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INTERNATIONAL STANDARD

NORME INTERNATIONALE

Electric appliances connected to the water mains – Avoidance of backsiphonage and failure of hose-sets

Appareils électriques raccordés au réseau d'alimentation en eau – Exigences pour éviter le retour d'eau par siphonnage et la défaillance des ensembles de raccordement

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ELECTRIC APPLIANCES CONNECTED TO THE WATER MAINS – AVOIDANCE OF BACKSIPHONAGE AND FAILURE OF HOSE-SETS

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International Standard IEC 61770 has been prepared by IEC technical committee 61: Safety of household and similar electrical appliances.

This second edition cancels and replaces the first edition published in 1998 including its Amendment 1 (2004) and Amendment 2 (2006). It constitutes a technical revision.

The principal changes in this edition as compared with the first edition are as follows (minor changes are not listed):

– normative references are updated;
– some notes have been converted to normative text (3.10, 5.2, 6.3, 7.2 and Annex A);
– the type of petroleum spirit has been specified (9.3).

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The text of this standard is based on the following documents:

FDIS	Report on voting
61/3647/FDIS	61/3687/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

NOTE 1 The following print types are used:

– requirements: in roman type;

– *test specifications: in italic type*;

– notes: in small roman type.

Words in **bold** in the text are defined in Clause 3. When a definition concerns an adjective, the adjective and the associated noun are also in bold.

The committee has decided that the contents of the base publication and its amendments will remain unchanged until the maintenance result date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

NOTE 2 The attention of National Committees is drawn to the fact that equipment manufacturers and testing organizations may need a transitional period following publication of a new, amended or revised IEC publication in which to make products in accordance with the new requirements and to equip themselves for conducting new or revised tests.

It is the recommendation of the committee that the content of this standard be adopted for implementation nationally not earlier than 12 months nor later than 36 months from the date of its publication.

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ELECTRIC APPLIANCES CONNECTED TO THE WATER MAINS – AVOIDANCE OF BACKSIPHONAGE AND FAILURE OF HOSE-SETS

1 Scope

This International Standard specifies requirements for appliances for household and similar purposes to prevent the backsiphonage of **non-potable water** into the water mains. It also specifies requirements for **hose-sets** used for connecting such appliances to the water mains that supply water at a pressure not exceeding 1 MPa.

NOTE 1 Examples of similar purposes are the installation of appliances in canteens, restaurants, launderettes and communal flats.

NOTE 2 This standard does not apply to

– appliances used for dry cleaning;

– appliances for medical purposes;

– appliances intended for industrial purposes;

– water heaters that are an integral part of the water supply system;

– water coolers that are an integral part of the water supply system.

NOTE 3 The connection of the appliance to the water mains may be temporary or permanent.

NOTE 4 When reference is made to the water mains, water supplied from a cistern or similar system is also included.

NOTE 5 Many countries have requirements concerning the prevention of contamination of potable water as a result of contact with unsuitable materials upstream of a **backflow prevention device**.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60730-2-8, *Automatic electrical controls for household and similar use – Part 2: Particular requirements for electrically operated water valves, including mechanical requirements*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
potable water
water which is obtained directly from the potable water mains and remains in a closed system up to the **backflow prevention device**

3.2
non-potable water
water which leaves the closed system after having passed the **backflow prevention device**

3.3
backflow prevention device
means to prevent contamination of **potable water** by backflow of **non-potable water**

NOTE Examples are **airgaps**, **dynamic backflow preventers** and **pipe interrupters**.

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3.4
airgap
unobstructed free distance between the water inlet or the end of the feed pipe and the **critical water level**

NOTE A distance is considered to be unobstructed if the airflow into the feed pipe under vacuum conditions is not restricted by the construction of the appliance.

3.5
pipe interrupter
device without movable or elastomeric parts, into which air can enter while water is passing through it

3.6
dynamic backflow preventer
backflow prevention device which prevents backsiphonage by the use of moving parts

3.7
overflow
means for discharging excess water from the appliance when the normal outlet is obstructed

3.8
maximum water level
highest level of the **non-potable water** in any part of the appliance when it operates continuously under fault conditions

3.9
critical water level
level to which the **non-potable water** is reduced from the **maximum water level** 2 s after water inlets have been closed

3.10
hose-set
assembly consisting of a flexible hose and couplings and used for connecting the appliance to the water mains

NOTE Couplings may be removable with or without the aid of a tool.

