Design Bureau Fizelektronpribor, Ltd.

Russian Classification of Production 42 1550

Moisture Analyzers (Moisture Meters) FIZEPR-SW100 for Measuring Crude Oil and Petroleum Products

Technical description and operation
manual
VIGT.415210.100 RE
Part 1
(Rev. 4.26)

Samara, 2023

CONTENTS

1. Introduction

1.1. This technical description and operation manual are designed for familiarization with the device, principle of operation, installation, preparation, inspection and maintenance rules of moisture analyzers (moisture meters) FIZEPR-SW100.

1.2. Moisture analyzers (moisture meters) FIZEPR-SW100 are entered into the State Register of Measuring Equipment of the Russian Federation, Certificate OC.C.31.006.A No. 74665, approved on 10.08.2019. Moisture meters are verified according to Verification Method MP 0919-6-2018 "GSI Instruction. Moisture Analyzers (Moisture Meters) FIZEPR-SW100. Verification Method" approved by FSUE "All-Russian Research Institute for Flow Metering" on 15.11.2018.

1.3. Moisture analyzers FIZEPR-SW100 are certified for use in explosive areas, Certificate No. TC RU C-RU.АД07.В.03758/21, Series RU No. 0264976, issued by CERTIFICATION CENTER "VELES" LLC on 09.09.2021. Explosion-proof marking: on the electronic unit - **1Exd[iaGa]IIBT5Gb**, on the sensor - **0ExiaIIBT5Ga**.

1.4. Moisture analyzers FIZEPR-SW100 may be used at pressures of up to 16MPa, Declaration of Conformity TR CU 032/2013 Reg. No. EAEU N RU Д-RU.АД07.В.02031/19 dated 28.12.2019, accepted under Test Report No. 1079ИЛПМД dated 25.12.2019 issued by the PROMMASH TEST LLC Testing Center.

1.5. Moisture analyzers FIZEPR-SW100 correspond to Class III of electrical shock protection in accordance with GOST 12.2.007.0-75 and are designed to operate at a safe ultra-low voltage 24V. Moisture analyzers have neither external nor internal electrical circuits operating at a higher voltage.

1.6. The manufacturer retains the right to make modifications in the design and circuit of moisture analyzers that do not affect their specifications, without adjusting the operating and maintenance documentation.

2. Purpose

2.1. Moisture analyzers (moisture meters) FIZEPR-SW100 (hereinafter – moisture meters) are designed to measure water content in crude oil and petroleum products (including in gas condensate) in volume fractions in automatic mode. Moisture meters may be used to control crude oil during its extraction and preparation after free gas separation. One of their applications is using as part of oil quantity and quality measurement systems (OQMS).

2.2. Due to the principle of operation the moisture meter FIZEPR-SW100 is a radiowave device – dielectric moisture meter. The method of permittivity ε_r measurement is direct, based on measuring deceleration factor ($k_{dec} = \varepsilon_r^{½}$) of an electromagnetic wave in the controlled material. Measurements are made by probing the medium with radio waves, and the moisture meter determines factor k_{dec}, by calculating the ratio of sensor resonant frequency in air to its resonant frequency in the controlled material. Based on the measured deceleration factor (permittivity) value, the moisture meter processor calculates water content taking into account the controlled

Design Bureau Fizelektronpribor, Ltd.
Samara Tel. +7 (846) 925-63-53, +7 (846) 359-17-01, +7-927-778-79-34
E-mail: info@fizepr.ru Website: http://www.fizepr.ru

material temperature. The calculation is made based on calibration tables prepared for each type of the controlled material and stored in the moisture meter memory. The moisture measuring method used provides high accuracy and repeatability of measurement results. The moisture meter metrological characteristics do not depend on external conditions, and measurements are not affected by the temperature of semiconductor converters and the electronic unit itself.

It is important to note that moisture meter calibration (preparation of calibration tables) must be performed on the crude oil and formation water to be measured to ensure high accuracy of moisture measurement specified in the data sheet.

2.3. Moisture content – a parameter measured by the moisture meter – is a ratio between the volume of water contained in the material to the wet material volume and is defined by the following formula:

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

where W - material moisture content (moisture);

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

V_{sample} - volume of the sample.

2.4. FIZEPR-SW100 moisture meters consist of an electronic unit and a sensor connected by a cable. Cable connection with the sensor is non-separable and filled with compound. Cable connection with the electronic unit is detachable.

Moisture meters are manufactured in versions provided in Tables 1 - 3. Electronic units of the same type are used in all moisture meter versions, and sensors differ by the method of their introduction into the pipeline. It should be noted the type of flanges used depends on the diameter of the pipeline where sensors are installed and on the pipeline working pressure. At the same time, all sensor versions have a structure of the same type: they comprise a pipe with a probe made as a pin installed inside the pipe. A thermal detector (thermocouple or thermal resistor) is located inside the sensor cavity to ensure measurements of the controlled material temperature. The sensor enclosure and probe are made of corrosion resistant steel AISI 321 (or AISI 316Ti).

Depending on application conditions and controlled material, two versions of moisture meters are available:

– With a corrosion resistant steel probe placed in a dielectric (ceramic) tube – for measuring moisture content (moisture) in the range of 0 to 100% at a salt content of up to 250 g/liter

– With a corrosion resistant steel probe without a dielectric sheath – for measuring moisture content in the range of 0 to 100% at a salt content of up to 0.5 g/liter and in a humidity range of 0 to 20% at a salt content of up to 250 g/liter.

Depending on the nominal bore DN and working pressure PN of the pipeline where the moisture meter is installed, moisture meter sensors are equipped with a corresponding flange type. The choice of the flange type does not affect the moisture meter metrological characteristics.

Moisture meters are certified for use in explosive areas. Electronic units are made in an explosion-proof enclosure 1ExdIIBT5 IP66 and have explosion-proof marking

1Exd[iaGa]IIBT5Gb. Explosion-proof marking of sensors - 0ExiaIIBT5Ga. The electronic unit may be installed in Explosive Zone 1, and the sensor may be installed in Explosive Zone 0 where explosive gas atmosphere is present continuously or for long periods of time.

Table 1

Moisture meter version:	Sensor design version
FIZEPR-SW100.**20**.x FIZEPR-SW100.**20**.x.K (straight-flow version)	The straight-flow sensor is made as a pipe section with two flanges, and these flanges are located on the same axis. Nominal bore: DN 50, DN 65, DN 80, DN 100, DN 125 and DN 150; pressure PN - up to 160 kgf/cm^2. Moisture meters in FIZEPR-SW100.**20**.x version have a moisture content measurement range of 0…20% at a salt content in an aqueous phase of up to 250 g/liter and 0… 100% at a salt content of up to 0.5 g/liter. Moisture meters in FIZEPR-SW100.**20**.x.K version have a sensor probe covered with a ceramic tube, moisture content measurement range is 0…100% at a salt content in an aqueous phase of up to 250 g/liter.
FIZEPR-SW100.**21**.x FIZEPR-SW100.**21**.x.K (full-flow version)	The full-flow sensor has a pipe and a probe inside this pipe mounted on one flange. There are openings in the lateral surface of the pipe. The sensor is designed for installation on the lateral surface of the pipeline with a nominal bore DN from 200 mm and more; working pressure PN - up to 160 kgf/cm^2. The sensor of this type may also be used for measurements in pipelines of a smaller diameter (DN 65 … 150) when using tee pipes making it possible to install the sensor along the pipeline section axis. Moisture meters in FIZEPR-SW100.**21**.x version have a moisture content measurement range of 0…20% at a salt content in an aqueous phase of up to 250 g/liter and 0… 100% at a salt content of up to 0.5 g/liter. Moisture meters in FIZEPR-SW100.**21**.x.K version have a sensor probe covered with a ceramic tube, moisture content measurement range is 0…100% at a salt content in an aqueous phase of up to 250 g/liter.
FIZEPR-SW100.**24**.x (angular version, L-type)	The angular sensor is made as a pipe section with two flanges where one of the flanges is located on the pipe axis and the second one is on the side of the pipe section. Nominal bore: DN 50, DN 65, DN 80, DN 100, DN 125 and DN 150; pressure PN - up to 160 kgf/cm^2. A sensor probe is covered with a ceramic tube, moisture content measurement range is 0…100% at a salt content in an aqueous phase of up to 250 g/liter.

Note.

An additional index "**x**" in the moisture meter designation is the flange type used which is selected depending on the pipeline nominal bore DN and working pressure PN.

Design Bureau Fizelektronpribor, Ltd.
Samara Tel. +7 (846) 925-63-53, +7 (846) 359-17-01, +7-927-778-79-34
E-mail: info@fizepr.ru Website: http://www.fizepr.ru

2.5. The list of moisture meter versions is provided in Tables 2 and 3.

Table 2

Moisture meter version:	Purpose, pipeline parameters	Sensor design version
Moisture analyzer FIZEPR-SW100.20.x / 20.x.K, straight-flow version		
FIZEPR-SW100. **20.31**	Liquid materials in a DN50 pipeline, pressure up to 6 atm. Range of operating temperatures: -20 … +145°C.	Straight-flow sensor made as a DN50, PN6 pipe section, made of steel AISI 321; 50-6-01-1-B flanges according to GOST 33259-2015; complete with 50-6-01-1-B mating flanges made of AISI 1020 steel according to GOST 33259-2015.
FIZEPR-SW100. **20.5**	Liquid materials in a DN50 pipeline, pressure up to 25 atm. Range of operating temperatures: -20 … +120°C.	Straight-flow sensor made as a DN50, PN6 pipe section, made of steel AISI 321; 50-25-01-1-B flanges according to GOST 33259-2015; complete with 50-25-01-1-B mating flanges made of AISI 1020 steel according to GOST 33259-2015.
FIZEPR-SW100. **20.51**	Liquid materials in a DN50 pipeline, pressure up to 25 atm. Range of operating temperatures: -20 … +145°C.	Straight-flow sensor made as a DN50, PN6 pipe section, made of steel AISI 321; 50-25-01-1-B flanges according to GOST 33259-2015; complete with 50-25-01-1-B mating flanges made of AISI 1020 steel according to GOST 33259-2015.
FIZEPR-SW100. **20.53**	Liquid materials in a DN50 pipeline, pressure up to 25 atm. Range of operating temperatures: -20 … +200°C.	Straight-flow sensor made as a DN50, PN6 pipe section, made of steel AISI 321; 50-25-01-1-B flanges according to GOST 33259-2015; complete with 50-25-01-1-B mating flanges made of AISI 1020 steel according to GOST 33259-2015.
FIZEPR-SW100. **20.6.K**	Crude oil with moisture content of up to 100% in a DN80 pipeline, pressure up to 25 atm. Range of operating temperatures: -20 …+120°C.	Straight-flow sensor made as a DN80, PN6 pipe section, made of steel AISI 321; 80-25-01-1-B flanges according to GOST 33259-2015; complete with 80-25-01-1-B mating flanges made of AISI 1020 steel according to GOST 33259-2015.
FIZEPR-SW100. **20.61**	Liquid materials in a DN80 pipeline, pressure up to 25 atm. Working temperature range -20 … +145°C.	Straight-flow sensor made as a DN80, PN6 pipe section, made of steel AISI 321; 80-25-01-1-B flanges according to GOST 33259-2015; complete with 80-25-01-1-B mating flanges made of AISI 1020 steel according to GOST 33259-2015.
FIZEPR-SW100. **20.81**	Liquid materials in a DN50 pipeline, pressure up to 40 atm. Range of operating temperatures: -20 … +145°C.	Straight-flow sensor made as a DN50, PN40 pipe section, made of steel AISI 321; 50-40-11-1-E flanges according to GOST 33259-2015; complete with 50-40-11-1-F mating flanges made of AISI 1020 steel according to GOST 33259-2015.
FIZEPR-SW100. **20.9**	Liquid materials in a DN80 pipeline, pressure up to 40 atm. Range of operating temperatures: -20 … +120°C.	Straight-flow sensor made as a DN80, PN40 pipe section, made of steel AISI 321; 80-40-11-1-E flanges according to GOST 33259-2015; complete with 80-40-11-1-F mating flanges made of AISI 1020 steel according to GOST 33259-2015.
FIZEPR-SW100. **20.9.K**	Crude oil with moisture content of up to 100% in a DN80 pipeline, pressure up to 40 atm. Range of operating temperatures: -20 …+120°C.	Straight-flow sensor made as a DN80, PN40 pipe section, made of steel AISI 321; 80-40-11-1-E flanges according to GOST 33259-2015; complete with 80-40-11-1-F mating flanges made of AISI 1020 steel according to GOST 33259-2015.

