

INTERNATIONAL STANDARD

**Household and similar electrical appliances – Safety –
Part 2-58: Particular requirements for commercial electric dishwashing
machines**

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**Household and similar electrical appliances – Safety –
Part 2-58: Particular requirements for commercial electric dishwashing
machines**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**HOUSEHOLD AND SIMILAR ELECTRICAL APPLIANCES –
SAFETY –****Part 2-58: Particular requirements for commercial
electric dishwashing machines**

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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International Standard IEC 60335-2-58 has been prepared by IEC Committee 61: Safety of household and similar electrical appliances.

This fourth edition cancels and replaces the third edition published in 2002 including its Amendment 1 (2008) and its Amendment 2 (2015). This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- The text has been aligned with Edition 5.2 of Part 1;
- Requirements and tests for vertical-lift doors with and without a counterbalance system are clarified (20.103, 20.104);

- Some notes have been converted to normative text or deleted (7.15, 9, 10.1, 11.7, 15.3, 19.4, 20.1, 20.102, 22.106, 22.107, 23.3).

The text of this International Standard is based on the following documents:

FDIS	Report on voting
61/5553/FDIS	61/5587/RVD

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

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

A list of all parts of the IEC 60335 series, under the general title: *Household and similar electrical appliances – Safety*, can be found on the IEC website.

This part 2 is to be used in conjunction with the latest edition of IEC 60335-1 and its amendments. It was established on the basis of the fifth edition (2010) of that standard.

NOTE 1 When "Part 1" is mentioned in this standard, it refers to IEC 60335-1.

This part 2 supplements or modifies the corresponding clauses in IEC 60335-1, so as to convert that publication into the IEC standard: Safety requirements for commercial electric dishwashing machines.

When a particular subclause of Part 1 is not mentioned in this part 2, that subclause applies as far as is reasonable. When this standard states "addition", "modification" or "replacement", the relevant text in Part 1 is to be adapted accordingly.

NOTE 2 The following numbering system is used:

- subclauses, tables and figures that are numbered starting from 101 are additional to those in Part 1;
- unless notes are in a new subclause or involve notes in Part 1, they are numbered starting from 101, including those in a replaced clause or subclause;
- additional annexes are lettered AA, BB, etc.

NOTE 3 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 of Part 1 concerns an adjective, the adjective and the associated noun are also in bold.

NOTE 4 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 publication be adopted for implementation nationally not earlier than 12 months or later than 36 months from the date of publication.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "<http://webstore.iec.ch>" in the data related to the specific document. At this date, the document will be

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

A bilingual version of this publication may be issued at a later date.

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INTRODUCTION

It has been assumed in the drafting of this International Standard that the execution of its provisions is entrusted to appropriately qualified and experienced persons.

This standard recognizes the internationally accepted level of protection against hazards such as electrical, mechanical, thermal, fire and radiation of appliances when operated as in normal use taking into account the manufacturer's instructions. It also covers abnormal situations that can be expected in practice and takes into account the way in which electromagnetic phenomena can affect the safe operation of appliances.

This standard takes into account the requirements of IEC 60364 as far as possible so that there is compatibility with the wiring rules when the appliance is connected to the supply mains. However, national wiring rules may differ.

If an appliance within the scope of this standard also incorporates functions that are covered by another part 2 of IEC 60335, the relevant part 2 is applied to each function separately, as far as is reasonable. If applicable, the influence of one function on the other is taken into account.

When a part 2 standard does not include additional requirements to cover hazards dealt with in Part 1, Part 1 applies.

NOTE 1 This means that the technical committees responsible for the part 2 standards have determined that it is not necessary to specify particular requirements for the appliance in question over and above the general requirements.

This standard is a product family standard dealing with the safety of appliances and takes precedence over horizontal and generic standards covering the same subject.

NOTE 2 Horizontal and generic standards covering a hazard are not applicable since they have been taken into consideration when developing the general and particular requirements for the IEC 60335 series of standards. For example, in the case of temperature requirements for surfaces on many appliances, generic standards, such as ISO 13732-1 for hot surfaces, are not applicable in addition to Part 1 or part 2 standards.

An appliance that complies with the text of this standard will not necessarily be considered to comply with the safety principles of the standard if, when examined and tested, it is found to have other features that impair the level of safety covered by these requirements.

An appliance employing materials or having forms of construction differing from those detailed in the requirements of this standard may be examined and tested according to the intent of the requirements and, if found to be substantially equivalent, may be considered to comply with the standard.

HOUSEHOLD AND SIMILAR ELECTRICAL APPLIANCES – SAFETY –

Part 2-58: Particular requirements for commercial electric dishwashing machines

1 Scope

This clause of Part 1 is replaced by the following.

This International Standard deals with the safety of electrically operated dishwashing machines for washing plates, dishes, glassware, cutlery and similar articles, with or without means for water heating or drying, not intended for household use, their **rated voltage** being not more than 250 V for single-phase appliances connected between one phase and neutral and 480 V for other appliances.

NOTE 101 These appliances are used for example in restaurants, canteens, hospitals, and commercial enterprises such as bakeries, butcheries, etc.

NOTE 102 Examples of such appliances are

- **conveyor dishwashers;**
- **batch dishwashers;**
- **brush machines.**

Requirements to avoid backsiphonage of non-potable water into the water mains are specified in Annex BB.

