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INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

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

IEC 60456:2010-02+AMD1:2022-12 CSV(en-fr)

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

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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.

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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.

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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*

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

3 Terms, definitions and symbols

3.1 Terms and definitions

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

3.1.1
washing machine
appliance for cleaning and rinsing of textiles using water which may also have a means of extracting excess water from the textiles

3.1.2
test washing machine
washing machine that is subjected to part or all of the requirements in this document in order to determine its performance

NOTE T**est washing machine** may include washing machines according to 3.1.7, 3.1.8, 3.1.9 and/or 3.1.10.

3.1.3
reference machine
specially constructed **washing machine** of known performance which is used to increase repeatability and reproducibility of results

NOTE It may 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 – refer 5.4.2.

3.1.4
washer-dryer
washing machine which includes both a **spin extraction** function and also a means for drying the textiles, usually by heating and tumbling

NOTE This document only covers the operations which relate to the **washing machine** function – see Scope.

3.1.5
spin extractor
separate water-extracting appliance in which water is removed 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
w**ashing machine** in which the load is placed in a drum which rotates around an axis which is vertical or close to vertical. For the purposes of this document, vertical axis is where the angle of the axis of rotation is more than 45 degrees to horizontal. Where the drum does not rotate, the washing machine shall be classified as a vertical axis washing machine.

NOTE 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 which rotates around an axis which is horizontal or close to horizontal. 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.

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NOTE 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
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 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. **Manual washing machines** have special requirements regarding the **programme** which is tested for this document; see Annex M.

3.1.10
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

3.1.11
test run
single performance assessment as specified in Clause 7 of this document

3.1.12
test series
group of **test runs** on a **test washing machine** which, collectively, are used to assess the performance of a **washing machine**

3.1.13
operation
each performance of a function that occurs during the **washing machine programme** such as pre-wash, washing, rinsing, draining or spinning

3.1.14
programme
series of **operations** which are pre-defined within the **washing machine** and which are declared by the manufacturer as suitable for washing certain textile types

3.1.15
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 Examples of **operations** that may occur after the completion of the **programme** are pumping, monitoring and anti-creasing (where applicable).

3.1.16
spin extraction
water-extracting function by which water is removed from textiles by centrifugal action. This is included as a function (built in **operation**) of an **automatic washing machine** but may also be performed in a **spin extractor**

3.1.17
spin speed
rotational frequency of a drum during **spin extraction**

NOTE A method for determination of **spin speed** is not defined in this standard.

3.1.18
base load
textile load used for testing without stain test strips or wool shrinkage specimens

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3.1.19
test load
base load used for testing plus stain test strips or wool shrinkage specimens

3.1.20
test load mass
actual mass of the base load plus stain test strips or wool specimen

3.1.21
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 part load). Target value for the conditioned **test load mass**

3.1.22
rated capacity
maximum mass in kg of dry textiles of a particular type which the manufacturer declares can be treated in the **washing machine** on the **programme** selected

3.1.23
programme time
programme time is the time from the initiation of the **programme** (excluding any user programmed delay) until the completion of the **programme**. If the end of **programme** is not indicated, the **programme time** is equal to the **cycle time**.

3.1.24
end of programme
the **programme** is complete when the **washing machine** indicates the end of the **programme** and the load is accessible to the user. 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. 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 drops to some steady state condition and is not performing any function.

NOTE 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.

3.1.25
cycle time
time from the initiation of the **programme** (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. If there is no activity after the end of the **programme**, the **cycle time** is equal to the **programme time**

NOTE **Cycle time** 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 any end of **programme** indicator. Any cyclic event that occurs indefinitely is considered to be steady state.

3.1.26
main wash duration
time 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 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 time used for calibration of the **reference machine** is defined differently. Refer to Table E.1.

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3.1.27
remaining moisture content
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 (refer to 6.4.5.2)

NOTE 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. Refer also to Annex G.

3.1.28
off mode
condition where the product is switched off using appliance controls or switches that are accessible and intended for operation by the user during normal use to attain the lowest power consumption that may persist for an indefinite time while connected to a mains power source and used in accordance with the manufacturer's instructions. Where there are no controls, the washing machine is left to revert to a steady state power consumption of its own accord.

3.1.29
left on mode
lowest power consumption mode that may persist for an indefinite time after the completion of the programme and unloading of the machine without any further intervention of the user

NOTE In some products this mode may be an equivalent power to **off mode**.

3.1.30
rated voltage
voltage assigned to the appliance by the manufacturer

3.2 Symbols

3.2.1 Symbols relating to Subclause 9.2 – washing performance

C_k the sum of the average reflectance values (Y-values) for each **test run**

$\overline{C}$ the average sum of the reflectance values (Y-values) for each of the five types of soils, for all valid **test runs**

$C_{k_{\text{test}}}$ the sum of the reflectance values in each **test run** of the **test washing machine**

$\overline{C}_{\text{test}}$ the average sum of the reflectance values of the **test washing machine**

$\overline{C}_{\text{ref}}$ the average sum of the reflectance values in each **test run** of the **reference machine**

m the number of soil types per stain test strip

n the number of stain test strips in each **test run**

p confidence interval for q

q ratio between the **test washing machine**, $\overline{C}_{\text{test}}$, and the **reference machine**, $\overline{C}_{\text{ref}}$

s_q standard deviation of the ratio q

s_C the standard deviation of C_k

s_i the standard deviation of the reflectance values for each soil type within a given **test run**