FIZEPR-SW100. **20.10**	Liquid materials in a DN125 pipeline, pressure up to 6 atm. Range of operating temperatures: -20 … +120°C.	Straight-flow sensor made as a DN125, PN6 pipe section, made of steel AISI 321; 125-6-01-1-B flanges according to GOST 33259-2015; complete with 125-6-01-1-B mating flanges made of AISI 1020 steel according to GOST 33259-2015.
FIZEPR-SW100. **20.11**	Liquid materials in a DN50 pipeline, pressure up to 63 atm. Range of operating temperatures: -20 … +120°C.	Straight-flow sensor made as a DN50, PN63 pipe section, made of steel AISI 321; 50-63-11-1-E (or 50-63-11-1-J) flanges according to GOST 33259-2015; complete with 50-63-11-1-F (or 50-63-11-1-J) mating flanges made of AISI 1020 steel according to GOST 33259-2015.
FIZEPR-SW100. **20.12**	Liquid materials in a DN80 pipeline, pressure up to 63 atm. Range of operating temperatures: -20 … +120°C.	Straight-flow sensor made as a D80, PN63 pipe section, made of steel AISI 321; 80-63-11-1-E (or 80-63-11-1-J) flanges according to GOST 33259-2015; complete with 80-63-11-1-F (or 80-63-11-1-J) mating flanges made of AISI 1020 steel according to GOST 33259-2015.
FIZEPR-SW100. **20.12.К**	Crude oil with moisture content of up to 100% in a DN80 pipeline, pressure up to 63 atm. Range of operating temperatures: -20 …+120°C.	Straight-flow sensor made as a D80, PN63 pipe section, made of steel AISI 321; 80-63-11-1-E (or 80-63-11-1-J) flanges according to GOST 33259-2015; complete with 80-63-11-1-F (or 80-63-11-1-J) mating flanges made of AISI 1020 steel according to GOST 33259-2015.
FIZEPR-SW100. **20.14**	Liquid materials in a DN100 pipeline, pressure up to 6 atm. Range of operating temperatures: -20 … +120°C.	Straight-flow sensor made as a DN100, PN6 pipe section, made of steel AISI 321; 100-6-01-1-B flanges according to GOST 33259-2015; complete with 100-6-01-1-B mating flanges made of AISI 1020 steel according to GOST 33259-2015.
FIZEPR-SW100. **20.15**	Liquid materials in a DN80 pipeline, pressure up to 160 atm. Range of operating temperatures: -20 … +120°C.	Straight-flow sensor made as a D80, PN160 pipe section, made of steel AISI 321; 80-160-11-1-E (or 80-160-11-1-J) flanges according to GOST 33259-2015; complete with 80-160-11-1-F (or 80-160-11-1-J) mating flanges made of AISI 1020 steel according to GOST 33259-2015.
FIZEPR-SW100. **20.15.К**	Crude oil with moisture content of up to 100% in a DN80 pipeline, pressure up to 160 atm. Range of operating temperatures: -20 …+120°C.	Straight-flow sensor made as a D80, PN160 pipe section, made of steel AISI 321; 80-160-11-1-E (or 80-160-11-1-J) flanges according to GOST 33259-2015; complete with 80-160-11-1-F (or 80-160-11-1-J) mating flanges made of AISI 1020 steel according to GOST 33259-2015.
FIZEPR-SW100. **20.16**	Liquid materials in a DN100 pipeline, pressure up to 16 atm. Range of operating temperatures: -20 … +120°C.	Straight-flow sensor made as a DN100, PN16 pipe section, made of steel AISI 321; 100-16-01-1-B flanges according to GOST 33259-2015; complete with 100-16-01-1-B mating flanges made of AISI 1020 steel according to GOST 33259-2015.
FIZEPR-SW100. **20.161**	Liquid materials in a DN100 pipeline, pressure up to 16 atm. Range of operating temperatures: -20 … +145°C.	Straight-flow sensor made as a DN100, PN16 pipe section, made of steel AISI 321; 100-16-01-1-B flanges according to GOST 33259-2015; complete with 100-16-01-1-B mating flanges made of AISI 1020 steel according to GOST 33259-2015.

Design Bureau Fizelektronpribor, Ltd.
Samara Tel. +7 (846) 925-63-53, +7 (846) 359-17-01, +7-927-778-79-34
E-mail: info@fizepr.ru Website: http://www.fizepr.ru

FIZEPR-SW100. **20.16.К**	Crude oil with moisture content of up to 100% in a DN100 pipeline, pressure up to 16 atm. Range of operating temperatures: -20 …+120°C.	Straight-flow sensor made as a DN100, PN16 pipe section, made of steel AISI 321; 100-16-01-1-B flanges according to GOST 33259-2015; complete with 100-16-01-1-B mating flanges made of AISI 1020 steel according to GOST 33259-2015.
FIZEPR-SW100. **20.17**	Liquid materials in a DN100 pipeline, pressure up to 25 atm. Range of operating temperatures: -20 … +120°C.	Straight-flow sensor made as a DN100, PN25 pipe section, made of steel AISI 321; 100-25-01-1-B flanges according to GOST 33259-2015; complete with 100-25-01-1-B mating flanges made of AISI 1020 steel according to GOST 33259-2015.
FIZEPR-SW100. **20.17.К**	Crude oil with moisture content of up to 100% in a DN100 pipeline, pressure up to 25 atm. Range of operating temperatures: -20 …+120°C.	Straight-flow sensor made as a DN100, PN25 pipe section, made of steel AISI 321; 100-25-01-1-B flanges according to GOST 33259-2015; complete with 100-25-01-1-B mating flanges made of AISI 1020 steel according to GOST 33259-2015.
FIZEPR-SW100. **20.18**	Liquid materials in a DN50 pipeline, pressure up to 160 atm. Range of operating temperatures: -20 … +120°C.	Straight-flow sensor made as a D50, PN160 pipe section, made of steel AISI 321; 50-160-11-1-E (or 50-160-11-1-J) flanges according to GOST 33259-2015; complete with 50-160-11-1-F (or 50-160-11-1-J) mating flanges made of AISI 1020 steel according to GOST 33259-2015.
FIZEPR-SW100. **20.181**	Liquid materials in a DN50 pipeline, pressure up to 160 atm. Range of operating temperatures: -20 … +145°C.	Straight-flow sensor made as a D50, PN160 pipe section, made of steel AISI 321; 50-160-11-1-E (or 50-160-11-1-J) flanges according to GOST 33259-2015; complete with 50-160-11-1-F (or 50-160-11-1-J) mating flanges made of AISI 1020 steel according to GOST 33259-2015.
FIZEPR-SW100. **20.19**	Liquid materials in a DN150 pipeline, pressure up to 16 atm. Range of operating temperatures: -20 … +120°C.	Straight-flow sensor made as a DN150, PN16 pipe section, made of steel AISI 321; 150-16-01-1-B flanges according to GOST 33259-2015; complete with 150-16-01-1-B mating flanges made of AISI 1020 steel according to GOST 33259-2015.
FIZEPR-SW100. **20.20**	Liquid materials in a DN100 pipeline, pressure up to 40 atm. Range of operating temperatures: -20 … +120°C.	Straight-flow sensor made as a DN100, PN40 pipe section, made of steel AISI 321; 100-40-11-1-E flanges according to GOST 33259-2015; complete with 100-40-11-1-F mating flanges made of AISI 1020 steel according to GOST 33259-2015.
FIZEPR-SW100. **20.20.К**	Crude oil with moisture content of up to 100% in a DN100 pipeline, pressure up to 40 atm. Range of operating temperatures: -20 … +120°C.	Straight-flow sensor made as a DN100, PN40 pipe section, made of steel AISI 321; 100-40-11-1-E flanges according to GOST 33259-2015; complete with 100-40-11-1-F mating flanges made of AISI 1020 steel according to GOST 33259-2015.
FIZEPR-SW100. **20.21**	Liquid materials in a DN100 pipeline, pressure up to 63 atm. Range of operating temperatures: -20 … +120°C.	Straight-flow sensor made as a DN100, PN63 pipe section, made of steel AISI 321; 100-63-11-1-E (or 100-63-11-1-J) flanges according to GOST 33259-2015; complete with 100-63-11-1-F (or 100-63-11-1-J) mating flanges made of AISI 1020 steel according to GOST 33259-2015.

FIZEPR-SW100. **20.21.К**	Crude oil with moisture content of up to 100% in a DN100 pipeline, pressure up to 63 atm. Range of operating temperatures: -20 …+120°C.	Straight-flow sensor made as a DN100, PN63 pipe section, made of steel AISI 321; 100-63-11-1-E (or 100-63-11-1-J) flanges according to GOST 33259-2015; complete with 100-63-11-1-F (or 100-63-11-1-J) mating flanges made of AISI 1020 steel according to GOST 33259-2015.
FIZEPR-SW100. **20.22**	Liquid materials in a DN100 pipeline, pressure up to 160 atm. Range of operating temperatures: -20 … +120°C.	Straight-flow sensor made as a DN100, PN160 pipe section, made of steel AISI 321; 100-160-11-1-E (or 100-160-11-1-J) flanges according to GOST 33259-2015; complete with 100-160-11-1-F (or 100-160-11-1-J) mating flanges made of AISI 1020 steel according to GOST 33259-2015.
FIZEPR-SW100. **20.22.К**	Crude oil with moisture content of up to 100% in a DN100 pipeline, pressure up to 160 atm. Range of operating temperatures: -20 … +120°C.	Straight-flow sensor made as a DN100, PN160 pipe section, made of steel AISI 321; 100-160-11-1-E (or 100-160-11-1-J) flanges according to GOST 33259-2015; complete with 100-160-11-1-F (or 100-160-11-1-J) mating flanges made of AISI 1020 steel according to GOST 33259-2015.
FIZEPR-SW100. **20.23**	Liquid materials in a DN125 pipeline, pressure up to 40 atm. Range of operating temperatures: -20 … +120°C.	Straight-flow sensor made as a DN125, PN40 pipe section, made of steel AISI 321; 125-40-11-1-E flanges according to GOST 33259-2015; complete with 125-40-11-1-F mating flanges made of AISI 1020 steel according to GOST 33259-2015.
FIZEPR-SW100. **20.24**	Liquid materials in a DN150 pipeline, pressure up to 6 atm. Range of operating temperatures: -20 … +120°C.	Straight-flow sensor made as a DN150, PN6 pipe section, made of steel AISI 321; 150-6-01-1-B flanges according to GOST 33259-2015; complete with 150-6-01-1-B mating flanges made of AISI 1020 steel according to GOST 33259-2015.
FIZEPR-SW100. **20.241**	Liquid materials in a DN150 pipeline, pressure up to 6 atm. Range of operating temperatures: -20 … +145°C.	Straight-flow sensor made as a DN150, PN6 pipe section, made of steel AISI 321; 150-6-01-1-B flanges according to GOST 33259-2015; complete with 150-6-01-1-B mating flanges made of AISI 1020 steel according to GOST 33259-2015.
FIZEPR-SW100. **20.25**	Liquid materials in a DN200 pipeline, pressure up to 6 atm. Range of operating temperatures: -20 … +120°C.	Straight-flow sensor made as a DN200, PN6 pipe section, made of steel AISI 321; 200-6-01-1-B flanges according to GOST 33259-2015; complete with 200-6-01-1-B mating flanges made of AISI 1020 steel.
FIZEPR-SW100. **20.261**	Liquid materials in a DN65 pipeline, pressure up to 25 atm. Range of operating temperatures: -20 … +145°C.	Straight-flow sensor made as a DN65, PN25 pipe section, made of steel AISI 321; 65-25-01-1-B flanges according to GOST 33259-2015; complete with 65-25-01-1-B mating flanges made of AISI 1020 steel according to GOST 33259-2015.
FIZEPR-SW100. **20.271**	Liquid materials in a DN125 pipeline, pressure up to 16 atm. Range of operating temperatures: -20 … +145°C.	Straight-flow sensor made as a DN125, PN16 pipe section, made of steel AISI 321; 125-16-01-1-B flanges according to GOST 33259-2015; complete with 125-16-01-1-B mating flanges made of AISI 1020 steel according to GOST 33259-2015.
Moisture analyzer FIZEPR-SW100.21.x / 21.x.K, full-flow version		

