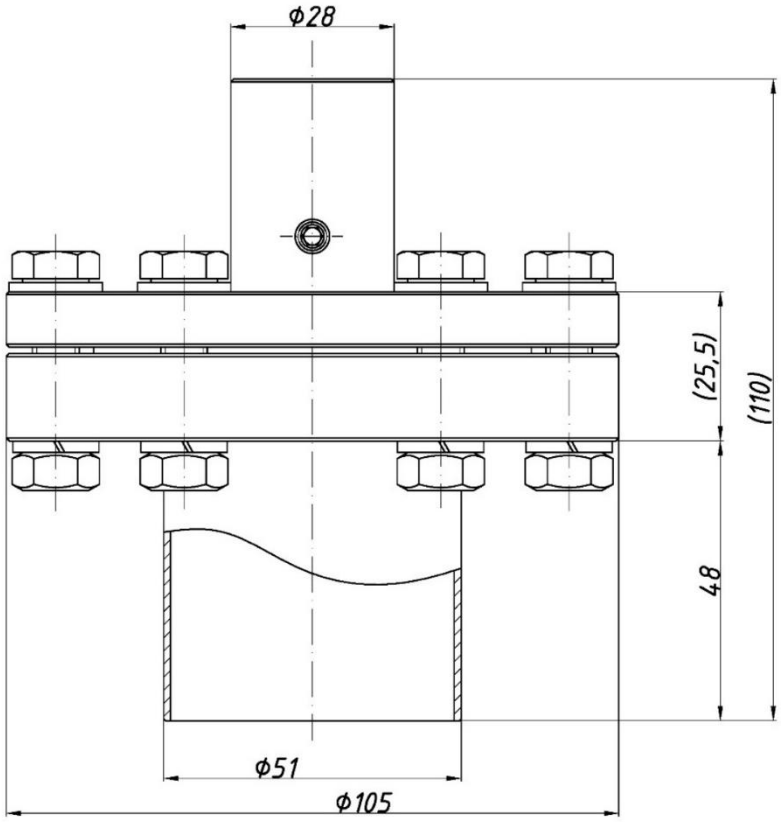


Figure 93. S-Comp ø51 separator - overall dimensions.

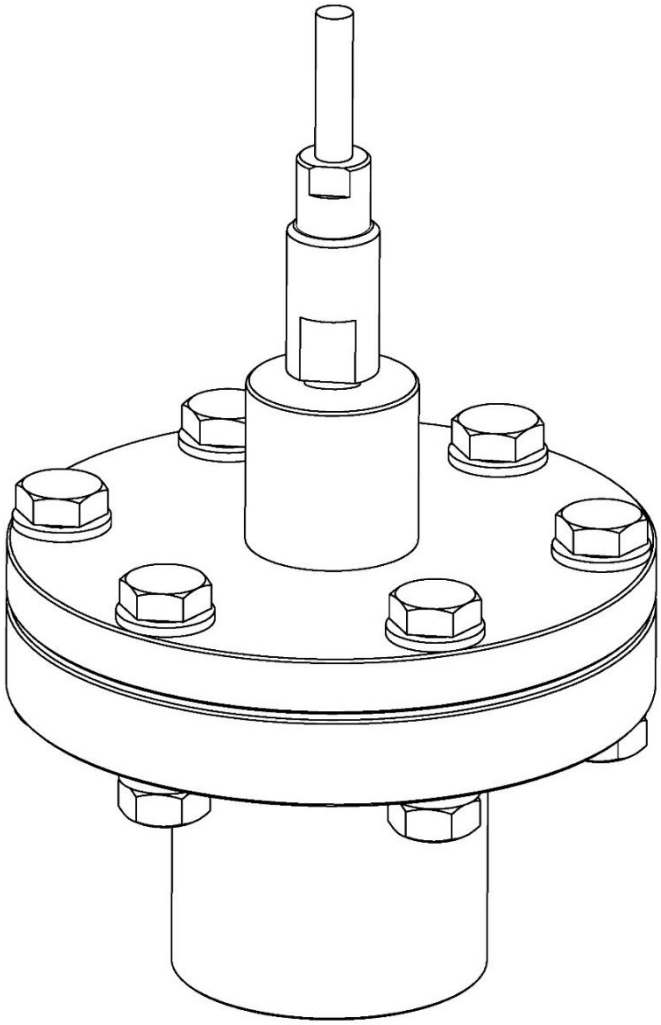


Figure 94. S-CompK ø51 separator - view in isometry.

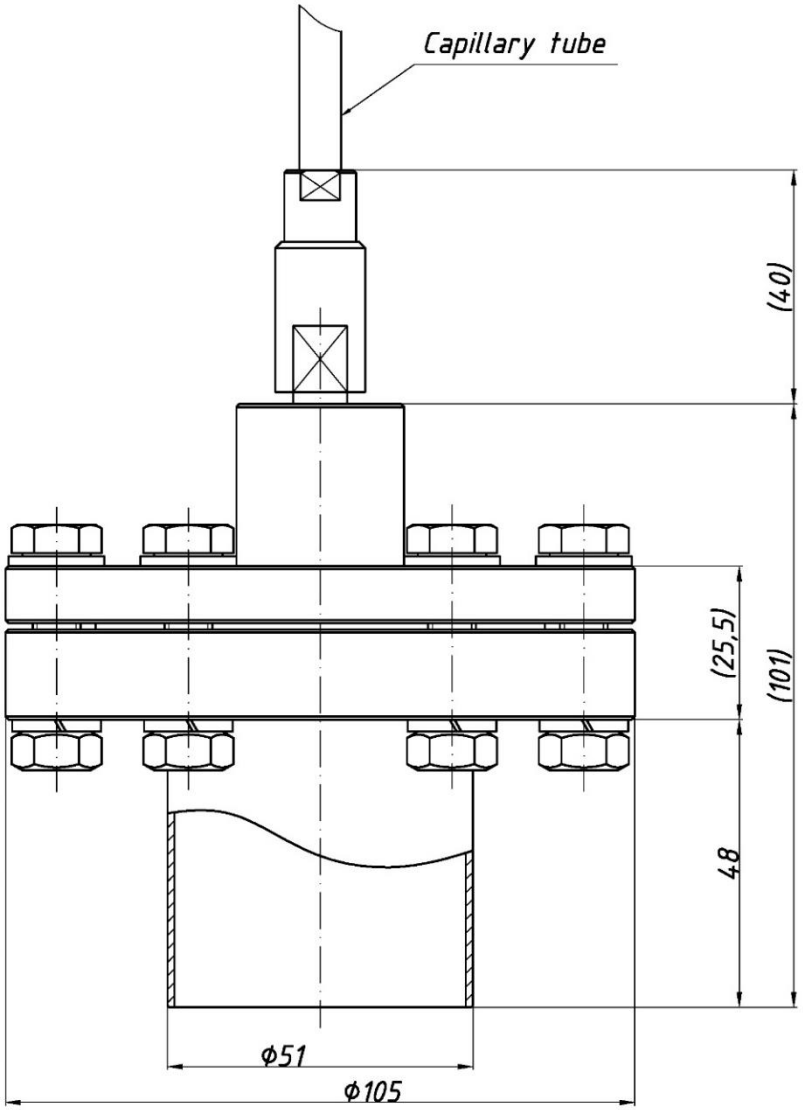


Figure 95. S-CompK ø51 - overall dimensions.

Pressure gauge	Type of separation	Minimum measurement range width
APC(R)-2000ALW*	Direct	20
	Distance	50
* The ranges listed in the table for the variable range transmitter APC(R)-2000ALW shall be understood as set ranges.		

Table 46. Recommended minimum measurement range width of separator S-Comp/K (kPa).

Maximum measurement range: 0 … 1,6 MPa

Type of separation	Absolute “zero” error
Direct	0.06 kPa/10°C
Distance capillary tube 2 m	0.2 kPa/10°C

Table 47. Additional absolute “zero” error due to the ambient temperature changes.

Please note!

Additional “zero” error due to the changes of the medium temperature depends on the temperature gradient in the oil separation system and in each case it is considerably smaller than the errors given in the table.

Medium temperature range:

- -30 … 200°C for distance separation;
- -30 … 150°C for direct separation.

Special versions:

- diaphragm made of Hastelloy C 276;
- capillary outlet at the side of the diaphragm seal;
- direct diaphragm seal for medium temp. over 150°C;
- other to be agreed with Aplisens consultants.

Separator diaphragm, flange and counter flange material: 1.4404 (steel 316L).

14.1.6. **Threaded seals with large diaphragm S-Comp10/25/60MPa**

Separators S-Comp are equipped with a large separating diaphragm (ø70) while maintaining an economic, compact design of the unit. Advantages of S-Comp type separators:

- possibility of performing measurements with low range width;
- ease of assembly.

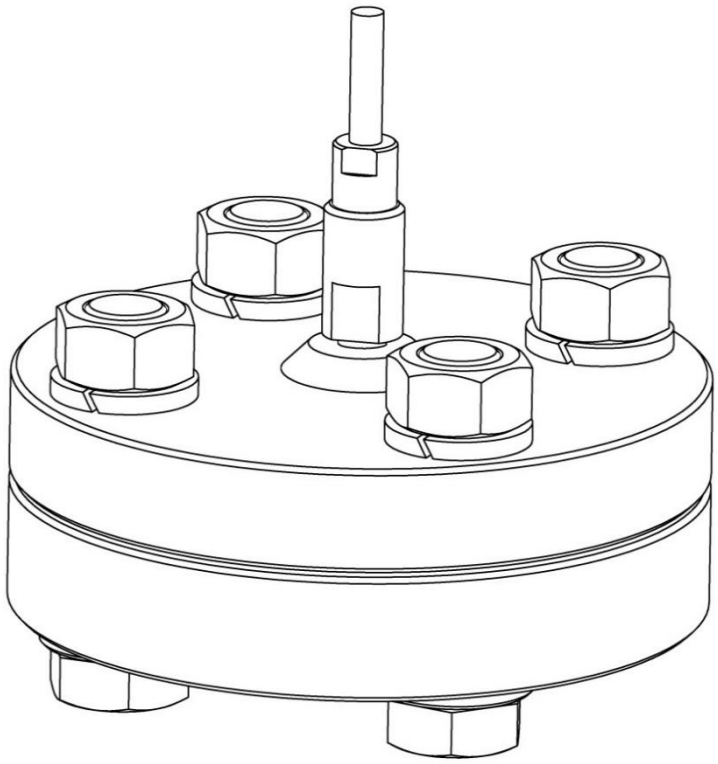


Figure 96. S-Comp10MPa separator - view in isometry.

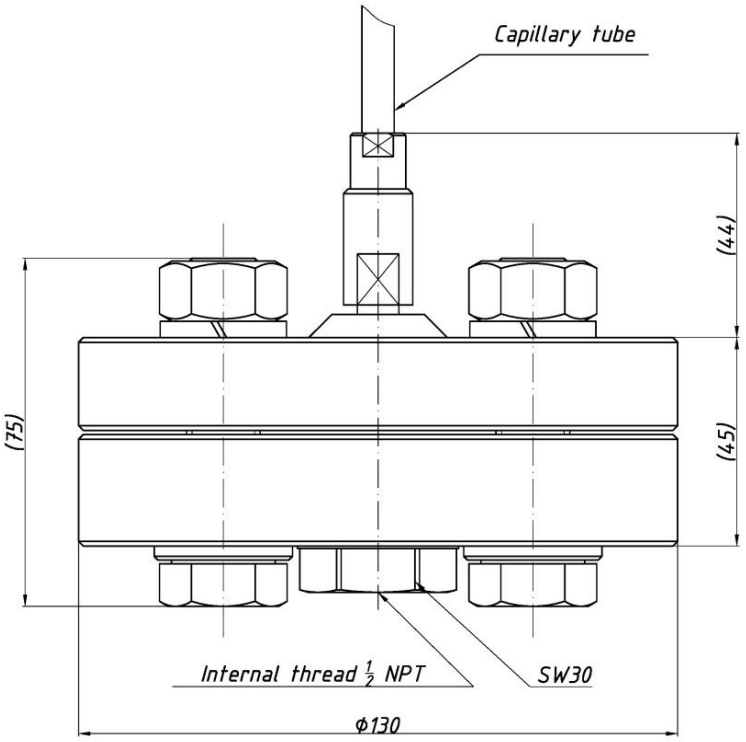


Figure 97. S-Comp10MPa separator - overall dimensions.

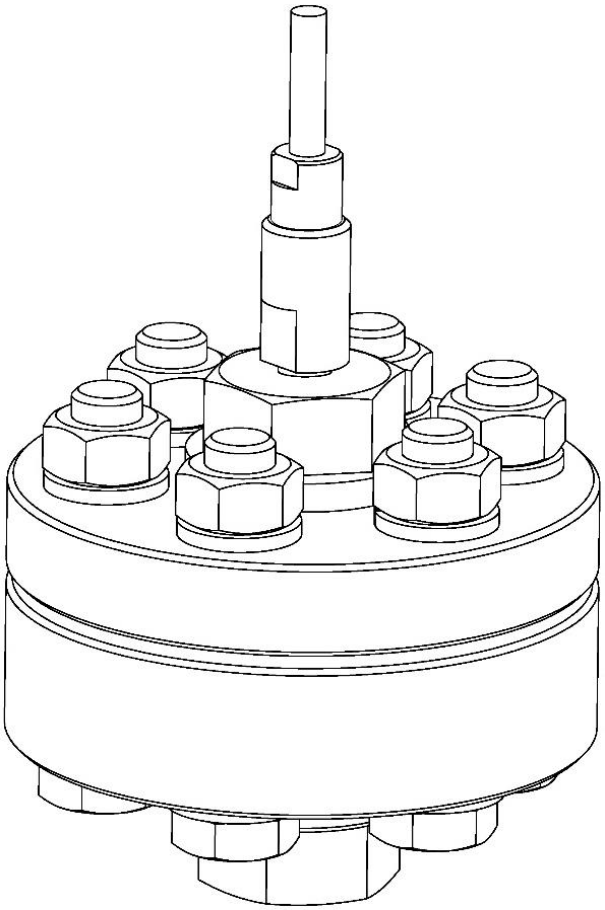


Figure 98. S-Comp25MPa separator - view in isometry.

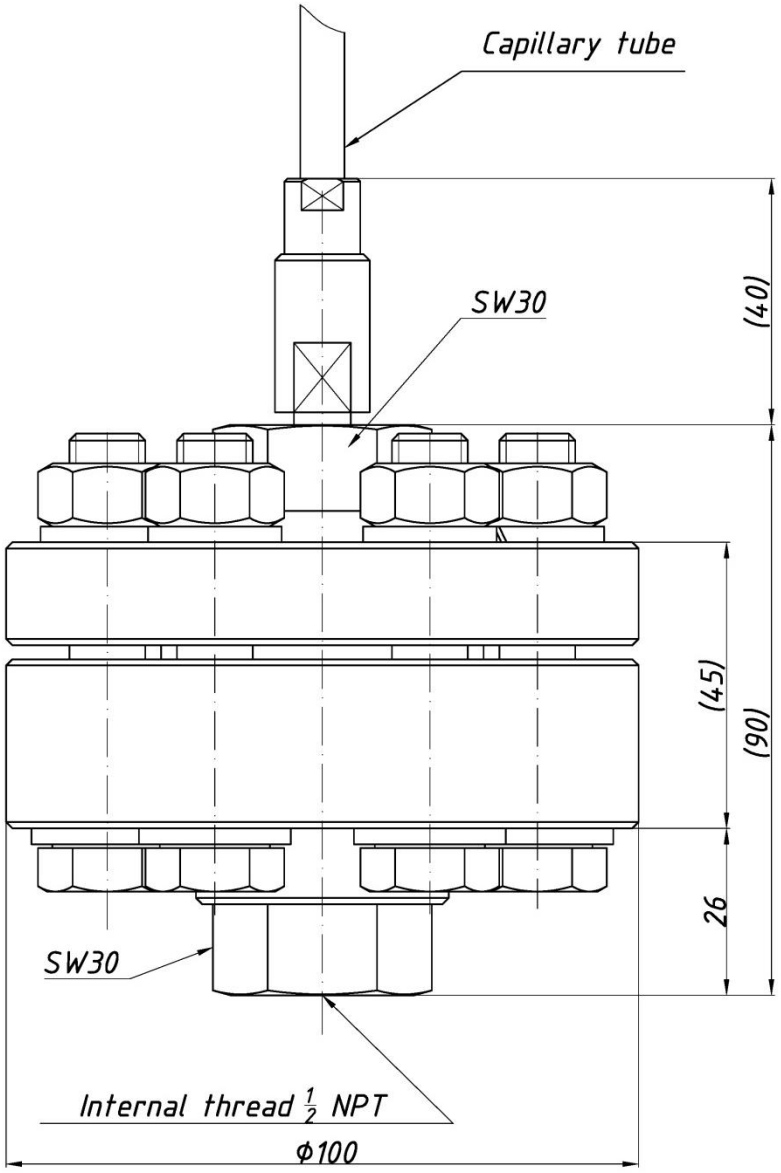


Figure 99. S-Comp25MPa separator - overall dimensions.

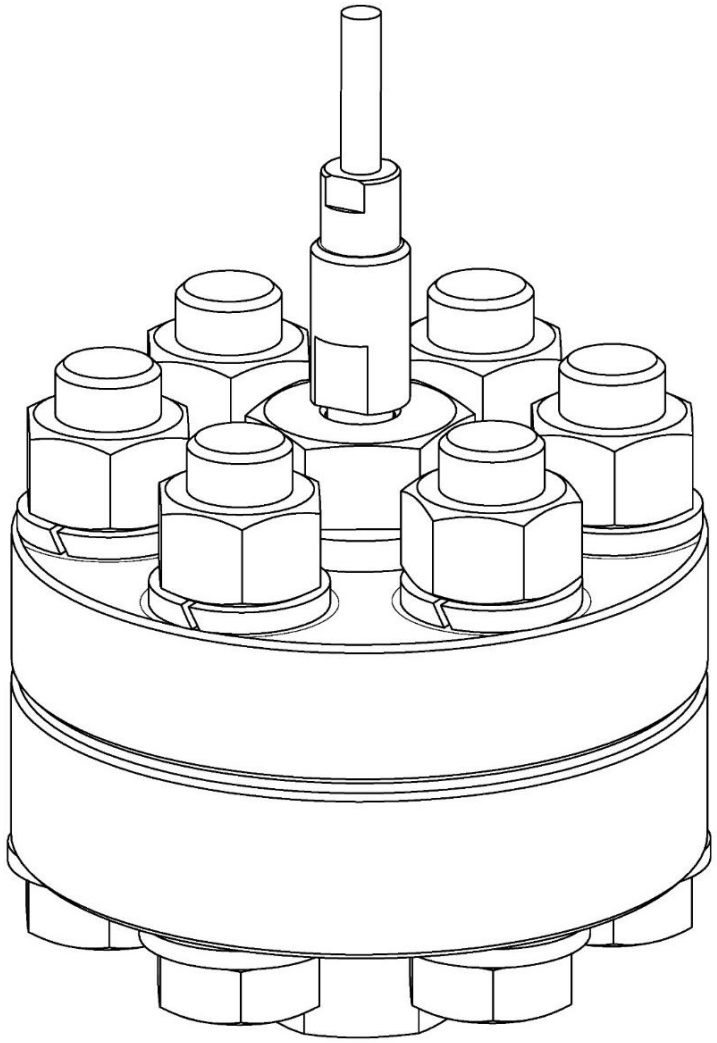


Figure 100. S-Comp60MPa separator - view in isometry.

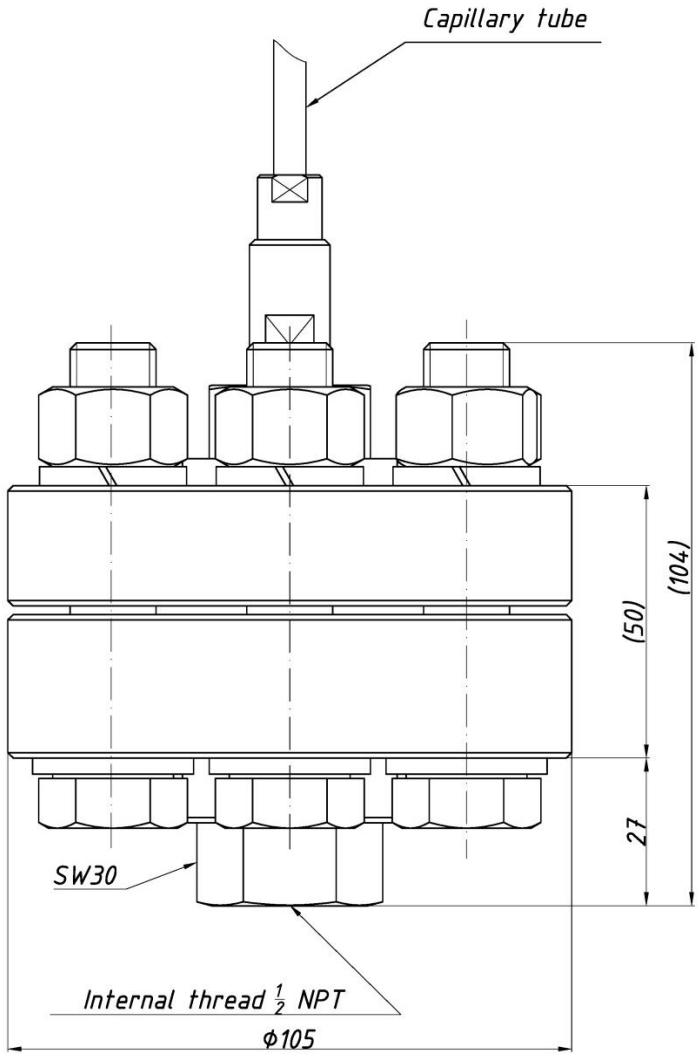
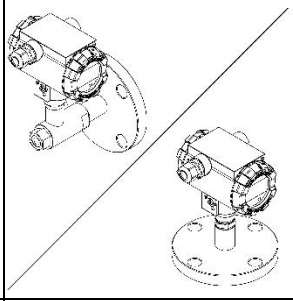
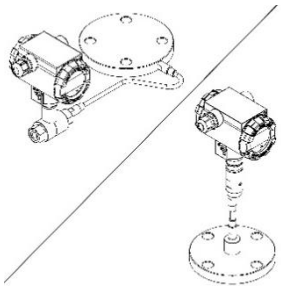
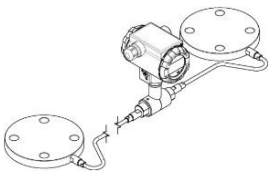
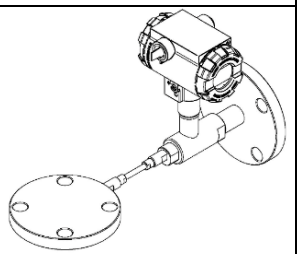


Figure 101. S-Comp60MPa separator - overall dimensions.

	Using in each type of separation			
Transmitter	Direct	Distance **(S-Comp10/25/60)**	With distance separators **(S-Comp10/25/60)**	With direct and distance separators **(S-Comp10/25/60)**
				
APC-2000ALW	✘	✓	✘	✘
APR-2000ALW	✘	✓	✓	✓
APR-2000ALW with diaphragm seals	✘	✘	✓	✓
*S-Comp10/25/60MPa is intended for distance mounting only.				

Pressure gauge	Type of separation	Minimum measurement range width
APC-2000ALW	Distance	1 MPa
APR-2000ALW with diaphragm seals	Distance with two separators	16 kPa

Table 48. Recommended minimum range width of separator S-Comp10/25/60MPa.

Maximum measuring range:
- S-Comp10MPa: 10 MPa;
- S-Comp25MPa: 25 MPa;
- S-Comp60MPa: 60 MPa.

Permissible overload:
- S-Comp10MPa: 16 MPa;
- S-Comp25MPa: 28 MPa;
- S-Comp60MPa: 70 MPa.

Medium temperature range: -30 … 180°C.

Special version:
- separators S-Comp25MPa, S-Comp60MPa with opening ¼ NPT which enables to flush the diaphragm.

Separator body and diaphragm material: steel 316L.
Gasket material:
- S-Comp10MPa, S-Comp25MPa – Teflon;
- S-Comp60MPa – Monel.

14.1.7. **Threaded chemical seals with large diaphragm S-CompCh**

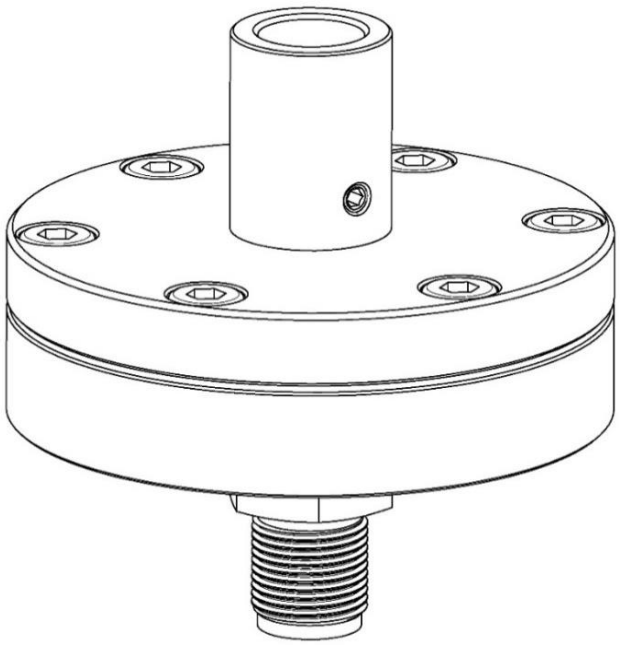


Figure 102. S-CompCh separator - view in isometry.

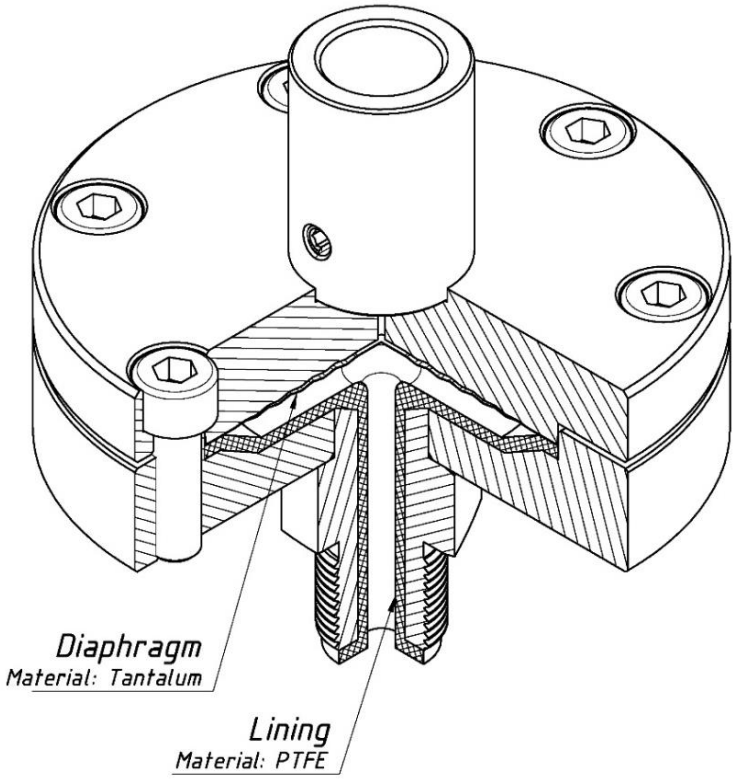


Figure 103. S-CompCh - view of half section.

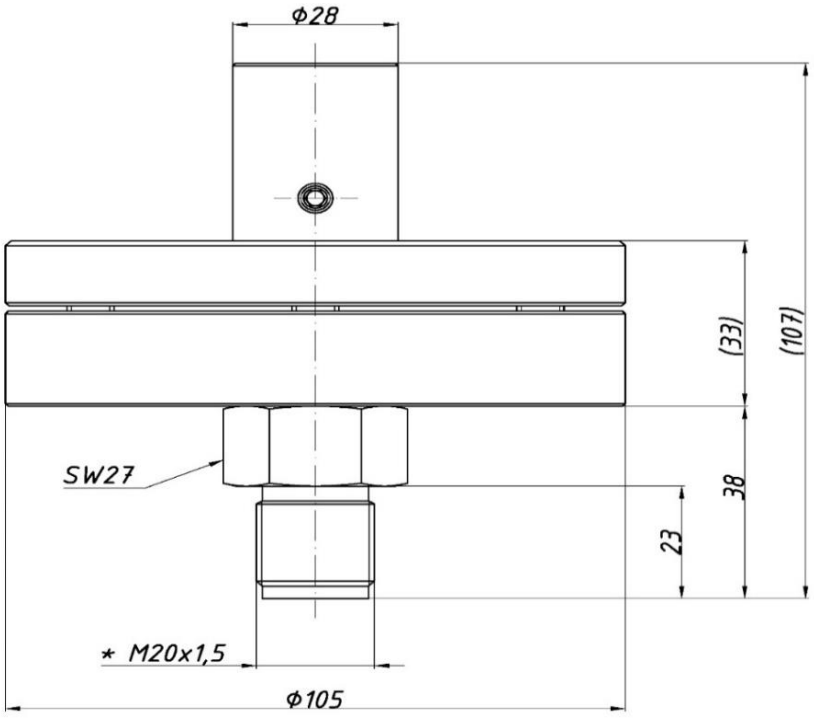


Figure 104. S-CompCh - overall dimensions.