$t_{\text{w-1, 0,05}}$ the "Student T" factor for (w-1) degrees of freedom for a confidence of 95 % (i.e. 2,776 for five **test runs** equals four degrees of freedom, two sided test)

w the number of **test runs** in the **test series**

$\overline{x}_i$ the average reflectance values for each soil type

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x_{ij} the average reflectance value of the 4 individual readings for each of the 5 soil types on a stain test strip

3.2.2 Symbols relating to Sublause 9.3 – water extraction (spinning)

RMC **remaining moisture content**

M the mass of the conditioned **base load** (g)

M_r the mass of **base load** at the end of the **test run** (g)

3.2.3 Symbols relating to Subclause 9.4 – rinsing performance

A_m the amount of wash alkali remaining in the **base load**

$A_{m,test}$ the amount of wash alkali remaining in the **base load** measured in the **test washing machine**

$A_{m,ref}$ the amount of wash alkali remaining in the **base load** measured in the **reference machine** with the relevant **programme** as described in Annex E

A_r the increased concentration of alkalinity in extracted water

W_e the averaged concentration of alkalinity in extracted water

W_s the averaged concentration of alkalinity in the laboratory supply water

m_e the mass of the sample of extracted water

m_s the mass of the sample of laboratory supply water

M the mass of the conditioned **base load** (g)

M_r the mass of **base load** at the end of the **test run**

R rinsing index

$\bar{R}$ the mean of rinse indices for all valid **test runs** in the **test series**

R_k the rinsing index from one **test run**

s standard deviation of the rinse indices for all valid **test runs**

3.2.4 Symbols relating to Subclause 9.5 – energy, water and time

t_c the measured average cold water inlet temperature (°C)

t_h the measured average hot water inlet temperature (°C)

V_c the volume of the cold water used during an operation (l)

V_h the volume of external hot water used during operation (l)

W_c the cold water energy correction for the operation (kWh)

W_{ct} the total cold water energy correction determined during the test (kWh)

W_{et} the total electrical energy metered during the test (kWh)

W_h the calculated hot water energy for the operation (kWh)

W_{ht} the calculated total hot water energy determined during the test (kWh)

W_{total} total energy (kWh)

3.2.5 Symbols relating to Clause 10 – wool shrinkage

CFS cycle felting severity – average shrinkage per wash

LS linear felting shrinkage (%) – length

SR the shrinkage rate at the completion of the **test series** (**test washing machine**)

SRI the shrinkage rate index (compared to reference shrinkage rate)

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W_0 the mean measurements (width or length), of the original wool shrinkage specimens after initial preparation and before washing

W_k the mean measurements (width or length) of the washed wool shrinkage specimens at the completion of the **test series**

WS Linear felting shrinkage (%) – width

$\bar{y}$ the arithmetic mean of the individual readings for each set of measurements (width or length) for the set of three wool shrinkage specimens

y_i the individual readings for each measurement (width or length) of each individual wool shrinkage specimen

3.2.6 Symbols relating to Annex G

M_{bd} the mass of base load at the end of the bone dry run (g)

3.2.7 Symbols relating to Annex I

$\bar{A}$ weighted average age of the **base load** as number of **test runs**

a_i age of item (after conditioning)

n_i number of items; (of the same type and age)

w_i the mass per piece given in Table C.1

3.2.8 Symbols relating to Annex L

P_{off} **Off mode** power

P_{on} **Left on mode** power

4 Requirements

4.1 General

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

- Washing performance
- Rinsing performance
- Water extraction performance
- Water consumption
- Energy consumption
- Off mode power and left on mode power
- Cycle time
- Wool shrinkage performance

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).

NOTE Methods for the determination of mechanical action on the clothes load are under consideration for inclusion in this document. Methods under consideration are available as a publicly available specification – see IEC/PAS 62473.

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

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4.2 Rated capacity

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

NOTE For different textile types the **rated capacity** of a **washing machine** is usually different.

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 gives a range of values for the **rated capacity** for a particular textile type, the highest value shall be used.

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 respectively 40 % and 20 % 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 access **washing machines** while dimension c_2 is generally only applicable to front access **washing machines**.

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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 which the test or results shall be invalid. The statement of tolerance does not permit the deliberate variation of these specified parameters.

Rounding shall only be applied to reported values in Annex S. If numbers have to be rounded, they shall be rounded to the nearest number according to ISO 31-0, Clause B.3 Rule B. If the rounding takes place to the right of the comma, the omitted places shall not be filled with zeros.

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

For measurement of **off-mode** power and **left-on mode** power, additional requirements may apply – refer to IEC 62301.

5.2 Ambient 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 frequency to each **test washing machine** shall be maintained at the rated frequency ±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 ± 0,2) mmol/l. If soft water is used it shall have a total water hardness of (0,5 ± 0,2) mmol/l.

Normalization of a **base load** prior to use in a **test series** (refer to 6.4.4) shall always be done 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.

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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 temperature of the laboratory supply water to each **test washing machine** shall be measured and recorded to the nearest 0,1 °C. It shall be:

– for cold water (15 ± 2) °C for all reference **programmes** except Cotton 20 °C;

– for cold water (20 ± 2) °C is the recommended option when using the Cotton 20ºC reference **programme**. This is recommended for **test washing machine programmes** with no internal heating and cold fill only (cold water wash). The cold water supply temperature to the **reference machine** in this case may be the same as the **test washing machine** or it may be 15 ºC as specified above.

– for hot water the temperature indicated by the manufacturer ± 2 K, or (60 ± 2) °C, if no value is given.

NOTE 1 The results for a water supply temperature of 15 °C and 20 °C to the **reference machine** may not be directly comparable.

