SASO 443

METHODS OF TESTING FOR PLUGS AND SOCKET OUTLETS FOR VOLTAGES UP TO 220 V FOR HOUSEHOLD AND SIMILAR GENERAL USE
METHODS OF TESTING FOR PLUGS AND SOCKET OUTLETS FOR VOLTAGES UP TO 220 V FOR HOUSEHOLD AND SIMILAR GENERAL USE

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1- **SCOPE**

This standard is concerned with methods of testing plugs, socket-outlets and socket-outlet adapters for use in residential buildings and the like, rated at 127V, 15 AMP and 220V, 13 AMP.

2- **SUPPLEMENTARY REFERENCES**

Saudi Arabian Standard No. …./…. "Plugs and Socket Outlets for voltages up to 220 V for Household and Similar General Use".

3- **REQUIREMENTS**

Unless otherwise specified, the tests shall be carried out at room temperature $(23 \pm 2){}^\circ C$ and at a relative humidity not exceeding 80%.

4- **VISUAL INSPECTION**

Plugs, socket-outlets and socket-outlet adaptors, shall be visually inspected to ensure conformity of materials, construction and marking with the relevant requirements.

5- **MEASUREMENT OF DIMENSIONS**

5.1 Plugs, socket-outlet and socket-outlet adaptors shall be tested for interchangeability.

5.2 The dimensions of plug pins and spacing between socket contacts, shall be checked by means suitable gauges. However, if gauges are not available, measurement of dimensions shall be made by means of suitable measuring devices readable to 0.01 mm.

5.3 The clearance and creepage distances shall be measured between the following parts:

5.3.1 Live parts of different polarity.

5.3.2 Live parts and accessible metallic parts.

5.3.3 Live parts and earth (when the socket-outlet is correctly mounted and connected as for service).

5.3.4 Live metallic parts and the enclosure or the service on which the socket-outlet is mounted.
6- **INSULATION RESISTANCE TEST**

6.1 The insulation resistance for plugs, socket-outlets and socket-outlet adaptors, shall be measured by applying a D.C. Voltage of 500V, for a period of one minute, between the following parts:

- Current carrying terminals.
- Current carrying terminals connected together and any other parts insulated there from including earthing terminals.

6.2 The insulation resistance measured shall be not less than 5 megohms. For resilient and non-rewireable plugs the insulation resistance shall not be less than 50 megohms. insulation resistance shall not be less than 2 megohms across the switch contacts with switch open, where applicable.

7- **ELECTRIC STRENGTH TEST**

7.1 A high voltage of substantially sine-wave form, shall be applied between the following parts of the plugs, socket-outlets and socket-outlet adaptors.

Initially, no more than half the prescribed voltage shall be applied, then it shall be raised gradually to the full value and maintained for one minute:

- Between current carrying terminals.
- Between current carrying terminals connected together and any other parts insulated there from including earthing terminals.

The voltage value shall be 2000 ±± 60 V. having a frequency of 50 or 60 Hz if applied to 250 V plugs, socket-outlet and socket-outlets adaptors, and 1500 V having a frequency of 60 Hz if applied to plugs and socket-outlets of 127V.

7.2 Any flashover or breakdown of insulation shall be recorded. Glow discharges without drop in voltage are ignored.

7.3 Each switched socket-outlet shall also pass a momentary high voltage of 750V r.m.s applied across each break with the switch open without any flashover or breakdown of insulation.

8- **WITHDRAWAL FORCE TEST**

For socket-outlet and socket-outlet adaptors.

8.1 The socket-outlet and the socket-outlet adaptors shall be mounted as in normal use.

8.2 A suitable test plug shall be correctly inserted into the corresponding socket-outlet contacts.

8.3 A tensile force shall be gradually applied to the test plug in a direction to pull it straight out and the value of the force, when the plug is just pulled out, shall be measured.

8.4 The withdrawal force shall be measured 3 times consecutively on the same socket-outlet and the average taken.
8.5 The average value shall conform with Table 1.