***Optionally G ½**

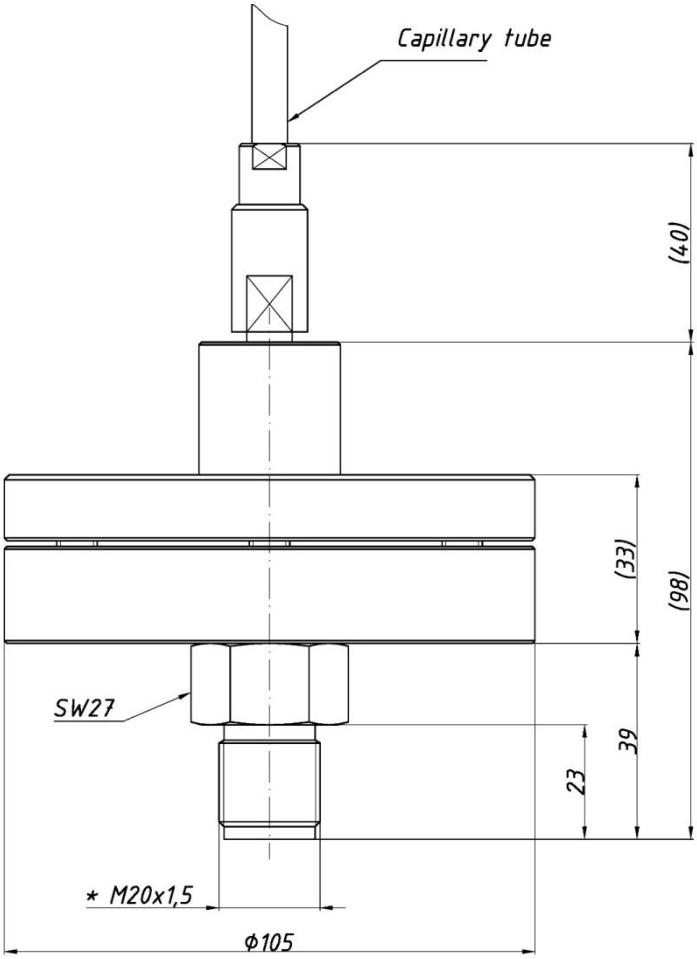


Figure 105. S-CompChK with capillary in axis - overall dimensions.

***Optionally G ½**

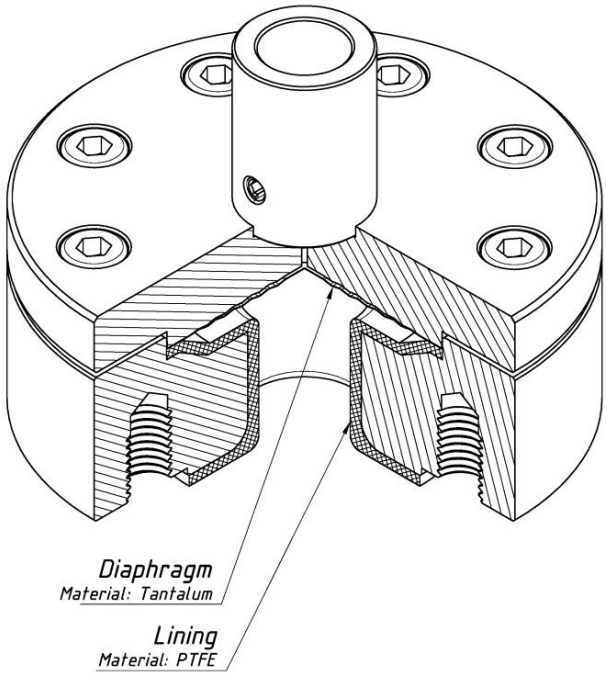


Figure 106. S-CompCh DN25 separator in half section view.

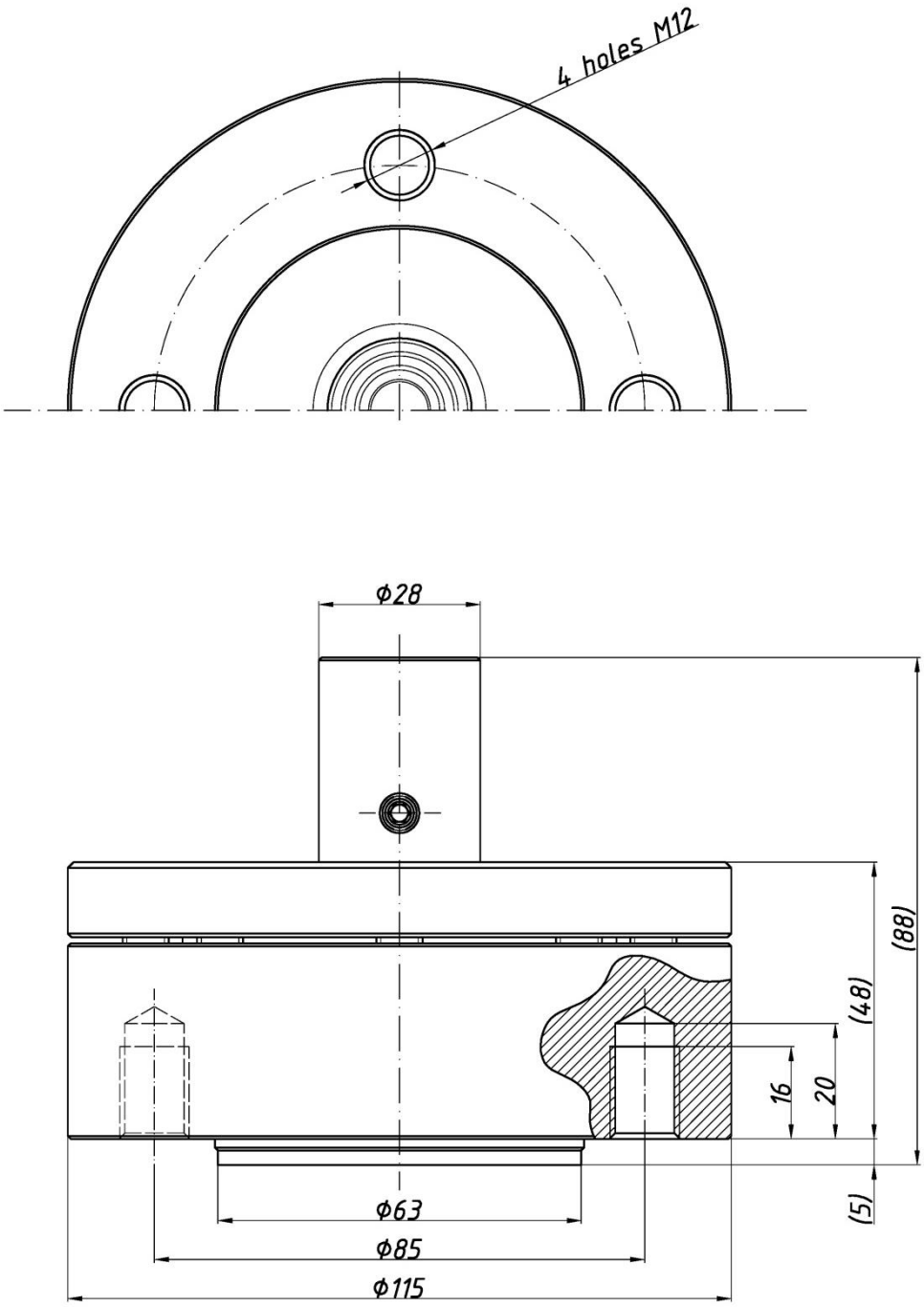
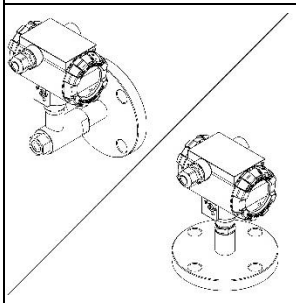
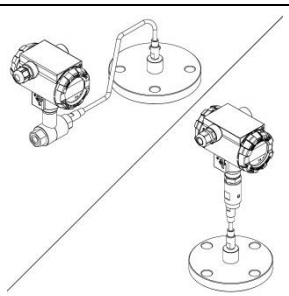
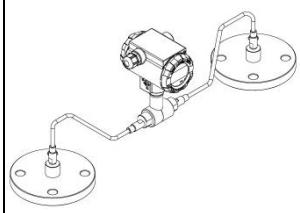
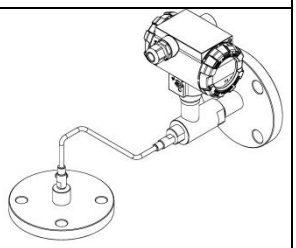


Figure 107. Separator S-CompCh DN25 - overall dimensions.

Separators S-CompCh are used for pressure measurements of chemically aggressive media. Separator parts that are in direct contact with measured medium are made of Teflon and Tantalum. These materials allow for the pressure measurements of many aggressive chemical compounds such as hydrochloric, sulphuric and nitric acid of any concentrations. Separators S-CompCh shall not be used for the measurement of hydrofluoric acid, gaseous fluorine and soda lye.

	Using in each type of separation			
Transmitter	Direct **(S-CompCh)**	Distance **(S-CompChK)**	With distance separators **(S-CompChK)**	With direct and distance separators **(S-Comp/ S-CompChK)**
				
APC-2000ALW	✓	✓	✗	✗
APR-2000ALW	✓	✓	✗	✗
APR-2000ALW with diaphragm seals	✗	✗	✓	✓

Transmitter	Type of separation	Minimum measurement range width
APC(R)-2000ALW	Direct	40
	Distance	100

Table 49. Recommended minimum measurement range width of separator S-CompCh/K (kPa).

Maximum measurement range width: 0…1.6 MPa.

Type of separation	Absolute “zero” error
Direct	0.1 kPa/10°C
Distance (capillary tube 2 m)	0.6 kPa/10°C

Table 50. Additional absolute “zero” error due to the ambient temperature changes.

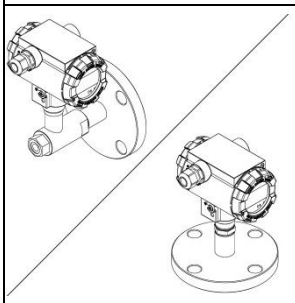
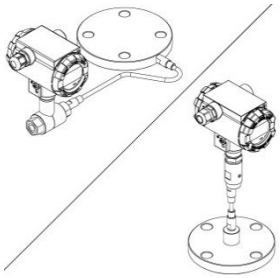
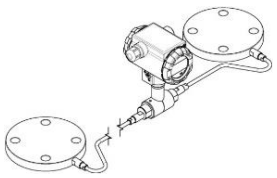
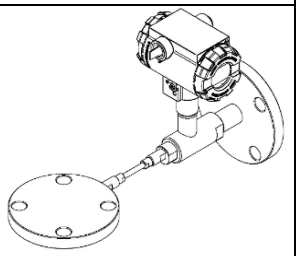
Please note!

The additional “zero” error due to changes of the medium temperature depends on the temperature gradient in the oil separation system and in every case is significantly smaller than the errors given in the table above.

Medium temperature range: -30 … 100°C.
Permissible overload: 2.5 MPa.

14.1.8. **Sanitary diaphragm seals**

Separators S-DIN and S-Clamp are equipped with standard hygienic connections enabling the execution of measurements under aseptic conditions. Typical application of the above-mentioned separators is the measurement of pressure and level in the food and pharmaceutical industry. Aseptic separator S-Poziom is most frequently installed in the bottom of tanks. Thanks to a special design with protruded diaphragm, it does not form a pit in the area of the tank head, which eliminates the problem of products or cleaning media deposited in the pressure connection.

	Using in each type of separation			
Transmitter	Direct	Distance	With distance separators	With direct and distance separators
	S-DIN/ S-SMS/ S-Clamp/ S-Poziom 50/ S-Poziom 25/ S-DRD 65/ S-Varivent®.			
				
APC-2000ALW	✓	✓	✗	✗
APR-2000ALW	✓	✓	✗	✗
APR-2000ALW with diaphragm seals	✗	✗	✓	✓

Transmitter	Type of separation	Minimum width measuring range
APC(R)-2000ALW*	Direct	10
	Distance	50
*The ranges listed in the table for the variable range transmitter APC(R)-2000ALW shall be understood as set ranges.		

Table 51 Recommended minimum measurement range width (kPa).

Maximum measurement range: 0 … 2.5 MPa.

Please note!

For the purpose of measurements within the ranges lower than the recommended ones, it is suggested to use the following types of separators special Clamp 3” and DIN 80 mm.

Type of separation	Absolute “zero” error per 10°C for the separator	
	S-Clamp and S-DIN	S-Poziom
Direct	0.08 kPa/10°C	0.03 kPa/10°C
Distance (capillary tube 2 m)	0.5 kPa/10°C	0.3 kPa/10°C

Table 52. Additional absolute “zero” error due to the ambient temperature changes.

For a set of pressure transmitter and special separator (with larger diameter) temperature errors diminish proportionally to the third power of the active diaphragm diameter.

Please note!

Additional “zero” error due to the changes of the medium temperature depends on the temperature gradient in the oil separation system and in each case it is considerably smaller than the errors given in the table above.

Basic dimensions of separators with standard connections intended for food industry.

S-DIN

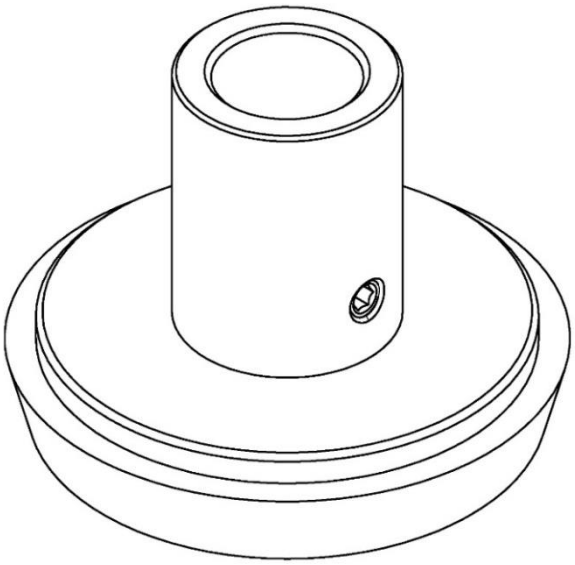


Figure 108. S-DIN separator. View in isometry.

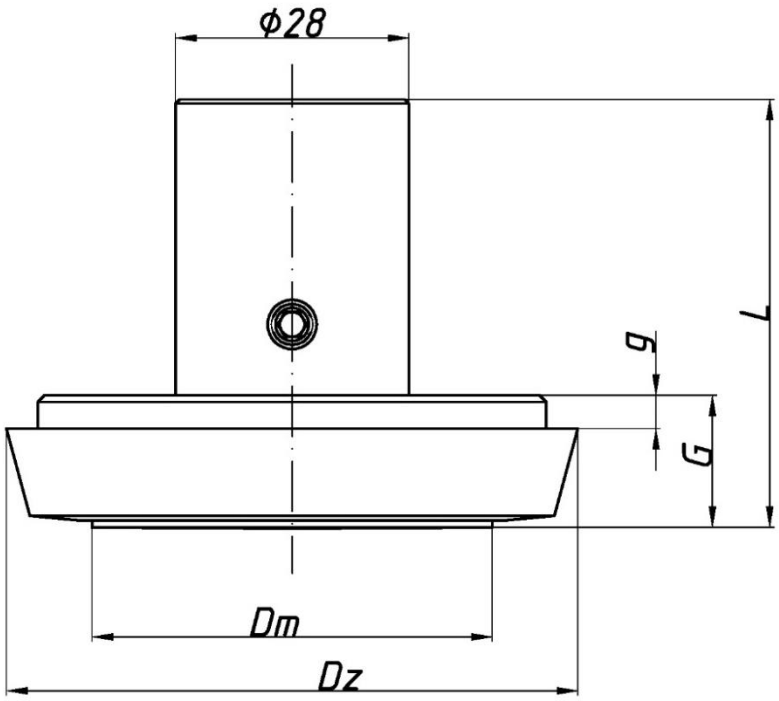


Figure 109. S-DIN - overall dimensions.

Separator	Dz [mm]	Dm [mm]	G [mm]	g [mm]	L [mm]
S-DIN 25	44	25	15,8	5	52,3
S-DIN 32	50	30	15,8	5	52,3
S-DIN 40	56	35	14,8	4	51,3
S-DIN 50	68,5	48	15,8	4	51,3
S-DIN 65	86	59	16,8	4	52,3
S-DIN 80	100	75	16,8	4	52,3

Table 53. Size of S-DIN separators acc. to DIN 11851, for pipes acc. to DIN 11850 series 2.

S-K DIN (distance separator with capillary in axis)

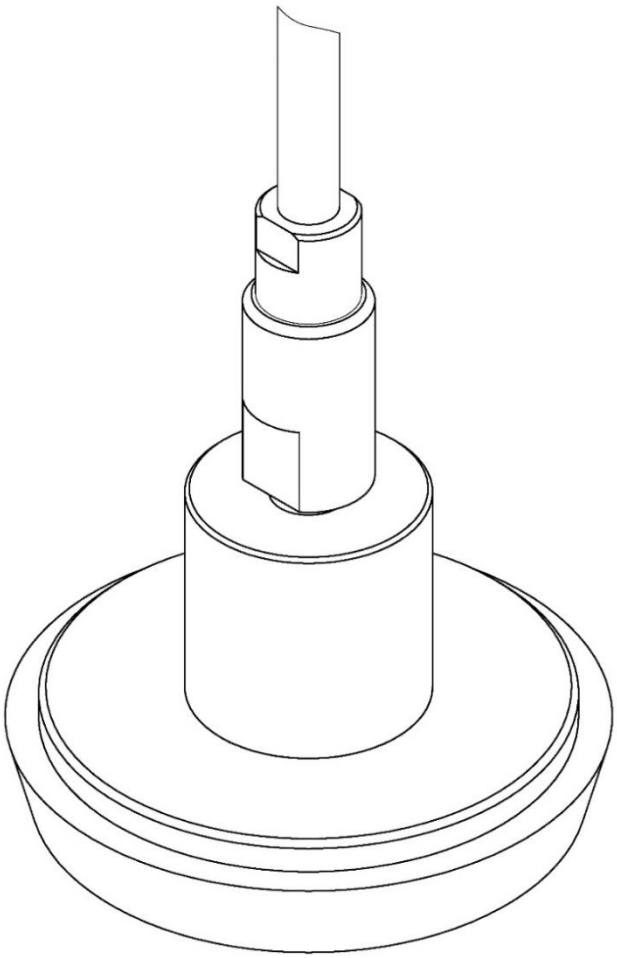


Figure 110. S-K DIN with capillary in axis - view in isometry.

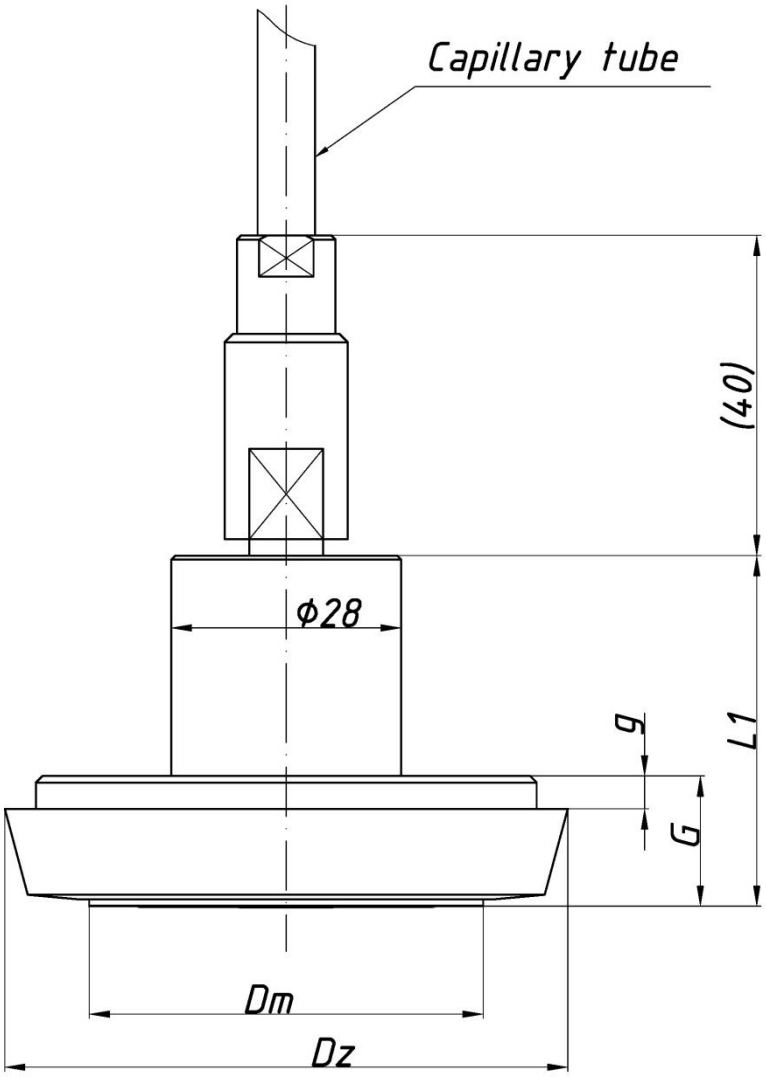


Figure 111. S-K DIN separator with capillary in axis - overall dimensions.

Separator	Dz [mm]	Dm [mm]	G [mm]	g [mm]	L_1 [mm]
S-K DIN 25	44	25	15.8	5	43,3
S-K DIN 32	50	30	15.8	5	43,3
S-K DIN 40	56	35	14.8	4	42,3
S-K DIN 50	68.5	48	15.8	4	42,3
S-K DIN 65	86	59	16.8	4	43,3
S-K DIN 80	100	75	16.8	4	43,3

Table 54. Dimensions of separators S-K DIN according to DIN 11851 for pipes consistent with DIN 11850 Series 2.

S-SMS

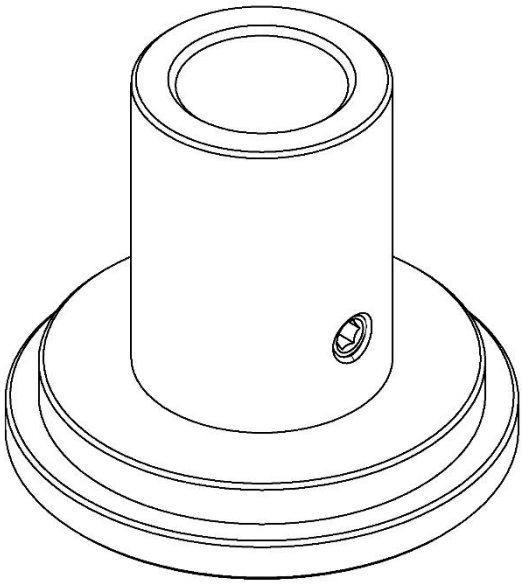


Figure 112. S-SMS separator. View in isometry.

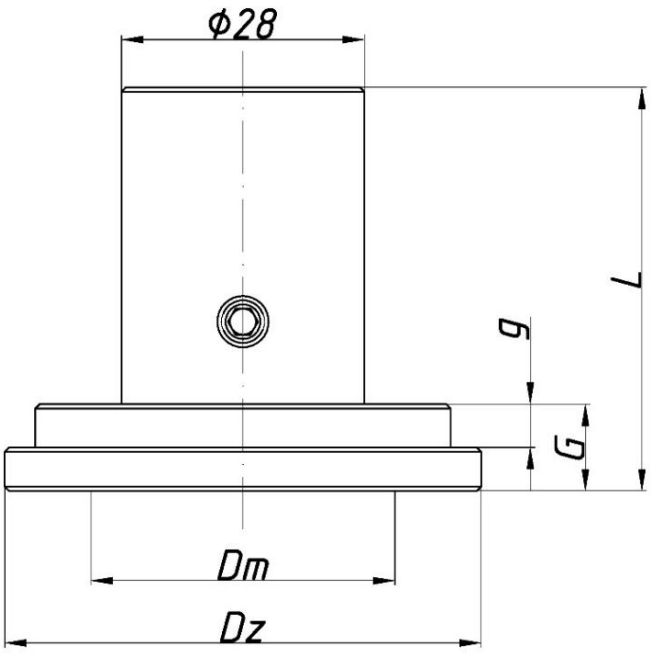


Figure 113. Overall dimensions of separator S-SMS.

Separator	Dz [mm]	Dm [mm]	G [mm]	g [mm]	L [mm]
S-SMS 1''	35.5	25	6.2	2	42.7
S-SMS 1.5''	54.9	35	10	4	46.5
S-SMS 2''	64.9	48	10	5	46.5

Table 55. Dimensions of separator S-SMS according to SMS (SS 3352) for pipes consistent with ISO 1127 Series 2 or ISO 2037/1992.

Separator S-K SMS distance with capillary in axis of separator

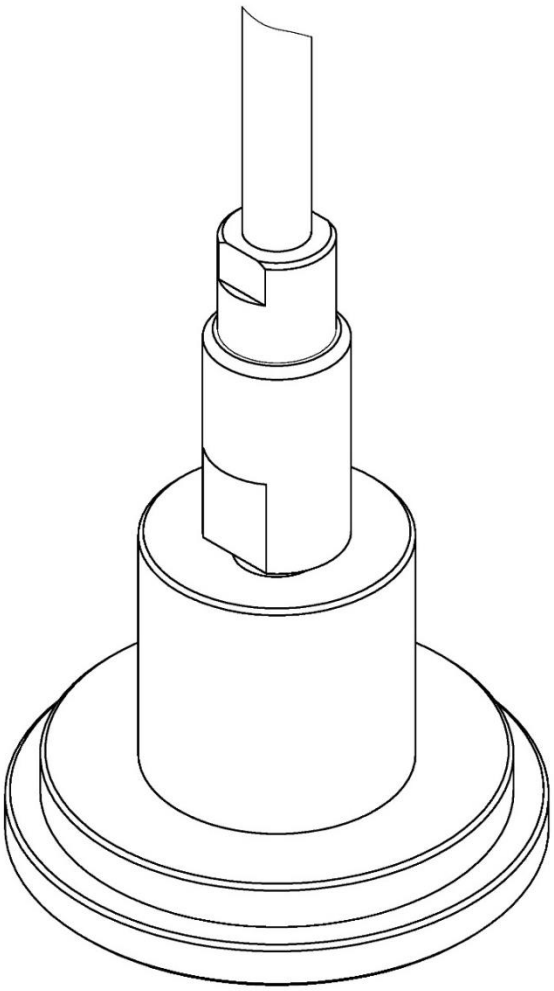


Figure 114. S-K SMS separator with capillary in axis. View in isometry.

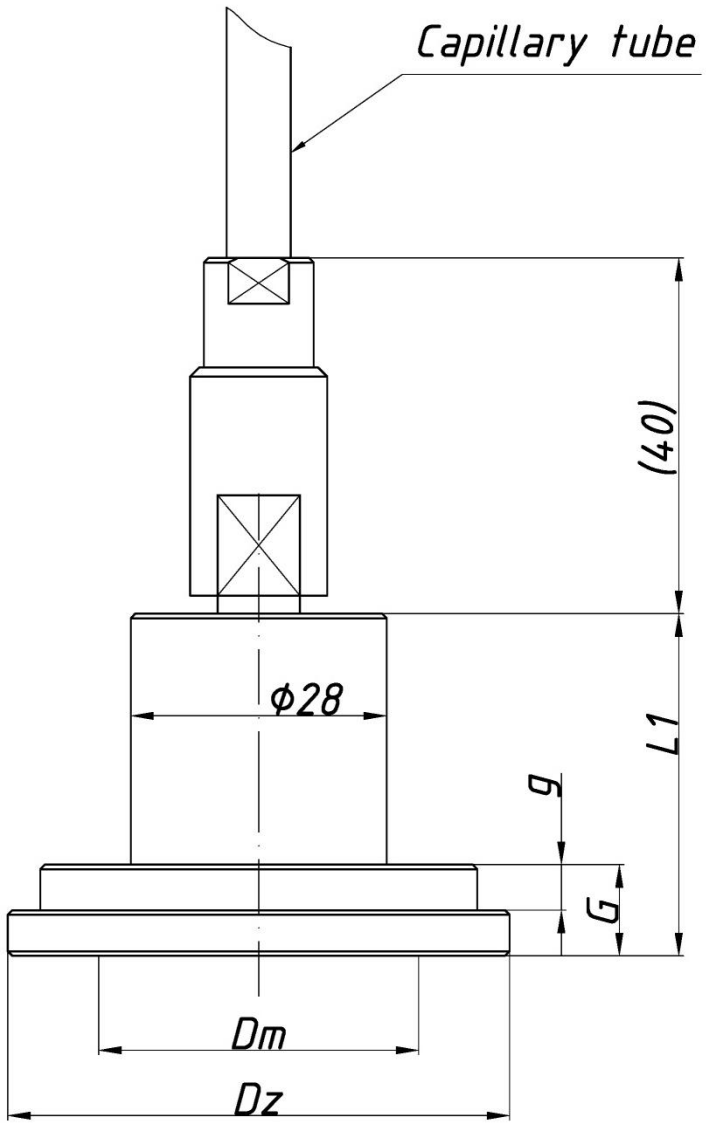


Figure 115. S-K SMS separator with capillary in axis - overall dimensions.

