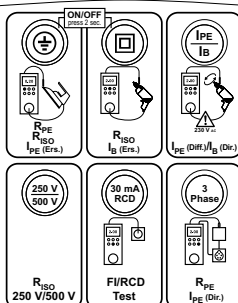



# BENNING

- (D) Bedienungsanleitung
- (GB) Operating manual
- (F) Notice d'emploi
- (CZ) Návod k obsluze
- (I) Istruzioni d'uso
- (NL) Gebruiksaanwijzing
- (PL) Instrukcja obsługi
- (S) Användarhandbok

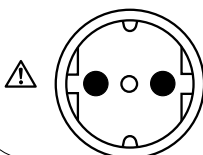
## BENNING ST 720

✓ R<sub>PE</sub> 0.06 Ω  
✓ R<sub>ISO</sub> > 19.99 MΩ  
✓ I<sub>LEAK</sub> 0.11 mA<sup>~</sup>  
✓ PASS



DIN VDE 0701-0702, BGV A3, ÖVE/ÖNORM E 8701, NEN 3140

Prüfung während der Prüfung einschalten  
Switch on test object during test



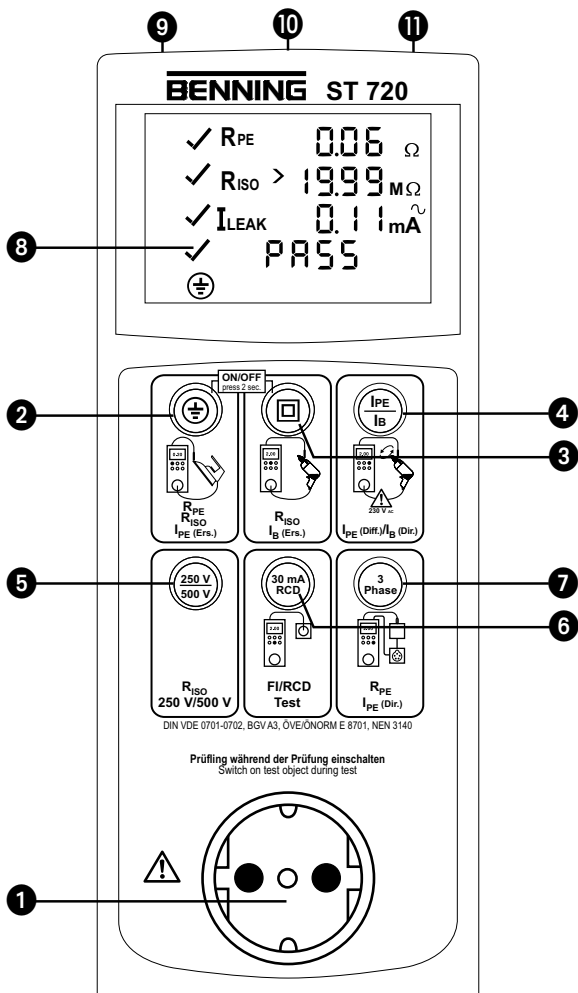


Bild 1: Gerätefrontseite  
 Fig. 1: Appliance front face  
 Fig. 1: Partie avant de l'appareil  
 Obr. 1: Přední strana přístroje

Figura 1: Lato anteriore strumento  
 Fig. 1: Voorzijde van het apparaat  
 Rys. 1: Panel przedni przyrządu  
 Bild 1: Framsida

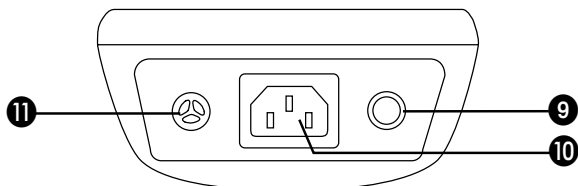
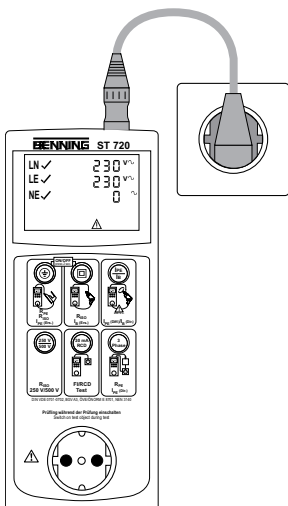


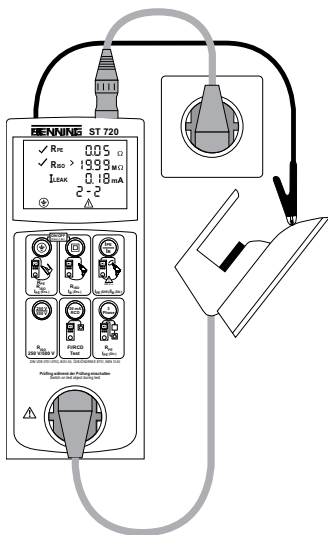
Bild 2: Geräteoberseite  
 Fig. 2: Top side of the device  
 Fig. 2: Face supérieure de l'appareil  
 Obr. 2: Horní strana přístroje

Figura 2: Lato superiore strumento  
 Fig. 2: Bovenaanzicht apparaat  
 Rys. 2: Górna strona urządzenia  
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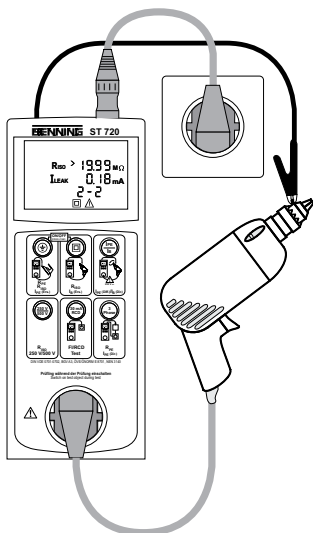
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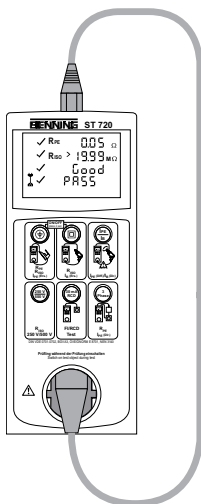
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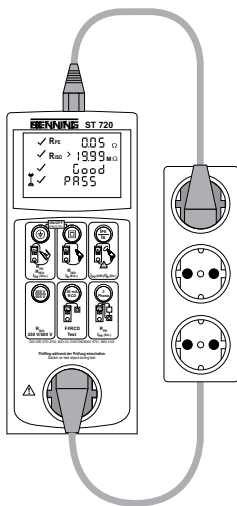
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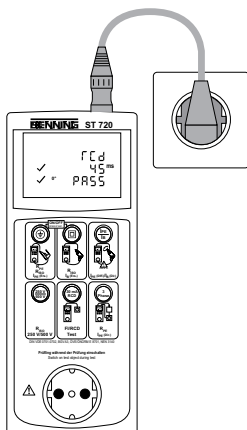