3.11
detachable part
part which can be removed without the aid of a tool

4 General requirements

4.1 Appliances shall be provided with a **backflow prevention device**.

For appliances incorporating a water softener located upstream of an **airgap** or **pipe interrupter**, a **dynamic backflow preventer** shall be incorporated upstream of the water softener.

Other components presenting a potable water hazard, such as dispensers for adding cleaning, rinsing, softening or similar agents to the water, shall not be located upstream of the **backflow prevention device**.

Pipework containing **potable water** located upstream of a **backflow prevention device** shall not pass through **non-potable water** in the appliance.

Compliance is checked by inspection.

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NOTE For a given point in a hydraulic system, "upstream" indicates the side from which the water flows and "downstream" indicates the side to which the water flows.

4.2 Backflow prevention devices shall be incorporated in, or fixed to, the appliance or they shall be incorporated in the inlet side of a **hose set**.

NOTE They may also be incorporated in the water inlet valves.

They shall be constructed so that

– their functional characteristics cannot be changed, even intentionally,
– they can only be removed with the aid of a tool,
– if omitted, the appliance is rendered inoperable or manifestly incomplete.

Compliance is checked by inspection and by manual tests.

4.3 Hose-sets for the connection of appliances to the water mains shall be constructed so that the risk of flooding is obviated as far as possible.

Compliance is checked by the tests of Clause 9.

4.4 Metallic parts of the water connection system of the appliance, the deterioration of which may cause the appliance to fail to comply with the requirements of this standard, shall be resistant to erosion, dezincification, oxidation or corrosion.

Compliance is checked by inspection.

NOTE Resistance to dezincification of brass can be checked in accordance with ISO 6509 [1].

5 General conditions for the tests

5.1 *When reference is made to normal conditions, the following applies:*

– *the appliance is placed on a horizontal support;*
– *the appliance is connected to a water supply in accordance with the instructions for installation;*
– *the water supply has a static pressure not exceeding 1 MPa and a dynamic pressure not less than 0,6 MPa;*
– *the appliance is supplied at rated voltage;*
– *the appliance is tested without being loaded and without cleaning, rinsing or similar agents, doors and lids being closed.*

NOTE When water pressures are stated, they are pressure differences from atmospheric pressure.

5.2 *When reference is made to fault conditions, the appliance is inclined at an angle of 2° to the horizontal in the most unfavourable position. In addition to the normal conditions, the following fault conditions are applied one at a time, as far as is reasonable, consequential faults being taken into consideration:*

– *the connection between any dispenser intended for adding cleaning, rinsing, softening or similar agents to the water and other parts of the appliance is blocked, unless the cross-sectional area of the connection exceeds 10 cm^2 throughout its length with no dimension less than 10 mm;*

[1] ISO 6509, *Corrosion of metals and alloys – Determination of dezincification resistance of brass*

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NOTE Dispenser connections are not blocked if they have cross-sections which are varied by user action each time the appliance is used, such as opening a detergent dispenser.

– ***overflows*** *are blocked if they have*
  - *a circular cross-section not exceeding 5 cm^2,*
  - *a non-circular cross-section with one dimension less than 3 mm and an area not exceeding 5 cm^2,*
– *all magnetic valves upstream of a* ***backflow prevention device*** *which can be open simultaneously during the normal programme of the appliance are held open;*
– *all motors are disconnected from the supply mains and the normal drain outlet is blocked.*

5.3 *Unless otherwise specified, the tests are made in the order indicated and*

– *for appliances,* ***pipe interrupters*** *and* ***dynamic backflow preventers****, on a single sample as supplied, which shall withstand all the relevant tests;*
– *for* ***hose-sets****, on three samples. If one sample fails, the tests are repeated on a further set of three samples, all of which shall withstand the repeated tests.*

Each of the tests of 9.1.9 to 9.1.11 is carried out on three new samples.