Separator	Dz [mm]	Dm [mm]	G [mm]	g [mm]	L_1[mm]
S-K SMS 1''	35,5	25	6,2	2	33,7
S-K SMS 1,5''	54,9	35	10	4	37,5
S-K SMS 2''	64,9	48	10	5	37,5

Table 56. Dimensions of separator S-K SMS according to SMS (SS 3352) for pipes consistent with ISO 1127 Series 2 or ISO 2037/1992.

S-Clamp

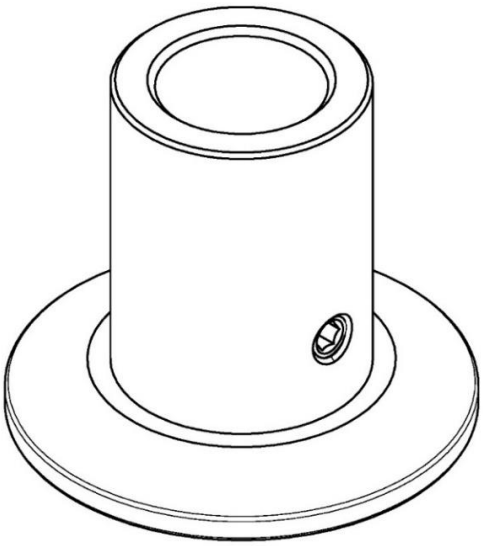


Figure 116. S-Clamp separator. View in isometry.

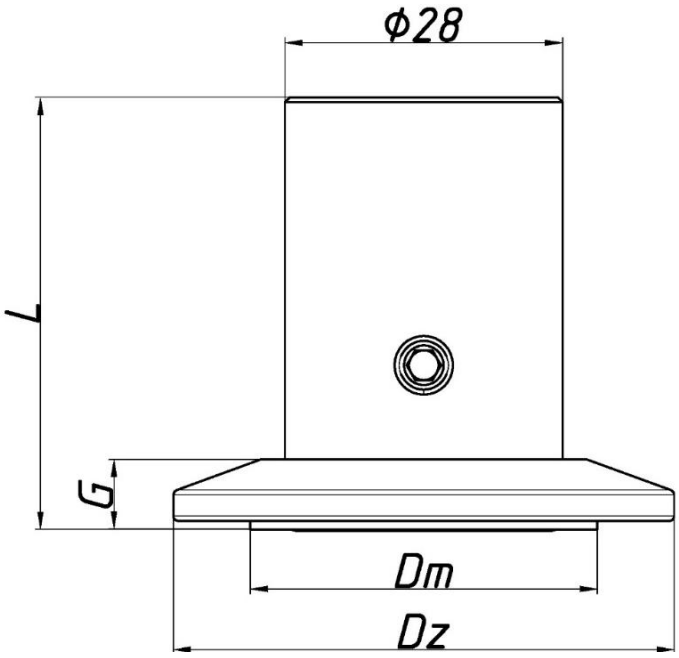


Figure 117. S-Clamp separator - overall dimensions.

Separator	Dz [mm]	Dm [mm]	G [mm]	L [mm]
S-Clamp 1''	50.5	22	7	43.5
S-Clamp 1.5"	50.5	35	7	43.5
S-Clamp 2''	64	48	7	43.5
S-Clamp 2.5"	77.5	54	7	43.5
S-Clamp 3''	91	70	7.8	44.3
S-Clamp 4''	119	89	9.8	45.8

Table 57. Dimensions of separator S-Clamp according to DIN 32676 for pipes consistent with DIN 11866 Series C or ASME BPE.

Separator	Dz [mm]	Dm [mm]	G [mm]	L [mm]
S-Clamp DN 25	50.5	25	7	43.5
S-Clamp DN 40	50.5	35	7	43.5
S-Clamp DN 50	64	48	7	43.5
S-Clamp DN 65	91	70	7.8	44.3
S-Clamp DN 100	119	89	9.8	45.8

Table 58. Dimensions of separator S-Clamp according to DIN 32676 for pipes consistent with DIN 11866 Series A or DIN 11850 series 2.

S-K Clamp (distance separator with capillary in axis)

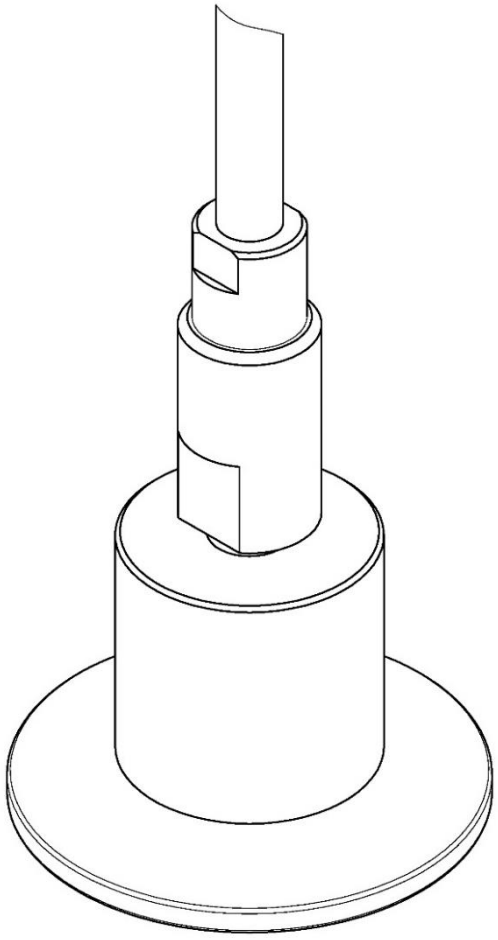


Figure 118. S-K Clamp separator (distance separator with capillary in axis).

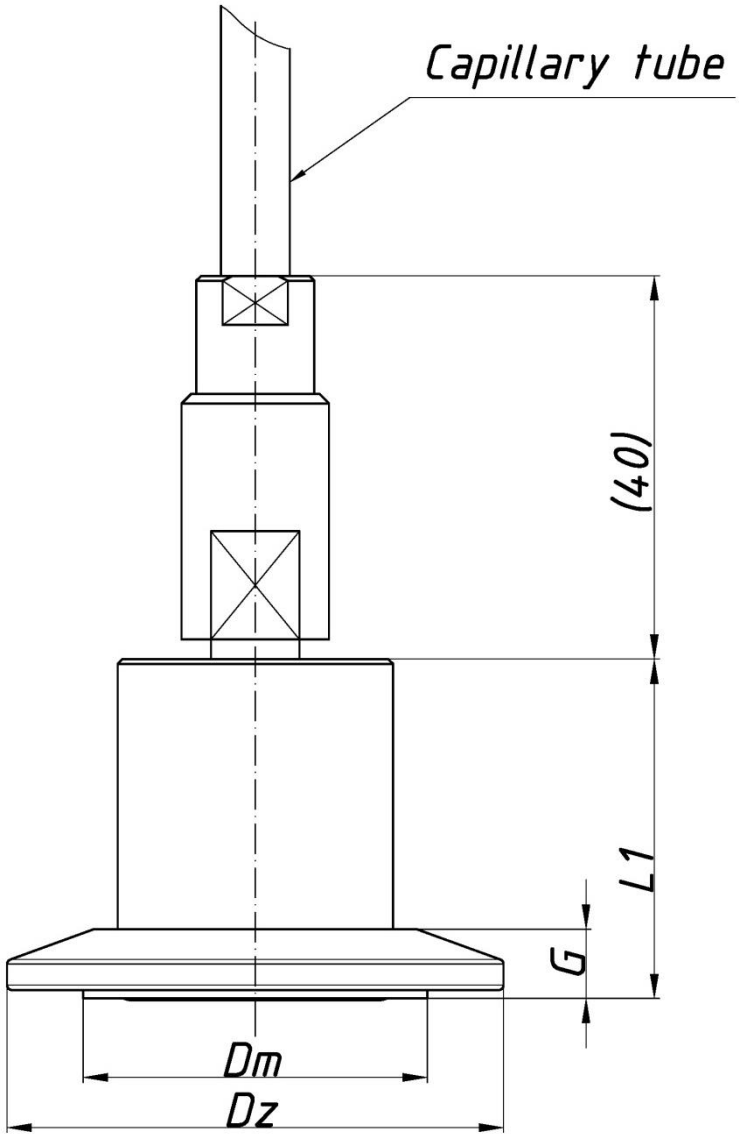


Figure 119. S-K Clamp separator - overall dimensions.

Separator	Dz [mm]	Dm [mm]	G [mm]	L_1 [mm]
S-K Clamp 1''	50.5	22	7	34.5
S-K Clamp 1.5"	50.5	35	7	34.5
S-K Clamp 2''	64	48	7	34.5
S-K Clamp 2.5"	77.5	54	7	34.5
S-K Clamp 3''	91	70	7.8	35.3
S-K Clamp 4''	119	89	9.8	36.8

Table 59. Dimensions of separator S-K Clamp according to DIN 32676 for pipes consistent with DIN 11866 series C or ASME BPE.

Separator	Dz [mm]	Dm [mm]	G [mm]	L_1 [mm]
S-K Clamp DN 25	50.5	25	7	34.5
S-K Clamp DN 40	50.5	35	7	34.5
S-K Clamp DN 50	64	48	7	34.5
S-K Clamp DN 65	91	70	7.8	35.3
S-K Clamp DN 100	119	89	9.8	36.8

Table 60. Dimensions of separator S-K Clamp according to DIN 32676 for pipes consistent with DIN 11866 series A or DIN 11850 series 2.

S-Poziom 25

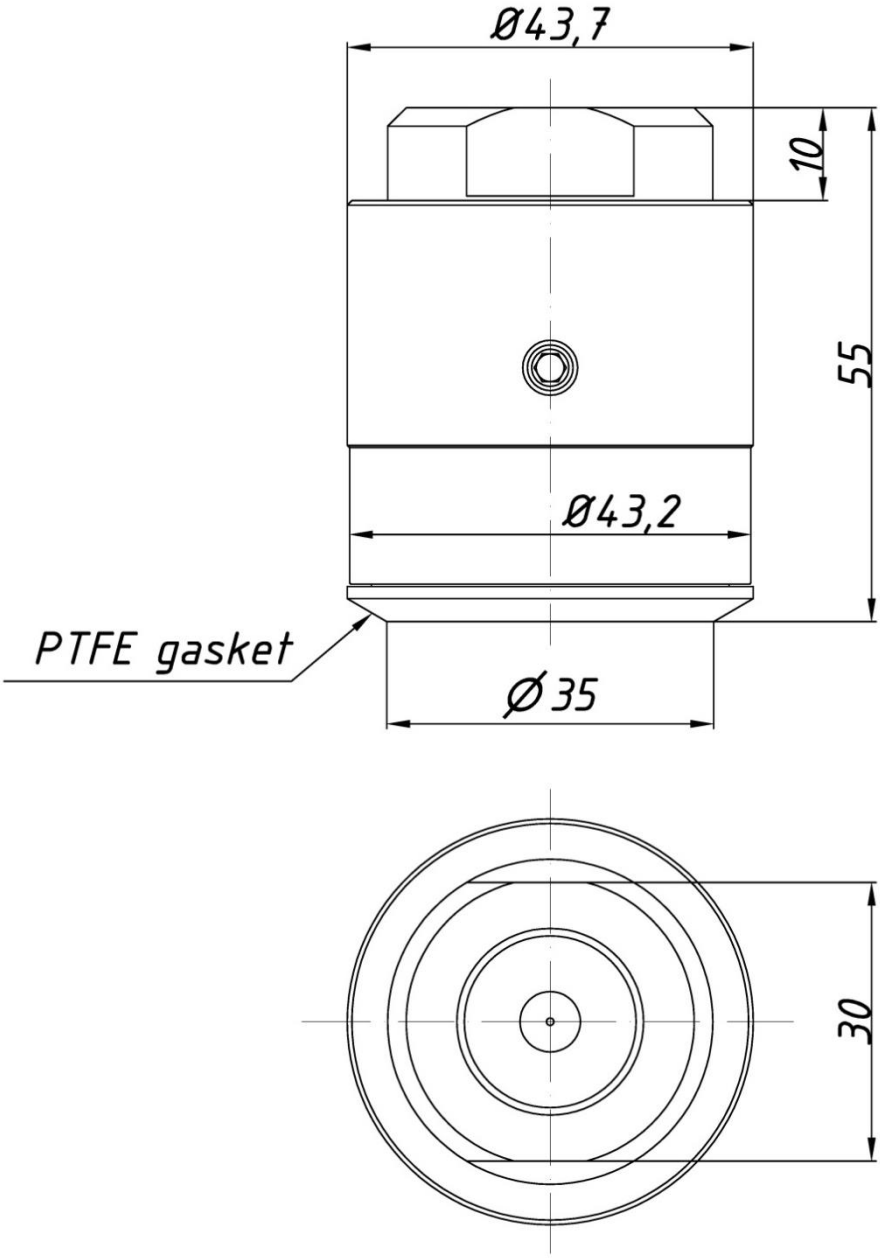


Figure 120. S-Poziom 25 separator - overall dimensions.

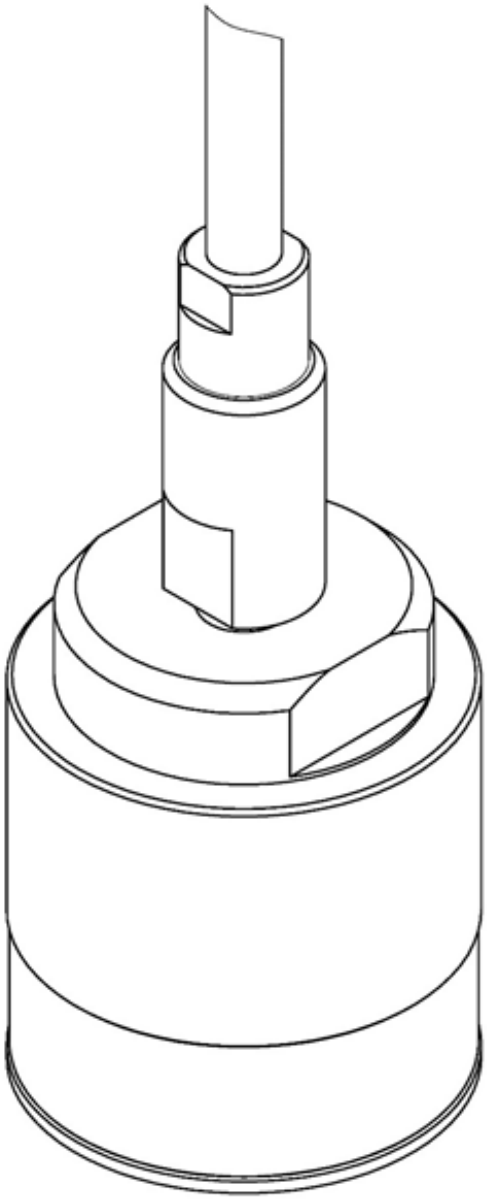


Figure 121. S-K Poziom 25 distance separator with capillary in axis - view in isometry.

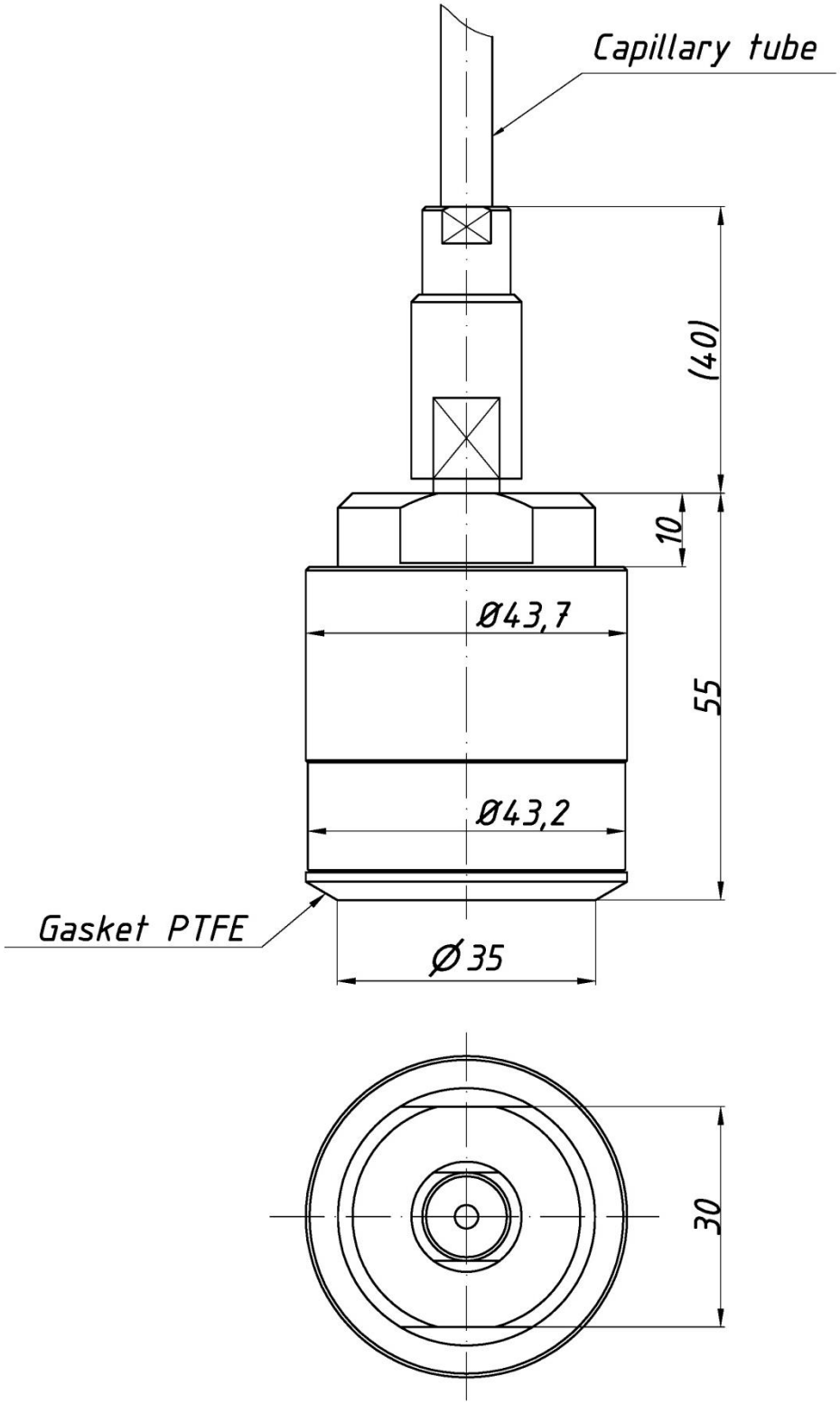


Figure 122. S-K Poziom 25 distance separator with capillary in axis - overall dimensions.

S-Poziom 50

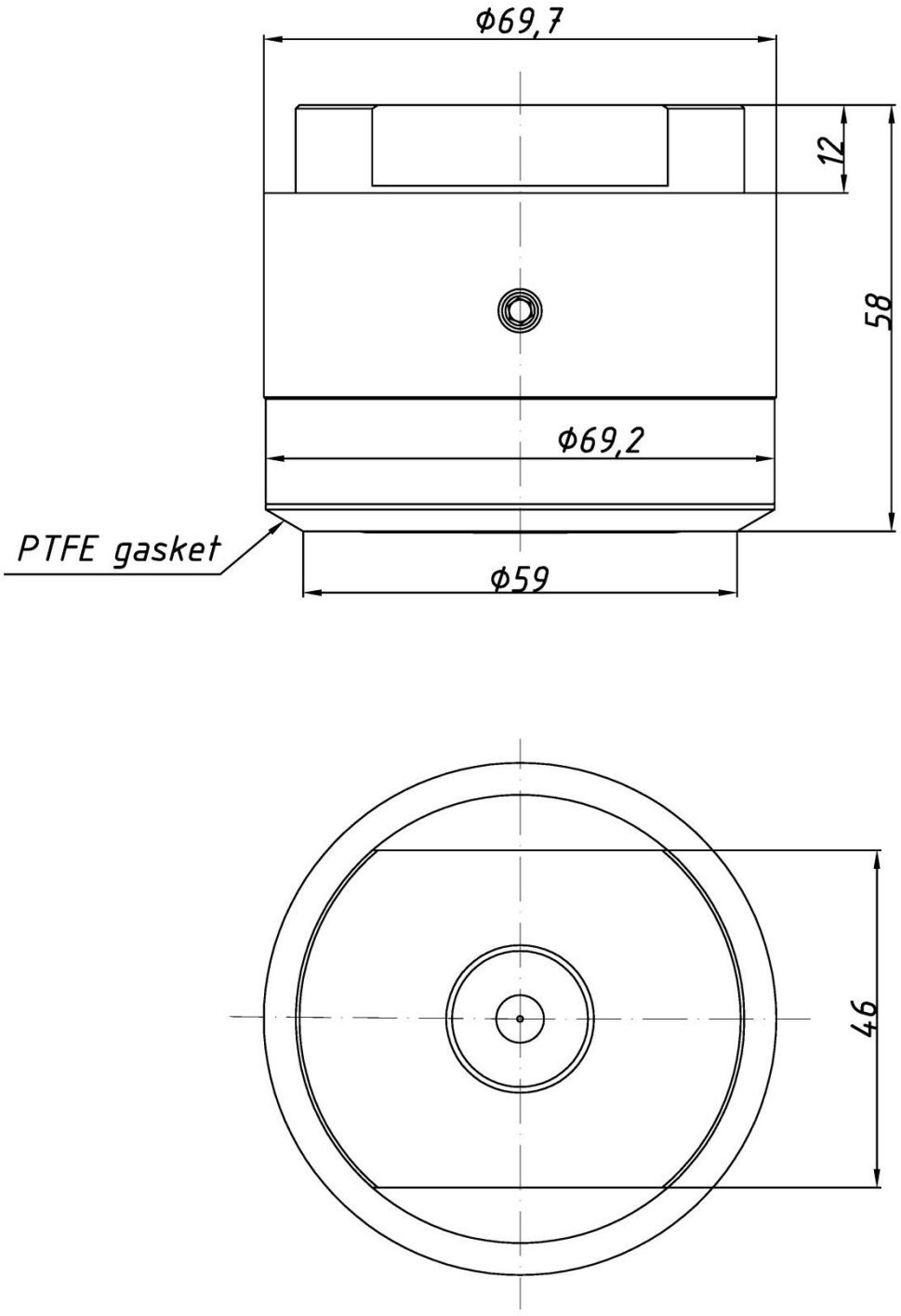


Figure 123. S-Poziom 50 separator - overall dimensions..

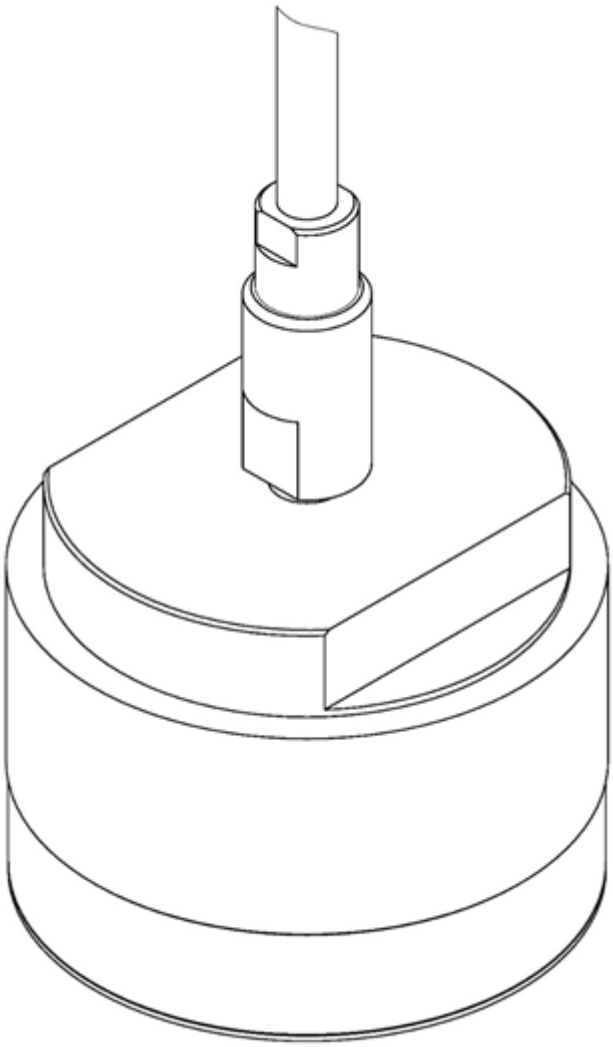


Figure 124. S-K Poziom 50 distance separator with capillary in axis - view in isometry.

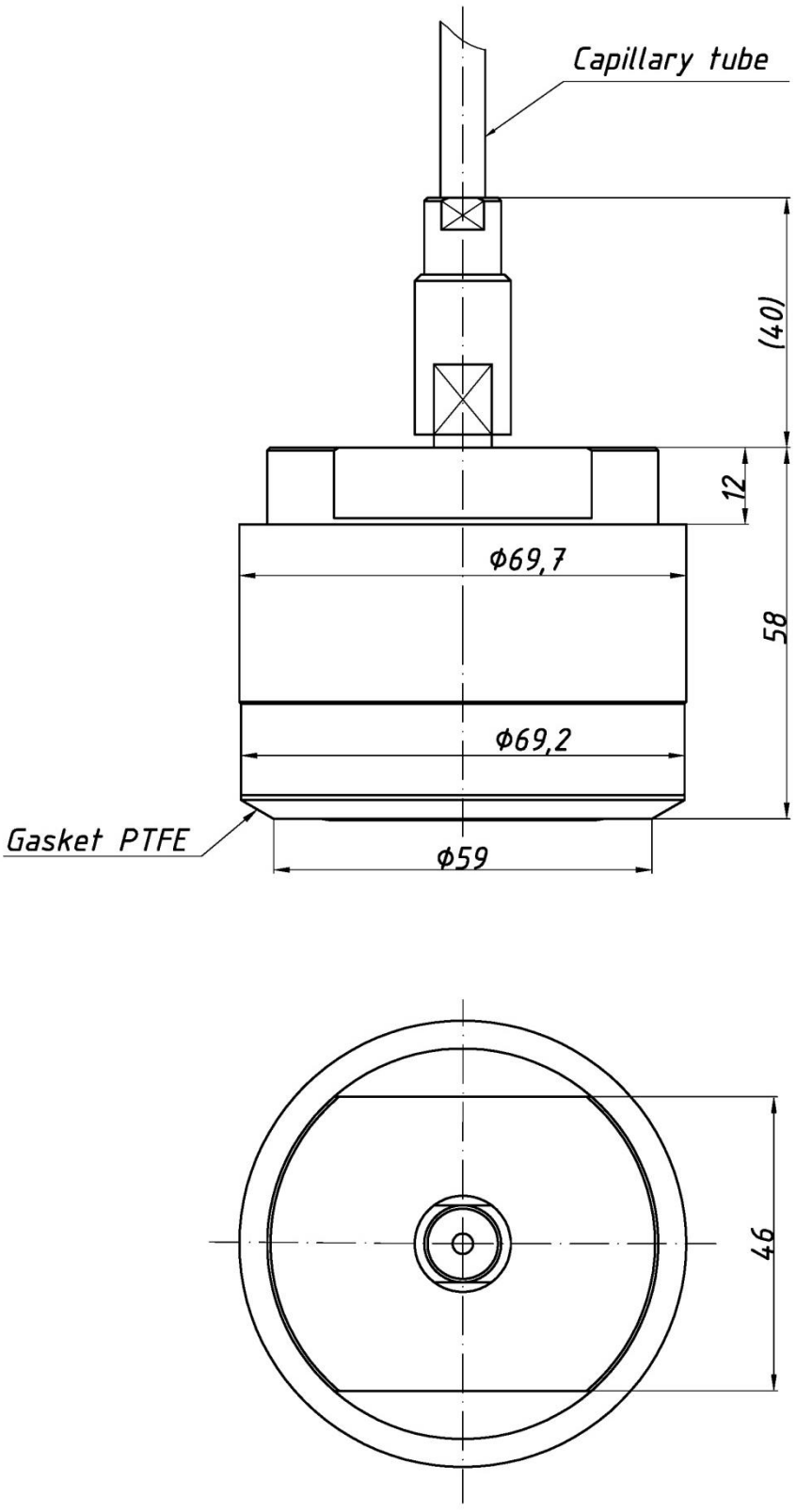


Figure 125. S-K Poziom 50 distance separator with capillary in axis - overall dimensions.

S-DRD 65

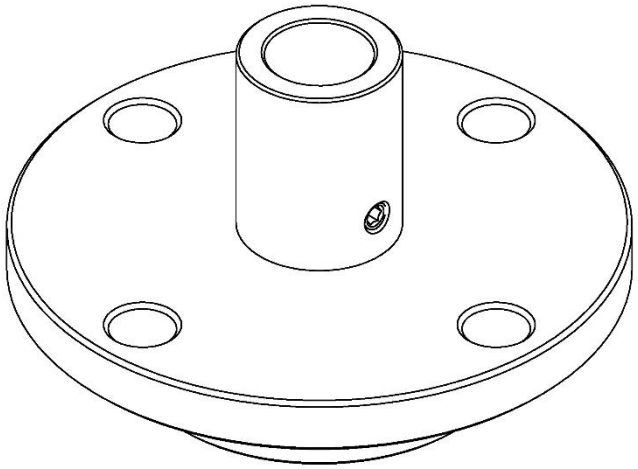


Figure 126. S-DRD 65 separator - view in isometry.

