HV Diagnostics

BA60/75/80/100

User Manual

ENGLISH

Rev 7.0

Breakdown Analyzer for Insulating Oil

HV Diagnostics, Inc.
North and South America

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Table of Contents

1 Introduction

Purpose

This operating manual serves to ensure the proper and safe use of the Breakdown Analyzer (BA) for Oil.

NOTICE

This is only an Operating Manual, not a Software Manual.

1.1 Regarding this Document

Target User

This operating manual is designed to inform various user groups. The scope and depth of the information provided may not be appropriate for all users. However, it is important that all users familiarize themselves with this document in full. The following is a guideline indicating the most significant information as a function of the user's responsibilities.

User	Responsibilities	Focus
BA Operator	• To adjust the BA instrument settings. • To handle test liquid samples, sample containers and test vessels appropriately. • To connect the BA test equipment. • To carry out BA tests. • To verify validity of BA application.	**All** Sections Particular focus on all **safety** messages
Procurement, Management	• To assure that liquid test samples are selected and handled appropriately. • To assure that the workplace is safe and has all required equipment. • To assure that BA operators are qualified technicians. • To assure that operators fulfill their responsibilities.	Particular focus on **safety** messages and information regarding **general** product description.

Safekeeping

NOTICE

This manual should always be on hand when using the BA test instrument.

1.2 Documentation Conventions

The following explain the **symbols**, and **safety messages** found in this document. The employment of safety symbols and signal words are according to the American National Standards Institute standard ANSI Z535.6 "Product Safety Signs and Labels".

Safety Messages

Danger

DANGER

Indicates a hazardous situation which if not avoided will result in death or serious injury.

Warning

WARNING

Indicates a hazardous situation which if not avoided could result in death or serious injury.

Caution

CAUTION

Indicates a hazardous situation which if not avoided could result in minor or moderate injury.

Notice

NOTICE

Indicates suggested practices to protect equipment and property.

Symbols

Yellow triangle, framed in black: Used to indicate a potential hazard.
Only used in conjunction with description of the possible hazard!
Detailed symbol may correspond to this specific hazard.

Red outlined circle with red diagonal line: Used to indicate forbidden practices.
The described handling practice must not be carried out!

Blue circle with white exclamation mark: Used to indicate recommended precautionary measures or a situation that can lead to property damage.

1.3 Legal Considerations

Warranty

HV Diagnostics provides a one-year warranty from the original purchase date of instrument for all necessary parts and labor. This warranty is void in the event of abuse, incorrect operation or use, unauthorized modification or repairs, or failure to perform the specified maintenance as indicated in this operation manual. This warranty does not include normal consumable items such as lamps, paper rolls, printer ink ribbons, batteries or other auxiliary items.

This warranty and our liability are limited to replacing or repairing defective equipment, at our discretion. Equipment that is returned to HV Diagnostics must be packed in original packaging. All shipped items must be prepaid and insured. No other warranties are expressed or implied.

Contact Information

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Your opinion matters!

Your comments and suggestions are of value. We are dedicated to supporting your needs. Offering you optimal documentation is part of our promise of quality.

Improvement suggestions regarding this manual may be sent to:

sales@hvdiagnostics.com

Thank you for your feedback!

2 Safety

Safety is a **priority**! Observe and adhere to all **safety information and regulations**; only use the BA for **appropriate applications** and ensure that operators possess the required **operator qualifications and training.**

NOTICE

Before carrying out any test with this instrument, read this Operating Manual in its entirety.

2.1 Work Safety

WARNING

Electric Potential

Never assume that equipment is safe to handle without using the necessary safety precautions.

- All procedures must comply with local safety regulations.
- Always ground the equipment prior to operation with an external power supply and ensure that ground connections are made first and removed last.
- All equipment must be inspected for damage before use. Damaged equipment must not be used.
- Avoid testing alone. In the event of an emergency another person's presence may be essential.

WARNING

Unauthorized Equipment Modifications

Unauthorized equipment modifications may lead to hazardous situations.

- Do not install substitute parts or make unauthorized modifications to the test instrument and accessories.
- Test instruments must only be repaired or modified by authorized HV Diagnostics' personnel.

WARNING

Flammable Materials

Improper handling and selection of test liquids and other solvents may result in fire.

- Do not test liquids with flash points < 110°C (230°F)!
- The test vessel and electrodes must be free from cleaning solvents before performing any high voltage test.

WARNING

Toxic Materials

Cleaning solvents and oil samples must be handled and disposed of according to manufacture indications.

NOTICE

Improper handling of the BA test equipment may lead to material damage.

- Always unpack and store the BA test equipment according to the instructions of this manual.

Improper handling of test vessels, oil and electrodes may lead to test sample contamination and result in inaccurate test results.

- Never touch the electrodes with bare fingers.
- It is recommended to wear powder-free latex, nitrile surgical gloves or equivalent when handling test vessels, oil and electrodes.

2.2 Appropriate Applications

The BA (Breakdown Analyzer) test instrument is designed to automatically test the breakdown strength of liquid dielectrics.

Test Liquids

Insulation oils used in electrical apparatus such as transformers, tap changers, circuit breakers, cables etc. are appropriate test liquids. Test liquids with boiling points below 110 °C (230 °F) are not appropriate!

Test Methods

Test Methods for determining the breakdown strength of liquid dielectrics are specified by various international standards organizations. The appropriate procedures, hardware and reporting requirements are specified in IEC, VDE and ASTM, etc. standards.

The number of tests to be performed, voltage rise-rate, timing sequences, test vessel and electrode configuration, test limits and ranges specified by certain standards are pre-programmed in the BA test equipment. Refer to the section “Technical Description” for a list of the automatic test standards applicable for this BA instrument.

It is the responsibility of the BA instrument user to follow appropriate liquid filling procedures and to set gap spacing of the electrodes according to the selected standard.

