DTR.APR...02 *(ENG)*

APLISENS

MANUFACTURE OF PRESSURE TRANSMITTERS
AND CONTROL INSTRUMENTS

USER'S MANUAL

SMART DIFFERENTIAL PRESSURE TRANSMITTERS TYPE:

APR-2000, APR-2000/AL
APR-2200, APR-2200/AL. WITH TWO DIAPHRAGM SEALS
APR-2000G FOR NON-AGGRESSIVE GASES

SMART LEVEL PROBE TYPE:

APR-2000/Y FOR PRESSURE TANKS

WARSAW, JANUARY, 2005

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I. APPENDIX Ex

DTR.APC.APR*(ENG)*
Appendix Ex.01

CE 1453

APC–2000EEx SMART PRESSURE TRANSMITTER,
APR-2000EEx, APR-2200EEx
ART DIFFERENTIAL PRESSURE TRANSMITTERS including
APR-2000EExG for non-aggressive gases
APR-2000EExY for measurement of level and density
EEx VERSIONS

1. Introduction

1.1. This "Appendix Ex.01" applies only to transmitters of types APC-2000EEx, APR-2000EEx, APR-2200EEx in EEx versions, marked on the rating plate as shown in 2.2 and denoted EEx in the Product Certificate.

1.2. The appendix contains supplementary information relating to the EEx versions of these transmitters. During installation and use of EEx transmitters, reference should be made to **DTR.APC...02** or **DTR.APR...02 in conjunction with "Appendix Ex.01".**.

2. Use of APC-2000EEx, APR-2000EEx, APR-2200EEx and APR-2000EExG, APR-2000EExY transmitters in danger zones.

2.1. The transmitters are produced in accordance with the requirements of the following standards PN-EN 50014:2002, PN-EN 50020:2003, PN-EN 50284:2003 and PN-EN 50303:2002 (U).

2.2. The transmitters may operate in areas where there is a risk of explosion, in accordance with the rating of the explosion protection design:

II 1/2G EEx ia IIC T4/T5/T6 (rating for industrial uses),
I M1 EEx ia I (rating for mining uses)
KDB 04ATEX059 (certificate number).

3. Identifying marks.

Intrinsically safe transmitters must have a rating plate containing the information specified in paragraph 4 of DTR.APC...02 or DTR.APR...02, and also at least the following:

- CE mark and number of notified unit: 1453 in the case of GIG KDB,  mark
- designation of explosion protection design, certificate number
- values of parameters such as Ui, Ii, Ci
- marking of electrical and process connections
- year of manufacture

4. User information.

Together with the transmitters ordered, the user will receive: User's Manual numbered DTR.APC...02 in the case of the APC–2000EEx or DTR.APR...02 in the case of the smart differential pressure transmitters with Appendix Ex, and also the Product Certificate.

5. Permitted input parameters (based on data from the KDB 04ATEX059 certificate, and certification documentation).

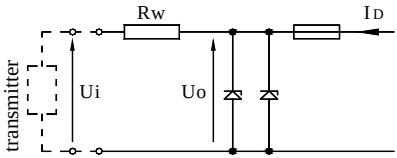
5.1. - for power supply with a linear characteristic

Supply parameters according to the certificate:

a) Ui=28V Ii=0,1A Pi=0,67W for Ta 60 C -T6 and for Ta 80 C -T5

b) Ui=28V Ii=0,1A Pi=0,53W for Ta 70 C -T6

Power supply with a "linear" characteristic may be e.g. a typical barrier with parameters Uo=28V Io=0.093A Rw=300 .



Example of practical provision of power supply for case a): use the barrier with the parameters given above

Fig.1. Power supply from a source with "linear" characteristic"".

5.2. – for power supply with a “trapezial” characteristic
Supply parameters according to the certificate:
a) Ui=22,5V Ii=0,1A for Ta 60 C and T6 and for Ta 80 C and T5,
b) Ui=22,5V Ii=0,1A Pi=0,53W for Ta=70 C and T6,

Example of power supply from a source with “trapezial” characteristic (see Fig. 2).

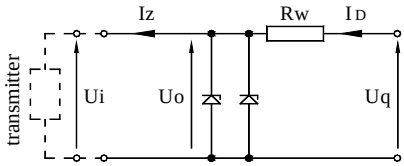


Fig. 2. Power supply from a source with “trapezial” characteristic”

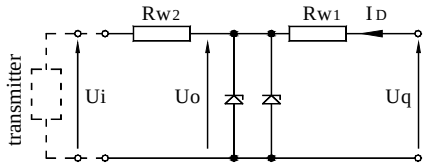


Fig. 3. Power supply from a source with “mixed” characteristic Rw = Rw1 + Rw2

Sources with “trapezial” or “mixed” characteristic often consist of seal power supplies (EEx version), which enable different voltages to be supplied.
When selecting or checking the input parameters, account should be taken of the short-circuit current (IZ) and the value Rw or Uq.
Example of practical provision of power supply from a source with “trapezial” power supply:
– supply the transmitter from a seal power supply or another source with voltage Ui 22,5V
and short-circuit current 0,1A for Ta 60 C and T6 and for Ta 80 C and T5

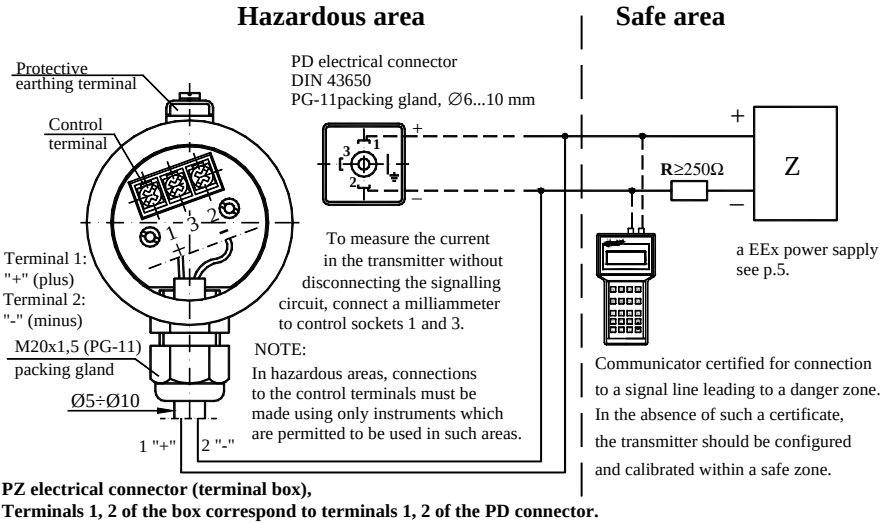
Recommended voltage Ui = 24V, Ii = 0,1A if Rw 67 for Ta=80 C and T5,

5.3. - for power supply with “rectangular” characteristic
a) Ui=28V Ii=0,03A Pi=0,67W for Ta 60 C -T6, for Ta 80 C -T5
b) Ui=28V Ii=0,03A Pi=0,53W for Ta 70 C -T6,

The supply of power from a source with a “rectangular” characteristic means that the voltage of the EEx power supply remains constant until current limitation activates.
The protection level of power supplies with a “rectangular” characteristic is normally “ib”.
The transmitter powered from such a supply is also a EEx device with protection level “ib”.
Example of practical provision of power supply for case a):
– use a stabilized power supply with Ui=24V with protection level „ib” and current limited to Ii=25mA.
This current limit ensures that the condition that the power Pi for case a), (Ii = 22 mA for case b).

5.4. Input inductance and capacity: Ci 40nF,
Li = 0,94mH for version with PZ
Li = 2mH for version with PD.

6. How to connect EEx transmitters: APC-2000EEx, APR-2000EEx, APR-2200EEx



PZ electrical connector (terminal box),
Terminals 1, 2 of the box correspond to terminals 1, 2 of the PD connector.

7. Basic requirements according to EN 50039 for type A and B leads used to connect the transmitter to the power supply and measurement circuit.

7.1. Thickness of insulation according to type of material, but not less than 0.2mm.
7.2. Insulation strength:
- $2U_N$ but not less than 500V AC for the wire;
- 500V AC between the cable screen and the connected wires;
- 1000V AC between two groups of wires, each of which contains half the connected wires of the cable.

7.3. Multiwire cable must not carry any circuit which is not a intrinsically safe circuit.
7.4. The cable must not carry circuits with a maximum voltage exceeding 60V.
7.5. The cables should be protected from damage, for example using channels, shielding pipes, cable racks, durable fastenings etc.

Note: Devices in the measurement loop of the transmitter should be connected in accordance with Intrinsic safety and explosion protection standards.

Note:It is not permitted to repair or otherwise interfere with the transmitter's electrical circuits in any way. Damage and possible repair may be assessed only by the manufacturer or another authorized party

1. INTRODUCTION

1.1. This manual is intended for users of **APR–2000**, **APR-2000/AL., APR–2200, APR-2200/AL, APR–2000G** smart differential pressure transmitters and **APR-2000/Y** smart level probes containing the data and guidelines necessary to understand the functioning of the transmitters and how to operate them.
It includes essential recommendations concerning installation and use, as well as emergency procedures.
Parameters and information given for APR... transmitters apply to the **APR–2000**, **APR-2000/AL, APR–2200, APR-2200/AL**, **APR–2000G** transmitters and **APR-2000/Y** probes.

1.2. Technical data for the diaphragm seals and for the **APR–2000**, **APR-2000/AL, APR–2200, APR-2200/AL** transmitters are contained in the catalogue cards “DIAPHRAGM SEALS”.

1.3. The transmitters comply with the requirements of EU directives as shown on the plate and with the relevant Declaration of Conformity.

1.4. Additional data on APR–2000EEx, APR–2000EExG, APR–2000EExY and APR–2200EEx transmitters in EEx versions covered by the EU-type test certificate number **KDB 04ATEX059** is contained in the appendix designated **DTR.APC.APR. Appendix Ex.01**.
During installation and use of the transmitters in EEx version, reference should be made to DTR.APC...02 in conjunction with Appendix Ex.

1.5. The APR–2000, APR-2000/AL, APR–2000EEx, APR-2000EEx/AL transmitters are also made in a version which complies with the PED pressure directive, meet the requirements for category IV, and then carry additional markings as in 4.3.

1.6. Parameters and information given for APR... transmitters apply to the APR–2000, APR-2000/AL, APR–2200, APR-2200/AL, APR–2000G, APR-2000/Y transmitters and to the corresponding anti-explosion versions APR–2000EEx, APR-2000EEx/AL, APR–2200EEx, APR-2200EEx/AL, APR–2000EExG, APR-2000EExY, as well as all variants with different types of electrical and process connections.

2. USER MATERIALS

Transmitters are delivered in single and/or multiple packs. A transmitter is delivered together with a “Product Certificate” which also serves as a guarantee card.
Each batch of transmitters also carries user’s manual in quantities agreed with the customer.

3. APPLICATIONS AND MAIN FEATURES

3.1. APR–2000, APR–2000/AL differential pressure transmitters are used to measure liquid levels in closed tanks, with static pressure of up to 16MPa, and to measure differential pressure across constrictions such as filters and orifices.
3.2. To measure a medium which contains suspensions or impurities, or is viscous, hot, corrosive etc., use an **APR–2000 or APR–2000/AL** with a single seal or **APR–2200, APR–2200/AL** transmitter with two seals, in accordance with the catalogue cards “DIAPHRAGM SEALS”.