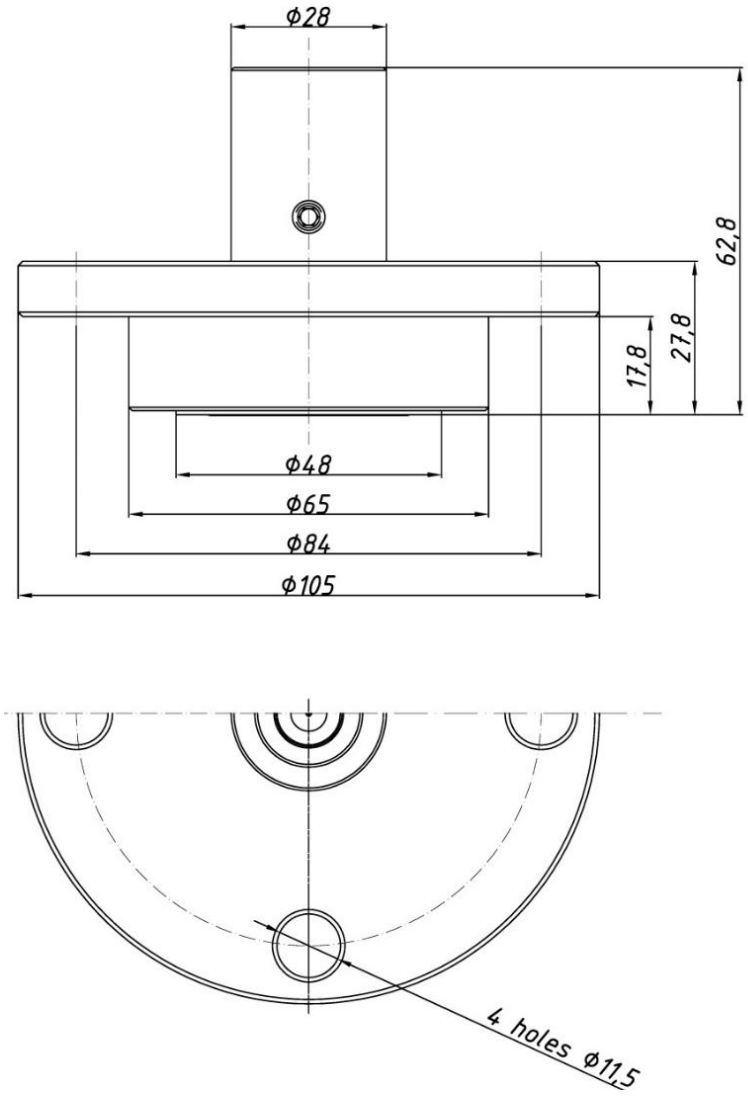


Figure 127. S-DRD 65 separator - overall dimensions.

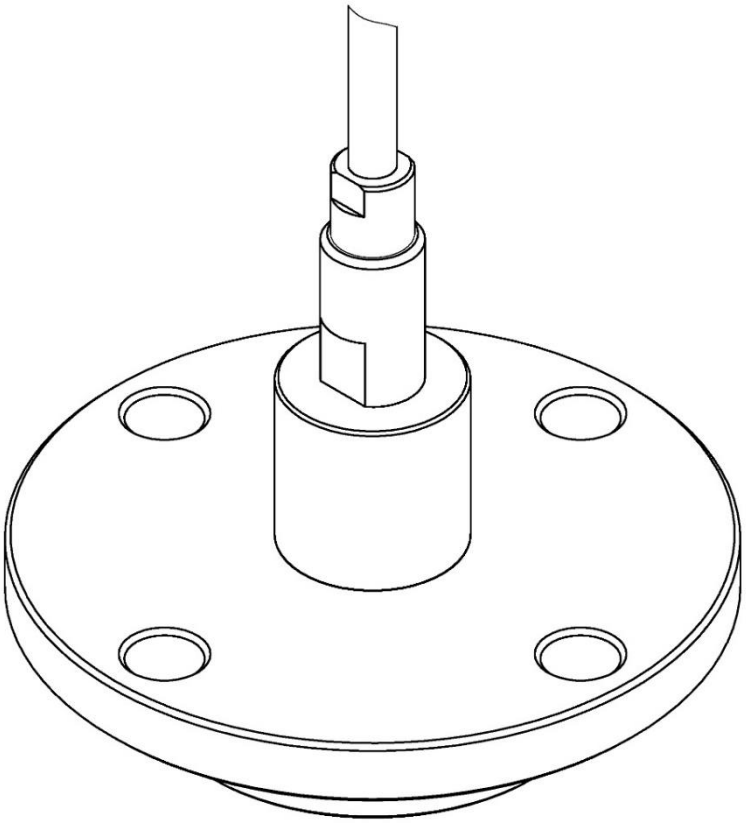


Figure 128. S-DRD 65 (distance separator with capillary in axis) - view in isometry.

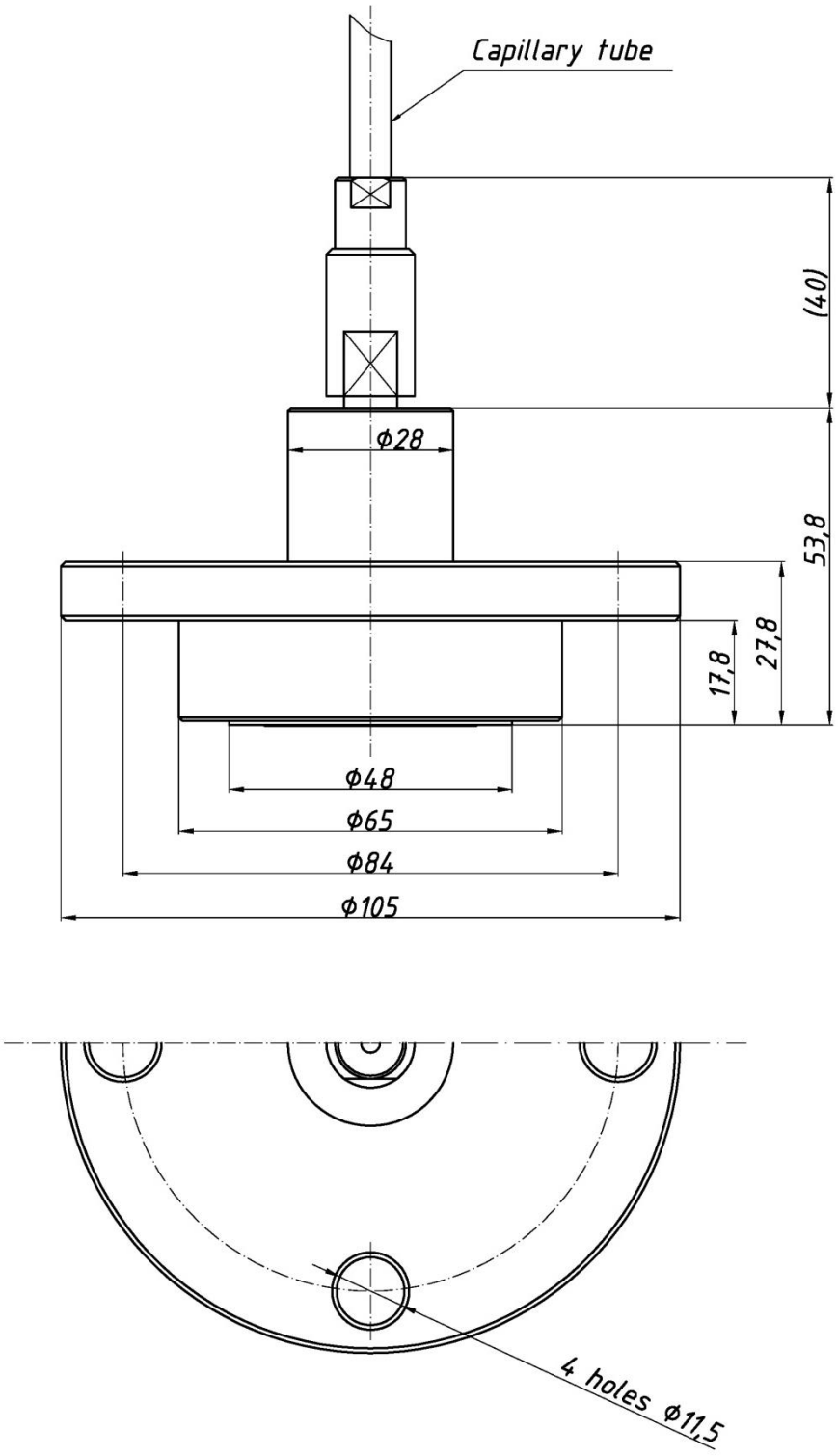


Figure 129. S-K DRD 65 (distance separator with capillary in axis) - overall dimensions.

S-Varivent

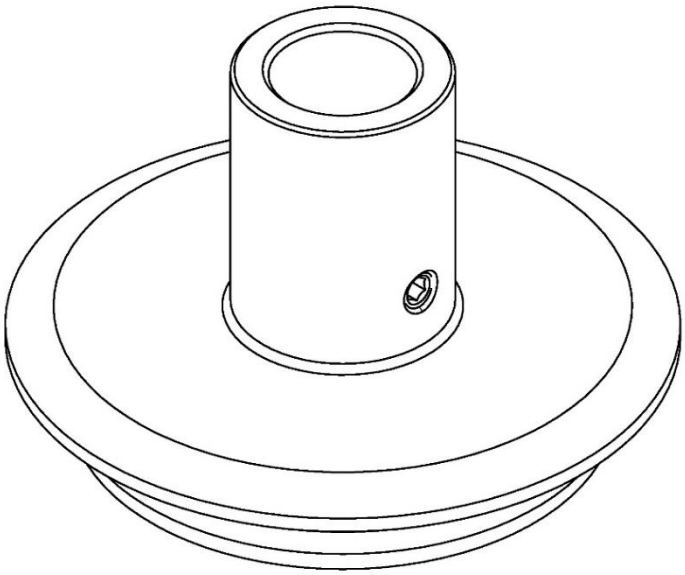


Figure 130. S-Varivent DN50 separator - view in isometry.

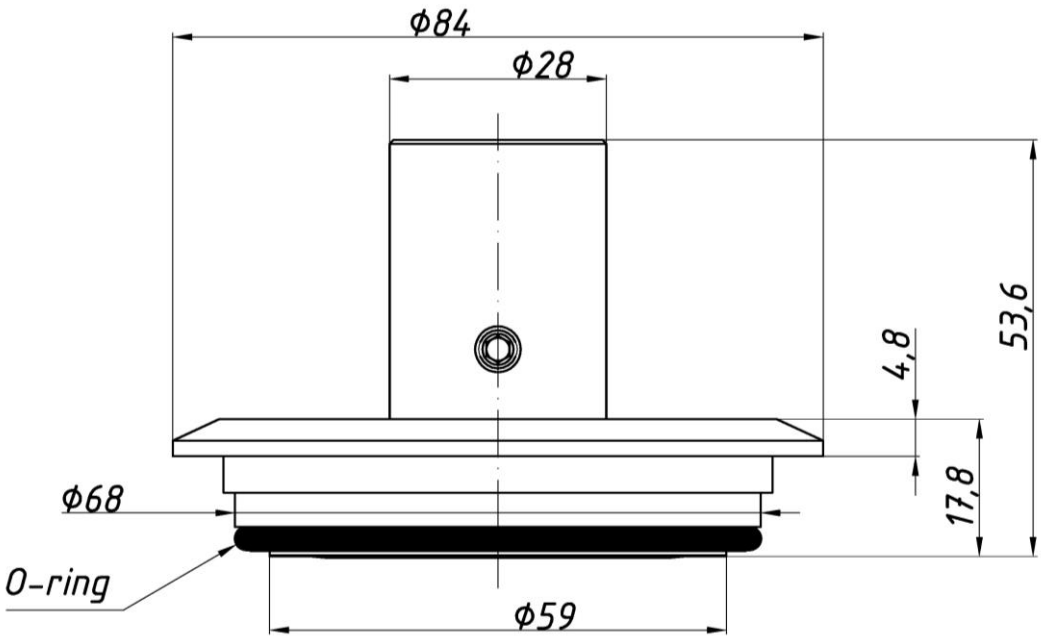


Figure 131. S-Varivent DN50 separator - overall dimensions.

S-K Varivent

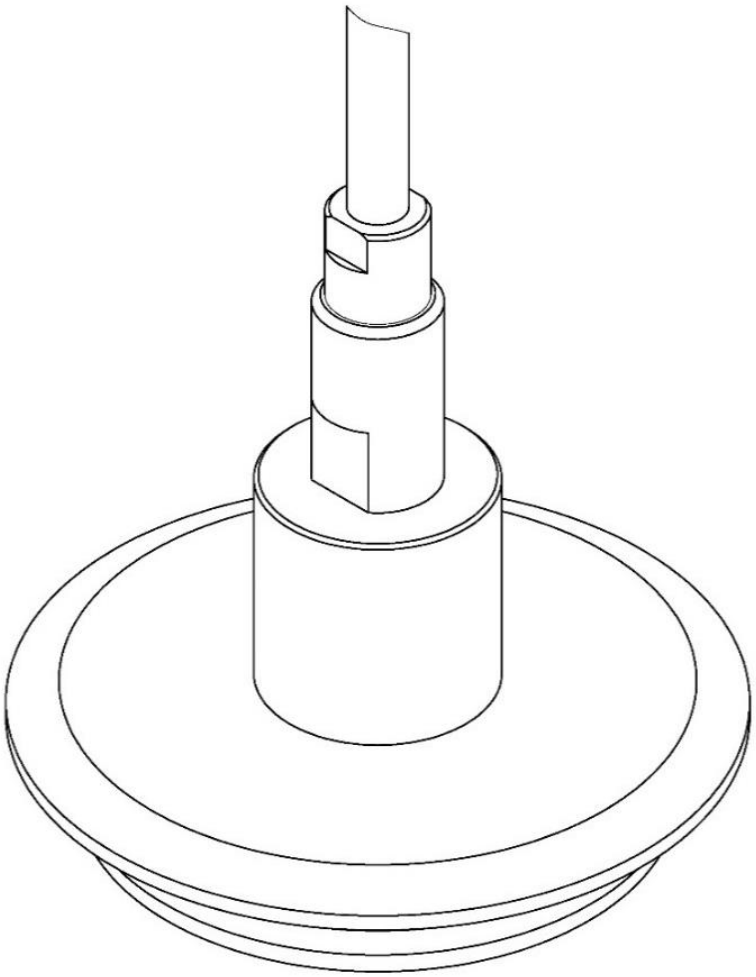


Figure 132. S-K Varivent DN50 (distance separator with capillary in axis) - view in isometry.

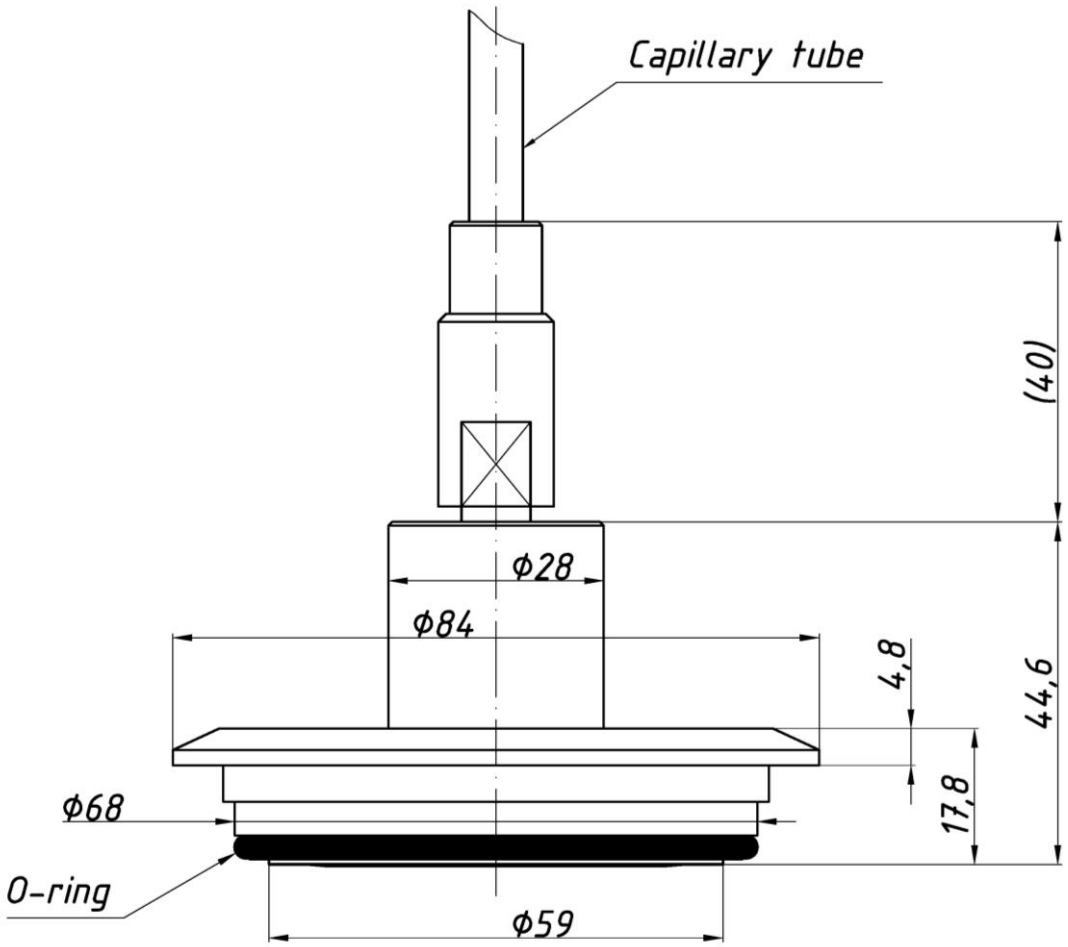


Figure 133. S-K Varivent DN50 (distance separator with capillary in axis) - overall dimensions.

Maximum measurement range 0 … 2,5 MPa.
Separator body and diaphragm material: steel 316L.

Medium temperature range:
- -30 … 200°C for distance separation;
- -20 … 150°C for direct separation;
- -30 … 85°C for operation in the range up to -100 kPa.

Special versions:
- filling with NEOBEE M-20 liquid permitted to come into contact with food (medium temperature: -10 … 150°C);
- separators sanitary seals, e.g. DIN 25 mm, DIN 40 mm or Tri-Clamp® 1'', Tri-Clamp1.5'', SMS 50 mm, DRD, Homogenizator, Varivent;
- seal with customised connection;
- direct diaphragm seal for medium temp. over 150°C;
- other to be agreed with Aplisens consultants.

14.1.9.**S-Mazut separators**

Separator S-Mazut is used to measure the media characterized by increased viscosity and temperature up to 150°C (315°C for distance separation). A typical application is the measurement of mazout pressure in burners and mazout nodes of power boilers.

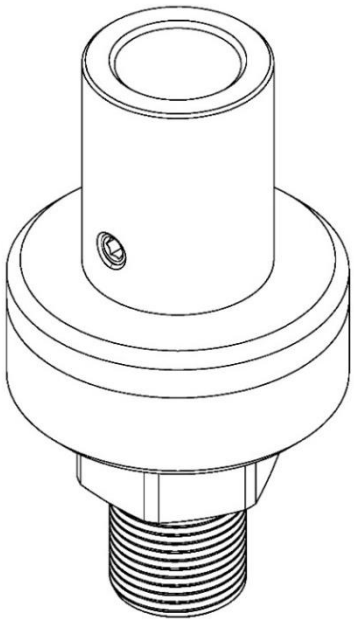


Figure 134. S-Mazut separator. View in isometry.

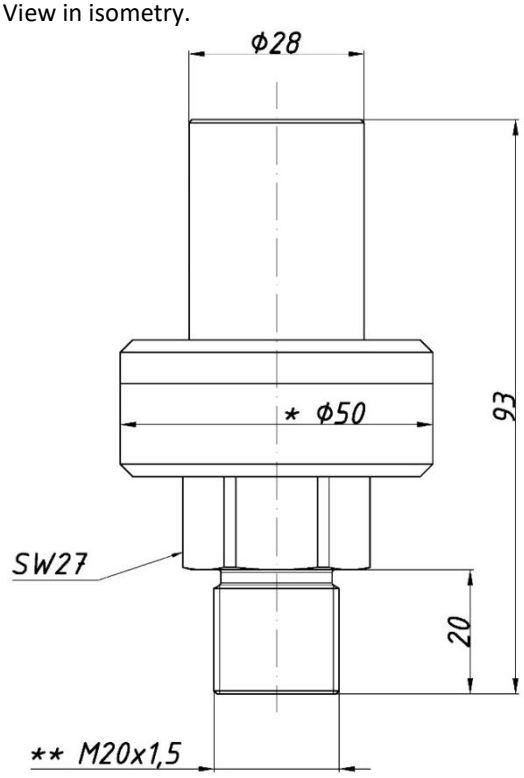


Figure 135. S-Mazut separator - overall dimensions.

Please note!
*special execution ø 75, ø 100;
**optionally G ½.

S-MazutK (distance separator with capillary in axis)

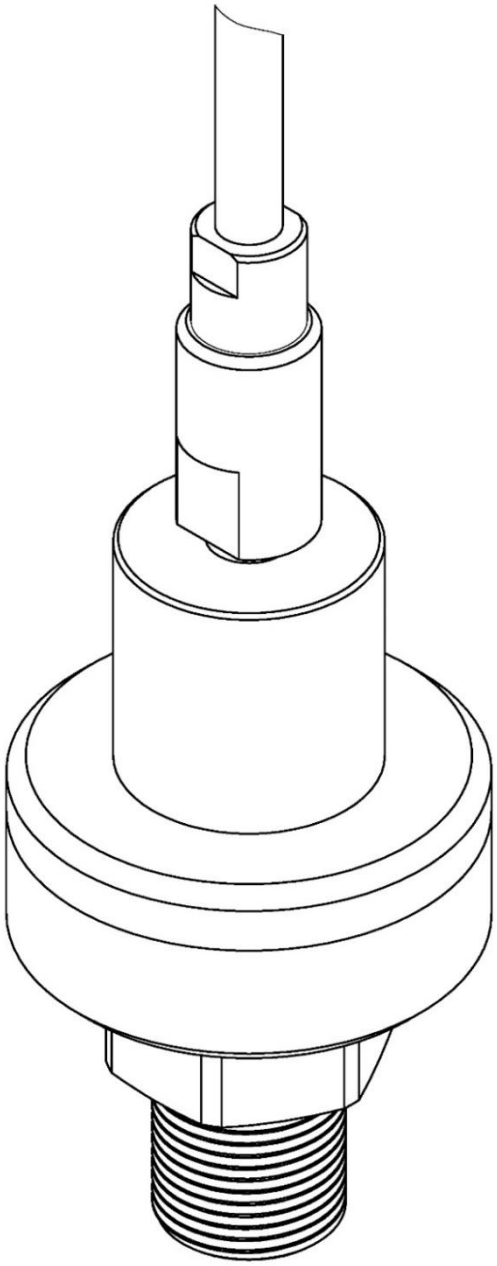


Figure 136. S-MazutK distance separator with capillary in axis. View in isometry.

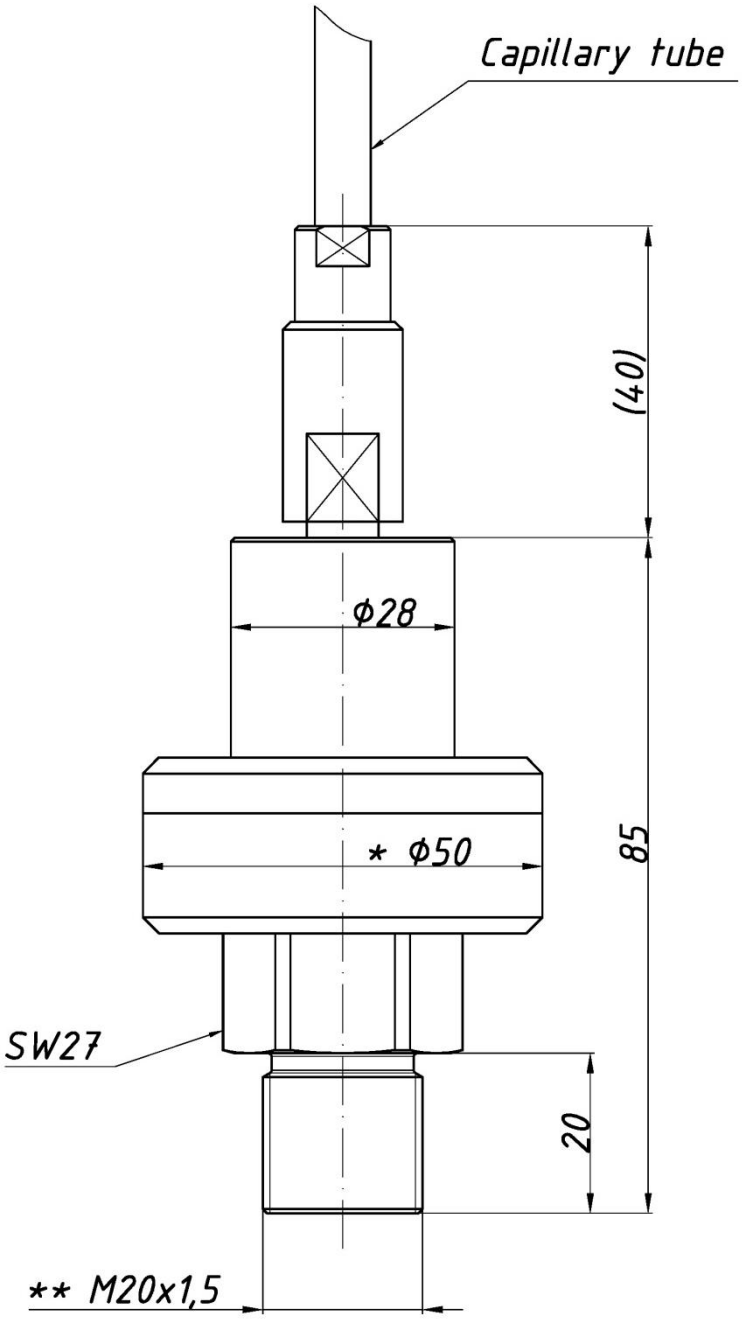
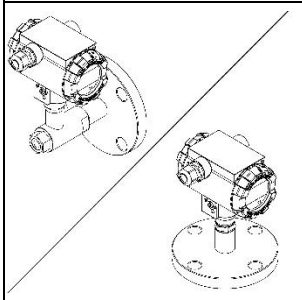
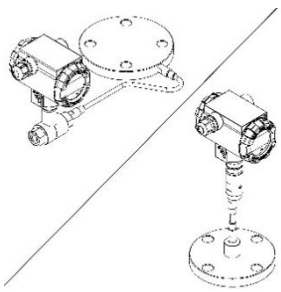
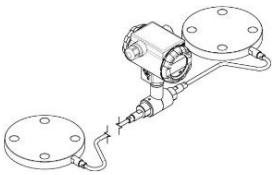
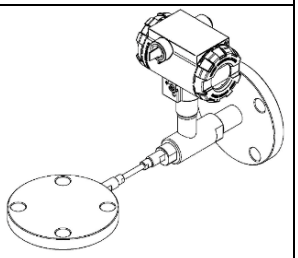


Figure 137. S-MazutK distance separator with capillary in axis - overall dimensions.

Please note!
*special execution ø 75, ø 100;
**optionally G ½.

	Using in each type of separation			
	Direct **(S-Mazut)**	Distance **(S-MazutK)**	With distance separators **(S-MazutK)**	With direct and distance separators **(S-Mazut/ S-MazutK)**
Transmitter				
APC-2000ALW	✓	✓	✗	✗
APR-2000ALW	✓	✓	✗	✗
APR-2000ALW with diaphragm seals	✗	✗	✓	✓

Type of separation	**Min. width range**		
	S-Mazut	**S-Mazut75**	**S-Mazut100**
Direct	250	10	5
Distance	600	40	25

Table 61. Recommended minimum measurement range width (kPa) for separator S-Mazut/K.

Maximum measurement range: 0 … 7 MPa.

Type of separation	**Absolute "zero" error**		
	S-Mazut	**S-Mazut75**	**S-Mazut100**
Direct	0,4 kPa/10°C	0,2 kPa/10°C	0,08 kPa/10°C
Distance (capillary 2m)	0,5 kPa/10°C	0,3 kPa/10°C	0,1 kPa/10°C

Table 62. Additional absolute "zero" error due to the ambient temperature changes of separator S-Mazut, S-Mazut75 and S-Mazut100.

Please note!

For a set of pressure transmitter and special separator (with larger diameter) temperature errors diminish proportionally to the third power of the active diaphragm diameter. Additional "zero" error due to the changes of the medium temperature depends on the temperature gradient in the oil separation system and in each case it is considerably smaller than the errors given in the table above.

Medium temperature range:

- -10 … 315°C for distance separation;
- -10 … 150°C for direct separation.