### Table 1
**Withdrawal force**

<table>
<thead>
<tr>
<th>Rating</th>
<th>Number of Poles</th>
<th>Force in Newtons</th>
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<tr>
<td></td>
<td></td>
<td>Max.</td>
</tr>
<tr>
<td>15A/127V</td>
<td>2</td>
<td>50</td>
</tr>
<tr>
<td>15A/127V</td>
<td>3</td>
<td>54</td>
</tr>
<tr>
<td>13A/220V</td>
<td>2</td>
<td>50</td>
</tr>
<tr>
<td>13A/220V</td>
<td>3</td>
<td>54</td>
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</table>

9- **CONTACT RESISTANCE TEST**

9.1 A current derived from an a.c. source having a no load voltage not exceeding 12 V, and equal to 1.5 times rated current or 25 A, whichever is the greater, shall be passed between:

- The earthing pin of a plug and the earthing terminal of a socket outlet or the earthing pin of a socket-outlet adaptor.
- The earthing terminal of a socket-outlet and each accessible metallic part.

9.2 The voltage drop between the earthing terminal and the accessible metallic part shall be measured, and the resistance shall be calculated from the current and this voltage drop. Care should be taken that the contact resistance between the tip of the measuring probe and the metallic part under test does not influence the test results.

9.3 The value of the resistance shall not exceed 0.05 ohm.

10- **TEMPERATURE RISE TEST**

10.1 The temperature rise of the terminals of a plug and current carrying parts of a socket outlet and a socket-outlet adaptor, shall be measured using suitable thermocouples attached to current carrying parts by low melting point alloy or by some other equally effective means of attachment.

10.2 The plug socket-outlet and socket-outlet adaptor, shall carry their rated current at the rated voltage + 10% & - 20%. The temperature of the current carrying parts shall be measured after a time has elapsed sufficient for the temperature to become steady (stability being taken as less than 1°C rise within one hour).

10.3 The temperature rise of the current carrying parts shall be calculated.

10.4 The temperature rise shall not exceed 45 K.
11- CURRENT BREAKING CAPACITY OF SOCKET-CONTACTS

11.1 Socket-outlet shall be mounted and connected for tests as they are normally to be mounted and connected in service, including the earthing connection. The test circuit shall be a non-inductive a.c. circuit.

11.2 The plug shall be inserted into the corresponding socket-outlet and a current 130% of the rated value at rated voltage shall be passed.

11.3 The plug shall be fully inserted, and immediately withdrawn at a speed of approximately 15cm/s from the socket-outlet, 10 times in succession at intervals of 30s.

11.4 During the test, no sustained arcing shall occur, and after the test no damage shall be evident.

11.5 The high voltage shall be applied as (specified in item 7), to the plug and the socket-outlet and any flashover or breakdown in insulation shall be recorded.

12- CURRENT BREAKING CAPACITY OF SWITCHES

(For switched socket-outlet):

12.1 Switched socket-outlet shall be mounted and connected for test as they are normally to be mounted and connected in service. The test circuit shall be a non-inductive a.c. circuit at 110% of the rated voltage. The test current shall be adjusted to 130% of the rated value.

12.2 The switch of the socket-outlet shall be operated so as to make and break the test current 10 times in succession at intervals of 30s.

12.3 The insulation resistance of the socket-outlet shall be measured as specified in item 6.

12.4 The high voltage shall be applied (as specified in item 7) to the socket outlet and any flashover or breakdown in insulation shall be recorded.

13- ELECTRICAL ENDURANCE OF SOCKET-CONTACTS

13.1 Socket-outlets shall be tested for capacity to make and break the rated current at the rated voltage, by insertion, and immediate withdrawal of a plug, 15000 times (30000 movements) in a non-inductive a.c. circuit, at a rate of six insertions and six withdrawals per minute. The speed of travel of the plug being approximately 15cm/s. The plug shall be renewed after each 5000 insertions and withdrawals (10000 movements). For the purpose of this test, no lubrication is applied to the plug or socket under test.

