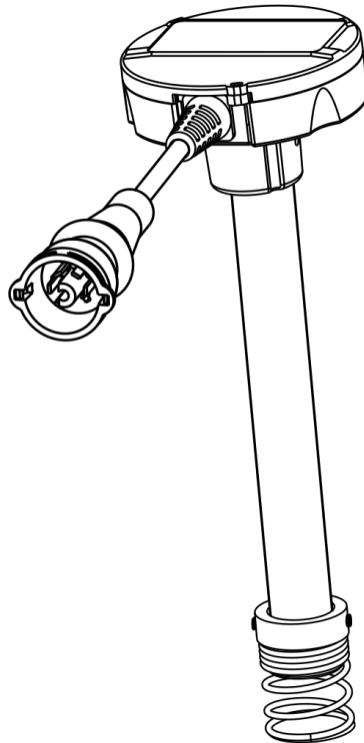


FUEL LEVEL SENSORS



DUT-E/DUT-E 2Bio/DUT-E GSM/DUT-E S7 INSTALLATION MANUAL

Version 9.1



TECHNOTON
ADVANCED MACHINERY TELEMATICS

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Revision history

Version	Date	Editor	Description of changes
7.0	12.2017	OD	Basic version.
8.0	01.2023	OD	<ul style="list-style-type: none"> • Earlier installation manuals for “classic” fuel level sensors and sensors that are designed based on IoT Burger Technology are united in one document; DUT-E S7 wireless sensors are added. • Recommendations on mounting and electrical connection of sensors are added. • Description of the sensors’ configuration is deleted. • Examples of the sensors’ connection schemes via CAN j1939/S6 interface are updated. • Dimensional drawings of the sensors mounting plates — standard one from MK DUT-E mounting kit and SAE 5 bolt are introduced. • Examples of calibration tables creation for tanks of sophisticated shape are provided.
8.1	07.2024	OD	Added information about the possibility of using data from a previously compiled calibration table for sensors installed in tanks of similar dimensions.
9.0	11.2024	OD	<ul style="list-style-type: none"> • Detailed information regarding mounting KDC additional section for fuel level sensors is added. • DUT-E 2Bio S7 wireless sensors are introduced.
9.1	05.2025	OD	Support for the Fuel Tanks Monitor mobile application has been discontinued for iOS devices.

1 Before installation

IMPORTANT:



- 1) Before you start your work, **we highly recommend** [to download from Technoton document center](#) (registration is needed) and study the operation manual of the fuel level sensor you are mounting.
- 2) In this document, in some cases, recommendations with the sensor **model type** specified, are provided. The model type is identified by the first three or five digits (depending on the specific model) of the sensor serial number placed on its measuring probe and on the packing label.

1.1 Inspecting Vehicle, where sensor will be installed

[DUT-E/DUT-E 2Bio/DUT-E GSM/DUT-E S7/DUT-E 2Bio S7](#) (further on — sensor) is mounted into the tank of a Vehicle. That is why, you should pay special attention to the tank visual examination. The sensor may be mounted both into the hole for a standard fuel sensor, and into a specially dedicated hole in the tank.

Whenever you mount a sensor instead of a standard fuel level sensor, you should note that the location of holes for the **mounting plate** fully coincides with those dedicated for a standard fuel level sensor in Vehicles manufactured in CIS countries. For vehicles manufactured in other countries, you may order separately the mounting plate **SAE 5 bolt** (see [annex A](#)).

In case the standard fuel level sensor is located not in the geometrical center of the tank, you should not mount another sensor in its place. As a rule, it is recommended to mount the sensor in the hole specially drilled for it; you should select the mounting location in **the geometrical center of the tank**. This will reduce the error of volume measurement in the tank in case of the Vehicle roll during parking and in case of the fuel fluctuations during movement (see figure 1).

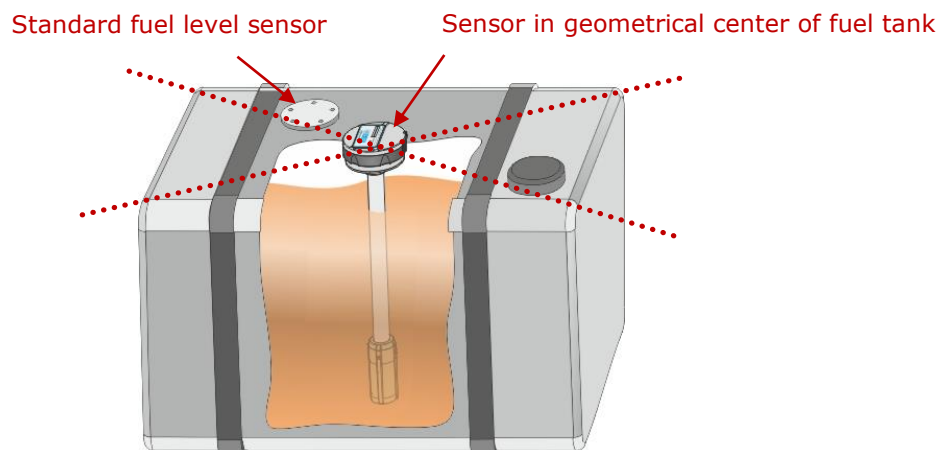


Figure 1 — Recommended location for mounting a fuel level sensor

Before drilling the hole, make sure that under the place of drilling there are no inner walls that can prevent from installing the sensor. Sensor installation can be performed both with dismantling or without dismantling fuel tank of vehicle. Make sure that there is enough space (not less than 30 mm) to place "head" of sensor between top of fuel tank and any elements of Vehicle above the tank.

Make sure that fuel tank and fuel pipes connected to it are tight, as well as check integrity of wires' insulation.



ATTENTION: Before drilling, fuel tank must be dried or filled with water to avoid ignition of fuel vapors!

Strictly follow safety rules of automobile repair works as well as local safety rules of the customer company when mounting sensor!

It is recommended to check condition of onboard power network of the Vehicle and its compliance with power supply range of sensor. Pay attention to condition of battery terminal and serviceability of main switch of the battery. Resistance between any point of Vehicle's chassis ground and "-" terminal of the battery or between terminals of the chassis ground switch should not exceed **1 Ohm**. If resistance exceeds 1 Ohm, sensor may work improperly.



IMPORTANT:

1) During mounting **DUT-E GSM** you are to take into account that modules of GLONASS/GPS and GSM antennas are located inside the sensor measuring "head". To ensure unimpeded reception of signals of GNSS it is necessary to provide **maximum view of the sky** in the place of sensor installation.

2) During mounting **DUT-E S7 / DUT-E 2Bio S7** you need to make sure that there are no sources of electromagnetic interference close to the sensor location (radio telephones, video signal transmission units and other wireless devices operating within 2.4 or 5.0 GHz frequency bands, as well as running electric motors, powerful transformers and switching equipment, welding equipment, high-voltage lines etc.). The maximum allowed distance between sensor and the receiving device depends on the quality of Bluetooth module of the receiving device. To assure the stable data transmission, it is recommended that this distance should not exceed **20 m**.

1.2 Tools and accessories for installation, connection and configuration

The list of recommended tools and accessories:

- delivery set of fuel level sensor;
- small tools: (open-end wrenches and spanner wrenches kits, drive sockets, screwdrivers, pliers, jab saw or angle grinder with a cutoff disk, rivet spinner);
- drill (screw driving machine) with a set of drill bits for metal;
- hollow drill set, d=38 mm;
- verified measuring reservoir for fuel (10...20 l volume);
- if the tank volume is greater than 200 l, the fuel filling station with a counter or [DUT-E ATS automatic calibration station](#) are desirable;
- calibration pipe with one end sealed, its length being no less than the height of the tank to be equipped;
- silicone sealing compound;
- rags;
- diesel fuel; full tank for each Vehicle;
- spare tank for fuel of volume equal to that of the given fuel tank;
- in case of configuration using the cable system — [S6 SK*](#)/SK DUT-E** service adapter and PC with the installed [Service S6 DUT-E*](#)/Service DUT-E** service software.
In case of wireless configuration — [S6 BT Adapter*](#) service adapter and the Android device with the installed Service S6 DUT-E (Android) service mobile application;
- mobile device (Android tablet or smartphone) with the installed Fuel Tanks Monitor application***;
- signal cable****.



RECOMMENDATION: Tank calibration using DUT-E ATS automatic calibration station eliminates the impact of human factor on the calibration accuracy and reduces the calibration error down to ± 0.5 % of the tank volume, it also reduces by 2...3 times labor costs and time for the tank calibration (see "[DUT-E ATS operation manual](#)").

* When mounting DUT-E 2Bio, DUT-E CAN, DUT-E AF (model type 05001), DUT-E GSM.

** When mounting DUT-E AF, DUT-E 232, DUT-E 485.

*** When mounting DUT-E S7 / DUT-E 2Bio S7.

**** Not required, when mounting DUT-E S7 / DUT-E 2Bio S7.

2 Mounting in a tank with flat surface

2.1 Tank drilling

IMPORTANT:



- 1) Before drilling a bore in a fuel tank, the tank must be emptied, dismantled (if necessary) and dried or filled with water.
- 2) Before drilling, make sure that there are no bulkheads that interfere sensor installation.
- 3) Eliminate contact of sensor measuring probe with the bar of the standard float fuel sensor.

A hole **d=38 mm** for the sensor mounting plate is to be drilled with a drilling bit for metal. We recommend to paste the pattern with the holes' locations indicated (it is included into the delivery set) on the tank surface and drill holes in accordance with the pattern (see figure 2).

In steel-made and thick-wall tanks it is also necessary to drill 5 holes **d=2 mm** to fix sensor with screws.

If installing in plastic tanks or tanks with thick walls, use threaded rivets to fix sensor. If you use threaded rivets, drill **d=7 mm** holes.

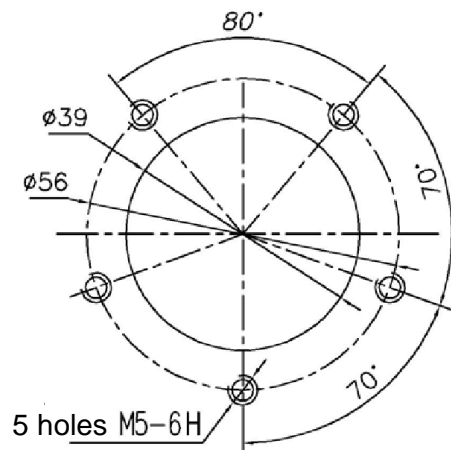


Figure 2 — Drilling a tank according to the drawing with the holes' locations indication

2.2 Cutting a sensor

Measure the tank depth from the sensor mounting plate down to the bottom. The length of the measuring probe for the sensor which is to be mounted must be **20...30 mm** shorter than the height of the tank, in order to:

- provide at least 10 mm operation area for bottom spring stopper (if the bottom spring is fixed in full loading position the bayonet mounting plate can get damaged);
- avoid the short circuit of the measuring probe tubes with conductive mud or water at the tank bottom.

For models **DUT-E A5 / DUT-E A10 / DUT-E F / DUT-E I**, cutting is allowed **up to 30 %** of the measuring probe **length**, without further sensor calibration for minimum and maximum fuel levels.

For **DUT-E AF / DUT-E 232/ DUT-E 485/ DUT-E CAN / DUT-E 2Bio / DUT-E GSM / DUT-E S7 / DUT-E 2Bio S7** models, cutting is allowed **to any length needed**, with subsequent obligatory sensor calibration for minimum and maximum fuel levels (see the [operation manual](#) for the respective sensor).