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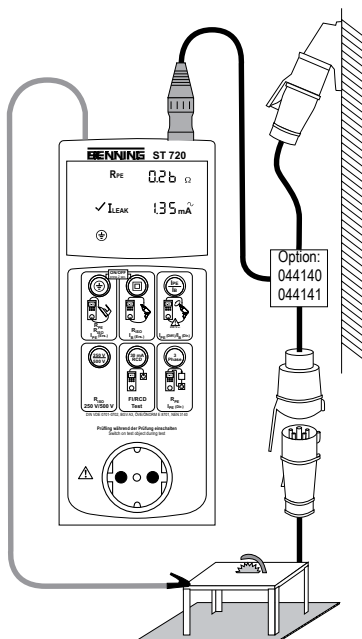


Bild 9: Batterie-/ Sicherungswechsel

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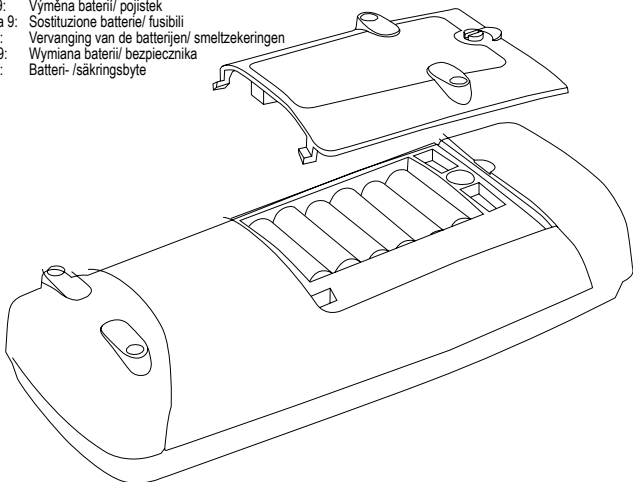
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Bild 9: Batteri- /säkringsbyte



# Operating instructions

## BENNING ST 720

Appliance tester for safety-related testing of portable electrical devices and equipment

- testing according to DIN VDE 0701-0702, ÖVE/ ÖNORM E 8701
- testing of cable reels, multiple distributors and IEC power cords
- tripping time measurement of RCDs
- voltage measurement on external shock-proof socket

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1. User notes
2. Safety note
3. Scope of delivery
4. Unit description
5. General information
6. Ambient conditions
7. Electrical specifications
8. Measuring with the BENNING ST 720
9. Maintenance
10. Environmental note

### 1. User notes

These operating instructions are intended for

- qualified electricians, competent persons and
- electrotechnically trained persons

The BENNING ST 720 is intended for making measurements in dry environment (More details in Section 6. "Ambient conditions").

The following symbols are used in these operating instructions and on the BENNING ST 720:



Warning of electrical danger!

Indicates instructions which must be followed to avoid danger to persons.



Important, comply with the documentation!

The symbol indicates that the information provided in the operating instructions must be complied with in order to avoid risks.



This symbol on the BENNING ST 720 means that the BENNING ST 720 complies with the EU directives.



This symbol appears on the display to indicate discharged batteries. As soon as the battery symbol flashes, immediately replace the batteries by new ones. Charged batteries are also required for measuring in mains operating mode.



(AC) Alternating voltage or current.



Ground (Voltage against ground).



protection class I



protection class II

## 2. Safety note

The instrument is built and tested in accordance with  
DIN VDE 0404 part 1 and 2  
DIN VDE 0411 part 1/ EN 61010 part 1  
DIN VDE 0413 part 1/ EN 61557 part 1, 2, 4 and 10  
and has left the factory in perfectly safe technical state.

To maintain this state and ensure safe operation of the appliance tester, the user must observe the notes and warnings given in these instructions at all times. Improper handling and non-observance of the warnings might involve severe **injuries** or **danger to life**.



**WARNING! Be careful when working with bare conductors or main line carrier! Contact with live conductors will cause an electric shock!**



The BENNING ST 720 may be used only in power circuits within the overvoltage category II with a conductor for 300 V AC max. to earth.  
Remember that work on electrical components of all kinds is dangerous. Even low voltages of 30 V AC and 60 V DC may be dangerous to human life.



The device must be connected to a single-phase mains with 230 V, 50 Hz, pre-fuse 16 A only. Please make sure not to exceed the maximum breaking capacity/ lamp load of the test socket of the BENNING ST 720 (see chapters 7.4 and 7.5). Exceeding the values might cause tripping of the fuses and damaging of the BENNING ST 720. Damages due to overload are excluded from possible warranty claims.



Do not carry out repeated protective conductor or contact current measurements with a measuring duration of 30 seconds at test objects with high current consumption (16 A). Repeated measurements at maximum load (16 A) might heat up the inside of the device and thus also its surface.



The protective conductor resistance measurement might be distorted by impedances connected in parallel of additional operating circuits and by transient currents.  
Measurements of the protective conductor resistance and of the insulating resistance must be carried out at idle system parts only.



Before starting the appliance tester up, always check it for signs of damage.

Should it appear that safe operation of the appliance tester is no longer possible, it should be shut down immediately and secured to prevent it being switched on accidentally.

It may be assumed that safe operation is no longer possible:

- if the instrument show visible signs of damage
- if the appliance tester no longer functions
- after long periods of storage under unfavourable conditions
- after being subjected to rough transport
- the device is exposed to moisture.



**In order to prevent danger**

- do not touch the bare measuring probe tips of the measuring leads,
- plug the leads into the correspondingly marked jacks at the measuring instrument



**Maintenance:**

Do not open the tester, because it contains no components which can be repaired by the user. Repair and service must be carried out by qualified personnel only!



**Cleaning:**

Regularly wipe the housing by means of a dry cloth and cleaning agent. Do not use any polishing agents or solvents!

## 3. Scope of delivery

The scope of delivery for the BENNING ST 720 comprises:

- 3.1 One BENNING ST 720,
- 3.2 One test lead with alligator clip,
- 3.3 One IEC power cord (IEC adapter cable)



- 3.4 One mains connection cable
- 3.5 One compact protective pouch,
- 3.6 Six 1.5-V-batteries/ type AA (IEC LR6) fitted in the unit as initial equipment,
- 3.7 One operating manual

Parts subject to wear:

- The BENNING ST 720 is provided with two fuses for overload protection: two fuses with a nominal current of 16 A, 250 V, F, breaking capacity  $\geq 500$  A, D = 5 mm, L = 20 mm (part no. 10019440)
- The BENNING ST 720 is supplied by six 1.5 V batteries/ type AA (IEC LR6).