Design Bureau Fizelektronpribor, Ltd.
Samara Tel. +7 (846) 925-63-53, +7 (846) 359-17-01, +7-927-778-79-34
E-mail: info@fizepr.ru Website: http://www.fizepr.ru

FIZEPR-SW100. **21.01** **21.01.К**	Liquid materials in a pipeline with a diameter of 150 mm or more (with a sensor mounted perpendicular to the flow). Pressure - up to 6 atm. Range of operating temperatures: -20 … +120°C.	Full-flow sensor, with one flange DN100, PN6 (sealing surface version – B according to GOST 33259-2015), made of steel AISI 321. The sensor is installed using a nozzle with 100-6-01(11)-1-B flanges according to GOST 33259-2015 welded to the pipeline wall.
FIZEPR-SW100. **21.012** **21.012.К**	Liquid materials in a pipeline with a diameter of 150 mm or more (with a sensor mounted perpendicular to the flow). Pressure - up to 6 atm. Range of operating temperatures: -20 … +120°C.	Full-flow sensor, with one flange DN80, PN6 (sealing surface version – B according to GOST 33259-2015), made of steel AISI 321. The sensor is installed using a nozzle with 80-6-01(11)-1-B flanges according to GOST 33259-2015 welded to the pipeline wall.
FIZEPR-SW100. **21.02** **21.02.К** **(probe diameter is 89 mm)**	Liquid materials in a pipeline with a diameter of 200 mm or more (with a sensor mounted perpendicular to the flow). Pressure - up to 16 atm. Range of operating temperatures: -20 … +120°C.	Full-flow sensor, with one flange DN100, PN16 (sealing surface version – B according to GOST 33259-2015), made of steel AISI 321. The sensor is installed using a nozzle with 100-16-01(11)-1-B flanges according to GOST 33259-2015 welded to the pipeline wall.
21.021 **21.021.К** **(probe diameter is 57 mm)**		
FIZEPR-SW100. **21.03** **21.03.К**	Liquid materials in a pipeline with a diameter of 200 mm or more (with a sensor mounted perpendicular to the flow). Pressure - up to 40 atm. Range of operating temperatures: -20 … +120°C.	Full-flow sensor, with one flange DN100, PN40 (sealing surface version – E according to GOST 33259-2015), made of steel AISI 321. The sensor is installed using a nozzle with a 100-40-11-1-F flange according to GOST 33259-2015 welded to the pipeline wall.
FIZEPR-SW100. **21.033.К**	Liquid materials in a pipeline with a diameter of 200 mm or more (with a sensor mounted perpendicular to the flow). Pressure - up to 40 atm. Range of operating temperatures: -20 … +120°C.	Full-flow sensor, with one flange DN80, PN40 (sealing surface version – E according to GOST 33259-2015), made of steel AISI 321. The sensor is installed using a nozzle with a 80-40-11-1-F flange according to GOST 33259-2015 welded to the pipeline wall.
FIZEPR-SW100. **21.034** **21.034.К**	Liquid materials in a pipeline with a diameter of 200 mm or more (with a sensor mounted perpendicular to the flow). Pressure - up to 40 atm. Range of operating temperatures: -20 … +250°C.	Full-flow sensor, with one flange DN100, PN40 (sealing surface version – E according to GOST 33259-2015), made of steel AISI 321. The sensor is installed using a nozzle with a 100-40-11-1-F flange according to GOST 33259-2015 welded to the pipeline wall.

FIZEPR-SW100. **21.035** **21.035.К**	Liquid materials in a pipeline with a diameter of 100 mm or more (with a sensor mounted perpendicular to the flow). Pressure - up to 40 atm. Range of operating temperatures: -20 … +120°C.	Full-flow sensor, with one flange DN100, PN40 (sealing surface version – B (E) according to GOST 33259-2015), made of steel AISI 321. The sensor is installed using a nozzle with a 100-40-11-1-B (F) flange according to GOST 33259-2015 welded to the pipeline wall. Length of a section immersed in a pipeline is 254 mm.
FIZEPR-SW100. **21.036** **21.036.К**	Liquid materials in a pipeline with a diameter of 100 mm or more (with a sensor mounted perpendicular to the flow). Pressure - up to 40 atm. Range of operating temperatures: -20 … +120°C.	Full-flow sensor, with one flange DN80, PN40 (sealing surface version – E according to GOST 33259-2015), made of steel AISI 321. The sensor is installed using a nozzle with a 80-40-11-1-F flange according to GOST 33259-2015 welded to the pipeline wall.
FIZEPR-SW100. **21.037** **21.037.К**	Liquid materials in a pipeline with a diameter of 200 mm or more (with a sensor mounted perpendicular to the flow). Pressure - up to 40 atm. Range of operating temperatures: -20 … +120°C.	Full-flow sensor, with one flange DN100, PN40 (sealing surface version – B (E) according to GOST 33259-2015), made of steel AISI 321. The sensor is installed using a nozzle with a 100-40-11-1-B (F) flange according to GOST 33259-2015 welded to the pipeline wall. Length of a section immersed in a pipeline is 356 mm. Probe length is 213 mm.
FIZEPR-SW100. **21.038** **21.038.К**	Liquid materials in a pipeline with a diameter of 200 mm or more (with a sensor mounted perpendicular to the flow). Pressure - up to 40 atm. Range of operating temperatures: -20 … +120°C.	Full-flow sensor, with one ASME B 16.5 3″ Class 300 RF AISI 321 steel flange (DN80, PN40). The sensor is installed using a nozzle with a ASME B 16,5 3″ Class 300 RF flange welded to the pipeline wall.
FIZEPR-SW100. **21.04** **21.04.К**	Liquid materials in a pipeline with a diameter of 200 mm or more (with a sensor mounted perpendicular to the flow). Pressure - up to 63 atm. Range of operating temperatures: -20 … +120°C.	Full-flow sensor, with one flange DN100, PN63 (sealing surface version – E (J) according to GOST 33259-2015), made of steel AISI 321. The sensor is installed using a nozzle with a 100-63-11-1-F (J) flange according to GOST 33259-2015 welded to the pipeline wall.
FIZEPR-SW100. **21.042** **21.042.К**	Liquid materials in a pipeline with a diameter of 200 mm or more (with a sensor mounted perpendicular to the flow). Pressure - up to 63 atm. Range of operating temperatures: -20 … +120°C.	Full-flow sensor, with one flange DN80, PN63 (sealing surface version – E (J) according to GOST 33259-2015), made of steel AISI 321. The sensor is installed using a nozzle with a 80-63-11-1-F (J) flange according to GOST 33259-2015 welded to the pipeline wall.

Design Bureau Fizelektronpribor, Ltd.
Samara Tel. +7 (846) 925-63-53, +7 (846) 359-17-01, +7-927-778-79-34
E-mail: info@fizepr.ru Website: http://www.fizepr.ru

FIZEPR-SW100. **21.043** **21.043.К**	Liquid materials in a pipeline with a diameter of 200 mm or more (with a sensor mounted perpendicular to the flow). Pressure - up to 63 atm. Range of operating temperatures: -20 … +120°C.	Full-flow sensor, with one ASME B 16.5 4″ Class 600 RF (RTJ) AISI 321 steel flange (DN100, PN63). The sensor is installed using a nozzle with a ASME B 16,5 4″ Class 600 RF (RTJ) flange welded to the pipeline wall.
FIZEPR-SW100. **21.05** **21.05.К**	Liquid materials in a pipeline with a diameter of 200 mm or more (with a sensor mounted perpendicular to the flow). Pressure - up to 160 atm. Range of operating temperatures: -20 … +120°C.	Full-flow sensor, with one flange DN100, PN160 (sealing surface version – E (J) according to GOST 33259-2015), made of steel AISI 321. The sensor is installed using a nozzle with a 100-160-11-1-F (J) flange according to GOST 33259-2015 welded to the pipeline wall.
FIZEPR-SW100. **21.052** **21.052.К**	Liquid materials in a pipeline with a diameter of 200 mm or more (with a sensor mounted perpendicular to the flow). Pressure - up to 160 atm. Range of operating temperatures: -20 … +120°C.	Full-flow sensor, with one flange DN80, PN160 (sealing surface version – E (J) according to GOST 33259-2015), made of steel AISI 321. The sensor is installed using a nozzle with a 80-160-11-1-F (J) flange according to GOST 33259-2015 welded to the pipeline wall.
FIZEPR-SW100. **21.055** **21.055.К**	Liquid materials in a pipeline with a diameter of 100 mm or more (with a sensor mounted perpendicular to the flow). Pressure - up to 160 atm. Range of operating temperatures: -20 … +120°C.	Full-flow sensor, with one flange DN80, PN160 (sealing surface version – E (J) according to GOST 33259-2015), made of steel AISI 321. The sensor is installed using a nozzle with a 80-160-11-1-F (J) flange according to GOST 33259-2015 welded to the pipeline wall.
FIZEPR-SW100. **21.062** **21.062.К**	Liquid materials in a pipeline with a diameter of 200 mm or more (with a sensor mounted perpendicular to the flow). Pressure - up to 200 atm. Range of operating temperatures: -20 … +120°C.	Full-flow sensor, with one flange DN80, PN200 (sealing surface version – E (J) according to GOST 33259-2015), made of steel AISI 321. The sensor is installed using a nozzle with a 80-200-11-1-F (J) flange according to GOST 33259-2015 welded to the pipeline wall.
FIZEPR-SW100. **21.07** **21.07.К**	Liquid materials in a pipeline with a diameter of 150 mm or more (with a sensor mounted perpendicular to the flow). Pressure - up to 160 atm. Range of operating temperatures: -20 … +120°C.	Full-flow sensor, with one flange DN100, PN160 (sealing surface version – E (J) according to GOST 33259-2015), made of steel AISI 321. The sensor is installed using a nozzle with a 100-160-11-1-F (J) flange according to GOST 33259-2015 welded to the pipeline wall.

FIZEPR-SW100. **21.071** **21.071.К**	Liquid materials in a pipeline with a diameter of 150 mm or more (with a sensor mounted perpendicular to the flow). Pressure - up to 40 atm. Range of operating temperatures: -20 … +120°C.	Full-flow sensor, with one flange DN100, PN40 (sealing surface version – E according to GOST 33259-2015), made of steel AISI 321. The sensor is installed using a nozzle with a 100-40-11-1-F flange according to GOST 33259-2015 welded to the pipeline wall.
FIZEPR-SW100. **21.072** **21.072.К**	Liquid materials in a pipeline with a diameter of 150 mm or more (with a sensor mounted perpendicular to the flow). Pressure - up to 16 atm. Range of operating temperatures: -20 … +120°C.	Full-flow sensor, with one flange DN100, PN16 (sealing surface version – B according to GOST 33259-2015), made of steel AISI 321. The sensor is installed using a nozzle with 100-16-01(11)-1-B flanges according to GOST 33259-2015 welded to the pipeline wall.
FIZEPR-SW100. **21.073** **21.073.К**	Liquid materials in a pipeline with a diameter of 150 mm or more (with a sensor mounted perpendicular to the flow). Pressure - up to 40 atm. Range of operating temperatures: -20 … +120°C.	Full-flow sensor, with one ASME B 16.5 3″ Class 300 RF AISI 321 steel flange (DN80, PN40). The sensor is installed using a nozzle with a ASME B 16,5 3″ Class 300 RF flange welded to the pipeline wall.
FIZEPR-SW100. **21.074** **21.074.К**	Liquid materials in a pipeline with a diameter of 150 mm or more (with a sensor mounted perpendicular to the flow). Pressure - up to 63 atm. Range of operating temperatures: -20 … +120°C.	Full-flow sensor, with one flange DN80, PN63 (sealing surface version – E (J) according to GOST 33259-2015), made of steel AISI 321. The sensor is installed using a nozzle with a 80-63-11-1-F (J) flange according to GOST 33259-2015 welded to the pipeline wall.
FIZEPR-SW100. **21.075** **21.075.К**	Liquid materials in a pipeline with a diameter of 150 mm or more (with a sensor mounted perpendicular to the flow). Pressure - up to 160 atm. Range of operating temperatures: -20 … +120°C.	Full-flow sensor, with one flange DN80, PN160 (sealing surface version – E (J) according to GOST 33259-2015), made of steel AISI 321. The sensor is installed using a nozzle with a 80-160-11-1-F (J) flange according to GOST 33259-2015 welded to the pipeline wall.
FIZEPR-SW100. **21.076** **21.076.К**	Liquid materials in a pipeline with a diameter of 150 mm or more (with a sensor mounted perpendicular to the flow). Pressure - up to 40 atm. Range of operating temperatures: -20 … +120°C.	Full-flow sensor, with one ASME B 16.5 3″ Class 150 RF AISI 321 steel flange (DN80, PN40). The sensor is installed using a nozzle with a ASME B 16,5 3″ Class 150 RF flange welded to the pipeline wall.