When the manufacturer specifies a hot water temperature range, which includes (60 ± 2) °C, the hot water temperature shall be set at (60 ± 2) °C. When the manufacturer specifies a hot water temperature range, which does not include (60 ± 2) °C, the hot water temperature shall be set at the end of the temperature range which is closest to (60 ± 2) °C. When the manufacturer specifies a single temperature with a tolerance, then that temperature shall be used.

The hot and cold water inlet supply temperature (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 2 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 during filling in order to determine weighted average temperature. The use of alternative cold water supply temperatures is under consideration.

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 machines shall be in accordance with D.1.5.1 or D.1.6.1 (as applicable).

The hot and cold water pressure (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, it shall be rounded to the nearest 0,5 °C.

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

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

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

- ambient temperature: (20 ± 2) °C
- ambient relative humidity: (65 ± 5) %.

The measured ambient temperature and relative humidity 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 Subclause 6.4.5.2. As an alternative to using a controlled room or chamber for conditioning the **base load**, the bone dry method may be used. Refer to 6.4.5.3.

5.3 Test materials

5.3.1 General

This section sets out the specifications for test materials required for **washing machine** testing to this document, including

- base loads (load items);
- stain test strips;
- wool shrinkage specimens;
- detergent.

NOTE Suitable sources of test materials are given in Annex U.

5.3.2 Base loads

5.3.2.1 Cotton base load

Where a cotton load is specified for testing, the cotton **base load** shall consist of sheets, pillowcases and towels as specified in Annex C.

5.3.2.2 Synthetics/blends base load

Where a synthetics/blends load is specified for testing, the synthetics/blends **base load** shall consist of men's shirts and pillowcases as defined in Annex C.

5.3.2.3 Polyester base load for the wool programme

For testing the wool programmes the **base load** shall consist of double knitted polyester test pieces as defined in Annex C.

5.3.3 Stain test strips

Stain test strips are attached to the **base load** prior to testing to assess the washing performance of a **test washing machine**. Different soil types are used in order to assess the following washing characteristics:

– the scouring effect, chiefly due to mechanical action, the first test piece used being soiled with sebum and the second with a mixture of carbon black and mineral oil;
– the removal of protein pigments, the test piece used being soiled with blood;
– the removal of organic pigments, the test piece used being soiled with cocoa;
– the bleaching effect, the test piece used being soiled with red wine.

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Stain test strips consist of square pieces with individual soil types measuring (120 ± 5) mm × (120 ± 5) mm each which are joined together into a strip with the different kinds of soil in the following order:

– unsoiled piece;
– sebum;
– carbon black/mineral oil;
– blood;
– cocoa;
– red wine.

NOTE 1 The red wine is an altered specification from Edition 4 of this document. Sebum is a new stain in Edition 5. The size of the square pieces for each soil type in the stain test strip has been reduced in Edition 5.

The specifications of test pieces with standardized soiling for each soil type which are used to make a stain test strip are given in Annex A.

NOTE 2 Information about the compliance of stains used in stain test strips with respect to importation regulations of particular countries can be obtained from the supplier.

5.3.4 Wool shrinkage specimens

Wool shrinkage specimens are as specified in Annex T.

Three wool shrinkage specimens are always used for the wool shrinkage test, irrespective of **rated capacity**. Each of the wool shrinkage specimens shall be prepared as specified in 10.3.1 prior to use in the wool shrinkage **test runs**.

5.3.5 Detergents

The specification for the IEC 60456 reference detergent A* is given in Annex B.

The reference detergent is distributed in three separate components:

- base powder (with enzyme and foam inhibitor);
- sodium perborate tetrahydrate;
- bleach activator (TAED).

It is recommended that the three components shall be stored separately and be used within a limited time. The date of manufacture for each component shall be marked by the supplier on the container. The life of each component for detergent A* and the storage conditions shall be as specified by the manufacturer. If no expiry date for the detergent components is specified by the manufacturer, the expiry date is deemed to be one year from the date of manufacture.

Mixing of detergent components, dosage and placement of detergent is specified in 6.3.

NOTE Base powder with neither perborate nor TAED shall be used in the preparation of wool shrinkage specimens.

5.4 Equipment

5.4.1 General

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

- reference machine
- spectrophotometer

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- equipment for conditioning the **base load**
- standard extractor
- iron
- titration equipment

A checklist of other laboratory equipment which may be required for **washing machine** testing is provided in 5.4.8.

5.4.2 Reference machine

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

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

Specifications for the **reference machine** are given in Annex D.

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

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

NOTE 2 When the **reference machine** is used to normalize the **base load** between **test series**, the maximum mass of dry **base load** which can be normalized in the **reference machine** is different to the **test load masses** above. Refer to Subclause 6.4.4.

5.4.3 Spectrophotometer

Optical measurements of each of the different stain test 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, between 400 nm and 700 nm
Parameter	tristimulus value Y (CIE No 15.2, 1986)
Illuminant / observer	D65 / 10° – ISO/CIE 10526
Measuring geometry	d / 8°
UV-filter	The ultraviolet filter shall have a spectral transmittance of ≤ 0,01 at wavelengths of 400 nm and less, and a spectral transmittance of ≥ 0,80 at wavelengths in the range 450 nm to 700 nm
Measurement aperture	minimum 20 mm diameter

NOTE Where a measurement aperture is not circular, an aperture area of not less than 314 mm^2 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.

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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 where a rinse performance measurement is required (refer to 8.5).

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 with a water extraction performance which results in a **remaining moisture content** determined in accordance with 8.5 as follows:

- (39 ± 3)% for a cotton **base load** when operated with a spinning time not more than 10 min; and
- (17 ± 3)% for a synthetic/blend **base load** when operated with a spinning time not more than 5 min.