3 General Description

3.1 Technical Specifications

Characteristic	BA60	BA75
Part Number	SB0006	800 001
Output Voltage [max.]	60 kV rms	75 kV rms
Measurement accuracy	±1 kV	±1 kV
Voltage slew rate	0.5 kV/s – 10 kV/s	0.5 kV/s – 10 kV/s
Resolution (displayed)	0.1 kV	0.1 kV
Power Supply	85 V – 264 V (47 Hz – 63 Hz)	85 V – 264 V (47 Hz – 63 Hz) 12 V external supply
Power Consumption	60 VA	60 VA
Internal Rechargeable Battery	Not applicable	1 x 12 V / 7.2 Ah, 12 h continuous
Switch-off Time on Flashover	< 5 µs	< 5 µs
Oil Temperature	0 °C – 100°C (32°F – 212 °F)	0 °C – 100°C (32°F – 212°F)
Temperature resolution	1°C (1.8°F)	1°C (1.8°F)
Display	2.8″ color (ultra-bright)	2.8″ color (ultra-bright)
Pre-programmed test standards	ÖVE EN 60156 BS EN 60156 NF EN 60156 UNE EN 60156 SABS EN 60156 PA SEV EN 60156 NEN 101 56 IEC 60156 / 95 VDE 370-5 / 96 ASTM 1816-04-1 ASTM 1816-04-2 ASTM 877-02A ASTM 877-02B AS 1767:2:1	ÖVE EN 60156 BS EN 60156 NF EN 60156 UNE EN 60156 SABS EN 60156 PA SEV EN 60156 NEN 101 56 IEC 60156 / 95 VDE 370-5 / 96 ASTM 1816-04-1 ASTM 1816-04-2 ASTM 877-02A ASTM 877-02B AS 1767:2:1
User specific programs	Unlimited	Unlimited
PC Software	BA Control Center	BA Control Center
Integrated Printer	Not applicable	Dot Matrix
Printer paper	Not applicable	Standard 44.5 mm wide roll
Interface	Bluetooth®, USB memory stick	Bluetooth®, USB memory stick
Operating Temperature	−5°C to +45°C (23°F to 113°F)	−5°C to +45°C (23°F to 113°F)
Storage Temperature	−20°C to +60°C (−4°F to 140°F)	−20°C to +60°C (−4°F to 140°F)
Relative Humidity	< 90%, non-condensing	< 90%, non-condensing
Weight (batteries included)	19 kg (42 lbs)	22 kg (49 lbs)
Dimensions	430 mm x 280 mm x 250 mm (16.9″ x 11″ x 9.9″)	430 mm x 280 mm x 250 mm (16.9″ x 11″ x 9.9″)

Note: HV Diagnostics reserves the right to modify values in accordance with future BA development.

Characteristic	BA80	BA100
Article Number	SB0007	801 001
Output Voltage [max.]	80 kV rms	100 kV rms
Measurement accuracy	±1 kV	±1 kV
Voltage slew rate	0.5 kV/s – 10 kV/s	0.5 kV/s – 10 kV/s
Resolution (displayed)	0.1 kV	0.1 kV
Power Supply	85 V – 264 V (47 Hz – 63 Hz) 12 V external supply	85 V – 264 V (47 Hz – 63 Hz) 12 V external supply
Power Consumption	60 VA	75 VA
Internal Rechargeable Battery	1 x 12 V / 7.2 Ah, 12 h continuous	1 x 12 V / 7.2 Ah 12 h continuous
Switch-off Time On Flashover	< 5 µs	< 5 µs
Oil Temperature	0°C – 100°C (32°F – 212°F)	0°C – 100°C (32°F – 212°F)
Temperature resolution	1°C (1.8°F)	1°C (1.8°F)
Display	2.8″ color (ultra-bright)	2.8″ color (ultra-bright)
Pre-programmed test standards	ÖVE EN 60156 BS EN 60156 NF EN 60156 UNE EN 60156 SABS EN 60156 PA SEV EN 60156 NEN 101 56 IEC 60156 / 95 VDE 370-5 / 96 ASTM 1816-04-1 ASTM 1816-04-2 ASTM 877-02A ASTM 877-02B AS 1767:2:1	ÖVE EN 60156 BS EN 60156 NF EN 60156 UNE EN 60156 SABS EN 60156 PA SEV EN 60156 NEN 101 56 IEC 60156 / 95 VDE 370-5 / 96 ASTM 1816-04-1 ASTM 1816-04-2 ASTM 877-02A ASTM 877-02B AS 1767:2:1
User specific programs	Unlimited	Unlimited
PC Software	BA Control Center	BA Control Center
Integrated Printer	Dot Matrix	Dot Matrix
Printer paper	Standard 44.5 mm wide roll	Standard 44.5 mm wide roll
Interface	Bluetooth®, USB memory stick	Bluetooth®, USB memory stick
Operating Temperature	−5°C to +45°C (23°F to 113°F)	−5°C to +45°C (23°F to 113°F)
Storage Temperature	−20°C to +60°C (−4°F to 140°F)	−20°C to +60°C (−4°F to 140°F)
Relative Humidity	< 90%, non-condensing	< 90%, non-condensing
Weight (batteries included)	22 kg (49 lbs)	32 kg (71 lbs)
Dimensions	430 mm x 280 mm x 250 mm (16.9″ x 11″ x 9.9″)	521 mm x 343 mm x 300 mm (20.5″ x 13.5″ x 11.8″)

Note: HV Diagnostics reserves the right to modify values in accordance with future BA development.

3.2 Design Features

To assure that the workplace is safe and that operators can fulfill their responsibilities with ease, the BA provides the following features.

Feature	Model	Purpose / Application	Advantage
Pre-programmed test sequences	BA60 BA75 BA80 BA100	• To automatically test according to internationally recognized standards	• Facilitates complex testing • Facilitates test repetition
Limited energy release during testing	BA60 BA75 BA80 BA100	• To minimize degradation during testing	• Maximizes test accuracy by reducing test influences
Self–Test	BA60 BA75 BA80 BA100	• To alert user of any device or power supply abnormalities prior to testing	• Improves safety
Stable test voltage	BA60 BA75 BA80 BA100	• To ensure testing is not affected by variations in line voltage	• Improves safety and functionality
Electromagnetic screening	BA60 BA75 BA80 BA100	• To ensure nearby electronic devices are not affected by any interference	• Improves safety and functionality
Auto Sensing power supply	BA60 BA75 BA80 BA100	• To allow for use under various power input modes	• Improves instrument portability and flexibility
Rechargeable Battery	BA75 BA80 BA100	• To allow for testing without an external power supply	• Increase instrument portability
USB Memory Stick	BA60 BA75 BA80 BA100	• To save test reports	• Facilitates documentation
Communication Port	BA60 BA75 BA80 BA100	• To provide USB and Bluetooth® interface	• Facilitates documentation
Built in Printer	BA75 BA80 BA100	• To document test reports	• Facilitates documentation
Intelligent Design	BA60 BA75 BA80 BA100	• To avoid moving parts and need for lubrication	• Reduces maintenance • Improves instrument durability and reliability

3.3 Materials

Shipment Content

The standard package is a model of the BA and specifically mentioned the model associated equipment. See standard package listed below. For inquiries, please contact HV Diagnostics.

