AFLOWT

ULTRASONIC LEVEL GAUGE
AFLOWT LV

VERSION
LV-2xx

INSTALLATION MANUAL

9001:2008

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The present manual covers the procedures for on-site mounting and dismounting of "AFLOWT LV" ultrasonic Level gauges of LV-2xx versions. In the course of work, also refer to "ULTRASONIC LEVEL GAUGE AFLOWT LV. LV-2xx version. Operation manual, Part I and Part II" document.

LIST OF ABBREVIATIONS

AS	- Acoustic system
BMD	- Digital measuring block
CB	- Communication block
PEP	- Piezoelectric converter
SPS	- Secondary power source
RTD	- Resistance temperature detector (temperature sensor)
LV	- Ultrasonic Level gauge.

NOTE. Words in the text marked in bold, for example, **Setting**, correspond to the items displayed on the Device's screen.

CAUTION!

1. It is highly recommended to study Operation Manual before you start work with the Level gauge.
2. You must not do the following, unless otherwise agreed by the manufacturer:

- Perform any modifications to the recommended measurement and mount procedures (Appendices B, C)
- Perform any modifications to PEP (Piezoelectric Converter) design
- Use cables of the types not specified in the present operational documentation for making connections between BMD (Digital Measuring Block) and PEP, and between RTDs (Resistance temperature detectors) and BMD
- Install self-manufactured and modified acoustic systems (AS) excluding fastening components.

1. SAFETY INSTRUCTIONS

1.1. The Level gauge should be mounted (dismounted) by the qualified technical staff:

- Certified for performing work of this type on the site where the Level gauge is installed and authorized by the manufacturer
- Authorized to work with electrical installations up to 1000 V
- Familiar with all the instructions outlined for the Level gauge and auxiliary equipment used for mounting and dismounting.

1.2 When working with the Level gauge, the dangerous factors are as follows:

- AC voltage with RMS of up to 264 V, frequency 50 Hz (when the device is powered from mains 220 V 50 Hz via Secondary Power Source)
- Other site-specific factors.

Prior to performing work, make sure that no dangerous AC/DC voltage which may cause injury or death is applied to the tank (pipeline) to be worked on. Use the appropriate measuring device for this purpose.

In the course of mounting, start-up, commissioning and dismounting works, it is strictly forbidden:

- To make connections to the Device, switch over modes and replace electronic components, if the Level gauge is powered up
- To use electronic devices and electric tools unless their cases are connected to the protective earthing trunk line. Also, you must not use the defective devices and tools.

1.5. Prior to connection of the device to mains, it is necessary to connect BMD grounding terminal and ⏚ terminal of SPS (if applicable) to the earthing trunk line.

2. PREPARATION FOR MOUNTING

2.1. To mount the Level gauge on site, the following areas should be available:

- Free channel (tank, pipeline) section for mounting an acoustic system (AS)
- Free space used to place structures providing protection of AS from precipitation, wind, and solar/heat radiation
- Free area suitable for positioning BMD, SPS and CB (Communication Block).

2.2. The Level gauge should be transported packed in the manufacturer's box.

After the Level gauge has been moved to the mounting location from a cold environment into a warm one (with ambient temperature above zero), it shall be left to stand in the manufacturer's box for at least 3 hours to make sure that no condensation remains inside.

When unpacking the Level gauge, check that the delivery package contains all items specified in the Equipment Certificate.

3. MOUNTING CONSIDERATIONS

3.1. Site requirements for mounting AS should be as follows:

- Tank (channel, pipeline) operation conditions exclude foreign items on the surface of media interface within the area of measurements
- Liquid turbulence and pulsations are absent or minimal
- Foams on the surface of media interface are minimal
- There are no structural components on the way of acoustic beam from PEP to the media interface
- Foreign items inside the AS sound guide are excluded
- Icing over PEP emitting surface and reference reflector surface as well as built-up of ice caused by fumes inside the sound guide are prevented.

3.2. AS can be mounted on a horizontal section of tank (channel, pipeline). Mounting location is selected considering the minimal distance from media interface to the AS base plane that must be no less than:

- 1400 mm – for acoustic systems of AS-40x-xx0 and AS-50x-xx0 versions
- 800 mm – for acoustic systems of AS-11x-xx3, AS-6xx-xx0, and AS-7xx-xx0 versions.

3.3. AS must be mounted in vertical plane. Deflection of the sound guide axis from the vertical axis must not exceed 3 degrees of arc.

It is recommended to mount acoustic systems of suspended type AS-50x-xx0, and AS-7xx-xx0 in the areas where rocking by wind and draft is excluded.

3.4. The on-site structure where AS is installed must be rigid enough to prevent sound guide axis shift from the vertical and shift of the base plane from the vertical.

Flanges on the ends of the acoustic system are fixed to the mount adaptor via a rubber gasket included in the set of AS fittings.

3.5. When mounting (dismounting) and operating the Level gauge, protection of PEP emitting surface from impacts must be provided.

3.6. The following conditions should be observed at the site of BMD installation:

- Operation conditions are in accordance with the requirements of the Operation Manual
- Free access to BMD and convenience in operation is provided

3.7. BMD must not be installed in areas where it can be exposed to water jets or near sources of heat and electromagnetic radiation.

3.8. When mounting the two-channel Level gauge, the components originally assigned to a particular measuring channel must be used: serial numbers of the components specified in the Equipment Certificate and marking of connection cables must relate to the measuring channel of a particular number. The connection cables must not be changed in length.

3.9. The following components may be sealed on completion of on-site mounting procedure:

- Two fixing screws located on the front panel of BMD
- Cover of Communication Block case
- Cover of RTD (if applicable).

4. MOUNTING THE LEVEL GAUGE

4.1. Types of acoustic systems

4.1.1. Simplistically designed AS-1xx-xx3 systems come without reference reflectors and sound guides. AS-11x-xx3 systems is equipped with disc mount ones (Fig.A.1). Mount disc both have holes for fixing an acoustic system to the object under control.

4.1.2. A sound guide as part of AS-40x-xx0 (having reference reflectors) systems is designed as a pipe run with a mount flange installed on the upper end. There are holes in the flange used to fix the assembly to the object under control (Fig.A.2). PEP is installed in the mount flange center with the emitting surface facing inside the sound guide.

Reference reflector, a hollow fluoroplastic cylinder on a metal rod, is fixed to the lower end of the sound guide by holders. Being installed at the known distance from the PEP emitting surface, the reference reflector provides reflection of ultrasonic waves from the reference distance.

4.1.3. AS-50x-xx0 (with reference reflector) acoustic systems come with a mount disc installed. The disc is without fixing holes, however, a ring bolt mounted on it provides suspension of AS by snap hooks and a cable (Fig.A.3).

Flexible suspension provides that the Level gauge is capable of working in thin-walled tanks that are prone to distort in shape under the effect of temperature.

4.1.4. A sound guide coming with AS-6xx-xx0 (with RTDs) acoustic systems has a mount flange with fixing holes (Fig.A.4). PEP and RTD are both installed on the flange. RTD's sensor is located inside the sound guide. These sound guides come without reference reflectors.

4.1.5. A sound guide included in AS-7xx-xx0 (with RTDs) acoustic systems has a mount flange without fixing holes, but it is equipped with a ring bolt (Fig.A.5). These sound guides come without reference reflectors.

4.1.6. To seamlessly mount an AS on any tank regardless of the design, the Level gauge can be supplied complete with optional mount adaptors of corresponding type. Types of mount adaptors and adaptor pipes are shown in Fig.A.6-A.9.

4.1.7. Selection of materials for the sound guide, mount adaptor, and seal gaskets is determined by AS design.

4.2. Mounting acoustic systems

4.2.1. Depending on the design of an object under control and type of AS in use, various types of mounting are available (Appendix B).

4.2.2. Various sets of fittings may be provided to mount BMD and AS on various objects under control. Contents of the set of fittings and number of particular items depend on the type of AS and mounting method.

4.2.3. Acoustic systems without sound guides are generally mounted on existing tanks or open channel structures. AS-1xx-xx3 system is installed on a mount disc (Fig.B.1).

4.2.4. AS-40x-xx0 and AS-6xx-xx0 systems are mounted as shown in figures B.2-B.4. Several mounting methods are available:

- Mounting AS on a frame installed on the object under control (Fig.B.2).

  AS mount flange is fixed to the frame by bolts. Deflection of the base plane of the mount flange from the horizontal plane is checked with a builder's level in two mutually perpendicular directions. This will ensure that the sound guide axis is positioned vertically.

- Mounting AS with use of mount adaptor (Fig.B.3, B.4).

  A mount adaptor (Fig.A.6) is welded to the tank (pipe) wall or to a frame constructed as desired and installed on the object under control, after which the AS mount flange is fixed to the mount adaptor flange by bolts.

- In the case when submerging of AS is possible, one (for AS-6xx-xx0 version) or two (for AS-40x-xx0 version) adaptor pipes are installed (Fig.A.8). The adaptor pipes are fixed by bolts between the mount adaptor flange and AS mount flange. Position of the sound guide axis is checked with a builder's level.

  To vent volatile gases in case these are present above the tank (pipeline) and/or to optimize AS heat exchange, you may use perforated adaptor pipes (Fig.A.9).

4.2.5. Acoustic systems of AS-50x-xx0 and AS-7xx-xx0 design versions are installed with use of the "Flexible mount" method (Fig.B.5, B.6). Several mounting techniques are available:

- AS is suspended from a structural component of the object under control on a snap hook or a cable via a ring bolt (Fig.B.5).
- Mount adaptor is welded to a tank (pipeline) wall. A flange with a ring bolt installed is fixed to the mount adaptor flange by bolts (Fig.A.7), and the acoustic system is suspended on snap hooks or on a cable via the ring bolt (Fig.B.6).

4.2.6. It is recommended to seal a recess on the mount flange at the PEP cable output to prevent moisture accumulation.

4.3. Mounting the modules

BMD, Power Source and Communication block (CB) are installed and fixed on the vertical plane considering their overall and mount dimensions (see Fig.A.1, A.3, A.5, A.6, Appendix A of Part I of the Operation manual). The modules are mounted on a pre-installed DIN rail (mount rail 35/7.5). The Communication Block can be installed at a certain distance from AS considering that the length of connection cables terminated in PEP and RTD is 5 m.

It is not necessary that the room where the system is installed be lighted considering that BMD has its own backlight.

4.4. Wiring the Level gauge

4.4.1. AS is connected to BMD considering that the components are assigned to particular channels as outlined in section 3.8.

4.4.2. Communication and network cables are fixed on the wall wherever possible. The network cable is laid separately at a distance of 0.3 m as

a minimum from other cables. It is recommended not to coil the excessive cables.

CAUTION! YOU MUST NOT change the length of BMD-CB and CB-PEP cables.

To avoid mechanical damages, it is recommended to place all cables in metal or plastic tubes, corrugated sleeves, and cable trays, trunks, or conduits.

DO NOT lay BMD-PEP and BMD-RTD cables and signal cables for external connections within proximity to power circuits, and, with presence of high-level electromagnetic interference, **DO NOT** lay the cables without putting them into properly grounded metal tubes or sleeves. The metal tubes or sleeves shall only be grounded on one side – on BMD side.

YOU MUST PREVENT tension of PEP and RTD cables connected to CB. This may result in deflection of the sound guide from the vertical axis.

4.4.4. Recommended cable types are given in Table.1.

Table 1

Circuit	Cable type
BMD – PEP *	UNITRONIC BUS IBS 3×2×0.22) – for AS-11x-xx3; any cable 2×0.35 or 2×0.5 – for other types AS
BMD – RTD	any cable 4×0.2
Mains AC 220 V 50 Hz – SPS	any cable 3×0.5
SPS – BMD	any cable 2×0.5

* - Cable length is no more than 250 m

4.4.4. Prior to connection, cut isolation from the cable ends by 5 mm and fabricate. The cables are directed via cable glands and attached to the connectors according to the Wiring diagrams given in Appendix C. To prevent ingress of moisture, the unused cable glands are covered by plugs included in the set of fittings.

4.4.5. When mounting AS by the method shown in Fig. B.6, signal cables are directed via cable glands on the mount flange and connected to CB.

4.4.6. The need for protective grounding is determined by power supply and environment conditions under which the devise is operated.

The protective grounding and earthing device should correspond to the rules on design of power electric installations.

Use a mechanically protected copper wire of no less than 2.5 mm^2 cross-section or a copper wire without mechanical protection of no less than 4 mm^2 cross section as a grounding wire connecting the Level gauge with the grounding device.

Grounding terminal must not be connected to the lightning protection system.

CAUTION! Prior to connecting the protective earthing trunk line, you must make sure that the voltage is off.

4.4.7. The Level gauge has no standby mains switch, therefore, it is connected to mains via an external switch.

5. START-UP PROCEDURES

5.1. Initial configuration

5.1.1. Prior to work, it is necessary to check that the Level gauge's operation settings specified in the Equipment Certificate or Check Form correspond to the ones in the Device's internal memory as well as to check its configuration settings.

