Downhole sensor

BP-95MT5-04

(rus. БП-95МТ5-04)

Installation Manual

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INTRODUCTION

This Installation Manual (hereinafter referred to as Instruction) is developed for getting to know the procedure of installation, configuring and inspection of the BP-95MT5-04 (*rus. БП-95МТ5-04*) downhole sensors (hereinafter referred to as BP or downhole sensor).

Please follow the rules set in this Instruction for correct installation and configuring the product.

While performing work according to requirements of this Instruction, also please use information provided in the Operation Manual and Technical Certificate for the downhole sensor.

Installation, configuring and inspection must be performed by personnel specially trained and admitted to such work.

The manufacturer reserves the right to make changes in the design and circuitry which are not reflected in the operational documentation and do not impair specifications of the product.

The downhole sensor is designed to measure and transfer to the external equipment real-time operation parameters, namely: oil temperature in the submersible electric motor, temperature and pressure of reservoir fluid in the bottomhole (intake), fluid pressure created by the centrifugal pump (discharge pressure) and vibration level in the area of the downhole equipment installation.

The downhole sensor represents a sealed cylinder; it is connected to the midpoint of the motor stator winding (extended from the motor bottom part) via hermetic connector.

The motor base shall be prepared for mating with the downhole sensor in accordance with Figure 4, the connecting dimensions of the downhole sensor are shown in Figure 5. Overall view of DH sensor variants is shown in Figure 1 and Figure 2.

Signal from the downhole sensor to the surface equipment goes via the “Motor Winding Y-point - Power Cable – Step-up Transformer Secondary Winding Y-point” communication line. If there is no Y-point in the Step-up Transformer, the “In 126” choke must be used for creating the Y-point and connecting to it.

Depending on the model, DH sensor bottom can have either flange connection with connecting dimensions shown in Figure 5 or 2-3/8” 8RD EUE thread.

