User manual

ENSURING THE FLOW.

Oil Breakdown Voltage Testers

DPA 60 C / DPA 75 C

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Table of contents

1 GENERAL

1.1 Using this manual

This user manual contains all necessary information that is needed for the commissioning and operation of the described product.

- Read this user manual completely before operating the product for the first time.
- Consider this user manual to be a part of the product and store it in an easily accessible location.
- If this user manual is lost, please contact BAUR Prüf- und Messtechnik GmbH or your nearest BAUR representative (http://www.baur.at/worldwide/).

1.2 Applicability of the instructions

These operating instructions apply to the DPA 60 C / DPA 75 C with the firmware version from 1.08.

The details of the firmware version currently installed can be found under:

Main menu > *Tools* > *Info*

1.3 Structure of safety instructions

The safety instructions in this user manual are presented as follows:

Danger symbol	⚠ SIGNAL WORD
	**Type of danger and its source** Possible consequences of violation. ▸ Measure to prevent the danger.

If a dangerous situation could arise at a specific step, the safety instruction is displayed immediately before this dangerous step and is shown as follows:

⚠ **SIGNAL WORD**

Type of danger and its source

Possible consequences of violation.

▸ Measure to prevent the danger.

Danger levels

Signal words in the safety instructions specify the danger levels.

⚠ **DANGER**	Will lead to severe injuries or death.
⚠ **WARNING**	May lead to severe injuries or death.
⚠ **CAUTION**	May lead to light to moderate injuries.
NOTICE	May lead to material damage.

Danger symbols

	**General danger**
	**Risk of electric shock**
	**Warning about combustible materials**

1.4 View Settings

Symbol	Meaning
▸	You are requested to perform an action.
1. 2. ...	Perform the actions in this sequence.
a. b. ...	If an operation consists of several operating steps, specify these with "a, b, c". Perform the operating steps in this sequence.
1 2 ...	Numbering in the legend
▪	List
	Indicates further information on the topic.
	Indicates tools required for the subsequent tasks.
	Indicates spare parts required for the subsequent tasks.
	Indicates required cleaning agents.

1.5 Information on the screenshots and graphics used

The screenshots and graphics used are intended to illustrate the procedure and may therefore differ slightly from the actual state.

1.6 Warranty

For warranty claims, please contact BAUR Prüf- und Messtechnik GmbH or your local BAUR representative (http://www.baur.at/worldwide/). Warranty is cancelled in case of misuse. Wear parts are excluded from the warranty.

1.7 After Sales Service

For questions contact BAUR Prüf- und Messtechnik GmbH or your BAUR representative (http://www.baur.at/worldwide/).

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2 FOR YOUR SAFETY

All BAUR devices and systems are reliable and are manufactured as per state-of-the-art technology. The individual parts and the finished devices are subject to continuous testing by our qualified personnel as part of our quality assurance system. Each device is fully tested before delivery.

However, the operational safety and reliability in practice can be achieved only when all necessary measures have been taken. The owner[1] and user[2] of the device or system are responsible for planning these measures and monitoring their implementation.

Before operating the device or system you should read and understand this user manual and the user manuals of all integrated devices.

2.1 Instructions to the user

The product may only be operated by authorised and trained electrical engineers. An electrical engineer is a person who, owing to his professional education (electrical engineering), knowledge, experience and familiarity with the applicable standards and regulations, can assess the tasks assigned to him and detect possible dangers.

In addition, the user must have:

- Knowledge of the technical equipment and operation of the DPA 60 C / DPA 75 C
- Knowledge of the testing and measurement procedures
- Knowledge of the electrical insulating materials, in particular the insulating oil, and how to handle them.

[1] Operator is the person or group that is responsible for the safe operation of the device and its maintenance (EN 61010-1, 3.5.12).
[2] User is the person who uses the device for its intended purpose (according to the definition of user in compliance with EN 61010-1, 3.5.11).

2.2 Intended use

The portable BAUR DPA 60 C and DPA 75 C oil breakdown voltage testers measure the electrical breakdown strength of insulating liquids fully automatically.

Note: With the DPA 60 C / DPA 75 C you can test insulating liquids with tan δ values < 4.5 and specific resistance ρ > 30 MΩm.

If the device is used without observing this condition, safe operation cannot be guaranteed. The operator or user is liable for any damage to persons and property resulting from incorrect operation.

Proper use also includes

- Compliance with all instructions in this user manual,
- Compliance with the technical data and connection requirements given on the rating plate and in the user manual,
- Compliance with the inspection and maintenance tasks.

2.3 Avoid dangers, take safety measures

- When operating the DPA 60 C / DPA 75 C, observe the following rules and guidelines:
  - Accident prevention and environment protection rules applicable for your country
  - Safety instructions and regulations of the country where the DPA 60 C / DPA 75 C is being used (according to the latest version)
  - Any relevant national and international standards and guidelines in the latest applicable version:
  - Local safety and accident prevention regulations
  - Employers' liability insurance association regulations (if any)

Technical secure state of the device

Safety, function and availability depend on the proper condition of the device. Upgrades, modifications or alterations to the product are essentially prohibited.

- Operate the device only in a technical perfect condition.
- In case of damage and malfunction, immediately stop the device, mark it accordingly and have the faults rectified by appropriately qualified and authorised personnel.
- Comply with the inspection and maintenance conditions.
- Use only accessories and original spare parts recommended by BAUR. The use of spare parts, accessories and special facilities that are not tested and approved by BAUR could adversely affect the safety, function and characteristics of the product.
- Never take apart the device. Inside the device there are no components that could be serviced or repaired by the user.

No operation with condensation

Condensation can form in devices and systems due to temperature fluctuations and high air humidity, which in some components can lead from leakage currents and flashovers up to short-circuit.

Maximum danger arises when relatively high air humidity and temperature fluctuations occur in a device consecutively, e.g. which is the case when storing the device in an unheated room or when placed outdoors. When the device is then exposed to a high ambient temperature, the cold device surfaces cool the air in the immediate vicinity, which leads to formation of condensation even inside the device.

In this process, two factors are crucial:

- The higher the relative air humidity, the faster the dew point is reached and water is condensed.
- The higher the temperature difference between the surfaces and the ambient air, the stronger the tendency for condensation.

▸ Always prevent condensation in devices. Temper the device and system before and during the measurements so that no condensation occurs.

No operation in areas with risk of explosion and fire

Measurements in direct contact with water, in environments with explosive gases and in areas with fire risks are not permitted.

Lifting and carrying the oil breakdown voltage tester

Depending on the installed battery, the DPA 60 C / DPA 75 C oil breakdown voltage tester weighs up to 29 kg. We recommend enlisting the help of a second person to lift or carry the fully equipped device with accessories, particularly over long distances.

2.3.1 Dangers when working with electric voltage

The DPA 60 C / DPA 75 C measurement process generates a dangerous voltage of up to 60 kV or 75 kV. Operating personnel need to pay special attention and must be very careful while working with electric voltage.

⚠ DANGER

Dangerous electric voltage

Danger to life or risk of injury due to electric shock

- ▸ Connect the oil breakdown voltage tester as described in this user manual.
- ▸ Take particular care to ensure the oil breakdown voltage tester is earthed properly.
- ▸ Before carrying out any cleaning or maintenance, switch the device off and remove the mains plug to ensure the device is completely disconnected from the mains voltage.

3 PRODUCT INFORMATION

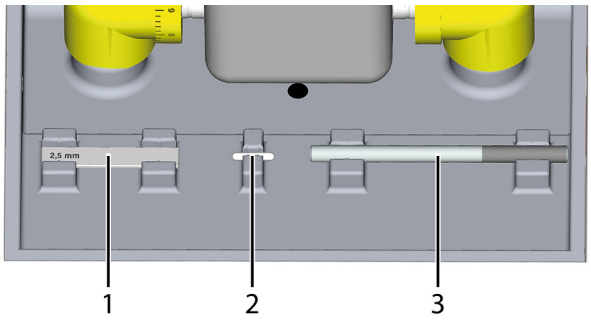
3.1 Full illustration

Front view

No.	Element	Function
1	Handle	Used to open and close the protective cover
2	Protective cover	Used to protect against dust and oil
3	Safety switch	Used as a protective device The protective cover must be closed in order to perform a measurement.

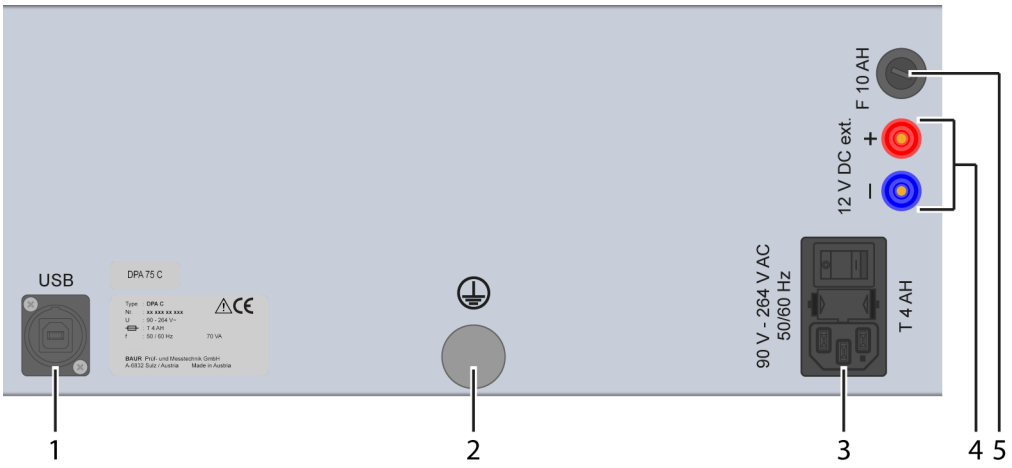
4	Test vessel with electrodes	Filled with insulating oil The test vessels have a standard holding capacity of 0.4 litres and are made of glass or a synthetic material. They comply with the following standards: ▪ IEC 60156 Fig. I or Fig. II ▪ ASTM D877 ▪ ASTM D1816 The electrode shape is specified in the standards and is indicated on the display before a measurement begins. The figure illustrates the 0.4 litre test vessel in accordance with IEC 60156 Fig. II with lid. Further information: ▪ Test vessel shapes – Chapter *Scope of delivery and options* (on page 90) ▪ Replacing the electrodes – Chapter *Replacing the electrodes* (on page 29)
5	Oil collecting tray	Used to collect insulating oil
6	Fold-out operating unit	Used to operate the oil breakdown voltage tester The operating unit contains the operator control panel and the membrane keyboard. Further information: Chapter *Operating and display elements* (on page 17)
7	Integrated plain paper printer	Used to print the measurement logs

Standard accessories



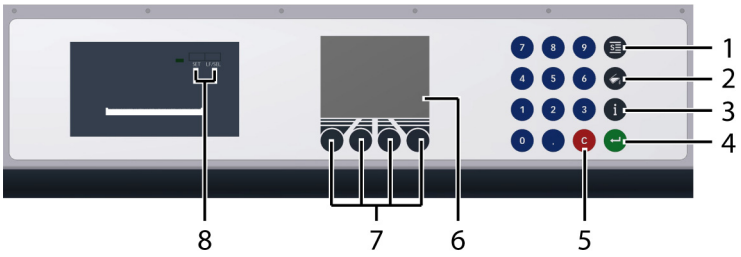
No.	Element	Function
1	Setting gauge	Used to set the electrode gap
2	Magnetic stirrer	Used to stir the oil sample
3	Lifting stick for magnetic stirrer	Used to remove the magnetic stirrer from the oil sample

Rear view



No.	Element	Function
1	USB port	Used to connect to a PC Type of interface: USB Type B
2	Protective earthing connection	Is used to connect the protective earthing
3	Mains connection	Is used to connect the device to the mains voltage (90 – 264 V, 50/60 Hz) The power supply connection comprises: ▪ Power supply socket ▪ Mains fuse, Type: T 4 AH ▪ Mains switch
4	External 12 V DC connector	Used to connect to an external 12 V DC power supply, e. g. a 12 V vehicle battery, and to charge the rechargeable battery (option)
5	Device protection fuse	Used to protect the oil breakdown voltage tester at the 12 V DC connection to the power supply, type: F 10 AH

3.2 Operating and display elements



No.	Element	Function
1	***Standardised measurement*** button	Opens the ***Standardised measurement*** menu Further information: Chapter *Standardised measurement* (on page 43)
2	***Measurement logs*** button	Opens the ***Measurement logs*** menu Further information: Chapter *Display of measurement results* (on page 65)
3	***Info*** button	Displays the device information. Further information: Chapter *Information on the oil breakdown voltage tester* (on page 26)
4	Input button	Used to confirm the input
5	***Delete*** button	Used to delete a character at the cursor position
6	Display	Show the menu of the device
7	Control keys	Used to navigate through the menu Further information: Chapter *Operating the oil breakdown voltage tester* (on page 23)
8	Printer operating keys	▪ The paper feed button ***LF/SEL*** is used to feed in the printer paper when the paper roll is replaced. Further information: Chapter *Replacing the printer paper roll* (on page 76) ▪ The ***SET*** button is not assigned.

3.3 USB interface

The USB interface is used:

- to connect to a PC for communicating with the BAUR ITS Lite software (option) for managing measurement data,
- for firmware updates performed by a BAUR representative.

Type of interface: USB Type B

3.4 Power supply

The DPA 60 C / DPA 75 C voltage supply can be provided both via an on-site mains supply or an external 12 V DC vehicle battery or integrated rechargeable battery (option).

3.4.1 Mains voltage power supply

Permissible mains voltage: 90 – 264 V

Permissible mains frequency: 50/60 Hz

NOTICE
Too high or too low mains voltage A low mains voltage adversely affects the function of the system, a high mains voltage can cause damage. ▸ Ensure that the supply voltage matches the specifications on the rating plate.

3.4.2 External 12 V DC power supply

The 12 V DC connector on the back of the oil breakdown voltage tester is used to connect to a 12 V vehicle battery.

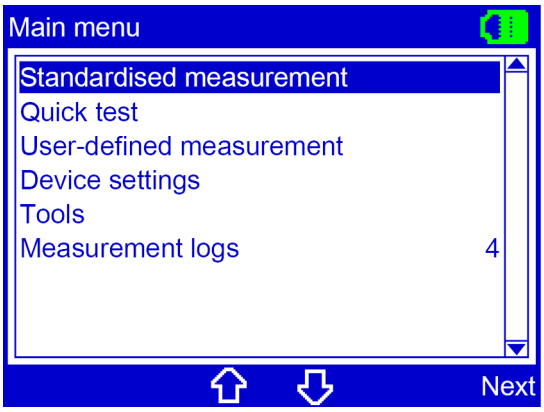
Note: The 12 V DC connection socket "**–**" is connected internally to the protective earth of the oil breakdown voltage tester.

3.4.3 Rechargeable battery mode (option)

If the oil breakdown voltage tester is fitted with a rechargeable battery, this will be indicated by the battery symbol top right on the display.

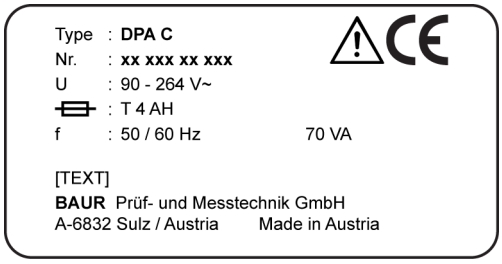
Further information:

- Chapter *Technical data* (on page 88)
- Chapter *Symbols and abbreviations on the display* (on page 23)



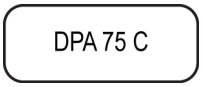
3.5 Rating plate

The rating plate is located on the back of the oil breakdown voltage tester.



Rating plate	Description
Type	Device type
No.	Serial number
U	Supply voltage If several supply voltages are possible, these are given consecutively one after another.
⊟	Time characteristics and nominal current of the device fuse Time characteristics: ▪ Very Quick Acting (FF) ▪ Quick Acting (F) ▪ Medium (M) ▪ Slow Blow (T) ▪ Very Slow Blow (TT)
f	Mains frequency
VA	Max. recorded apparent output in VA
[TEXT]	Additional information on the device (optional)

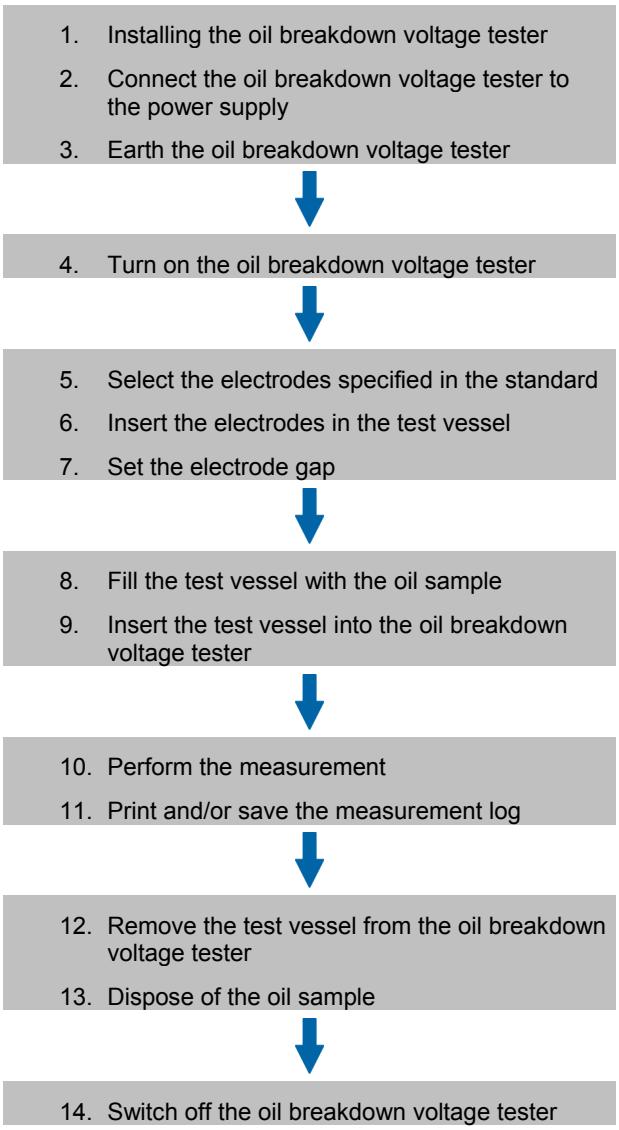
Device designation with information on the output voltage



The exact device designation is given on the rating plate and indicates which oil breakdown voltage tester it is:

- DPA 60 C
- DPA 60 C Battery: DPA 60 C with rechargeable battery
- DPA 75 C
- DPA 75 C Battery: DPA 75 C with rechargeable battery

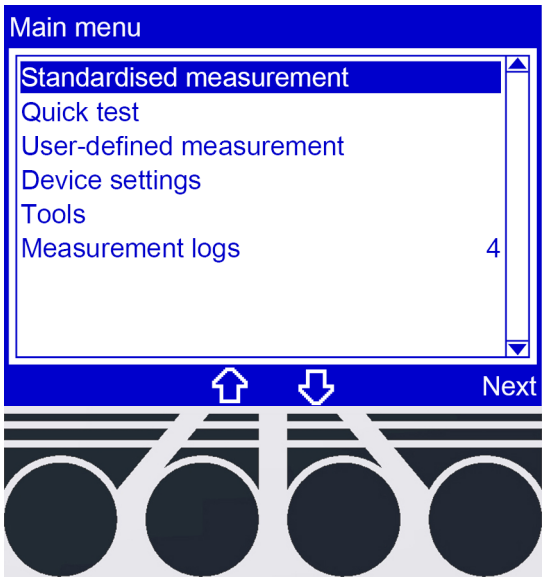
4 BASIC INSULATING OIL TEST PROCEDURE



5 OPERATING THE OIL BREAKDOWN VOLTAGE TESTER

5.1 Menu navigation

The control menu is displayed on the colour display. The menu is operated with the control keys under the colour display and the function keys on the membrane keypad. The meaning of the relevant control key is displayed in plain text or as a symbol in the lowest row of the display.



