

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 © 2022 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 Secretariat
3, rue de Varembe
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 corrigendum or an amendment might have been published.

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 It also gives information on projects, replaced and withdrawn publications.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 once a month by email.

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.

IEC Products & Services Portal - products.iec.ch

Discover our powerful search engine and read freely all the publications provided. With a subscription you will always have access to up to date content tailored to your needs.

Electropedia - www.electropedia.org

The world's leading online dictionary on electrotechnology, containing more than 22 300 terminological entries in English and French, with equivalent terms in 19 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

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.

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.

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 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.

IEC Products & Services Portal - products.iec.ch

Découvrez notre puissant moteur de recherche et consultez gratuitement tous les aperçus des publications. Avec un abonnement, vous aurez toujours accès à un contenu à jour adapté à vos besoins.

Electropedia - www.electropedia.org

Le premier dictionnaire d'électrotechnologie en ligne au monde, avec plus de 22 300 articles terminologiques en anglais et en français, ainsi que les termes équivalents dans 19 langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (IEV) en ligne.

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 978-2-8322-6310-5

**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.**

Currently in preview, click buy full version

REDLINE VERSION

VERSION REDLINE



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

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	66
Annex D (normative)	Reference machine specification	69
Annex E (normative)	Reference machine programme definition	74
Annex F (informative)	Reference programmes and examples of comparable washing machine programmes	77
Annex G (normative)	The bone-dry method of conditioning	78
Annex H (normative)	Folding and loading the test load	80
Annex I (normative)	Calculation of weighted average age of the cotton base load	97
Annex J (normative)	Loading a large standard extractor (rinsing performance)	99
Annex K (informative)	Laboratory internal testing guide	103
Annex L (normative)	Measurement of energy consumption in low power modes of washing machines	108
Annex M (normative)	Testing procedure for manual washing machines	111
Annex N (normative)	Procedure to determine test load size where rated capacity is not declared	113
Annex O (informative)	Additional evaluation of washing performance	115
Annex P (informative)	Testing deviations to reduce costs and their limitations	119
Annex Q (informative)	Uncertainty of measurements in IEC 60456	125
Annex R (informative)	Environmental aspects of washing machine use determined in IEC 60456	128
Annex S (normative)	Test report – data to be reported	131
Annex T (normative)	Wool shrinkage specimens	139
Annex U (informative)	Sources of materials and supplies	140
	Bibliography	141
	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.....	80
Figure H.2 – Folding towel without a stain test strip attached.....	81
Figure H.3 – Folding pillowcases.....	81
Figure H.4 – Folding bed sheets.....	81
Figure H.5 – Folding pillowcases with a stain test strip attached.....	82
Figure H.6 – Folding pillowcases without a stain test strip attached.....	82
Figure H.7 – Folding shirts.....	83
Figure H.8 – Illustration of horizontal axis washing machine.....	83
Figure H.9 – Illustration of vertical axis washing machine.....	84
Figure H.10 – Horizontal axis washing machine: placement of items in the drum.....	85
Figure H.11 – Vertical axis washing machine: placement of items in the drum.....	85
Figure H.12 – Horizontal axis washing machine: illustration of alternating orientation.....	87
Figure H.13 – Placement of 2 towels with strips in one layer for load sizes larger than 10 kg.....	89
Figure H.14 – Vertical axis washing machines, four quadrants (plan view).....	92
Figure I.1 – Example for the exchange of load items for 5 kg cotton load.....	98
Figure J.1 – Example of a large standard extractor.....	99
Figure J.2 – View from the top: loading the large standard extractor.....	99
Figure J.3 – Areas for loading.....	100
Figure J.4 – Folding of items.....	100
Figure J.5 – 3 areas of loading.....	101
Figure J.6 – Outer circle, with sheets.....	101
Figure J.7 – Outer circle, with sheets and pillow cases on top.....	101
Figure J.8 – Middle circle.....	102
Figure J.9 – Inner circle.....	102
Figure J.10 – Towels covering the load.....	102
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 B.2 – composition of the standard powder detergent (IEC-P).....	64
Table C.1 – Specification of the cotton base load items.....	66
Table C.2 – Specification of the synthetics/blends base load items.....	67
Table D.1 – Description of the reference washing machine and method of use type 1.....	70

