The Precision of Ultrasonics

# Ultrasonic Tank Test System
# SDT 170 MTT

## User's Manual

Lors de son utilisation, l'appareil SDT 170M TT doit être exclusivement alimenté par sa batterie. L'usage du chargeur est alors strictement interdit.

Bij het gebruik van de SDT 170 MTT dient het toestel uitsluitend met de batterij gevoed te worden. Het gebruik van de lader is dan strikt verboden

During its use, the SDT 170M TT device must be exclusively supplied with its battery. The use of the charger is then strictly prohibited.

***IT, ES*** ⟶

In occasione del suo utilizzo, l'apparecchio SDT 170 MTT deve essere esclusivamente alimentato dalla sua batteria. L'utilizzo del caricabatterie è allora strettamente vietato.

En su utilización, el aparato SDT 170 MTT debe ser abastecido exclusivamente por su batería. La utilización del cargador está entonces estrictamente prohibida.

*FR, NL, EN* →

# Ultrasonic system *SDT 170 MTT* for tightness controlling of underground fuel tanks and their associated pipe work

***Version with acquisition of reference values***

## *User's manual*

The information herein is believed to be accurate to the best of our knowledge.

Due to continued research and development, specifications of this product can change without prior notice.

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# Content

## 2nd part – Installing the application



## 3rd part – Carrying out the test

## 4th part - Appendix

*The undisputed leader in its field, SDT International designs and manufactures a wide range of measuring instruments for ultrasonic detection and the evaluation of various other physical parameters.*

*The company's expertise covers a wide range of applications: tightness tests on large and small volume and underground tanks, leaks detection on any pressurized circuit, production quality control, wear and tear anomalies detection in the predictive maintenance of mechanical installations.*

*Our company's success is based on our philosophy and our desire to always respond to our customers' problems by the most efficient and cost saving answers.*

# 1. The ultrasonic system *SDT TankTEST*

The *SDT TankTEST* method is the quickest, the most effective and the cheapest way to control the tightness of underground fuel tanks and their associated piping.

**The *SDT 170 MTT* system**

Two control procedures have been applied to the version named *SDT 170 MTT*.

- **A control procedure in free mode,** without recording data.
- **A procedure for control confirmations or data recording mode,** to be used as an option **after** the first procedure.

  In this case, recorded data are, on the one hand, data entered into the device by the operator and, on the other hand, data automatically recorded by the device, as follows:

  *A. Data entered into the device by the operator*

  - The identity of the tank (up to 12 alphanumeric characters);
  - The depression level applied to the tank;
  - The duration of measurement-taking. One measurement per second will be recorded during the selected duration, with an equal and automatic distribution of the total control duration on each of the two sensors.

  *B. Data automatically recorded by the device*

  - Full date and time stamping of the control;
  - The serial numbers on the interface box and detector;
  - The number of measurements made at the ratio of one measurement per second over the total duration of the test, with identification of the sensor for each measurement.

  All these data can then be transferred to a PC, with a view to producing a control and archiving report. They represent evidence of the test and the measurements taken. The control is automatically date and time stamped.

The *SDT 170 MTT* detector also enables, via a suitable cable, recording of sounds on audio *minidisc* for archiving on PC.

# 2. Technical advantages of the tightness control by ultrasounds

The technology developed by *SDT International* (depression method) has numerous advantages:

**Ecological**

- In the event of a leak, no fuel is spilled in the ground during the test. The pollution is not worsened by the liquid (heating oil or water) under pressure being spilled in the ground (pressurizing method).
- No use of filling water having to be cleaned after the test.

**Fast**

- The ultrasound technique does not require draining/filling of the tank and waiting time, so there is no down time (hydraulic method).
- It allows you to check the tank and its filler and bleeding pipes in a single operation and without dismantling the panel of the manhole.
- The test lasts for around 60 minutes.

**Precise**

- The *SDT TankTEST* technique detects even the smallest of perforations or "mini faults" not yet causing a leak.
- It allows you to locate the tightness problem, either on the tank itself, or around the manhole cover, or on the pipes or on their connections.

**Reliable**

- The test can be carried out whatever the height of the liquid (max. 2 meters) except if the tank is 100 % full.
- The *SDT TankTEST* is not influenced by temperature, humidity or the angle of the tank. It is just as effective in dry environments as in wet.

**Economical**

- In addition to the time gains linked to the set-up, the *SDT TankTEST* offers the benefits of robust equipment for work "in the field" and is able to perform thousands of checks.

**Portable**

- The pump and the 2 boxes are easy to transport. The *SDT 170 MTT* measuring appliance only weighs 0.7 kg.
- The Ni-Cd power pack provides total freedom of movement (8 to 10 hours autonomy).

**Easy to use**

- The equipment is ergonomic and the check can easily be carried out by anyone who has received technical or practical training from the manufacturer or the latter's representative.
- In data recording mode procedure confirming controls, the user is helped by having each phase of the test displayed. Moreover, all measurements taken are saved in the internal memory and can be uploaded to a PC for reference, reporting or archiving purposes. Use of this function is optional for each user.

**The *SDT TankTEST* system is much more sensitive to detection than any other methods of test under pressure. It detects all tightness problems in an audible (listening to signal picked up by the headphone) and measurable (digital display in dB*µV*) way.**

# 3. The user’s manual

This *User’s manual* must be red carefully and completely prior to anyone using the equipment.

The *User’s manual* is designed as an educational guide and reference tool for anyone who wishes to use the *SDT 170 MTT* equipment in the framework of controlling tightness of underground tanks.

*SDT* produces this manual with the sole purpose of supplying simple and accurate information to the user. *SDT* shall not be held responsible for any miss-interpretation of this manual. Despite our efforts to provide an accurate manual, it may contain technical errors beyond our control. If in doubt, contact your local *SDT* distributor for clarification.

While every effort was made to present a true and accurate text, modifications and/or improvements to the product described herein can be made at any time without corresponding changes being made to the manual.

This *User’s manual* and its contents remain the inalienable property of *SDT*.

*1st part*

# The equipment

# 4. Definitions

## 4.1 SOUND AND ULTRASOUND

Sound is generally produced by a vibrating body. The surrounding air participates in its movement creating waves around it, which transmit the sound energy. The frequency, measured in cycles per second or hertz, is the number of sound wave vibrations in a second. The lower the number of vibrations, the lower the frequency.

Ultrasound is a vibration with the same nature as sound, but of a frequency higher than 20 kHz, inaudible to the human ear whose hearing range is between 15 Hz and 20 kHz.

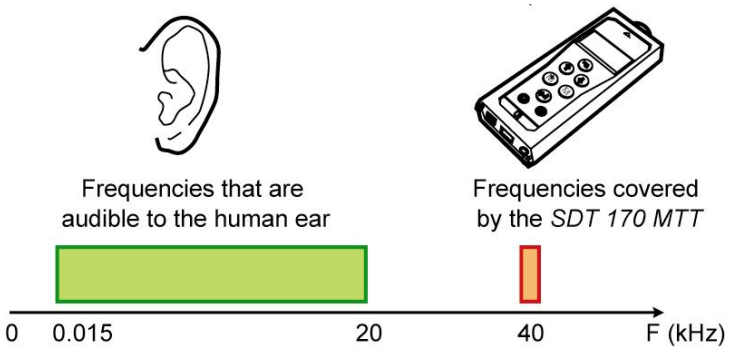



*Figure 1 : The ultrasound frequency range is higher than frequencies that are audible to the human being.* 503

In terms of the diffuse transmission of sound, the ultrasound is propagated more directionally, like a beam of light whose intensity decreases based on the distance. In fact, the higher the frequency, the more the acoustic transmission is absorbed into the air. The extent to which the high frequency transmission is absorbed gives the directionality to the ultrasonic transmission.

Ultrasound is naturally generated by the following phenomena:

- Fluid turbulence: caused by pneumatic or hydraulic problems (leaks)
- Friction: the cause of mechanical problems.

## 4.2 CONTROL PRINCIPLE

**Listening is understanding**

Using sensitive sensors, the *SDT 170 MTT* detector picks up specially defined frequencies to detect any tightness problems in the underground tanks, both above the level and in the liquid itself.

It converts them into audible frequencies making an unknown part of his environment perceptible to the human being.

A digital indicator displays (in dBµV) the peak value of the ultrasonic signal detected.

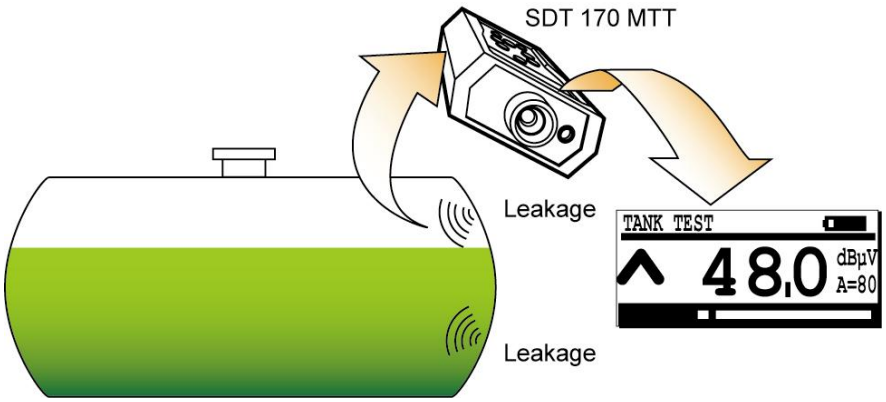



*Figure 2 : Any defects in terms of tightness will produce a signal that is detectable by the SDT 170 MTT.* 504

# 5. Delivered equipment

## 5.1 DESCRIPTION OF THE DELIVERED EQUIPMENT

Refer to picture on page 21.

### (1) Measuring instrument type *SDT 170 MTT*

The *SDT 170 MTT* detector treats and measures the ultrasonic signals coming from the sensors. The appliance converts these signals to audible frequencies via a headphone. The operator can avail of a double diagnosis: the digital display of the measures and the acoustic detection of leaks.

The *SDT 170 MTT* is equipped with the following accessories:

- One flexible rod with open sensor (not watertight) allowing to check the tightness of the connections, of the manhole, etc.
- One headphone, noise isolated.
- One power pack in the appliance, with an overall autonomy of 8 to 10 hours operation.
- One charger.
- One precision connection + 3 small ad hoc accessories.
- One RS 232 C cable.
- One software for data transfer from SDT 170 MTT to PC delivered on a CD Rom.

### (2) Two ultrasonic sensors

They must be installed inside the tank. These 32 mm Ø sensors are watertight, ex-proof and resistant to hydrocarbons. They are certified in accordance with Directive 94/9/EC (ATEX) by ISSEP (0492) with **EX** II 1G degree of protection.

### (3) Interface (Switchbox)

This provides a link between the two sensors 2 and the *SDT 170 MTT*. This intrinsic safety interface is equipped with intrinsic safety barrier, an earth connection and a fixed interconnection cable to the *SDT 170 MTT*. This box is certified in accordance with Directive 94/9/EC (ATEX) by ISSEP (0492) with **EX** II (1)G degree of protection.

### (4) Mechanical bush

To be fitted to the manhole panel with a 2 inch male or female threaded connection.

### (5) Camlock

Connection between the vacuum pump and the mechanical bush allowing the depth adjustment of the sensors..

### (6) Suction hose

Connection in plastic, between the vacuum pump and the camlock. Length: 5 meters.

### (7) Drain hose

Connection in plastic, to the pump outlet with anti-flame return. Length: 5 meters.

### (8) Tube of water-finding paste

Reacting to the water by colour change.

### (9) Non-ex-proof vacuum pump

- Max. flow 67 $m^3$ / h
- Negative pressure ± 300 mBar relative
- Single-phase motor 0.75 kW
- Safety valve calibrated to ± 250 mBar
- Pressure and depression manometers.

## 5.2 AVAILABLE OPTIONS

- A small box of conical rubber sealing plugs of various diameters.
- A wheeled support for the pump.
- 3 screwable one meter long cylindrical gauges, with sliding reference piece.
- Two ultrasonic sensors complete with cables protected by a VITON sheath for frequent use in petrol and for use in aggressive liquids (solvents, etc.).
- Cable for recording sounds on an auxiliary device and ‘Y’ connector.

## 5.3 OPTIONS FOR HAZARDOUS ENVIRONMENTS

**For tanks containing flammable and/or explosive liquids, the pump and the hoses are replaced by the following flameproof (EX-PROOF) equipments:**

(1) A bush ENIVAC ex-proof vacuum pump ATEX approved.
- Max. flow.16 $m^3$ / h
- Negative pressure: safety valve calibrated to ± 250 mBar
- 0.45 kW single-phase EEexd motor
- Depression manometer.

(2) Flameproof suction and exhaust hoses (5 m) made of conductive rubber.

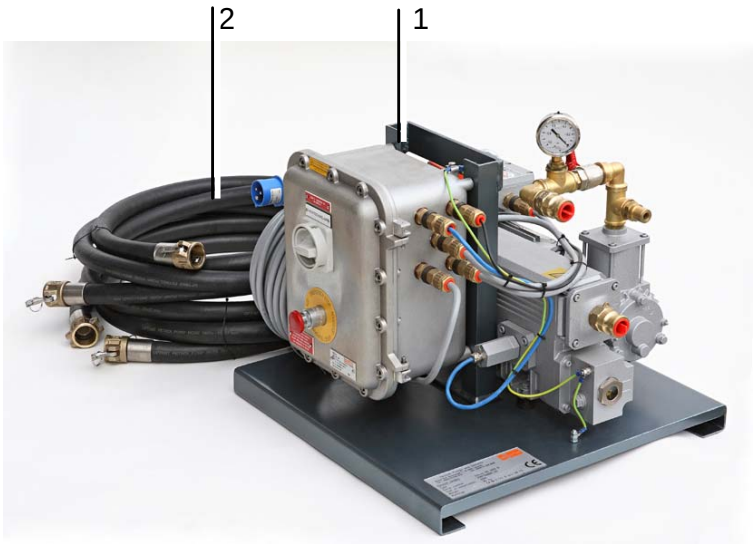



*Figure 3 : Optional flameproof equipment: (1) ex-proof vacuum pump, (2) suction and exhaust hoses.*

## 5.4 TABLE OF THE EQUIPMENT COMPOSITION

The full equipment is made up of the following elements, most of which are brought together in 2 transport boxes.

| Designation | Rep |
|---|---|
| *SDT 170 MTT* detector, with one battery block inside the detector, rubber protection and user's manual, including: | 1a |
| - Headphone, noise isolated. | 1b |
| - Flexible rod with open sensor | 1c |
| - Battery charger | |
| - Precision connection + 3 small ad hoc accessories | |
| - Software *Graphs & measurements* (1) | |
| - RS232 cable | |
| Two ultrasonic sensors | 2a/b |
| Interface box (*Switchbox*) | 3 |
| Mechanical bush | 4 |
| Camlock | 5 |
| Suction hose | 6 |
| Drain hose | 7 |
| Tube of water-finding paste | 8 |
| Non-ex-proof vacuum pump | 9 |

*(*) Data transfer from the unit to the PC. Delivered on a CD-ROM.*


*Figure 4 : The delivered equipment.*

589

# 6. Detection principle

**Reminder: for checking tanks containing flammable and/or explosive liquids, both the vacuum pump and the suction and exhausts hoses must be of the type EXPROOF (flameproof).**

## 6.1 INTERCONNECTION OF ELEMENTS

The diagram on page 25 shows all necessary equipment for ultrasonic tightness controls.

## 6.2 PRINCIPLE

Checking tightness using ultrasound involves collecting and amplifying the ultrasound vibrations generated by the passage of water, air or matter through a hole in the wall of the tank. This is after the tank has been set under negative pressure and using two sensitive sensors, one in the liquid and the other above the level of the liquid.

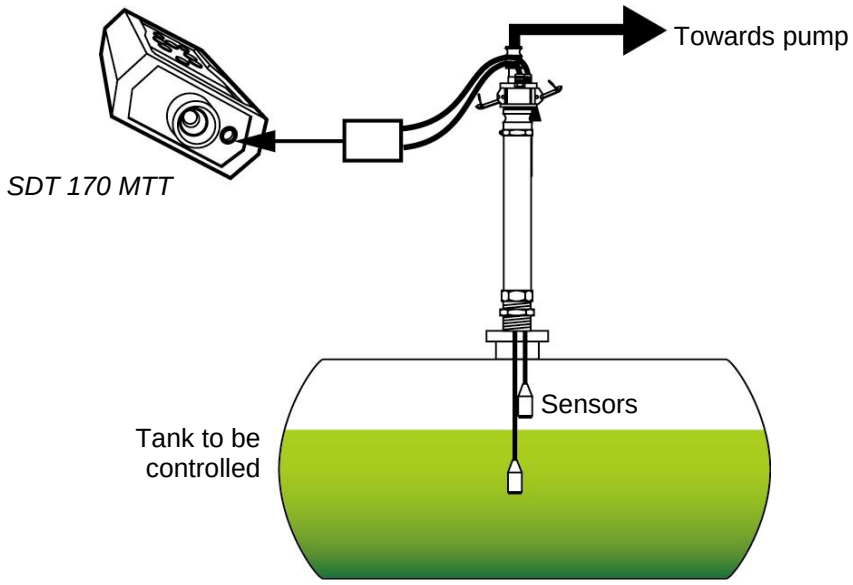



*Figure 5 : Principle of ultrasonic tightness controls.* 505

**The operator must consider the comparison between the measurements got during the test and the reference values measured before the setting under negative pressure of the tank.**

- First, the operator carries out the measurement of the reference value on each of the two sensors.
- The vacuum pump creates then a gradual vacuum in the tank.
- As soon as the vacuum created is higher than the hydrostatic pressure due to the height of the liquid, leaks generate signals.
- The two sensitive sensors placed inside the tank (one *above* and the other *in* the liquid) detect even the smallest leaks and thus control the tightness of fuel tanks of $P_1$, $P_2$, $P_3$ and $P_4$ as stipulated in the environmental regulations.
- When a sufficient vacuum is reached:

  1. If the tank is tight, no signal is detected on either sensor; the value displayed on the *SDT 170 MTT* shall be near or equal to the reference value measured before the setting under negative pressure of the tank.
  2. If the tank is not tight, audible and measurable signals are detected due to air or liquid charged with matter being sucked above or below the liquid level. The value displayed by the SDT 170 MTT is then greater than the reference value.

  In fact, putting the wall of the tank under a differential pressure generates an outflow through any tightness problems, which causes:

  - Ultrasonic hissing through the faults above the liquid present in the tank.
  - A return of air or liquid through the faults located in the submerged part of the wall generating characteristic signals.

The *SDT 170 MTT* detector enables the operator to control the tank with two consecutive complementary procedures:

- **A control procedure in free mode without saving data**;
- **A procedure for confirming controls in data recording mode** which may be used as an option after the first procedure (free mode control procedure). The number of controls that may be recorded on the internal memory depends on the amount of data recorded and the length of time taken for the control; memory capacity corresponds to 20 hours of measurement-taking, i.e. 72,000 measurements, as the device makes one measurement per second during the recording phase. Once all measurements have been taken this data can be uploaded to a PC in order to draw up a final report.

The next page shows interconnected parts.

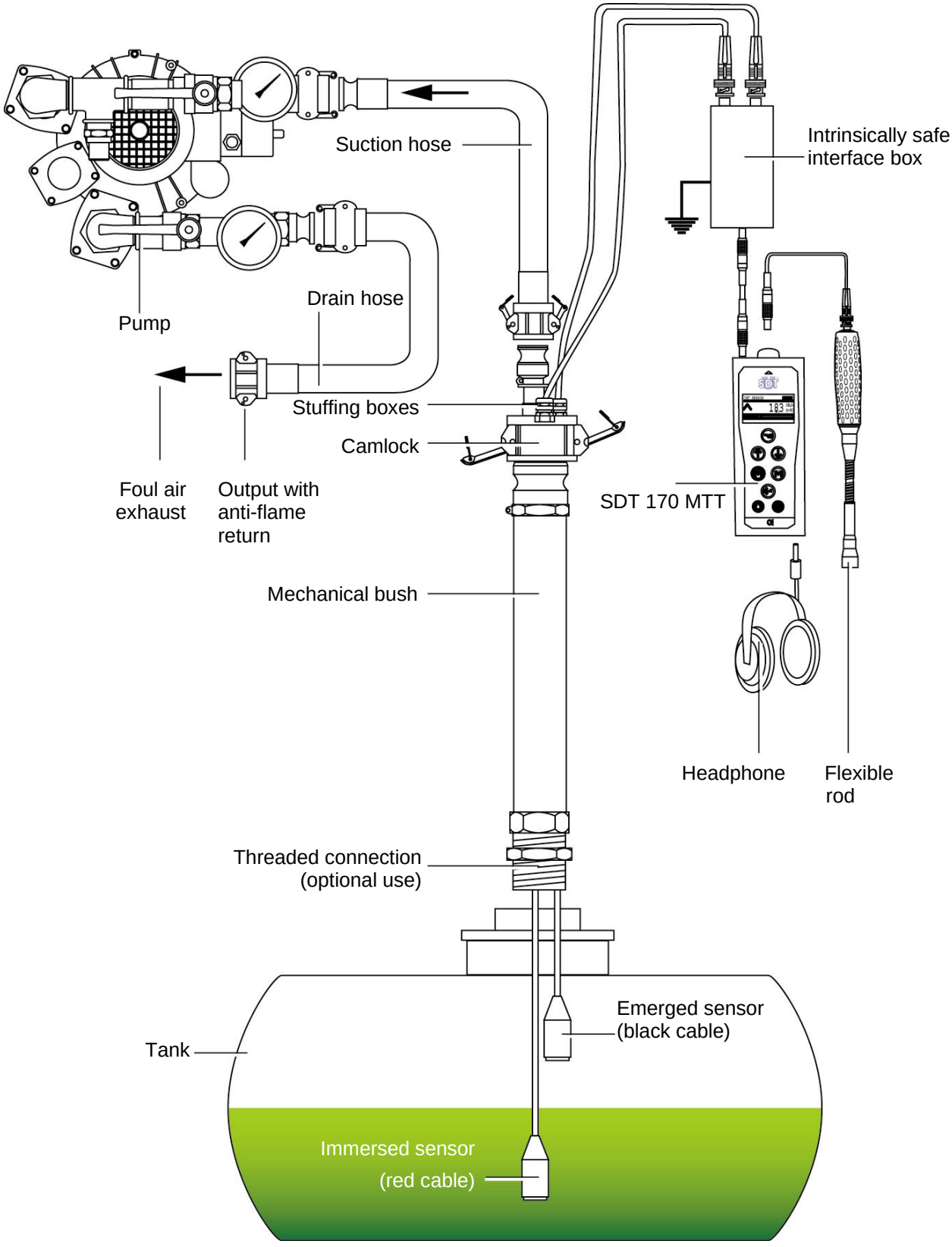
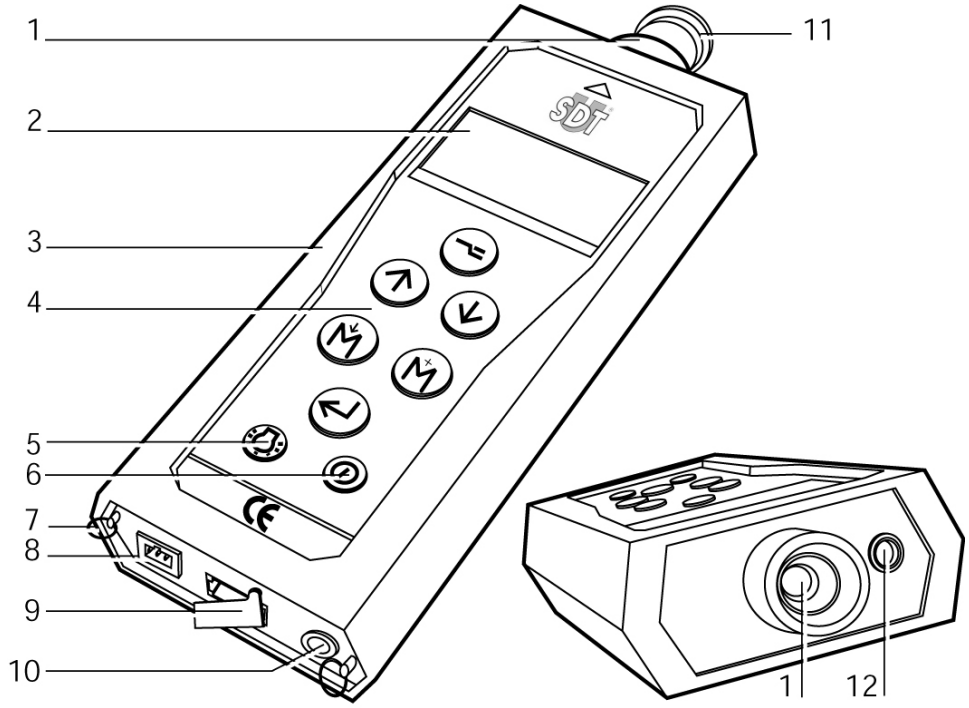