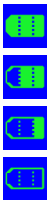
5.2 Entering numbers

There are two options for entering or changing numbers:

- Enter a value with the number keys on the membrane keypad.
- Press the arrow keys to change a value:
  - To increase a value, press the <up arrow>.
  - To decrease a value, press the <down arrow>.

5.3 Symbols and abbreviations on the display

Symbols

Symbol	Description
	Indicates an information message
	Indicates a request
	Indicates that the menu for setting the time is open
	Indicates that the menu for setting the date is open
	Indicates that the menu for setting the withstand voltage is open
	Indicates that, for oil breakdown voltage testers with a rechargeable battery, the device is being run off the mains voltage When the rechargeable battery is being recharged, this indicates that the battery is fully charged.
	Indicates the state of charge of the rechargeable battery for oil breakdown voltage testers with a rechargeable battery when battery operated When the battery is charging, the symbols will alternate successively.
	Indicates that, for oil breakdown voltage testers with a rechargeable battery, the rechargeable battery is almost empty and has to be recharged When the red battery symbol flashes, it is possible to carry out three further standardised measurements. Further information: Chapter *Charging the battery* (on page 80)
	Indicates whether an option has been enabled
	Used to switch between menu items
	Used to move the cursor to the left/right
	Indicates an important process for achieving a precise measurement
	Indicates that there is high voltage at the electrodes
	Indicates which electrode shape is required to perform a measurement Further information: Chapter *Replacing the electrodes* (on page 29)

Abbreviations

Stand. dev.	Standard deviation The standard deviation shows how close the individual recorded values are to the average value.
Std.dev./Avg.	Ratio of the standard deviation to the average value in % (coefficient of variation). In IEC 60156, diagram 3 in section 11 illustrates the ratio of the standard deviation to the average value. This diagram and the determined values can be used to check whether the measurement result lies within the permitted range.

5.4 Main menu

All functions and user settings can be accessed from the main menu.

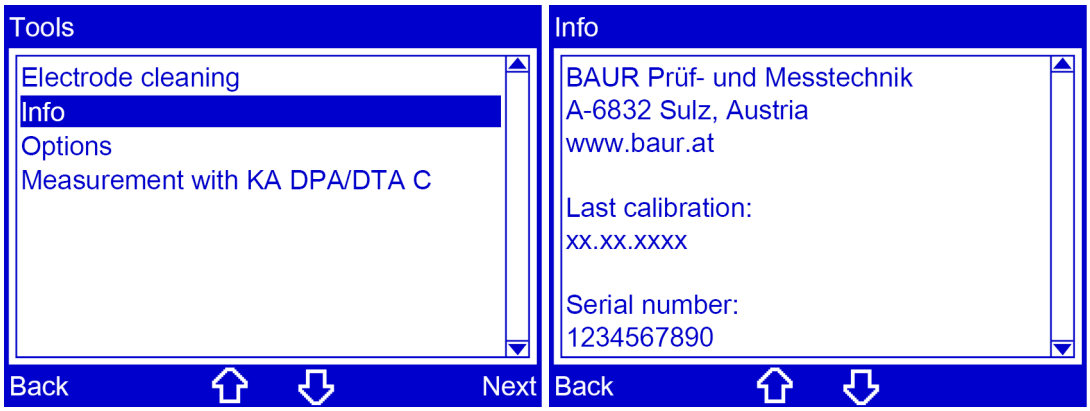
Menu item	Description
Standardised measurement	Configure settings for measurements in compliance with specific standards and start measurements.
Quick test	Start test for quick evaluation of the insulating oil status
User-defined measurement	Configure settings for user-defined measurements and start measurements
Device settings	You can define or change general system settings for the device: ▪ Set display brightness ▪ Select a language ▪ Switch printer on or off ▪ Define how to proceed if the measurement log memory is full and a new measurement is to be performed (overwrite logs yes/no) ▪ Configure settings for IEC 60156:1995 and the standards based on it ▪ Configure ASTM-D standard settings ▪ Set date ▪ Set time ▪ View information about the USB interface
Tools	▪ Perform electrode cleaning ▪ View device information on the oil breakdown voltage tester: Serial number, date of last calibration and the manufacturer's contact details ▪ Activate options ▪ Check the measurement accuracy of the oil breakdown voltage tester with the calibrator KA DPA/DTA C (option).
Measurement logs	Display, print or delete measurement logs.

5.5 Information on the oil breakdown voltage tester

Under *Main menu* > *Tools* > *About,* you will find the following information on the oil breakdown voltage tester:

- Date on which the oil breakdown voltage tester was last calibrated
- Oil breakdown voltage tester serial number
- Oil breakdown voltage tester firmware version
- Hardware version
- Available options
- Correction factors

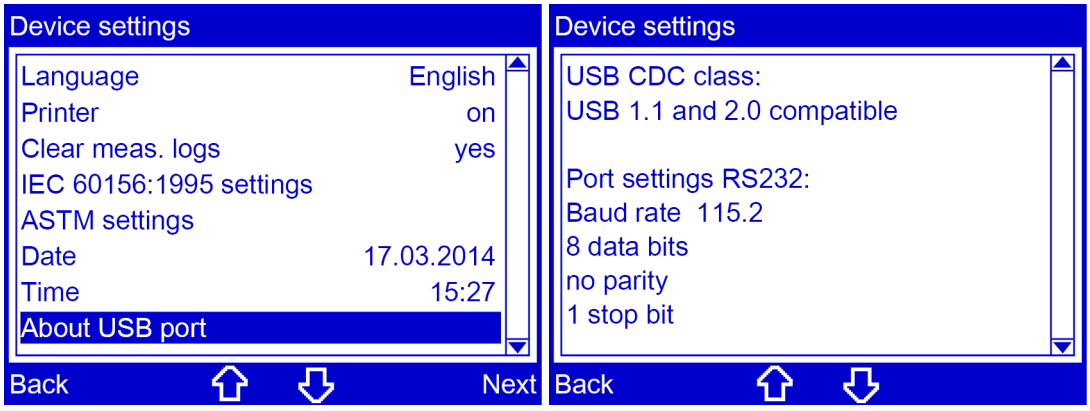
Main menu > *Tools* > *Info*



1. Select the menu item *Info* by pressing the arrow keys.
2. Select the menu item *Next* to confirm the selection.
   Information on the oil breakdown voltage tester is displayed.

5.5.1 Information on the USB interface

Main menu > Device settings > About USB interface



1. Select the position by pressing the arrow keys.
2. Select the menu item *Next* to confirm the selection.

The version and technical data of the USB port are displayed.

6 COMMISSIONING

- Observe the following information:
  - The safety instructions in the chapter *For your safety* (on page 10)
  - Local safety and accident prevention regulations
  - Safety instructions and regulations according to the state-of-the-art
  - Any relevant national and international standards and guidelines in the latest applicable version.

6.1 Checks to perform before commissioning

⚠ CAUTION

Safety defects due to use of damaged device.

- Never use devices that are visibly damaged or clearly have a malfunction.
- Secure devices that are visibly damaged or clearly have a malfunction against unintentional switching-on.
- Rectify faults immediately.

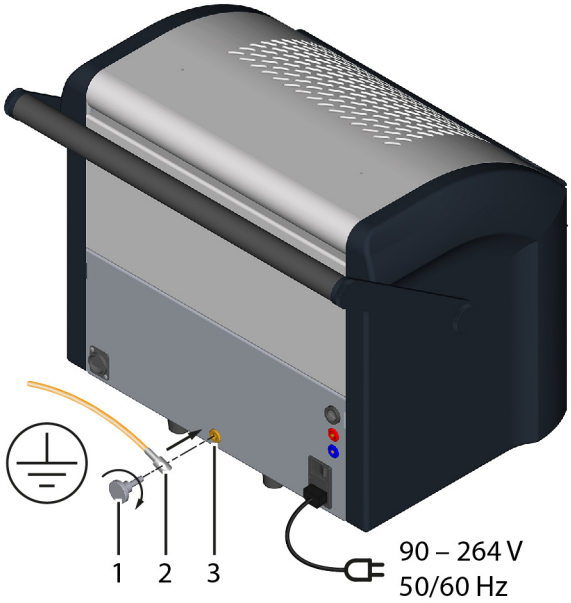
1. Check the oil breakdown voltage tester for mechanical damage.
2. Check electrical connections and connection cables for damage.
   Use only undamaged connection cables.
3. Check the electrodes of the test vessel for pitting. If corrosion was detected, replace the test vessel. Further information: Chapter *Ordering accessories and spare parts* (on page 80)
4. Always keep the oil breakdown voltage tester clean.
   The cleanliness of the oil breakdown voltage tester and the test cell will have a strong influence on the measurement results.

5. Always wipe off spilled or leaked oil with petroleum ether or other similar mild solvent and a lint-free cloth, in particular:
   - on the test vessel isolators
   - in the oil collecting tray (test chamber floor)
   - on the test vessel
6. Allow the oil breakdown voltage tester to dry well before closing it.

6.2 Installing the oil breakdown voltage tester

1. Select the place of installation for the oil breakdown voltage tester in such a way that
   - a stable base with sufficient air circulation is guaranteed,
   - the oil breakdown voltage tester is standing on a flat, horizontal surface,
   - the oil breakdown voltage tester is accessible for making connections and for use.
2. If the oil breakdown voltage tester is in a transport case (option), remove the lid of the case. The oil breakdown voltage tester can be operated in the transport case.

6.3 Earth the oil breakdown voltage tester



1 Earth connection screw
2 Cable lug
3 Protective earthing connection

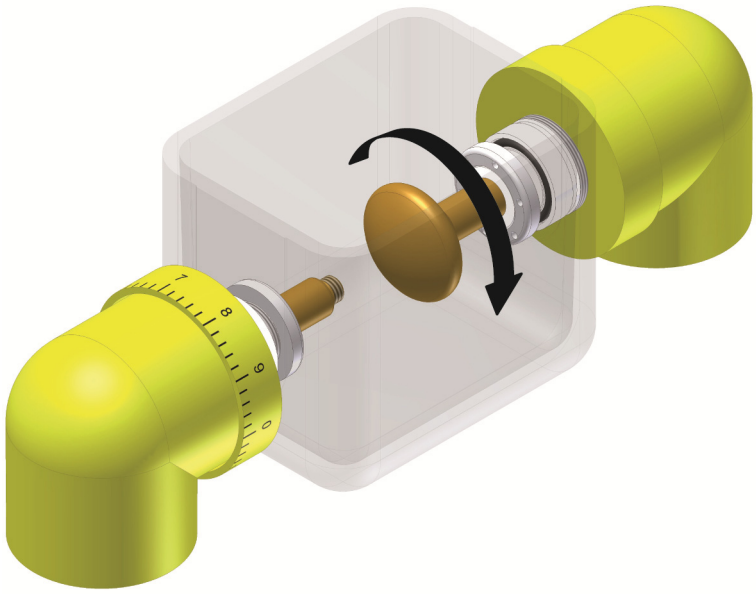
1. Connect a protective earthing cable to the station ground.
2. The earth connection screw is located on the back of the oil tester. Unscrew the earth connection screw (1).
3. Connect the cable lug of the protective earthing cable (2) to the earth connection screw (1).
4. Re-screw the earth connection screw into the protective earthing connection (3).

6.4 Replacing the electrodes

The electrode shape is defined by standards and is shown pictographically on the display before a measurement begins.

Note:

- Before each measurement, check that the electrodes used meet the selected standard.
- If the wrong electrodes are used, replace them.



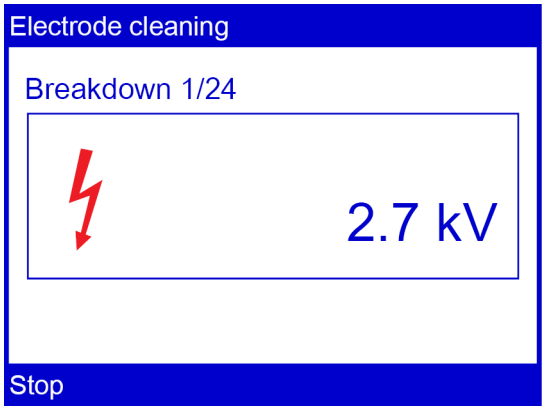
1. Open the protective cover.
2. Remove the lid of the test vessel.
3. First, turn one and then the other electrode anticlockwise until they are released from the thread.
4. Take the other electrode pair that must be used. First, turn one and then the other electrode clockwise on the thread.
5. Close the lid of the test vessel.

Note: When bringing new electrodes into service, clean them (see "Cleaning the electrodes" on page 29)!

6.5 Cleaning the electrodes

Note: Clean electrodes only when they are first brought into service as new electrodes.

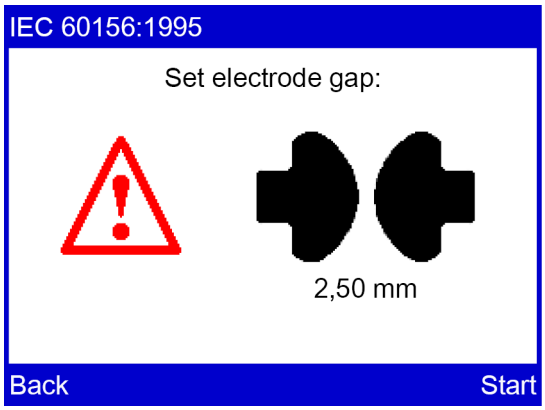
Main menu > *Tools* > *Electrode cleaning*



1. In the main menu, select the menu item *Tools*.
2. Select the menu item *Next* to confirm the selection.
3. In the *Tools* menu select the menu item *Electrode cleaning* and then menu item *Next*.
4. Fill the test vessel with clean, unused oil of the same type that will be tested next.
5. Select menu item *Start* to start the electrode cleaning process.
   24 cleaning breakdowns are performed.

6.6 Setting an electrode gap

The electrode gap is defined by standards and is shown pictographically on the display before a measurement begins:



- Set an electrode gap according to the selected standard. Proceed as follows:

1. Open the protective cover.
2. Set the Vernier scale to zero (1).
3. On the other side of the ring with Vernier scale, there is an adjusting ring without scale (2). Turn the adjusting ring clockwise until you hear an acoustic signal. The electrodes are in contact with each other.
4. Slowly turn the adjusting ring anticlockwise until the acoustic signal stops.
   The electrode gap is set to zero.
5. Set the Vernier scale to the desired electrode gap.
   1 rotation (360°) = 1 mm
6. Remove the lid of the test vessel.
7. Use a setting gauge to check the set electrode gap.
8. Close the lid of the test vessel.

6.7 Fill and use the test vessel

NOTICE
Measurement errors caused by improper sampling and handling of the oil sample Improper sampling and handling of the oil sample can have a strong influence on the measurement results which can lead to incorrect conclusions being drawn regarding the quality of the insulating oil. ▸ The sampling must only be performed by experienced, qualified personnel. ▸ Follow the instructions for sampling below.

6.7.1 Instructions for sampling

Important: In order to achieve reliable measurement results, all devices, containers and tools that come into contact with the oil must be clean.

- Follow the manufacturer's instructions and safety instructions for the relevant sampling container or electrical device.
- When sampling, ensure you follow the instructions given in the relevant standard.
- Only take oil samples during dry weather. Avoid sampling during rain or if it is very humid. High humidity adversely affects the measurement results.
- Remove any impurities at the sampling port (e.g. on the transformer) and in the sampling container.
- Use separate sampling containers for each oil type.
- Take the sample during regular operation of the electrical equipment.
- Once the oil samples have been received by the laboratory, they must be left to stand in the room for approximately 24 hours in order for any bubbling to subside and for the oil to adjust to the room temperature.
- Protect the sample against moisture and solar radiation.
- Condensation adversely affects the measurement results. To prevent condensation, ensure that the temperature of the oil to be tested corresponds to the ambient temperature of 20 °C ± 5 °C before measuring.
- Heat the sampling container to above the ambient temperature.

  Note: Some standards stipulate maintaining specific temperature conditions during the measurement process, e.g.

  - IEC 60156:1995: The temperature of the oil sample should not deviate more than 5 °C from the ambient temperature.
  - ASTM D1816: The temperature of the oil sample and the sampling container should be the same as the room temperature (20 °C - 30 °C).