The electrical part of appliances making use of other forms of energy is also within the scope of this standard.

As far as is practicable, this standard deals with the common hazards presented by these types of appliances.

NOTE 103 Attention is drawn to the fact that:

- for appliances intended to be used in vehicles or on board ships or aircraft, additional requirements may be necessary;
- in many countries, additional requirements are specified by the national health authorities, the national authorities responsible for the protection of labour, the national water supply authorities and similar authorities;
- in many countries, additional requirements are specified for pressure appliances.

NOTE 104 This standard does not apply to:

- appliances designed exclusively for industrial purposes, for example machines used in the food industry for cleaning receptacles that serve as packaging for final products (e.g. bottle-cleaning machines), and machines used in manufacturing processes;
- sterilizers and washer-disinfectors used to treat medical materials (IEC 61010-2-040);
- dishwashers that do not form one functional unit, for example where a transportation device transfers the load from one separate unit to another;
- separately driven transport devices not confined in the appliance;
- appliances intended to be used in locations where special conditions prevail, such as the presence of a corrosive or explosive atmosphere (dust, vapour or gas).

2 Normative references

This clause of Part 1 is applicable except as follows.

Addition:

IEC 60436:2015, *Electric dishwashers for household use – Methods for measuring the performance*

IEC 61770:2008, *Electric appliances connected to the water mains – Avoidance of back-siphonage and failure of hose-sets*
IEC 61770:2008/AMD 1:2015¹

ISO 1817:2015, *Rubber, vulcanised or thermoplastic – Determination of the effect of liquids*

3 Terms and definitions

This clause of Part 1 is applicable except as follows.

3.1.4 *Addition:*

Note 1 to entry: The **rated power input** is the sum of the power inputs of all the individual elements in the appliance that can be on at one time; where there are several such combinations possible, that giving the highest power input is used in determining the **rated power input**.

3.1.9 *Replacement:*

normal operation

operation of the appliance under the following conditions

Appliances intended to be connected to a water supply are connected to a water supply having the pressure and temperature specified in the instructions.

If a range of temperatures and pressures is specified in the instructions then the water supply is at the conditions within the range that will give the most unfavourable temperature results. Water inlets intended for cold water only are connected to a source supplying water at a temperature of $15\text{ °C} \pm 5\text{ °C}$.

The appliance is filled with the maximum quantity of water for which it is designed, without detergents or rinsing agents. **Brush machines** are tested with dishes and the dishwasher is loaded with the maximum number of dishes specified in the instructions for use. The dimensions of the dishes are as specified in IEC 60436. Other appliances are tested without dishes.

Batch dishwashers are operated on continuous cycles, each cycle being followed by a rest period of 1 min. Lids or covers, if any, are left open during the rest period.

Conveyor dishwashers and **brush machines** are operated continuously.

The appliance is operated as follows:

- appliances with automatic timers or programmers are operated with the programme that will give the most unfavourable temperature results;
- appliances that have neither an automatic timer nor a programmer are operated in accordance with the instructions for use, but with the controls intended to be set by the user set at maximum or that setting giving the most unfavourable temperature results.

3.5.101

batch dishwasher

appliance in which the various processes are carried out sequentially on a single load

¹ There exists a consolidated edition 2.1 (2015) that includes edition 2 and its Amendment 1.

3.5.102

brush machine

appliance in which plates are cleaned by being placed between or held in contact with brushes or similar devices

3.5.103

conveyor (rack or flight) dishwasher

appliance in which the various processes, e.g. washing, rinsing etc., are carried out, the load being moved through the various operations automatically

3.8.101

indicated level

mark on the appliance to indicate the maximum liquid level for correct operation

4 General requirement

This clause of Part 1 is applicable.

5 General conditions for the tests

This clause of Part 1 is applicable except as follows.

5.3 Addition:

The tests of 22.6 are carried out before the tests of Clause 19.

5.101 Appliances are tested as **motor-operated appliances**, even if they incorporate a heating element.

Appliances incorporating means for heating water, but that may also be operated without the heating elements being energized, are tested without the heating elements energized should this be more unfavourable.

5.102 Appliances, when assembled in combination with or incorporating other appliances, are tested in accordance with the requirements of this standard. The other appliances are operated simultaneously in accordance with the requirements of the relevant standards.

6 Classification

This clause of Part 1 is applicable except as follows.

6.1 Replacement:

Appliances shall be **class I** with respect to protection against electric shock.

Compliance is checked by inspection and by the relevant tests.

6.2 Replacement:

Appliances shall be at least IPX1 with respect to protection against harmful ingress of water.

Compliance is checked by inspection and by the relevant tests.

7 Marking and instructions

This clause of Part 1 is applicable except as follows.

7.1 Addition:

Appliances shall be marked with

- the maximum permissible steam pressure, in kilopascals (kPa);
- the maximum permissible hot water pressure, in kilopascals (kPa);
- the maximum permissible water, steam and hot water temperatures in degrees Celsius.

If the reversal of a motor could result in a hazard, the direction of rotation shall be clearly and visibly indicated on the motor.

Modification:

The instruction concerning persons (including children) with reduced physical, sensory or mental capabilities, or lack of experience and knowledge is not applicable.