Note on optional accessories:

- Test badges "next test", 300 pieces
- Measuring adapter for three-phase loads (passive, without mains voltage-dependent switching devices) for  $R_{PE}$ ,  $R_{ISO}$  (insulating resistance) and  $I_{EA}$  (alternative leakage current) measurements:
  - 16 A CEE coupling - shock-proof plug (044122)
  - 32 A CEE coupling - shock-proof plug (044123)
- Measuring adapter for three-phase loads (active, with mains voltage-dependent switching devices) for  $R_{PE}$  and  $I_{PE}$  measurements (direct measurement) under operating conditions:
  - 16 A CEE adapter, three-phase, active (044140)
  - 32 A CEE adapter, three-phase, active (044141)







As an alternative:

- BENNING CM 9 leakage current clamp for measuring the differential current, protective conductor current and load current of single-phase and three-phase loads (044065)
- Measuring adapter for BENNING CM 9 leakage current clamp, conductors led through individually, with double insulation:
  - 16 A shock-proof coupling - 16 A shock-proof plug (044131)
  - 16 A CEE coupling - CEE plug (044127)
  - 32 A CEE coupling - CEE plug (044128)
- Test certificate forms for "Testing of electrical devices" are available for download free of charge at [www.benning.de](http://www.benning.de)

#### 4. Unit description

- See figure 1: Appliance front face  
See figure 2: Top side of the device

The display and operator control elements specified in Fig. 1 and 2 are designated as follows:

- 1 **test socket**, for connecting the device to be tested,
- 2 -key, testing of devices of protection class I (devices with protective conductor and accessible conductive parts which are connected to the protective conductor),
- 3 -key, testing of devices of protection class II (shock-proof devices without protective conductor and with accessible conductive parts) and testing of devices of protection class III (safety extra-low voltage),
- 4 -key, testing the protective conductor current (differential measurement) or contact current (direct measurement) under operating conditions (test sample is supplied with mains voltage)
- 5 -key, reducing the testing voltage to 250 V<sub>DC</sub> or 500 V<sub>DC</sub> for measuring the insulating resistance
- 6 -key, testing of 30 mA RCDs
- 7 -key, testing of three-phase devices under operating conditions
- 8 **Digital display**, indicates the test progress and individual measuring results,
- 9 **4 mm test socket**, for connecting the test lead with alligator clip
- 10 **IEC connector**, for connecting the IEC power cord
- 11 **Mains connection socket**, for connecting the mains voltage (230 V, 50 Hz), for voltage measurement at external shock-proof socket or for connecting the measuring signal cable of the measuring adapter (16 A CEE adapter, three-phase, active/ 32 A CEE adapter, three-phase, active)

#### 5. General information

The BENNING ST 720 is intended for electrical safety tests according to DIN VDE 0701-0702, BGV A3 and ÖVE/ ÖNORM E8701.

Automatically, the BENNING ST 720 verifies the type of the connected test object and informs the user in case of incorrect selection of the testing procedure [2...3]: preset limiting values and measuring results with "pass/ fail" information make it easier to evaluate the test.

- At full battery capacity, the BENNING ST 720 allows to carry out approx. 2,500 device tests.

#### 6. Ambient conditions

- The BENNING ST 720 is intended for making measurements in dry environment.
- Maximum barometric elevation for making measurements: 2000 m,
- Over voltage category/ setting category: IEC 61010-1 → 300 V category II,
- Contamination class: 2,
- Protection class: IP 40 (DIN VDE 0470-1 IEC/ EN 60529)

IP 40 means: Protection against access to dangerous parts and protection against solid impurities of a diameter > 1 mm, (4 - first index). No protection against water, (0 - second index).

- EMC: EN 61326-1

- Operating temperature and relative humidity:

For operating temperatures from 0 °C to 30 °C: relative humidity less than 80 %

For operating temperatures from 31 °C to 40 °C: relative humidity less than 75 %

- Storage temperature: The BENNING ST 720 can be stored at any temperature within the range of - 25 °C to + 65 °C (relative humidity from 0 to 80 %). The battery should be removed from the instrument for storage.

## 7. Electrical specifications

Note: The measuring accuracy is specified as the sum of

- a relative fraction of the measured value and

- a number of digits (i.e. counting steps of the last digit).

This specified measuring accuracy is valid for temperatures within the range of 18 °C to 28 °C and relative humidity lower than 80 %.

### 7.1 Protective conductor resistance

Measuring range	Resolution	Measuring accuracy
0.05 Ω - 19.99 Ω	0.01 Ω	5 % ± 2 digits
Testing current:	> 200 mA (2 Ω)	
open-circuit voltage:	4 V - 9 V	
Preset limiting value:	0.3 Ω	

### 7.2 Insulating resistance

Measuring range	Resolution	Measuring accuracy
0.1 MΩ - 19.99 MΩ	0.01 MΩ	5 % ± 2 digits
Testing voltage:	250 V <sub>DC</sub> / 500 V <sub>DC</sub> , + 20 %, - 0 %	
Testing current:	> 1 mA, < 2 mA at 2 kΩ	
Preset limiting value:	1 MΩ (protection class I), 2 MΩ (protection class II)	

### 7.3 Protective conductor current and contact current by means of alternative leakage current measurement method

Measuring range	Resolution	Measuring accuracy
0.25 mA - 19.99 mA	0.01 mA	5 % ± 2 digits
Testing voltage:	40 V <sub>AC</sub> , 50 Hz	
Testing current:	< 10 mA at 2 kΩ	
Preset limiting value:	3.5 mA (protection class I), 0.5 mA (protection class II)	

### 7.4 Protective conductor current (differential current measurement method)

Measuring range	Resolution	Measuring accuracy
0.25 mA - 19.99 mA	0.01 mA	5 % ± 2 digits
Nominal voltage:	230 V ± 10 % (as mains feed-in)	
Rated current:	16 A	
Max. breaking capacity:	3000 VA	
Max. lamp load:	1000 W	
Max. measuring duration:	30 seconds	
Preset limiting value:	3.5 mA (protection class I)	
Resistance to external voltages:	max. 276 V	

For non-sinusoidal current supply, an additional error has to be considered:

crest factor of > 1.4 to 2.0, additional error + 0.4 %

External magnetic fields might influence the measuring result additionally.