Further information on sampling, handling the oil sample and cleaning can be found in the following standards:

- IEC 60475:2011
- IEC 60156:1995
- ASTM D923:2007
- ASTM D877:2013
- ASTM D1816:2012

6.7.2 Insert the test vessel

1. Open the protective cover.
2. Remove the test vessel.
3. Remove the lid of the test vessel.
4. Clean the test vessel and the lid with a clean, lint-free cloth.
5. Rinse the test vessel and lid with petroleum ether or acetone.
6. Dry the test vessel and lid.
7. Rinse the test vessel and lid three times with the oil to be tested.
8. Allow the oil to be tested to flow down the inside wall of the test vessel slowly, without bubbles until the vessel is 95 to 98% full.
9. Replace the full test vessel in the oil breakdown voltage tester.
10. Close the lid of the test vessel.

6.8 Turn on the oil breakdown voltage tester

Mains voltage power supply

1. If you plan to operate the oil breakdown voltage tester from the mains, check that your supply voltage matches the specifications on the oil breakdown voltage tester rating plate.
2. Connect the oil breakdown voltage tester to the mains voltage.
3. There is a mains switch on the back of the oil breakdown voltage tester. Use this switch to turn on the oil breakdown voltage tester.
4. Fold out the operating unit.

   After the operating unit has been opened, the firmware starts and the oil breakdown voltage tester performs a self test. On completion of a successful self test, the Start window of the last measurement opens.

External 12 V DC power supply

1. Check whether your 12 V DC vehicle battery corresponds to the power requirement stated on the rating plate.
2. Connect the oil breakdown voltage tester to the 12 V DC vehicle battery.

   Note:The connecting cable for die vehicle battery is not included in the scope of delivery.
3. Fold out the operating unit.

   After the operating unit has been opened, the firmware starts and the oil breakdown voltage tester performs a self test. On completion of a successful self test, the Start window of the last measurement opens.

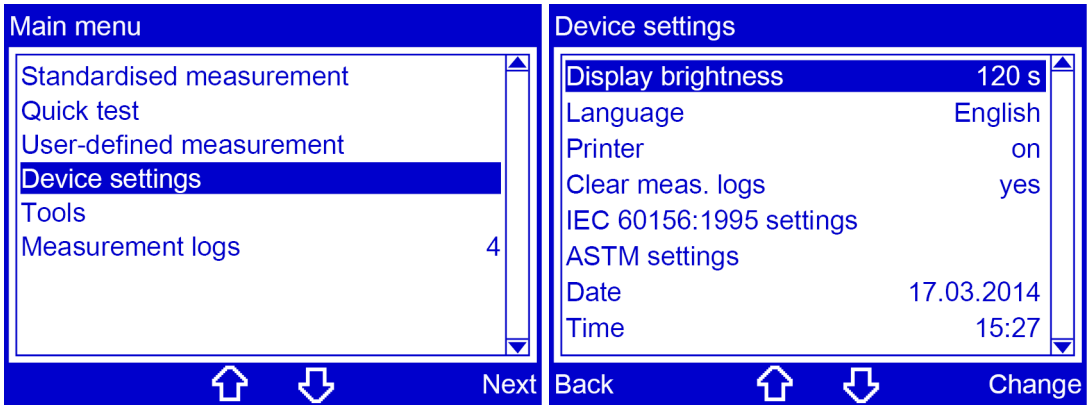
Rechargeable battery mode (option)

- Fold out the operating unit.

  After the operating unit has been opened, the firmware starts and the oil breakdown voltage tester performs a self test. On completion of a successful self test, the Start window of the last measurement opens.

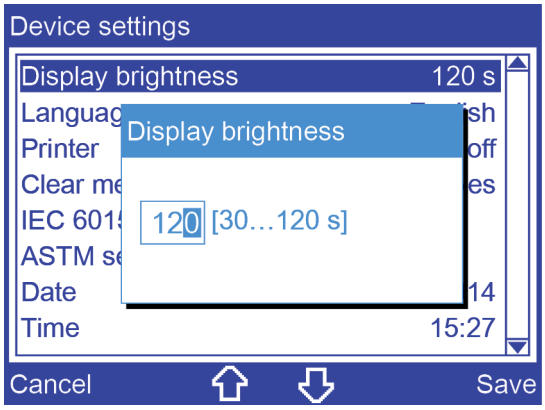
7 DEVICE SETTINGS

The oil breakdown voltage tester settings are adjusted via the main menu item *Device settings*.



7.1 Set display brightness

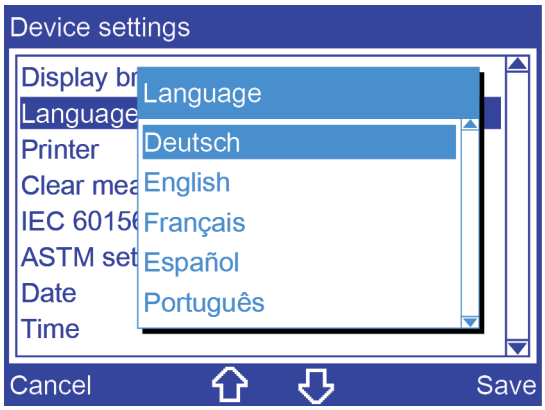
Main menu > *Device settings* > *Display brightness*



1. In the main menu, select the menu item *Device settings*.
2. Select the menu item *Next* to confirm the selection.
3. In the *Device settings* menu select the menu item *Display brightness* and then menu item *Change*.
4. Select the time after which the brightness of the display light automatically reduces if the device is inactive.
5. Click *Save* to confirm the entry.

7.2 Select language

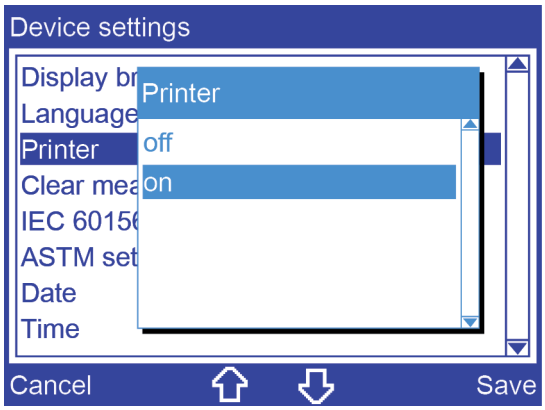
Main menu > *Device settings* > *Language*



1. Choose a language by pressing the arrow keys.
2. Click *Save* to confirm the entry.

7.3 Switch printer on/off

Main menu > *Device settings* > *Printer*

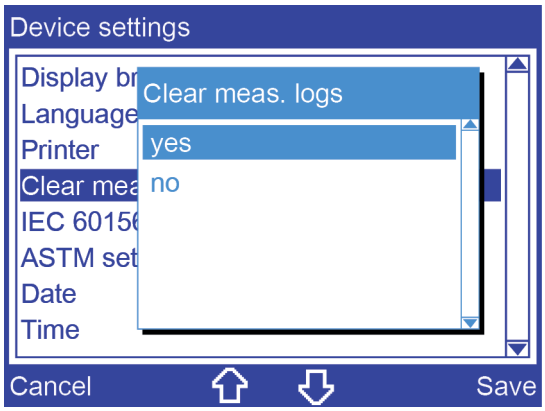


1. Choose one of the following settings by pressing the arrow keys:
   - *off*: The printer is switched off.
   - *on*: The printer is switched on.
2. Click *Save* to confirm the entry.

7.4 Overwrite measurement logs

The device can store up to ten measurement logs. When the measurement log memory is full, old measurement logs must be deleted before you can save new ones. Under *Clear meas. logs* you can define how to proceed when the measurement log memory is full and a measurement is to be performed.

Main menu > *Device settings* > *Clear meas. logs*



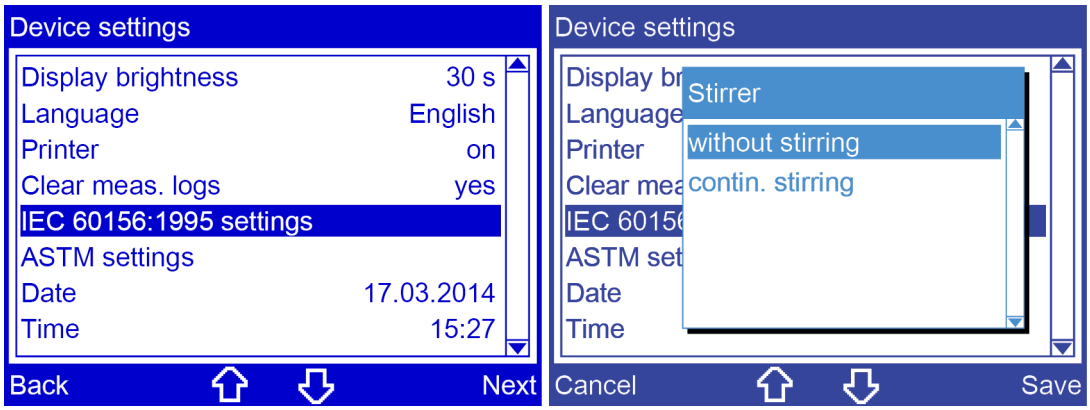
1. Choose one of the following settings by pressing the arrow keys.
   - *yes*: When you start the next measurement log, the oldest measurement log will be automatically deleted.
   - *no*: Before starting the next measurement log, a saved measurement log must be deleted manually (see "Display of measurement results" on page 65).
2. Click *Save* to confirm the entry.

7.5 Configure settings for IEC 60156:1995

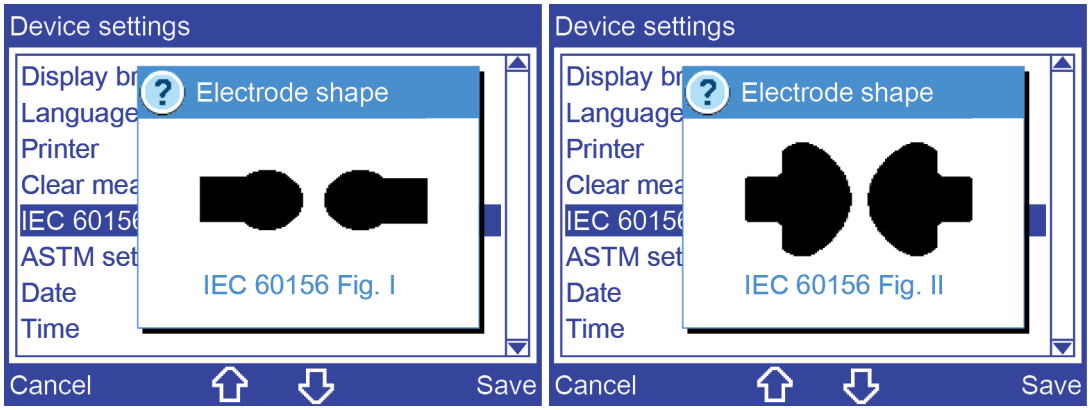
The IEC 60156:1995 standard and the standards based on it allow various stirrer settings and electrode shapes. The settings configured under this menu item are applied automatically for the following standards:

- IEC 60156:1995
- AS 1767.2.1
- BS EN 60156
- CEI EN 60156
- SEV EN 60156
- UNE EN 60156
- NF EN 60156
- SABS EN 60156
- VDE 0370 Part 5:1996

Main menu > *Device settings* > *IEC 60156:1995 settings*



1. In the main menu, select the menu item *Device settings*.
2. Select the menu item *Next* to confirm the selection.
3. In the *Device settings* menu select the menu item *IEC 60156:1995 settings* and then menu item *Next*.
4. Choose one of the following settings by pressing the arrow keys:
   - *without stirring*: The stirrer is inactive when a standard based on IEC 60156:1995 is selected.
   - *contin. stirring*: The stirrer runs constantly when a standard based on IEC 60156:1995 is selected.
5. Click *Save* to confirm the entry.
   A prompt to select an electrode shape appears on the display.



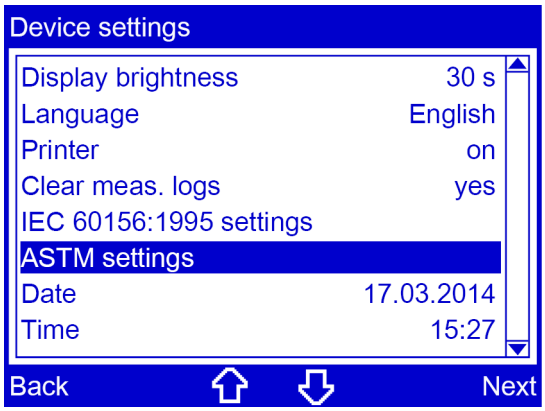
6. Choose an electrode shape by pressing the arrow keys.
7. Click *Save* to confirm the entry.

7.6 Configure the ASTM settings

With the ASTM-D standards, it is possible to display the individual breakdown values and set the hold time before the first measurement. The settings configured under this menu item are applied automatically for the following standards:

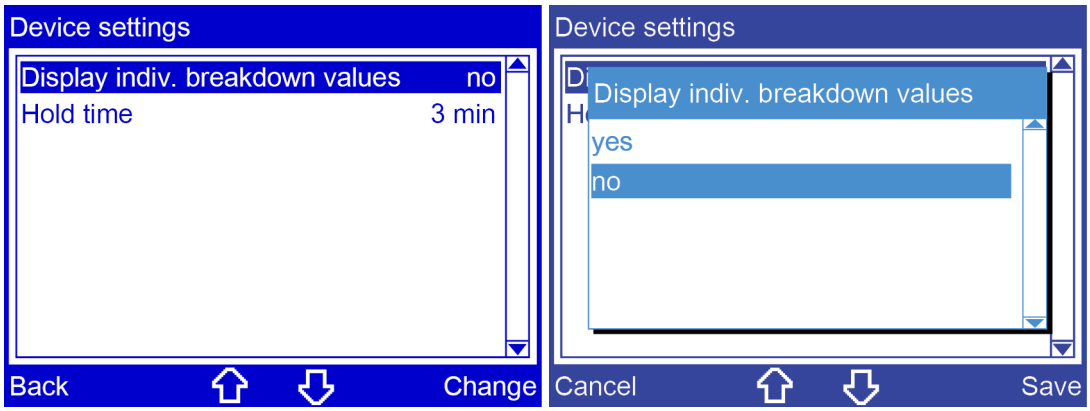
- ASTM D1816:2012 1 mm
- ASTM D1816:2012 2 mm
- ASTM D877/D877M:2013 PA
- ASTM D877/D877M:2013 PB

Main menu > *Device settings* > *ASTM settings*



7.6.1 Display individual breakdown values

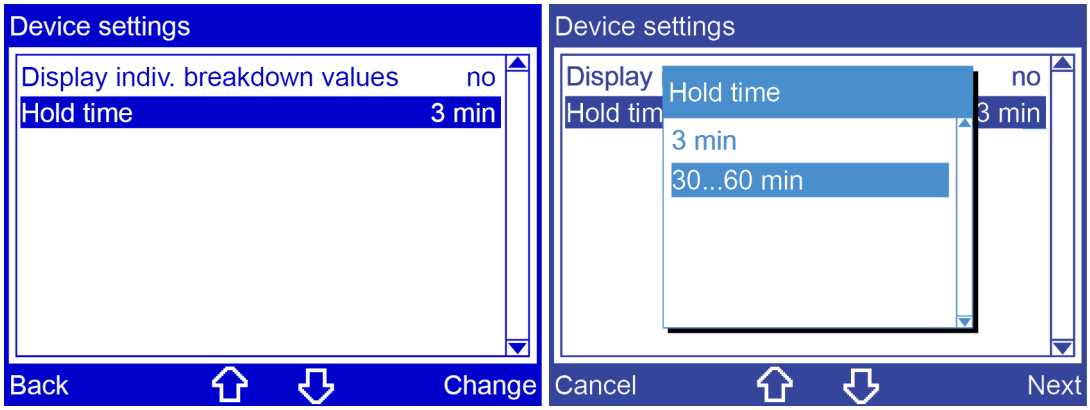
Main menu > *Device settings* > ... > *Display indiv. breakdown values*



1. In the main menu, select the menu item *Device settings*.
2. Select the menu item *Next* to confirm the selection.
3. In the *Device settings* menu select the menu item *ASTM settings* and then menu item *Next*.
4. Select menu item *Display indiv. breakdown values*.
5. Select menu item *Change*.
6. Choose one of the following settings by pressing the arrow keys:
   - *yes*: The individual breakdown values recorded during a series are listed in the measurement log.
   - *no*: The average value of the recorded breakdown values is calculated and displayed in the measurement log.
7. Click *Save* to confirm the entry.

7.6.2 Setting the hold time before the first measurement

Main menu > *Device settings* > ... > *Hold time*

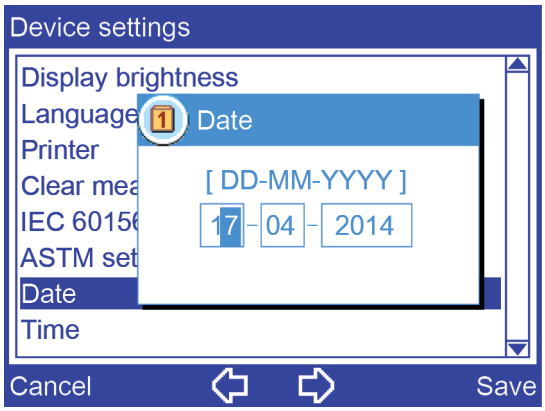


1. In the main menu, select the menu item *Device settings*.
2. Select the menu item *Next* to confirm the selection.
3. In the *Device settings* menu select the menu item *ASTM settings* and then menu item *Next*.

4. Select menu item *Hold time*.
5. Select menu item *Change*.
6. Choose one of the following settings by pressing the arrow keys:
   - *3 min*: The hold time is 3 minutes.
   - *30-60 min*: The hold time can be set to between 30 and 60 minutes.
7. If you have enabled the *30-60 min* setting, select the menu item *Next*.
8. Enter the desired hold time.
9. Click *Save* to confirm the entry.

7.7 Set date

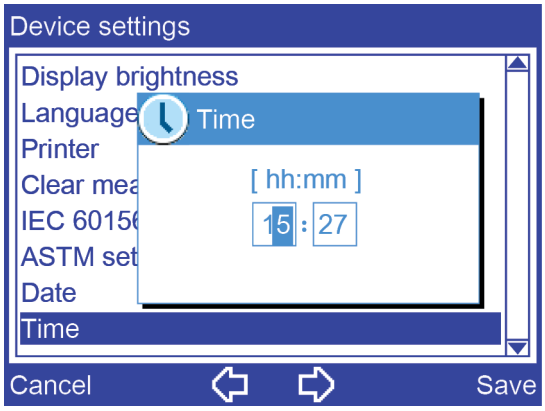
Main menu > *Device settings* > *Date*



1. Select the position by pressing the arrow keys.
2. Change the date with the membrane keypad.
3. Click *Save* to confirm the entry.