*Figure 6: Interconnection of the various parts.* 520

# 7. Overview of the *SDT 170 MTT*

## 7.1 FULL VIEW

Presents itself as follows:




| N° | Fonction | N° | Fonction |
|---|---|---|---|
| 1. | Built-in ultrasonic sensor and cap. | 8. | Battery charger connector. |
| 2. | LCD display. | 9. | RS 232C connector and cap. |
| 3. | Holster. | 10. | Audio output connector (*minidisc*, |
| 4. | Keyboard. | | headphones, PC, analyzer). |
| 5. | Backlight switch.. | 11. | Sensor protective cap. |
| 6. | On/Off switch. | 12. | External sensor connector. |
| 7. | Strap carrying rings. | | |

*Figure 7 : The visible elements of the SDT 170 MTT.* 502

## 7.2 THE KEYBOARD

The keys correspond to the following functions:

| Key | Function |
|---|---|
|  | First press: access to the menus and sub-menus. |
| | Second press: return to previous or basic screens. |
|  | Increase amplification level. |
| | Scroll up through menus. |
| | Increment figures. |
|  | Reduce amplification level. |
| | Scroll down through menus and sub-menus. |
| | Decrement figures. |
|  | Storage of the shown (measured) value. |
| | Move the cursor to the left. |
|  | Measurement peak and hold key. |
| | Move the cursor to the right. |
|  | Acceptance of the choice (Enter). |
|  | Activate backlighting.<br>From the moment the interface box is connected, the backlighting function is stopped for interference reasons. Pressing the  button at this point does not work. |
|  | On/Off switch. |

# 7.3 FULL VIEW OF THE *SDT 170 MTT*

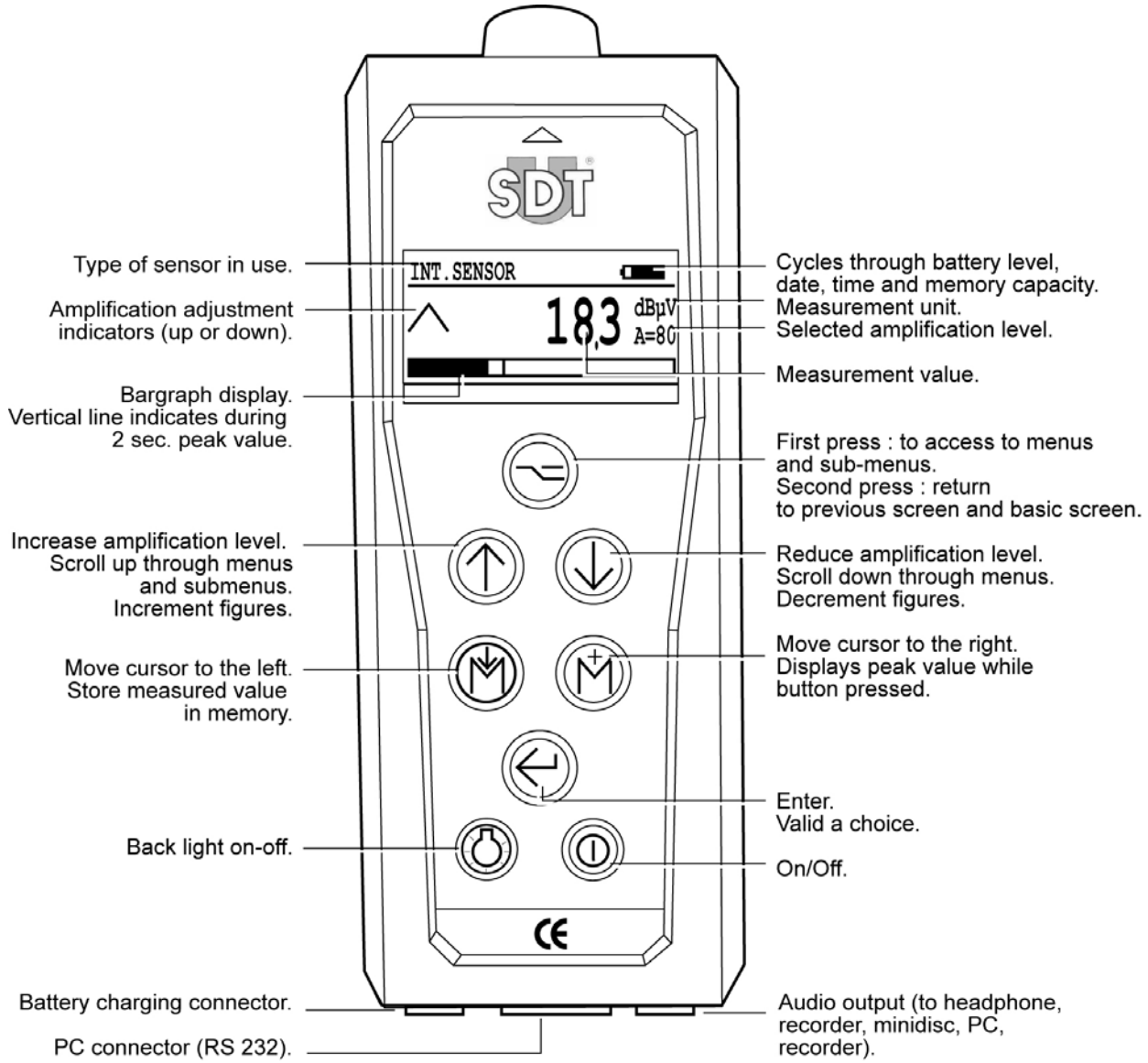
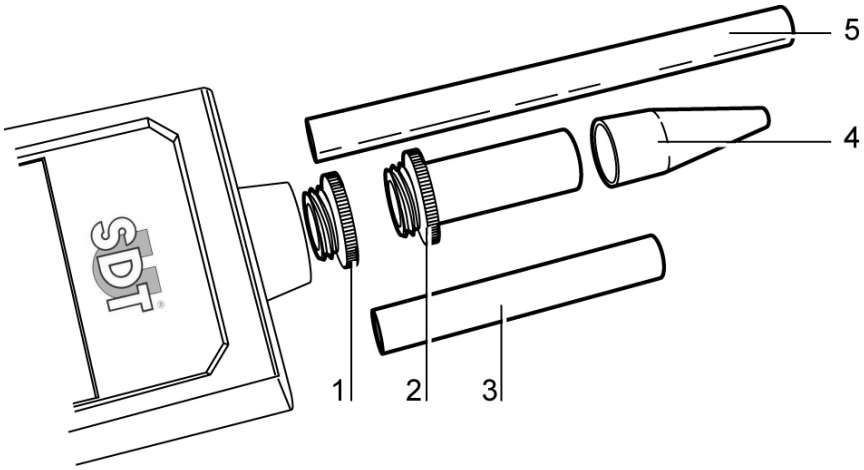



*Figure 8 : The function of the main components of the SDT 170 MTT.* 519

In addition to the flexible rod with built-in sensor, several precision accessories are delivered with the unit. Mounted on the sensor of the *SDT 170 MTT*, they enable the emission point to be focused (toward the connection of the manhole, for instance). They are to be connected as follows:




1. Protection cap to be removed before any measurement.
2. Threaded tip to be used with the elements 3, 4 or 5, if useful.
3. Extension to be fitted between 2 and 4.
4. Rubber precision cone to be fitted on items 2, 3, and 5, if useful.
5. Plastic extension to be fitted between 2 and 4.

*Figure 9 : Precision accessories to be mounted on the sensor of the SDT 170 MTT.* 072

## 7.4 DISPLAY

In addition to the measurement, the display indicates cyclically, in the top right corner of the display (see figure next page), the following information:

| Icon | Meaning |
|---|---|
| **06/16/2006** | Date in the form MM/DD/YYYY. |
|  | Remaining battery capacity. A completely black icon indicates a charged battery. |
| **04:20 P** | Local time (**A** = morning, **P** = afternoon). |
|  **3%** | Volume of memory actually used, expressed as a percentage.<br>The remaining volume of memory is therefore equal to [100 – value displayed]. The memory capacity corresponds to 20 hours of measurement-taking, i.e. 72,000 measurements, as the device makes one measurement per second during the recording phase. |

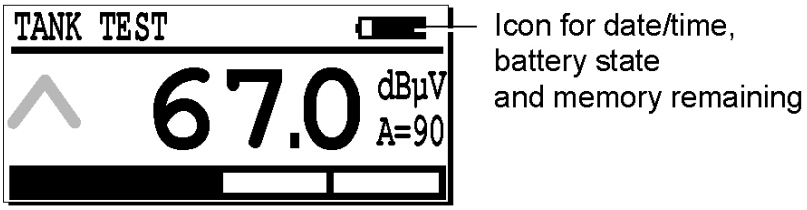



*Figure 10: Location of icons for date, time, battery state and memory used.* 592

# 7.5 FIELDS OF USE FOR THE *SDT 170 MTT*

As the *SDT 170 MTT* is a multi-purpose model, it may be used for various types of controls and measurements:

## Tank tightness controls

The present guide has been specifically written for this kind of control. It describes procedures for the following modes:

- **Free mode**: carrying out the test without the help of the procedure that has been built into the equipment. Refer to chapter 11, page 57.
- **Data recording mode**: carrying out the test using the procedure that has been built into the equipment. Specific menus are displayed and guide the operator throughout the process. Refer to chapter 12, page 77. This procedure is to be used after the control procedure in free mode.

## For various measurements

The *SDT 170 MTT* may be used as a multi-purpose detector for the following main measurements:

- **With the internal ultrasonic sensor**: measuring ultrasonic frequency levels.
- **With external ultrasonic sensors**: measuring ultrasonic frequency levels with a contact sensor, flexible sensor, parabolic sensor, magnetic sensor, screw sensor, tight sensors and open sensors.
- **With external non-ultrasonic sensors**: functions relating to sound level meters, speed sensors, an interface for a pyrometer, infrared thermometer without contact, air leak flowmeter.

For these kinds of measurements, instructions for using the *SDT 170 MTT* are exactly the same as for the *SDT 170 M*, and are described in the user's manual *Ultrasonic Detector SDT 170* which has also been included.

*2nd part*

# Installing the application

# 8. Installing the *Graphs & measurements* application

The **Graphs & measurements** application is provided on CD-ROM supplied with the hardware. Once installed on the PC hard disk, this application allows you to:

- Transfer data memorized by the *SDT 170 MTT* to the PC.
- View them in text format.
- View them in graph form.
- Convert them to PDF format.

To use these functions, the user must first install the application on the hard disk of their PC.

Moreover, as the application prints data in PDF format via another application, which is freely available, called *Acrobat Reader*, it requires input of specific information, such as the name of the company that carried out the test, for example. This information will be viewed automatically in the page header on each of the printed documents.

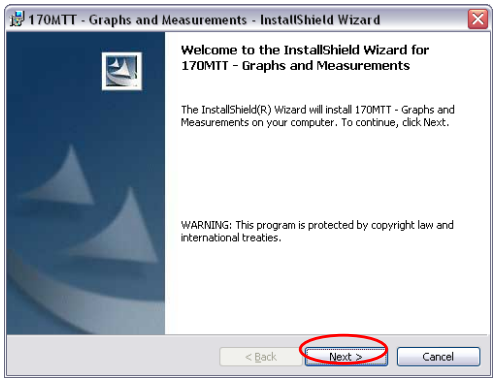
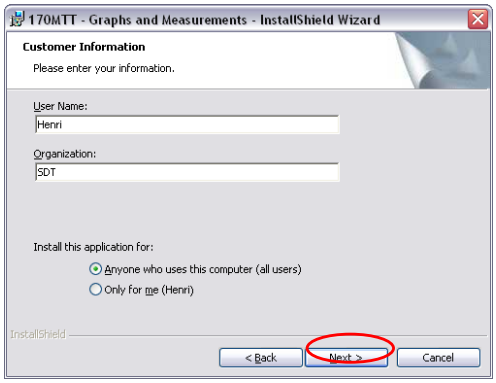
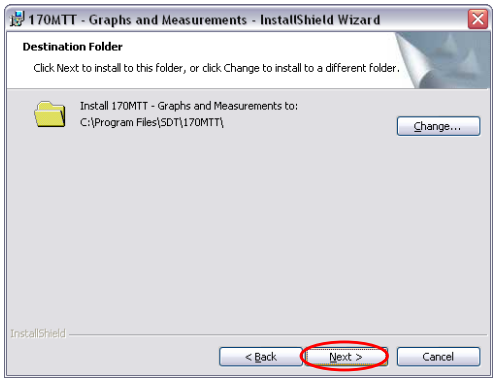
## 8.1 MINIMAL CONFIGURATION M OF THE PC

The PC supporting the **Graphs & measurements** application should have the minimal following characteristics :

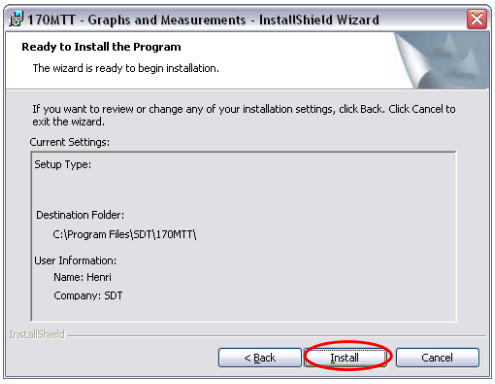
- PC environment Windows 2000 or XP (95, 98 and Me are not followed by *SDT*).
- Screen with a minimal resolution of 1024 * 768 pixels.

## 8.2 INSTALLING THE APPLICATION

This procedure installs the *Graphs & measurements* application in the SDT directory of the PC's *Program file* directory (or in the directory specifically chosen during the installation of the corresponding screen). The *SDT* directory will be created automatically during installation.

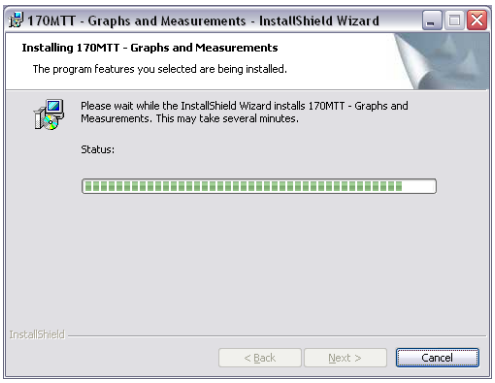
| Step | Screen | Action |
|---|---|---|
| 1 | | Insert the *SDT170 MTT* CD-ROM in the PC's CD-ROM player. |
| 2 |  APP014 | Select the icon *Poste de travail (Workstation)* or launch the Explorer (*Start / Programs / Accessories / Windows Explorer*). |
| 3 |  APP00 | Double-click on the icon displayed opposite. |
| 4 |  | The window opposite is displayed |
| 5 |  | Specify the destination directory of the application; the default directory being `C:\Program Files\SDT\170MTT`.<br>Click on the *Next* button to launch installation. |
| 6 |  | Valid the selected directory in the previous step by clicking on the *Next* button or modify by clicking on the *Change* button. |

**7**



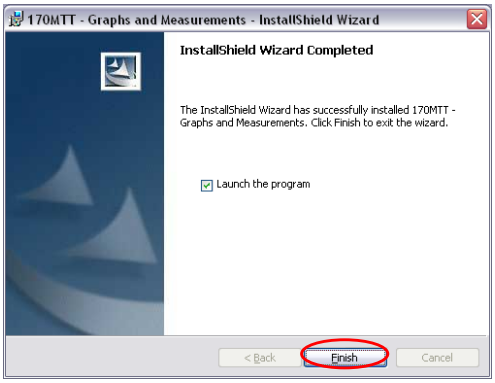

Click on the *Install* button to launch the installation procedure.

**8**




The barograph displays the progress of the installation.

**9**




With the check box *Launch the program* checked before clicking *Finish*, the application is immediately launched.

Once the window shown opposite is displayed, click on the *Finish* button. The installation procedure is finished.

## 8.3 PARAMETERIZING THE APPLICATION

This procedure enables parameterization of the contact details of the *SDT 170 MTT* owner, which will be displayed (printed) automatically at the top of all pages of the report (see Figure 11).

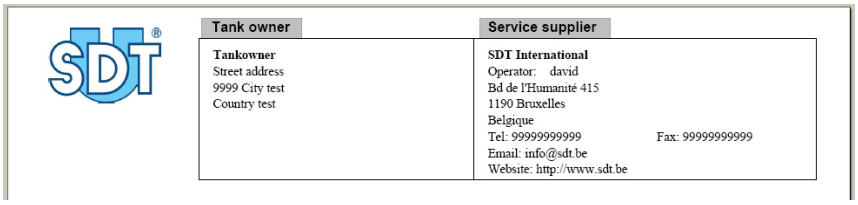
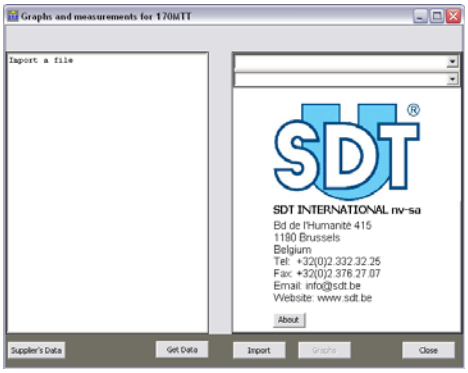
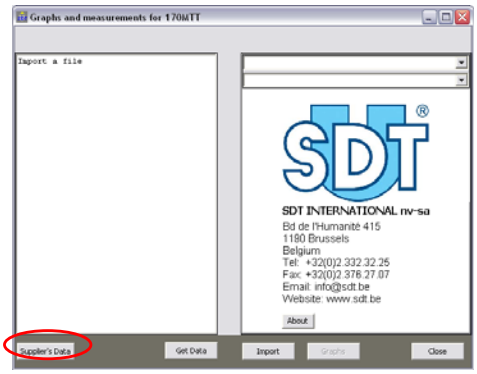



*Figure 11: Locating data in the top of the sheet, right hand side.* APP45

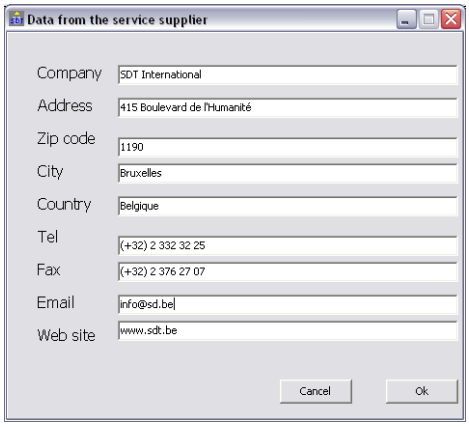
| Step | Screen | Action |
|---|---|---|
| **1** |   APP010 | Launch the *Graphs & measurements* application by selecting *Start / Programs / SDT 170* or double-clicking on the icon automatically installed on the *Windows* desktop. |
| **2** |   | The welcome screen of the *Graphs & measurements* application is displayed. |
| **3** |   | Click on the *Supplier's data* button (data relating to the firm providing this service. |

**4**


In the window displayed, enter the data specific to the *SDT 170 MTT* owner (company or own name):

*Company*: name.
*Address*: postal address.
*City*: town/city.
*Zipcode*: zip code.
*City*: city.
*Country*: country.
*Tel*: telephone number.
*Fax*: fax number.
*E-mail*: e-mail address.
*Website*: website address.

**5**




Click on the *OK* button to record the data, close the window and return to the welcome screen (step 2 of this paragraph).

# 9. Interconnecting to *SDT 170 MTT* through USB

The *SDT 170 MTT* detector is equipped with an RS 232C connector (see page 27, Figure 7, reference 9) for transferring data from the device to a PC. However, on some of today's computers, this connector is removed. As transfer by RS 232C is not possible in this case, the user must obtain a RS 232C → USB 1 or 2 converter.

## 9.1 INSTALLING THE CONVERTER SOFTWARE

Once the RS 232C → USB converter has been obtained from a local dealer, the user should install the application using the documentation supplied with the converter, in accordance with the manufacturer's instructions.

## 9.2 CONNECTING THE *SDT 170 MTT* TO THE USB PORT

The *SDT 170 MTT* must be connected as follows:

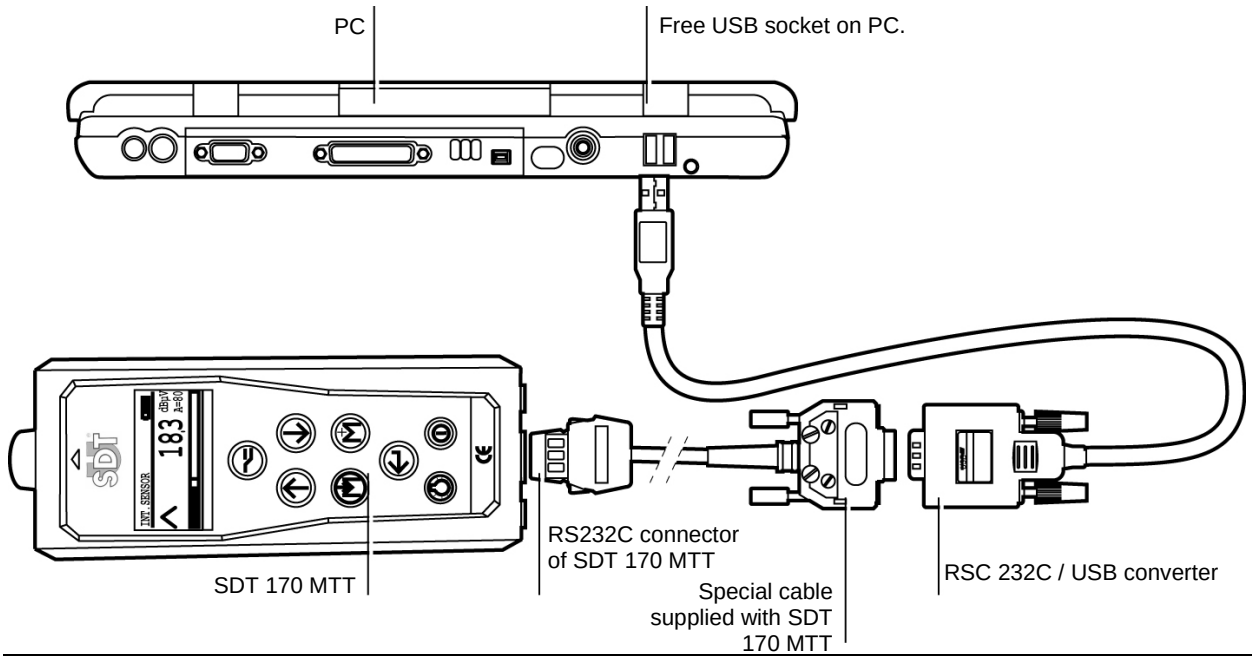
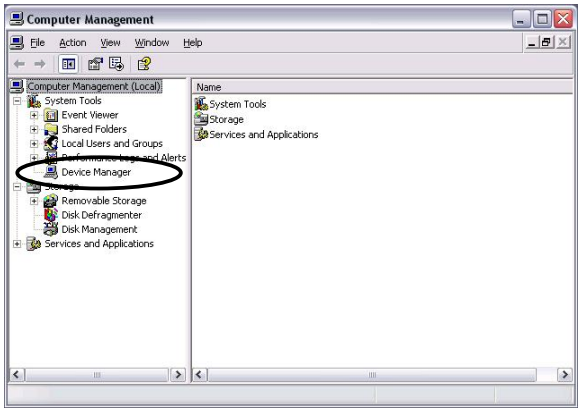



*Figure 12: Principle of a SDT 170 MTT connection to a USB converter.* 532

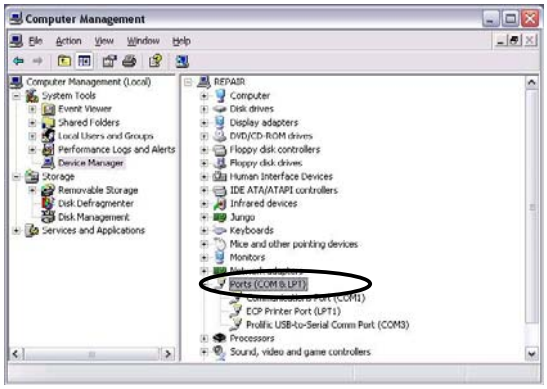
- RS 232C connector from *SDT 170 MTT* to DB9 socket of converter via special RS 232C cable supplied with *SDT 170 MTT*.
- Connection from USB socket of converter to a free USB socket on PC.