## 7.5 Contact current (direct measurement method)

Measuring range	Resolution	Measuring accuracy
0.1 mA - 1.99 mA	0.01 mA	5 % ± 2 digits
Nominal voltage:	230 V ± 10 % (as mains feed-in)	
Rated current:	16 A	
Max. breaking capacity:	3000 VA	
Max. lamp load:	1000 W	
Max. measuring duration:	30 seconds	
Preset limiting value:	0.5 mA (protection class II)	
Resistance to external voltages:	max. 276 V	

For non-sinusoidal current supply, an additional error has to be considered: crest factor of > 1.4 to 2.0, additional error + 3.1 %

## 7.6 Cord test

- measurement of the protective conductor resistance according to 7.1
- measurement of the insulating resistance according to 7.2
- line break testing of the external conductor (L) and the neutral conductor (N)
- short-circuit testing of the external conductor (L) and the neutral conductor (N)

## 7.7 Tripping time measurement of RCDs

Measuring range	Resolution	Measuring accuracy
10 ms - 500 ms	1 ms	5 % ± 2 digits
Testing current/ polarity:	30 mA sinusoidal/ 0° and 180°	
Preset limiting value:	200 ms	

## 7.8 Protective conductor current (direct measurement method) of three-phase test objects under operating conditions

Measuring range	Resolution	Measuring accuracy
0.25 mA - 9.99 mA	0.01 mA	5 % ± 2 digits
Nominal voltage:	3 x 400 V ± 10 % (as mains feed-in)	
Rated current:	16 A respectively 32 A	
Preset limiting value:	3.5 mA	

## 7.9 Voltage measuring on external shock-proof socket

Measuring range	Resolution	Measuring accuracy	Overload protection
50 V - 270 V <sub>AC</sub>	1 V	5 % ± 2 Digit	300 V

Display:

- voltage between the external conductor (L) and the neutral conductor (N)
- voltage between the external conductor (L) and the ground conductor (PE)
- voltage between the neutral conductor (N) and the ground conductor (PE)

## 7.10 Limiting values according to DIN VDE 0701-0702 and ÖVE/ ÖNORM E 8701-1

Note:

Limiting values preset in **bold** are stored in the BENNING ST 720.

	Protection class I	Protection class II, III	Line test
<b>Protective conductor resistance</b> <b>R<sub>PE</sub></b>	for cords with rated current ≤ 16 A: ≤ <b>0.3 Ω</b> up to a length of 5 m, per further 7.5 m: additional 0.1 Ω, max. 1 Ω, For cords with higher rated currents the calculated ohmic resistance value applies.		≤ <b>0.3 Ω</b> (see protection class I)

Insulating resistance $R_{ISO}$	$\geq 1 \text{ M}\Omega$ $\geq 2 \text{ M}\Omega$ for proving safe disconnection (transformer) $\geq 0.3 \text{ M}\Omega$ for devices with heating element	$\geq 2 \text{ M}\Omega$ (protection class II), $\geq 0.25 \text{ M}\Omega$ (protection class III),	$\geq 1 \text{ M}\Omega$
Protective conductor current $I_{EA} / I_{LEAK}$	$\leq 3.5 \text{ mA}$ on conductive parts with PE connection  1 mA/ kW for devices with heating elements $P > 3.5 \text{ kW}$		
Contact current $I_{EA} / I_{LEAK}$	$\leq 0.5 \text{ mA}$ on conductive parts without PE connection	$\leq 0.5 \text{ mA}$ on conductive parts without PE connection	

## 8. Measuring with the BENNING ST 720

### 8.1 Preparations for measuring

Operate and store the BENNING ST 720 only at the specified storage and operating temperatures conditions. Do not permanently expose the device to sunlight.

- Check rated voltage and rated current details specified on the safety measuring leads.
- Strong sources of interference in the vicinity of the BENNING ST 720 might lead to unstable readings and measuring errors.



Before starting the BENNING ST 720, always check the device, the lines and the test object for damages.



Please make sure not to exceed the maximum breaking capacity/ lamp load of the test socket of the BENNING ST 720 (see chapters 7.4 and 7.5). Exceeding the values might cause tripping of the fuses and damaging of the BENNING ST 720. Damages due to overload are excluded from possible warranty claims.



The plug of the mains connection cable can be connected with the socket ① of the BENNING ST 720 in one position only (see white mark). Do not exert force to the plug of the mains connection cable in order to avoid damaging of the BENNING ST 720.



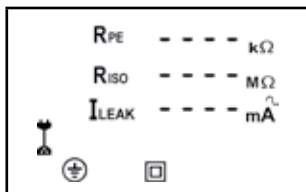
Before starting the test, switch the test object on (mains switch ON). If the BENNING ST 720 is connected to the mains voltage, the test object will be supplied with mains voltage during the protective conductor/ contact current measurement. During measurement, check the test object for proper functioning!



At the beginning of the test it has to be checked whether the selected testing procedure complies with the protection class of the connected test object.

#### 8.1.1 Switching the BENNING ST 720 ON/ OFF

- Press and hold the keys ② and ③ for approx. 3 seconds to switch the BENNING ST 720 on. Acoustic signals confirm that the device is switched on. Press the keys again to switch the device off.

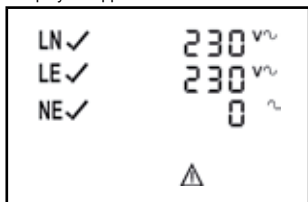


- After approx. 2 minutes, the BENNING ST 720 switches off automatically (APO, Auto Power-Off). It switches on again when the keys ② and ③ are pressed. An acoustic signal indicates that the device has switched off automatically.

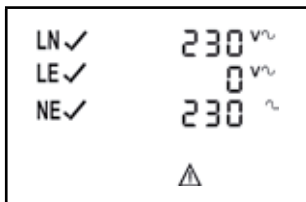
#### 8.1.2 Testing the mains voltage on external shock-proof socket

- Connect the mains connection cable to the mains connection socket ① of the BENNING ST 720.
- Connect the shock-proof plug to the shock-proof socket to be tested. With the mains voltage being applied, the voltage measurement will start automatically.
- Depending on the external conductor position (right or left) of the shock-proof socket, the

voltage potentials between the connecting terminals L, N and PE will be shown on the display for approx. 3 seconds.



or



- If the voltage potentials are within the following limiting values, there will be a ✓ next to the "LN", "LE" and "NE" symbols.

LN	195 V - 253 V
LE	195 V - 253 V
NE	< 30 V

or

LN	195 V - 253 V
LE	< 30 V
NE	195 V - 253 V



**Only the voltage potentials between the individual connections L, N and PE are measured. The measurement does not provide any information on the proper installation of the shock-proof socket. There will be no warning in case of a dangerous contact voltage of the PE conductor!**

**The BENNING ST 720 must not be permanently connected to the mains voltage!**

- After approx. 3 seconds, the BENNING ST 720 automatically switches to stand-by mode. See figure 3: Voltage measurement on external shock-proof socket

### 8.1.3 Testing procedure

The BENNING ST 720 is intended for electrical safety tests according to DIN VDE 0701-0702 and ÖVE/ ÖNORM E 8701. Please refer to the current version of the standards for detailed information concerning the tests and limiting values.