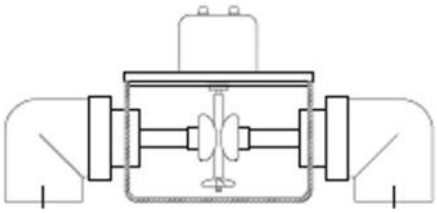
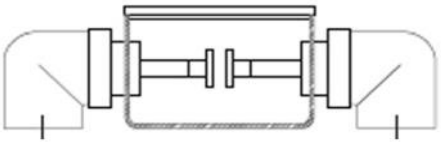
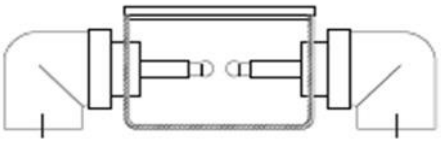
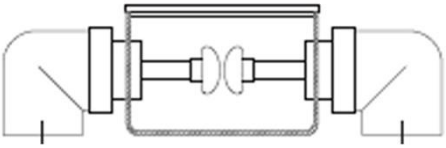
Part No.	Model	Item	Description
SB0006	BA60	Fully automatic Portable Liquid Dielectric Oil Tester	
800 001 SB0007 801 001	BA75 BA80 BA100	Fully automatic Portable Liquid Dielectric Oil Tester including integrated battery and printer.	
700 199	BA60 BA75 BA80 BA100	USB memory stick incl. BA Control Center (Software) and BA Control Center Manual as PDF	
	BA60 BA75 BA80 BA100	Bluetooth USB Adapter 200m	

Part No.	Model	Item	Description
	BA60 BA75 BA80 BA100	Mains Cable (country specific)	
800 201	BA60 BA75	VT75 75 kV Calibrator	
GB0014	BA80	VT80 80 kV Calibrator	
801 201	BA100	VT100 100 kV Calibrator	

Accessories

Optional and additional equipment is not included upon standard delivery of the BA. These items are available for order through HV Diagnostics.
For orders, please contact HV Diagnostics or our distributor.

Part No.	Model	Item	Description
VKR0010 800 005 VKR0010 801 005	BA60 BA75 BA80 BA100	Rugged transport case	
800 006 801 006	BA60 BA75 BA80 BA100	Rugged transport case. ATA approved transport case for two test cells	
VKR0011	BA60 BA75 BA80	Transport Bag	
VKR0016 800 007 VKR0016 801 007	BA60 BA75 BA80 BA100	Dust Cover	
800 010	BA75 BA80 BA100	12 V DC power supply lead for connection to vehicle battery or cigarette lighter socket; 5 m (16 ft)	
800 011	BA60 BA75 BA80 BA100	Ring nut wrench for test vessel	

Part No.	Model	Item	Description
800 110	BA60 BA75 BA80 BA100	Setting gauge 1 mm	
800 111	BA60 BA75 BA80 BA100	Setting gauge 2 mm	
800 112	BA60 BA75 BA80 BA100	Setting gauge 2.5 mm (0.1″)	
800 113	BA60 BA75 BA80 BA100	Setting gauge 4 mm	
800 114	BA60 BA75 BA80 BA100	Setting gauge 5 mm	
800 004 801 004	BA60 BA75 BA80 BA100	Test Vessel ASTM D1816 (0.4 l) including: • 1 mm or 2 mm spacer gauge specified by upon ordering.	
800 002 801 002	BA60 BA75 BA80 BA100	Test Vessel ASTM D877 (0.4 l) including: • 2.54 mm (0.1″) spacer gauge	
800 008 801 008	BA60 BA75 BA80 BA100	Test Vessel IEC 60156-Fig I (0.4 l) including: • 2.5 mm spacer gauge • magnetic stirrer • lifting stick for magnetic stirrer	
800 009 801 009	BA60 BA75 BA80 BA100	Test Vessel IEC 60156 Fig II (0.4 l) including: • 2.5 mm spacer gauge • magnetic stirrer • lifting stick for magnetic stirrer	
800 301	BA60 BA75 BA80 BA100	Electrode Pair “Mushrooms” for ASTM D1816 IEC 60156-Fig II	

Part No.	Model	Item	Description
800 302	BA60 BA75 BA80 BA100	Electrode Pair “Discs” for ASTM D877	
800 303	BA60 BA75 BA80 BA100	Electrode Pair “Sphere” for IEC 60156-Fig I	

Equipment not included

Grounding cable for use with an external power supply is not supplied by HV Diagnostics. Grounding cables should have a cross-section of min. 1.5 mm^2.

Printer Replacement Parts

NOTICE

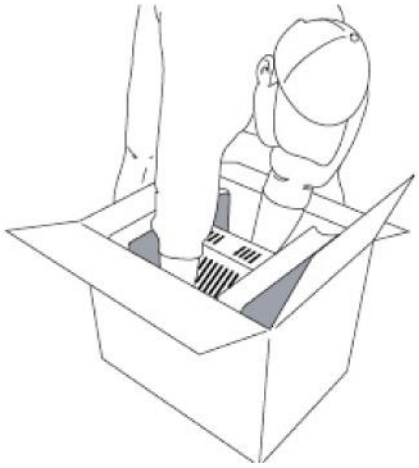
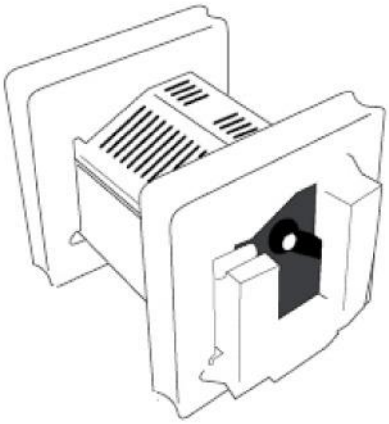
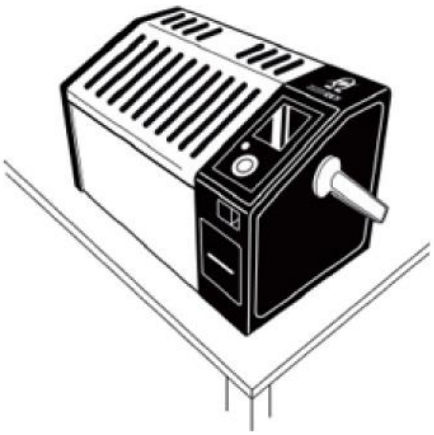
Only applicable for models with integrated printer.