Special versions:

- versions ø75, ø100 for low ranges;
- other to be agreed with Aplisens consultants.

Permissible overload:

- S-Mazut: 11 MPa;
- S-Mazut75: 5 MPa;
- S-Mazut100: 4 MPa.

Diaphragm and connection material: 1.4404 (steel 316L).

14.1.10. **S-RC separators**

Separators S-RC are used for measurements of hot media characterized by increased viscosity, solidification or contamination wherever it is impossible to use an impulse tube.
For installation of transmitters with S-RC separators on site, it is recommended to welding mounting rings manufactured by Aplisens S.A.

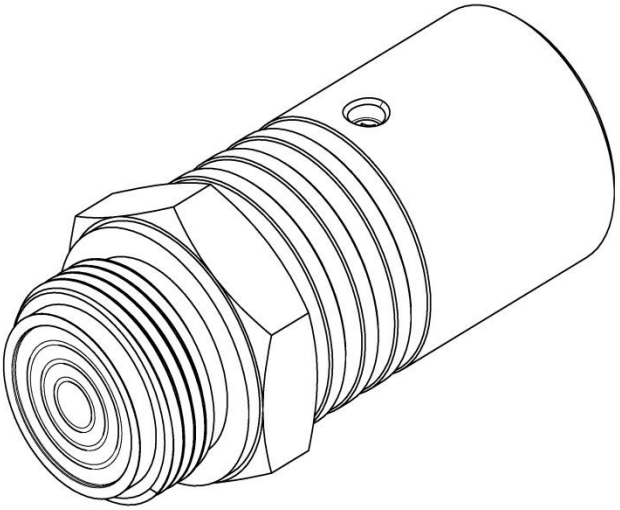


Figure 138. S-RCM 30x2 separator - view in isometry.

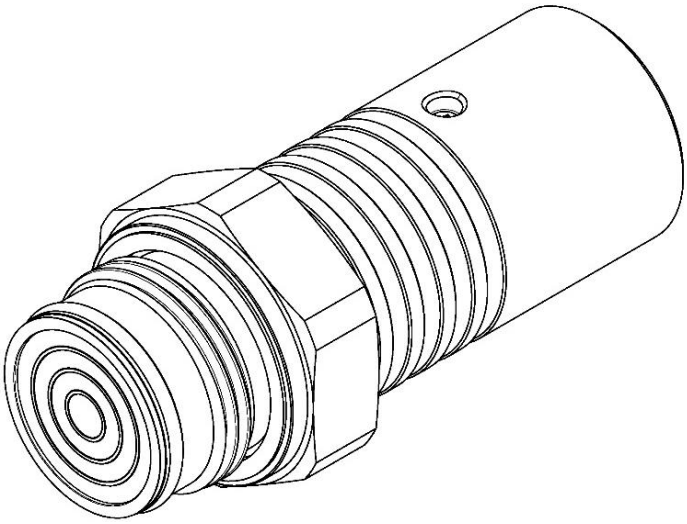


Figure 139. S-RCG1 separator - view in isometry.

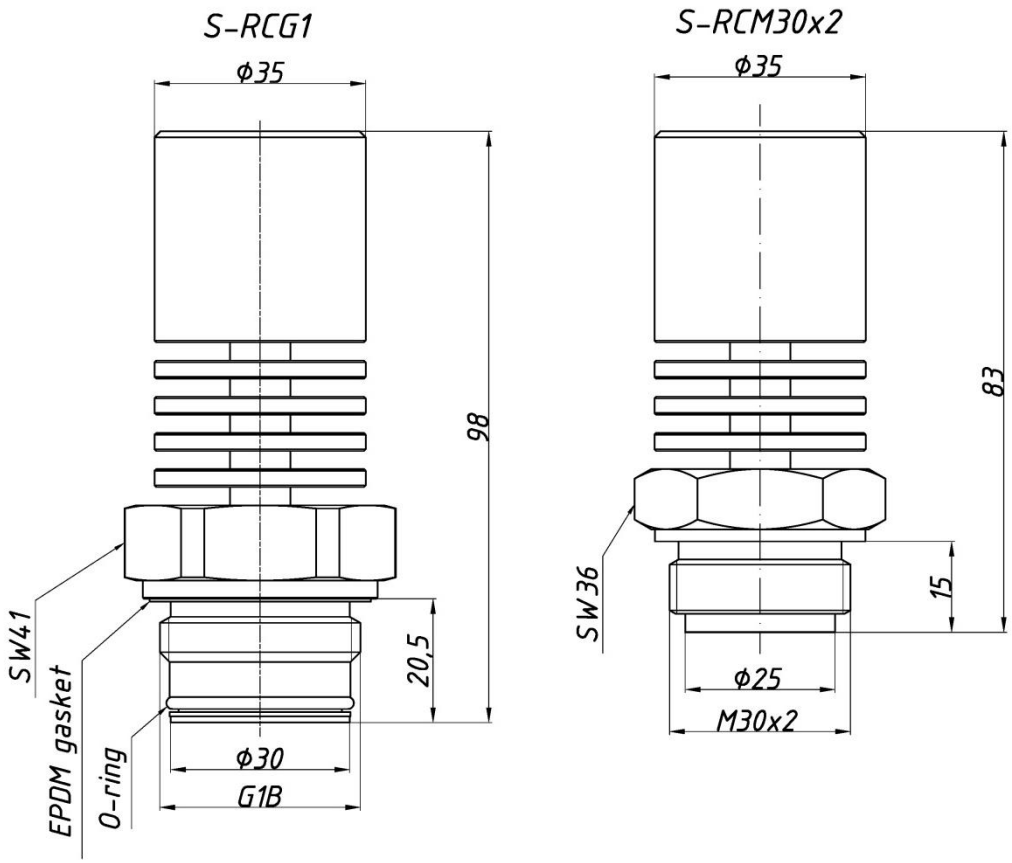
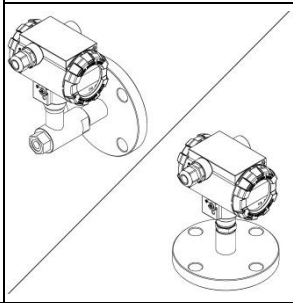
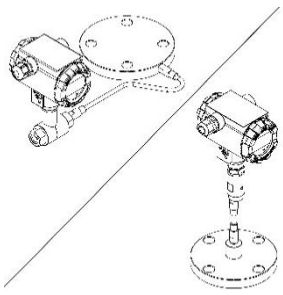
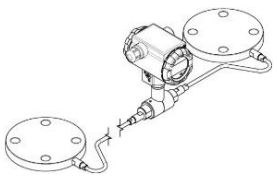
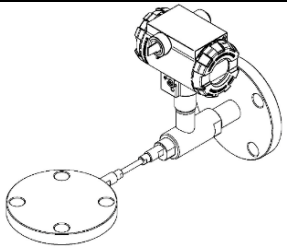


Figure 140. S-RCG1 and S-RCM30x2 separators - overall dimensions.

	Using in each type of separation			
Transmitter	Direct **(S-RC)**	Distance	With distance separators	With direct and distance separators **(S-RC)**
				
APC-2000ALW	✓	✘	✘	✘
APR-2000ALW	✓	✘	✘	✘
APR-2000ALW with diaphragm seals	✘	✘	✘	✓*
*S-RC separators is intended for direct mounting only.				

Recommended minimum measurement range width: 40 kPa.
Medium temperature range: 0 … 160°C.

Maximum measuring range:
- for S-RCM30x2: 0 … 4 MPa;
- for S-RCG1: 0 … 4 MPa.

Permissible overload:
- for S-RCM30x2: 10MPa;
- for S-RCG1: 10 MPa.

Additional absolute "zero" error due to the ambient temperature:
- 6 kPa/10°C for range ≥ 250 kPa;
- 1 kPa/10°C for range < 250 kPa.

Diaphragm and separator material: 1.4404 (steel 316L).

Special versions:
- separator for the temperature up to 260°C;
- Hastelloy-wetted parts of separator made of Hastelloy C 276 (permissible pressure 4 MPa);
- aseptic version S-RCG1, S-RCM30x2 – sealing upstream the thread, filling with edible oil (max. temp. 150°C);
- other to be agreed with Aplisens consultants.

14.2. Diaphragms and gauge fluids

Two components of separator have the greatest impact on temperature errors occurring after its application. These are the flexibility of the separator diaphragm and the thermal expansion coefficient of the liquid filling the measuring set.
Flexibility of the diaphragm is mostly affected by the diaphragm diameter proportionally to the third power of the active diameter. Diaphragms with smaller diameter are stiffer than those with large diameters. Diaphragms and rabbets are made of the following materials:
- 316L or 321;
- Hastelloy C 276;
- Tantalum;
- titanium;
- nickel;
- Monel.

When selecting liquids to fill the separators, the following should be taken into account:
- their different thermal expansion. Greater expansion- more serious measurement errors;
- their different density. Higher density- longer response time to pressure signal;
- their range of operating temperatures. At low temperatures the liquids become too dense and at high temperatures begin to evaporate;
- their usability in the food industry or oxygen installations.

Separator liquids						
Liquid symbol	Density at 25°C [kg/dm^3]	Viscosity at 25°F [cSt]	Expansion coefficient [x10^{-3}°C]	Permissible temperature range for absolute pressures from 1 kPa to 100 kPa [°C]	Permissible temperature range for pressures above 100 kPa$_{ABS}$ [°C]	Comments
DC550	1,068	115	0.78	-40; +200	-40; +315	-
DH	1,097	175	0.77	+20; +260	+20; +370	-
AK20	0,945	20	0.97	-70; +150	-70; +270	-
M20	0.92	9.5	1,008	-20; +150	-20; +150	For food
Fluorolube	1.87 at 38°C	5.0 at 38°C	10 °C- 1.53 38 °C- 0.85	-30; +80	-30; +150	For versions designed for oxygen applications

Table 63. List of fluid parameters for separators.

14.3. Temperature operating ranges

Distance separators may operate at permissible temperatures for gauge fluids with which the separators are filled.
Direct separators may operate at ambient temperatures up to 85°C and may measure the media with the temperature below the maximum allowable temperature for liquid filling the separator. The temperature of the medium must not cause the increase of the temperature of the transmitter above 85°C. Therefore, direct separators, depending on their separating diaphragm, can measure the media in a very limited range of temperatures. The use of a direct separator with a radiator increases the permissible temperature of the medium, even by 40°C. Variations of the medium temperature and ambient temperature cause an indication error of transmitter resulting from different thermal expansion of the liquid and separator material. This error is higher the more rigid the separator diaphragm is.

14.4. Response times

Response time T98 of separator S-P DN80 filled with DC550 oil with capillary tube 1.5 m at 25°C is 3 seconds.

14.5. Maintenance

If sediment is formed on the diaphragm, it is not allowed to remove it by mechanical method by scraping or rubbing. The deposit should be dissolved and rinsed using only a soft brush to facilitate these operations.
When washing, do not direct a strong stream of the cleaning agent to the diaphragm.
Flanged separators may also be equipped with separator diaphragm flushing rings or have an integrated flushing ring. Flushing of the diaphragm is done without the necessity to dismantle the separator from the customer's system.

14.6. Installation instructions

General mounting recommendations:

- protect the separating diaphragms (especially at low measuring ranges) from dynamic impacts of the medium, e.g. when filing the tank with liquid;
- never allow for freezing of the medium, crystallization or precipitation of hardening deposits in the place where the separator is installed.

The figure below shows an exemplary mounting diagram of transmitter APR-2000ALW with direct separator:

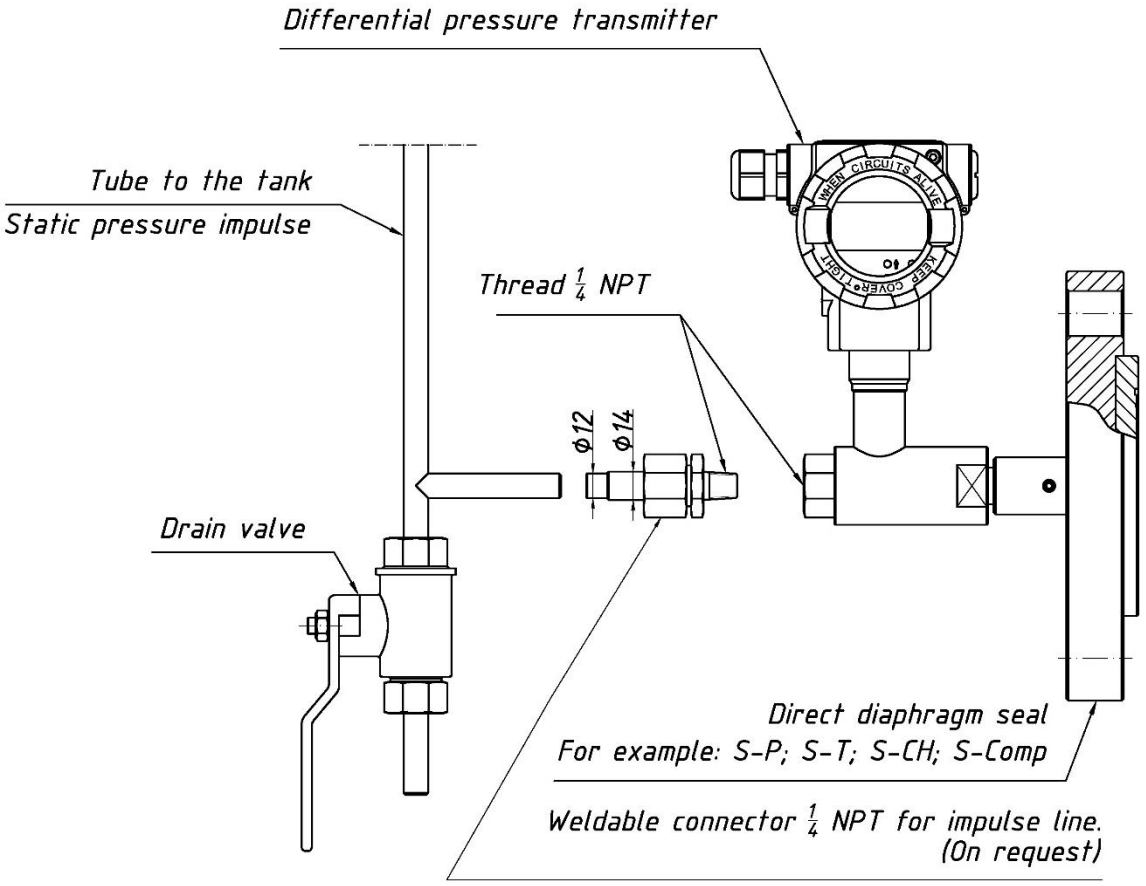


Figure 141. Exemplary installation of transmitter APR-2000ALW with direct separator.

APR-2000ALW with diaphragm seals is recommended to use with two distance separators for measuring the differential pressure wherever the hydrostatic pressure of the gauge fluid in capillary tubes, related to the vertical spacing of separators, is significantly lower than the measurement range of the transmitter. The best metrological results are obtained using the possibly shortest identical capillary tubes ended with identical separators. In such configuration, additional temperature errors associated with distance separation equally affect both measuring chambers of the differential pressure transmitter and thus compensate each other.

The figure below shows an exemplary diagram of the filter loss measurement when two distance separators are used:

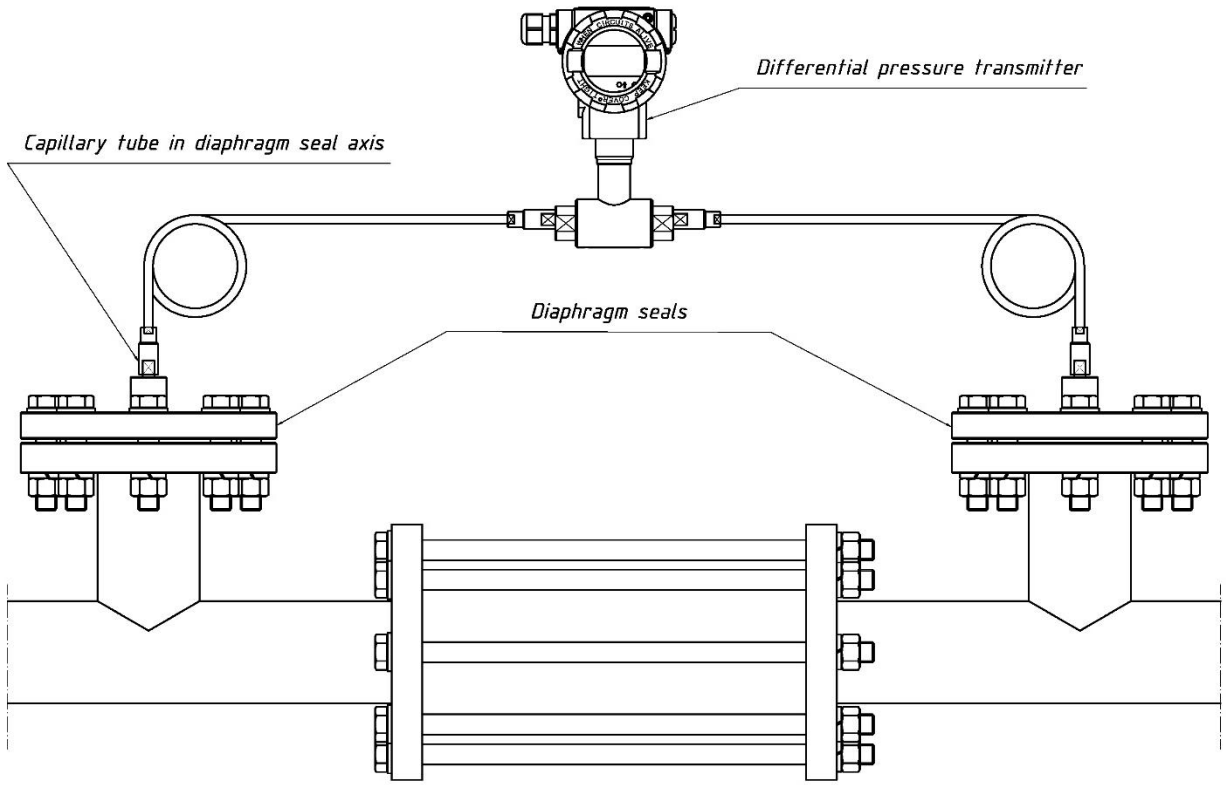


Figure 142. Exemplary installation of transmitter APR-2000ALW with distance separators.

14.7. Vacuum/negative pressure applications

In case of liquid level measurement in the tank using two distance separators, it is recommended to install the transmitter below the lower separator. This applies to the situation when negative pressure may occur in the tank. This will prevent the vacuum load of the separator diaphragm caused by the presence of oil in the capillary tubes. If for any reasons the transmitter must be installed above the lower separator, it should not be higher than one meter.

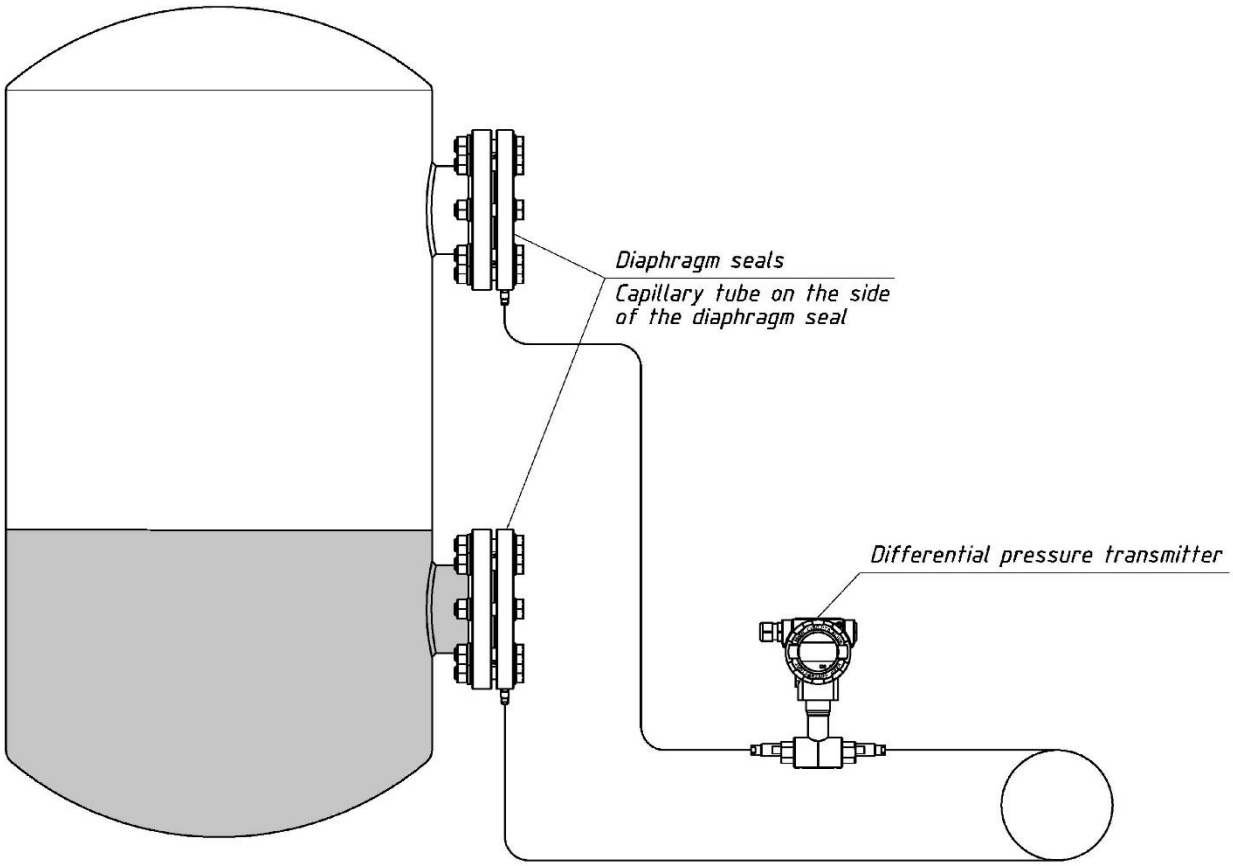


Figure 143. Example of installation in the case of vacuum/negative pressure application.

15. Troubleshooting

15.1. Malfunction messages on LCD display

In the case of diagnosed failures, transmitter APC(R)-2000ALW will inform the user about the failure by setting alarm current I_AL < 3.650 mA or I_AL > 21.500 mA (depending on the settings) and displaying a blinking collective error number on LCD2. The error number is displayed in the E character format and 4-digit decimal numbers. To identify the cause of malfunction, it is necessary to:

- read out statuses of Analog Input, Physical Block, Sensor Block and Transmitter Block through HART communication. The statuses marked in these blocks will indicate a relatively accurate cause of a failure. This is a recommended method of obtaining information about a kind of malfunction.

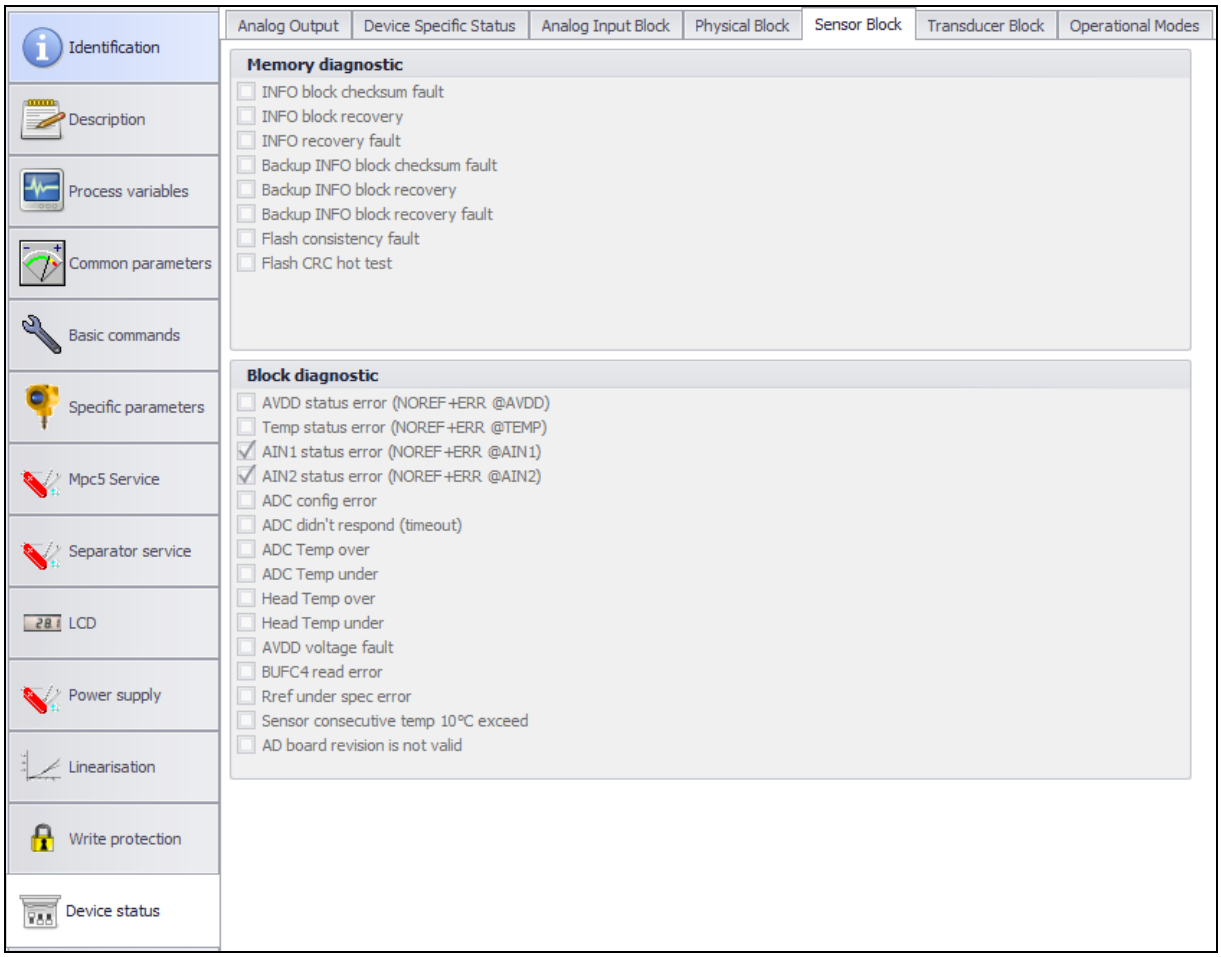


Figure 144. Example of the Sensor Block statuses read out from the transmitter via Raport 2.

- If the readout via HART communication is difficult or impossible for some reasons, it is possible to use the error status number displayed on the transmitter's LCD2 screen. This is a summary status which is a synthesis of failures and errors of all the blocks. For this reason, it is less precise.

To decode it, proceed as follows:

- replace a 4-digit decimal number displayed after E to a binary value, e.g. by means of a Windows calculator with a programmer's view option;
- read out statuses from the table below, one in the binary value item means that the status is active, zero means the status is not active.