13.2 After the test, the socket-outlet shall be checked to detect any wear impairing its operation and any appreciable damage to the openings in the cover provided for the plug pins. The shutter shall be checked to detect any malfunction or defect in shielding of the socket-outlet.
13.3 The insulation resistance of the socket-outlet shall be measured as specified in item 6.

13.4 The high voltage shall be applied (as specified in item 7) to the socket-outlet and any flashover or breakdown in insulation shall be recorded.

14- ELECTRICAL ENDURANCE OF SWITCHES
(For switched socket-outlet).

14.1 Switches shall be tested for capacity to make and break the rated current at rated voltage, in a non-inductive a.c. circuit, 15000 times (30000 movements) at a rate not exceeding six complete cycles per minute at regular intervals. The periods during which the switches are ON and OFF shall be approximately equal.

14.2 In order to facilitate inspection, the switched socket-outlet plates need not be in position after the first 4000 operations. Metallic switched socket-outlet plates and all non-current carrying metallic parts that are normally exposed when the switched socket-outlet plate is not in position and that may become live in the event of failure of insulation shall be connected to the earthed pole of the test circuit. The connection to earth may be through a fine wire fuse. The means used for operating the switch shall be such as to move the actuating member at a speed of approximately 30 cm/s both in making and breaking the circuit, and shall be so positioned that the normal action of the mechanism as a whole is not interfered with, in any way.

14.3 After the test, the switches shall be checked to detect any malfunction and the insulation resistance shall be measured as specified in item 6.

14.4 The high voltage shall be applied (as specified in item 7) to the socket-outlet and any flashover or breakdown in insulation shall be recorded.

14.5 At the end of the test, the switches shall be checked to determine whether they are still in a serviceable condition.

15- MECHANICAL STRENGTH TEST

15.1 Any decorative cover or parts not providing protection against electric shock, shall be removed.

15.2 Plugs: Non-rewireable plugs are tested as delivered. Rewireable plugs are fitted with 3-core PVC 1.25 mm² flexible cord. The flexible cords attached to plugs are cut to a length of 120 ± 5mm.

Plugs are tested in the tumbling barrel shown in Fig (1) falling 500 mm on to a plywood base 10mm thick. The barrel is turned at a rate of 5 r/min, 10 falls per minute thus taking place.

Only one plug is tested at a time, the number of drops is as follows:

- Non-rewireable plugs 2500
- Rewireable plugs 1000
15.3 After the test the plug shall have no external damage which might affect the safety and no components shall become detached.

15.4 Socket-outlets are tested with the impact test apparatus shown in Fig. (2-a). The pendulum consists of a steel tube suspended in such a way that it swings only in a vertical plane. A hammer of 0.15 kg is rigidly fixed to the lower end with its axis 1 m from the axis of suspension.

The striking element is hemispherical face made of polyamide having a Rockwell hardness of HR 100 and a radius of 10 mm Fig. (2-b). The design of the apparatus is such that a force of between 1.9 N and 2 N has to be applied to the face of the hammer to maintain the pendulum in a horizontal position. The socket-outlet is mounted on a sheet of plywood 8 mm thick and 175 mm square secured at its top and bottom edges to a mounting support. having a mass of 10± 1Kg. is mounted on a rigid bracket by means of pivots. The bracket is mounted on a frame which is fixed to a solid wall, See Fig. (2-c).

The design of the mounting assembly shall be such that:
- The sample can be so placed that the point of impact lies in the vertical plane through the axis of the pivot of the pendulum.
- The sample can be moved horizontally and turned about an axis perpendicular to the surface of the plywood.
- The plywood can be turned about a vertical axis.

The socket-outlet is mounted on the plywood as in normal use. The socket-outlet is placed so that the point of impact lies in the vertical plane through the axis of the pivot of the pendulum. For all tests, the hammer falls from a height of 150 mm measured vertically between the point of impact on the sample and the face of the hammer at the point of release. Ten blows are applied to points evenly distributed over the socket-outlet.