Any **spin extractors** may be used as a standard extractor if it can be demonstrated that they can achieve the water extraction performance requirements specified above. The extraction time or speed shall be adjusted to achieve the **remaining moisture content** specified above for the relevant load types and sizes, but this time may not exceed 10 min for cotton or 5 min for synthetic/blends. As re-loading of the **base load** after one **spin extraction operation** is not permitted, a pre-test to determine the appropriate spin time 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 about 2 800 r/min using standard bundles defined in 8.5.2 for a period of 10 min will meet the specification above.

Where a standard extractor which is larger than the primary specification above is used, the standard extractor shall be loaded and used in accordance with Annex J. The maximum load size of any **base load** placed in a **standard extractor** shall not exceed the maximum load recommended by the manufacturer.

NOTE 1 A standard extractor should be of a design that allows the user to remove any retained water in the extractor between runs.

NOTE 2 A large extractor with a capacity of max. 10 kg is available commercially. See Annex U for manufacturer.

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5.4.6 Iron for preparation of stain test strips after washing

Where an iron or ironing appliance is used to prepare stain test strips after washing and prior to reflectance readings, it shall have a surface temperature between 130 °C and 150 °C.

5.4.7 Titration equipment

The following equipment is required when an alkalinity measurement is required under 8.5.

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 ± 0,05 pH units (1 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 µl / 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. For calibration follow the instruction manual of your pH meter.

5.4.8 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

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- time

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 the following section shall be achieved.

Note that 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 5.5.2).

Determination of wool shrinkage (refer to Clause 10) also requires the following equipment:

- tray with flat bottom about 50 cm × 50 cm and with sides approximately 5 cm high – for preparation of wool shrinkage specimens;
- ruler accurate to ± 0,5 mm for measurement of wool shrinkage specimens.

5.5 Instrumentation and accuracy

5.5.1 General

Instruments used and measurements made for this document shall comply with the following specifications.

5.5.2 Instruments

Parameter	Unit	Minimum resolution	Minimum accuracy	Additional requirements
Mass				
Full **test load mass** or **base load** mass above 3 kg	g	2 g	± 5 g	-
Individual load items, full **test load mass** or **base load** mass less than or equal to 3 kg	g	0,5 g	± 1 g	-
Detergent mass	g	0,05 g	± 0,1 g	-
Titration mass	g	0,005 g	± 0,01 g	-
Temperature				
Ambient temperature	°C	0,1 °C	± 1 K	-
Water temperature	°C	0,1 °C	± 0,6 K	-
Ambient humidity	% (RH)	1 % (RH)	± 3 % (RH)	The specifications shall be met over a temperature range of 15 °C to 25 °C.
Water volume (water inlet)	L	0,1 L	± 2 %	Separate metering for hot and cold inlets, where applicable NOTE Devices using viscosity should be calibrated at the actual nominal temperature ± 5 °C, and the nominal flow rate. Liquid volumes for titration are

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Parameter	Unit	Minimum resolution	Minimum accuracy	Additional requirements
				covered by the specification for mass in Subclause 5.4.1.
Water pressure	kPa	10 kPa	± 5 %	-
Time	s	5 s	± 1 %	-

5.5.3 Measurements

Parameter	Unit	Minimum accuracy	Additional requirements
Total water hardness	mmol/L	± 2 %	-
Electrical energy			
Programme energy	kWh	± 1 %	Due to distortion of the voltage and current wave forms caused by inductive devices such as motor controls specific requirements for energy meters are necessary. See e.g. IEC 62053-21 for more information.
Off mode and **left on mode** power	kWh	Measurement instrumentation for off mode and left on mode power are described in IEC 62301	
pH	-	± 0,05	The accuracy requirement shall be met over a temperature range of 15 °C to 25 °C.

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 **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 new **washing machine** which is installed and used in accordance with the manufacturer's instructions, except as required by this document. Where there is more than one option for installation, the option chosen for testing shall be documented in the test report.

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 the maximum wash temperature set and setting maximum main wash water level if applicable, the first run without load and with 50 g of the reference detergent

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and the second run without load and without detergent. 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**.

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).

Any filters shall be thoroughly cleaned before each **test series**. Prior to the **test series** (not more than one day in advance) a cleaning run shall be undertaken on a **programme** with the maximum wash temperature set and setting maximum main wash water level if applicable without load and without detergent.

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 within 2 °C of the ambient air temperature, 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 Annex E 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 E.4).

The **reference machine** shall meet the requirements of 6.2.1.4 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 5.3.5. 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.

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NOTE 2 Base powder with neither perborate nor TAED shall be used in the preparation of wool shrinkage specimens. However full detergent A* is used for a wool shrinkage test.

6.3.2 Detergent dose

The detergent dose for the **test washing machine** and the **reference machine** shall be determined from the selected reference **programme** and the **test load** as set out in Table 1:

Table 1 – Detergent dose

Load type and Reference Programme	Test Washing Machine		Reference machine Type 1		Reference machine Type 2	
	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)	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	54 g + 16 g/kg	36 g + 10,7 g/kg	155 g	100 g	180 g	120 g
Cotton – Cotton 20 °C and Cotton 30 °C only	54 g + 8 g/kg	36 g + 5,3 g/kg	78 g	52 g	78 g	52 g
Synthetic/Blends	54 g + 16 g/kg	36 g + 10,7 g/kg	125 g	80 g	150 g	100 g
Wool	54 g + 16 g/kg	36 g + 10,7 g/kg	70 g	46,7 g	70 g	46,7 g

6.3.3 Mixing 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 detergent shall be stored in a sealed container if not used immediately. The maximum storage time prior to use of reference detergent after mixing of detergent components is fourteen days. All detergent components shall be within their expiry date at the time of use.