The instruction concerning children playing with the appliance is not applicable.

7.12.1 Addition:

The maximum level of the water discharge outlet shall be indicated in the instructions. Instructions for **user maintenance**, for example cleaning, shall also be given. They shall include a statement that the appliance is not to be cleaned with a water jet.

For appliances that are intended to be permanently connected to fixed wiring and for which leakage currents may exceed 10 mA, the instructions shall give recommendations concerning additional protective measures to be taken, such as supplementary protective equipotential bonding or residual current protective devices (RCDs), to be installed.

Compliance is checked by inspection.

7.12.4 Addition:

The instructions for **built-in appliances** having a separate control panel for several appliances shall state that the control panel is only to be connected to the specified appliances in order to avoid a possible hazard.

7.15 Addition:

When it is not practical to place the marking of **fixed appliances** so that it is visible after the appliance has been installed, the relevant information shall also be included in the instructions for use or on an additional label that can be fixed near the appliance after installation.

7.101 Appliances intended to be filled by hand or a manually operated tap shall be marked with an **indicated level**.

Compliance is checked by inspection.

7.102 Equipotential bonding terminals shall be marked with symbol IEC 60417-5021 (2002-10).

These markings shall not be placed on screws, removable washers or other parts that can be removed when conductors are being connected.

Compliance is checked by inspection.

8 Protection against access to live parts

This clause of Part 1 is applicable.

9 Starting of motor-operated appliances

This clause of Part 1 is applicable except as follows.

9.101 Fan motors providing a cooling effect in order to comply with the requirements of Clause 11 shall start under all voltage conditions that may occur in use.

*Compliance is checked by starting the motor three times at a voltage equal to 0,85 times **rated voltage**, the motor being at room temperature at the beginning of the test. The supply source shall be such that during the test the drop in voltage does not exceed 1 %.*

*The motor is started each time under the conditions occurring at the beginning of **normal operation** or, for automatic appliances, at the beginning of the normal cycle of operation, the motor being allowed to come to rest between successive starts. For appliances provided with motors having other than centrifugal starting switches, this test is repeated at a voltage equal to 1,06 times **rated voltage**.*

*In all cases, the motor shall start and it shall function in such a way that safety is not affected and overload **protection devices** of the motor shall not operate.*

10 Power input and current

This clause of Part 1 is applicable except as follows.

10.1 Addition:

A representative period is the period with the highest total power input.

11 Heating

This clause of Part 1 is applicable except as follows.

11.2 Addition:

*Appliances intended to be fixed to the floor and appliances with a mass greater than 40 kg and not provided with rollers, castors or similar means are installed in accordance with the instructions. If no instructions are given, these appliances are considered as appliances normally placed on the floor. However, appliances provided with heating elements for drying, except **conveyor dishwashers**, are placed in the test corner as near to the walls as possible.*

11.5 Addition:

Conveyor dishwashers may be supplied at **rated voltage**. In this case, the addition to 11.8 applies.

11.7 Replacement:

Appliances are operated until steady conditions are established. In order to reach steady conditions, it may be necessary to operate the appliance for more than one cycle of operation.

*At the conclusion of the test and with the appliance at maximum temperature, motor-driven emptying pumps that employ separate motors and that are manually switched on and off are subjected to an operating period equal to 1,5 times the period for emptying the container(s) when filled to the **indicated level**, the level of the water discharge outlet being the maximum indicated in the instructions.*

11.8 Addition:

*For **conveyor dishwashers** tested at **rated voltage**, the relevant values shown in Table 3 are reduced by 10 %.*

12 Void

13 Leakage current and electric strength at operating temperature

This clause of Part 1 is applicable except as follows.

13.1 Addition:

***Conveyor dishwashers** may be supplied at **rated voltage**. In this case, the permissible leakage current allowed is reduced by 10 %.*

13.2 Modification:

Instead of the permissible leakage current for **stationary class I appliances**, the following applies:

- | | |
|---|---|
| <ul style="list-style-type: none">– for cord and plug connected appliances– for other appliances | <p>1 mA per kW rated power input of the appliance with a maximum of 10 mA,</p> <p>1 mA per kW rated power input of the appliance with no maximum.</p> |
|---|---|

14 Transient overvoltages

This clause of Part 1 is applicable.

15 Moisture resistance

This clause of Part 1 is applicable except as follows.

15.1.1 Addition:

Appliances are subjected for 5 min to the following splash test.

The apparatus shown in Figure 101 is used. During the test, the water pressure is so regulated that the water splashes up 150 mm above the bottom of the bowl. The bowl is placed on the floor for appliances normally used on the floor. For all other appliances on a horizontal support 50 mm below the lowest edge of the appliance, the bowl is so moved

around as to splash the appliance from all directions. Care is taken that the appliance is not hit by the direct jet.

15.1.2 Modification:

Appliances normally used on a table are placed on a support having dimensions that are $15\text{ cm} \pm 5\text{ cm}$ in excess of those of the orthogonal projection of the appliance on the support.

15.2 Replacement:

Appliances shall be so constructed that spillage of liquid in normal use does not affect their electrical insulation. The requirement applies even if an inlet valve fails to close.

Compliance is checked by the following tests using a spillage solution comprising water containing approximately 1 % NaCl and 0,6 % rinsing agent.

