

# INTERNATIONAL STANDARD



**Electric dishwashers for household use – Methods for measuring the performance**

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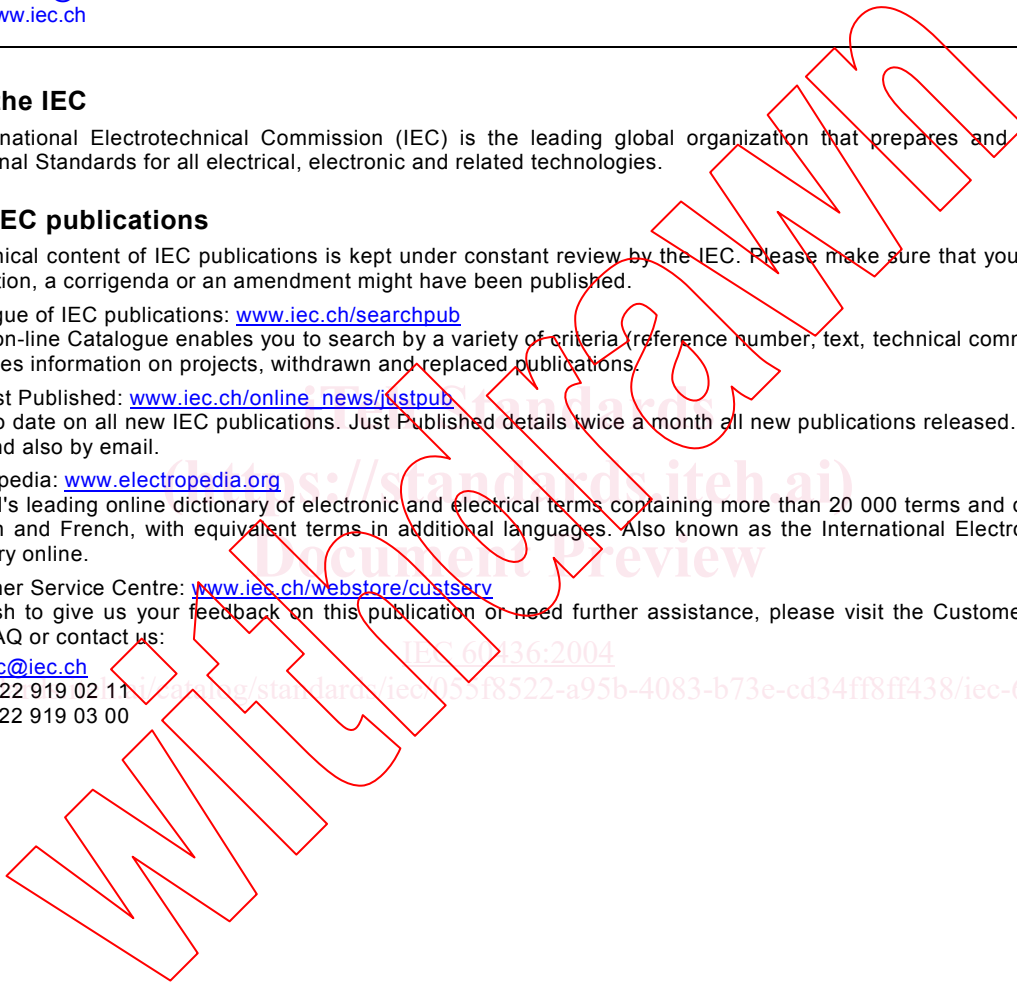
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# INTERNATIONAL ELECTROTECHNICAL COMMISSION

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## **ELECTRIC DISHWASHERS FOR HOUSEHOLD USE – METHODS FOR MEASURING THE PERFORMANCE**

### FOREWORD

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International Standard IEC 60436 has been prepared by subcommittee 59A: Electric dishwashers, of IEC technical committee 59: Performance of household electrical appliances.

This consolidated version of IEC 60436 consists of the third edition (2004) [documents 59A/114A/FDIS and 59A/116/RVD] and its amendment 1 (2009) [documents 59A/138/CDV and 59A/139/RVC].

The technical content is therefore identical to the base edition and its amendment and has been prepared for user convenience.

It bears the edition number 3.1.

A vertical line in the margin shows where the base publication has been modified by amendment 1.

This third edition cancels and replaces the second edition published in 1981 and constitutes a technical revision. Major changes introduced in the second edition include

- changes made to the soils used in the standard;
- the use of an oven and microwave oven to dry the soils;
- the alternate 15 to 18 hour air dry method to dry the soils;
- the addition of a reference dishwasher;
- the recognition of alternate supply voltages and frequencies;
- the recognition of a cold or hot water supply to the dishwasher;
- the detergent and rinse aid compositions have been updated to reflect current technology;
- the addition of the Aham load;
- the evaluation of the filter systems;
- the modification of the scoring system from 2 to 5 grades;
- the definition of program and cycle time;
- the temperature correction for energy testing;
- harmonization of ambient conditions.

