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Introduction

This draft standard is based on national and international discussions. Your comments on this draft are invited and will assist in the preparation of the consequent standard.

For international standards, comments will be reviewed by the relevant UK national committee before sending the consensus UK vote and comments to the international committee, which will then decide appropriate action. If the international standard is approved, it is usual for the text to be published as a British Standard.

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Date: xx/xx/20xx	Document: ISO/DIS xxxx
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1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex (e.g. 3.1)	Paragraph/ Figure/Table/Note	Type of comment	Comment (justification for change) by the MB	Proposed change by the MB	Secretariat observations on each comment submitted
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	

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IEC SC 59D : PERFORMANCE OF HOUSEHOLD AND SIMILAR ELECTRICAL LAUNDRY APPLIANCES	
SECRETARIAT: Italy	SECRETARY: Ms Milena Presutto
OF INTEREST TO THE FOLLOWING COMMITTEES:	PROPOSED HORIZONTAL STANDARD: ☐ Other TC/SCs are requested to indicate their interest, if any, in this CD to the secretary.
FUNCTIONS CONCERNED: ☐ EMC ☒ ENVIRONMENT ☐ QUALITY ASSURANCE ☐ SAFETY	

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TITLE:

Washing machines for household use – Methods for measuring the performance

NOTE FROM TC/SC OFFICERS:

The CD of the 6th Edition of IEC 60546 is circulated under the maintenance procedure of this IS to collect comments from SC59D members. The text has been prepared by SC59D/MT15 under the convenorship of Mr. Phillip Robinson (AU). In this first CD a number of information are still missing and will be added as soon as available at a later stage.

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

WASHING MACHINES FOR HOUSEHOLD USE - METHODS FOR
MEASURING THE PERFORMANCE

FOREWORD

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International Standard IEC 60456 has been prepared by subcommittee 59D: Performance of household and similar electrical laundry appliances, of IEC technical committee 59: Performance of household and similar electrical appliances.

This sixth edition cancels and replaces the fifth edition published in 2010 and its corrigendum published in 2011 and constitutes a technical revision.

Experience with the use of the fifth edition of IEC 60456 highlighting the necessity to revise, certain test conditions and the continuous effort towards a more globally applicable standard, are the main reasons for this sixth edition.

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

- a) Separation of the test method results from the number of **test runs** in a **test series**, by ensuring the independence of each **test run** or **test series**, allowing different **test classes** to be evaluated.
- b) Introduction of a new standard powder detergent IEC-P, that substitutes the standard powder detergent IEC-A* by replacing sodium perborate with sodium percarbonate, for a better correlation with market offerings and in line with health/safety recommendations.

Introduction of the new standard liquid detergent IEC-L and of the new wool standard detergent IEC-W with associated dosage instructions.

- c) Introduction of new measurement and evaluation methods for:
- i) **wool cleaning performance**
 - ii) LAS rinsing effectiveness
 - iii) **gentleness of action**
 - iv) low power mode consumption
 - v) temperature inside the laundry load
 - vi) **intermittently recurring functions**
 - vii) **cold water washing machines**
 - viii) **cleaning performance**
- d) Addition of alternative ambient conditions for conditioning of the **test load** with associated correction factors.
- e) Extension of the description of the **washing machine** loading, up to and beyond 25kg of cotton **test load**, and introduction of a new mixed polyester-cotton load.
- f) Addition of the necessary definitions, measurement and calculation methods for the evaluation of **multi-compartment washing machines**.
- g) Relocation of supplementary information to the IEC free-access Supporting Documents dashboard: **reference machine** maintenance information, **test materials** supplier information, expanded uncertainty values and any other pertinent information for the general public.

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

Draft	Report on voting
XX/XX/FDIS	XX/XX/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 language used for the development of this International Standard is English.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/standardsdev/publications. 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.

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

The National Committees are requested to note that for this document the stability date is publication date plus 6 years.

INTRODUCTION

The International Electrotechnical Commission (IEC) draws attention to the fact that it is claimed that compliance with this document may involve the use of a patent. IEC takes no position concerning the evidence, validity, and scope of this patent right.

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WASHING MACHINES FOR HOUSEHOLD USE - METHODS FOR MEASURING THE PERFORMANCE

1 Scope

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

Note 1 to entry: Household **washer-dryer** combined performance is assessed to IEC 62512

Note 2 to entry: Household tumble dryer performance is assessed to IEC 61121.

The object is to state and define the performance characteristics of household **washing machines**, the washing related functions of **washer-dryer** and **spin extractors** and to describe the test methods for measuring these characteristics.

This international standard does not apply to **washing machines** for commercial use such as in laundries.

Note 3 to entry: The preparation of methods for measuring the performance of **washing machines** for commercial use is under evaluation

This International Standard does not specify the acoustical noise measurement for household **washing machines**.

Note 4 to entry: Acoustical noise measurements and evaluation for household **washing machines** are specified in IEC 60704-1, IEC 60704-2-4 and IEC 60704-3.

This International Standard is not intended to be used for the comparative evaluation of detergents.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

CIE 15.4, 4th Edition, 2018 – Colorimetry

IEC 60027-1:1992+AMD1:1997+AMD2:2005 CSV - Letters symbols to be used in electrical technology - Part 1: General

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 139:2005 + Amd.1:2011 Textiles- Standard atmospheres for conditioning and testing

ISO 11664-2:2007, Colorimetry — Part 2: CIE standard illuminants

ISO 80000-1:2009 + Cor 1:2011, *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*

EN 12127, *Textiles – Fabrics – Determination of mass per unit area using small samples*

3 Terms, definitions and symbols

For the purposes of this document, the following terms, definitions and symbols apply. Figure 1 shows the use and the relations of definitions for performance measures.

3.1 Terms and definitions

3.1.1

washing machine

appliance for cleaning and rinsing of textiles using water, which can also have a means of extracting excess water from the textiles

3.1.2

test washing machine

washing machine that is subjected to tests described in part or all of this document in order to determine its performance

3.1.3

reference machine

specially constructed **washing machine** of known performance, which is used to increase repeatability and reproducibility of results

Note 1 to entry: It can be used to provide a known performance level within a laboratory against which to compare selected performance parameters on **test washing machines** as defined in this document

3.1.4

washer-dryer

washing machine that includes both a **spin extraction** function and also a means for drying the textiles, usually by heating and tumbling

Note 1 to entry: This document only covers the **operations** which relate to the **washing machine** function

3.1.5

spin extractor

separate water-extracting appliance that removes water from textiles by centrifugal action (**spin extraction**)

3.1.6

standard extractor

spin extractor used to remove water remaining in the **base load** at the completion of the **programme** where a rinse performance measurement is required

3.1.7

vertical axis washing machine

washing machine in which the load is placed in a drum that rotates around an axis which is vertical or close to vertical.

Note 1 to entry: For the purposes of this document, vertical axis is where the angle of the axis of rotation is more than 45° to horizontal. Where the drum does not rotate, the **washing machine** shall be classified as a **vertical axis washing machine**.

Note 2 to entry: The classification of vertical axis or horizontal axis in this document is only used to define the placement of the load into the drum

3.1.8**horizontal axis washing machine**

washing machine in which the load is placed in a drum that rotates around an axis which is horizontal or close to horizontal.

Note 1 to entry: For the purposes of this document, horizontal axis is where the angle of the axis is less than or equal to 45 degrees to horizontal.

Note 2 to entry: The classification of vertical axis or horizontal axis in this document is only used to define the placement of the load into the drum.

3.1.9**automatic machine**

washing machine where the load is fully treated by the machine without the need for user intervention at any point during the **programme** prior to its completion

3.1.10**manual washing machine**

washing machine where the machine requires user intervention at one or more points during the **programme** to enable the machine to proceed to the next **operation**

Note 1 to entry: Examples of user intervention could include manual fill (non-automatic water level), transfer of the load between a washing drum and a **spin extractor** drum or manual draining

Note 2 to entry: **Manual washing machines** have special requirements regarding the **programme** which is tested - see Annex M.

3.1.11**multi-compartment washing machine**

washing machine equipped with more than one drum whether in separate units or in the same casing

3.1.12**cold water washing machine**

a **washing machine** which does not have an internal heater to heat up water or washing liquor and does not use any kind of externally pre-heated water or washing liquor

3.1.13**test run**

performance assessment of one **programme** execution in the **test washing machine**

3.1.14**test series**

group of **test runs** on a single **test washing machine** or multiples of the same model **test washing machines** which, collectively, are used to assess the performance of a **washing machine** and the statistical variability of this performance applied to the general population of the model tested unit

3.1.15**test class**

purpose of the **test series**

Note 1 to entry: Multiple tests on a single **test washing machine**: provide a statistical basis to assess the performance variability of a single **programme** on a single **test washing machine** when run under identical conditions

Note 2 to entry: Single test on multiple **test washing machines** provides a statistical basis to assess the performance variability over the manufacturing process using a single **programme** when run on multiple identical **test washing machines** under identical conditions

Note 3 to entry: Statistical independence of **test runs** and **test series** requires normalisation between runs and series to minimise carryover effects. Refer to Annex O for guidance.

3.1.16**cycle**

complete washing process, as defined by the **programme** selected, consisting of a series of **operations** (wash, rinse, spin, etc.) and including any **operations** that occur after the completion of the **programme**

Note 1 to entry: Examples of **operations** that can occur after the completion of the **programme** are pumping, monitoring and anti-creasing (where applicable)

3.1.17

run in parallel

means on the same working day under the same testing conditions and for the same test unit(s)

Note 1 to entry: This definition refers to the running of the **reference machine** in relation to the running of the **test washing machine**

Note 2 to entry: The intention is that the **reference machine** should be tested so far as possible under the same conditions as the **test washing machine**. If it is known that the actual test conditions vary significantly during the day it may be necessary to test the **reference machine** at the exact same time as the **test washing machine** to ensure that both machines are tested under the same conditions.

3.1.18

operation

each performance of a function that occurs during the **programme** such as pre-wash, washing, rinsing, draining or spinning

3.1.19

programme

series of **operations** that are pre-defined within the **washing machine** and which are declared by the manufacturer as suitable for washing certain textile types

3.1.20

multi-drum mode

operational mode of a **multi-compartment washing machine** where some or all of the drums are operated simultaneously with the **simultaneous programmes**.

Note 1 to entry: This definition applies only when two or more drums in a **multi-compartment washing machine** operate simultaneously with the **simultaneous programmes**

Note 2 to entry: A **multi-compartment washing machine** with more than one drum for the treatment of the textiles, where at least two of the drums cannot be operated simultaneously is not regarded as having a **multi-drum mode**.