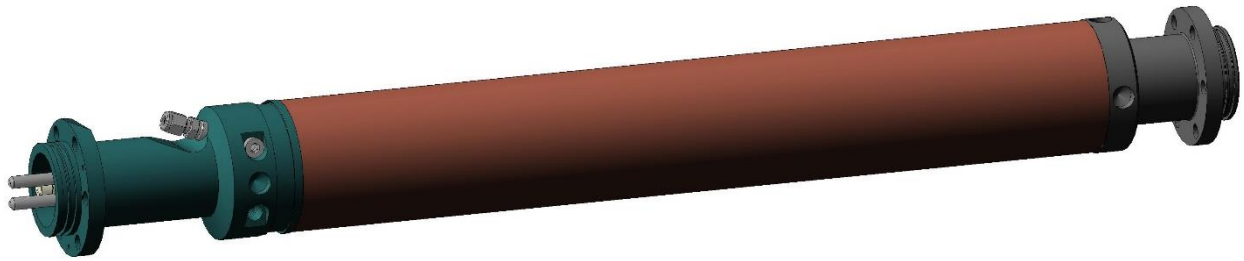

Figure 1 – Overall view of BP-95MT5-60MPa-V2-T3-N0-04

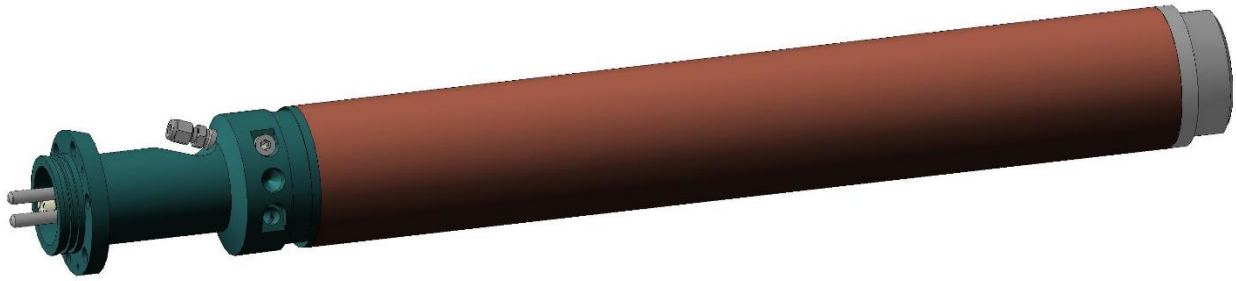

Figure 2 – Overall view of BP-95MT5-40MPa-V2-T3-N4-04

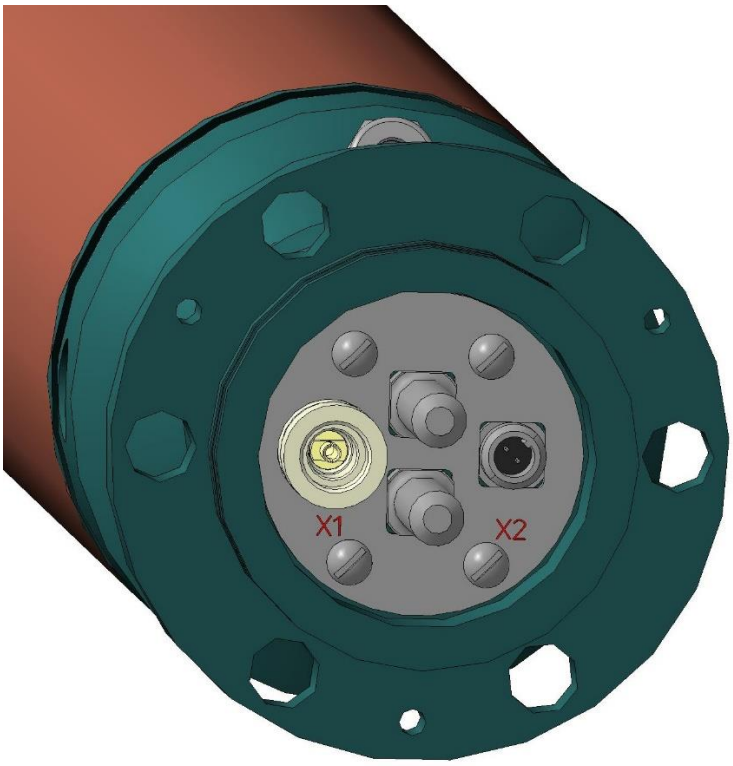

Figure 3 – View from the connector side

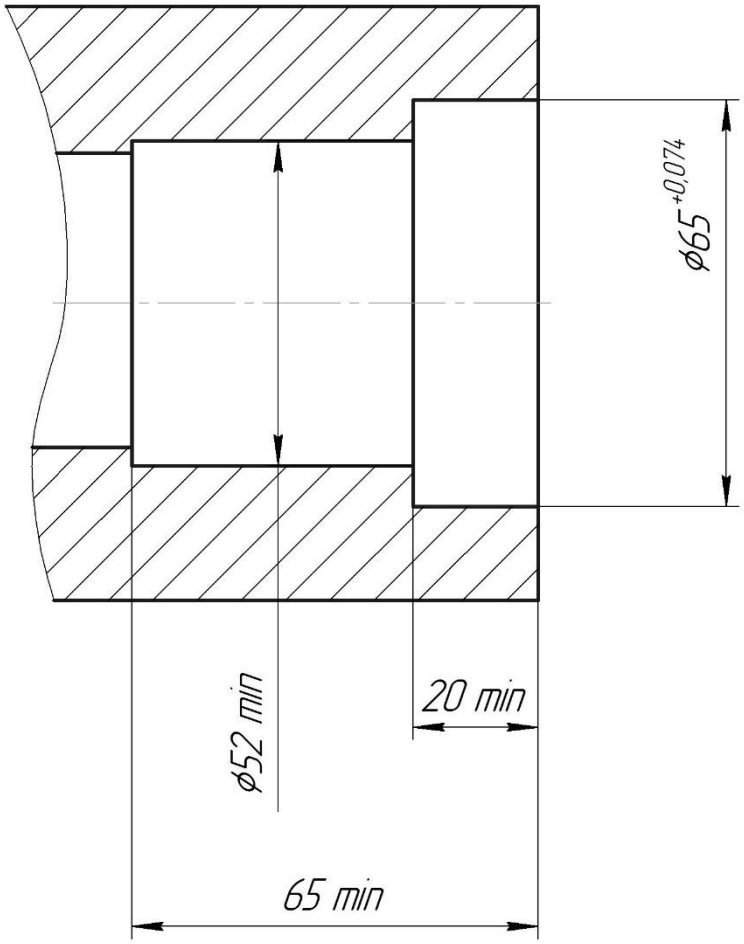

Figure 4 – Required motor dimensions

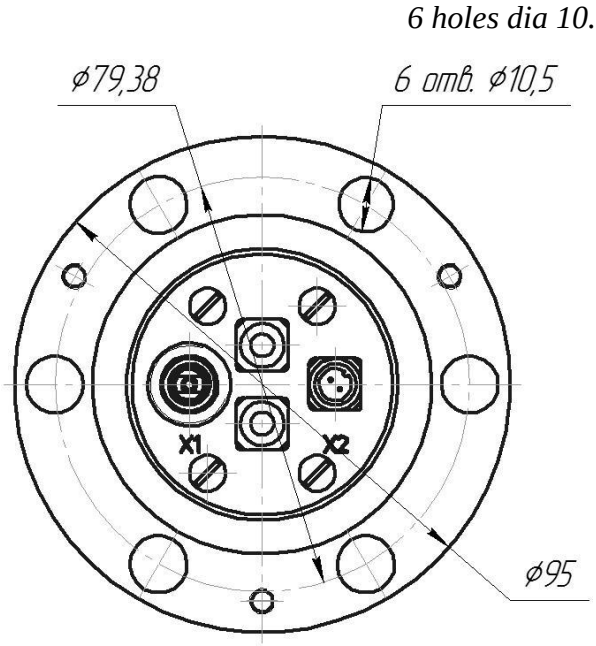

Figure 5 – DH sensor connecting dimensions

GENERAL INSTRUCTIONS

Installation, configuring and inspection of the downhole sensor are to be performed at the motor manufacturing facility or ESP servicing base.

