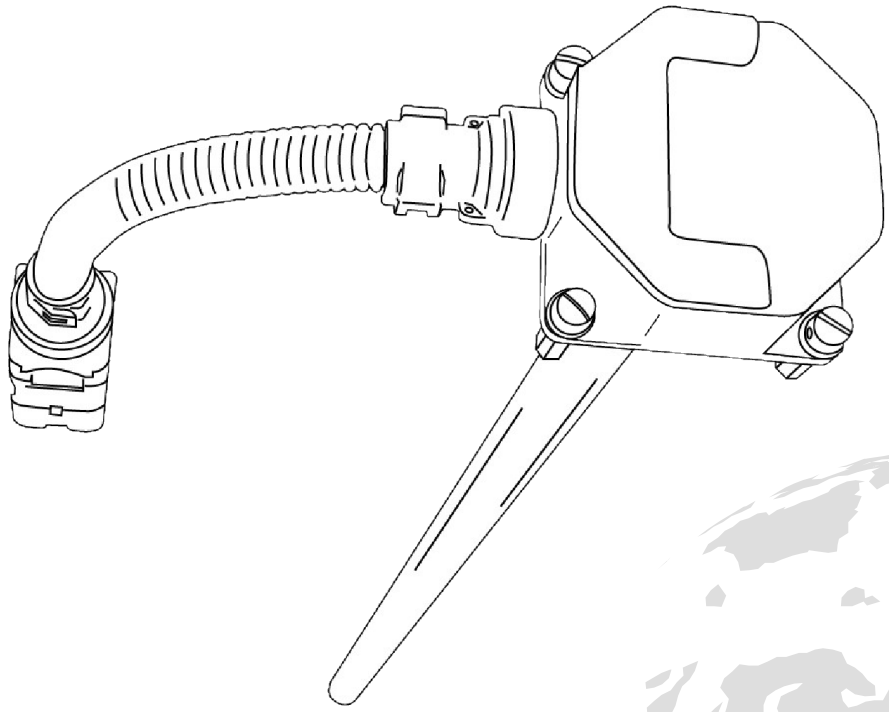
DYSCOVI SYSTEMS RPE LIMITED
Company code 16303375, account №260075014037759
In "UKREXIMBANK" in Kyiv
MFI 380333, tax number 163033726585

95-S Vidradniy avenue, Kyiv, Ukraine, 03061. Phone +38044 507 02 07. Fax +38044 507 02 02. www.bitrek.com.ua, sales@bitrek.com.ua

FUEL GAUGE
BI FLSENSOR

USER MANUAL



Version 2018.04.1

Content

FUEL GAUGE SCOPE, PURPOSE AND OPERATION PRINCIPLE

Purpose

The fuel gauge **BI FLSensor** (hereinafter referred to as the FG, gauge) is designed for continuous fuel level measurement in stationary tanks or tanks of moving objects, and transfer the information to the GPS monitoring system.

Operation principle

BI FLSensor operates on the capacitive principle, based on the property of a capacitor to change its capacity according to the change of the fuel composition and level in the measuring probe of the gauge.

Technical specifications

Parameter	Specifications
Supply voltage	8-36 V
Current consumption	Up to 100 mA
Built-in galvanic isolation	Transformer
Power protection	ISO 7637-2, GOST28751-90
Built-in temperature sensor	+
Measurement error:	
at temperature from -20° to +80°C	±0,7 %
at temperature from -40° to -20°C	±0,9 %
Temperature measuring range	-40.... + 125 °C
Temperature measuring range error	±2 °C
Interface	RS-485
Data transmission rate	19200 Mbit/s
Admissible data transmission rate	1200/2400/4800/9600/38400/57600/115200 Mbit/s
Date filtration type	Kalman filter

Parameter	Specifications
Measured fluids	Diesel fuel, Petrol, Kerosene, Engine Oil
Cable length	7 000 mm / optional
Standard probe length	750 mm / optional
Housing protection class	IP-67
Connection socket ingress protection rating	IP-67
Housing material	PA6(glass fiber polyamide)
Operating temperatures range	-40...+80 °C
Weight sensor equipment	920 g
Diameter of the measure probe neck	35 mm
Size of the head of fuel gauge (with the neck)	61.7x62x32(51) mm

GAUGE CONFIGURATION AND CALIBRATION

Introduction

Software **BI FLSensor Configurator** (hereinafter referred to as the Configurator) is purposed for configuration, calibration and diagnostics of capacitance fuel gauges.

You can receive the configurator in the Technical Support Service of **BITREK™** upon request.

Configurator provides an opportunity to perform the necessary operations for the implementation of fuel gauges **BI FLSensor** in transport GPS-monitoring systems: setting the level of an empty tank, selection of the network address, setting the level of filtering data, fuel level change tracking in real time.

The BI FLSensor Configurator software can be installed on PC or laptops based on the Windows operation system.

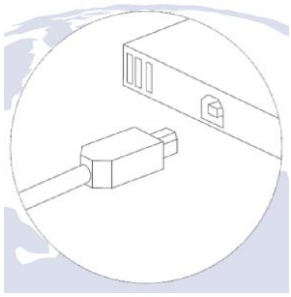
To connect FG to computer you should have ad hoc adapter **BI FLSensor Programmer** to connect it to the USB port.

If you have any question about the installation or operation of the fuel gauges BI FLSensor or the software BI FLSensor Configurator, please contact your equipment supplier or the technical support of **BITREK TM**.

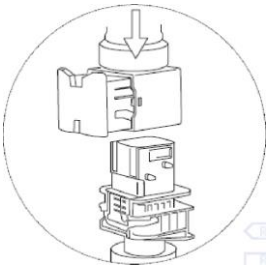
Connection

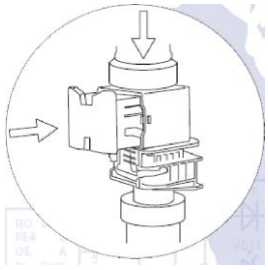
The fuel gauge **BI FLSensor** is connected to the computer by inserting the **BI FLSensor Programmer** unit to any USB port using a USB cable (USB-A -USB-B).

When the drivers are installed, connect the **BI FLSensor** gauge to the configurator (the driver is installed automatically or is available through the link http://www.ftdichip.com/Drivers/VCP.htm or in the software directory).



