

INTERNATIONAL STANDARD

NORME INTERNATIONALE



Clothes washing machines for household use – Methods for measuring the performance

Machines à laver le linge pour usage domestique — Méthodes de mesure de l'aptitude à la fonction





THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2010 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 Varembé
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
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 - webstore.iec.ch/advsearchform

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 It also gives information on projects, replaced and withdrawn publications.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 21 000 terms and definitions in English and French, with equivalent terms in 16 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IEC Glossary - std.iec.ch/glossary

67 000 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: sales@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.

Electropedia - www.electropedia.org

Le premier dictionnaire en ligne de termes électroniques et électriques. Il contient 21 000 termes et définitions en anglais et en français, ainsi que les termes équivalents dans 16 langues additionnelles. Egalelement appelé Vocabulaire Electrotechnique International (IEV) en ligne.

Recherche de publications IEC - webstore.iec.ch/advsearchform

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.

Glossaire IEC - std.iec.ch/glossary

67 000 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.

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.

Service Clients - webstore.iec.ch/csc

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

This is a preview. Click here to purchase the full publication.



IEC 60456

Edition 5.0 2010-02

INTERNATIONAL STANDARD

NORME INTERNATIONALE



Clothes washing machines for household use – Methods for measuring the performance

Machines à laver le linge pour usage domestique — Méthodes de mesure de l'aptitude à la fonction

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 97.060

ISBN 978-2-8322-6206-1

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.

® Registered trademark of
Marque déposée de la C

This is a preview. Click here to purchase the full publication.

CONTENTS

FOREWORD	7
1 Scope	9
2 Normative references	9
3 Terms, definitions and symbols	10
3.1 Terms and definitions	10
3.2 Symbols	13
3.2.1 Symbols relating to Subclause 9.2 – washing performance	13
3.2.2 Symbols relating to Subclause 9.3 – water extraction (spinning)	14
3.2.3 Symbols relating to Subclause 9.4 – rinsing performance	14
3.2.4 Symbols relating to Subclause 9.5 – energy, water and time	14
3.2.5 Symbols relating to Clause 10 – wool shrinkage	14
3.2.6 Symbols relating to Annex G	15
3.2.7 Symbols relating to Annex I	15
3.2.8 Symbols relating to Annex L	15
4 Requirements	15
4.1 General	15
4.2 Rated capacity	16
4.3 Dimensions	16
5 Test conditions, materials, equipment and instrumentation	17
5.1 General	17
5.2 Ambient conditions	17
5.2.1 Electricity supply	17
5.2.2 Water supply	17
5.2.3 Ambient temperature and humidity	18
5.3 Test materials	19
5.3.1 General	19
5.3.2 Base loads	19
5.3.3 Stain test strips	19
5.3.4 Wool shrinkage specimens	20
5.3.5 Detergents	20
5.4 Equipment	20
5.4.1 General	20
5.4.2 Reference machine	21
5.4.3 Spectrophotometer	21
5.4.4 Equipment for conditioning the base load	22
5.4.5 Standard extractor	22
5.4.6 Iron for preparation of stain test strips after washing	23
5.4.7 Titration equipment	23
5.4.8 Other equipment	23
5.5 Instrumentation and accuracy	24
5.5.1 General	24
5.5.2 Instruments	24
5.5.3 Measurements	25
6 Preparation for testing	25
6.1 General	25
6.2 Test washing machine and reference machine preparation	25