A sensor is cut with hacksaw. The ends of the pipes are to be dressed carefully and washed with fuel (see figure 3 and 4).



Figure 3 — Cutting a sensor and removal of barbs after cutting

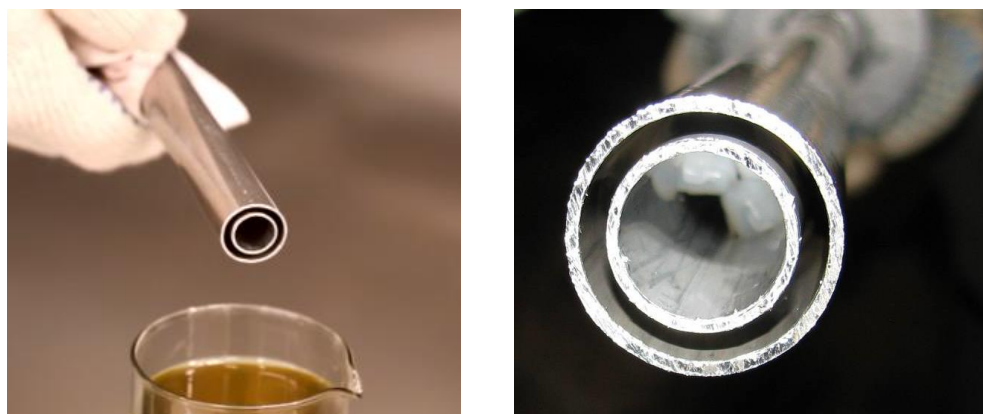


Figure 4 — Washing the cut with fuel and checking the cleanliness of the cut



IMPORTANT: When cutting [DUT-E 2Bio](#) / DUT-E 2Bio S7, to ensure proper operation of automatic fuel correction function it is necessary to leave a distance of **9...10 cm** from upper part of third electrode to the cut of measuring tubes (see figure 5).

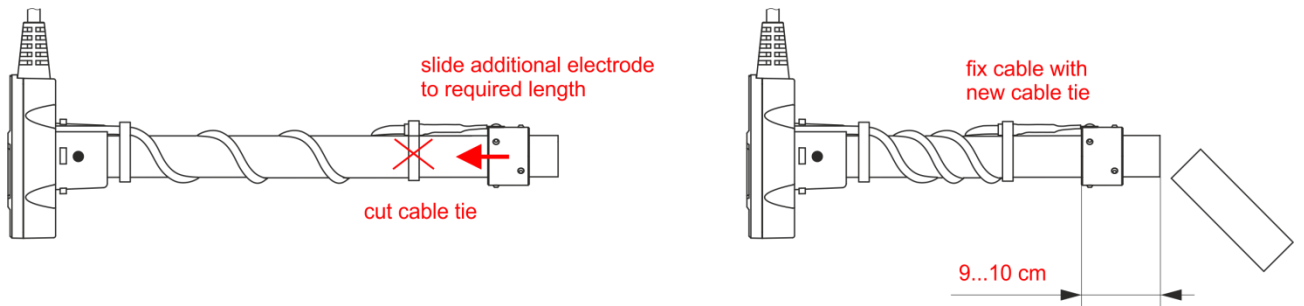


Figure 5 — Measuring tube cutting procedure for DUT-E 2Bio / DUT-E 2Bio S7

2.3 Length extension

If you need to extend the sensor length, **additional DUT-E sections** of the following models (see figure 6) are attached to its measuring probe: **KDC 250**, **KDC 500** and **KDC 1000** (lengths of 250, 500 and 1000 mm respectively).

For models **DUT-E A5/ DUT-E A10/ DUT-E F/ DUT-E I**, length extension is only possible **to recover their initial length** after cutting, without subsequent sensor calibration for minimum and maximum fuel levels.

For models **DUT-E AF / DUT-E 232/ DUT-E 485/ DUT-E CAN / DUT-E 2Bio / DUT-E GSM / DUT-E S7** (model type 0113) / **DUT-E 2Bio S7** length extension **up to 6000 mm** is allowed, with subsequent obligatory sensor calibration for minimum and maximum fuel levels (see the [operation manual](#) for the respective sensor).

For model **DUT-E S7** (model type 0107) length extension **up to 3000 mm** is allowed, with subsequent obligatory sensor calibration for minimum and maximum fuel levels.

The maximally allowed measuring probe length extension for standard modifications of **DUT-E 2Bio / DUT-E 2Bio S7** limited by the additional electrode cable length is calculated according to the formula (1):

$$L_{\max} = 1.7 \cdot L \quad (1)$$

where **L** – nominal length of the sensor measuring probe.

Upon special order, we can manufacture models DUT-E 2Bio / DUT-E 2Bio S7 with any length extension of the measuring probe **up to 6000 mm**.

To increase the length of DUT-E 2Bio / DUT-E 2Bio S7 take off additional electrode together with its cable from the measuring probe. After fixing the additional sections place additional electrode to the end of measuring probe and equally wrap the cable around the tubes.

After length extension of DUT-E 2Bio / DUT-E 2Bio S7, sensor calibration for minimum and maximum fuel levels is obligatory.

Additional sections can be cut to necessary size. During their cutting, you should be guided by the recommendations for sensors that are set out above.

The procedure for mounting the additional section:

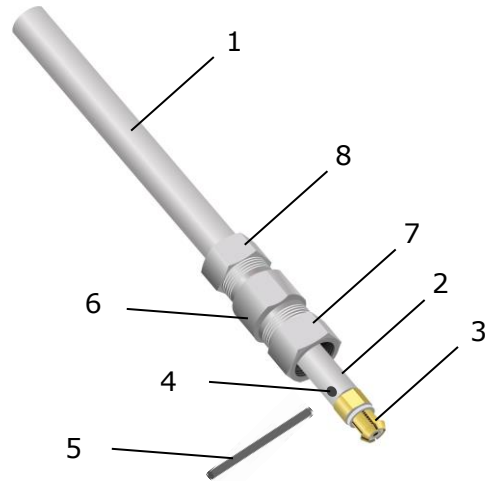
- 1)** Unscrew the collet (3) from the internal pipe (2) of the additional section and move out the threaded connection of the internal pipe about 10 cm from the edge of the external pipe (1) (see figures 6 a, b).
- 2)** Insert the collet (3) into the internal pipe of the measuring probe of the sensor whose length is extended.
- 3)** Screw the internal pipe of the additional section (2) into the collet (3) which is inserted into the sensor measuring probe. For convenience and to create the necessary effort (**3 N·m**), to tighten the threaded connection of the internal pipes, insert the auxiliary axle (5) into the hole (4) of the internal pipe.



IMPORTANT: When tightening the threaded connection of the internal pipes, fix firmly the collet (3) with **13 mm** open-end wrench. **You must not let rotate the internal pipe of the sensor measuring probe!** The internal pipe rotation would result in its breaking and damaging the sensor.

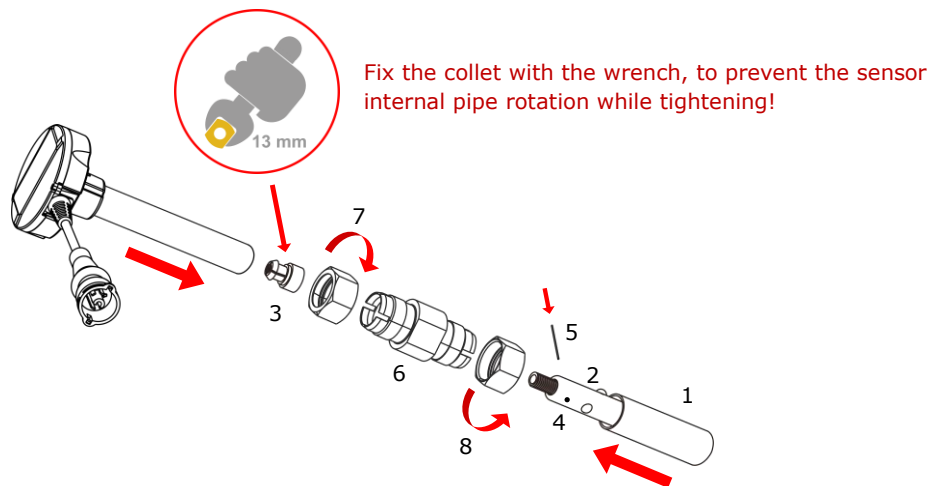
- 4)** Using the coupling (6) connect the external pipe of the additional section (1) with the external pipe of the measuring probe of the sensor whose length is extended.

- 5)** Tighten nuts (7) and (8) in succession, using two **27 mm** open-ended wrenches. The effort for tightening the threaded connections of the external pipes of the additional section and the sensor— **10 N·m**.

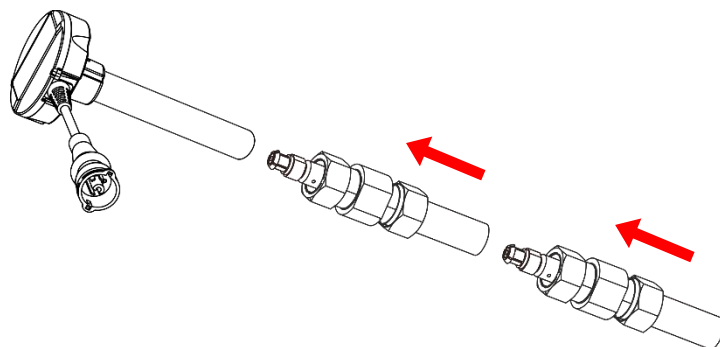


- 1 - external pipe;
- 2 - internal pipe;
- 3 - collet;
- 4 - hole to insert the auxiliary axle while tightening the internal pipes;
- 5 - auxiliary axle from the delivery set;
- 6 - coupling;
- 7,8 - nuts.

a) external view and elements



b) fastening order of one section



c) fastening order of two sections

Figure 6 — Additional DUT-E section

2.4 Mounting a screen filter

Screen filter is mounted on the measuring probe tubes of sensor (see figure 7) to protect measuring probe electrodes from mud and water. Using the screen-filter significantly extends faultless lifetime of the sensor.

The screen filter is fixed in accordance with sequence of operations shown in figure 8. First, a fixing element is put on the measuring probe. Then, the bottom stop is mounted and fixed with two screws on the side. The screen filter is put over the bottom stop and fixed with locks of the fixing element.