SAFETY MEASURES

The safety measures while performing the work outside of Russia shall correspond to safety measures established at the facilities.

The safety measures while performing the work in Russia shall correspond to the Rules for Operation of Customers' Electrical Installations approved by the Ministry of Energy of Russia No 6 dated 13.01.03 and to the Interbranch Rules on Labour Safety in Operation of Electricity Generating Equipment POT R M–016–2001 RD 153-34.0.03.150–00 (*rus. ПОТ Р М–016–2001 РД 153-34.0.03.150–00*).

While performing the work in Russia, it is necessary to observe fire safety requirements according to the Fire Safety Rules in the Russian Federation ref. PPBO 01-93 (rus. ППБО 01-93).

The downhole sensor can be installed only when power supply of the motor is off.

PRODUCT PREPARATION TO INSTALLATION

Assemble the product with the motor bottom part indoors in a specially equipped workplace.

To assemble the motor adapter with the motor bottom part, the following tools are required:

- bench for horizontal placement of the motor;
- megaohmmeter with output voltage up to 2,500 V.

Check of the downhole sensor performance:

- remove the protective cover.
- measure insulation resistance between the downhole sensor X1 socket and the downhole sensor body by the megaohmmeter. Connect the positive terminal to the downhole sensor body and the negative terminal to the downhole sensor X1 socket. Insulation resistance at megaohmmeter voltage of 1,000 V shall be not less than 100 MOhm for a new the downhole sensor and not less than 30 Mohm for a downhole sensor already operated.

<u>Attention</u>: It is allowed to measure insulation resistance using voltage not exceeding 2,500 V!

<u>Attention</u>: After measuring insulation resistance, it is necessary to remove charge by connecting the X1 socket to the downhole sensor body.

MOTOR PREPARATION TO PRODUCT INSTALLATION

Prepare the submersible electric motor according to requirements specified in the operation manual for the motor.

- remove temporary covers from the motor;
- disassemble the bottom part of the motor;

PRODUCT INSTALLATION

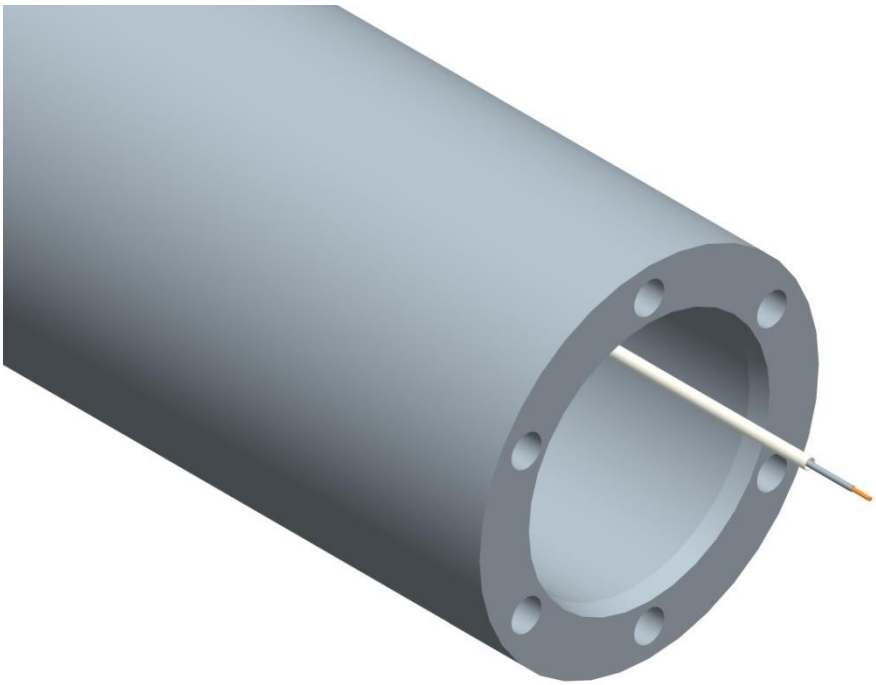

Figure 6 – Motor base

- take out the wire, soldered to the motor Y-point;
- make sure that the motor Y-point wire has sufficient length for convenient connection with the downhole sensor;
- cut off the excess of the Y-point wire, leaving the length of the wire with a margin for re-soldering and ease of installation;

ATTENTION: *Check insulation resistance of the wire between motor stator winding Y-point and motor housing using megaohmmeter with 2,500V output voltage. The resistance value must be in accordance with the regulations of the manufacturer of the motor.*