6.3.4 Detergent placement

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 only be used 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

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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**. Refer to Clause 7 regarding the selection of the required **test load mass** and requirements for tests at **rated capacity**. This section sets out

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

The same **base load** shall be used for all **test runs** in a **test series**. No normalization runs shall occur between **test runs** in a **test series**. The **base load** is dried in a dryer between **test runs** within a **test series** but the **base load** does not have to be conditioned prior to the next test run. Subclause 8.2.5 specifies requirements for checking the **base load** between **test runs** in a **test series**.

A schematic flow diagram showing the preparation of load items prior to a test series is shown in Figure 1. A schematic flow diagram showing the selection of load items to meet age requirements for a **test series** is shown in Figure 2.

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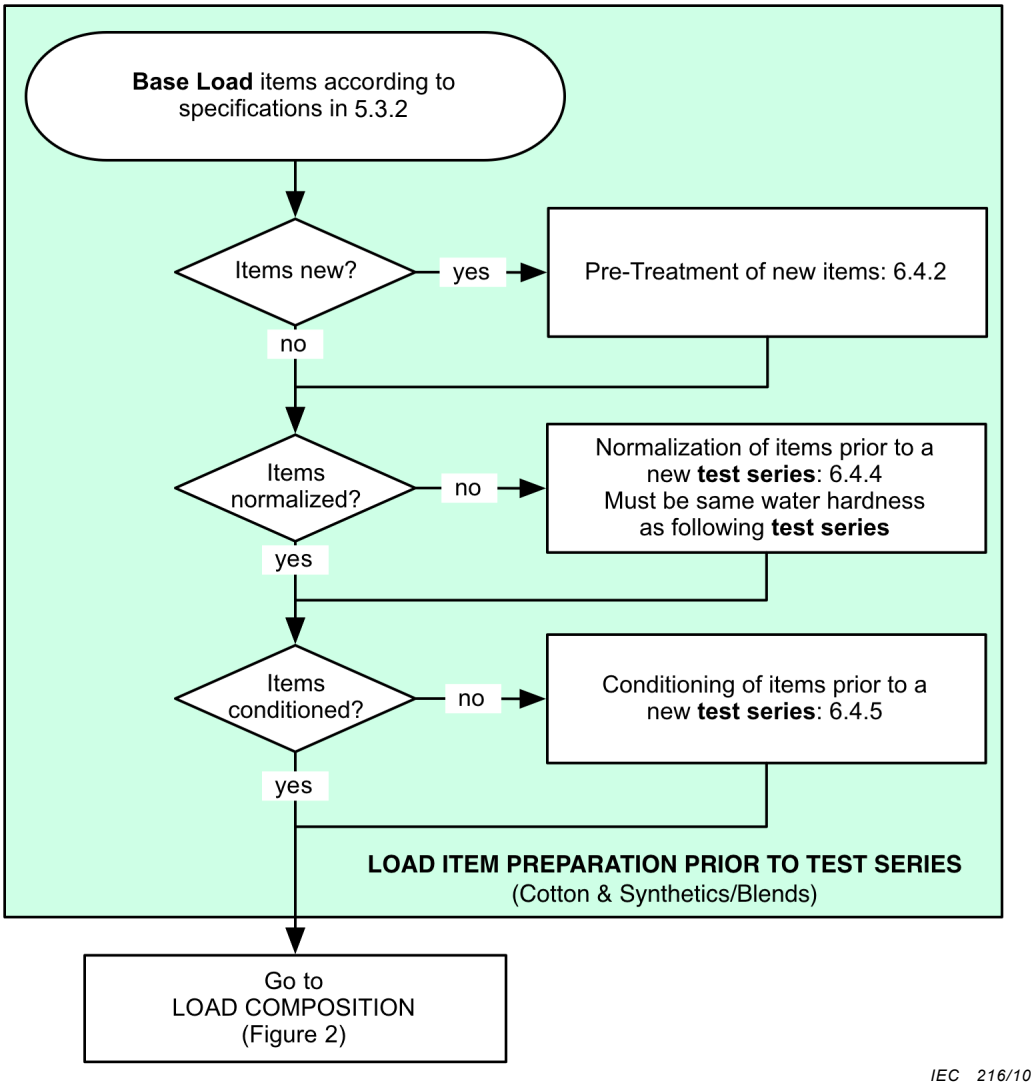