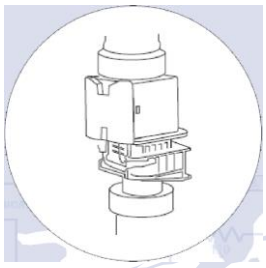
Release the slide by clicking on the socket connector





switched off

Keep the connector pressed and close the slide



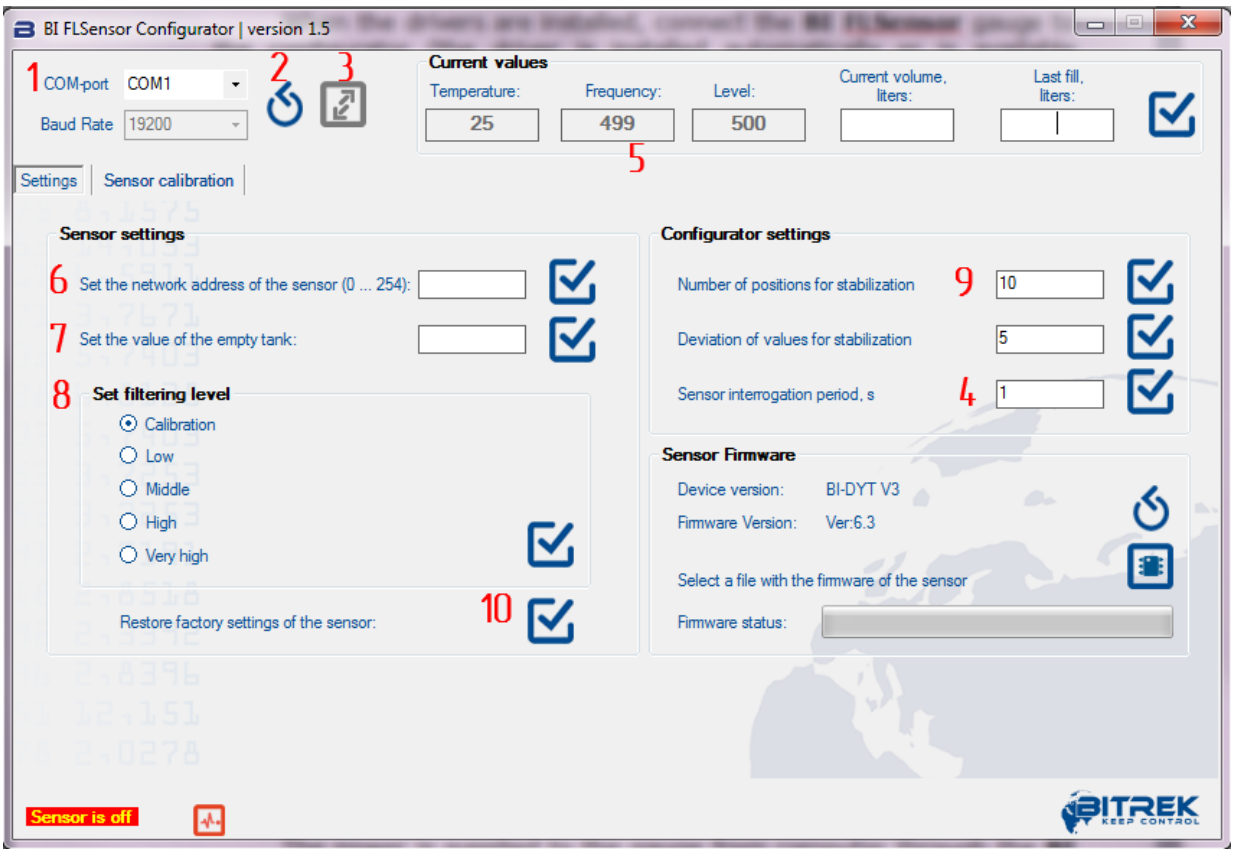
switched on

The power is supplied to the gauge from computer through the **BI FLSensor Programmer** configurator unit; therefore, it is not necessary to connect the gauge to a power source separately.

Configurator description

The **BI FLSensor Configurator** software (hereinafter referred to as the Configurator) is designed for configure the BI FLSensor fuel gauge and gage the fuel tank.

The main window of the Configurator is shown below:

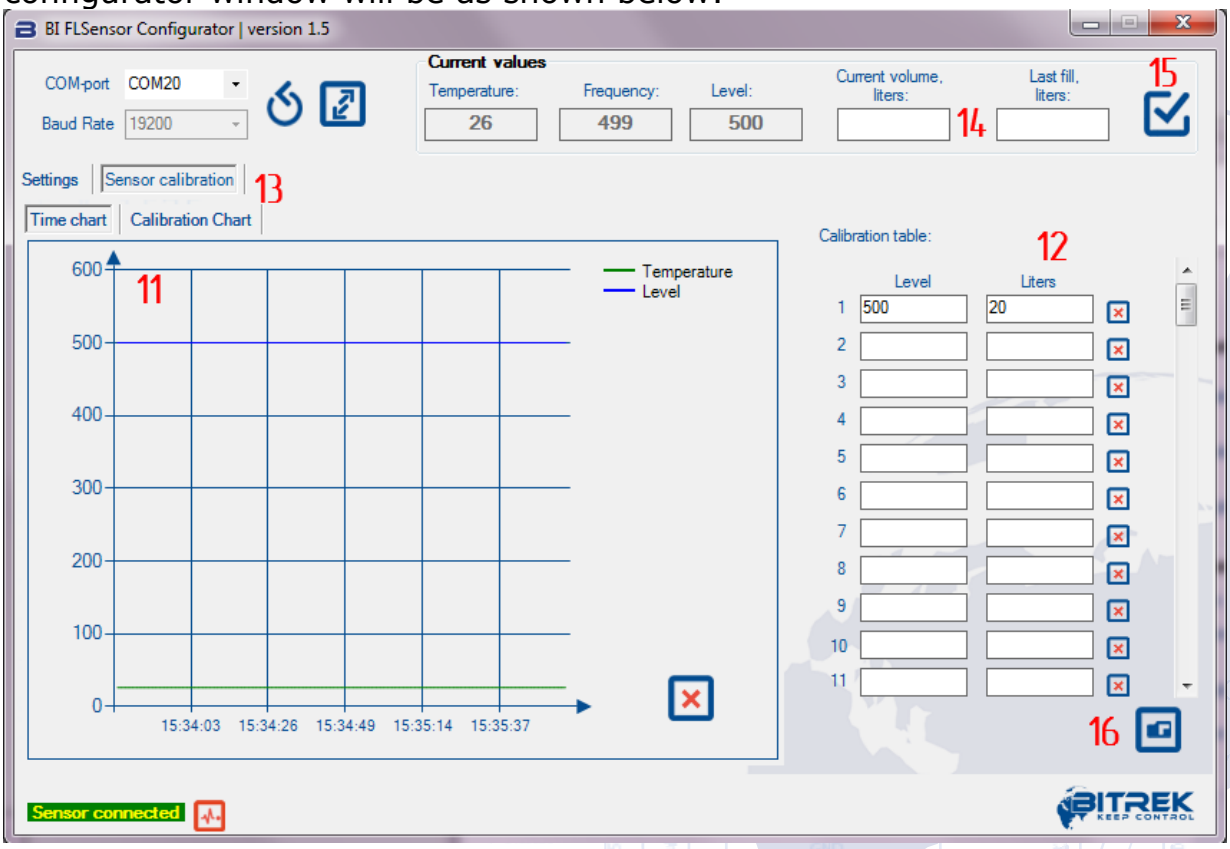


Configurator operation procedure

1	Connect the fuel gauge to a USB port of your computer using a programmer. Run the Configurator. Select the port name from the drop down list in the cell "COM port"
2	If the COM port in absent in the list, use the "update" button
3	Press the button for connecting to the COM port If the configurator is connected successfully to the COM port, the connection button looks like, and "Gauge is connected" text will appear in the status line. When the link is broken, the connection button looks like again, and "Gauge is disconnected" will appear in the status line.
4	If the Configurator is connected successfully to the fuel gauge, it switches to a mode shifts to the gauge periodic polling actions mode. The polling time can be changed using the properly cell in the Settings tab and the button to the right of the cell.