The following settings shown in Fig.1 are determined during the configuration procedure, after which they are entered in the Device's Start-up List (Appendix D):

- **B** – base level, m
- $\mathbf{H_{max}}$ – maximal level of liquid in the tank under control
- **C0** – velocity of ultrasound in gas medium inside the tank under control at 0°C (applicable only for systems AS-11x-xx3, AS-61x-xx0, AS-62x-xx0, AS-71x-xx0, AS-72x-xx0)**,** m/s
- Volume/Level characteristic of the tank under control (required for calculation of volume and/or filled volume).

When configuring the Device, the following settings are also checked and recalculated:

- $\mathbf{D_{min}}$, $\mathbf{D_{max}}$ – threshold values of the distance measuring range, m
- $\mathbf{C_{min}}$, $\mathbf{C_{max}}$ – threshold values of the range of actual ultrasound velocities within the sound guide**,** m/s;
- $\mathbf{C_{mc}}$ – ultrasound velocity value entered for the manual correction mode (if necessary), m/s.

5.1.2. In the course of start-up, the base level **B** can be determined by two methods:

- Measuring the distance between the base (reference) plane, from which the distance readings are taken, and the bottom of the tank or a conventional plane which is taken as the reference for level measurements
- Calculating the sum of measured distance $\mathbf{D_{mcr}}$ and liquid level $\mathbf{H_{mcr}}$ in the tank under control:

$$B = D_{mcr} + H_{mcr} \quad (1)$$

The distance is determined as a range from the base plane to the media interface. You may use the Level gauge readings to determine the distance.

For all acoustic systems, the base plane is a plane going through the outer surface of the mount flange, mount bar, or mount disc.

Values of distance, level and the measurement base can be measured by a measuring crossbar, measuring needle, or laser ranger.

The recommended accuracy for distance, level, and base level measurements is ± 1 mm.

5.1.3. The threshold values for distance measuring range $\mathbf{D_{min}}$ and $\mathbf{D_{max}}$ are calculated as follows:

$$D_{min} = B - 1.2 \cdot H_{max} \quad (2)$$

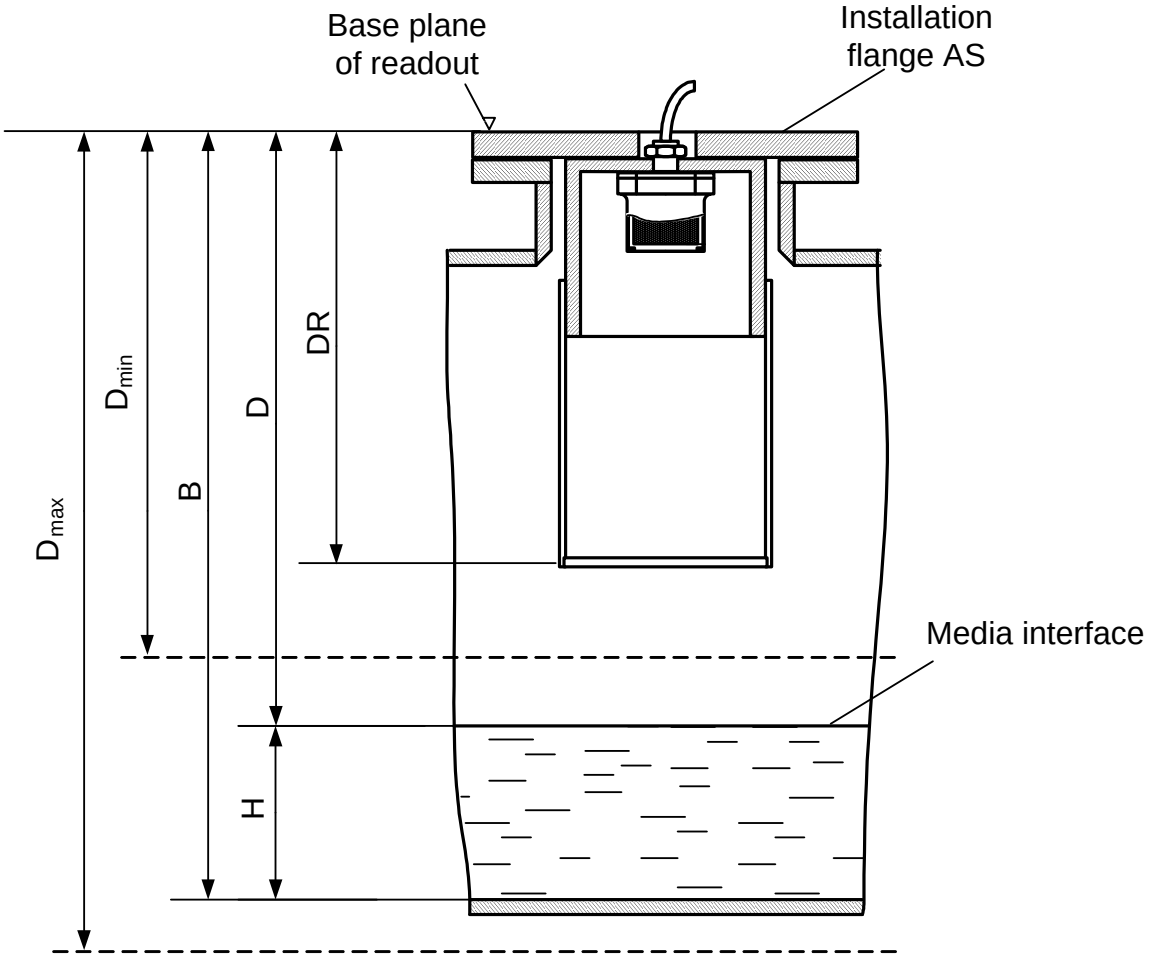
$$D_{max} = 1.2 \cdot B \quad (3)$$

The following conditions must be met:

$B - H_{max} \geq 1.4$ m – for AS-40x-xx0, AS-50x-xx0 acoustic systems

$B - H_{max} \geq 0.8$ m – for AS-1xx-xx3, AS-6xx-xx0, and AS-7xx-xx0 acoustic systems.

D_{min} and **D_{max}** calculation formulae contain **1.2** factor, which is included to widen the range of signal search and prevent loss of signal on powering up the Device after a standstill period (dead time). The loss of signal may result from the situation, when characteristics of gas medium have significantly changed during the standstill period, and no ultrasound velocity correction has been performed.



B – measurement base level; D_{min}, D_{max} – minimal and maximal distances respectively; H – level of liquid; DR – distance to the reference reflector.

Fig. 1. Configuration settings

5.2. Configuring the Level gauge installed on the object under control

5.2.1. Configuration procedure is performed after determining all initial settings and completing all mount procedures. The Level gauge is configured from the keyboard, which is operated as described in "ULTRASONIC LEVEL GAUGE AFLOWT LV. LV-2xx version. The operation manual,

Part II" document. Also, the Level gauge can be configured from a PC with use of "Monitor AFLOWT LV-2xx" software.

5.2.2. The Level gauge is switched to SERVICE mode, and then powered on.

Setting/ Configuration menu is opened and the following parameters are set for each channel:

- **Calc. Mode** – Algorithm of channels operation for two-channel versions
- **Enable** – Inclusion of measurements
- **Auto C calc.** – Turning on/off automatic ultrasound velocity correction
- **Preset profile** – Selecting the adjustment profile for an acoustic system in use
- **Indication settings** – Selecting parameters to be displayed and measurement units of volume (m^3, L)
- **Current profile** – Viewing and correcting parameters of the preset adjustment profile.

CAUTION! It is recommended to enable the standard profiles: **profile 1** for AS-40x-xx0 and AS-50x-xx0 acoustic systems, **profile 2** - for AS-1xx-xx3, AS-6xx-xx0 and AS-7xx-xx0 acoustic systems. Values of the factory-installed parameters used in the standard profiles are listed in Appendix E.

Note: The manufacturer corrects configuration settings in exceptional cases under mandatory control of signal shapes.

5.2.3. **Settings**/ **Object settings**/ **OBJ. SETTINGS chan. X** menu is opened and the following parameters are set for each channel:

- **Dmin** – Minimal distance
- **Dmax** – Maximal distance
- **B** – Measurement base
- **Hmax** – Maximal level (if necessary)
- **Cman** – Ultrasound velocity for the manual correction mode (when automatic correction is disabled)
- **HV-function** – Volume/level characteristic of the tank under control (if necessary).

Note: When entering Volume/Level characteristic data into the Device, it is recommended to specify the values of level **H** in ascending order starting from the zero level. The maximum settable value of volume **V** is 999999.875 regardless of selected measurement units.

5.2.4. The Level gauge is connected to the service modules and external devices. The parameters required to match the Level gauge's outputs with the inputs of the devices are set in **Settings** / **System settings** / **Connection settings** and **Settings** / **Periphery settings** menu.

Temperature measurement channels to be used are enabled, and RTD sensor curve is set as specified in the Equipment Certificate (if necessary) in **Settings** / **Periphery settings** / **Temperature sensor** / **Temp. channels** / **t channel X** menu.

5.2.5. Current date and time are set if necessary in **Settings** / **System settings** / **Time settings** menu.

5.2.6. **Signal view** (**Settings** / **Object settings** / **Signal view**) window is used to set characteristics of a desired echo-signal per each channel. Then it

is necessary to check that the signals reflected from the media interface and reference reflector (for AS with reference reflector) are displayed. If the Device is configured correctly, the measured distance is equal to the actual distance, and positions of the selection marker and the desired echo-signal match on the display.

Note: The value of measured distance is displayed in the **Signal view** window, presence of the desired echo-signal is detected by the icon  indicated in the lower left corner.

If the selection marker matches the image of a noise echo-signal, the Level gauge should be reconfigured as described below.

In the menu **Settings** / **Configuration** / **Current profile** / **Search by:** the operator selects one of the criteria by which the desired echo-signal is detected among the following:

- **max (A)** - a signal with maximal amplitude within the specified measuring range
- **min (D)** - a signal corresponding to the closest distance within the specified measuring range
- **max (D)** - a signal corresponding to the longest distance within the specified measuring range
- **max (D∗A)** - maximal value of the product of signal amplitude into the square root of distance within the specified measuring range.

The manual alignment mode is selected from **Signal view** window. When you press the button  in **Signal view** window, the selection marker starts blinking, and you can move it using buttons  ,  . While in the moving mode, the selection marker is positioned at the desired signal. After pressing button  , the tracing mode is activated, and the marker stops blinking.

5.2.7. If necessary, you may configure the interval log and clear logged data. Data is cleared from the **Data logs** menu, the same for event logs is done from the **Status logs** menu.

5.2.8. The Level gauge is powered off and switched to OPERATION mode by removing a jumper from the terminal used for modification of service parameters. This service terminal is sealed. If necessary, two fixing screws are sealed from the front panel side of BMD.

5.3. Special-purpose configuration

5.3.1. Special-purpose configuration is performed if required. Typically, this configuration procedure is carried out on the sites where gas composition differs considerably from the air composition or is unknown.

5.3.2. Special-purpose configuration is performed for the Level gauges having acoustic systems complete with RTDs (sensitive element): AS-11x-xx3, AS-61x-xx0, AS-62x-xx0, AS-71x-xx0, or AS-72x-xx0. The procedure follows the general configuration procedure and is made for the Device being switched in SERVICE mode.

5.3.3. Prior to configuration, measurement base **B** (section 5.1.2) is determined along with an actual value of liquid level in the tank $\mathbf{H_{act}}$. The measurements are performed with other measuring tools (e.g., measuring needle, measuring rod etc). At the same time, the actual level value is measured by the Level gauge, and the following readings are taken from the Device's display: distance **D′**, ultrasound velocity **C′**, and gas medium temperature **t′**.

5.3.4. The actual value of ultrasound velocity in the gas medium near the tank under control at 0°C is determined in the following order:

a) Actual value of distance $\mathbf{D_{act}}$ is derived from the formula:

$$D_{act} = B - H_{act} \quad (4)$$

b) Actual value of time of receiving the desired echo-signal $\mathbf{T_{act}}$ is determined according to the formula:

$$T_{act} = \frac{2(D' - dD)}{C'}, \text{ s} \quad (5)$$

where D′ - value of distance to liquid according to Level gauge's readings, m

dD – zero offset as specified in the Equipment Certificate, m

C′ - ultrasound velocity according to Level gauge's readings, m/s

c) Actual value of ultrasound velocity $\mathbf{C_{act}}$ in the gas medium is derived from the formula:

$$C_{act} = \frac{2(D_{act} - dD)}{T_{act}}, \text{ m/s} \quad (6)$$

d) Actual value of ultrasound velocity $\mathbf{C_{0act}}$ at $0\,^{o}C$ is calculated by the formula:

$$C_{0act} = C_{act} - 0.59 \cdot t', \quad (7)$$

where t′ - value of on-site temperature of gas medium according to Level gauge's readings, °C

0.59 – correction factor, m/s·°C

5.3.5. In the menu **Settings**/ **Object settings**, the calculated value of $\mathbf{C_{0act}}$ is entered instead of **C0** value used in the Level gauge.