Automatically, the BENNING ST 720 verifies the type of the connected test object and informs the user in case of incorrect preselection of the testing procedure [2...3].

#### Note:

- The BENNING ST 720 can be used for tests in battery operating mode and in mains operating mode with connection of a mains voltage of 230 V. In battery operating mode, it has to be observed that the protective conductor current and contact current measurement is carried out by means of the alternative leakage current measurement method. This method is appropriate for test objects which do not contain any mains voltage-dependent switching elements (e.g. mains supply units).
- If the internal structure of the test object is not known or if it contains mains voltage-dependent switching elements, the test has to be carried out in mains operating mode with connection of a mains voltage of 230 V. As soon as the BENNING ST 720 is supplied with mains voltage via the jack ①, the protective conductor current/ contact current measurement will be carried out automatically by means of the differential current/ direct measurement method under operating conditions of the test object.
- The testing voltage for insulating resistance measurement is preset to 500 V<sub>DC</sub> according to the applicable standard. For test objects with integrated overvoltage arresters and for electronic devices for which there are objections regarding a testing voltage of 500 V<sub>DC</sub>, the testing voltage can be reduced to 250 V<sub>DC</sub> by means of the Ⓜ-key ⑤.

## 8.2 Testing of electrical devices / equipment according to DIN VDE 0701-0702 and ÖVE/ ÖNORM E 8701



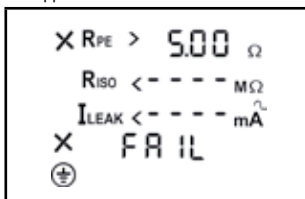
**Prior to test, a visual inspection of the test object has to be carried out. In case of possible damages, the test must be stopped.**

### 8.2.1 Testing of devices of protection class I Ⓣ

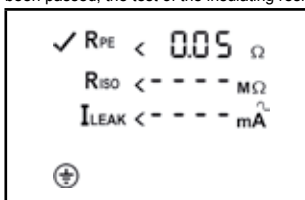
Testing of devices with protective conductor and accessible conductive parts which are connected to the protective conductor.

- Connect the test object to the test socket ① of the BENNING ST 720.
- Plug the 4 mm safety plug of the test lead with alligator clip into the 4 mm safety socket ② and establish a connection with a metal part of the test object.
- For mains operating mode (protective conductor current by means of differential current measurement method, test object in operation!): Connect the plug of the mains connection cable with the socket ① and the shock-proof plug with a protected shock-proof socket (230 V, 50 Hz, 16 A).

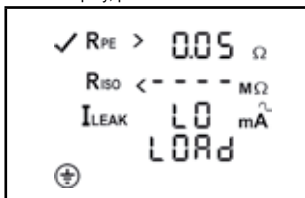
- If necessary, the testing voltage of the  $R_{ISO}$  (insulating resistance) measurement can be reduced to  $250 V_{DC}$  by means of the  $\text{⊕}$ -key ⑤. The selected testing voltage is briefly shown on the display ③. Press the key again to switch back to the preset testing voltage of  $500 V_{DC}$ .
- Switch the test object on.
- Press the  $\text{⊕}$ -key ② to start the automatic testing procedure.
- The test starts with measuring the protective conductor resistance  $R_{PE}$ . If  $R_{PE}$  is higher than the admissible limiting value, the measured value of  $R_{PE}$  will be shown on the display and a  $\times$  will appear next to the  $R_{PE}$  symbol. "FAIL" appears on the display to confirm that the measurement has been stopped.



- If  $R_{PE}$  is lower than the admissible limiting value, the measured value of  $R_{PE}$  is shown and a  $\checkmark$  appears next to the  $R_{PE}$  symbol. Now, the  $R_{PE}$  measurement is carried out again with reversed polarity and the highest measured value of both measurements will be displayed. After the  $R_{PE}$  test has been passed, the test of the insulating resistance is started.



- If "Lo LOAD" is shown on the display, please check whether the test object is switched on.

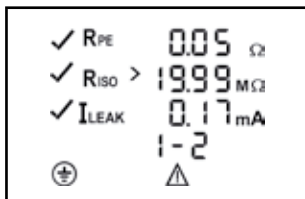


- Press the key ② to continue the testing procedure in case of the load being too low ( $R_{L-N} > 6 \text{ k}\Omega$ ).
- If "HIGH LOAD" is shown on the display, this indicates an excessive load ( $R_{L-N} \ll 14 \Omega$ ,  $I_{LAST} (I_{LOAD}) > 16 \text{ A}$ ) of the test object. There might be danger of a short-circuit or of an earth fault. Check whether there is a short-circuit between the external conductor (L) and neutral conductor (N) of the test object.
- If there is no short-circuit, you can continue with the testing procedure by pressing the key ②.
- If the insulating resistance  $R_{ISO}$  is higher than the admissible limiting value, a  $\checkmark$  appears next to the  $R_{ISO}$  symbol.

#### BENNING ST 720 in mains operating mode:

- The BENNING ST 720 interrupts the testing procedure after the  $R_{ISO}$  (insulating resistance) measurement and requests the user to switch the mains voltage of  $230 \text{ V}$  to the test socket ① by showing a flashing " $I_{LEAK}$ " symbol. Make sure that the test sample is protected and press the  $\text{⊕}$  key ④ to measure the protective conductor current by means of the differential current measurement method.
- The protective conductor current measurement (differential current measurement method) only starts as soon as the mains voltage is correct applied.

step 1 of 2:



- After a measuring time of 5 seconds or by pressing the key 4, mains polarity will be reversed and the protective conductor current will be measured with reversed mains voltage ("L/N" - "N/L"). The highest measured value of both measurements will be displayed. (step 2 of 2)

step 2 of 2:

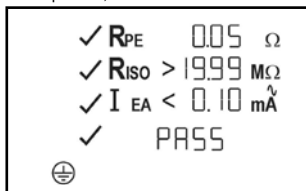


- If the protective conductor current is lower than the admissible limiting value, a ✓ will be shown next to the  $I_{LEAK}$  symbol.
- The overall test is considered to be passed, if "PASS" is shown on the display.

As an alternative:

#### BENNING ST 720 in battery operating mode (without mains supply):

- Similarly, a ✓ will be shown next to the  $I_{EA}$  symbol, if the protective conductor current  $I_{EA}$  (alternative leakage current measurement method) is lower than the admissible limiting value.
- The test is considered to be passed, if "PASS" is shown on the display.