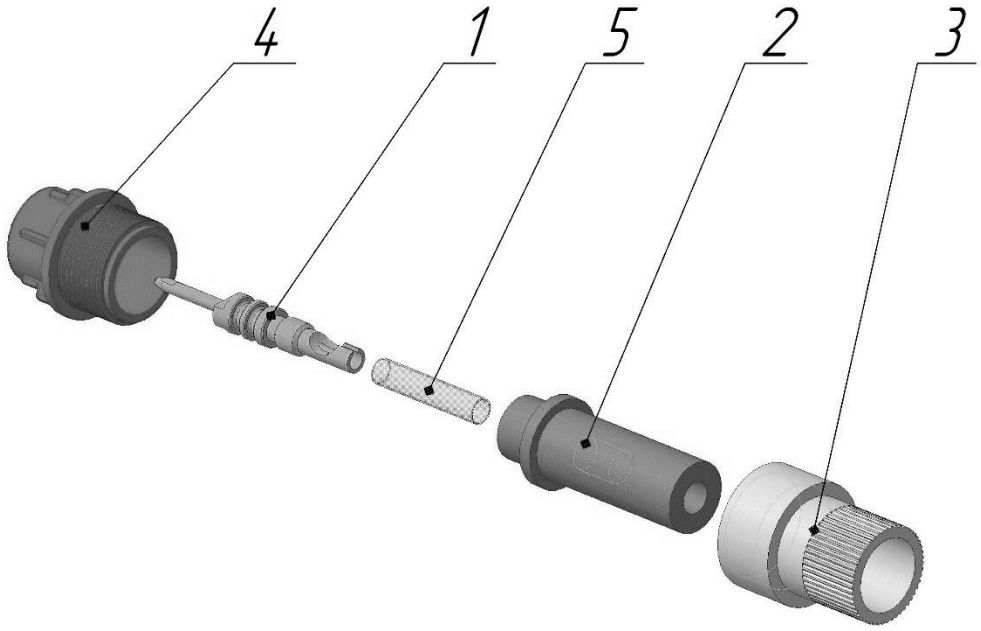

Figure 7 – E511.SBP.07.10 connector components (rus. Э511.СБП.07.10)

- disassemble the E511.SBP.07.10 connector, cover 4 shall be removed;
- put nut 3, isolator 2 and heat-shrink tubing 5 on the Y-point wire;
- remove insulation of the wire for a length of 3-4 mm;
- tin the end of the wire and the end of contact 1;
- solder the motor Y-point wire to the end of contact 1 using soldering alloy with melt temperature not less than 220°C (Sn95) or other solder with similar properties;
- rinse the soldering point with washing liquid;
- put heat-shrink tube 5 on the soldering point and heat-shrink at a temperature of 175 ° C to 230 ° C;
- crimp the wire with fluoroplastic tube in the end of the contact;
- screw contact 1 in insulator 2;

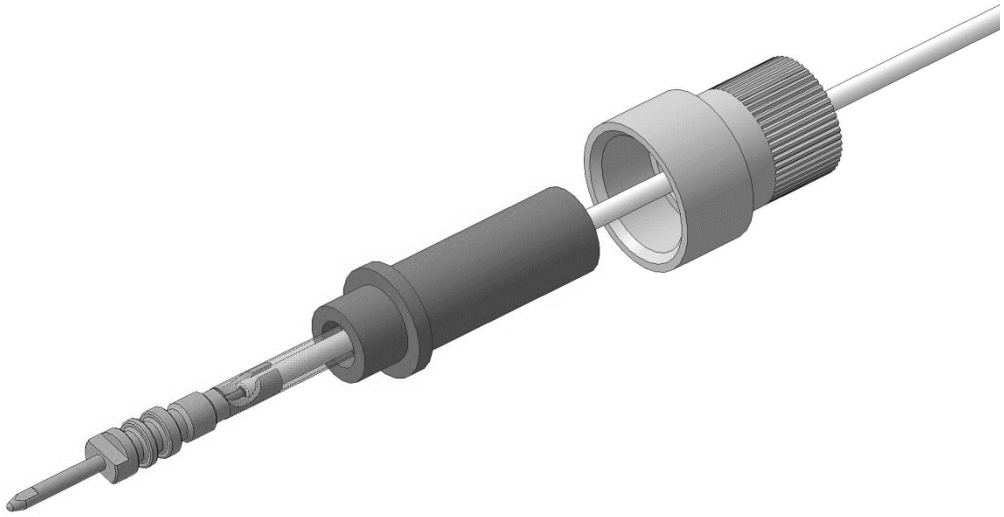

Figure 8 – Installation of the connector on the Y-point wire

If length of the motor Y-point wire is not enough to install the connector, extend the wire using the component from the installation kit (see Figure 9):

- mate the end of the wire from the installation kit with the motor Y-point wire and solder the joint; wires shall be soldered using soldering alloy with melt temperature not less than 220°C (Sn95) or other solder with similar properties;
- rinse the soldering point with washing liquid;
- insulate the soldering point by the technology accepted at the consumer's enterprise;