Upon initial delivery of the BA the printer mechanism is fully installed. Additional printer replacement parts are available for order through HV Diagnostics. For orders, please contact HV Diagnostics or our distributor.

Part. No.	Model	Item	Description
800 102	BA75 BA80 BA100	Paper roll 44 x 50 / 12, 1 VPE	
800 103	BA75 BA80 BA100	Printer incl. ribbon	

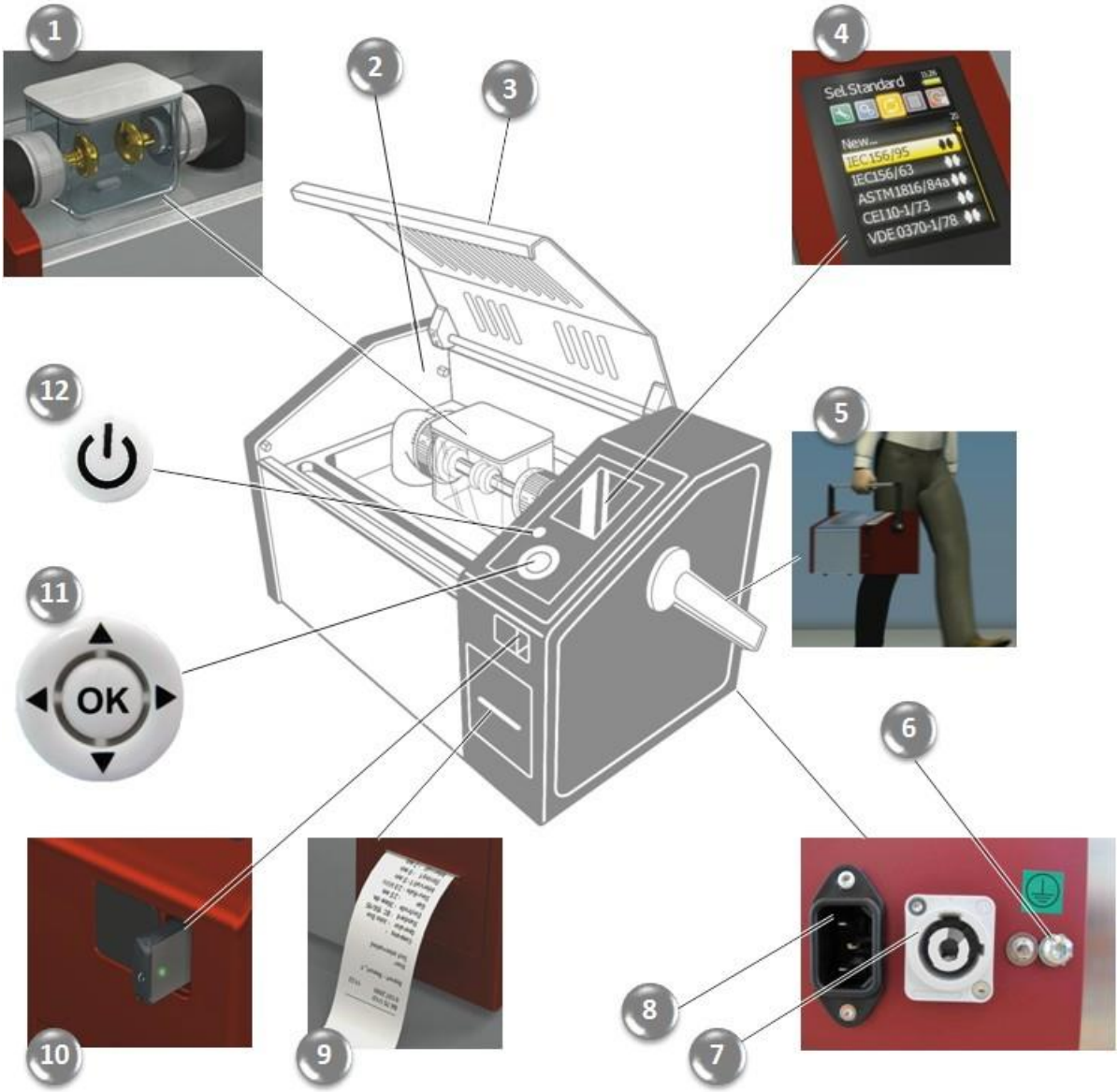
4 Unpacking the instrument

The instrument is shipped in a well-protected padded box. On either side of instrument foam inserts are molded around the instrument. To prevent against injury and equipment damage, adhere to the following instructions when unpacking the instrument:

Step	Procedure	Example
1	Grasp the instrument around the front and back. Do not pick the instrument up from the foam inserts as they may release causing the instrument to fall.	
2	With the foam inserts still intact, lift the instrument, from the box and place it on a stable surface.	
3	Carefully remove foam inserts one at a time.	
4	Check the instrument for damage that may have occurred during transport. In the event of damage notify HV Diagnostics and the shipping company.	
5	For future shipping or transportation, do not discard the original shipment packaging.	

5 Design and Construction

5.1 Instrument Layout



Reference Image Only!

Pos.	Name	Description
1	Test vessel	Liquid dielectric test cell including an electrode pair with adjustable spacing.
2	Test chamber	Isolated housing with integrated electromagnetic screening and built-in oil pan.
3	Lid	Hinged with safety interlocks
4	Display screen	Ultra-Bright color display to show menu options and status information.
5	Carrying handle	Facilitates instrument portability.
6	Grounding screw	Connection point from the BA to ground cable. (Applicable for testing with an external power source)
7	12 V DC power supply plug (Only applicable for models with integrated battery)	Connection point from the BA to an external DC power source.
8	AC power supply plug	Connection point from the BA to an external AC power source.
9	Printer (Only applicable for models with integrated printer)	Provides hardcopy record of during BA test. Report format and content depends on the test standard selected and its corresponding required parameters.
10	Communication port	Connection point from the BA to a USB memory stick
11	Navigation wheel	• Pressing the Up / Down arrows allows the user to select menu items. • Pressing the Left / Right arrows allows the user to change the function values and instrument settings. • Clicking “OK” in the center of the navigation wheel enters the menu selection or value entered.
12	On / Off Button	• To turn on the instrument, press the button for approx. 1 second. • To turn off the instrument, press and hold the button until display gets dark.

