

INTERNATIONAL STANDARD

NORME INTERNATIONALE



Electric dishwashers for household use – Methods for measuring the performance

Lave-vaisselle électriques à usage domestique – Méthodes de mesure de l'aptitude à la fonction



THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2015 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester. If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

Droits de reproduction réservés. Sauf indication contraire, aucune partie de cette publication ne peut être reproduite ni utilisée sous quelque forme que ce soit et par aucun procédé, électronique ou mécanique, y compris la photocopie et les microfilms, sans l'accord écrit de l'IEC ou du Comité national de l'IEC du pays du demandeur. Si vous avez des questions sur le copyright de l'IEC ou si vous désirez obtenir des droits supplémentaires sur cette publication, utilisez les coordonnées ci-après ou contactez le Comité national de l'IEC de votre pays de résidence.

IEC Central Office
3, rue de Varembe
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00
info@iec.ch
www.iec.ch

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigenda or an amendment might have been published.

IEC Catalogue - webstore.iec.ch/catalogue

The stand-alone application for consulting the entire bibliographical information on IEC International Standards, Technical Specifications, Technical Reports and other documents. Available for PC, Mac OS, Android Tablets and iPad.

IEC publications search - www.iec.ch/searchpub

The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee,...). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished

Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and also once a month by email.

Electropedia - www.electropedia.org

The world's leading online dictionary of electronic and electrical terms containing more than 30 000 terms and definitions in English and French, with equivalent terms in 15 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IEC Glossary - std.iec.ch/glossary

More than 60 000 electrotechnical terminology entries in English and French extracted from the Terms and Definitions clause of IEC publications issued since 2002. Some entries have been collected from earlier publications of IEC TC 37, 77, 86 and CISPR.

IEC Customer Service Centre - webstore.iec.ch/csc

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: csc@iec.ch.

A propos de l'IEC

La Commission Electrotechnique Internationale (IEC) est la première organisation mondiale qui élabore et publie des Normes internationales pour tout ce qui a trait à l'électricité, à l'électronique et aux technologies apparentées.

A propos des publications IEC

Le contenu technique des publications IEC est constamment revu. Veuillez vous assurer que vous possédez l'édition la plus récente, un corrigendum ou amendement peut avoir été publié.

Catalogue IEC - webstore.iec.ch/catalogue

Application autonome pour consulter tous les renseignements bibliographiques sur les Normes internationales, Spécifications techniques, Rapports techniques et autres documents de l'IEC. Disponible pour PC, Mac OS, tablettes Android et iPad.

Recherche de publications IEC - www.iec.ch/searchpub

La recherche avancée permet de trouver des publications IEC en utilisant différents critères (numéro de référence, texte, comité d'études,...). Elle donne aussi des informations sur les projets et les publications remplacées ou retirées.

IEC Just Published - webstore.iec.ch/justpublished

Restez informé sur les nouvelles publications IEC. Just Published détaille les nouvelles publications parues. Disponible en ligne et aussi une fois par mois par email.

Electropedia - www.electropedia.org

Le premier dictionnaire en ligne de termes électroniques et électriques. Il contient plus de 30 000 termes et définitions en anglais et en français, ainsi que les termes équivalents dans 15 langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (IEV) en ligne.

Glossaire IEC - std.iec.ch/glossary

Plus de 60 000 entrées terminologiques électrotechniques, en anglais et en français, extraites des articles Termes et Définitions des publications IEC parues depuis 2002. Plus certaines entrées antérieures extraites des publications des CE 37, 77, 86 et CISPR de l'IEC.

Service Clients - webstore.iec.ch/csc

Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions contactez-nous: csc@iec.ch.

INTERNATIONAL STANDARD

NORME INTERNATIONALE



Electric dishwashers for household use – Methods for measuring the performance

Lave-vaisselle électriques à usage domestique – Méthodes de mesure de l'aptitude à la fonction

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 97.040.40

ISBN 978-2-8322-2970-5

**Warning! Make sure that you obtained this publication from an authorized distributor.
Attention! Veuillez vous assurer que vous avez obtenu cette publication via un distributeur agréé.**