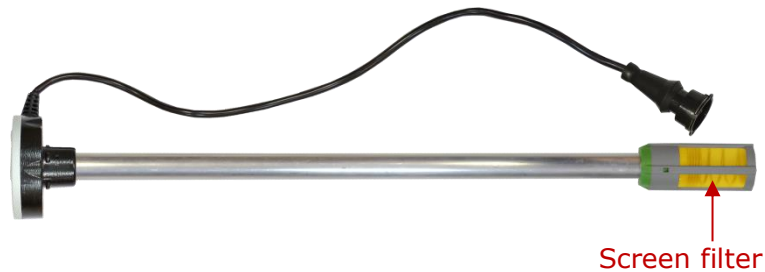


Figure 7 – Sensor with installed screen filter

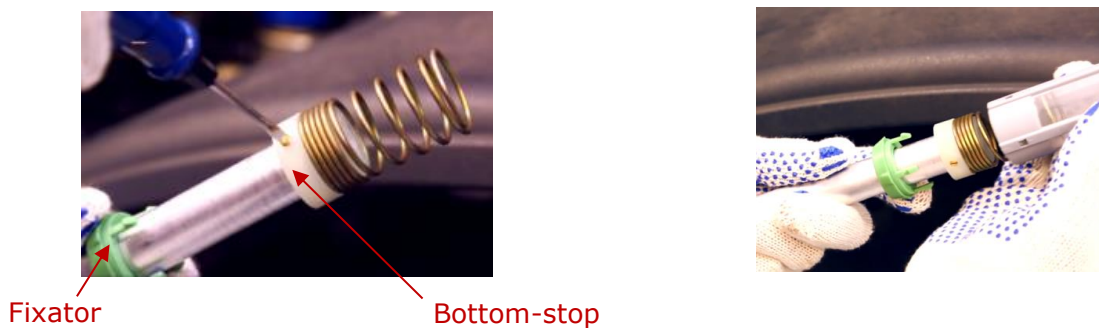


Figure 8 – Screen-filter installation procedure

When installing screen filter on [DUT-E 2Bio](#) / DUT-E 2Bio S7, third electrode should be moved by **9...10 cm** from the end of measuring tubes of the sensor (see figure 9).

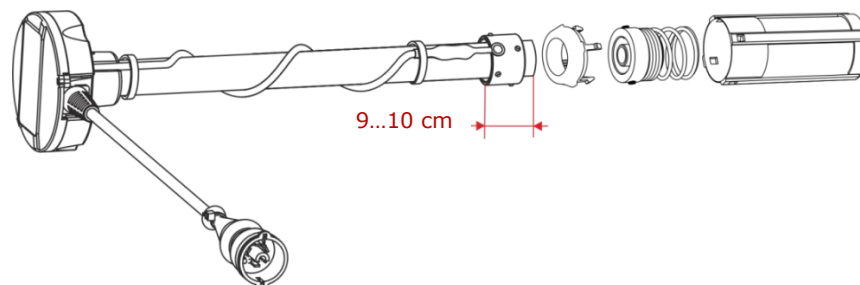


Figure 9 – Position of third electrode when installing screen-filter on DUT-E 2Bio / DUT-E 2Bio S7

WARNING:



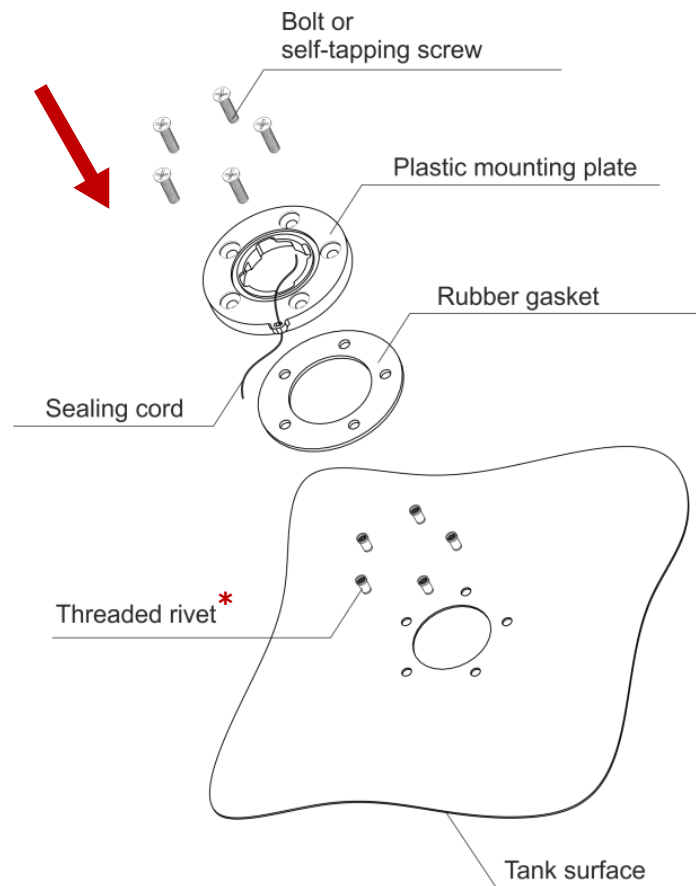
- 1) It is not allowed to install screen filter without installing fixation ring of bottom stop.
- 2) When installing sensor to plastic tank or fuel tank with thin walls, it is not recommended to install entire bottom stop, but only its fixation ring (grey plastic ring with screws).

2.5 Sensor fixing

As soon as the mounting hole is ready, place the rubber gasket and the mounting plate on it; after that, fix it with screws and threaded rivets or self-tapping screws from **MK DUT-E mounting kit** (see figure 10) included into the sensor delivery set.



BE CAREFUL: The mounting plate can be installed only in one position! Therefore, **before** marking and drilling, examine the place where you plan to fix the mounting plate so that the sealing holes should be accessible.



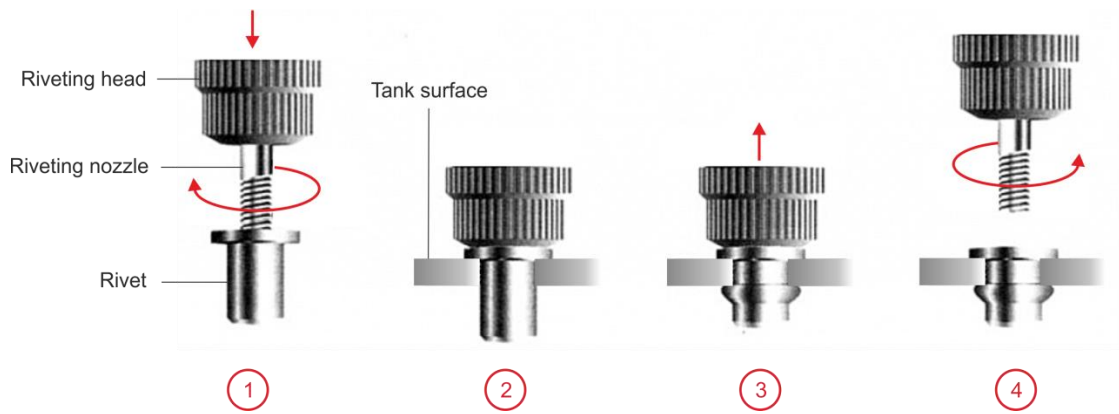
* Recommend for installation of sensor in fuel tank with thin metal walls (**less than 2 mm**).

Figure 10 — Mounting plate fastening



RECOMMENDATION: For a further easier sealing of DUT-E sensor pass the sealing cord through the sealing hole of the plate **prior** to fastening the plate to the tank.

Fix the mounting plate using threaded rivets according to figure 11.



a) threaded rivets procedure of installation



b) installed mounting plate view of from inside of tank

Figure 11 — Threaded rivets usage for sensor installation



ATTENTION: When fixing the mounting plate to the tank, make sure that the bolt or screw heads are not skewed and completely sunk in the plate in order to provide electrical isolation between the tank and sensor.

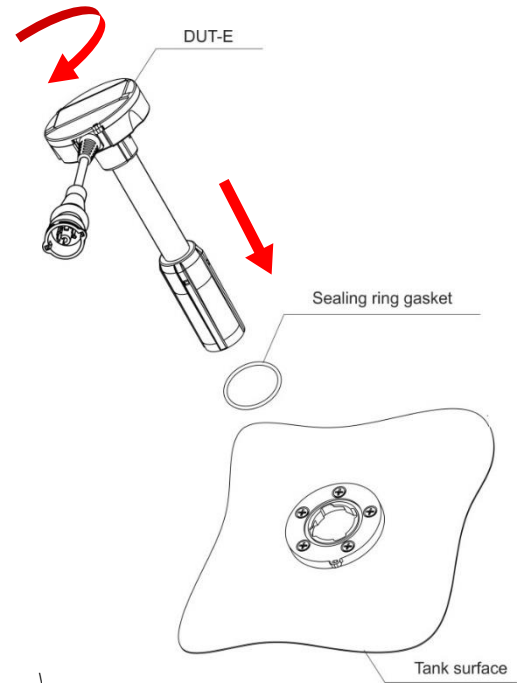
If the tank surface is not perfectly smooth but rough, we recommend to put some silicone sealant under the mounting plate and screw heads (heads of self-tapping screws). A little sealant on the heads of screws (self-tapping screws) would prevent the accumulation of water in those places (see figure 12 a).

To fix the sensor, you need to place the sealing ring into the groove of the mounting plate. For smooth gliding, moist it with oil or diesel fuel, to prevent its warp during the sensor fixing. Put the sensor measuring probe, with the screen filter mounted, down into the hole. Then, press the sensor "head" and fix it by turning it clockwise (see figure 12 b).

The rubber sealing ring must be placed precisely into the groove of the mounting plate. For smooth gliding, you may moist it with oil or diesel fuel, to prevent its warp during the sensor fixing.



a) correctly fastened mounting plate with O-ring



b) order of fixing operations

Figure 12 — Sensor fixing

3 Installation to barrel-shaped, D-shaped or other fuel tanks with inclined surface

For installing fuel level sensor into a fuel tank, which has **rounded surface**, it is recommended to use special mounting plate — **DUT-E FP CT** (see figure 13).

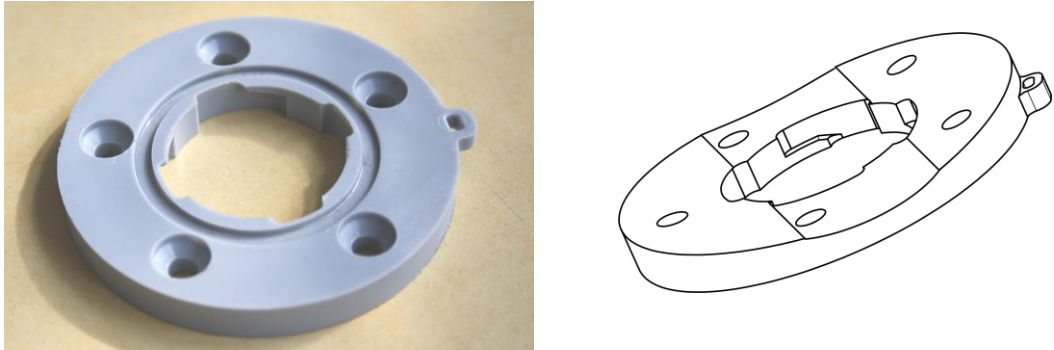


Figure 13 — DUT-E FP CT mounting plate

For installing fuel level sensor into a fuel tank, which has inclined surface, it is recommended to use wedged fastening plate — **DUT-E WP-10**, which has 10° angle of slope (see figure 14).

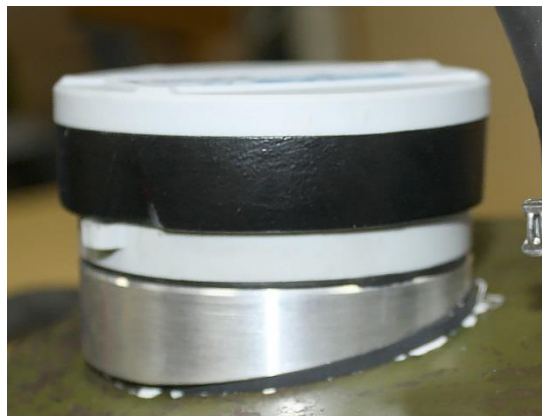


Figure 14 — DUT-E WP-10 wedged fastening plate

When installing on uneven surface, use two rubber gaskets and silicone sealant.