ATTENTION: *It is forbidden to use active flux.*

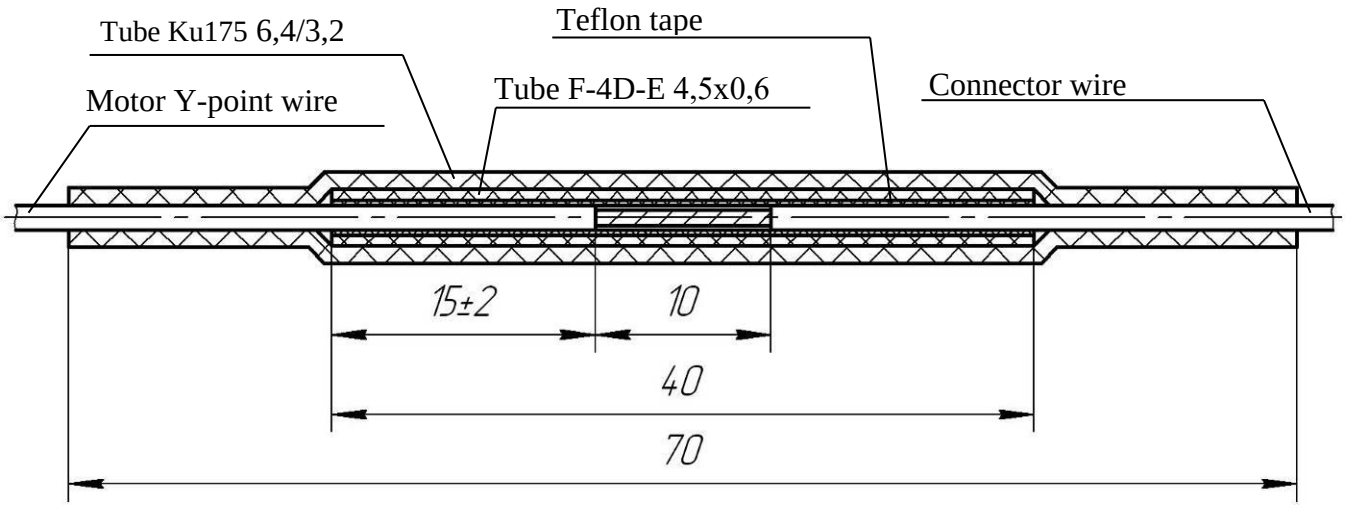

Figure 9 – Example of wire extension

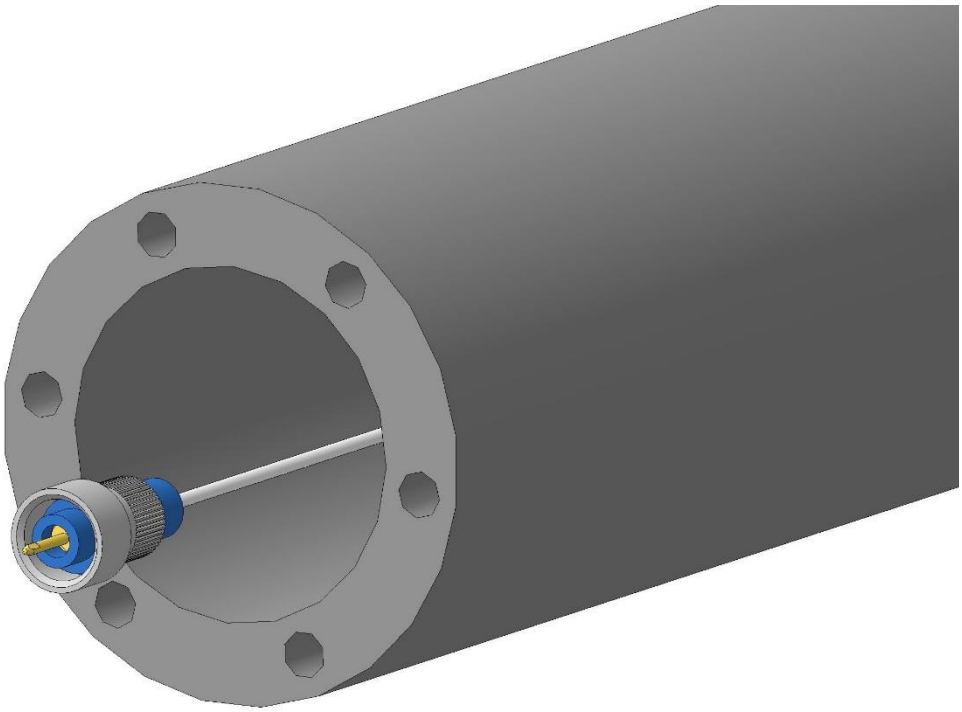

Figure 10 – View of prepared motor base

- check insulation resistance between the motor winding Y-point wire and motor housing using megaohmmeter with output voltage 1,000 V.