Any commercially available non-ionic rinsing agent may be used, but if there is any doubt with regards to the test results, the rinsing agent shall have the following properties:

- viscosity, 17 mPa·s;
- pH, 2,2 (1 % in water)

and its composition shall be

Substance	Parts by mass %
Plurafac ® LF 221 ²	15,0
Cumene sulfonate (40 % solution)	11,5
Citric acid (anhydrous)	3,0
Deionized water	70,5

Appliances with **type X attachment**, except those having a specially prepared cord, are fitted with the lightest permissible type of flexible cable or cord of the smallest cross-sectional area specified in Table 13, and other appliances are tested as delivered.

Detachable parts are removed.

Appliances intended to be filled with water by the user are completely filled with the spillage solution. A further quantity of the solution, equal to 5 % of the capacity of the appliance or 10 l, whichever is the greater, is then poured in steadily over a period of 1 min.

Other appliances are operated through one complete cycle of **normal operation**, after which the timer switch, float or pressure-operated switch is made inoperative, and 5 g of the standard detergent given in IEC 60436 is added per litre of water in the appliance at the highest level of fill during **normal operation** and the appliance is operated in the intended manner.

Only one switch is rendered inoperative at a time.

If a means is not provided to prevent overfilling of the appliance, the fill is continued for an additional 15 min following the first evidence of overflow. If a float or pressure-operated switch is provided to prevent overfilling, actuation of the fill switch to terminate the fill shall also terminate the test. If both timer and fill switch are provided, a second test shall be

² Plurafac ® LF 221 is the trade name of a product supplied by BASF. This information is given for the convenience of users of this document and does not constitute an endorsement by IEC of this product.

conducted as described above with the timer operating normally and with the fill switch rendered inoperative.

Immediately after this test, the appliance shall withstand the electric strength test as specified in 16.3 and inspection shall show that there is no trace of water on insulation that could result in a reduction of **clearances** or **creepage distances** below the values specified in Clause 29.

For appliances, the tops of which are intended to form working surfaces, a quantity of 0,2 l of the spillage solution is poured steadily from a height of about 50 mm on to the middle of the top of the appliance for a period of 15 s.

Immediately after this test, the appliance shall withstand the electric strength test as specified in 16.3 and inspection shall show that there is no trace of water on insulation that could result in a reduction of **clearances** or **creepage distances** below the values specified in Clause 29.

15.101 Appliances that are provided with a tap intended for filling or cleaning shall be constructed so that the water from the tap cannot come into contact with **live parts**.

Compliance is checked by the following test.

The tap is fully opened for 1 min with the appliance connected to a water supply having the maximum water pressure indicated. Tilttable and movable parts, including lids, are tilted or placed in the most unfavourable positions. Swivelling outlets of water taps are so positioned as to direct water on to those parts that will give the most unfavourable result. Immediately following this treatment, the appliance shall withstand the electric strength test of 16.3.

16 Leakage current and electric strength

This clause of Part 1 is applicable except as follows.

16.2 Modification:

Instead of the permissible leakage current for **stationary class I appliances**, the following applies:

- | | |
|--|--|
| – for cord and plug connected appliances | 1 mA per kW rated power input of the appliance with a maximum of 10 mA, |
| – for other appliances | 1 mA per kW rated power input of the appliance with no maximum. |

17 Overload protection of transformers and associated circuits

This clause of Part 1 is applicable.

18 Endurance

This clause of Part 1 is applicable.

19 Abnormal operation

This clause of Part 1 is applicable except as follows.

19.1 Addition:

Appliances with a programme controller or timer are also subjected to the test of 19.101.

*For **conveyor dishwashers** incorporating heating elements, the tests of 19.2, 19.3, and where applicable 19.4, 19.5 and 19.6 may be made at **rated voltage**. In this case, the addition to 19.13 applies.*

19.2 Addition:

Appliances are filled with just sufficient water to cover the heating elements.

19.4 Addition:

The main contacts of the contactor intended for switching on and off the heating element(s) in normal use are locked in the "ON" position. However, if two contactors operate independently of each other or if one contactor operates two independent sets of main contacts, these contacts are locked in the "ON" position in turn.

19.7 Modification:

*Starting with the appliance at the ambient temperature specified in 5.7, it is supplied at **rated voltage** or at the upper limit of the **rated voltage range**, with moving parts locked.*

For each of the tests, appliances without a programme controller or timer are operated for 5 min and appliances provided with a programme controller or timer are operated for a time equal to the maximum period allowed by the programme controller or timer.

19.13 Addition:

*For **conveyor dishwashers** supplied at **rated voltage**, the appliance shall not emit any poisonous or ignitable gas during the tests.*

*In addition, for **basic insulation**, the test voltage for the electric strength test in 16.3 is 1 000 V plus **rated voltage**.*

19.101 Appliances provided with a programme controller or a timer shall be so constructed that the risk of fire, mechanical hazard or electric shock is obviated as far as is practicable in the event of incorrect operation, or the development of defects in control devices, such as programme controllers and timers, or in their associated devices.

*Compliance is checked by applying any form of operation or any defect that may be expected in normal use, while the appliance is operated under **normal operation** and at **rated voltage** or at the upper limit of the **rated voltage range**. Only one fault condition is reproduced at a time, the tests being made consecutively.*

During the tests, the appliance shall not emit flames or molten metal and the temperature of windings shall not exceed the values shown in Table 8.