All other recommendations on mounting are similar to those provided in section [2](#).

4 Electrical connection

4.1 General provisions

[DUT-E S7](#) / [DUT-E 2Bio S7](#) **wireless sensors** are powered only from the inbuilt battery, so they don't need any electrical connection.



WARNING: Wireless transfer of DUT-E S7 indications to the tracking device (Telematics terminal, smartphone/tablet, data display etc.) is possible **only after the sensor BLE-module activation** (see details in "[DUT-E S7 / DUT-E 2Bio S7 User manual](#)").

All models of [DUT-E/DUT-E 2Bio/DUT-E GSM](#) sensors are powered from the onboard circuit of the Vehicle to be equipped. They are electrically connected using the special **signal cable** contained in the delivery set*.

IMPORTANT:

1) Before mounting and connecting the sensor switch off power supply of the vehicle electrical circuits. To do this switch off the battery switch or release the terminals of the wires connected to the battery.

2) Prior to electrical connection of the sensor pay special attention to checking Vehicle chassis ground. Resistance between any point of vehicle chassis and "-" terminal of the battery or between terminals of the chassis ground switch should not exceed **1 Ohm**. Great oxidization of the ground switch contacts or the switch malfunction may result in the distortion of the sensor output signal!



3) When connecting sensor to onboard electrical network of Vehicle, use **fuses** from delivery set in accordance to scheme of connection (see figure 15). Nominal fuse current is not more than 2 A.

4) To connect the signal cable wires, we recommend to purchase and use **connectors** (see figure 16).

5) It is **strongly recommended** to lay signal cable together with standard electrical vehicle wiring with mandatory cable ties fixing of every **50 cm**, at a positive ambient temperature (see figure 17).

6) The Telematics terminal and the sensor must be connected to the onboard power supply and to the Vehicle ground **in the same location!**

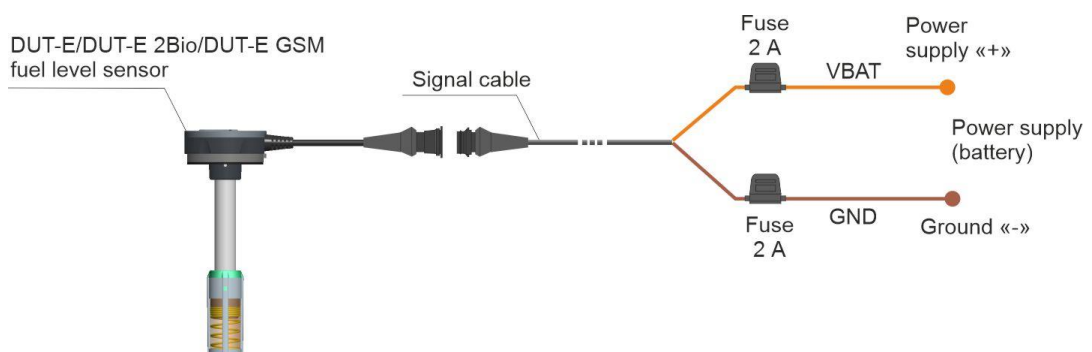


Figure 15 — Sensor electrical connection to the power source

* In case there is no need to connect DUT-E GSM via CAN j1939/S6 interface, the **power cable** from the delivery set is used. For sensors with CAN j1939/S6 interface (models DUT-E CAN / DUT-E 2Bio CAN / DUT-E GSM), signal cables are to be purchased separately (see [annex B](#)).

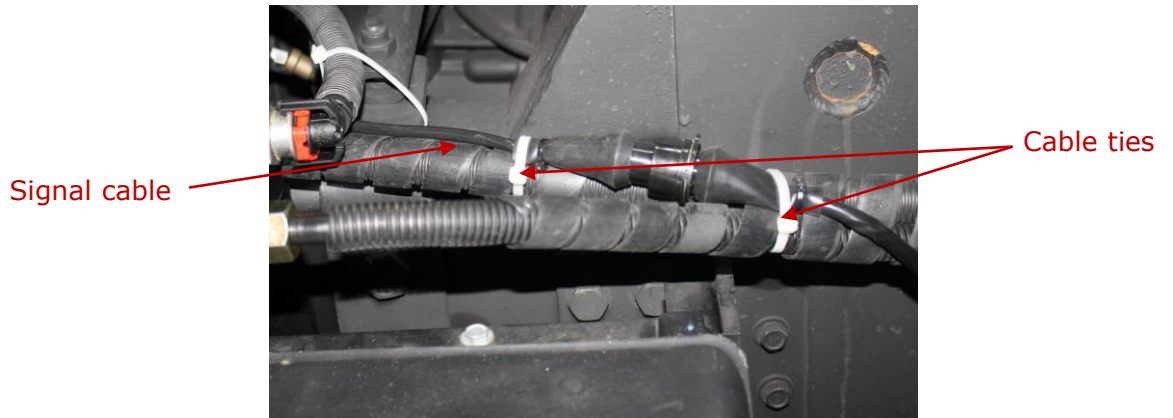


Figure 16 — Signal cable laying

Whenever you need to connect the bunch of wires of the signal cable to a terminal or to a tracking device, we recommend to use connectors (see figure 17).

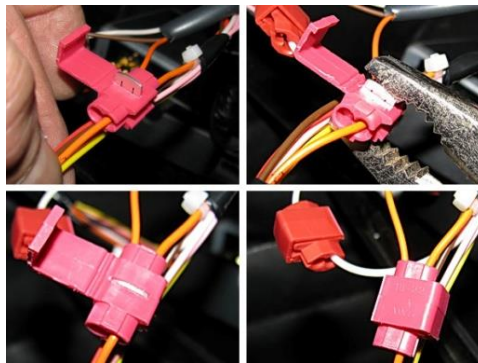


Figure 17 — Using connectors to connect wires of signal cable



IMPORTANT: [DUT-E](#)/[DUT-E 2Bio](#)/[DUT-E GSM](#) body is electrically connected to Ground "-" (brown wire of the connection cable). Electrical isolation between the sensor body and the fuel tank is provided by the mounting plate made of dielectric plastic material.

4.2 Connection of DUT-E CAN / DUT-E 2Bio /DUT-E GSM

Electrical connection of **DUT-E CAN / DUT-E GSM / DUT-E 2Bio** sensors is performed in accordance with the connector pinout and designation of the interface cable wires, in accordance with figure 18 and table 1.

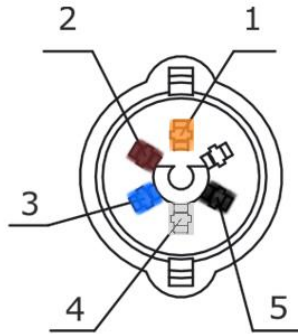


Figure 18 — DUT-E CAN/DUT-E GSM/DUT-E 2Bio interface cable connector pinout

Because the signal cable is not included into the delivery set for sensors with CAN j1939/S6 interface (models DUT-E CAN, DUT-E GSM and DUT-E 2Bio CAN), you need to purchase the necessary **elements of S6 cable system** for connecting these sensors to tracking devices (options of the sensors connection schemes, with specification of cables models included, are provided in [annex C](#), see more examples in [CAN j1939/S6 Telematics interface Operation manual](#)).

In case there is no need to connect DUT-E GSM via CAN j1939/S6 interface, the **power cable** from the delivery set is used.

Table 1 — DUT-E CAN/DUT-E AF (model type 05001)/DUT-E GSM/DUT-E 2Bio interface cable connectors assignment

Pin number	Wire marking	Wire color***	Assignment
1	VBAT	Orange	Power supply "+"
2	GND	Brown	Ground "-"
3*	CANH/232TX/485B/OUT	Blue	CAN-High (SAE j1939)/ Data transmitted (RS-232)/ Exchange of data (RS-485)/ output signal (current)
4**	CANL/232RX/485A/OUT	White	CAN-Low (SAE j1939)/ Data received (RS-232)/ Exchange of data (RS-485)/ output signal (analog / frequency)
5	KLIN	Black	K-Line (ISO 14230) Service interface
<p>* Wire marking and designation are specified, respectively, for models of the sensors DUT-E CAN, DUT-E GSM and DUT-E 2Bio CAN / DUT-E 2Bio 232/ DUT-E 2Bio 485/ DUT-E 2Bio I.</p> <p>** Wire marking and designation are specified, respectively, for models of the sensors DUT-E CAN, DUT-E AF (model type 05001), DUT-E GSM and DUT-E 2Bio CAN / DUT-E 2Bio 232/ DUT-E 2Bio 485/ DUT-E 2Bio AF.</p> <p>*** Manufacturer reserves the right to modify wire colors, that is why pay attention to its marking.</p>			



IMPORTANT: The obligatory condition for correct data transfer via CAN j1939/S6 interface is the availability of two **120 Ohms** terminal resistors at the ends of CAN 2.0B (SAE j1939) communication line, between CAN LOW and CAN HIGH wires.

If you have just one or two sensors your [CAN j1939/S6 Telematics interface](#), you can use **S6 SC-CW-700 cables** for connection. One 120 Ohms terminal resistor in this cable (close to the connector) is connected permanently, while the other 120 Ohms terminal resistor (close to the bunch of wires) is connected to the two rosy wires. These resistors must be connected to the circuit in case the sensor with CAN j1939/S6 interface is the only device in the CAN-bus, or disconnected, in case the other sensor is connected with a similar cable (see [annex B](#)).

4.3 Connection of DUT-E AF

Electrical connection of **DUT-E AF** sensors is performed in accordance with the connector pinout and designation of the interface cable wires, in accordance with figure 19 and table 2.

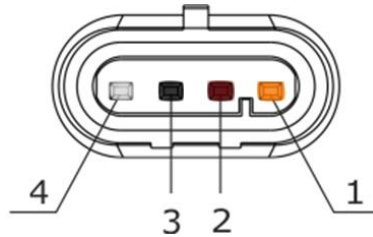






Figure 19 — DUT-E AF interface cable connector pinout

Table 2 — DUT-E AF interface cable connectors assignment

Pin number	Wire marking	Wire color*		Assignment
1	VBAT	Orange		Power supply "+"
2	GND	Brown		Ground "-"
3	KLIN	Black		K-Line (ISO 14230) Service interface
4	T034	White		Output signal (analog / frequency)

* [Manufacturer](#) reserves the right to modify wire colors, that is why pay attention to its marking.

4.4 Connection of DUT-E 232 / DUT-E 485

Electrical connection of **DUT-E 232 / DUT-E 485** sensors is performed in accordance with the connector pinout and designation of the interface cable wires, in accordance with figure 20 and table 3.

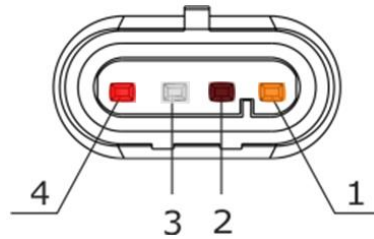






Figure 20 — DUT-E 232 / DUT-E 485 interface cable connector pinout

Table 3 — DUT-E 232 / DUT-E 485 interface cable connector pinout interface cable connectors assignment

Pin number	Wire marking	Wire color*	Assignment
1	VBAT	Orange 	Power supply "+"
2	GND	Brown 	Ground "-"
3	232R/485A	White 	Received data (RS-232) Data exchange (RS-485)
4	232T/485B	Red 	Transmitted data (RS-232) Data exchange (RS-485)

* [Manufacturer](#) reserves the right to modify wire colors, that is why pay attention to its marking.