15.5 After the test the socket-outlet shall still be in accordance with the (creepage and clearance distances, Insulation resistance and Electric strength requirements).

16- HEAT RESISTANCE TEST

16.1 Plugs, socket-outlet and socket-outlet adaptors, shall be heated in a thermostatically controlled oven. The used oven in the test shall be capable of holding the temperature of the air surrounding the test samples within (100 ± 2)°C and shall be such as to prevent the samples from being raised to a temperature above that specified.

16.2 The temperature of the oven shall in advance, be adjusted to the test temperature, and then the samples shall be inserted.

16.3 The samples shall be kept for a period of one hour inside the oven and then taken out and allowed to cool to room temperature naturally.
16.4 After the test, there shall be no marked deformation, softening or other defects in the samples, which any impair their safety.

16.5 All other parts of insulating material shall be subjected to the ball pressure test using the apparatus shown in Figure 3.

16.5.1 The surface of the part to be tested is placed in the horizontal position and a steel ball of 5 mm diameter is pressed against this surface with a force of 20 N.

16.5.2 The test is made in a heating cabinet at a temperature of 125±2°C. After 1 h, the ball is removed from the sample which is then cooled down within 10s to approximately room temperature by immersion in cold water.

16.5.3 The diameter of the impression caused by the ball is measured and shall not exceed 2 mm.

17- RESISTANCE TO ABNORMAL HEAT AND FIRE

Glow wire test shall be carried out as follows:

Notes: 1- The tests shall not be made on parts of ceramic material or metal.

2- Small parts unlikely to be subjected to abnormal heat and whose failure to pass these tests would not materially affect the safety of the unit are not subjected to the test.

17.1 Description of test apparatus

17.1.1 The glow-wire consists of a specified loop of a nickel/chromium (80/20) wire 4 mm in diameter; when forming the loop, care must be taken to avoid fine cracking at the tip.

17.1.2 A sheathed fine-wire thermocouple, having an overall diameter of 0.5 mm and wires of NiCr and NiAl with the welded point located inside the sheath, is used for measuring the temperature of the glow-wire.

17.1.3 The glow-wire, with the thermocouple, is shown in figure 4.

17.1.4 The sheath consists of a metal resistant to a temperature of at least 960°C. The thermocouple is arranged in a pocket hole, 0.6 mm in diameter, drilled in the tip of the glow-wire, as shown in detail Z of Figure 4. The thermovoltages shall comply with the temperatures indicated in table 2. The cold connection shall be kept in melting ice unless a reliable reference temperature is obtained by other means, for example by a compensation box.

17.1.5 The instrument for measuring the thermovoltage should be accurate to 1%.

17.1.6 The glow-wire is electrically heated; the current necessary for heating the tip to a temperature of 960°C is between 120 A and 150 A.

17.1.7 The test apparatus shall be so designed that the glow-wire is kept in a horizontal plane and that it applies a force of 0.8 N to 1.2 N to the specimen, the force being maintained at this value when the glow-wire or the specimen is moved horizontally one towards the other over a distance of at least 7 mm.

An example of the test apparatus is shown in Figure 5.
17.1.8 To evaluate the possibility of spread of fire, for example by burning or glowing particles falling from the specimen, a layer of the material or components normally surrounding or situated underneath the specimen is placed underneath the specimen at a distance equal to the distance between the specimen and the surrounding material or components when the specimen is mounted as in normal use.

17.2 Calibration of the thermocouple
The calibration of the thermocouple shall be carried out at the temperature 960°C using as standard method a foil of silver, 99.8% pure, 2 mm square and 0.06 mm thick, placed on the upper face of the tip of the glow-wire. The glow-wire is heated and a temperature of 960°C is reached when the silver foil melts.

17.3 Preconditioning
If not otherwise specified in the relevant specification, the specimen is stored for 24 h in an atmosphere having a temperature between 15°C and 35°C and a relative humidity between 45% and 75%.

17.4 Initial measurements
The specimen shall be examined visually and, when specified in the relevant specification, the physical/electrical parameters measured.