Design Bureau Fizelektronpribor, Ltd.
Samara Tel. +7 (846) 925-63-53, +7 (846) 359-17-01, +7-927-778-79-34
E-mail: info@fizepr.ru Website: http://www.fizepr.ru

FIZEPR-SW100. **21.077** **21.077.К**	Liquid materials in a pipeline with a diameter of 150 mm or more (with a sensor mounted perpendicular to the flow). Pressure - up to 40 atm. Range of operating temperatures: -20 … +120°C.	Full-flow sensor, with one flange DN80, PN40 (sealing surface version – E according to GOST 33259-2015), made of steel AISI 321. The sensor is installed using a nozzle with a 80-40-11-1-F flange according to GOST 33259-2015 welded to the pipeline wall.
FIZEPR-SW100. **21.161**	Liquid materials featuring high conductivity, in a pipeline with a diameter of 150 mm or more (with a sensor mounted perpendicular to the flow). Pressure - up to 6 atm. Range of operating temperatures: -20 … +120°C.	Full-flow sensor, with one flange DN80, PN6 (sealing surface version – B according to GOST 33259-2015), made of steel AISI 321. The sensor is installed using a nozzle with 80-6-01(11)-1-B flanges according to GOST 33259-2015 welded to the pipeline wall.
Moisture analyzer FIZEPR-SW100.24.x, angular version		
FIZEPR-SW100. **24.5**	Liquid materials in a DN50 pipeline, pressure up to 25 atm. Range of operating temperatures: -20 … +120°C.	Sensor made as a DN50 PN25 L-pipe section (angular) of steel AISI 321; 50-25-01-1-B flanges according to GOST 33259-2015; complete with 50-25-01-1-B mating flanges made of AISI 1020 steel according to GOST 33259-2015. Connecting dimensions: L=254 mm; S= 120 mm.
FIZEPR- SW100. **24.8**	Liquid materials in a DN50 pipeline, pressure up to 40 atm. Range of operating temperatures: -20 … +120°C.	Sensor made as a DN50 PN40 L-pipe section (angular) of steel AISI 321; 50-40-11-1-E flanges according to GOST 33259-2015; complete with 50-40-11-1-F mating flanges made of AISI 1020 steel according to GOST 33259-2015. Connecting dimensions: L=254 mm; S= 118 mm.
FIZEPR-SW100. **24.82**	Liquid materials in a DN50 pipeline, pressure up to 40 atm. Range of operating temperatures: -20 … +120°C.	Sensor made as a DN50 PN40 L-pipe section (angular) of steel AISI 321; 50-40-11-1-B flanges according to GOST 33259-2015; complete with 50-40-11-1-B mating flanges made of AISI 1020 steel according to GOST 33259-2015. Connecting dimensions: L=256.5 mm; S=165.5 mm.
FIZEPR-SW100. **24.83**	Liquid materials in a DN50 pipeline, pressure up to 40 atm. Range of operating temperatures: -20 … +120°C.	Sensor made as an L-pipe section (angular) with ASME B 16.5 2″ Class 300 RF flanges, steel AISI 321 (DN50, PN40); complete with ASME B 16.5 2″ Class 300 RF mating flanges, AISI 1020 steel. Connecting dimensions: L=254 mm (10″); S= 164 mm (6.45″).
FIZEPR-SW100. **24.9**	Liquid materials in a DN80 pipeline, pressure up to 40 atm. Range of operating temperatures: -20 … +120°C.	Sensor made as a DN80 PN40 L-pipe section (angular) of steel AISI 321; 80-40-11-1-E flanges according to GOST 33259-2015; complete with 80-40-11-1-F mating flanges made of AISI 1020 steel according to GOST 33259-2015. Connecting dimensions: L=254 mm; S= 130 mm.

FIZEPR-SW100. **24.92**	Liquid materials in a DN80 pipeline, pressure up to 40 atm. Range of operating temperatures: -20 … +120°C.	Sensor made as an L-pipe section (angular) with ASME B 16.5 3″ Class 300 RF flanges, steel AISI 321 (DN80, PN40); complete with ASME B 16.5 3″ Class 300 RF mating flanges, AISI 1020 steel Connecting dimensions: L=254 mm (10″); S= 194 mm (7.62″).
FIZEPR-SW100. **24.11**	Liquid materials in a DN50 pipeline, pressure up to 63 atm. Range of operating temperatures: -20 … +120°C.	Sensor made as a DN50, PN63 L-pipe section (angular), made of steel AISI 321; 50-63-11-1-E (or 50-63-11-1-J) flanges according to GOST 33259-2015; complete with 50-63-11-1-F (or 50-63-11-1-J) mating flanges made of AISI 1020 steel according to GOST 33259-2015. Connecting dimensions: L=254 mm; S= 118 mm.
FIZEPR-SW100. **24.12**	Liquid materials in a DN80 pipeline, pressure up to 63 atm. Range of operating temperatures: -20 … +120°C.	Sensor made as a DN80, PN63 L-pipe section (angular), made of steel AISI 321; 80-63-11-1-E (or 80-63-11-1-J) flanges according to GOST 33259-2015; complete with 80-63-11-1-F (or 80-63-11-1-J) mating flanges made of AISI 1020 steel according to GOST 33259-2015. Connecting dimensions: L=254 mm; S= 147 mm.
FIZEPR-SW100. **24.15**	Liquid materials in a DN80 pipeline, pressure up to 160 atm. Range of operating temperatures: -20 … +120°C.	Sensor made as a DN80, PN160 L-pipe section (angular), made of steel AISI 321; 80-160-11-1-E (or 80-160-11-1-J) flanges according to GOST 33259-2015; complete with 80-160-11-1-F (or 80-160-11-1-J) mating flanges made of AISI 1020 steel according to GOST 33259-2015.
FIZEPR-SW100. **24.16**	Liquid materials in a DN100 pipeline, pressure up to 16 atm. Range of operating temperatures: -20 … +120°C.	Sensor made as a DN100 PN16 L-pipe section (angular) of steel AISI 321; 100-16-01-1-B flanges according to GOST 33259-2015; complete with 100-16-01-1-B mating flanges made of AISI 1020 steel according to GOST 33259-2015. Connecting dimensions: L=254 mm; S= 143 mm.
FIZEPR-SW100. **24.18**	Liquid materials in a DN50 pipeline, pressure up to 160 atm. Range of operating temperatures: -20 … +120°C.	Sensor made as a DN50, PN160 L-pipe section (angular), made of steel AISI 321; 50-160-11-1-E (or 50-160-11-1-J) flanges according to GOST 33259-2015; complete with 50-160-11-1-F (or 50-160-11-1-J) mating flanges made of AISI 1020 steel according to GOST 33259-2015. Connecting dimensions: L=254 mm; S= 123.5 mm.
FIZEPR-SW100. **24.20**	Liquid materials in a DN100 pipeline, pressure up to 40 atm. Range of operating temperatures: -20 … +120°C.	Sensor made as a DN100 PN40 L-pipe section (angular) of steel AISI 321; 100-40-11-1-E flanges according to GOST 33259-2015; complete with 100-40-11-1-F mating flanges made of AISI 1020 steel according to GOST 33259-2015.
FIZEPR-SW100. **24.21**	Liquid materials in a DN100 pipeline, pressure up to 63 atm. Range of operating temperatures: -20 … +120°C.	Sensor made as a DN100, PN63 L-pipe section (angular), made of steel AISI 321; 100-63-11-1-E (or 100-63-11-1-J) flanges according to GOST 33259-2015; complete with 100-63-11-1-F (or 100-63-11-1-J) mating flanges made of AISI 1020 steel according to GOST 33259-2015.

Design Bureau Fizelektronpribor, Ltd.
Samara Tel. +7 (846) 925-63-53, +7 (846) 359-17-01, +7-927-778-79-34
E-mail: info@fizepr.ru Website: http://www.fizepr.ru

FIZEPR-SW100. **24.22**	Liquid materials in a DN100 pipeline, pressure up to 160 atm. Range of operating temperatures: -20 … +120°C.	Sensor made as a DN100, PN160 L-pipe section (angular), made of steel AISI 321; 100-160-11-1-E (or 100-160-11-1-J) flanges according to GOST 33259-2015; complete with 100-160-11-1-F (or 100-160-11-1-J) mating flanges made of AISI 1020 steel according to GOST 33259-2015.

Table 3

<table>
<tr><th colspan="8">FIZEPR-SW100.20.x - straight-flow sensor (with two flanges on one axis)
FIZEPR-SW100.24.x - angular sensor (L-type)</th><th colspan="6">FIZEPR-SW100.21.x - full-flow sensor
(submersible, with one flange)</th></tr>
<tr><th colspan="8"></th><th colspan="3">with DN80 flange</th><th colspan="3">with DN100 flange</th></tr>
<tr><th>PN, bar</th><th>DN50</th><th>DN65</th><th>DN80</th><th>DN100</th><th>DN125</th><th>DN150</th><th>DN200</th><th>for DN100</th><th>for DN150</th><th>for DN200</th><th>for DN100</th><th>for DN150</th><th>for DN200</th></tr>
<tr><td>6</td><td>20.31</td><td></td><td>20.28</td><td>20.14</td><td>20.10</td><td>20.24
20.241</td><td>20.25</td><td></td><td>21.012
21.161</td><td></td><td></td><td>21.01</td><td></td></tr>
<tr><td>10</td><td rowspan="3">20.5
20.51
20.53
24.5</td><td rowspan="3">20.261</td><td rowspan="3">20.61
20.6.К</td><td rowspan="2">20.16
20.161
20.16.К
24.16</td><td rowspan="2">20.271</td><td rowspan="2">20.19</td><td rowspan="2"></td><td rowspan="4">21.036</td><td rowspan="4">21.073
21.076
21.077</td><td rowspan="4">21.033
21.038</td><td rowspan="2"></td><td rowspan="2">21.072</td><td rowspan="2">21.02
21.021</td></tr>
<tr><td>16</td></tr>
<tr><td>25</td><td>20.17
20.17.К</td><td></td><td></td><td></td><td rowspan="2">21.035</td><td rowspan="2">21.071</td><td rowspan="2">21.03
21.034
21.037</td></tr>
<tr><td>40</td><td>20.81
24.8
24.82
24.83</td><td></td><td>20.9
20.9.К
24.9
24.92</td><td>20.20
20.20.К
24.20</td><td>20.23</td><td></td><td></td></tr>
<tr><td>63</td><td>20.11
24.11</td><td></td><td>20.12
20.12.К
24.12</td><td>20.21
20.21.К
24.21</td><td></td><td></td><td></td><td>21.078</td><td>21.074</td><td>21.042</td><td></td><td>21.079</td><td>21.04
21.043</td></tr>
<tr><td>100</td><td rowspan="2">20.18
20.181
24.18</td><td rowspan="2"></td><td rowspan="2">20.15
20.15.К
24.15</td><td rowspan="2">20.22
20.22.К
24.22</td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2">21.055</td><td rowspan="2">21.075</td><td rowspan="2">21.052</td><td rowspan="2"></td><td rowspan="2">21.07</td><td rowspan="2">21.05</td></tr>
<tr><td>160</td></tr>
<tr><td>200</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>21.062</td><td></td><td></td><td></td></tr>
</table>

