**DESIGN BUREAU "FIZELEKTRONPRIBOR"**

**OKP 42 1550**

# Moisture meters FIZEPR-SW100

Technical Description and
Operating manual instructions for VIGT.415210.100-01 RE
**Part 1**
(ed. 3.16)

**Samara, 2026**

CONTENT

## 1. Introduction

1.1 This technical description and operating manual is intended to familiarize you with the design, operating principle, installation rules, preparation, testing and maintenance of moisture meters. FIZEPR-SW100 VIGT.415210.100.

1.2 FIZEPR-SW100 moisture meters are included in the State Register of Measuring Instruments of the Russian Federation:

1) Registration number 58390-14, Certificate of approval of the type of measuring instruments RU.C.31.001.A No. 56698, 09/08/2014, verification procedure MP 242-1715-2014;

2) Registration number 75771-19, Certificate of approval of the type of measuring instruments OS.S.31.006.A No. 74665, 08/26/2019, verification procedure MP 0919-6-2018.

1.3 FIZEPR-SW100 moisture meters are registered in the Register of the State System for Ensuring the Uniformity of Measurements of the Republic of Kazakhstan:

1) certificate No. 12284, registered on October 27, 2015, number KZ.02.03.06827-2015/58390-14;

2) certificate No. 587, registered on 03.03.2021, number KZ.02.03.00587-2021/75771-19.

1.4 FIZEPR-SW100 moisture meters are available in two main versions:

- general industrial performance;
- explosion-proof design.

The explosion safety of moisture meters is confirmed by a certificate of conformity TR CU 012/2011 No. TC RU C-RU.АД07.B.03758/21, series RU No. 0264976, issued by VELES CS LLC on September 9, 2021. Explosion protection marking is given in Table 12.

For explosion-proof moisture meters, the scope of application of the electronic unit is hazardous areas of classes 1 and 2 according to GOST 31610.10-1-2022 (IEC 60079-10-1:2020) of categories of explosive mixtures IIA, IIB according to GOST 31610.20-1-2020 (ISO/IEC 80079-20-1:2017), hazardous areas of classes 21 and 22 according to GOST IEC 60079-10-2-2011, containing explosive dust of subgroups IIIA, IIIB and IIIC, as well as underground workings of coal mines and pits, including those hazardous in gas (methane) and (or) coal dust, and their above-ground structures according to explosion protection markings of electrical equipment, GOST IEC 60079-14-2013 and other regulatory documents governing the use of electrical equipment in potentially explosive environments.

The scope of application of the sensor for explosion-proof moisture meters is hazardous areas of classes 0, 1 and 2 according to GOST 31610.10-1-2022 (IEC 60079-10-1:2020) of categories of explosive mixtures IIA, IIB according to GOST 31610.20-1-2020 (ISO/IEC 80079-20-1:2017), hazardous areas of classes 20, 21 and 22 according to GOST IEC 60079-10-2-2011, containing explosive dust of subgroups IIIA, IIIB and IIIC, as well as underground workings of coal mines and pits, including those hazardous in terms of gas (methane) and (or) coal dust, and their above-ground structures according to explosion protection markings of electrical equipment, GOST IEC 60079-14-2013 and other regulatory documents governing the use of electrical equipment in potentially explosive environments.

1.5 FIZEPR-SW100 moisture meters comply with Class III protection against electric shock according to GOST 12.2.007.0-75. These moisture meters are designed to operate at safe extra-low voltage (24 V) and have no external or internal electrical circuits operating at higher voltages.

1.6 FIZEPR-SW100 moisture meters are equipped with two channels for transmitting measurement results:

- digital interface RS-485, MODBUS RTU protocol;
- analog interface current loop 4–20 mA.

1.7 The manufacturer reserves the right to make changes to the design and layout of moisture meters that do not affect their technical characteristics, without adjusting the operating and technical documentation.

## 1. Purpose and general description of moisture meters

2.1. Moisture meters FIZEPR-SW100 (hereinafter referred to as moisture meters) are designed to measure moisture content – the proportion of water (in percent) in bulk, granular and pasty materials, as well as in liquid materials, including in aqueous suspensions.

***Note.*** For FIZEPR-SW100 moisture meters intended for measuring water content in oil, petroleum products, and other liquid materials, the operation manual "Moisture meters FIZEPR-SW100 for measuring oil and petroleum products. Technical description and operation manual VIGT.415210.100 RE. Part 1" applies. These moisture meters comply with GOST 8.614-2013 GSI "State verification scheme for instruments for measuring the volumetric moisture content of oil and petroleum products" and are verified according to the document "GSI Instructions. Moisture meters FIZEPR-SW100. Verification methodology MP 0919-6-2018" approved by FSUE "VNIIR" on November 15, 2018

2.2 According to its operating principle, the FIZEPR-SW100 moisture meter is a radio wave device – a dielectric meter. The method for measuring dielectric permittivity $\varepsilon_r$ direct, based on measuring the deceleration coefficient $K_{dec}$ electromagnetic wave in the controlled material. Deceleration factor $k_{dec}$, also known as the refractive index, is the ratio of the speed of propagation of an electromagnetic wave in air (i.e., the speed of light) to the speed of its propagation in the material being measured. Measurements are made by probing the medium with radio waves at frequencies in the range of 40 to 750 MHz and in the range of 0.2 MHz to 1500 MHz for moisture meter modifications "with an extended frequency range." To find $K_{dec}$ the moisture meter calculates the ratio of the sensor's resonant frequency in air to its resonant frequency in the material being monitored. Using this deceleration factor, the moisture meter's processor calculates the water content, taking into account the material's temperature. The calculation is based on calibration tables prepared for each type of material being monitored and stored in the moisture meter's memory.

The moisture measurement method used ensures high accuracy and repeatability of measurement results. The moisture meter's metrological characteristics are independent of external conditions, and the temperature of the semiconductor converters and the electronic unit itself does not affect the measurements.

It should be noted that to ensure high accuracy of moisture measurement, the calibration of the moisture meter (preparation of calibration tables) must be performed on samples of the exact material on which the moisture meter will be used.

2.3 The parameter measured by a moisture meter – moisture – is the ratio of the mass of water contained in the material to the mass of the wet material and is determined by the following expression:

$$W = \frac{m_{wet} - m_{dry}}{m_{wet}} \times 100\%$$

Where $W$ - moisture of the material;

$m_{wet}$- mass of wet material sample;

$m_{dry}$ - the mass of the same sample of material after drying.

For measuring liquid materials, calibration is most often used that corresponds to the volumetric moisture content of the material, which is determined by the following expression:

$$W = \frac{V_{water}}{V_{sample}} \times 100\%$$

$V_{water}$ - volume of water in the sample;

$V_{sample}$ - sample volume.

The type of calibration applied is indicated in the moisture meter's passport.

2.4 Moisture meters consist of an electronic unit and a sensor connected by a cable. The cable connection to the sensor is permanent and sealed with compound. The cable connection to the electronic unit is detachable.

Depending on the conditions of use and the materials being monitored, moisture meters are available in the following modifications:

1) VIGT.415210.100-**1x (where x = 0, 1, 2, …) for measuring bulk and pasty materials in bunkers, tanks, augers, chutes, conveyor belts and mixers;**

2) VIGT.415210.100-**2x (where x = 0, 1, 2, …) for measuring oil, petroleum products, as well as vegetable oils and other liquid materials in pipelines under pressure and in tanks;**

3) VIGT.415210.100-**3x (where x = 0, 1, 2, …) for laboratory measurements of various** materials.

All of the moisture meter models listed differ in their sensor design. All sensor variants contain a probe that is inserted into the material being monitored. The probe is made of corrosion-resistant steel of the following grades: AISI 321, AISI 420, AISI 440B, AISI 316Ti, and AISI 431. The moisture meter's electronic units are interchangeable. For moisture meters used in hazardous environments, the electronic unit is housed in an explosion-proof housing, which also includes spark-proof barriers, ensuring the explosion safety of the signal transmission line to the sensor and its electrical circuits.

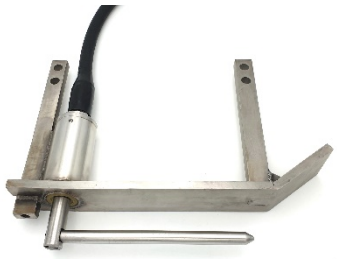
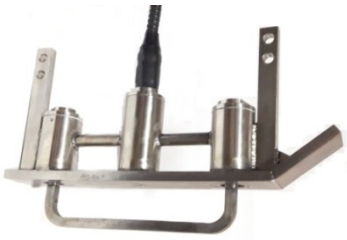
In all modifications of moisture meters, the sensor includes a temperature sensor (thermocouple or thermistor), which measures the temperature of the monitored material.

2.5 The list of moisture meter modifications (design options) is given in Tables 1 - 9.

Table 1

**Moisture meters FIZEPR-SW100.10.x,**
**containing a shield on which the probe is mounted**

| Designation moisture meter* | Purpose, controlled materials | Design of the sensor |
|---|---|---|
| FIZEPR-SW100 VIGT.415210.100 -10.6 | Bulk materials in bunkers, augers, chutes, pipes, or conveyor belts, as well as in drying units (grain, sand, etc.). For materials with particle sizes up to 20 mm. |  The sensor is made as a shield with a U-shaped probe mounted on it. The shield measures 120 x 356 mm. The gap between the probe and the shield is 40–45 mm. Sensor material: stainless steel AISI 321. |
| FIZEPR-SW100 VIGT.415210.100 -10.21 | Bulk materials in bunkers, augers, chutes, pipes, or conveyor belts, as well as in drying units (grain, sand, etc.). For materials with particle sizes up to 20 mm. |  The sensor is made as a shield on which a U-shaped probe is mounted. An additional shield conductor is placed parallel to the probe on the shield, eliminating the influence of metal objects located near the sensor. The gap between the probe and the shield is 40 mm. The sensor is made of AISI 321 stainless steel. |
| FIZEPR-SW100 VIGT.415210.100 -10.61 | Bulk materials in drying units (grain, sand, etc.). For materials with a particle size of up to 20 mm. Operating temperature: up to +300°C. |  The sensor is made as a panel with a U-shaped probe mounted on it. The gap between the probe and the panel is 40–45 mm. The sensor is made of AISI 321 stainless steel. The sensor's measuring cell (model B or B1) is located away from the probe, ensuring its operability at extreme temperatures. |
| FIZEPR-SW100 VIGT.415210.100 -10.63 | Powdered, granular, and bulk materials in a mixer (silicate mass, sand, etc.). For materials with a fraction size of up to 20 mm. |  The sensor is made as a shield with a U-shaped probe mounted on it. The shield, measuring 120 x 356 mm, is curved to a radius (the radius is specified when ordering). The gap between the probe and the shield is 40 mm. The sensor material is AISI 321 stainless steel. |

| | | |
|---|---|---|
| FIZEPR-SW100 VIGT.415210.100 -10.22 | Powdered, granular, and bulk materials in a mixer (silicate mass, sand, etc.). For materials with a fraction size of up to 20 mm. |  The sensor is made as a shield on which a U-shaped probe is mounted. An additional shield conductor is placed parallel to the probe on the shield, eliminating the influence of metal objects located near the sensor. The shield is curved to a radius (the radius is specified when ordering). The gap between the probe and the shield is 40 mm. The sensor is made of AISI 321 stainless steel. |
| FIZEPR-SW100 VIGT.415210.100 -10.5 | Bulk materials (crushed rock, sand) on a conveyor belt. For materials with particle sizes up to 20-30 mm. |  The sensor is made of AISI 321 (or AISI 316Ti) stainless steel. It is installed above the conveyor belt in the material flow. Its shape is optimized to create minimal flow resistance. A "bucket" made of high-impact and abrasion-resistant steel is mounted at the front of the sensor, loosening the material and completely filling the gap between the shield and the probe. |
| FIZEPR-SW100 VIGT.415210.100 -10.51 | Bulk materials (sand, silicate mass in sand-lime brick production) on a conveyor belt. For materials with particle sizes up to 20-30 mm. |  The flat sensor is made of wear-resistant AISI 321 stainless steel. It is installed above the conveyor belt in the material flow. Its shape is designed to create minimal flow resistance. |
| FIZEPR-SW100 VIGT.415210.100 -10.166 | Bulk materials with high electrical conductivity (coal, iron ore, salt, etc.) in a bin or chute. For materials with particle sizes up to 20–30 mm. The sensor can be used on materials with temperatures up to 120°C. |  The sensor is made as a shield on which a probe is mounted. The probe is replaceable in case of wear. The probe diameter is 18 mm. The probe is made of heat-treated (hardened) AISI 440B stainless steel. The gap between the probe and the shield is 45 mm.<br>The sensor body is made of AISI 321 stainless steel. |
| FIZEPR-SW100 VIGT.415210.100 **-10.56** | Bulk materials with high electrical conductivity (coal, iron ore, salts, etc.) in a flow on a conveyor belt. For materials with particle sizes up to 20-30 mm. |  The flat sensor is made of AISI 321 stainless steel (or AISI 316Ti). It is installed above the conveyor belt in the material flow. Its shape is optimized to create minimal flow resistance. The sensor probe is made of impact-resistant Hadfield steel (ASTM A128). |



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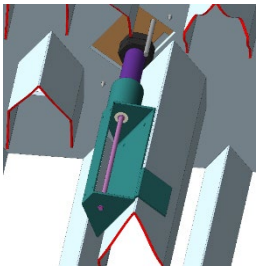
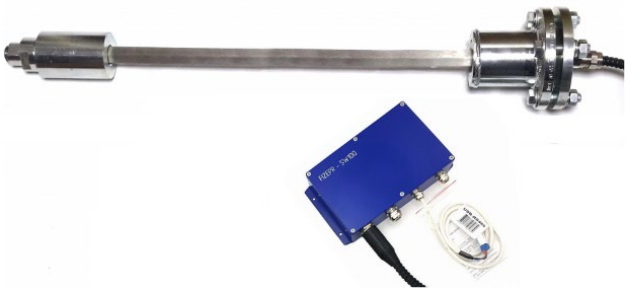
| FIZEPR-SW100 VIGT.415210.100 **-10.561** | Bulk materials with high electrical conductivity (coal, iron ore, salts, etc.) in a flow on a conveyor belt. For materials with particle sizes up to 20-30 mm. | The flat sensor is made of AISI 321 stainless steel (or wear-resistant AISI 316Ti).<br>  <br>It is installed above the conveyor belt in the material flow. The sensor's shape is optimized to create minimal flow resistance. The sensor probe is replaceable and made of hardened AISI 440B stainless steel. If significantly worn, the probe can be easily replaced with a spare one. |
| FIZEPR-SW100 VIGT.415210.100 **-10.8** | Grain in mines grain dryers. |   <br>The sensor is mounted in a shaft grain dryer, securing the mounting plate to the dryer wall with screws or self-tapping screws. Its sensing portion (frame with pin) is mounted directly on the air duct body, ensuring a constant and consistent flow of grain into the sensor. The sensor's compact dimensions (300 x 100 x 60 mm) allow it to be easily installed between air ducts of any dryer model. The permissible temperature of the sensor housing is 145°C. |

Table 2

**Moisture meters FIZEPR-SW100.10.4x, containing a rod-shaped probe**

| | | |
|---|---|---|
| FIZEPR-SW100 VIGT.415210.100 -10.4 | Bulk materials (sand, crushed stone, ore, grain, wood chips, etc.) in a bunker or dispenser, including materials that tend to build up on the bunker walls and probe. For materials with a particle size of up to 100–150 mm. |  <br>The sensor contains a probe made from a 27 mm hexagonal rod up to 1.2 m long. The probe is made of AISI 321 corrosion-resistant steel. The coupling holder set is also made of AISI 321 steel. |

| | | |
|---|---|---|
| FIZEPR-SW100 VIGT.415210.100 -10.44 | Bulk materials (sand, crushed stone, ore, grain, etc.) in the bunker and dispenser, including those that tend to build up on the bunker walls and probe. For materials with fraction sizes up to 100...150 mm. |  The probe is made of a 27 mm hexagonal rod up to 1.5m long, made of AISI 321 stainless steel. The set of coupling holders is also made of AISI 321 steel. |
| FIZEPR-SW100 VIGT.415210.100 -10.441 | Bulk materials (sand, crushed stone, ore, grain, etc.) in the bunker and dispenser, including those that tend to build up on the bunker walls and probe. For materials with fraction sizes up to 100...150 mm. |  The probe is a 27 mm hexagonal rod up to 2m long made of AISI 321 stainless steel. The set of coupling holders is also made of AISI 321 steel. |
| FIZEPR-SW100 VIGT.415210.100 -10.41 | Powdered, granular, bulk materials in a bin, pipe or chute, including sawdust, chips, shavings, grain, etc. |  The probe is a straight rod with a diameter of 14 mm and a length of up to 0.6 m, made of AISI 321 stainless steel. The sensor includes a set of AISI 321 stainless steel holders. |
| FIZEPR-SW100 VIGT.415210.100 -10.410 | Powdered, granular, bulk materials in a bin, pipe or chute, including sawdust, chips, shavings, grain, etc. |  The sensor contains a straight rod (probe) with a diameter of 20 mm and a length of up to 1.0 m. The probe and its mounting brackets are made of AISI 321 steel. |
| FIZEPR-SW100 VIGT.415210.100 -10.411 | Powdered, granular, bulk materials in a bin, pipe or chute, including sawdust, chips, shavings, grain, etc. The moisture meter can be used on materials with temperatures up to 180°C. |  The sensor (version B) contains a straight rod (probe) with a diameter of 20 mm and a length of up to 1 m. The sensor probe and mounting sleeves are made of AISI 321 steel. The sensor's measuring cell is located outside the mounting sleeves, enabling measurement of materials at extreme temperatures. |
| FIZEPR-SW100 VIGT.415210.100 -10.43 | Bulk materials (grain, sawdust, etc.) in an auger. |  The probe is a 14mm diameter, radius-curved rod. The bend is made to match the auger diameter; auger dimensions are specified when ordering. The sensor is made of AISI 321 stainless steel. |