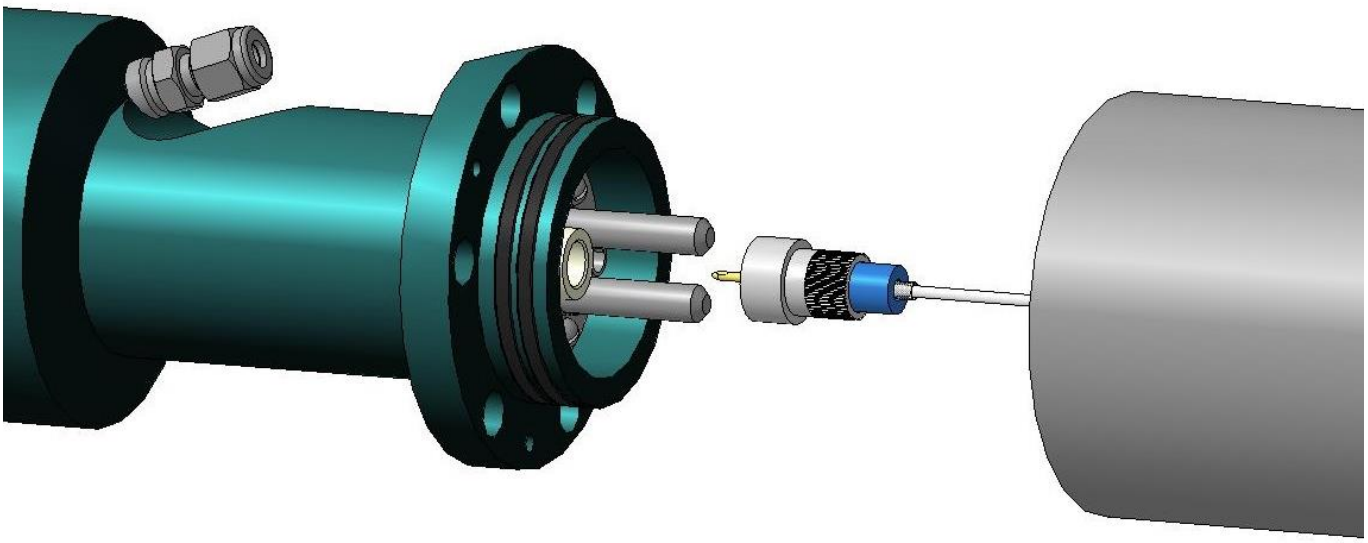

Figure 11 – Connecting the motor to the downhole sensor

- mate the corresponding X1 motor connector with the downhole sensor X1 connector.

ATTENTION: *Do not allow dirt and foreign objects to enter the connector X1*.

- lubricate rubber rings by dielectric oil, and connect the downhole sensor with the motor by tightening the studs. Use spring washers with nuts on the studs. Tighten the connections uniformly using a wrench with tension force according to the regulatory documents of the motor manufacturer.

ATTENTION: *Do not plug the opening for measuring reservoir fluid pressure on the downhole sensor!*

ATTENTION: *Check insulation resistance of the motor assembled with the downhole sensor. Connect the positive output to the motor body and the negative output to the motor socket for cable lead extension. Insulation resistance at megaohmmeter voltage of 1,000 V shall be not less than 100 MOhm for a new the downhole sensor and not less than 30 MOhm for a downhole sensor already operated.*

ATTENTION: *The allowable weight of equipment mounted to the downhole sensor bottom is up to 1,000 kg.*

Disassembly shall be executed in the reverse sequence:

- disconnect the downhole sensor.
- assemble the motor base according to the regulatory documents of the motor manufacturer.

ATTENTION: *Before to re-use the downhole sensor, wash the X1 connector and the related mating parts to it and blow with compressed air. Replace used O-rings.*

HYDRAULIC CONTROL LINE INSTALLATION

Hydraulic control line installation is performed when the equipment is installed in the well.

When installing hydraulic control line on the downhole sensor, it is necessary to:

- take steps to prevent from falling small parts down in the well;
- disconnect the nut and rings from the downhole sensor fitting;
- remove the cap at the end of the tube using 1/2 "and 9/16" wrenches. The nut, rings and cap must be retained in a safe place for further installation on the remaining hydraulic tube.
- install the tube with a nut and crimped ferrules to the downhole sensor fitting as far as it can go and manually tighten the nut;