7.8 Set time

Main menu > *Device settings* > *Time*

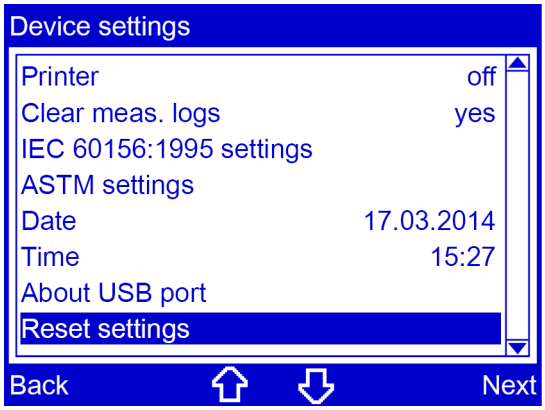


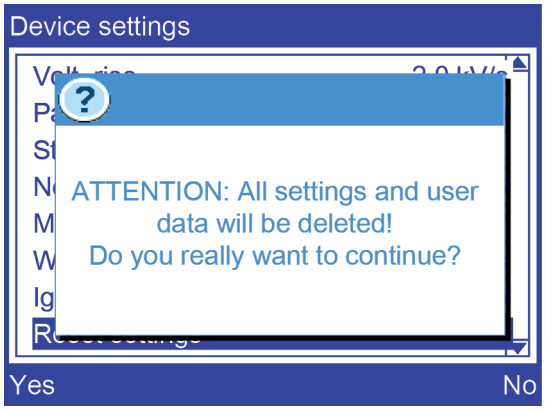
1. Select the position by pressing the arrow keys.
2. Change the time with the membrane keypad.
3. Click *Save* to confirm the entry.

7.9 Reset settings

Note: This menu item resets all settings to the factory defaults. All user-defined measurements and measurement logs will be deleted!

Main menu > *Device settings* > *Reset settings*





1. Select the menu item by pressing the arrow keys.
2. Click *Next* to confirm the entry. A warning is displayed that all settings and user data will be deleted upon resetting the settings.
3. Confirm with *Yes*.

8 STANDARDISED MEASUREMENT

8.1 Overview of standards

The factory calibrated settings for the standardised measurements are configured as follows:

Test standard	Electrodes				Sequences						Oil sample	
	Shape and dimensions		Distance in mm (inch)	Tolerance in mm (inch)	Slew rate in kV/s	Hold time in min	Measurements per filling	Unevaluated measurements	Pause between measurements in mm	Stirring the oil sample	Temperature required during measurement in °C	Test vessel volume in litres
IEC 60156:1995			2.5 (0.098)	± 0.05 (0.002)	2 ± 0.2	5	6	–	2	Continuous[3]	20 ± 5	0.35 – 0.6
AS 1767.2.1			2.5 (0.098)	± 0.05 (0.002)	2 ± 0.2	5	6	–	2	Continuous[3]	20 ± 5	0.35 – 0.6
BS EN 60156			2.5 (0.098)	± 0.05 (0.002)	2 ± 0.2	5	6	–	2	Continuous[3]	20 ± 5	0.35 – 0.6
CEI EN 60156			2.5 (0.098)	± 0.05 (0.002)	2 ± 0.2	5	6	–	2	Continuous[3]	20 ± 5	0.35 – 0.6
SV EN 60156			2.5 (0.098)	± 0.05 (0.002)	2 ± 0.2	5	6	–	2	Continuous[3]	20 ± 5	0.35 – 0.6
UNE EN 60156			2.5 (0.098)	± 0.05 (0.002)	2 ± 0.2	5	6	–	2	Continuous[3]	20 ± 5	0.35 – 0.6
NF EN 60156			2.5 (0.098)	± 0.05 (0.002)	2 ± 0.2	5	6	–	2	Continuous[3]	20 ± 5	0.35 – 0.6
SABS EN 60156			2.5 (0.098)	± 0.05 (0.002)	2 ± 0.2	5	6	–	2	Continuous[3]	20 ± 5	0.35 – 0.6
DIN VDE 0370 Part 5:1996			2.5 (0.098)	± 0.05 (0.002)	2 ± 0.2	5	6	–	2	Continuous[3]	20 ± 5	0.35 – 0.6
ASTM D1816:2012 1 mm	–		1.0 (0.039)	± 0.03 (0.001)	0.5 ± 5%	3[2]	5	–	1	Continuous	20 – 30	0.5
ASTM D1816:2012 2 mm	–		2.0 (0.079)	± 0.03 (0.001)	0.5 ± 5%	3[2]	5	–	1	Continuous	20 – 30	Approx. 0.9
ASTM D877/ D877M:2013 PA	–		2.54 (0.1)	± 1%	3 ± 5%	3[2]	5	–	1	Without	20 – 30	0.35 – 0.6
ASTM D877/ D877M:2013 PB	–		2.54 (0.1)	± 1%	3 ± 5%	3[2]	1/5[4]	–	–	Without	20 – 30	0.35 – 0.6
CSSR RVHP:1985	–		2.5 (0.098)	± 0.05 (0.002)	2 ± 20%	10	6	–	5	After each breakdown 1 min	20 ± 5	–
IRAM 2341:1972	–		2.5 (0.098)	± 0.05 (0.002)	2 ± 0.2	10	6	Largest deviation	2	After each breakdown 1 min	20 ± 5	> 0.25
JIS C2101:1999		–	2.5 (0.098)	–	3	3	5/2[4]	First	1	After each breakdown 1 min	15 – 35	–
PN 77/E-04408	–		2.5 (0.098)	± 0.05 (0.002)	2 ± 20%	10	6	–	5	After each breakdown 1 min	Approx. 20	Approx. 0.3
ASTM D1816/97	–		2 / 1 (0.079 / 0.039)	± 0.03 (0.001)	0.5 ± 20%	3	5	–	1	Continuous	20 0 30	0.5 (1 mm) / approx. 0.9 (2 mm)

[1] Can be selected under *Main menu* > *Device settings* > *IEC 60156:1995 settings*

[2] Can be selected under *Main menu* > *Device settings* > *ASTM settings*.
When testing ester liquids in accordance with ASTM D1816:2012 the hold time before the first measurement must be at least 30 mins.

[3] Can be deactivated under *Main menu* > *Device settings* > *IEC 60156:1995 settings*

[4] Measurements per filling / number of measurements

The electrode shapes and their dimensions:

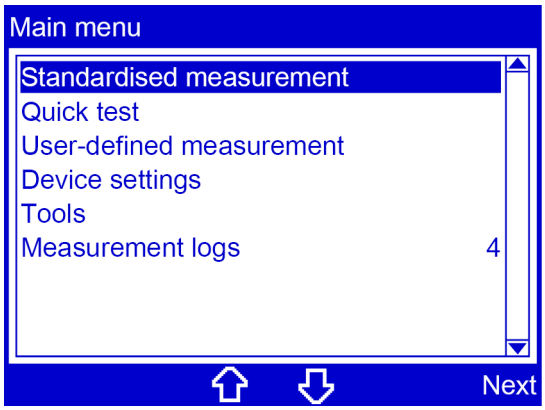
 : IEC 60156:1995 Fig. I, ball Ø 12.5 to 13.0

 : IEC 60156:1995 Fig. II, Ø 36.0 / radius 25.0

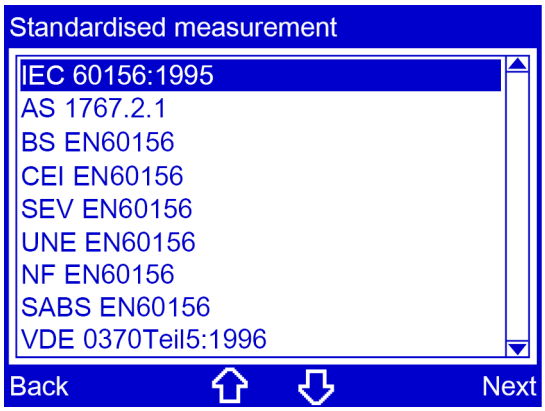
 : ASTM D877, disc Ø 25.4

8.2 Carry out a standardised measurement

Main menu > *Standardised measurement*

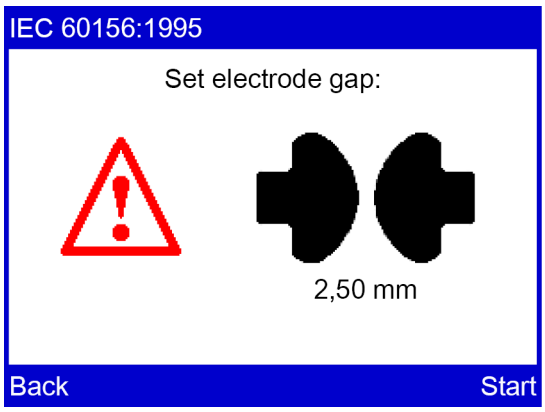


1. In the main menu, select the menu item *Standardised measurement*.
2. Select the menu item *Next* to confirm the selection.



3. Select a standard, then menu item *Next*.
   The electrode shape and spacing are defined by the relevant standard.

A prompt appears on the display to set the electrode gap according to the selected standard. The required electrode shape is displayed pictographically.



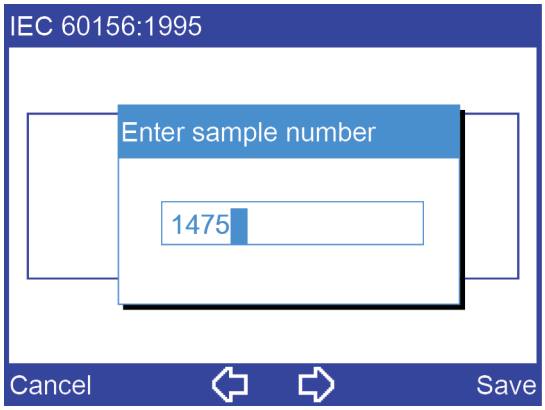
4. Check that the electrodes used meet the selected standard.

   If the wrong electrodes are used, replace them. Further information: Chapter *Replacing the electrodes (on page 29).*

5. Set the indicated electrode gap. Further information: Chapter *Setting an electrode gap* (on page 30).

6. Select the menu item *Start*.

   A prompt to enter a sample number appears on the display. The oil breakdown voltage tester will suggest a sample number composed of the date and time in DDMMYYhhmm format. This sample number can be extended as required.

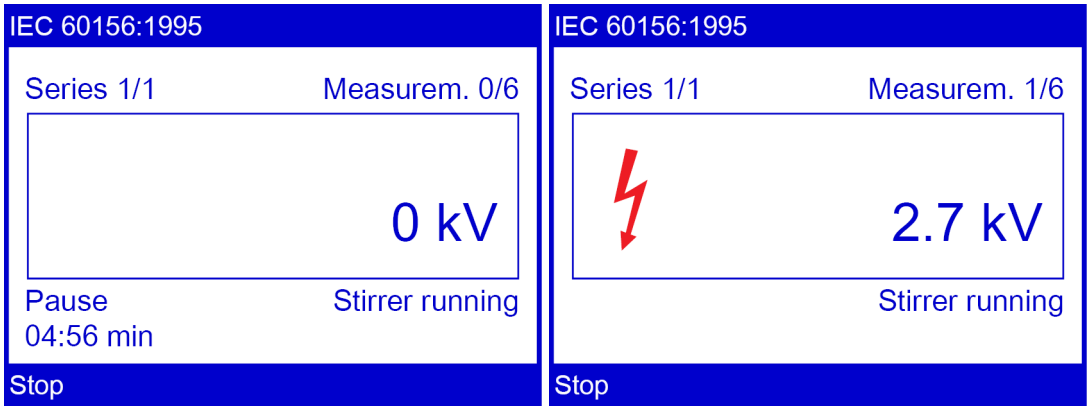


7. If you want to amend the suggested sample number, do so or enter any sample number with the number keys on the membrane keyboard.

8. Click *Save* to confirm the entry.

   The measurement begins. A window displays the details of the measurement process.

   The symbol indicates that there is high voltage at the electrodes.



When the oil breakdown voltage tester has completed the measurement, the measurement log is shown on the display. If the printer is switched on, the measurement log will automatically be printed first.

9. Select the menu item *Details* in the lower menu bar for a detailed view of the measurement results.
10. Select the menu item *Back* to perform further measurements or to stop the measurement process.

    The oil breakdown voltage tester switches to the beginning of the measurement. A prompt appears on the display to set the electrode gap.
11. Repeat the process to perform additional measurements.

    Select the menu item *Back* to stop the measurement process.

    The oil breakdown voltage tester switches to the main menu.

Cancelling the measurement manually

- Select menu item *Stop*.

9 QUICK TEST

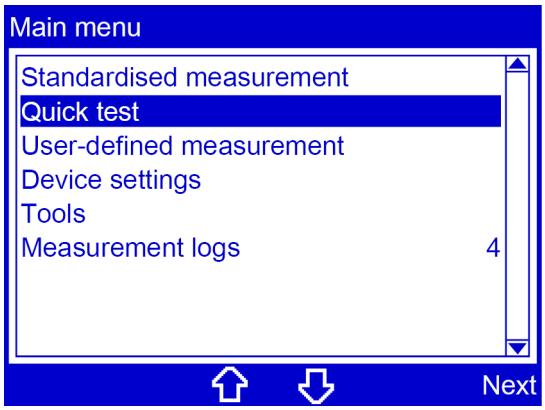
A quick test is used to make a quick evaluation of the oil status. In this process, an orientation value will be determined for the breakdown strength of the insulating oil.

Quick test parameters:

- Standard: none;
- Stirrer: inactive;
- Output voltage: max. possible output voltage.

It is not possible to adjust the quick test parameters. To adjust individual parameters, create a user-defined measurement. Further information: Chapter *User-defined measurement (on page 51).*

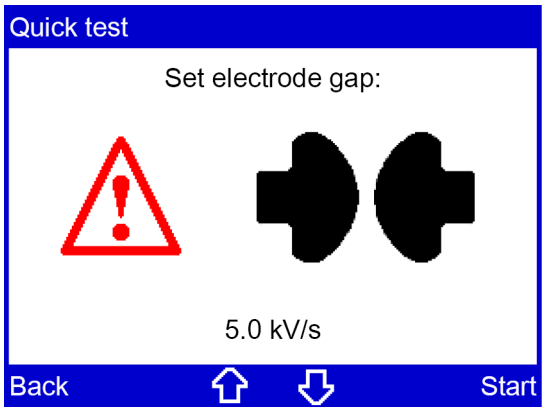
Main menu > *Quick test*



1. In the main menu, select the menu item *Quick test*.
2. Select the menu item *Next* to confirm the selection.

   A prompt appears on the display to set the electrode gap. You can choose any electrode shape you want during a quick test.

   Recommendation: Select an electrode shape based on the selected standard.



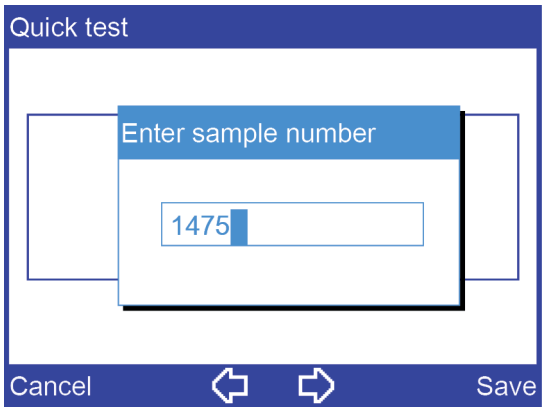
3. Set the electrode gap according to the selected standard.

Further information:

- Chapter *Setting an electrode gap* (on page 30)
- Chapter *Overview of standards* (on page 43)

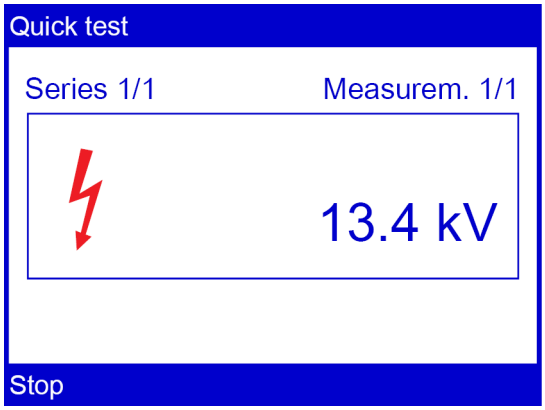
4. Set the slew rate for the test voltage. Please use the arrow keys to make entries.
5. Select the menu item *Start*.

   A prompt to enter a sample number appears on the display. The oil breakdown voltage tester will suggest a sample number composed of the date and time in DDMMYYhhmm format. This sample number can be extended as required.



6. If you want to amend the suggested sample number, do so or enter any sample number with the number keys on the membrane keyboard.
7. Click *Save* to confirm the entry.

   The measurement begins. A window displays the details of the measurement process. The symbol indicates that there is high voltage at the electrodes.



When the oil breakdown voltage tester has completed the measurement, the measurement log is shown on the display. If the printer is switched on, the measurement log will automatically be printed first.

8. Select the menu item *Details* in the lower menu bar for a detailed view of the measurement results.
9. Select the menu item *Back* to perform further measurements or to stop the measurement process.

   The oil breakdown voltage tester switches to the beginning of the measurement. A prompt appears on the display to set the electrode gap.

10. Repeat the process to perform additional measurements.

    Select the menu item *Back* to stop the measurement process.

    The oil breakdown voltage tester switches to the main menu.

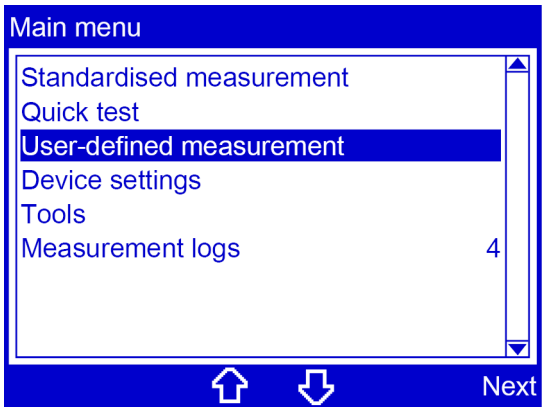
11. Select the menu item *Back* to perform further measurements or to stop the measurement process.