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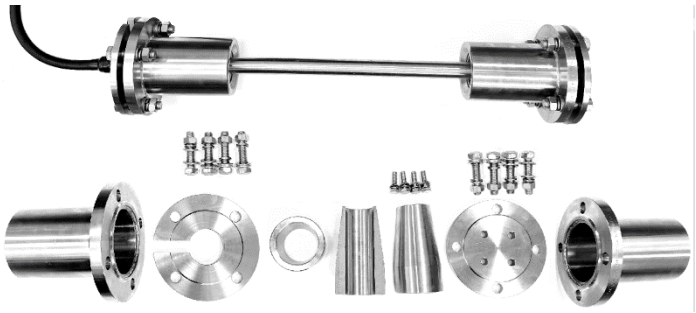
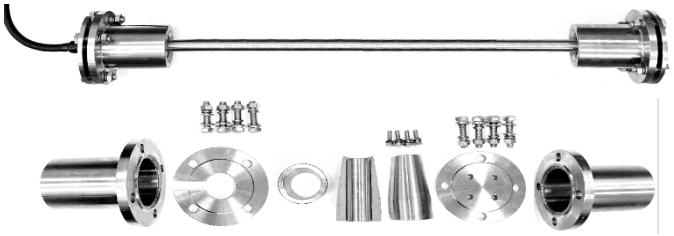
|---|---|---|
| FIZEPR-SW100 VIGT.415210.100 -10.46 | Bulk materials (coal, including anthracite, iron ore, and other materials) characterized by high electrical conductivity, including those that tend to build up on the bin walls and probe. For lump materials with a particle size of up to 100 mm. |  The probe is made in the form of a straight rod with a diameter of 32 mm and a length of up to 1 m. All sensor parts are made of AISI 321 stainless steel. |
| FIZEPR-SW100 VIGT.415210.100 -10.461 | Bulk materials (coal, including anthracite, iron ore, and other materials) with high electrical conductivity, including those that tend to build up on the bunker walls and probe. For lump materials with a particle size of up to 100–150 mm. |  The probe is made in the form of a straight rod with a diameter of 32 mm and a length of up to 1.5 m. All sensor parts are made of AISI 321 stainless steel. |
| FIZEPR-SW100 VIGT.415210.100 -10.47 | Bulk materials (sand, crushed stone, ore, grain, etc.) in a bunker or dispenser. For materials with a particle size of up to 10...25 mm. |  The probe is a straight rod with a 27 mm cross-section and up to 0.6m in length, made of AISI 321 stainless steel. The probe is installed in the bunker and secured with a coupling and a clamping flange. The probe must be positioned so that its axis is parallel to one of the walls. bunker. |

Table 3

**Moisture meters FIZEPR-SW100.11.x, in which the probe is made in the form of parallel pins**

| | | |
|---|---|---|
| FIZEPR-SW100 VIGT.415210.100 -11.32 | Powdery and granular materials in a bunker, mixer, as well as liquid materials (e.g. sludge) in a tank, chute. Can be used for measuring bulk materials in piles. |  A sensor with a two-pin probe. The sensor body is equipped with a G1 threaded fitting. The sensor is permanently mounted on a 1" pipe, but can also be attached directly to the bin wall. The probe is made of AISI 321 stainless steel. The sensor body is made of 2024-T3 aluminum alloy, but can be made of AISI 321 stainless steel upon customer approval. |

| | | |
|---|---|---|
| FIZEPR-SW100 VIGT.415210.100 -11.33 | Powdery, granular, and pasty materials (e.g., silicate mass) on a conveyor belt. Can also be used to control liquid materials (e.g., sludge) in a chute. |  A sensor with a two-pin curved probe. The sensor body is equipped with a G1¼ threaded connection for 1¼" pipe mounts. All sensor parts are made of AISI 321 stainless steel. |
| FIZEPR-SW100 VIGT.415210.100 -11.4 | For monitoring soil moisture, measuring the moisture content of bulk materials. |  An immersion sensor with a dual-pronged probe. The probe is equipped with a tip that allows the sensor to be immersed in dense test material, including soil. The housing is equipped with a G1 threaded nipple. It is permanently mounted on a 1" pipe. The sensor components are made of AISI 321 stainless steel. |
| FIZEPR-SW100 VIGT.415210.100 -11.41 | Bulk, pasty and liquid materials. |  An immersion sensor with a two-prong probe. The probe prongs are 160 mm long and have a diameter of 10 mm. The housing is equipped with a G1 threaded nipple, allowing the sensor to be attached to a 1" pipe. The sensor components are made of AISI 321 stainless steel. |
| FIZEPR-SW100 VIGT.415210.100 -11.411 | For use in cooking kettles with temperatures up to 180°C and pressure up to 6 atm. |  An immersion sensor with a dual-prong probe. The probe prongs are 160 mm long and have a diameter of 10 mm. The housing is equipped with a G1 threaded nipple, allowing the sensor to be attached to a 1" pipe. The housing diameter is 48 mm. The sensor components are made of AISI 321 stainless steel. The operating temperature is up to +180°C. |
| FIZEPR-SW100 VIGT.415210.100 -11.412 | Bulk and pasty materials in bunkers and tanks |  A submersible sensor equipped with mounting hardware for installation on the wall of a tank or bin. The sensor components are made of AISI 321 stainless steel. |



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|---|---|---|
| FIZEPR-SW100 VIGT.415210.100 -11.6 | Paste-like and liquid materials with high electrical conductivity located in trays and tanks, including sewage sludge, ion-exchange resin, etc. |  An immersion sensor with a two-prong probe. The housing is equipped with a G1 threaded fitting and can be mounted on a 1" pipe. |
| FIZEPR-SW100 VIGT.415210.100 -11.81 | Grain in shaft grain dryers, as well as some other bulk products in bunkers and on conveyor belts. |  The sensor is mounted in the air duct window of a shaft grain dryer and secured with a clamp. This quick-release connection allows the moisture meter to be quickly repositioned to find the optimal monitoring zone. Thanks to a thermistor built into one of the pins, the moisture meter provides virtually instantaneous grain temperature measurement. The permissible temperature of the sensor housing is 145°C. |
| FIZEPR-SW100 VIGT.415210.100 -11.82 | Grain in dryers and bunkers, as well as some other bulk products, including those on a conveyor belt. |  The sensor is installed inside the bin or grain dryer through a 150x30mm cutout in the wall. The device's mounting plate is secured to the outside of the wall with screws or self-tapping screws. Thanks to a thermistor built into one of the pins, the moisture meter provides virtually instantaneous grain temperature measurement. The permissible temperature of the sensor housing is 145°C. |

Table 4

**Moisture meters FIZEPR-SW100.12.x**
**for liquid and pasty materials**

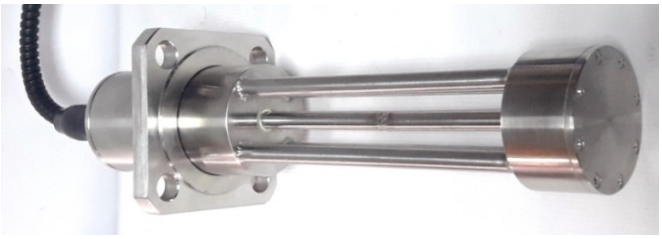
| | | |
|---|---|---|
| FIZEPR-SW100<br>VIGT.415210.100<br>-12 | Paste-like and liquid materials in trays and tanks, including sludge from cement production, water-oil emulsion, etc. |  <br>The probe sensor consists of a central pin and four pins around the perimeter. The sensor is made of AISI 321 stainless steel. The sensor body has a G2 thread, but it can also be attached to a G1 threaded fitting. The sensor is installed in the tank and secured to a 1" or 2" pipe. |
| FIZEPR-SW100<br>VIGT.415210.100<br>-12.16<br>**(-21.16)** | Paste-like and liquid materials with high electrical conductivity located in trays and tanks, including sewage sludge, ion-exchange resin, etc. |  <br>The probe sensor consists of a central pin and four pins around the perimeter. The sensor is made of AISI 321 stainless steel. The sensor includes a flange for mounting on the tank wall. |

Table 5

**Moisture meters FIZEPR-SW100.16.x**
**for measuring bulk, pasty and liquid materials**
**in tanks, boilers and pipelines**

| | | |
|---|---|---|
| FIZEPR-SW100<br>VIGT.415210.100<br>**-16.1** | Water-sand pulp, coal sludge and other liquid and pasty materials, as well as bulk materials in tanks and pipelines with a diameter of at least 200 mm, working pressure - up to 10 atm.<br><br>The sensor can be manufactured in a version for operation in cooking boilers at temperatures up to 200°C. |  <br>A flow probe sensor with a single 16mm diameter pin, 150mm long, is installed along the pipeline diameter. It is mounted to a flanged pipe welded to the wall of the pipeline or tank. The sensor body and probe are made of AISI 321 stainless steel. For use in water-sand slurries and sand flows, the probe is made of hardened AISI 440B stainless steel. |



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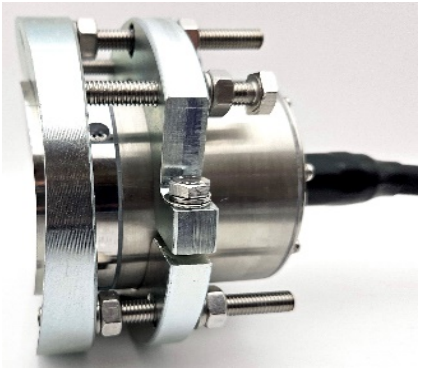
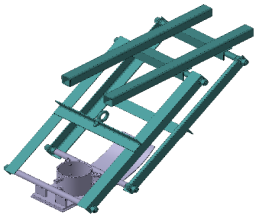
**Moisture meters FIZEPR-SW100.17.x**
**for concrete mix, coal and other bulk and pasty materials**

| | | |
|---|---|---|
| FIZEPR-SW100 VIGT.415210.100 -17.1 | Measuring the water content of concrete mix in a concrete mixer, measuring the moisture content of materials on a conveyor belt. |  The sensor has a diameter of 80 mm (supplied with a mounting kit). The sensor head is made of corrosion-resistant, hardened steel. |
| FIZEPR-SW100 VIGT.415210.100 -17.2 | Measurement of water content in concrete mix in twin-shaft concrete mixers, measurement of moisture content of bulk and pasty materials in sampling systems. The surface of the sensor head is made concave for mounting the sensor on walls that have the shape of a round cylinder. |  The sensor is housed in a cylindrical housing with a diameter of 80 mm (the sensor is supplied with a mounting kit). The sensor's sensing surface is concave, resembling the surface of a circular cylinder. The radius of this cylinder can be customized to meet customer requirements, allowing the sensor to be mounted on the cylindrical wall of a twin-shaft mixer or inside a sampling system pipe. The sensor's sensing head is made of corrosion-resistant, hardened steel. |
| FIZEPR-SW100 VIGT.415210.100 -17.4 | Measuring the moisture content of bulk materials, such as sawdust and other wood chip waste, in a screw conveyor. |  The sensor is housed in a rectangular housing. The sensor's touch surface is made of AISI 321 stainless steel. |
| FIZEPR-SW100 VIGT.415210.100 **-17.8** | Measuring the water content of concrete mix in a concrete mixer, measuring the moisture content of bulk materials on a conveyor belt. |   The sensor has a diameter of 108 mm (supplied with a mounting kit). The sensor head is replaceable and made of corrosion-resistant, hardened steel. The sensor housing is made of AISI 321 stainless steel. |

| | | |
|---|---|---|
| FIZEPR-SW100<br>VIGT.415210.100<br>**-17.81** | Replacement sensor head for the moisture meter sensor FIZEPR-SW100.17.8 |  <br>The replaceable sensor head is made of corrosion-resistant, hardened steel. |
| FIZEPR-SW100<br>VIGT.415210.100<br>**-17.85** | Measurements in twin-shaft concrete mixers. The surface of the sensor head is made concave to fit the cylindrical surface of the concrete mixer. |  <br>The sensor has a diameter of 108 mm (supplied with a mounting kit). The sensor head is replaceable and made of corrosion-resistant, hardened steel. The sensor housing is made of AISI 321 stainless steel. |
| FIZEPR-SW100<br>VIGT.415210.100<br>**-17.12**<br><br>(SW100.17.12U - corner cable entry;<br><br>SW100.17.12P - straight cable input) | Control of water content in concrete mix in concrete mixer.<br><br>It is also used for measuring bulk materials with small fraction sizes on a conveyor belt. For this application, the moisture meter is supplied complete with the VIGT.415210.100-17.125L ski.<br>  <br>and the ski fastening mechanism<br>  |  <br>The sensor has a diameter of 108 mm (included with a mounting kit). The sensor head is covered with a silicon nitride disc (plate), which is highly resistant to impact and abrasion. A unique design feature of the sensor is that the ceramic disc is user-replaceable.<br>  |
| FIZEPR-SW100.17.124 | Replacement silicon nitride ceramic disc for the FIZEPR-SW100.17.12 sensor |  <br>Replacement ceramic silicon nitride disc for the FIZEPR-SW100.17.12 sensor. It offers increased strength compared to a corundum disc. |

| | | |
|---|---|---|
| FIZEPR-SW100 VIGT.415210.100 **-17.122** | A device for removing/installing a cover, used when replacing a ceramic disc |  Tool - a key for unscrewing the sensor cover when replacing the ceramic disc FIZEPR-SW100.17.121. |
| FIZEPR-SW100 VIGT.415210.100 **-17.15** | Designed for use in cooking kettles. Pressure: up to 6 atm. Temperature: up to 180°C. |  The sensor has a diameter of 76 mm. The sensor head is covered by a disc (plate) made of silicon nitride ceramic, which is particularly impact-resistant. |
| FIZEPR-SW100 VIGT.415210.100 **-17.16** | Measurement of water content in bulk and pasty materials in mixers and screw conveyors. |  The sensor has a diameter of 76 mm. The sensor head is covered by a disc (plate) made of silicon nitride ceramic, which is particularly impact-resistant. Mounting hardware is included, allowing for adjustable insertion depth into the monitored area under excess pressure while ensuring a tight seal. |
| FIZEPR-SW100 VIGT.415210.100 **-17.21** | Measurement of bulk and pasty materials in sampling systems with a diameter of 50 mm (diameter is specified when ordering). |  The sensor is a 50mm diameter piston. The permissible piston force is 5000N. |

Table 7

**Moisture meters FIZEPR-SW100.2x.x**
**for liquid materials in flow**

(full information on in-line analyzers for liquid materials is given in the Technical Description and Operating Manual VIGT.415210.100-2 RE, Part 1)

| | | |
|---|---|---|
| FIZEPR-SW100 VIGT.415210.100 **-20.53** | Liquid materials, as well as steam-water mixtures in a DN50 pipeline, pressure - up to 25 atm. Operating temperature range: -20 … +200°C. The analyzer is designed to monitor inhomogeneous media, such as the flow of steam-water media formed by mixing water and superheated steam. |  Straight-through sensor in the form of a DN50, PN25 pipe section made of AISI 321 steel; flanges 50-25-01-1-B GOST 33259-2015. |

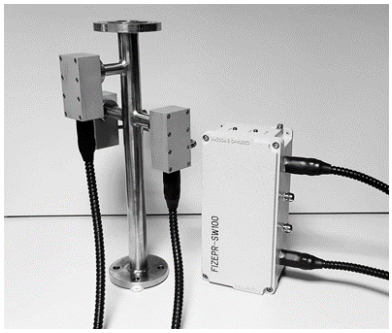
| | | | |
|---|---|---|---|
| FIZEPR-SW100<br>VIGT.415210.100<br>**-23.01** | Liquid materials, as well as steam-water mixtures in a DN50 pipeline, pressure - up to 160 atm. Operating temperature range: -20 … +320°C. The analyzer is designed to monitor longitudinally homogeneous media. |  | Straight-through sensor in the form of a DN50, PN160 pipe section made of AISI 321 steel; flanges 50-160-11-1-E (or 50-160-11-1-J) GOST 33259-2015. |
| FIZEPR-SW100<br>VIGT.415210.100<br>**-23.32** | Liquid materials, as well as steam-water mixtures in a DN32 pipeline, pressure - up to 6 atm. Operating temperature range: -20 … +200°C. The analyzer is designed to monitor longitudinally homogeneous media. |  | Straight-through sensor in the form of a DN32, PN6 pipe section made of AISI 321 steel; flanges 32-6-01-1-B GOST 33259-2015. |
| FIZEPR-SW100<br>VIGT.415210.100<br>**-27.19** | Liquid and pasty materials with high electrical conductivity (detergents, salt solutions, sludge, clay, pulp) in a DN150 pipeline, pressure - up to 16 atm. Operating temperature range: -20 … +120°C. |  | Straight-through sensor in the form of a pipe section DN150, PN16, made of AISI 321 steel; ANSI B16.5 flanges, Class 150, 6”. |