6.2.1	Test washing machine	25
6.2.2	Reference machine.....	26
6.3	Detergent	26
6.3.1	General	26
6.3.2	Detergent dose.....	27
6.3.3	Mixing detergent.....	27
6.3.4	Detergent placement	27
6.4	Test loads	28
6.4.1	General	28
6.4.2	Pre-treatment of new base load items prior to use	30
6.4.3	Requirements regarding the age of base load items	30
6.4.4	Normalization of base load items before a new test series.....	31
6.4.5	Conditioning of base load items before a new test series.....	32
6.4.6	Test load composition.....	33
6.4.7	Addition of stain test strips or wool shrinkage specimens to the base load	36
7	Performance measurements – general requirements	37
8	Tests for performance	38
8.1	General	38
8.2	Test procedure for performance tests	38
8.2.1	Test conditions, materials and preparation for testing	38
8.2.2	Test load and loading	39
8.2.3	Programme.....	39
8.2.4	Test procedure	39
8.2.5	Test series	40
8.3	Measurements to determine washing performance	41
8.3.1	General	41
8.3.2	Removal and drying of stain test strips	42
8.3.3	Assessment of stain test strips	42
8.4	Measurements to determine water extraction performance	43
8.4.1	General	43
8.4.2	Washing machines	43
8.4.3	Spin extractors	43
8.5	Measurements to determine rinsing performance	43
8.5.1	General	43
8.5.2	Spin extraction and sampling	44
8.5.3	Alkalinity measurements.....	45
8.6	Measurements to determine water and energy consumption and programme time	46
8.6.1	General	46
8.6.2	Procedure.....	46
9	Assessment of performance	46
9.1	General	46
9.2	Evaluation of washing performance	47
9.3	Evaluation of water extraction performance	49
9.4	Evaluation of rinsing performance	49
9.4.1	General	49
9.4.2	Calculations.....	49
9.4.3	Evaluation	50

9.5	Evaluation of water and energy consumption and programme time	51
9.5.1	General	51
9.5.2	Water volumes	51
9.5.3	Programme time	51
9.5.4	Energy consumption	51
10	Shrinkage during the wool wash programme	52
10.1	General	52
10.2	Overview	52
10.2.1	General	52
10.2.2	Determination of reference shrinkage	53
10.3	Procedure	53
10.3.1	Preparation of wool shrinkage specimens	53
10.3.2	Wool programme test	55
10.3.3	Evaluation	56
11	Data to be reported	57
Annex A (normative)	Specification of stain test strips with standardized soiling	58
Annex B (normative)	Reference detergent A*	62
Annex C (normative)	Specifications for base loads	64
Annex D (normative)	Reference machine specification	67
Annex E (normative)	Reference machine programme definitions	72
Annex F (informative)	Reference programmes and examples of comparable washing machine programmes	75
Annex G (normative)	The bone-dry method of conditioning	76
Annex H (normative)	Folding and loading the test load	78
Annex I (normative)	Calculation of weighted average age of the cotton base load	95
Annex J (normative)	Loading a large standard extractor (rinsing performance)	97
Annex K (informative)	Laboratory internal testing guide	101
Annex L (normative)	Measurement of energy consumption in low power modes of washing machines	106
Annex M (normative)	Testing procedure for manual washing machines	109
Annex N (normative)	Procedure to determine test load size where rated capacity is not declared	111
Annex O (informative)	Additional evaluation of washing performance	113
Annex P (informative)	Testing deviations to reduce costs and their limitations	118
Annex Q (informative)	Uncertainty of measurements in IEC 60456	124
Annex R (informative)	Environmental aspects of washing machine use determined in IEC 60456	127
Annex S (normative)	Test report – data to be reported	130
Annex T (normative)	Wool shrinkage specimens	138
Annex U (informative)	Sources of materials and supplies	139
Bibliography	140	
Figure 1 – Load item preparation prior to a test series	29	
Figure 2 – Load composition and age requirements	30	
Figure 3 – Attached test strip	37	
Figure 4 – Test series: process and decisions for load mass and age	41	