3.3. APR–2000G transmitters are designed to measure absolute pressure, overpressure and differential pressure of non-reactive gases. Typical applications include the measurement of air blasts, chimney draughts, or pressure and overpressure in combustion chambers. The transmitter is constructed to withstand excess pressure of up to 100kPa.

3.4. The APR-2000/Y smart probes are designed to measure the level in pressure tanks in case of access to medium from top of tank.

3.5. APR... transmitters generate a 4...20mA output signal and a digital communication signal in a two-wire system**.** The use of smart electronics enables regulation of the zero point, the measurement range, damping, radical conversion characteristic and other functions using an Aplisens **KAP** communicator or from a PC using a Hart/RS232 converter and Aplisens “Raport-01” configuration software.

4. IDENTIFYING MARKS. ORDERING PROCEDURE

4.1. Every transmitter carries a rating plate containing at least the following information: CE mark, numbers of notified institutions and designations of certificates obtained, name of manufacturer, type, factory number, basic range, min. set range, static pressure limit, output signal, power supply voltage.
4.2. APR... Transmitters in version: ATEX Intrinsic safety and ATEX Flameproof approval have additional markings as described in DTR.APC.APR. Appendix Ex.01.

4.3. The rating plates of transmitters of type APR... in versions compliant with the PED pressure directive contain the notified unit number 0062 next to the CE mark, as well as the designations of certificates number:
CE-PED- H1D-APL 002-05-PL.

5. TECHNICAL DATA.

5.1. The APR–2000, APR-2000/AL without diaphragm seals, The APR–2000, APR-2000/AL with one diaphragm seal. Technical data.

5.1.1. Measurement ranges.

N	Basic range (FSO)	Minimum set range	Ability to shift the start of the range	Overpressure limit	Static pressure limit
1	0...1,6 MPa	160 kPa	0...1440 kPa	16 MPa (4 MPa for P-type connector)	
2	0...200 kPa	20 kPa	0..180 kPa		
3	0...100 kPa	7 kPa	0...93 kPa		
4	0...16 kPa	1 kPa	0...15 kPa		
5	0...4 kPa	0,4 kPa	0...3,6 kPa	10 MPa	
6*****	-50...+50 kPa	10 kPa	-50...+40 kPa	4MPa	
Other ranges available upon agreement.					

***** - recommended for measurement of levels with a direct mount diaphragm seal and a filled (or empty) impulse line.

5.1.2. Metrological parameters.

Basic range (FSO)	0...1,6 MPa, 0...200 kPa 0...100 kPa, -50...+50 kPa	0...16 kPa 0...4 kPa
Accuracy	0,1% (FSO)	0,2 % (FSO)
Accuracy for the minimum set range	0,3 % (FSO)	0,5 % (FSO)
Thermal error	0,08 % (FSO)/10%	0,15 % (FSO)/10 C
Thermal error for the whole thermal compensation range	0,3 % (FSO)	0,5 % (FSO)
Zero shift error for static pressure*	0,08 % (FSO)/1 MPa 0,16 % (FSO)/1 MPa (for range 0...4 kPa)	
Error related to changes of Usup.	0,002 % (FSO)/V	
Cut-off on radical characteristic curve	cut-off of up to10% of flow.	

This error can be eliminated by zeroing the transmitter in static pressure conditions with zero differential pressure.

5.1.3. APR... Electrical parameters

Power supply 10,5 ÷ 30V DC, nominal 24V DC, [EEx-12 ÷ 28V]
APR–2000/AL, APR–2200/AL without displays illumination 10,5 ÷ 30 V DC
APR–2000/AL, APR–2200/AL with displays illumination 13,5 ÷ 30 V DC
Output signal 4÷20mA or inverse 20÷4mA set from communicator
Communication Communication takes place via a 4÷20mA signal using specialized Aplisens equipment, (see. 10.2.4).

Resistance required for communication 250÷1100

Load resistance $R_{Lmax}[\ ] = \frac{Usup[V]-10,5V^{*)}}{0,02A} \times 0,85$

Load resistance $U_{min}[V] = \frac{R_L[\ ] \times 0,02A}{0,85} + 10,5V^{*)}$

Damping added electronically 0...30s
Voltage for insulation testing 500 VAC lub 750 VDC, see. .9.5.
Excess voltage protection see..9.5.

*) 13,5 for APR–2000/AL, APR–2200/AL with displays illumination

5.1.4. APR–2000. Permitted Environmental Conditions

Ambient temperature limit -25°C ÷ 85°C
also applies APR-2000/AL with display
Process temperature limit -25°C ÷ 95°C – (direct measurement);
Above 95°C only through a remote diaphragm seals or a impulse line

Process temperature limit for APR-2000, APR–2000/AL with one direct diaphragm seal	Permitted temperatures and medium types are dependent on the type of seal fitted
Thermal compensation range	-25º ÷ 80ºC, (-5º ÷ 65ºC for range 0...4 kPa)
Relative humidity	0% ÷ 90%
Vibration during operation	not recommended
Exposure to direct sunlight	not recommended

5.1.5. APR... Construction Materials

APR....Diaphragm seal and sensing module		Stainless steel 316L (00H17N14M2)
Liquid filling the interior the sensing module		Silicone oil, chemically inactive liquid for oxygen of versions
APR–2000, APR–2200	C-type vented covers	Stainless steel 316L (00H17N14M2)
	Casing for electronic parts	Steel pipe, 304 (0H18N9)
	PZ-type terminal box	Thick steel pipe, 304 (0H18N9)
	Angular connector, PD-type	itamid

APR–2000/AL, APR–2200/AL. Casing a high-pressure cast of aluminium alloy, varnished (Not applicable to APR-2000G)

5.1.6. APR-2000, APR-2000/AL Pressure Connectors

APR-2000, APR-2000/AL without diaphragm seal – P-type connector with M20x1.5 thread – see diagram 3 and 4 or C-type connector to mount together with a valve manifold see diagram 5, 14.
APR-2000, APR-2000/AL with single direct diaphragm seal – as in the example (figure 6) or with other diaphragm seals in accordance with catalogue cards “DIAPHRAGM SEALS”.

5.1.7. APR... Electrical Connectors and Ingress Protection Rating of Case

I**P65** – for APR-2000, APR-2200, APR-2000/Y transmitters with PD-type connector;
IP65 – for APR-2000, APR-2200, APR-2000/Y transmitters with PZ-type terminal box;
IP65 – for APR-2000/AL, APR-2200/AL transmitters.

5.2. APR-2200, APR-2200/AL (with two diagram seals). Technical Data

5.2.1. APR-2200, APR-2200/AL. Measurement ranges

Basic range (FSO)	Minimum range	Vertical spacing of diaphragm seals.	Maximum configurable range dependent on the actual vertical spacing of diaphragm seals. (m)	Static pressure limit
-10...10 kPa	0,1 mH2O	1,2m	[1+(vertical spacing of seals 0,94)]m H2O	4MPa
-50...50 kPa	0.5 mH2O	6m	[5+(vertical spacing of seals 1,04)]m H2O	4MPa
-130...200 kPa	1,5 mH2O	12m	[20+(vertical spacing of seals 1,04)]m H2O	4MPa
-130...1600 kPa	100 kPa	12m	1600kPa	4MPa

5.2.2 APR–2200, APR-2200/AL. Metrological parameters

Basic range (FSO)	-50...50, -130...200 kPa, -130...1600 kPa	-10...10 kPa
Accuracy	0,2 % (FSO)	0,2 % (FSO)
Accuracy for the minimum range	0,4 % (FSO)	0,5 % (FSO)
Thermal error	0,1 % (FSO) / 10 C	0,15 % (FSO)/10 C
Thermal error for the whole thermal compensation range	0,4 % (FSO)	0,5 % (FSO)
Zero shift error for static pressure	0,08 % (FSO) / 1MPa	
Error related to changes of Usup.	0,002 % (FSO) / V	
Additional errors due to effects of sealing	see catalogue cards “DIAPHRAGM SEALS”.	

NOTE: The maximum vertical diaphragm seal spacing shown in the table applies to level measurement, ensuring that it is possible to set the zero point of the transmitter when the tank is empty. For measurements of density or phase boundaries (in the sugar and chemical industries and in refineries) the vertical spacing of the diaphragm seals can be larger.

5.2.3. APR–2200, APR-2200/AL. Electrical Parameters: see p. 5.1.3.

5.2.4. APR–2200, APR-2200/AL. Permitted Environmental Conditions.

Vibration during operation: vibration of the transmitter is not recommended, but vibration is permissible at the place where the seals are installed. Permitted temperature and corrosive properties of medium are dependent on the diaphragm seal type (see catalogue cards “DIAPHRAGM SEALS”).
Other parameters as given in 5.1.4.

5.2.5. APR–2200, APR-2200/AL. Construction Materials see 5.1.5, materials for diaphragm seals see catalogue cards “DIAPHRAGM SEALS”.

5.2.6. APR–2200, APR-2200/AL. Pressure Connectors, **Remote Diaphragm Seals** - see catalogue cards “DIAPHRAGM SEALS”.

5.2.7. APR–2200, APR-2200/AL Electrical Connectors and Ingress Protection Rating of Case– see.5.1.7..

5.3. APR-2000G. Technical Data

5.3.1. APR-2000G. Measurement ranges:

N	Basic range (FSO)	Minimum set range	Ability to shift the start of the range	Overpressure limit	Static pressure limit
1	0...2500 Pa	100 Pa	0...2400 Pa	100 kPa	100 kPa
2	-250...250 Pa	20 Pa	-250...230 Pa		
3	-700...700 Pa	100 Pa	-700...600 Pa		
4	-2500...2500 Pa	500 Pa	-2500...2000 Pa		
5	-10...10 kPa	2 kPa	-10...8 kPa		

5.3.2. APR–2000G. Metrological parameters

Basic range	0...2500 Pa	-250...250 Pa	-700...700 Pa	-2500...2500 Pa	-10...10 kPa
Accuracy	0,16 %	0,4 %	0,2 %	0,2 %	0,2 %
Set range	0...250 Pa	-50...50 Pa	-50...50 Pa	-250...250 Pa	-1...1kPa
Accuracy	1 %	1%	1,6 %	1 %	1 %
Thermal error	0,1 % (FSO) / 10 C max 0,4 % (FSO) for the whole thermal compensation range				
Error related to changes of Usup.	0,002 % (FSO) / 1V				

5.3.3. APR-2000G. APR– 2000G. Electrical Parameters: see 5.1.3

5.3.4. APR– 2000G. Permitted Environmental Conditions:

Ambient temperature limits	- 25 85 C
Thermal compensation range	- 10 70 C
Relative humidity	- 0% ÷ 90%
Vibration during operation	- not recommended
Exposure to direct sunlight	- not recommended

5.3.5. APR– 2000G. Construction Materials

Adapter M20x1,.5/ 6x1	brass
Valve manifold	Stainless steel 316L
Adapter for valve manifold	Stainless steel 316L
Connector ¼ NPT	brass, 316L or St3S(galvanized)

(Other materials as given in 5.1.5 for APR..., APR-2000, APR-2200).