4.5 Connection of DUT-E A5/ DUT-E A10 / DUT-E F/ DUT-E I

Electrical connection of **DUT-E A5/ DUT-E A10 / DUT-E F/ DUT-E I** sensors is performed in accordance with the connector pinout and designation of the interface cable wires, in accordance with figure 21 and table 4.

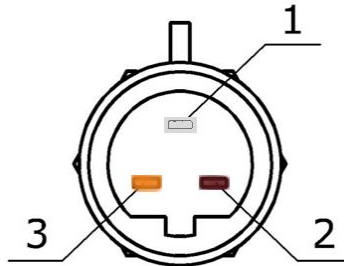





Figure 21 — DUT-E A5/ DUT-E A10 / DUT-E F/ DUT-E I interface cable connector pinout

Table 4 — DUT-E A5/ DUT-E A10 / DUT-E F/ DUT-E I interface cable connector pinout
interface cable connectors assignment

Pin number	Wire marking	Wire color*		Assignment
1	T701/T034	White		Output signal (analog/frequency/current)
2	GND/T734	Brown		Ground “-”
3	VBAT	Orange		Power supply “+”

* [Manufacturer](#) reserves the right to modify wire colors, that is why pay attention to its marking.

5 Fuel tank calibration table



IMPORTANT: The obligatory condition for correctness of indications of the mounted sensor is conducting the **calibration procedure of the fuel tank equipped, before you start to use it!**

The purpose of the calibration procedure — creation of the table of dependence of fuel volume values on the fuel level in the tank which is measured by the sensor (further on — calibration table). The calibration table is used in the Telematics system for automatic calculation of the current fuel volume in the tank.

Calibration procedure is a sequence of fuel fillings by fixed portions from empty to full state of the fuel tank.



IMPORTANT: To measure the volume of fuel portions it is necessary to use measuring reservoir with inaccuracy not more than 0.25 %.

Values of the calibration table points (no less than 15 points are recommended) are recorded into the sensor settings* (see details in the [operation manual](#) for the respective sensor) of the Telematics terminal and/or server (e.g. — [ORF 4](#) / [ORF 5](#)).



RECOMMENDATION: When creating the calibration table, we recommend to enter for its first point (0.0 mm level) the value of fuel volume which is equal to the fuel volume not used which is remaining in the tank. Because the end of the mounted sensor measuring probe is located 20...30 cm from the tank bottom, there are normally 10...30 l of fuel not used in the dead zone beyond the limit of monitoring.

To make fuel tank calibration correctly, where the sensor is installed, it is required to follow the procedure:

- Vehicle being equipped should not be loaded and should be parked on even horizontal surface;
- fuel tank should be empty;
- all Vehicle wheels must be of standard type and size (replacement with wheels of non-standard type and size results in the decrease of measurements accuracy or another calibration is needed);
- pressure in tires should be within allowed range for this model;
- Vehicle should not move, ignition is turned on, engine not running;
- between to consequent tank refilling operations, please, wait at least 60 seconds.



RECOMMENDATION: Tank calibration using [DUT-E ATS automatic calibration station](#) reduces the calibration error down to $\pm 0,5$ % of the tank volume; labor input and time needed for the tank calibration are reduced by 2...3 times (see [DUT-E ATS Operation manual](#)).

[Annex D](#) provides examples of creating calibration tables for tanks of most widespread sophisticated shapes.



IMPORTANT:

- 1) It is permissible to use a pre-calculated calibration table when installing the sensor in a tank of the same size that was previously calibrated.
- 2) If the new tank deviates in size and/or shape from the previously calibrated one, the measurement error may be higher than stated.

* Except sensors for which there is no option of configuration (models DUT-E A5 / DUT-E A10 / DUT-E F / DUT-E I).

6 Measurement accuracy check

Basic principles:

Accuracy check test is done to find out relative and absolute inaccuracy of fuel volume measurement for particular Vehicle fuel tank.

Control test includes fill-up/discharge of the fuel tank and comparing readings received from the sensor with the actual volume of the fuel discharged/filled.

Fuel is discharged using a hand pump or a mechanical pump.

When running tests, use only certified measuring containers (canisters) to measure volume of filled-up/drained fuel.



ATTENTION: When running accuracy check, fill-up/drain volume should be equal at least 20% of total fuel tank volume.

Check test procedure:

- 1) Drain a fixed volume of fuel.
- 2) Determine the exact amount of drained fuel with the calibrated measuring container.
- 3) Record the data into the Check test report.
- 4) Wait for the fuel getting still in the tank (for stable the sensor readings).
- 5) Refuel the tank with the previously drained fuel.
- 6) Record the data into the Check test report.
- 7) When analyzing accuracy errors, "Drain" and "Refill" parameters are estimated as a percentage relative to the total tank capacity.

See [annex E](#) for check test report template and error calculation formula.

7 Frequently asked questions

Q: Do I need to use any power supply stabilizers or converters when installing the sensor?

A: No. All sensors stabilize power supply automatically.

Q: What does it mean when fuel level value suddenly increases from current fuel level to maximum (or almost maximum) fuel level possible for this tank?

A: 1) Most frequent reason – short circuit of sensor’s tubes by water or mud from bottom of the tank.

2) Also, rapid increase can be caused by poor quality of Vehicle’s chassis ground.

Q: What are the disadvantages of installing the sensor instead of standard fuel level sensor?

A: 1) Fuel level indicator on dashboard does not work without additional devices ([MasterCAN DAC15](#) digital-to-analogue converter).

2) The sensor will be placed not in geometrical center of fuel tank, which may lead to increase of inaccuracy of fuel volume measurement.

Q: Why false filling/draining is depicted and values on fuel level chart are fluctuating much?

A: 1) Vehicle moves on uneven ground and filling/draining is a result of fuel movement inside a tank.

2) Water or mud is getting between sensor’s tubes and periodically short circuits the tubes.

Q: How many steps (calibration points) should be done when calibrating fuel tank?

A More points — more accurate data would be received from the sensor. If you know exactly that the tank is of simple shape (that is, when the tank walls are strictly vertical, while the top and the bottom are strictly horizontal) and there are no additional crossbars and partitions inside the tank, the number of points may be reduced down to 5...7 pcs.

For tanks of sophisticated shapes, with a great number of partitions inside, the number of points may reach 60 pcs. and more. In such cases, you are to record values of the calibration table points into the settings of the Telematics terminal and/or server (e.g. [ORF 4](#) / [ORF 5](#)).

For fixed tanks, we recommend to use values of the calibration points specified in their operation documentation.

Q: How temperature expansion of fuel is taken in account and does it influence accuracy of measurement?

A: The feature of thermal correction is employed in the sensor in order to take into account thermal expansion. The thermal correction coefficient may be set using the service adapter.

8 Technical support

In [Technoton document center](#) there is elaborate operation documentation containing detailed information on all fuel level sensors, related software and necessary equipment:

- "DUT-E fuel level sensors. Operation manual".
- "DUT-E CAN fuel level sensor. Operation manual".
- "DUT-E 2Bio fuel level sensors. Operation manual".
- "DUT-E GSM fuel level sensor. Operation manual".
- "DUT-E S7/DUT-E 2Bio S7 fuel level sensors. Operation manual".
- "Fuel Tanks Monitor mobile application. User manual".
- "DUT-E ATS automatic tank calibration stations. Operation manual".
- "CAN j1939/S6 Telematics interface. Operation manual".

In case you need, you may always contact [Technoton technical support service](#).

E-mail: support@jv-technoton.com

Skype: [technoton.support](https://www.skype.com/join/technoton.support)



Annex A Dimensions of mounting plates for sensors

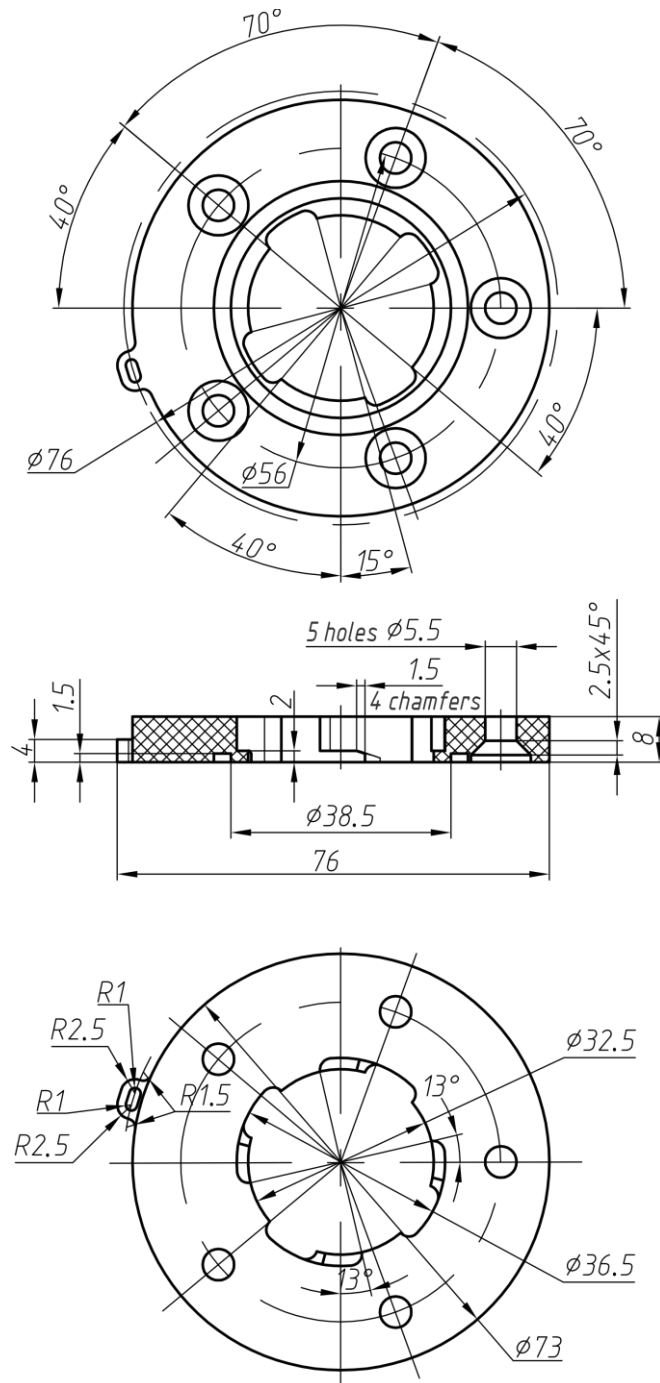


Figure A.1— Mounting plate from DUT-E mounting kit

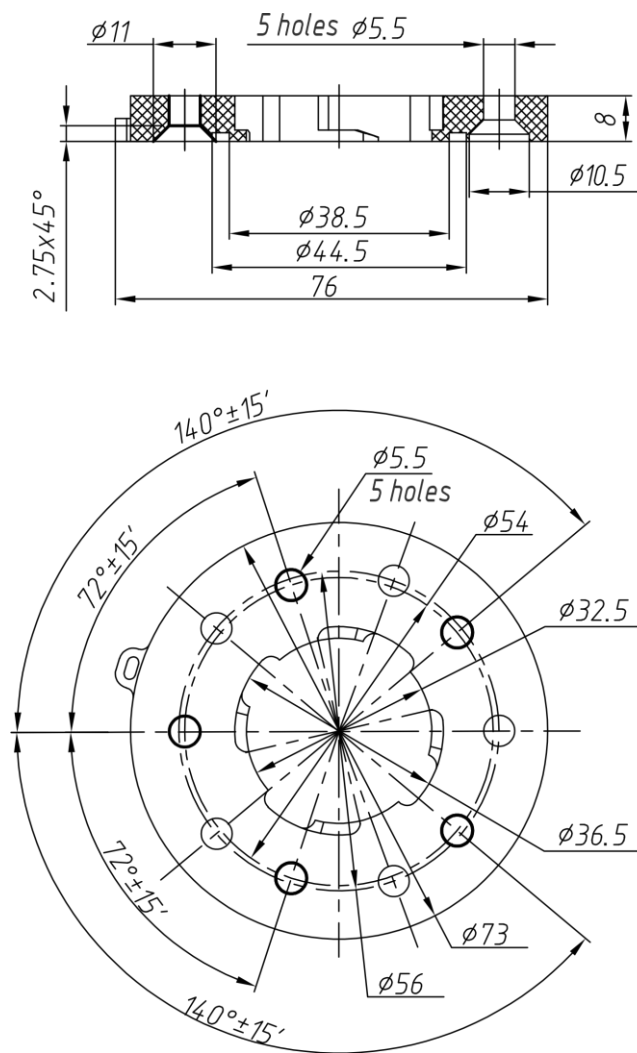

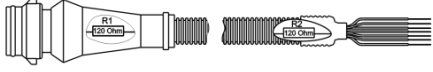
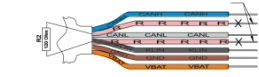
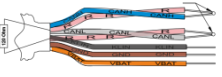