5.2 Instrument Set-up

Prior to first utilization, the BA instrument settings should be established. These settings can be modified at any time thereafter. Under the “Instrument Settings” menu the following functions can be adjusted:

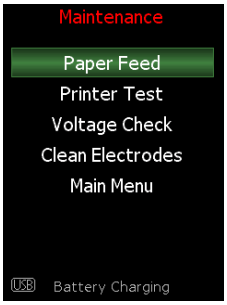
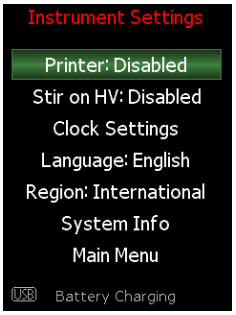
- Paper on/off
- Stirrer on/off
- Clock
- Language
- Region

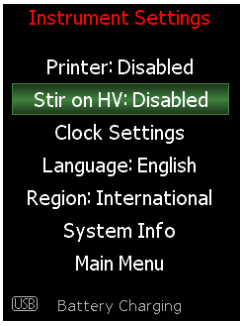
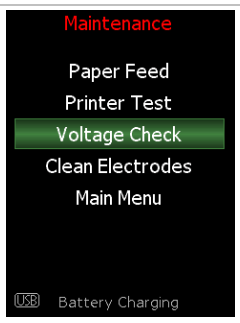
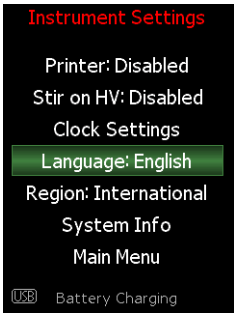
Under the “Maintenance” you can handle the following points:

- Paper Feed
- Printer Test
- Voltage Check
- Clean Electrodes

Use the Up / Down arrows of the navigation wheel to select one of the menu functions.

To return to the main menu use the Up / Down arrows to place the cursor on the “Main Menu” option and click “OK”.

Setting	Options	Example
Paper Feed	To activate the printer line feed, with the cursor on the “Paper Feed” option, click “OK”. The motor of the printer is switched on for approx. 5 seconds.	
Printer	To enable or disable the printer, with the cursor on the “Printer” option. Use “OK” to toggle one of the following options: • Enabled • Disabled	

Setting	Options	Example
Stir on HV	To activate or deactivate the liquid stirring function, with the cursor on the “Stir on HV” option. Use “OK” to toggle one of the following options: • Enabled • Disabled Depending on the standard selected, this option selects whether the stirrer is on/off during High Voltage.	
Clock Setting	Use the Up / Down arrows to place the cursor on one of the following options: • Clock Hours • Clock Minutes • Date Day • Date Month • Date Year Use the Left / Right arrows change the value	
Voltage Check	To initiate a voltage check, with the cursor on the “Voltage Check” option, click “OK”. • The device will automatically run up to 35 kV. This option allows performing a quick check using the VT Calibrator (option). During the “Voltage Check” use left/right arrows to change the voltage.	
Language	To change the display language, with the cursor on the “Language” option. Use “OK” to toggle one of the following options: • English • Deutsch • French • Italian • Spanish • Dutch Click “OK” to set the selected language.	

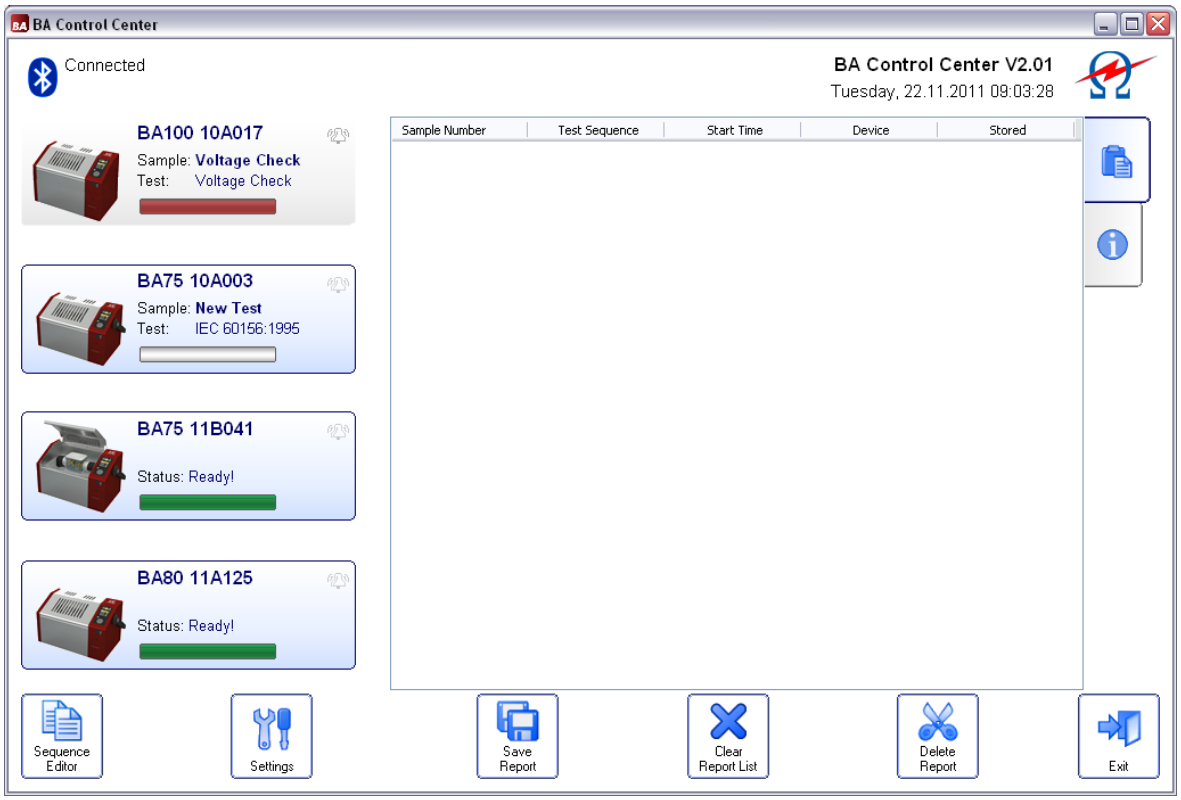
6 PC Software – Remote Control

Oil testers of the BA Family can be remote controlled via the PC Software “BA ControlCenter“.