Note 3 to entry: A **multi-compartment washing machine** with at least two drums that can be operated simultaneously with the **simultaneous programmes** and at least one drum that cannot be operated simultaneously is regarded as having a **multi-drum mode** only for those drums that can be operated simultaneously..

3.1.21

simultaneous programme

series of **operations** which are pre-defined within the **multi-compartment washing machine** and which are declared by the manufacturer as suitable for washing certain textile types in two or more drums at the same time

Note 1 to entry: This **programme** can be also used for drums that can be operated separately

3.1.22

intermittently recurring function

function that occurs before, during or after some but not all **cycles** of a specific **programme** (or **programmes**) and which alters water consumption, energy consumption and / or **programme duration** for the **cycle**

Note 1 to entry: Examples are water softening **operations**, water reuse **operations** or similar **operations**

3.1.23

spin extraction

water-extracting function that removes water from textiles by centrifugal action

Note 1 to entry: This is included as a function (built in **operation**) of an automatic **washing machine**, but it can also be performed by a **spin extractor**

3.1.24

spin speed

rotational frequency of a drum during **spin extraction**

Note 1 to entry: A method for determination of **spin speed** is not defined in this standard

3.1.25

base load

textile load used for testing without **tracer textiles**

3.1.26**test load**

base load used for testing including **tracer textiles**

3.1.27**test load mass**

actual mass of the **base load** plus **tracer textiles**, where applicable

3.1.28**nominal test load mass**

mass of dry textiles of a particular type for which the performance of the **test washing machine** shall be tested (**rated capacity** or partial load)

Note 1 to entry: The **nominal test load mass** is the target value for the conditioned **test load mass**

3.1.29**rated capacity**

maximum mass in kg of dry textiles of a particular type that the manufacturer declares can be treated in the **washing machine** on the **programme** selected; when a **multi-compartment washing machines** operates in **multi-drum mode** the **rated capacity** is considered for each individual drum

3.1.30**combined rated capacity**

sum of rated capacities of all drums operating in **multi-drum mode** with the **simultaneous programme**

3.1.31**programme duration**

duration from the initiation of the **programme** (excluding any user programmed delay) until the completion of the **programme**

Note 1 to entry: If the **end of programme** is not indicated, the **programme duration** is equal to the **cycle duration**

3.1.32**combined programme duration**

the duration from the simultaneous initiation of the **simultaneous programme** for two or more drums (excluding any user programmed delay) until the end of the **simultaneous programme**.

Note 1 to entry: If the **end of programme** is not indicated, the **combined programme duration** is equal to the **combined cycle duration**

3.1.33**end of programme**

programme is complete when the **washing machine** indicates the end of the **programme** and the load is accessible to the user

Note 1 to entry: Where there is no **end of programme** indicator and the door is locked during **operation**, the **programme** is complete when the load is accessible to the user.

Note 2 to entry: Where there is no **end of programme** indicator and the door is not locked during **operation**, the **programme** is complete when the power consumption of the appliance falls to a steady state condition and it is not performing any function.

Note 3 to entry: An indication of the end of the **programme** may be in the form of a light (on or off), a sound, an indicator shown on a display or the release of a door or latch. In some **washing machines** there may be a short delay from an **end of programme** indicator until the load is accessible by the user.

3.1.34**cycle duration**

duration from the initiation of the **programme** (excluding any user programmed delay) until all activity ceases

Note 1 to entry: Activity is considered to have ceased when the power consumption reverts to a steady state condition that persists indefinitely without user intervention.

Note 2 to entry: If there is no activity after the end of the **programme**, the **cycle duration** is equal to the **programme duration**.

Note 3 to entry: **Cycle duration** includes any activity that may occur after the **programme** is completed. This could include any electronic activity or any additional mechanical activity that occurs for a limited period after the **programme** indicator. Any cyclic event that occurs indefinitely is considered to be steady state

3.1.35**combined cycle duration**

duration from the simultaneous initiation of the **simultaneous programme** for two or more drums (excluding any user programmed delay) until all activity ceases; activity is considered to have ceased when the power consumption reverts to a steady state condition that persists indefinitely without user intervention.

Note 1 to entry: **Cycle duration** includes any activity that may occur after the **simultaneous programme** is completed. This could include any electronic activity or any additional mechanical activity that occurs for a limited period after any end of **simultaneous programme** indicator. Any cyclic event that occurs indefinitely is considered to be steady state.

Note 2 to entry: If there is no activity after the end of the **simultaneous programme**, the **combined cycle duration** is equal to the **combined programme duration**

3.1.36**main wash duration**

duration from the commencement of the initial water intake for the main wash until the commencement of the initial water intake for the first rinse

Note 1 to entry: Variations in the laboratory water supply pressure may affect the **main wash duration**. This definition is only applicable to **test washing machines**. The **reference machine** wash duration used for calibration of the **reference machine** is defined differently.

3.1.37**remaining moisture content****RMC**

measure for the additional amount of moisture that is contained in the **base load** in relation to the equilibrium condition for **base load** items which have been conditioned in a controlled space

Note 1 to entry: This equilibrium condition is defined as 0 % **remaining moisture content** in this document. Hence it is possible for a **base load** or load items to have a negative **remaining moisture content** when treated with a tumble drier

3.1.38**off-mode**

condition in which the **test washing machine** is connected to the mains and is not providing any function

Note 1 to entry: The following shall also be considered as off mode:

a) conditions providing only an indication of **off-mode**;

b) conditions providing only functionalities intended to ensure electromagnetic compatibility

[SOURCE: EN 60456:2020, 3.1.28]

3.1.39**standby mode**

condition where the **test washing machine** is connected to the mains and provides only the following functions, which may persist for an indefinite time:

(a) reactivation function, or reactivation function and a mere indication of enabled reactivation function; and/or

(b) reactivation function through a connection to a **network**; and/or

(c) information or status display; and/or

(d) detection function for emergency measures

[SOURCE: EN 60456:2020, 3.1.220]

3.1.40**network**

communication infrastructure with topology of links, an architecture, including the physical components, organizational principles, communication procedures and formats protocols

[SOURCE: EN 60456:2020, 3.1.221]

3.1.41**delay start**

condition where the user has selected a specified delay to the beginning of the **cycle** of the selected **programme**

[SOURCE: EN 60456:2020, 3.1.Z22]

3.1.42**wrinkle guard function**

operation of the **test washing machine** after completion of a **programme** to prevent excessive wrinkling of the load

[SOURCE: EN 60456:2020, 3.1.Z23]

3.1.43**rated voltage**

voltage assigned to the appliance by the manufacturer

3.1.44**test material**

used to analyse differences in a parameter of the washing performance, including **tracer textiles**, **base load** and other **test materials**

3.1.45**tracer textile**

textile-based **test material** as **standard stain strip**, **wool stain strip**, **cold water stain strip**, **thread removal specimen** and **wool shrinkage specimen**, excluding the **base load**

3.1.46**stain swatch**

individually soiled swatches on the same white basic cotton fabric used in stain strip

3.1.47**standard stain strip**

consists of 5 different standard **stain swatches**, plus an unsoiled swatch of the same white basic cotton fabric

3.1.48**wool stain strip**

consists of two different wool **stain swatches** used in wool performance testing

3.1.49**cold water stain strip**

consists of 3 different cold water **stain swatches**, plus an unsoiled swatch of white basic cotton fabric, used in **cold water cleaning performance** testing

3.1.50**ballast soil**

is a soiled swatch intended to generate a defined soil ballast impact during a wash

3.1.51**gentleness of action****GoA**

defines the influence of the washing process of a **washing machine** on irreversible changes of textile properties

Note 1 to entry: These changes can be visible or non-visible, as for example loss of tensile and tear strengths, surface friction as abrasion or pilling, and structural disorientation.

3.1.52**thread removal specimen**

woven polyamide fabrics with an open structure to all sides, allowing loosening of threads by mechanical impact - used for **gentleness of action** (GoA) testing

3.1.53**GoA-A**

is a **thread removal specimen** without a covering item as used in the **wool cleaning performance** test

3.1.54**GoA-B**

is a **thread removal specimen** in a covering item as used in all non-wool **cleaning performance** tests

3.1.55**wool shrinkage specimen**

specific wool fabric pieces intended to show the extent of wool shrinkage due to a wool wash

3.1.56**washing machine performance**

performance of the **washing machine**, such as **standard cleaning performance**, **wool cleaning performance**, **cold water cleaning performance**, **remaining moisture content**, rinsing performance, energy consumption, water consumption, **programme duration**, **gentleness of action** (GoA), wool shrinkage

3.1.57**washing performance with tracer textiles**

result of performance tests with **tracer textiles**

EXAMPLE **Standard cleaning performance**, **wool cleaning performance**, **cold water cleaning performance**, wool shrinkage and **gentleness of action** (GoA) or combinations of such.

3.1.58**cleaning performance**

washing performance with tracer textiles of the **test washing machine** related to the **washing performance with tracer textiles** in a washing **programme** in a **reference machine**

3.1.59**standard cleaning performance**

cleaning performance of a cotton **base load**

3.1.60**wool cleaning performance**

washing performance of wool wash **programmes** of the **test washing machine** related to the wool **washing performance with tracer textiles** in a wool washing **programme** in a **reference machine**

3.1.61**cold water cleaning performance**

washing machine performance of **cold water washing machine** of the **test washing machine** related to the cold water **washing performance with tracer textiles** in a cold washing **programme** in a **reference machine**

3.1.62**LAS rinsing performance**

linear alkylbenzene sulfonate surfactant rinsing performance

performance of the **washing machine** at extracting surfactant parts of the detergent used in the washing process by rinsing with tap water

3.1.63**alkalinity rinsing performance**

performance of the **washing machine** at extracting soluble parts of the detergent used in the washing process by rinsing with tap water

3.2 Washing machine performance overview

Figure 1 shows an overview of the different performance and consumption measures for the **washing machine** performance.