NOTE 1 Examples of fault conditions are

- the programme controller stopping in any position;
- the disconnection and reconnection of one or more phases of the supply during any part of the programme;
- the open-circuiting or short-circuiting of components;
- the failure of a magnetic valve;
- the opening and reclosing of the door or lid during any part of the programme, if this is possible.

NOTE 2 In general, tests are limited to those cases that may be expected to give the most unfavourable results.

NOTE 3 If operation without water in the appliance is considered to be a more severe condition for starting any programme, the tests with that programme are made with the water inlet valve closed; however, this valve is not

closed after the programme has been started. If the appliance stops at any particular point in the programme, the test with that fault condition is considered to be ended.

NOTE 4 For the purpose of these tests, thermal controls are not short-circuited.

NOTE 5 Components complying with the relevant IEC standards are not open-circuited or short-circuited, provided the appropriate standard covers the conditions that occur in the appliance.

NOTE 6 The test, during which the automatic filling device is held open, has already been made during the test of 15.2.

NOTE 7 The test with motor capacitors short-circuited or open-circuited has already been made during the test of 19.7.

20 Stability and mechanical hazards

This clause of Part 1 is applicable except as follows.

20.1 Replacement:

Appliances other than those intended to be fixed to their supporting surface shall have adequate stability.

Compliance is checked by the following test.

*The appliance, not connected to the supply mains, is placed in any normal position of use on a plane inclined at an angle of 10° to the horizontal, the **supply cord** resting on the inclined plane in the most unfavourable position. However, if part of an appliance comes into contact with the horizontal supporting surface when the appliance is tilted through an angle of 10°, the appliance is placed on a horizontal support and tilted in the most unfavourable direction through an angle of 10°. In this case for appliances provided with rollers, castors or feet, the castors or rollers may be blocked to prevent the appliance from rolling.*

Appliances provided with doors are tested with the doors open or closed, whichever is the more unfavourable.

Appliances are tested empty or filled with water, whichever imposes the most severe condition, and the maximum load of dishes specified in the instructions for use and with doors, lids, rollers or castors, if any, in the most unfavourable position.

The appliance shall not overturn.

Appliances having a mass greater than 40 kg are also subjected to the test of 20.101. In addition, front loading appliances are also subjected to the test of 20.102 unless these appliances are intended to be fixed to the supporting surface or are intended to be built-in in such a manner that tilting cannot occur.

20.101 *A force of 340 N is applied to the top edge of the appliance with doors or lids closed and in the most unfavourable direction under the conditions described in 20.1 but with the appliance supported on a horizontal plane.*

The appliance shall not overturn.

NOTE This test is only made in case of doubt.

20.102 *A weight of 23 kg is applied to or suspended from the centre of the open door or the loading drawer when it is in its outermost position, whichever is the more unfavourable, with no dishes or water in the appliance and with the rollers or castors, if any, turned to the most unfavourable position.*

Water containers integral with the appliance are filled unless they are drained during any part of the operating cycle or when the appliance is switched off.

During this test, the machine shall not tilt.

20.103 Vertical-lift doors not having a counterbalance system shall be constructed to provide adequate protection against personal injury.

Vertical-lift doors with a mass of more than 5 kg not having a counterbalance system and all vertical-lift doors with a lift height of more than 400 mm and not having a counterbalance system shall be provided with an operational and emergency locking device. The emergency locking device shall become operational at least 120 mm above the impact surface.

Other vertical-lift doors not having a counterbalance system shall have impact surfaces at least 20 mm wide and be provided with an operational locking device. If an emergency locking device is also provided, the requirement related to the impact surface does not apply. In this case the emergency locking device shall become effective at least 120 mm above the impact surface.

Compliance is checked by inspection, by manual test and by measurement.

20.104 Vertical-lift doors with a counterbalance system shall be so constructed as to provide adequate protection against personal injury.

Compliance is checked by either test (a) or test (b) as follows.

Test (a)

A fault is introduced in the counterbalance system and the force causing the door to descend is measured. The force measured shall not exceed 50 N.

Test (b)

The counterbalance system is subjected to 100 000 cycles of operation. For vertical-lift doors intended to be used for maintenance purposes only, the number of cycles of operation is reduced to 10 000.

After this test, the counterbalance system shall not be damaged and the force causing the door to descend is measured. The force measured shall not exceed 50 N.

20.105 For cleaning and maintenance work as in normal use in accordance with the instructions provided, mechanical risks shall be prevented, for example by the use of key-switches or tools.

Compliance is checked by inspection and by manual test.

20.106 Doors and lids shall be interlocked in such a way that the dishwasher can only be operated when the door or lid is closed, unless there is adequate protection against ejection of hot water when the door or lid is open.

Compliance is checked by inspection and by manual test.

NOTE Slight splashing or spraying of hot water, occurring immediately after the door or lid has been opened, is neglected.

20.107 Conveyor dishwashers shall not start automatically after doors or lids have been closed.

Compliance is checked by inspection and by manual test.

21 Mechanical strength

This clause of Part 1 is applicable except as follows.