Binary value bit	Status name	Description
BIT0 (1 dec)	RAM_TEST_ERROR	RAM memory failure was detected. This is a major hardware failure. The message on the display may appear only momentarily because due to the critical failure, the control will be taken over by the internal redundant alarm module WDT_SIL which will disconnect the transmitter's internal power supply. The display will be off. Current in the current loop will be I_AL << 3.650 mA. This status will last approximately 10 s, then the transmitter will attempt to restart. If the failure is repeated once again, the transmitter must be sent back to the service center.
BIT1 (2 dec)	FLASH_CRC_ERROR	FLASH program memory failure was detected. This is a major hardware failure. The message on the display may appear only momentarily because due to the critical failure, the control will be taken over by the internal redundant alarm module WDT_SIL which will disconnect the transmitter's internal power supply. The display will be off. Current in the current loop will be I_AL << 3.650 mA. This status will last approximately 10 s, then the transmitter will attempt to restart. If the failure is repeated once again, the transmitter must be sent back to the service center.
BIT2 (4 dec)	BADCRC_IN_SEGMENT_INFO	FLASH data memory failure was detected. This is a major hardware failure. The message on the display may appear only momentarily because due to the critical failure, the control will be taken over by the internal redundant alarm module WDT_SIL which will disconnect the transmitter's internal power supply. The display will be off. Current in the current loop will be I_AL << 3.650 mA. This status will last approximately 10 s, then the transmitter will attempt to restart. If the failure is repeated once again, the transmitter must be sent back to the service center.
BIT3 (8 dec)	OSCILLATOR_FAULT	The local quartz generator failure was detected. The transmitter will switch to the operation mode with the DCO standby generator and will set alarm current I_AL < 3.650 mA or I_AL > 21.500 mA (depending on the settings). This condition will continue until the transmitter is reset or disconnected and then re-energized. If the failure is repeated once again, the transmitter must be sent back to the service center.
BIT4 (16 dec)	CURRENT_ LOOP_FAULT	Difference greater than 1% (160 µA) between the current measured by the transmitter in the current loop 4 ... 20 mA and set current calculated by the transmitter was detected. The transmitter will set the alarm current depending on the settings I_AL < 3.650 mA or I_AL > 21.500 mA. If in an alarm condition the difference between the measured current and the set current calculated by the transmitter is less than 1%, the transmitter will remain in such an alarm condition for several seconds and then it will attempt to set proper process current. If this error reoccurs, the alarm condition will be enabled again. This condition will continue until the cause of the damage ceases to exist. However, if the alarm current will also deviate by more than 1% from the value of set current calculated by the transmitter, the control will be taken over by redundant alarm module WDT_SIL which will disconnect the transmitter's internal power supply. The display will be off. Current in the current loop will be I_AL << 3.650 mA. This status will last approximately 10 s, then the transmitter will attempt to restart. As the error may appear as a result of very strong above-standard radio interference, the quality of the voltages supplying the transmitter with

		regard to EMC must be checked. If the power supply is correct and the failure is repeated once again, the transmitter must be sent back to the service centre.
BIT5 (32 dec)	EEP_LOOPBACK_ FAULT	The digital communication failure with the measuring head's EEPROM memory through an optical galvanic isolation was detected. The transmitter will set the alarm current depending on the settings I_AL < 3.650 mA or I_AL > 21.500 mA. This condition will continue until the cause of the damage ceases to exist. The transmitter must be sent back to the service center.
BIT6 (64 dec)	ADC_LOOPBACK_ FAULT	Malfunction or lack of digital communication with transmitter ADC in the pressure / differential pressure measuring head was detected. The transmitter will set the alarm current depending on the settings I_AL < 3.650 mA or I_AL > 21.500 mA. This condition will continue until the cause of the damage ceases to exist. The transmitter must be sent back to the service center.
BIT7 (128 dec)	ADC_NOT_ RESPONDED	Exceeding of transmitter ADC response time was detected after sending the measurement configuration. The transmitter will set the alarm current depending on the settings I_AL < 3.650 mA or I_AL > 21.500 mA. This condition will continue until the cause of the damage ceases to exist. The transmitter must be sent back to the service center.
BIT8 (256 dec)	SENSOR_FAILURE	Saturation of A/D transducer (USAL, LSAL), hardware problem related to damage of pressure measuring structure in the head or component damage in the pressure sensor block or sensor power supply was diagnosed. The transmitter will set the alarm current depending on the settings I_AL < 3.650 mA or I_AL > 21.500 mA. This condition will continue until the cause of the damage ceases to exist. To determine whether the cause may be pressure overload, the pressure transmitter should be vented or pressure should be compensated between L and H levels (for differential pressure transmitter). If after this operation the transmitter returns to the measurement indication without error, this means that the cause of the error was exceeded pressure (USAL or LSAL). Otherwise, if the error is still displayed, it is likely that a failure occurred and the transmitter must be sent back to service centre.
BIT9 (512 dec)	SENSOR_NOT_ CONNECTED	Damage of the pressure measurement sensor or its associated components was detected. The transmitter will set the alarm current depending on the settings I_AL < 3.650 mA or I_AL > 21.500 mA. This condition will continue until the cause of the damage ceases to exist. The transmitter must be sent back to the service center.
BITA (1024 dec)	PRIMARY_VARIABLE_ NOT_VALID	Failure of the microcontroller was diagnosed during mathematical operations. This is a critical failure. Current in the current loop will be I_AL << 3.650 mA. This status will last approximately 10 s, then the transmitter will attempt to restart. If the failure is repeated once again, the transmitter must be sent back to the service center.
BITB (2048 dec)	PRIMARY_VARIABLE_ OUT_OF_LIMITS	The LPL or UPL point was exceeded on pressure / differential pressure scale. The digital measurement of the transmitter beyond these points is not possible. The transmitter will set the alarm current depending on the settings I_AL < 3.650 mA or I_AL > 21.500 mA. This condition will continue until the cause of the overload ceases to exist. If the transmitter is within the correct pressure range according to the information on the nameplate and the error message is still displayed, this may indicate a failure of the transmitter component. In this situation, the transmitter

		must be sent back to the service center.
BITC (2048 dec)	SECONDARY_ VARIABLE_ OUT_OF_LIMITS	The limits of the permissible temperature range of the transmitter operation were exceeded. The temperature measurement is done at 3 points: pressure sensor, A/D transducer and main CPU microcontroller. The transmitter will set the alarm current depending on the settings I_AL < 3.650 mA or I_AL > 21.500 mA. This condition will continue until the operating temperature returns to its correct range. If the transmitter is within the correct temperature range according to the information on the nameplate and the error message is still displayed, this may indicate a failure of the transmitter component. In this situation, the transmitter must be sent back to the service center.

Table 64. Numbers of error statuses displayed on the display.

15.2. Failure statuses read using HART

The transmitter allows to reading out statuses using HART communication. The range of information available in this way is broader than the information that is diagnosed based on the error number shown on the transmitter display. Diagnostics allows to read out the operation parameters of the transmitter blocks. Exemplary screen shots from “Raport 2” show the range of available diagnostic information. If the transmitter reports an error and the cause is not known, the manufacturer recommends using HART diagnostics to determine the type of failure during contact with the service centre. The statuses indicated in the figures below are of indicative nature and show the way of displaying the failures.

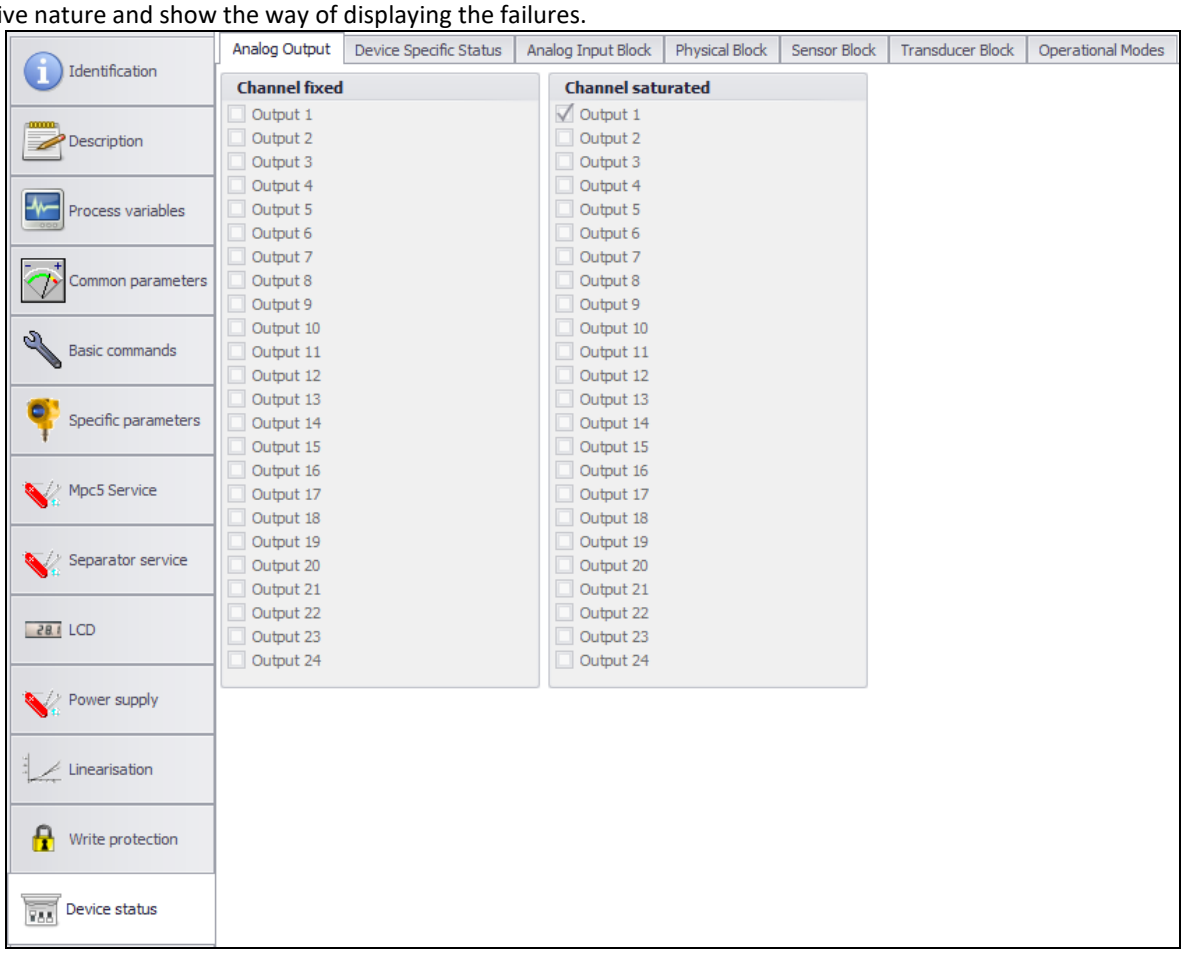


Figure 145. Statuses of the analog output block.

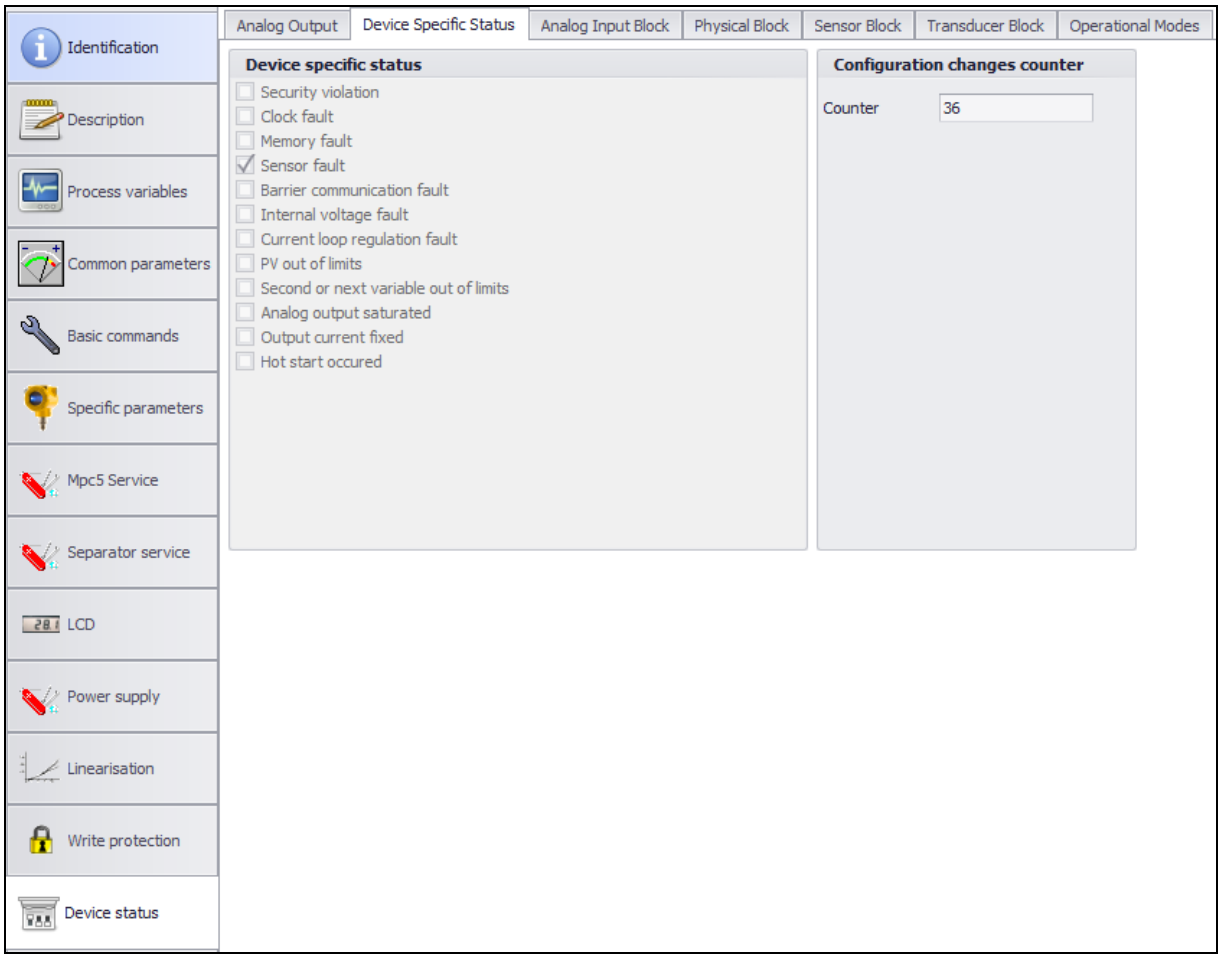


Figure 146. Summary statuses.

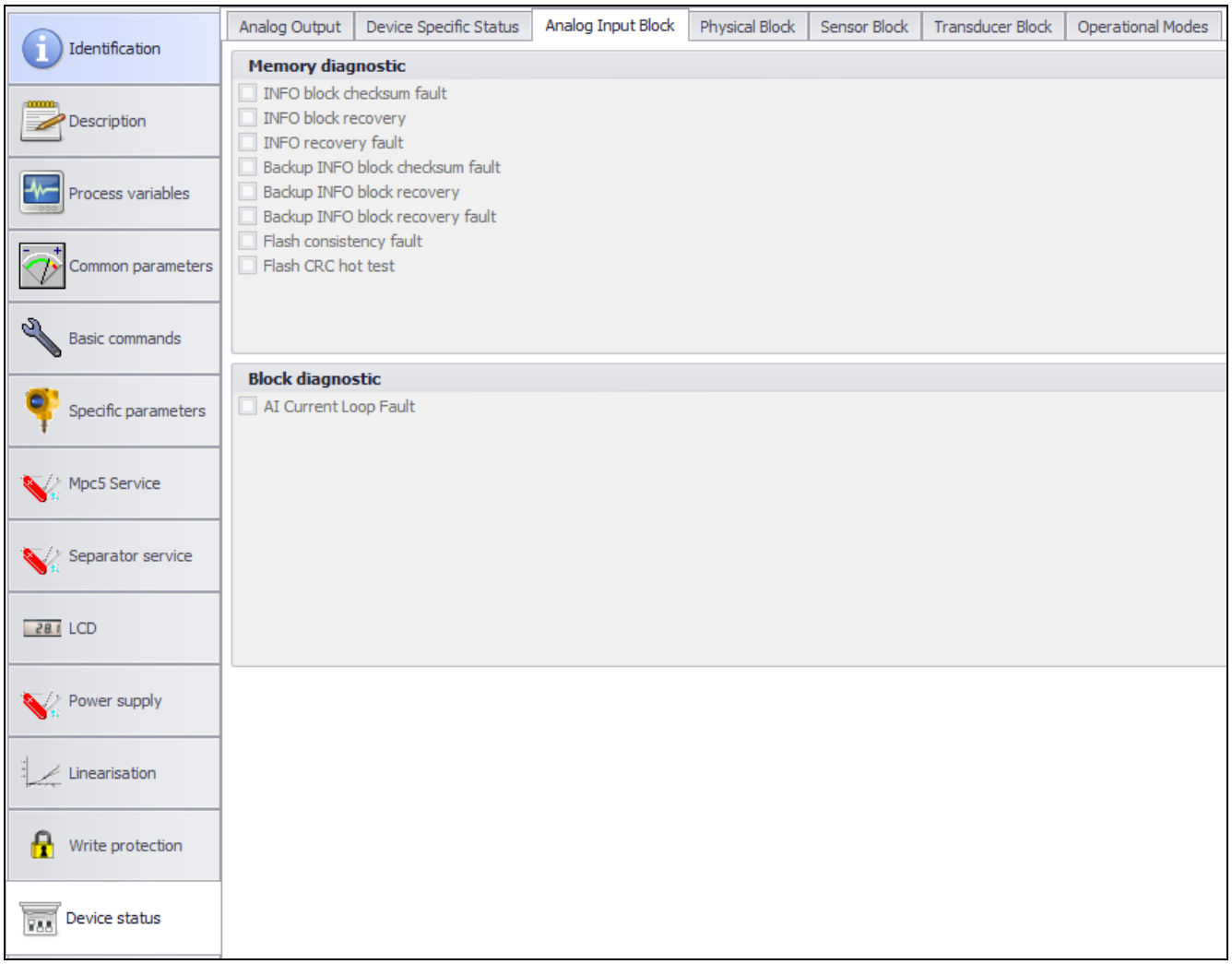


Figure 147. Analog input block statuses.

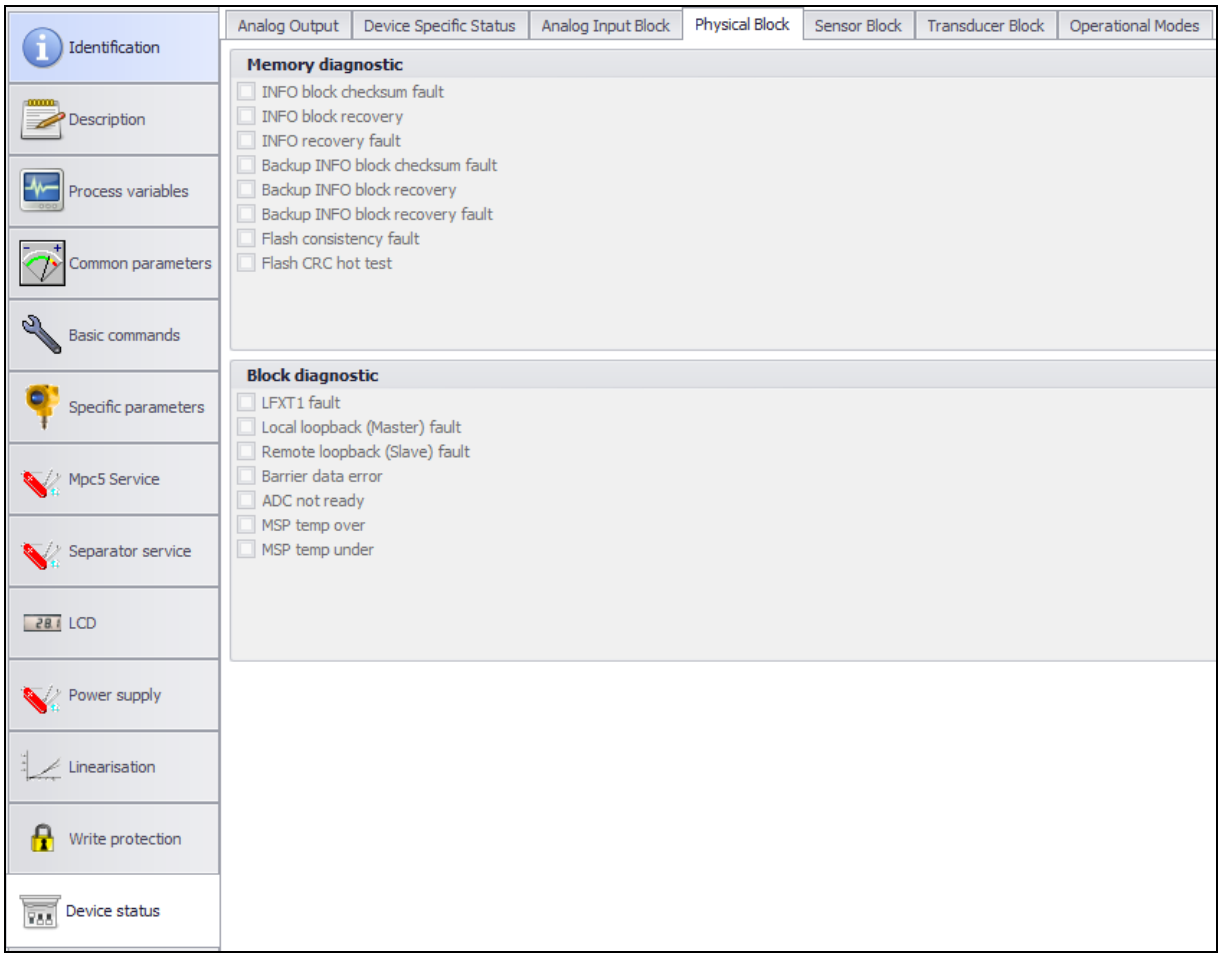


Figure 148. Physical block statuses.

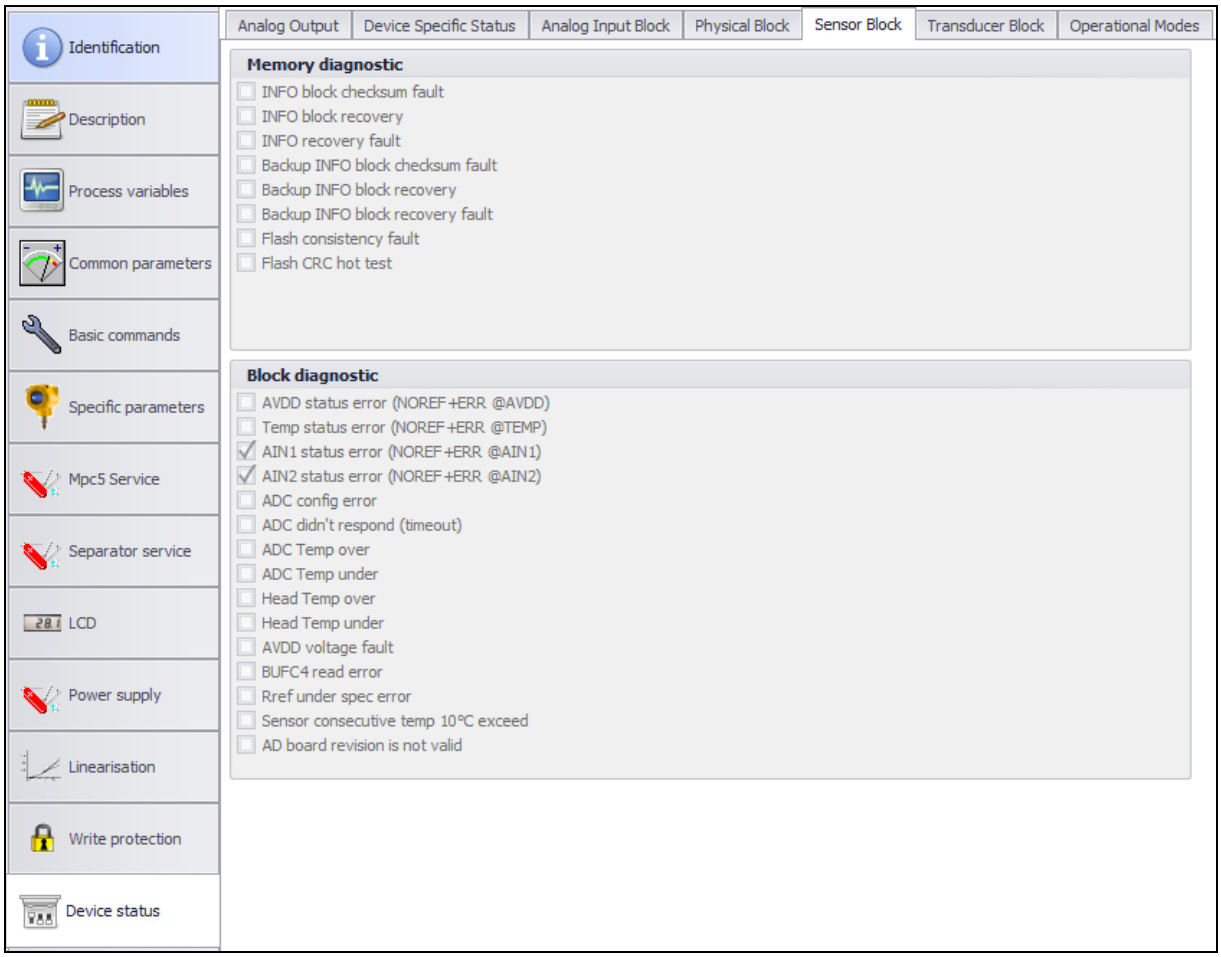


Figure 149. Sensor block statuses.

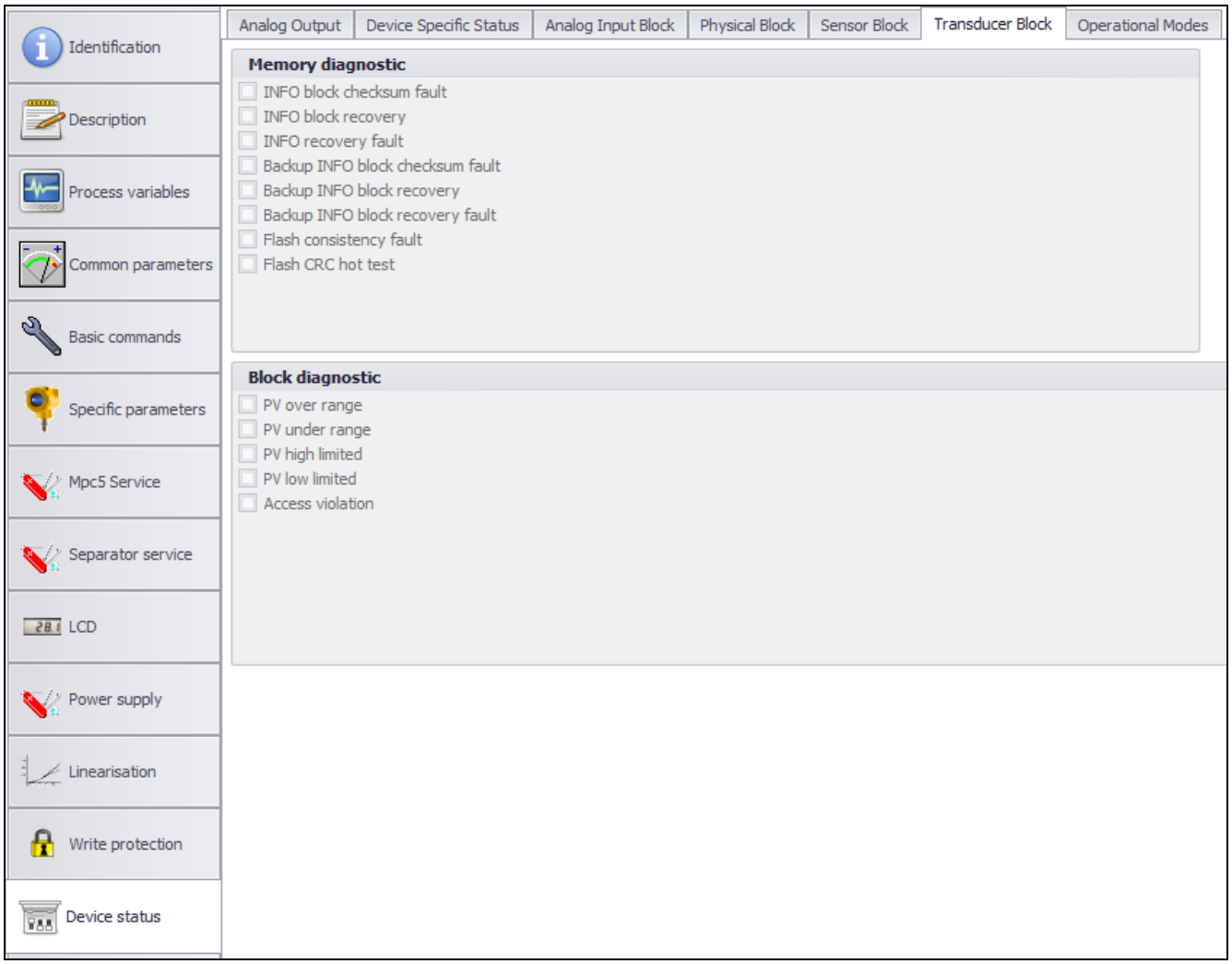


Figure 150. Transducer block statuses.

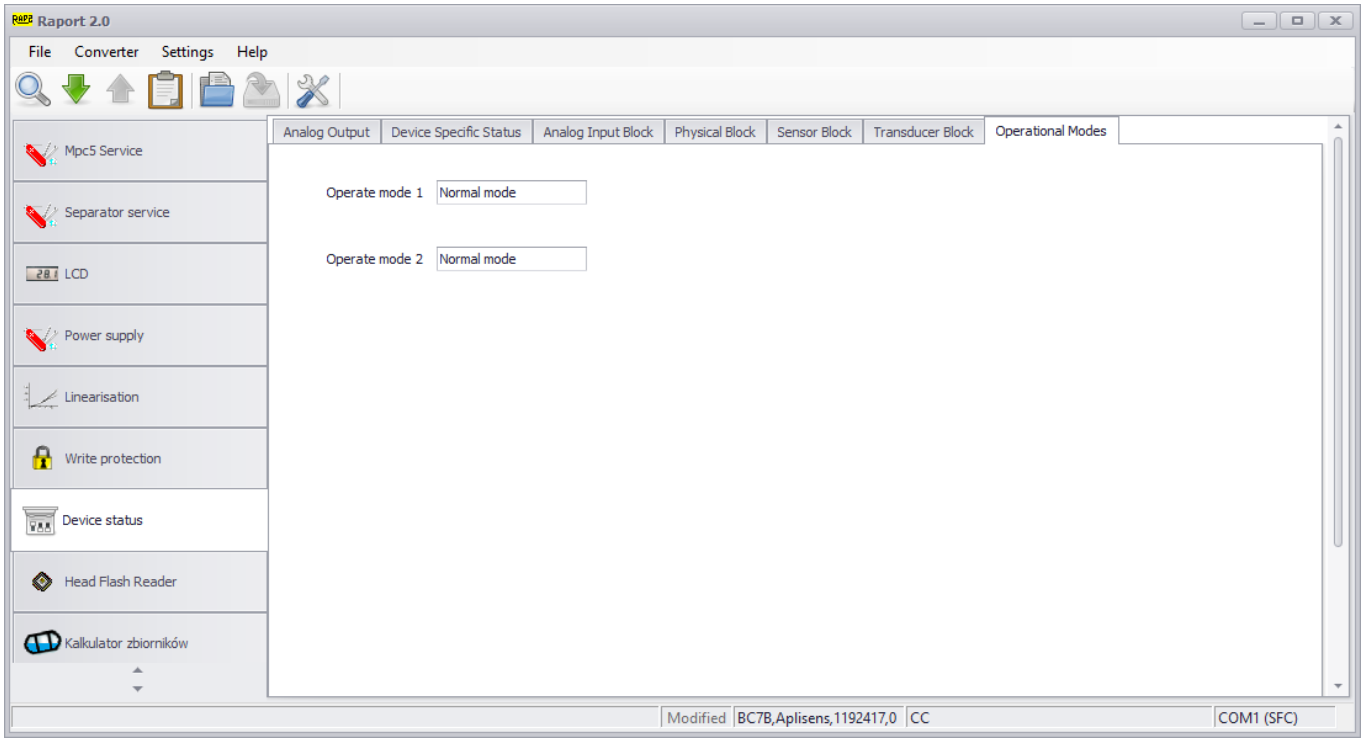


Figure 151. Operational modes statuses.