Figure 1 – Load item preparation prior to a test series

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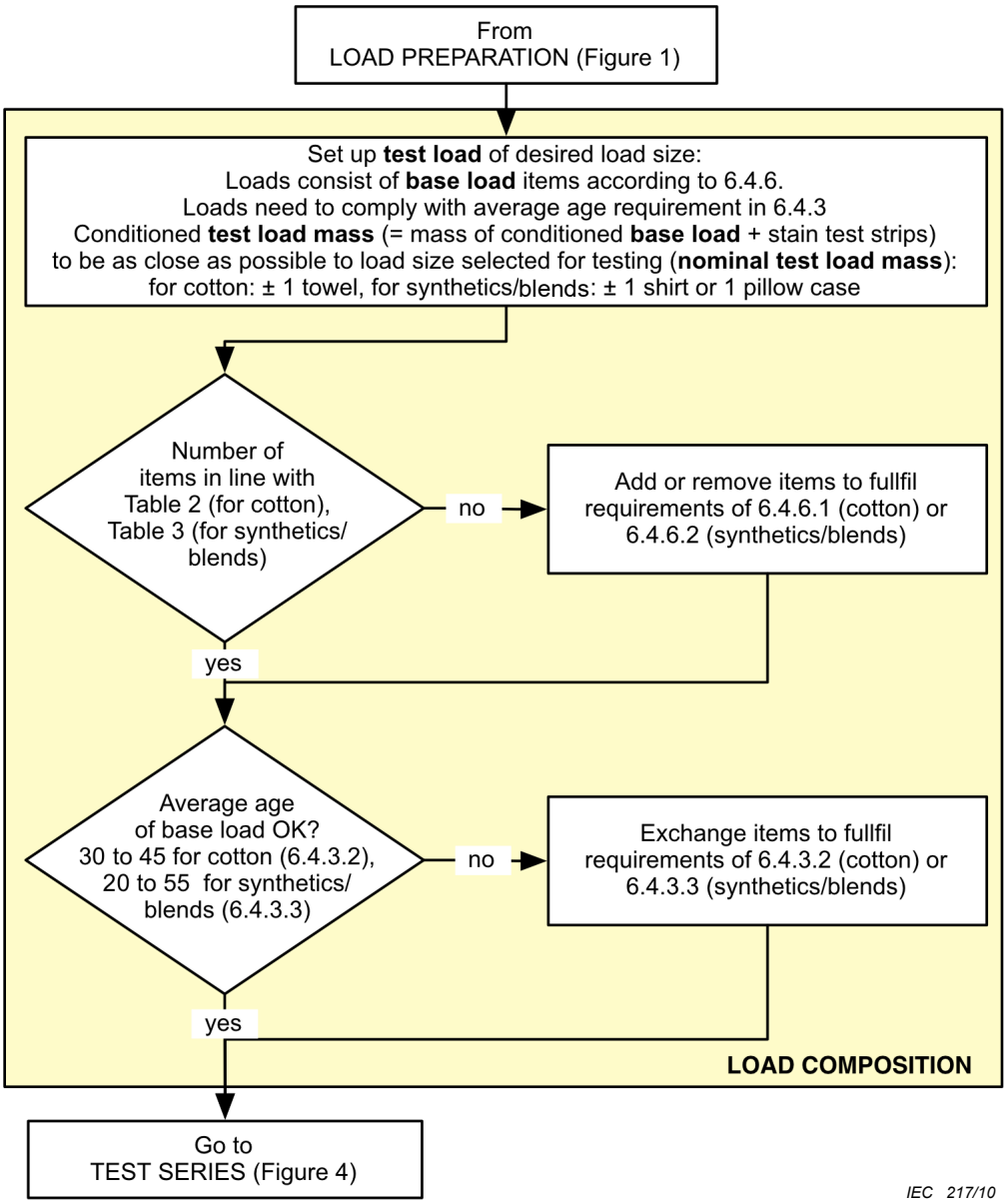

Figure 2 – Load composition and age requirements

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

New cotton and synthetics/blend **base load** items shall be treated before their first use by undergoing a normalization wash process five times, as defined in 6.4.5 but without intermediate drying and using 15 g/kg of the reference detergent A*. This is followed by normalization 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 or synthetic/blend **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 the normalization runs between each **test series** (refer to 6.4.4).

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NOTE To meet the age requirements specified in this document, a system of tracking the number of **test runs** for each load item is required.

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 30 and 50 **test runs**. That means the weighted average age of the **base load** before starting a **test series** shall be between 30 and 45 **test runs**. The number of items or average age shall not be adjusted during a test series.

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

6.4.3.3 Average age requirements for 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 synthetics/blends **base load** shall consist of items used up to 40 **test runs** and the other half more than 40 **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.** That means the weighted average age of the **base load** before starting a **test series** shall be between 20 and 55 **test runs**. The number of items or average age shall not be adjusted during a test series.

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 Normalization of base load items before a new test series

6.4.4.1 General

Normalization 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 commencing the next **test series**.

Before a new **test series** the **base load** shall be normalized as specified below for each load type. Normalization 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 prior to commencement of the next **test series**. Normalization of a **base load** prior to use in a **test series** shall always be done using a laboratory supply water with the same total water hardness (refer to 5.2.2.2) as that is to be used for the subsequent **test series**.

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

6.4.4.2 Normalization of cotton base load items before a new test series

All cotton **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 normalization, then the **remaining moisture content** on removal from the dryer must be less than 0 %.

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

6.4.4.3 Normalization of synthetics/blend base load items before a new test series

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.

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

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

6.4.4.4 Normalization of polyester base load items for wool programmes before a new test series

The polyester **base load** does not have to be normalized after a **test series**, but the **base load** items shall be dried in a tumble dryer.

6.4.5 Conditioning of base load items before a new test series

6.4.5.1 General

Conditioning is the process of bringing the **base load** to reach a known **remaining moisture content** after normalisation and drying at the completion of a **test series** in order to check the standardized mass of each load item prior to commencing the next **test series**.

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

NOTE The **base load** does not have to be conditioned between **test runs** within a **test series**. However, the **base load** is to be dried in a tumble dryer and some checks on the **base load** mass between **test runs** are specified in 8.2.5.

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

In this method, the **base load** items are dried in a tumble dryer to a **remaining moisture content** of each single item of less than 0 % and are then stretched or flattened by hand before conditioning. They are then allowed to reach an equilibrium **remaining moisture content** when placed in a room/chamber with an ambient temperature and humidity which is maintained in accordance with 5.2.3.2. Under this method, two options are available as follows:

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

6.4.5.3 Conditioning of base load items using the bone dry method

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

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

6.4.6 Test load composition

6.4.6.1 Cotton test load composition

The **test load** consists of the **base load** as specified in 5.3.2.1 and the stain test strips as specified in 5.3.3. Affixing stain test strips is specified in 6.4.7. Subclauses 6.4.2 to 6.4.5 set out requirements regarding the preparation, maintenance and selection of a **base load** for a **test series**.