## 9.3 PARAMETERIZING THE USB PORT

Proceed as follows to parameterize the USB port to which the *SDT 170 MTT* is connected:

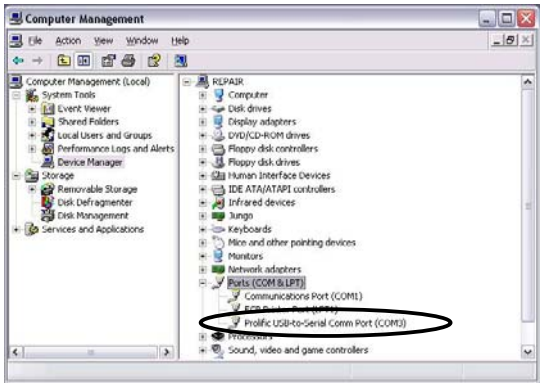
| Step | Screen | Action |
|---|---|---|
| **1** |  USB01 | Depending on the type of display on the *Start* menu, use one of the following two methods:<br>- *Standard Start menu*: right-click on the *My computer* icon on the desktop.<br>- *Start menu*: select *Start / My computer*. |
| **2** |  | In both cases, right-click and select *Manage*. |
| **3** |  | Click on *Device manager*. |

**4**



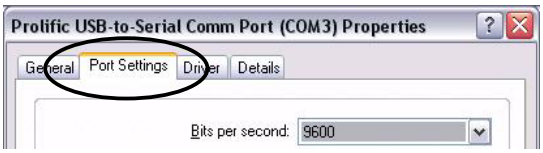

Click on the + sign in *Ports (Com and LPT)*.

**5**



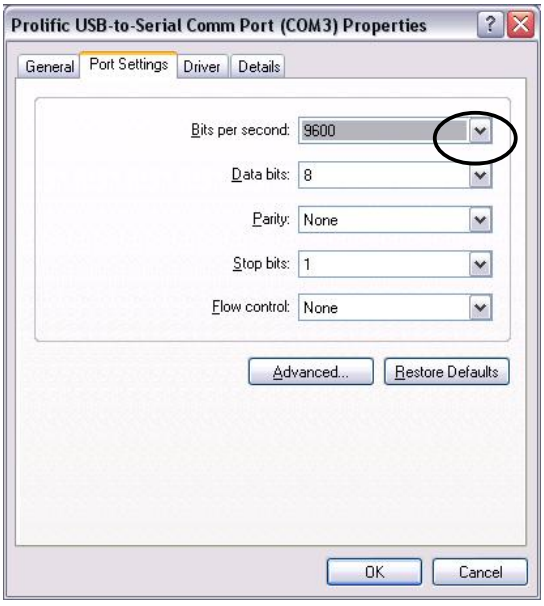

Double-click on the icon for the installed *USB* converter.

**6**




In the window displayed, click on the *Port settings* tab.

**7**




Define the parameters as follows (by clicking on the drop-down list located on the right of each field):

*Bits per second:* 9600.

*Data bits*: 8.

*Parity*: none.

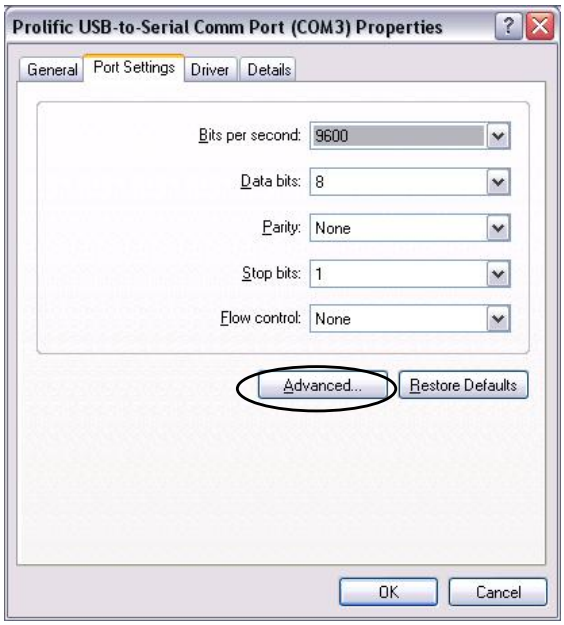
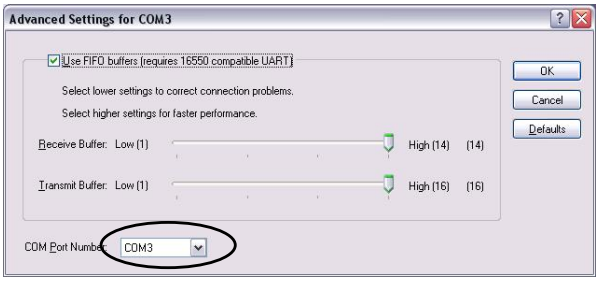
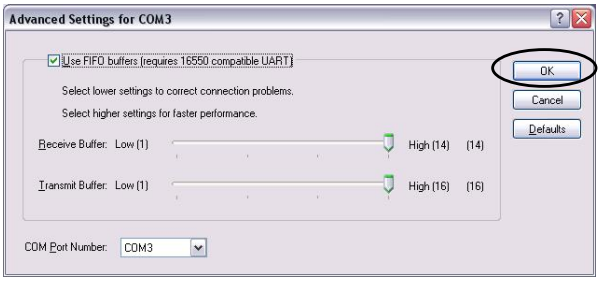
*Stop bits*: 1.

*Flow control*: none.

**8**

Click on the *OK* button to record the data, close the window and return to the welcome screen (step 2 in this paragraph).

NB: if, after a further communication test, no communication is possible between the *SDT 170 MTT* and the PC, you must modify the PC's communication port. Proceed as follows:

| | | |
|---|---|---|
| **9** | | Carry out steps 1 to 7 described above. |
| **10** |  | In the window displayed (illustration opposite), click on the *Advanced* button. |
| **11** |  | In the window displayed (illustration opposite) select another COM port. |
| **12** |  | Click on the *OK* button to record the data, close the window and return to the welcome screen (step 2 in this paragraph). |
| **13** | | Carry out a new transmission test. If the test is still not conclusive, redo steps 9 to 12 above until the right COM port has been found. |

*3rd part*

# Carrying out the test

# 10. Installation procedure

## 10.1 WARNINGS

**When the equipment is used in places where gases, vapours, mists, or flammable dust may be present in the atmosphere, safety precautions must be taken to reduce the risk of explosion due to ignition caused by arcing, sparks or hot surfaces, either in normal service or in specific default conditions.**

- It is imperative to take care of the mechanical resistance of the tank to avoid damaging it (deformation and/or implosion). To avoid any incident, the vacuum pump must be fitted with a relief valve pre-set at 250 mBar relative (750 mBar absolute) and before each test a check must be carried out to ensure it is working correctly by closing off the suction feed tap and making sure, using the depression manometer, that the 250 mBar is not exceeded.
  - For less than 20,000 liter tanks, the calculation of the vacuum value to be applied to beat the hydrostatic pressure of the liquid is based on a very simple formula taking the density of the liquid into consideration (page 64, step 4).
  - For the tanks over 20,000 liters, it must refer to the calculation table of the maximum permissible vacuum according to the ROARK-YOUNG formula (page 103).
  - For the tanks containing petrol, it must also take account of the boiling point, see chapter 13, page 99, *Specific procedures for petrol tanks*.
- A tank filled "to the brim" can never be checked, to avoid to suck out the liquid and keep the depression at an acceptable value.
- Before starting the test, you must make sure that the fill pipe of the tank does not go down into the liquid. If this is the case, the test must be done using another opening.
- It is of the utmost importance that care is paid to the 2 sensors. They lose their sensitivity when damaged. Make sure the sensors are working correctly before each test and protect them during transport.
- Any tractive movement over sensor cables should be strictly avoided (possibility of damage to internal connections).

- Annual re-calibration of your equipment in our workshops and the delivery of a calibrating certificate are essential. Otherwise, there is the risk of incorrect values causing a faulty diagnosis, thereby incurring liability on yourself during the downgrading or approval of a tank.

  Last but not least, failing to observe these regulations may bring your liability into play when it comes to downgrading or approving a storage tank.

- Check the status of the *SDT 170 MTT* detector batteries. The remaining capacity in the battery is expressed by an icon (the amount of blackening corresponds to the remaining capacity of the battery). :

  - by the icon ( ▬ ) located in the upper right corner of the display (100% black means fully charged battery). This icon is cyclically displayed after the system date.

  - in the third screen of the *Info screen*.

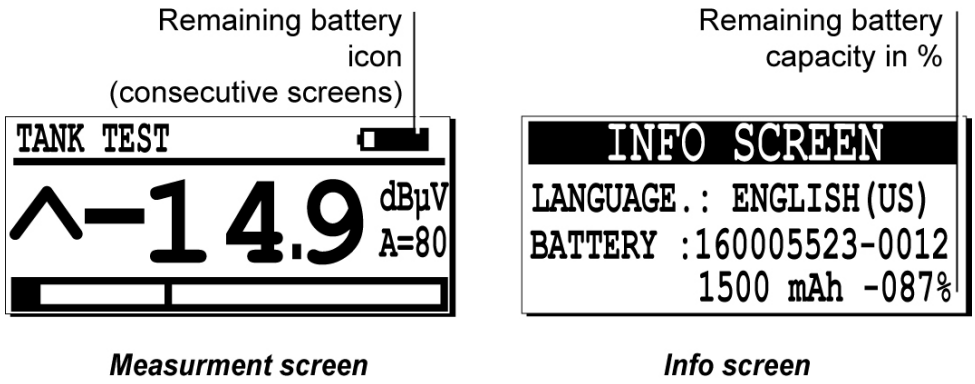



*Figure 13 : Example of battery capacity remaining.* 510

The message **`Battery charge too low`** flashes on the display, when the battery pack's charge is to low.

- It is in your interest to work with an appliance in perfect working condition and in compliance with the procedures described in the present manual. The user shall also comply with the usual safety standards of his country and in particular the instructions described in chapter 13, *Specific procedures for petrol tanks*.

- Under no circumstances, can *SDT International* be held liable for any accident occurring after the equipment has been used and/or as a result of non-compliance with safety standards.

## 10.2 INSTALLING PUMP AND SENSORS

**1** For safety reasons, before testing a tank, one must ensure using an explosimeter that there are no explosive gases in the surrounding air. Contrary to what you expect, the tank could contain an inflammable and/or explosive product.

**2** Switch off the burner of the heating system and close off the feed pipe to the burner.

**3** Seal all the openings and ventilation pipes of the tank (caps, tap closings, etc.).

**4** If the tank is fitted with a pneumatic gauge, disconnect it to avoid damaging it.

**5** Screw the mechanical bush onto the filler neck of the tank.

**6** Accurately measure the level of product contained in the tank using the gauge introduced via the bush opening. Coat the rod with colour cut water-finding paste to locate and accurately measure the level of any water in the bottom of the tank.

Before removing the gauge, do not forget to tighten the screw on the sliding reference piece. Make a careful note to the closest mm of the readings of the 2 levels located, as these will have to be compared with the readings taken at the end of the test.

Also note the diameter of the tank.

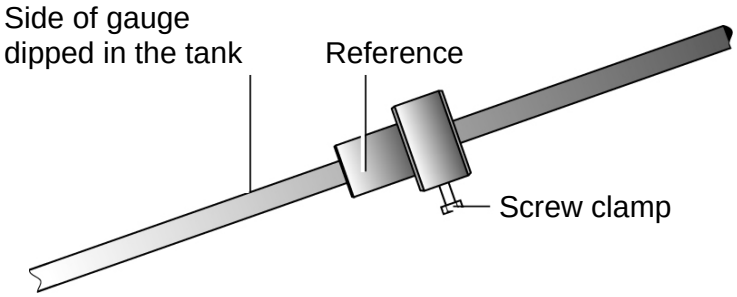



*Figure 14 : Level gauge (optional).* 523

**7** The liquid level shown on the gauge makes it possible to place the black sensor at the right height above the level of the liquid, which is the closest position to the man hole, and to find the right position for the red sensor, which must be immersed at ±10 to 20cm into the liquid.

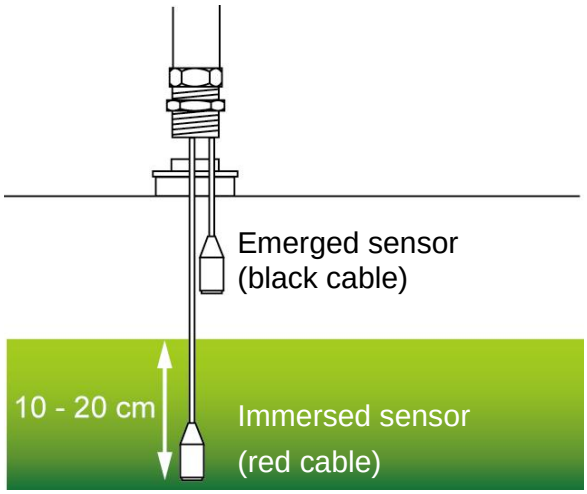



*Figure 15 : Position of sensors in and out of the liquid.* 521

**8** With your hands, tighten the stuffing boxes of the sensor cables to avoid distorting the protective sheet of the cables (see picture below). When the tank is in depression, you can check if you have done this tightly enough using the flexible rod.

**9** Connect the 2 BNC sensors connectors to the interface - *Switchbox* (red on red/ and black on black). Then connect the interface and the headphone to the *SDT 170 MTT* detector.

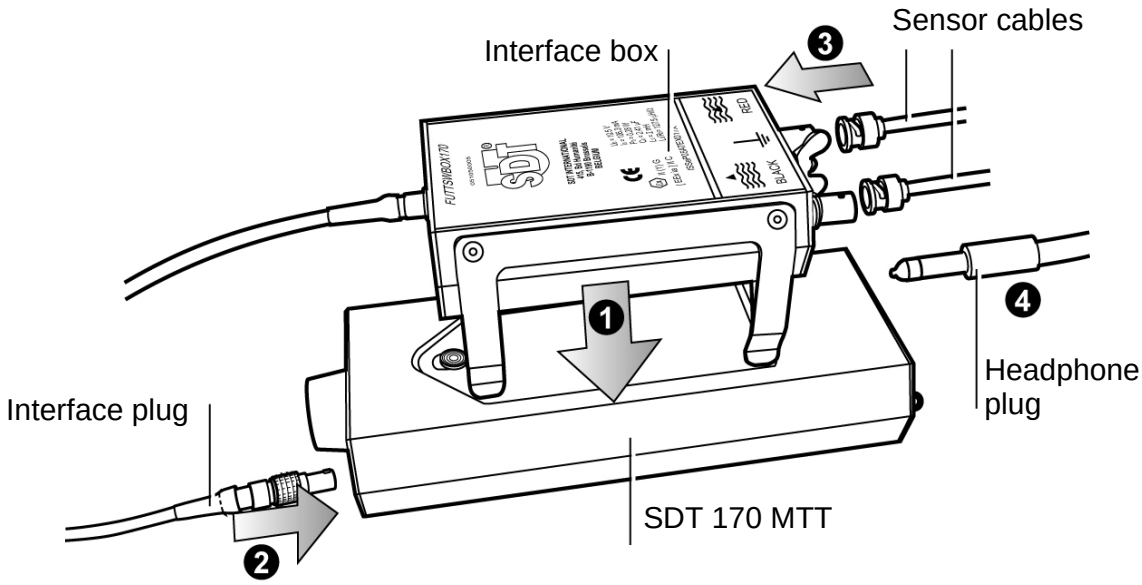



*Figure 16 : The interface is positioned under the SDT 170 MTT and connected to the latter and the two ultrasonic sensors.* 533

*From the moment the interface box is connected to the detector, the amplification level is adjusted automatically to the maximum (A = 90), as shown in the figure below.*


*Figure 17 : The amplification level is adjusted automatically to the maximum (A = 90) as soon as the interface box is connected to the detector.* 513

*From the moment the interface box is connected, the backlighting function is stopped for interference reasons. Pressing the button at this point does not work.*

**10** The 2 sensors must be tested and measured (display of the *SDT 170 MTT*). This measure is done by rubbing the upper part of the sensor with the thumb or rubbing it against an item of clothing for example.

NB: do not forget to remove the protective cap from both sensors.

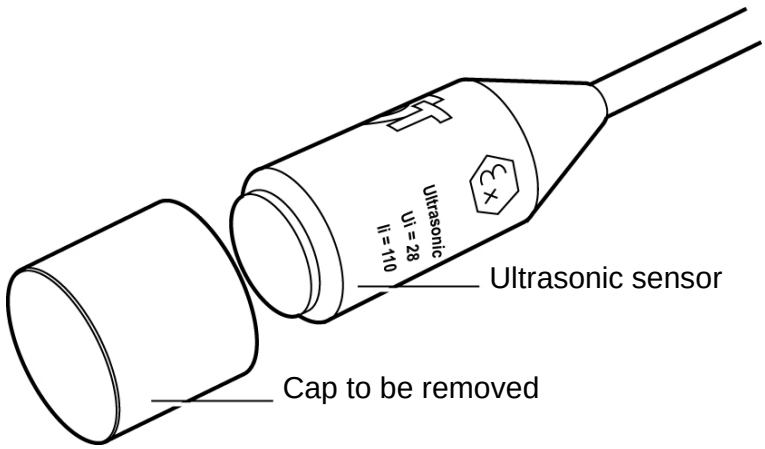



*Figure 18: Each sensor is protected during transportation by a cap. The latter must be removed before doing any measurements.* 527

While rubbing, press on the buttons or in order to adjust the level of amplification. The aim is to have neither arrow (amplification level indicator) visible on the display.

Then push on the key and read the signal value. A minimum value of 40 dBµV should be displayed to validate the sensors, with an amplitude (**A**) first settled to 60 (**A=60**).


*Figure 19 : Arrow signs will disappear when the level of amplification is right and the measurement value reaches at least 40 dBµV when pressing the thumb on the sensor.* 511

In the event that the minimum value of 40 dBµV has not been attained, the appliance along with the set of sensors should be returned to the manufacturer to be checked.

The 2 sensors are identical but the frequency bands selected in the signal received by these sensors are different. This selection is integrated into the interface.

**11** Once each of the sensors has been placed at a good height, insert them delicately into the tank through the opening in the bush and make sure the camlock is attached using the 2 small clamping levers.

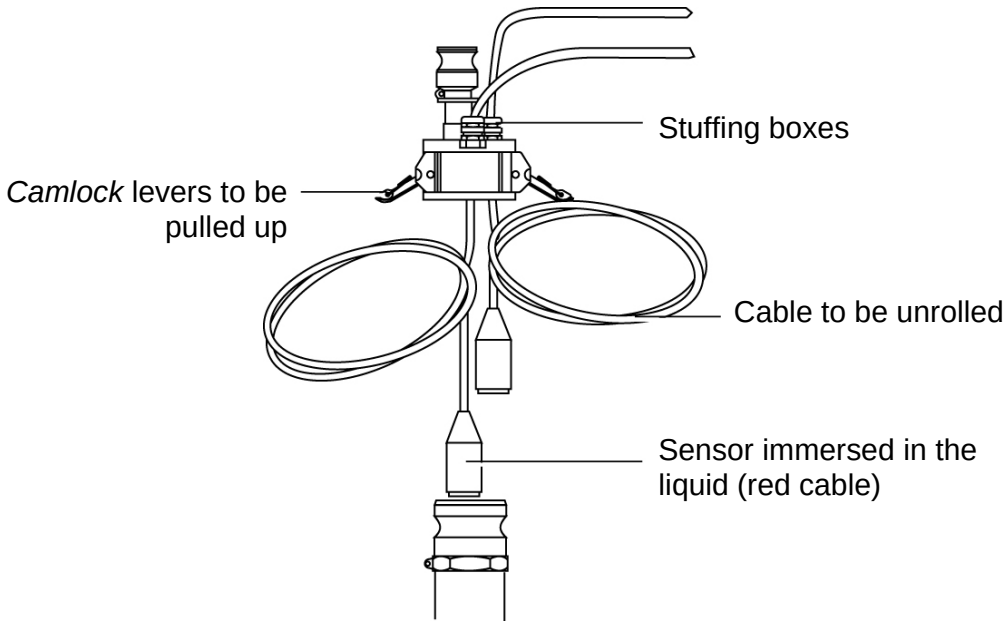



*Figure 20 : Introducing sensors and fixing the camlock.* 524

**12** Connect the suction hose onto the vacuum pump and onto the camlock. Also fit the drain hose to the pump outlet. The pump suction outlet is the one where the safety valve is.

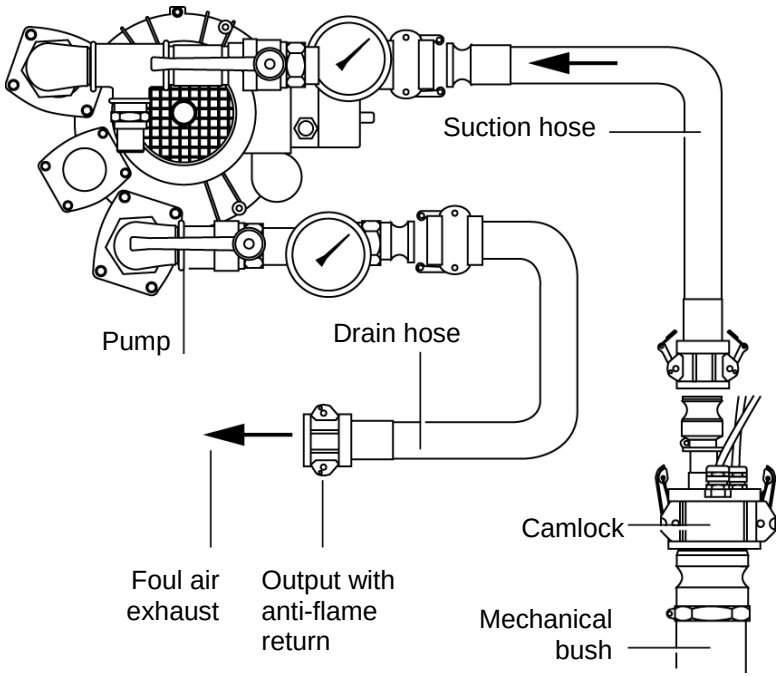



*Figure 21 : Connection of piping to the vacuum pump (non-flame-proof version) and to the camlock.* 525

**13** Everything is installed for carrying out the test. However beforehand, you must absolutely check whether the pump's safety valve is in fact set to 250 mBar and that it is working correctly.