15.3. Influence of malfunction and failure on transmitter operation and output current

If alarm enabling was set up properly, any diagnosed malfunctions and failures will trigger alarm current I_AL < 3.650 mA (approx. 3.600 mA), I_AL > 21.500 mA or I_AL << 3.600 mA (approx. 0.150 mA). These types of alarms differ from one another in the method of their handling.
When the cause of failure ceases to exist, alarm current I_AL < 3.650 mA (approx. 3.600 mA) or I_AL > 21.500 mA usually automatically returns to the process current of the measurement.
Alarm current I_AL << 3.600 mA (approx. 0.150 mA) is activated by a separate alarm module triggered in critical situations from the point of view of the transmitter diagnostics. This condition continues for approximately 10 s. Then the transmitter restarts the software and attempts to restore operation. If the defect persists, the transmitter will be switched to the alarm mode once again.
Alarm may be configured using Raport 2 software (from Aplisens S.A.) or other software using DD or DTM library. The screenshot from Raport 2 presented below shows a list for configuration of alarm enabling / disabling.

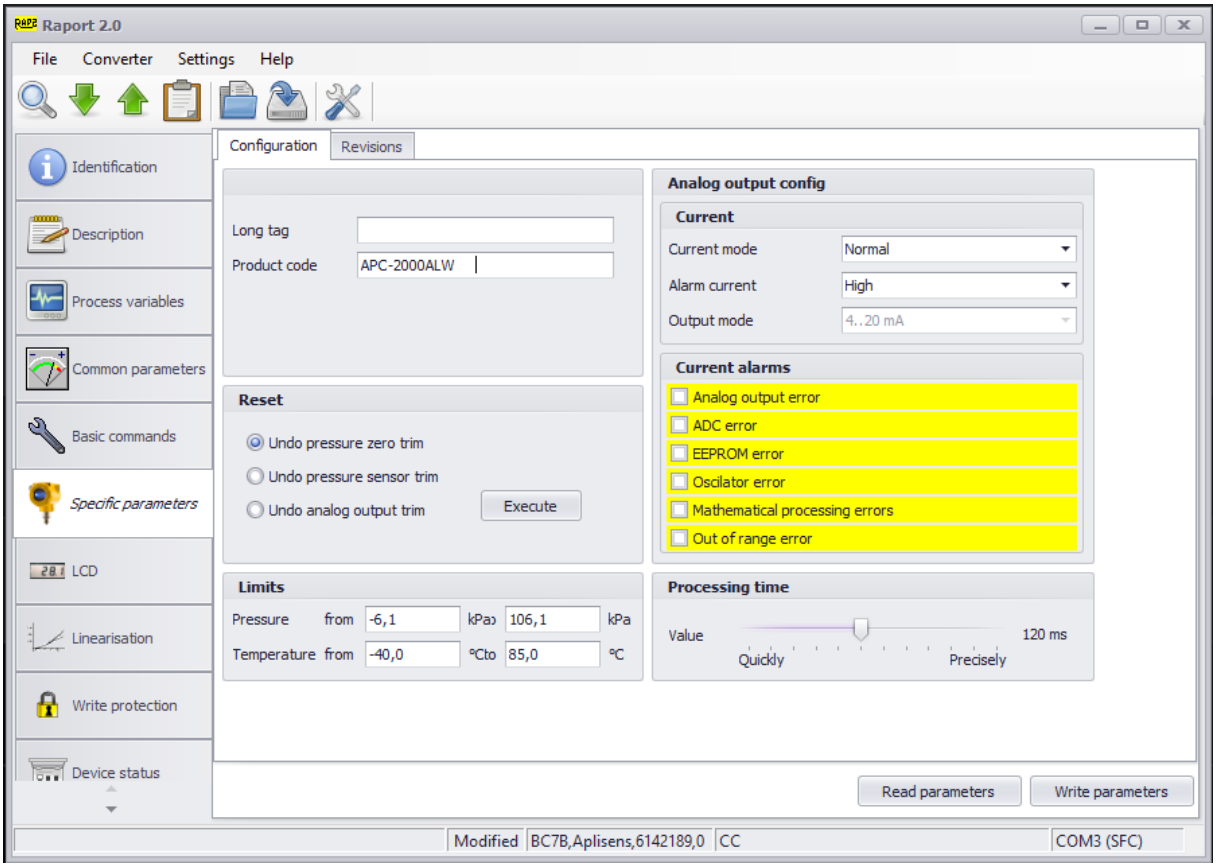


Figure 152. Configuration tab in Raport 2.

16. Certificates, approvals, attestation, declarations

16.1. CE mark

Transmitters APC(R)-2000ALW have been designed to meet the latest safety requirements, and they have been tested and have left the factory in a safe condition. The transmitters comply with the applicable standards and regulations listed in the EU declaration of conformity and therefore meet the statutory requirements of the EU directives. Aplisens S.A. confirms the conformance of the transmitter by placing the CE mark on it.

16.2. Ex certificates

Certificates allowing to use the transmitter in explosion-risk areas.

16.2.1. ATEX Certificates (Europe)

On the nameplate indicates that the product complies with the requirements of the European ATEX directive on explosion protection.

Intrinsically safe Exi version

Certificate No.: FTZU 08 ATEX 0020X

Applied standards: EN 60079-0:2012 + A11:2013, EN 60079-11:2012, EN 50303:2000

Designation: I M1 Ex ia I Ma (only in the housing made of steel 316)

II 1/2G Ex ia IIC T4/T5 Ga/Gb

II 1/2G Ex ia IIB T4/T5 Ga/Gb (version with PTFE cable)

II 1D Ex ia IIIC T105°C Da

Linear power supply	Orthogonal power supply		Trapezoidal power supply
Ui = 30 V	Ui = 24 V	Ui = 24 V	Ui = 24 V
Ii = 0,1 A	Ii = 25 mA	Ii = 50 mA	Ii = 50 mA
Pi = 0,75 W	Pi = 0,6 W	Pi = 1,2 W	Pi = 0,7 W
Ci = 2,5 nF	Ci = 2, 5 nF	Ci = 2,5 nF	Ci = 2,5 nF
Li = 18 µH	Li = 18 µH	Li = 18 µH	Li = 18 µH
Temperature class T5	Temperature class T5	Temperature class T4	Temperature class T5

Table 65. Intrinsically safe Exi version (ATEX). Permissible input parameters.

- Range of permissible ambient temperatures: Ta = -50°C to +80°C for 1G/2G;
- Range of permissible ambient temperatures: Ta = -40°C to +80°C for 1D and M1.

Specific safe use conditions:

- Version of transmitter with surge arrester marked on plate as “SA” does not meet the requirements of Section 10.3 of EN 60079-11:2012 (500 Vrms). This must be taken into account when installing the equipment.
- Under certain extreme circumstances in dust explosive atmospheres, the device with painting of aluminum enclosure and with plastic tables and with elements of diaphragm seals covered by PTFE may store an ignition-capable level of electrostatic charge. The device shall not be installed in a location where the external conditions are conductive to the build-up of electrostatic charge.
- If a diaphragm separator contains titan components, it must be protected against mechanical drops.
- Galvanically separated part of apparatus placed into measuring head in electrically connected with mass of enclosure. It should be taken into account when installing the apparatus with remote measuring head of cable.

16.2.2. **IECEx certificates**

Intrinsically safe Exi
Certificate No.: IECEx FTZU 14.0026X
Applied standards: IEC 60079-0:2011, IEC 60079-11:2011
Designation: Ex ia IIC T4/T5 Ga/Gb)
Ex ia IIB T4/T5 Ga/Gb (version with PTFE cable)
Ex ia I Ma (only in the housing made of steel 316)
Ex ia III C T105°C Da

Linear power supply	Orthogonal power supply		Trapezoidal power supply
Ui = 30 V	Ui = 24 V	Ui = 24 V	Ui = 24 V
Ii = 0,1 A	Ii = 25 mA	Ii = 50 mA	Ii = 50 mA
Pi = 0,75 W	Pi = 0,6 W	Pi = 1,2 W	Pi = 0,7 W
Ci = 2,5 nF	Ci = 2,5 nF	Ci = 2,5 nF	Ci = 2,5 nF
Li = 18 µH	Li = 18 µH	Li = 18 µH	Li = 18 µH
Temperature class T5	Temperature class T5	Temperature class T4	Temperature class T5

Table 66. Intrinsically safe Exi version (IECEx). Permissible input parameters.

- Range of permissible ambient temperatures: Ta = -50°C to +80°C for group II;
- Range of permissible ambient temperatures: Ta = -40°C to +80°C for group I and II.

Specific safe use conditions:

- Version of transmitter with surge arrester marked on plate as “SA” does not meet the requirements of Section 10.3 of EN 60079-11:2012 (500 Vrms). This must be taken into account when installing the equipment.
- Under certain extreme circumstances in dust explosive atmospheres, the device with painting of aluminum enclosure and with plastic tables and with elements of diaphragm seals covered by PTFE may store an ignition-capable level of electrostatic charge. The device shall not be installed in a location where the external conditions are conductive to the build-up of electrostatic charge
- If a diaphragm seal contains titan parts, it must be protected against mechanical drops.
- Galvanically separated part of apparatus placed into measuring head is electrically connected with mass of enclosure. It should be taken into account when installing the apparatus with remote measuring head on cable.

16.3. Hygienic applications

Transmitters with separators equipped with hygienic connectors allow for measurements in aseptic/hygiene conditions. They are usually used in the food, pharmaceutical and biotechnology industries. The measuring instrument can be connected to a separator directly or using a capillary tube. Hygienic transmitters have a hygiene certificate issued by NIZP-PZH (National Institute of Public Health – National Institute of Hygiene). A certificate issued by NIZP-PZH (National Institute of Public Health – National Institute of Hygiene) for a given product certifies that it is safe for human health and/or the environment, provided that it is used in accordance with the intended purpose.

16.4. Marine certificates

Pressure and differential pressure transmitters: APC-2000ALW, APR-2000ALW designed for marine applications meet Det Norske Veritas (DNV) rules for classification vessels, ships, offshore units, high speed and light crafts and have DNV GL Certificate No TAA000019J for applications in the following system standards:

- temperature: class D;
- humidity: class B;
- vibrations: class B;
- EMC class: B;
- housing: class C.

16.5. Special PED execution

APC-2000ALW, APR-2000ALW with permissible pressure/overload exceeding 200 bar ordered as PED execution are supplied with the manufacturer's declaration of compliance with the Pressure Directive 2014/68/EU cat. I, module A.
The conformity assessment procedures provided for Module A have been applied. The process is based on internal control covering the design phase as well as the production phase.
These transmitters are designed as pressure accessories for measuring and controlling the pressure of the media in group 1 (hazardous) and the permissible overloads higher than 1000 bar for media pressure measurement and control systems of group 1 and 2.
APC-2000ALW, APR-2000ALW with permissible pressure/overload 200 bar and a lower one are manufactured in accordance with Article 4 para. 3 of Directive 2014/68/EU. Design and manufacture is in accordance with recognized engineering practice to ensure safe use.
The manufacturer does not issue a declaration of conformity with the PED Directive for these transmitters.

16.6. Standards and guidelines

Directives/Standards	Standards
ATEX 2014/34/EU	EN 60079-0, EN 60079-11, EN 50303
EMC 2014/30/EU	EN 61326-1, EN 61000-4-2, EN 61000-4-3, EN 61000-4-4, EN 61000-4-5, EN 61000-4-6,
PED 2014/68/EU	EN ISO 13445, EN ISO 14732, WUDT-UC/2003
RoHS 2011/65/EU	EN 50581
IECEx	IEC 60079-0, IEC 60079-11,
Other	EN 60068-2-6, EN 60068-2-27, EN 60529, EN 60654, EN 61298, EN 60770

Table 67. Applied standards and guidelines.

16.7. Inspection certificates

The following certificates are available on request:

Type of certificate	Standard, description
Final calibration certificate (0);	
Transmitter temperature compensation control certificate (16.7.2);	
Calibration certificate issued by Accredited Laboratory (16.7.3);	
Material certificate (wetted parts) (16.7.4);	PN-EN10204;2006
Material certificate (wetted parts) (16.7.4);	NACE MR0175/ISO 15156
Certificate of the National Institute of Hygiene (16.7.5);	PN-EN 1672-2
Hydrostatic test (16.7.6)	
Washing certificate (16.7.7)	
Roughness certificate (16.7.8)	

Table 68. Inspection certificates.

16.7.1. **Final calibration certificate.**

In the course of the manufacturing process, in addition to automated computerised temperature compensation, linearization and calibration, the transmitter is subject to final pressure calibration and calibration of the output current controller. A final calibration certificate is available on request. Below there is an exemplary printout from the process program for semi-automatic final calibration.

APLISENS®

APLISENS S.A. - MANUFACTURE OF INDUSTRIAL
MEASURING INSTRUMENTS AND AUTOMATION EQUIPMENT
7, MORELOWA STR. 03-192 WARSAW, POLAND
tel. +48 22 814-07-77, fax +48 22 814-07-78

Test certificate

Type:	**APC-2000ALW**		
Serial No:	**10150394**		
Sensor No:	**1507K143**		
TECHNICAL PARAMETERS:			
Base range:	**0 ... 25 kPa**	Accuracy:	**± 0.075 %**
Set range:	**0 ... 0.25 bar**		
Output signal:	**4 ... 20 mA**	Transf. func.:	**Linear**
TEST EQUIPMENT:			
Pressure controller:	**MENSOR, 600, [610445]**		
Multimeter:	**KEITHLEY, MODEL 2000,**		
Standard resistor:	**100 Ohm, RN-1[123/20**		
Ambient temperature:	**22.7 °C**		

Operational characteristics for base range

Standard input pressure as % of range	Pressure applied	Standard output signal	Measured output signal	Deviation
%	kPa	mA	mA	%
0	0.000	4.000	4.000	0.000
25	6.250	8.000	7.997	-0.019
50	12.500	12.000	11.998	-0.013
75	18.750	16.000	15.999	-0.006
100	25.000	20.000	20.000	0.000

This product complies with operational requirements.

Test date: **Monday, 12 October 2015**
Printed on: **Monday, 22 July 2019**

QUALITY INSPECTION

Remarks:

Aplisens S.A. informs about calibration possibilities of pressure and differential pressure transmitters in our accredited calibration laboratory

Figure 153. Final calibration certificate.

A final calibration certificate is available on the request.

16.7.2. **Transmitter temperature compensation control certificate**

Automated temperature compensation, linearization and calibration of the transmitter are performed at the stage of manufacture. Below there is an exemplary record from the process of the transmitter temperature compensation control. This is a certificate of fulfilment of the required metrological parameters of the transmitter in the assumed range of operating temperatures.

Rozpoczęcie procesu: 2019-07-18 09:29:25
Zakończenie procesu: 2019-07-19 06:03:14
Stanowisko: KOMORA16
Zbiór: MPC5 -10÷10kPa *
Numer seryjny: 5912050; nr głowicy: 1905K050 , Software: 3.5, Hardware: 3.0, Zakres nastawiony: -10,0 ... 10,0 [kPa]
Pozycja: 1
Użyte przyrządy pomiarowe:
- Zadajnik: Zadajnik #1 MENSOR,PCS 400,600383,4.38.0
- Woltomierz: Keithley KEITHLEY INSTRUMENTS INC.,MODEL 2000,1160167,A20 /A02

Błędy procesu: Brak

Odczytana wartość ciśnienia obliczona przez przetwornik [kPa]:
Zakładana dokładność obliczonego ciśnienia: 0,1%

[kPa]/[°C]	-25	0	75	50	25
-10,000	-9,999	-9,963	-9,97	-9,912	-9,994
-5,000	-5,001	-4,983	-4	-4,958	-5,002
0,000	-0,018	-0,008	0	0,096	-0,003
5,000	4,981	4,994	4,9	4,967	4,997
10,000	10,003	10,030	9,90	9,963	10,021
Max błąd [%]	0,094	0,186	0,482	0,478	0,107
Max błąd temp./10°C [%]	0,018	0,062	0,11	0,197	-

Odczytana wartość prądu odczytana komendą HART w funkc nia [mA]:
Zakładana dokładność prądu w linii: 0,1%

Prąd [mA]/[°C]	-25	75	50	25
4,000	4,001	03	4,057	4,070	4,005
8,000	7,999	014	8,009	8,033	7,998
12,000	11,986	94	12,053	12,076	11,998
16,000	385	15,996	15,956	15,974	15,998
20,000		20,024	19,923	19,971	20,017
Max błąd [%]	094	0,186	0,482	0,478	0,107
Max błąd temp./10°C [%]		0,062	0,118	0,197	-

Zmierzona wartość prądu w rądu zadanego [mA]:
Zakładana dokładność prądu w linii: 0 %

Prąd [mA]/[°C]	-25	0	75	50	25
4,000	3,994	3,997	4,008	4,003	4,000
8,000	7,995	7,998	8,006	8,003	8,000
12,000	11,996	11,999	12,004	12,001	12,000
16,000	15,998	16,000	16,003	16,001	16,000
20,000	20,001	20,001	20,002	20,000	20,000
Max błąd [%]	0,041	0,017	0,050	0,022	0,003
Max błąd temp./10°C [%]	0,008	0,007	0,010	0,009	-

Odczytana wartość prądu zwrotnego PVIret (na rezystorze R28) w funkcji prądu zadanego [mA]:
Zakładana dokładność prądu zwrotnego : 0,1%

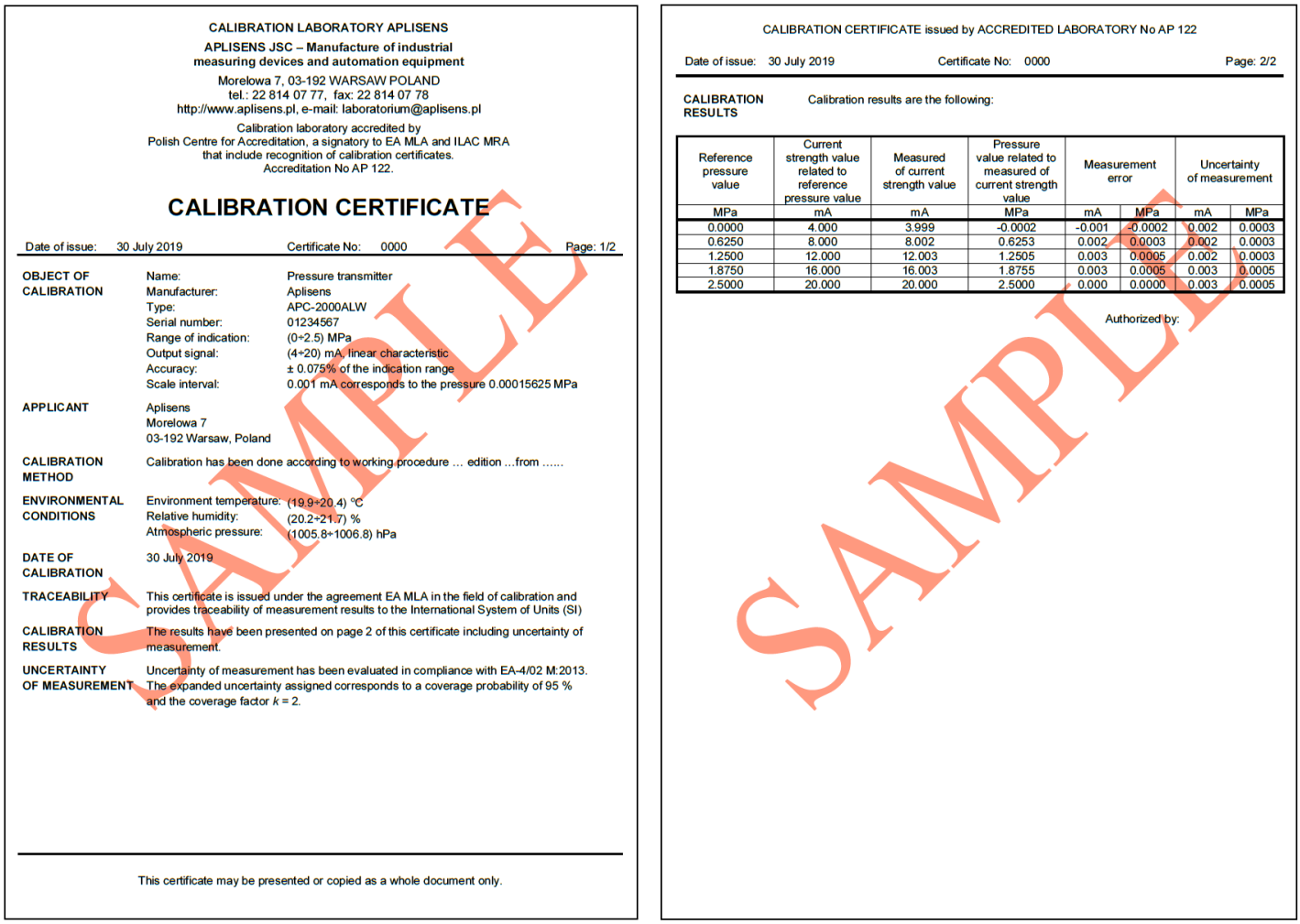
Prąd [mA]/[°C]	-25	0	75	50	25
4,000	3,989	3,994	4,011	4,006	3,997
8,000	7,992	7,994	8,002	8,000	7,997
12,000	11,991	11,994	12,003	11,999	11,997
16,000	15,993	16,000	16,000	15,995	15,993
20,000	19,998	20,000	19,995	19,998	20,003
Max błąd [%]	0,067	0,040	0,067	0,039	0,042
Max błąd temp./10°C [%]	0,018	0,062	0,118	0,197	-

Wersja programu: 1.43.0.0

Figure 154. Transmitter compensation control certificate- example.

A transmitter temperature compensation control certificate is available on the request.

16.7.3. Calibration certificate issued by Calibration Laboratory Aplisens



CALIBRATION LABORATORY APLISENS

APLISENS JSC – Manufacture of industrial measuring devices and automation equipment

Morelowa 7, 03-192 WARSAW POLAND
tel.: 22 814 07 77, fax: 22 814 07 78
http://www.aplisens.pl, e-mail: laboratorium@aplisens.pl

Calibration laboratory accredited by Polish Centre for Accreditation, a signatory to EA MLA and ILAC MRA that include recognition of calibration certificates. Accreditation No AP 122.

CALIBRATION CERTIFICATE

Date of issue: 30 July 2019 Certificate No: 0000 Page: 1/2

OBJECT OF CALIBRATION	Name:	Pressure transmitter
	Manufacturer:	Aplisens
	Type:	APC-2000ALW
	Serial number:	01234567
	Range of indication:	(0÷2.5) MPa
	Output signal:	(4÷20) mA, linear characteristic
	Accuracy:	± 0.075% of the indication range
	Scale interval:	0.001 mA corresponds to the pressure 0.00015625 MPa
APPLICANT	Aplisens Morelowa 7 03-192 Warsaw, Poland	
CALIBRATION METHOD	Calibration has been done according to working procedure ... edition ...from	
ENVIRONMENTAL CONDITIONS	Environment temperature:	(19.9÷20.4) °C
	Relative humidity:	(20.2÷21.7) %
	Atmospheric pressure:	(1005.8÷1006.8) hPa
DATE OF CALIBRATION	30 July 2019	
TRACEABILITY	This certificate is issued under the agreement EA MLA in the field of calibration and provides traceability of measurement results to the International System of Units (SI)	
CALIBRATION RESULTS	The results have been presented on page 2 of this certificate including uncertainty of measurement.	
UNCERTAINTY OF MEASUREMENT	Uncertainty of measurement has been evaluated in compliance with EA-4/02 M:2013. The expanded uncertainty assigned corresponds to a coverage probability of 95 % and the coverage factor $k = 2$.	

This certificate may be presented or copied as a whole document only.

CALIBRATION CERTIFICATE issued by ACCREDITED LABORATORY No AP 122

Date of issue: 30 July 2019 Certificate No: 0000 Page: 2/2

CALIBRATION RESULTS Calibration results are the following:

Reference pressure value	Current strength value related to reference pressure value	Measured of current strength value	Pressure value related to measured of current strength value	Measurement error		Uncertainty of measurement	
MPa	mA	mA	MPa	mA	MPa	mA	MPa
0.0000	4.000	3.999	-0.0002	-0.001	-0.0002	0.002	0.0003
0.6250	8.000	8.002	0.6253	0.002	0.0003	0.002	0.0003
1.2500	12.000	12.003	1.2505	0.003	0.0005	0.002	0.0003
1.8750	16.000	16.003	1.8755	0.003	0.0005	0.003	0.0005
2.5000	20.000	20.000	2.5000	0.000	0.0000	0.003	0.0005

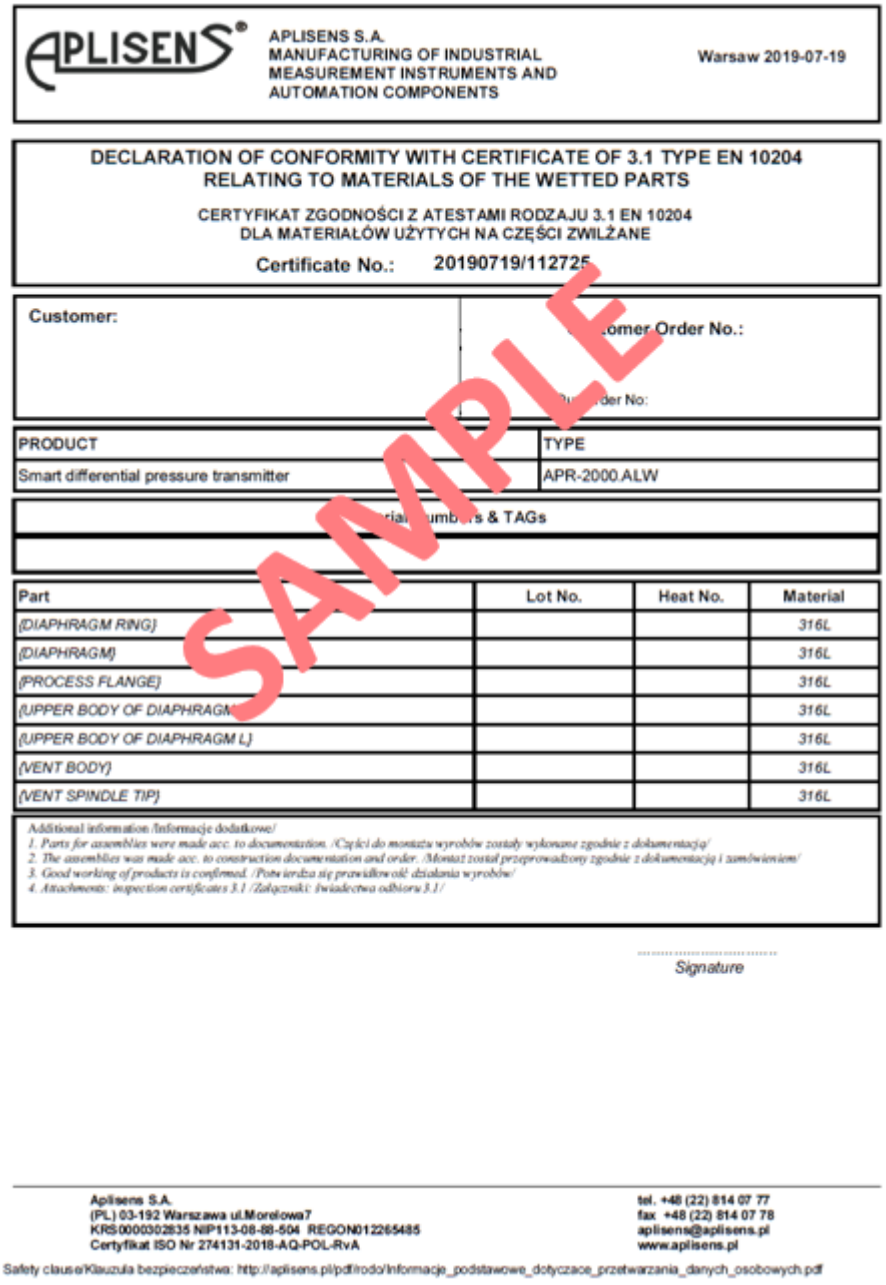
Authorized by:

Figure 155. Calibration certificate.