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.

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## INTRODUCTION

In 1996, IEC subcommittee 59A charged its Working Group 2 with the revision of the second edition of IEC 60436 to make it suitable for the international needs and to make it suitable for the current levels of dishwasher performance and technology.

The second edition was published in 1981 and has not been significantly updated.

SC59A instructed the WG2 to take the Cenelec draft standard EN 50242 as the basis for the third edition.

An important reason for the third edition was the need to take into account the needs of all countries such as varying voltages and frequencies, different water supply temperatures and water hardness and availability of specified soils in the various countries.

To meet the goal the following significant technical changes were made.

- The repeatability and reproducibility of the test results have been improved by the introduction of the same model reference dishwasher specified for all locations.
- The soils have been changed to reflect the modern dishwasher's capability.
- The preparation of the soils has been improved to enhance repeatability and reproducibility by the introduction of new drying methods.
- The standard also recognizes various supply voltages and frequencies, cold or hot water supply, an alternate Aham load, the evaluation of dishwasher filter systems.
- The standard has updated the formulation of the detergent and rinse agents to reflect the products on the market today.
- The standard has increased the sensitivity of the grading scale from two to five points to improve repeatability and reproducibility.
- Ambient conditions have been brought closer to harmonization.
- More detailed instructions have been provided for the installation of the various designs of dishwashers.
- Correction formulae have been provided for the correction of energy consumption measurements for varying water supply temperature.



# ELECTRIC DISHWASHERS FOR HOUSEHOLD USE – METHODS FOR MEASURING THE PERFORMANCE

## 1 Scope

This international standard applies to electric dishwashers for household use that are supplied with hot and/or cold water.

The object is to state and define the principal performance characteristics of electric dishwashers for household use and to describe the standard methods of measuring these characteristics.

This standard is concerned neither with safety nor with performance requirements.

## 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 60350, *Electric cooking ranges, hobs, ovens and grills for household use – Methods for measuring performance*

IEC 60704-2-3, *Household and similar electrical appliances – Test code for the determination of airborne acoustical noise – Part 2-3: Particular requirements for dishwashers*

IEC 60704-3, *Test code for the determination of airborne acoustical noise emitted by household and similar electrical appliances – Part 3: Procedure for determining and verifying declared noise emission values*

IEC 60705, *Household microwave ovens – Methods for measuring performance*

IEC 60734, *Household electrical appliances – Performance – Hard water for testing*

ISO 607, *Surface active agents and detergents – Methods of sample division*

AHAM DW-1:2003, *Performance testing methods for household electric dishwashers*

## 3 Terms and definitions

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

### 3.1 dishwasher

machine which cleans, rinses, and dries dishware, glassware, cutlery, and, in some cases, cooking utensils by chemical, mechanical, thermal, and electric means. A dishwasher may or may not have a specific drying operation at the end of the program

### 3.2

#### **rated dishwasher capacity**

whole number of place settings together with the serving pieces (see Annexes A & B) stated by the manufacturer, which can be cleaned and dried when loaded in accordance with the manufacturer's instructions

### 3.3

#### **operation**

each event that occurs during the dishwasher programme such as cleaning, rinsing or drying

### 3.4

#### **programme**

series of operations which are pre-defined within the dishwasher and which are declared as suitable for specified levels of soil and/or type of load and together form a complete cycle

### 3.5

#### **cycle**

complete washing, rinsing, and drying process, as defined by the programme selected, consisting of a series of operations

### 3.6

#### **programme time**

programme time is measured from the initiation of the programme (excluding any user programmed delay) until an end of programme indicator. If there is no end of programme indicator, the programme time is equal to the cycle time

### 3.7

#### **cycle time**

cycle time is measured from the initiation of the programme (excluding any user programmed delay) until all activity ceases (i.e. the end of the cycle)

### 3.8

#### **automatic dispenser**

device activated automatically which injects or dispenses detergent, rinse agent, etc., one or more times into the dishwasher at predetermined points in the dishwasher cycle

### 3.9

#### **non-automatic dispenser**

device, usually a fixed cup or cavity on the dishwasher door, cover, or dish rack, which deposits a previously measured amount of detergent, rinse agent, etc., into the dishwasher at the beginning of the dishwasher cycle

### 3.10

#### **water softener**

device which reduces the hardness of water

### 3.11

#### **rack**

support for holding dishware, cutlery, and/or glassware in the dishwasher

### 3.12

#### **detergent**

cleaning agent in powder, granular, tablet or liquid form, manufactured for use in household electric dishwashers to aid in the removal of food soils by chemical means

NOTE A reference detergent in powder form is specified for use in this standard (see 5.7).