## Tank containing a flammable and/or explosive product

**In the case of controlling a tank containing a flammable and/or explosive product (petrol etc.), the following procedures MUST ALSO be respected:**

- Connect the interface to the earth using the elements supplied.
- For safety reasons, the exhaust pipe should be fastened vertically and fitted with a fire-stop system, to prevent the exhaust gases stagnating on the ground. A **better** solution involves connecting the exhaust to a tank located nearby so that the gases sucked out are condensed and escape normally through the ventilation holes.
- Also follow the instructions described in chapter 13, page 99, *Specific procedures for petrol tanks*.

It should be noted that the interface acts as a galvanic separation between the electrical parts linked to the inside of the tank (sensors) and the measurement device (*SDT 170 MTT*). The connection box **must** be grounded.

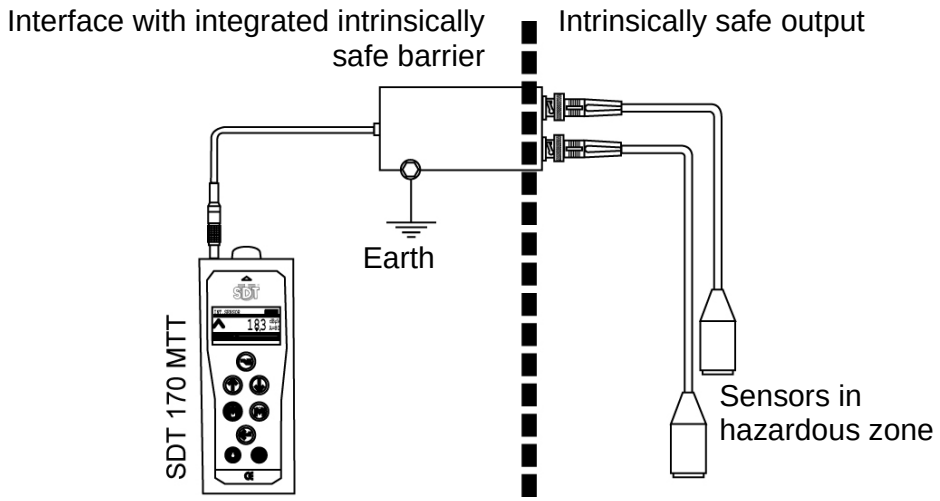



*Figure 22 : The interface acts as a galvanic separation between the electrical parts linked to the inside of the tank (sensors) and the measurement device (*SDT 170 MTT*).* *507*

## Tanks that are forbidden to be put under depression

**The following tanks cannot be put under depression**:

- All parallelepiped tanks.
- All polyethylene tanks; polyester cisterns can be tested.
- Over ground cylindrical tanks with flat bottom.

Also note that it is impossible to set a tank presenting significant perforations (gradual vacuum cannot be created) in depression.

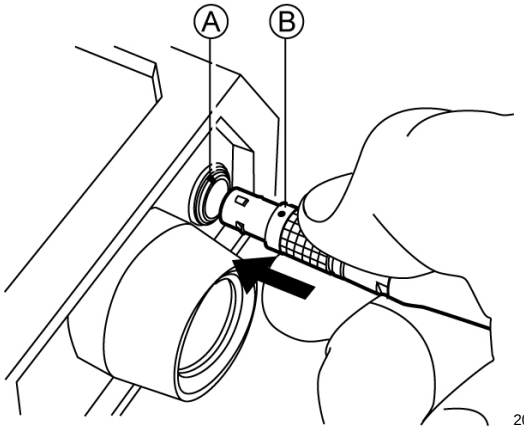
## Important note concerning the plugging to the connector

### Connection to the connector

The connection box is fitted with a fixed cable and 7 pin LEMO plug for connection to the SDT 170 MTT. The two cables from the sensors must be connected to the BNC sockets.

### Plugging of the LEMO plug into the connector

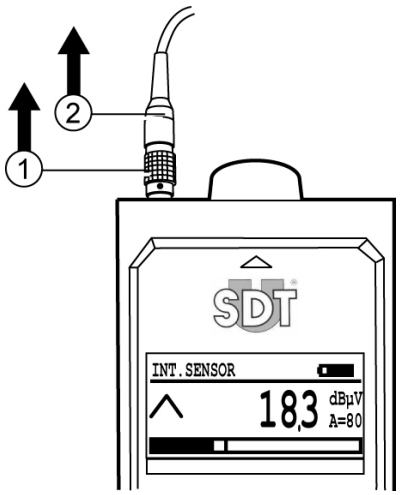
1. Line up the red dot of the plug (B) with the red mark of the connector (A).
2. Insert the plug into the connector **without any rotating movement**.



201

### Unplugging of the LEMO plug from the connector

1. Move up, towards the cable, the ring located on the bottom of the plug.
2. Only pull the plug **without any rotation**.



202

Note: the cable of the flexible rod is also equipped with a 7 pin LEMO plug.

# 11. Procedure for carrying out the tightness test in free mode
***(Initial test)***

This is the initial test for controlling the tank. The procedure is carried out without saving data. It includes the various parts relating to installation, the taking and recording of the reference values, the tests themselves and any necessary action for insulating the tank. The next chapter of this manual covers the process that follows this initial procedure: data recording mode, which enables results of controls to be saved.

**The tightness test procedures described below apply to tanks containing diesel oil or heating oil.**

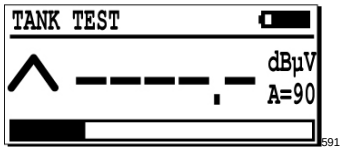
**For tanks containing or having contained a flammable and/or explosive product (petrol, etc.), the specific procedures for these types of tank (see chapter 13, page 99) must also be considered.**

From the moment the interface box is connected, the backlighting function is stopped for interference reasons. Pressing the button at this point does not work.

## 11.1 APPLIANCES INITIAL ADJUSTING

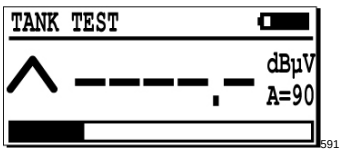
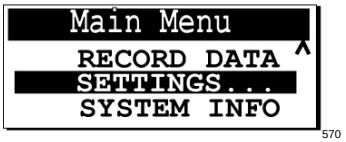
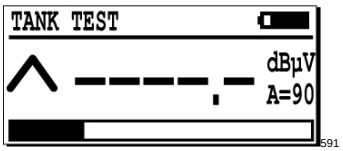
### Switching the detector on

Proceed as follows:

| N° | Screen | Action |
|---|---|---|
| 1 | | Switch the *SDT 170 MTT* on. |
| 2 |  | The display is on. A reading can be displayed according the detector configuration. |

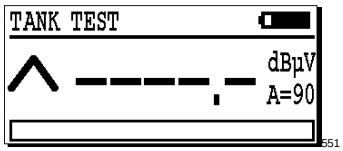
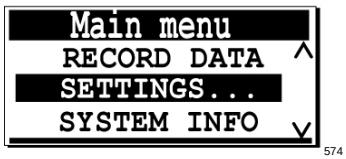
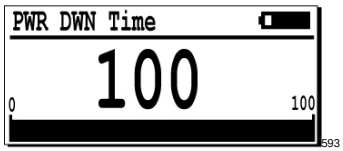
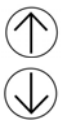
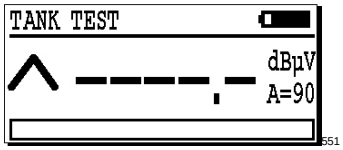
## Selecting the working language

Proceed as follows:

| N° | Screen | | Action |
|---|---|---|---|
| 1 |  591 | | The display being on, push on the key. |
| 2 |  571 | | The *Main menu* being displayed, push several times on this key until reaching the last menu line.<br>*Note: this explanation does not display any text in the menu. The current display depends on the last language used.* |
| 3 |  570 | | Push this key once to go up in the menu. |
| 4 | | | Push this key. |
| 5 |  572 | | Push this key several times until the last option is reached. |
| 6 |  573 | | Push this key twice to go up 2 options. |
| 7 | | | Push this key. |
| 8 |  562 | | Select the language (English) with these keys. . |
| 9 | | | Confirm. |
| 10 |  591 | | Push this key to go back to the measuring screen. |

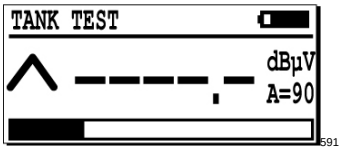
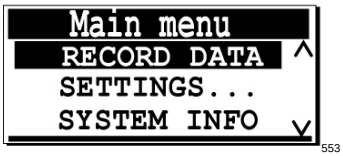
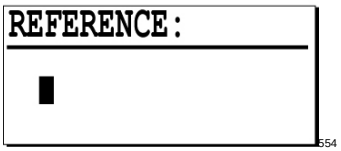
## Setting the automatic switch-off delay at maximum duration

Proceed as follows:

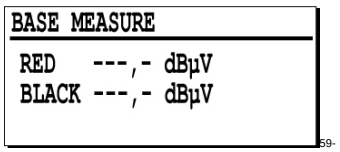
| N° | Screen | | Action |
|---|---|---|---|
| 1 |  |  | The display being on, push on the  key. |
| 2 |  |  | The *Main menu* being displayed, select *Parameters*. |
| 3 | |  | Push this key. |
| 4 |  |  | Select *Auto PWR-DWN*. |
| 5 | |  | Push this key. |
| 6 |  |  | Select the value 100. |
| 7 | |  | Push this key. |
| 8 |  |  | Push this key. |
| 9 |  |  | The measuring screen is displayed. |

## 11.2 TAKING AND RECORDING OF THE REFERENCE VALUES

The *SDT 170 MTT* is a detector having a high degree of accuracy of the measurements. Its amplification level being important, it has sensitiveness to the temperature. It is therefore advisable to take a reference value (dBµV) on each of the two sensors before the setting under negative pressure of the tank.

| N° | Screen | | Action |
|---|---|---|---|
| 1 |  | | The display being on, push on the key to display the **Main menu**. |
| 2 |  | | In the **Main menu**, select **Record data** with and .<br>Confirm. |
| 3 |  | | The screen relating to the reference of the tank is displayed. Enter the tank reference (12 characters maximum). This is generally a tank identification number or any other information acting as tank registration (address, other recognizable data).<br>The authorized alphanumeric characters are displayed on the screen in the following order:<br>**ABCDEFGHIJKLMNOPQRSTUVWXYZ0123456789! " # $ % ' < > * + - / . : = > ? (space)**<br>Use the keys as follows: |
| | | | Select the next character in the list (A, B, etc.). The 'space' character is this after the letter **A**. |
| | | | Select the previous character in the list. |
| | | | Move the cursor to the right (next position). |
| | | | Move the cursor to the left (previous position). |
| | | | Confirm the entered text. |

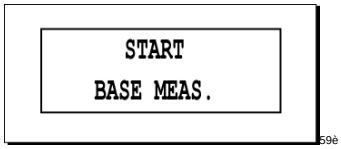
**4**




The screen **`Base Measure`** is displayed.

Confirm.

**5**

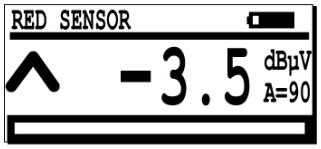



Check that the environment is quiet (no audible or to come interference noise, because already visually identifying)

Confirm.

If not, wait or quit the menu by pushing for a later operation recovery.

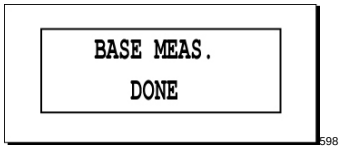
**6**




The detector measure then the ultrasounds consecutively on the two sensors, during 5 seconds on each sensor.

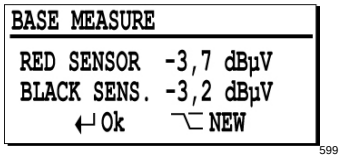
Wait for the automatic display of the next screen.

**7**




As soon as this screen is displayed (end of measurements), confirm for get the reference value screen of each sensor.

**8**

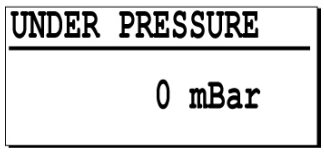



The screen displays the reference values of each sensor. The displayed measure is the average of the measurements during 5 seconds.

If no there was no perturbation during the measuring of the data, **write down these measurements** to make your later work easier and confirm with .

From this moment, these reference measurements as well as the reference of the tank are recorded by the detector.

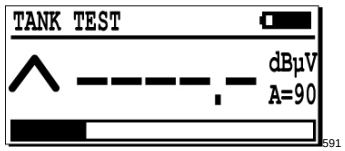
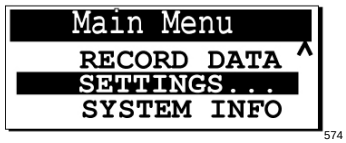
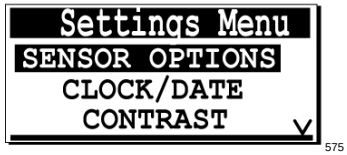
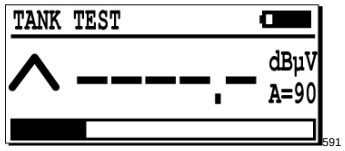
If perturbations arise during the measuring of the data, begin again the step. Push . The **`Start Base Measure`** screen is displayed. Follow from step 5.

| | | | |
|---|---|---|---|
| **9** |  | | In this procedure relating to the test in free mode, this screen is not used. Exit by pushing to launch the test in free mode after having set the detector in **Max value** (next paragraph). |

## 11.3 SELECTING THE MAX VALUE FUNCTION

Before proceed to the effective test in free mode, it is imperative to set the SDT 170 MTT in **Max value** mode, so as to display the maximal values.

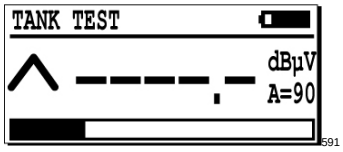
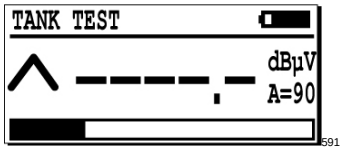
Proceed as follows.

| N° | Screen | | Action |
|---|---|---|---|
| **1** |  | | *Note: the amplification level is automatically adjusted to 90 (**A = 90**) when the interface box is connected.*<br>The display being on, push on the key. |
| **2** |  | | The *Main menu* being displayed, push several times on one of these keys until reaching the *Settings…* line. |
| **3** | | | Push this key. |
| **4** |  | | Select *Sensor options*. |
| **5** | | | Push this key. |
| **6** |  | | Select MAX VALUE. |
| **7** |  | | Press this button to validate and return to the measuring screen. |

## 11.4 TIGHTNESS TESTING UNDER THE LIQUID LEVEL

Refer to the flow chart on page 71 for a visual explanation of the procedure. Proceed as follows:

*NB: When the detector is switched on, the numerical value shown depends on the ambient noise level. The numerical values in the illustrations are provided only as examples.*

| N° | Screen | | Action |
|---|---|---|---|
| **1** |  | | The measuring screen is displayed.<br>At this point, a measurement can be displayed by pressing **.** |
| **2** |  | | If the label **`Black Sensor`** is displayed on the upper left corner of the display, push the key to select the immersed sensor (sensor with red cable). The upper left corner of the display must indicate successively <**`Red Sensor`** and **`Tank test>`**.<br>In fact, **testing a tank must always start with measuring the tightness under the level of the liquid**. |
| **3** | | | Before taking any other steps, put the headphone on your ears to listen continuously to the signals from the engaging to the stopping of the pump.<br>- **Control with the non ex-proof pump**: engage on this the open suction and exhaust taps. No preheating is necessary.<br>- **Control with the ex-proof pump**: check beforehand that it contains enough oil. Start it with the valves closed and let it heat for 10 to 15 minutes. |

**4**

Switch on the vacuum pump to overcome the hydrostatic pressure of the liquid (max 250 mBar) using a simple calculation based on the density of the liquid.

To calculate the value of the vacuum to be applied in the tank, take the density of the water as a reference. A water height of one meter corresponds more or less to a hydrostatic pressure of 100 mBar.

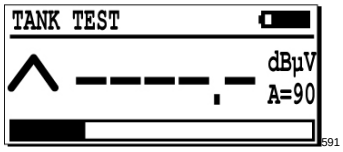
This value can be used to calculate the hydrostatic pressures of hydrocarbons. In fact, the correction due to the specific density of the hydrocarbon has practically no effect on the effectiveness of the check.

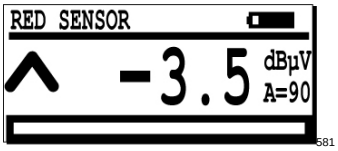
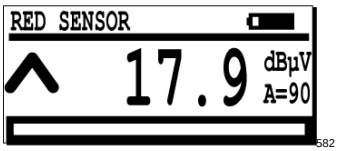
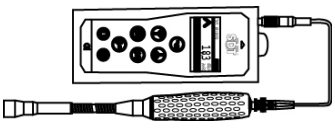
| Liquid | Density (at 15 ° C) |
|---|---|
| Water | 1 |
| Super green petrol | 0,765 |
| Super petrol | 0,755 |
| Unleaded petrol | 0,768 |
| Diesel oil / Heating oil | 0,842 |

*Example : in a tank containing 1.5 m of diesel or heating oil, the calculated vacuum is:*
*150 mBar X 0,842 (density of the gas oil) = 126 mBar.*
*But the vacuum applied may be 150 mBar (with density = 1).*

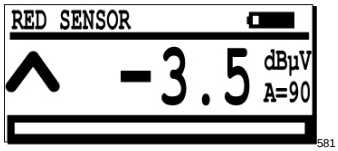
It is very important to listen to the signals picked up by the sensor in the liquid throughout the duration of the creation of the gradual vacuum.

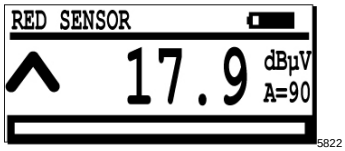
In fact, during this phase a noise lasting for a very short time (cracking type) may be heard, which would mean that a perforation in the wall of the tank is clogged up through suction of elements on its outside face. This type of perforation cannot be detected after this suction phase.

| | | | |
|---|---|---|---|
| | | | If this happens, and only on a tank of heating oil, you are advised to release the depression and create a slight pressure of ± 300 mBar (by reversing the pipes on the pump) to remove any clogging. This action will last for a very short time to avoid generating underground pollution by projecting liquid under pressure via the perforation thus cleared.<br><br>**Pressurizing tanks is strictly forbidden for any tank containing a flammable and/or explosive product (petrol etc.).**<br><br>After this operation, re-start the test as described above. In the event of perforation, the noise picked up initially will be more precise and repetitive. |
| **5** |  | | When a sufficient vacuum is reached, stop the pump. Check that the *SDT 170 MTT* is set to maximal sensitivity (A = 90).<br><br>If not, push the key. |

| | | |
|---|---|---|
| **6** | | Take the reading of the signals by pressing the key 2 to 4 times consecutively for 3 to 5 seconds.<br>To obtain the right measurement, you must adjust the amplification level with the and keys so that the arrows ( ∧ and ∨ ) are NOT visible on the display. |
| | | In order to estimate the tank tightness, always take into account the comparison between the measure gathered during the test and the reference values measured before the setting under negative pressure of the tank (paragraph 11.2, page 60, step 8). |
| |  <br>581 | **No noise**: if during this period any characteristic noise is picked in the headphone and a measured value equal or near to the reference value is displayed by pressing the key, this indicates that the tank is tight below the level of the liquid. |
| |  <br>582 | **Presence of noise**: if, during this period, sound signals are heard in the headphone and a value greater than the reference value is shown on the display by pressing the key, this indicates to find the origin of these signals before confirming that the tank is actually perforated below the level of the liquid. Insure that the installation is tight on the surface. |
| **7** |  <br>583 | Disconnect the connector of the interface box and connect the flexible sensor.<br>Slide the flexible sensor connected to the *SDT 170 MTT* along the contour of the manhole cover and on the different connections fitted on this cover.<br>If necessary, make sure these elements are totally tight by sealing or tightening. |

**8**




Disconnect the flexible sensor and connect the connector of the interface box.

Take the reading of the signals again on the immersed sensor by pressing the key:

- **If the noise has disappeared and the value measured is equal or near the reference value**: the tank is tight below the level of the liquid and the tightness problem is located at the manhole and/or on the connections of the pipes.
- **If the noise picked up and the value greater than the reference value persist**: the tank must be completely insulated.

**9**

Disconnect all the connections on the manhole taking care to remove all the pipes going down into the tank.

Place a sealing cap on all the openings of the manhole and make sure that the fastenings of the cover are completely sealed. The test is impossible with a manhole, which is not totally tight.

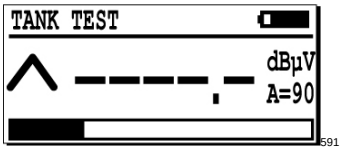
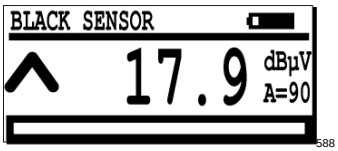
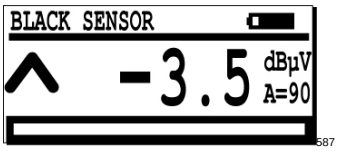
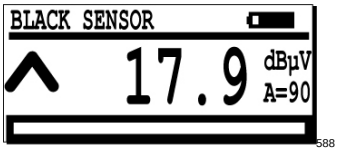
**10**

Take the reading of the signals again on the immersed sensor (press ).

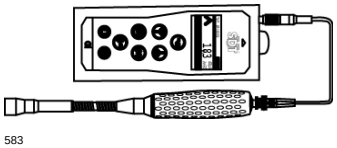
**If the noise picked up and the value greater than the reference value persist**, **only then** - ***and on a totally insulated tank*** - there is confirmation of a tightness problem on the tank under the level of the liquid

## 11.5 TIGHTNESS TESTING ABOVE THE LIQUID LEVEL

Refer to the flow chart on page 71 for a visual explanation of the procedure. Proceed as follows:

| N° | Screen | Action |
|---|---|---|
| 1 |  | Push the key ↵ to display the label **Black Sensor** on the upper left corner of the display.<br>The upper left corner of the display must indicate alternatively <**Black Sensor** and **Tank test>**. |
| 2 | | Make sure that the level of depression has not decreased during some of the previous handling. |
| 3 |  | Take the reading of the signals by pressing the Ⓜ key 2 to 4 times consecutively for 3 to 5 seconds.<br>To obtain the right measurement, you must adjust the amplification level with the ↑ and ↓ keys so that the arrows ( ∧ and ∨ ) are NOT visible on the display. |
| |  | **No noise**: If during this period any characteristic noise in the headphone is picked up and a value equal or near the reference value is seen by pressing the Ⓜ key, the tank is tight above the level of the liquid. |
| |  | **Presence of noise**: if, during this period, sound signals are heard in the headphone and a value greater than the reference value is shown on the display by pressing the Ⓜ key, this indicates to find the origin of these signals before confirming that the tank is actually perforated above the level of the liquid. Insure the installation is tight on the surface if the tank has not been totally insulated for the test under the level of the liquid. |

**4**



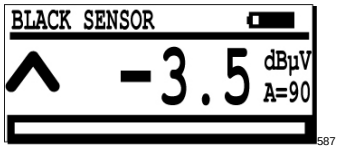
583

Disconnect the connector of the interface box and connect the flexible sensor.