In case of pure gas application, **C0** correction can be made by entering the ultrasound velocity value for the corresponding gas taken from Table F.1, Appendix F.

5.3.6. The special-purpose configuration is finished by the procedure described in section 5.2.8.

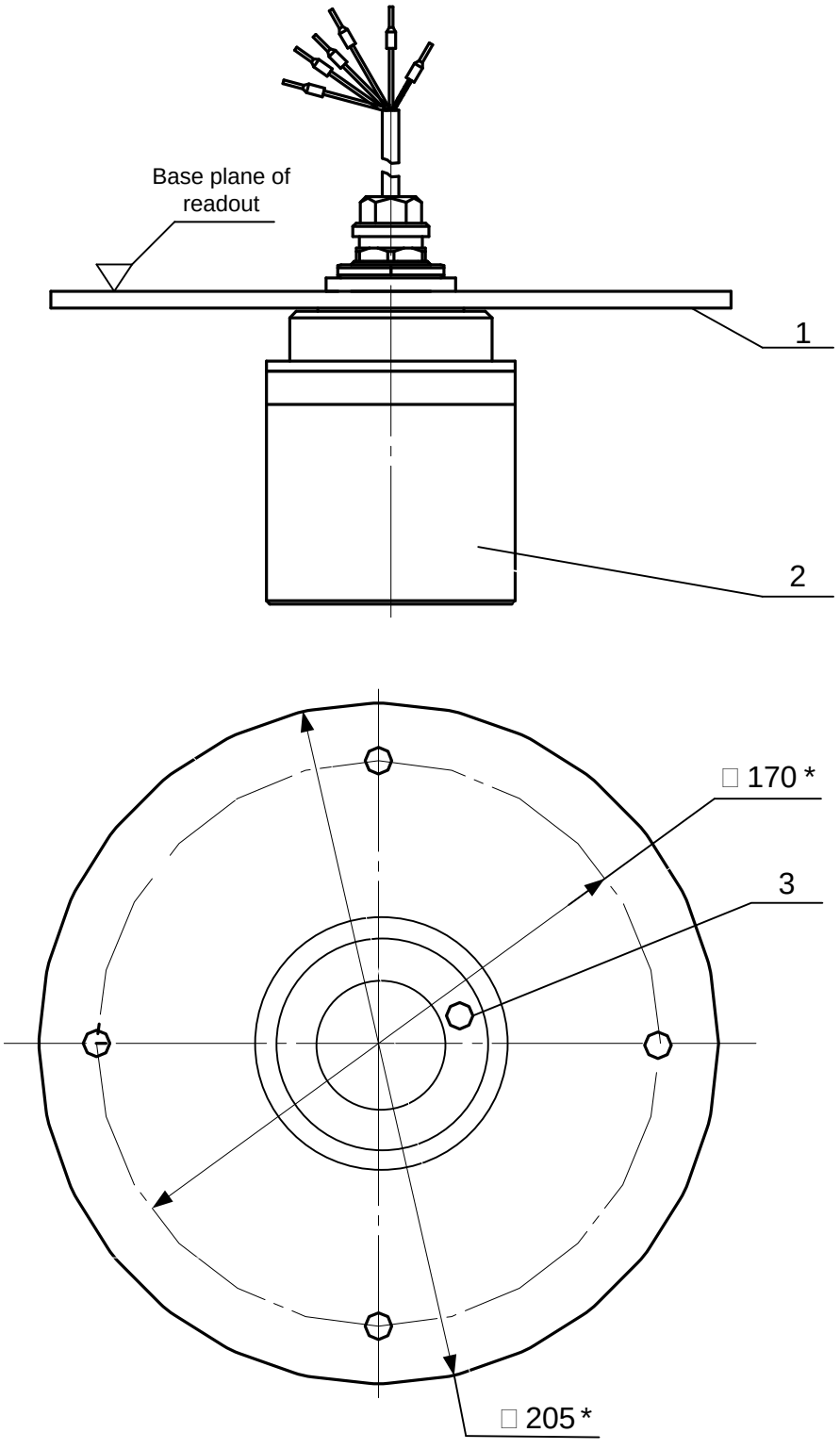
6. DISMOUNTING

To dismount the Level gauge before dispatching for regular calibration or repair, it is necessary to:

- Turn power off the Device
- Unscrew 6 screws fixing the Measurement Subblock to the Mount Module from the front panel side
- Disconnect signal cables connecting BMD with external devices from the terminal blocks
- Screw 6 screws fixing the Measurement Subblock to the Mount Module
- Remove BMD
- Unscrew 4 screws on the cover of the Communication Block
- Disconnect all CB cables from the terminal blocks
- Remove AS together with the rigidly terminated cable.

When the Level gauge (BMD, AS) is dispatched for calibration or repair, the acoustic systems should be cleaned off sediments, residue, scale, etc.

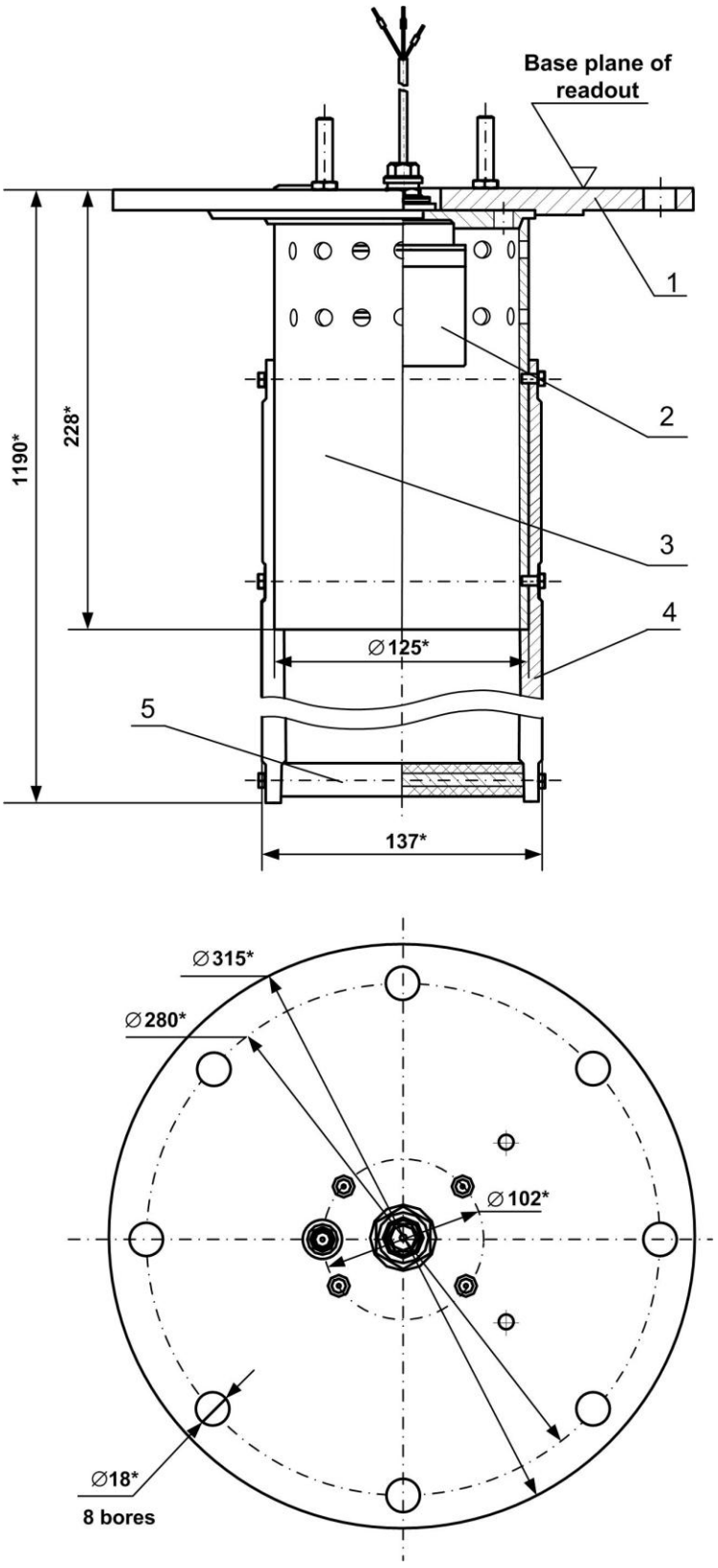
APPENDIX A. Acoustic systems



** - reference dimension*

1 – Mount rail; 2 – PEP; 3 – sensitive element RTD

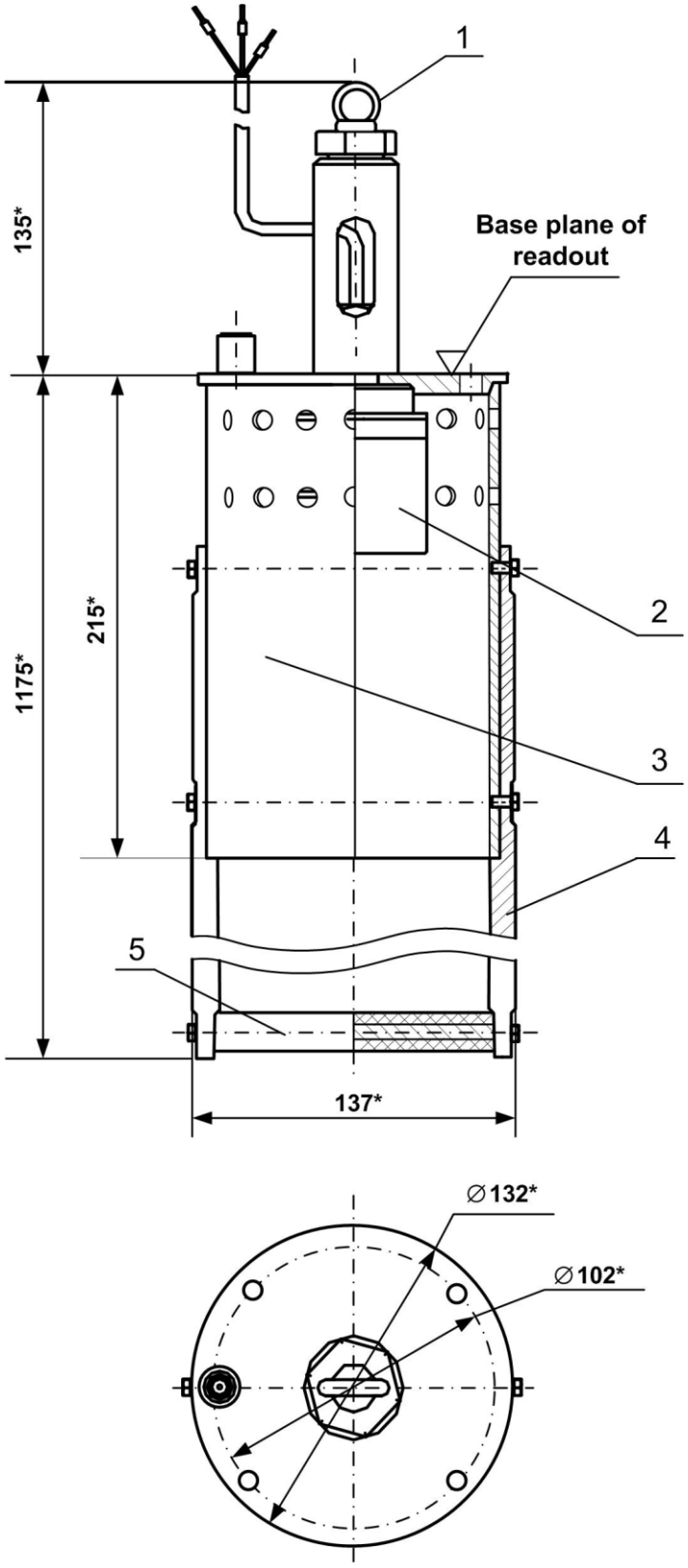
Fig. A.1. AS-11x-xx3 acoustic system



** - reference dimension*

1 – AS mount flange; 2 – PEP; 3 – sound guide; 4 – holder of reference reflector; 5 – reference reflector