Table 8

**Laboratory moisture meters FIZEPR-SW100.30.x**

| | | | |
|---|---|---|---|
| FIZEPR-SW100<br>VIGT.415210.100<br>**-30.1** | Laboratory measurements of mainly liquid materials. |  | The sensor contains a 46mm diameter probe, allowing measurements to be taken in a standard 500ml graduated cylinder (included). The sample volume is 450ml. The sensor body and probe are made of AISI 321 stainless steel. |

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| | | |
|---|---|---|
| FIZEPR-SW100 VIGT.415210.100 **-30.11** | Laboratory measurements, primarily of liquid materials, as well as measurements in tanks at various depths. The sensor is equipped with a coupling for mounting on a rod (pipe) with a G1 thread. |  The sensor contains a 46mm diameter probe, allowing measurements to be taken in a standard 500ml graduated cylinder (included). The sample volume is 450ml. The sensor body and probe are made of AISI 321 stainless steel. |
| FIZEPR-SW100 VIGT.415210.100 **-30.2** | Laboratory measurements of bulk and pasty materials (the sensor can also be used to control liquid materials) |  The sensor contains rectangular cuvette 220 x 100 x 100 mm with probe. The volume of the controlled sample is 2 liters. The sensor is made of AISI 321 stainless steel. |
| FIZEPR-SW100 VIGT.415210.100 **-30.26** | Laboratory measurements of bulk, pasty and liquid materials with high electrical conductivity (including salt solutions, etc.). |  The sensor contains a rectangular cuvette 220 x 100 x 100 mm with probe. Sample volume: 2 liters. The sensor is made of AISI 321 stainless steel. |
| FIZEPR-SW100 VIGT.415210.100 **-30.261** | Laboratory measurements of bulk, pasty and liquid materials differing in high electrical conductivity (including salt solutions, etc.) |  The sensor contains a rectangular cuvette measuring 210 x 60 x 60 mm with a probe and lid. The sample volume is 0.7 liters. The sensor is made of AISI 321 stainless steel. |
| FIZEPR-SW100 VIGT.415210.100 -30.3 | Laboratory measurements of liquid materials | The sensor has a diameter of Ø17.5 mm and a length of 190 mm for test tubes P1-21-200 and P2-21-200 GOST 25336-82. The volume of the controlled sample is 15 ml. The sensor is made of AISI 321 stainless steel. |

**Note: the decimal number of the moisture meter version corresponds to the decimal number of the sensor used.*

2.6 The list of modifications of the electronic unit is given in Table 9.

Table 9

| Electronic unit designation (decimal number) | Design |
|---|---|
| VIGT.415210.101 | General-purpose electronic unit with cable glands.<br>Additional symbols in block marking:<br>**N** – with an extended frequency range;<br>**P** – with phase measurement;<br>**I** – with built-in digital indicator. |
| VIGT.415210.101-01 | General-purpose electronic unit with radio-frequency connectors (sockets). |
| VIGT.415210.101-02 | Electronic unit in explosion-proof certified housing. Explosion protection marking on the unit body – in accordance with Table 12.<br>Additional symbols in block marking:<br>**N**– with an extended frequency range;<br>**P**– with phase measurement. |

## 3. Technical requirements

3.1 Main parameters and characteristics

The moisture meter is manufactured according to technical specifications 4215-010-21161167-2014TU (VIGT.415210.100TU) based on a set of design documentation VIGT.415210.100.

The main technical parameters of the moisture meter are given in Table 10.

Table 10

| No. of technical requirements | Parameter name | Meaning of the characteristic for analyzer design options | |
|---|---|---|---|
| | | -10…-19 | -20…-29<br>**-30…-39** |
| 3.1.1 | Moisture measurement range W - mass(volume) fraction of water, %<br>(see note 1) | from 0 to 100 | |
| 3.1.2 | Limits of permissible absolute error Δ in measuring the mass (volume) fraction of water according to MP242-1715-2014, %<br>***(see note 2)*** | **Δ**=0.035+0.05*W | **Δ**= 0.02+0.025*W |
| 3.1.3 | Limits of permissible absolute error Δ of measuring the volume fraction of water according to MP 0919-6-2018 (for analyzer versions: -20.x, -21.x, -24.x), %<br>- when measuring in the range from 0 to 2%<br>- when measuring in the range from 2 to 10%<br>- when measuring in the range from 10 to 20%<br>- when measuring in the range from 20 to 50%<br>- when measuring in the range from 50 to 100% | | <br>±0.06<br>±0.15<br>±0.4<br>±1.0<br>±2.5 |

| | | |
|---|---|---|
| 3.1.4 | Dielectric permittivity measurement range:<br>- real component (εr)<br>- dielectric loss tangent (tg δ)<br>***(see note 3)*** | <br><br>1 … 100<br>0 … 100 |
| 3.1.5 | Temperature range of controlled materials in which the moisture meter was calibrated, °C<br>(see notes 4 and 5) | + 5 … + 80 |
| 3.1.6 | Operating temperature range of the sensor,°C:<br>- execution A<br>- performance B<br>- version B1 (for extreme temperatures)<br>***(see notes 5 and 6)*** | <br><br>-20 … +120<br>-20 … +180<br><br>-20 … +300 |
| 3.1.7.1 | Operating temperature range of the electronic unit of version A,°C | -20 … +80 |
| 3.1.7.2 | Operating temperature range of the electronic unit of version B (with an extended temperature range),°C | -40 … +80 |
| 3.1.7.3 | Operating temperature range of explosion-proof electronic unitexecution A,°C | -20 … +60 |
| 3.1.7.4 | Operating temperature range of explosion-proof electronic unitexecution B(extended temperature range option)),°C | -40 … +60 |
| 3.1.8 | Temperature measurement range, °C<br>for performance sensors:<br>- A<br>**- B**<br>- B1 (for extreme temperatures) | <br><br>-50 … +150<br>-50 … +200<br>-50 … +340 |
| 3.1.8.1 | Limits of permissible absolute error of temperature measurement (in the temperature range +5 … +80°C), °C | ±1 |
| 3.1.9 | Measurement period, no more than, sec<br>***(see note 7)*** | 1 |
| 3.1.10 | Output interface<br>- digital<br>- current, mA | <br>RS-485 Modbus RTU<br>4-20 |
| 3.1.11 | Supply voltage, V<br>nominal<br>acceptable<br>***(see note 8)*** | <br>24<br>18...30 |
| 3.1.12 | Current consumption, mA, no more than | 200 |
| 3.1.13 | Dimensions of the general-purpose electronic unit, mm | 255 x 170 x 60 |

| | | |
|---|---|---|
| 3.1.14 | Dimensions of the electronic unit in an explosion-proof certified housing, mm | 285 x 230 x 120 |
| 3.1.15 | Weight of the general-purpose electronic unit, kg | 2 |
| 3.1.16 | Weight of the electronic unit in an explosion-proof certified housing, kg | 7 |
| 3.1.17 | Degree of dust and moisture protection of the electronic unit of general industrial design according to GOST 14254-2015 | IP54 |
| 3.1.18 | The degree of dust and moisture protection of the electronic unit in an explosion-proof housing according to GOST 14254-2015 | IP66 |
| 3.1.19 | The sensor's dust and moisture protection level according to GOST 14254-2015 | IP67 |
| 3.1.20 | Length of communication cable between the sensor and the electronic unit, m ***(see note 9)*** | 1 … 4 |
| 3.1.21 | Maximum length of data transmission cable (digital signal RS-485, analog signal 4-20 mA) from the electronic unit to the display or control device (controller, computer), not less than, m | 1000 |
| 3.1.22 | Mean time between failures, h | 25,000 |
| 3.1.23 | Average service life, years | 10 |
| 3.1.24 | Opening hours | continuous |

***Notes***

1. Moisture meters for bulk materials are calibrated in mass units of moisture. For liquid materials, calibration can be performed in either mass or volume units of moisture. The calibration method used is indicated in the moisture meter's data sheet.
2. Absolute error values and factors influencing the magnitude of the error are given in Section 3.2 of this manual.
3. The value of the dielectric loss tangent (tg δ) of the controlled material for moisture meters of versions -10.x, -11.x, -12.x, -30.1 and -30.2 must be in the range of tg δ = 0…0.5. For moisture meters of versions -10.16, -10.46, -10.56, -30.26 and their modifications, the range of possible values of the dielectric loss tangent is 0…100, and in some cases even higher.
   At the customer's request, the value of the dielectric loss tangent of the monitored material can be displayed on an external display device.
4. Using the software included in the delivery set, according to the methodology described in the operating instructions, the user can independently supplement the analyzer calibration with data to expand the temperature range of the materials being measured.
5. When measuring materials containing ice, the moisture meter only records unfrozen water. The accuracy of measurements for materials containing ice is not regulated.
6. For use with materials with temperatures exceeding +120°C but not exceeding +180°C, the sensors are available in the "B" modification, in which the measuring cell is mounted on a

nozzle remote from the sensor body. For measuring materials with temperatures exceeding +180°C, the sensors are available in the "B1" modification, in which the measuring cell is housed in a housing thermally insulated from the sensor body.

7. The measurement time for monitoring fast-moving technological processes can be reduced.
8. The supply voltage can be set to 12V upon customer request.
9. The required communication cable length between the sensor and the electronic unit is agreed upon when ordering. The maximum cable length for an explosion-proof moisture meter is 4 m.

3.2 Measurement error.

The values of absolute error Δ, calculated using the mathematical expressions (formulas) given in section 3.1.2, are given in Table 11.

Table 11

| Meaning moisture W | Limits of permissible absolute error Δ | |
|---|---|---|
| | for design options - 10 … - 19 | for design options - 20 … - 29, - 30 … - 39 |
| 5% | 0.3% | 0.15% |
| 10% | 0.5% | 0.3% |
| 20% | 1% | 0.5% 1% |
| 40% | 2% | 1.3% |
| 50% | 2.5% | 1.8% 2.5% |
| 70% | 3.5 | |
| 100% | 5% | |

The stated absolute error value is established based on verification procedure MP242-1715-2014, in accordance with clause 6.4 of the said MP. It is important to note that the following liquids are used to verify the moisture meter according to the specified MP: standard samples of mass (volume) fraction of water GSO 9829 - 2011, GSO 8999-9007 - 2008, GSO 9261-9262 - 2008, or control mixtures of transformer oil and water. However, when measuring liquid materials, a very serious factor influencing the results of bulk material measurements is excluded: namely, the effect of the bulk material's bulk density on measurements.

The bulk density of bulk materials depends on the selected location and measurement conditions (see Sections 9.7 and 12.4 of this guide). Bulk density of bulk materials on a conveyor belt is unstable. Moreover, the higher the conveyor belt speed, the greater the variation in bulk density and, consequently, the greater the measurement error. Experience has shown that the bulk density of bulk materials measured in bunkers is the most stable. However, even in bunkers, the actual absolute measurement error is typically no less than 0.4%.

3.3 The explosion protection of the moisture meter is ensured by its design in accordance with the general requirements of GOST 31610.0-2019 (IEC 60079-0:2017), the type of explosion protection "flameproof enclosures "db"" according to GOST IEC 60079-1-2011, the type of explosion protection "intrinsically safe electrical circuit "i"" according to GOST 31610.11-2014 (IEC 60079-11:2011) and the type of explosion protection against dust ignition by enclosures "t" according to GOST IEC 60079-31-2013.

Main technical data and explosion protection marking of the explosion-proof moisture meterare given in Table 12.

Table 12

| Parameter name | Meaning |
|---|---|
| Explosion protection marking:<br>- electronic unit<br><br><br><br>- sensor | <br>1Ex db [ia Ga] IIB T5 Gb / IP66<br>Ex tb [ia Da] IIIC T100ºC Db / IP66<br>PB Ex db [ia Ma] I Mb / IP66<br><br>0Ex ia IIB T5 Ga / IP67<br>Ex ia IIIC T100ºC Da / IP67<br>RO Ex ia I Ma / IP67 |
| Ambient temperature range, °C:<br>- for electronic unit of version A<br>- for the electronic unit of version B | <br>from -20 to +60<br>from –40 to +60 |
| Operating temperature range of the sensor (temperature range of the measured material), °C<br>- for sensor type A<br>- for sensor type B | <br><br>from –20 to +120<br>from -20 to +180 |
| Degree of protection against external influences according to GOST 14254-2015:<br>- electronic unit<br>- sensor | <br><br>IP66<br>IP67 |
| Electronic unit supply voltage (DC), V | <br>18 – 30 |
| Maximum voltage Um, V | 30 |
| Parameters of intrinsically safe circuits of the electronic unit | |
| Maximum output voltage Uo, V | 10.5 |
| Maximum output current Io, A | 1.11 |
| Maximum external capacitance Co, μF | 14 |
| Maximum external inductance Lo, mH | 0.02 |

## 4. Delivery set

4.1 Analyzer delivery set:

1) sensor;
2) electronic unit;
3) technical description and operating manual VIGT.415210.100 RE;
4) passport VIGT.415210.100 PS;
5) USB flash drive with technical documentation and software specified in Section 13 of this Manual.

4.2 Additionally, the following products listed in Table 13 may be included in the delivery kit at the customer's request.

Table 13

| Product name | Type, brand |
|---|---|
| USB to RS485 interface converter | OWEN-AC4 from Owen,<br>ACDR.426469.032 from Bolid Scientific and Production Enterprise<br>or other type |
| Meter-regulator with digital indication (input signal – current 4-20 mA) | ITP-11, TRM1, TRM-201 from Owen,<br>or other type |

| | |
|---|---|
| Operator panel with digital indication (input signal RS485 MODBUS RTU) | SMI2-M, IPP120 from Owen |
| 24 V power supply | BP30B-D3-24 from Owen |
| Explosion-proof thermal cover for the electronic unit. Used when operating the moisture meter at low temperatures. | EcoTerm Ex-02 by EcoTerm<br>Included:<br>- thermal cover (wear-resistant, chemical-resistant, water- and oil-repellent fabric);<br>- self-regulating heating tape 25NTR2-VT, 50Hz, 220V, 2ExeIIT6 with a power cable in a 3m metal sleeve;<br>- terminal box. |

4.3 Example of recording the moisture meter designation when ordering and in technical documentation of other products:

Moisture meter FIZEPR-SW100 VIGT.415210.100-10.6

The following abbreviated designation may be used:

**"Moisture meter FIZEPR-SW100.10.6"**

## 5. Design features of moisture meter variants and operation of the moisture meter

5.1 Probe moisture meters VIGT.415210.100-10.x are designed to monitor the moisture content of powdered, granulated, pasty and bulk materials, including crushed stone, gravel, sand, ore, grain, peat, sawdust, etc.

The sensor probe is made of corrosion-resistant AISI 321 steel rod (sensors can also be made from AISI 420, AISI 316Ti, and other steel grades). The probe is embedded in the monitored material. VIGT.415210.100-10.x sensors can be mounted in bunkers, silos, on chutes, or above a conveyor belt. The design of the sensors allows for easy installation and removal during operation.

5.1.1 The moisture meter sensors of the VIGT.415210.100-10.21 and VIGT.415210.100-10.6 designs are shown in Appendices 1 - 2. The sensor is made of AISI 321 stainless steel and contains a U-shaped probe, which is secured to the mounting panel. The sensor can be mounted on the walls of bunkers, dryers, or above conveyor belts. The moisture meter of the VIGT.415210.100-10.21 version differs from the VIGT.415210.100-10.6 by the presence of an additional screen electrode - a U-shaped rod installed parallel to the probe. The additional screen electrode eliminates the influence of metal structures located near the sensor.

These moisture meter options can be used to monitor bulk materials in tanks, drying units, and for conveyor belt measurements. The material being monitored must completely fill the space between the probe and the shield, as well as the area around the probe at distances of 10–15 cm or more. When selecting a sensor installation location, avoid placing protruding metal elements near the probe (at distances of less than 20 cm).

5.1.2 The moisture meter of the VIGT.415210.100-10.16 version (shown in Appendix 3) is similar in design and application features to the moisture meter of the -10.6 version, but is intended for monitoring materials with high electrical conductivity, such as anthracite and concentrates of various ores.

5.1.3 The VIGT.415210.100-10.5 moisture meter (see Appendix 4) is designed exclusively for monitoring bulk materials on conveyor belts. The sensor is installed along the material flow. Its special shape ensures complete filling of the sensor with the material being monitored and minimal flow resistance.