Table D.2 – Description of the reference washing machine and method of use type 2.....	72
Table D.3 – Programmed volume for type 2 reference machine	73
Table E.1 – Specification of reference washing programmes.....	75
Table E.2 – Tolerances given for some procedure parameters	76
Table F.1 – Reference programmes and examples of comparable washing machine programmes.....	77
Table H.1 – Vertical axis washing machines, loading sequence example for a synthetics/blends load	86
Table H.2 – Horizontal axis washing machines, loading sequence	88
Table H.3 – Horizontal axis washing machine, loading example (5 kg).....	90
Table H.4 – Vertical axis washing machines, small loads without sheets (1,0 kg to 2,5 kg)	92
Table H.5 – Vertical axis washing machines, medium loads with two sheets (3,0 kg to 7,0 kg)	93
Table H.6 – Vertical axis washing machines, large loads with three sheets (7,5 kg to 8,5 kg)	94
Table H.7 – Vertical axis washing machines, very large loads with four sheets (9,0 kg to 10,0 kg)	95
Table H.8 – Vertical axis washing machine – loading example (5 kg).....	96
Table S.1 – Data for test washing machine	131
Table S.2 – Data, parameters and performance results, cotton or synthetics/blends base loads	133
Table S.2a – Data, parameters and results, cotton or synthetics/blends base loads	133
Table S.2b – Performance results, cotton or synthetics/blends base loads.....	134
Table S.3 – Data, parameters and results – wool shrinkage – polyester base load.....	135
Table S.4 – Weighted average age – cotton load	136
Table S.5 – Materials	137
Table S.6 – Equipment	138

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.

This consolidated version of the official IEC Standard and its amendment has been prepared for user convenience.

IEC 60456 edition 5.1 contains the fifth edition (2010-02) [documents 59D/358/FDIS and 59D/360/RVD], its corrigendum (2011-09) and its amendment 1 (2022-12) [documents 59D/486/CDV and 59D/496/RVC].

In this Redline version, a vertical line in the margin shows where the technical content is modified by amendment 1. Additions are in green text, deletions are in strikethrough red text. A separate Final version with all changes accepted is available in this publication.

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 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 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 the base publication and its amendment will remain unchanged until the stability date indicated on the IEC web site under 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.

CLOTHES WASHING MACHINES FOR HOUSEHOLD USE – METHODS FOR MEASURING THE PERFORMANCE

1 Scope

This International Standard specifies methods for measuring the performance of clothes **washing machines** for household use, with or without heating devices utilising cold and/or hot water supply. It also deals with appliances for water extraction by centrifugal force (**spin extractors**) and is applicable to appliances for both washing and drying textiles (**washer-dryers**) with respect to their washing related functions. This International Standard also covers **washing machines** which specify the use of no detergent for normal use.

NOTE 1 Tumble dryer performance is assessed to IEC 61121.

The object is to state and define the principal performance characteristics of electric household **washing machines** and **spin extractors** and to describe the test methods for measuring these characteristics.

NOTE 2 This international standard applies also to **washing machines** for communal use in blocks of flats or in launderettes. It does not apply to **washing machines** for commercial laundries. This International Standard is not intended to be used for the comparative evaluation of detergents.

NOTE 3 This International Standard does not specify acoustical noise requirements for **washing machines**. Acoustical noise measurements are specified in IEC 60704-1 and IEC 60704-2-4.

NOTE 4 This International Standard does not specify safety requirements for **washing machines**. Safety requirements are specified in IEC 60335-2-7.

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 60335-2-7, *Household and similar electrical appliances – Safety – Part 2-7: Particular requirements for washing machines*

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

IEC 62053-21, *Electricity metering equipment (a.c.) – Particular requirements – Part 21: Static meters for active energy (classes 1 and 2)*

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

IEC Guide 109, *Environmental aspects – Inclusion in electrotechnical product standards*

ISO 31-0:1992, *Quantities and units – Part 0: General principles*

ISO 2060, *Textiles – Yarn from packages – Determination of linear density (mass per unit length) by the skein method*

ISO 2061, *Textiles – Determination of twist in yarns – Direct counting method*

ISO 7211-2, *Textiles – Woven fabrics – Construction – Methods of analysis – Part 2: Determination of number of threads per unit length*