Cancelling the measurement manually

- Select menu item *Stop*.

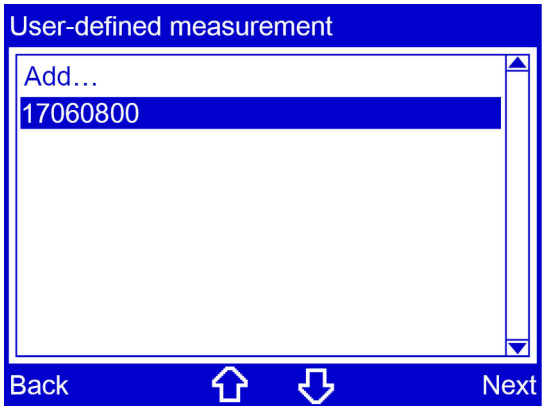
10 USER-DEFINED MEASUREMENT

Main menu > *User-defined measurement*



1. Select the menu item by pressing the arrow keys.
2. Select the menu item *Next* to confirm the selection.

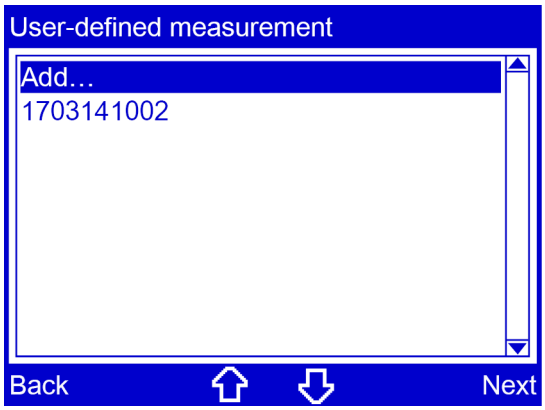
   The *User-defined measurement* menu opens.



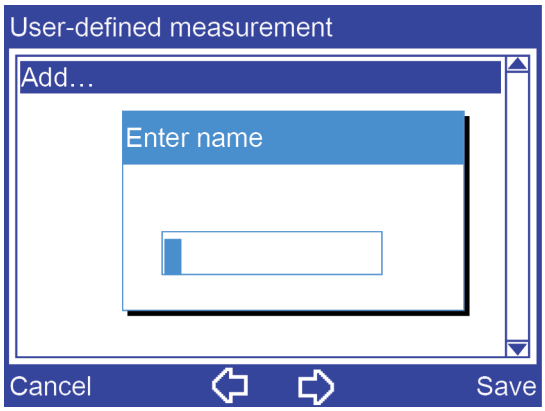
3. You have the following options:
   - Add a new measurement (see "Creating a user-defined measurement" on page 52)
   - Select an existing measurement (see "Editing or deleting a user-defined measurement" on page 64, "Run user-defined measurement" on page 62)

10.1 Creating a user-defined measurement

Main menu > *User-defined measurement*



1. Select the menu item by pressing the arrow keys.
2. Select the menu item *Next* to confirm the selection.
   A prompt appears on the display to enter a name for the measurement.



3. Enter a name for the measurement. If you do not enter a name, the device will issue a name based on the date and time in a DDMMYYhhmm format.
4. Click *Save* to confirm the entry.
   The menu for defining measurement parameters will open.

10.1.1 Overview of templates

If your measurement is similar to a standardised measurement, you can load the settings from a standard as a template and customise them in the other menu items.

The following table provides an overview of the settings according to the template.

	No template	Continuous measurement	Withstand voltage	IEC 60156:1995	ASTM D1816:2012 1 mm	ASTM D1816:2012 2 mm	ASTM D877/D877M:2013 PA	ASTM D877/D877M:2013 PB	CSSR RVHP:1985	IRAM 2341:1972	JIS C2101:1999	PN 77/E-04408	ASTM D1816/97
Hold time	x	–	x	x	x	x	x	x	x	x	x	x	x
Stirring in hold time	–	–	–	x	–	–	x	x	x	x	x	x	–
Voltage rise	x	x	x	x	x	x	x	x	x	x	x	x	x
Pause	x	x	–	x	x	x	x	x	x	x	x	x	x
Stirrer	x	x	–	x	x	x	x	x	x	x	x	x	x
Number of measurements	x	–	–	x	x	x	x	x	x	x	x	x	x
Max. output voltage	x	x	x	x	x	x	x	x	x	x	x	x	x
Withstand voltage	–	–	x	–	–	–	–	–	–	–	–	–	–
Ignore measurement values	x	–	–	x	x	x	x	x	x	x	x	x	x

x: Adjustment possible
–: Adjustment not possible

Note: When a template is selected, only the settings relevant for that specific template will be displayed. If you make an adjustment to one setting which then makes another setting impossible, the setting which can no longer be selected will automatically be greyed out.

The following chapter explains in more detail how to adjust each parameter.

Continuous measurement template

A continuous measurement consists of blocks of 6 measurements each. The blocks will be repeated until the menu item *Stop* is selected.

Withstand voltage template

In the case of a measurement with a withstand voltage, the voltage is raised gradually until the desired voltage is achieved. The level of the withstand voltage, the number of steps and the time the withstand voltage remains at a particular level, are all freely selectable.

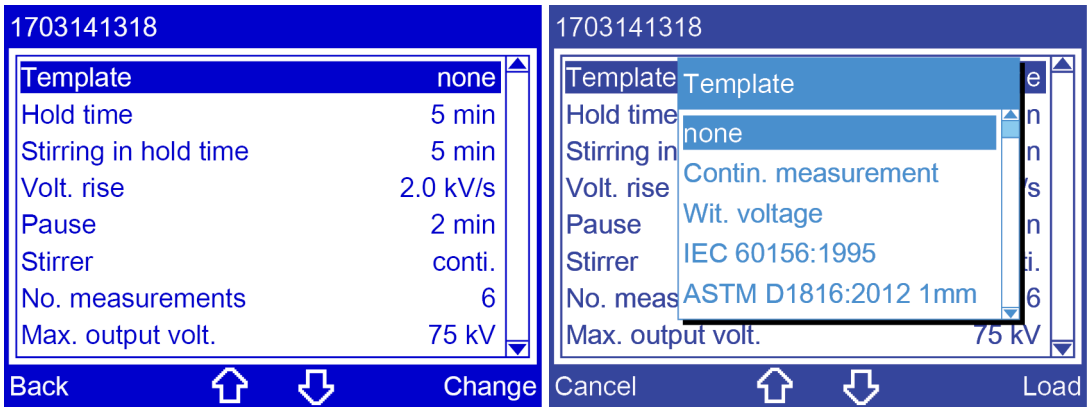
The oil sample is stirred constantly during the measurement taken with a withstand voltage. The parameter *Stirring in hold time* is not active in this template and is not displayed.

Note: The measurement with withstand voltage can also be used to check whether the oil breakdown voltage tester is capable of generating the required high voltage.

Further information: Chapter *Setting the withstand voltage* (on page 58)

10.1.2 Selecting a template

Main menu > *User-defined measurement* > *Template*

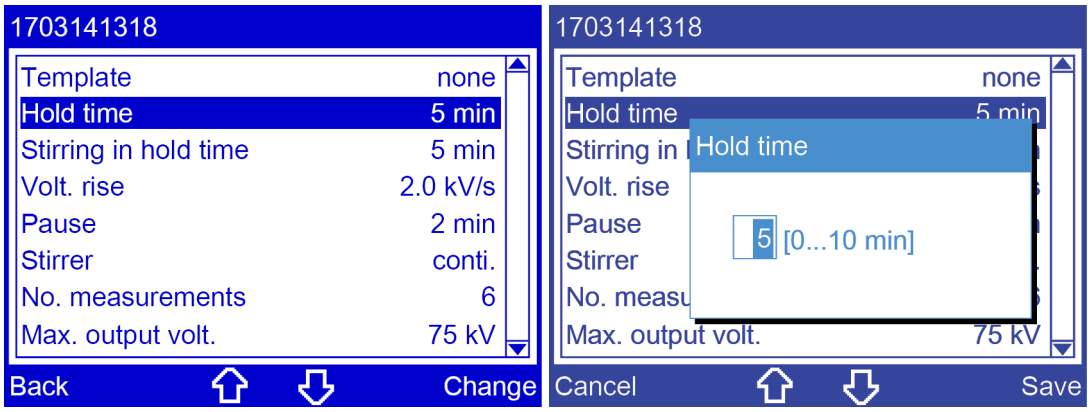


1. In the main menu, select the menu item *User-defined measurement*.
2. Select the menu item *Next* to confirm the selection.
3. In the *User-defined measurement* menu select the menu item *Template* and then menu item *Change*.
4. Select a template by pressing the arrow keys.
5. Confirm the selection with *Load*.
   The selected template is registered in the measurement log.

Note: If you define additional settings for the measurement which deviate from the selected standard, a message appears stating that: *You cannot change this setting in the selected template!* If you apply the different setting despite this, the selected template will be disabled.

10.1.3 Setting the hold time before the first measurement

Main menu > *User-defined measurement* > ... > *Hold time*

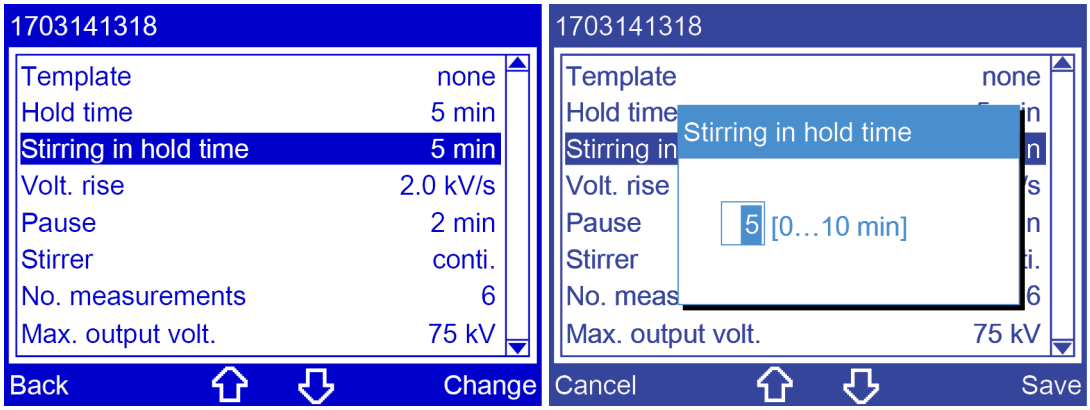


1. Select menu item *Hold time*.
2. Select menu item *Change*.
3. Enter the hold time before the first measurement using the number keys on the membrane keyboard.
4. Click *Save* to confirm the entry.

10.1.4 Setting the stirring time during the hold time

Recommendation: As the homogeneity of the oil sample has a strong influence on the quality of the measurement results, stir the oil sample during the measurement process.

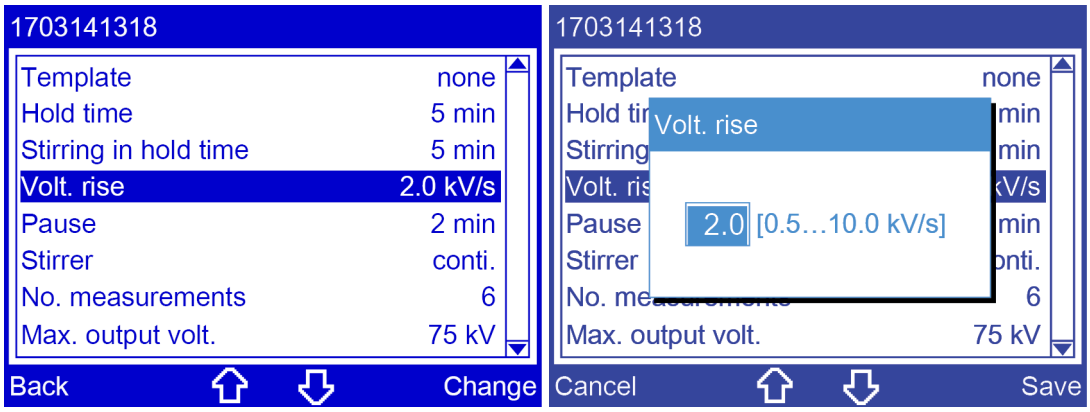
Main menu > *User-defined measurement* > ... > *Stirring in hold time*



1. Select menu item *Stirring in hold time*.
2. Select menu item *Change*.
3. Enter the stirring time during the hold time before the first measurement using the number keys on the membrane keyboard.
4. Click *Save* to confirm the entry.

10.1.5 Setting the slew rate for the test voltage

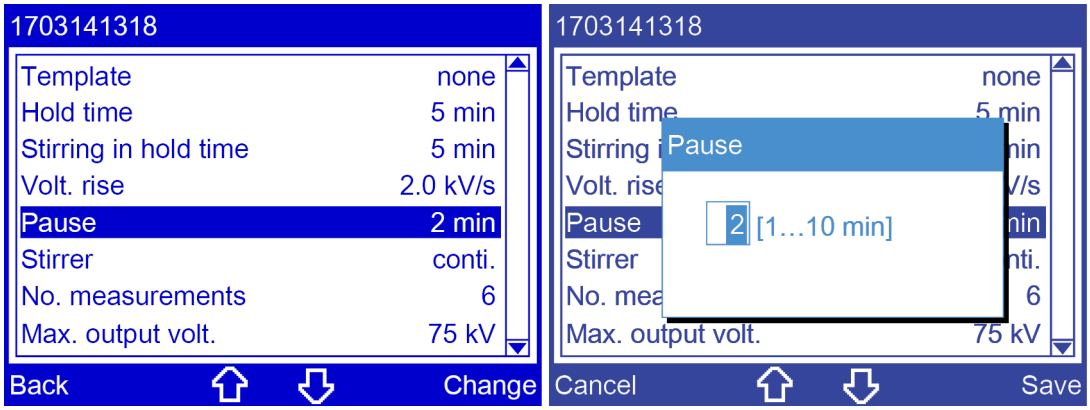
Main menu > *User-defined measurement* > ... > *Volt. rise*



1. Select the menu item by pressing the arrow keys.
2. Select menu item *Change*.
3. Enter the slew rate for the test voltage with the number keys on the membrane keypad.
4. Click *Save* to confirm the entry.

10.1.6 Setting the duration of the pauses between measurements

Main menu > *User-defined measurement* > ... > *Pause*

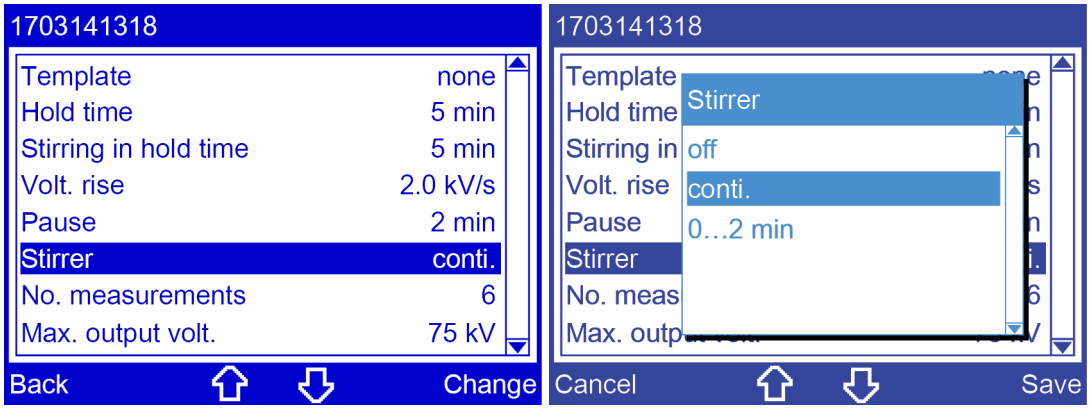


1. Select the menu item by pressing the arrow keys.
2. Select menu item *Change*.
3. Enter the duration of the pauses between measurements with the number keys on the membrane keypad.
4. Click *Save* to confirm the entry.

10.1.7 Setting the stirring time in the pauses

Recommendation: As the homogeneity of the oil sample has a strong influence on the quality of the measurement results, stir the oil sample during the measurement process.

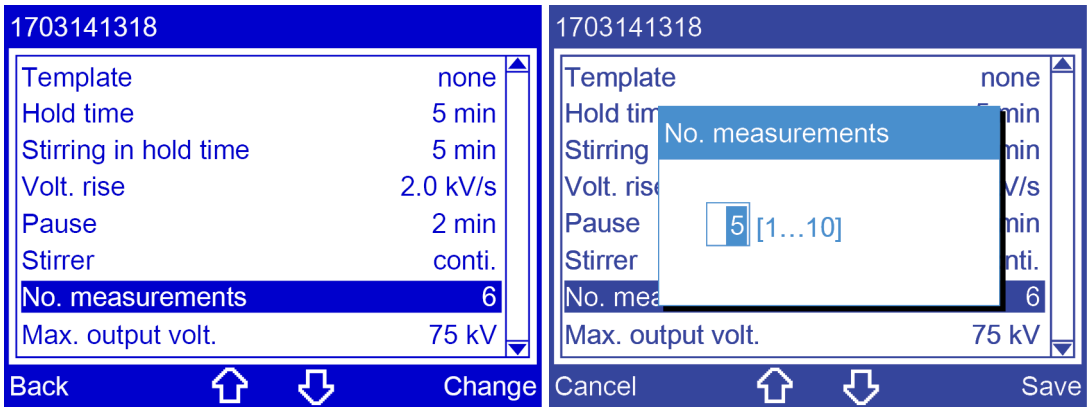
Main menu > *User-defined measurement* > ... > *Stirrer*



1. Select menu item *Stirrer*.
2. Select menu item *Change*.
3. Choose one of the following settings by pressing the arrow keys:
   - *off*
     The stirrer is inactive.
   - *conti.*
     The stirrer runs continuously.
   - *0...x min*
     Define how long the oil sample is stirred during the pauses
     Note: The max. stirring time equates to the duration of the pause
4. Click *Save* to confirm the entry.