5.3.6.. APR– 2000G. Pressure Connectors

- The terminals fit ø 6x1 plastic tubes,
- adapter to a valve manifold or ¼ NPT connector- see. 8.6. and fig.11)

5.3.7. APR– 2000G. Electrical Connectors and Ingress Protection Rating of Case.

I**P65** – for APR– 2000G transmitters with **PD**-and **PZ** type connector;

5.4. APR– 2000/Y. Technical Data

5.4.1. APR– 2000/Y. Measurement ranges

N	1	2
Basic range	0... –6000 mmH_2O	0... –1600 mmH_2O
Minimum set range	600 mmH_2O	160 mmH_2O
Static pressure limit	4 MPa	

5.4.2. APR– 2000/Y. Metrological parameters.

Accuracy for full range	0,16 %	0,2 %
Accuracy for minimum range	0,5 %	0,6 %
Error due to ambient teperature changes	0,4 % (FSO) for temperatures –25...+80 C	
Zero shift error for static pressure *	0,08 % (FSO) / 1MPa	0,1 % (FSO) / 1MPa

* This error can be eliminated by zeroing the transmitter in static pressure conditions with zero differential pressure.

Range of medium densities – up to 1,1 g/cm^3 – (standard version)

– over 1,1 g/cm^3 – (special version by arrangement with APLISENS)

5.4.3. APR– 2000/Y. Electrical Parameters: see .5.1.3.

5.4.4. APR– 2000/Y. Permitted Environmental Conditions: see .5.1.4

5.4.5. APR– 2000/Y. Construction Materials: see fig.12.

Other materials as given in 5.1.5. for APR..., APR-2000, APR-2200

Other parameters as given for APR–2000, APR–2000/AL.

6. CONSTRUCTION, PRESSURE CONNECTORS, ELECTRICAL CONNECTORS

6.1. Measurement Principles, Electronic System

APR... electronic differential pressure transmitters work by converting changes in the resistance of a piezoresistant bridge, which are proportional to the pressure difference being measured, into a standard current signal.

The active sensing element is a silicon diaphragm with in-diffused piezoresistors, separated from the medium by a sealing diaphragm and manometric fluid.

The electronic system digitally processes the measurement signal and generates output signals: an analogue 4÷20 mA signal and a digital communication signal.

A block diagram of the transmitter is presented in Figure 1. In the input circuit two analogue signals are formed, reflecting the measured pressure and the temperature of the sensing module**.** These signals are digitalized and input to a microprocessor which controls the transmitter's operation. Using data input during the production process adjusts for thermal errors and carries out linearization.

After processing, the digital signal is again converted into an analogue 4÷20mA current signal, with a superimposed digital communication signal.

For communication with the transmitter via the signal line a special Aplisens KAP communicator, or a computer meeting the requirements given in 10.2.4, is used.

The transmitter's input point is fitted with a noise filter and elements protecting against excess voltage.

6.2. Construction .

The main components of the smart differential pressure transmitter are the sensing module, in which the pressure signal is converted into a non-uniformized signal, and the electronic system, which converts the signal from the sensing module into a 4...20mA output signal and produces a digital communication signal.

6.2.1. In the **APR–2000** and **APR–2000/AL** transmitters, the sensing module has two P-type connectors (Figure 3), or C-type connecting covers for installation on a valve manifold (Figures 5, 14).

The **APR–2000** and **APR–2000/AL** transmitters may be fitted with an single direct diaphragm seal, mounted on the "+" pressure input of the sensing module, while the "–" input is a ¼NPT socket (Figure 6).

6.2.2. The **APR–2200** and **APR–2200/AL** transmitter is fitted with two diaphragm seals and can be produced in two versions: - with one direct diaphragm seal and one remote diaphragm seal (Figure 8);

- with two remote diaphragm seals (Figure 7).

6.2.3. The diaphragm seal transmits the pressure obtained from the medium. The pressure is transmitted via a manometric fluid which fills the space between the diaphragm of the seal and the diaphragm of the sensing module. In the case of remote diaphragm seals, pressure is transmitted via a capillary linking the transmitter's sensing module to the diaphragm seal.

The construction of the seals depends on the medium properties and operating conditions for which they are intended.

Technical data relating to the diaphragm seals' dimensions and operating conditions can be found in catalogue cards "DIAPHRAGM SEALS".

6.2.4. In the case of the **APR-2000G** transmitter, the sensing module is located inside the casing. It is designed for the measurement of low pressures of non-aggressive gases, with a permitted overpressure of 100kPa. The basic (economy) version of this transmitter has terminals fitting ø6x1 elastic tubes, while the industrial version has adapters as shown in Figure 11.

6.2.5. APR-2000/Y smart level probe is equipped in diaphragm seal and flange to fixing on tank.

6.3. Casing, Electrical Connections

6.3.1. In **APR-...** transmitters with PD-type connectors, the base of the connector is mounted on the bottom of the casing (made of ø51 pipe) and sealed with a rubber washer.
The base of the connector and the casing are connected detachably to the active sensing module and are fastened with two slotted nuts.

6.3.2. Transmitters with a **PZ** type connector have a terminal box connected permanently to the casing.
The box is closed with a serrated lid (in EEx-version with a smooth rounded lid) and has an external earthing terminal. Mounted on the inside is a terminal block equipped with additional control terminals, galvanically connected to terminals 1, 2 and 3. By connecting a milliammeter to sockets 1 and 3, a local measurement can be made of the current in the transmitter without the need to disconnect the measuring circuit. (see 9.5).

6.3.3. The **APC**–**2000/AL** transmitters have a casing made from high-pressure cast of aluminium alloy, giving o IP-65 protection. The design of the casing enables the use of a local display, rotation of the display by 90 , rotation of the casing by 0-355 relative to the sensor, and a choice of cable direction.

Configuration of the transmitter involving zero-setting and setting of the start and end-points of the range by applied pressure can by carried out using magnetized elements applied at marked points on the casing.
For electrical connection of the transmitter a row the terminals is provided, which also enable a communicator to be connected and the output current to be measured without breaking the circuit.
Two possible versions of the transmitter are available for taking measurements in hazardous areas: ATEX Intrinsic safety II 1/2G EEx ia IIC T5 or ATEX Flameproof approval EEd IIC T5.

7. PLACE OF INSTALLATION OF TRANSMITTERS

7.1. Introduction

7.1.1. The smart differential pressure transmitter can be installed both indoors and outdoors. It is recommended that transmitters intended for outdoor use be placed in a box or under cover. There is no need for a cover in the case of transmitters with **PZ** type connectors or **APR–2000/AL.**

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7.1.2. The place of installation should be chosen in such a way as to allow access to the device and to protect it from mechanical damage. In planning the installation of the transmitter and configuration of the impulse lines, attention should be paid to the following requirements:

- The impulse lines should be as short as possible, with a sufficiently large cross-section, and free of sharp bends, in order to prevent blockages;
- Where the medium is a gas, the transmitters should be installed above the measuring point, so that condensation flows down towards the site of the pressure measurement; where the medium is a liquid or where a protective liquid is used, the transmitters should be installed below the place where the pressure measurement is taken;
- The impulse lines should be inclined at a gradient of at least 10cm/m;
- The levels of filling liquid in the impulse lines should be equal or kept constant difference,
- The configuration of the impulse lines and the valve connection system should be chosen with regard to the measurement conditions and to requirements such as the need to reset the transmitters in position and the need for access to the impulse lines during water or gas removal and flushing.

7.1.3. In places where there is a danger of being struck by heavy objects, appropriate safety precautions should be taken, or else installation of the transmitters in such locations should be avoided.

7.1.4. Attention should also be paid to possible installation faults which may lead to measurement errors, such as connections which are not tight, sediment blockage in lines which are too narrow, gas bubbles in a liquid line or liquid column in a gas line etc.

7.2. Low Ambient Temperature.

When the solidification point of the liquid whose pressure is being measured is greater than the ambient temperature, steps should be taken to protect the measurement apparatus from freezing.
This is particularly important in the case open-air installations.
Protection is obtained by filling the apparatus with a mixture of ethylene glycol and water, or another liquid whose solidification point does not exceed the ambient temperature. Thermal insulation can protect the casing of the transmitter and lines only from brief exposure to low temperatures. Where the temperature is very low, the transmitter and impulse lines are should be heated.

7.3. High Medium Temperature.

The **APR-2000** and **APR-2000/AL** transmitters may be used to measure media with temperatures of up to 95°C. To protect the sensing module from temperatures in excess of 95ºC, suitably long impulse lines are used to disperse the heat and to lower the temperature of the module. Where it is not possible to use impulse lines of the required length, **APR-2200 or APR-2200/AL** transmitters with remote diaphragm seals should be used (see catalogue cards "DIAPHRAGM SEALS").

7.4. Mechanical Vibration, Corrosive Media.

7.4.1. The transmitter should be installed in a place which is free of vibrations. If vibrations are carried to the transmitter via the impulse lines, use should be made of elastic lines or a **APR-2200 or APR-2000/AL** transmitter with a remote diaphragm seal.
7.4.2. Transmitters should not be installed in places where the diaphragm, made of 316L steel (00H17N14M2), would be subject to corrosion by the medium being measured. Where such danger exists, use should be made of pressure transmitters with diaphragm seals designed for the measurement of reactive media (see catalogue cards "DIAPHRAGM SEALS").

8. INSTALLATION AND MECHANICAL CONNECTIONS

8.1. The **APR 2000 and APR-2000/AL** transmitters can be mounted directly on rigid impulse lines.
To connect the basic versions of transmitters, with two M20 x 1.5 stubs (P-type connector), one can use (for example) straight connecting elements with nuts (type C).
If elastic impulse lines are used for connection purposes, the transmitter should be additionally fastened to a pipe, panel or supporting construction.

8.2. The **APR-...** transmitters can operate in any position. When installed on an object with a high-temperature medium, it is advantageous to mount the transmitter in a horizontal position with the packing gland pointing downwards or to the side, in such a way that the transmitter is kept away from the stream of rising hot air.
When the measurement range is small, the reading can be affected by the position of the transmitter and by the configuration of the impulse lines and the way in which they are filled with liquid. This error can be corrected using the zero-setting function.

8.3. The **APR-2000** transmitters and **APR-2200** transmitters with remote diaphragm seals for 1600kPa range can be installed using the M6x7 opening or using the Assembly Set produced by APLISENS (figure 10) to ø25 pipe or to a wall.

8.4. The **APR-2000** and **APR-2000/AL** for range n 2...6 (see 5.1.1.) can be installed using the Assembly Set (figure.9.) on a ø25 pipe or on a flat surface using an angle bracket.

8.5. The **APR-2000** and **APR-2000/AL** with connecting cover (C-type connector) (figure.5, 14) are designed for installation on 3-valve or 5-valve manifolds (figure 16), to a 2" pipe or to a flat surface using an fastener C-2 (figure15).

8.6. APR-2000G. Installation and Connections

8.6.1. The "economy" version of the **APR-2000G** transmitter can be mounted on a wall, panel or other stable construction, using a clamp with Ø9 holes (Figure 11).
The transmitter is fitted with stubs with a terminal which fits a Ø 6x1 elastic impulse tube.
When the impulse is transmitted via a metal terminal with M20 x 1.5 opening, an adapter is used between the M20 x 1.5 thread and the Ø6x1 terminal. Install the transmitter in a vertical position.
Where there is a significant difference between the height at which the transmitter is mounted and the height of the impulse source, particularly if the measurement range is small, the reading may fluctuate depending on the temperature difference between the impulse lines.
This effect can be reduced by ensuring that the lines run side by side.