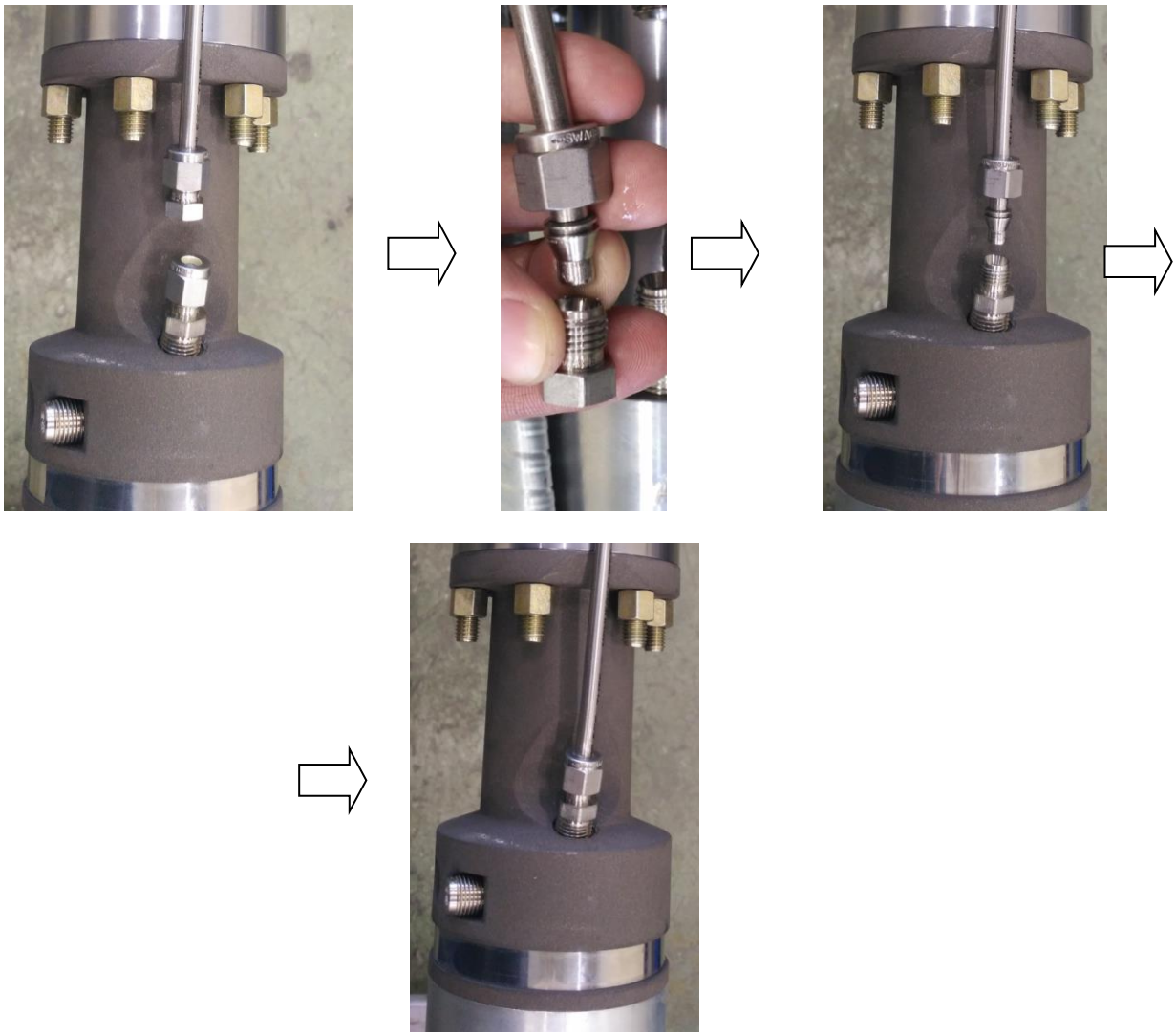

Figure 12 – Connection of the hydraulic control line to the downhole sensor

- using two 9/16” wrenches slightly tighten the nut on the downhole sensor fitting

according to fittings manufacturer installation manual, reassembly section (www.swagelok.com);

Connection leakage test:

- remove the cap from the other (free) end of the tube;

- similar to the downhole sensor side connection, attach the tube to the leakage test equipment using the set of tools supplied with the downhole sensor system;

- apply 10 MPa pressure using the pump;

ATTENTION: *Initially, pressure in the system will fall due to the presence of residual air;*

- when the instrument's readings stabilize, raise pressure to 10 MPa again, wait for 5 minutes, pressure should be steady;

- using the pump, apply max operating pressure for the BP downhole sensor, wait for 5 minutes, pressure should be stable, there shouldn’t be any leakage from the fitting mounted on the downhole sensor;

- release pressure from the system by rotating the valve wheel, remove the tube from the leakage test equipment;

ATTENTION: *After the test, put the cap at the end of the tube and slightly tighten to prevent oil leakage from the tube.*

Figure 13 – Leakage test

Then the ESP unit is installed and put down into the well. Ensure that the tube is not damaged during the descend process. If necessary, protectolizers can be installed on necks of the seal and pump sections for additional protection of the tube. The tube is laid next to the ESP cable, and connected by clamps along with the cable.

There are 2 types of discharge subs for measuring ESP discharge pressure:

1. Thread-end discharge sub (PNR);
2. Flange-end discharge sub (PNF).

The instruction shows installation of the hydraulic control line to the PNR discharge sub. Installation of the hydraulic control line to PNF is performed in a similar way. The only difference is in the way of attachment of the discharge subs to the ESP and laying of the cable (see Figures 14-15).

Figure 14 – Thread-end discharge sub

Figure 15 – Flange-end discharge sub

Installation of the hydraulic control line to the PNR discharge sub:

When installing PNR to ESP, tighten the threaded connection with the tubing until fitting position coincides with direction of laying the hydraulic control line tube within the tightening torque established by regulatory documents for this type of threaded connection. The ESP cable should be laid in one of the grooves on the outer surface of PNR.