CONTENTS

FOREWORD.....	7
INTRODUCTION.....	9
1 Scope.....	10
2 Normative references	10
3 Terms, definitions and symbols	10
3.1 Terms and definitions.....	10
3.2 Symbols.....	14
3.2.1 Symbols related to the application of egg (6.4.5.3)	14
3.2.2 Symbols related to the calculation of the drying index (7.2.3)	14
3.2.3 Symbols related to the calculation of the cleaning index (7.3.2)	14
3.2.4 Symbols related to the measurements (Clause 8 and Annex U)	15
3.2.5 Symbols related to the microwave calibration (Annex F)	15
4 List of measurements	15
5 General conditions for measurements.....	16
5.1 General.....	16
5.1.1 General information	16
5.1.2 Free standing dishwashers	16
5.1.3 Built-in and integrated dishwashers	16
5.2 Sequence of test procedures and conditioning of the test machine	17
5.3 Electricity supply for machines.....	17
5.3.1 Electricity supply for test machine.....	17
5.3.2 Electricity supply for the reference machine.....	17
5.4 Test programme.....	18
5.5 Ambient conditions	18
5.6 Water.....	18
5.6.1 General	18
5.6.2 Water temperature.....	18
5.6.3 Water hardness	19
5.6.4 Water pressure	19
5.7 Detergent.....	19
5.8 Rinse aid	20
5.9 Salt.....	20
6 Combined cleaning and drying performance tests	20
6.1 General and purpose	20
6.2 Load	20
6.2.1 Composition of the test load	20
6.2.2 Requirements for pre-conditioning of new tableware.....	21
6.2.3 Requirements for conditioning of tableware	21
6.2.4 Requirements for re-conditioning tableware.....	21
6.3 Soiling agents and preparation equipment	21
6.4 Preparation and application of soiling agents	22
6.4.1 General	22
6.4.2 Milk	22
6.4.3 Tea.....	24
6.4.4 Minced meat.....	26
6.4.5 Egg.....	27

6.4.6	Oat flakes	28
6.4.7	Spinach	28
6.4.8	Margarine	29
6.5	Drying of the soiled tableware items	30
6.5.1	General	30
6.5.2	Oven drying method	30
6.5.3	Air drying method	31
6.6	Loading and operating	31
6.6.1	Loading	31
6.6.2	Operating	32
7	Combined cleaning and drying performance assessment	32
7.1	General requirements	32
7.2	Determination of the drying performance	33
7.2.1	General requirements to enable subsequent cleaning assessment	33
7.2.2	Drying assessment procedure	33
7.2.3	Calculation of the drying index	35
7.3	Determination of the cleaning performance	37
7.3.1	General	37
7.3.2	Calculation of the cleaning index	39
7.3.3	Dishwasher filter systems	40
7.3.4	Assessing $In W_C$	40
7.4	Results	41
7.4.1	Expressing drying results	41
7.4.2	Expressing cleaning results	41
8	Energy consumption, water consumption, cycle time and programme time	41
8.1	General and purpose	41
8.2	Method of measurement	42
8.2.1	General	42
8.2.2	Energy consumption	42
8.2.3	Hot water energy	42
8.2.4	Water consumption	43
8.2.5	Time	43
9	Airborne acoustical noise	43
Annex A (normative) Place settings and serving pieces		44
A.1	General information	44
A.2	Test load specifications	44
Annex B (informative) Tableware specifications		48
Annex C (normative) Illustration of soil application quantities		57
C.1	Soil application	57
C.1.1	Soil application example for type A tableware items	57
C.1.2	Soil application example for type B tableware items	57
C.1.3	Soil application on the serving pieces	58
C.1.4	Soil application quantities for different rated dishwasher capacities	59
Annex D (informative) Pictures of the soiled items		60
Annex E (normative) Test additives		64
E.1	General	64
E.2	Detergent	64
E.3	Rinse aid	64