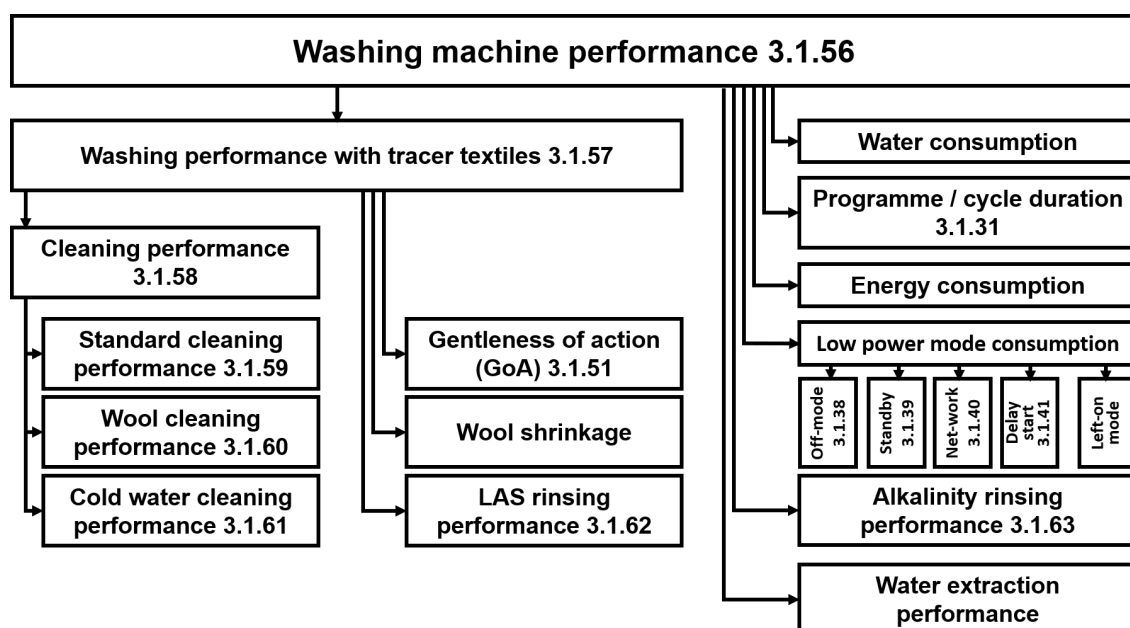


Figure 1 – Overview of the different performance measures

3.3 Symbols

3.3.1 General

The following rules for creation of symbols have been applied:

- Rules for the use of symbols and subscripts as given in IEC 60027
- Use of SI symbols
- Use of the same letters and symbols for all product standards under IEC SC59D for the same quantities
- Use of upper-case for quantities and lower case for specific values
- Multiple subscripts are separated by comma

3.3.2 Key to symbols

Table 1 – System of symbols consisting of variables, superscripts and subscripts title

Symbol	Unit	Definition
<i>O</i>	cycles	Age of textile
$N_{n,j} / n$		Number of items of the same type and age / number of test runs
<i>u</i>	mmol/L	Alkalinity per extracted water
<i>w</i>	meq/kg	Alkalinity concentration per kg base load
<i>c</i>	mg/L	Concentration
σ	S/m	Conductivity
<i>d</i>	%	Condensation efficiency
<i>dil</i>		Dilution factor
<i>Y</i>		Reflectance value / Tristimulus Y value
$\bar{Y}$		Sum of the Tristimulus Y values over all stain types in a stain strip
<i>h</i>	mmol / L	Water hardness
<i>W</i>	L	Water consumption

E^*	kWh	Energy consumption
C		Cleaning performance
Q		Washing performance (see Annex O)
v	m ³ /min	Volumetric flow rate
P^*	W	Electric power
r		Rinsing index
t^*, D	s or min	Time / Programme duration
v, V^*	L or m ³	Volume
m^*	g	Mass
μ	%	Moisture content
S		Evenness of drying
q		Ratio of results from the test washing machine and the reference machine
ρ^*	kg/l	Density of water
K		Constant
b	%	Shrinkage rate
B		Shrinkage Rate Index
ϑ / T^*	° C / K	temperature in ° Celsius / thermodynamic temperature
l, h^*	m	Length
G	remaining threads	Gentleness of Action
GoA		Gentleness of Action ratio of results from the test washing machine and the reference machine
A		Absorbance for LAS rinsing measurement
D	mg / g	Mass of detergent recovered per gram of test swatch
L	g / kg	Mass of detergent per kg of load
a, e		Intercept and slope of the detergent concentration curve
p	N/m ² = Pa	pressure if needed
F		Frequency of occurrence / Factor
α		number of test runs in a test series
β		number of stain strips in a test run
γ		number of stain swatches on a stain strip
Superscripts		Definition (or similar for other programmes / temperatures)
$c60$		Cotton 60 °C cycle (may be omitted if clear from the context of use or only written as 'c')
$s40$		Synthetics/ blends 40 °C cycle (may be omitted if clear from the context of use or only written as 's')
$w30$		Wool 30°C cycle (may be omitted if clear from the context of use or only written as 'w')
cw		Cold water

* Symbol according to IEC 60027 or SI-symbol

Subscripts	Definition
<i>w</i>	Washing/cleaning cycle
<i>d</i>	Drying cycle
<i>ct</i>	Continuous operation cycle
<i>wd</i>	Complete operation cycle wash and dry
<i>s</i>	Starting / initial value
<i>f</i>	Final value
<i>t</i>	Target value
<i>0</i>	Conditioned / unwashed
<i>p</i>	Partial load of the base load
<i>m</i>	Measured value
<i>bd</i>	bone-dry
<i>in</i>	inlet
<i>l, r</i>	Length / warp direction or width / weft / filling direction
<i>a</i>	Area
<i>cv</i>	Corrected value
<i>om</i>	Off-mode
<i>sm</i>	Standby mode
<i>ns</i>	Networked standby mode
<i>ds</i>	Delay start mode
<i>c</i>	Cold water
<i>h</i>	Hot water
<i>L</i>	Load
<i>W</i>	Water
<i>Det</i>	Detergent
<i>Tst</i>	Test washing machine
<i>Ref</i>	Reference machine
<i>min</i>	Minimum
<i>max</i>	Maximum
<i>Fe, Cu, Mn, Cl⁻</i>	Chemical elements
λ , 223, 330	Wave length of photospectrometer
<i>wss</i>	Working Standard Solution
<i>i</i>	Running number / sequence
<i>j</i>	Index within a test run , e.g. soil type or age class of test load
<i>k</i>	Index within an individual item, e.g. swatch / stain strip or age class number
<i>n</i>	Index within a test series , e.g. test run number or type of bases load
Statistical values	
$\bar{}$ (bar)	Average / mean (bar above the variable)

σ	Standard deviation
<i>CI</i>	Confidence interval

4 Requirements

4.1 General

This document describes test methods for the measurement of following performance parameters:

- **Standard cleaning performance**
- **Wool cleaning performance**
- **Cold water cleaning performance**
- **Alkalinity rinsing performance and LAS rinsing performance**
- Water extraction performance
- Water consumption
- Energy consumption
- Low power modes (including off mode, **standby mode**, **delay start**, with or without **network connection**)
- **Programme duration and cycle duration**
- Wool shrinkage
- **Gentleness of action (GoA)**

Any claims of performance referring to this document for these parameters shall be measured in accordance with the requirements of this document (refer to clause 7 for details).

This document does not specify minimum performance requirements for clothes **washing machines**.

4.2 Rated capacity

The manufacturer or supplier shall declare the **rated capacity** at 0,5 kg intervals for each relevant textile type. Relevant textile types are cotton, synthetics/ blends and wool.

NOTE The **rated capacity** of a **washing machine** usually varies according to the textile type.

The **rated capacity** for any textile type shall not exceed the maximum mass of dry laundry, in kilograms, to be used in the **test washing machine** in accordance with IEC 60335-2-7.

When the manufacturer or supplier provides a range of values for the **rated capacity** with a particular textile type, the highest value shall be used for related tests.

Where information on the **rated capacity** is not available, the **test load mass** shall be determined according to Annex N.

If the **rated capacity** for synthetics/ blends and wool is not specified by the manufacturer or supplier, the **test load** shall be 40 % and 20 % respectively of that for cotton.

4.3 Dimensions

Where a manufacturer declares dimensions, these shall be in accordance with the following requirements, as applicable. The dimensions shall be given in centimetres and shall be rounded to the nearest whole centimetre.

- Height a_1 = vertical dimension measured from the floor to a horizontal plane at the maximum height of the **washing machine**, with the door/lid closed. If adjustable levelling feet are provided, they shall be moved up and down to determine minimum and maximum possible heights.
- Height a_2 = maximum vertical dimension measured from the floor to a horizontal plane at the maximum height of the **washing machine** with the door/lid open (generally when at right angles to the machine top). If adjustable levelling feet are provided, they shall be moved up and down to determine minimum and maximum possible heights.
- Width b = horizontal dimension, between the sides, as measured between two parallel vertical planes against the sides of the **washing machine** including all projections.
- Depth c_1 = horizontal dimension as measured from a vertical rear plane against the back of the **washing machine** and the most prominent part of the front fascia, with the door/lid closed. For this measurement, the door thickness, knobs and handles are generally not included in the measurement.
- Depth c_2 = horizontal dimension as measured from a vertical rear plane against the **washing machine** and the most prominent part of the front, knobs and handles also being taken into account, with the door/lid open (generally when at right angles to the machine front).
- Drum volume = the volume of a **washing machine** or **spin extractor**, where required, shall be determined in accordance with Annex N.

NOTE 1 Dimension c_1 is intended to provide an indication of the required depth for the **washing machine** where the fascia is intended to be flush with adjacent furniture or appliances.

NOTE 2 Dimension a_2 is generally only applicable to top loading **washing machines** while dimension c_2 is generally only applicable to front loading **washing machines**.

5 Test conditions, materials, equipment and instrumentation

5.1 General

The tolerances specified for parameters within this document, using the symbol "±", indicate the allowable limits of variation from the specified parameter, outside of which the test or results shall be invalid. The statement of tolerance does not permit the deliberate variation of these specified parameters.

Rounding means replacing the magnitude of a given number by another number called the rounded number, selected from the sequence of integral multiples of a chosen rounding range. Rounding shall only be applied to reported values with a rounding range as defined in Annex S, to the nearest number according to ISO 80000-1:2009 + Cor 1:2011 Annex B, following B.3 Rule B. If the rounding takes place to the right of the comma, the omitted places shall not be filled with zeros. Rounding in more than one stage by the application of the rules given above may lead to errors. Therefore, calculations requested within this document shall always use the precise value of a measurement (without rounding) and apply rounding according to Annex S only on the final result. An example is given in Annex S.

Unless otherwise specified, the **reference machine** shall be considered a **test washing machine** with respect to conditions, materials and equipment specified.