5.1.4 For the moisture meter version VIGT.415210.100-10.4 (shown in the appendices5 - 8) The sensor probe is made of a 27 mm hexagonal rod (27 mm is the diameter of the inscribed circle) of AISI 321 stainless steel. The probe is fixed to the opposite walls of the bunker using holders-couplings (see Appendix9). The probe length of the -10.4 moisture meter can be selected from 50 cm to 120 cm, the -10.44 probe length is up to 1.5 m, and the -10.441 probe length is up to 2 m. This moisture meter provides averaging of measurement results over volumes ranging from hundreds of liters to 1 cubic meter. By averaging over such a large volume, differences in the moisture content of individual local areas do not lead to errors in determining the average moisture content.In concrete production, such averaging helps reduce errors in component dosage caused by uneven moisture distribution in sand and crushed stone.

This moisture meter is indispensable for monitoring materials that adhere to the probe and the bin walls. The volume of adhering material in relation to the measured volume is a very small value, therefore the influence of adhesion on the measurement results is negligible.

Moisture meter sensor optionVIGT.415210.100-10.46 by design similar to the variant -10.4, but this moisture meter is designed for measuring in bunkers of materials with high electrical conductivity(anthracite, concentrates of various ores, salts, etc.).

5.1.5 For the moisture meter version VIGT.415210.100-10.41 (shown in the appendices5, 10, 11) the sensor probe is made in the form of a straight rod made of AISI 321 stainless steel rod14 mm in diameter. The probe is secured to opposite walls of the bin using coupling holders. The probe length for this moisture meter can be selected from 25 cm to 60 cm. This option ensures averaging of measurement results across the entire bin, and differences in moisture content in individual local areas do not lead to errors in the average moisture content. Its primary application is monitoring wood waste, including chips, shavings, and grain.

Modifications of the specified sensors VIGT.415210.100-10.410 and VIGT.415210.100-10.411 are made with a probe with a diameter of 20 mm, the length of the probe can reach up to 1 m, and the 10.411 version is designed for operation at high temperatures - up to180°C (250°C).

5.2. A separate category of probe moisture meters is made up of moisture meters of the seriesVIGT.415210.100-11.x, which can be classified as universal, as they can also be used on liquid materials.

5.2.1 In the VIGT.415210.100-11.3x, VIGT.415210.100-11.4x probe moisture meters, the sensor contains two pins (sensor options are shown in the appendices 12 and 13). This moisture meter is designed to monitor both bulk materials (e.g., grain in bunkers) and liquid (paste-like) materials. The sensor is sealed and can be immersed in a tank containing liquid material (e.g., fuel oil). The sensor is attached to a 1" or 1 1/4" pipe. The sensor cable is passed through the pipe. Appendix 13 shows the mounting of the -11.41 sensor.

Thanks to their pin-type design, the -11.x moisture meters can also be used to monitor the moisture content of soil, peat, and plant products in storage piles. Unlike other versions of the -11.x series, the -11.33 sensor's pins are rotated relative to the sensor's axis. This sensor is designed for measuring bulk materials on conveyor belts and liquid materials in chutes.

5.2.2 The VIGT.415210.100-11.8x moisture meters (see Appendix 14) are designed primarily for measuring grain crops, but can also be used with other materials. The sensor is made of AISI 321 stainless steel and contains three pins that must be completely immersed in the grain. A thermistor is installed at the end of one of the pins, ensuring rapid measurement of grain temperature, which is necessary for accurate grain moisture determination.

The sensor version - 11.81 is designed for use in shaft grain dryers. It is inserted into the air duct (exhaust duct) of the grain dryer and secured to the wall with a clamp. To ensure structural rigidity, it is recommended to place a metal sheet under the clamping screws.

The zone monitored by the sensor is shaped like a cylinder with a radius of 8-10 cm, coaxial with the central pin. The upper boundary of the zone coincides with the pin attachment point to the housing, while the lower boundary is located approximately 8 cm below the end of the central pin. To ensure accurate measurements, this area must be completely filled with grain. The presence of voids or debris in the monitored zone, as well as incomplete immersion of the pins in the grain, will result in unreliable measurement results.

Variant -11.82 is identical in design and parameters to the - 11.81 sensor, but the mounting method differs. This sensor contains a mounting plate that attaches to the wall of the dryer or bin. To insert the sensor into the grain dryer (bin), a 25 x 150 mm window is made in the wall. For measurements in a conveyor grain dryer, it is recommended to install the sensor at an angle, with the pins pointing in the direction of the grain flow, ensuring that the grain layers above and below the sensor are at least 8 cm thick.

5.3 The VIGT.415210.100-12 probe moisture meter is designed for use with liquid materials. The sensor was developed to monitor cement production sludge in overflow tanks. The sensor contains a central probe pin and four screen pins located around the central pin (see Appendix 15). The probe and sensor housing are made of AISI 321 stainless steel. The sensor can be attached to a pipe with a 1" cylindrical pipe thread (G1) according to GOST 6357-81, or to a pipe with a 2" internal thread (G2). The sensor cable is passed through the specified pipe. This attachment allows you to adjust the sensor's immersion depth in the tank, thereby monitoring moisture at different levels. Silicone sealants are recommended for sealing the sensor connection to the pipe.

5.4 Moisture meters VIGT.415210.100-17, -17.1, -17.2, -17.8, -17.12 (see Appendix 16) are intended for measuring bulk, pasty materials in mixers and on a conveyor belt. The sensing element (probe) of sensors of versions -17, -17.1 and -17.8 is a flat surface made of hardened corrosion-resistant steel (AISI 440B). In sensors of version -17.2 and -17.85 the probe surface is made curved along the radius, which allows installing the sensor of this version on the side wall of a twin-shaft concrete mixer. The sensing element (probe) of sensors of versions -17.12, -17.15 and -17.16 is covered with a ceramic disk made of silicon nitride. This type of ceramic surpasses all known ceramic materials (those with dielectric properties suitable for use in moisture meters) in strength and impact resistance. The metal ring securing the ceramic disc is made of hardened, corrosion-resistant steel (AISI 440B).

5.5 Laboratory moisture meters VIGT.415210.100-30.x are used to control liquid, bulk and pasty materials.

5.5.1 The moisture meter version VIGT.415210.100-30.1 (see Appendix 17) contains a 46 mm diameter sensor, which allows monitoring liquid materials in standard 500 ml graduated cylinders according to GOST 1770-74. The volume of the monitored sample is 450 ml.

5.5.2 The VIGT.415210.100-30.11 moisture meter contains a sensor that is externally identical to the VIGT.415210.100-30.1 sensor, but can be used to monitor liquids in tanks. The sensor is equipped with a G 3/4 (or G1) pipe thread for mounting on a rod (pipe) when inserted into the tank.

5.5.3 The VIGT.415210.100-30.2 moisture meter (see Appendix 18) is designed as a rectangular cuvette that holds the bulk material being tested, but can also be filled with liquid. The cuvette is made of AISI 321 stainless steel. The internal dimensions of the cuvette are 220 x 100 x 100 mm, and the sample volume is 1.8 liters.

5.5.4 Moisture meter version VIGT.415210.100-30.26 (see appendix18) is designed as a rectangular cuvette into which the bulk material to be tested is poured, but liquid can also be added.

The cuvette is made of AISI 321 stainless steel. The internal dimensions of the cuvette are 220 x 100 x 100 mm, and the sample volume is 1.8 liters. This moisture meter, unlike the VIGT.415210.100-30.2, is designed for testing materials with high electrical conductivity.

5.5.5 The VIGT.415210.100-30.3 moisture meter is a small-diameter probe designed for measuring liquids in P1-21-200 and P2-21-200 test tubes (GOST 25336-82), which are widely used in chemical laboratories. The sample volume is 15 ml.

5.6 Electronic units of three design variants are presented in the appendices19 and 20. The moisture meter can be equipped with an electronic unit as a general industrial of the original design, as well as those made in an explosion-proof certified housing with explosion protection markings given in Table 12.

The general-purpose industrial electronic unit is equipped with two LEDs for monitoring the moisture meter's operation. One LED, connected to the +24 V input power supply, lights when power is applied. The second LED is bicolor. A green light indicates data exchange via the RS-485 network. A red light illuminates when the moisture meter is transmitting data to the network.

For a stationary moisture meter, the electronic unit is mounted near the sensor at a distance determined by the connecting cable length specified in the order. For a cable length of 2.5 m, the electronic unit should be installed no more than 1.5 to 2 m from the sensor.

## 6. Physical principles of operation of a moisture meter

The operation of the moisture meter is based on measurement the deceleration coefficient ***Kdec*** electromagnetic wave in the controlled material. Deceleration factor ***Kdec*** is equal to the square root of the permittivity (***εr***) and is the ratio of the speed of propagation of an electromagnetic wave in air (i.e., the speed of light) to its speed of propagation in the tested material. As the water content in the material increases, the permittivity of the material increases and, accordingly, the wave propagation speed decreases. The proportion of water—moisture—is calculated using the slowing factor.***W*** material.

Measurements are made by probing the environment with radio waves while simultaneously tuning the probing signal's frequency within the operating frequency range. The choice of operating frequency range is determined by the sensor design and the potential dielectric properties of the material being monitored. The minimum possible operating frequency is 0.2 MHz, the maximum is 750 MHz, but if necessary, the maximum frequency can be increased to 1500 MHz.

Finding ***Kdec*** is performed using characteristic (resonant) frequencies in the sensor signal spectrum, i.e., the frequencies at which an integer number of half-waves of the electromagnetic signal fits within the length of the sensor's primary transducer. At these frequencies, the sensor signal spectrum has minima (an example spectrum is shown in Fig. 1 in Part 2 of this manual).

The coefficient of deceleration of an electromagnetic wave in a material ***Kdec*** calculated according to the formula:

$$Kdec = f0 / fM \ ,$$

Where ***f0*** – resonant frequency of an empty sensor (the sensor is filled with air);
***fM*** – the resonant frequency of the sensor when it is filled with the controlled fluid material.

The measurement process involves periodically measuring the resonant frequency ***fM*** and calculating the retardation factor Kdec. The conversion of ***Kdec*** to moisture ***W*** is performed using

calibration tables, which are correspondence tables between the retardation factor ***Kdec***, moisture, and temperature.

Thus, the operating principle of the moisture meter is to periodically search for the resonant (characteristic) frequency ***fM*** of the sensor, measure the temperature and calculate the moisture based on these parameters.

A tunable generator, which generates a harmonic probing signal, and a sensor signal processing unit are housed in the moisture meter's electronic unit. The sensor includes a primary transducer (i.e., a probe) and an electronic detector, which converts the high-frequency signal at the sensor's output into a low-frequency voltage.

In sensors of variants -30.x, -11.x, -12.x, the primary converter (probe) is formed by two (or more) rods, which form a section of the so-called long transmission line.

In the -10.x variant sensors, the probe is also a section of a two-wire line, but it is formed by a metal rod and a shield conductor (a steel shield or the metal walls of the bunker). In the -17.x variant sensors, the primary transducer is a capacitive structure forming a capacitor, to which an inductive element is connected.

The moisture meter's generator automatically tweaks its frequency range periodically. In the spectrum obtained by scanning, the moisture meter detects resonant (characteristic) frequencies. ***fM*** . At the lowest frequency found ***fM***, as well as frequency ***f0*** the moisture meter calculates the electromagnetic wave deceleration coefficient in the material. Next, using calibration tables compiled for a set of temperatures and stored in the electronic unit's memory for the selected material, the moisture meter's microcontroller calculates the moisture ***W*** Material. Calibration tables for various materials (sand, crushed stone, sunflower oil, cement sludge, etc.) are entered into the electronic unit's memory from a computer. The total number of such tables stored in the moisture meter's memory is virtually unlimited.

It should be noted that water has a dielectric permittivity $\varepsilon r \approx 80$, the dielectric permittivity of most materials does not exceed $\varepsilon r = 3$. Such a significant difference in the dielectric permittivity of water and the controlled materials makes it possible to determine their water content due to a noticeable increase in dielectric permittivity in the presence of moisture in the material.

***Please note***: The dielectric permittivity of ice is $\varepsilon r \approx 3$, therefore the moisture meter “sees” only unfrozen water and the accuracy of moisture measurement in this case is not regulated.

The resulting moisture value is transmitted from the electronic unit output via the RS-485 digital interface and, simultaneously, via a 4-20 mA current signal to an external indicator or industrial controller that controls the technological process.

## 7. Marking

7.1 The following inscriptions are applied to the body of the electronic unit:

device type - on the front panel (on the cover);

The moisture meter serial number is on the side wall of the housing or also on the cover.

7.2 When using the moisture meter for commercial metering, a seal is installed on one of the screws securing the protective cover inside the electronic unit.

## 8. Containers and packaging

8.1 The container and packaging are intended for storage and transportation of the moisture meter and ensure its safety during transportation throughout the entire storage period.

8.2 The moisture meter, parts and elements included in the delivery set, and operating documentation must be packed in a container.

8.3 Operating documentation is wrapped in polyethylene film.

8.4 Together with the delivery set, a packing list indicating the name and quantity of the delivered products must be included in the shipping container.

## 9. General operating instructions

9.1 The moisture meter consists of an electronic unit and a sensor connected by a cable. The cable connection to the sensor is permanent and sealed with compound. Opening the sensor is not permitted and will void the warranty. The cable connection to the electronic unit is detachable. To disconnect the sensor from the electronic unit, open the cover of the electronic unit, disconnect the cable wires from the terminal block, disconnect the RF connector, loosen the cable entry clamp, and gently pull the cable out of the electronic unit's cable entry without applying force.

9.2 The moisture meter must be powered from a stabilized, general-purpose DC power source with an output voltage of 24 V (maximum permissible supply voltage values are 18...30 V). The power consumption of the moisture meter's electronic unit does not exceed 3.6 W.

9.3 Information transmission is carried out simultaneously and independently along two lines:

- digital communication line, RS-485 Modbus RTU interface;
- current loop 4–20 mA.

9.4 After applying the supply voltage, the moisture meter is ready for operation in 1-2 minutes.

9.5 Unpacking rules.

9.5.1 Upon receipt of the moisture meter container, it must be visually inspected by the person responsible for transportation. It is essential to ensure that the container is completely intact. If the container is damaged, a report must be drawn up, signed by the persons responsible for acceptance and transportation, sealed, and sent to the transport company.

9.5.2 During the cold season, unpacking of containers should be carried out only after keeping them for 2 hours in a warm room with a temperature of at least 18-20°C.

9.5.3 After unpacking, check the package contents against the inventory on the packing lists and verify completeness according to the "Package Contents" section of the data sheet. The name, designation, serial number, and quantity of the items listed in the data sheet must match the entries on the packing lists.

9.6 Inspection rules.

9.6.1 During a visual inspection of the product, check the integrity and absence of damage to the moisture meter housing. The product should be free of scratches, cracks, dents, signs of corrosion, and other defects that may be detected during a visual inspection.

9.6.2 A complaint report is drawn up for all defects and discrepancies discovered during unpacking, visual inspection and check of completeness, which is signed by the persons responsible for acceptance of the moisture meter, approved by the head of the consumer enterprise and sent to the manufacturer.

9.7 Selection of the option and location of the sensor installation, requirements for operating conditions.

For the FIZEPR-SW100 moisture meters to function properly, the following conditions must be met:

9.7.1 The area monitored by the moisture meter sensor (the space between the sensor electrodes and around them) must be completely filled with the material being measured. If, instead of the

material being measured, this area is filled, even partially, with air or foreign objects (debris), accurate measurements will not be possible.

The specified requirement, as applied to sensors used on conveyors (options -10.5x, -11.33, -17.x), is as follows: the thickness (height) of the material layer on the conveyor belt must be such as to prevent the formation of an air gap under the "ski" (base) of the sensor. This condition can only be met at a moderate conveyor speed and with a material layer thickness on the belt of at least 10 cm (for -17.x sensors - at least 5 cm), and the layer width for the specified thickness must be at least 15 cm. At high conveyor speeds, the sensor may scatter the material, which will lead to an underestimation of the measured moisture content. However, if there is a "reserve" layer of material on the sides of the sensor and above the sensor, the effect of material "scattering" can in some cases be compensated for.

9.7.2 The amount of material in the volume (area) monitored by the sensor should be approximately the same for all measurements, i.e., the bulk density of the material should be stable. When the bulk density of the material changes, the mass of the material within the volume monitored by the sensor changes. Accordingly, in this volume, the change in the mass of the material also changes the amount of water to which the sensor responds. This statement is true for all moisture meters available worldwide, regardless of their measurement principle, except for optical (infrared) moisture meters. It should be noted that, as practice shows, the bulk density of bulk material is most stable in a b, so maximum measurement accuracy is achieved with -10.4x moisture meters installed in bunkers.

9.7.3 When measuring materials on a conveyor belt or in a concrete mixer, it is necessary to prevent material build-up, as this will affect the measurement results. If adhesion cannot be avoided, it is recommended to switch to periodic measurements for conveyor sensors, for example, once every 30-60 seconds or even less frequently. In this case, the sensor should be inserted into the material flow for 5-10 seconds, then lifted. This is easily accomplished using a standard drive. This mode will reduce material adhesion to the sensor. Additionally, when lifting, the sensor can be configured to pass between brushes, which remove any adhesion.

It should be noted that material adhesion to the -10.4x sensors installed in the bunker, and to the walls of the bunker itself, is entirely acceptable, since hundreds of liters of material are measured at once, and typically no more than ten liters adhere, so the adhering material, due to its relatively small volume, does not affect the measurements.