5.4 *Tests on* ***airgaps****,* ***pipe interrupters*** *and* ***dynamic backflow preventers*** *are made on the appliance, unless this is impracticable or is otherwise specified.*

5.5 *When determining the* ***critical water level*** *of appliances having more than one water inlet, and a programme permitting simultaneous filling, each water inlet is closed in turn, other water inlets being open.*

5.6 *Unless otherwise specified, the tests are carried out at an ambient temperature of 20 °C ± 5 °C.*

6 Airgaps

6.1 **Airgaps** shall be constructed so that the water can flow freely through the air section and that water downstream of the **airgap** cannot be drawn into the feed pipe.

Compliance is checked by inspection and by the tests of 6.2 and 6.3. The test of Annex A may be carried out instead of the test of 6.3.

6.2 *The appliance is operated under fault conditions until the* ***maximum water level*** *is reached.*

The water outlet of the feed pipe shall not come into contact with ***non-potable water****.*

6.3 *The appliance is operated under fault conditions until the* ***critical water level*** *is reached.*

The length of the ***airgap*** *shall be at least twice the smallest diameter of the water supply system within the appliance, with a minimum of 20 mm. There shall also be a clear space of 20 mm between the outlet of the feed pipe and other parts in any downward direction. The thickness of any water film and the dimensions of waterdrops shall be taken into account.*

7 Pipe interrupters

7.1 **Pipe interrupters** shall be constructed so that the air-inlet openings remain permanently free and open to the atmosphere. Water which may leak in normal use from an air-inlet opening shall flow into the container of the appliance but shall not reach a sufficient level for the vertical dimensions to be reduced below those specified in 7.3 and 7.4.

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Pipe interrupters shall be protected against deliberate obstruction or manipulation which could affect the results of the tests.

The total cross-sectional area of the air-inlet openings shall not be less than the cross-sectional area of the water-inlet opening. The smallest dimension of each air-inlet opening shall be at least 3 mm. The dimensions are measured at right angles to the direction of the airflow.

Compliance is checked by inspection, measurement and by the tests and measurements of 7.2 to 7.4. However, if the measurements of 7.3 and 7.4 cannot be made due to the construction of the appliance, compliance is checked by the test of Annex A.

7.2 *For separate **pipe interrupters**, a vertical tube of glass or other transparent material having approximately the same internal diameter and a length of at least 500 mm, is connected to the outlet of the **pipe interrupter**. The free end of the tube is immersed in water to a depth of at least 25 mm, as shown in Figure 1.*

*A vacuum pump is connected directly to the inlet of the **pipe interrupter** and a negative pressure of 65 kPa ± 15 kPa is applied for at least 5 s. The distance h between the water level in the tube and the water level in the container is measured.*

*For **pipe interrupters** which are incorporated in the appliance downstream of a magnetic valve, the test is carried out in the appliance. The vacuum pump is connected directly to the water inlet of the appliance by means of the shortest possible length of tube.*

The cross-sectional area of the connection of the vacuum pump shall be sufficient so that the airflow is not restricted.

NOTE If the inlet hose cannot be removed even with the aid of a tool, the vacuum pump is connected to the inlet of the hose.

7.3 *The appliance is operated under fault conditions, until the **maximum water level** is reached.*

*The vertical distance between the **maximum water level** and the lowest rim of the air-inlet opening of the **pipe interrupter** is measured. It shall be at least equal to dimension h, shown in Figure 2.*

7.4 *Immediately after the test of 7.3, the water inlet is closed. The vertical distance between the **critical water level** and the lowest rim of the air inlet opening is measured. It shall be at least equal to h + 20 mm.*

*The **critical water level** in the hoses connecting the **pipe interrupter** to a water softener downstream of a **dynamic backflow preventer** is also checked.*

NOTE If the **critical water level** cannot be observed due to an opaque part or hose, this part or hose is replaced by a transparent part or transparent hose having the same shape and dimensions.