These units (except BA60) have a built in Bluetooth radio interface which is used for communication to a PC. On the PC side, please use the equipped Bluetooth USB Dongle or, if available, the internal Bluetooth of your Notebook.

BA ControlCenter is capable of remote controlling up to 4 units at a time and automatically retrieves reports to the PC as a PDF document. Some settings like Date and Time can be synchronised for user convenience.

You can start and manage tests directly from the PC and a live status information is shown on the screen.



7 Test Procedure

7.1 Test Environment Criteria

To facilitate testing and to maximize the quality and accuracy of the test results, adhere to the following instructions:

1. Select a dust-free test environment.
2. Verify that the test equipment is isolated from vibrations.
3. Verify that there is sufficient space around the instrument for ventilation and movement of the mechanical parts such as the lid opening etc.
4. Confirm that relative humidity is less than 90% and non-condensing.
5. Confirm that ambient temperature is within the acceptable range as specified in the technical specification.

7.2 Sample Selection and Handling

To maximize the quality and accuracy of the test results adhere to the following recommendations:

1. Select the liquid test sample so as to represent the liquid's source.
2. Ensure that ambient conditions during testing are similar to those of liquid's source.
3. Handle the sample with care so as to avoid moisture and dirt contamination.
4. Store and house the sample in a clean, dry, non-permeable and sealable container.

Impact of the Dielectric Properties

Avoid using plastic containers. Plastic is permeable and can impact the dielectric properties of the liquid test sample

5. Shield the container from light sources prior to testing.
   Dark or amber glass bottles are recommended.
6. Adhere to recognized standards such as ASTM D923 that outline the guidelines for oil sampling procedures.

7.3 Instrument Connection

Power sources

Model	External AC power supply	External DC power supply	Internal Battery
BA60	✓		
BA75	✓	✓	✓
BA80	✓	✓	✓
BA100	✓	✓	✓

Connecting AC power supply

1. Ground the BA instrument by connecting a suitable grounding cable to the grounding screw.
2. Verify that the AC power supply meets the BA instrument input requirements.
3. Connect the AC power supply to the AC plug with a ground contact (prong).

Connecting 12 V DC power supply (accessory required)

1. Ground the BA instrument by connecting a suitable grounding cable to the grounding screw.
2. Connect the DC power supply to DC input plug with the HV Diagnostics-approved 12 V DC power supply lead (i. e. 800 010) in accessory material list).

Operation with battery supply

When the internal battery is charged, the BA instrument does not need to be connected to a power supply.

The BA display screen displays the battery status. For example, when the integrated battery is fully charged, “Battery 100%” is displayed at the bottom of the display screen.

To charge the internal battery, see Section “Charging Internal Battery”.

7.4 Instrument Activation

Model without printer

1. Turn ON the instrument, by pressing the On/Off button
2. After a few seconds, the display will indicate the version of firmware and other information related to the test instrument.
3. The test instrument will perform a self- test during startup to alert the user to of any power supply or device abnormalities.

Model with printer

1. Turn ON the instrument, by pressing the On/Off button.
   (If the instrument fails to start under internal battery power, the battery must either be charged or is in need of replacement. To activate the instrument in this case, connect the instrument to a power supply.)
2. After a few seconds, the display will indicate the version of firmware and other information related to the test instrument.
3. The test instrument will perform a self- test during startup to alert the user to of any power supply or device abnormalities.
4. The printer will print and line feed to inform the user that that printer is ready for operation (i.e. paper is not jammed and ink ribbon is in adequate condition).

7.5 Test Vessel Preparation

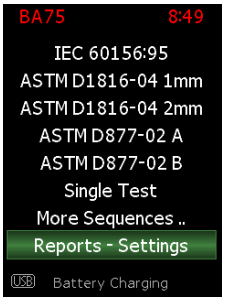
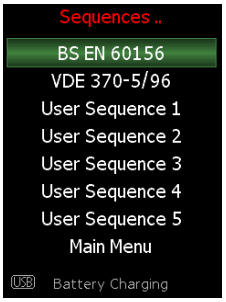
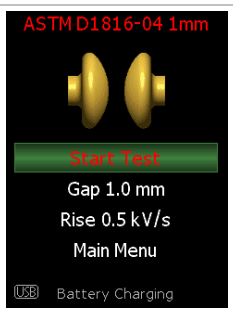
To maximize the quality and accuracy of the test results adhere to the following recommendations and instructions:

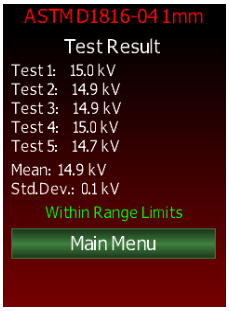
1. Select the appropriate test vessel.
2. Clean the test vessel and electrodes with lint-free wipes and a suitable solvent such as hexane, heptane or petroleum ether.
3. Remove residual solvent from the test vessel.
4. Install the test vessel in the test chamber
5. Insert the spacer gauge between the electrode pair.
6. Rotate the spacing control arms until the electrodes contact the spacer gauge with light pressure.
7. Remove the spacer gauge. The gap is set.
5. Once the test instrument is activated, fill the test vessel according to local filling standards for sampling. Avoid agitating the test liquid in order to prevent air bubbles.
6. Verify that the test sample liquid covers the electrodes.

7.6 Standard Test Execution

Before executing a Standard Test, the test vessel must be correctly installed in the test chamber.
The electrode gap spacing is not assessed automatically the BA instrument. It is the BA operator's responsibility to verify that this variable correspond to the specified value by the standard.

The USB memory stick has to be inserted into the instrument in order to save test results before start of testing! Results are stored as a pdf-file and a text-file.
At the bottom of the BA display screen the communication port status will be displayed. "USB" is displayed when the USB adapter is inserted in the communication port.