17.5 Test procedure
Warning note
Precautions must be taken to safeguard the health of personnel conducting tests against:
- the risks of explosion or fire;
- the inhalation of smoke and/or toxic products;
- the toxic residues.

17.5.1 The specimen is arranged so that:
- the surface in contact with the tip of the glow-wire is vertical;
- the tip of the glow-wire is applied to the part of the surface of the specimen which is likely to be subjected to thermal stresses in normal use. The tip of the glow-wire is applied at a place where the section is thinnest, but preferably not less than 15 mm from the upper edge of the specimen. If possible the tip of the glow-wire is applied to flat surfaces and not to grooves, knock-outs, narrow recesses or sharp edges.

17.5.2 The glow-wire is electrically heated to the temperature given in table 2, which is measured by means of the calibrated thermocouple. Care must be taken to ensure that, before starting the test, this temperature and the heating current are constant for a period of at least 60 s and that heat radiation does not influence the specimen during this period or during the calibration, for example by providing an adequate distance or by using an appropriate screen.
17.5.3 The tip of the glow-wire is then brought into contact with the specimen for 30 ± 1 s. The heating current is maintained during this period. After this period, the glow-wire and specimen are slowly separated, avoiding any further heating of the specimen and any movement of air which might affect the result of the test.

The movement of the tip of the glow-wire into the specimen when pressed to it shall be mechanically limited to 7 mm.

17.5.4 If not otherwise specified by the relevant specification, the test is made on one specimen. In the case of doubt with regard to the results of the test, the test is repeated on two further specimens.

Before each test, it is necessary to clean the tip of the glow-wire of any residue of previously tested material, for example by means of a brush.

<table>
<thead>
<tr>
<th>Part</th>
<th>Temperature of glow-wire ºC</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Parts necessary to retain live parts in position</td>
<td>850 ± 15</td>
</tr>
<tr>
<td>- Parts not necessary to retain live parts in position (although they may be in contact with live parts)</td>
<td>650 ± 10</td>
</tr>
</tbody>
</table>

17.6 The test specimen shall be either a complete unit or, if the test cannot be made on a complete unit, a suitable part may be cut from one for the purpose of the test. The test is made on one specimen.

In case of doubt, the test shall be repeated on two further specimens.

The test shall be made, applying the glow wire once.

The specimen shall be positioned during the test in the most unfavourable position of its intended use (with the surface tested in a vertical position).

The tip of the glow wire shall be applied to the specified surface of the specimen taking into account the conditions of the intended use under which a heated or glowing element may come into contact with the specimen.

17.7 The specimen shall be regarded as having passed the glow wire test if:

a) there is no visible flame and no sustained glowing; or

b) flames and glowing at the specimen extinguish within 30 s after the removal of the glow wire.

There shall be no ignition of the tissue paper or scorching of the board.
18- RESISTANCE TO AGEING AND HUMIDITY TESTS

18.1 Resistance to humidity test

18.1.1 A convenient temperature (T°C) between 20°C and 30°C shall be chosen as a reference temperature. Each unit shall be brought to a temperature of between T°C and (T+4)°C. then it shall be placed in a humid cabinet maintained between 91% and 95%.

The temperature of the air at all positions within the cabinet where the units can be placed shall be kept within 1°C of the chosen value.

18.1.2 The unit shall be left in the cabinet for 48 hours.

18.1.3 Immediately after the humidity treatment, the insulation resistance shall be measured as specified in clause 6.

18.1.4 The value of insulation resistance shall not be less than 5 megohms except across switch contacts with the switch open (where applicable) where it shall be not less than 2 megohms.

NOTE: A relative humidity of between 91% and 95% can be obtained by placing in the humidity cabinet a saturated solution of potassium nitrate (KNO₃) or sodium sulfate (Na₂SO₄) in water having a sufficiently large contact surface with the air.

18.2 Resistance to ageing test

18.2.1 Units are subjected to a test in a heating cabinet with an atmosphere having the composition and pressure of the ambient air and ventilated by natural circulation.