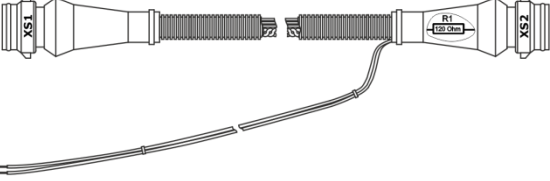


Figure A.2— Mounting plate SAE 5 bolt

Annex B Signal cables for sensors with CAN j1939/S6 interface

Table A.1 – Signal cables for *DUT-E/DUT-E 2Bio/DUT-E GSM* sensors

Name and exterior	Design	Purpose of use and description																					
<p>S6 SC-CW-700 Cable</p> 	 <table border="1" data-bbox="836 645 1018 757"> <thead> <tr> <th>Pin</th> <th>Wire color</th> <th>Circuit</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>orange</td> <td>VBAT</td> </tr> <tr> <td>2</td> <td>brown</td> <td>GND</td> </tr> <tr> <td>3</td> <td>blue</td> <td>CANH</td> </tr> <tr> <td>4</td> <td>white</td> <td>CANL</td> </tr> <tr> <td>5</td> <td>black</td> <td>KLIN</td> </tr> <tr> <td>6</td> <td>-</td> <td>-</td> </tr> </tbody> </table> <p>Connecting</p> <p>without built-in terminal resistor R2</p>  <p>with built-in terminal resistor R2</p>  <p>* Do not connect R2 resistor wires (pink, identification mark R), insulate.</p> <p>** Connect electrically one of the R2 resistor wires (pink, identification mark R) with CANH wire, and the other - with CANL wire.</p>	Pin	Wire color	Circuit	1	orange	VBAT	2	brown	GND	3	blue	CANH	4	white	CANL	5	black	KLIN	6	-	-	<p>Designed to connect sensors with S6 SC connector and CAN j1939/S6 interface to tracking devices and to external power supply.</p> <p>Length 7 m.</p> <p>Includes two built-in terminating resistors (120 Ohm) between CANH and CANL wires.</p>
Pin	Wire color	Circuit																					
1	orange	VBAT																					
2	brown	GND																					
3	blue	CANH																					
4	white	CANL																					
5	black	KLIN																					
6	-	-																					
<p>S6 SC-Mol-300 S6 SC-Mol-700 Extension cable adapter</p> 	 <table border="1" data-bbox="836 1326 970 1460"> <thead> <tr> <th>Pin</th> <th>Circuit</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>VBAT</td> </tr> <tr> <td>2</td> <td>GND</td> </tr> <tr> <td>3</td> <td>CANH</td> </tr> <tr> <td>4</td> <td>CANL</td> </tr> <tr> <td>5</td> <td>KLIN</td> </tr> <tr> <td>6</td> <td>-</td> </tr> </tbody> </table>	Pin	Circuit	1	VBAT	2	GND	3	CANH	4	CANL	5	KLIN	6	-	<p>Designed to connect the section of S6 cable system outside the cabin (S6 CS connector) and its section inside the cabin with Molex connector.</p> <p>Versions with cable length of 3 m and 7 m available.</p>							
Pin	Circuit																						
1	VBAT																						
2	GND																						
3	CANH																						
4	CANL																						
5	KLIN																						
6	-																						
<p>S6 2SC-30 power Extension cable with power wire</p> 	 <table border="1" data-bbox="836 1854 970 1989"> <thead> <tr> <th>Pin</th> <th>Circuit</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>VBAT</td> </tr> <tr> <td>2</td> <td>GND</td> </tr> <tr> <td>3</td> <td>CANH</td> </tr> <tr> <td>4</td> <td>CANL</td> </tr> <tr> <td>5</td> <td>KLIN</td> </tr> <tr> <td>6</td> <td>-</td> </tr> </tbody> </table>	Pin	Circuit	1	VBAT	2	GND	3	CANH	4	CANL	5	KLIN	6	-	<p>Designed to connect sensors with S6 SC connector and CAN j1939/S6 interface to tracking devices and external power supply.</p> <p>Length 0.3 m.</p> <p>It has 120 Ohms inbuilt terminal resistor at one end of CANH and CANL wires.</p>							
Pin	Circuit																						
1	VBAT																						
2	GND																						
3	CANH																						
4	CANL																						
5	KLIN																						
6	-																						