NOTE Justification for the selected specifications and the consequences of deviations can be found in Annex P

5.2 Test conditions

5.2.1 Electricity supply

The supply voltage to each **test washing machine** shall be maintained at the **rated voltage** ±2 % throughout the test. If a voltage range is indicated, then the supply voltage shall be the nominal voltage of the country in which the appliance is intended to be used. The supply voltage measured during the tests shall be recorded.

The supply frequency to each **test washing machine** shall be maintained at the rated frequency $\pm 1\%$ throughout the test. If a frequency range is indicated, the test frequency shall be the nominal frequency of the country in which the machine is intended to be used.

NOTE Voltage stabilisers should be designed such that the normal **operation** of the **test washing machine** does not cause undue distortion of the voltage waveform.

5.2.2 Water supply

5.2.2.1 General

The measured total water hardness, water temperature and water pressure of water supplied to **test washing machines** shall comply with the following requirements and shall be reported. This water is generally referred to as laboratory supply water in this document.

5.2.2.2 Water hardness

For all treatments of the **test load** prior to a **test series** and all **washing machine test runs** in accordance with this document either hard water or soft water may be used. If hard water is used it shall have a total water hardness of $(2,5 \pm 0,2)$ mmol/l. If soft water is used it shall have a total water hardness of $(0,5 \pm 0,2)$ mmol/l.

Normalisation of a **base load** prior to use in a **test series** (refer to 6.4.4) shall always be performed using laboratory supply water with the same total water hardness as that used for the subsequent **test series**.

Total water hardness is determined and expressed in mmol/l of CaCO_3 equivalent.

If total water hardness needs to be adjusted, it shall be prepared according to IEC 60734.

Measurements of total water hardness shall be undertaken on water that is representative of the laboratory supply water used for tests.

5.2.2.3 Water temperature

The water supply system shall be configured so that the temperature of all water entering the inlet hose of the **test washing machine** is within specified tolerance with the exception of up to 250 ml of each increment. A temperature recording system shall record inlet water temperature at intervals of no less than once per second.

The temperature of the laboratory supply water to each **test washing machine** shall be measured and recorded to the nearest $0,1\text{ }^\circ\text{C}$.

The cold water supply temperature shall be $(15 \pm 2)\text{ }^\circ\text{C}$ for **standard cleaning performance** tests, for wool wash **cleaning performance** tests and for all reference **programmes**.

For cold water wash **cleaning performance** tests the cold water supply temperature shall be within a range from $15\text{ }^\circ\text{C}$ to $25\text{ }^\circ\text{C}$ (refer to 8.9.1).

The hot water supply temperature shall be the temperature indicated by the manufacturer $\pm 2\text{ K}$, or $(60 \pm 2)\text{ }^\circ\text{C}$, if no value is given.

When the manufacturer specifies a hot water temperature range, which includes $(60 \pm 2)\text{ }^\circ\text{C}$, the hot water temperature shall be set at $(60 \pm 2)\text{ }^\circ\text{C}$. When the manufacturer specifies a hot water temperature range which does not include $(60 \pm 2)\text{ }^\circ\text{C}$, the hot water temperature shall be set at the highest value in the temperature range which is closest to $(60 \pm 2)\text{ }^\circ\text{C}$. When the manufacturer specifies a single temperature with a tolerance, then that temperature shall be used.

The hot and cold water inlet supply temperatures (as applicable) shall be determined as close as possible to the point of connection of each **test washing machine** to the laboratory water supply system.

NOTE 1 It is recommended that temperature be the last parameter measured before the supply point to the **washing machine**. Clause 8 requires water temperatures and volumes to be recorded on a continuous basis (see Annex Y.1) during filling in order to determine weighted average temperature.

NOTE 2 Some countries specify a hot water temperature for regulatory purposes, in which case this water temperature should be used for testing

NOTE 3 Annex X provides a measurement and evaluation method for the determination of the representative maximum temperature reached inside the **base load** during washing.

NOTE 4 Justification for the selected specifications and the consequences of deviations can be found in Annex P.8

5.2.2.4 Water pressure

The static (gauge) pressure of the laboratory supply water at the inlet to each **test washing machine** shall be maintained at (240 ± 50) kPa throughout the test, including during filling operations. The water supply to the **reference machine** shall be in accordance with E.1.3.1.

The hot and cold water pressures (as applicable) shall be determined as close as practicable to the point of connection of each **test washing machine** to the laboratory water supply system. The measured pressure shall be rounded to the nearest whole 10 kPa to compare with the allowed range.

5.2.3 Ambient temperature and humidity

5.2.3.1 Ambient temperature and humidity for **washing machine** testing

The ambient temperature of the test room shall be maintained at (23 ± 2) °C throughout the **washing machine** test. The measured ambient temperature for **washing machine** testing shall be reported, rounded to the nearest 0,5 °C.

The ambient humidity is not specified for **washing machine** testing.

NOTE Justification for the selected specifications and the consequences of deviations can be found in Annex P.9.

5.2.3.2 Ambient temperature and ambient relative humidity for conditioning of **base load** items

Base load conditioning shall be either by the bone-dry method or by ambient controlled chamber. Applicable correction factors to achieve comparable measures of the conditioned load mass are described in Annex G.

Where an ambient controlled room or chamber is used for conditioning the **base load**, the following conditions shall be maintained:

- Either standard atmosphere: (20 ± 2) °C and (65 ± 5) % relative humidity (refer to ISO 139:2005 + Amd.1:2011)
- Or alternative ambient conditions (23 ± 2) °C and (55 ± 5) %

The method of applying correction factors to measured values of ambient temperature and relative humidity and for conditioning **base load** items shall be reported. The ambient temperature shall be rounded to the nearest 0,5 °C. The ambient relative humidity shall be rounded to the nearest whole percentage.

NOTE Specific requirements regarding conditioning of the **base load** are specified in 6.4. As an alternative to using a controlled room or chamber for conditioning the **base load**, the bone-dry method may be used as described in 6.4.5.3.

5.2.3.3 Ambient pressure

The atmospheric pressure at the test location shall be reported. This is to allow the atmospheric pressure of the test location to be considered when the test results are verified or compared..

5.3 Test materials

This section sets out the specifications for textile **test materials** and the detergents required for the washing performance testing according to this document, including:

- **base loads** (load items) as specified in Annex D
 - Cotton as specified in D.1 as used in 8
 - Synthetics/ blends as specified in D.2 as used in 8
 - Polyester as specified in D.3 as used in 8
 - Polycotton as specified in D.4 as used in 8

- 611 • **standard stain strips** as specified in A.2.1 as used in 8.4
- 612 • **wool stain strips** as specified in A.2.2 as used in 8.8
- 613 • **cold water stain strips** as specified in A.2.3 as used in 8.9
- 614 • **wool shrinkage specimen** as specified in A.3 as used in Annex W
- 615 • **thread removal specimen** as specified in A.4 as used in 8.7
- 616 • IEC-P detergent as specified in B.1 as used in 8
- 617 • IEC-W wool detergent as specified in B.3 as used in 8.8 and Annex W
- 618 • IEC-L detergent as specified in Annex C

619 There are two ways to include **thread removal specimens** for testing (8.7):

620 **GoA-A** is used for **gentleness of action** evaluation in the **wool cleaning performance** test;

621 **GoA-B** is used for **gentleness of action** evaluation in all **cleaning performance** tests except
622 **wool cleaning performance**.

623 NOTE 1 This differentiation is made to ensure a large enough range of measurable values for **Gentleness of Action**
624 tests

625 NOTE 2 Suitable sources of **test materials** are given in U.3

626 NOTE 3 Justification for the selected specifications and the consequences of deviations can be found in Annex P.4
627 and P.5

628 5.4 Equipment

629 5.4.1 General

630 This section sets out the specifications for specialized test equipment required for **washing**
631 **machine** testing to this document, including:

- 632 • **reference machine**
- 633 • spectrophotometer
- 634 • equipment for conditioning the **base load**
- 635 • **standard extractor**
- 636 • iron
- 637 • titration equipment

638 A checklist of other laboratory equipment which may be required for **washing machine** testing
639 is provided in 5.4.9.

640 5.4.2 Reference machine

641 A **reference machine** shall be **run in parallel** with the **test washing machine**, applying the
642 same procedure to both machines to provide a measure of relative performance and
643 reproducible results.

644 NOTE 1 For wool shrinkage tests, the **reference machine** is used to calibrate shrinkage of **wool shrinkage**
645 **specimens** and is not normally operated in parallel with the **test washing machine**.

646 Specifications for the **reference machine** are given in Annex E and Annex F

647 NOTE 2 Justification for the selected specifications and the consequences of deviations can be found in Annex P.2

648 For the purposes of this document, the **test load mass** used in the **reference machine** shall
649 always be

- 650 • 5,0 kg for cotton **programmes**
- 651 • 2,0 kg for synthetics/ blends **programmes**
- 652 • 1,0 kg for the wool **programme**.

653 NOTE 2 When the **reference machine** is used to normalise the **base load** between **test runs** and series, the
654 maximum mass of dry **base load** which can be normalised in the **reference machine** is different from the **test load**
655 **masses** above. Refer to 6.4.4

5.4.3 Spectrophotometer

Optical measurements of each of the different stain strip pieces after washing are performed using a spectrophotometer. The minimum instrument specification is provided below:

Measuring instrument	spectrophotometer that provides reflectance data at a minimum of 16 wavelengths spaced at 20 nm intervals or closer, in the range 400 nm and 700 nm
Parameter	tristimulus value Y (CIE No 15.2, 1986)
Illuminant / observer	D65 / 10° – ISO 11664-2/CIE S 014-2/E
Measuring geometry	d / 8°
UV-filter	The ultraviolet filter shall have a spectral transmittance of $\leq 0,01$ at wavelengths of 400 nm and less, and a spectral transmittance of $\geq 0,80$ at wavelengths in the range 450 nm to 700 nm
Measurement aperture	minimum 20 mm diameter

NOTE 1 Where a measurement aperture is not circular, an aperture area of not less than 314 mm² is acceptable.

Gloss / specular excluded, i.e. measurement with open gloss / specular trap

Calibration The calibration process shall be performed at least once a day during continuous use or after any restart of the device using:

- white standard: barium sulphate tablet or certified white ceramic tile; and
- black standard: black body or light trap or certified black ceramic tile; or
- using procedures as specified by the instrument manufacturer.