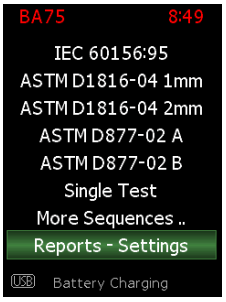
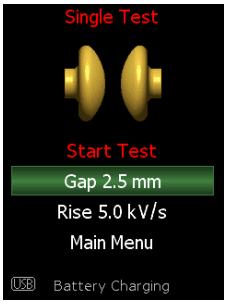
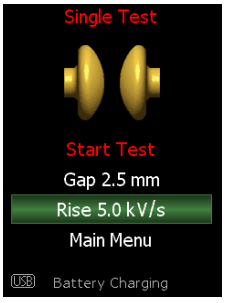
Step	**Procedure** (Run Standard Test)	**Example**
Main Menu	Use the Up / Down arrows to place the cursor on the desired standard test. The nomenclature includes the year the standard was approved. In some cases the gap is also included by the value preceding „mm". Click "OK" to select the chosen standard.	
More Sequences	More Sequences and the user Sequences are displayed.	
Sample Number	Use the Up / Down arrows to enter Sample Number. Up/down: Edit Character Left: Delete Character Right: Next Character Click "OK" to continue.	
Start Test	The voltage "Rise" rate and electrode "Gap" for the chosen standard are displayed. These values are pre-programmed and cannot be adjusted be the user. Click "OK", with the cursor on "Start Test", to activate the test.	

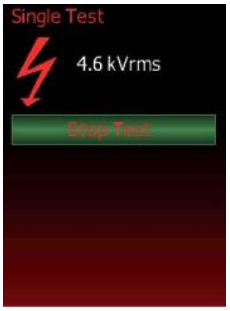
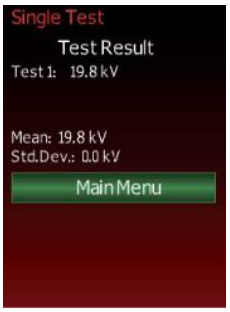
Step	**Procedure** (Run Standard Test)	**Example**
Test Active	The test cycle begins. The BA automatically detects breakdowns records them as they occur in the sequence. During the test the cursor is automatically on the “Stop Test” field. To interrupt the test in progress, click “OK” and the test will immediately terminate.	
Test Result / Start Next Cycle	The test cycle ends. The summary of the test results appear on the screen and the test test report is printed. Until the range and deviation limits satisfy the criteria of the corresponding standard, the user is prompted to carry out an additional test cycle. Select the “Start Next Test Cycle” function.	
Test Result / End Test	Once the test results satisfy the criteria of the corresponding standard, the test sequence has ended. To return to the main menu, select “Main Menu”.	

Single Test Execution

Before executing a user defined test the test vessel must be correctly installed in the test chamber.

The electrode gap spacing and the voltage rate of rise are not assessed automatically the BA instrument. It is the BA operator's responsibility to verify that these variables are properly adjusted.

Step	**Procedure** (Run Single Test)	**Example**
Main Menu	Use the Up / Down arrows to place the cursor on "Single Test". Click "OK".	
Sample Number	Use the Up / Down arrows to enter Sample Number. Up/down: Edit Character Left: Delete Character Right: Next Character Click "OK" to continue.	
Set "Gap"	Set the electrode gap spacing that will appear in the test report. Place the cursor on "Gap". Use "OK" to toggle the value so that it corresponds with the actual electrode gap spacing.	
Set "Rise"	Set the voltage rise rate. Place the cursor on "Rise". Use "OK" to toggle the value.	

Step	**Procedure** (Run Single Test)	**Example**
Start Test	To activate the test, place the cursor on “Start Test”. Click “OK”.	
Test Active	The test cycle begins. The BA automatically detects breakdowns records them as they occur in the sequence. During the test the cursor is automatically on the “Stop Test” field. To interrupt the test in progress, Click “OK” and the test will immediately terminate.	
Test Result / End Test	The test cycle ends. The summary of the test results appear on the screen and the test report is printed. The test has ended. To return to the main menu, select „Main Menu“.	

7.7 Instrument Disconnection and Termination

After performing a test, adhere to the following recommendations and instructions:

1. Turn OFF the instrument, by pressing for one second the On / Off button
2. Remove the power supply source from the input plug (if applicable).
3. Remove the ground connection (if applicable).
4. Remove the test vessel from the test chamber.
5. Discard the tested sample liquid from the test vessel according to local environmental regulations.
6. Fill the test vessel with fresh oil for storage.

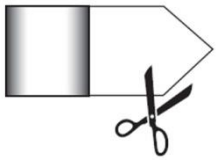
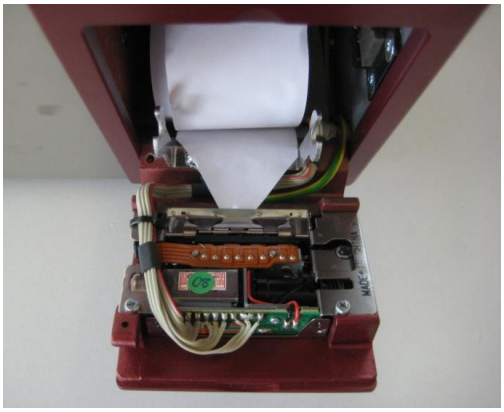
8 Instrument Care

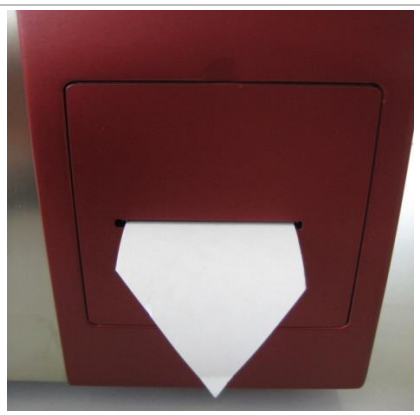
8.1 Installing Printer Paper Roll

NOTICE

Only for models with an integrated printer applicable.

To replace and install the printer roll, adhere to the following recommendations and instructions:

Step	**Procedure** (Paper Roll Replacement)	**Example**
1	Turn off the instrument.	
2	Pull out the hinged plate of the printer mechanism.	
3	Cut the end of the paper roll into an arrow or point.	
4	Fold over the tip of the point, forming a „bent arrow“.	
5	Insert the “bent arrow” of the paper into the printer mechanism guide just below the metal plate section.	