The **test load mass** is adjusted so that it corresponds to the required **test load mass** for the specified **programme** of the test machine. The numbers of sheets, pillowcases and towels in the cotton **base load** for various required **test load masses** are specified in Table 2. The number of stain test strips are also specified in Table 2. Final adjustment of the **test load mass**, which includes the weight of the stain test strips, is made by adding or removing towels so that the total mass is as close as possible (± 60 g) to the nominal required **test load mass**.

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Table 2 – Number of items in the cotton test load for various test load masses

Required test load mass kg [a, b]	Approximate base load mass kg [b]	Number of stain test strips	Number of sheets	Number of pillowcases	Number of towels [c]
1	0,96	2	0	2	4
1,5	1,46	2	0	3	7
2	1,96	2	0	4	9
2,5	2,44	3	0	5	11
3	2,94	3	2	4	5
3,5	3,42	4	2	4	9
4	3,92	4	2	4	14
4,5	4,40	5	2	6	14
5	4,90	5	2	6	18
5,5	5,38	6	2	8	18
6	5,88	6	2	8	23
6,5	6,36	7	2	10	23
7	6,86	7	2	12	23
7,5	7,34	8	3	12	21
8	7,84	8	3	12	25
8,5	8,32	9	3	14	25
9	8,82	9	4	14	23
9,5	9,30	10	4	14	28
10	9,80	10	4	16	28
10,5	10,28	11	5	15	28
11	10,78	11	5	15	32
11,5	11,26	12	5	16	35
12	11,76	12	6	17	30
12,5	12,24	13	6	17	35
13	12,74	13	6	18	37
13,5	13,22	14	6	19	39
14	13,72	14	6	19	44
14,5	14,20	15	7	20	39
15	14,70	15	7	21	42

[a] For **test load masses** to the whole or half kilogram rating which are greater than those specified in the table, the number of stain test strips is equal to the **nominal test load mass** (rounded to the nearest kilogram), the number of sheets is the **nominal test load mass** divided by (3 × 0,725) (rounded to the nearest whole sheet) and the number of pillowcases is the **nominal test load mass** divided by (3 × 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] Difference between **base load** mass and **test load mass** is due to the mass of the test strips, see definitions 3.1.18 / 3.1.19.

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

6.4.6.2 Synthetics/blends test load composition

The **test load** consists of the **base load** as specified in 5.3.2.2 and the stain test strips as specified in 5.3.3. Affixing stain test strips is specified in 6.4.7. Subclauses 6.4.2 to 6.4.5 set out requirements regarding the preparation, maintenance and selection of a **base load** for a **test series**.

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The **test load mass** is adjusted so that it corresponds to the required **test load mass** for the specified **programme** of the test machine. The numbers of pillowcases and shirts in the synthetics/blends **base load** for various required **test load mass**es are specified in Table 3. The number of stain test strips are also specified in Table 3. The synthetic/blends **base load** is set up first with an equal number of shirts and pillowcases. Final adjustment of the **test load mass**, which includes the weight of the stain test strips, is made by adding or subtracting one shirt or one pillowcase, whichever brings the **test load mass** to be closest to the nominal required **test load mass**.

Table 3 – Number of items in the synthetics/blends test load for various test load masses

Required test load mass kg [a, b]	Approximate base load mass kg [b]	Number of stain test strips	Number of shirts [c]	Number of pillowcases [c]
1	0,96	2	2	3
1,.5	1,46	2	4	4
2	1,96	2	5	6
2,5	2,44	3	7	6
3	2,94	3	8	7
3,5	3,42	4	9	9
4	3,92	4	11	10
4,5	4,40	5	12	12
5	4,90	5	13	13

[a] For **test load masses** greater than 5 kg, the number of items is specified as follows: the **base load** consists of an equal number of shirts and pillowcases. Adjustment of the **test load mass** is made after adding the stain test strips, by adding or subtracting one shirt or one pillowcase whichever adjusts the **test load mass** to be closest to the required **nominal test load mass**. The number of stain test strips is equal to the required **nominal test load mass** rounded to the nearest whole kilogram.

[b] Difference between **base load** mass and **test load mass** is due to the mass of the test strips, see definitions 3.1.18 / 3.1.19.

[c] The actual number of items above are indicative only. The difference between the number of shirts and pillowcases for any **test load** shall be not more than one. The mass of all **base load** items can be expected to decline slightly with increasing age.

6.4.6.3 Polyester test load mass for wool programmes

The **test load** consists of the **base load** as specified in 5.3.2.3 and three wool shrinkage specimens as specified in 5.3.4. Wool shrinkage specimens are not affixed to polyester **base load** items but are distributed through the **base load** as specified in Clause 10. Subclauses 6.4.2 to 6.4.5 set out requirements regarding the preparation, maintenance and selection of a **base load** for a **test series**.

The **test load mass** is adjusted so that it corresponds to the required **test load mass** for the specified programme of the test machine. The estimated number of **base load** items for various required **test load mass**es is specified in Table 4. The **test load mass** shall be adjusted by adding or subtracting **base load** items to be closest to the nominal **test load mass**.