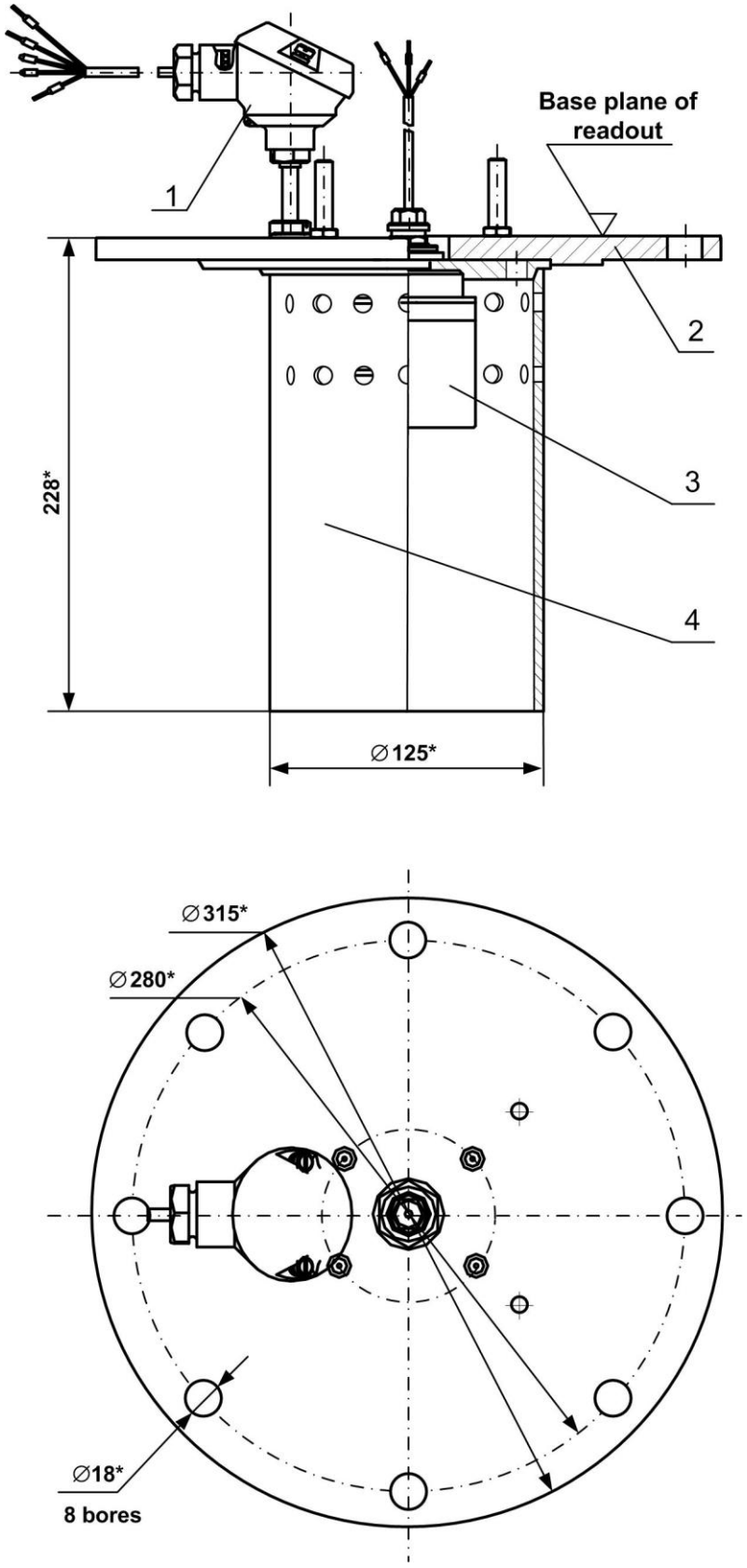
Fig. A.2. AS-40x-xx0 Acoustic system



** - reference dimension*

1 – ring bolt; 2 – PEP; 3 – sound guide; 4 – holder of reference reflector; 5 – reference reflector