Design Bureau Fizelektronpribor, Ltd.
Samara Tel. +7 (846) 925-63-53, +7 (846) 359-17-01, +7-927-778-79-34
E-mail: info@fizepr.ru Website: http://www.fizepr.ru

3. Metrological and technical characteristics

3.1. Table 4 lists main metrological characteristics of the moisture meter.

Table 4

Item No.	Parameter	Value
3.1.1	Volumetric moisture content (volume water fraction) measurement range, % - For -20.x.K, -21.x.K, -24.x versions (for moisture meters with a probe placed in a dielectric sheath) at a salt content of up to 250 g/liter - For -20.x and -21.x versions (for moisture meters with a probe without a dielectric sheath) at a salt content of up to 0.5 g/liter - For -20.x and -21.x versions (for moisture meters with a probe without a dielectric sheath) at a salt content of up to 250 g/liter ***(see Notes 1, 2)***	 0 to 100 0 to 100 0 to 20
3.1.1	Limits of permissible absolute error of volumetric moisture content (volume water fraction) measurement, % - When measuring moisture content in the 0 to 2% volume water fraction range - When measuring moisture content in the 2 to 10% volume water fraction range - When measuring volume water fraction in the 10 to 20% volume water fraction range - When measuring moisture content in the 20 to 50% volume water fraction range - When measuring volume water fraction in the 50 to 100% volume water fraction range ***(see Notes 1, 2)***	 ±0.06 ±0.15 ±0.4 ±1.0 ±2.5
3.1.3	Operating temperature range of the liquid to be analyzed (temperature range of moisture meter calibration), °C ***(see Note 3)***	0 to plus 80

3.1.4	Working temperature range of sensor operation, °C: for design versions: - Version A - Version B (with extended temperature range) ***(see Note 4)***	 minus 20 to plus 120 minus 20 to plus 145 (plus 180)
3.1.5	Working temperature range of electronic unit operation, °C for design versions: - Version A - Version B (with extended temperature range)	 minus 20 to plus 55 minus 40 to plus 55
3.1.6	Flow rate of the liquid to be analyzed, m/sec	0.4 to 4.6
3.1.7	Range of salt content in an aqueous phase, g/liter	0 to 250
3.1.8	Measurement period, maximum, sec	1
3.1.9	Output interface - digital - current, mA	 RS485 Modbus RTU 4-20
3.1.10	Supply voltage, V nominal allowable	 24 18...36
3.1.11	Current consumption, mA, maximum	200
3.1.12	Nominal bore DN, mm	50; 65; 80; 100; 125; 150; (200 and more for full-flow sensors)
3.1.13	Maximum excess pressure in a pipeline, MPa	16.0
3.1.14	Sensor weight, maximum, kg	24
3.1.15	Sensor overall dimensions, mm, maximum - Height - Width - Length	 300 300 600
3.1.16	Electronic unit weight, maximum, kg	7
3.1.17	Electronic unit overall dimensions, mm, maximum - Height - Width - Length	 120 230 285
3.1.19	Ambient temperature range, °C	minus 45 to plus 70
3.1.20	Dust and moisture ingress protection rating of electronic unit	IP66 GOST 14254-2015
3.1.21	Dust and moisture ingress protection rating of sensor	IP67 GOST 14254-2015

Design Bureau Fizelektronpribor, Ltd.
Samara Tel. +7 (846) 925-63-53, +7 (846) 359-17-01, +7-927-778-79-34
E-mail: info@fizepr.ru Website: http://www.fizepr.ru

3.1.22	Length of communication cable between sensor and electronic unit, m ***(see Note 5)***	1.5 … 4
3.1.23	Maximum length of cable for RS485 digital signal transmission from electronic unit to external control device (controller, computer), minimum	1000
3.1.24	Maximum length of cable for 4-20 mA analog signal transmission from electronic unit to external indicating device, minimum, m	1000
3.1.25	Average time between failures with a confidence coefficient of 0.95, h, minimum	25,000
3.1.26	Average life, years	10

Notes

1. Moisture meters in **-20**.x and **-21**.x versions are designed to measure water content in crude oil and petroleum products in the moisture content measurement range of 0 to 20% at a salt content in an aqueous phase of up to 250 g/liter. At a salt content of up to 0.5 g/liter, the moisture content measurement range is 0 to 100%. Accordingly, measurement error in the 20% to 100% range for **-20**.x and **-21**.x versions is standardized for liquids with a salt content of up to 0.5 g/liter only.

Moisture meters in **-20**.x.K**;** **-21**.x.K; **-24**.x versions are designed to measure water content in crude oil and petroleum products in the moisture content measurement range of 0 to 100% at a salt content in an aqueous phase of up to 250 g/liter.

2. At the customer's request, the moisture meter may be equipped with calibration corresponding to the mass moisture content of the material defined as follows:

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

where W - material moisture content;

m_{water} - mass of water in the material sample;

m_{sample} - mass of the material sample.

3. Analyzer calibration tables may be supplemented for a wider temperature range of the controlled material in accordance with recommendations in Sections 5 and 6, Section 2 of this Operation Manual.

4. For materials with a temperature of up to +145°C, sensors are available in a version with a measuring cell mounted on a nozzle at a distance from the sensor enclosure. In order to measure materials with a temperature above +145°C, sensors are available in a version with a measuring cell placed in an enclosure thermally insulated from the sensor enclosure.

5. Required communication cable length between the sensor and the electronic unit is agreed when ordering. Maximum cable length for the moisture meter in explosion-proof version is 4 m.

3.2. Explosion protection of moisture meters is ensured by compliance with the requirements:

1) GOST 30852.1-2002 (IEC 60079-1:1998) Explosion-proof electrical equipment.
Part 1. "Flameproof enclosure" type explosion protection
2) GOST 30852.10-2002 (IEC 60079-11:1999) Explosion-proof electrical equipment.
Part II. Intrinsic safety "i"
3) GOST 30852.0-2002 (IEC 60079-0:1998) Explosion-proof electrical equipment.
Part 0. General requirements.

Intrinsically safe electric parameters of the electronic unit:

– Maximum output voltage, Uo, V	10.5
– Maximum output current, Io, A	1.11
– Maximum external capacity, Co, μF	14
– Maximum external inductance, Lo, mH	0.02

3.3. According to its metrological characteristics, the moisture meter is a measuring instrument in case of its usage in sectors subject to state control and oversight in the Russian Federation.

3.4. The moisture meter is designed for continuous operation.

4. Scope of supply

4.1. Moisture analyzer scope of supply:

1. Sensor VIGT.415210.100-2x.x
2. Electronic unit VIGT.415210.101-02
3. Technical description and operation manual VIGT.415210.100 RE
4. Data sheet VIGT.415210.100 PS
5. CD with SW100 and SWPro software
6. Mating flanges (according to Table 2).

4.2. The items listed in Table 5 may be additionally included in the scope of supply at the customer's request.

Table 5

Item description	Type, brand
USB – RS485 interface converter (PC USB port supply)	OWEN-AS4 converter by Owen
USB – RS485 interface converter (PC USB port supply)	ATsDR.426469.032 by RPE "Bolid"
Measuring and regulating device with digital indication (input signal – 4-20 mA current)	OWEN TRM-201 converter by Owen
Operator panel with digital indication (MOD-BUS RTU RS485 digital input signal)	OWEN SMI1 converter by Owen
Measuring and regulating device (input signal – 4-20 mA current)	METAKON-1105 by KontrAvt
24V supply unit	OWEN BP30B-D3-24 by Owen

Design Bureau Fizelektronpribor, Ltd.
Samara Tel. +7 (846) 925-63-53, +7 (846) 359-17-01, +7-927-778-79-34
E-mail: info@fizepr.ru Website: http://www.fizepr.ru

Explosion-proof thermal cover for electronic unit. It is used when operating at temperatures below -40°C. Supplied with: - Thermal cover, wear and chemically resistant, water-oil repellent fabric - 25 NTR2-VT, 50Hz, 220V, 2ExellT6 self-regulating heating tape with power cable in the 3 m metal hose - Terminal box.	EkoTerm Ex-02 by EkoTerm

4.3. Example of the moisture meter designation in the order and technical documentation of other products:

"Moisture analyzer FIZEPR-SW100.20.6"

5. Moisture meter design description, moisture meter operation

FIZEPR-SW100 moisture meters consist of an electronic unit and a sensor connected by a cable.

5.1. Moisture analyzer (moisture meter) FIZEPR-SW100.**20**.x / FIZEPR-SW100.**20**.x.K, straight-flow version

The sensor is made as a straight pipe section with a nominal bore of DN 50, DN 65, DN 80, DN 100, DN 125 or DN150 and contains two coaxial flanges (see Appendices 1, 2). A flat-topped probe is installed inside the pipe. Enclosure and probe material is corrosion resistant steel AISI 321 (or AISI 316Ti). A cavity is made inside the probe with a thermal detector installed inside to control the temperature of the measured media.

Moisture meters in FIZEPR-SW100.**20**.x.K version have a sensor probe placed in a dielectric enclosure (ceramic tube), the range of moisture content measurement in crude oil and petroleum products with a salt content of up to 250 g/liter is 0… 100%.

Moisture meters in FIZEPR-SW100.**20**.x have a sensor probe made without a dielectric enclosure, and therefore the range of moisture content measurement in crude oil and petroleum products with a salt content of up to 250 g/liter is 0…20%.

The length of the pipe section with flat flanges is 400 mm or 500…550 mm – for versions with weld neck flanges and/or K version (with a ceramic tube). Flange design corresponds to the required operating pressure and can be selected in the range up to 160 kgf/cm^2 from the next array: PN 6; PN 10; PN 16; PN 25; PN 40; PN 63; PN 100, PN 125 and PN 160 kgf/cm^2.

For materials with a temperature above +120°C, sensors are available in a version with an extended temperature range. This version features a measuring cell mounted on a nozzle at a distance from the sensor enclosure to ensure a decrease in the temperature of sensor semiconductor elements to values below +90…100°C. At the same time, sensors for pressures above 63 kgf/cm^2 use long cable glands so that semiconductor elements are located at a distance from the enclosure, and these sensors can be used on liquid materials with a temperature of up to +145°C.

5.2. Moisture analyzer (moisture meter) FIZEPR-SW100.**21.**x / FIZEPR-SW100.**21.**x.K, full-flow version

The sensor is made as a pipe section mounted with its end on the flange. There is a probe placed inside the pipe. Openings made on the side of the pipe ensure free passage of the controlled liquid into the sensor (see Appendices 3-6). The sensor is available with three flange sizes: DN65, DN80 and DN100. For measurements in pipelines with a diameter from 200 mm (and more), the sensor is mounted on the side of this pipeline. For measurements in pipelines with smaller diameters (DN 65 … 150) a tee joint is introduced into the pipeline to install the sensor along the pipeline section axis. Working pressure PN – 6 to 160 kgf/cm^2. Enclosure and probe material is corrosion resistant steel AISI 321 (or AISI 316Ti). A thermal detector is located inside the sensor to ensure temperature control of the measured media.

Moisture meters in FIZEPR-SW100.**21**.x.K version have a sensor probe placed in a dielectric enclosure (ceramic tube), the range of moisture content measurement in crude oil and petroleum products with a salt content of up to 250 g/liter is 0… 100%.

Moisture meters in FIZEPR-SW100.**21**.x have a sensor probe made without a dielectric enclosure, and therefore the range of moisture content measurement in crude oil and petroleum products with a salt content of up to 250 g/liter is 0…20%.

5.3. Moisture analyzer (moisture meter) FIZEPR-SW100.**24.**x, angular version

The angular sensor (L-type) is made as a pipe section with two flanges where one of the flanges is located on the pipe axis and the second one is on the side of the pipe section (see Appendix 7). Nominal bore: DN 50, DN 65, DN 80, DN 100, DN 125 and DN 150; working pressure PN - up to 160 kgf/cm^2. Moisture measurement range is 0…100%. The sensor enclosure and probe material is corrosion resistant steel AISI 321 (or AISI 316Ti). The sensor is equipped with a thermal detector to ensure temperature control of the measured media. The sensor probe is placed in a dielectric enclosure (ceramic tube).