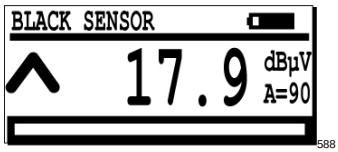
Slide the flexible sensor connected to the *SDT 170 MTT* along the contour of the manhole cover and on the different connections fitted on this cover.

If necessary, make sure these elements are totally tight by sealing or tightening.

**5**




587




588

Disconnect the flexible sensor and connect the connector of the interface box.

Take the reading of the signals again on the sensor above the level of the liquid by pressing the key:

- **If the noise has disappeared and the value measured is equal or near the reference value**: the tank is tight above the level of the liquid and the tightness problem is located at the manhole and/or on the connections of the pipes.
- **if the noise picked up and the value greater than the reference value persist**: the tank must be completely insulated.

**6**

Disconnect all the connections on the manhole taking care to remove all the pipes going down into the tank.

Place a sealing cap on all the openings of the manhole and make sure that the fastenings of the cover are completely sealed. The test is impossible with a manhole, which is not totally tight.

| | | |
|---|---|---|
| **7** | | Take the reading of the signals again on the sensor above the level of the liquid by pressing the key.<br>**If the noise picked up and the value greater than the reference value persist, only then - *and on a totally insulated tank* -** there is confirmation of a tightness problem on the tank above the level of the liquid. |
| **8** | | Push to follow with the test in *Recording mode*, chapter 12, page 77. |

## 11.6 CONCLUSION OF THE TIGHTNESS TEST

These comments apply to both procedures (chapters 11 and 12) describe in this manual.

**Even in the presence of audible noises and value measured greater than the reference value, a tank will never be decommissioned if the tightness problem has not been confirmed after complete insulation of the tank as described in 11.4 and 0.**

**If work is required to get to this stage, the test can only be carried out after completion of these services and repairs.**

Proceed as follows:

| N° | Action |
|---|---|
| **1** | If the tightness problem is confirmed after complete insulation of the tank, you are strongly recommended to keep the tank in depression for around ¾ of an hour before measuring precisely the levels of the product and any water in the tank. |

| | |
|---|---|
| **2** | You must always end the test with these measures of the level of liquids (point 1 above) with the gauge and the water-finding paste.<br>• Any increase in the level of the liquid or the water gives you additional confirmation of the presence of a tightness problem under the level of the liquid.<br>• If you notice a decrease in the level of the liquid and the fact that the gauge does not go down as deep into the tank, this is confirmation of distortion of the bottom of the tank, resulting from putting the tank in depression.<br>• The loss of depression will provide you with additional confirmation of the presence of the tightness problem. |
| **3** | After the test, carefully take out the 2 sensors, clean them and protect them for transport. |
| **4** | Do not forget to set the heating installation back in function (filter cock and burner) and remove the cap of the tank's ventilation pipe. |
| ⚠ | **If you have put the tank under light pressure for a very short period as described in paragraph 9.2, step 4 and there is confirmation of a tightness problem on the tank itself, you must warn the occupant of the place so that the tank can be emptied as quickly as possible, in any case within 24 hours.** |

## 11.7 GENERAL FLOW CHART FOR THE TIGHTNESS TEST

This flow chart displays the various phases of the tightness test: below and above the level of the liquid and conclusions. To confirm a tightness problem, always taking into account the measures obtained during the test and the reference values measured before the setting under negative pressure (see paragraph 11.2, page 60, step 8).

# Step 1/3: test under the liquid level

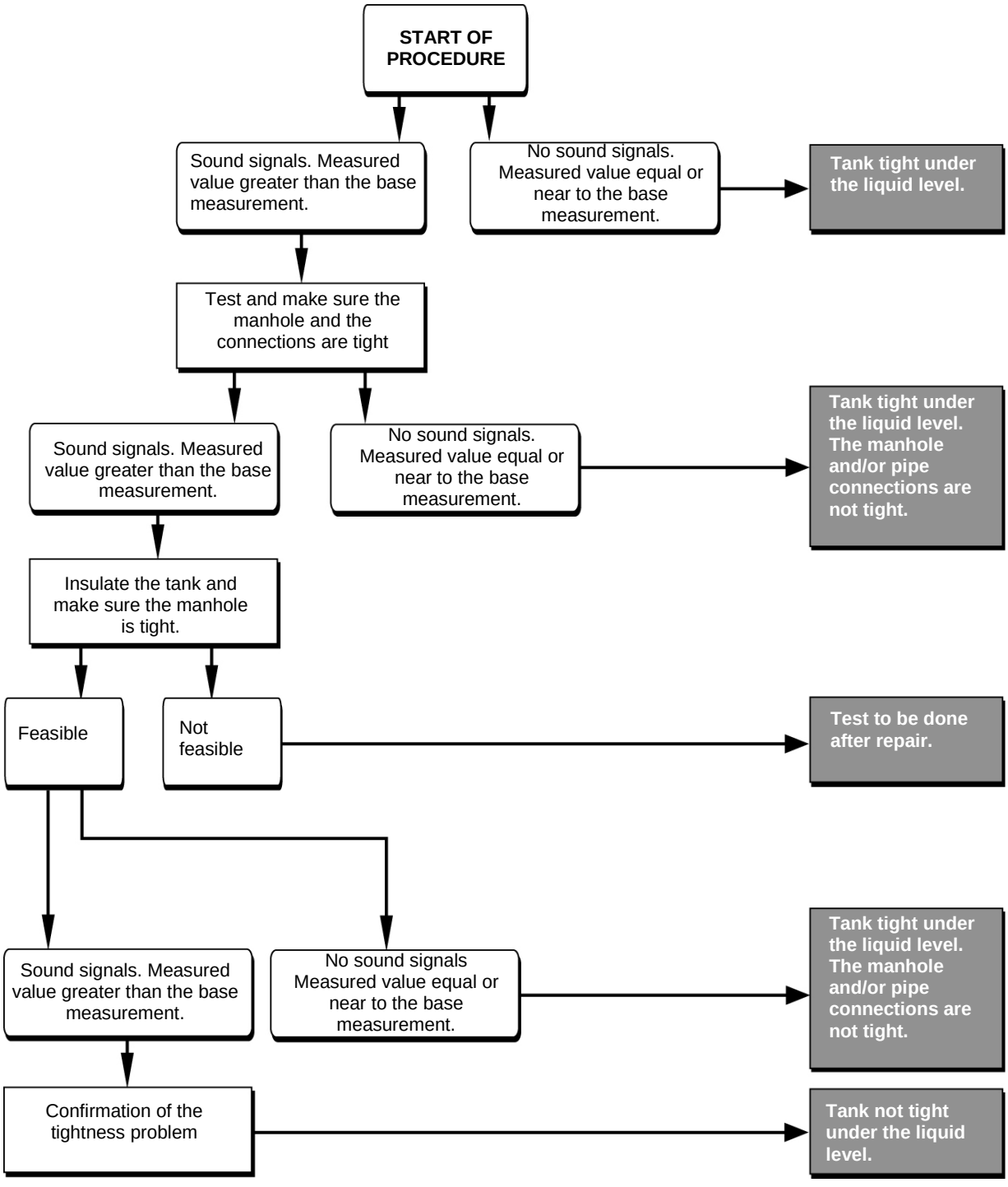



*Figure 23 : Test under the liquid level.* 515

## Step 2/3: test above the liquid level

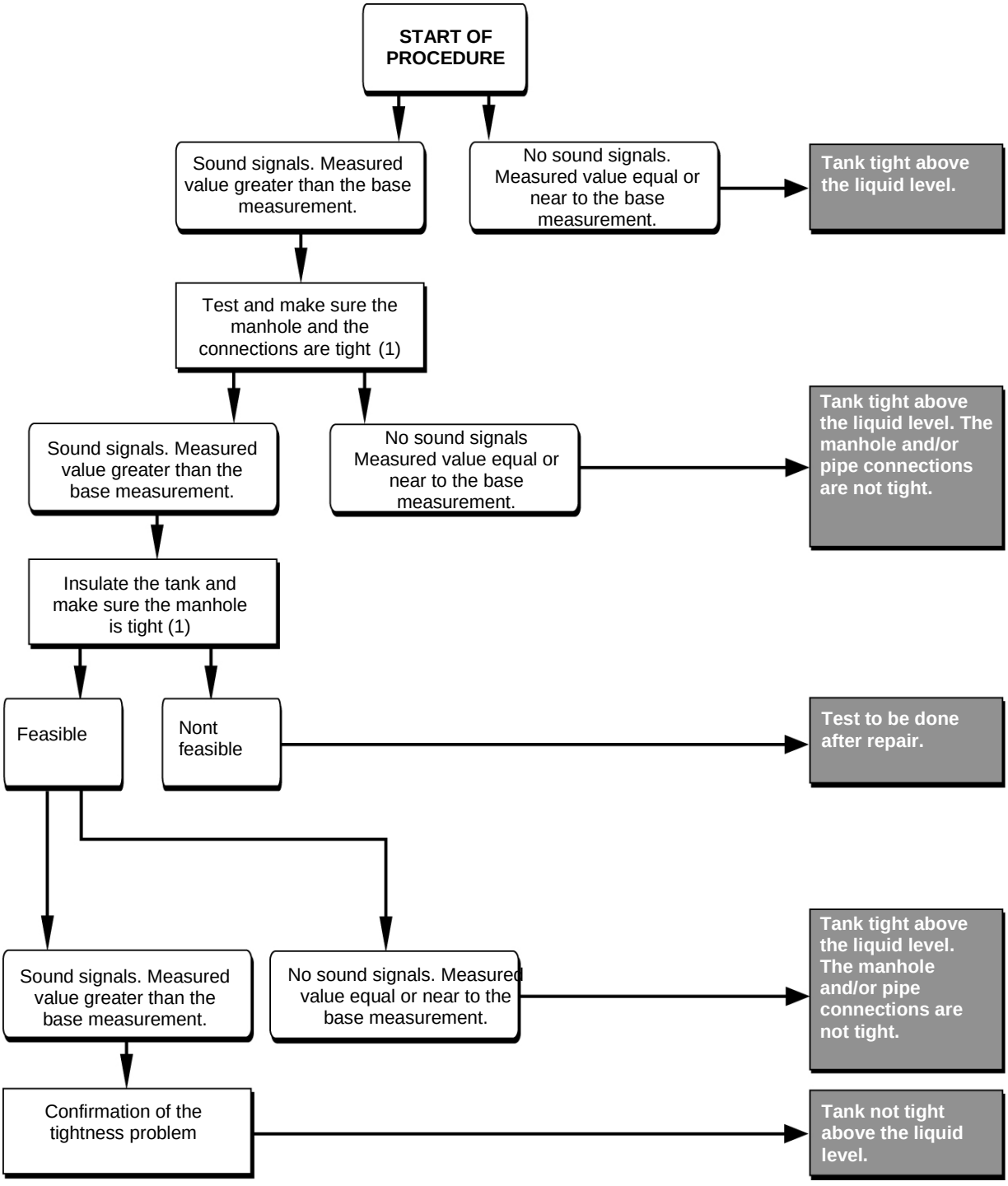



*Figure 24 : Test above the liquid level.* 515

(1) if not done in step 1.

## Step 3/3: conclusion of the test

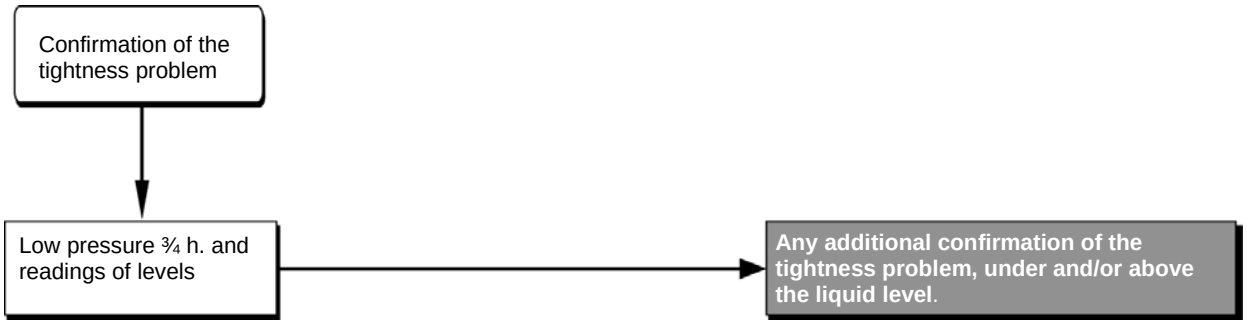



*Figure 25 : Depressurize the tank for confirmation of tightness defect(s).* 516

# 11.8 SOME ADVICE

## "Explosion" when depressurizing the tank

If you notice an "explosion" when the tank is being set in depression, stop the pump immediately and notify the owner. In all likelihood the tank does not meet the standards and the test can only be carried out at the owner's risk.

## Tank with a non disconnectable remote filler

When the tank is fitted with a remote filler not disconnectable on the manhole, another opening must be used to do the test.

## Irregular noise of bubbles heard when depressurizing the tank

When the tank is set under negative pressure, you can hear an intermittent and regular noise of bubbles coming from the immersed sensor and stopping once the pump stops. This is not a tightness problem but the draining - via suction – of the air present in the disconnected and blocked pipe of the burner pump.

## Regular noise of droplets

If you hear a continuous noise of drops falling on the surface of the liquid, this is due to a small leak on the return pipe, in other words from the infiltration through the manhole joint of the water present in the well. If it is of short frequency, this noise can also be caused by drops of condensation falling from the upper wall of the tank.

## Changing in colour on the -

A change in colour in a vertical line on the water finding paste on the gauge shows that it has been in contact with a condensation drop at the filler head.

## Final test of sensors

After all tightness tests have been carried out, it is recommended to test the sensors again following the same methods described for installation (rubbing with the thumb or against a piece of clothing). If the same results are obtained it guarantees that measurements have been taken correctly.

# 12. Procedure for carrying out the tightness test in data recording mode
## *(Second test)*

This optional procedure involves redoing the test and recording measurements taken and after actions described in the previous chapters has been carried out.

This procedure is not time consuming as any tank preparation has already been done.

***The data to be entered into the device by the operator are:***

- The identity of the tank (up to 12 alphanumeric characters);
- The depression level applied to the tank;

  The duration of measurement-taking. One measurement per second will be recorded during the selected duration, with equal and automatic distribution of the total duration of the control on each sensor.

***The data that will automatically be recorded by the device are:***

- Full date and time stamping of the control;
- The serial numbers on the interface box and detector;
- The number of measurements made at the ratio of one measurement per second over the total duration of the test, with identification of the sensor for each measurement.

In this procedure, the succession of the different phases is predefined and presented automatically by the detector. The procedure starts with the sensor below the liquid level (**Red sensor**).

Data recorded will be printed out after uploading to a PC and can be used as proof of the test and measurements taken.

**The tightness test procedures described below apply to tanks containing diesel oil or heating oil.**

**For tanks containing or having contained a flammable and/or explosive product (petrol, etc.), the specific procedures for these types of tank (see chapter 13) must also be considered.**

## 12.1 APPLIANCES INITIAL ADJUSTING

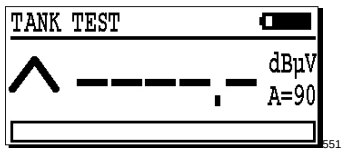
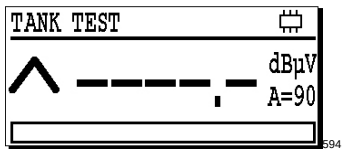
This confirmation procedure is carried out in the continuity of the test made in the previous chapters. The current state is as follows:

- Sensors are installed;
- The interface box is connected to sensors and the SDT 170 MTT;
- Taking and memorization of the reference values, steps done before the setting under negative pressure;
- The level of depression for the tank has been reached;
- The language for menus has been selected.

If this is not the case, necessary installations and work must be made as described in chapters10 and 11.

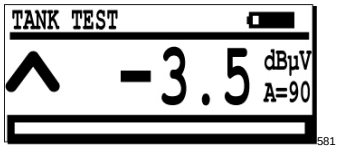
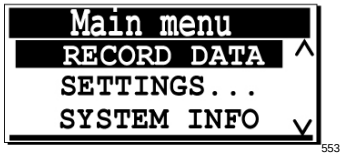
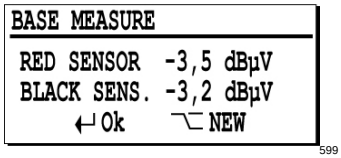
### Switching the detector on

Proceed as follows:

| N° | Screen | | Action |
|---|---|---|---|
| **1** |  |  | If the *SDT 170 MTT* has been switched off, switch on the detector. |
| **2** |  | | Before entering in record data mode, check the remaining memory capacity (icon **3%**) at the top right of the display). See paragraph 7.4 on page 30. Memory capacity corresponds to 20 hours of measurement-taking, i.e. 72,000 measurements, as the device makes one measurement per second during the recording phase. |

## 12.2 ENTERING THE TEST INFORMATIONS

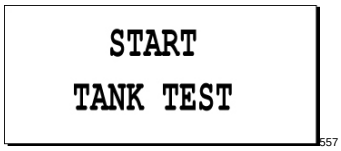
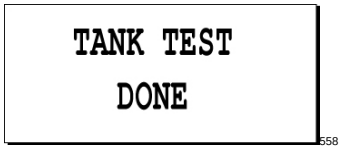
Proceed as follows:

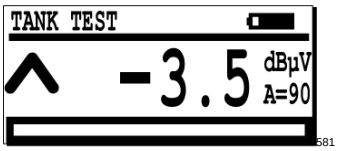
| N° | Screen | | Action |
|---|---|---|---|
| 1 |  | | Push this key to display the **Main menu**. |
| 2 |  | | Select **Record data** and … |
| | | | …confirm. |
| 3 |  | | The display shows the reference values of each sensor. The displayed measurement indicates the average of the measurements done during the 5 seconds, during the free mode test. |
| | | | Push to get next step. |
| | | | If, at this stage, the reference values are not displayed, the reference values have to be taken again. The screen of the reference of the tank is displayed.<br>- Free the setting under negative pressure.<br>- Follow steps 3 to 8 included of paragraph 11.2. |

| | | | |
|---|---|---|---|
| **4** | UNDER PRESSURE<br>0 mBar<br>555 | ↑ ↓ | Check that the correct under negative pressure has been maintained. If not, readjust.<br>Enter the relative depression applied to the tank. The maximum negative pressure value is -250 mBar (pump safety valve). This value is reached in 50 mBar steps.<br>**The value stated must be negative (-250 mBar).** |
| | | ↵ | Confirm the entered value. |
| **5** | TIME TO CAPTURE<br>0 min 0 sec<br>556 | ↑ ↓ | Select the length of time necessary to take measurements, by periods of 10 seconds. One measurement will be taken per second throughout the whole time stated, with equal and automatic distribution of the time on each of the two sensors. |
| | | ↵ | Confirm the entered value. |
| **6** | START<br>TANK TEST<br>557 | | This screen will be displayed before measurements are started manually. See the following paragraph. |
| | | ⏻ | To abandon the start of the procedure, press this key and return to the measurement screen. |

## 12.3 CARRYING OUT THE TIGHTNESS TEST IN DATA RECORDING MODE

Proceed as follows:

| N° | Screen | | Action |
|---|---|---|---|
| 1 |  | | With this screen displayed, launch the measurement procedure by pressing . |
| | | | In this mode with recording data, measurements are automatically done in Continuous mode. |
| 2 |  | | The measuring starts automatically with the submerged sensor (**Red Sensor**). The top left part of the screen indicates alternately <**Red Sensor**> and <**Tank test**>.<br>The *SDT 170 MTT* then does one measurement per second. Each measurement is then memorized for the duration of the test laid down in step 5 of § 12.2. |
| | | | ***Temporary pause during a test***<br>In order to pause during a test or cancel a test during step 2 see paragraph *Pause or cancel a test that is running* (below). |
| 3 |  | | End of automatic test display. |
| 4 | | | Push this key to return to the measurement screen. |

| | | | |
|---|---|---|---|
| **5** |  | | If necessary, the *SDT 170 MTT* can be switched off, without losing any measured data during this test.<br>***Note: measured data cannot be viewed on the detector. They must be downloaded onto a PC, as described on paragraph 12.4, on page 84.*** |
| | | | Another test on the same tank or on another tank can be launched again **without** the operator having to transfer recorded data beforehand to a PC. New data will simply be added to the end of the data sheet relating to the previous tank. When consulting all the data from the different tanks, after transfer to the PC, these data will be clearly separated and identified by the time and date for each test carried out (see *Reading displayed data*, on page 89). |

## Pausing or canceling a test that is running

### *Pausing a test*

Measurements and their recordings will be suspended during this period. No data will be lost and the test can be continued upon request from the operator. Proceed as follows:

| N° | Screen | | Action |
|---|---|---|---|
| **1** |  | | The apparatus is in measurement mode as described in point 2 of the paragraph *12.3 - Carrying out the test.* |
| **2** |  |  | Press this key to display the option screen.<br>**Measurements are stopped while this screen is displayed.** |
| **3** | |  | Press this key to start taking measurements again and return to the measurement screen. |
| **4** | | | Return to point 2 of the paragraph *12.3 - Carrying out the test.* |

### *Cancelling a test*

This action stops a test permanently. Measurements done before this permanent stoppage are memorized. Proceed as follows:

| N° | Screen | | Action |
|---|---|---|---|
| **1** |  | | The apparatus is in measurement mode as described in point 2 of the paragraph *Carrying out the test.* |
| **2** |  |  | Press this key to display the option screen.<br>**Measurements are stopped while this screen is displayed.** |
| **3** | |  | Stops the test immediately and goes back to the measurement screen. Readings previously recorded will be kept in memory but the test will be stopped permanently. . |

# 12.4 TRANSFERRING DATA FROM THE *SDT 170 MTT* TO THE PC

## Installing transfer software on the PC

To install the `Graphs & measurements` software on the PC, refer to Chapter 8 on page 35.

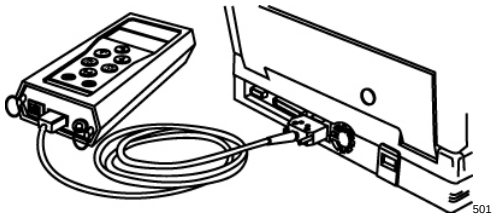
## Effective transfer of data from the *SDT 170 MTT* to the PC

**Erasing data**: transferring data from the *SDT 170 MTT* to the PC automatically erases data memorized in the *SDT 170 MTT*.

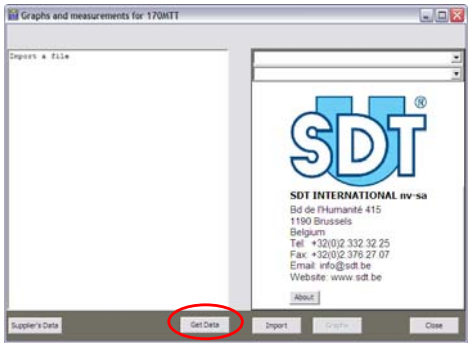
**Type of data file**: data transferred to the PC are available in a `.txt` type format.
The data files in *txt* format generated by the previous version of the application can always be used.