Figure 5 – Positions for measuring soiled test pieces.....	42
Figure 6 – Wool shrinkage specimen, uncut.....	53
Figure 7 – Wool shrinkage specimen, fraying the edges and V-cuts	54
Figure 8 – Wool shrinkage specimen, marks	54
Figure H.1 – Folding towel with a stain test strip attached.....	78
Figure H.2 – Folding towel without a stain test strip attached.....	79
Figure H.3 – Folding pillowcases	79
Figure H.4 – Folding bed sheets	79
Figure H.5 – Folding pillowcases with a stain test strip attached	80
Figure H.6 – Folding pillowcases without a stain test strip attached	80
Figure H.7 – Folding shirts.....	81
Figure H.8 – Illustration of horizontal axis washing machine	81
Figure H.9 – Illustration of vertical axis washing machine	82
Figure H.10 – Horizontal axis washing machine: placement of items in the drum	83
Figure H.11 – Vertical axis washing machine: placement of items in the drum	83
Figure H.12 – Horizontal axis washing machine: illustration of alternating orientation	85
Figure H.13 – Placement of 2 towels with strips in one layer for load sizes larger than 10 kg	87
Figure H.14 – Vertical axis washing machines, four quadrants (plan view).....	90
Figure I.1 – Example for the exchange of load items for a 5 kg cotton load	96
Figure J.1 – Example of a large standard extractor	97
Figure J.2 – View from the top: loading the large standard extractor	97
Figure J.3 – Areas for loading	98
Figure J.4 – Folding of items.....	98
Figure J.5 – 3 areas of loading	99
Figure J.6 – Outer circle	99
Figure J.7 – Outer circle	99
Figure J.8 – Middle circle	100
Figure J.9 – Inner circle	100
Figure J.10 – Towels covering the load.....	100
Table 1 – Detergent dose.....	27
Table 2 – Number of items in the cotton test load for various test load masses	34
Table 3 – Number of items in the synthetics/blends test load for various test load masses	35
Table 4 – Number of items in the wool programme test load for various test load masses	36
Table A.1 – Ratios and tolerances of standardized soils, Reference Machine CLS and MP Lab	61
Table B.1 – Composition of the reference detergent A*	62
Table C.1 – Specification of the cotton base load items	64
Table C.2 – Specification of the synthetics/blends base load items	65
Table D.1 – Description of the reference washing machine and method of use type 1	68
Table D.2 – Description of the reference washing machine and method of use type 2	70

Table D.3 – Programmed volume for type 2 reference machine	71
Table E.1 – Specification of reference washing programmes.....	73
Table E.2 – Tolerances given for some procedure parameters.....	74
Table F.1 – Reference programmes and examples of comparable washing machine programmes.....	75
Table H.1 – Vertical axis washing machines, loading sequence example for a synthetics/blends load	84
Table H.2 – Horizontal axis washing machines, loading sequence	86
Table H.3 – Horizontal axis washing machine, loading example (5 kg).....	88
Table H.4 – Vertical axis washing machines, small loads without sheets (1,0 kg to 2,5 kg) ...	90
Table H.5 – Vertical axis washing machines, medium loads with two sheets (3,0 kg to 7,0 kg)	91
Table H.6 – Vertical axis washing machines, large loads with three sheets (7,5 kg to 8,5 kg)	92
Table H.7 – Vertical axis washing machines, very large loads with four sheets (9,0 kg to 10,0 kg)	93
Table H.8 – Vertical axis washing machine – loading example (5 kg).....	94
Table S.1 – Data for test washing machine	130
Table S.2 – Data, parameters and performance results, cotton or synthetics/blends base loads	132
Table S.2a – Data, parameters and results, cotton or synthetics/blends base loads	132
Table S.2b – Performance results, cotton or synthetics/blends base loads.....	133
Table S.3 – Data, parameters and results – wool shrinkage – polyester base load.....	134
Table S.4 – Weighted average age – cotton load	135
Table S.5 – Materials	136
Table S.6 – Equipment	137

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**CLOTHES WASHING MACHINES 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 60456 has been prepared by subcommittee 59D: Home laundry appliances, of IEC technical committee 59: Performance of household and similar electrical appliances.

This fifth edition cancels and replaces the fourth edition published in 2003 and constitutes a technical revision.

Experience with the use of the fourth edition of IEC 60456, together with some revised test conditions and the need for a more globally applicable standard, are the main reasons for this fifth edition.

This edition includes the following significant technical changes from the previous edition.

- Modified test load mass requirement for cases where rated capacity of test machine is not declared. Test load mass determination in case rated capacity is not declared was changed to remove the ambiguity in edition 4 and to encourage declaration.
- Introduction of soft water option.
- Expanded stain/soil set (for assessment of washing performance).

- Improved method of loading and folding test load items to better suit vertical axis, horizontal axis and twin tub systems.
- Revised and amended reference machine specification reflecting full qualification of new Electrolux Wascator CLS.
- New reference programmes for lower temperatures and vertical axis systems. New informative annex comparing reference programmes to typical household programmes.
- Refined rinsing efficiency method.
- Introduction of low power modes "Off" and "Left On" (for assessment of energy consumption).
- New annex about uncertainty of measurements.

This bilingual version (2018-11) corresponds to the monolingual English version, published in 2010-02.

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

FDIS	Report on voting
59D/358/FDIS	59D/360/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.

The French version of this standard has not been voted upon.

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

Words in **bold** in the text 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 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.

The contents of the corrigendum of September 2011 have been included in this copy.

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.