The temperature in the cabinet is kept at 70°C ± 5°C.

The specimens are kept in the cabinet for a minimum of 7 days.

18.2.2 After the treatment, the specimens are removed from the cabinet and kept at normal room temperature and relative humidity for at least 4 h.

18.2.3 The specimens shall show no crack visible with normal or corrected vision without additional magnification, nor shall the material have become sticky or greasy, when tested as follows:

With the forefinger wrapped in a dry piece of rough cloth the specimen is pressed with a force of between 4.9 N and 5.0 N. The force can be obtained in the following way. The specimen is placed on one of the pans of a balance and the other pan is loaded with a mass equal to the mass of the specimen plus 500 g. Equilibrium is then restored by pressing the specimen with the forefinger wrapped in a dry piece of rough cloth.

No traces of the cloth shall remain on the specimen and the material of the specimen shall not stick to the cloth.

18.2.4 After the test the specimens shall show no damage.
19- RESISTANCE TO EXCESSIVE RESIDUAL STRESSES AND TO RUSTING

19.1 Copper alloy parts shall be checked by the following test:

19.1.1 The specimen is degreased in a suitable alkaline degreasing solution or organic solvent, then immersed in an aqueous solution of mercurous nitrate containing 10 g of Hg₂(NO₃)₂ and 10 ml of HNO₃ (relative density 1.42) per litre of solution for 30 min ± 1 min at a temperature of 20°C ± 5°C.

*NOTE:* Attention is drawn to the fact that due precautions should be taken when using these liquids as they are toxic.

19.1.2 After the treatment, the specimen is washed in running water, any excess mercury is wiped off, and the specimen is immediately visually examined. There shall be no cracks visible with normal or corrected vision without additional magnification.

19.2 Ferrous parts shall be checked by the following test:

19.2.1 The specimen is degreased in a suitable alkaline degreasing solution or organic solvent, the parts are then immersed for 10 min ± 0.5 min in a 10% solution of ammonium chloride in water at a temperature of 20°C ± 5°C.

19.2.2 Without drying but after shaking off any drops, the parts are placed for 10 min ± 0.5 min in a box containing air saturated with moisture at a temperature of 20°C ± 5°C.

19.2.3 After the parts have been dried for at least 10 min in a heating cabinet at a temperature of 100°C ± 5°C their surfaces shall show no signs of rust.

*NOTE 1:* Traces of rust on sharp edges and any yellowish film removable by rubbing should be ignored.
Note: This drawing is not intended to govern design except as regards the dimensions and specific requirements shown. All dimensions are in millimeters.

Figure 1. Tumbling barrel
Materials
1: Polyamide or horn beam
2, 3, 4 and 5: Steel

(b) Constructional details of striking element

NOTE: The drawing is not intended to govern design except as regards the dimensions and specific requirements shown.

Figure 2 Pendulum impact test apparatus
(c) Constructional details of mounting support for test samples.

**NOTE:** This drawing is not intended to govern design except as regards the dimensions and specific requirements shown.

All dimensions are in millimeters.

**Figure 2 (concluded)**
Figure 3 – Apparatus for ball pressure test

Dimension is in millimetres.

NOTE. This drawing is not intended to govern design except as regards the dimensions and specific requirements shown.
Figure 4 - Glow-wire and position of the thermocouple

1. glow-wire hard soldered at 3
2. thermocouple
3. stud
Figure 5 - Test apparatus (example)

1. positioning clamp
2. carriage
3. tensioning cord
4. base plate
5. weight
6. stop
7. scale for measure of flame
8. scale for penetration
9. glow-wire (Fig. 1)
10. break-through in base plate for particles falling from the specimen
The preliminary draft of this standard has been developed by the work team composed of:

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<th>Name</th>
<th>Agency</th>
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</tbody>
</table>

The draft standard was studied and the comments received from concerned bodies discussed. It has been adopted, in its present form, by the following members of Technical Committee No. (5):

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