8.6.2. The **APR-2000G** transmitter can also be fitted with an adapter (Figure 11) creating a C-type connector, designed for installation on a 3-valve or 5-valve manifold. Aplisens can also supply transmitters ready mounted on valves.

8.7. The **APR-2000/Y** level probes installed in places where liquid levels are measured in closed tanks,with access to medium from top of tank see figure 12 and 10.2.6.
Install the probe in a vertical position.

NOTE: Pressure should be applied only after making sure that the measurement range of the installed transmitter corresponds to the value of the pressure being measured, the seals have been properly chosen and fitted, and the connections have been properly made and tightened.
When detaching the transmitter, cut it off from process pressure or bring the pressure to the level of atmospheric pressure, taking particular precautions and care in the case of highly reactive, caustic, explosive or otherwise dangerous media.

8.8. In selecting assembly components, it may be helpful to consult information on Aplisens connection elements, reduction elements, sockets, valves, reduction clamps and signal tubes.
Information on this subject can be found on the catalogue page “FITTING ACCESSORIES”.

9. ELECTRICAL CONNECTION

9.1. Signal lines

It is recommended that twisted pair cabling be used for the signal lines. If the transmitter and signal line are subject to a large amount of electromagnetic interference, then screened twisted pair cable should be used. The signal wires should not run alongside network power supply cables or near to large electrically-powered devices. The devices used together with the transmitters should be resistant to electromagnetic interference from the transmission line in accordance with compatibility requirements.
It is also beneficial to use anti-interference filters on the primary side of the transformers, the power supplies used for the transmitters and apparatus used in conjunction with them.

9.2. The transmitters with PD-connectors

The **APR...** transmitters with **PD** type connectors are to be connected as shown in figure 2b.
To make the connections, remove the terminal block from the contact pins together with its cover.
Then remove the block from its cover, levering it off with the end of a screwdriver inserted into the slot provided for this purpose. Connect the wires to the block. Where the isolation of the wires in the packing gland is ineffective (for example, when single wires are used) the opening of the gland should be carefully sealed with an elastic sealing compound to obtain IP65 ingress protection. It is useful to form the segment of the signal wire leading to the PG-11 packing gland into a protective loop to prevent condensation from running down in the direction of the gland.

9.3. The transmitters with PZ-connectors.

The transmitters with **PZ**-type connectors should be connected by linking the signal wires to a terminal block, as shown in figure 2a. Carefully screw in the cover and cork of the packing gland, making sure that the wire is tightly packed. Where necessary, the packing gland should be further sealed as described in 9.1.

9.4. The APR-2000/AL and APR-2200/AL transmitters

The **APR-2000/AL** and **APR-2200/AL** transmitters are to be connected as shown in figure 2c.

Note: : In **APR-2000/AL** and **APR-2200/AL** transmitters, a 250 resistor is permanently fitted in series in the transmitter’s current circuit. It can be shorted using the jumper on the connection terminals between “SIGNAL –” and “TEST – ”.

9.5. Protection from excess voltage

9.5.1. The transmitters may be in danger from excess voltage caused by connection faults or atmospheric electrical discharge.
Protection from excess voltage between the wires of the transmission line is provided by transil diodes installed in all types of transmitter (see the table, column 2).

9.5.2. In order to protect against excess voltage between the transmission line and the casing or earth (not prevented by the diodes connected between the transmission wires), additional protection is provided in the form of plasma surge arresters or transil diodes (see the table, column 3).
In the case of unprotected transmitters, external protective devices may be used, e.g. the UZ-2 system produced by Aplisens, or others. When the transmission lines are long, it is advantageous to use one protective device near the transmitter (or inside it), and another near entry points to other devices used in conjunction with it.

Devices used to protect transmitters:

Type of transmitter (probe)	Protection between wires (transil diodes) – permitted voltage	Protection between wires and earth and/or casing – type of protection, permitted voltage.
APR -...	30V DC	Plasma surge arresters - 100V DC

9.5.3. When excess voltage protection is used, the voltage in the protective elements must not exceed the maximum permitted values given in columns 2 and 3 of the table.
Such protection is not used in EEx versions of transmitters.

Note: The insulation test voltages (500V AC or 750V DC) given in 5.1.3 refer to transmitters without the protective devices described in 9.5.2.

9.6. Earthing

The methods of earthing the transmitters are shown in figure 2 and 14.
If the transmitter has, via a connector, a reliable galvanic connection with a properly earthed metal pipe or tank, additional earthing is not necessary.

10. SETTING AND REGULATION

APR... transmitters are factory calibrated to the range stated in the order or to the basic range.
After installation, the transmitter's zero-point may drift and require adjustment. This applies particularly in cases where the measurement range is small, where the impulse lines are filled with a separating liquid or where APR-2200 or APR-2200/AL transmitters are used with remote diaphragm seals.

10.1. Transmitter Range, Definitions

10.1.1. The maximum range of absolute or differential pressure which the transmitter can measure is called the **"basic range"** (for specifications of basic ranges see 5.1.1, 5.2.1 and 5.3.1).
The width of the basic range is the difference between the upper and lower limits of the basic range.
The internal characteristic conversion curve for the basic range is coded in the transmitter's memory.
This is the reference curve used when making any adjustments which affect the transmitter's output signal.

10.1.2. When the transmitter is in use the term **"set range"** is used. The set range is the range whose lower end-point corresponds to an output current of 4mA and whose upper end-point corresponds to a current of 20mA (or 20mA and 4mA respectively when the conversion curve is inverted).
The set range may cover the whole of the basic range or only a part of it.
The width of the set range is the difference between its upper and lower end-points.
The transmitter may be set to any range within the basic range of pressure values, subject to the restrictions set out in the table in 5.1.1, 5.2.1 and 5.3.1.

10.2. Configuration and Calibration

10.2.1. The transmitter has features which enable metrological and identification parameters to be set and altered.
The configurable metrological parameters affecting the transmitter's output current include the following:

a) unit in which the measured pressure is expressed on the display
b) upper end-point of the set range
c) lower end-point of the set range
d) time constant
e) type of characteristic curve: linear or radical

Parameters of an informational nature which cannot be altered include the following:

f) upper limit of the maximum range
g) lower limit of the maximum range
h) minimum range

10.2.2. Other identification parameters, not affecting the output signal, include: device address, device type code, factory identification code, factory device code, number of preambles (3÷20), UCS, TSD, program version, electronics version, flags, factory number, label tag, description tag, date tag, message, record number, sensing module number.
The process of setting the parameters listed in 10.2.1 and 10.2.2 is called **"Configuration".**

10.2.3. . It is possible to adjust the transmitter's zero point, for example to compensate for deviation resulting from a change in position of installation.
The transmitter may also be **calibrated**, by taking readings with the input pressure controlled using a standard device. This process and zero-point adjustment are called **"Calibration".**

10.2.4. Configuration and Calibration of the transmitter are carried out using an Aplisens KAP communicator, certain Hart communicators or a PC with Hart/RS232 converter and Aplisens Raport-01 software.
A description of the functions of the KAP communicator is contained in the KAP Communicator Operating Manual, and information on the Hart/RS232 converter can be found on the Hart/RS232/01 Converter information sheet.

10.2.5. APR-2000/AL and **APR-2200/AL** transmitters may also be configured with an applied pressure and calibrated for zero pressure just using magnetized elements applied to marked points on the casing, i.e. without using a communicator (see figure 13).
The configuration procedure is as follows.
First unscrew the cover of the local display and move switch no. 2 to the OFF position.
The same applies to the version with no local display, which also has a similar switch under the front cover.
This unblocks the device so as to allow configuration to take place.
Apply the pressure corresponding to the starting point of the set range, then bring the magnetic elements simultaneously to points A and B, and hold them for at least 5 seconds in the position shown in figure 13.
To set the end-point of the range, apply the appropriate pressure, bring the magnetic element to point A and hold it for at least 5 seconds in the position shown in figure 13.
To calibrate for zero pressure, bring the magnetic element to point B only and hold for at least 5 seconds.
After completing the configuration, move switch no. 2 to the ON position.

NOTE: **APR-2000/AL** and **APR-2200/AL** transmitters may also be programmatically blocked to prevent modification of settings using magnetic elements.

This can be done using the KAP-02 communicator or the RAPORT 01 program (version 3.14 or higher).
Therefore if it is found to be impossible to carry out the procedure of resetting using an applied pressure and magnetic elements, the transmitter must also be unblocked programmatically.

10.2.6. APR-2000/AL and **APR-2200/AL** transmitters with local display sometimes require changes relating to the display mode.
The following operations can be performed using the KAP-02 communicator:

- change of decimal point position (SEPARATRIX);
- selection of displayed process variable (PV) from the following options: pressure, output current, % of width of output range, or a special user-defined process variable;
- programmatic blocking to prevent modification of settings using applied pressure (BLOCKING).

Information on how to perform these operations can be found in the instructions for the KAP-02 communicator.

The RAPORT-01 program (version 3.14 or higher) can be used to perform the same display-configuration operations as the communicator, but also offers the following additional functions:

- reversal of display mode;
- switching off the display;
- rotation of readings by 180 ;
- display test;
- contrast regulation;
- free user-definition of the units and range of readings.

10.2.7. If the transmitter with display is to be used in a rotated position, the position of the display can be adjusted accordingly.
To do this, unscrew the front cover and the screws holding the display unit, take the unit out and place it in the desired position, and then replace the screws and the front cover. Finally, if necessary, reverse the display mode using the RAPORT-01 program (version 3.14 or higher).

NOTE: The procedure for rotating the display mode involves an automatic reset of the transmitter (current change).
It is therefore recommended that this operation be carried out outside the process circuit or that the regulation method be previously set to manual control.

10.2.8. Illumination of the display can be switched on or off.
This is done using switch no. 1, with the front cover removed.
The ON position means that illumination is turned off.

NOTE: As the display illumination components are connected in series in the current circuit, an additional drop of approximately 3V DC can be expected at the transmitter's signal terminals.

10.2.9. Configuration of the APR-2200 and APR-2200/AL transmitters to measure the level, density of liquid and phase boundary

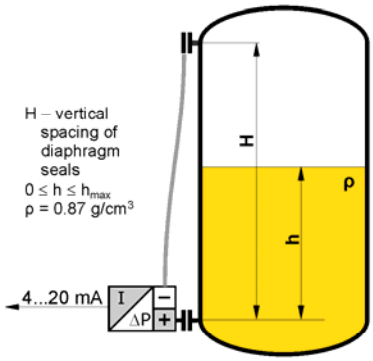
To simplify the mathematical operations we introduce the density coefficient of the medium **Xρ**.

$$X\rho = \frac{\rho_{medium}\,[g/cm^3]}{\rho_{water\ at\ 4^\circ C}\,[g/cm^3]}$$

Since the density of water at 4°C is 1 g/cm^3, the **density coefficient Xρ is numerically equal to the density of the medium expressed in g/cm^3**. To determine the hydrostatic pressure of a column of liquid in mm H_2O, it is sufficient to multiply the height of the column h [mm] by the density coefficient of the liquid Xρ. Since it is easy to determine the hydrostatic pressure in mm H_2O and the transmitter can be configured in those units, in the descriptions of measurement methods given below we will make use of pressures expressed in mm H_2O and the density coefficient Xρ.

Configuration of the APR-2200 transmitter to measure the level of liquid in a tank

The measurement task:
To convert a variation in the level of a liquid with density ρ = 0.87 g/cm^3 between 0 and h_{max} to a variation in the output signal from 4 to 20 mA.