5.4. Electronic unit

All versions of moisture meters for measuring moisture content in crude oil and petroleum products use an explosion-proof electronic unit VIGT.415210.101-02 (photos are provided in Appendices 8-9). This unit is made in an explosion-proof enclosure and have explosion-proof marking 1Exd[iaGa]IIBT5Gb.

Three LEDs are installed inside the block housing to control the connection with the moisture meter and the operating mode.

The "POWER" LED is connected to the +24 V input power supply circuit and illuminates when power is supplied.

The "RX/TX" LED is bi-color. Green light indicates RS-485 network communication. Red light illuminates when the moisture meter responds to requests from an external device (computer, controller, etc.).

The "STATE" LED illuminates during measurements. If it does not illuminate, the measurement process is completed (e.g. in the "fast spectrum transmission without moisture measurement" mode).

Design Bureau Fizelektronpribor, Ltd.
Samara Tel. +7 (846) 925-63-53, +7 (846) 359-17-01, +7-927-778-79-34
E-mail: info@fizepr.ru Website: http://www.fizepr.ru

The length of the cable connecting the electronic unit with the sensor is 1.5…4 m (a specific value is to be confirmed when ordering). Therefore, the distance between the electronic unit and the place of sensor installation at on-site mounting must not exceed 1.0...3.5 m.

Depending on the operating temperature range, the electronic unit is supplied in two versions:

- For operation in a temperature range from -20°C
- With an increased temperature range for operation at temperatures from -40°C.

Both versions have identical designs, but temperature resistance tests during acceptance testing are conducted at the following temperatures depending on requirements:

- Version A -20°C and +80°C
- Version B -40°C and +80°C.

For operation at temperatures below -40°C, the electronic unit must be placed in a thermal cover. A possible version of an explosion-proof thermal cover is shown in Table 5, and its photos are shown in Appendix 9.

Two or three explosion-proof sealed cable glands KOB1NHK or FECA1NB (depending on how the temperature meter lead is made on the sensor) are installed on the electronic unit enclosure. They are used for connecting cables from the sensor, as well as connecting power and communication cables. Cables between the sensor and the electronic unit are protected by a RZ-SLP-NG-12 or MRPI-NG-12 metal hose in a PVC jacket. The metal hose with the cable on the side of the electronic unit is filled with compound over at least 100 mm long section. Cable entries into the sensors are also made through the specified cable glands installed on the sensor enclosure and filled with compound.

Note: Cable connection with the sensor is non-separable.

An armored cable, e.g. KIPEVBV 3x2x0.6, is used to power the electronic unit from the external 24V voltage source and to transmit measurement results from the electronic unit to the external device.

5.5. Description of moisture analyzer operation

FIZEPR-SW100 moisture meters consist of an electronic unit and a sensor. The electronic unit contains a tunable generator for the 2 ... 700 MHz frequency range. The moisture meter processor periodically tunes the generator in the frequency range in discrete steps (from 100 kHz to 1 MHz) and analyzes input parameters of the transmission line formed by the probe and the enclosure of the sensor itself at every turning step. When tuning, the moisture meter processor stores voltages at the input and output of the measuring cell connected to the input of this transmission line. As a result of this measurement, a spectrum is stored in the moisture meter memory as a frequency dependence of measuring cell voltages in the range of generator turning frequencies. A typical spectrum view is shown in Fig. 1, Part 1 of this manual.

Then the moisture meter processor analyzes the measured spectrum and finds resonant frequencies of the primary sensor transducer when it is filled with the controlled material. Then the moisture meter processor calculates the ratio of the sensor resonant frequency in air (stored in memory) to the obtained resonant frequency in the controlled material. This ratio is the deceleration factor k_{dec} of an electromagnetic wave propagating in the material relative to the wave velocity in air (i.e. to the speed of light). Permittivity ε_r is connected with the deceleration factor by the dependence: $\varepsilon_r = (k_{dec})^2$.

As a result of scanning in the frequency range. the moisture meter finds values of the deceleration factor k_{dec} of an electromagnetic wave in the material and permittivity ε_r of the material. Based on the measured deceleration factor (or permittivity) value, the moisture meter processor automatically calculates the moisture content W of the controlled material. The moisture content is calculated taking into account the material temperature.

This calculation is made based on calibration tables linking the material moisture content W to k_{dec} (or ε_r) at different temperatures. Calibration tables are stored in the moisture meter memory. There is a specific calibration table for each type of the controlled material. An example of the calibration table is given in Section 6.2.5, Part 2 of this manual.

In order to explain the moisture meter operating principle, it should be noted: water permittivity ε_r is about 80, permittivity of hydrocarbons (crude oil and petroleum products) is between 2 and 3 (for alcohols, ε_r reaches 30). Significant difference between permittivity of water and other materials is exactly what allows to measure water content in the mixture due to a sharp increase of total mixture permittivity if water is present in the material.

Note: ice permittivity ε_r is about 3, so moisture meters (like all famous industrial moisture meters of other types) have no frozen water measurement capacity.

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

The deceleration factor (permittivity) measurement method used is direct and absolute, measurement results do not depend on external conditions, and measurements are not affected by the temperature of semiconductor converters and the electronic unit itself. This method provides high accuracy and repeatability of moisture content measurement results.

6. Labeling

6.1. The front panel (cover) of the electronic unit bears the following inscriptions:
- Moisture meter name (MOISTURE ANALYZER FIZEPR-SW100)
- Serial (factory) number of the moisture meter and year of manufacture
- Manufacturer (Design Bureau Fizelektronpribor, Ltd.)
- Authority that conducted explosion-proof certification of the moisture meter (CERTIFICATION CENTER "VELES" LLC)
- Electronic unit explosion protection code (1Exd[iaGa]IIBT5Gb)
- Power ratings (24VDC voltage and 0.2A current)
- Dust and moisture ingress protection rating of electronic unit (IP66)
- Warning ("De-energize before opening").

A pattern approval mark is applied on the front panel of the electronic unit as a holographic sticker.

In addition to the above inscriptions, similar inscriptions related to the electronic unit enclosure (shell) are allowed (e.g. CCFE-01 brand manufactured by GORELTEKH PLANT LLC).

6.2. The sensor enclosure bears the following inscriptions:
- Moisture meter name (MOISTURE ANALYZER FIZEPR-SW100)
- Sensor explosion protection code (0ExiaIIBT5Ga)
- Serial (factory) number of the moisture meter and year of manufacture.

6.3. A seal is applied on the protective plate inside the electronic unit to prevent unauthorized tampering with the factory assembly and to protect the moisture meter processor (microcontroller) against reprogramming. A sealing position is shown in Appendix 8.

7. Transport and consumer packaging

7.1. Transport and consumer packaging is designed to store and transport the moisture meter, and to ensure its safety during transportation for the entire storage period.

7.2. The moisture meter, parts and components included in the scope of supply complete with operational documentation must be packed in a transport packaging.

7.3. Operational documentation must be wrapped in a polyethylene film.

7.4. The scope of supply shall include a packing list in the transport container indicating the name and quantity of the products delivered in it.

8. General operation instructions

8.1. The FIZEPR-SW100 moisture meter consists of an electronic unit and a sensor connected by a cable. Cable connection with the sensor is non-separable and filled with compound. **Opening the sensor is not allowed and leads to loss of warranty.** Cable connection with the electronic unit is detachable. If it is necessary to disconnect the sensor and the electronic unit, open the electronic unit cover, disconnect the cable from the terminal block, disconnect the connector, then loosen the cable entry clamp. After that the cable must be carefully removed from the electronic unit cable entry.

8.2. The moisture meter must be powered from a general-purpose stabilized DC voltage source with the output voltage of 24V (maximum permissible supply voltage values are 18...32V). Own power consumption of the moisture meter electronic unit does not exceed 3.6 W.

8.3. Information is transmitted simultaneously and independently via two lines:

- Digital communication line, RS-485 Modbus RTU interface
- 4-20 mA current loop.

8.4. The moisture meter is ready for operation in 1-2 minutes after the supply voltage is applied.

8.5. Unpacking rules.

8.5.1. Upon receipt of the container with a moisture meter, visually inspect it together with the person responsible for transportation. It is necessary to make sure that the container is completely safe. In case of any container damage, a relevant report shall be drawn up and signed by persons responsible for acceptance and transportation, sealed and sent to the carrier.

8.5.2. After unpacking, the contents of packages shall be checked with the inventory in the packing lists.

8.5.3. Check the completeness in the “Scope of supply” section of the data sheet. Description, designation, serial number and quantity of products listed in the data sheet shall correspond to the records in packing lists.

8.6. Inspection rules.

8.6.1. Perform visual inspection in order to check safety and integrity of the moisture meter enclosure. The product must be free from any scratches, cracks, dents, traces of corrosion and other defects that can be detected during external inspection.

8.2.6. All defects and non-conformities detected during unpacking and external inspection and completeness verification are reported in a damage claim signed by persons responsible for moisture meter acceptance, approved by the head of the customer plant and sent to the manufacturer.

9. Safety precautions

9.1. A 24VDC voltage source used to power the moisture meter must be a power source that converts a higher voltage to a safe extra-low voltage by an isolation transformer or a converter with separate windings. For example, OWEN BP30B-D3-24 24V power supplies meet the above requirements.

The moisture meter corresponds to Electric Shock Protection Class III in accordance with GOST 12.2.007.0-75 when using a source for powering the moisture meter that meets the above requirement.

9.2. It is prohibited to use the moisture meter in the following cases:

- With the removed electronic unit cover
- With poorly attached connectors or poor contact in terminal connectors
- In explosive production conditions without grounding the moisture meter electronic unit.

9.3. The moisture meter electronic unit and sensor must be installed on grounded metal structures.

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

9.5. All types of maintenance, repair and installation associated with the replacement of fuses, disconnection and switching of wires, etc., as well as moisture meter dismantling must be performed only when it is disconnected from the power source.

10. Installation procedure

10.1. Safety regulations set out in Section 9 of this operation manual and in regulatory technical documents applicable at the customer plant shall be strictly observed during the moisture meter installation.

10.2. The moisture meter supplied for on-site installation has passed in-plant testing.

10.3. First choose mounting locations for a sensor and an electronic unit. Take into account permissible operating conditions when choosing mounting locations. Then prepare mounting locations for moisture meter components in accordance with overall and mounting dimensions and taking into account the length of the cable between the sensor and the electronic unit.

10.3.1. The sensor must be installed in a pipeline downstream the degassing section. Residual free gas volume - maximum 1%.

It is advisably to install the sensor on the vertical section of the pipeline, and the relative position of the sensor input and output does not matter. Any sensor position relative to the horizon is allowed subject to the following requirements:

- Residual free gas must not accumulate in the sensor cavity
- Sediment must not accumulate in the sensor cavity.

10.3.2. When installing the sensor into the bypass line, it is necessary to ensure the exact correspondence of the liquid flowing through the sensor to the main flow.

Design Bureau Fizelektronpribor, Ltd.
Samara Tel. +7 (846) 925-63-53, +7 (846) 359-17-01, +7-927-778-79-34
E-mail: info@fizepr.ru Website: http://www.fizepr.ru

10.3.3. The liquid flow through the sensor must be turbulent and well mixed. If water in the analyzed liquid flow forms separate streams, a mixer or a disperser must be used at the sensor input.

10.4. The moisture meter on-site installation is carried out in the following order:

- Install and secure the sensor in the pipeline
- Conduct pressure tests of the pipeline with the sensor
- Fix the electronic unit in a prepared location
- Remove the electronic unit cover and make electrical installation.

10.5. Possible moisture meter wiring diagrams are provided in Appendices 9 and 10.

Measurement results can be displayed on a controller or a computer via RS-485 Modbus RTU interface. Besides, measurement results can be displayed on any display device with 4-20 mA current input. For example, the OWEN TRM-201 measuring and regulating device (see Appendix 10), as well as other similar measuring devices manufactured by a number of companies, can be connected to the moisture meter current output.

The moisture meter must be powered from a 24 VDC voltage source, e.g. OWEN BP 30B-D3-24.