9.7.4 When ordering moisture meters for materials for which there is insufficient practical experience, we generally recommend that customers send 2-4 liter samples of the material to Design Bureau Fizelektronpribor. These samples allow us to select the optimal sensor option and perform pre-calibration on the provided material.

## 10. Safety precautions

10.1 To power the moisture meter, use a 24 V DC power supply that converts higher voltage to safe extra-low voltage using an isolating transformer or a converter with separate windings. For example, 24 V power supplies such as the BP30B-D3-24 from Owen, which meet the above requirements, can be used as a power source for the moisture meter.

The moisture meter complies with class III of protection against electric shock according to GOST 12.2.007.0-75 when using a power source that meets the above requirement to power the moisture meter.

10.2 It is prohibited to operate the moisture meter with the electronic unit cover removed.

10.3 It is not permitted to operate the moisture meter if the connectors are poorly connected or there is poor contact in the terminal connectors.

10.4 It is prohibited to use the moisture meter in explosive production conditions without grounding the electronic unit of the moisture meter.

10.5 The electronic unit and the moisture meter sensor should be installed on grounded metal structures.

10.6 Only persons who have studied this technical description and have been instructed in safety precautions for working with electrical installations and electronic equipment should be allowed to install (dismantle), operate, maintain and repair the moisture meter.

10.7 All types of maintenance, repair and installation related to replacing fuses, disconnecting and switching wires, etc., as well as dismantling the moisture meter should be carried out only when it is disconnected from the power source.

## 11. Installation rules

11.1 When installing the moisture meter, the safety regulations set out in Section 10 of this instruction and in the regulatory and technical documents in force at the consumer enterprise must be strictly observed.

11.2 A moisture meter that has passed in-house testing is supplied for installation at the facility.

11.3 The first step is to select the installation locations for the sensor and electronic unit. When selecting locations, consider the permitted operating conditions. Prepare the installation locations for the moisture meter components in accordance with the overall and installation dimensions.

11.4 Installation of a moisture meter at the facility is carried out in the following order:

- Mount the sensor in the prepared location;
- Secure the electronic unit to the prepared location;
- With the electronic unit cover removed, carry out electrical installation.

11. Possible moisture meter connection diagrams are presented in Appendix 21. The measurement results can be output to a controller or a computer via the RS-485 Modbus RTU digital interface. Moisture measurement results are transmitted simultaneously and independently via a 4-20 mA current loop. The TRM-201 meter-controller from Owen can be connected to the moisture meter's current output (see Appendix 21), as well as other similar meters produced by a number of companies. Calibration instructions for the TRM-201 meter-regulator are provided in Appendix 22.

The moisture meter should be powered from a 24 V DC voltage source, for example, BP30B-D3-24 from Owen.

If you need to adjust the current output parameters, obtain diagnostic information about the moisture meter's operation, read its characteristics, fine-tune the moisture meter, or change communication parameters, connect a computer (laptop) to the electronic unit using an RS-485 to USB interface converter. Instructions for adjusting the parameters are provided in Part 2 of this manual.

11.6 The electrical connection of the moisture meter must be made in the following order:

11.6.1 Connect the grounding contact on the explosion-proof electronic unit housing to the grounding bus.

11.6.2 Connect the digital interface cable to the “RS-485” terminals (if a digital data transmission channel from the moisture meter is used).

11.6.3 Connect the communication cable to the 4–20 mA current output terminals “GND Current”, “+I Current” (if a data transmission channel from the moisture meter via a current loop is used).

***Note.*** The current output and RS-485 signal circuits are not galvanically isolated from the 24 V power supply circuits.

11.6.4 The cable connection to the sensor is permanent and sealed with compound. The cable connection to the electronic unit is detachable. If the sensor cable is disconnected from the electronic unit, connect the cable wires to the terminals according to the markings, as per the diagram provided in the appendix.21.

***Note.*** When moisture meters are delivered, they are packaged in such a way that the sensor cable was connected to the electronic unit.

11.6.5. Connect the power cable to the “24 V” terminals.

11.7.Features of installation and removal of sensors of variants -10.21, -10.6

11.7.1. To install the sensor on the bin containing the material being monitored, a rectangular opening measuring (310...315) x (80...85) mm should be made in the bin wall. The sensor shield is mounted outside the bin so that the probe is located inside the bin and completely immersed in the material being monitored. When selecting a location for the sensor, avoid placing protruding metal elements within the bin near the sensor probe (at a distance of less than 20 cm).

11.7.2. The sensor shield is fastened to the bunker wall using screws.

11.8Features of installation and removal of sensors of variant -10.x on the walls of a metal bunker

***PLEASE NOTE:*** WHEN WELDING, THE MOISTURE METER PROBE MUST BE REMOVED FROM THE COUPLINGS AND DISCONNECTED FROM THE ELECTRONIC UNIT.

11.8.1 Sequence of installation of sensors of variants -10.4x with a probe made in the form of a straight rod (Appendix5 - 11), the following: end 4 of rod 5 is inserted into the hole in coupling 9 and passed through the hole in coupling 8. Housing 6 is pressed to the base by screwing on the cap-fixer 1 (or using a flange fixed with four bolts). Then, sleeve 7, made with an internal thread, is screwed onto the second end 4 of rod 5, and it is screwed until it is tightly pressed against the bottom of coupling 8. In this position, sleeve 7 is fixed with the help of cap-fixer 2. This ensures reliable contact of the high-frequency circuits of the primary converter without the need to precisely select the length of the probe (rod 5) to the dimensions of the bunker.

11.8.2 For sensors of variant -10.4x, after installation is complete, it is necessary to perform calibration with an empty bunker in accordance with paragraph 5 of part 2 of this operating manual. Calibration is necessary because the probe length is matched to the couplings attached to the bunker. For example, with a nominal probe length of 900 mm, after welding the couplings to the bin walls, the probe length may be within the acceptable range of 800 to 1000 mm.

***Note.*** The nominal length of the probe is the distance along the probe axis between the walls of the bunker.

The probe is removed in reverse order.

11.9 Features of installation and removal of sensors of variants -11.x, -12

When attaching the specified sensors to a pipe, silicone sealant should be applied to the threaded connection to prevent liquid from entering the pipe in which the cable connecting the sensor to the electronic unit is laid.

## 12. Preparation and work procedure, measurement methodology

12.1 The moisture meter is operated by an operator familiar with the operation of electronic equipment, who has studied this technical description and operating instructions, and who has received safety training when working with electrical equipment.

12.2 Preparation for work is carried out in the following sequence:

12.2.1 Check that the electrical connections comply with the electrical connection diagram and that the wire connections to the contact clamps are secure.

12.2.2 Turn on the power of the moisture meter.

12.2.3 Make sure that the "POWER" LED indicator on the side panel of the electronic unit is lit.

12.2.4 Make sure that the "CONTROL" LED indicator on the side panel of the electronic unit is flashing (when connecting the RS485 line).

***Note.*** In electronic units housed in an explosion-proof enclosure, LED indicators are located on the top board – the connection board.

12.2.5 After completing all the above steps, the moisture meter is ready for operation.

12.2.6 If a malfunction of the moisture meter is detected, it is necessary to turn off the power, find and eliminate the malfunction according to the methods of sections 13, 14 of this manual (part 1).

12.3 Taking measurements

Before taking measurements, ensure that the moisture meter sensor is completely filled with the material being measured. The measurement result should be read from an indicator device (such as a TRM-201 meter from OWEN or from a computer screen).

12.4 Evaluation of the reliability of measurements

The reliability (accuracy) of measurements is assessed by comparing moisture meter readings with the results of laboratory analyses.

These data are entered into the “Reliability Assessment Protocol for Measurements” (see Appendix 38), indicating the sampling date and temperature of the material.

When a sample is collected for laboratory measurements of the material being monitored by a moisture meter, the moisture meter readings are recorded in the protocol. After the laboratory analysis is completed, the results are entered in the appropriate line. The difference between the obtained values is calculated, taking into account the sign.

The frequency of sampling is determined by the enterprise.

If systematic, unacceptable discrepancies between the moisture meter and laboratory data are detected, an analysis of the possible causes is carried out, a list of which is given below.

***List of possible reasons for discrepancies:***

1) after installation, the moisture meter was not calibrated on an empty bin;
2) the enterprise laboratory uses a method for calculating moisture content that is different from that given in paragraph 2.3 of this manual;
3) a non-representative sample is taken for laboratory analysis;
4) the controlled material has an unstable moisture composition;
5) incomplete filling of the sensor (the volume of space covered by the sensor during measurements) with the controlled material;
6) instability of the bulk density (looseness) of the controlled bulk material (the moisture meter was calibrated at one bulk density of the material, but during measurements the bulk density changed);
7) clogging of the sensor due to the monitored material being stuck in it or due to foreign objects getting into the sensor. The material stuck in the sensor will determine the moisture meter readings.

**The following solutions are recommended for the indicated causes of discrepancies:**

Reason 1: After installation, the device was not calibrated on an empty bunker.

After installing the pin-type sensors (-10.4x), the moisture meter must be calibrated to determine the resonant frequency on an empty bin in accordance with paragraph 11.8.2 of this operating manual. Failure to calibrate may result in over- or under-reporting. Calibration should be performed when the bin is completely empty. To assess the moisture meter's performance and calibration accuracy, you can use the manufacturer's warranty service by sending a configuration file to the following email address: fizepr@gmail.com. This file must be saved immediately after calibration using the software included in the delivery set (see paragraph 2.2 of Part 2 of the Operation Manual).

Reason 2. The company's laboratory uses a different method for calculating moisture content.

There are two main methods for determining moisture content, specified in industry standards:

1) moisture is calculated as the ratio of the mass of water to the mass of the wet substance;
2) moisture is calculated as the ratio of the mass of water to the mass of dry matter.

FIZEPR-SW100 moisture meters typically use the first method (see section 2.3 of this operating manual). If measurements using the second method or volumetric moisture units are required, the calibration tables should be adjusted to the selected method and moisture units by recalculating the table values. This recalculation can be performed independently or by using the manufacturer's services (warranty service) after delivery of the moisture meter or when ordering it.

Reason 3. An unrepresentative sample is taken for laboratory analysis.

When sampling material for laboratory analysis, the following condition must be met: the moisture content of the sampled material must be equal to the average moisture content of the volume of material being measured by the moisture meter. The measured volume for probe moisture meters is -10.4x ranges from hundreds of liters to 1 cubic meter. For moisture meters, there are options -10.21 and -10.6 the measured volume is tens of liters.

As an example, in a standard batcher, the moisture content of sand prepared for loading into a concrete mixer can vary by 1% or more at different points within the volume (approximately 0.5 cubic meters). Therefore, there are specific considerations when selecting a sample for laboratory analysis. A representative sample must contain material from various parts of the entire volume, which can be achieved, for example, by repeatedly gradually dispensing the material in small doses from the bunker (batcher). Otherwise, the calculated accuracy of the laboratory analysis will not be achieved, and its results cannot be considered reliable.

Another method for obtaining samples can be recommended: take at least 8-10 samples from different areas of the volume monitored by the moisture meter (this is done while pouring sand from the bin). For each sample, determine the moisture content using a laboratory method. The resulting moisture content is determined by mathematical averaging. The advantage of this method is that it simultaneously allows you to assess the accuracy of the laboratory analysis by the magnitude of the scatter in the sample results.

Reason 4. The controlled material has an unstable composition that changes over time.

Moisture measurement results for bulk materials are affected by the material's particle size distribution, fine dust content, and salt content. All these physical factors can affect the material's dielectric properties, and the standard calibration used by the manufacturer may not be suitable. In this case, a new calibration must be created by comparing the moisture meter's readings with laboratory analysis results. Based on the comparative statistics of the moisture meter's readings and the corresponding laboratory results, the user can create a new calibration themselves or contact the moisture meter manufacturer.

Reason 5. Incomplete filling of the sensor (the volume of space covered by the sensor during measurements) with the controlled material

Reason 6. Instability of bulk density (looseness) of the controlled bulk material (the moisture meter was calibrated at one bulk density of the material, but during measurements the bulk density changed)

Reason 7. The sensor is clogged with the monitored material stuck in it or foreign objects that have entered the sensor (for example, wire, rags, grass when measuring sand)

To accurately measure the moisture content of bulk materials, it is necessary:

a) ensure the stability of the bulk density of the material at the location of the sensor;

b) completely fill the sensor with the controlled material;

c) prevent the sensor from becoming clogged, since if the sensor becomes clogged with material, then this stuck material will determine the moisture meter readings.

Explanation of the reasons for the influence on the bulk density measurements of the material:

Measurements with any moisture meter (except optical moisture meters) can be thought of as measuring the total amount of water in the volume captured by the sensor. If a larger amount of bulk material is placed (compacted) within this volume, the water content will also increase. Consequently, the moisture meter will show a higher moisture content.

It should be noted that on a conveyor belt, especially at high belt speeds, it is relatively difficult to ensure a stable bulk density. In a bin, if the material is pressed down by the top layer, the bulk density stabilizes, and measurements become more accurate.

To prevent debris from reaching the sensor installed on the conveyor, it is recommended to install a rake approximately 1 meter in front of the sensor. Large debris can be prevented from entering the bunker by selecting the correct mesh size for the grate installed above the bunker.

## 13.The software used and the description of the communication protocol

13.1 To collect data and configure the moisture meter, a set of specialized software (SW) supplied on a USB flash drive is used.

The software package includes the following programs:

1) SWLite - a program for the operator's workstation that, provides the following functions:

- simultaneous polling and control of up to 8 FIZEPR-SW100 moisture meters;
- display of current values of moisture (%) and temperature (°C) of the controlled environment in real time;
- automatic archiving and maintaining log files of measurement results;
- quick selection and switching of calibration tables;
- graphical display of the dynamics of changes in moisture and temperature over time.

2) SWMaster and SWPro - service utilities for setting up, configuring and maintaining moisture meters.

These utilities provide:

- loading and adjusting calibration tables in the device’s memory;
- reading and storing diagnostic information about the condition and performance of the moisture meter;
- setting up measurement algorithms.

***Note:***

The choice of a specific utility - SWPro or SWMaster - depends on the firmware number of the moisture meter (the version number of the internal software of the moisture meter).

For moisture meters with firmware numbers up to and including #64, the SWPro utility is used (all moisture meters manufactured before 2026 and a number of moisture meters that are still in production).

For moisture meters with firmware version No. 65 and higher, the SWMaster utility is used.

The firmware number is determined automatically when the specified utilities are launched. The moisture meter's firmware number is also listed in its data sheet.

3) SpectrViewer – a program for viewing saved moisture meter configuration files (*.cfg files).

Launching SpectrViewer to view files from the current working directory without stopping the reception of data from the moisture meter can be done either autonomously or directly from the SWPro and SWMaster utilities.

4) CalibViewer - a specialized module for working with calibration tables.

Functions performed:

- creation of calibration tables for new materials;
- statistical verification, adjustment and optimization of existing calibration tables based on laboratory measurement results.

13.2 Digital communication with the moisture meter is carried out via the MODBUS RTU protocol with the following parameters:

- communication speed – 9600, 14400, 19200, 38400; 57600 or 115200 baud;
- parity – not checked;
- number of stop bits – 2 or 1.

Default communication parameters (factory settings):

- communication speed – 19200 baud;
- number of stop bits – 2;
- address – 127.
- timeout between requests 100ms.

13.3 Features of the MODBUS RTU protocol implementation:

- reading of registers is performed by command 03 (03h);
- echo-return test command 08 (08h) is supported;
- when attempting to read a range of addresses that is outside the limits specified in the table, the moisture meter does not respond;
- writing of registers is performed by command 16 (10h);

Writing to registers is only possible in those registers for which writing is enabled. Furthermore, for firmware versions #42 and earlier, writing must be additionally enabled by writing the password 4988 to register 0020 (0014h). When attempting to write to read-only registers or without a password, the moisture meter does not respond.

13.4 MODBUS RTU Register Map

The MODBUS register map depends on the moisture meter's firmware version number. The firmware version number is specified in the moisture meter's data sheet and can also be read from register address 0003 (the lower 10 bits are used).

The register map for the internal software version No. 33 and earlier versions is presented in Table 14.1.

Table 14.1

| Register Address (DEC) | Register address (HEX) | Description | R/W |
|---|---|---|---|
| 0000 | 0000 | Measured moisture expressed in hundredths of a percent. True moisture should be calculated using the formula: W = reg[0000] / 100 with an accuracy of 2 decimal places. | R |
| 0001 | 0001 | Temperature in whole degrees Kelvin. Calculation of temperature in degrees Celsius should be done using the formula: t = reg[0001] – 273 | R |
| 0002 | 0002 | Error code | R |
| 0003 | 0003 | The version number of the internal software (firmware) of the moisture meter | R |
| 0007 | 0007 | The retardation coefficient measured by a moisture meter $k$, multiplied by 5000. The deceleration factor is calculated using the formula: k = reg[0007] / 5000 with an accuracy of 4 decimal places. (The register value is valid only for coefficients k<13) | R |
| 0020 | 0014 | Write-protect register | R/W |
| 0163 | 00A3 | Number of calibrations used in a moisture meter | R |
| 0164 | 00A4 | Current calibration number | R/W |
| 0224 | 00E0 | Temperature in whole degrees Celsius. ***(The register value is only relevant for positive temperatures)*** | R |

The register map for the internal software of versions with numbers from 34 to 64 is presented in Table 14.2.