10.1.8 Setting the number of measurements

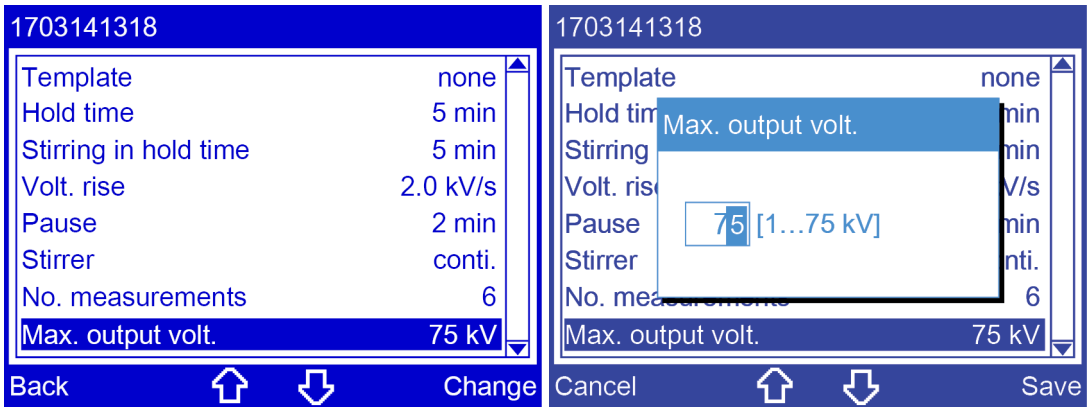
Main menu > *User-defined measurement* > ... > No. *measurements*



1. Select the menu item by pressing the arrow keys.
2. Select menu item *Change*.
3. Enter the number of measurements with the number keys on the membrane keypad.
4. Click *Save* to confirm the entry.

10.1.9 Setting the maximum output voltage

Main menu > *User-defined measurement* > *Max. output volt.*



1. Select the menu item by pressing the arrow keys.
2. Select menu item *Change*.
3. Enter the maximum output voltage with the number keys on the membrane keypad.
4. Click *Save* to confirm the entry.

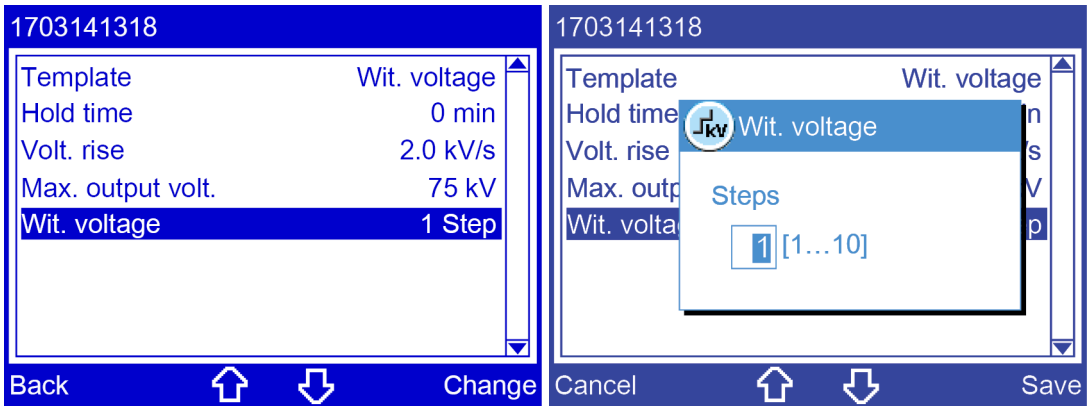
10.1.10 Setting the withstand voltage

Prerequisite

The template *Withstand voltage* has been selected.

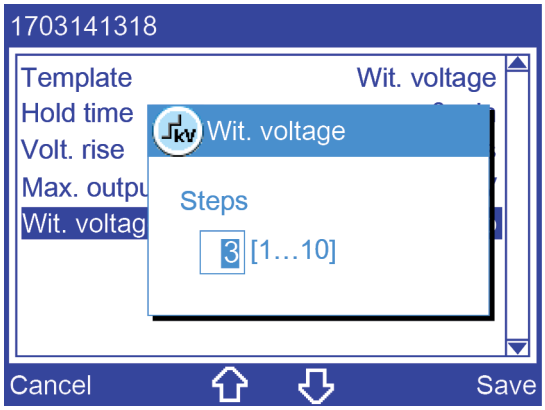
Procedure

Main menu > *User-defined measurement* > *Template* > *Withstand voltage*

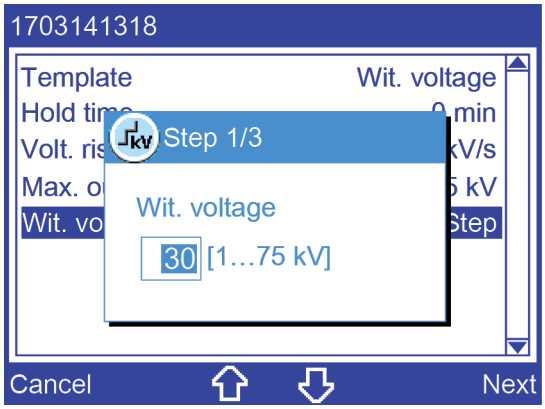


1. Select menu item *Withstand voltage*.
2. Select menu item *Change*.
3. Select the number of steps in which the withstand voltage is to be achieved.

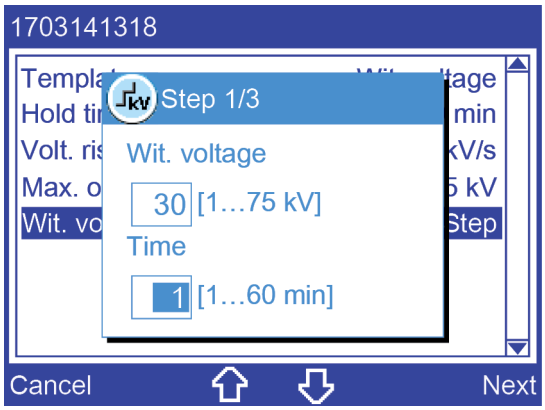
For example:



4. Click *Save* to confirm the entry.
5. Select the withstand voltage value for the first step.



6. Select the menu item *Next* to confirm the selection.
7. Select the duration for which the withstand voltage is maintained during the first step.

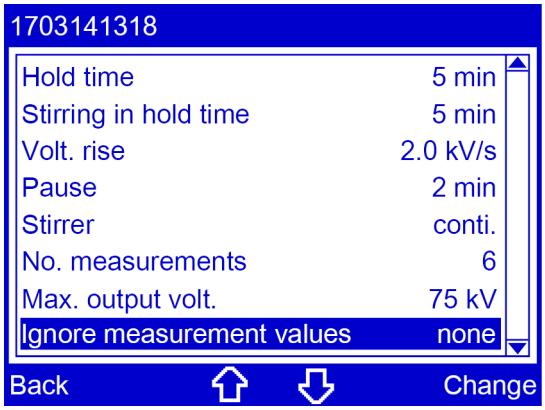


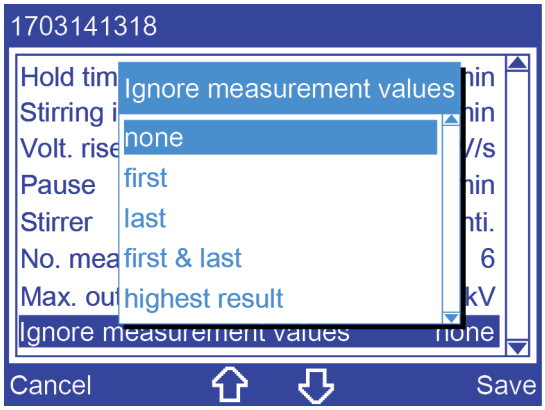
8. Select the menu item *Next* to confirm the selection.
9. Select the withstand voltage value and the duration of the withstand voltage for all subsequent steps. To do this, repeat steps 5 to 8 for each further step.

10.1.11 Select which measured values are not to be evaluated.

Define which measured values are considered in the measurement result.

Main menu > *User-defined measurement* > ... > *Ignore measurement values*



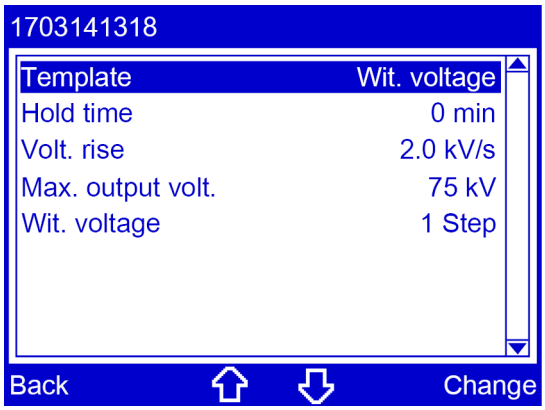


1. Select the menu item by pressing the arrow keys.
2. Select menu item *Change*.
3. Choose one of the following settings by pressing the arrow keys:
   - *none*
     The measured values of all measurements are included in the measurement result.
   - *First*
     The first measurement is not included in the measurement result.
   - *Last*
     The last measurement is not included in the measurement result.
   - *First & Last*
     The first and last measurements are not included in the measurement result.
   - *Highest result*
     The maximum measured value is not included in the measurement result.
4. Click *Save* to confirm the entry.

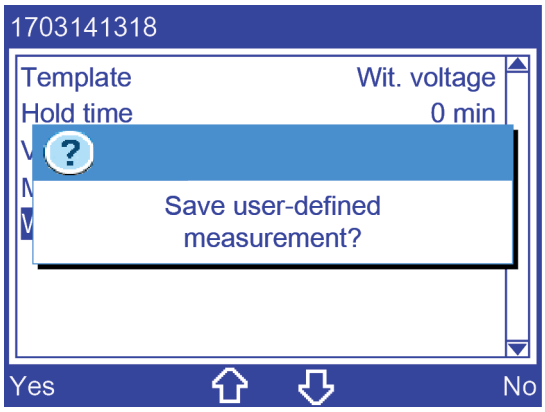
10.1.12 Saving user-defined measurements

After you have defined the parameters for a user-defined measurement, you can save this measurement.

Main menu > *User-defined measurement* > selected measurement



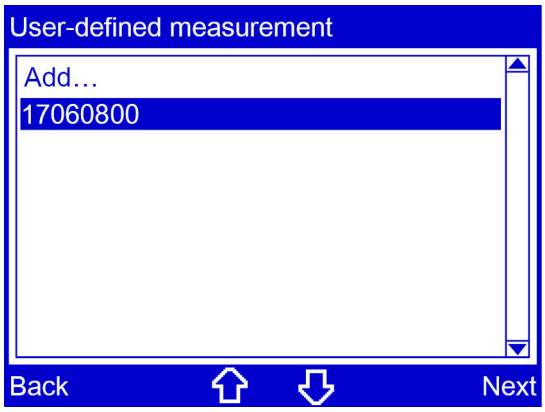
1. Select *Back*.
   You will be asked if you want to save the measurement with modified parameters.



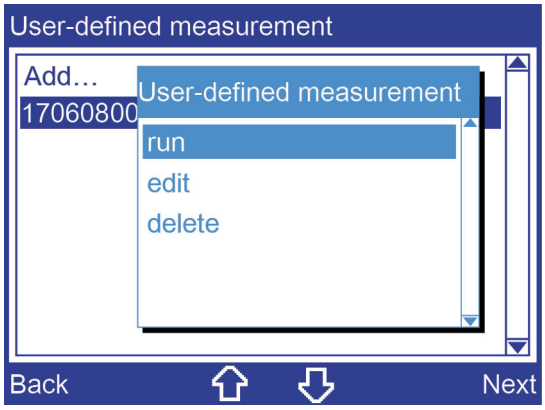
2. Select *Yes*.
   The measurement will be saved.

10.2 Run user-defined measurement

Main menu > *User-defined measurement*

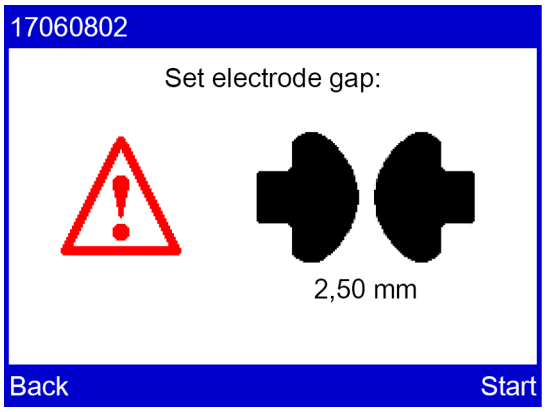


1. In the main menu, select the menu item *User-defined measurement*.
2. Select the menu item *Next* to confirm the selection.
3. In the *User-defined measurement* menu, select a saved measurement, followed by the menu item *Next*.



4. Select the menu item *Run*, followed by the menu item *Next*.

   A prompt appears on the display to set an electrode gap. The required electrode shape is displayed pictographically.

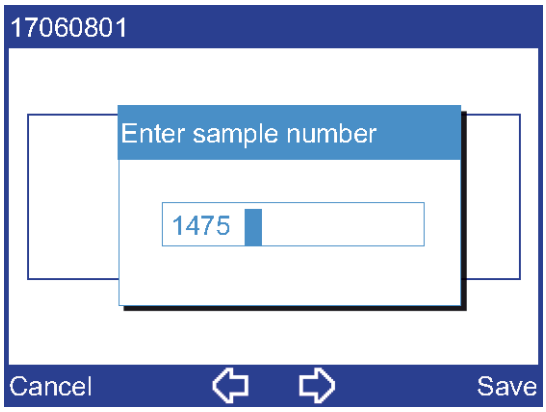


5. Check whether the correct electrodes have been selected.

   If the wrong electrodes are used, replace them. Further information: Chapter *Replacing the electrodes (on page 29)*.

6. Set the indicated electrode gap. Further information: Chapter *Setting an electrode gap* (on page 30).
7. Select menu item *Start*.

   A prompt to enter a sample number appears on the display. The oil breakdown voltage tester will suggest a sample number composed of the date and time in DDMMYYhhmm format. This sample number can be extended as required.



8. If you want to amend the suggested sample number, do so or enter any sample number with the number keys on the membrane keyboard.
9. Click *Save* to confirm the entry.

   The measurement begins. A window displays the details of the measurement process.

   The symbol indicates that there is high voltage at the electrodes.

   When the oil breakdown voltage tester has completed the measurement, the measurement log is shown on the display. If the printer is switched on, the measurement log will automatically be printed first.
10. Select the menu item *Details* in the lower menu bar for a detailed view of the measurement results.
11. Select the menu item *Back* to perform further measurements or to stop the measurement process.

    The oil breakdown voltage tester switches to the beginning of the measurement. A prompt appears on the display to set the electrode gap.
12. Repeat the process to perform additional measurements.

    Select the menu item *Back* to stop the measurement process.

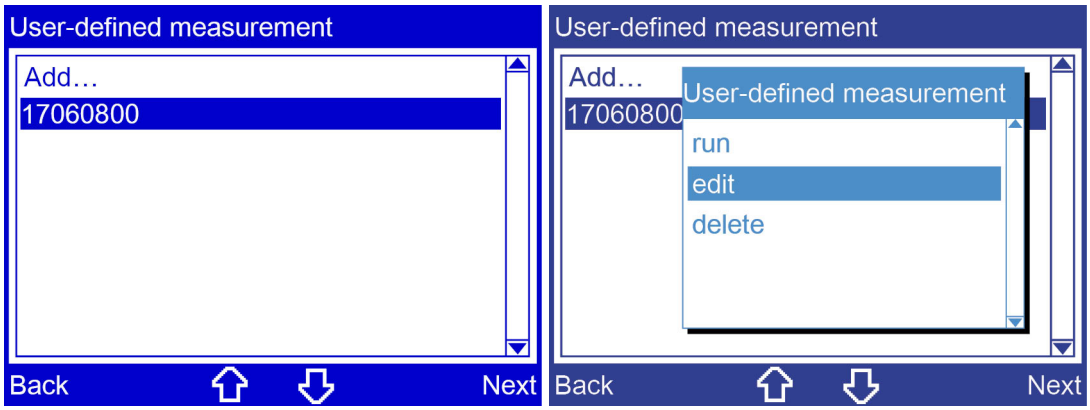
    The oil breakdown voltage tester switches to the main menu.

Cancelling the measurement manually

- Select menu item *Stop*.

10.3 Editing or deleting a user-defined measurement

Main menu > *User-defined measurement*



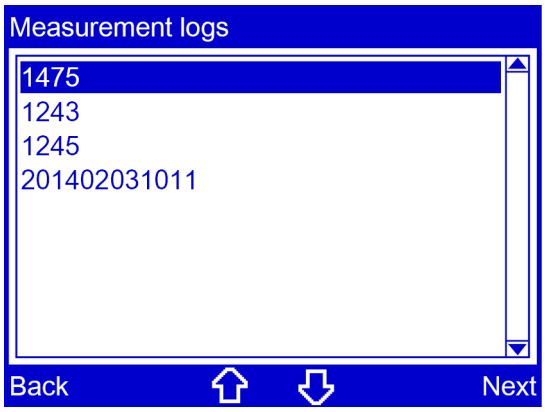
1. Select a saved measurement by pressing the arrow keys.
2. Select the menu item *Next* to confirm the selection.
3. Choose one of the following settings by pressing the arrow keys:
   - *edit*

     This will take you to the menu for editing the parameters of the selected measurement where you can edit the settings (see "Creating a user-defined measurement" on page 52).
   - *delete*

     The device deletes the selected measurement.
4. Select the menu item *Next* to confirm the selection.

11 DISPLAY OF MEASUREMENT RESULTS

Main menu > *Measurement logs*



1. Choose a measurement log by pressing the arrow keys.
2. Select the menu item *Next* to confirm the selection.
3. Choose one of the following settings by pressing the arrow keys:
   - *show*
     The selected measurement log is displayed.
   - *print*
     The selected measurement log is printed.
   - *delete*
     The selected measurement log is deleted.
   - *delete all*
     All measurement protocols that are saved on the device are deleted.
4. Select the menu item *Next* to confirm the selection.