If it is necessary to set the current output parameters, obtain diagnostic information about the moisture meter operation, record its characteristics, adjust the moisture meter or change the communication parameters, connect a computer (laptop) to the electronic unit using the RS485-USB interface adapter converter. Parameter adjustment instructions are provided in Part 2 of this manual.

10.6. Electrical connection of the moisture meter shall be carried out in the following order:

10.6.1. Connect the grounding contact on the electronic unit enclosure with the ground bus.

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

10.6.3. Connect the communication cable to the 4-20 mA "+ I GND Current" terminals of the current output (if a data transmission channel from the moisture meter is used via the current loop).

Note. "+ I GND Current" current output and RS485 signal circuits are not galvanically isolated from 24V power circuits.

10.6.4. Moisture meters are delivered with their sensor cable connected to the electronic unit. Cable connection with the sensor is non-detachable. If the sensor cable is disconnected from the electronic unit, cable wires must be connected in accordance with the marking on the terminals as provided by the diagram given in Appendix 10.

10.6.5. Connect the power cable to "24V" terminals.

11. Preparation and procedure of moisture meter operation

11.1. The moisture meter must be serviced by an operator who is familiar with the operation of electronic instrumentation, has studied this technical specification and operation manual and have been instructed in safety precautions when working with electrical equipment.

11.2. Preparation for work is carried out in the following order:

11.2.1. Make sure that electrical connections correspond to the wiring diagram. Check reliability of wire connection to terminal clamps.

11.2.2. Energize the moisture meter.

11.2.3. Make sure that measurement results are transmitted to the external indication device.

11.2.3.1. During the trial operation of the moisture meter in environments where explosive gas atmosphere is excluded, the moisture meter operation may be monitored by three LEDs located under the electronic unit cover:

- The "POWER" LED illuminates when power is supplied
- The "RX/TX" LED glows green when the moisture meter receives a signal via RS485 line, and glows red when sending data to the external device (if the RS485 line is not used or there is no communication via this line, "RX/TX" does not illuminate)
- The "STATE" LED illuminates during measurements. If it does not illuminate, the measurement process is completed (e.g. in the "fast spectrum transmission without moisture measurement" mode).

11.2.3.2. In order to check moisture meter operation in normal conditions, it is recommended to monitor its operation by the spectrum transmitted via digital interface to a PC (laptop). Refer to Section 4.5, Part 2 of this manual for monitoring recommendations.

11.2.4. Before operation, it is recommended to check the sensor resonant frequency with the sensor filled with air. The sensor inner surface must be dry and clean during this check, so this check must be carried out before sensor installation in the pipeline. If the measured resonance frequency in air does not meet specifications, it must be adjusted in accordance with recommendations provided in Section 5, Part 2 of this manual.

In addition, before installing the sensor in the pipeline, it is recommended to adjust the moisture meter metrological characteristic by dielectric characteristics of crude oil to eliminate the impact of the oil grade (oil composition). To make this adjustment, fill the sensor with a controlled oil sample with a maximum water content of 0.05% (volume fraction). Then carry out calibration "by dry matter" according to Method 6.3, Part 2 of this manual.

The moisture meter metrological characteristic may be adjusted by the manufacturer representative or a specialist trained by the manufacturer. The characteristic may be adjusted by the manufacturer remotely using remote access software (a PC with the moisture meter connected must have Internet connection).

11.5.2. If any moisture meter failure is detected, turn off power, identify and correct the occurred failure as described in Sections 13 and 14 of this operation manual.

11.3. Measurement procedure

Before taking measurements, make sure that the moisture meter sensor is completely filled with the controlled material. Read measurement results from the indicator device (e.g. OWEN TRM-201 measuring and regulating device or a computer screen).

11.4. Measurement reliability evaluation

Evaluation of measurement reliability (accuracy) is performed by comparing moisture meter readings with laboratory test results.

These data are entered into the "Measurement Reliability Evaluation Report" (see Appendix 11) with the date of sampling and the temperature of the material.

When taking samples for laboratory measurements from the controlled material volume with the moisture meter, the moisture meter readings are recorded in the report, and once the laboratory analysis is completed, the results are recorded in a corresponding line. Then the difference between obtained values is calculated taking into account the sign.

The frequency of sampling is determined by the company.

Design Bureau Fizelektronpribor, Ltd.
Samara Tel. +7 (846) 925-63-53, +7 (846) 359-17-01, +7-927-778-79-34
E-mail: info@fizepr.ru Website: http://www.fizepr.ru

In case of systematic unacceptable differences between moisture meter and laboratory data perform the analysis of possible causes.

Possible reasons for such differences are listed below:

- Moisture meter calibration does not correspond to the controlled material, in particular, the moisture meter was not calibrated on a "dry material"
- The moisture meter sensor is heavily contaminated with sediments
- An unrepresentative sample is taken for laboratory analysis.

The following solutions are recommended:

1. Moisture meter calibration does not correspond to the controlled material

Compare the laboratory measurement results accumulated for a long period of time and respective moisture meter measurement results. It should be noted that these data must include measurements in a sufficiently wide moisture measurement range.

If the error persists, adjust calibration. The calibration table may be adjusted by both a trained specialist and the manufacturer. For manufacturer's after-sales service, send a configuration file and a measurement result comparison table to: info@fizepr.ru

2. The moisture meter sensor is heavily contaminated with sediments

Clean the sensor from sediments.

3. An unrepresentative sample is taken for laboratory analysis

Take such a big volume of the controlled liquid from the pipeline and in such a way that to prevent predominant occurrence of certain individual fractions in it. Then mix it carefully to ensure a uniform composition of the entire liquid volume. After that, take a sample from it with a relatively small volume required for laboratory analysis.

12. Communication with the moisture meter via MODBUS protocol

12.1. Digital communication with the moisture meter is carried out via MODBUS RTU protocol through RS-485 Modbus RTU interface with the following parameters:

- Connection speed - 4800, 9600, 14400, 19200, 38400; 57600 or 115200 baud
- Parity - none
- Number of stop bits - 1 or 2.

Default communication parameters (factory settings):

- Connection speed – 19200 baud
- Number of stop bits – 2
- Address – 127
- Timeout between requests 100 ms.

12.2. Features of MODBUS RTU protocol implementation:

- Register reading by 03 (03h) command
- Register record by 16 (10h) command
- Support of echoing back testing 08 (08h) command

When trying to read or write addresses beyond the limits specified in Table 6, the moisture meter gives no response.

12.3. The moisture meter is protected against any modifications in its settings by inhibiting write commands transmitted via MODBUS interface.

Without a password for external software, it is only possible to read moisture meter setting parameters and measurement results.

Changes in moisture meter calibration and other settings require a specific password to be written by software in Register 0020 (0014h).

12.4. MODBUS registers are shown in Table 6.

Table 6

Register address (DEC)	Register address (HEX)	Description	R/W
0000	0000	Measured moisture content expressed in hundredths of a percent. True moisture content must be calculated according to the formula: W = reg[0000] / 100 with an accuracy of 2 decimal places.	R
0001	0001	Temperature in degrees Kelvin. Temperature in degrees Celsius must be calculated according to the formula: t = reg[0001] – 273.	R
0002	0002	Not used	R
0003	0003	Moisture meter firmware version number	R
0007	0007	***For firmware version 33 and earlier.*** Deceleration factor k measured by the moisture meter and multiplied by 5000. Deceleration factor is calculated according to the formula: k = reg[0007] / 5000 with an accuracy of 4 decimal places.	R
0020	0014	Record protection register	R/W
0163	00A3	Total number of moisture meter calibrations	R
0164	00A4	Number of current calibration	R/W
0224	00E0	Temperature in degrees Celsius. ***(Register value is relevant only for positive temperatures)***	R
0229-0230	00E5-00E6	***For firmware version 34 and later.*** Refined refractive index (x100000). Deceleration factor is calculated according to the formula: k = (reg[0230]+reg[0229]*65536) / 100000 with an accuracy of 5 decimal places.	R
0231	00E7	***For firmware version 34 and later.*** Temperature in tenths Kelvin. Temperature in degrees Celsius must be calculated according to the formula: t = reg[0231] / 10 – 273 accurate to a tenth.	R

Register 0164 (00A4h) may be used for switching the moisture meter calibration tables. Calibration number must be in the range from 1 to the quantity of calibrations available in the moisture meter. For details refer to Section 6, Part 2 of this manual.

Design Bureau Fizelektronpribor, Ltd.
Samara Tel. +7 (846) 925-63-53, +7 (846) 359-17-01, +7-927-778-79-34
E-mail: info@fizepr.ru Website: http://www.fizepr.ru

13. Maintenance

13.1. General instructions.

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

13.2.1. Maintenance is the systematic monitoring of the moisture meter technical condition, regular technical inspection and elimination of any failures.

13.1.3. After troubleshooting, check the moisture meter technical state for normal operation.

13.2. Types and frequency of maintenance.

13.2.1. Depending on frequency and scope of work the following maintenance types are specified as listed in Table 7.

Table 7

Maintenance types	Frequency	Person responsible for maintenance
1. Scheduled maintenance: - weekly maintenance - preventative maintenance	 Once a week Every six months	 Operator handling the moisture meter Specialist handling the moisture meter
2. Unscheduled maintenance	When a moisture meter failure is detected	Specialist handling the moisture meter

13.2.2. Dates of preventive maintenance can be changed and brought in line with the production plans and terms adopted at the plant operating the moisture meter. At the same time, preventative maintenance frequency shall be at least once a year.

13.2.3. Weekly maintenance includes a visual inspection to ensure:

- Reliability of connection, as well as the absence of breaks or damage of the connecting cable insulation.
- Absence of dents and visible mechanical damage to the moisture meter enclosure.

13.2.4. During preventive maintenance, the following works shall be carried out:

- Removal of dust and dirt from external surfaces of the electronic unit and the moisture meter sensor.
- Visual inspection
- Checking the status of communication cables and connecting wires, grounding
- Cleaning the internal surface of the sensor from contaminations (carried out if indications deviate sharply from the laboratory analysis results).

13.2.5. Unscheduled maintenance is carried out in case of failure and includes moisture meter repair.

14. Troubleshooting

14.1. It is allowed to eliminate detected failures directly on site only when the moisture meter is disconnected from the power supply.

14.2. When replacing failed components, strictly follow instructions specified in Section 13 "Maintenance" of this manual.

14.3. Replacing the failed components and checking the moisture meter after the elimination of detected failures must be carried out by a service technician.

14.4. A list of the most possible failures is provided in Table 8.

Table 8

Description of malfunction, external manifestations and additional signs	Probable cause	Method of elimination
1. Power LED is off when the moisture meter is energized. Additional signs: - Supply voltage at the electronic unit input is 24V - Power supply circuit current is absent or less than 20 mA.	Broken power wire. Reversed power wires. Burnt-out FU1 fuse.	Persons responsible for electrical installation and operation of communication lines shall correct the failure in accordance with regulations in force. Disconnect the moisture meter from the mains. Open the cover of the electronic unit and replace the FU1 fuse.
2. Power LED is off when the moisture meter is energized. Additional signs: - Supply voltage at the electronic unit input is absent or low	Short circuit in the moisture meter power supply circuit	Persons responsible for electrical installation and operation of communication lines, as well as for moisture meter operation, shall correct the failure in accordance with regulations in force.
3. No connection with the moisture meter.	Breakdown or reversal of the communication cable, incorrect network settings of the moisture meter	Persons responsible for electrical installation and operation of communication lines, as well as for moisture meter operation, shall correct the failure in accordance with regulations in force. If cable is OK, but there is still no connection, check network settings of the moisture meter. Press and hold "Reset" button for at least 5 seconds to reset moisture meter network settings (restore default network settings). "Reset" button is located on the bottom board of the electronic unit under the cut in the top board. For details refer to Section 3.1, Part 2 of this manual.

Design Bureau Fizelektronpribor, Ltd.
Samara Tel. +7 (846) 925-63-53, +7 (846) 359-17-01, +7-927-778-79-34
E-mail: info@fizepr.ru Website: http://www.fizepr.ru

15. Storage and transportation

Moisture meter storage and transportation conditions are in accordance with GOST 15150-69 for Groups 3 and 5, respectively.