**Effective transfer of data**: this can only be done if the `Graphs & measurements.exe` software has been installed beforehand on the PC, as indicated in Chapter 8 on page 35.

Proceed as follows:

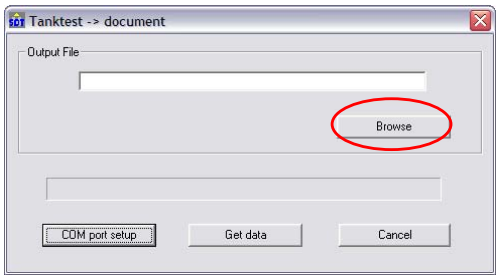
| Step | Screen displayed | Action |
|---|---|---|
| **1** |  501 | Connect the cable provided, between the *SDT 170 MTT* and the serial input (RS 232C) of the PC.<br>NB: for connection by USB cable, refer to page 41. |
| **2** | | Switch on the *SDT 170 MTT* by pressing the ⏻ key. |
| **3** |  170 MTT APP010 | On the PC, launch the application by double-clicking on the `170 MTT` icon. |

**4**



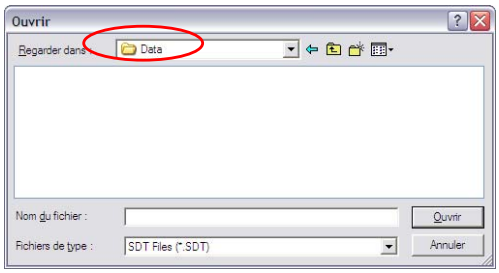

Click on the button *Get Data*.

**5**



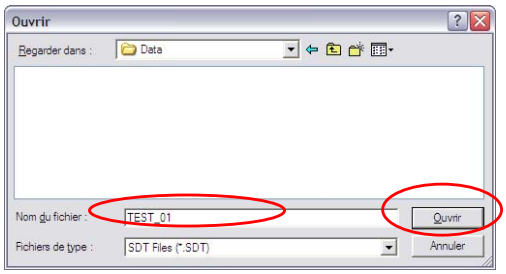

In the new window displayed, click on the *Browse* button to select the destination folder of the file to be transferred.

**6**



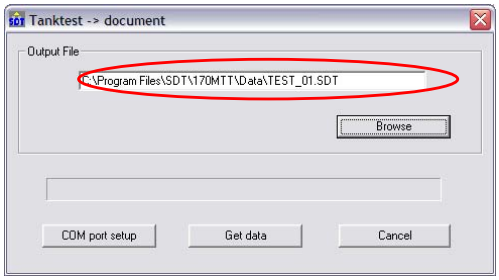

Select the folder in which the data extracted from the *SDT 170* MTT will be stored.

**7**



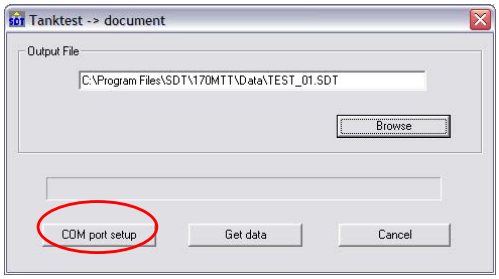

In the *File name* field, enter the name of the `.txt` type file under which the data extracted from the *SDT 170 MTT* will be stored, and click *Open*.

**8**

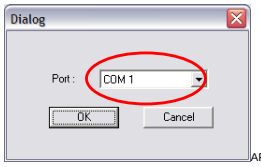
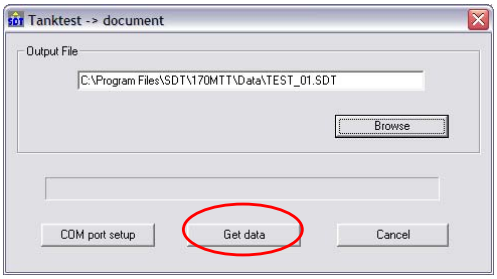
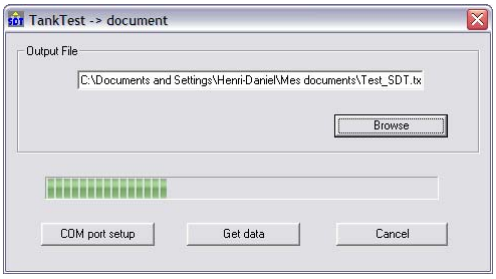
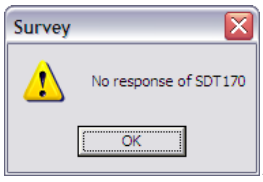


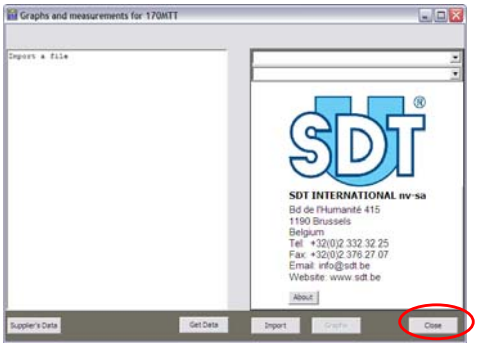

...to return to the previous window. Note that the TO address of the file to be transferred from the *SDT170 MTT* to the PC is specified in the *Output file* zone.

**9**




In the same window, click on *COM port setup*.

| | | |
|---|---|---|
| **10** |  <br>APP26 | Select the serial communication port to which the PC- *SDT 170 MTT* interconnection cable is connected, and click on *OK*. |
| **11** |  | Click on the *Get data* button to launch the transfer of data memorized by the *SDT 170 MTT* to the PC. |
| **12** |  | During transfer, a status bar indicates the loading progress. |
| |  <br>595 | During transfer of information from the *SDT 170 MTT* to the PC, the display indicates **`Remote control!!.`** |
| |  | **Once transfer to the PC has finished, all data initially memorized by the *SDT 170 MTT* will be automatically deleted from the latter's memory.** |
| |  <br>APP27 | If the message `No response of SDT 170` is displayed, you must solve one or more of the following problems:<br>- *SDT 170 MTT* switched off.<br>- Insufficient battery charge.<br>- Interconnection cable not properly connected or faulty.<br>- Wrong choice of *Com. port*. |

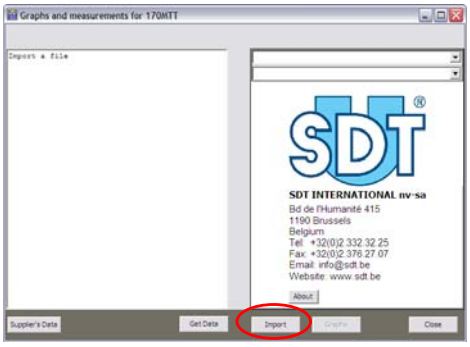
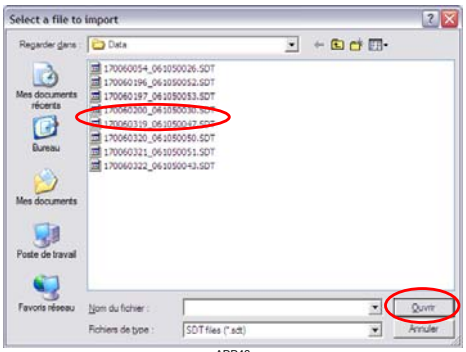
| | | |
|---|---|---|
| **13** |  | Once the transfer has finished, click on *Close* to close the `Graphs & measurements.exe` application. |

## 12.5 CONSULTING UPLOADED DATA

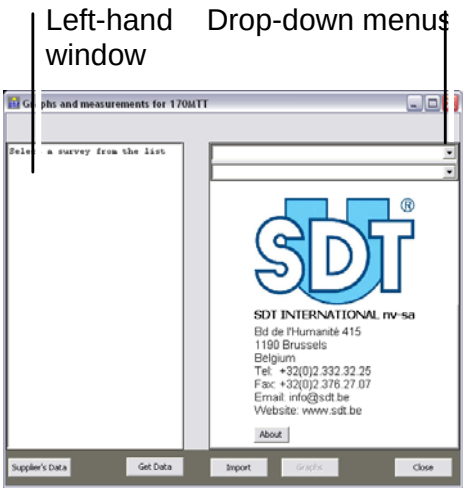
Once they have been transferred to the PC, data memorized during measurements can be consulted as follows:

### Displaying measurements in the application window

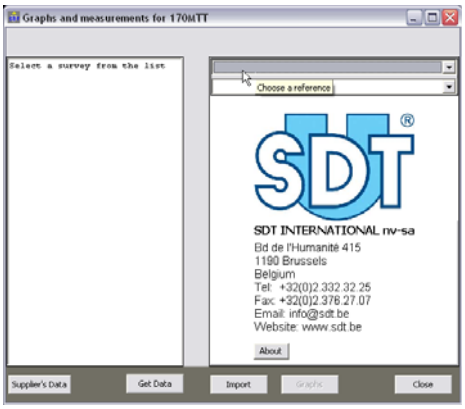
Proceed as follows:

| Step | Screen displayed | Action |
|---|---|---|
| **1** |  APP020 | Launch the `170 MTT` application. |
| **2** |  | In the window displayed, click on *Import*. |
| **3** |  APP40 | Select the file of data transferred to the hard disk and click on *Open*. To open a file generated with :<br>- the previous version of the application, select `Type of files:` `« TXT Files (*.txt)».`<br>- the current version, select `Type of files : « SDT Files (*.sdt) ».` |

**4**

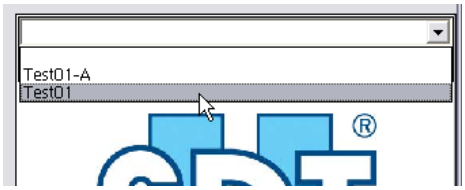



The right-hand window show two drop-down menus.



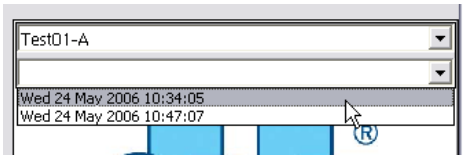

Locate the pointer of the mouse above one of these drop-down menus to display a tool-tip.

APP50



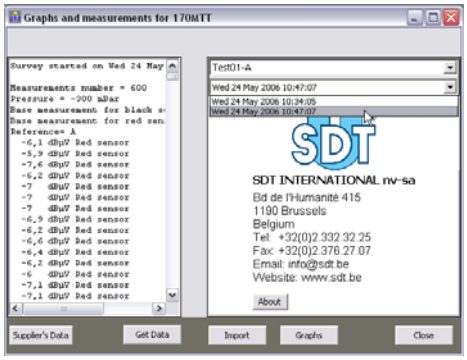

**The above drop-down menu** selects a test on the tank reference. As soon the selection is done, the lower drop-down menu displays the tests relating to this reference.

APP52




**The lower drop-down menu** displays all the tests of the imported file if no reference has been selected. In this menu, the tests are identified by their date/time line.

APP53




Click on the date/time line (right hand window) to display all the measurements and data of this test in the left hand window.

APP54

## Reading displayed data

In the left-hand part and for each test, the measurements are identified by sensor (`Red sensor=` submerged sensor and `Black sensor =` emerged sensor). These measurements are preceded by the date/time and the test identification data.

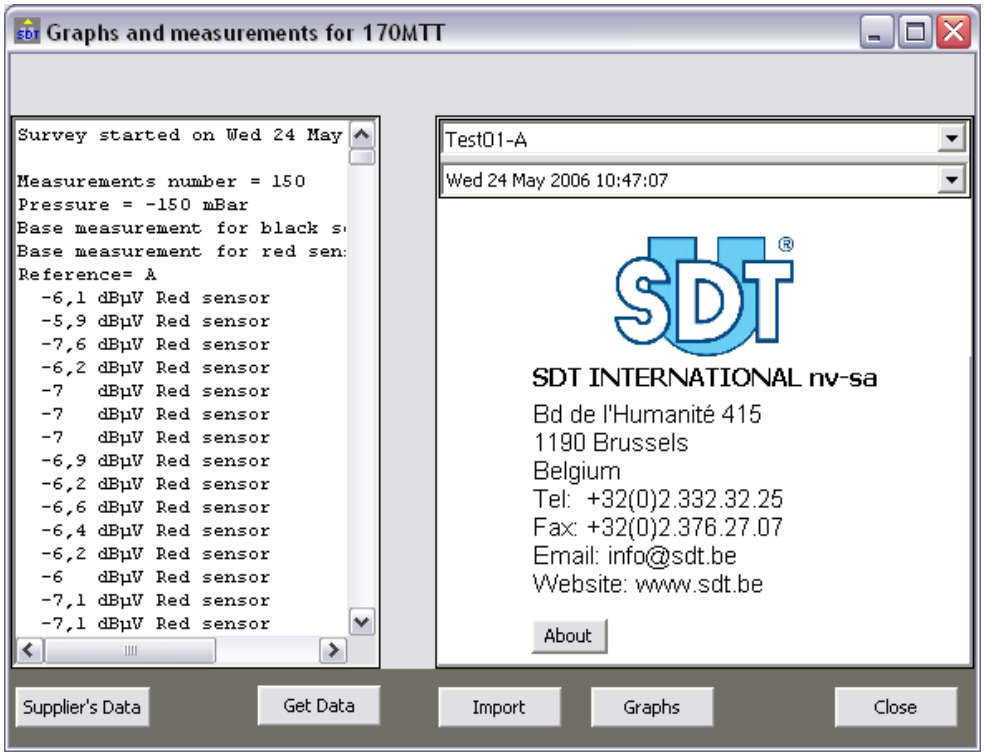



*Figure 26: Example of a window of data imported from a file.*

APP60

## Displaying the graph relating to data

1. Click on the **Graphs** button located at the bottom of the window to display the graph window.


*Figure 27: Location of the Graphs button in the application window.*

Figure 28 displays an example of a graph. The references correspond to the explanatory notes provided.

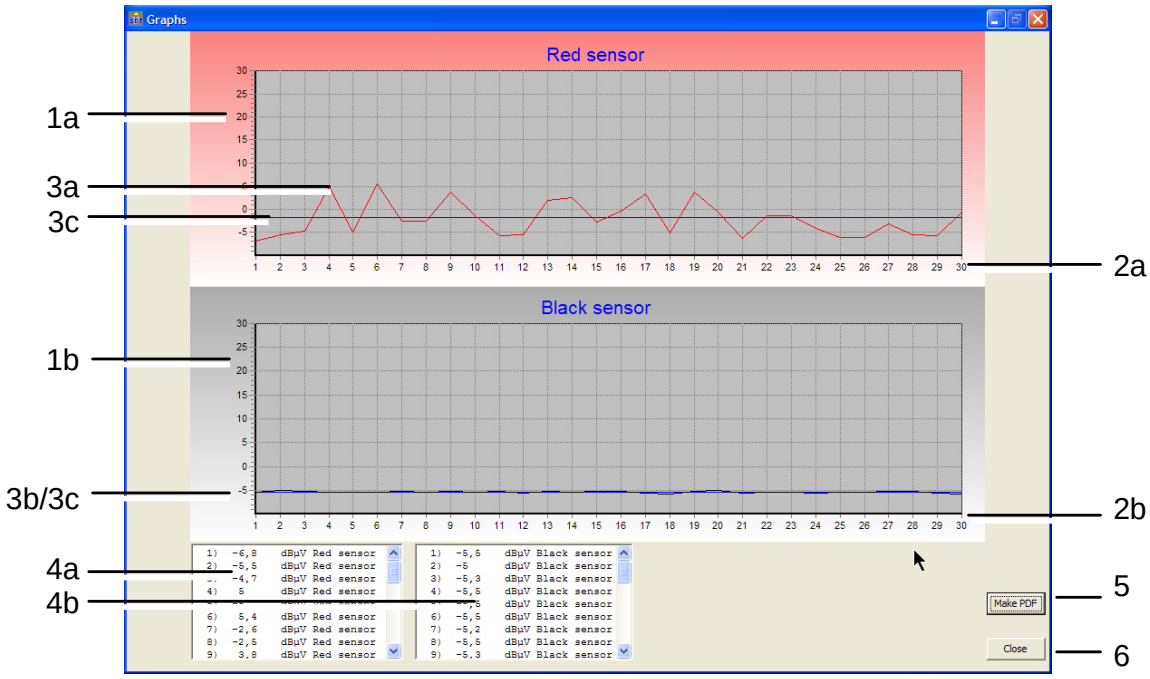



*Figure 28: Example of data displayed in graph form.*

| Ref. | Explanatory note |
|---|---|
| **1** | Vertical axis: the scale of measurements in dBµV, with maximum and minimum values from -10 to +30, for the red (ref. 1a) and the black sensors (ref. 1b). |
| **2** | Horizontal axis: the number of measurements taken by the red (ref. 2a) and black (ref. 2b) sensors at the ratio of one measurement per second over the selected duration. |
| **3** | Measurements graphs in dBµV for the red sensor (ref. 3a) and the black sensor (ref. 3b), compared to the reference horizontal blue line (3c). |
| **4** | Corresponding numerical data of the red (ref. 4a) and black (ref. 4b) sensors, separately displayed in two drop-down lists at the bottom of the window. |
| **5** | Button generating PDF file. See next paragraph. |
| **6** | Button to close the window. Returns to imported data window (see Figure 26). |

## Converting the graph into PDF format

This graph can be converted into *pdf* format for future consultation by free software *Acrobat Reader* simply by clicking on the *Make PDF* button (see Figure 28, ref. 5).

### Step 1: entering additional information about the tank

Prior to creating the *PDF* file, additional information is required via this window.

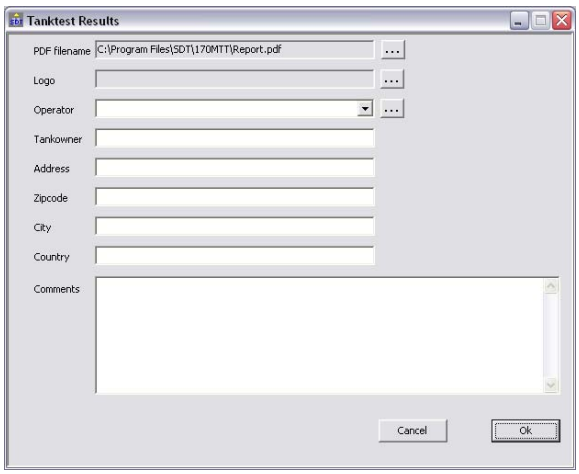



*Figure 29: Data required for creating PDF file.*

APP43

| Ref. | Explanatory note |
|---|---|
| **PDF filename** | Name of the PDF file to be generated.<br>*Warning: if any name is specified, the generated PDF file will automatically be saved under the name "report.pdf" in the directory root of the application.* |
| ... | Open a window allowing the selection of the location and the name of the file to be saved. |
| **Logo** | Name of the bmp file to be used as logo for the header of the PDF pages. |
| ... | Open a window allowing the selection of the location and the name of the BMP picture file to be used as logo. |
| **Operator** | Drop-down list showing the name of the operator who carried out the test (see also paragraph *Operator list window* on next page). |
| ... | Open a window allowing the creation of a new operator's list, add or remove an operator name (see below). |
| **Tankowner** | Name of the tank owner. |
| **Address** | Address of the tank tested. |
| **City** | Town/city. |
| **Zip** | Zipcode. |
| **Country** | Country. |
| **Comments** | Open comment, generally relating to the test. |
| **OK** | Clicking on this button launches the creation of a corresponding PDF file. |

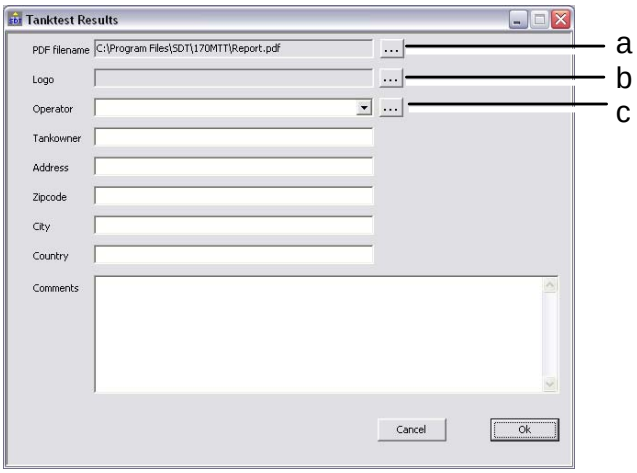



*Figure 30 : Reminder of the window for data required for creating PDF file.*

APP43

## Operator list window

To add an operator, enter the operator's name (Figure 31, rep. 1) and click *Add* (rep. 3). The name will be displayed in the list (rep. 2) and then in the drop-down list labeled *Operator* of the windows *Tanktest Results* (Figure 29 and Figure 31).

To erase an operator's name, just select it in the list (rep. 2) and click Delete (rep. 4).

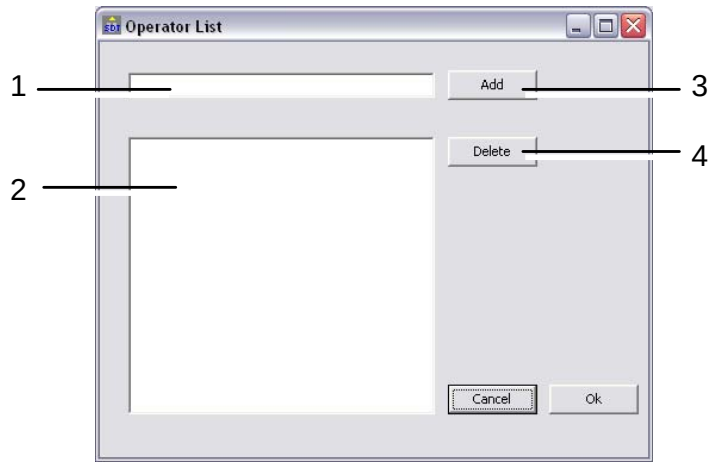
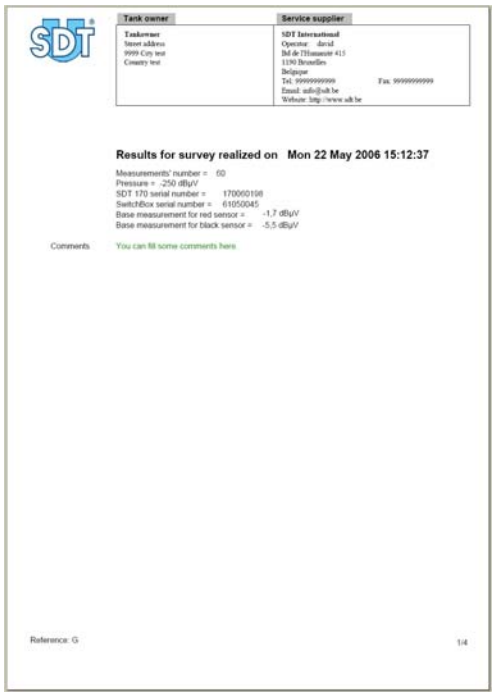



*Figure 31 : This window allows the creation of the operator's list.*

## Step 2: displaying the created PDF file

After a few seconds, the *pdf* file created is automatically displayed by the *Acrobat Reader* application freely available to download. The inspection report is presented as follows:

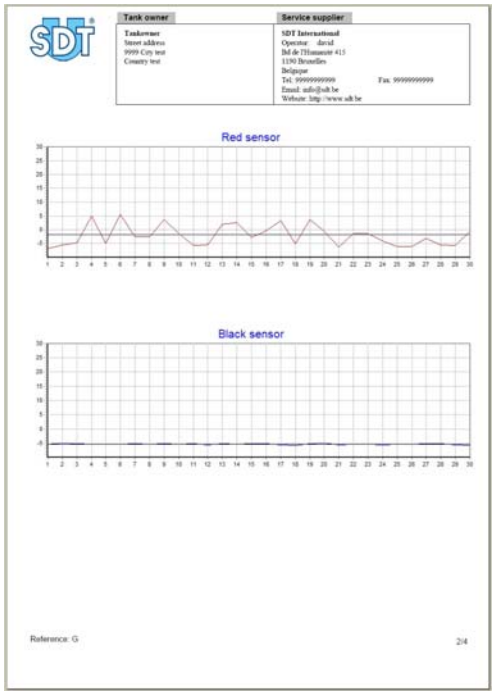



The header of each page of the report shows, from the left to the right :

- The logo of the firm;
- A zone containing the data relating to the owner of the tank;
- A zone containing the name of the operator having carry out the test and all identification data of this firm (data entered during parameterization of the application - see paragraph 8.3, page 38).