NOTE 2 Justification for the selected specifications and the consequences of deviations can be found in Annex P.6

The spectrophotometer shall be checked for its spectral performance and measurement accuracy at least once a year.

General handling of the spectrophotometer and its use and calibration shall be in accordance with the supplier operating instructions.

5.4.4 Equipment for conditioning the **base load**

This document requires **base load** items to be treated in a controlled manner prior to their use in performance tests, in order to determine their mass under standardised ambient conditions. The alternative methods of conditioning the **base load** items are as follows:

- leaving the **base load** items in a room or chamber with a controlled ambient temperature and humidity (refer to 5.2.3.2) until their **remaining moisture content** is in equilibrium. Refer to 6.4.5.2 for details;
- treating the **base load** items in a clothes dryer of specified performance to ensure that the **base load** items are in a “bone-dry” state. Refer to 6.4.5.3 for details. Annex G sets out the method and the specifications for a tumble dryer which is used for this method.

5.4.5 Standard extractor

A **standard extractor** meeting the following specific performance requirements shall be used for the sampling when measuring residual alkalinity measurement (refer to 8.6.2.1).

The nominal inner drum diameter and nominal **spin speed** of the **standard extractor** used shall be reported.

The **standard extractor** shall have a g-force suitable for a water extraction performance which results in a **remaining moisture content** determined in accordance with 8.6 as follows:

- (39 ± 3) % for a cotton **base load** when operated with a spinning duration not more than 10 min; and

- (17 ± 3) % for a synthetics/ blends **base load** when operated with a spinning duration not more than 5 min.

Any **spin extractor** may be used as a **standard extractor** if it can be demonstrated that it can achieve the water extraction performance requirements specified above. The extraction duration or speed shall be adjusted to achieve the **remaining moisture content** specified above for the relevant load types and sizes, but this duration may not exceed 10 min for cotton or 5 min for synthetics/ blends. As reloading of the **base load** after one **spin extraction operation** is not permitted, a pre-test to determine the appropriate spin duration is required for other **spin extractors**.

Experience has shown that use of a **standard extractor** with an inner drum diameter of between 240 mm and 250 mm and a **spin speed** of approximately 2 800 r/min, using standard bundles defined in 8.6.2.1 for a period of 10 min will meet the specification above.

NOTE A **standard extractor** should be of a design that allows the user to remove any retained water in the extractor between runs.

5.4.6 Iron for preparation of stain strips after washing

Where an iron or ironing appliance is used to prepare stain strips after washing and prior to reflectance readings, it shall have a surface temperature between 100 °C and 130 °C.

5.4.7 Titration equipment

The following equipment is required when an **alkalinity rinsing performance** measurement is required under 8.6.2.

All volumetric glassware should meet all “Class A” specifications, as defined by the American Society for Testing and Materials (ASTM) Standards E 287, E 288, and E 969 unless otherwise stated (e.g. DIN 12691, “Blaubrand”)†.

pH meter: accuracy least $\pm 0,05$ pH units (2 decimal place)

Glass beaker with stirrer: sufficient size to place the pH-electrode below the surface of the sample

Titration equipment:

- manual titration (additional): burette / burette stand, 10 ml burette calibrated in 0,01 ml divisions and stopcock; or
- automatic titration (additional): microprocessor controlled titration device. Burette size: preferably 10 ml calibrated in 0,01 ml divisions. Minimum rate: 25 μ l / min or less.

Reagents: all reagents used are ACS reagent grade unless otherwise stated (e.g. puriss p.a.):

- 0,1 N hydrochloric acid: accurately standardised to four decimal places;
- water: wherever “water” is applicable, use either reverse osmosis (RO), demineralised or distilled water.

The pH meter shall be calibrated at least once a day during continuous use or after any restart of the device.

The calibration of the pH meter shall be performed at pH 7 and then at pH 4 with commercially available pH buffers.

Precautions should be initiated to avoid temperature differences between calibration and measurement phase (optimal: 23 °C). The stirring rate should also be kept equal for calibration and measurement phase. Calibration shall be in accordance with the supplier's operating instructions.

† This information is given for the convenience of users of this International Standard and does not constitute an endorsement by IEC of these brands or suppliers.

5.4.8 LAS rinsing performance equipment

Ultraviolet (UV) spectrophotometer

The absorption of the ultraviolet light shall be measured with an ultraviolet spectrophotometer with the following specifications:

- wavelength range: 190 nm to 350 nm;
- spectral bandwidth: ≤ 2 nm;
- wavelength accuracy (at D_2 peak 656,1 nm): - 0,2 nm to + 0,2 nm;
- wavelength repeatability (10 measurements at 656,1 nm, slit width 1 nm): - 0,05 nm to + 0,05 nm;
- photometric range: - 0,1 A to + 3,0 A;
- photometric accuracy (UV with $K_2Cr_2O_7$, Ph.Eur. at 1 A): - 0,02 A to + 0,02 A;
- photometric repeatability (10 measurements with $K_2Cr_2O_7$, Ph.Eur. at 1 A): - 0,002 nm to + 0,002 nm;
- The spectrophotometer shall be calibrated regularly according to the manufacturer's specification.

Quartz cuvette

- The cuvettes to be used for the measurement of the ultraviolet absorption shall be rectangular with a path length of 10 mm and be made from quartz.

Orbital shaker

- The device for the extraction of the linear alkylbenzene sulfonate shall be an orbital shaker. The orbital shaker shall have a device for securing sample bottles on it;
- Orbit: 4 mm to 20 mm;
- Shaker speed: $\geq 350 \text{ min}^{-1}$.

NOTE 1 The speed of the shaker can be checked by a tachometer, either optical by light beam reflection or mechanical by a magnetic sensor. For details it is advised to refer to the manufacturer's specification.

Scale for weighing detergent and samples

- Minimum specification: 0 g to 150 g range;
- Minimum resolution: 0,001 g;
- Accuracy: $\pm 0,002$ g.

Volumetric flask

- For the preparation of the working standards for calibration volumetric flasks with a volume of 100 ml and 1000 ml shall be used.

Magnetic stir bar

- Small, medium and large stir bars shall be used.

Pipette

- Pipette of volume 1, 2, 5, 10 and 25 ml shall be used.

Disposable glass pipettes (e.g. Pasteur pipettes)

- Disposable glass pipettes without cotton stoppers, non-sterile and with a volume of 2 ml or greater shall be used for transferring the extract to the cuvettes.

NOTE 2 A transfer pipette with disposable plastic tips can be used in place of glass pipettes after correlation tests.

Sample bottle with cap (for test swatch extraction):

- Plastic bottles with caps made from high-density polyethylene with a volume of 500 ml and a diameter of (73 ± 3) mm.

All distilled water used for extractions, dilutions and the preparation of calibration standards shall meet the following criteria:

- Conductivity at 25 °C: $\leq 1 \mu\text{S/cm}$;
- Net absorbance (223 nm to 330 nm): - 0,002 A to 0,002 A;
- Absorbance curve spectrum 200 nm to 350 nm: no relative peak absorbance greater than $\pm 0,002$ A in the range between 223 nm to 330 nm;
- The procedure for calculating these values is given in Annex J.2.

NOTE 3 Water prepared by methods other than distillation having equivalent specifications can be used instead of distilled water.

5.4.9 Other equipment

Testing of **washing machines** according to this document requires equipment for the measurement of a range of parameters. These parameters include the following:

- mass
- volume of water and other liquids
- length and dimensions
- electrical parameters (voltage, energy, frequency)
- temperature of water and air and humidity of air
- water pressure supplied to the **washing machine**
- total water hardness of the laboratory supply water supplied to the **washing machine**
- pH of the laboratory supply water and various liquors extracted from the **washing machine** and the **test load** during the test
- duration

For some of the above measurements, the specifications of instruments used to take these measurements are not explicitly defined in this document, except that the accuracy of measurement as specified in Annex Y shall be achieved.

NOTE Several different instruments for the measurement of mass are likely to be required for determining mass of load items and the whole **base load**, mass of titration liquids and mass of detergent (refer to Annex Y.9). Equipment for determination of wool shrinkage is described in Annex W.

6 Preparation for testing

6.1 General

This section sets out the requirements for the preparation of the **test washing machine** and **reference machine** prior to testing. It also specifies the requirements for the preparation of **test loads** for the **test washing machine** and the **reference machine**.

6.2 Test washing machine and reference machine preparation

6.2.1 Test washing machine

6.2.1.1 General

The measurements shall generally be carried out on a **washing machine** which is installed and used in accordance with the manufacturer's instructions, except as required by this document. Manufacturer instructions which aim at achieving more favourable results for the tested products may be disregarded if not explicitly requested in this standard. Where there is more than one option for installation, the option chosen for testing shall be documented in the test report.

NOTE Performance of an aged and/or used machine may differ from a new and/or unused machine.

6.2.1.2 Preparation of the **test washing machine** after installation

After installation, the **test washing machine** shall be run for two complete cleaning runs on a cotton **programme** with maximum wash temperature and maximum main wash water level settings if applicable, the first run without load and with 50 g of the reference detergent and the second run without load and without detergent. .

6.2.1.3 Preparation of the **test washing machine** for a **test series**

Before a **test series** is commenced, the **test washing machine** shall be checked to confirm that it has no operating defects that may affect the **operation** of the unit. Where separate inlets are supplied for both hot and cold water, they shall each be connected to an appropriate laboratory water supply system for testing (refer to 5.2.2).

All filters shall be thoroughly cleaned before each **test series**.

After cleaning the filters, a cleaning run shall be undertaken on a **programme** set to the maximum wash temperature and maximum main wash water level, if applicable, without load and without detergent. The cleaning run shall be carried out not less than one day in advance but not more than two weeks in advance and without any other run before the **test series** is started. After the cleaning run the **test washing machine** shall be allowed to cool down to the ambient temperature of the test room. It shall be accepted that this requirement has been met if the internal surface temperature of the **test washing machine** drum is at ambient air temperature of the test room, or if the **test washing machine** has been left standing at stable laboratory ambient temperature with the door left open at maximum angle for not less than 16 h. The **test washing machine** shall remain in the test room at ambient temperature for the duration of the **test series**. No additional runs or **cycles** of any type (loaded or empty) shall be undertaken on the **test washing machine** between **test runs** within a **test series** (refer to clause 7, 8 and Annex Q).

6.2.1.4 Preparation of the test machine for a **test run**

Before each **test run**, any detergent dispenser shall be clean and dry prior to the addition of detergent.