Annex C

Examples of sensor connection diagrams via CAN j1939/S6 interface

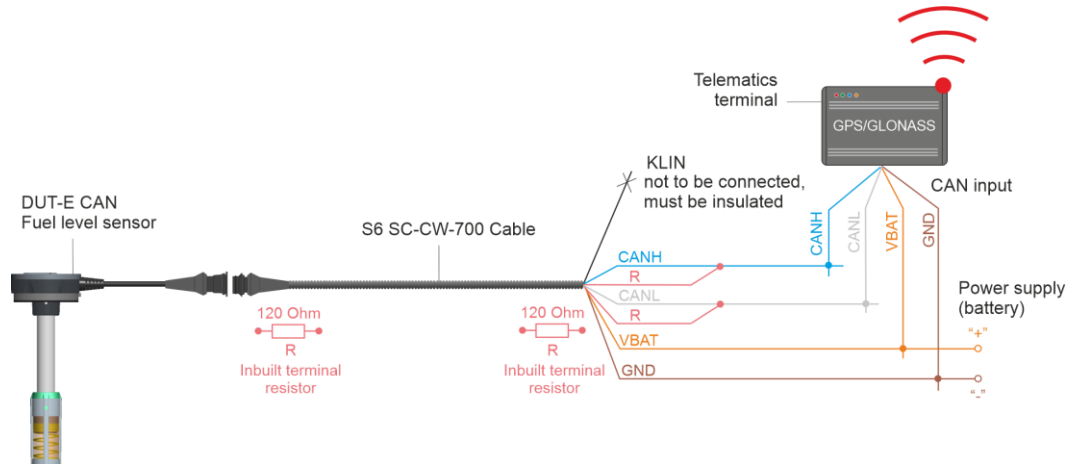


Figure C.1 — Connection of one sensor to the Telematics terminal

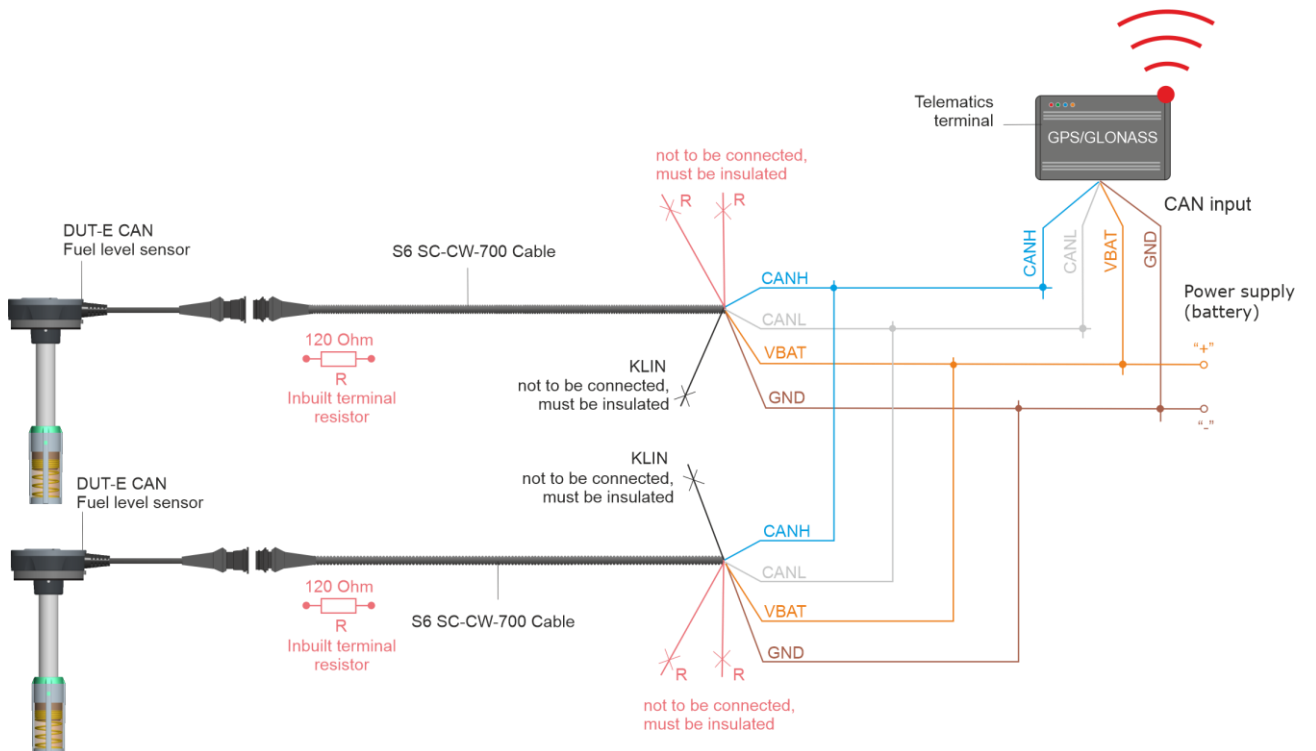
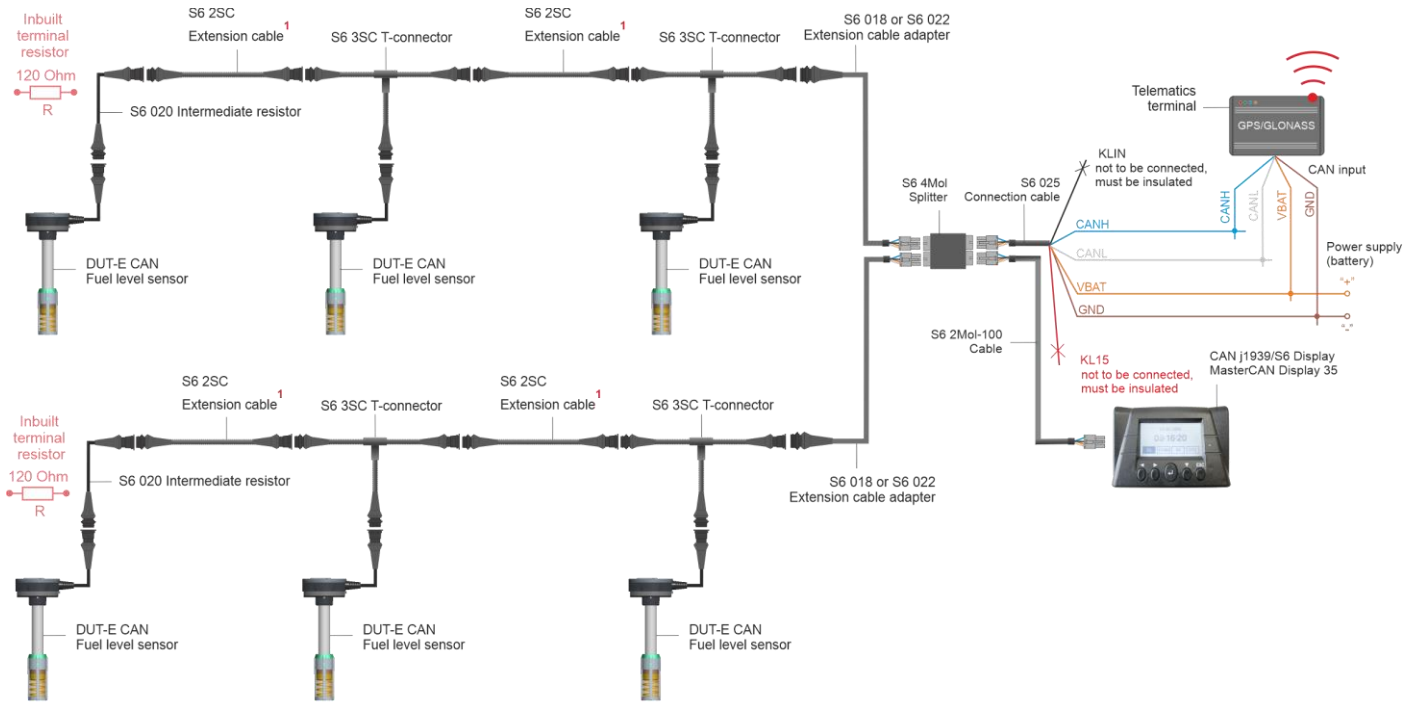
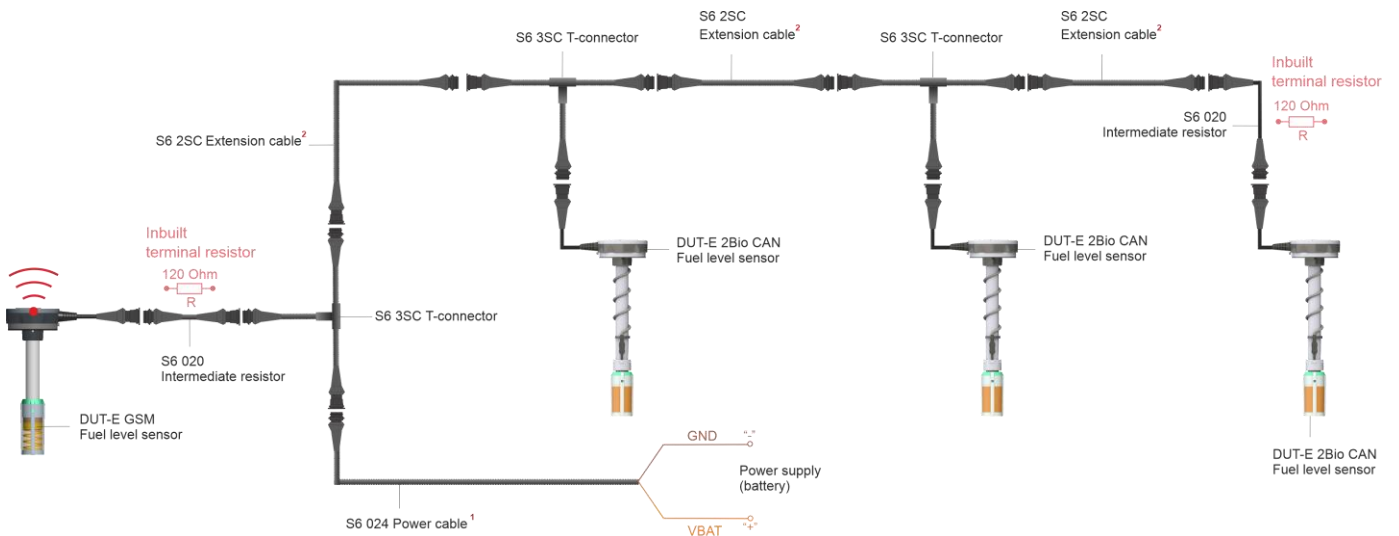


Figure C.2 — Connection of two sensors to the Telematics terminal



¹The length is selected according to installation conditions. Standard lengths are 1, 3, 7 and 12 m.

Figure C.3 — Connection of several sensors to the Telematics terminal and CAN display



¹ Cable is included into DUT-E GSM delivery set. Length: 7.5 m.

² The length is selected according to installation conditions. Standard lengths are 1, 3, 7 and 12 m.

Figure C.4 — Connection of several sensors to DUT-E GSM

Annex D

Examples of creation of calibration tables for tanks of sophisticated shapes

Two sensors are mounted in the tank to enhance the accuracy of measurements in case the Vehicle operates in conditions of difficult terrain or in conditions of prolonged smooth accelerations (e.g. in railway transport). Besides, such a way of mounting is required for monitoring the whole tank volume in conditions of its complicated geometrical structure.

Mounting two sensors is recommended in the following cases:

- Flat tank (low, wide) whose geometrical center is inaccessible.
- Long tank (often employed in the railway equipment).
- Step-shaped tank.
- Staircase-shaped tank.
- Sloping tank.

IMPORTANT:



- 1) It is permissible to use a pre-calculated calibration table when installing the sensor in a tank of the same size that was previously calibrated.
- 2) If the new tank deviates in size and/or shape from the previously calibrated one, the measurement error may be higher than stated.

Example 1: Flat tank

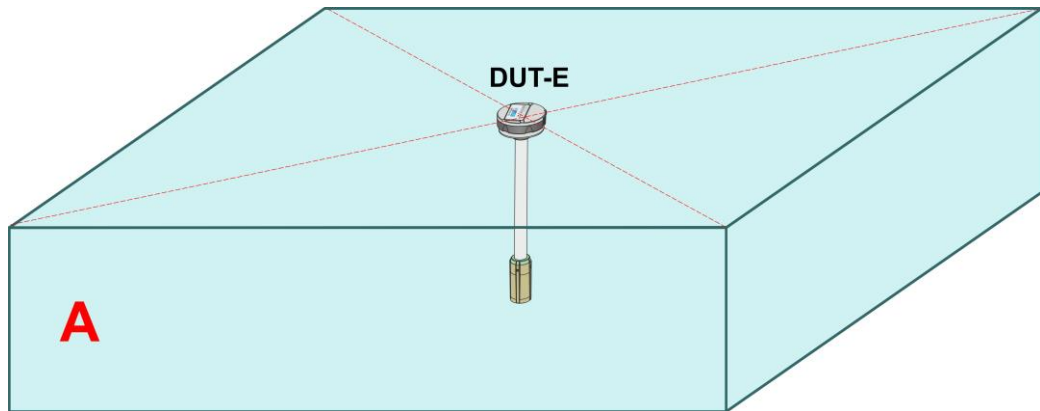


Figure D.1— The best location for mounting one tank — the geometrical center of the tank

Table D.1 — Example of the calibration table for a flat tank with one sensor which is mounted in the geometrical center

Section	Portion, l	Level, mm	Volume, l
		DUT-E	
A	—	0	0
	20	10	20
	30	30	50
	30	50	80
	30	70	110
	30	90	140

In case it is impossible to mount one sensor in the geometrical center of the tank (see figure D.1), two diagonally placed tanks are mounted (see figure D.2). The length of DUT-E₁ and DUT-E₂ sensors must be the same. The calibration table for each sensor is generated in the same way. The value of volume for each calibration point V_i is recorded as half of the measured portion volume V_{mi} , that is, $V_{1i} = V_{2i} = \frac{1}{2}V_{mi}$ (see table D.2).

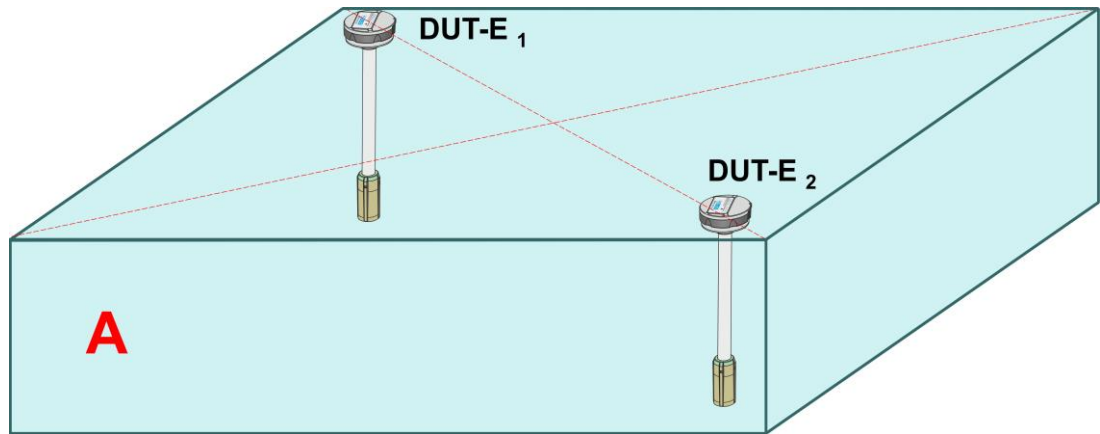


Figure D.2— Mounting two sensors diagonally, in case the tank geometrical center is inaccessible

Table D.2 — Example of a calibration table for a flat tank with two diagonally mounted sensors

Section	Portion, l	Level, mm	Volume, l	Level, mm	Volume, l
		DUT-E₁		DUT-E₂	
A	—	0	0	0	0
	20	10	10	10	10
	30	30	25	30	25
	30	50	40	50	40
	30	70	55	70	55
	30	90	70	90	70

Example 2: Long tank

Normally, two sensors are mounted in a long tank at both ends of it (e.g. of the railway type) (see figure D.3). DUT-E₁ and DUT-E₂ sensors must be of equal length. The calibration table for each tank is generated in the same way.

The value of volume for each calibration point V_i is recorded similar to the example of two diagonally mounted sensors; that is, as half of the volume of the measured portion: $V_{1i} = V_{2i} = 1/2 V_{mi}$ (see table D.3).