5	During the periodic polling actions, the Configurator receives three parameters from gauge, i.e., temperature, frequency, and fuel level. They are visualized in the respective cells and are not available for editing.
6	First step for setting up the FG. Specify the FG network address in the appropriate cell and apply the changes using the button to the right of the cell.
7	Second step for setting up the FG. Specify the level corresponding to the empty tank.
8	We recommended that you set a low level of data filtering before starting the gaging procedure.
9	Within the process of gaging, the data are constantly changing. Use parameters to stabilize the readings for convenience in processing these data. Specify the number of positions to assess stabilization (default value is 10) and the stabilization deviation (default value is 5). If in the last ten positions the difference between the minimum and maximum values is not more than 5, the readings will be considered stabilized.
10	Use the properly button to restore the factory settings of the gauge.

During the gaging, switch to the Gauge gaging tab. In addition, the configurator window will be as shown below:



11	Changing of fuel gauge readings in real time mode can be conveniently monitored using the time schedule of temperature and level. Remove data of the graph using the button

12	The gaging table can be filled during the process of gaging. The first column contains the fuel level value, and the second column contains the appropriate fuel volume (litres). Using the button  , the data can be manually entered to the table, and the existing entries can be edited or deleted. The data in the table are automatically sorted in level values ascending order.
13	The gaging curve is available to analyse using the graph on the tab "Schedule of gaging table".
14	In addition, the data to the gaging table can be entered directly from the Field of current values. To do this, specify either the volume of fuel in the tank at the current level (cell "Current volume, litres"), or the volume of last filling (cell "Recent filling, litres"). You can use only one way and only one of two cells will be active.
15	Use the button  to enter the data from the Current values field to the gaging table. If the data are not stabilized (see clause 9), the button will be yellow. If the data are stabilized, the button will be green.
16	When the gaging process is ended, the gaging table can be saved to a text file by pressing the button  .
	We also recommend that you set the level of data filtering (see clause 8) according to the vehicle operation mode.
	Press the button  (disconnection from the COM port) to stop properly the operation with a gauge, (see clause 3).

Calibration

You may calibrate only after cutting the measure probe to required length.

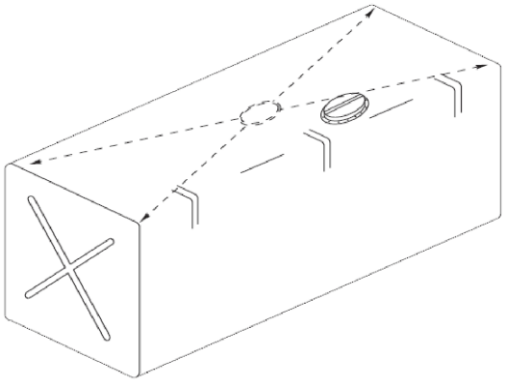
Do not immerse the gauge within the measured liquid prior to calibration. By all means, set 500 in the Set a value of an empty tank field.

INSTALLATION AND GAGING

Preparation for installation

- Switch off the vehicle power supply.
- Before installation, the tanks for flammable substances shall be emptied and cleaned by steaming. If possible, clean to remove accumulated sediment and debris.
- Select a place as close as possible to the geometric centre of the top of the tank (at the intersection of two diagonals). In addition, when

you select the place for gauge mounting, it is necessary to consider the fasteners, frames, and internal baffles of the tank.



If the tank is specially shaped and has two upper levels or overflow holes, we recommend that you install 2 fuel gauges to eliminate the deadzones of measuring.

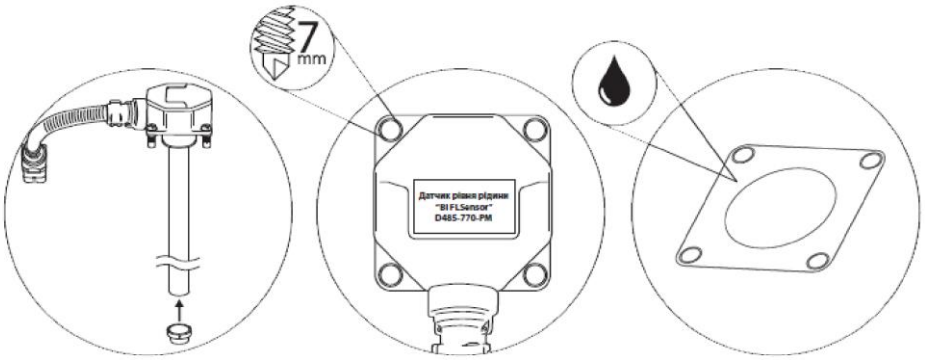
Clipping

To trim the sensor you need to do the following steps:

- Unscrew the clamping screws on the sides of the plastic cap at the bottom of the sensor;
- Remove the plastic cap;
- Measure the height of the tank and cut the probe. We recommend making it shorter by 15-20 mm than the tank height;
- Clean the cut edge from the metallic facings and burrs;
- Fasten the plastic tip on the cut edge of the measuring tube;
- Clamp the fixing screws on the sides of the cap.

Installation

- Make a hole of small diameter in the preliminary prepared tank in the selected place, and use a thin rod to check the presence of obstacles, walls, humps and compression marks on the bottom.
- Extend the hole to the diameter of the probe - 35 mm - using crown milling tool or stepped drills. At the same time, make sure that the facings and debris clog the tank to the minimum degree as possible.
- Place the gauge into the hole and mark 4 points for the fastener.
- Before installing the gauge, lubricate the rubber gasket on with gas-oil resistant sealant in the marked slot and making sure that the sealant does not come within the hole in the bottom of the gauge head.
- If the gauge is fastened with rivets, it is necessary to make 7 mm diameter holes for special threaded rivets. If the gauge is fixed with self-driving screws, they are screwed directly into the tank using a screwdriver or a tipped drill. Detailed description of a fastener is provided in Appendix C.
- Fasteners (self-driving screws or rivets) shall be fixed to the holes on the diagonal sides of the gauge head for the subsequent sealing.



- Extend and securely tight the corrugated cable along the body of the vehicle to the place of installation of the GPS-tracker.

Gaging

Gaging of the fuel tank is required to reveal the conformity of the value received from the gauge with the actual volume of fuel in the fuel tank.

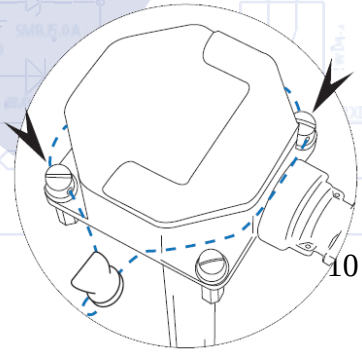
Tank gaging is a unit-dose filling of fuel into the tank from empty to full state. Measurement is carried out with a certain filling step, recording the gauge readings in the gaging table. The tank shape determines dependence on the level of the fuel volume and it is unique for each vehicle.