When installing the hydraulic control line to PNR it is necessary to:

- take steps to prevent from small parts falling down in the well;
- mark the place of cutting the tube. The length of the tube to be cut should be with

a margin. The required margin is defined when the cutting location is approximately in the middle of the fitting, as shown in Figure 16. Cut the tube by placing the knife-tool exactly on the cut mark, as shown in Figure 17.

- if there are any burrs at the tube cutoff, they shall be removed.

ATTENTION: *At the end of the tube in the area of ferrules installation, shape deformation is not allowed, as well as any scratches, burrings and other surface defects that may affect leak tightness.*

Figure 16 – Marking the place of cutting

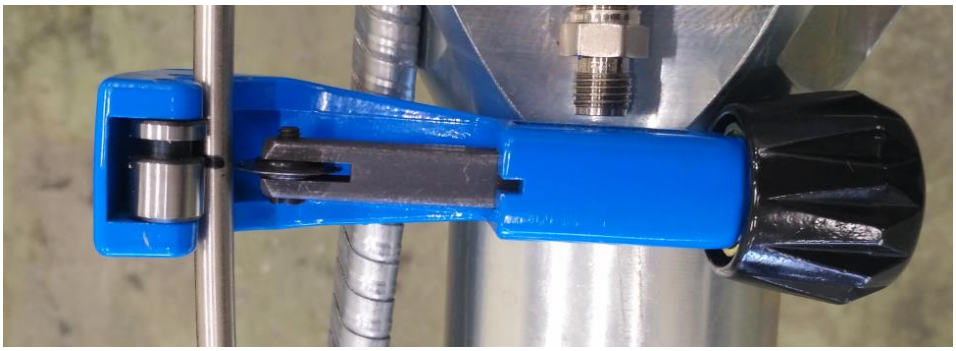

Figure 17 – Knife-tool position in relation to the cutting mark

- disconnect the nut with ferrules from the PNR fitting;

Figure 18 – Preparing for installation

- for ease of operation, to avoid small parts mounted on the tube falling down into the well, wind some layers of any available insulating or other adhesive tape on the tube at some distance from the end;

- put the nut with ferrules on the tube in the correct order, as shown in the Figure 19;

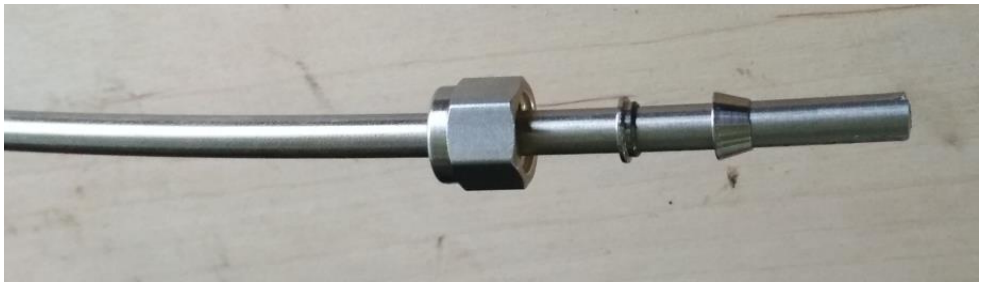

Figure 19 - The correct order of the rings arrangement

- insert the tube into the leakage test equipment fitting as far as it will go;

- manually tighten the nut on the PNR fitting;

- using two 9/16” wrenches tighten the nut for 1 ¼ turns according to fittings manufacturer installation manual (www.swagelok.com);

- make leakage test of the assembled connection, similar to the tests after connection with the downhole sensor, which will confirm tightness of the connection between the ferrules and the tube, and hence the absence of critical surface defects on the tube.

- remove the tube from the leakage test equipment;

- install the tube with the nut and already crimped ferrules in the PNR fitting as far as it will go, and manually tighten the nut;

- using two 9/16” wrenches slightly tighten the nut on the PNR fitting according to the fittings manufacturer installation manual, reassembly section;

- remove adhesive tape from the tube.

Figure 20 – Connecting the hydraulic control line with PNR

If the remainder of the tube has sufficient length for subsequent installation and you would like to use it later, it is necessary to plug the cut end of the tube in the same way as described above, using the nut, rings and cap remaining after hydraulic control line installation.

In case of damaging the hydraulic control line tube during the pull up and pull down operations, repair is allowed which consists of removing damaged sector and extending the required tube length using a coupling included in the hydraulic control line delivery set. Installation and leakage testing of the coupling are carried out in the same way as described above. The coupling shouldn’t protrude beyond the maximum dimensions of the equipment. Also, it is not allowed to install the coupling in places of equipment diameter difference.

Manufacturer’s post address:

OOO «IRZ TEK»

19 Bazisnaya str., Izhevsk,

Udmurt Republic, Russia, 426034

Fax: (3412) 63-65-85, 65-83-06, 66-52-34

Phone.: (3412) 63-73-43, 65-83-06, 68-29-07

24/7 technical support: 8-800-100-63-93

E-mail: bso@irz.ru tok@irz.ru