21.101 Shelves and racks supporting articles to be washed shall have adequate mechanical strength and shall not deform in normal use.

Compliance is checked by the following test.

Each shelf in turn is loaded uniformly at a rate of 1 000 N/m², left for 1 min and then unloaded. The shelf and shelf supports shall show no appreciable distortion.

22 Construction

This clause of Part 1 is applicable except as follows.

22.6 Modification:

Instead of the test specification the following applies.

Compliance is checked by inspection and by the following tests that are made in the order given.

*The appliance is operated under the conditions specified in Clause 11 except that it is subjected to three successive cycles. A **conveyor dishwasher** is only subjected to one cycle of duration equal to the time needed to move a dish through all the operations of the appliance.*

The water to be used for the test has a hardness between 2,5 mmol/l and 7,5 mmol/l related to calcium carbonate (CaCO₃). At the beginning of each rinsing period and after the machine has been filled with water, a foaming agent is added through the opened door, which is then closed until the machine stops according to the programme. Automatically controlled dispensers for the rinsing agent are rendered ineffective during the test.

The foaming agent is a solution of 25 % by mass of alcohol ethoxylate (Triton DF-12³) in water, 2,5 ml of the solution and 20 g of sodium chloride being added for every 8 l of water.

If the machine stops due to excessive foam production, the test is finished 1 h after the rinsing period started.

Drops of a solution composed of 0,6 ml of the rinsing agent specified in 15.2, per litre of distilled water, are then applied by means of a syringe to those parts inside the appliance where leakage of a liquid could occur and affect the electrical insulation. Moving parts are in operation or at rest, whichever is the more unfavourable.

*After these tests, inspection shall show that there is no deposit of rinsing agent or any traces of liquid on windings or insulation that could result in a reduction of **creepage distances** below the values specified in 29.2.*

³ Triton DF-12 is the trade name of a product supplied by Union Carbide. This information is given for the convenience of users of this International Standard and does not constitute an endorsement by IEC of this product.

Addition:

Parts that withstand the ageing test specified in Annex AA are not considered to be parts where leakage could occur.

22.101 For three-phase appliances, **thermal cut-outs** protecting circuits with heating elements, and those for motors of which the unexpected starting may cause a hazard, shall be of the non-self-resetting trip-free type and shall provide **all-pole disconnection** from related supply circuits.

For single-phase appliances and for single-phase heating elements and/or motors connected between one phase and neutral or between phase and phase, **thermal cut-outs** protecting circuits with heating elements, and those for motors of which the unexpected starting may cause a hazard, shall be of the non-self-resetting and trip-free type, and shall provide at least one-pole disconnection.

If the **non-self-resetting thermal cut-out** is only accessible after removing parts with the aid of a **tool**, the trip-free type is not required.

NOTE **Thermal cut-outs** of the trip-free type have an automatic action, with a reset actuating member, so constructed that the automatic action is independent of manipulation or position of the reset mechanism.

Thermal cut-outs of the bulb and capillary type that operate during the tests of Clause 19 shall be such that rupture of the capillary tube shall not impair compliance with the requirements of 19.13.

Compliance is checked by inspection and by manual test and by rupturing the capillary tube in such a way that it does not seal the tube.

22.102 Lights, switches or push-buttons shall only be coloured red for the indication of danger, alarm or similar situations.

Compliance is checked by inspection.

22.103 The level to which manually filled appliances are to be filled shall be so located as to be readily visible when filling.

Compliance is checked by inspection.

22.104 Portable appliances shall not have openings on the underside that would allow small items to penetrate and touch **live parts**.

*Compliance is checked by inspection and by measuring the distance between the supporting surface and **live parts** through openings. This distance shall be at least 6 mm. However, if the appliance is fitted with legs, this distance is increased to 10 mm if the appliance is intended to stand on the table and to 20 mm if it is intended to stand on the floor.*

22.105 Appliances shall withstand the water pressure to which they may be subjected in normal use.

Compliance is checked by subjecting those parts of the appliance that are under pressure from the water supply to a static pressure equal to twice the maximum permissible inlet water pressure or 1 200 kPa (12 bar), whichever is the higher, for a period of 5 min.

During the test, there shall be no leakage from any part, including the inlet water hose.

The pressure shall be applied to the inlet with the valves set in the most unfavourable position encountered in normal use.

22.106 Appliances shall be constructed so that no fire hazard is caused by objects intended to be cleaned contacting heating elements not covered by water during the drying period.

Compliance is checked by the following test.

The appliance is placed on a piece of white pine-wood board covered with tissue paper. Polyethylene disks, 80 mm in diameter and 2 mm thick, are placed at the most unfavourable place and, where possible, directly on the heating element. The tissue paper used for the test shall have a specific mass between 12 g/m² and 30 g/m². The material of the disks used for the test is unfilled natural colour polyethylene without flame-retardants and has a relative density of $0,96 \pm 0,005$.

The appliance is then operated for a drying period under the following conditions, with the heating element energized.

The appliance is connected to a water supply having a maximum hardness of 5,0 mmol/l $\pm$ 2,5 mmol/l related to CaCO₃, as in normal use, but without detergents or rinsing agents and without dishes.

Appliances provided with a programme controller are tested using the most unfavourable programme.

Appliances without a programme controller are operated on continuous cycles in accordance with the instructions for use.