Gaging process recommendations:

- Before gaging start, the gauge shall be calibrated in accordance with the instructions.
- We recommend that you perform the gaging procedure at a constant temperature (+20 °C).
- The liquid used for gaging shall be the same as within operation of the fuel gauge.
- Place the vehicle or tank (if removable) horizontally and do not change its position during the entire process.
- The procedure can be performed for each vehicle separately.
- Measured liquid shall not contain any impurities, sludge, dirt and debris.
- Gaging shall be carried out in portions of not more than 10% of the total volume of the tank (the lower portion of the filling ensures more accurate indications of the system).
- After each filling of liquid in the tank, wait until level stabilization, then record the gauge readings in the table.
- Avoid impacts on the tank, which can cause vibration, shaking or change of the tank shape.

Sealing

Sealing procedure is performed to protect the device against outside interference during its operation. The standard equipment consist of 600 mm wire for sealing and 2 seals. If you want to seal the gauge head, extend the wire through the



hole on the fastener of corrugated item, then to the holes in the screw heads (located on the diagonal) and through the second hole on the fastener of the corrugated item. Extend both ends of the wire through reach-through holes, turn the seal clockwise against stop. Break off the tail piece used for the sealing.Cut the excess wire with the tool.

To seal the connecting group, extend the wire through the sealing holes of the corrugated holder on both sides of the connection (from the side of the fuel gauge and from the cable connected to the tracker). Then perform seal tightening up on the wire.

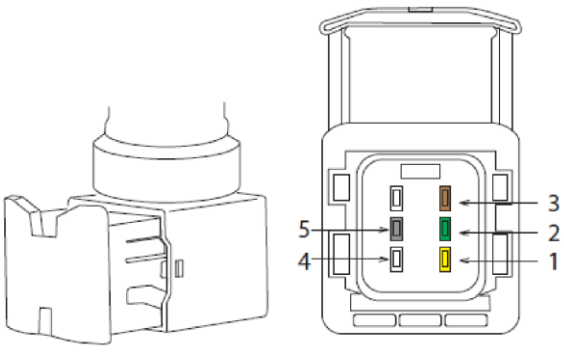
Do not forget to record the serial numbers of the seals specified on the front side.

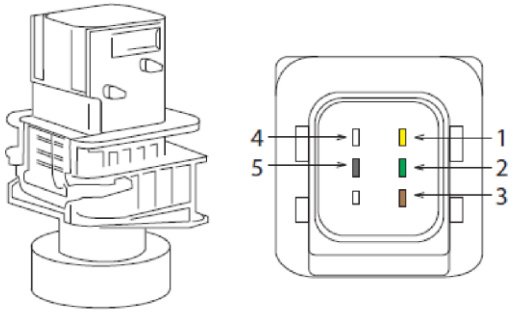
CONNECTION TO TRACKER

The fuel gauge equipment includes a connection cable for the data reading device, one side of the cable contains is a connector (to connect directly to fuel gauge BI FLSensor itself), on the other side it contains the cut end with 5 wires, which is connected to a data reading and processing device. Purpose of conductors is specified in Table 4.1.

Table 4.1. Purpose of conductors

BI FLSensor			**Connected equipment**			
No.	**Wire colour**	**Purpose**	**BI910/BI920**		**BI810/BI820**	
1	Yellow	A	Green/Red	B7	Orange	A
2	Green	B	Green/Black	C7	Green	B
3	Brown	Signal	Black	C1/C8	Black	GND
4	White	+VCC	Yellow	B8	Yellow	+Vout
5	Grey	Power GND	Black	C1/C8	Black	GND
6	Not applied	-	-	-	-	-





Different issues can be solved depending on organization of the fuel gauge connection to the in vehicle network and GPS-tracker.

The diagrams below contain the circuit examples:

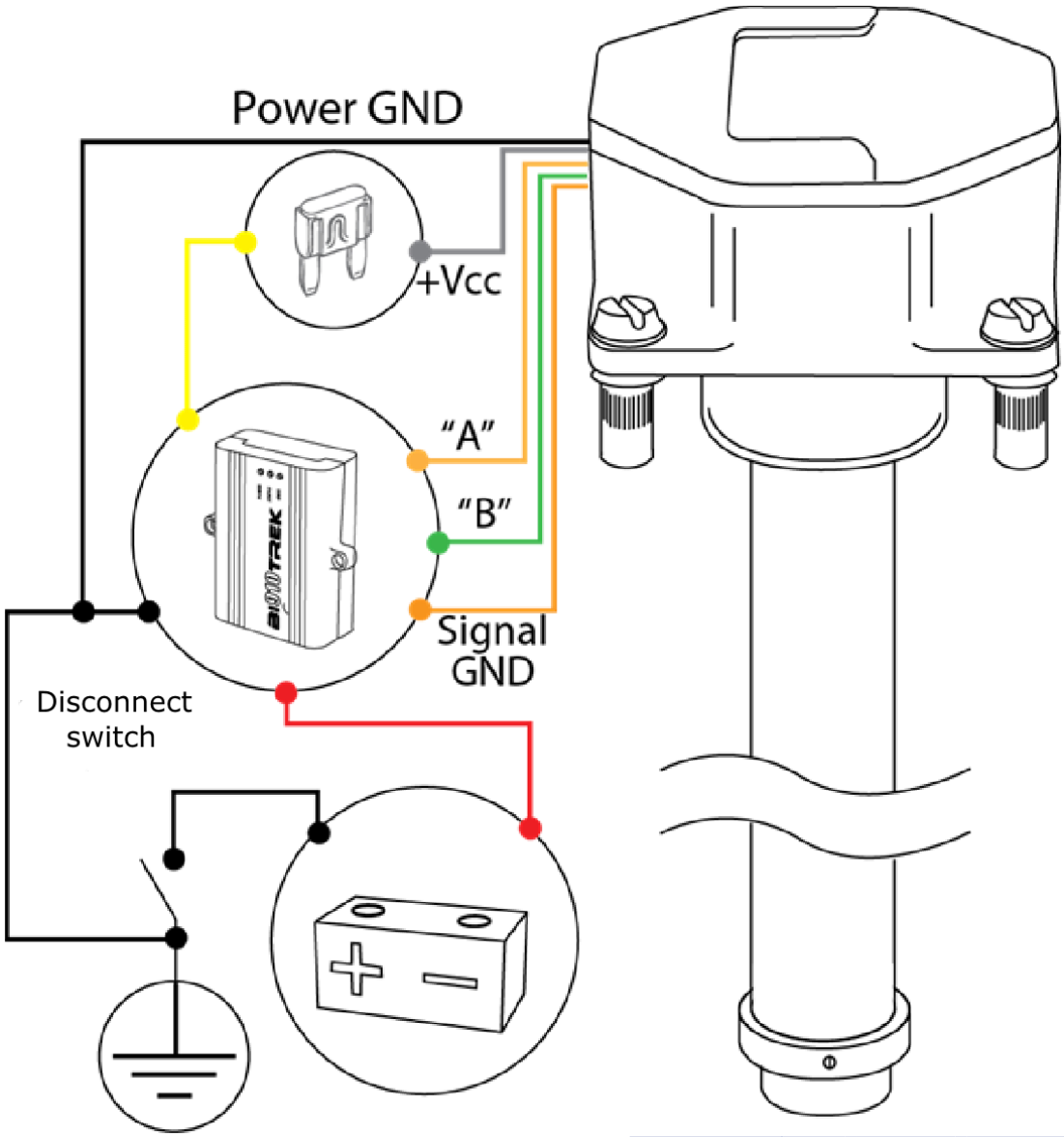
(1) before the battery disconnect switch