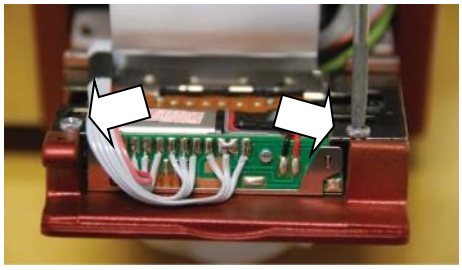
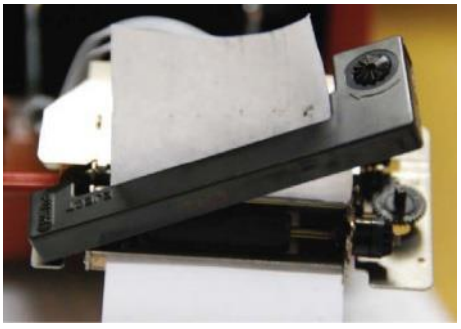
Step	**Procedure** (Paper Roll Replacement)	**Example**
6	Verify that the paper roll is oriented so that it feeds downward into the guide. Although the paper will not feed all the way through, it is important to ensure that the paper is held by the printer mechanism guide.	
7	Push in the hinged plate of the printer mechanism carefully, making sure not to jam the paper. A magnet will lock the printer in place.	
8	Turn on the instrument.	
9	The printer will automatically line feed and should push the paper through the outside paper slot of the printer housing. If this does not occur, select “Paper Feed” from the “Instrument Settings” menu.	

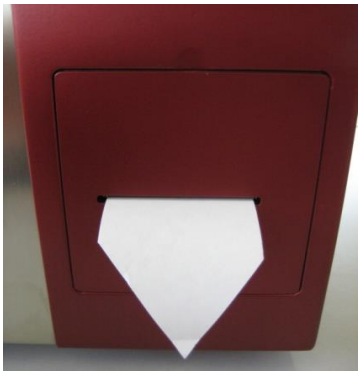
8.2 Replacing Printer Ink Ribbon

NOTICE

Only for models with an integrated printer applicable.

To replace and install the printer ink ribbon, adhere to the following recommendations and instructions:

Step	**Procedure** (Ink Ribbon Replacement)	**Example**
1	Turn off the instrument.	
2	Pull out the hinged plate of the printer mechanism.	
3	Unscrew the two fastening screws. **Note:** Phillips / Star screw driver is required!	
4	Tilt the printer mechanism upwards. Gently lift the printer mechanism from the groove and remove it from the printer housing.	
5	Flip over the printer mechanism. Press the “EJECT” indication on the printer ink ribbon and unlatch the ribbon.	

Step	**Procedure** (Ink Ribbon Replacement)	**Example**
6	Carefully insert the new ribbon.	
7	Flip over the printer mechanism.	
8	Verify that the cables run over the top of the printer. Do not pull or twist the cables that attach the ribbon to the printer mechanism!	
9	Verify that the paper feeds through the paper slot.	
10	Screw in the two fastening screws.	
11	Push in the hinged plate of the printer mechanism carefully, making sure not to jam the paper. A magnet will lock the printer in place.	
12	Turn on the instrument.	
13	The printer will automatically line feed and should push the paper through the outside paper slot of the printer housing. If this does not occur, select “Paper Feed” from the “Instrument Settings” menu.	

8.3 Charging Internal Battery

Once the AC power supply is connected the integrated battery will automatically begin charging when the unit is turned on.

NOTICE

With a DC power supply connected, the integrated battery will not charge.

1. Connect an AC power supply (according to the procedure indicated in the Section “Test Procedure”)
2. Turn on the BA

8.4 Storage/ Repairs

Storage

NOTICE

Do not store the BA test equipment outdoors!

The storage temperature must comply with the temperature range specified in section “Technical Data”.

Maintenance and Repairs

HV Diagnostics

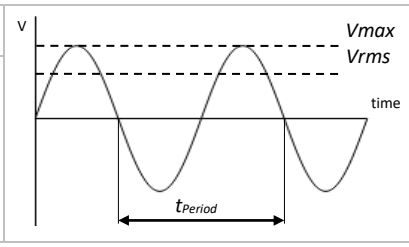
NOTICE

Repairs and maintenance should only be performed by authorized HV Diagnostics’ personnel.

9 Glossary and Abbreviations

The following explains abbreviations and selected terms used in this document.

Term	Explanation
Arc	Self-maintained gas conduction for which most of the charge carriers are electrons supplied by primary-electron emission (source: IEC)
BA	Breakdown Analyzer
Breakdown or Dielectric strength	The maximum RMS voltage at which a dielectric can sustain an applied electrical stress. Above this limit a small arc or breakdown leads to a collapse of the applied voltage. High dielectric breakdown values indicate good dielectric properties. Low dielectric breakdown values often indicate the presence of contamination and/or oil degradation.
Frequency [Hz]	Number of cycles per unit of time 1 Hz = 1cycle pro second. Unit = Hz $f = \frac{1}{t_{Period}}$
Peak value	Maximum Voltage = A_{max}
RMS value	Root Mean Square voltage. For sinusoidal waveforms: $V_{rms} = \frac{V_{max}}{\sqrt{2}}$
ASTM	ASTM International, originally known as the American Society for Testing and Materials. http://www.astm.org/
AS	Standards Australia. http://www.standards.org.au/
IEC	International Electrotechnical Commission. http://www.iec.ch/
VDE	Verband der Elektrotechnik Elektronik Informationstechnik. http://www.vde.com
EN 60156 **IEC 60156**	Insulating liquids - Determination of the breakdown voltage at power frequency - Test method (Replacement for DIN VDE 0370-5; VDE 0370-5:1992-08)
ASTM D877-02	Standard Test Method for Dielectric Breakdown Voltage of Insulating Liquids Using Disk Electrodes
ASTM D923	Standard Practices for Sampling Electrical Insulating Liquids
ASTM D1816-04	Standard Test Method for Dielectric Breakdown Voltage of Insulating Oils of Petroleum Origin Using VDE Electrodes
AS 1767	Insulating oil for transformers and switchgear



10 Declaration of Conformity

The BA60, BA75, BA80 and B100 are CE certified and meet the following requirements of the European Council:

Category	Standard
EMC	IEC61004-2 , ESD Level 4 (8/15 kV) IEC61004-4 , Burst 4 kV 5 kHz EN55011
Safety	EN60950 EN50191 EN61010-1