11.1 Measurement log as printout

Main menu > *Measurement logs* > *print*

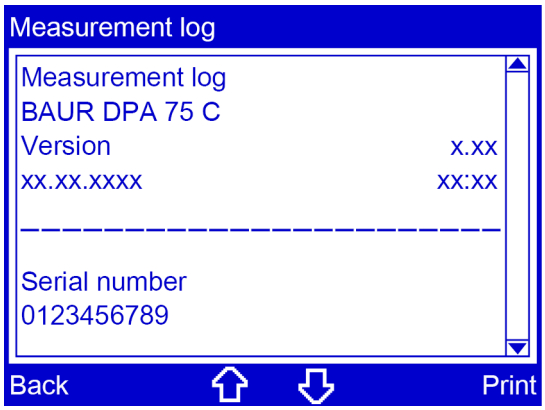
```
Measurement log
BAUR DPA 75 C
Version                          1.08
16.04.2014                      10:12
-----------------------------------------------------
Serial number:
0801900001
Sample number:
1002091355

-----------------------------------------------------
Standardised measurement:
IEC 60156:1995

Electrode shape:
IEC 60156 Fig. II
Distance:                     2.5 mm

Test frequency:                60 Hz
-----------------------------------------------------
Temperature                    20 °C

Measurement 1                47.2 kV
Measurement 2                43.2 kV
Measurement 3                44.4 kV
Measurement 4                46.9 kV
Measurement 5                44.6 kV
Measurement 6                21.7 kV

Avg. value                   41.3 kV
Stand. dev.*                  9.7 kV
Std.dev./Avg.*               23.6%

Test completed!

-----------------------------------------------------
Test performed by:

.....
```

* Abbreviations:

Stand. dev.	Standard deviation The standard deviation shows how close the individual recorded values are to the average value.
Std.dev./Avg.	Ratio of the standard deviation to the average value in % (coefficient of variation). In IEC 60156, diagram 3 in section 11 illustrates the ratio of the standard deviation to the average value. This diagram and the determined values can be used to check whether the measurement result lies within the permitted range.

11.2 Measurement log on the display

Main menu > *Measurement logs* > *show*



- Use the arrow keys to scroll through the text.

12 TAKING OUT OF OPERATION

1. Turn off the oil breakdown voltage tester.

   Mains voltage power supply

   a. Close the operating unit.

      The firmware stops.

   b. There is a mains switch on the back. Turn off the oil breakdown voltage tester.

   c. To disconnect the device completely from the mains voltage, pull out the mains plug.

   External 12 V DC power supply

   d. Close the operating unit.

      The firmware stops.

   e. Remove the external 12 V DC vehicle battery from the oil breakdown voltage tester.

   Rechargeable battery mode (option)

   ▸ Close the operating unit.

      The firmware stops.

2. Open the protective cover.
3. Remove the test vessel.
4. Empty the test vessel and dispose of the oil sample in an environmentally friendly manner and in accordance with the applicable national regulations.
5. To protect the test vessel from dirt or dust, store the test vessel as follows:

   ▸ Fill the test vessel with new, filtered oil. (This only applies to glass vessels.)

   or

   ▸ Clean the test vessel with petroleum ether and store the closed test vessel in a dust-free environment.

      Further information: IEC 60156:1995, ASTM D877, chapter *Cleaning the oil breakdown voltage tester* (on page 73)

6. Close the protective cover.

13 ACTIVATION OF THE “COMMUNICATION ITS” OPTION

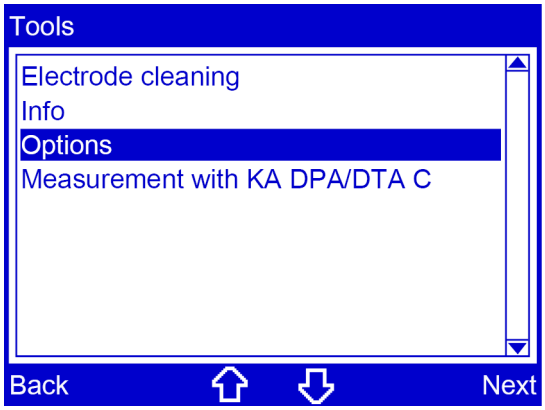
If you bought the ITS oil testing software to upgrade your oil breakdown voltage tester (i.e. retrospectively), activate the interface on the oil breakdown voltage tester to enable communication between the ITS software and the oil breakdown voltage tester.

Prerequisite

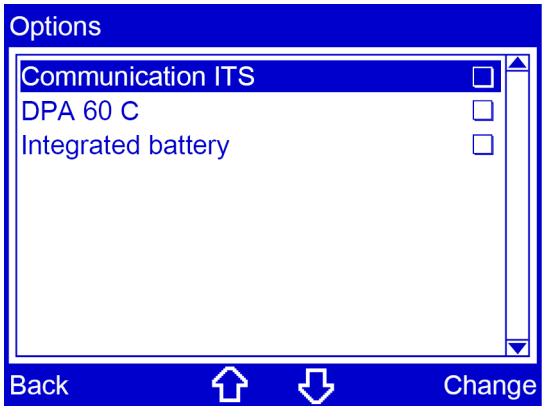
To activate the software, you need an option code, which you received together with the software.

Procedure

Main menu > *Tools* > *Options*

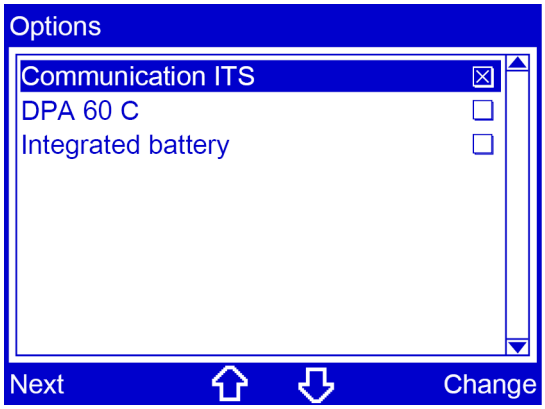


1. In the main menu, select the menu item *Tools*.
2. Select the menu item *Next* to confirm the selection.
3. In the *Tools* menu, select the menu item *Options* and then menu item *Next*.
   A new window is displayed.



4. Check whether the *Communication ITS* option is enabled. This can be seen from the checkbox. If the checkbox is marked, the interface is already enabled and the ITS software can be operated right away with your oil breakdown voltage tester. In this case, you do not need to enter an option code.
   If the option is not enabled, go to the next step and activate the interface.

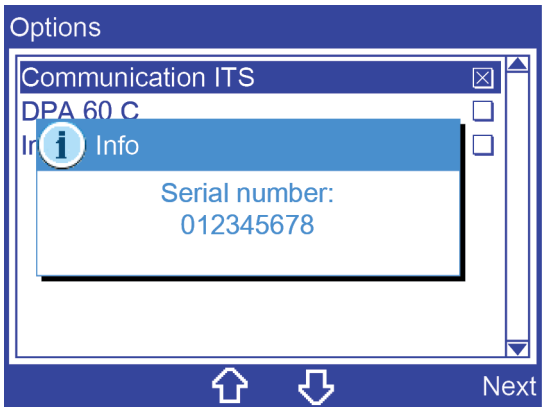
5. Select menu item *Change*.



The checkbox will be marked.

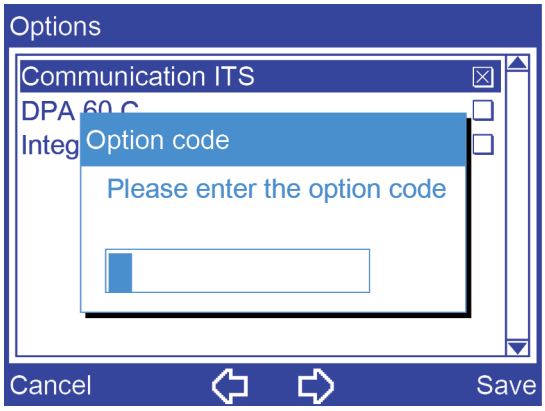
6. Select the menu item *Next* to confirm the selection.

A new window with the device serial number is displayed.



7. Select menu item *Next*.

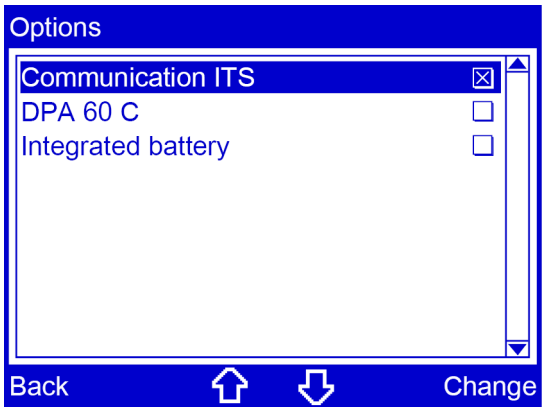
You will be prompted for the software option code. You should have received the option code together with the software.



8. Enter the option code.

9. Click *Save* to confirm the entry.

   The *Communication ITS* option is now enabled.

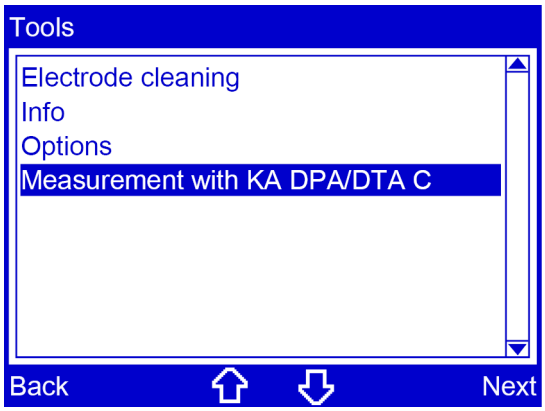


14 CHECKING THE MEASUREMENT ACCURACY OF THE OIL BREAKDOWN VOLTAGE TESTER (OPTIONAL)

You can check the voltage values with a 0.7 % measuring accuracy using a KA DPA/DTA C (option) calibrator.

Further information: User manual for the KA DPA/DTA C calibrator.

Main menu > *Tools* > *Measurement with KA DPA/DTA C*



15 MAINTENANCE

DANGER

Dangerous electric voltage

Danger to life or risk of injury due to electric shock

- Work on electrical devices may only be performed by qualified technical staff.

NOTICE

Damage to device due to improper handling

The user is liable for damages caused due to improper maintenance or care.

- Never take apart the device. This can lead to device damages. Inside the device there are no components that could be serviced or repaired by the user.
- Maintenance tasks must be carried out only by personnel trained and authorised by BAUR

NOTICE

Material damage caused by unauthorised spare parts

- Use only accessories and original spare parts recommended by BAUR. The use of spare parts, accessories and special fittings that have not been tested and approved by BAUR could adversely affect the safety, function and features of the product.

The use of any unauthorised spare parts will invalidate the warranty.

15.1 Cleaning the oil breakdown voltage tester

⚠ DANGER

Electrical voltage on device

Danger to life or risk of injury from electrical voltage.

- Switch off the device before cleaning.
- To disconnect the device completely from the mains voltage, pull out the mains plug.

⚠ WARNING

Fire hazard posed by petroleum ether or other cleaning solvent

We recommend using cleaning solvent to clean the test chamber of the oil breakdown voltage tester and the test vessel. The cleaning solvent is highly flammable and in some circumstances may cause a fire.

- Do not smoke when working with cleaning solvent.
- Avoid naked flames.

NOTICE

Damage to the device may be caused by using the wrong cleaning agents

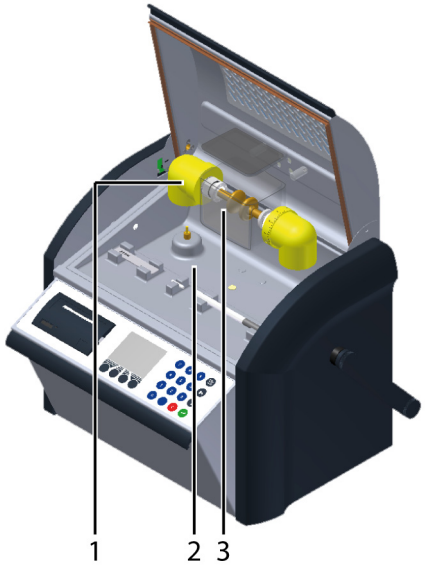
- Do not use any abrasive, corrosive cleaning agents or strong solvents.
- Ensure material compatibility.
- Do not clean the product with acetone or thinner.
- Never clean electrical devices with water.

Prerequisites

Safety gloves to prevent coming into contact with insulating oil

- Mild detergent for cleaning the surfaces of the device
- Petroleum ether or other similar mild solvent for cleaning the test chamber
- Lint-free cleaning cloth

Cleaning the test chamber



1 Test vessel isolators
2 Oil collecting tray
3 Test vessel

1. Always keep the oil breakdown voltage tester clean.
   The cleanliness of the oil breakdown voltage tester and the test cell will have a strong influence on the measurement results.
2. Always wipe off spilled or leaked oil with petroleum ether or other similar mild solvent and a lint-free cloth, in particular:
   - on the tes vessel isolators
   - in the oil collecting tray (test chamber floor)
   - on the test vessel
3. Allow the oil breakdown voltage tester to dry well before closing it.

Cleaning the display

- Clean the displays with a dry or slightly damp lint-free cloth.

Cleaning the device surfaces and connection cable

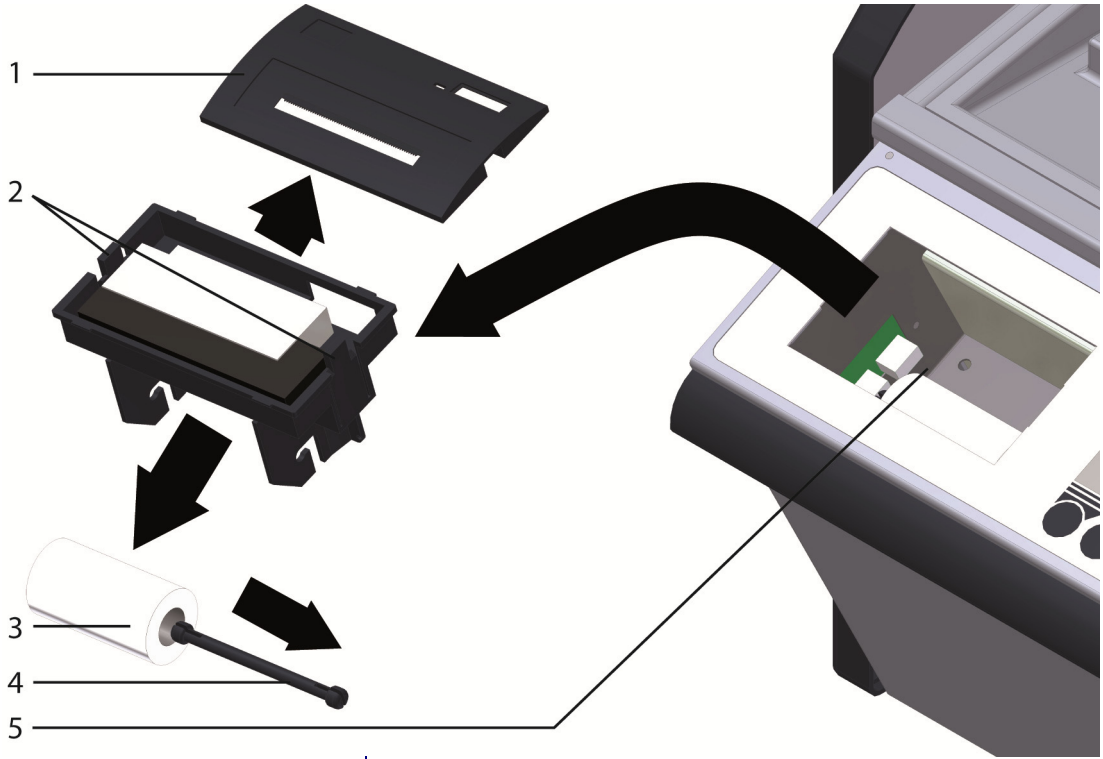
1. Clean the device surfaces and connection cable with mild detergent and a lint-free cloth.
2. *NOTICE!* Damage to device due to leaking fluids. Do not allow liquids to leak into devices.

15.2 Replacing the printer paper roll

Prerequisites

	Paper scissors for cutting the paper roll.
	Paper roll for printer, plain paper, Ø 30 cm, width 57 mm Order number: 565-514

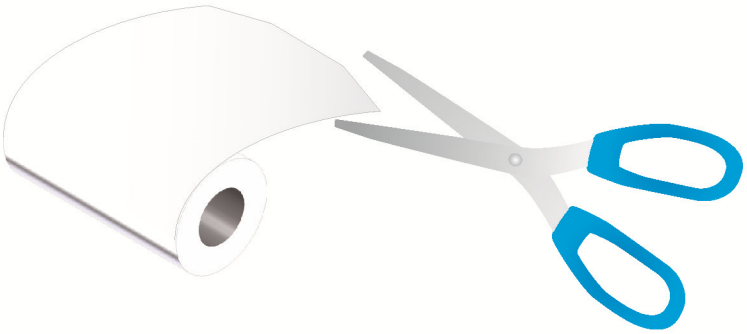
Procedure



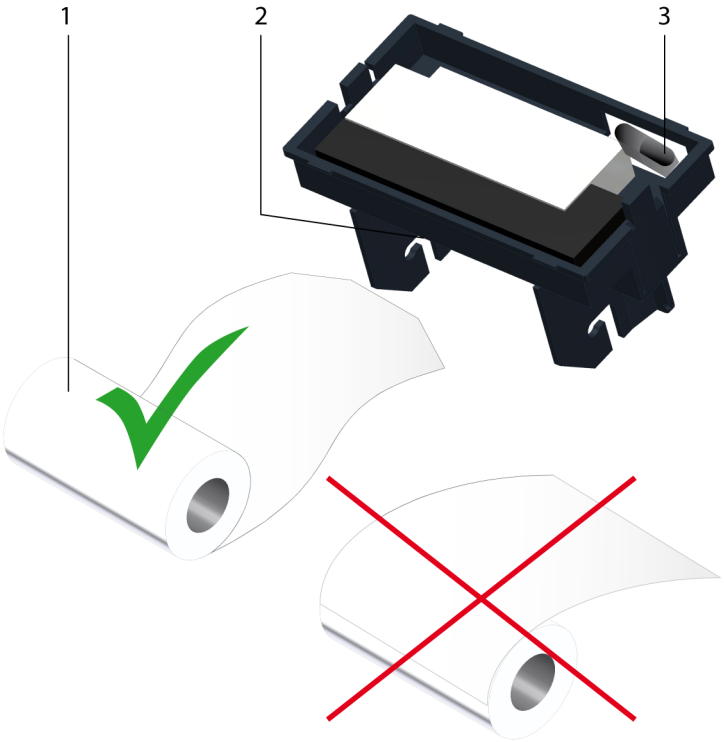
1 Cover
2 Latches
3 Paper roll
4 Paper roll holder
5 Groove

1. Remove the cover (1) from the printer.
2. Press both latches (2) inwards and remove the printer.
3. Remove the paper roll holder (4).
4. Remove the empty paper roll.