1. Install the transmitter in its working position on an empty tank.
2. Make the electrical connections of the transmitter, providing for the ability to use HART communication.
3. Connect the KAP-01 communicator, identify the transmitter and select the "configuration" function.
4. On the configuration menu select the "Reranging" procedure.
5. On the "Reranging" menu:
   a) change the units of measurement to mm H_2O at 4°C;
   b) enter the values for the start (Xρ × h_{min} [mm]) and end (Xρ × h_{max} [mm]) of the measurement range, namely 0 and (0.87 h_{max} [mm]) respectively;
   c) to compensate for the hydrostatic pressure of the manometric fluid, the start of the measurement range should be set using regulated pressure; when subject to the action of only the manometric fluid (empty tank) the transmitter will shift the start and end-points of the range, compensating for the value of that pressure.

When the transmitter has been configured in this way it is ready to be used to carry out the given measurement task.

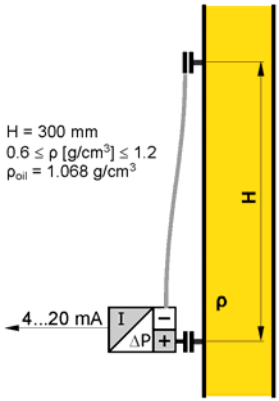
If it is not possible to empty the tank to configure the transmitter, the hydrostatic pressure of the manometric fluid should be calculated by multiplying the vertical spacing of the diaphragm seals by the density coefficient of the oil in the capillaries. This pressure should be taken into account when entering the values for the start and end of the range:

Start [mm H_2O] = –H [mm] × $X\rho_{oil}$

End [mm H_2O] =
= h_{max} [mm] × $X\rho_{measured\ liquid}$ – H [mm] × $X\rho_{oil}$

ρ_{oil} for DC-550 oil is equal to 1.068 g/cm^3
ρ_{oil} for AK-20 oil is equal to 0.945 g/cm^3

Configuration of the APR-2200 transmitter to measure density of liquids



The measurement task:
To convert a variation in liquid density from ρ_{min} = 0.6 g/cm^3 to ρ_{max} = 1.2 g/cm^3 to a variation in the output signal from 4 to 20 mA, with the vertical spacing of the diaphragm seals equal to H = 3000 mm. The sealing system is filled with DC-550 oil with density ρ_{oil} = 1.068 g/cm^3.

1. Calculate the value of the start of the range as follows:
   $H_{[mm]} \times (X\rho_{min} - X\rho_{oil})$ =
   = 3000 × (0.6 – 1.068) = –1404 [mm H_2O]
2. Calculate the value of the end of the range as follows:
   $H_{[mm]} \times (X\rho_{max} - X\rho_{oil})$ =
   = 3000 × (1.2 – 1.068) = 396 [mm H_2O]
3. Set the zero point of the transmitter with the diaphragm seals positioned at the same level.
4. Install the transmitter in its working position.
5. Make the electrical connections to the transmitter, providing for the possibility of using HART communication.

6. Connect the KAP-01 communicator, identify the transmitter and select the "configuration" function.
7. On the configuration menu select "Reranging" procedure.
8. On the "Reranging" menu:
   a) change the measurement units to mm H_2O at 4°C;
   b) enter the calculated values for the start (–1404) and end (396) of the range.

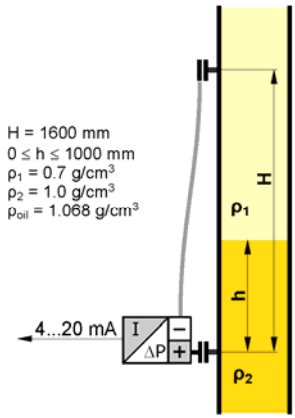
When the transmitter has been configured in this way it is ready to be used to carry out the given measurement task.

Note: If it is possible to fill the space between the seals with a liquid whose density corresponds to the start of the measurement range, the start of the range of the transmitter can be set using regulated pressure.

Measurement of phase boundary

The height of the phase boundary of liquids of different densities is determined by measuring the average density of the medium between the seals.

Example:
Calculate the measurement range start and end points for an APR-2200 transmitter configured to measure phase boundary height in the range 0–1000 mm between liquids of density $\rho_1 = 0.7$ g/cm^3 and $\rho_2 = 1.0$ g/cm^3, where the vertical spacing of the seals H = 1600 mm. The sealing system uses DC-550 oil with a density of 1.068 g/cm^3.



To determine the start of the measurement range, calculate the pressure difference at the transmitter when the tank is filled with the lighter liquid only:

1600 [mm] × (0.7 – 1.068) = –588.8 [mm H_2O]

To determine the end-point of the range, add the increase in pressure resulting from the appearance of a 1 metre column of the heavier liquid:

–588.8 [mm H_2O] + (1.0 – 0.7) × 1000 [mm] =
= –288.8 [mm H_2O]

Additional remarks

The settings of the transmitter can be adjusted with reference to laboratory results from density measurements carried out on samples of the liquid being measured. This is most often necessary when the measurement takes place in a pipeline segment where the flow velocity of the measured liquid reaches several m/s.

Increasing the vertical spacing of the diaphragm seals widens the range and often improves measurement accuracy.

In planning the spacing of the diaphragm seals, ensure that the pressure difference at the transmitter lies within the basic range.

The maximum vertical spacing of the diaphragm seals (H) depends on the transmitter's basic range and the boundary values for the density of the measured liquid (ρ_{min}, ρ_{max}).

If $\rho_{min} < \rho_{oil} < \rho_{max}$, the seal spacing H should satisfy the following conditions:

$$H\,[\text{mm}] \le \frac{\text{lower boundary of range [mm } H_2O]}{X\rho_{min} - X\rho_{oil}}$$

$$H\,[\text{mm}] \le \frac{\text{upper boundary of range [mm } H_2O]}{X\rho_{max} - X\rho_{oil}}$$

Example:
Determine the maximum vertical spacing of the seals for the **APR-2200 / -10...10 kPa** transmitter when measuring the density of liquid between 0.6 and 1.2 g/cm^3. The sealing system uses AK-20 silicone oil with a density of 0.945 g/cm^3.

The lower boundary of the range of the transmitter is –10 kPa = –1020 mm H_2O

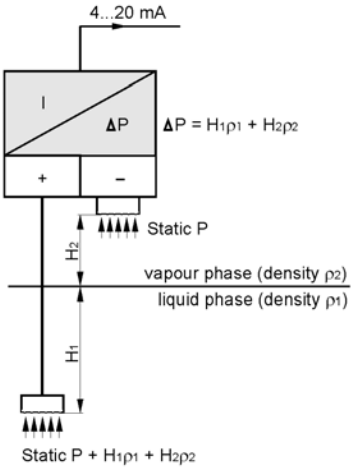
$$H\,[\text{mm}] \le \frac{-1020}{0.6 - 0.945} \Rightarrow H\,[\text{mm}] \le \frac{-1020}{-0.345} \Rightarrow$$
$$H\,[\text{mm}] \le 2957$$

The upper boundary of the range of the transmitter is +10 kPa = 1020 mm H_2O

$$H\,[\text{mm}] \le \frac{1020}{1.2 - 0.945} \Rightarrow H\,[\text{mm}] \le \frac{1020}{0.255} \Rightarrow$$
$$H\,[\text{mm}] \le 4000$$

In the example, both conditions are satisfied when the spacing of the seals is not more than 2957 mm.

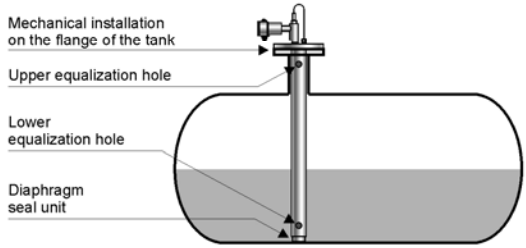
10.2.10. Configuration of the APR-2200/Y smart level probes..



Principles of operation

Measurement is carried out using an APR-2000 differential pressure transmitter, enabling compensation for static pressure in the tank. The value processed is just the hydrostatic pressure of the medium measured at the level of the diaphragm of the lower seal. This pressure is the sum of the hydrostatic pressures of the liquid and vapour phases of the medium. In most practical measurement situations the density of the vapour phase is negligibly small, and therefore the measured hydrostatic pressure relates only to the height of the liquid phase column and can be taken as representing the level of the surface of the liquid phase. For media where the density of the vapour phase is significant (e.g. propane) the level found by the method described can be treated as the theoretical level of the liquid level obtained by adding the actual liquid phase to the condensed vapour phase.

Example of installation on a tank



Configuration example

To convert a rise in the level of liquid with density 0.87 from 0 to 3200 mm to a current change from 4 to 20 mA.

1. Install the transmitter in working position, place the seal at the appropriate height (tank empty).
2. Calculate the width of the measurement range in mm H_2O (4°C): **3200 mm × 0.87 g/cm³ = 2784 mm H_2O**.
3. Using the communicator, set the transmitter to use the units **mm H_2O at 4°C**.
4. To determine the start of the measurement range, read off via the communicator the hydrostatic pressure produced by the manometric fluid in the capillary (e.g. **−4250 mm H_2O**).
5. To determine the end-point of the measurement range, add the value −4250 mm H_2O and the width of the measurement range −4250 mm H_2O + 2784 mm H_2O = **−1466 mm H_2O**.
6. Using the communicator enter the calculated start (**−4250 mm H_2O**) and end-point (**−1466 mm H_2O**) of the measurement range and send as a block to the transmitter. After receiving these parameters the transmitter will perform measurements as required.

11. INSPECTIONS AND SPARE PARTS.

11.1. Periodic inspections

should be made in accordance with the regulations to which the user is subject. During inspection, the pressure connectors should be checked for loose connections and leaks, the electrical connectors should be checked with regard to tightness and the state of the gaskets, packing glands, and the diaphragm seals should be checked for tarnishing and corrosion.

Check the characteristic conversion curve by following the procedures for “Calibration” and, where appropriate, “Configuration”.

If the transmitters or probes are installed in a location where they may be exposed to mechanical damage, excess pressure, hydraulic impulses or excess voltage, or the diaphragm may be in danger from sedimentation, crystallization or erosion, inspections should be carried out as required. The diaphragm should be inspected and cleaned, the protective diodes should be checked for shorting, and the conversion curve should be verified.

Where it is found that the signal in the transmission line is absent or its value is incorrect, a check should be made on the line and its terminal connections.

Check whether the values of the supply voltage and load resistance are correct.

If a communicator is connected to the power supply line of the transmitter, a fault in the line may be indicated by the message “No response” or “Check connection”.

If the line is in order, check the operation of the transmitter. After checks have been made, take steps to eliminate the faults detected.

11.2. Cleaning the Diaphragm Seal, Overloading Damage

11.2.1. Sediment and dirt which have formed on the diaphragm in the course of operation must not be removed by mechanical means, as this may damage both the diaphragm and the transmitter itself.
The only permitted method is the dissolving of sediment.

11.2.2. Sometimes transmitters malfunction due to damage caused by overloading, e.g. in case of:
- application of excessive pressure;
- freezing or solidification of the medium;
- action of a hard object, such as a screwdriver, on the diaphragm.

Usually in such cases the symptoms are such that the output current falls below 4mA or rises above 20mA, and the transmitter fails to respond to input pressure.