(2) after the battery disconnect switch

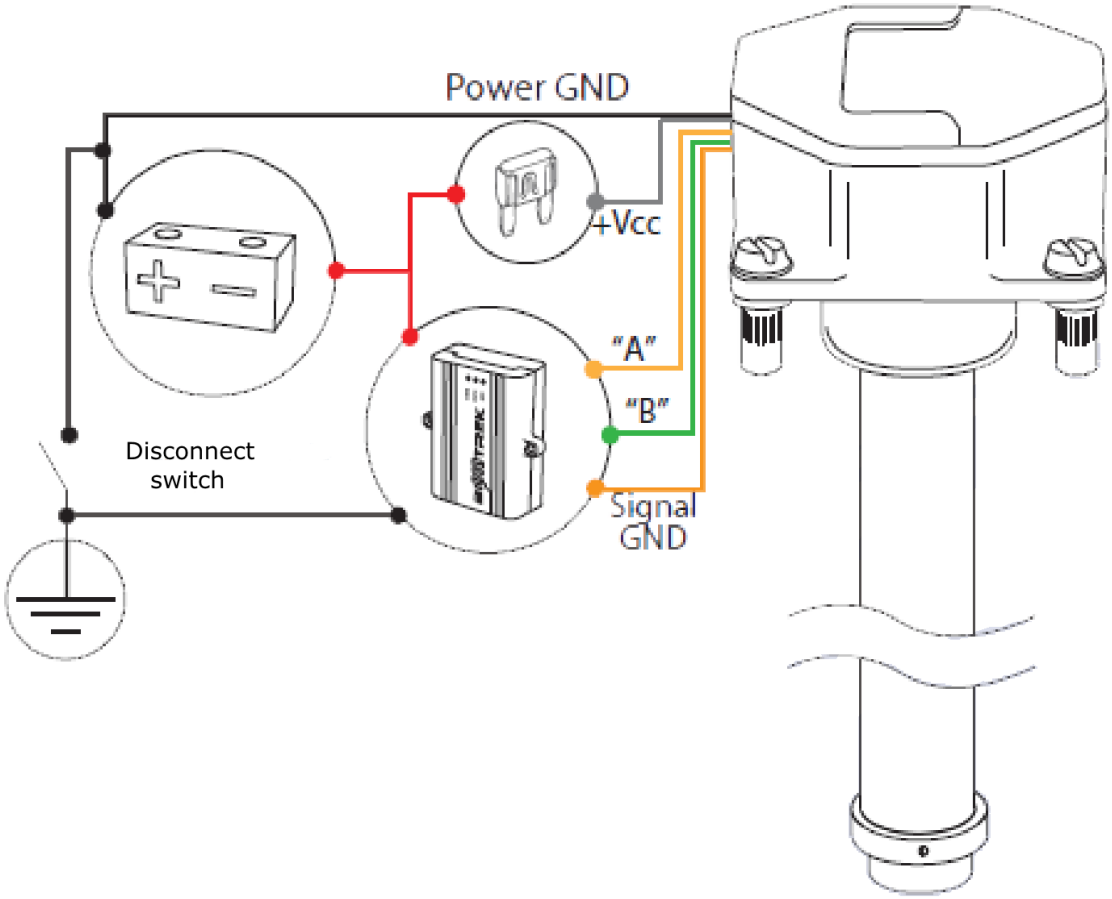
Each of the above switching circuits has its own application.

The scheme (1) is applied for continuous monitoring of the vehicle. The limitation of this scheme is a constant discharge of the car battery. If the car battery is used for a long time without recharging, it can be completely discharged

The scheme (1) is applied for monitoring of the vehicle and fuel consumption only at battery disconnect switch on. When the battery disconnect switch is off, the tracker and the fuel gauge will be disconnected from the power supply.



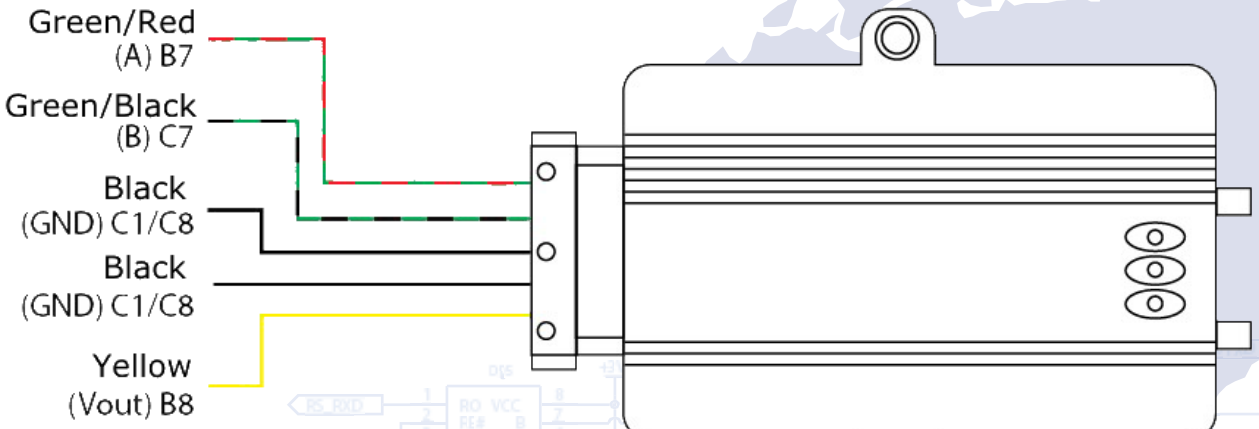
Scheme (1).

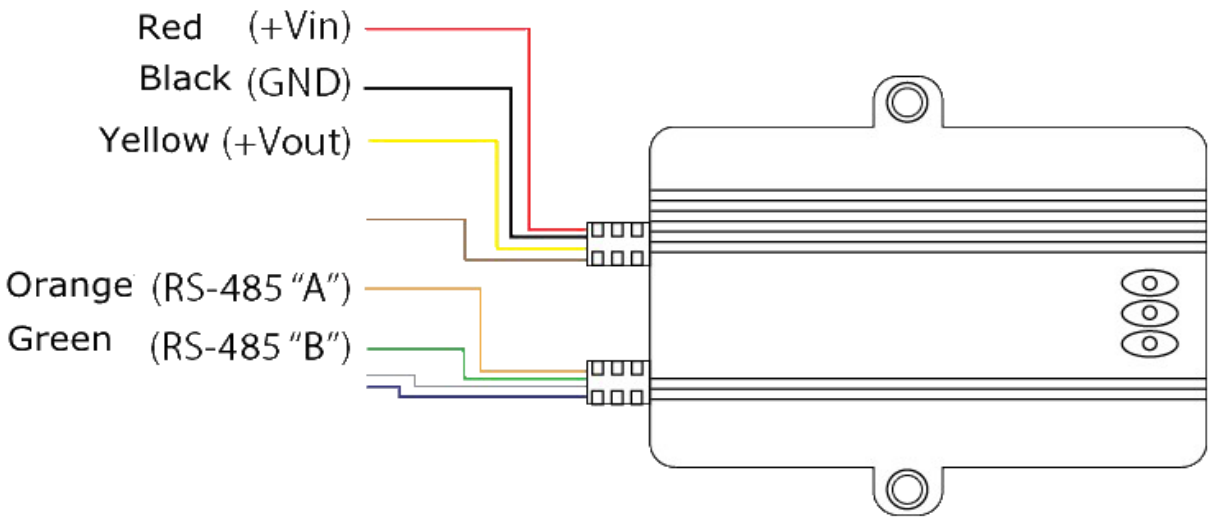


Scheme (2).