The CALIBRATION CERTIFICATE issued by the Calibration Laboratory is available on the request.

16.7.4. **Material certificate of wetted parts according to PN-EN 10204**

Below you will find an exemplary certificate compliant with PN-EN 10204-3.1.



APLISENS S.A.
MANUFACTURING OF INDUSTRIAL MEASUREMENT INSTRUMENTS AND AUTOMATION COMPONENTS

Warsaw 2019-07-19

DECLARATION OF CONFORMITY WITH CERTIFICATE OF 3.1 TYPE EN 10204 RELATING TO MATERIALS OF THE WETTED PARTS

CERTYFIKAT ZGODNOŚCI Z ATESTAMI RODZAJU 3.1 EN 10204 DLA MATERIAŁÓW UŻYTYCH NA CZĘŚCI ZWILŻANE

Certificate No.: 20190719/112725

Customer:

omer Order No.:

der No:

PRODUCT	TYPE
Smart differential pressure transmitter	APR-2000.ALW

& TAGs

Part	Lot No.	Heat No.	Material
(DIAPHRAGM RING)			316L
(DIAPHRAGM)			316L
(PROCESS FLANGE)			316L
(UPPER BODY OF DIAPHRAGM			316L
(UPPER BODY OF DIAPHRAGM L)			316L
(VENT BODY)			316L
(VENT SPINDLE TIP)			316L

Additional information /Informacje dodatkowe/
1. Parts for assemblies were made acc. to documentation. /Części do montażu wyrobów zostały wykonane zgodnie z dokumentacją/
2. The assemblies was made acc. to construction documentation and order. /Montaż został przeprowadzony zgodnie z dokumentacją i zamówieniem/
3. Good working of products is confirmed. /Potwierdza się prawidłowość działania wyrobów/
4. Attachments: inspection certificates 3.1 /Załączniki: świadectwa odbioru 3.1/

SAMPLE

Signature

Aplisens S.A.
(PL) 03-192 Warszawa ul.Morelowa7
KRS 0000302835 NIP 113-08-88-504 REGON 012265485
Certyfikat ISO Nr 274131-2018-AQ-POL-RvA

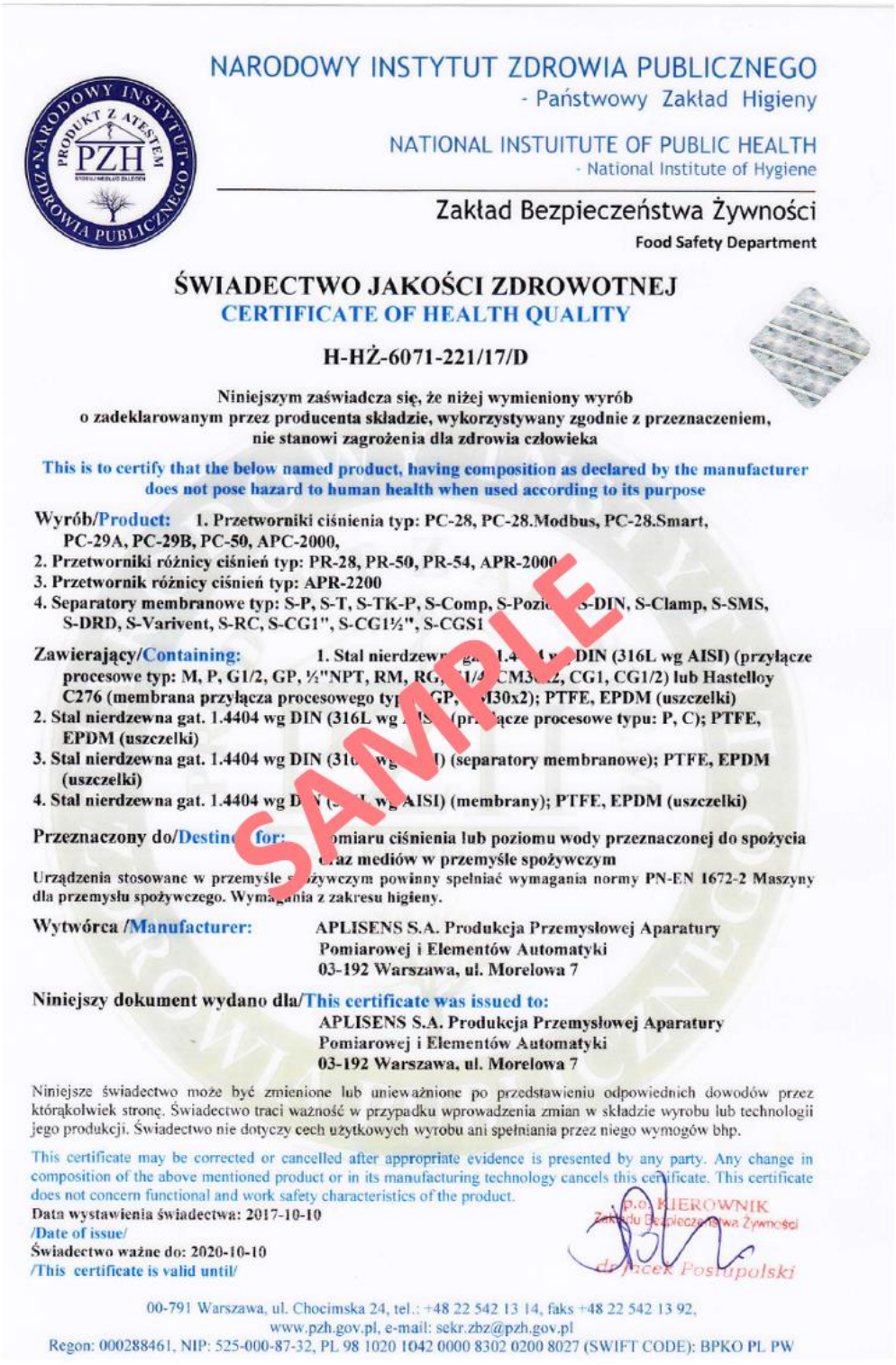
tel. +48 (22) 814 07 77
fax +48 (22) 814 07 78
aplisens@aplisens.pl
www.aplisens.pl

Safety clause/Klauzula bezpieczeństwa: http://aplisens.pl/pdf/rodo/Informacje_podstawowe_dotyczace_przetwarzania_danych_osobowych.pdf

Figure 156. Material certificate of wetted parts according to PN-EN 10204.

A declaration of conformity with certificates for the materials used in the transmitter wetted parts is available on the request.

16.7.5. **Certificate of the National Institute of Hygiene**



NARODOWY INSTYTUT ZDROWIA PUBLICZNEGO
- Państwowy Zakład Higieny

NATIONAL INSTUITUTE OF PUBLIC HEALTH
- National Institute of Hygiene

Zakład Bezpieczeństwa Żywności
Food Safety Department

ŚWIADECTWO JAKOŚCI ZDROWOTNEJ
CERTIFICATE OF HEALTH QUALITY

H-HŻ-6071-221/17/D

Niniejszym zaświadcza się, że niżej wymieniony wyrób o zadeklarowanym przez producenta składzie, wykorzystywany zgodnie z przeznaczeniem, nie stanowi zagrożenia dla zdrowia człowieka

This is to certify that the below named product, having composition as declared by the manufacturer does not pose hazard to human health when used according to its purpose

Wyrób/Product: 1. Przetworniki ciśnienia typ: PC-28, PC-28.Modbus, PC-28.Smart, PC-29A, PC-29B, PC-50, APC-2000,
2. Przetworniki różnicy ciśnień typ: PR-28, PR-50, PR-54, APR-2000
3. Przetwornik różnicy ciśnień typ: APR-2200
4. Separatory membranowe typ: S-P, S-T, S-TK-P, S-Comp, S-Pozi…S-DIN, S-Clamp, S-SMS, S-DRD, S-Varivent, S-RC, S-CG1", S-CG1½", S-CGS1

Zawierający/Containing: 1. Stal nierdzew… …DIN (316L wg AISI) (przyłącze procesowe typ: M, P, G1/2, GP, ½"NPT, RM, RG, …CM3…2, CG1, CG1/2) lub Hastelloy C276 (membrana przyłącza procesowego ty… …GP, …30x2); PTFE, EPDM (uszczelki)
2. Stal nierdzewna gat. 1.4404 wg DIN (316L wg …S …ącze procesowe typu: P, C); PTFE, EPDM (uszczelki)
3. Stal nierdzewna gat. 1.4404 wg DIN (31… …) (separatory membranowe); PTFE, EPDM (uszczelki)
4. Stal nierdzewna gat. 1.4404 wg D… …wg AISI) (membrany); PTFE, EPDM (uszczelki)

Przeznaczony do/Destin… for: …omiaru ciśnienia lub poziomu wody przeznaczonej do spożycia …raz mediów w przemyśle spożywczym

Urządzenia stosowane w przemyśle …ożywczym powinny spełniać wymagania normy PN-EN 1672-2 Maszyny dla przemysłu spożywczego. Wymagania z zakresu higieny.

Wytwórca /Manufacturer: APLISENS S.A. Produkcja Przemysłowej Aparatury Pomiarowej i Elementów Automatyki 03-192 Warszawa, ul. Morelowa 7

Niniejszy dokument wydano dla/This certificate was issued to: APLISENS S.A. Produkcja Przemysłowej Aparatury Pomiarowej i Elementów Automatyki 03-192 Warszawa, ul. Morelowa 7

Niniejsze świadectwo może być zmienione lub unieważnione po przedstawieniu odpowiednich dowodów przez którąkolwiek stronę. Świadectwo traci ważność w przypadku wprowadzenia zmian w składzie wyrobu lub technologii jego produkcji. Świadectwo nie dotyczy cech użytkowych wyrobu ani spełniania przez niego wymogów bhp.

This certificate may be corrected or cancelled after appropriate evidence is presented by any party. Any change in composition of the above mentioned product or in its manufacturing technology cancels this certificate. This certificate does not concern functional and work safety characteristics of the product.

Data wystawienia świadectwa: 2017-10-10
/Date of issue/
Świadectwo ważne do: 2020-10-10
/This certificate is valid until/

p.o. KIEROWNIK Zakładu Bezpieczeństwa Żywności
dr Jacek Postupolski

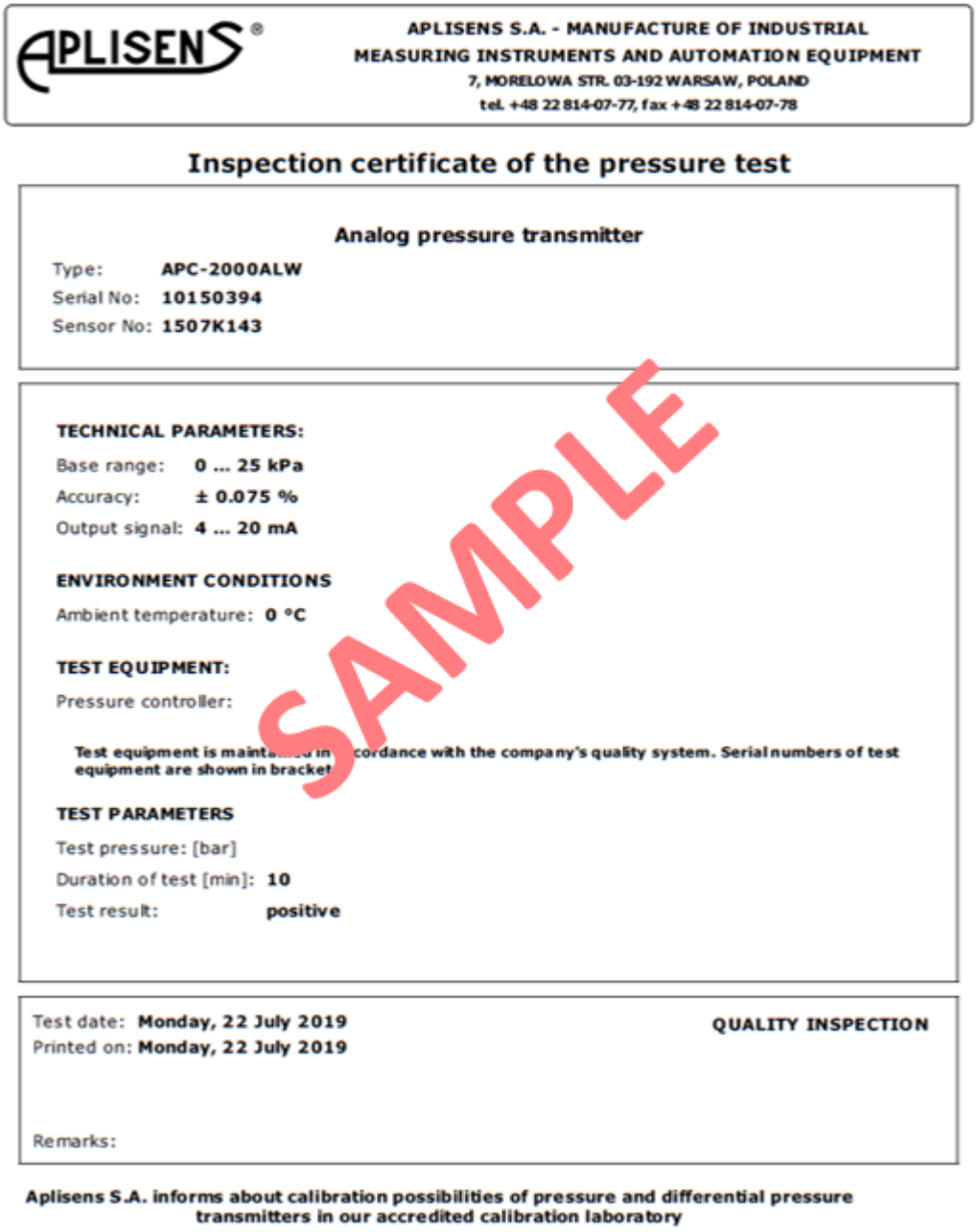
00-791 Warszawa, ul. Chocimska 24, tel.: +48 22 542 13 14, faks +48 22 542 13 92,
www.pzh.gov.pl, e-mail: sekr.zbz@pzh.gov.pl
Regon: 000288461, NIP: 525-000-87-32, PL 98 1020 1042 0000 8302 0200 8027 (SWIFT CODE): BPKO PL PW

SAMPLE

Figure 157. Certificate of the National Institute of Hygiene.

A certificate of the National Institute of Hygiene is available on the request.

16.7.6. **Certificate of hydrostatic test**



APLISENS S.A. - MANUFACTURE OF INDUSTRIAL
MEASURING INSTRUMENTS AND AUTOMATION EQUIPMENT
7, MORELOWA STR. 03-192 WARSAW, POLAND
tel. +48 22 814-07-77, fax +48 22 814-07-78

Inspection certificate of the pressure test

Analog pressure transmitter

Type: **APC-2000ALW**
Serial No: **10150394**
Sensor No: **1507K143**

TECHNICAL PARAMETERS:

Base range: **0 ... 25 kPa**
Accuracy: **± 0.075 %**
Output signal: **4 ... 20 mA**

ENVIRONMENT CONDITIONS

Ambient temperature: **0 °C**

TEST EQUIPMENT:

Pressure controller:

Test equipment is maint... in ...cordance with the company's quality system. Serial numbers of test equipment are shown in bracket

TEST PARAMETERS

Test pressure: [bar]
Duration of test [min]: **10**
Test result: **positive**

Test date: **Monday, 22 July 2019**
Printed on: **Monday, 22 July 2019**

QUALITY INSPECTION

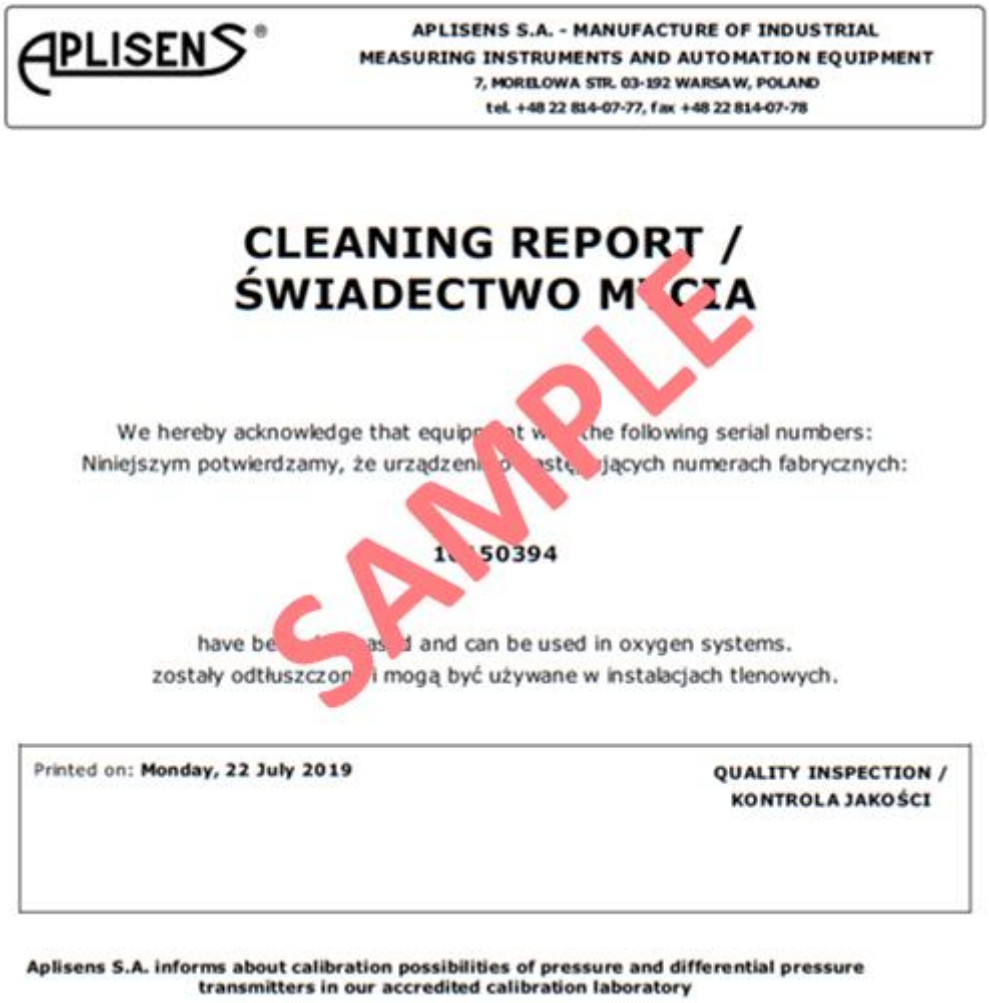
Remarks:

Aplisens S.A. informs about calibration possibilities of pressure and differential pressure transmitters in our accredited calibration laboratory

Figure 158. Certificate of hydrostatic test.

A pressure hydrostatic test is available on the request.

16.7.7. **Cleaning certificate**



APLISENS S.A. - MANUFACTURE OF INDUSTRIAL
MEASURING INSTRUMENTS AND AUTOMATION EQUIPMENT
7, MORELOWA STR. 03-192 WARSAW, POLAND
tel. +48 22 814-07-77, fax +48 22 814-07-78

CLEANING REPORT /
ŚWIADECTWO M CIA

SAMPLE

We hereby acknowledge that equip t w the following serial numbers:
Niniejszym potwierdzamy, że urządzeni stę ących numerach fabrycznych:

1 50394

have be d and can be used in oxygen systems.
zostały odtłuszczon i mogą być używane w instalacjach tlenowych.

Printed on: **Monday, 22 July 2019**

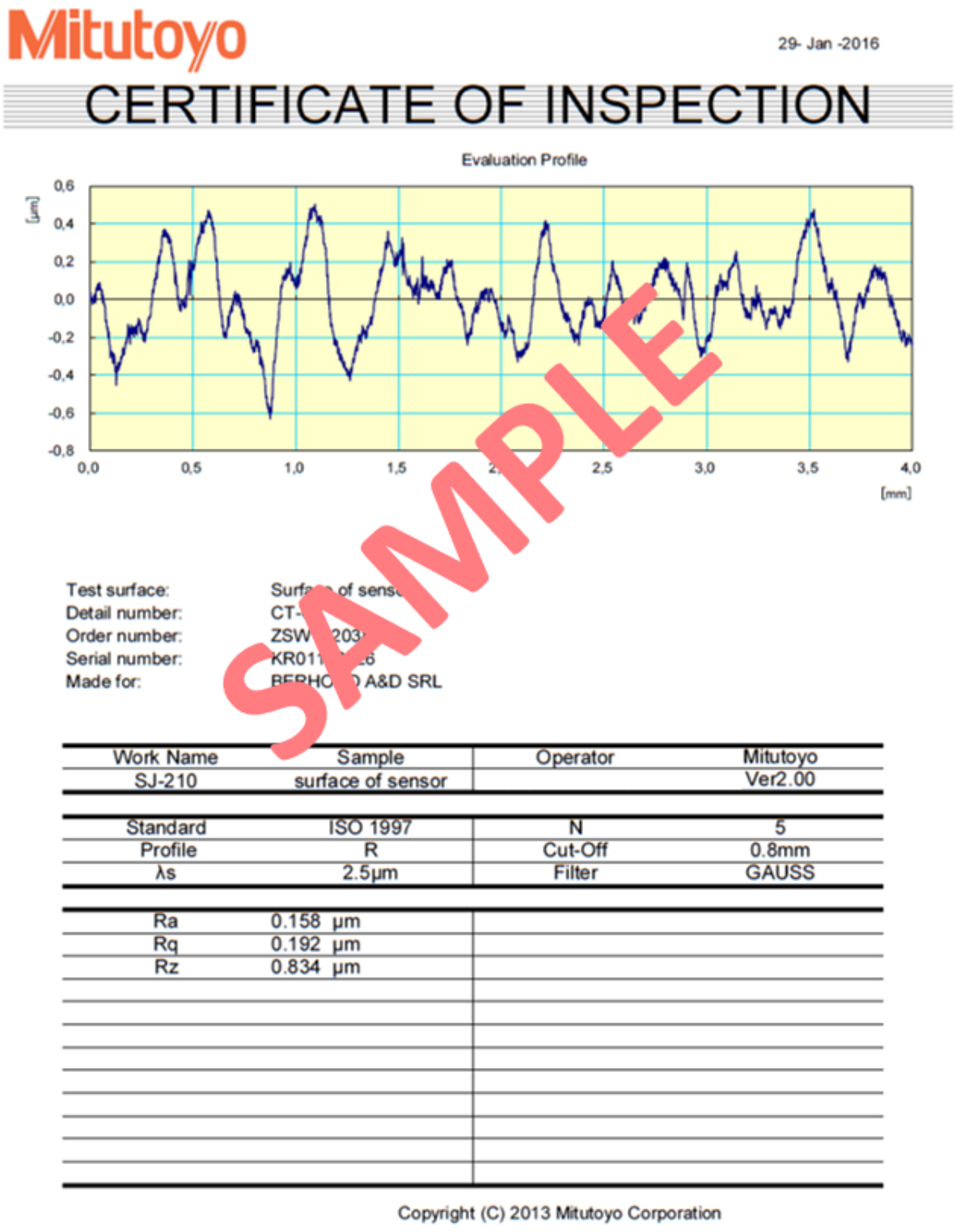
QUALITY INSPECTION /
KONTROLA JAKOŚCI

Aplisens S.A. informs about calibration possibilities of pressure and differential pressure transmitters in our accredited calibration laboratory

Figure 159. Cleaning certificate.

A cleaning report is available on the request.

16.7.8. **Roughness certificate**



Mitutoyo

29- Jan -2016

CERTIFICATE OF INSPECTION

Evaluation Profile

SAMPLE

Test surface: Surface of sensor
Detail number: CT-
Order number: ZSW 203
Serial number: KR011 26
Made for: BERHO A&D SRL

Work Name	Sample	Operator	Mitutoyo
SJ-210	surface of sensor		Ver2.00

Standard	ISO 1997	N	5
Profile	R	Cut-Off	0.8mm
λs	2.5µm	Filter	GAUSS

Ra	0.158 µm	
Rq	0.192 µm	
Rz	0.834 µm	

Figure 160. Roughness certificate.

A roughness certificate is available on the request.

17. Declaration of conformity

APLISENS

No EN.DZ.APC.APR.ALW.U9

EU Declaration of Conformity

issued under the sole responsibility of the manufacturer

The object of this declaration, pressure device: pressure transmitters **APC-2000ALW**, differential pressure transmitters **APR-2000ALW, APR-2000ALW/G, APR-2000YALW.**

Manufacturer: **APLISENS S.A., ul. Morelowa 7, 03-192 Warszawa**

We hereby declare under the sole responsibility, that the object of the declaration defined above comply with relevant Union harmonization legislation.

Pressure transmitters type **APC-2000ALW**, differential pressure transmitters **APR-2000ALW, APR-2000ALW/G, APR-2000YALW** in all versions comply with directives:

- **EMC – 2014/30/EU** dated 26 February 2014

Conformity assessment procedure: module A.
The following standards were applied EN 61326-1:2013, EN 61326-[illegible]:2013.

- **RoHS – 2011/65/EU** dated 08 June 2011

Conformity assessment procedure: module A, according t[illegible]ecision No [illegible]008/EC of the European Parliament and of the Council.
The following standard was applied: EN 50581:2012

Pressure transmitters type **APC-2000AL[illegible]** differential pressure transmitters **APR-2000ALW** in **PED** version comply with directive:

- **PED – 2014/68/EU** date[illegible]May 20[illegible]

Transmitters in PED ver[illegible]acc. t[illegible]mo[illegible] have specified on the nameplate parameters PS>200bar, PT..., TS...
The following standard[illegible]ere appli[illegible]EN 13445-3:2014, EN ISO 14732:2013, WUDT-UC/2003.

Transmitters without spe[illegible]ar[illegible]ters values PS, PT, TS were manufactured on the basis of article 4 p.3 Directive 2014/68/UE in accordance with[illegible]e sound engineering practice. In this case, PED Directive doesn't require CE marking, however transmitter is mar[illegible]E due to requirement of other regulations of EU harmonization legislation.

Pressure transmitters **APC-2000ALW**, differential pressure transmitters **APR-2000ALW, APR-2000ALW/G, APR-2000YALW** in Ex versions comply with directive:

- **ATEX – 2014/34/EU** dated 26 February 2014

Intrinsically safe versions of transmitters are marked with the following certificate marking:

II 1/2G Ex ia IIC T4/T5 Ga/Gb
II 1/2G Ex ia IIB T4/T5 Ga/Gb (version with teflon shield cable)
II 1D Ex ia IIIC T105°C Da
I M1 Ex ia I Ma (version with enclosure ss316)
FTZU 08ATEX0020X

The following standards were applied: EN 60079-0:2012+A11:2013, EN 60079-11:2012, EN 50303:2000.
Conformity assessment procedure: module B. Notified Body no.1026, Physical Technical Testing Institute, Pikartska 7, 716 07 Ostrava Radvanice.

Pressure transmitters **APC-2000ALW** model ID 0005 0008 ...., differential pressure transmitters **APR-2000ALW** model ID 0006 0008 ...., **APR-2000ALW/G** model ID 0008 0008 ...., **APR-2000ALW** model ID 0007 0008 ...., **APR-2000YALW** model ID 0009 0008 .... in explosion-proof versions are marked with the following certificate marking:

I M2 Ex db ia I Mb (version with enclosure ss316)		I M2 Ex db ia I Mb (version with enclosure ss316)
II 1/2G Ex ia / db IIC T6/T5 Ga/Gb	or	II 2G Ex ia / db IIC T6/T5 Gb
II 1/2D Ex ia / tb IIIC T105°C Da/Db		II 2D Ex ia / tb IIIC T105°C Db
KDB 19 ATEX 0011X		KDB 19 ATEX 0011X

The following standards were applied: EN 60079-0:2012+A11:2013, EN 60079-1:2014, EN 60079-11:2012, EN 60079-26:2015, EN 60079-31:2014.
Conformity assessment procedure: module B. NB no.1453, Central Mining Institute, Plac Gwarków 1, 40-166 Katowice.
Notification of quality assurance: Module D. Notified Body no.1453, Central Mining Institute, Plac Gwarków 1, 40-166 Katowice.

Warsaw, 27.08.2020

Adam Żurawski
General Manager

7, Morelowa Street Warsaw 03-192, Poland
tel. +48 22 814-07-77 fax +48 22 814-07-78
e-mail: aplisens@aplisens.pl
www.aplisens.com

18. Additional documentation

User's manual:

- EN.IO.APC.APR.ALW.
  User's manual. Pressure and differential pressure transmitters APC-2000ALW, APR-2000ALW, APR-2000ALW with diaphragm seals, APR-2000ALW/G.

Ex safety instructions:

- EN.IX.APC.APR.ALW.
  Explosion-proof device manual.

19. History of revisions

Revision No.	Document revision	Description of changes
-	01.A.001/2019.11	First version of the document, developed by KBF, DKD, DR.
1	01.A.002/2020.11	Supplement with PED, editorial changes. Change of differential pressure transmitter name APR-2200ALW on APR-2000ALW with diaphragm seals and APR-2000GALW on APR-2000ALW/G. Liquid pressure measurement application was deleted. Declaration of conformity and ID codes was updated.