11.3. Spare parts.

The following transmitter parts may need replacing due to damage or normal wear:
- Transmitters with PD connector – terminal block with angular cover and seal, connector base with seal, rating plate, case.
- Transmitters with PZ connector and APR-2000/AL– cover seal and packing gland.

In the EEx version, the user may replace only the terminal block with angular shield and the seal in the PD connector, or the seal and packing gland in the PZ connector.
Other parts, due to their special characteristics and anti-explosive requirements, may be replaced only by the manufacturer or an authorized firm..

12. PACKING, STORAGE AND TRANSPORT

The transmitters should be packed singly or in sets, in such a way as to protect them from damage during transportation.
The transmitters should be stored in multiple packs under cover, in a place free of vapours and reactive substances, with an air temperature between +5°C and +40°C, and relative humidity of not more than 85%.Transmitters with uncovered diaphragm or seal connectors, stored without packaging, should have covers to prevent damage to the diaphragm.
During transportation, the transmitters should be packed and secured so as to prevent them from shifting.
Any means of transport may be used, provided direct atmospheric effects are eliminated.

13. GUARANTEE

The manufacturer guarantees the proper operation of the transmitters for a period of 24 months from the date of purchase and servicing provided under the guarantee and following the guarantee period. In the case of special versions, the guarantee period shall be agreed by the manufacturer and the user, but shall not be less than 12 months..

14. ADDITIONAL INFORMATION

14.1. The manufacturer reserves the right to make constructional and technological changes which do not lower the quality of the transmitters.

14.2. Related documents

- "KAP– Communicator Operating Manual" supplied with the Aplisens communicator.
- Hart/RS232/01 Converter information sheet.
- "Raport-01" software.

14.3. Related standards

PN-EN 60529:2003	Degrees of protection provided by enclosures (IP Code)
PN-EN 61010-1:2004	Safety requirements for electrical equipment for measurement, control and laboratory use. General requirements
PN-82/M-42306	Screwed connectors of pressure gauges
PN-81/M-42009	Automatics and industrial measurements. The packing, the storage and transport of devices. General requirements
PN-EN 1092-1:2004 (U)	Flanges and their joints – Circular flanges for pipes, valves, fittings and accessories. – Part 1: Steel flanges

15. FIGURES

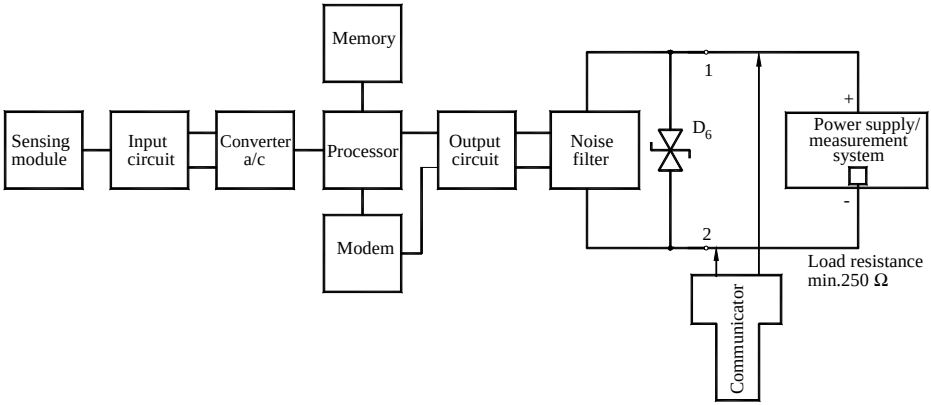


Figure 1. APR-... transmitter – block diagram.

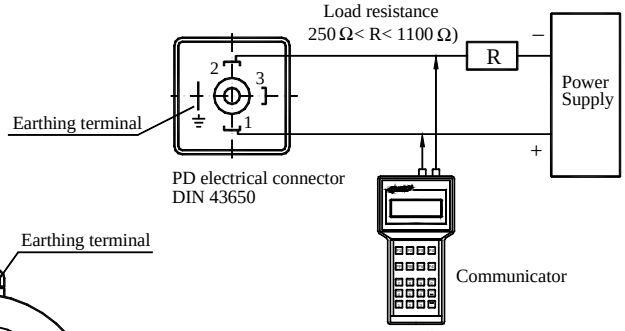
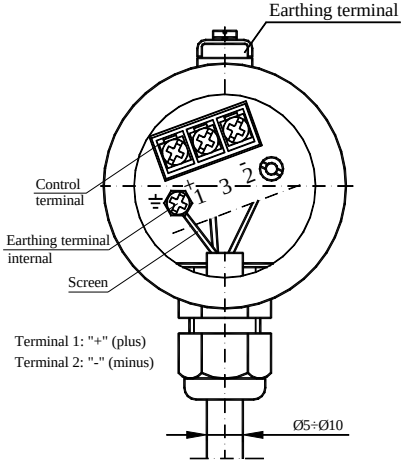


Figure 2b. Electrical connections for APR-2000 and APR-2200 transmitters with PD type connector.
(Not applicable to EEx version)



Connecting the communicator:
1. Connect as shown in Figure 2b (connectors PD and PZ).
2. To terminals 2, 3 or 1, 2 in the case of the PZ connector (Figure 2a).

To measure the current in the transmitter without disconnecting the signalling circuit, connect a milliammeter to control sockets 1 and 3. Permitted fall in voltage on the milliammeter: 200mV.
Connect the communicator to sockets 1 and 2 or sockets 3 and 2.

Figure 2a. Electrical connections for APR-2000, APR-2200transmitters with terminal box (PZ type connector).
(Not applicable to EEx version).

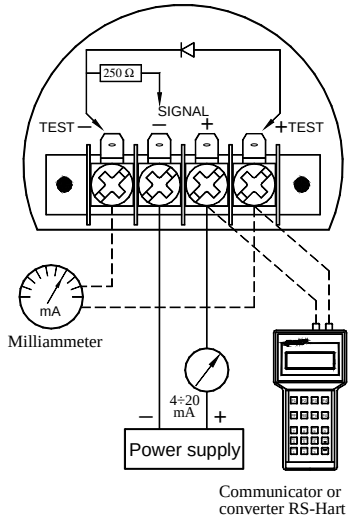


Figure 2c. Electrical connections for APR-2000/AL, APR-2200/AL transmitters

Figure 2. Electrical connections for APR... transmitters

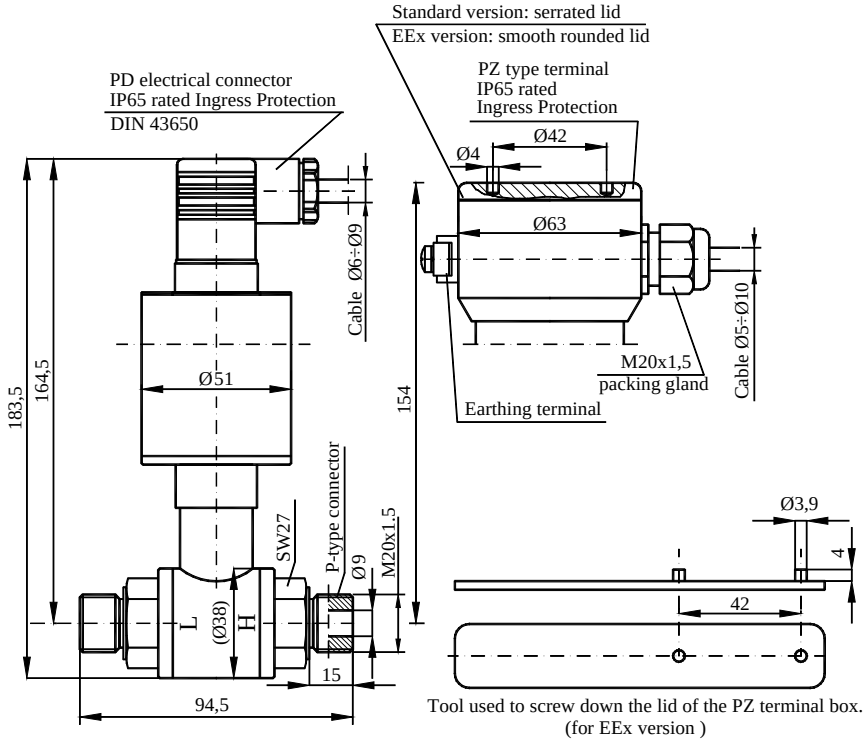


Figure 3. APR-2000 differential pressure transmitter for basic ranges 0...4 kPa 0...200 kPa.

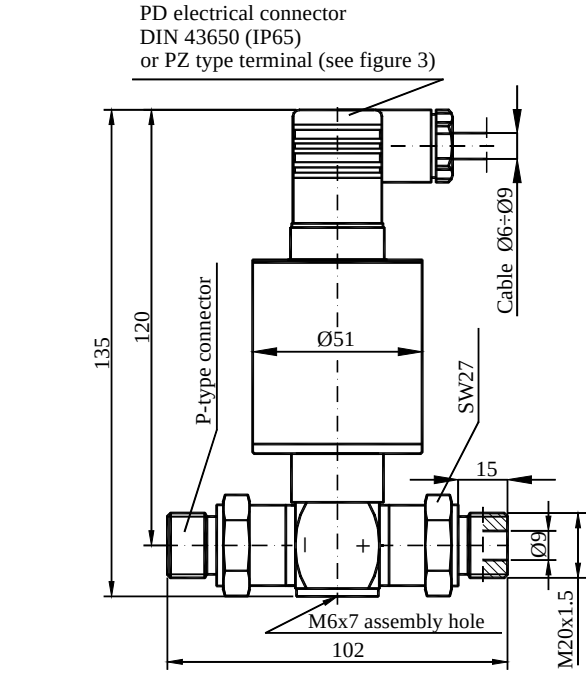


Figure 4. APR-2000 differential pressure transmitter for basic range 0...1,6MPa.

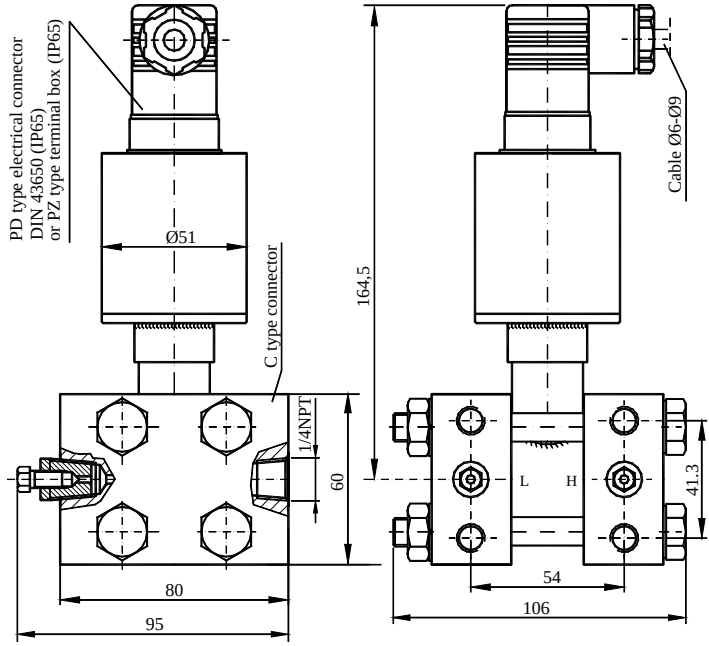


Figure 5. APR-2000 differential pressure transmitter with C type vented covers.