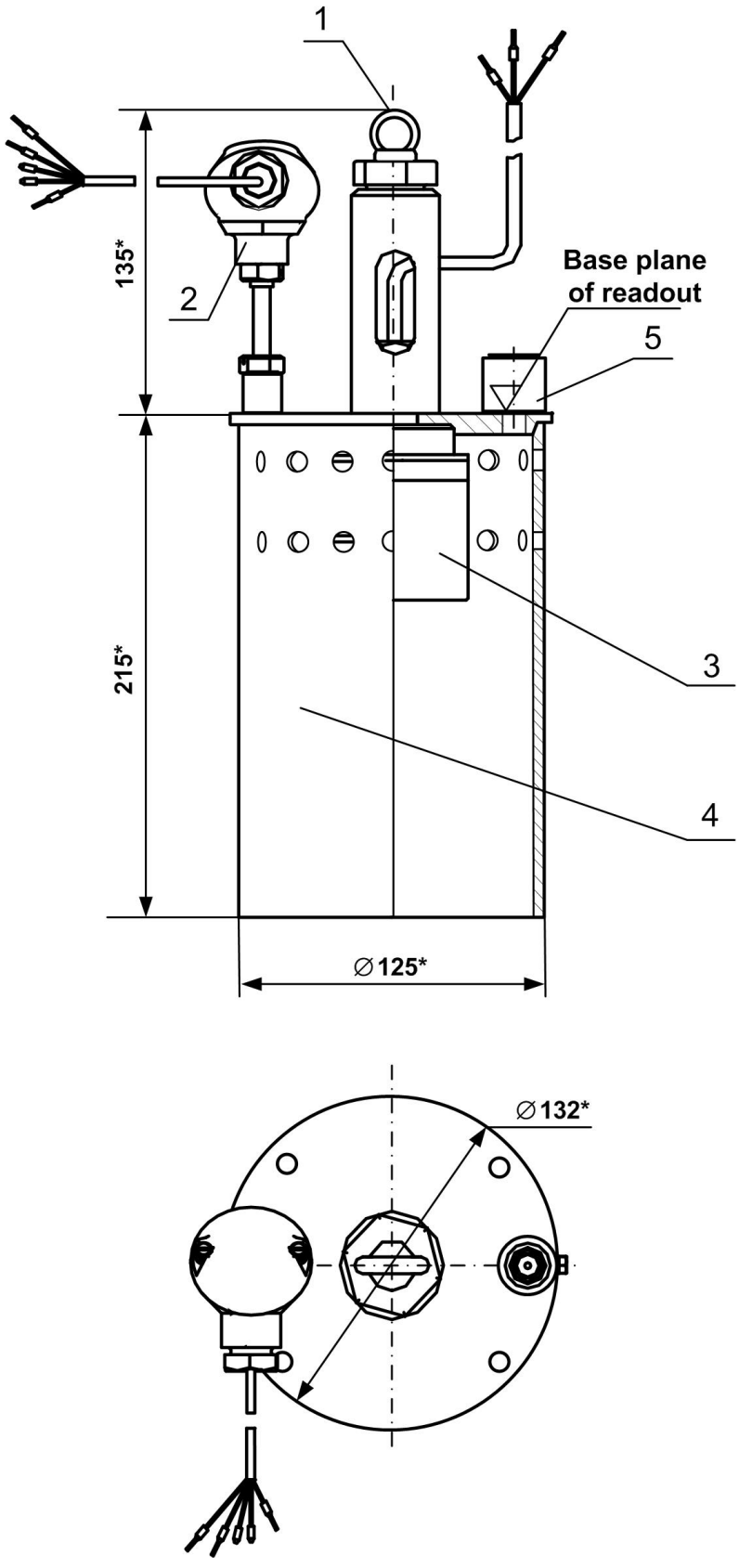
Fig. A.3. AS-50x-xx0 Acoustic system



** - reference dimension*

1 – RTD; 2 – mount flange; 3 – PEP

Fig. A.4. 61x-xx0 Acoustic system



** - reference dimension*

1 – ring bolt; 2 – RTD; 3 – PEP; 4 – sound guide; 5 – counterbalance

Fig. A.5. AS-71x-xx0 Acoustic system

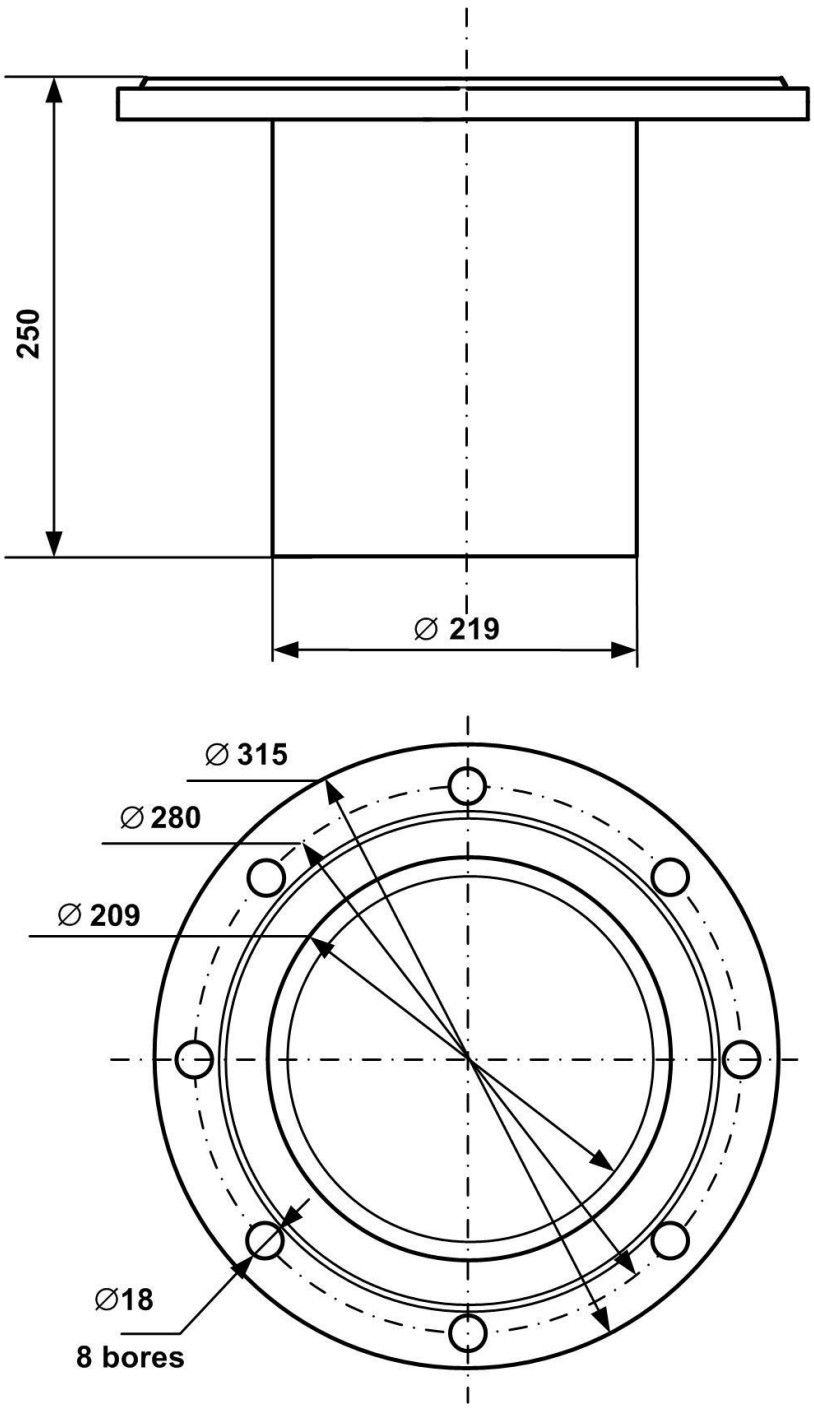


Fig. A.6. Mount Adaptor

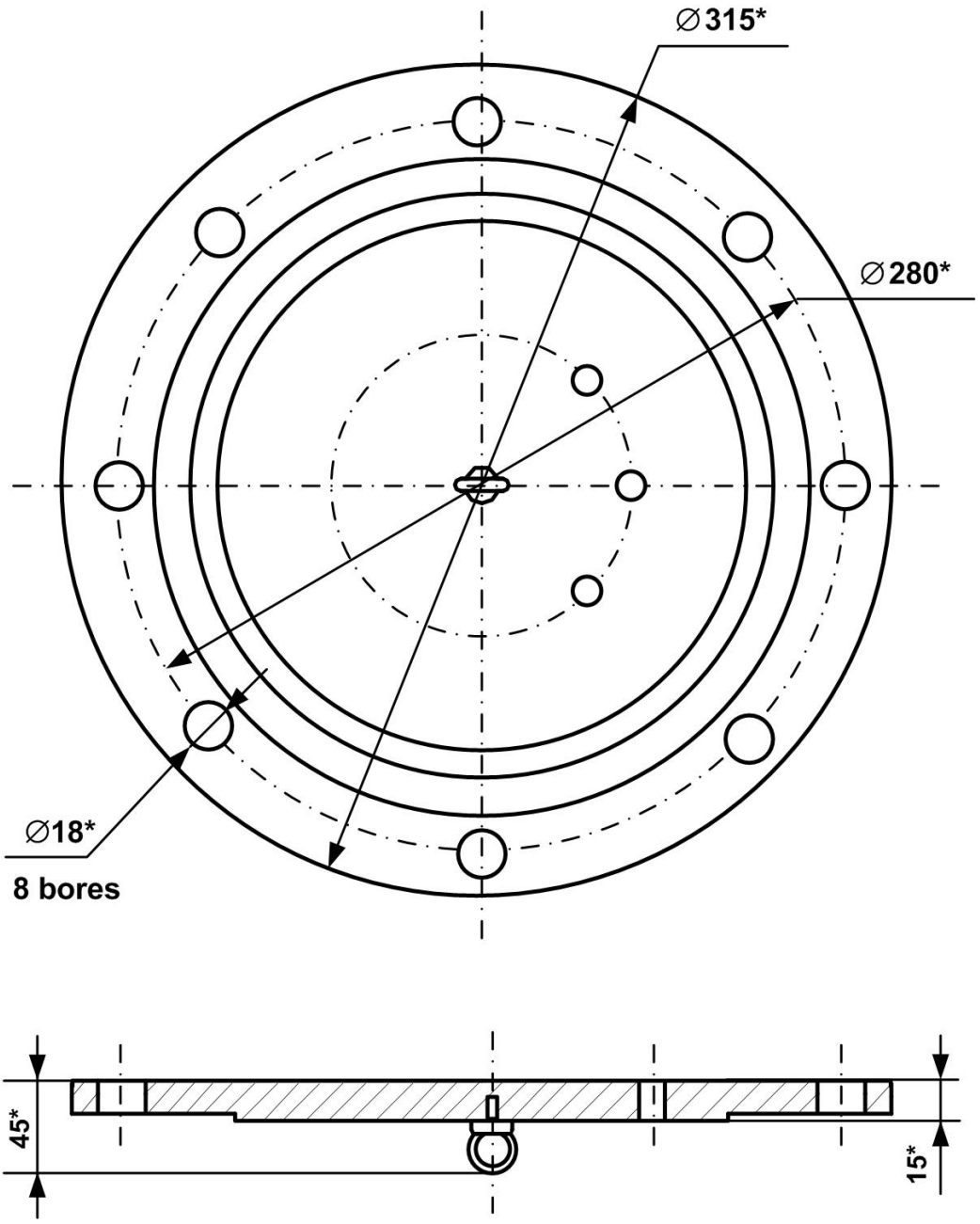


Fig. A.7. Flange with the ring bolt installed

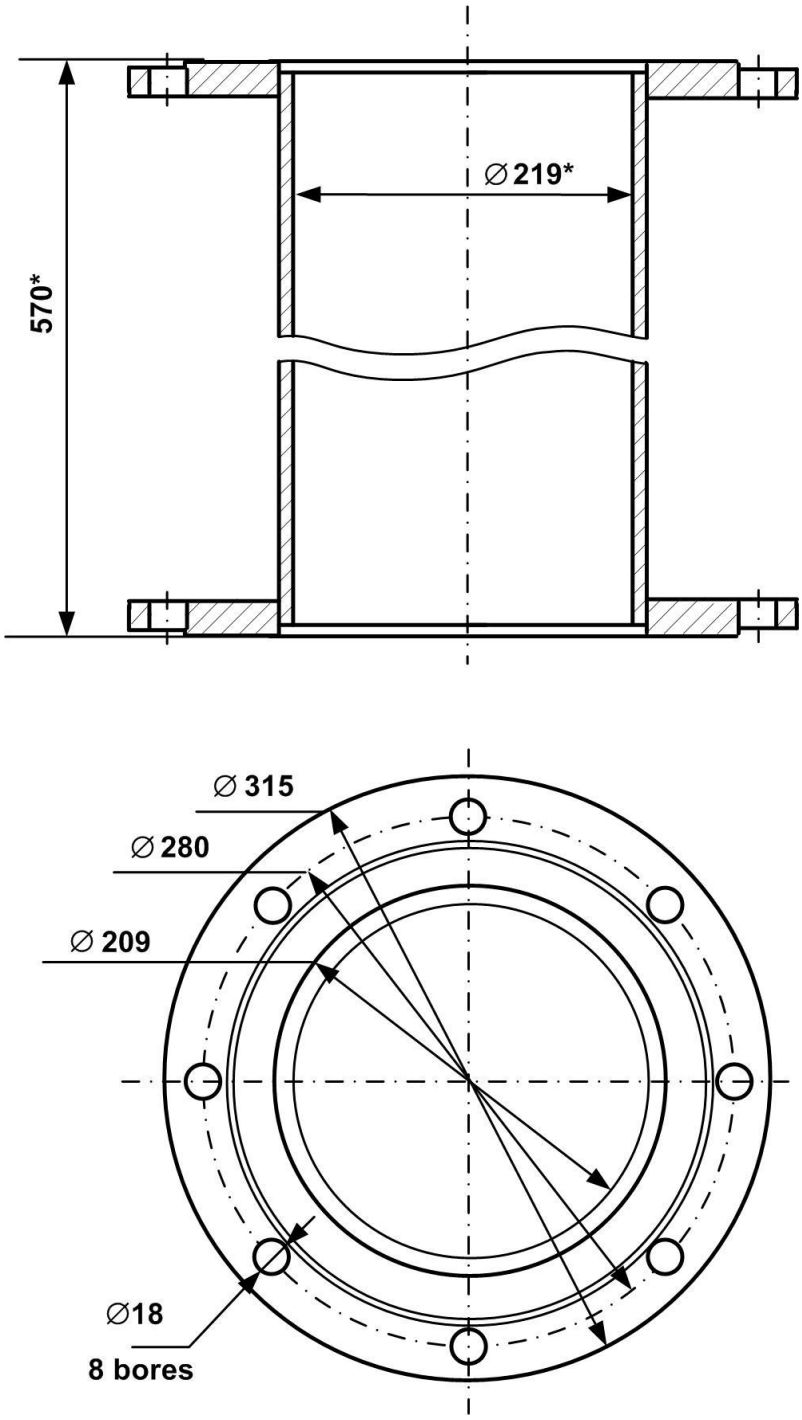


Fig. A.8. Pipe mount adaptor

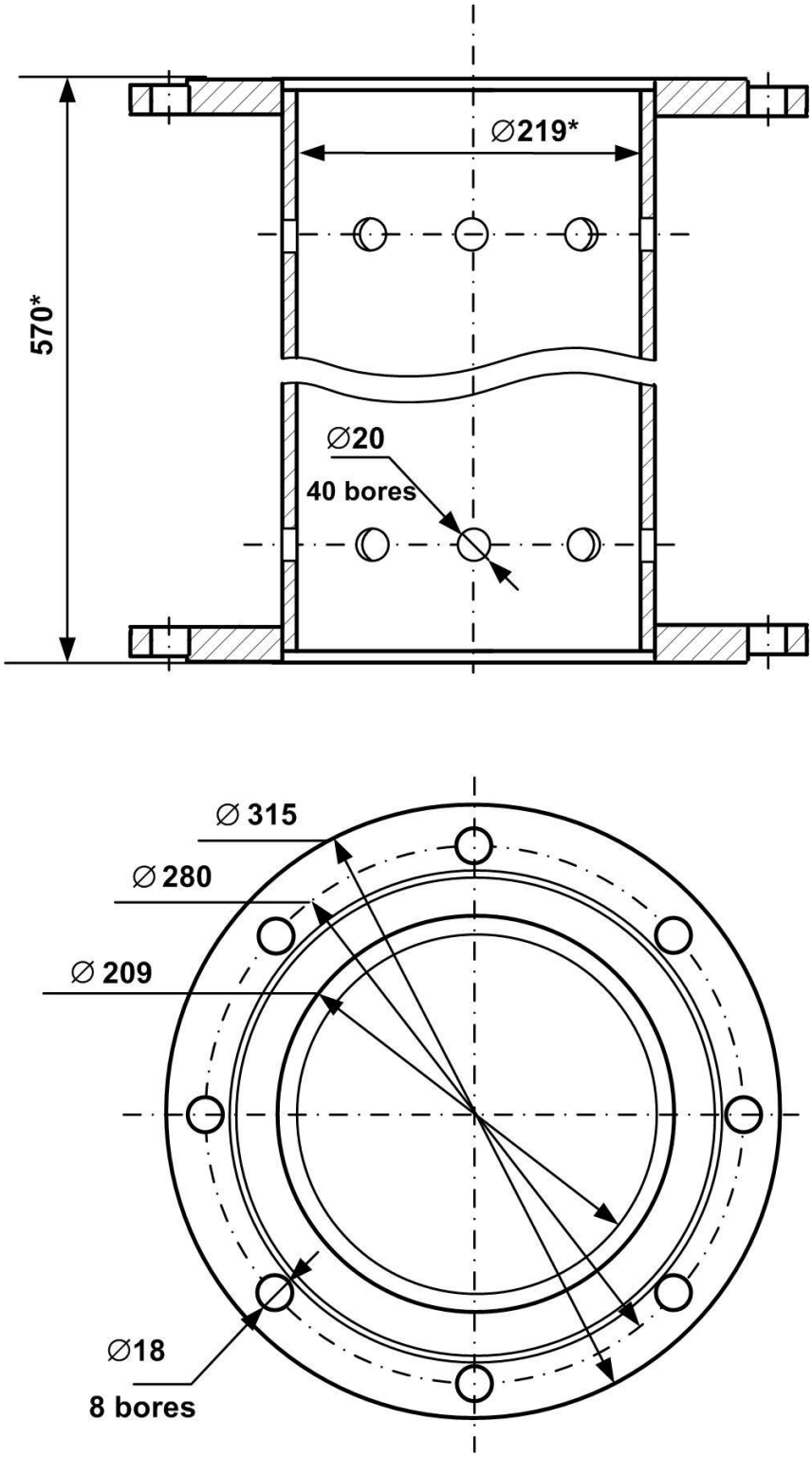


Fig. A.9. Perforated adaptor pipe

APPENDIX B. Methods for mounting acoustic systems

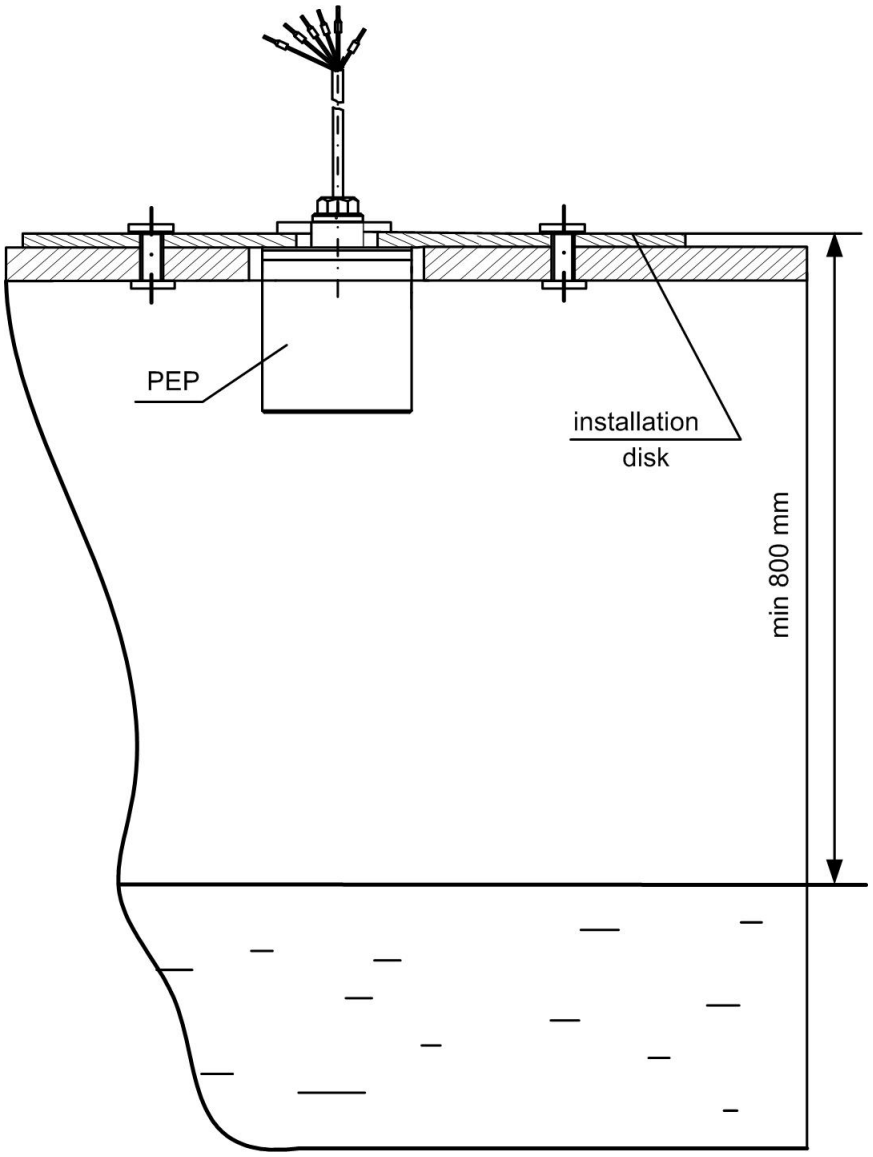
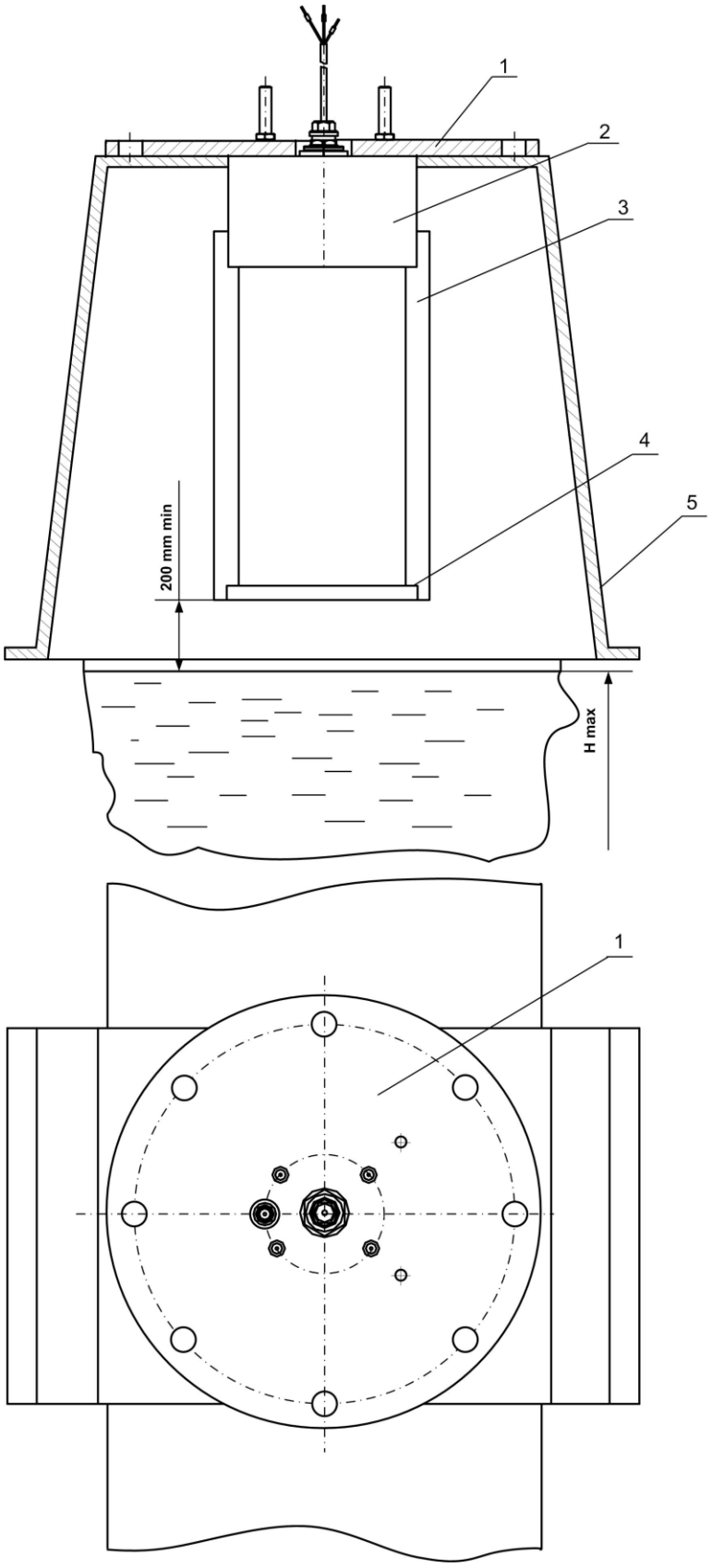