The **test washing machine** shall be at laboratory ambient temperature at the beginning of each **test run**. It shall be accepted that this requirement has been met if the internal surface temperature of the **test washing machine** drum is at ambient air temperature of the test room, or if the **test washing machine** has been left open and standing at the stable laboratory ambient temperature for not less than 2 h.

Where the **test washing machine** is equipped with a temperature sensor to determine the water temperature in the sump during the wash **operation**, the temperature measured by this sensor may be taken as an alternative to the drum temperature to assess whether the **test washing machine** is at ambient temperature.

6.2.2 Reference machine

The **reference machine** shall be checked in accordance with the requirements of E.1.3.3) prior to a **test series**. The **reference machine** start-up **programme** shall be run immediately (not more than 30 min) prior to the commencement of any **test run** (refer to F.4)

The **reference machine** shall meet the requirements of 0 before the start up **programme** is started prior to the commencement of each **test run**.

6.3 Detergent

6.3.1 General

The detergent used for all **test runs** shall be as specified in Annex B. The **reference machine** and all **test washing machines run in parallel** shall use detergent from the same batch for every **test run** in the **test series**.

This document may also be used for assessment of all performance measures (except rinsing) on **test washing machines** where the manufacturer recommends the use of no detergent and where no other consumable material is added by the user during normal use. In such cases tests on the **test washing machine** shall be performed without the addition of any consumable material (i.e. detergent) and with a connection to an electricity supply (refer to 5.2.1) and a standard laboratory water supply system (refer 5.2.2).

NOTE 1 In all cases the **reference machine** is tested using the detergent dose specified in 6.3.2 irrespective of whether detergent is used in the **test washing machine** or not.

NOTE 2 In Annex C a standard liquid detergent IEC-L is specified and its application described.

NOTE 3 Justification for the selected specifications and the consequences of deviations can be found in Annex P.3

6.3.2 Detergent dose

The detergent dose for the **reference machine** and the **test washing machine** shall be determined from the selected reference **programme** and the **test load** as set out in Table 2:

Table 2 – Detergent dose

Load type and Reference Programme	Detergent	Test Washing Machine		Reference machine	
		Dose Hard Water (refer to 5.2.2.2)	Dose Soft Water (refer to 5.2.2.2)	Dose Hard Water (refer to 5.2.2.2)	Dose Soft Water (refer to 5.2.2.2)
Cotton – all reference programmes except Cotton 20 °C and Cotton 30 °C	IEC-P	37,6 g + 11,3 g/kg	25,4 g + 7,5 g/kg	103,4 g	68,9 g
Cotton – Cotton 20 °C and Cotton 30 °C only		37,6 g + 5,6 g/kg	25,4 g + 3,8 g/kg	54,5 g	36,7 g
Synthetics/ Blends		37,6 g + 11,3 g/kg	25,4 g + 7,5 g/kg	103,4 g	68,9 g
Wool	IEC-W	54,0 g + 8,0 g/kg	36,0 g + 5,3 g/kg	70,0 g	46,7 g

NOTE 1 Please be aware that for wool shrinkage performance test (refer to Annex W) IEC-W is used and not as in the former edition the standard IEC-A* base

NOTE 2 g/kg means grams of detergent per kg of **nominal test load mass**. Dosage for **reference machine** is fixed by **programme** and load type and is a dose different from the **test washing machine**. The **reference machine** is always operated at a fixed load size, refer to 5.4.2.

NOTE 3 The quantity of detergent specified in this document is fixed by the **nominal test load mass** and water hardness. The reference detergent and the quantity specified may not be reflective of some commercial detergents.

6.3.3 Weighing and mixing of detergent

6.3.3.1 Powder detergent

Weigh the quantity of detergent components specified in Annex B to make up the detergent dose required for each single **test run**. The components shall be thoroughly mixed together prior to use. Mixed reference detergent shall be stored in a sealed container if not used immediately. The maximum storage time prior to use of reference detergent is fourteen days after mixing of detergent components. All detergent components shall be within their expiry date at the time of use.

6.3.3.2 Liquid detergent

The liquid reference detergent shall be stored at ambient temperature. It shall be mixed immediately before dosing by turning the flask carefully upside down twice.

Reference detergent shall be weighed in an appropriate way to ensure an accuracy of $\pm 0,05$ g:

- or, use a beaker glass with an empty syringe, place it on the scale and tare it. The syringe is filled with the reference detergent with a greater quantity than is specified in 6.3.2. The initial mass is recorded. Detergent is added to the test machine as outlined in 6.3.4. The mass of the syringe is checked on the scale, and dosing is continued until the amount specified in 6.3.2 is added to the test machine.

- or, use the dosing device of the test machine. Place the dosing device on the scale, tare it, and add the specified quantity of the reference detergent directly to the dosing device.

NOTE 1 Ensure that the liquid detergent does not run out of the dosing device.

- for the **reference machine**, the dosing device provided with the **reference machine** and no alternative dosing method shall be used. Place the dosing device on the scale, tare it, and add the specified quantity of the reference detergent, directly to the dosing device. Then place the dosing device in the main wash detergent compartment of the **reference machine**, lift the device so that the lip of the device protrudes between the wall and the water inlet flange of the detergent compartment and lock it in place using the mechanism on the device.

NOTE 2 Dosing device and instructions for its use are available from the manufacturer of the **reference machine**. For suppliers, see Annex U.

6.3.4 Detergent placement

6.3.4.1 Powder detergent

Where a detergent dispenser is present, the detergent dose specified in 6.3.2 shall be placed as follows:

- where dispenser is large enough to hold the whole dose, place all detergent in the dispenser; or

- where the dispenser is not large enough to hold the whole dose, fill the dispenser to the maximum level indicated and place any excess detergent for the **test run** into the base of the drum before the load is added.

Only in the case of **vertical axis washing machines**, where the manufacturer recommends in the user guide that the detergent dispenser be used only when using a **delay start** option on the machine (e.g. to avoid damage to fabrics which are in contact with the detergent), then the detergent shall be placed in the base of the drum as if the dispenser is not present.

Where there is no detergent dispenser, follow the manufacturer's instructions for detergent placement. If no instructions are given, all of the detergent is added to the base of the drum before the load is added.

6.3.4.2 Liquid detergent

Where a detergent dispenser is present, the detergent dose specified in 6.3.2 shall be placed as follows:

- where the dispenser is large enough to hold the whole dose, place all detergent in the dispenser by applying it with the syringe or the peristaltic pump; or

- where the dispenser is not large enough to hold the whole dose, fill the dispenser to the maximum level indicated and place any excess detergent for the **test run** into the base of the drum before the load is added.

For the **reference machine**, place the dosing device with the liquid detergent into the dispenser.

NOTE Dosing device is available from the manufacturer of the **reference machine**. For suppliers, see Annex U.

In the case of **vertical axis washing machines** only, where the manufacturer recommends in the user guide that the detergent dispenser be used only when using a **delay start** option on the machine (e.g. to avoid damage to fabrics which are in contact with the detergent), then the detergent shall be

placed by using the syringe or the peristaltic pump in the base of the drum as if the dispenser is not present.

Where there is no detergent dispenser, follow the manufacturer's instructions for detergent placement. If no instructions are given, all of the detergent is added by using the syringe or the peristaltic pump to the base of the drum before the load is added.

6.4 Test loads

6.4.1 General

This section sets out requirements for the preparation of the **test loads** used in the **test washing machine** and the **reference machine**.

- the determination of **test load mass**,
- the average age requirements for **base load** items used in a **test load**,
- the pre-treatment of new **base load** items prior to use in testing,
- the normalisation of the **base load** items between **test runs**,
- the conditioning of **base load** items to determine the **base load** mass at a known **remaining moisture content**,
- the measurement of unwashed stain strips prior to testing
- the fixing of stain strips to the **base load** to make up the appropriate **test load** prior to each **test run**.

The **base load** is normalised after each **test run**, except for the polyester **base load** (for use with wool **programmes**) which does not require any normalisation. After normalisation the **base load** is dried in a tumble dryer.

NOTE Previous editions of this standard specified no normalisation runs between **test runs** in a **test series**. Extensive testing has confirmed that each run is not statistically independent, as detergent residues amongst other contaminants accumulate at each run. When independent testing is not needed then the tests can be run according to Annex P. The procedure which had been used shall be stated in the test report.

A schematic flow diagram showing the necessary preparation of load items prior to a **test run** is shown in Figure 2. A schematic flow diagram showing the selection of load items to meet age requirements for a **test run** is shown in Figure 3.

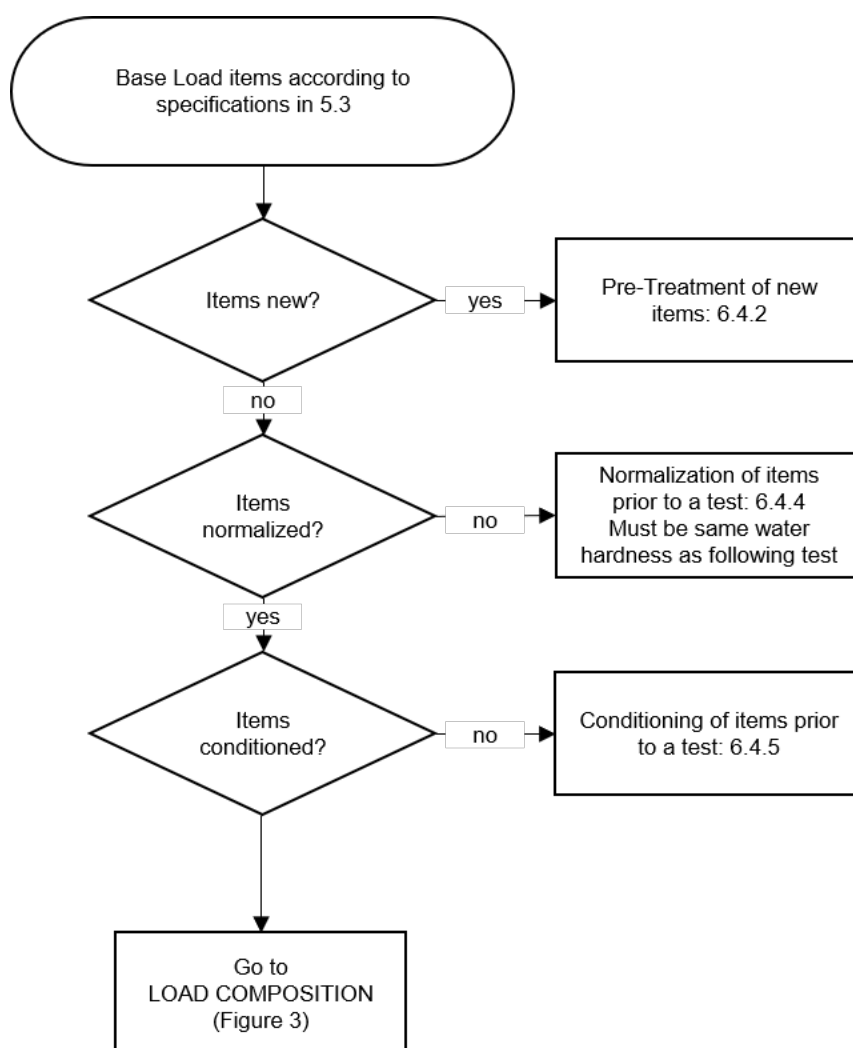


Figure 2 – Load item preparation prior to a test run

6.4.2 Pre-treatment of new **base load** items prior to use

New cotton, polycotton and synthetics/ blends **base load** items shall be treated before their first use by undergoing a normalisation wash process five times, as defined in 6.4.4 but without intermediate drying and using 15 g /kg of the standard powder detergent IEC-P. This is followed by normalisation according to 6.4.4 and by conditioning according to 6.4.5.