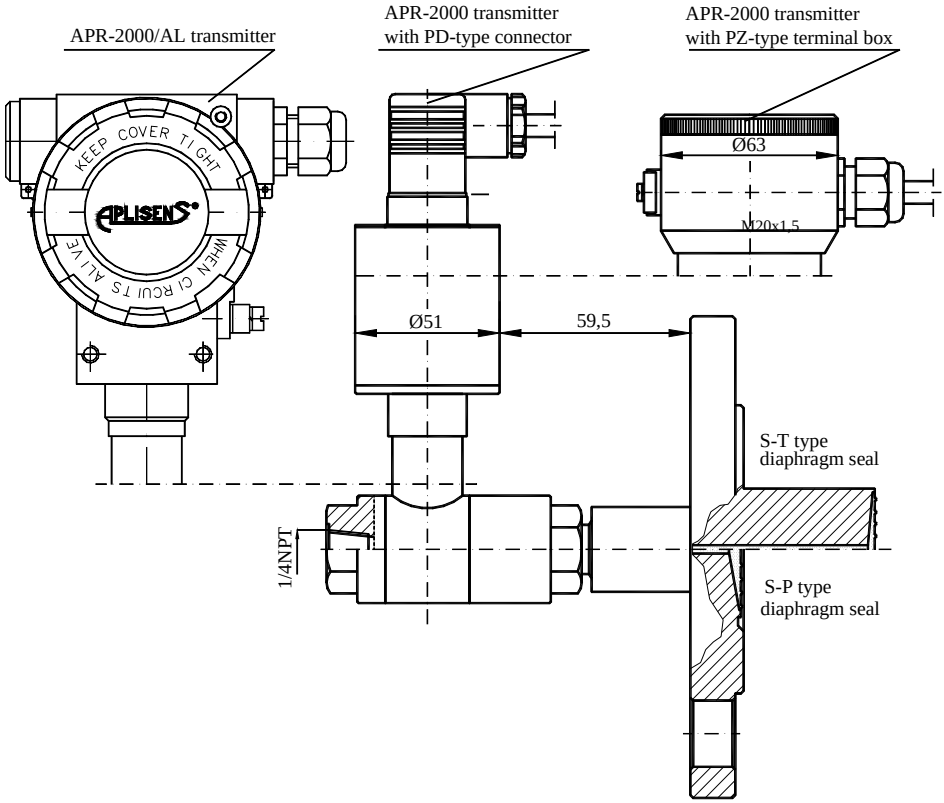


Figure 6. APR-2000, APR-2000/AL differential pressure transmitter with a single direct diaphragm seal (examples).

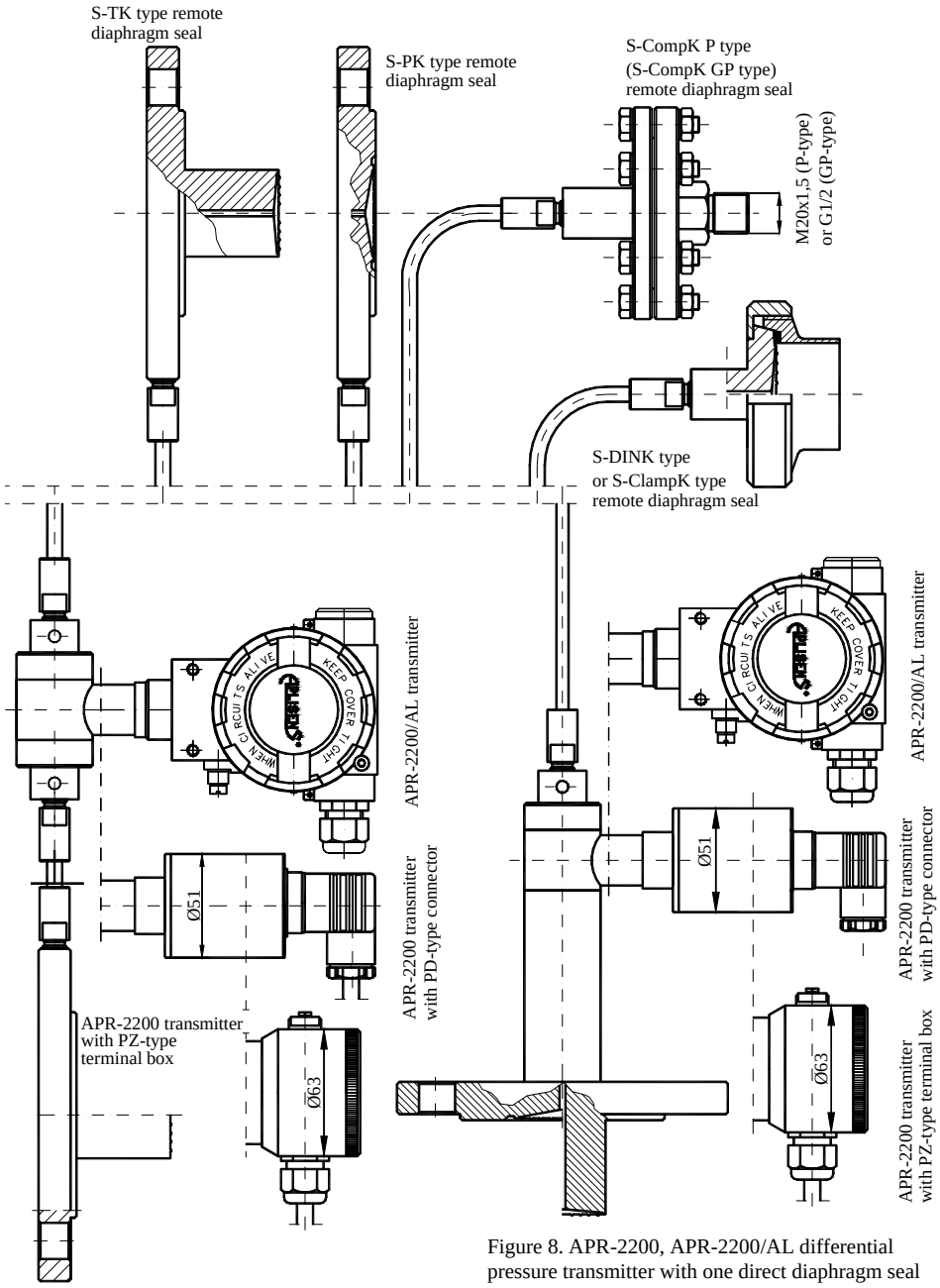


Figure 7. APR-2200, APR-2200/AL differential pressure transmitter with two remote diaphragm seals (examples).

Figure 8. APR-2200, APR-2200/AL differential pressure transmitter with one direct diaphragm seal and a second remote diaphragm seal (examples).

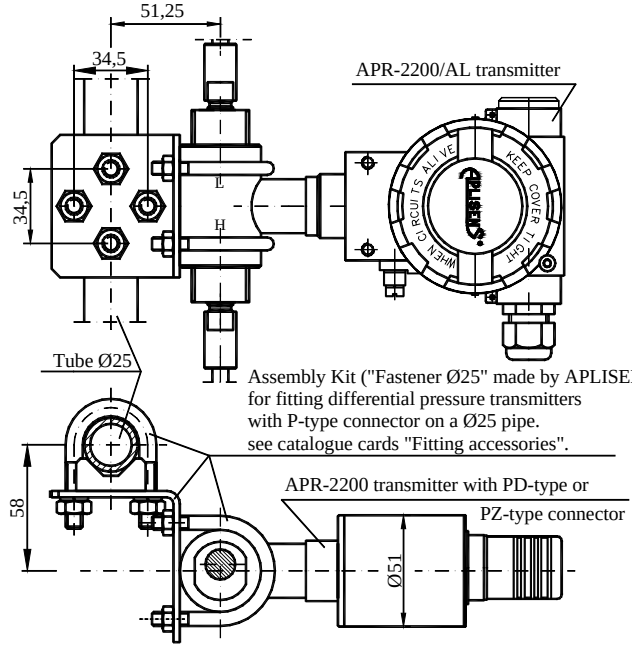


Figure 9. Example: how to install the APR-2200, APR-2200/AL transmitters with two remote diaphragm seals for basic ranges -10...10 kPa ÷ -130...200kPa.

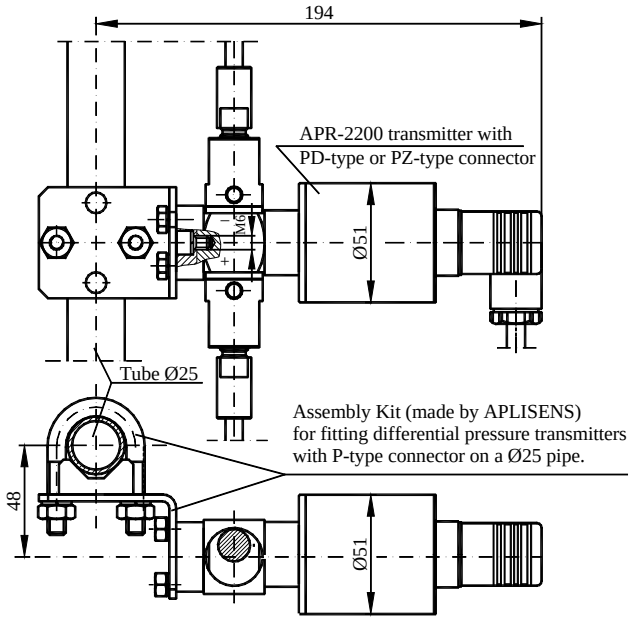


Figure 10. Example: how to install the APR-2200 transmitters with two remote diaphragm seals for basic range -130...1600kPa.

Figure a. Figure b.

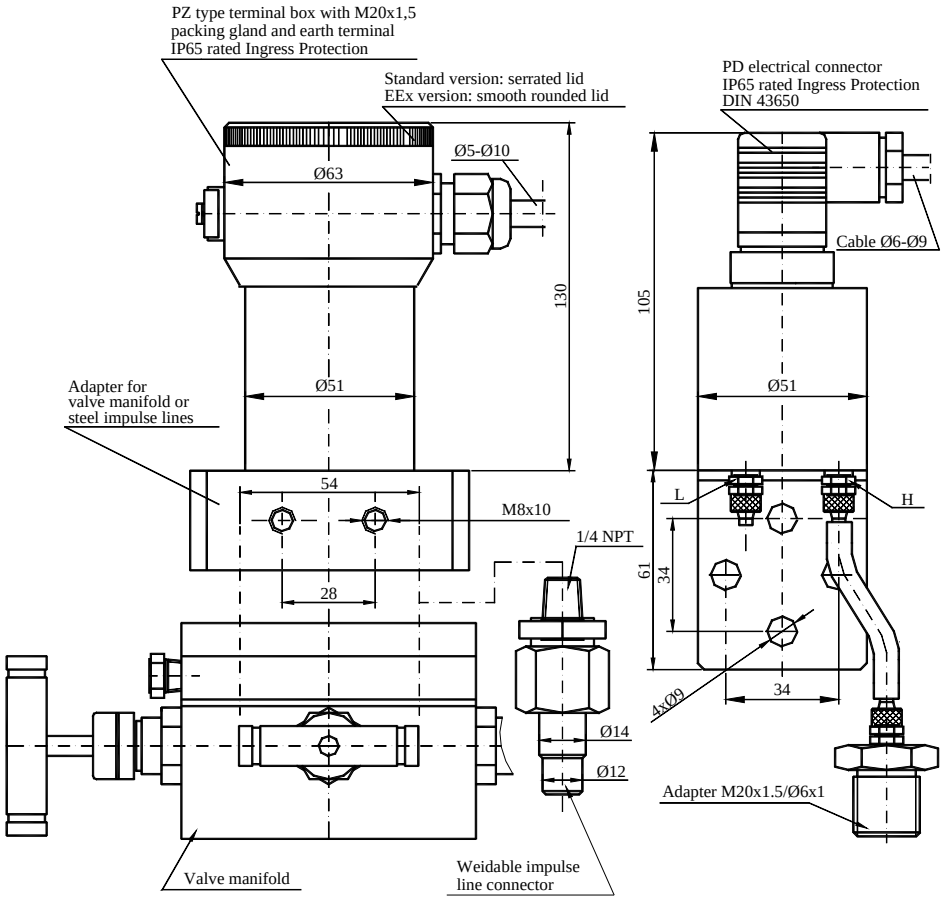


Figure 11. APR-2000G Smart differential pressure transmitter for non-aggressive gases.

a). APR-2000G transmitter – industrial version with C type process connector to mount together with a valve manifold or weldable impulse line connectors.
An example with PZ type electrical connector.

b) APR-2000G transmitter – economical version with PCV type process connector.
An example with PD type electrical connector..