*The appliance is operated at a voltage equal to 1,1 times the **rated voltage**.*

After one-third of the drying period has elapsed or when smoke or smell occurs, whichever occurs first, the door or lid is opened.

During the test, flames, burning drops or glowing particles shall not spread fire to other parts of the appliance or to its surroundings. Any flames, except from the disks, shall extinguish within 30 s. The tissue paper shall not burn or the board become scorched.

NOTE Tissue paper is referred to in 4.215 of ISO 4046-4:2016 as wrapping tissue and is defined as soft and strong, lightweight wrapping paper of grammage generally between 12 g/m² and 30 g/m², primarily intended for protective packaging of delicate articles and for gift wrapping.

22.107 Appliances shall be constructed so that heating elements cannot come into contact with combustible material inside the appliance or in any container used in the appliance as a result of deformation of the heating elements or of parts supporting them or of the container itself. This requirement is not applicable to metallic containers, whether or not coated with thermoplastic material.

Compliance is checked by inspection.

22.108 The appliance shall not automatically restart when the supply is re-established after a temporary disconnection, if restarting could result in a hazard, for example mechanical (moving parts) or thermal (hot parts or liquids).

Compliance is checked by the following test:

*The appliance is operated at **rated voltage** and in accordance with the instructions for use.*

At any time during the operating cycle the supply to the appliance is switched off and any moving parts are allowed to come to rest.

The supply is then restored.

22.109 For appliances that are controlled by programmable **electronic-circuits** that limit the number of heating elements and motors from being energised at the same time, simultaneous activation of any combination of heating elements and motors shall not render the appliance unsafe.

Compliance is checked as follows:

- *the fault/error conditions specified in Table R.1 are applied and evaluated in accordance with the relevant requirements of Annex R; or*
- *the appliance is operated under the conditions of Clause 11 while being supplied at **rated voltage**, the programmable **electronic circuits** being modified to allow simultaneous activation of all heaters and motors under their control. Under these conditions, compliance with 19.13 shall be fulfilled.*

23 Internal wiring

This clause of Part 1 is applicable except as follows.

23.3 Addition:

*When the capillary tube of the **thermostat** is liable to flexing in normal use, the following applies:*

- *where the capillary tube is fitted as part of the internal wiring, Part 1 applies;*
- *where the capillary tube is separate, it is subjected to 1 000 flexings at a rate not exceeding 30 per minute.*

After the test, the capillary tube shall show no sign of damage within the meaning of this standard and no damage impairing its further use.

However, if a rupture of the capillary tube renders the appliance inoperative (fail-safe), separate capillary tubes are not tested, and those fitted as part of the internal wiring are not inspected for compliance with the requirements.

Compliance in this instance is checked by rupturing the capillary tube in such a way that it does not seal the tube.

Modification:

Instead of the test being carried out while the appliance is in operation, it is carried out with the appliance disconnected from the supply.

The number of flexings for conductors flexed during normal use is increased to 100 000.

24 Components

This clause of Part 1 is applicable.

25 Supply connection and external flexible cords

This clause of Part 1 is applicable except as follows.

25.1 *Modification:*

Appliances shall not be provided with an appliance inlet.

25.3 *Addition:*

Fixed appliances and appliances with a mass greater than 40 kg and not provided with rollers, castors or similar means shall be constructed so that the **supply cord** can be connected after the appliance has been installed in accordance with the instructions.

Terminals for permanent connection of cables to fixed wiring may also be suitable for the **type X attachment** of a **supply cord**. In this case a cord anchorage complying with 25.16 shall be fitted to the appliance.

If the appliance is provided with a set of terminals allowing the connection of a flexible cord, they shall be suitable for the **type X attachment** of the cord.

In both cases the instructions shall give full particulars of the power **supply cord**.

The connection to the supply wires of **built-in appliances** may be made before the appliance is installed.

Compliance is checked by inspection.

25.7 *Modification:*

*Instead of the types of **supply cords** specified, the following applies.*

Supply cords shall be oil-resistant, sheathed flexible cable not lighter than ordinary polychloroprene or other equivalent synthetic elastomer-sheathed cord (code designation 60245 IEC 57).

26 Terminals for external conductors

This clause of Part 1 is applicable.

27 Provision for earthing

This clause of Part 1 is applicable except as follows.

27.2 *Addition:*

Stationary appliances shall be provided with a terminal for the connection of an external equipotential conductor. This terminal shall be in effective electrical contact with all fixed exposed metal parts of the appliance, and shall allow the connection of a conductor having a nominal cross-sectional area of up to 10 mm². It shall be located in a position convenient for the connection of the bonding conductor after installation of the appliance.

NOTE 101 Small fixed exposed metal parts, for example name-plates and the like, are not required to be in electrical contact with the terminal.

28 Screws and connections

This clause of Part 1 is applicable.

29 Clearances, creepage distances and solid insulation

This clause of Part 1 is applicable except as follows.

29.2 Addition:

The microenvironment is pollution degree 3 and the insulation shall have a comparative tracking index (CTI) not less than 250, unless the insulation is enclosed or located so that it is unlikely to be exposed to pollution due to

- condensation produced by the appliance;
- chemicals, such as detergent or rinse aid.

30 Resistance to heat and fire

This clause of Part 1 is applicable except as follows.