At the bottom of each page of the report is given the reference assigned to the tank and the page numbering.

The first page get back all test identification data entered through the date/time line, as well as possible comments. APP45




The second page shows the two test measurement graphs, one graph per sensor.

APP46


The third and following pages gather all the test's numerical measurements, for each sensor, on separated pages and in as much pages as necessary.

APP47

*Figure 32 : Data shown after generation of the PDF file.*

## Step 3: printing the created PDF file

Print these pages by clicking on the *Print* button in the *Acrobat Reader* application or through its *File/Print* menu.

If necessary, close the *Acrobat Reader* application or return to the *Graphs & measurements* application by clicking on the taskbar on the 

icon.

*Acrobat Reader* ® is a registered trademark of *Adobe Inc*.

*Graphs & measurements* is not a software package endorsed by *Adobe* ®. Any reference to *Acrobat Reader* ® is for information purposes only.

*4rd part*

# Appendix

# 13. Specific procedure for petrol tanks

## 13.1 SPECIFIC OPERATIONS

**For tanks containing or having contained petrol or a flammable and/or explosive liquid you must follow the same procedure as the one in controlling the tightness of the tanks containing gas oil while complying with the following specificities.**

- You must carry out the check with the rubber ex-proof suction and exhaustion hoses and using the ex-proof vacuum pump (options EXPROOF available from SDT).
  Note: you must connect the switchbox interface to the earth using the elements supplied.
- Check that the pump contains sufficient oil. Start it with the valves closed and leave it at preheat for 10 to 15 minutes.
- You can **never pressurize** the tank**.**
- You must pay strict attention to safety local standards.
- You must take into account the distillation temperature of the fuel to calculate the vacuum to be created in the tank.

**Distillation temperature of the fuels under atmospheric pressure**

Note: the distillation temperature is also called the boiling point.

Graph P = f (T°) (see paragraph on page 110) shows that the higher the vacuum (decrease in pressure P), the lower the boiling point (T).

It is therefore necessary to check the value of the vacuum applicable to the tank to prevent the fuel from vaporizing. See paragraph 14.3, *Link between boiling point and pressure*, on page 109.

| | Supergreen petrol | Super petrol | Unleaded petrol | Diesel oil / Heating oil |
|---|---|---|---|---|
| Density at 15 ° C | 0.765 | 0.755 | 0.768 | 0.842 |
| ° C start of distillation | 34 | 33 | 34 | 180 |
| Distillation 10 % vol. | 60 | 58 | 60 | 220 |
| Distillation 50 % vol. | 100 | 95 | 100 | 280 |
| Distillation 90 % vol. | 158 | 158 | 160 | 340 |
| ° C end of distillation | 192 | 192 | 198 | 370 |
| Residue | 1.0 | 1.0 | - | 1.5 |

## Calculation examples

*(see Pressure/Temperature chart* on page 111).

**Note**

Practical vacuum = value of the vacuum necessary to overcome the hydrostatic pressure of the liquid ($V_p = H_{liq} \times 100$ mBar x $d_{liq}$ ).

*$V_p$ = Practical vacuum* *$d_{liq}$ = density of the liquid* *$H_{liq}$ = height of the liquid*

Theoretical vacuum = maximum vacuum value applicable to the tank (according to the Pressure / Temperature chart).

***Example 1***

- The temperature of an underground fuel tank is 10 °C. The tank contains 1.50 m of super petrol. The density is 0.75.
- The practical vacuum is: (1.5 m x 100 mBar) x 0.75 ($d_{liq}$) = 113 mBar.
- The theoretical vacuum given in the chart is 450 mBar (paragraph 14.3, on page 109).

***Example 2***

- The tank is filled with 2.5 m of super petrol. The following rule is applied: Practical vacuum = 2.5 m x 100 mBar x 0.75 (density of the super petrol) = 187 mBar.
- If the temperature in the tank is 10°C, you can achieve a theoretical vacuum of 450 mBar without the risk of the fuel evaporating (temperature at start of distillation = 33°C).

***Example 3***

- Diesel oil / Heating oil: temperature at start of distillation = 180°C.
- If the temperature in the tank is 50°C, you can achieve an absolute theoretical vacuum without the risk of evaporation (see chart on page 111).

## 13.2 SAFETY INSTRUCTIONS

- You must have at hand a powder type fire extinguisher of a minimum of 6 kg.
- Under no circumstances must the tools used for assembly and dismantling create any sparks.
- Smoking or producing fire in the working area and in the vicinity of the exhaust opening of the vapors is strictly prohibited.
- Clearly legible panels (or statutory pictograms) in accordance with the local Regulations for protection of the workplace will be posted to highlight this ban, to point out that a tank of flammable liquid is being checked and to mark out a sufficiently large safety area inaccessible to any person not involved in the check being carried out.
- The vapors from the flammable liquids are recovered in a suitable tank or passed out into the air through a vertical exhaust opening located at a minimum height of 3 meters.
- The vacuum pump must work in the open air and at least 3 meters from the manhole of the tank.

## 13.3 SAFETY MARKINGS

### Marking on sensors

The marking indicates:

- The article code of the sensor: OQBP2501
- The code of the ISSEP certifying authority: 0492
- The type of protection in accordance with Directive 94/9/CE (ATEX): ⟨Ex⟩ II 1G
- The type of protection in accordance with standard EN50014: EEx ia II C T6
- The maximum power supply parameters: $U_{max}$ = 28V, $I_k$ = 93.3A
- Internal parameters: Ci = 9.4nF, Li = 4 µH

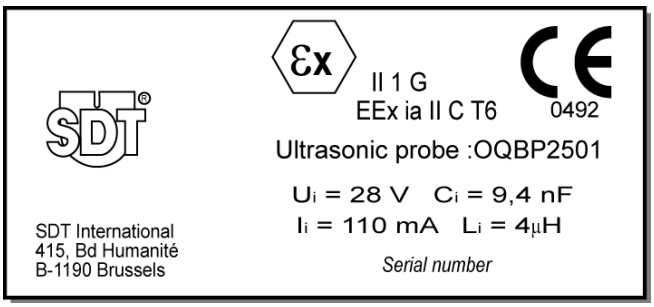



*Figure 33: Detail of marking on sensors.*

## Marking on interface box

The marking indicates:

- The article code of the box: FUTTSWBOX170
- The code of the ISSEP certifying authority: 0492
- The type of protection in accordance with Directive 94/9/CE (ATEX): II (1)G
- The type of protection in accordance with standard EN50014: [EEx ia ] II C.

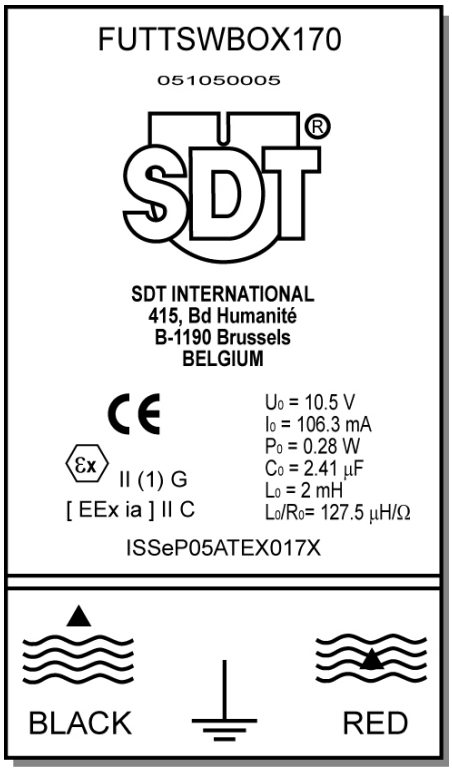



*Figure 34: Detail of marking on interface box.*

# 14. Useful information for calculation

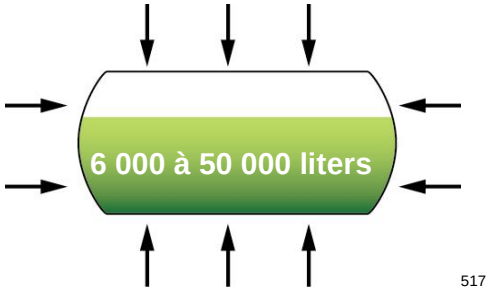
## 14.1 PRESSURE UNITS CONVERSION TABLE

| | Bar | Pascal | m CE | kg/cm² | Atmosphere | lb per Sq inch (P.S.I) |
|---|---|---|---|---|---|---|
| **1 bar** | 1 | $10^5$ | 10,2 | 1,02 | 0,987 | 14,5 |
| **1 pascal** | $10^{-5}$ | 1 | $102\ 10^{-6}$ | $10{,}2.10^{-6}$ | $9{,}87\ 10^{-6}$ | $0{,}145\ 10^{-3}$ |
| **1 m CE** | $98{,}1\ 10^{-3}$ | $9{,}81\ 10^{-3}$ | 1 | 0,1 | $96{,}8\ 10^{-3}$ | 1,42 |
| **1 kg/cm²** | 0,981 | $98{,}1\ 10^{3}$ | 10 | 1 | 0,968 | 14,2 |
| **1 Atm.** | 1,013 | $101{,}3\ 10^{3}$ | 10,33 | 1,033 | 1 | 14,7 |
| **1 lb per Sq inch (P.S.I)** | $68{,}9\ 10^{-3}$ | $6{,}89\ 10^{3}$ | 0,703 | $70{,}3\ 10^{-3}$ | $68{,}0\ 10^{-3}$ | 1 |

## 14.2 THE RESISTANCE TO DISTORTION CALCULATION

### Roark - Young formula

***Standard fuel tanks***




Example 1: Thickness of the metal sheet 3mm, Ø 1.27m, length 5.25m.

Example 2: Thickness of the metal sheet 6mm, Ø 2.5m, length 10m.

Method of calculating resistance to distortion due to the external pressure (= internal vacuum).

Calculations based on an empty tank placed on the ground (without any support or earth around the tank).

$$q' = \frac{E\frac{t}{r}}{1+\frac{1}{2}\left(\frac{\pi r}{nl}\right)^2}\left\{\frac{1}{n^2\left[1+\left(\frac{nl}{\pi r}\right)^2\right]^2}+\frac{n^2t^2}{12r^2\left(1-v^2\right)}\left[1+\left(\frac{\pi r}{nl}\right)^2\right]^2\right\}$$

*(n* = number of parts making up the tank*)*

To determine q' with a given t/r, plot a number of curves; a curve for each integral value of n of 2 or more, with l/r on the Y-axis and q' on the X-axis; the curve that gives the lowest value for q' is then used to determine q' for a given l/r.

If $60 < \left(\frac{l}{r}\right)^2\left(\frac{r}{t}\right) < 2.5\left(\frac{r}{t}\right)^2$, then the critical pressure can be estimated by

$$q' = \frac{0.92E}{\left(\frac{l}{r}\right)\left(\frac{r}{t}\right)^{2.5}}$$

The pressure values determined experimentally vary by 20% above and below the theoretical values obtained with the formulae given above. A minimum acceptable pressure of 0.80q' is recommended.

q' = resistance in kg/cm² or Bar

r = radius in cm

l = length in cm

t = thickness of the sheet metal in cm

E = modulus of elasticity for steel $2{,}1.10^6$ kg/cm²

Example 1: $\frac{0{,}92\left(2{,}1.10^6\right)}{\left(\frac{525}{63{,}5}\right)\left(\frac{63{,}5}{0{,}3}\right)^{2{,}5}} = 0{,}3585 kg/cm^2 = 0{,}358 Bar = 358 mBar$

Example 2:

$$\frac{0,92\left(2,1.10^{6}\right)}{\left(\frac{525}{63,5}\right)\left(\frac{63,5}{0,3}\right)^{2,5}} = 0,3585 kg/cm^{2} = 0,358 Bar = 358 mBar$$

Care should be taken when checking old tanks, which could present a considerable reduction in wall thickness (corrosion).

**For old tanks for which is no data available, it is advisable to check them when they contain a small amount of liquid to keep the pressure as low as possible.**

**For high capacity tanks higher to 50.000 liters and/or with a liquid height greater than 2 meters, one must take account of the precise calculation of resistance to distortion and of necessity drain up to this maximum height of 2 meters to allow a depression higher than the hydrostatic pressure of the liquid.**

## Table of the maximum permissible vacuum

*Source: ROARK'S formulas for stress and strain - 6th edition, chap 14, tab 35, item 20.*

Elastic stability of steel tanks put under vacuum.

Wall of the tank without strengthening hoops.

### Acceptable external pressure (vacuum) Q' (kg/cm$^2$)

r: radius

l: length

t: thickness of the wall

Determine the values of r/t et l/r and read the maximum acceptable depression (external pressure) in the table (Q').

Experimental values for the critical pressure vary by ± 20 %.

### *Table Q' following value r/t on l/r*

| r/t / l/r | 150 | 160 | 170 | 180 | 190 | 200 | 210 | 220 | 230 | 240 | 250 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **3** | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0,9 | 0,8 | 0,72 | 0,65 |
| **3,2** | 1 | 1 | 1 | 1 | 1 | 1 | 0,94 | 0,84 | 0,75 | 0,68 | 0,61 |
| **3,4** | 1 | 1 | 1 | 1 | 1 | 1 | 0,89 | 0,79 | 0,71 | 0,64 | 0,58 |
| **3,6** | 1 | 1 | 1 | 1 | 1 | 0,95 | 0,84 | 0,75 | 0,67 | 0,6 | 0,54 |
| **3,8** | 1 | 1 | 1 | 1 | 1 | 0,9 | 0,8 | 0,71 | 0,63 | 0,57 | 0,51 |
| **4** | 1 | 1 | 1 | 1 | 0,97 | 0,85 | 0,76 | 0,67 | 0,6 | 0,54 | 0,49 |
| **4,2** | 1 | 1 | 1 | 1 | 0,92 | 0,81 | 0,72 | 0,64 | 0,57 | 0,52 | 0,47 |
| **4,4** | 1 | 1 | 1 | 1 | 0,88 | 0,78 | 0,69 | 0,61 | 0,55 | 0,49 | 0,44 |
| **4,6** | 1 | 1 | 1 | 0,97 | 0,84 | 0,74 | 0,66 | 0,59 | 0,52 | 0,47 | 0,43 |
| **4,8** | 1 | 1 | 1 | 0,93 | 0,81 | 0,71 | 0,63 | 0,56 | 0,5 | 0,45 | 0,41 |
| **5** | 1 | 1 | 1 | 0,89 | 0,78 | 0,68 | 0,6 | 0,54 | 0,48 | 0,43 | 0,39 |
| **5,2** | 1 | 1 | 0,99 | 0,85 | 0,75 | 0,66 | 0,58 | 0,52 | 0,46 | 0,42 | 0,68 |
| **5,4** | 1 | 1 | 0,95 | 0,82 | 0,72 | 0,63 | 0,56 | 0,5 | 0,45 | 0,4 | 0,36 |
| **5,6** | 1 | 1 | 0,92 | 0,79 | 0,69 | 0,61 | 0,54 | 0,48 | 0,43 | 0,39 | 0,35 |
| **5,8** | 1 | 1 | 0,88 | 0,77 | 0,67 | 0,59 | 0,52 | 0,46 | 0,42 | 0,37 | 0,34 |
| **6** | 1 | 0,99 | 0,85 | 0,74 | 0,65 | 0,57 | 0,5 | 0,45 | 0,4 | 0,36 | 0,33 |
| **6,2** | 1 | 0,96 | 0,83 | 0,72 | 0,63 | 0,55 | 0,49 | 0,43 | 0,39 | 0,35 | 0,32 |
| **6,4** | 1 | 0,93 | 0,8 | 0,69 | 0,61 | 0,53 | 0,47 | 0,42 | 0,38 | 0,34 | 0,31 |
| **6,6** | 1 | 0,9 | 0,78 | 0,67 | 0,59 | 0,52 | 0,46 | 0,41 | 0,36 | 0,33 | 0,3 |
| **6,8** | 1 | 0,88 | 0,75 | 0,65 | 0,57 | 0,5 | 0,44 | 0,4 | 0,35 | 0,32 | 0,29 |
| **7** | 1 | 0,85 | 0,73 | 0,63 | 0,55 | 0,49 | 0,43 | 0,38 | 0,34 | 0,31 | 0,28 |
| **7,2** | 0,97 | 0,83 | 0,71 | 0,62 | 0,54 | 0,47 | 0,42 | 0,37 | 0,33 | 0,3 | 0,27 |
| **7,4** | 0,95 | 0,81 | 0,69 | 0,6 | 0,52 | 0,46 | 0,41 | 0,36 | 0,33 | 0,29 | 0,26 |
| **7,6** | 0,92 | 0,79 | 0,67 | 0,58 | 0,51 | 0,45 | 0,4 | 0,35 | 0,32 | 0,28 | 0,26 |
| **7,8** | 0,9 | 0,76 | 0,66 | 0,57 | 0,5 | 0,44 | 0,39 | 0,35 | 0,31 | 0,28 | 0,25 |
| **8** | 0,88 | 0,75 | 0,64 | 0,56 | 0,49 | 0,43 | 0,38 | 0,34 | 0,3 | 0,27 | 0,24 |
| **8,2** | 0,85 | 0,73 | 0,63 | 0,54 | 0,47 | 0,42 | 0,37 | 0,33 | 0,29 | 0,26 | 0,24 |
| **8,4** | 0,83 | 0,71 | 0,61 | 0,53 | 0,46 | 0,41 | 0,36 | 0,32 | 0,29 | 0,26 | 0,23 |

*See next page.*

| r/t<br>l/r | 150 | 160 | 170 | 180 | 190 | 200 | 210 | 220 | 230 | 240 | **250** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **8,6** | 0,82 | 0,69 | 0,6 | 0,52 | 0,46 | 0,4 | 0,35 | 0,31 | 0,28 | 0,25 | 0,23 |
| **8,8** | 0,8 | 0,68 | 0,58 | 0,51 | 0,44 | 0,39 | 0,34 | 0,31 | 0,27 | 0,25 | 0,22 |
| **9** | 0,78 | 0,66 | 0,57 | 0,49 | 0,43 | 0,38 | 0,34 | 0,3 | 0,27 | 0,24 | 0,22 |
| **9,2** | 0,76 | 0,65 | 0,56 | 0,48 | 0,42 | 0,37 | 0,33 | 0,29 | 0,26 | 0,24 | 0,21 |
| **9,4** | 0,75 | 0,63 | 0,55 | 0,47 | 0,41 | 0,36 | 0,32 | 0,29 | 0,26 | 0,23 | 0,21 |
| **9,6** | 0,73 | 0,62 | 0,53 | 0,46 | 0,4 | 0,36 | 0,31 | 0,28 | 0,25 | 0,23 | 0,2 |
| **9,8** | 0,72 | 0,61 | 0,52 | 0,45 | 0,4 | 0,35 | 0,31 | 0,27 | 0,25 | 0,22 | 0,2 |
| **10** | 0,7 | 0,6 | 0,51 | 0,44 | 0,39 | 0,34 | 0,3 | 0,27 | 0,24 | 0,22 | 0,2 |
| **10,2** | 0,69 | 0,58 | 0,5 | 0,44 | 0,38 | 0,33 | 0,3 | 0,26 | 0,24 | 0,21 | 0,19 |
| **10,4** | 0,67 | 0,57 | 0,49 | 0,43 | 0,37 | 0,33 | 0,29 | 0,26 | 0,23 | 0,21 | 0,19 |
| **10,6** | 0,66 | 0,56 | 0,48 | 0,42 | 0,37 | 0,32 | 0,29 | 0,25 | 0,23 | 0,2 | 0,18 |
| **10,8** | 0,65 | 0,55 | 0,47 | 0,41 | 0,36 | 0,32 | 0,28 | 0,25 | 0,22 | 0,2 | 0,18 |
| **11** | 0,64 | 0,54 | 0,47 | 0,4 | 0,35 | 0,31 | 0,27 | 0,24 | 0,22 | 0,2 | 0,.18 |
| **11,2** | 0,63 | 0,53 | 0,46 | 0,4 | 0,35 | 0,3 | 0,27 | 0,24 | 0,22 | 0,19 | 0,17 |
| **11,4** | 0,61 | 0,52 | 0,45 | 0,39 | 0,34 | 0,3 | 0,27 | 0,24 | 0,21 | 0,19 | 0,17 |
| **11,6** | 0,6 | 0,51 | 0,44 | 0,38 | 0,33 | 0,29 | 0,26 | 0,23 | 0,21 | 0,19 | 0,17 |
| **11,8** | 0,59 | 0,51 | 0,43 | 0,38 | 0,33 | 0,29 | 0,26 | 0,23 | 0,2 | 0,18 | 0,17 |
| **12** | 0,58 | 0,5 | 0,43 | 0,37 | 0,32 | 0,28 | 0,25 | 0,22 | 0,2 | 0,18 | 0,16 |
| **12,5** | 0,56 | 0,48 | 0,41 | 0,36 | 0,31 | 0,27 | 0,24 | 0,22 | 0,19 | 0,17 | 0,16 |
| **13** | 0,54 | 0,46 | 0,39 | 0,34 | 0,3 | 0,26 | 0,23 | 0,21 | 0,19 | 0,17 | 0,15 |
| **13,5** | 0,52 | 0,44 | 0,38 | 0,33 | 0,29 | 0,25 | 0,22 | 0,2 | 0,18 | 0,16 | 0,14 |
| **14** | 0,5 | 0,43 | 0,37 | 0,32 | 0,28 | 0,24 | 0,22 | 0,19 | 0,17 | 0,15 | 0,14 |
| **14,5** | 0,48 | 0,41 | 0,35 | 0,31 | 0,27 | 0,24 | 0,21 | 0,19 | 0,17 | 0,15 | 0,13 |
| **15** | 0,47 | 0,4 | 0,34 | 0,3 | 0,26 | 0,23 | 0,2 | 0,18 | 0,16 | 0,14 | 0,13 |
| **15,5** | 0,45 | 0,38 | 0,33 | 0,29 | 0,25 | 0,22 | 0,2 | 0,17 | 0,16 | 0,14 | 0,13 |

## 14.3 LINK BEWTEEN BOILING POINT AND PRESSURE

### Clapeyron's integrated equation

$$\ln P = \frac{-\Delta H}{R} \cdot \frac{1}{T} + Cte \quad (1)$$

where:

P : pressure (in atm.)