Contact arrangement on the tracker:

BI 910 TREK / BI 920 TREK





ADDITIONAL INFORMATION

Transportation and storage

Climatic conditions of gauges transportation:

- ambient temperature -50... + 40 °C
- relative humidity 98% at temperature of +25 °C

The air area should not contain acids, alkali and other aggressive impurities.

Storage

The gauges shall be stored in the manufacturer's packaging, in closed spaces with natural ventilation, without artificially controlled climatic conditions, without heating. Storing of gauges without packaging is not allowed. It is forbidden to store the gauges in the same premise with substances causing metal corrosion and substances with aggressive impurities.

Operating conditions

The gauge shall be used for units with a successful fuel supply system.

The marking for mounting of the gauge assembly shall conform to mounting holes.

The gauge shall be protected from corrosive environment, electromagnetic field, as well as mechanical and environmental stresses that exceed the parameters indicated in the specification to prevent from failure.

Do not connect the gauge to the devices with interface that does not meet the characteristics specified in the passport.

Unpack the gauge only after keeping it under normal conditions for at least 2 hours.

It is necessary to perform an external inspection of the gauge prior to commissioning. If there are detected any mechanical damages (cracks, shears, dishes), further installation is not allowed.

Only the personnel familiar with the device, operation principle and instructions specified in the technical specification of the gauge may perform the installation of the gauge.

Manufacturer warranty

The manufacturer guarantees the serviceability of the gauge under keeping of service rules such as conditions of storage, transportation and operation, as well as Instructions for use.

Warranty period of gauge use is **12 months** from the manufacture date.

Warranty does not cover a gauge with defects (cracks, shears, dishes, shock marks, contamination of the measurement chamber or tank) occurring due to the fault of the user, when there is a violation of use, storage and transportation conditions.

Appendix A

BITREK TRACKER™ CONFIGURATION

Proper operation of devices requires proper configuration of the necessary parameters. There are some examples of fuel gauge configuration (see tables below).

Note: The fuel gauge contains an internal intelligent filter based on Kalman filter.

You can set the following parameters for fuel gauges in the trackers manufactured by BITREK:

1. Filtered data of fuel level:

Table. Filtered data of fuel gauge					
1 network address	**2 network address**	**5 network address**	**6 network address**	**Parameter Value**	**Parameter Description**
ID 100	ID 101	ID 129	ID 130		ID at transmission
setparam 0580	setparam 0590	setparam 0850	setparam 0860	1	Parameter activation
setparam 0581	setparam 0591	setparam 0851	setparam 0861	0	Priority
setparam 0582	setparam 0592	setparam 0852	setparam 0862	0	Upper limit off
setparam 0583	setparam 0593	setparam 0853	setparam 0863	0	Lower limit off
setparam 0584	setparam 0594	setparam 0854	setparam 0864	3	Monitoring Mode
setparam 0585	setparam 0595	setparam 0855	setparam 0865	5	Constant of averaging

Gauges use 2 filters (optional):
Butterworth filter (setparam 0209 0;)
Kalman filter (setparam 0209 1;)

Factor F	950	Coefficient F for Kalman filter
Factor Q	951	Coefficient Q for Kalman filter
Factor H	952	Coefficient H for Kalman filter
Factor Rs STOP MOTION	953	Coefficient R for Kalman filter at motion absence
Factor Rm IN MOTION	954	Coefficient R for Kalman filter at motion
Switch filters	209	Setting of the filters switching; for filtered fuel gauges. (0-Butterworth filter) (1-Kalman filter)

The 1-byte parameter type filter with ID = 0209 was entered to select the used filter type; default value

When setparam value is setparam 0209 0, the Butterworth filter is used,

For properly operation of the filter, it is desirable to set the following data:

Kalman filter is used at the value of parameter.

setparam 0209 1;

Example of standard setting via SMS:
setparam 0950 1000000;
setparam 0951 2000000;
setparam 0952 1000000;
setparam 0953 20000000;
setparam 0954 400000000;

Value of the last valid level of fuel
setparam 0819 1;

Timeout of movement start according to the accelerometer
setparam 0284 50;

Timeout of movement stop according to the accelerometer
setparam 0285 200;

2. Transfer to the database server without fuel level filtering:

Table. Unfiltered data of fuel gauge					
1 network address	**2 network address**	**5 network address**	**6 network address**	**Parameter Value**	**Parameter Description**
ID 112	ID 113	ID 131	ID 132		ID at transfer
setparam 0690	setparam 0700	setparam 0870	setparam 0880	1	To activate the parameter
setparam 0691	setparam 0701	setparam 0871	setparam 0881	0	Priority
setparam 0692	setparam 0702	setparam 0872	setparam 0882	0	Upper limit off
setparam 0693	setparam 0703	setparam 0873	setparam 0883	0	Lower limit off
setparam 0694	setparam 0704	setparam 0874	setparam 0884	3	Monitoring mode
setparam 0695	setparam 0705	setparam 0875	setparam 0885	5	Constant of averaging

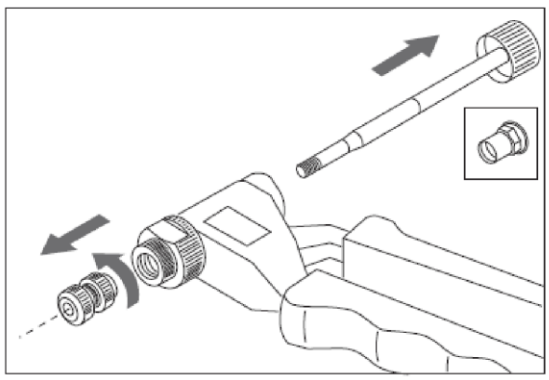
3. Readings from the temperature sensor located in the fuel level gauge:

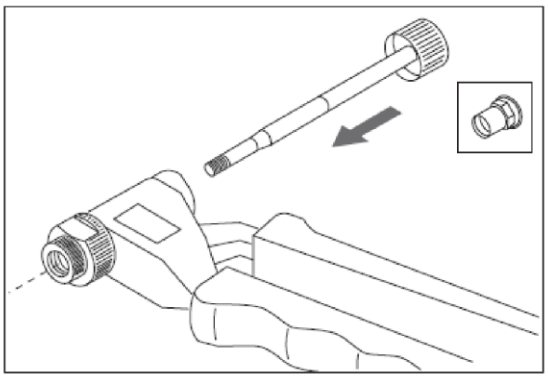
Table. Temperature measured by the fuel gauge					
1 network address	**2 network address**	**5 network address**	**6 network address**	**Parameter Value**	**Parameter Description**
ID 102	ID 103	ID 127	ID 128		ID at transmission
setparam 0600	setparam 0610	setparam 0520	setparam 0530	1	Parameter activation
setparam 0601	setparam 0611	setparam 0521	setparam 0531	0	Priority
setparam 0602	setparam 0612	setparam 0522	setparam 0532	0	Upper threshold off
setparam 0603	setparam 0613	setparam 0523	setparam 0533	0	Lower threshold off
setparam 0604	setparam 0614	setparam 0524	setparam 0534	3	Mode of monitoring
setparam 0605	setparam 0615	setparam 0525	setparam 0535	5	Constant of averaging

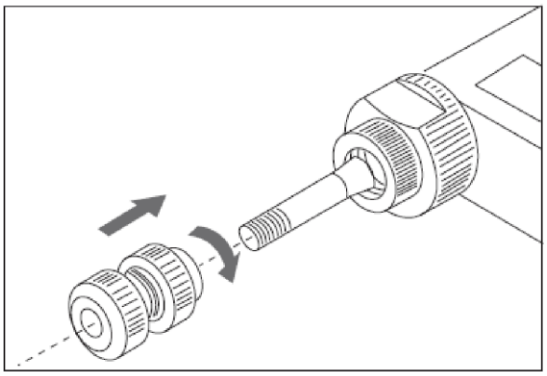
Appendix B

Mounting of female-threaded rivets

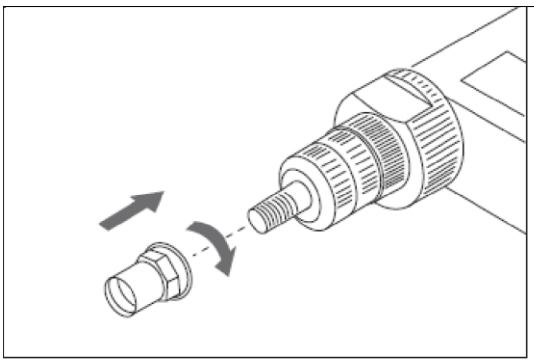
Select the mandrel (core) and insert the pin with locknut for the required rivet diameter - M5.

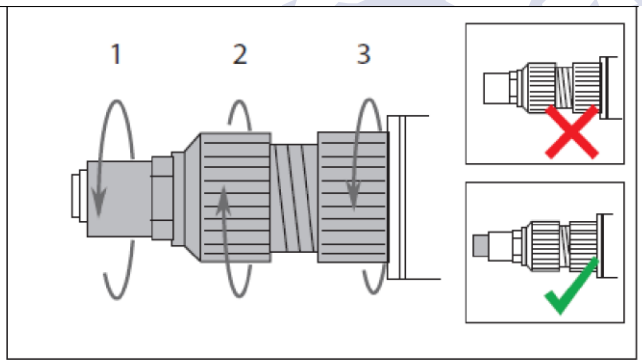




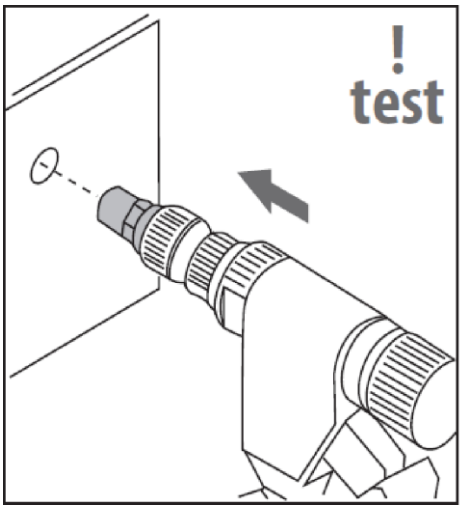


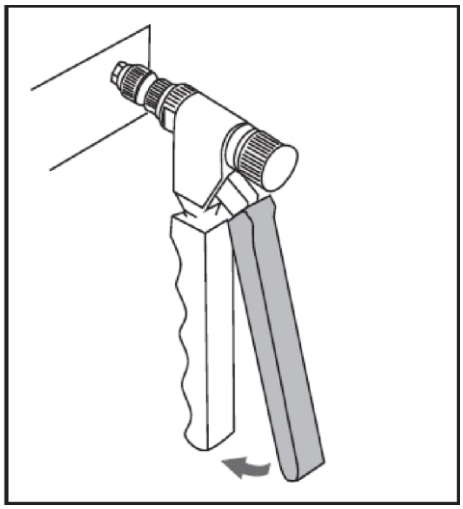
Fix the rivet on the threaded part of the core (the core must extend on the other side). Fix the rivet with the pin and lock the locknut on the front sleeve.



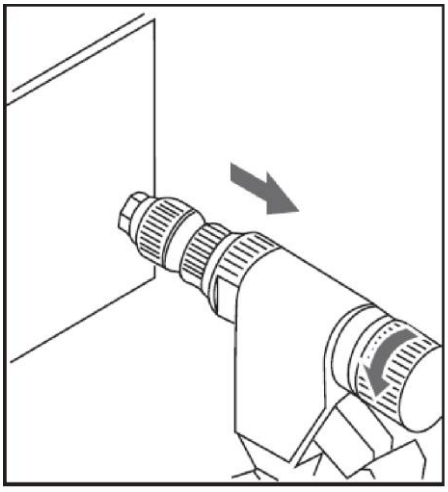


Install the wound rivet into the hole, perpendicular to the surface, and press the handle of the riveter against stop.

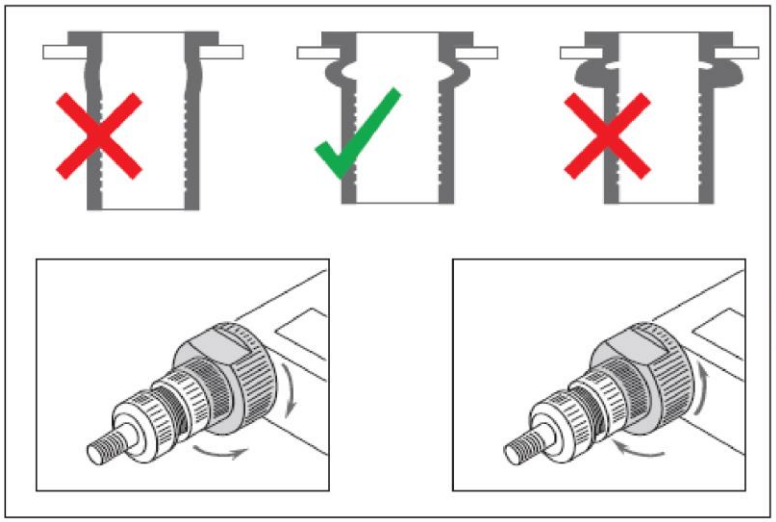




Remove the core of the riveter from the mounted rivet.



If the rivet is mounted incorrectly, is loose or it is difficult to screw the fixing screw, drill out the rivet tool and adjust the lock nut of the tool and the front sleeve according to the scheme provided below.