30.2.1 Modification:

The glow-wire test is carried out at 650 °C.

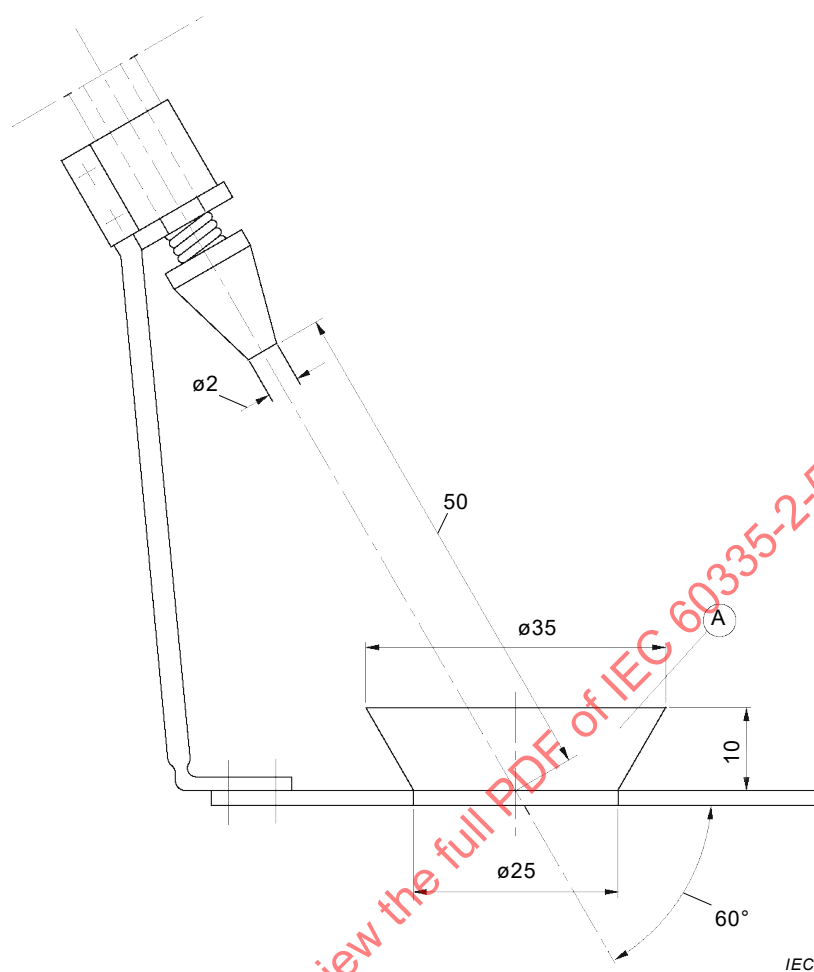
30.2.2 Not applicable.

31 Resistance to rusting

This clause of Part 1 is applicable.

32 Radiation, toxicity and similar hazards

This clause of Part 1 is applicable.

Dimensions in millimetres**Key**

A bowl

Figure 101 – Splash apparatus

Annexes

The annexes of Part 1 are applicable except as follows.

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Annex R (normative)

Software evaluation

R.2.2.5 *Modification:*

For programmable **electronic circuits** with functions requiring software incorporating measures to control the fault/error conditions specified in Table R.1 or Table R.2, detection of a fault/error shall occur before compliance with Clauses 19, and 22.109 is impaired.

R.2.2.9 *Modification:*

The software and safety-related hardware under its control shall be initialized and shall terminate before compliance with Clauses 19, and 22.109 is impaired.

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Annex AA (normative)

Ageing test for elastomeric parts

The ageing test on elastomeric parts is carried out by measuring their hardness and mass before and after immersion in solutions of detergent and rinsing agent at elevated temperature.

The test is carried out on at least three samples of each part. The test procedure is as specified in ISO 1817, with the following modifications.

5 Test liquids

Two test liquids are used:

- one liquid is obtained by dissolving 6 g of the detergent specified in IEC 60436 per litre of distilled water;*
- the other liquid is composed of 0,6 ml of rinsing agent as specified in 15.2 per litre of distilled water.*

Care is to be taken to ensure that the total mass of the test pieces immersed does not exceed 100 g for each litre of solution, that the test pieces are completely immersed and that their entire surface is freely exposed to the solution. During the tests, the test pieces are not to be exposed to direct light. Test pieces of different compounds are not to be immersed at the same time in the same solution.

6 Test pieces

6.4 Conditioning

The temperature is $23\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ and the relative humidity is $(50 \pm 5)\%$.

7 Immersion in the test liquid

7.1 Temperature

The solution is heated within 1 h with the test pieces immersed, to a temperature of $75^{+5}_0\text{ }^{\circ}\text{C}$ and maintained at this value. The solution is renewed every 24 h and heated in the same way.

NOTE To avoid undue evaporation of the solution, a closed-circuit system or similar method can be used for renewing the solution.

7.2 Duration

The test pieces are immersed for a total period of 48^{+1}_0 h .

The test pieces are then immediately immersed in a fresh solution, which is maintained at ambient temperature. The pieces are immersed for $45\text{ min} \pm 15\text{ min}$.

After having been removed from the solution, the test pieces are rinsed in cold water at $15\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$ and then dried with blotting paper.