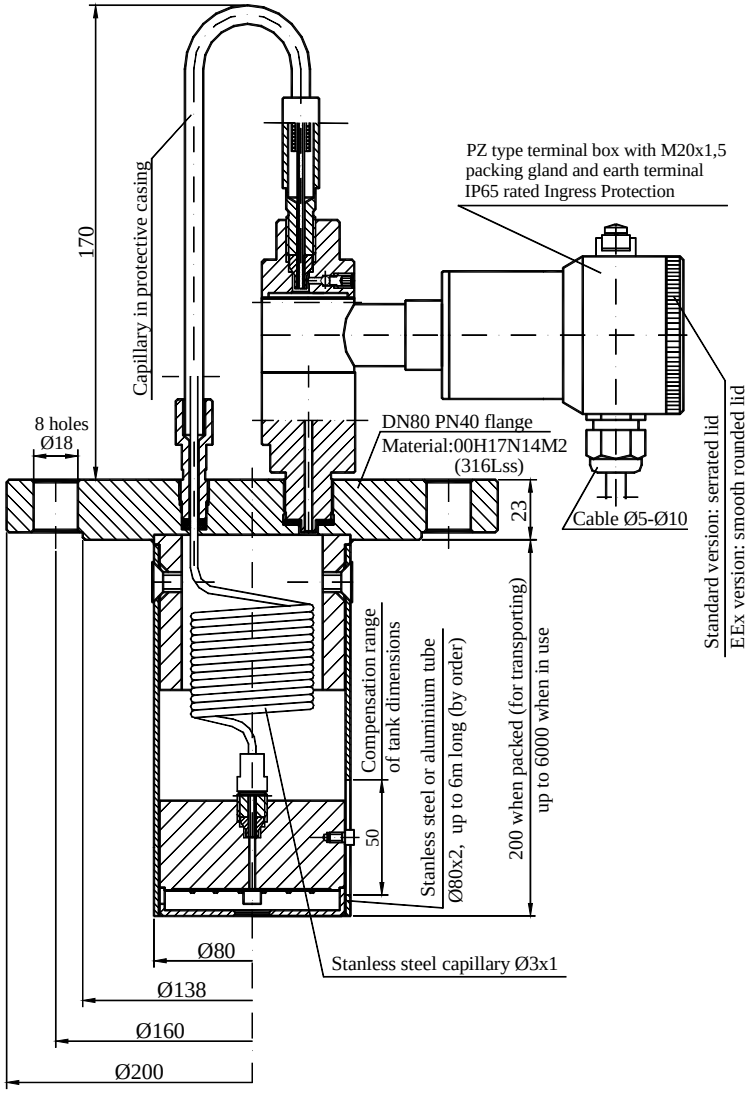


Figure 12. APR-2000/Y Smart level probe for pressure tanks

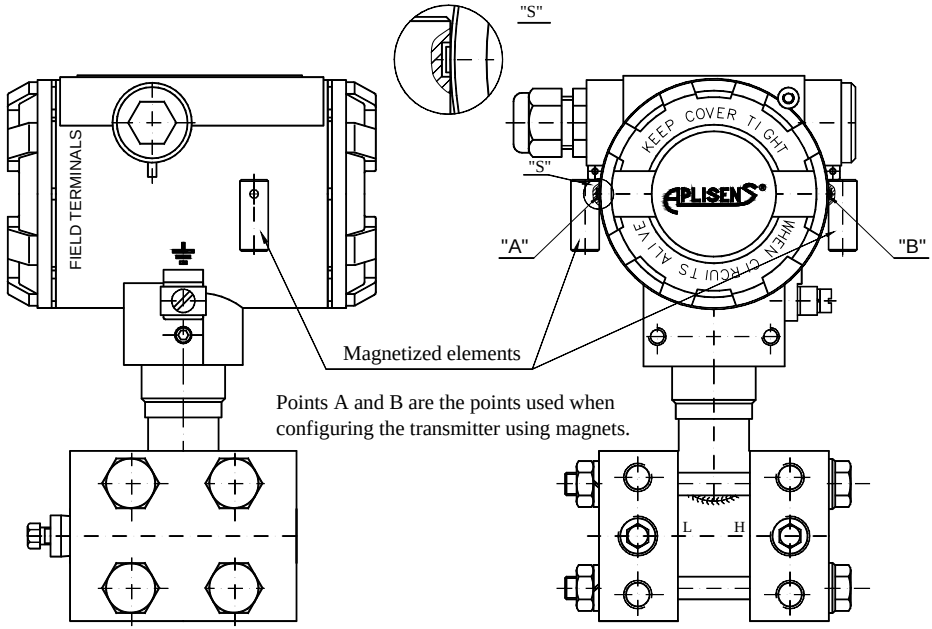


Figure 13. Configuration of the APR-2000/AL transmitter using magnetized elements

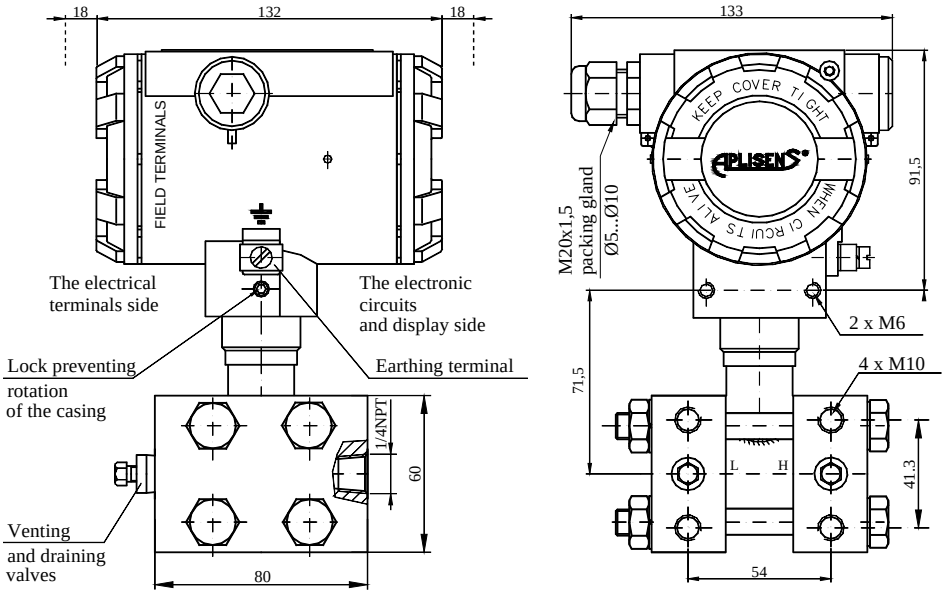


Figure 14. APR-2000/AL Smart differential pressure transmitter

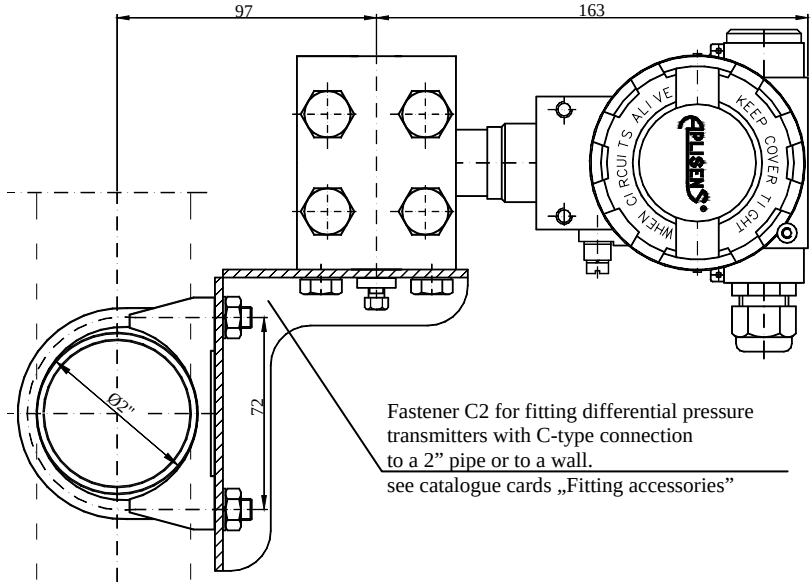


Figure 15. Example: how to install the APR-2000/AL transmitter on a vertical or horizontal pipe.

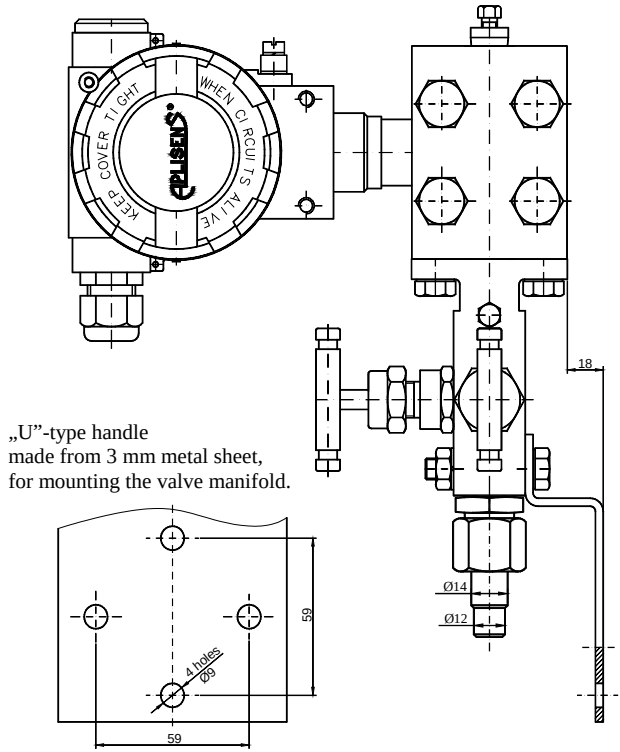


Figure 16. Example: how to install the APR-2000/AL transmitter with a valve manifold to a wall.