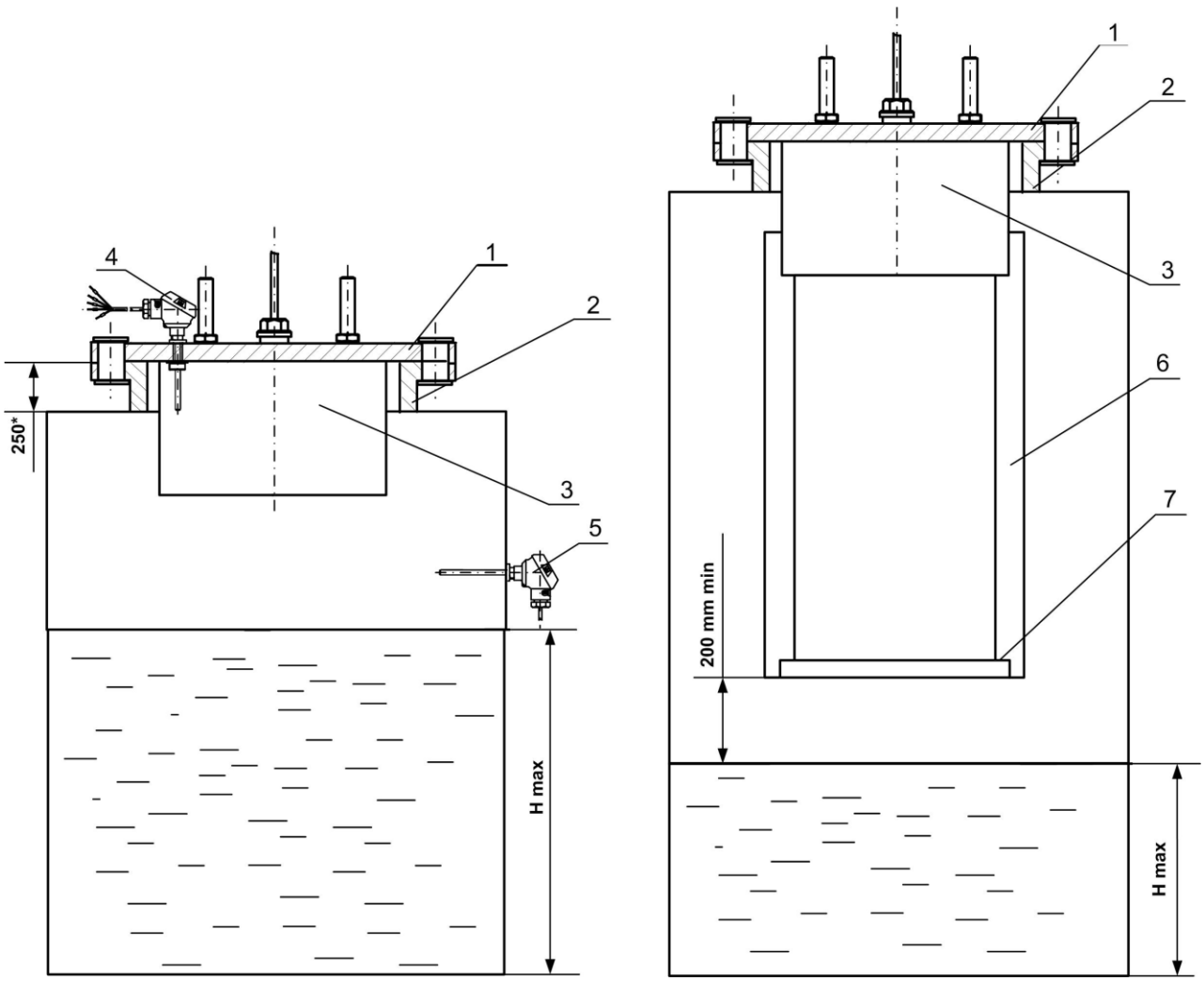


Fig. B.1. Mounting AS-11x-xx3



1 – AS mount flange; 2 – sound guide; 3 – reference reflector holder; 4 – reference reflector; 5 – frame

Fig. B.2. Mounting AS-40x-xx0 on a frame

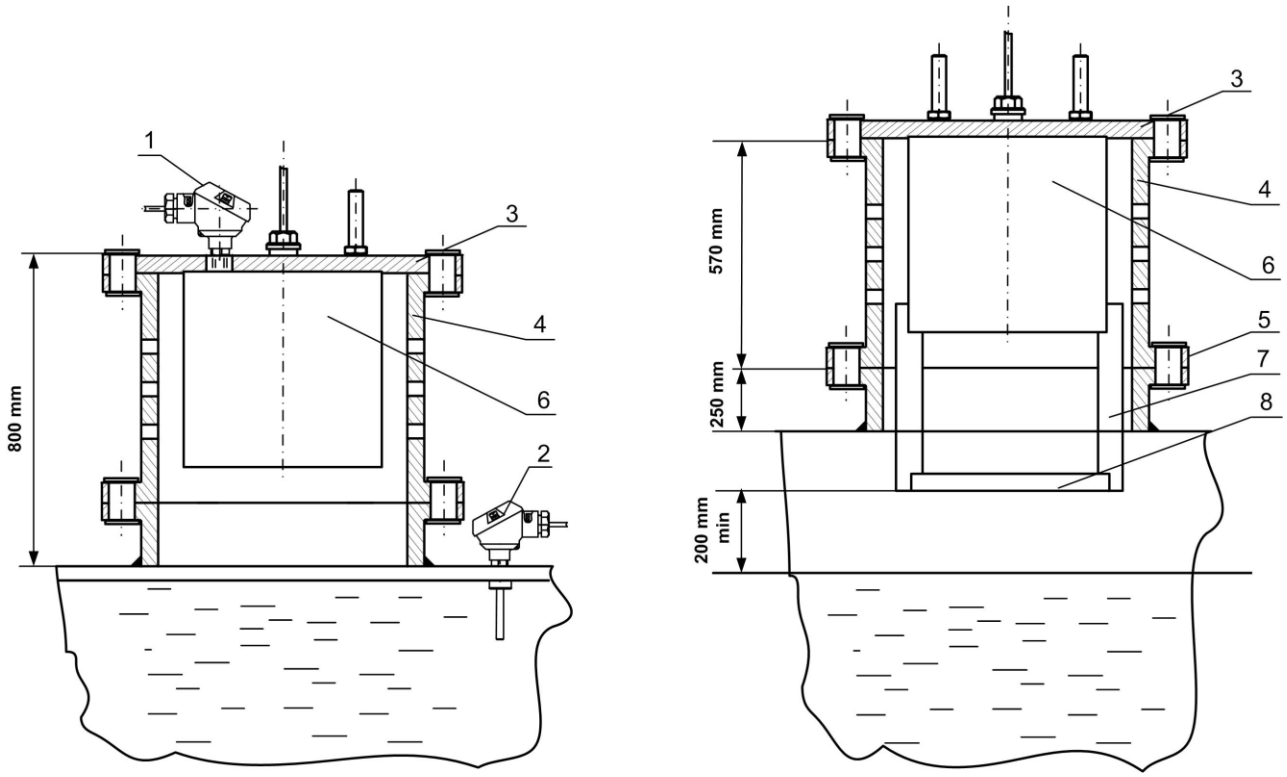


a) AS-62x-xx0 b) AS-40x-xx0

** - reference dimension*

1 – AS mount flange; 2 – mount adaptor; 3 – sound guide; 4 – RTD1; 5 – RTD2; 6 – reference reflector holder; 7 – reference reflector

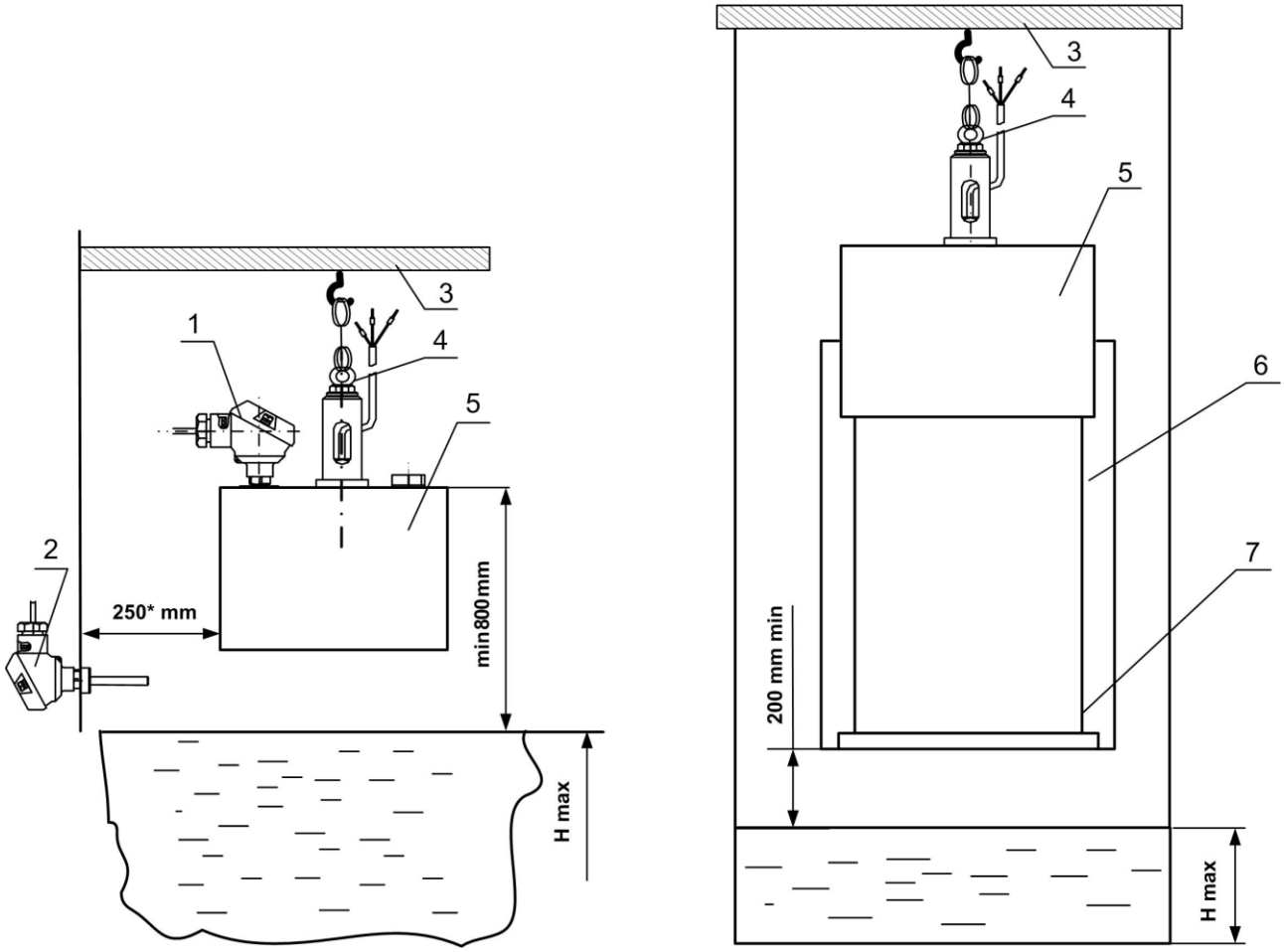
Fig. B.3. Rigid mounting of AS using Mount Adaptor



a) AS-61x-xx0, 62-x-xx0 b) AS-40x-xx0

1 – RTD1; 2 – RTD2; 3 – AS mount flange; 4 – adaptor pipe; 5 - mount adaptor; 6 – sound guide; 7 – reference reflector holder; 8 – reference reflector