Table 14.2

| Register Address (DEC) | Register address (HEX) | Description | R/W |
|---|---|---|---|
| 0000 | 0000 | Measured moisture expressed in hundredths of a percent. True moisture should be calculated using the formula: W = reg[0000] / 100 with an accuracy of 2 decimal places. | R |
| 0001 | 0001 | Temperature in whole degrees Kelvin. Calculation of temperature in degrees Celsius should be done using the formula: t = reg[0001] – 273 | R |
| 0002 | 0002 | Error code | R |
| 0003 | 0003 | The version number of the internal software (firmware) of the moisture meter | R |

| | | | |
|---|---|---|---|
| 0007 | 0007 | The retardation coefficient measured by a moisture meter $k$, multiplied by 5000. The deceleration factor is calculated using the formula: k = reg[0007] / 5000 with an accuracy of 4 decimal places.<br>(The register value is valid only for coefficients k < 13) | R |
| 0020 | 0014 | Write-protect register | R/W |
| 0163 | 00A3 | Number of calibrations used in a moisture meter | R |
| 0164 | 00A4 | Current calibration number | R/W |
| 0221 | 00DD | Moisture meter serial number | R |
| 0224 | 00E0 | Temperature in whole degrees Celsius.<br>***(The register value is only relevant for positive temperatures)*** | R |
| 0229<br>0230 | 00E5<br>00E6 | Specified deceleration factor (x100000).<br>The deceleration factor is calculated using the formula:<br>$k$ = ( reg[0230]+reg[0229]*65536 ) / 100000<br>accurate to 5 decimal places | R |
| 0231 | 00E7 | Temperature in tenths of a Kelvin.<br>Calculation of temperature in degrees Celsius should be done using the formula: t = reg[0231] / 10 – 273<br>accurate to tenths | R |

The MODBUS RTU register map for firmware version 65 and later is presented in Table 14.3.

Table 14.3

| Register Address (DEC) | Register address (HEX) | Description | R/W |
|---|---|---|---|
| 0000 | 0000 | Measured moisture expressed in hundredths of a percent.<br>True moisture should be calculated using the formula: W = reg[0000] / 100 with an accuracy of 2 decimal places. | R |
| 0001 | 0001 | Temperature in whole degrees Kelvin.<br>Calculation of temperature in degrees Celsius should be done using the formula: t = reg[0001] – 273 | R |
| 0002 | 0002 | Error code | R |
| 0003 | 0003 | The version number of the internal software (firmware) of the moisture meter | R |
| 0004 | 0004 | Number of calibrations used in a moisture meter | R |
| 0005 | 0005 | Moisture meter serial number | R |
| 0006<br>0007 | 0006<br>0007 | Specified deceleration factor (x100000).<br>The deceleration factor is calculated using the formula:<br>$k$ = ( reg[0007]+reg[0006]*65536 ) / 100000<br>accurate to 5 decimal places | R |

| | | | |
|---|---|---|---|
| 0020 | 0014 | Temperature in tenths of a Kelvin.<br>Calculation of temperature in degrees Celsius should be done using the formula: t = reg[0020] / 10 – 273<br>accurate to tenths | R |
| 0163 | 00A3 | Number of calibrations used in a moisture meter | R |
| 0164 | 00A4 | Current calibration number | R/W |
| 0224 | 00E0 | Temperature in whole degrees Celsius.<br>***(The register value is only relevant for positive temperatures)*** | R |

## 14.Technical condition check

The list of the main technical condition checks is given in Table 15.

Table 15

| Test method | Technical requirements |
|---|---|
| 1. Checking the grounding with an ohmmeter | The standard for the value of transition resistance of wires and grounding contacts, determined according to the regulatory documents in force at the consumer enterprise and the Electrical Installation Code. |
| 2. Checking the insulation resistance using a megohmmeter | Not less than 20 MΩ at relative humidity of ambient air from 30 to 80% and temperature of 20°C. |
| 3. Visual inspection | See Section 15, Maintenance. |

## 15. Possible malfunctions and how to fix them

15.1 It is permissible to eliminate detected faults directly at the place of operation only after disconnecting the moisture meter from the power supply.

15.2 When replacing failed components, strictly follow the instructions in Section 15 “Maintenance” of this manual.

15.3 Replacement of failed components and checking of the moisture meter after elimination of the detected malfunction must be carried out by a service specialist.

15.4 The list of the most possible faults is given in Table 16.

Table 16

| Malfunction, external manifestations and additional signs | Probable cause | Method of elimination |
|---|---|---|
| 1. When power is supplied to the moisture meter, the power indicator LED does not light.<br>Additional signs:<br>- the supply voltage at the input of the communication line power supply wire is 24 V;<br>- there is no current in the power supply circuit or it is less than 20 mA. | Power supply wire is broken.<br><br>Reversal of polarity of power wires.<br><br>Fuse FU1 has blown. | Persons responsible for electrical installation and operation of the communication line must eliminate the fault in accordance with applicable regulations.<br><br>Disconnect the moisture meter from the power supply. Open the electronic unit cover and replace fuse FU1. |

| | | |
|---|---|---|
| 2. When power is supplied to the moisture meter, the power indicator LED does not light. | Short circuit in the moisture meter power supply circuit | Persons responsible for electrical installation and operation of the communication line and for operation of the moisture meter must eliminate the malfunction in accordance with applicable regulations. |
| 3. There is no connection with the moisture meter. | Communication cable is broken or polarity is reversed; incorrect network settings for the moisture meter are specified. | Persons responsible for electrical installation and operation of the communication line and the operation of the moisture meter should check the network cable and connection. If the cable is intact but there is still no connection, check the moisture meter's network settings. To reset the moisture meter's network settings (restore default network parameters), press and hold the "Reset" button for at least 5 seconds. The "Reset" button is located on the lower circuit board of the electronic unit, under the cutout on the upper circuit board. |

## 16. Maintenance

16.1 General instructions.

16.1.1 Maintenance is carried out to ensure normal operation and preservation of the operational and technical characteristics of the moisture meter throughout its entire service life.

16.1.2 Maintenance consists of systematic monitoring of the technical condition of the moisture meter, regular technical inspection and troubleshooting.

16.1.3 After troubleshooting, it is necessary to check the technical condition of the moisture meter for normal operation.

16.2 Types and frequency of maintenance.

16.2.1 Depending on the timing and volume of work, the following types of technical maintenance are established, listed in Table 17.

Table 17

| Types of maintenance | Frequency of events | Who is serving? |
|---|---|---|
| 1. Scheduled Maintenance:<br>- weekly care | - Weekly | Operator servicing a moisture meter |
| - preventive | - Once every six months | A specialist servicing a moisture meter |
| 2. Unscheduled maintenance | If a moisture meter malfunction is detected | A specialist servicing a moisture meter |

16.2.2 The timing of preventive inspections may be changed and aligned with with the production plans and schedules adopted by the moisture meter user. However, the frequency of inspections must be at least once per year.

16.2.3 Weekly maintenance includes a visual inspection to ensure:

- reliability of connection, as well as the absence of breaks or damage to the insulation of connecting cables;

- in the absence of dents and visible mechanical damage on the moisture meter body.

16.2.4 During preventive maintenance the following works are carried out:

- removing dust and dirt from the outer surfaces of the electronic unit and the moisture meter sensor;
- external examination;
- checking the condition of communication cables and connecting wires;
- measurement of consumed current and supply voltage.

16.2.5 Unscheduled maintenance is carried out when malfunctions occur and includes work related to the repair of the moisture meter.

## 17. Storage and transportation

The storage and transportation conditions of the moisture meter comply with GOST 15150-69 for groups 3 and 5, respectively.

17.1 The components of the moisture meter in the packaging of the manufacturer may be stored in the conditions of permanently heated premises in the absence of vapors of acids, alkalis and other harmful substances in the air that cause corrosion.

17.2 The shelf life of the moisture meter in the manufacturer's packaging is up to 1 year.

17.3 The moisture meter, packed in a transport container, can be transported by any type of transport in closed vehicles over any distance.

17.4 Transportation must be carried out in compliance with all safety precautions; boxes with packaging must not be thrown or tilted.

## 18. Disposal

18.1 The moisture meter does not contain precious metals or other substances subject to mandatory disposal.

18.2 The moisture meter does not pose a danger to human life, health, or the environment. At the end of its service life (operational life), it can be disposed of according to the technology adopted by the company operating the moisture meter.

## 19. Verification of the moisture meter, calibration of the moisture meter

19.1 The need for initial verification of a moisture meter is determined by its intended use. According to GOST R 8.674-2009, measuring instruments intended for use in areas of state regulation in the field of ensuring the uniformity of measurements must undergo a type approval test procedure, as well as a verification procedure, in accordance with the established procedure.

Measuring instruments (MI) and technical systems and devices with measuring functions (TSMF) that are not intended for use in areas of state regulation in the field of ensuring the uniformity of measurements must undergo calibration in the order established by the manufacturer of the MI or TSMF and regulated in the operating documentation for the MI or TSMF.

19.2 Verification of moisture meters designed to measure oil and petroleum products, as well as, in some cases, other liquid materials in the flow, is carried out in accordance with the document "Instructions for the State Standards Institute. Moisture meters FIZEPR-SW100. Verification methodology MP 0919-6-2018", approved by FSUE "VNIIR" on November 15, 2018.

19.3 Verification of the metrological parameters of moisture meters intended for measuring bulk materials can be carried out according to the document "Moisture meters

FIZEPR-SW100. Verification Methodology MP242-1715-2014", approved by the State Centre for Measurement Systems of the Federal State Unitary Enterprise "VNIM named after D.I. Mendeleev" on May 16, 2014.

The use of dielectric moisture meters for bulk materials is permitted only for process measurements and process control. In areas of government regulation (for commercial operations, such as grain), the use of dielectric moisture meters is not permitted.

19.4 Periodic verification of a moisture meter that has passed the initial verification is carried out at least once a year.

An unscheduled verification of the moisture meter is carried out:

- after repair;
- if necessary, make sure that the moisture meter is in good working order;
- if the seal is damaged and documents confirming that the moisture meter has passed periodic verification are lost.

Verification of the moisture meter after troubleshooting that does not affect the metrological characteristics (replacement of fuses, wires, connectors) is not carried out.

19.5 When the customer specifies the material to be measured with the moisture meter, the manufacturer stores the corresponding calibration tables in the memory of the supplied moisture meter. However, even materials of the same type may have compositional differences, so the moisture meter calibration may need to be adjusted during operation. Moisture meter calibration is performed according to the document: "Setup Instructions and Software Description" (Technical Description and Operating Manual. Part 2).

The user can independently change and adjust the calibration tables, but can also use the services of the manufacturer - Design Bureau Fizelektronpribor LTD.

Fizelektronpribor Design Bureau provides comprehensive support to moisture meter buyers, regardless of their year of manufacture, and provides remote assistance on issues related to operation, commissioning, and calibration changes. The moisture meter software allows the manufacturer to remotely diagnose and configure the meter's operating modes.

## 20. Warranty obligations

The warranty period for moisture meters is at least 24 months from the date of delivery to the customer.

Warranty obligations apply subject to compliance with the operating, transportation, and storage conditions and rules specified in this user manual. Mechanical damage to the sensor and electronic unit of the moisture meter is not covered by the warranty.

## 21. Appendices

***List of applications***

1. Moisture meter sensors VIGT.415210.100-10.6 and VIGT.415210.100-10.21 for bulk materials
2. Design of the VIGT.415210.100-10.6 (-10.21) sensor with a U-shaped probe for bulk materials
3. VIGT.415210.100-10.61 sensor for bulk materials with temperatures up to 145°C
4. Moisture meter sensors VIGT.415210.100-10.51 and VIGT.415210.100-10.561 for bulk materials on a conveyor belt
5. Sensor VIGT.415210.100-10.4 (-10.41) with a probe in the form of a straight rod
6. Moisture meter sensor VIGT.415210.100-10.4 for bulk materials in a bunker
7. Moisture meter sensor VIGT.415210.100-10.4 (front coupling)
8. Moisture meter sensor VIGT.415210.100-10.4 (rear coupling with lock)
9. Installation option for the VIGT.415210.100-10.4 moisture meter sensor
10. Moisture meter sensor VIGT.415210.100-10.41 for bulk materials
11. Moisture meter sensor VIGT.415210.100-10.41 (coupling design)
12. Sensors VIGT.415210.100-11.32 and -11.6
13. Moisture meter sensor VIGT.415210.100-11.41
14. Moisture meters VIGT.415210.100-11.81 and -11.82
15. Moisture meter sensor VIGT.415210.100-12
16. Moisture meter sensors VIGT.415210.100-17.8 and -17.12
17. Laboratory moisture meter sensor VIGT.415210.100-30.1
18. Sensors for laboratory moisture meters VIGT.415210.100-30.2 and -30.26
19. Electronic units in three design variants
20. View of the electronic unit VIGT.415210.101-02 in an explosion-proof housing 1ExdIIBT5 with the top cover removed
21. Wiring diagram for the FIZEPR-SW100 moisture meter to external circuits (using the OWEN TRM-201 moisture meter and regulator as an indicator)
22. Setting the operating parameters of the relay of the OWEN-TRM-201 measuring and regulator
23. Moisture meter FIZEPR-SW100.27.19 with an electronic unit and a set of counter flanges
24. Protocol for assessing the reliability of measurements



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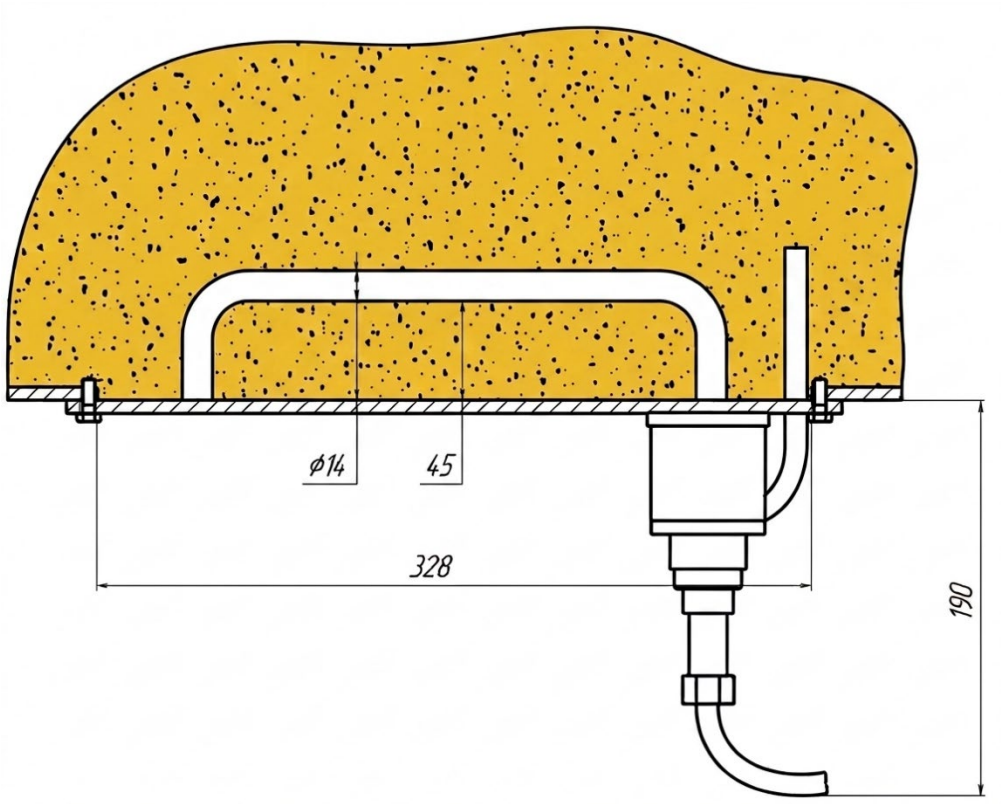
# Moisture meter sensors VIGT.415210.100-10.6 and VIGT.415210.100-10.21 for bulk materials