8 Dynamic backflow preventers

8.1 Dynamic backflow preventers shall be constructed so that wear or damage of movable parts, their supports or guides, or the removal of **detachable parts** does not allow backsiphonage. The movable parts shall operate each time the water passes through the device under conditions of normal use and failure of any of them shall render the appliance inoperable or shall be evident to the user.

*Compliance is checked by inspection and by operating the **dynamic backflow preventer** as described in 8.2, followed by the test of Annex A.*

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The test of Annex A is carried out under the following conditions:

- *with movable parts placed in the most unfavourable position, one at a time;*
- *after **detachable parts** have been removed;*
- *after simulating damage to movable parts, including their supports or guides, one at a time.*

Only one of these three conditions is applied at any one time.

8.2 *The device is operated for 5 000 cycles. Each cycle comprises a period of 3 s during which water flows through the device and a period of 3 s without water flow. The water is at a pressure of 0,2 MPa and has a temperature of*

- *15 °C ± 5 °C, for **dynamic backflow preventers** in the cold water supply;*
- *65 °C ± 5 °C, for **dynamic backflow preventers** in the hot water supply;*
- *65 °C ± 5 °C, for **dynamic backflow preventers** if the inlet is unmarked.*

*The test is carried out 10 times with a 48 h rest period. Before each test, the **dynamic backflow preventer** is checked to ensure that movable parts operate when water flows through it.*

9 Hose-sets

9.1 **Hose-sets** shall withstand the stresses to which they may be subjected in normal use.

Compliance is checked by the relevant tests specified in 9.1.1 to 9.1.9 as shown in Table 1 for different types of hoses and by the tests of 9.1.10 and 9.1.11 for couplings.

During the tests of 9.1.1 to 9.1.8, the hose shall not leak, burst or slip from its couplings.

NOTE 1 Deformation which does not impair the function of the **hose-set** is ignored.

NOTE 2 Flexible metal **hose-sets** having a length less than 1 m are not subjected to the tests of 9.1.2 and 9.1.3.

NOTE 3 For **hose-sets** which incorporate devices for protection against flooding and the hose of which is contained in a flexible tube, only the hose is subjected to the tests of 9.1.6 to 9.1.8.

NOTE 4 Hoses downstream of a magnetic valve are not subjected to the tests of 9.1.6 to 9.1.8 as long as they cannot come under pressure due to the operation of another magnetic valve.

Table 1 – Tests applicable to different types of hoses

Test	Type of hose				
	Non-thermoplastic	Non-thermoplastic with metal braiding	Thermoplastic	Thermoplastic with metal braiding	Flexible metal
Kinking	9.1.1	–	9.1.1	–	–
Flexing	–	–	–	–	9.1.2
Bending	–	–	–	–	9.1.3
Crushing	–	9.1.4	–	9.1.4	–
Low temperature	–	–	9.1.5	9.1.5	–
Ageing	9.1.6	9.1.6	9.1.6	9.1.6	–
Pulsing	9.1.7	9.1.7	9.1.7	9.1.7	9.1.7
Pressure	9.1.8	9.1.8	9.1.8	9.1.8	9.1.8
Ozone	9.1.9	9.1.9	–	–	–

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9.1.1 *The kinking test is carried out as follows.*

The hose is folded through an angle of 180° at its mid-point between parallel plates so that the distance between the plates is equal to twice the outer diameter of the hose, as shown in Figure 3. After 5 s, the plates are removed.

The test is carried out 10 times with a rest period of 1 min during which the hose is unstressed. The hose is folded in the same direction each time.

9.1.2 *The flexing test is carried out as follows.*

One of the couplings of the ***hose-set*** *is fixed to an oscillating arm as shown in Figure 7. A mass of 2 kg is attached to the other coupling, the hose being freely suspended. The oscillating arm is moved through an angle of 180° at a rate of (10 ± 2) flexings per minute for 500 flexings.*

NOTE A flexing is one movement of 180°.

9.1.3 *The bending test is carried out as follows.*

The hose is folded through an angle of 180° at its mid-point between parallel plates as shown in Figure 8. A force of 30 N is applied to the upper plate.

The distance between the plates shall not exceed 200 mm plus twice the outer diameter of the hose.