Fig. B.4. Rigid mounting of AS using Mount Adaptor and adaptor pipes

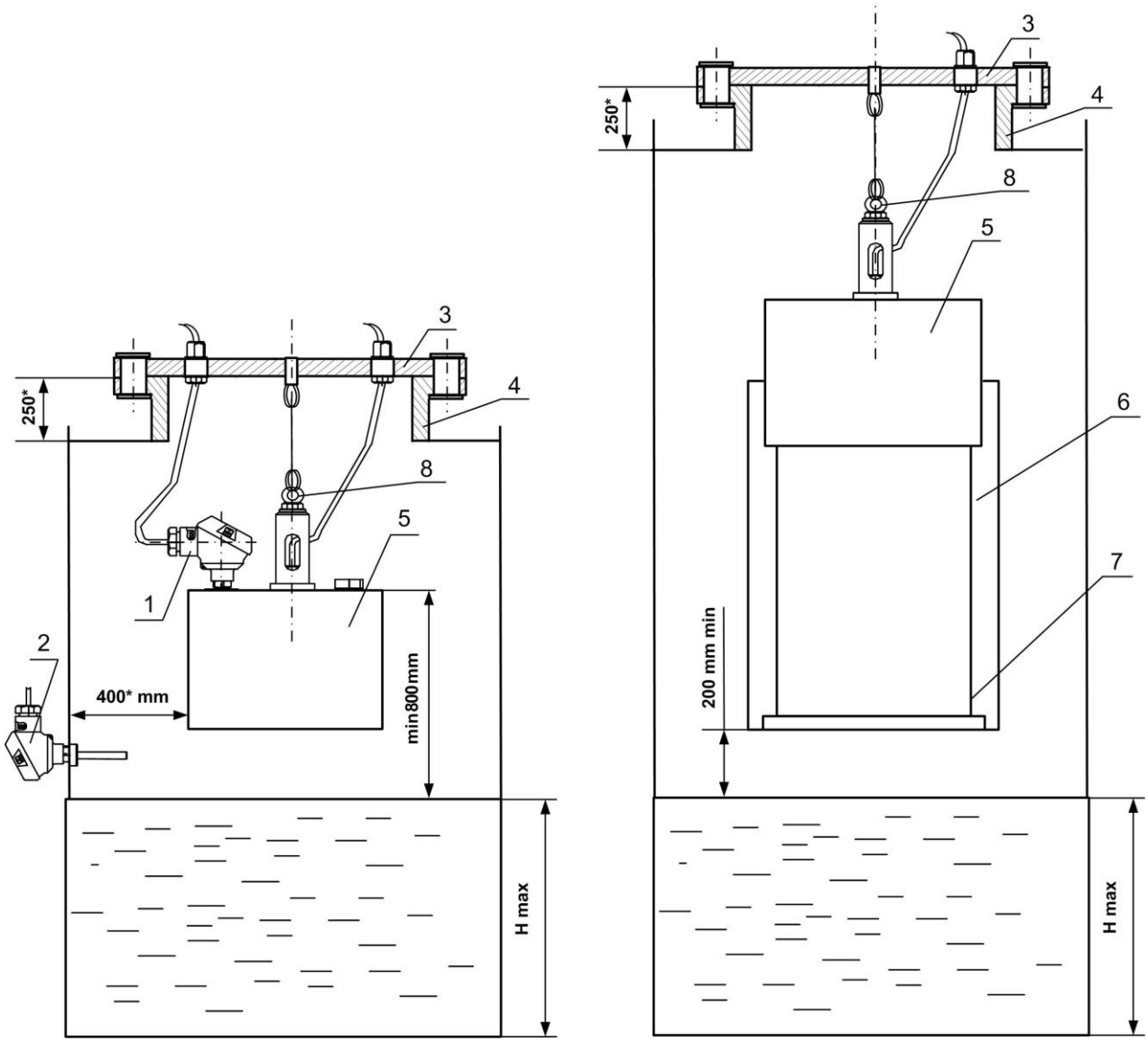


a) AS-72x-xx0 b) AS-50x-xx0

** - reference dimension*

1 – RTD1; 2 – RTD2; 3 – structural component; 4 – ring bolt; 5 – sound guide; 6 – reference reflector holder; 7 – reference reflector

Fig. B.5. "Flexible mount", AS suspended from a structural component of the object under control



** - reference dimension*

1 – RTD1; 2 – RTD2; 3 – flange with ring bolt; 4 – mount adaptor; 5 – sound guide; 6 – reference reflector holder; 7 – reference reflector

Fig. B.6. "Flexible mount", AS suspended from a flange on a ring bolt

APPENDIX C. Wiring diagrams

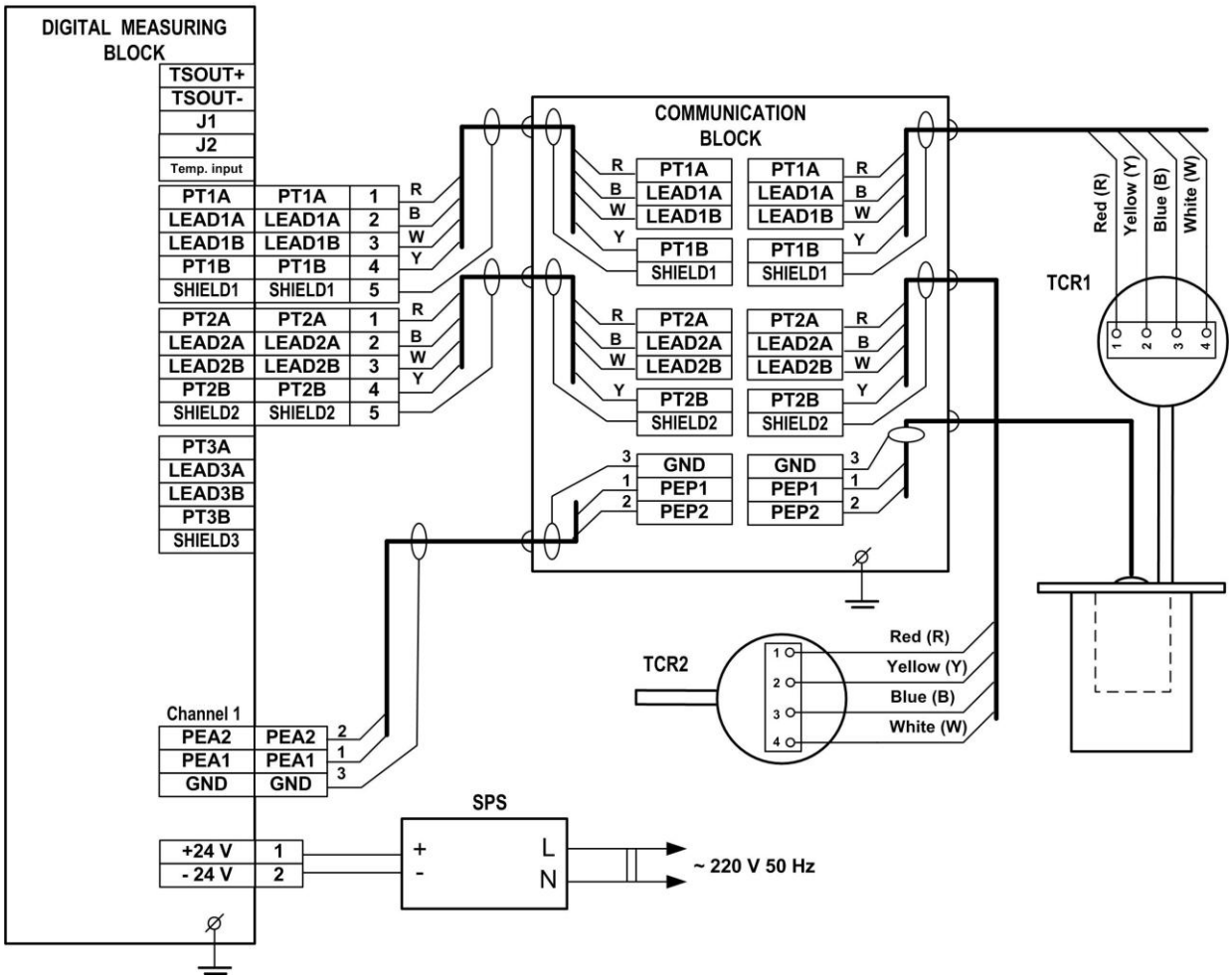
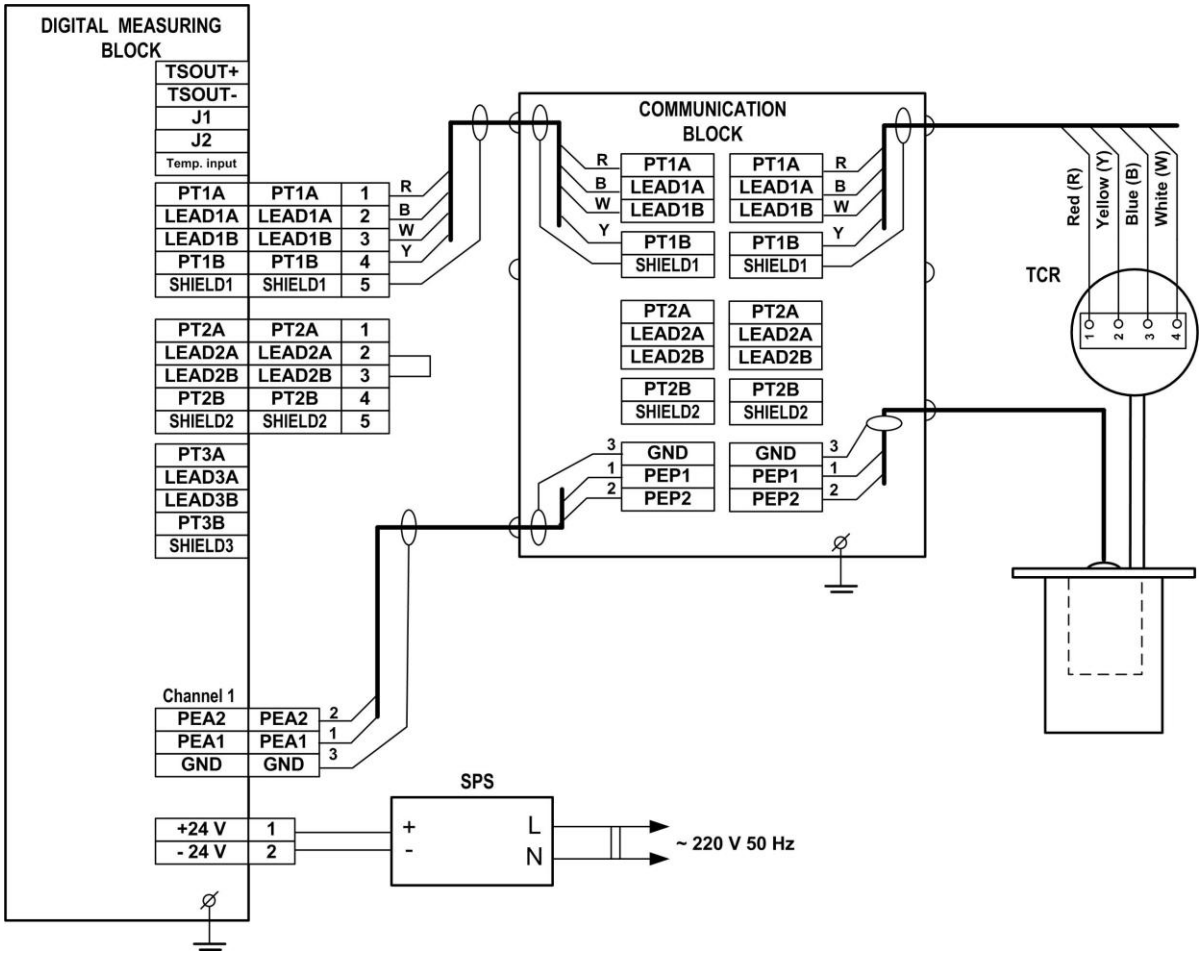


Fig. C.1. Diagram for connection of AS-62X-XX0, -72X-XX0 acoustic systems (fore 2 RTD) to the one-channel BMD



NOTE. If RTD2 is not installed, LEAD2A and LEAD2B contacts must be closed by a jumper.