The polyester **base load** (for use with wool **programmes**) does not require any pre-treatment prior to use in tests.

6.4.3 Requirements regarding the age of **base load** items

6.4.3.1 General

Any individual cotton, polycotton or synthetics/ blends **base load** item shall not be used for more than 80 **test runs**, excluding pre-treatment runs prior to initial use (refer to 6.4.2) and normalisation runs between tests or **test series**.

For the purposes of meeting the age requirements specified, a **base load** item is considered to have undergone a **test run** if it has been subjected to any mechanical action or exposure to detergent and/or water.

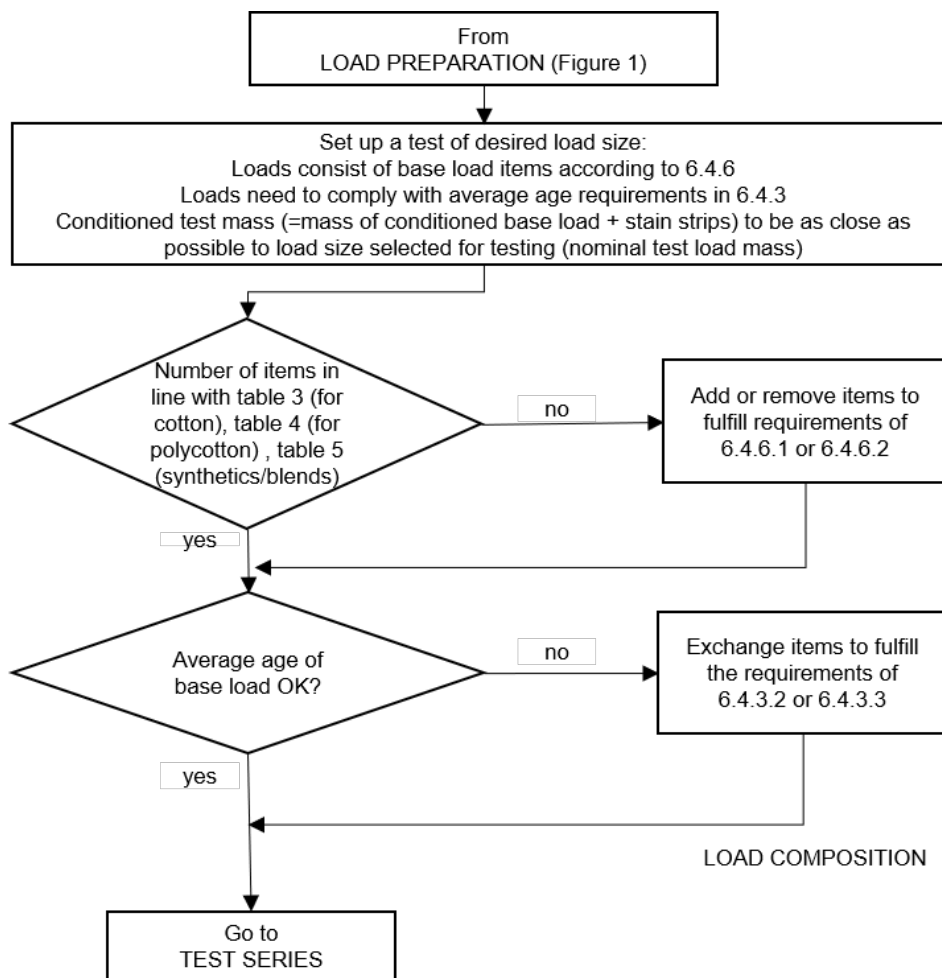


Figure 3 – Load composition and age requirements

NOTE To meet the age requirements specified in this document, a system of tracking the number of normalisation and **test runs** for each load item is required. Electronic systems such as RFID technology can be used. RFID chip should be attached to the load in such a way that mechanical action is not influenced.

6.4.3.2 Average age requirements for cotton **base load** items

To minimise the influence of changes in the characteristics of the **base load** items with increasing age, the cotton **base load** for each **test run** shall consist of load items that are well distributed in age for each different item type to give a weighted average age of the **base load** between 20 and 60 normalisation and **test runs**.

The weighted average age of the **test load** is calculated according to Annex I.

NOTE For **gentleness of action** tests, special care is needed when replacing towels by **GoA-B**. Refer to Annex I.

6.4.3.3 Average age requirements for polycotton or synthetics/ blends **base load** items

To minimise the influence of changes in the characteristics of the **base load** items with increasing age, half of the polycotton or the synthetics/ blends **base load** shall consist of items used up to 40 **test runs** and the other half more than 40 **test runs**. The polycotton **base load** shall consist of load items that are well distributed in age to give a weighted average age of the **base load** between 20 and 60 **test runs**. The synthetics/ blends **base load** shall consist of shirts and pillowcases that are well distributed in age to give a weighted average age of the **base load** between 20 and 60 **test runs**.

NOTE For **gentleness of action** tests, special care is needed when adding **GoA-B** items and replacing synthetics/blends pillow cases or polycotton load items. Refer to Annex I.

6.4.3.4 Average age requirements for polyester **base load** items for wool programmes

There are no weighted average age requirements for polyester **base load** items for wool programmes.

6.4.4 Normalisation of **base load** items

6.4.4.1 General

Normalisation is the process of washing the **base load** in the **reference machine** using a specified **programme** in order to bring the **base load** back into a standardized state prior to testing.

The **base load** shall be normalised as specified below for each load type. Normalisation of the **base load** is followed by conditioning according to 6.4.5 in order to determine the load item mass in a standardized state. Normalisation of a **base load** prior to use shall always be done using a laboratory supply water with the same total water hardness (refer to 5.2.2.2) as that to be used for the subsequent **test run**.

NOTE Typical laboratory practice would be to normalise the **base load** at the completion of a test and then dry the **base load** as specified and place it in a conditioning room/chamber until the next test. However, knowledge of the water hardness for the next likely test would be useful.

6.4.4.2 Normalisation of cotton and polycotton **base load** items

6.4.4.2.1 General

All cotton and polycotton **base load** items shall be treated once in a **reference machine** without detergent and using the 60 °C cotton reference **programme**. On completion of the **programme** the **base load** items shall then be dried in a tumble dryer.

If the **base load** is to be conditioned in a room/chamber in accordance with 6.4.5.2 after normalisation, then the **remaining moisture content** on removal from the dryer must be less than 0 %.

6.4.4.2.2 Normalisation of **base load** items in **reference machine**

For normalisation purposes, up to 6,5 kg can be washed in the **reference machine**. Where the **base load** to be normalised is more than 6,5 kg, the **base load** shall be split into two or more even parts (as far as is possible, with a mix of items in each part) for the normalisation process.

6.4.4.2.3 Normalisation of cotton **base load** items in other **washing machines**

For normalisation in other **washing machines**, the same level of rinsing performance as normally achieved in the **reference machine** using the 60 °C cotton reference **programme** must be ensured. To confirm this, the **LAS rinsing performance** or **alkalinity rinsing performance** achieved in the other **washing machine** in a 60 °C cotton **programme** must be equal, within $\pm 30\%$, of the **LAS rinsing performance** or **alkalinity rinsing performance** achieved in the **reference machine** when used as a **test washing machine** with 6,5 kg load and corresponding amount of detergent.

NOTE 1 The maximum load used in the other **washing machine** may be different from the maximum load in the **reference machine**.

NOTE 2 Detergent is used only for confirmation of the rinsing performance of the other **washing machine**

Alternatively, all **base load** items shall be treated once without detergent in a **washing machine** with a loading capacity that is equal or larger than the **test load** and using a 60 °C **programme** with a mechanical action similar to a cotton **programme** and with one main wash and 4 rinses. The water quantity in the process shall be approximately 5 l/kg load in main wash and 5 l/kg load in each rinse. The normalisation **programme** shall contain a final spin using a g-force of at least 339 g for at least 5 min or reach a final moisture content of less than 50% for cotton **base load**.

NOTE 3 The g-force is a measurement of the acceleration that causes a perception of weight, with a g-force of 1 g equal to the conventional value of gravitational acceleration on Earth. It is common to use this measure in commercial **washing machines**.

NOTE 4 The g-force of the **reference machine**'s final spin at 1100 rpm in 60 °C cotton reference **programme** is (352 ± 13) g

6.4.4.3 Normalisation of synthetics/ blends **base load** items

All synthetics/ blends **base load** items shall be treated in a **reference machine** without detergent and using the 60 °C synthetics/ blends reference **programme**. On completion of the **programme** the **base load** items shall then be dried in a tumble dryer.

1078 If the **base load** is to be conditioned in a room/chamber in accordance with 6.4.5.2 after
1079 normalisation, then the **remaining moisture content** on removal from the dryer must be less
1080 than 0 %.

1081 For normalisation purposes, up to 4 kg can be washed in the **reference machine**. Where the
1082 **base load** to be normalised is more than 4 kg, the **base load** shall be split into two or more
1083 even parts (as far as is possible, with a mix of items in each part) for the normalisation process.

1084 **6.4.4.4** Normalisation of polyester **base load** items for wool programmes

1085 The polyester **base load** need not be normalised after a **test run**, but the **base load** items shall
1086 be dried in a tumble dryer.