5. Use scissors to cut the end of the new paper roll in the shape of a trapeze.



6. Put the paper roll holder with the new paper roll into the printer.



1	Paper roll
2	Paper feed
3	Paper feed button *LF/SET*

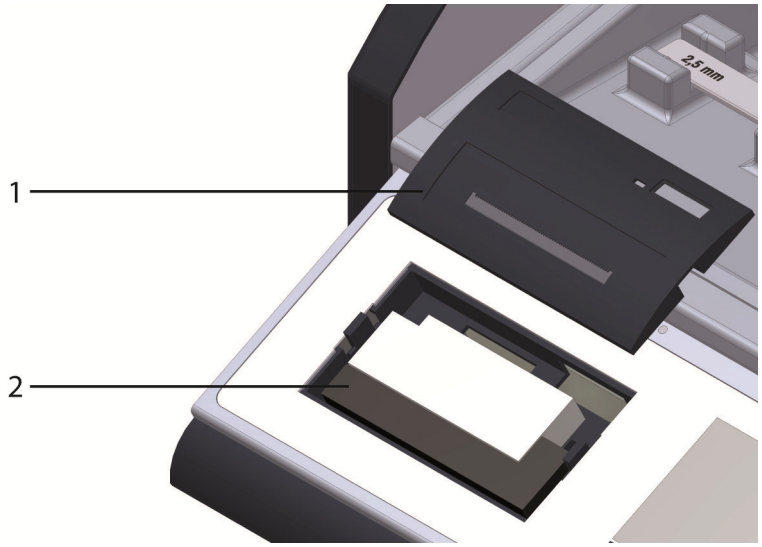
7. Guide the end of the new paper roll into the paper feed (2).
   Make sure that the paper is folded in such a way that the printer can pull it in easily.
8. Press the paper feed button *LF/SET* (3) until the end of the paper protrudes by a few centimetres on the top side of the printer.
9. Tighten the paper roll slightly.
10. Place the printer in the groove so that it snaps into place.
11. Place the cover on the printer.

15.3 Replacing the printer ink ribbon

Prerequisites

	Printer ink ribbon, blue Order number: 565-513

Procedure



1 Cover
2 Printer ink ribbon

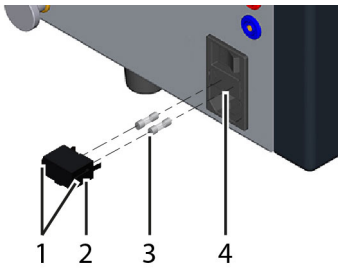
1. Remove the cover (1) from the printer.
2. Replace the printer ink ribbon (2).
3. Place the cover (1) on the printer.

15.4 Replacing the fuse

Prerequisites

	Flat-headed screw 1.2 x 6.5 mm
	▪ Mains fuse: 250 V / 4 A slow-blow, rated breaking capacity 1,500 A (H) ▪ Device protection fuse: 250 V / 10 A quick acting, rated breaking capacity 1,500 A (H)

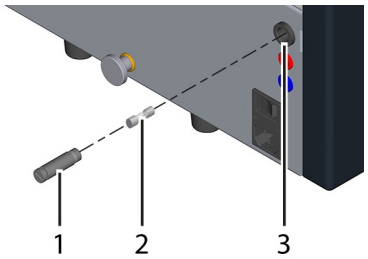
15.4.1 Replacing mains fuse



1 Latches
2 Fuse cartridge
3 Fuses
4 Groove

1. Press both latches (1) inwards and remove the fuse cartridge (2).
2. Replace the fuses (3).
3. Place the fuse cartridge (2) in the groove (4) so that it snaps in place.

15.4.2 Replacing the device protection fuse



1 Fuse cartridge
2 Fuse
3 Groove

1. Unscrew the fuse cartridge (1) out of the groove (3)
2. Replace the fuse (2).
3. Screw the fuse cartridge (1) back into the groove (3)

15.5 Charging the battery

NOTICE
Material damage may be caused by excessive battery voltage Excess battery voltage may damage the battery. ▸ Ensure that the battery voltage lies within the range of 11.4 V to 14.4 V. **Recommendation:**Charge the battery with a voltage of 12 V DC.

1. Connect the oil breakdown voltage tester to the mains voltage or an external 12 V DC voltage source.
2. Fold out the operating unit.
   The battery charging symbols will alternate successively.
   Note: The battery will not charge if the operating unit is folded closed.

15.6 Calibration

The product functions have been inspected, adjusted and calibrated before delivery. The customer receives a test and calibration log. If required, a test and calibration log can be delivered with the proof of traceability of the calibration to national and international standards.

BAUR Prüf- und Messtechnik GmbH recommends calibrating the product once a year to guarantee high accuracy levels.

In case of questions, please contact BAUR Prüf- und Messtechnik GmbH or your local BAUR representative (http://www.baur.at/worldwide/).

15.7 Ordering accessories and spare parts

- Only use accessories and original spare parts recommended by BAUR.
- Order accessories and spare parts from your nearest BAUR representative (http://www.baur.at/worldwide/).

Order number	Description
415-593	BAUR ITS Lite software
670-105	Transport case
670-086	Protective bag
565-513	Printer ink ribbon, blue
565-514	Paper roll for printer, plain paper, Ø 30 mm, width 57 mm
650-209	Face pin wrench for disassembling the test vessel
650-129	Magnetic stirrer
650-229	Lifting stick for magnetic stirrer
432-270	Setting gauge 1 mm in accordance with ASTM D1816
430-109	Setting gauge 2 mm in accordance with ASTM D1816
430-110	Setting gauge 2.5 mm in accordance with IEC 60156
430-105	Setting gauge 2.54 mm in accordance with ASTM D877
431-298	Setting gauge 4 mm in accordance with BS EN 60156
430-111	Setting gauge 5 mm in accordance with SEV EN 60156
415-5383	Pair of electrodes in accordance with IEC 60156 Fig. II or ASTM D1816
415-539	Pair of electrodes in accordance with IEC 60156 Fig. I
415-540	Pair of electrodes in accordance with ASTM D877
415-567	Test vessel 0.4 litre made of glass in accordance with IEC 60156 Fig. I
415-566	Test vessel 0.4 litre made of glass in accordance with IEC 60156 Fig. II
415-568	Test vessel 0.4 litre made of glass in accordance with ASTM D1816
415-585	Test vessel 0.4 litre made of glass in accordance with ASTM D877
415-505	Test vessel 0.4 litre made of synthetic material PA 12 in accordance with IEC 60156 Fig. I
415-506	Test vessel 0.4 litre made of synthetic material PA 12 in accordance with IEC 60156 Fig. II
415-507	Test vessel 0.4 litre made of synthetic material PA 12 in accordance with ASTM D1816
415-508	Test vessel 0.4 litre made of synthetic material PA 12 in accordance with ASTM D877

16 FAULTS

DANGER

Dangerous electric voltage

Danger to life or risk of injury due to electric shock

- Work on electrical devices may only be performed by qualified technical staff.

NOTICE

Damage to device due to improper handling

The user is liable for damages caused due to repairs.

- Never take apart the device. This can lead to device damages. Inside the device there are no components that could be serviced or repaired by the user.
- Repairs must be carried out only by personnel trained and authorised by BAUR

16.1 Troubleshooting

When a fault occurs, proceed as follows:

1. Check the supply voltage, the connection cable and earth cable.
2. If the oil breakdown voltage tester is fitted with a rechargeable battery, check the level of battery charge status.
3. Pay attention to the message on the display.
   Further information: Chapter *Error messages und corrective measures* (on page 82)
4. Restart the oil breakdown voltage tester.
5. If the error occurs again after the device has been restarted, contact your nearest BAUR representative (http://www.baur.at/worldwide/).
   It may be possible for the BAUR Prüf- und Messtechnik After Sales Service Team to determine the cause of the fault remotely. To do so, please specify the following data:
   - Oil breakdown voltage tester serial number
   - Firmware Version
   - Message on display
   - Procedure that caused the error.

16.2 Error messages und corrective measures

Error message	Possible cause	Remedy
Output voltage too low. Measurement cancelled.	Impaired measurement conditions	▸ Repeat the measurement. ▸ Conduct a reference measurement, e. g. with a specific withstand voltage.
	No space between the electrodes	▸ Check whether there is a space between the electrodes. ▸ If the electrodes are touching one another, adjust the setting to a suitable distance. **Note**: If a signal sounds when the electrodes short circuit, please contact your BAUR representative (http://www.baur.at/worldwide/).
	Test vessel positioned incorrectly on the HV isolators	▸ Check whether the test vessel is seated correctly on the HV isolators and contacts and correct the position if necessary.
	In oil breakdown voltage testers with a rechargeable battery: Battery empty	▸ Check the battery charge status and charge the battery if required
	Faulty test vessel	▸ Repeat the measurement with another test vessel and a slightly higher withstand voltage.
	Conductive oil sample due to contamination by water	▸ Dispose of the contaminated oil sample in an environmentally friendly manner and in accordance with the applicable national regulations. ▸ Clean the test vessel with petroleum ether or other similar mild solvent. Further information: Chapter *Cleaning the oil breakdown voltage tester* (on page 73) ▸ Repeat the measurement with a new oil sample.

Error message	Possible cause	Remedy
The output voltage lies beyond the tolerance range! Continue anyway?	–	▸ If you want to continue with the measurement despite the deviation in the output voltage, select the menu item ***Yes.*** The measurement will be continued. The corresponding measured values will be identified with an asterisk in the measurement log.
	Impaired measurement conditions	▸ Repeat the measurement. ▸ Conduct a reference measurement, e. g. with a specific withstand voltage.
	The oil breakdown voltage tester is not clean	▸ Clean the oil breakdown voltage tester. Further information: Chapter *Cleaning the oil breakdown voltage tester* (on page 73)
	The test vessel is not clean	▸ Clean the test vessel with petroleum ether or other similar mild solvent. Further information: Chapter *Cleaning the oil breakdown voltage tester* (on page 73)
	Relative permittivity of the oil sample is too high	▸ Check the relative permittivity of the oil sample. The relative permittivity ε_r must be less than 30.
	In oil breakdown voltage testers with a rechargeable battery: Battery empty	▸ Check the battery charge status and charge the battery if required

17 TRANSPORTATION AND STORAGE

NOTICE
Damage to the device caused by improper transportation and incorrect storage ▸ Always transport and store the device as intended. ▸ Comply with the ambient conditions specified in the technical data for this device.

17.1 Packaging

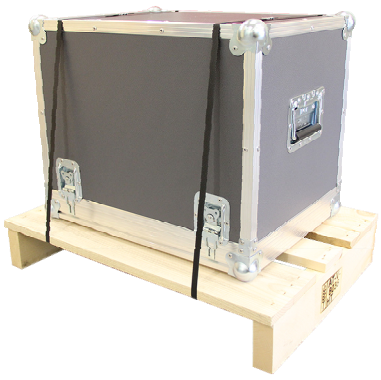
1. Keep the original packaging because it provides the best protection for your oil breakdown voltage tester during transportation.
2. If you would like to dispose of the packaging, ensure you comply with the applicable national regulations when doing so.

17.2 Transportation

If you are sending the oil breakdown voltage tester to BAUR Prüf- und Messtechnik GmbH, a BAUR representative or to the Technical Service for repairs or any other reason, ensure the following:

- Depending on the installed battery, the DPA 60 C / DPA 75 C oil breakdown voltage tester weighs up to 29 kg. We recommend enlisting the help of a second person to lift or carry the fully equipped device with accessories, particularly over long distances.
- To avoid damage during transportation or as a result of faulty packaging, it is best to use the original packaging.

  If none of the original packaging is available, select packaging that is strong enough to protect against mechanical damage and the ingress of liquids.
- The oil breakdown voltage tester must be transported and shipped on a pallet.



Note: The transport case does not constitute shipping packaging. Do not ship the oil breakdown voltage tester in the transport case without a pallet.

- Dismantle the glass test vessel before transporting the oil breakdown voltage tester.

  The glass test vessel is very delicate. To avoid damage during transportation, pack the glass test vessel as securely as possible to ensure it does not break.

  The synthetic material vessel does not have to be dismantled before transportation.
- *NOTICE!* Damage to device due to improper transport. **Transport the oil breakdown voltage tester in an upright position only**.
- Protect the oil breakdown voltage tester against strong vibrations.
- Protect the oil breakdown voltage tester against moisture.

17.3 Storage

- Store the oil breakdown voltage tester in an upright position only.

  Storage temperature: -20 °C to +60 °C
- Always store the oil breakdown voltage tester with the protective cover closed.

  The rubber seals integrated in the protective cover protect the HV isolators and contacts from dirt and dust.
- Protect the oil breakdown voltage tester against moisture.
- Protect the oil breakdown voltage tester against unauthorised access.

18 DISPOSAL

18.1 Disposing of the device

BAUR devices do not belong in the domestic waste!

- Dispose of the device in an environmentally friendly manner and in accordance with the applicable national regulations.

18.2 Disposing of the insulating oil

- Dispose of the insulating oil in an environmentally friendly manner and in accordance with the applicable national regulations.

19 TECHNICAL DATA

General information

Input voltage	90 – 264 V (50/60 Hz) or 12 V DC
Power consumption	Max. 70 VA
Battery type (Option)	Lead battery, 2 x 6 V / 6.5 Ah
Battery life (Option)	Approx. 8 hours (independent operation)
Display	LCD colour display (320 x 240)
Data interfaces	USB 2.0
Printer	Matrix printer, 24 characters, 57 mm plain paper
Ambient temperature (operation)	-10 to +55 °C
Storage temperature	-20 to +60 °C
Humidity	Non condensing
Dimensions (W x H x D)	476 x 372 x 340 mm (closed) 476 x 635 x 420 mm (open)
Weight	Approx. 27 kg (without battery) Approx. 29 kg (with battery)
Degree of protection	IP 32
Safety and EMC	CE-compliant in accordance with the Low Voltage Directive (2006/95/EC) and EMC Directive (2004/108/EC)
Software available in	German, English, French, Spanish, Portuguese, Italian, Russian, Czech, Polish, Dutch, Chinese (CN),Chinese (TW), Korean

Insulating oil testing

Output voltage	DPA 60 C: 0 – 60 kV_{rms} symmetrical DPA 75 C: 0 – 75 kV_{rms} symmetrical
Voltage slew rate	0.5 – 10 kV/s
Switch-off time	< 10 µs
Voltage slew monitoring	Real Breakdown Monitoring (RBM)
Accuracy	DPA 60 C: 0 – 60 kV ±1 kV DPA 75 C: 0 – 75 kV ±1 kV
Resolution	0.1 kV
Internal temperature recording of the oil sample	0 – 99 °C
Temperature resolution	1 °C
Test standards	IEC 60156:1995, AS 1767.2.1, BS EN 60156, CEI EN 60156, SEV EN 60156, UNE EN 60156, NF EN 60156, SABS EN 60156, VDE 0370 Part 5:1996, ASTM D1816:2012 1 mm, ASTM D1816:2012 2 mm, ASTM D1816/97, ASTM D877/D877M:2013 PA, ASTM D877/D877M:2013 PB, CSSR RVHP:1985, IRAM 2341:1972, JIS C2101:1999, PN 77/E-04408
User-specific test sequences	10

Available test vessels 0.4 litres made of glass or synthetic material, with lid


Test vessel in accordance with IEC 60156 Fig. I


Test vessel in accordance with IEC 60156 Fig. II


Test vessel in accordance with ASTM D877


Test vessel in accordance with ASTM D1816

20 DELIVERY INCLUDES AND OPTIONS

Standard delivery includes	Options
▪ BAUR oil breakdown voltage tester DPA 60 C or DPA 75 C ▪ 1 x test vessel (test standard acc. to choice) DPA 60 C: Synthetic material test vessel DPA 75 C: Glass test vessel ▪ Magnetic stirrer ▪ Lifting stick for magnetic stirrer ▪ Setting gauge ▪ Integrated plain paper printer ▪ Carrying strap ▪ Mains connection cable ▪ User manual	▪ BAUR ITS Lite software ▪ Integrated lead-acid battery 2 x 6 V / 6.5 Ah (cannot be retrofitted) ▪ Protective bag ▪ Transport case ▪ Setting gauges, 1 / 2 / 2.5 / 2.54 / 4 / 5 mm ▪ Ink ribbon for printer ▪ Paper roll for printer, 57 mm width, 30 mm diameter ▪ Face pin wrench for disassembling the test vessel ▪ Test vessels 0.4 l made of glass or synthetic material in accordance with IEC 60156 Fig. I or Fig. II, ASTM D877 or ASTM D1816 ▪ Pairs of electrodes for test vessels in accordance with IEC 60156 Fig. I or Fig. II, ASTM D877, ASTM D1816

21 DECLARATION OF CONFORMITY

We

BAUR Prüf- und Messtechnik GmbH
Raiffeisenstraße 8
A-6832 Sulz / Austria
headoffice@baur.at
www.baur.at

declare, under our sole responsibility, that the product

BAUR DPA C Oil Breakdown Voltage Tester,

to which this declaration refers, conforms to the following standards or standard documents:

- Low voltage guideline 2006/95/EG
  EN 61010-1:2010
- EMC Guideline 2004/108/EG
  EN 55011:2009 + A1:2010
  EN 61000-4-2:2009
  EN 61000-4-4:2004 + A1:2010
  EN 61000-4-5:2006
  EN 61000-4-11:2004
- Environmental protection
  EN 60068-2-ff

Signed: Torsten Berth, Technical Director
Dr. Eberhard Paulus, Director QM/QS

Sulz, 14.05.2014

22 INDEX

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