See figure 4:

Testing of devices of protection class I (devices with protective conductor and accessible conductive parts which are connected to the protective conductor)

#### Note on measuring the protective conductor resistance:

- Alternatively, the measurement of the protective conductor resistance  $R_{PE}$  can be carried out as permanent measurement (max. 4 minutes). For this purpose press the key 2 for approx. > 5 seconds until the  $\Delta$  symbol appears on the display. Check the connecting line of the test object by bending it over the entire length in order to detect weak points or a break of the protective conductor. The BENNING ST 720 continuously records the current measured value on the display and stores the maximum value in the memory. By pressing the key 2 again, the measurement is carried out with reversed polarity. Press the key 2 again to indicate the maximum value of  $R_{PE}$  on the display and to continue the testing procedure as described in section 8.2.1.

#### Note on measuring the protective conductor current in mains operating mode:

- Alternatively, the measurement of the protective conductor current  $I_{LEAK}$  can be carried out as permanent measurement (max. 30 seconds). Press the key 4 for approx. > 5 seconds to start permanent measurement. After 30 seconds, the polarity of the mains voltage will be reversed automatically ("L/N" - "N/L"). By pressing the key 4 earlier, the mains voltage polarity reversal can be activated manually and by pressing the key 4 again, the measurement can be stopped.

#### Note on measuring the contact current:

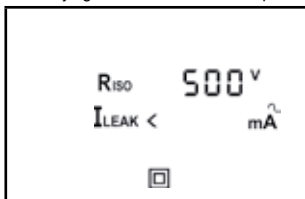
- Accessible conductive parts which are not connected with the protective conductor have to be tested as described in section 8.2.2. For measuring the contact current (direct measurement method), the BENNING ST 720 has to be operated with a mains voltage of 230 V.
- During contact current measurement by means of the direct measurement method, no part of the test object must have a connection to the earth potential. The test object must be

placed onto an insulated surface. Otherwise, leakage currents to earth might influence the measuring result.

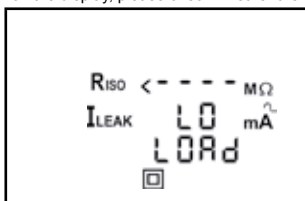
### 8.2.2 Testing of devices of protection class II $\square$ (shock-proof) and of devices of protection class III $\diamond$ (safety extra-low voltage)

Testing of devices without protective conductor and with accessible conductive parts

- Connect the test object to the test socket ① of the BENNING ST 720.
- Establish a connection between the 4 mm test socket ② and a metal part of the test object by means of the test lead with alligator clip.
- For mains operating mode (contact current by means of the direct measurement method, test object in operation!): Connect the plug of the mains connection cable with the socket ① and the shock-proof plug with a protected shock-proof socket (230 V, 50 Hz, 16 A).
- If necessary, the testing voltage of the  $R_{ISO}$  (insulating resistance) measurement can be reduced to 250 V<sub>DC</sub> by means of the  $\frac{500V}{250V}$ -key ⑤. The selected testing voltage is briefly shown on the display ③. Press the key again to switch back to the preset testing voltage of 500 V<sub>DC</sub>.



- Switch the test object on.
- Press the  $\square$  key ③ to start the automatic testing procedure.
- If "Lo LOAD" is shown on the display, please check whether the test object is switched on.

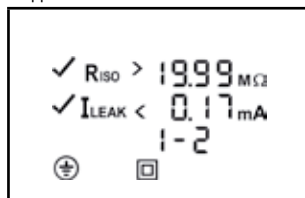


- Press the key ③ to continue the testing procedure in case of the load being too low ( $R_{L-N} > 6 \text{ k}\Omega$ ).
- If "HIGH LOAD" is shown on the display, this indicates an excessive load ( $R_{L-N} << 14 \Omega$ ,  $I_{LAST} (I_{LOAD}) > 16 \text{ A}$ ) of the test object. There might be danger of a short-circuit or of an earth fault. Check whether there is a short-circuit between the external conductor (L) and neutral conductor (N) of the test object.
- If there is no short-circuit, you can continue with the testing procedure by pressing the  $\square$ -key ③.
- If the insulating resistance  $R_{ISO}$  is higher than the admissible limiting value, a  $\checkmark$  appears next to the  $R_{ISO}$  symbol.

#### BENNING ST 720 in mains operating mode:

- The BENNING ST 720 interrupts the testing procedure after the  $R_{ISO}$  (insulating resistance) measurement and requests the user to switch the mains voltage of 230 V to the test socket ① by showing a flashing " $I_{LEAK}$ " symbol. - Make sure that the test sample is protected and press the  $\frac{500V}{250V}$ -key ④ to measure the contact current  $I_{LEAK}$  (direct measurement method).
- The contact current by means of the direct measurement method only starts as soon as the mains voltage is correct applied.

step 1 of 2:



- After a measuring time of 5 seconds or by pressing the key ④, mains polarity will be reversed and the contact current will be measured with reversed mains voltage ("L/N" - "N/L"). The highest measured value of both measurements will be displayed. (step 2 of 2)



step 2 of 2:

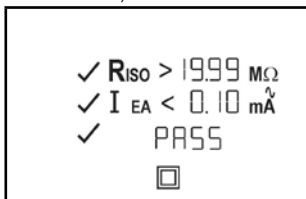


- If the contact current is lower than the admissible limiting value, a ✓ will be shown next to the  $I_{LEAK}$  symbol.
- The overall test is considered to be passed, if "PASS" is shown on the display.

As an alternative:

#### BENNING ST 720 in battery operating mode (without mains supply):

- Similarly, a ✓ will be shown next to the  $I_{EA}$  symbol, if the contact current  $I_{EA}$  (alternative leakage current measurement method) is lower than the admissible limiting value.



- The test is considered to be passed, if "PASS" is shown on the display.

See figure 5: Testing of devices of protection class II (shock-proof devices without protective conductor and with accessible conductive parts) and testing of devices of protection class III (safety extra-low voltage)

#### Note on measuring the contact current in mains operating mode:

- During contact current measurement by means of the direct measurement method, no part of the test object must have a connection to the earth potential. The test object must be placed onto an insulated surface. Otherwise, leakage currents to earth might influence the measuring result.
- Alternatively, the measurement of the contact current  $I_{LEAK}$  can be carried out as permanent measurement (max. 30 seconds). Press the key 4 for approx. > 5 seconds to start permanent measurement. After 30 seconds, the polarity of the mains voltage will be reversed automatically ("L/N" - "N/L"). By pressing the key 4 earlier, the mains voltage polarity reversal can be activated manually and by pressing the key 4 again, the measurement can be stopped.