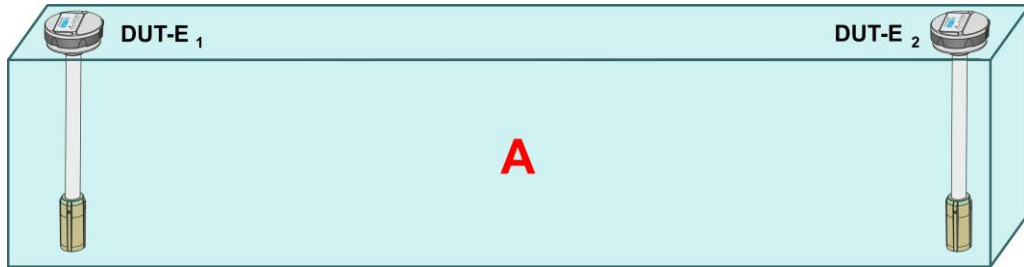


Figure D.3— Mounting two sensors at both ends of a long tank

Table D.3 — Example of a calibration table for a long tank with two sensors mounted at both ends

Section	Portion, l	Level, mm	Volume, l	Level, mm	Volume, l
		DUT-E₁		DUT-E₂	
A	—	0	0	0	0
	20	10	10	10	10
	30	30	25	30	25
	30	50	40	50	40
	30	70	55	70	55
	30	90	70	90	70

After that, plain summation mode is configured for DUT-E₁ and DUT-E₂ sensors at the server. Normally, two sensors with CAN j1939/S6 interface are connected to one CAN-port of the terminal. Because the sensors have different network addresses in the bus, data are transferred separately for each sensor. The sensors output data are digitalized in liters. Values from each sensor are summed up at the server, to receive the current value of fuel volume in the tank.

The advantage of diagonal mounting of sensors in a flat tank or of mounting sensors at both ends of a long tank is that fuel moves from one sensor to the other; however, the total value is always the same. This enhances the accuracy and correctness of measurement of fuel volume in the tank ($V_{\Sigma} = V_{DUT-E1} + V_{DUT-E2}$).

Example 3: Step-shaped tank

For a step-shaped tank, in some cases, you may mount one DUT-E₁ sensor (see figure D.4) (e.g. if the tank geometrical center is accessible for mounting the sensor). However, if the geometrical center is inaccessible for mounting the sensor due to the tank sophisticated shape and if long-time deviations from the horizontal position occur during the Vehicle operation, using a second sensor may considerably enhance measurements accuracy.

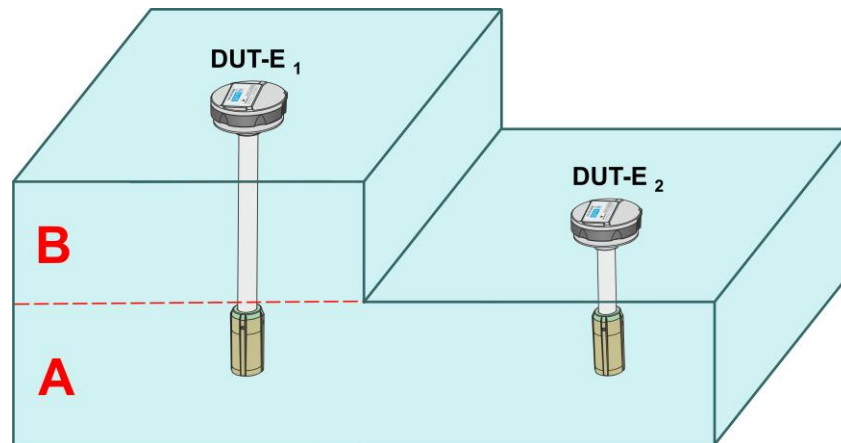


Figure D.4— Mounting two sensors in a complicated step-shaped tank

It is typical for a step-shaped tank that for fuel levels in **A** section, indications of both DUT-E₁ and DUT-E₂ sensors change. But as soon as the fuel level reaches section **B** during the calibration procedure, indications of DUT-E₂ will remain unchanged, while indications of DUT-E₁ will continue to change.

In this case, fuel volume values for each calibration point V_i are entered in the following way: $V_{1i}=V_{2i}=\frac{1}{2}V_{mi}$ (section **A**) and $V_{1i}=V_{mi}$ (section **B**) (see table D.4).

Table D.4 — Example of a calibration table for a complicated step-shaped tank with two sensors mounted

Section	Portion, l	Level, mm	Volume, l	Level, mm	Volume, l
		DUT-E ₁		DUT-E ₂	
A	—	0	0	0	0
	20	10	10	10	10
	30	30	25	30	25
B	30	50	55	—	—
	30	70	85	—	—
	30	90	115	—	—

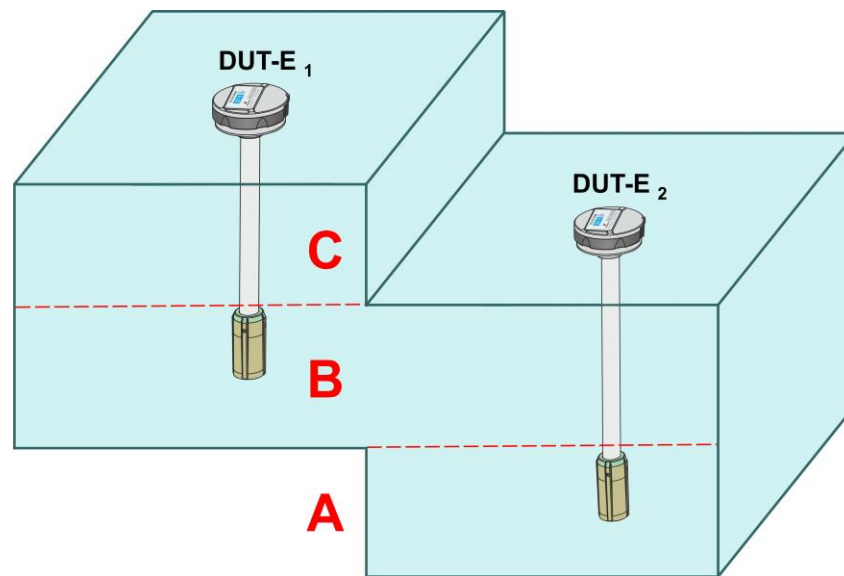
Example 4: Staircase-shaped tank

Figure D.5— Mounting two sensors in a complicated staircase-shaped tank

It is typical for a staircase-shaped tank (see figure D.5) that for fuel levels in **A** section, indications of only one DUT-E₂ sensor change. Further on, in section **B** indications of both DUT-E₁ and DUT-E₂ sensors change. But as soon as the fuel level reaches section **C** during the calibration procedure, indications of DUT-E₂ will remain unchanged, while indications of DUT-E₁ will continue to change.

In this case, fuel volume values for each calibration point V_i are entered in the following way: $V_{2i}=V_{mi}$ (section **A**), $V_{1i}=V_{2i}=\frac{1}{2}V_{mi}$ (section **B**) and $V_{1i}=V_{mi}$ (section **C**) (see table D.5).

Table D.5 — Example of a calibration table for a complicated staircase-shaped tank with two mounted sensors

Section	Portion, l	Level, mm	Volume, l	Level, mm	Volume, l
		DUT-E₁		DUT-E₂	
A	—	—	—	0	0
	20	—	—	10	20
	30	0	0	30	50
B	30	20	15	50	65
	30	40	30	70	80
	30	60	45	90	95
C	30	80	75	—	—
	30	100	105	—	—

In order to obtain the summary fuel level, you need to configure the plain data summation mode at the server: $V_{\Sigma}=V_{DUT-E1}+V_{DUT-E2}$.

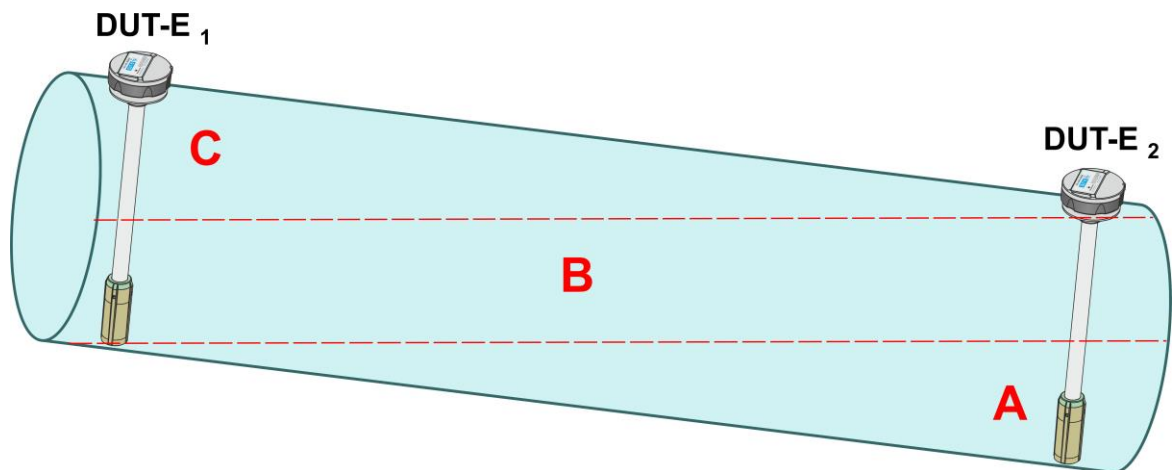
Example 5: Sloping tank

Figure D.6— Mounting two sensors in a sloping tank

In this case, the division into sections is similar to the staircase-shaped tank (see figure D.6). Fuel volume values for calibration points of sections **A**, **B** and **C** are generated in the similar way (see table D.6).

Table D.6 — Example of a calibration table for a complicated sloping tank with two mounted sensors

Section	Portion, l	Level, mm	Volume, l	Level, mm	Volume, l
		DUT-E₁		DUT-E₂	
A	—	—	—	0	0
	300	—	—	20	300
	300	0	0	40	600
B	300	10	150	50	750
	300	20	300	60	900
	300	30	450	70	1050
	300	40	600	80	1200
	300	60	750	100	1350
C	300	80	1050	—	—
	300	100	1350	—	—

In order to define limits of each section during the calibration of complicated-shape or sloping tanks, you should watch carefully and simultaneously the readings of DUT-E₁ and DUT-E₂ sensors. For example, for a sloping tank, at the beginning of the calibration procedure readings of DUT-E₂ sensor are entered into the table. The signal for passing over to section **B** is the minimal changing of DUT-E₁ sensor readings. The signal for passing over to the next section **C** is stopping changing of readings of DUT-E₂ sensor.

In the similar way, you may create calibration tables for tanks of more sophisticated shapes into which three or four sensors are mounted. In those cases, the tank volume is also divided into virtual sections. After that, depending on how many sensors (1, 2, 3 or 4) provide readings in each of these sections, indications of fuel volume for each sensor are generated in calibration points with corresponding coefficients (1, 1/2, 1/3 or 1/4).

Annex E

Template of check test report

Report

Date: _____

Sensor model and serial number	
Vehicle type, model, registration number	
Tracking/displaying device model and serial number	

Drainage volume	According to calibrated container V_M , liters	
	According to tracking device V_{track} , liters	
Accuracy error	Absolute error $\Delta = V_{track} - V_M$, liters	
	Normalized to total tank volume $\delta = \frac{V_{track} - V_M}{V_{total_volume}} \cdot 100\%$	

Refueling volume	According to calibrated container V_M , liters	
	According to tracking device V_{track} , liters	
Accuracy error	Absolute error $\Delta = V_{track} - V_M$, liters	
	Normalized to total tank volume $\delta = \frac{V_{track} - V_M}{V_{total_volume}} \cdot 100\%$	

Resume:

The results of measurement **match/do not match** specifications.

The results of refueling measurement **match/do not match** specifications.

Comments: _____

representative of the CUSTOMER: _____/_____

representative of the CONTRACTOR: _____/_____