1087 **6.4.5** Conditioning of **base load** items

1088 **6.4.5.1** General

1089 Conditioning is the process of bringing the **base load** to reach a known **remaining moisture**
1090 **content**, after normalisation plus drying at the completion of a **test run** or **test series**, and in
1091 order to check the standardized mass of each load item.

1092 Conditioning of a **base load** shall be performed after selecting load items to set up a **base load**
1093 of required mass and required age prior to a **test run** and a **test series** or when for a **base**
1094 **load** items need to be exchanged to meet age requirements and at least again after every 6th
1095 run with a **base load** consisting of same items.

1096 Conditioning may be done in an ambient controlled room/chamber or using the bone-dry
1097 method. The method used shall be reported.

1098 **6.4.5.2** Conditioning of **base load** items in an ambient controlled room/chamber

1099 In this method, the **base load** items are dried in a tumble dryer to a **remaining moisture**
1100 **content** of each single item of less than 0 % and are then stretched or flattened by hand before
1101 conditioning. They are then allowed to reach an equilibrium **remaining moisture content** when
1102 placed in a room/chamber with an ambient temperature and humidity which is maintained in
1103 accordance with 5.2.3. Under this method, two options are available:

- 1104 • the **base load** items shall be hung singly and separately so that air can freely circulate
1105 between individual load items. The load is left for a period of not less than 15 h;
- 1106 • the **base load** items shall be left until their mass has changed by less than 0,5 % for two
1107 successive measurements which are taken at intervals of 2 h or more.

1108 If the conditioning is done under alternative ambient conditions (23 ± 2) °C and (55 ± 5) %
1109 (5.2.3.2) a correction factor for cotton **base load** shall be applied: the weight of **base load**
1110 determined has to be multiplied with the factor 1.0109 to achieve the conditioned mass.

1111 **6.4.5.3** Conditioning of **base load** items using the bone-dry method

1112 In this method, the **base load** items are dried continually in a tumble dryer of known
1113 performance until the **remaining moisture content** has been reduced to a level that is known
1114 as the “bone-dry” condition, where very little free moisture is present. The conditioned mass of
1115 each load item is then determined by taking the bone-dry mass and multiplying it by a factor
1116 which is determined by the dryer performance characteristics.

1117 The specification for the tumble dryer used and the method to prepare the **base load** to the
1118 bone-dry condition prior to a **test run** and the calculation of conditioned mass is specified in
1119 Annex G.

1120 **6.4.6** Test load composition

1121 **6.4.6.1** Cotton test load composition

1122 The **test load** consists of the **base load** as specified in Annex D.1 (cotton **base load**), D.4
1123 (polycotton **base load**) and the stain strips as specified in A.2.1 (**standard stain strips**) or
1124 A.2.3 (**cold water stain strips**).

- 1125 Affixing stain strips is specified in 6.4.8.1. Subclauses 6.4.2, 6.4.3, 6.4.4 and 6.4.5 set out
1126 requirements regarding the preparation and maintenance of a **base load**.
- 1127 The **test load mass** is adjusted so that it corresponds to the required **test load mass** for the
1128 specified **programme** of the test machine.
- 1129 The numbers of sheets, pillowcases and towels in the cotton **base load**, the number of stain
1130 strips and the the number of **thread removal specimen** for various **test load masses** are
1131 specified in Table 3.
- 1132 The numbers of load items in the polycotton **base load**, the number of stain strips and the the
1133 number of **thread removal specimen** for various **test load masses** are specified in Table 4.
- 1134 Final adjustment of the **test load mass**, which includes the mass of the stain strips, is made by
1135 adding or removing towels or polycotton load items so that the total mass is as close as possible
1136 (± 60 g) to the nominal required **test load mass**.
- 1137 Additional **thread removal specimen** are added to the **test load** for performance tests including
1138 **Gentleness of Action** according to 8.7. The mass of the **thread removal specimen** is not
1139 considered for mass adjustments of the **test load**. To eliminate the influence of the age of the
1140 cover item (cotton towel or polycotton load item), a new item (after pre-conditioning) must be
1141 used for each **test run**. For average age calculation refer to Annex I.
- 1142
- 1143

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Table 3 – Number of items in the cotton test load for various test load masses

Required test load mass kg ^a	Approximate base load mass kg ^b	Number of sheets	Number of pillowcases	Number of towels ^c	Number of stain strips ^d	Number of thread removal specimen ^e
1,0	0,96	0	2	4	2	2
1,5	1,53	0	3	7	2	2
2,0	1,99	0	4	9	2	2
2,5	2,47	0	5	11	3	2
3,0	3,02	2	4	5	3	2
3,5	3,48	2	4	9	4	2
4,0	4,03	2	4	14	4	2
4,5	4,53	2	6	14	5	3
5,0	4,97	2	6	18	5	3
5,5	5,47	2	8	18	6	3
6,0	6,02	2	8	23	6	3
6,5	6,52	2	10	23	7	4
7,0	7,00	2	12	23	7	4
7,5	7,53	3	12	21	8	4
8,0	7,97	3	12	25	8	4
8,5	8,47	3	14	25	9	5
9,0	8,97	4	14	23	9	5
9,5	9,54	4	14	28	10	5
10,0	10,02	4	16	28	10	5
10,5	10,53	5	15	28	11	6
11,0	10,97	5	15	32	11	6
11,5	11,56	5	16	35	12	6
12,0	11,97	6	17	30	12	6
12,5	12,54	6	17	35	13	7
13,0	13,00	6	18	37	13	7
13,5	13,48	6	19	39	14	7
14,0	14,03	6	19	44	14	7
14,5	14,47	7	20	39	15	8
15,0	15,04	7	21	42	15	8
15,5	15,52	7	22	44	16	8

^a For **test load masses** to the whole or half kilogram rating which are greater than those specified in the table, the number of sheets is the **nominal test load mass** divided by $(3 \times 0,725)$ (rounded to the nearest whole sheet) and the number of pillowcases is the **nominal test load mass** divided by $(3 \times 0,24)$ (rounded to the nearest whole pillow case). The balance of the required **nominal test load mass** is made up of towels as required. The mass of all **base load** items can be expected to decline slightly with increasing age.

^b The difference between **base load mass** and **test load mass** is due to the mass of the stain strips

^c The actual number of towels may differ from the number indicated above (which is intended to be indicative).

^d The number of stain strips is equal to the **nominal test load mass** (rounded up to the nearest kilogram), The minimum is 2 stain strips.

^e The number of GoA specimens is one **thread removal specimen** per 2 kg of **base load** (rounded up to the nearest two kilograms). The minimum is 2 **thread removal specimens**.

Required test load mass kg ^a	Approximate base load mass kg ^b	Number of sheets	Number of pillowcases	Number of towels ^c	Number of stain strips ^d	Number of thread removal specimen ^e
16,0	15,96	7	22	48	16	8
16,5	16,50	8	23	44	17	9
17,0	16,96	8	24	46	17	9
17,5	17,53	8	24	51	18	9
18,0	17,99	8	25	53	18	9
18,5	18,54	9	26	49	19	10
19,0	18,98	9	26	53	19	10
19,5	19,46	9	27	55	20	10
20,0	20,03	9	28	58	20	10
20,5	20,49	9	28	62	21	11
21,0	21,01	10	29	58	21	11
21,5	21,49	10	30	60	22	11
22,0	21,95	10	31	62	22	11
22,5	22,52	10	31	67	23	12
23,0	23,05	11	32	63	23	12
23,5	23,53	11	33	65	24	12
24,0	23,97	11	33	69	24	12
24,5	24,56	11	34	72	25	13
25,0	25,02	11	35	74	25	13

^a For **test load masses** to the whole or half kilogram rating which are greater than those specified in the table, the number of sheets is the **nominal test load mass** divided by $(3 \times 0,725)$ (rounded to the nearest whole sheet) and the number of pillowcases is the **nominal test load mass** divided by $(3 \times 0,24)$ (rounded to the nearest whole pillow case). The balance of the required **nominal test load mass** is made up of towels as required. The mass of all **base load** items can be expected to decline slightly with increasing age.

^b The difference between **base load mass** and **test load mass** is due to the mass of the stain strips

^c The actual number of towels may differ from the number indicated above (which is intended to be indicative).

^d The number of stain strips is equal to the **nominal test load mass** (rounded up to the nearest kilogram), The minimum is 2 stain strips.

^e The number of GoA specimen is one **thread removal specimen** per 2 kg of **base load** (rounded up to the nearest two kilograms). The minimum is 2 **thread removal specimens**.

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1147 **Table 4 – Number of load items in the polycotton test load for various test load masses**

Required test load mass kg ^a	Approximate base load mass kg ^b	Number of load items ^c	Number of stain strips ^d	Number of thread removal specimen ^e
1,0	1,00	9	2	2
1,5	1,54	14	2	2
2,0	1,97	18	2	2
2,5	2,52	23	3	3
3,0	2,95	27	3	3
3,5	3,50	32	4	3
4,0	4,04	37	4	3
4,5	4,49	41	5	4
5,0	5,02	46	5	4
5,5	5,47	50	6	4
6,0	6,01	55	6	4
6,5	6,45	59	7	5
7,0	6,99	64	7	5
7,5	7,54	69	8	5
8,0	7,97	73	8	5
8,5	8,53	78	9	6
9,0	8,95	82	9	6
9,5	9,51	87	10	6
10,0	10,04	92	10	6
10,5	10,49	96	11	7
11,0	11,03	101	11	7
11,5	11,48	105	12	7
12,0	12,01	110	12	7
12,5	12,46	114	13	8
13,0	12,99	119	13	8
13,5	13,55	124	14	8
14,0	13,98	128	14	8
14,5	14,53	133	15	9
15,0	14,96	137	15	9

^a For **test load masses** to the whole or half kilogram rating which are greater than those specified in the table, the number of load items is the **nominal test load mass** minus the mass of the required number of stain strips divided by 0,107 (rounded to the nearest load item). The mass of **base load** items can be expected to decline slightly with increasing age.

^b The difference between **base load mass** and **test load mass** is due to the mass of the stain strips

^c The actual number of load items may differ from the number indicated above (which is intended to be indicative).

^d The number of stain strips is equal to the **nominal test load mass** (rounded up to the nearest kilogram), The minimum is 2 stain strips.

^e The number of GoA specimen is one **thread removal specimen** per 2 kg of **base load** (rounded up to the nearest two kilograms),. The minimum is 2 **thread removal specimens**.