E.4	Salt.....	65
Annex F (normative)	Microwave oven	66
F.1	Specification of the microwave oven	66
F.2	Calibration of the microwave oven	66
Annex G (normative)	Through-circulation thermal cabinet	68
G.1	Specification of the thermal cabinet	68
G.2	Calibration of the thermal cabinet	68
Annex H (informative)	Alternate cleaning and drying assessment tables	70
H.1	General.....	70
H.2	Alternate drying performance table	70
H.3	Alternate cleaning performance table	71
Annex I (normative)	Description of the reference machine	73
I.1	Specification of the reference machine	73
I.1.1	General	73
I.1.2	General specifications	73
I.1.3	Guidelines for performance values.....	74
I.2	Installation and use of the reference machine	74
I.3	Specification check of the reference machine	74
I.3.1	General	74
I.3.2	Checking spray arm rotation	75
I.3.3	Checking the water hardness.....	75
I.3.4	Checking the energy consumption and water consumption	75
I.3.5	Checking the water level in the sump.....	75
I.3.6	Checking the water temperature in the sump	75
I.3.7	Checking the cycle time.....	76
I.3.8	Checking the cleaning and drying performance.....	76
I.4	Reference machine loading plan	76
Annex J (informative)	Shade chart	78
J.1	General.....	78
J.2	Classification of shade numbers	78
Annex K (normative)	Additional aspects of energy consumption of dishwashers	79
K.1	General.....	79
K.2	Determination of left on mode power.....	81
K.3	Determination of left on mode duration	82
K.4	Determination of end of cycle mode power.....	82
K.5	Determination of end of cycle mode duration	83
K.6	Determination of off mode power	83
K.7	Determination of delay start mode power	83
Annex L (informative)	Addresses of suppliers	84
L.1	General suppliers.....	84
L.2	Alternative suppliers	88
L.2.1	General	88
L.2.2	Alternative food soils	88
Annex M (informative)	Test report format	89
M.1	General.....	89
M.2	Machine description	89
M.3	Laboratory details	89
M.4	Test Conditions.....	89

M.5	Test Results and measurements	89
M.5.1	Setup.....	89
M.5.2	Results	89
Annex N	(normative) Test enclosure for built-in and integrated dishwashers	91
Annex O	(informative) Internal evaluation guidelines	92
Annex P	(informative) Test procedure for sensing programmes.....	93
P.1	General.....	93
P.2	General conditions.....	93
P.3	Loading.....	94
P.4	Soiling	94
P.5	Measured data.....	94
Annex Q	(informative) Additional rinse performance evaluation.....	95
Q.1	General.....	95
Q.2	General conditions.....	95
Q.3	Loading.....	95
Q.4	Evaluation.....	95
Q.5	Measured data.....	96
Annex R	(informative) Dishwasher filtration evaluation.....	98
R.1	General.....	98
R.2	General conditions.....	98
R.3	Test procedure.....	98
R.3.1	General	98
R.3.2	Coffee grounds.....	98
R.3.3	Spinach	100
R.4	Evaluation.....	100
Annex S	(Informative) Flow chart – test sequence for IEC 60436.....	103
Annex T	(normative) Instrumentation and accuracy.....	104
Annex U	(informative) Inlet water temperature influence on energy consumption	105
U.1	General.....	105
U.2	Cold water energy correction	105
U.3	Correlating energy consumption tests with different cold water inlet temperatures	106
U.3.1	General	106
U.3.2	Estimating regional energy consumption from standard cold water temperature.....	107
U.3.3	Estimating standard energy consumption from regional cold water temperature.....	107
Bibliography	109
Figure 1	– Position of the glasses on the microwave turntable	24
Figure 2	– The thermal cabinet for pre-drying of soiled cups, mugs and saucers.....	25
Figure 3	– Schematic view of the different beef pieces.....	26
Figure 4	– The thermal cabinet with soiled load items (30 place settings)	30
Figure G.1	– Location of the thermocouple on upper, intermediate and lower wire shelves.....	69
Figure K.1	– Measurement procedure for low power modes (Left on mode and Off mode).....	80
Figure K.2	– Measurement procedure for low power mode (End of cycle mode)	81

Figure N.1 – Test enclosure for built-in and integrated dishwashers..... 91

Figure Q.1 – Example for an assessment light box..... 96

Figure Q.2 – Photo catalogue to assess spots on glasses..... 97

Table 1 – Evaluation of the drying performance 34

Table 2 – Evaluation to determine the drying performance 35

Table 3 – Evaluation of the cleaning performance 38

Table 4 – Evaluation to determine the cleaning performance 38

Table 5 – Numerical Values of the t-factor for statistical calculations 40

Table A.1 – Specifications of tableware items 45

Table A.2 – Composition of test loads 46

Table B.1 – Tableware specifications 48

Table C.1 – Soil application example for type A tableware items 57

Table C.2 – Soil application example for type B tableware items 58

Table C.3 – Soil application on the serving pieces 58

Table C.4 – Soil application quantities for different rated dishwasher capacities 59

Table E.1 – Ingredients of reference detergent type D 64

Table E.2 – Ingredients of reference rinse aid III..... 65

Table H.1 – Alternate drying performance table 70

Table H.2 – Alternate cleaning performance table 71

Table J.1 – Shade chart..... 78

Table P.1 – Test scenarios for testing the sensing programme 93

Table P.2 – Example for a one week schedule 94

Table R.1 – Evaluation to determine the cleaning performance 101

Table R.2 – Soil application on the serving pieces 102

Table R.3 – Soil application quantities for different rated dishwasher capacities 102

Table T.1 – Specification of instruments 104

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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

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.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

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

This fourth edition cancels and replaces the third edition published in 2004, its Amendment 1 published in 2009 and its Amendment 2 published in 2012.