**3.13****rinse agent**

chemical agent added to the water in the last rinsing operation to improve the drying effect and reduce water marks

NOTE Two reference rinse agents are specified for use in this standard (see 5.8).

**3.14****serving pieces**

defined set of crockery and cutlery for serving (see Annexes A and B)

**3.15****place settings**

defined set of crockery, glass and cutlery for use by one person (see Annexes A and B)

**4 List of measurements**

Standard methods of measuring the performance characteristics are determined as follows:

- cleaning performance according to Clause 6;
- drying performance according to Clause 7;
- energy, water consumption and time according to Clause 8;
- airborne acoustical noise according to Clause 9.

**5 General conditions for measurements****5.1 General**

The dishwasher manufacturer's instructions regarding installation and use of the dishwasher shall be followed, except where there is a conflict, in which case this standard shall prevail.

Performance tests according to this standard shall be generally carried out on a new machine, with a reference machine running parallel with the machine(s) under test, i.e., at the same time under the same conditions using soil prepared at the same time from the same batch. The reference machine shall be in accordance with the description given in Annex E or Annex N.

The reference machine shall always be installed as a free standing machine independent of the type of machine under test.

Before commencing measurements, the dishwasher and the reference machine shall be checked to ensure that they are operating properly.

All tests shall be started with the appliances at the ambient temperature according to 5.5.

**5.1.1 Free standing dishwashers**

Dishwashers shall be tested as free standing except where they are designated as built-in or integrated (refer to 5.1.2). Dishwashers that can be installed as either free standing or built-in/integrated shall be tested as free standing.

**5.1.2 Built in and integrated dishwashers**

Built-in dishwashers have to be installed in an enclosure. See Figure I.1.

The front edge of the housing of the dishwasher (except the door) shall be 20 mm to 25 mm behind the front edge of the test enclosure. If required by the manufacturer's instructions, the enclosure shall be provided with ventilation openings accordingly.

If an appliance is provided with spacers, strips or other special means of solid or resilient material for closing the gap(s) between the contours of the appliance and the cabinet enclosure, these means shall be used accordingly. If such means are not provided, the gap(s) shall be left open.

Appliances to be integrated shall be installed under the same conditions as built-in appliances. In addition, the door of the dishwasher shall be equipped, in accordance with the manufacturer's instruction, with a board of the maximum size allowed by the manufacturer and of the same material and thickness as the test enclosure; see Annex I.

Moreover, for integrated types, the test enclosure shall be provided, in accordance with the manufacturer's instructions, at its lower front side with a skirting board of the maximum height which corresponds with the size of the board on the door of the appliance and of the same material and thickness as the test enclosure, see Annex I. If no instructions are given by the manufacturer, a skirting board as described above shall be pressed against the skirting board of the appliance.

## 5.2 Conditioning of the machine under test and sequence of test procedures

Before conducting the performance tests, the dishwasher shall be operated for at least 3 complete cycles using a clean load with reference detergent (specified in 5.7) and without rinse agent. The following cycle(s) can be a noise test according to Clause 9. No additional cycles shall be carried out on the machine under test between the sequential steps specified in the following procedure.

The tests shall be performed in the following order: cleaning performance (Clause 6) then drying performance (Clause 7). The determination of energy, water and cycle/program time (Clause 8) shall be done in conjunction with a wash performance test (Clause 6).

NOTE 1 The above sequence is necessary for better reproducibility, i.e. to avoid differences in drying performance due to the ageing process of the plastic parts in the dishwasher (for example, racks).

NOTE 2 Any cycles or operations performed on the appliance during the manufacture of the product are ignored.

NOTE 3 Noise tests require that the test should be carried out before the rinse aid dispenser is filled for the first time.

## 5.3 Electricity supply for machines

### 5.3.1 Electricity supply for test machine

#### 5.3.1.1 Voltage

The test voltage shall be set at the rated voltage of the machine and maintained within the range of  $\pm 2$  % throughout the test. If a voltage range is indicated, then the test voltage shall be set at the nominal voltage of the country in which the appliance is intended to be used. The measured voltage shall be reported.

NOTE If the rated voltage of the machine differs from the system voltage of the country of intended use, measurements should be carried out at the nominal voltage of the country of intended use.

#### 5.3.1.2 Frequency

The supply frequency shall be set at the rated frequency of the machine and maintained within the range  $\pm 1$  % throughout the test. If a frequency range is indicated, then the testing shall be carried out at the nominal frequency of the country in which the appliance is intended to be used. The measured frequency shall be reported.

NOTE If the rated frequency of the machine differs from the system frequency of the country of intended use, measurements should be carried out at the nominal frequency of the country of intended use.