#### Note on measuring the insulating resistance for test objects of protection class III:

- Due to the preset limiting value of 2 MΩ for test objects of protection class II, for the testing of test objects of protection class III it has to be observed that measured values between the limiting values of 2 MΩ (protection class II) and up to 0.25 MΩ (protection class III) are indicated with a X next to the  $R_{ISO}$  symbol. In this case, the measured value has to be evaluated by a competent person.

### 8.2.3 Cord test

The cord test can be used both for the testing of IEC power cords (device connecting cables with IEC coupler) and for the testing of cable reels, multiple distributors and extension cables.

#### 8.2.3.1 Testing of IEC power cords (IEC adapter cables)

- Disconnect the plug of the mains connection cable from the socket 11 of the BENNING ST 720.
- Connect the IEC power cord to be tested to the BENNING ST 720 by means of the IEC connector 10.
- Press the ⊕ key 2 to start the automatic testing procedure.
- The test starts with measuring the protective conductor resistance  $R_{PE}$ .
- Depending on whether the value is higher or lower than the limiting value, a X or a ✓ is indicated next to the  $R_{PE}$  symbol.




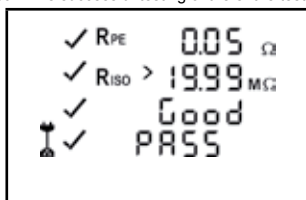
The protective conductor resistance depends on the length and cross-section of the line to be tested. It is possible that the measuring result is acceptable although the BENNING ST 720 indicates a X next to the  $R_{PE}$  symbol.

- Please refer to Table 1 for typical resistance values of lines.

Length	Cross-section		
	1.0 mm <sup>2</sup>	1.5 mm <sup>2</sup>	2.5 mm <sup>2</sup>
5 m	0.1 Ω	0.06 Ω	0.04 Ω
10 m	0.2 Ω	0.12 Ω	0.08 Ω
25 m	0.5 Ω	0.3 Ω	0.2 Ω
50 m	1.0 Ω	0.6 Ω	0.4 Ω

Table 1: Resistance values of the protective conductor depending on length and cross-section




- After the  $R_{PE}$  test has been passed, the measurement of the insulating resistance is carried out automatically.
- Depending on whether the value is higher or lower than the limiting value, a ✓ or a ✗ is indicated next to the  $R_{ISO}$  symbol.
- After the  $R_{ISO}$  test has been passed, the external conductor (L) and the neutral conductor (N) are checked for line breaks and short-circuits. A passed test regarding line breaks and short-circuits is indicated by a ✓ next to the  and the "Good" symbol.
- The "PASS" symbol confirms successful testing of the entire testing procedure.







- If the test regarding line breaks and short-circuits has failed, one of the following symbols is indicated instead of the "Good" symbol:
  - "OPEN" symbol: confirms a line break of the external conductor (L) or neutral conductor (N)
  - "Shor" symbol: confirms a short-circuit between the external conductor (L) and the neutral conductor (N)

See figure 6a: Testing of device connecting cables with IEC connector

#### Note on measuring the protective conductor resistance:


- Alternatively, the measurement of the protective conductor resistance  $R_{PE}$  can be carried out as permanent measurement (max. 3 minutes). For this purpose press the key  for approx. > 5 seconds until the  $\Delta$  symbol appears on the display. Check the connecting line of the test object by bending it over the entire length in order to detect weak points or a break of the protective conductor. The BENNING ST 720 continuously records the current measured value on the display and stores the maximum value in the memory. By pressing the key  again, the measurement is carried out with reversed polarity. Press the key  again to indicate the maximum value of  $R_{PE}$  on the display and to continue the testing procedure as described in section 8.2.3.1.

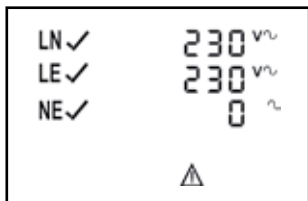
#### 8.2.3.2 Testing of cable reels, multiple distributors and extension cables

- Disconnect the plug of the mains connection cable from the socket  of the BENNING ST 720.
- Connect the IEC power cord (IEC adapter cable) included in the scope of delivery to the IEC connector  of the BENNING ST 720.
- Connect the line to be tested to the test socket  and to the shock-proof socket of the IEC power cord.
- Press the key  to start the automatic testing procedure.
- The further testing procedure corresponds to the testing procedure described in section 8.2.3.1.

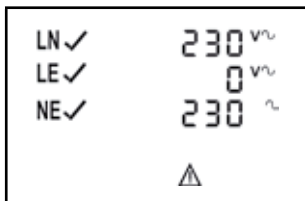
See figure 6b: Testing of lines, multiple distributors and cable reels

#### 8.3 Testing RCDs with a nominal fault current of 30 mA

- Connect the mains connection cable to the mains connection socket  of the BENNING ST 720.
- Make sure to connect the shock-proof plug with a shock-proof socket which is protected by the RCD to be tested. With the mains voltage being applied, the voltage measurement will start automatically.
- Depending on the external conductor position (right or left) of the shock-proof socket, the voltage potentials between the connecting terminals L, N and PE will be shown on the display for approx. 2 seconds.



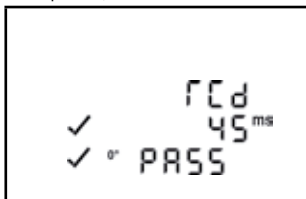
or



- With correct mains voltage ("LN" and "LE" symbols on the display), press the -key **6** to start the RCD test.

LN	LE	NE	Mains voltage
Flashing	Flashing	OFF	No mains voltage
OFF	Flashing	Flashing	Earth fault

- The BENNING ST 720 generates a fault current of 30 mA with positive (0°) or negative (180°) initial polarity. The RCD will be tripped and the tripping time will be measured.
- If the tripping time is less than the limiting value (200 ms), a ✓ will be shown next to the tripping time.
- The test is considered to be passed, if "PASS" is shown on the display.



- Repeat the test with reversed initial polarity.
- See figure 7: Testing of RCD ( $I_{\Delta N}$  30 mA)

#### Note:

- By generating a fault current of 30 mA, it is proven that the RCD will trip when the nominal fault current is reached. If the limiting value of the maximum contact voltage of 50 V is exceeded, the "UB > 50 V" symbol will be shown on the display and the testing will be stopped.
- When testing mobile RCDs, make sure that the mobile RCD is connected with a shock-proof socket which is not protected by an own RCD.