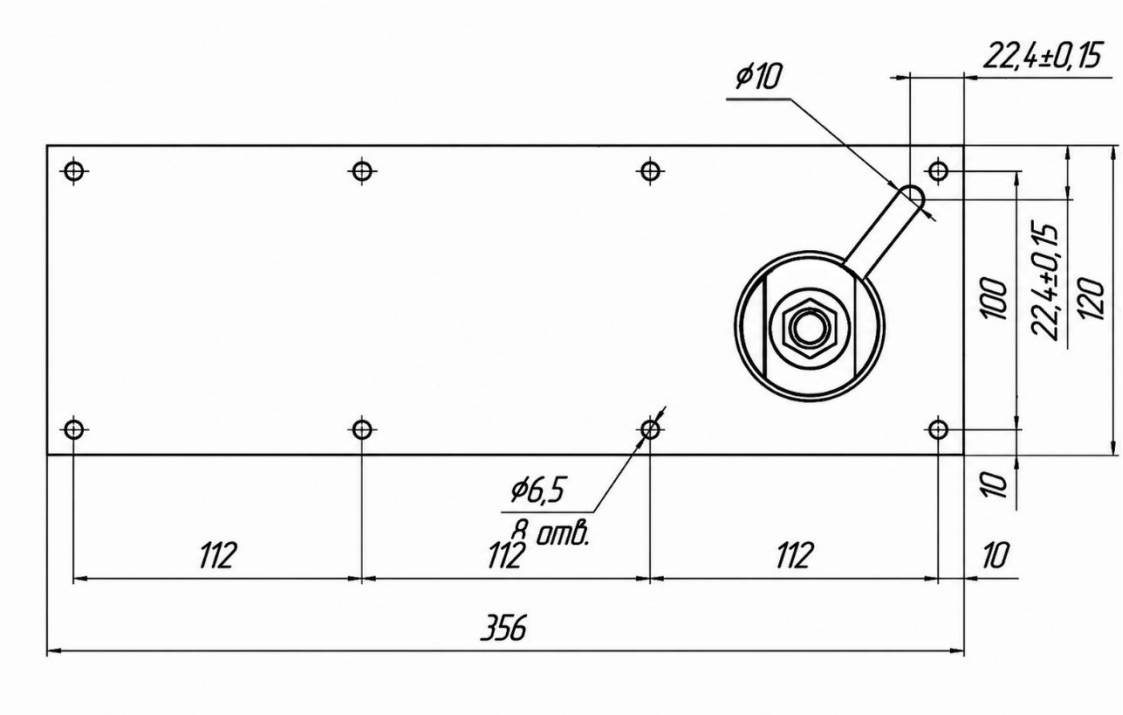
*Sensor VIGT.415210.100-10.6*

*Sensor VIGT.415210.100-10.21*

**Design of the VIGT.415210.100-10.6 (-10.21) sensor with a U-shaped probe for bulk materials**




*An example of attaching a sensor to the wall of a bunker*




*Overall and mounting dimensions of the sensor shield*

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# Sensor VIGT.415210.100-10.61
# for bulk materials with temperatures up to 145°C


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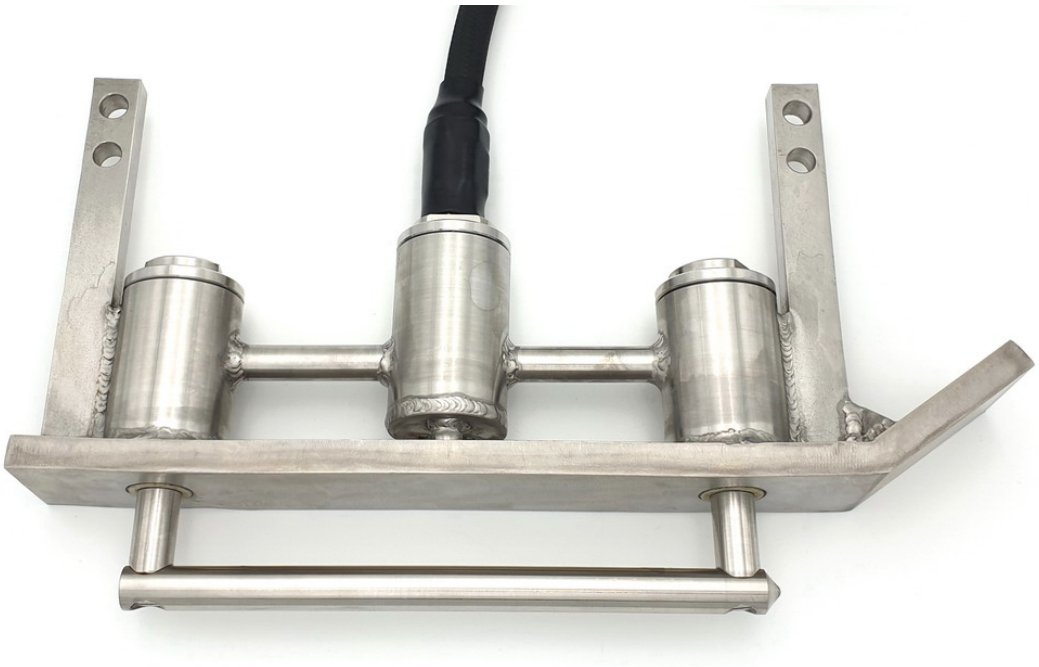
**Moisture meter sensor VIGT.415210.100-10.51(-10.561)
for bulk materials on a conveyor belt**

*Sensor VIGT.415210.100-10.51*



*Sensor VIGT.415210.100-10.561 for materials with high electrical conductivity*

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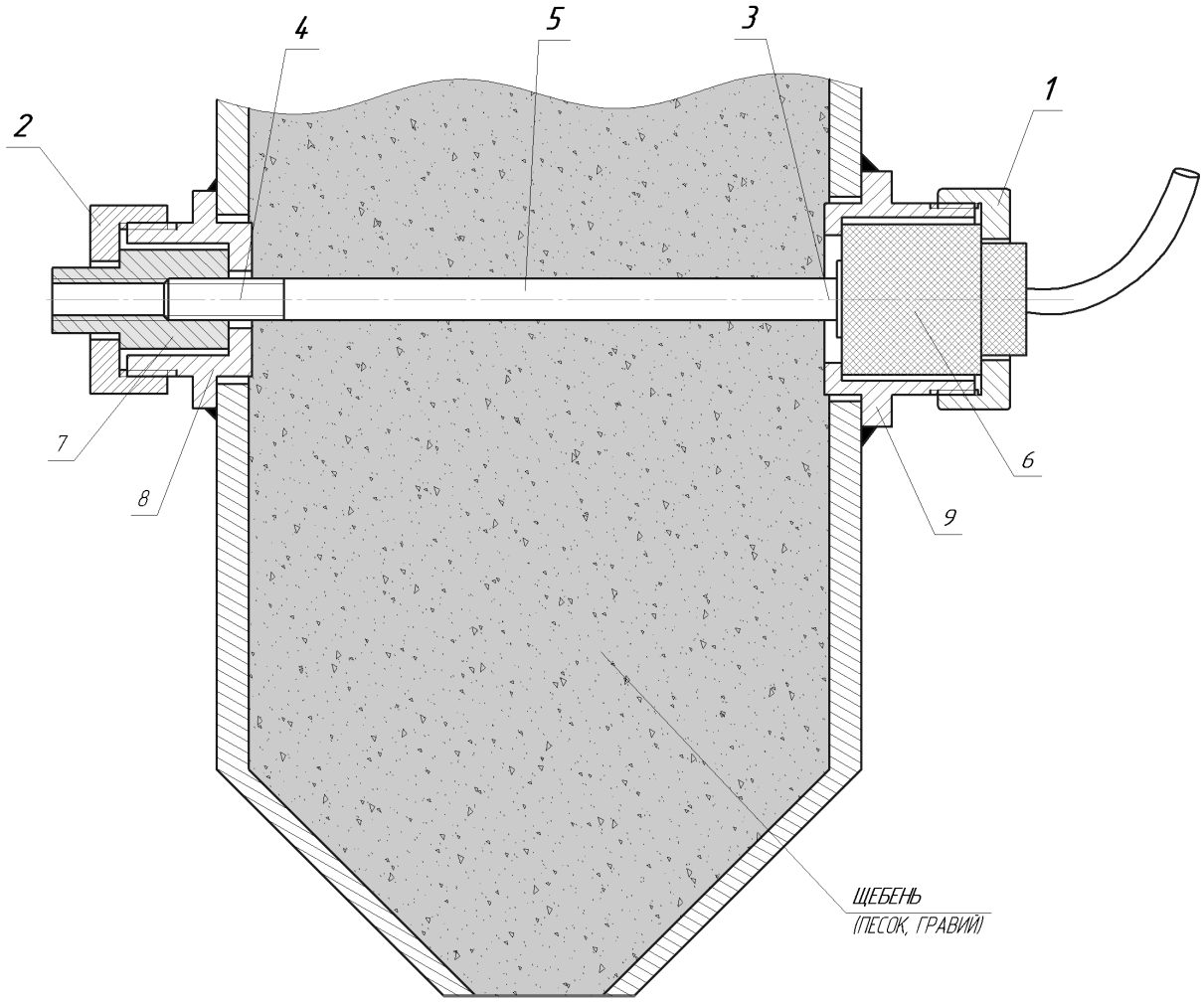
# Sensor VIGT.415210.100-10.4 (-10.41) with straight rod probe



# Moisture meter sensor VIGT.415210.100-10.4 for bulk materials in a bunker

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# Moisture meter sensor VIGT.415210.100-10.4 (front coupling)

*Probe with front coupling assembly with flange*

*Probe with front coupling,*
*view of the structure before fixing the probe using a flange*

# Moisture meter sensor VIGT.415210.100-10.4
# (rear coupling with lock)




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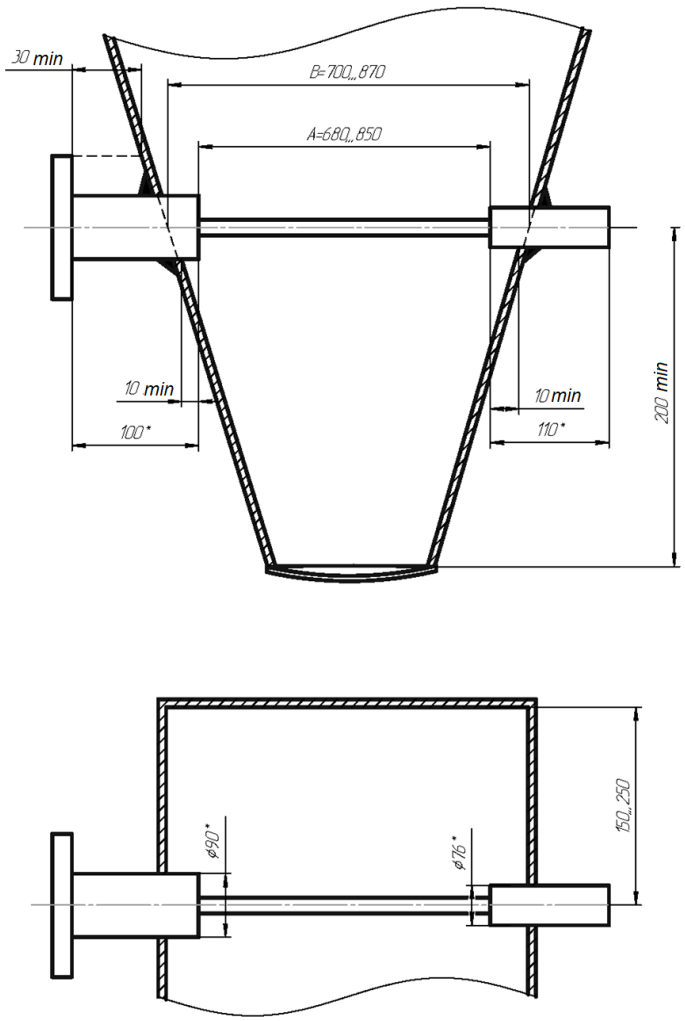
# Installation option for the VIGT.415210.100-10.4 moisture meter sensor




1. * *Reference dimension*
2. *It is acceptable to reduce size A to 400 mm. In this case, thread M27x2 on the rod shall be extended.*
   *PLEASE NOTE! When thread cutting, the sensor shall be attached only to the rod.*

# Moisture meter sensor VIGT.415210.100-10.41 for bulk materials

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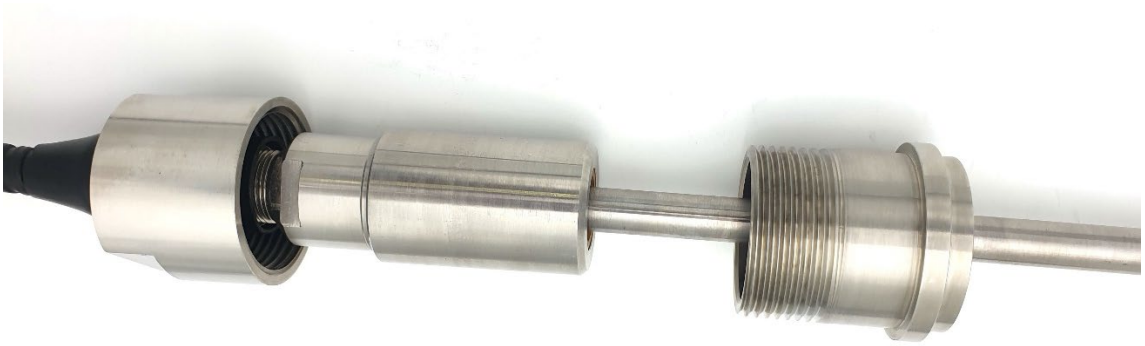
**Moisture meter sensor VIGT.415210.100-10.41**
**(coupling design)**

*Front coupling assembly*



*The front coupling disassembled before fixing the probe*

*Rear coupling disassembled*

# Sensors VIGT.415210.100-11.32 and -11.6

*Sensor VIGT.415210.100-11.32*

*VIGT.415210.100-11.6 sensor for pasty and liquid materials with high electrical conductivity*

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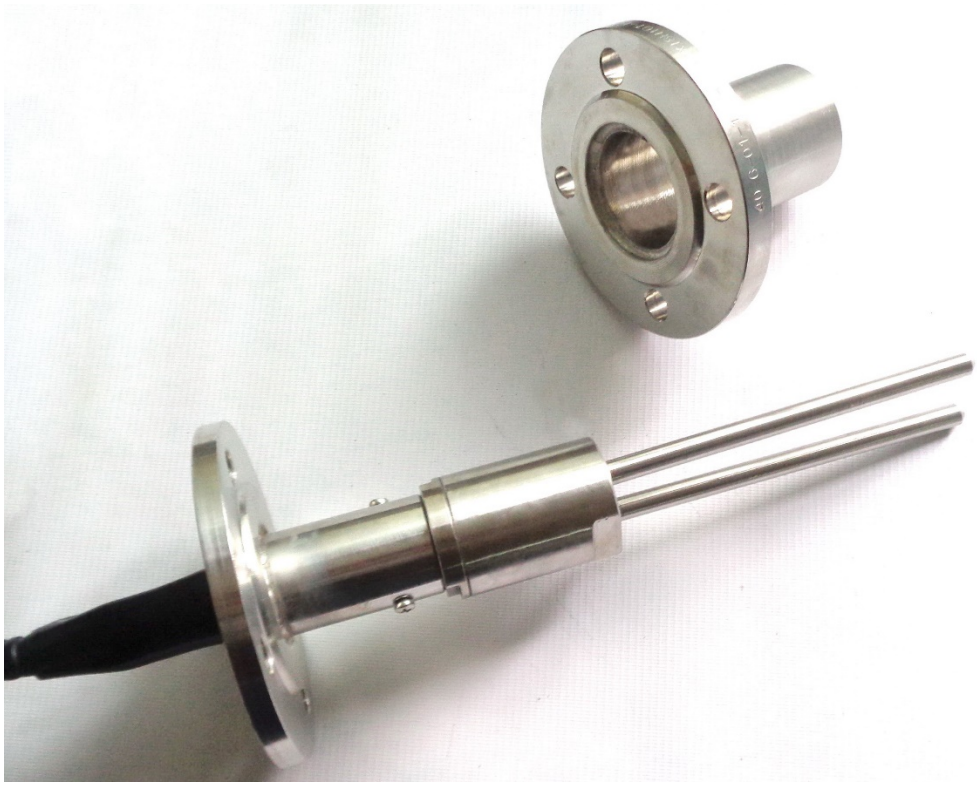
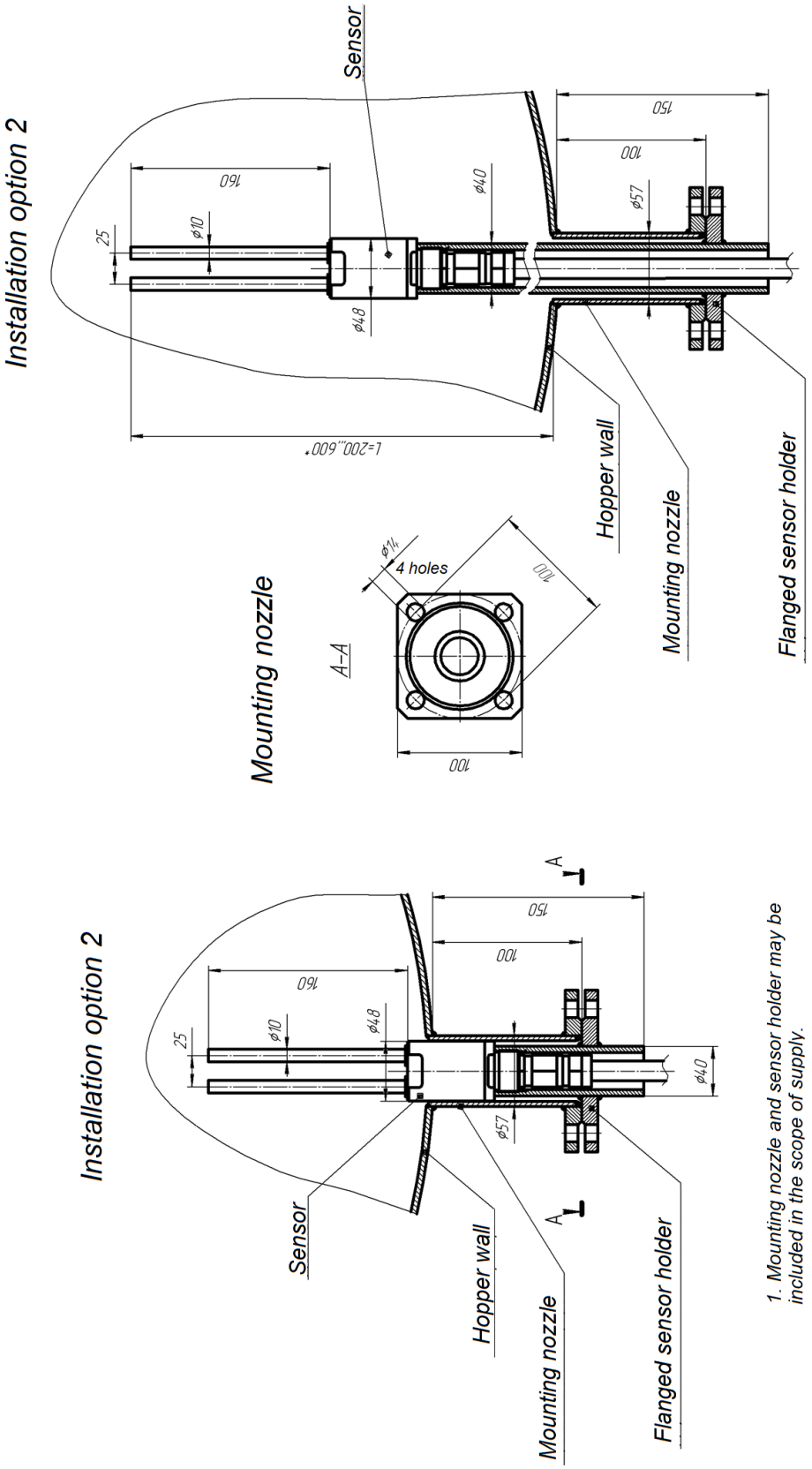
# Moisture meter sensor VIGT.415210.100-11.41