### 5.3.2 Electricity supply for the reference machine

#### 5.3.2.1 Voltage

The supply voltage shall be set at 230 V a.c. and maintained within  $\pm 2$  % throughout the test. The measured voltage shall be reported.

#### 5.3.2.2 Frequency

The supply frequency shall be set at 50 Hz and maintained within  $\pm 1$  % throughout the test. The measured frequency shall be reported.

### 5.4 Test programme

The first programme to be tested shall be the one recommended by the manufacturer for a normally soiled load.

NOTE In some countries the manufacturer has to declare the programme to be used, for the purpose of energy labelling (which may not be for a normally soiled load), in which case this programme shall be the one tested first.

The same programme shall be used for measuring the cleaning performance according to Clause 6, the drying performance according to Clause 7, the energy and water consumption and time according to Clause 8, and the noise according to Clause 9, if tested.

Additional programmes may then be tested.

### 5.5 Ambient conditions

The following ambient conditions shall be maintained throughout the measurements.

#### Oven drying method

- Ambient temperature of the room:  $(20 \pm 2) ^\circ\text{C}$
- Relative humidity:  $(55 \pm 10) \% \text{RH}$

#### Air dry method

- Ambient temperature of the room:  $(20 \pm 2) ^\circ\text{C}$
- Relative humidity:  $(65 \pm 10) \% \text{RH}$

The ambient temperature and the relative humidity measured during the tests shall be reported in the test report.

### 5.6 Water supply

#### 5.6.1 General

The actual water conditions (temperature, hardness, and pressure) maintained during the tests shall be reported in the test report.

NOTE Some countries specify a hot water temperature for regulatory purposes, in which case this water temperature should be used for testing.

#### 5.6.2 Water supply – Temperature

The temperature of the supply water shall be

- cold water feed temperature:

- $(15 \pm 2) ^\circ\text{C}$ .
- hot water feed temperature:
  - temperature indicated by the manufacturer  $\pm 2 ^\circ\text{C}$ , or
  - where a range is specified which does include  $60 ^\circ\text{C}$ ,  $(60 \pm 2) ^\circ\text{C}$ , or
  - where a range is specified which does not include  $60 ^\circ\text{C}$ , the value nearest to  $60 ^\circ\text{C} \pm 2 ^\circ\text{C}$ , or
  - $(60 \pm 2) ^\circ\text{C}$ , if instructions are not given.

### 5.6.3 Hardness

A water hardness of  $(2,5 \pm 0,5)$  mmol/l for hard water areas or  $\leq 0,7$  mmol/l for soft water areas shall be used. If water hardness needs to be adjusted to meet these specifications, it shall be prepared according to IEC 60734 – Method C. The measured water hardness shall be reported. The water hardness used in the test shall be the one most applicable to the country of intended use.

NOTE The impact of water hardness variation between 0,0 mmol/l to 0,7 mmol/l is still under investigation.

### 5.6.4 Water pressure

The pressure of the water supply at each water inlet shall be set at 240 kPa and shall be maintained within the range  $\pm 20$  kPa, including during all fills. The measured water pressure shall be reported. Where the manufacturer specifies a range of water pressure that does not include  $240 \text{ kPa} \pm 20 \text{ kPa}$ , the water pressure shall be set at the end of the pressure range closest to  $240 \text{ kPa} \pm 20 \text{ kPa}$ .

### 5.7 Detergent

The reference detergent C, as described in Annex D, shall be used in the reference machine and test machine(s) when measuring performance. The quantity shall be as recommended by the manufacturer. But shall not be more than  $15,0 \text{ g} + 1,25 \text{ g}$  per place setting.

- $15,0 \text{ g} + 1,25 \text{ g}$  per place setting.

If no recommendation is given by the manufacturer, use

- $12,0 \text{ g} + 1,0 \text{ g}$  per place setting

For dishwashers not equipped with a water softener and being tested with hard water (see 5.6.3), follow the manufacturer's recommendation, but the quantity shall not exceed  $15,0 \text{ g} + 1,25 \text{ g}$  per place setting, in both the pre-wash and the main wash. If no recommendation is given by the manufacturer, use  $12,0 \text{ g} + 1,0 \text{ g}$  per place setting, in both the pre-wash and the main wash. The quantity of detergent used in g/place setting during the tests shall be recorded.

The detergent shall be placed in the dishwasher immediately prior to starting the programme. If a dispenser is incorporated in the dishwasher it shall be used. The dispenser shall be clean and dry prior to the placement of detergent. In the absence of manufacturer's recommendations, the detergent shall be placed in the main compartment of the dispenser.

Detergent from the same batch shall be used for the dishwasher under test and for the reference dishwasher.

Before use the detergent shall be homogenized in accordance with ISO 607 (refer to Annex F for suitable equipment).