#### Measurement might be influenced by:

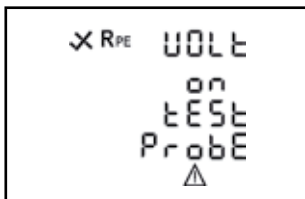


- a possibly existing voltage between the protective conductor of the shock-proof socket and earth
- leakage currents in the circuit behind the RCD
- further earthing equipment
- equipment which is connected behind the RCD and which will cause a longer tripping time, e.g. capacitors or rotating machines

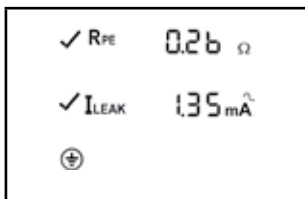
#### 8.4 Testing three-phase test objects under operating conditions

Three-phase test objects are tested by means of the optional measuring adapters 16 A CEE, three-phase, active (044140) or 32 A CEE, three-phase, active (044141).

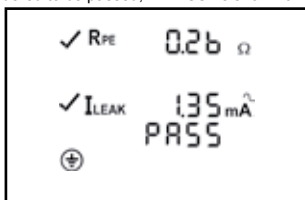
- Connect the CEE plug of the test lead with the CEE coupling of the measuring adapter and connect the CEE plug of the measuring adapter to a protected supply mains (3 x 400 V, N, PE, 50 Hz, 16 A/ 32 A).
- Connect the measuring signal cable of the measuring adapter with the mains connection socket **1** of the BENNING ST 720.
- Connect the 4 mm safety plug of the test lead with alligator clip with the 4 mm safety socket **9** of the BENNING ST 720 and establish a connection with a metal part of the test object.
- Make sure that the test sample is protected and switch it on.
- Press the key **7** to start the automatic testing procedure.
- If a contact voltage is applied to the metal part of the test object, measurement will be interrupted and the following warning will be shown on the display:



- Otherwise, the measurement of the protective conductor resistance ( $R_{PE}$ ) will be started with automatic polarity reversal and the highest measured value of both measurements will be shown on the display.
- After the  $R_{PE}$  test has been passed, the test of the protective conductor current  $I_{LEAK}$  will be carried out as permanent measurement for max. 30 seconds. Press the  $\text{Phase}$  key  $\text{7}$  to finish early the measurement.



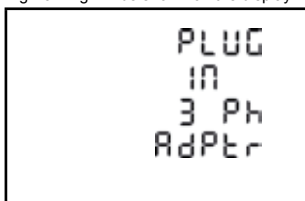
- If the protective conductor current is lower than the admissible limiting value, a ✓ will be shown next to the  $I_{LEAK}$  symbol.
- The overall test is considered to be passed, if "PASS" is shown on the display.



See figure 8: Testing three-phase test objects under operating conditions (test sample placed on insulated surface)

#### Note on testing three-phase test objects under operating conditions:

- The protective conductor current measurement will be carried out by means of a current transformer in the protective conductor of the measuring adapter. The test object must be placed onto an insulated surface. No part of the test object must have a connection to the earth potential. Otherwise, leakage currents to earth might influence the measuring result.
- When pressing the key  $\text{7}$  without previously connecting the measuring adapter to the BENNING ST 720, the following warning will be shown on the display:



## 9. Maintenance



**Before opening the BENNING ST 720, make sure that it is free of voltage! Electrical danger!**

Work on the opened BENNING ST 720 under voltage must be carried out **by skilled electricians with special precautions for the prevention of accidents only!**

Make sure that the BENNING ST 720 is free of voltage as described below before opening the instrument:

- Switch the tester off.
- Remove all connecting cables from the object.

### 9.1 Securing the instrument

Under certain circumstances safe operation of the BENNING ST 720 is no longer ensured, for example in the case of:

- Visible damage of the casing.
- Incorrect measurement results.
- Recognisable consequences of prolonged storage under improper conditions.
- Recognisable consequences of extraordinary transportation stress.

In such cases the BENNING ST 720 must be switched off immediately, disconnected from the measuring points and secured to prevent further utilisation.

### 9.2 Cleaning

Clean the exterior of the housing with a clean dry cloth (exception: special cleaning wipers). Avoid using solvents and/ or scouring agents for cleaning the instrument. It is important to make sure that the battery compartment and battery contacts are not contaminated by leaking electrolyte.


If electrolyte contamination or white deposits occur in the area of the batteries or battery compartment, clean them too with a dry cloth.

### 9.3 Battery replacement



**Before opening the BENNING ST 720, make sure that it is free of voltage! Electrical danger!**

The BENNING ST 720 is supplied by means of six 1.5 V batteries/ type AA (IEC LR6).

A battery replacement (see Figure 9) is required, if the battery symbol appears on the display unit .

Proceed as follows to replace the batteries:

- Switch the BENNING ST 720 off.
- Put the BENNING ST 720 face down and unscrew the screw of the battery compartment cover.
- Lift off the battery compartment cover (in the area of the housing slots) from the bottom part of the battery compartment.
- Remove the discharged batteries from the battery compartment.
- Then, insert the new batteries into the battery compartment at the provided places (please observe correct polarity of the batteries).
- Lock the battery compartment cover into place on the bottom part and tighten the screw.

See figure 9: Battery/ fuse replacement



**Make your contribution to environmental protection! Do not dispose of discharged batteries in the household garbage. Instead, take them to a collecting point for discharged batteries and special waste material. Please inform yourself in your community.**

### 9.4 Fuse replacement



**Before opening the BENNING ST 720, make sure that it is free of voltage! Electrical danger!**

The BENNING ST 720 is protected against overload by means of two built-in fuses (16 A, 250 V, F, D = 5 mm, L = 20 mm) (10019440).

Proceed as follows to replace the fuse (see Figure 9):

- Switch the BENNING ST 720 off.
- Put the BENNING ST 720 face down and unscrew the screw of the battery compartment cover.
- Lift off the battery compartment cover (in the area of the housing slots) from the bottom part of the battery compartment.
- Laterally lift one side of the defective fuse off the fuse holder by means of a slotted screwdriver.
- Completely remove the defective fuse from the fuse holder.
- Insert the new fuse. Only use fuses of the same nominal current, nominal voltage, nominal breaking capacity, tripping characteristic and dimensions.
- Lock the battery compartment cover into place on the bottom part and tighten the screw.

See figure 9: Battery/ fuse replacement

### 9.5 Calibration

To maintain the specified accuracy of the measurement results, the instrument must be recalibrated at regular intervals by our factory service. We recommend a recalibration interval of one year. Send the appliance to the following address:

BENNING Elektrotechnik & Elektronik GmbH & Co. KG  
Service Centre  
Robert-Bosch-Str. 20  
D - 46397 Bocholt

### 9.6 Spare parts

Fuses F 16 A, 250 V, breaking capacity  $\geq 500$  A, D = 5 mm, L = 20 mm, part no. 10019440

### 10. Environmental note



At the end of the product's useful life, please dispose of the device at collection points provided in your community.