This edition constitutes a technical revision and includes the following significant technical changes with respect to the previous edition:

- a) Addition of a specification of the reference dishwasher G1222, addition of the microwave oven 752C, inclusion of standby/low power modes and updated cutlery and tableware items.
- b) Combined cleaning and drying: combining the cleaning and drying performance evaluations into one test, along with the energy and water consumption evaluation, prevents an opportunity for circumvention if tests were performed separately. A dishwasher can detect whether soil is present (cleaning evaluation) or not (drying

evaluation) and adjust the cycle to favour performance; combining the tests addresses this.

- c) New dish load items: new dish load items were incorporated which reflect consumer use. New items are: stainless pots, coffee mugs, melamine plastic items, and glass bowl. The new load items provide different shapes which challenge a dishwasher water spray patterns and provide additional surfaces for soil removal assessment.
- d) Detergent: a new detergent “D” is specified which mirrors current tablet formulations available on the market. Detergent type D is phosphate free, with percarbonate instead of perborate bleach and more active enzymes.
- e) Repeatability and reproducibility improvements.
- f) Addition of annexes for the evaluation of soil sensing programmes, rinsing performance, dishwasher filtration and of an annex on the inlet water temperature influence on energy consumption.

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

FDIS	Report on voting
59A/202/FDIS	59A/203/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.

The following print type is used in this standard:

- words in **bold** are defined in Clause 3.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC website 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.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

The history of this fourth edition of IEC 60436 is provided as follows:

- Discussion began during the Sydney Australia meeting in September 2008.
- A first working draft was developed and discussed during the Seattle USA meeting in October 2010.
- A questionnaire (59A/149/Q) regarding proposed changes was published January 2011. Responses (59A/153/RQ) were reviewed during a meeting in Bonn Germany April 2011 and published May 2011.
- A Document for Comment (59A/155/DC) was published May 2011. Review of responses (59A/164/INF) began during the Melbourne Australia meeting in October 2011.
- A Committee Draft (59A/168/CD) was published May 2012. Review of responses (59A/170/CC) began during the Oslo Norway meeting in October 2012.
- A second Committee Draft (59A/175/CD) was published May 2013. Review of responses (59A/177/CC) began during the New Delhi India meeting in October 2013.
- Committee Documents for Vote (59A/183/CDV and 59A/184/CDV) were published June 2014. 59A/183/CDV (fragment 1) contained the complete edition 4, except for some Annex U content; 59A/184/CDV (fragment 2) contained additional Annex U content. Review of responses (59A/190b/RVC and 59A/191b/RVC for fragments 1 and 2) began during the Tokyo Japan meeting in October 2014.
- The FDIS document was prepared for publication built upon this history of work.

A Round Robin Test (RRT) has been planned and will be carried out using edition 4. Results from the RRT will be available after the edition 4 is published. Edition 4 updates, if needed, will be incorporated into edition 4 Amendment 1.

ELECTRIC DISHWASHERS FOR HOUSEHOLD USE – METHODS FOR MEASURING THE PERFORMANCE

1 Scope

This International Standard applies to electric **dishwashers** for household and similar 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 and similar use and to describe the standard methods of measuring these characteristics.

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

2 Normative references

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

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

IEC 60734, *Household electrical appliances – Performance – Water for testing*

IEC 62301, *Household electrical appliances – Measurement of standby power*

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

ISO 80000-1:2009, *Quantities and Units – Part 1: General*

3 Terms, definitions and symbols

3.1 Terms and definitions

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

3.1.1

dishwasher

machine that cleans, rinses and dries **tableware** by chemical, mechanical, thermal, and electric means

Note 1 to entry: A **dishwasher** can have a specific drying **operation** at the end of the **programme**.

Note 2 to entry: Different **dishwasher** types are designated by manufacturers e.g. **free-standing**, **built-in** or **integrated**.

3.1.2

free-standing dishwasher

dishwasher which is intended to be installed without an enclosing structure