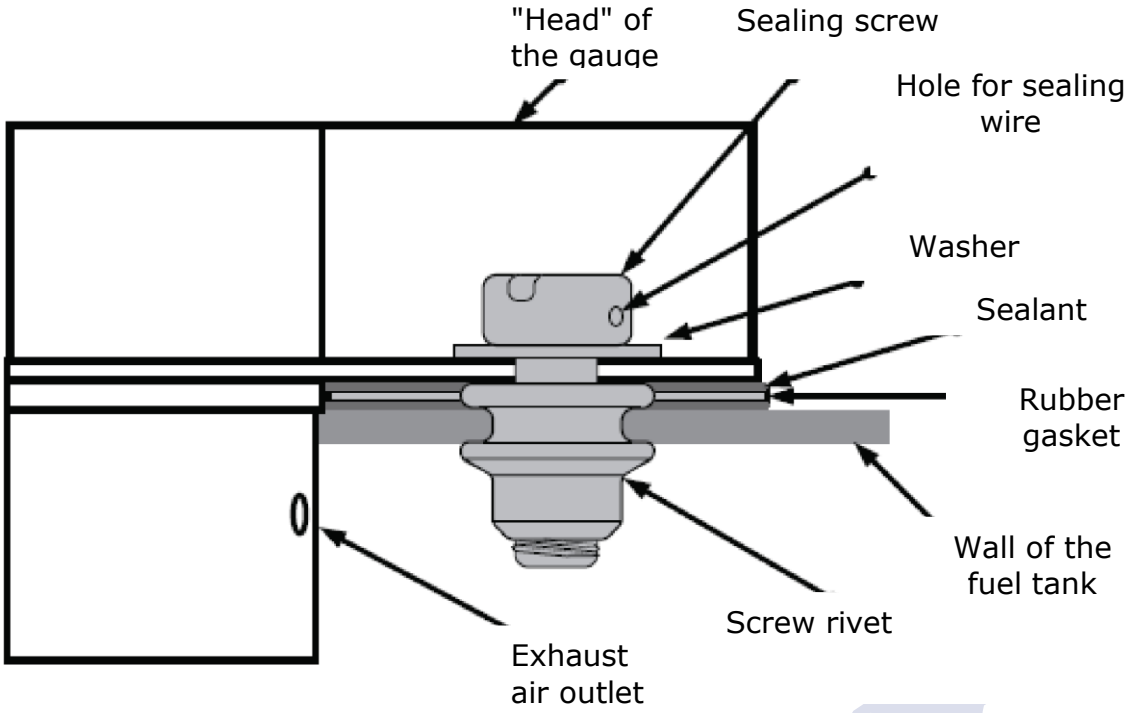


Appendix C

How to fix the fuel gauge to the tank

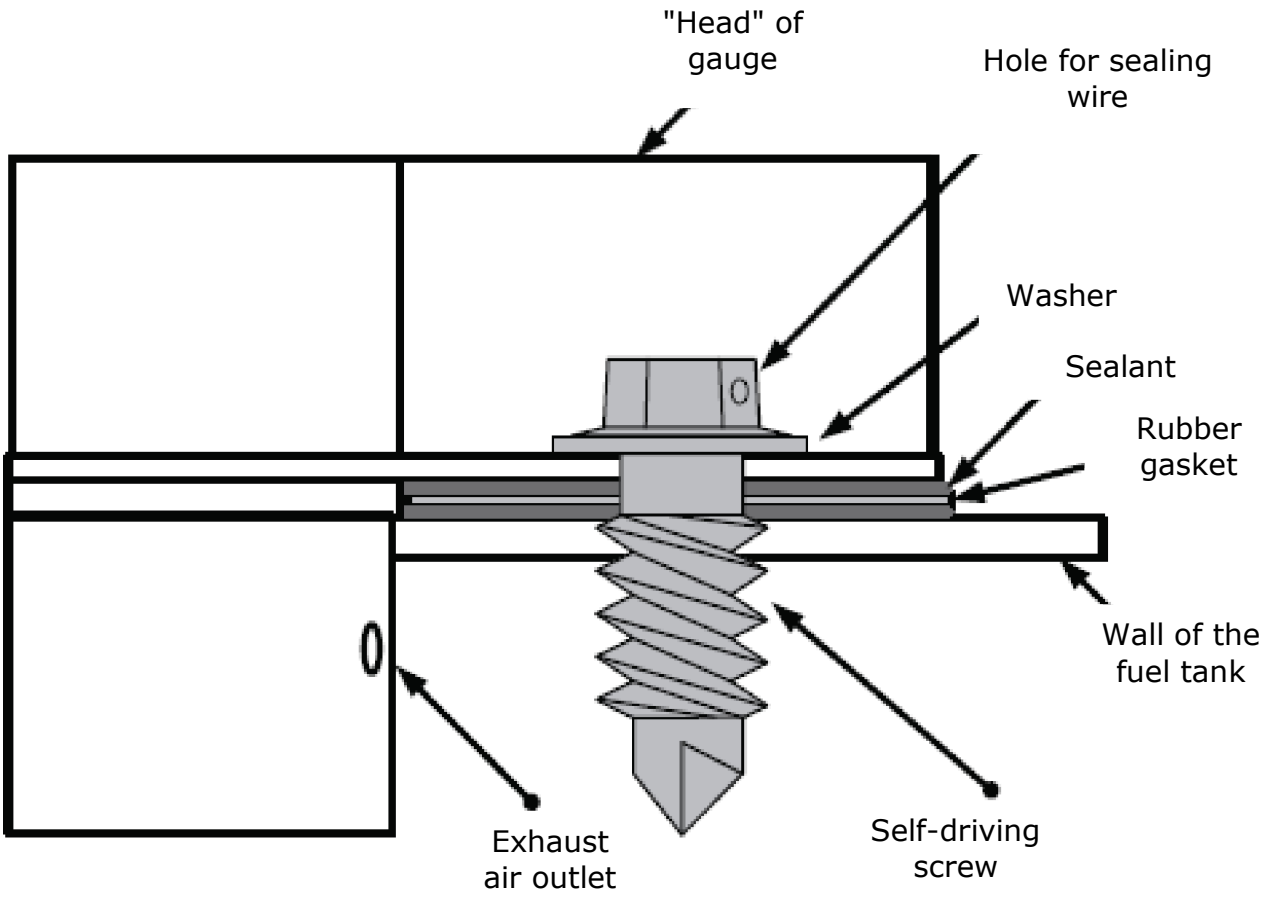
The fuel gauge is fixed to the tank using screw rivets and self-driving screws; each fixing method is designed for a specific type of fuel tanks.

We recommend that you use screw rivets for plastic fuel tanks with a wall thickness up to 3 mm; they fix securely the gauge on the tank.



Fixing with female-threaded rivet

We recommend that you use special self-driving screws for tanks with a wall thickness of more than 3 mm.



Fixing with self-driving screw

Apply the gas-oil resistant sealant on both sides of the rubber gasket to seal the gauge better. Make sure that the sealant does not come on the hole of the measure probe; otherwise the gauge operation may be fault.