$\Delta$H : molar evaporation heat, specific to each material; expressed in J $mol^{-1}$

R : universal gas constant = 8,314 J $K^{-1}$ $mol^{-1}$

T : absolute temperature in °K

Cte : constant value that can be determined from the normal boiling point ($T_{kp,n}$) where P = 1 atmosphere.

$$\Rightarrow \ln P \Rightarrow \ln 1 = 0 = \frac{-\Delta H}{R} \cdot \frac{1}{T_{kp,\,n}} + Cte$$

$$\Rightarrow Cte = \frac{\Delta H}{R} \cdot \frac{1}{T_{kp,\,n}} \quad (2)$$

Combination of (1) and (2) gives:

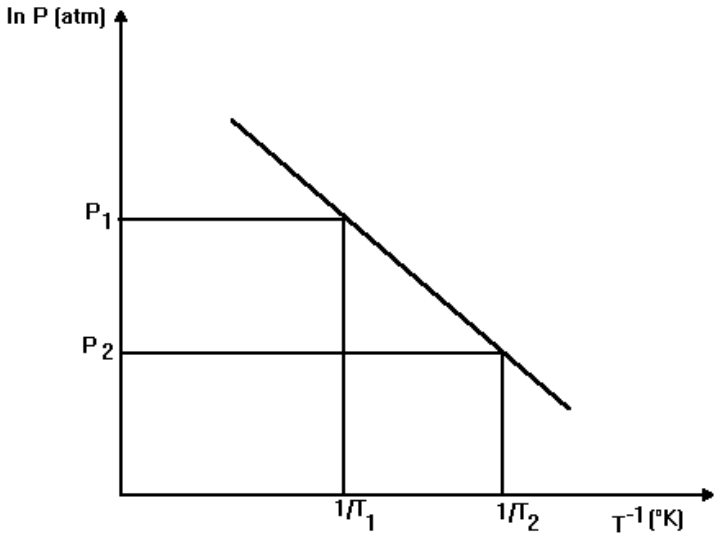
$$\ln P = \frac{-\Delta H}{R} \cdot \frac{1}{T} + \frac{\Delta H}{R} \cdot \frac{1}{T_{kp,\,n}} = \frac{\Delta H}{R}\left(\frac{1}{T_{kp,\,n}} - \frac{1}{T}\right)$$

Or, depending on the temperature:

$$\frac{R}{\Delta H} \ln P = \frac{1}{T_{kp,\,n}} - \frac{1}{T}$$

$$\Rightarrow \frac{1}{T} = \frac{1}{T_{kp,\,n}} - \frac{R}{\Delta H} \ln P \quad \text{(equation in the form: } \frac{1}{Y} = b - ax\text{)}$$

## Diagram InP = f ($T^{-1}$)




So, for a decrease in pressure ($P_2$) there is an increase of $1/T_2$ i.e. a lower temperature T.

***Note***

For the boiling point to be calculated exactly, ΔH, the evaporation heat of the first fraction of petrol, must be known. The pressure-temperature chart (see following page) uses an extrapolated ΔH value, which gives a sufficient approximation of the boiling point reduction when the pressure is reduced, for most products. Therefore, one can accept, with a certain degree of safety, that the values shown in the graph are correct.

***Example for super petrol***

*Tank T°: 10 ° C*

*Lowest distill T°: 33 ° C*

*Max. acceptable vacuum: 600 mBar relative (theoretical).*

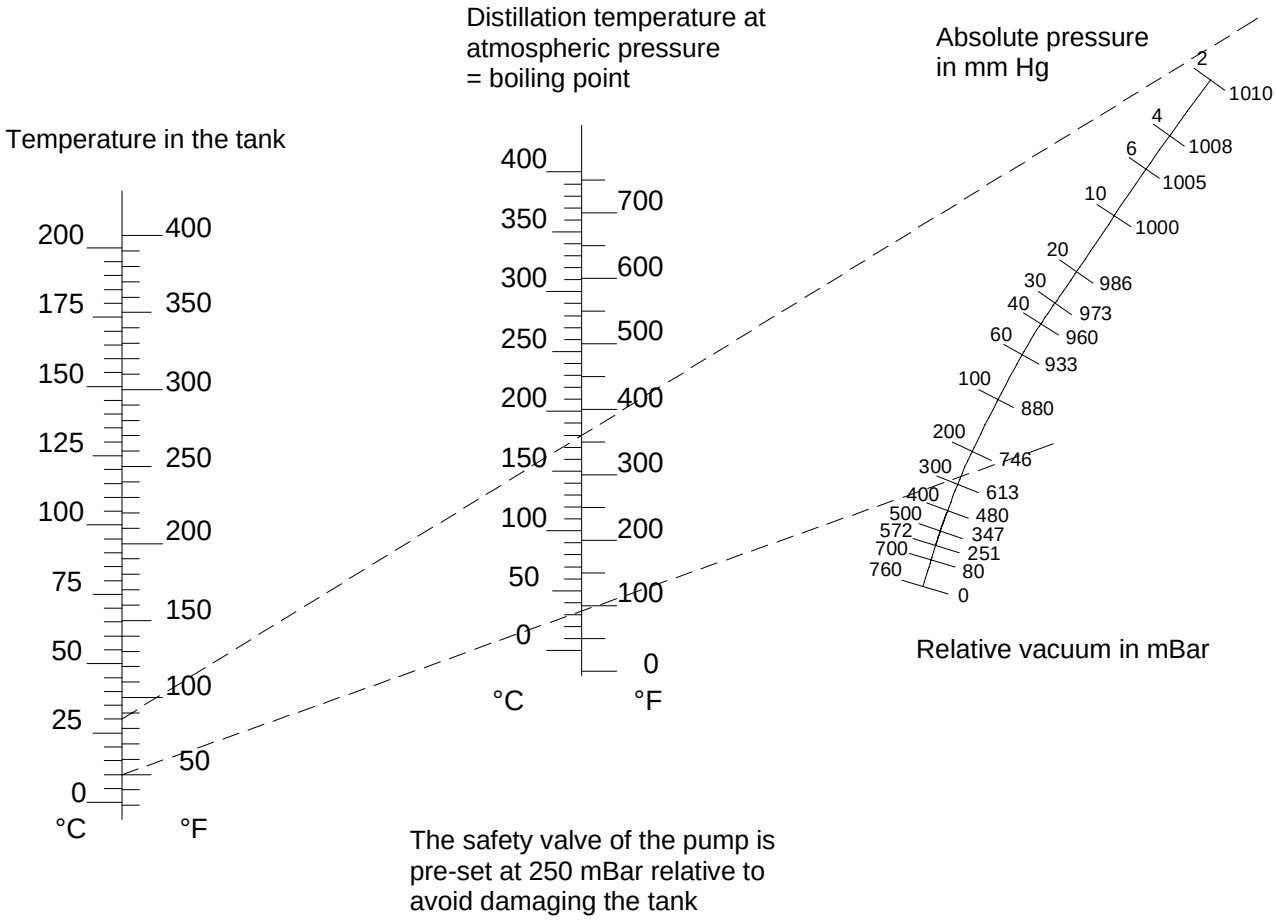
***Example for Diesel oil***

*Tank T°: 30 ° C*

*Lowest distill T°: 180 ° C*

*Absolute vacuum allowed (theoretical) NEVER in practice to avoid damaging the tank.*

# Pressure/Temperature chart




The safety valve of the pump is pre-set at 250 mBar relative to avoid damaging the tank

# 15. Technical specifications

This chapter presents the main characteristics of the *SDT 170 MTT* and its sensors. The detailed characteristics and specificities of the *SDT 170 MTT* are those of the *SDT 170,* which are listed in the *SDT 170 User's manual*.

## 15.1 SDT 170 MTT

| | |
|---|---|
| Function | Multifunction detector. |
| Display | LCD graphic display with backlight. |
| Keyboard | Eight (8) functions keys. |
| Ultrasonic sensor | Integrated. |
| External sensors | Through dedicated connector (LEMO 7 pins). |
| Data Logger | **For tank tightness tests in data recording mode**: identification of the tank, level of negative pressure, length of time for the test, measurements taken in dbµV.<br>The memorizable number of controls varies according to the number of memorized data and the duration of the control. The memory capacity corresponds to 20 hours of measurement-taking, i.e. 72,000 measurements as the device makes one measurement per second during the recording phase.<br>**For other ultrasonic and non-ultrasonic applications**: see features of the *SDT 170 M* in the *SDT 170* user's manual. |
| Communication | Communication interface RS 232C (19,2 kB).<br>**For tank tightness tests in data recording mode**: detector to PC transfer software called "**`Graphs & measurements`**", supplied on CD-Rom.<br>This software can be downloaded on our site **`ftp://ftp.sdt.be`** or transferred on request by e-mail.<br>**For other ultrasonic and non-ultrasonic applications**: see features of the *SDT 170 M* in the *SDT 170* user's manual. |

| | |
|---|---|
| Battery pack | Rechargeable NiMH (Nickel Metal Hydrate).<br>Autonomy of 8 to 10 hours without backlighting.<br>Recharge time: 5 to 6 hours.<br>Nominal Capacity: 1.5 Ah.<br>Life span: 500 to 1,000 charge/discharge cycles.<br>Recharge only with appropriate SDT charger. |
| Auto power down | Auto power down after preset time. |
| Operating temp. | -15 °C to +60 °C / 14 °F to 140 °F. |
| Housing | Extruded aluminum. |
| Weight | 750 g / 26.45 oz. (with battery and holster included). |
| Dimensions | 225 x 90 x 40 mm / 8.86 x 3.54 x 1.57inches (L x W x H). |
| Holster | Rubber resistant to hydrocarbons (fluor silicone). |
| Headphones | 130 dB, noise isolating. |

## 15.2 EXTERNAL ULTRASONIC SENSORS

| | |
|---|---|
| Tight sensors | Type OQBP2501. |
| Certification | Sensors certified in accordance with Directive 94/9/CE (ATEX) (certificate below). |
| Resistance | to hydrocarbons: yes.<br>to hydrostatic pressure: 1 Bar. |
| Temperature of use | -30 to + 80 °C. |
| Sensitive element | Piezo-electrical (f resonance = 40 kHz) |
| Sensitivity | - 67 db / V / µ Bar. |
| External diameter | 32 mm (sensor 25 mm). |
| Interface box | aluminium. |
| Length of the connection cable | 5 m (5 m extension as option). |
| Sheath | NBR (Acrylonitrile) or *Viton* as option. |

## 15.3 INTERFACE BOX (SWITCHBOX)

This box also encloses an intrinsically safe barrier.

- Intrinsic safety connection interface between *SDT 170 MTT* sensors and detector (certificate below).
- Diode-type protection.
- Electrical characteristics:
  - Uo = 10.5 V
  - Io = 106.3 mA
  - Po = 0.28 W
  - Co = 2.41 µF
  - Lo = 2mH
  - Lo/Ro = 127.5µH/Ohm.

The safety values of a protective barrier refer to the maximum voltage at output diode terminals and to the maximum value of the corresponding short-circuit current. They give an indication of the energy that can be generated at the explosive range and **not** of the maximum permissible working voltage.

# 16. Certificate of conformity of the sensors and interface box

The certificates of conformity of the sensors and interface box are presented in the following pages.

Institut Scientifique de Service Public

(1) **EC TYPE EXAMINATION CERTIFICATE**

(2) **Equipment or protective system intended for use in potentially explosive atmospheres Directive 94/9/EC**

(3) EC type examination certificate number: **ISSeP03ATEX139X**

(4) Equipment or protective system:
Impervious ultrasonic probe type OQBP2501

(5) Applicant – Manufacturer – ~~Authorized representative in the Community~~:
SDT INTERNATIONAL S.A. N.V.

(6) Address: Boulevard de l'Humanité 415
B – 1190 BRUXELLES

(7) This equipment or protective system and any acceptable variation thereto is specified in the schedule to this certificate and the documents therein referred to.

(8) ISSeP, notified body n$^{r}$ 492 in accordance with article 9 of the Council Directive 94/9/EC of 23 March 1994, certifies that this equipment or protective system has been found to comply with the Essential Health and Safety Requirements relating to the design and construction of equipment and protective systems intended for use in potentially explosive atmospheres given in annex II to the Directive.

The examination and test results are recorded in confidential report n$^{r}$ 03225.

(9) Compliance with the Essential Health and Safety Requirements has been assured by compliance with:
EN 50014 : 1997 + A1 and A2 : 1999
EN 50020 : 2002
EN 50284 : 1999

(10) If the symbol "X" is placed after the certificate number, it indicates that the equipment or protective system is subject to special conditions for safe use specified in the schedule to this certificate.

(11) This EC TYPE EXAMINATION CERTIFICATE relates only to the design, examination and tests of the specified equipement or protective system in accordance to the Directive 94/9/EC. Further requirements of this Directive may apply to the manufacturing process and supply of this equipment or protective system. These are not covered by this certificate.

(12) The marking of the equipment or protective system shall include the following indications:
Ex II 1 G EEx ia II C T6

Colfontaine, the 15.12.2003

Renaud Alain
Manager of Colfontaine division

INSTITUT SCIENTIFIQUE DE SERVICE PUBLIC
Zoning A. Schweitzer, rue de la Platinerie
B-7340 COLFONTAINE (Wasmes)
Tél: ++ 32 65 610811 – Fax: ++ 32 65 610808



*Figure 35: Facsimile of the certificate of conformity of the ultrasonic sensor (page 1/2).* CE-C1G

(13) **SCHEDULE**

(14) **EC TYPE EXAMINATION CERTIFICATE N$^{R}$ ISSeP03ATEX139X**

(15) Description of the equipment or protective system:

Impervious ultrasonic probe type OQBP2501 for the tanks and citerns tightness control.
The probe can be equipped with a cable of 10 meters maximum.

Electrical parameters
Ui = 28 V
Ii = 110 mA
Pi = 0.77 W
Ci = 9.4 nF
Li = 4 µH

Routine tests :
The manufacturer shall make the routine verifications and tests necessary to ensure that the electrical apparatus produced complies with the specification submitted to the testing station together with the prototype or sample (EN 50014 - clause 24).

Eventual prescriptions : None.

(16) Report n$^{r}$ 03225 of 28.11.2003

Composed in total of 21 pages, completed by the following descriptive documents :
The manuel : "Systeme Ultrasonore SDT Tanktest"

The drawings :

| Number | Date | Pages | Description |
|---|---|---|---|
| I94AC00A.doc | 12.10.1998 | 4/8 | |
| P94AC01B | 20.01.2000 | | Tank test sensor (OQBP2501) Mounting |
| I94AC01A | 08.10.1998 | | Tank test sensor (OQBP2501) Connectors |
| P94AC00G | 05.11.2001 | | Tank test Sensor housing |
| I94AC17B | 29.09.2003 | | Tank test sensor (OQBP2501) Marking (engraving) |

(17) Special conditions for safe use:
Symbol X :
The probes enclosure shall be protected against all impact or friction which can ignite the explosive atmosphere.

(18) Essential Health and Safety Requirements: covered by the Standards listed in (9).

This certificate may only be reproduced in its entirety and without any change, schedule included

*Figure 36: Facsimile of the certificate of conformity of the ultrasonic sensor (page 2/2).*


(1) **EC TYPE EXAMINATION CERTIFICATE**

(2) **Equipment or protective system intended for use in potentially explosive atmospheres Directive 94/9/EC**

(3) EC type examination certificate number: **ISSeP05ATEX017X**

(4) Equipment or protective system:
Intrinsically safe interface box type FUTTSWBOX170

(5) Applicant – Manufacturer – ~~Authorized representative in the Community~~:
SDT International S.A./N.V.

(6) Address: 415 Boulevard de l'Humanité
B – 1190 BRUXELLES

(7) This equipment or protective system and any acceptable variation thereto is specified in the schedule to this certificate and the documents therein referred to.

(8) ISSeP, notified body n$^{r}$ 492 in accordance with article 9 of the Council Directive 94/9/EC of 23 March 1994, certifies that this equipment or protective system has been found to comply with the Essential Health and Safety Requirements relating to the design and construction of equipment and protective systems intended for use in potentially explosive atmospheres given in annex II to the Directive.

The examination and test results are recorded in confidential report n$^{r}$ 05029

(9) Compliance with the Essential Health and Safety Requirements has been assured by compliance with:
EN 50014 : 1997 + A1 and A2 : 1999
EN 50020 : 2002
EN 50284 : 1999

(10) If the symbol "X" is placed after the certificate number, it indicates that the equipment or protective system is subject to special conditions for safe use specified in the schedule to this certificate.

(11) This EC TYPE EXAMINATION CERTIFICATE relates only to the design, examination and tests of the specified equipement or protective system in accordance to the Directive 94/9/EC. Further requirements of this Directive may apply to the manufacturing process and supply of this equipment or protective system. These are not covered by this certificate.

(12) The marking of the equipment or protective system shall include the following indications:
Ex II(1) G [EEx ia] II C

Colfontaine, the 08.03.2005

Renaud Alain
Manager of Colfontaine division

INSTITUT SCIENTIFIQUE DE SERVICE PUBLIC
Zoning A. Schweitzer, rue de la Platinerie
B-7340 COLFONTAINE (Wasmes)
Tél: ++ 32 65 610811 – Fax: ++ 32 65 610808

This certificate may only be reproduced in its entirety and without any change, schedule included

*Figure 37: Facsimile of the certificate of conformity of the interface box (page 1/2).*

(13) **SCHEDULE**

(14) **EC TYPE EXAMINATION CERTIFICATE N$^{R}$ ISSeP05ATEX017X**

(15) Description of the equipment or protective system:

Intrinsically safe interface box type FUTTSWBOX170

Electrical parameters : :

| | |
|---|---|
| Uo = 10.5 V | Co = 2.41 µF |
| Io = 106.3 mA | Lo = 2 mH |
| Po = 0.28 W | Lo/Ro = 127.5 µH/Ohm |

Routine tests :

The manufacturer shall make the routine verifications and tests necessary to ensure that the electrical apparatus produced complies with the specification submitted to the testing station together with the prototype or sample (EN 50014 - clause 24).

Eventual prescriptions : None.

(16) Report n$^{r}$ 05029 of 04.03.2005

Composed in total of 22 pages, completed by the following descriptive documents :

The instruction manual « Ultrasonic Tank Test System SDT 170 MTT »

The drawings

| Number | Rev. | Date | Pages | Description |
|---|---|---|---|---|
| Tanktest Issue1.SCHDOC | | 02.03.2005 | | SDT170 TT Barrier V3.0 |
| Tanktest_Issue 1.PCBDOC | 01 | 03.03.2005 | 3 | SDT170 TT Barrier V3.0 |
| P04AB01A | | 21.09.2004 | | PCB |
| P04AB04C | | 02.03.2004 | | Assembly & Marking |
| P04AB02A | | 07.12.2004 | | Profilé Boîtier |
| P04AB03A | | 07.12.2004 | | Side Plates |
| P04AB05A | | 13.12.2004 | | Front Plate |

The nomenclature FUTTSWBOX170V3 (4 pages)

(17) Special conditions for safe use: Symbol X

The material shall be earthed before all use.

(18) Essential Health and Safety Requirements: covered by the Standards listed in (9).



*Figure 38: Facsimile of the certificate of conformity of the interface box (page 2/2).*

# 17. Declaration of conformity in the European Union

Manufacturer
SDT International n.v. s.a.
Boulevard de l'Humanité 415
B - 1190 BRUSSELS
BELGIUM

declares that

**the SDT 170 Multifunction Detector,**

**the sensors of the 170 MTT system,**

**and the interface box**

making the object of this declaration, is conform to the fundamental description concerning security stipulated in de EMC 89/336/CEE directive.

The equipment contains the CE logo of being compliant to the current CE regulations.

To be able to operate by state of the art rules, as stipulated in the directive, the SDT 170 detection device has been designed in accordance with the following rules:

- The SDT 170 does not radiate electromagnetic waves (EMC);
- The SDT 170 is immunized against external electromagnetic radiation (EMI);
- The SDT 170 is protected against electrostatic discharges (ESD).

Note: the owner is obliged to preserve the present users manual with the obligation to pass it on to future users, or been resold to an other user.

Brussels, March 2005.

The Manager.

# 18. Acknowledgments

Our company developed the *SDT TankTEST* method applied to test the tightness of underground tanks.

It has been tested and approved since 1995 by different bodies including AIB Vinçotte, Bureau Veritas, Apragaz and the Lloyd's Register of Antwerp for Belgium.

In Belgium, the equipment complies with the stipulations of the decrees of the Walloon Government of the 3rd of July 1997 and 30th of November 2000. It is also covered by an approval from the Ministry of the Flemish Community (Aminal under number AMV/30.06.95/1 and VLAREM edition II, paragraphs 5.17.2.8 and 6.5.7.2).

The method has been successfully tested abroad by Ken Wilcox Ass., an American company licensed by the EPA to check the compliance of performances of certain products with the regulations of the EPA 14.12.95. EPA is the only body in the world to have defined the minimum level of sensitivity a technique must reach when being used on the American market.

In France, in 1998, the *Cetim de Senlis*, on behalf of the French Ministry of the Environment tested and compared our method with the hydraulic method (checking through pressurizing the tank after it is filled with water). The *SDT TankTEST* method is recognized there as being more sensitive to detection, easier to set up, faster and more economical.

The method is approved by the French Ministry of National Planning and the Environment.

Having participated directly or indirectly in the checking of several thousand tanks in Belgium, France, Italy, Denmark, Spain and the United States, SDT International has a team of technicians and specialists with unique experience in this type of service.

Copies of one or several certificates or acknowledgements may be obtained upon request from SDT International.

# 19. Warranty and limit of responsibility

## 19.1 CONDITIONS OF WARRANTY

Warranties dating from the delivery shall take precedence over our general conditions of sale and are the following:

Two (2) years for the *SDT 170 MTT* appliance with the exception of the batteries*.

One (1) year for the pump*.

* The warranty provides for the replacement free of charge of any part found to be faulty, either by a material default or a design fault. It shall not be applied in the event of improper use, lack of maintenance or incorrect voltage. The warranty does not apply to revised, transformed, repaired or dismantled appliances, even partially by persons outside our services, or to the appliances damaged by the insertion of a foreign body.

Six (6) months for the *SDT 170 MTT* batteries and for all the parts and accessories of the *SDT TankTEST* other than the *SDT 170 MTT* detector.

## 19.2 LIMIT OF RESPONSIBILITY

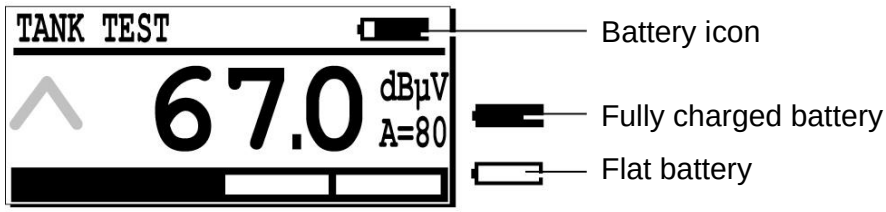
Neither the company *SDT International*, nor any related company, will in any circumstances be liable for any damages, including, without limitation, damages for loss of business, business interruption, loss of information, defect of the *SDT 170 MTT* unit or its accessories, bodily harm, loss of time, financial or material loss or any other indirect or consequential loss arising out of the use, or inability to use this product, even when it has been warned of possible damages..

The specifications of these appliances correspond to the current state of our expertise. As our research and development activities are ongoing, these specifications may be changed without advance notice.

## 19.3 IMPORTANT RECOMMENDATIONS

The long life of the batteries depends on their being used correctly and on the maintenance of a minimum electrical charge. Consequently:

- Recharge the battery pack or replace it with the spare battery pack as soon as the battery icon is no more black.




*The charging icon is located in the upper right corner of the display.* 586

- Recharge the power pack immediately, using only the charger supplied with the appliance.
- Recharge all unused power packs every 2 weeks.
- Avoid using the receiver outside the temperature range for which it has been designed (-10° / +50 °c) otherwise you will get incorrect measurements. These will be higher beyond 50° and lower below -10°.
- The built-in sensor of the of the *SDT 170 MTT* and the sensor of the flexible rod are not tight sensors. Any penetration by foreign bodies such as water, grease, dust, etc. should be avoided.

# 20. Index

# Your SDT 170 MTT detector