*Sensor VIGT.415210.100-11.41*

# Options for mounting the VIGT.415210.100-11.41 sensor in a bunker



# Moisture meters VIGT.415210.100-11.81 and -11.82 for grain dryers and bunkers


*Moisture meter VIGT.415210.100-11.81*


*Moisture meter VIGT.415210.100-11.82*

# Moisture meter sensor VIGT.415210.100-12

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# Moisture meter sensors VIGT.415210.100-17.8 and -17.12


*VIGT.415210.100-17.8 sensor with electronic unit*

*VIGT.415210.100-17.12 sensor with mounting hardware*

# Laboratory moisture meter sensor VIGT.415210.100-30.1





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**Sensors for laboratory moisture meters VIGT.415210.100-30.2 and -30.26**

*Sensor VIGT.415210.100-30.2*

*Sensor VIGT.415210.100-30.26*

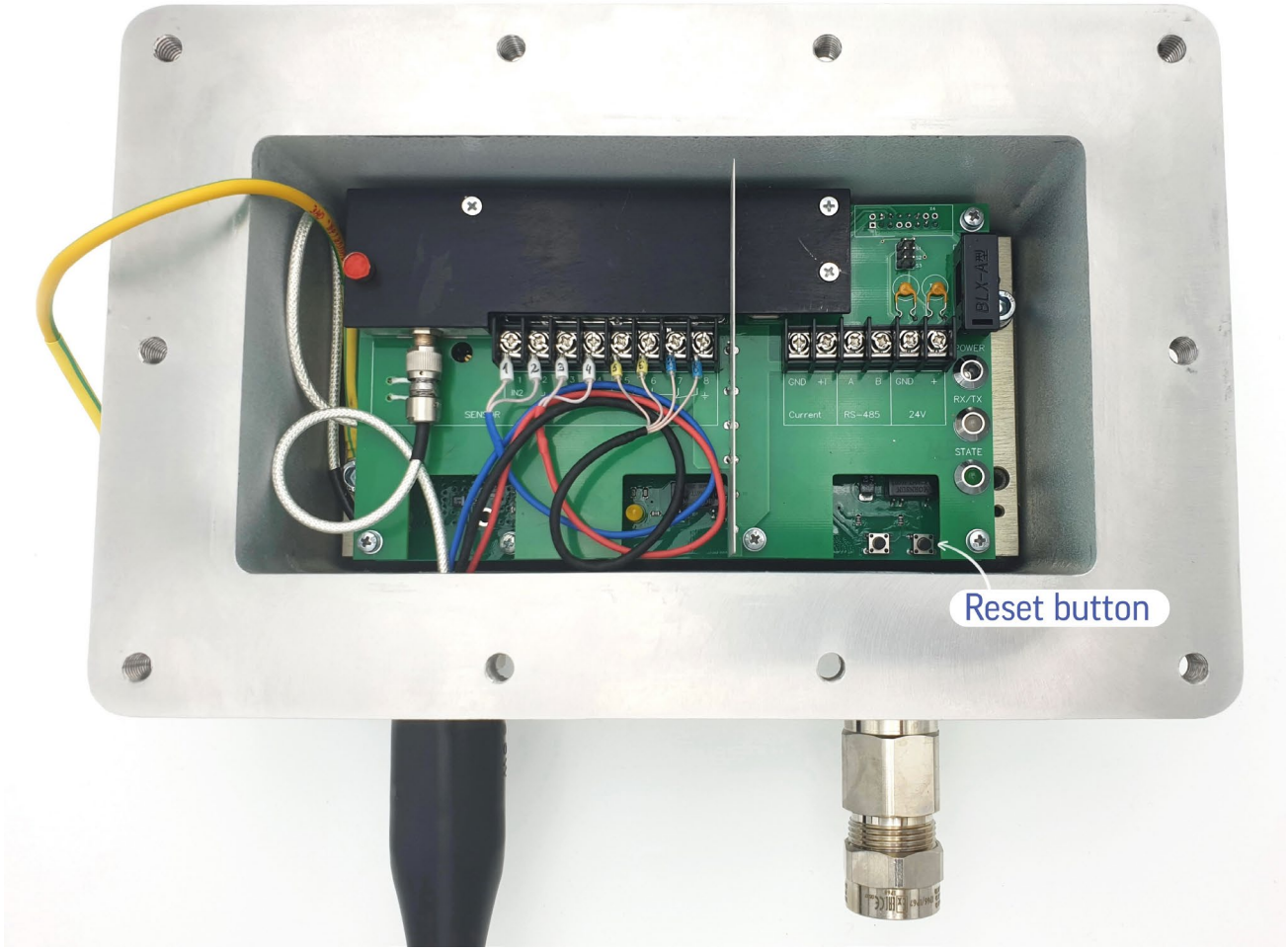
# Electronic units in three design variants


*General-purpose industrial unit VIGT.415210.101*

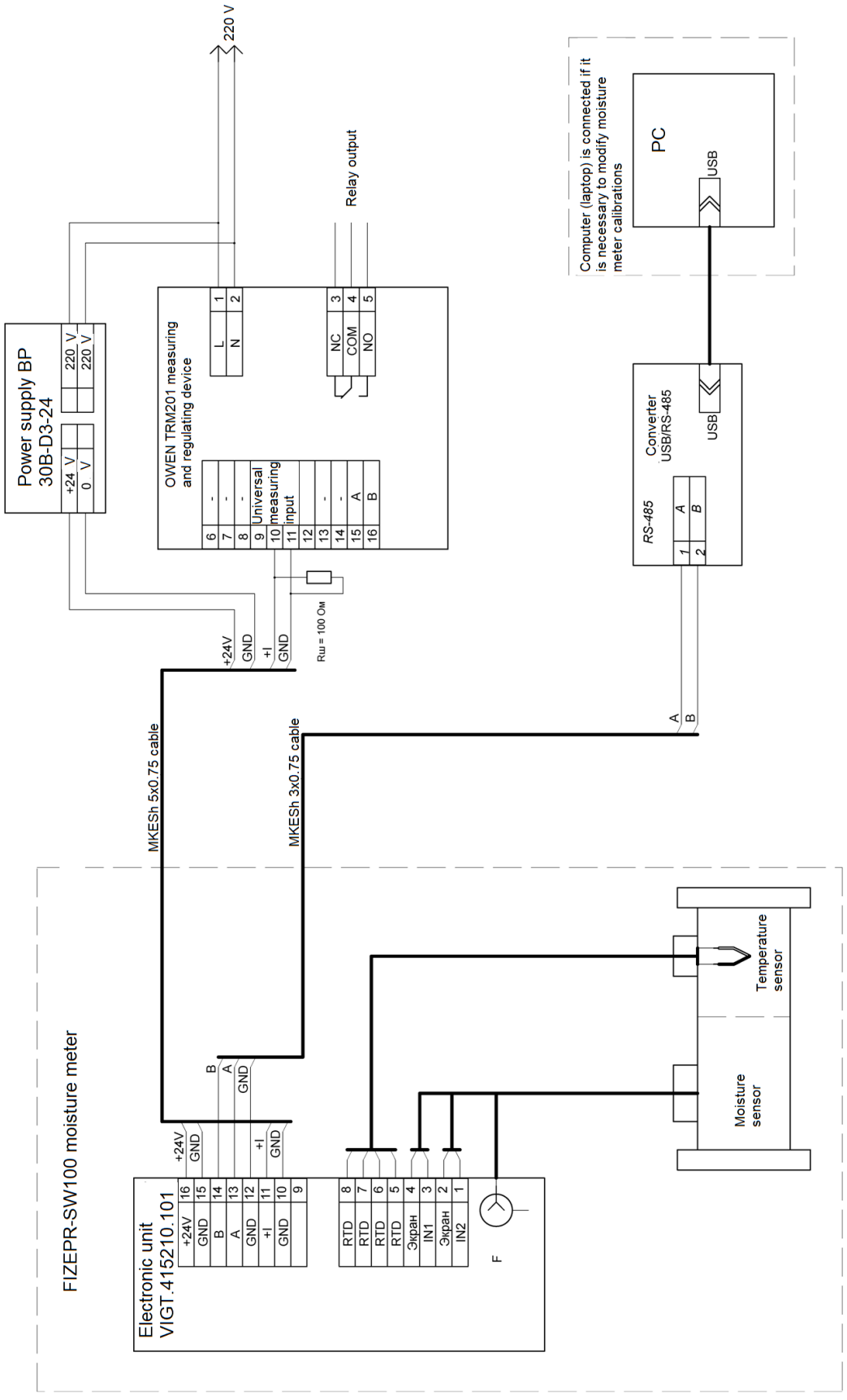

*General-purpose industrial unit VIGT.415210.101-01 with connectors*


*VIGT.415210.101-02 electronic unit in explosion-proof enclosure 1Exd[iaGa]IIBT5Gb*

**View of the electronic unit VIGT.415210.101-02**
**in explosion-proof enclosure 1Exd[iaGa]IIBT5Gb**
**with the top cover removed**



# Wiring diagram for the FIZEPR-SW100 moisture meter connection to external circuits (as an indicator - the TRM-201 meter-regulator from OWEN)







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# Setting relay operation parameters
# TRM 201 flow meter and regulator from OWEN

As an example, it is shown how to program a measuring controller to control a water supply valve depending on the moisture of a water-oil emulsion.

Let's consider the following case:
the water supply valve must be closed when the moisture of the water-oil emulsion increases to 15% or more;
If the emulsion moisture has dropped to 10% or less, the water supply valve should be open.
For this case, the following is set on the TRM-201 meter-regulator:
threshold - 12.5%; hysteresis - 2.5%.

1. ***Selecting the response threshold*** (the response threshold value is displayed on the lower green indicator)
   1.1. The desired response threshold is selected using the up and down arrow buttons. Let's set the threshold to 12.5 (long-pressing the buttons will speed up the selection process).
   1.2. Press the "PROG" button briefly.

***2. Setting hysteresis***
2.1. Enter the menu by pressing and holding the “PROG.” button for 3 - 6 seconds.
The upper indicator should show the inscription 'nEnU' (the first letter 'n' with an underscore), and the lower indicator should show the inscription 'LuōP' (menu items are displayed on a green indicator).
2.2. Press the up button several times to find the menu item 'LuōU'.
2.3. Briefly press the "PROG." button (the upper red indicator will show 'SL.L').
2.4. By pressing the "PROG." button several times, find the submenu item with the inscription 'HYS' on the upper red indicator.
2.5. Use the up and down arrow buttons to set the desired hysteresis value. We'll set it to 2.5.
2.6. Press the "PROG" button briefly.
2.7. To access the initial menu you need to:
   2.7.1. Press and hold the "PROG." button until the following text appears: on the upper red indicator - 'nEnU' (the first letter 'n' with an underscore), on the lower one - 'LuōU').
   2.7.2. Use the down arrow button to find the 'LuōP' menu item.
   2.7.3. Press the “PROG” button (switch to indication mode: the red indicator shows the measured value of the parameter, the green one shows the relay response threshold).

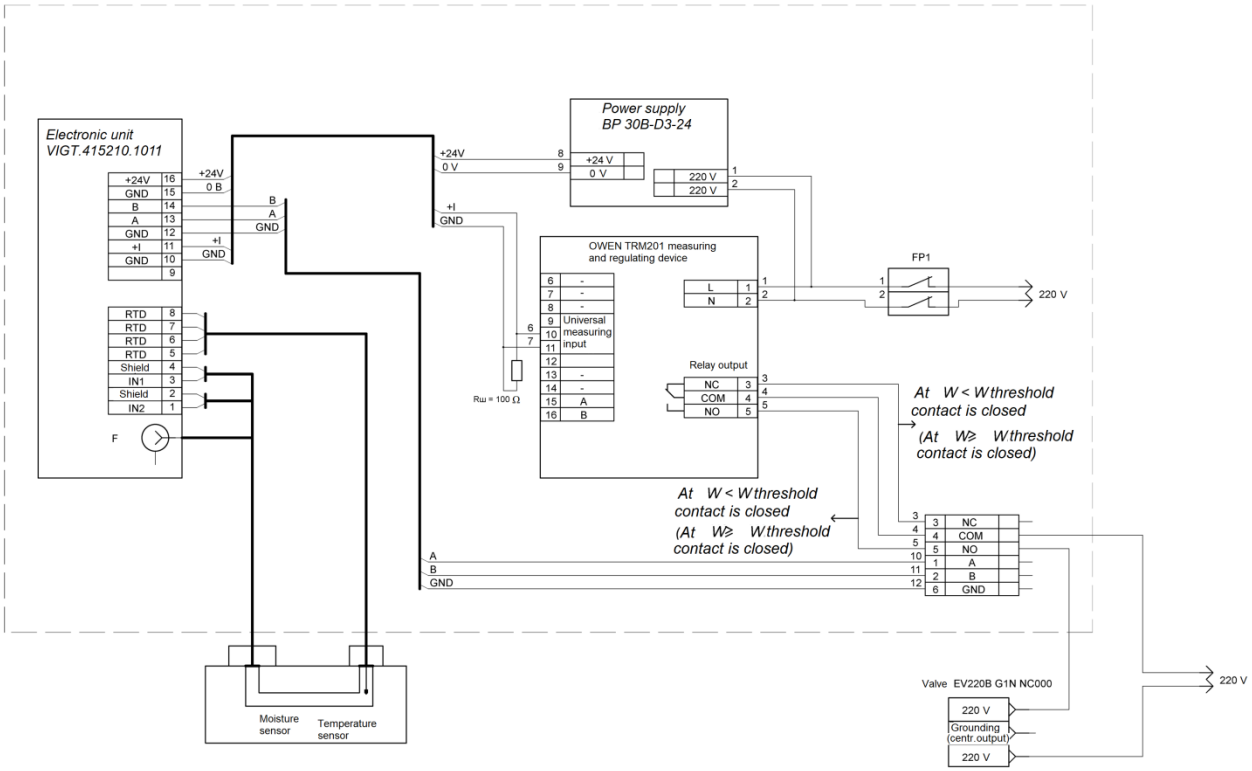
***3. Setting the relay operation method***
Complete points 2.1 - 2.3.
3.1. Press the “PROG.” button briefly until the inscription CnP (the letter 'n' with an underscore) appears on the upper indicator.
3.2. Use the arrow buttons to select the parameter value: 1. If you select 1, the relay is on (relay contacts 3,4 are open, the valve is open) if the moisture is below 10% and off (valve is closed) if the moisture is above 15%.

*Note: When you select the value of this parameter equal to 2, the relay will be turned off when the moisture is below the threshold, and turned on when the moisture is above the threshold.*

3.3. Press the "PROG" button briefly.

3.4. Complete point 2.7.

*Note that the valve shuts off the water supply when no voltage is applied to it. The valve is connected to the normally open contacts of the relay (5, 6) as shown in the diagram below.*




*Wiring diagram for the FIZEPR-SW100 moisture meter to control the water supply valve (normally closed valve)*

**Moisture meter FIZEPR-SW100.27.19 with electronic unit and a set of mating flanges.**

## Protocol for assessing the reliability of measurements

| Date and time Taking samples | Temperature product, °C | Moisture according to the moisture meter, % | Moisture according to laboratory data, % | Difference in readings, % | Notes |
|---|---|---|---|---|---|
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