15.1. The moisture meter components in the manufacturer's package can be stored under conditions of heated hard-wall rooms depending on the period.

15.2. Moisture meter shelf life in the manufacturer's package is 1 year.

15.3. The moisture meter packed in a shipping container can be transported by any means of transport in closed vehicles at any distance.

15.4. Transportation must be carried out with all precautionary measures. Boxes with packaging must not be thrown or turned over.

16. Recycling

16.1. The moisture meter contains no precious metals or other substances subject to mandatory recycling.

16.2. The moisture meter is not dangerous to human life and health, as well as the environment. After the end of the service (operation) life, it can be disposed according to the technology adopted by the company operating the moisture meter.

17. Moisture meter verification

17.1. Initial verification is conducted at the time when the moisture meter production is completed and after repair.

17.2. When in operation, periodic verification of the moisture meter that has passed initial verification shall be performed at least once a year.

17.3. Unscheduled verification of the moisture meter is carried out:

- After repair
- When moisture meter operability must be proved
- When the seal is damaged and documents confirming periodic verification of the moisture meter are missing.

17.4. Verification of the moisture meter after elimination of failures that do not affect its metrological characteristics (replacement of fuses, wires or connectors) is not performed.

17.5. Verification must be carried out using only measuring instruments that have passed metrological certification and conforming to standard measuring instruments in terms of accuracy.

Periodic verification must be preceded by the following preparatory works: washing and cleaning the sensor from sediments.

17.6. Moisture meters are verified according to Verification Method MP 0919-6-2018 "GSI Instruction. Moisture analyzers (moisture meters) FIZEPR-SW100. Verification Method" approved by FSUE "All-Russian Research Institute for Flow Metering" on 15.11.2018.

18. Warranty

Moisture meter warranty period is at least 24 months from the date of delivery to the customer.

Warranty obligations are subject to the conditions and rules of operation, transportation and storage specified in this operation manual.

19. Appendices

List of appendices

1. FIZEPR-SW100.20.141 moisture meter sensor, photo
2. FIZEPR-SW100.20.261 moisture meter sensor, dimensional drawing
3. FIZEPR-SW100.21.036K moisture meter sensor, photo
4. FIZEPR-SW100.21.077 moisture meter sensor, photo
5. FIZEPR-SW100.21.033-01 moisture meter sensor, photo
6. FIZEPR-SW100.21.051K moisture meter sensor, photo
7. FIZEPR-SW100.24.181 moisture meter, photo
8. Appearance of the VIGT.415210.101-02 electronic unit with the top cover removed
9. VIGT.415210.101-02 electronic unit and EkoTerm Ex-02 thermal cover
10. Wiring diagram for FIZEPR-SW100 moisture meter connection with the OWEN TRM201 measuring and regulating device
11. Measurement Reliability Evaluation Report

Design Bureau Fizelektronpribor, Ltd.
Samara Tel. +7 (846) 925-63-53, +7 (846) 359-17-01, +7-927-778-79-34
E-mail: info@fizepr.ru Website: http://www.fizepr.ru

FIZEPR-SW100.20.141 MOISTURE METER SENSOR

FIZEPR-SW100.20.261 MOISTURE METER SENSOR, dimensional drawing

Design Bureau Fizelektronpribor, Ltd.
Samara Tel. +7 (846) 925-63-53, +7 (846) 359-17-01, +7-927-778-79-34
E-mail: info@fizepr.ru Website: http://www.fizepr.ru

FIZEPR-SW100.21.036K moisture meter sensor

FIZEPR-SW100.21.077 moisture meter sensor

Design Bureau Fizelektronpribor, Ltd.
Samara Tel. +7 (846) 925-63-53, +7 (846) 359-17-01, +7-927-778-79-34
E-mail: info@fizepr.ru Website: http://www.fizepr.ru

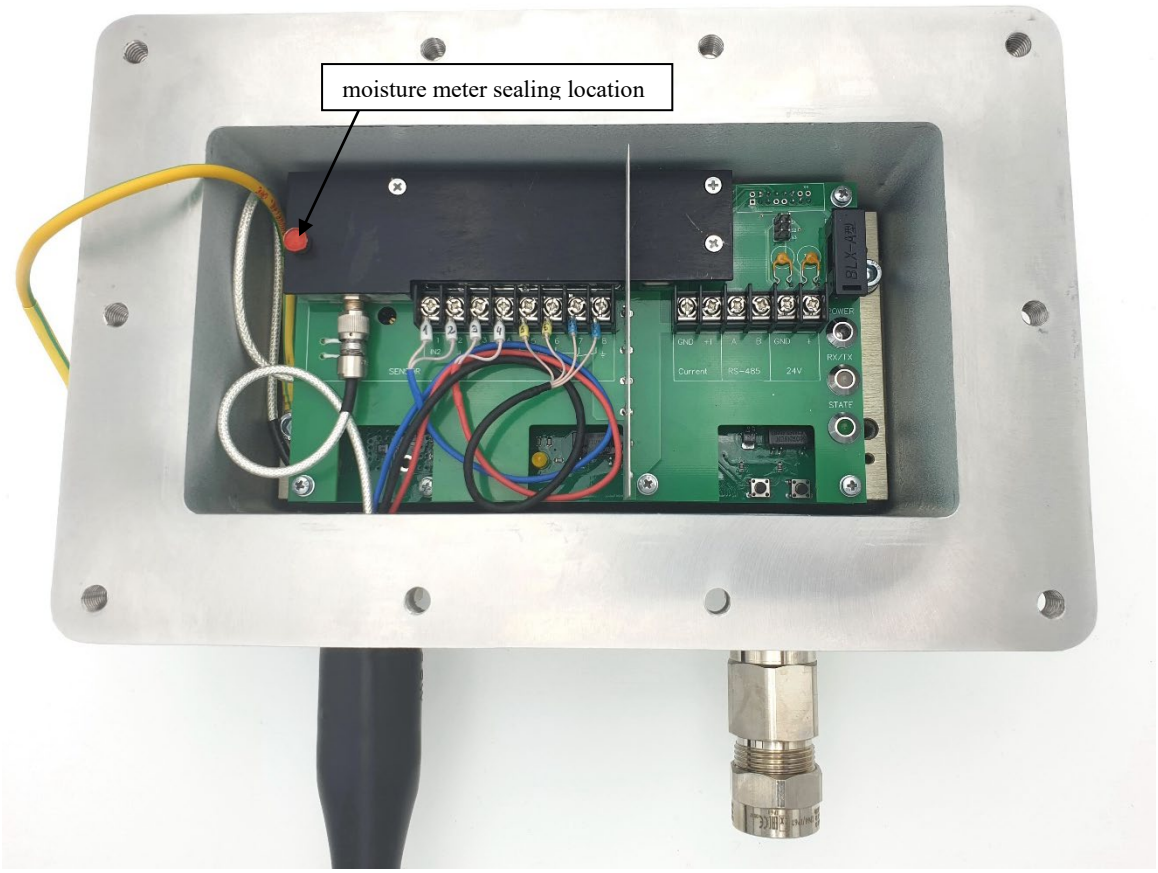
FIZEPR-SW100.21.033-01 moisture meter sensor

FIZEPR-SW100.21.051K moisture meter sensor

Design Bureau Fizelektronpribor, Ltd.
Samara Tel. +7 (846) 925-63-53, +7 (846) 359-17-01, +7-927-778-79-34
E-mail: info@fizepr.ru Website: http://www.fizepr.ru

FIZEPR-SW100.24.181 moisture meter

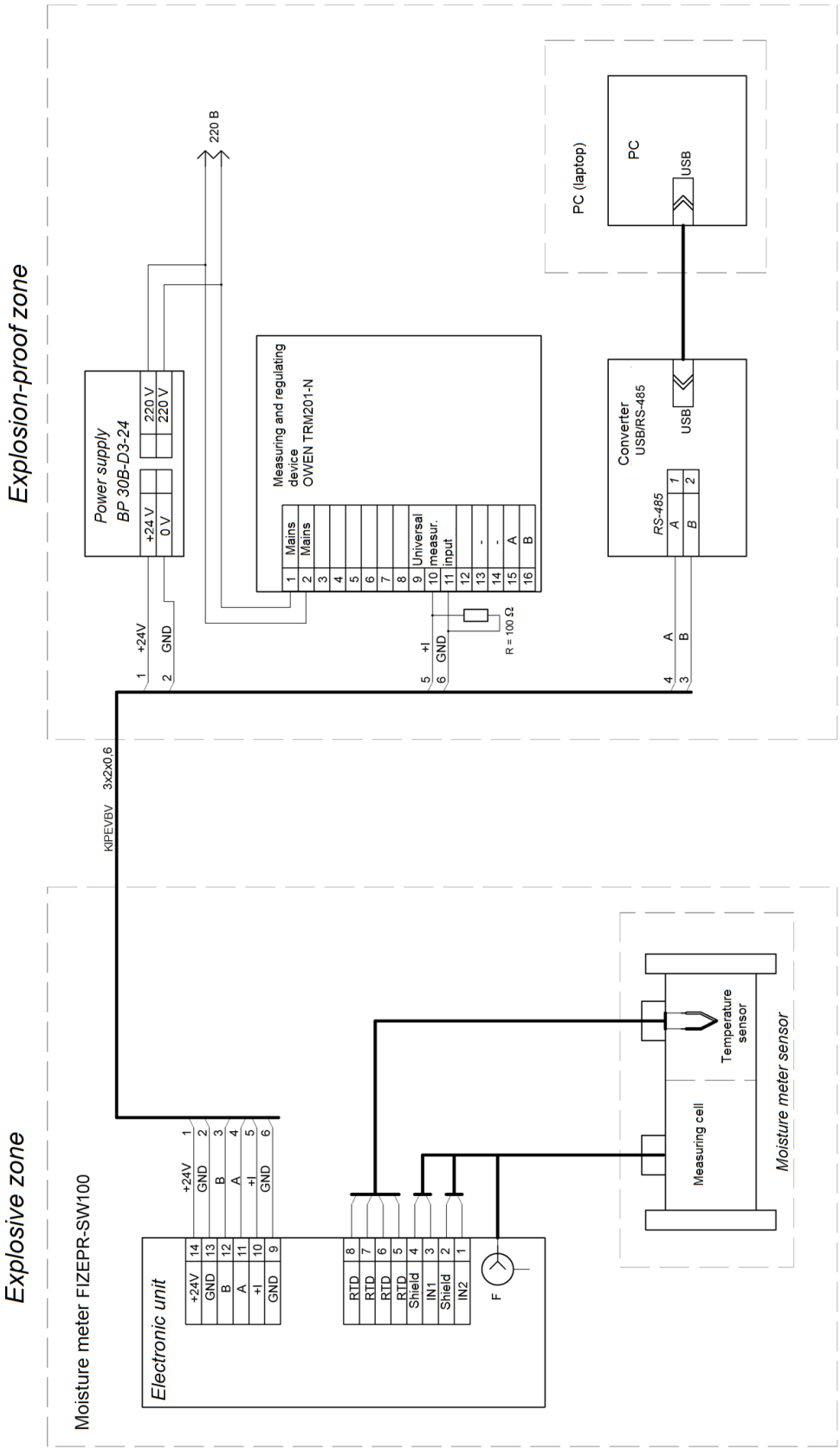
Appearance of the VIGT.415210.101-02 electronic unit with the top cover removed



Design Bureau Fizelektronpribor, Ltd.
Samara Tel. +7 (846) 925-63-53, +7 (846) 359-17-01, +7-927-778-79-34
E-mail: info@fizepr.ru Website: http://www.fizepr.ru

VIGT.415210.101-02 electronic unit and EkoTerm Ex-02 thermal cover

Wiring diagram for FIZEPR-SW100 moisture meter connection with the OWEN TRM201 measuring and regulating device



Design Bureau Fizelektronpribor, Ltd.
Samara Tel. +7 (846) 925-63-53, +7 (846) 359-17-01, +7-927-778-79-34
E-mail: info@fizepr.ru Website: http://www.fizepr.ru

Measurement Reliability Evaluation Report

Sampling date and time	Material temperature, ˚C	Moisture measured with the moisture meter, %	Moisture measured in laboratory, %	Difference in readings, %	Remarks