9.1.4 *The crushing test is carried out as follows.*

The hose is folded through an angle of 180° at its mid-point between parallel plates. A force of 100 N is applied to the plates and maintained for 5 s.

The test is carried out 10 times with a rest period of 1 min during which the hose is straightened out. The hose is folded in the same direction each time.

NOTE The arrangement for the test is similar to that shown in Figure 3.

9.1.5 *The low temperature test is carried out as follows.*

The hose is wound into coils having a diameter of 300 mm ± 10 mm and placed in a cabinet having a temperature of –15 °C ± 2 °C. After 16 h, the hose is uncoiled and within 6 s a full turn is wound around a cylinder which is at the same temperature. The diameter of the cylinder is three times the outer diameter of the hose. The hose is then straightened out.

9.1.6 *The ageing test is carried out as follows.*

The hose is wound into coils having a diameter of 300 mm ± 10 mm. It is filled with water which is maintained at a pressure of 1,2 MPa. The temperature of the water is

– *50 °C ± 5 °C, for* ***hose-sets*** *marked 25 °C max.;*

– *70 °C ± 5 °C, for* ***hose-sets*** *marked 70 °C max.;*

– *90^{+5}_{0} °C, for* ***hose-sets*** *marked 90 °C max.*

The ***hose-set*** *is placed in a cabinet having the same temperature as specified for the water, for 168 h. The* ***hose-set*** *is then removed from the cabinet and allowed to cool to approximately room temperature.*

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9.1.7 *The pulsing test is carried out as follows.*

The ***hose-set*** *is connected to a system in which water is circulated and subjected to pressure pulses, as shown in Figure 4. The temperature of the water is*

– *20 °C ± 5 °C, for* ***hose-sets*** *marked 25 °C max.;*

– *70 °C ± 5 °C, for* ***hose-sets*** *marked 70 °C max.;*

– *90^{+5}_{0} °C, for* ***hose-sets*** *marked 90 °C max.*

The pressure is 1,5 MPa and varies sinusoidally with an amplitude of 0,5 MPa, the frequency being 30 pulses per minute. The number of pulses applied is 25 000.

9.1.8 *The pressure test is carried out as follows.*

The ***hose-set*** *is filled with water having a temperature of*

– *20 °C ± 5 °C, for* ***hose-sets*** *marked 25 °C max.;*

– *70 °C ± 5 °C, for* ***hose-sets*** *marked 70 °C max.;*

– *90^{+5}_{0} °C, for* ***hose-sets*** *marked 90 °C max.*

The ***hose-set*** *is connected to a pressurized water system. The hydrostatic pressure is increased at a uniform rate of approximately 100 kPa/s until 3,15 MPa is attained. This pressure is maintained for 1 min.*

9.1.9 *The ozone test is carried out as follows.*

The samples of hose, each approximately 10 cm long and provided with a coupling, are placed in a cabinet at a temperature of 30 °C ± 5 °C for 96 h. The ozone concentration in the cabinet is $0,5 \times 10^{-6}$. The ratio between the total exposed surface area of the three samples in square centimetres and the volume of the cabinet in cubic centimetres is not to exceed 0,1.

After the test, the samples shall show no cracks visible when using a glass with 6 times magnification.

NOTE If bulging of the hose caused by the coupling is not visible, for example when it is hidden by a cover, the coupling is replaced by a mandrel as shown in Figure 6 pressed into the hose.

9.1.10 *The strength of coupling nuts is checked by the following test.*

Before starting the test, coupling nuts of thermoplastic material are conditioned for 72 h at a temperature of 23 °C ± 2 °C and a relative humidity between 45 % and 55 %.

The coupling nut with its sealing washer is screwed onto the mandrel shown in Figure 5 with a maximum of four full threads of engagement and tightened with a torque of 15 Nm.

NOTE Washers may be used to limit the engagement.

The assembly is placed in a cabinet at a temperature of 90^{+5}_{0} °C for 96 h. It is then allowed to cool to approximately room temperature.

The torque required to loosen the nut shall not be less than 4 Nm.

The test is carried out twice on the same assembly.

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