Fig. C.2. Diagram for connection of AS-61X-XX0, -71X-XX0 acoustic systems (fore 1 RTD) to the one-channel BMD

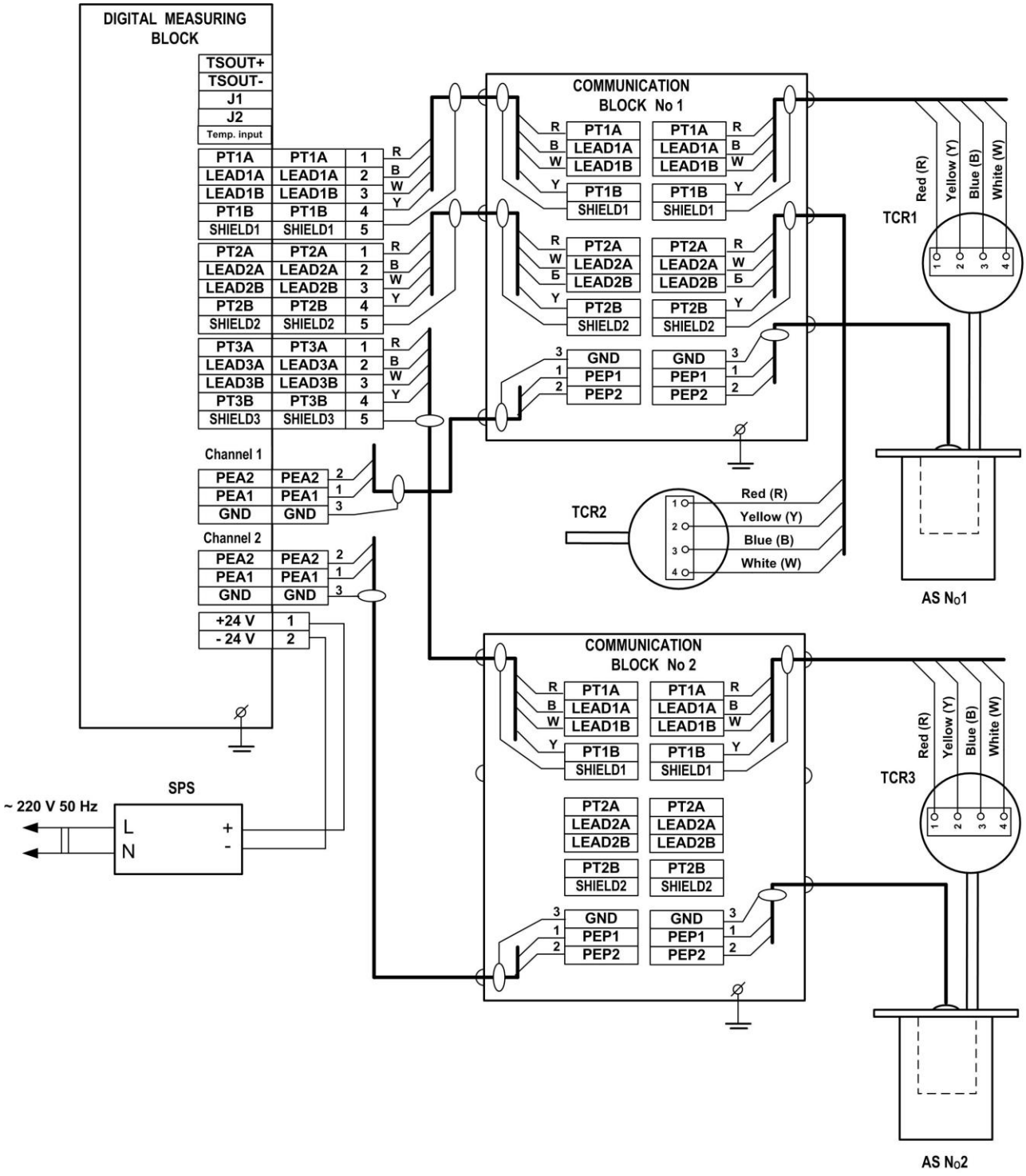


Fig. C.3. Diagram for connection of AS-61X-XX0, -71X-XX0 acoustic systems and AS-62X-XX0, -72X-XX0 acoustic systems to the two-channel BMD

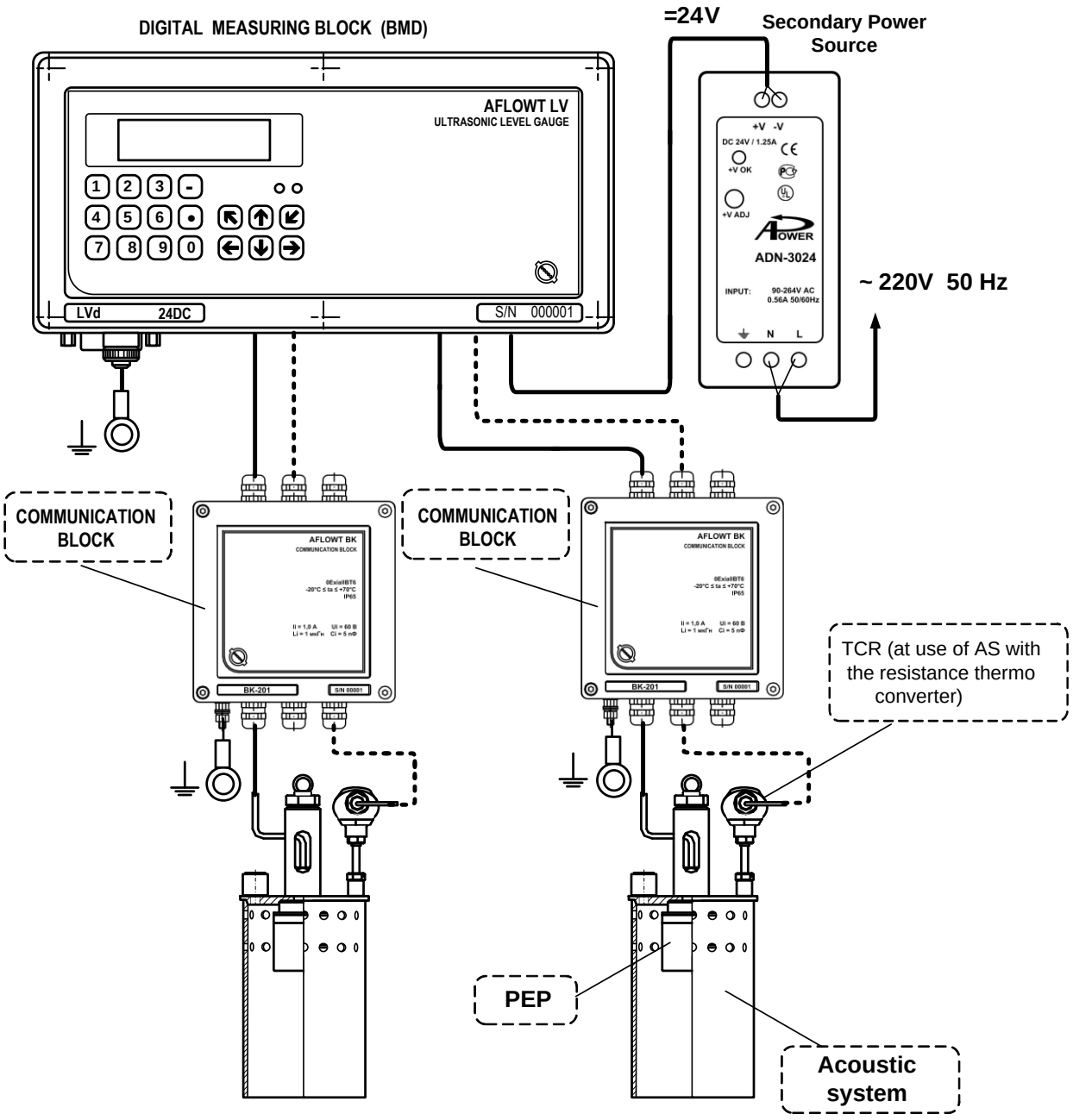


Fig. C.4. Diagram for connection of two-channel Level gauge

APPENDIX D. Report on mounting and start-up procedures

(Recommended)

REPORT
on mounting and start-up procedures for "AFLOWT LV" Level gauge
Serial No_____

(page___ of____) UL-2 version_____Channel No_____

BMD____ Serial No _____

AS type_____ Serial No_____, PEP type_____ Serial No _____,

RTD1 type _____Serial No _____,

Add. RTD2 type _____ Serial No _____

1. Site

_____
Organization name, postal address, tel/fax

2. Characteristics of the object under control:
Type of the tank (channel, cylinder, pipe, etc.) _____
Location of the tank _____
Liquid (substance) under control _____
Maximal level H_{max}, m _____
Minimal level H_{min}, m _____
Level measurement base B, m _____
Velocity of ultrasound (C_0) in the sound guide at 0 °C, m/s _____

3. Sketch of the tank and mounting method of the Acoustic system

4. Overall dimensions of the tank: _____

5. HV-function of the tank

Table D.1

No of the point	1	2	3	4	5	6	7	8
Level, m								
Volume,m^3/h								
No of the point	9	10	11	12	13	14	15	16
Level, m								
Volume,m^3/h								
No of the point	17	18	19	20	21	22	23	24
Level, m								
Volume,m^3/h								
No of the point	25	26	27	28	29	30	31	32
Level, m								
Volume,m^3/h								

6. Notes _____

_____

Representative of start-up organization

_____ / _____ /

Signature name and initials

«___ " _____ 20__

Customer representative

_____ / _____ /

Signature name and initials

«___ " _____ 20__

APPENDIX E. Adjustment profiles

Tables E.1-E.4 contain standard values of the parameters included in the factory-installed adjustment profiles.

Table E.1. Profile1 (for AS-40X-XX0, AS-50X-XX0)

Parameter	Type of ultrasound velocity correction*	Dead zone, m	Correlation threshold	Number of cycles in a sounding pulse	Search criterion
Representation on the display	**Type of correction**	**Ddz**	**Smin**	**Np**	**Search by**
Value	**ref.**	1.000	10	20	**max (D*A)**

Table E.2. Amplification characteristic

Curve	DAC1				DAC3			
Point	1	2	3	4	1	2	3	4
Time, μs	6000	7000	40000	100000	6000	10000	35000	100000
Amplification, convent. units	55	85	40	30	50	60	150	220

Table E.3. Profile 2 (for AS-1xx-xx3, AS-6xx-xx0, and AS-7xx-xx0)

Parameter	Type of ultrasound velocity correction*	Dead zone, m	Correlation threshold	Number of cycles in a sounding pulse	Search criterion
Representation on the display	**Type of correction**	**Ddz**	**Smin**	**Np**	**Search by**
Value	**t °C**	0.800	10	20	**max (D*A)**

Table E.4. Amplification characteristic

Curve	DAC1				DAC3			
Point	1	2	3	4	1	2	3	4
Time, μs	3000	7000	60000	100000	3000	6000	40000	100000
Amplification, convent. units	110	90	40	30	55	30	150	220

* - type of correction of ultrasound velocity in the gas medium:

- ref. - by the reference reflector

- t °C - by RTD.

APPENDIX F. Velocity of ultrasound for pure gases

Velocity of ultrasound in pure gases at 0 °C

Table F1

Name of the gas	Ultrasound velocity C_0, m/s
Nitrogen	334
Nitrogen monoxide (laughing gas)	263
Nitrogen dioxide	324 *
Ammonia	415
Argon	308
Dry air	331
Hydrogen	1284
Hydrogen bromide	200
Hydrogen iodide	157
Hydrogen sulphide	289
Hydrogen chloride	206
Blue gas	453
Sulfur dioxide gas SO_2	213
Helium	965
Deuterium	890
Oxygen	316
Methane (swamp gas)	430
Neon	435
Carbon monoxide CO	338
Carbon dioxide CO_2	259
Chlorine	206
Ethane	308 *
Ethyl	317

* Ultrasound velocity at a temperature of 10 °C