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Table 4 – Number of items in the wool programme test load for various test load masses

Required test load mass kg	Approximate base load mass kg	Number of wool shrinkage speci-mens	Number of polyester base load items [a]
1	0,95	3	27
1,5	1,45	3	42
2	1,95	3	56
2,5	2,45	3	70
3	2,95	3	94
3,5	3,45	3	98
4	3,95	3	113
4,5	4,45	3	127
5	4,95	3	141

[a] Number shall be adjusted to make the **base load** mass as close as possible to the required **base load** mass. The mass of **base load** items can be expected to decline slightly with increasing age.

6.4.7 Addition of stain test strips or wool shrinkage specimens to the base load

6.4.7.1 General

Stain test strips are attached to cotton and synthetic/blend base loads in order to assess washing performance as set out in 6.4.7.2. Wool shrinkage specimens are used with a polyester base load to assess wool shrinkage performance as set out in 6.4.7.3.

6.4.7.2 Attachment of stain test strips to cotton and synthetic/blend base loads

Stain test strips specified in 5.3.3 shall be affixed to specified **base load** items for each load type as follows:

- cotton **base load** – stain test strips are attached to towels;
- synthetics/blends **base load** – stain test strips are attached to pillowcases;

The number of stain test strips used for a performance test shall be as shown in Table 2 for a cotton **base load** (refer to 6.4.6.1) or Table 3 for a synthetics/blends **base load** (refer to 6.4.6.2).

The orientations described in the following text refer to a plan view of the towel or pillowcase and stain test strip in Figure 3.

Towels or pillowcases to which stain test strips are attached for a washing performance test shall be flattened by hand or iron prior to attachment. Attach the stain test strips to towels or pillowcases as follows:

- place the stain test strip on top of the towel or pillowcase so that the unsoiled piece of the strip is at the top and with serial number or other manufacturers marking facing up, as shown in Figure 3;
- move the stain test strip so that the right hand edge of the strip aligns with the right hand edge of the towel or pillowcase without overlap and that the strip is located centrally from top to bottom;
- Sew or fasten the right-hand edge of the stain test strip onto the right-hand edge of the towel or pillowcase in this position along a line that is a distance of (10 ± 5) mm from the right-hand edge of towel or pillowcase and strip. Where non-metallic fasteners are used, a sufficient number shall be used to ensure that the strip is adequately secured along its length. Metallic fasteners of any type are not permitted.

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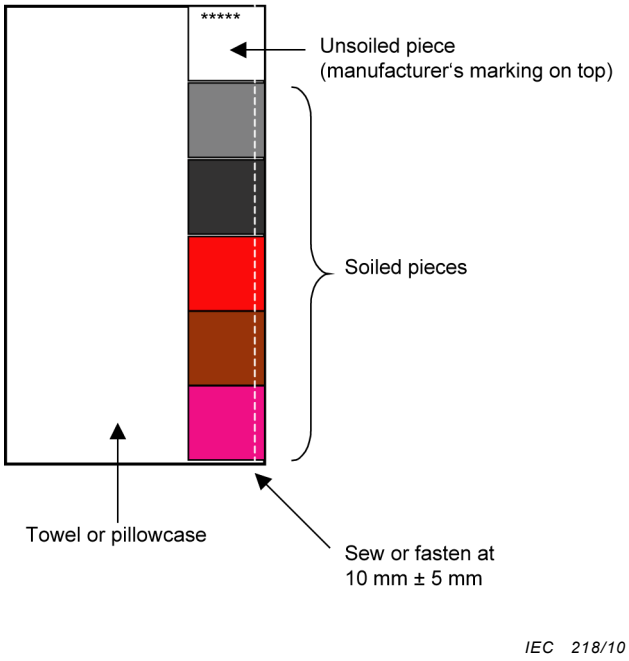

Figure 3 – Attached test strip

6.4.7.3 Wool shrinkage specimens

In the case of assessment of wool **programmes** for shrinkage performance, wool shrinkage specimens are not attached to polyester base load items but are placed throughout the **base load.** Only 3 wool shrinkage specimens are used, irrespective of the **test load** size (refer to 6.4.6.3). Refer to Clause 9 for details of the wool shrinkage test.

7 Performance measurements – general requirements

This clause sets out the main performance test methods specified in this document.

The following performance parameters are intended to be measured using a common single **test series** as set out in Clause 8:

- washing performance
- water extraction performance
- rinsing performance (soluble components)
- energy consumption
- water consumption
- programme time

The evaluation of these measured parameters is specified in Clause 9.

The measurement and evaluation of wool shrinkage performance is specified in Clause 10. The assessment of wool performance shrinkage requires the use of a separate **base load** and **test series**.

NOTE 1 Other performance parameters (washing, rinsing, water extraction, energy and water) are not normally determined for a wool shrinkage test.

NOTE 2 Increased alkalinity is used in this document as a tracer to detect soluble residues from detergent and soil in the **base load**. Other residues, such as non-soluble or surface active components are not part of this as-

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sessment. A method for the assessment of rinse performance for insoluble detergent components is under consideration.

NOTE 3 The measurement of energy consumption in low power modes are set out in Annex L. Alternative evaluation options are set out in Annex O.

Prior to performing a **test series**, the following parameters need to be selected:

- load type (e.g. cotton, synthetics/blends, polyester load for wool shrinkage tests)
- performance tests required (washing performance, water extraction performance, rinsing performance, water and energy consumption, programme time)
- **programme** to be tested on the **test washing machine** and the relevant reference **programme** on the **reference machine**
- test load mass (rated capacity or part load)
- water hardness (soft or hard)

The primary requirement of this document is for determination performance at **rated capacity** for each relevant load type and set of test conditions. Any claim of performance to this document without a statement of load size shall be determined on the basis of tests at **rated capacity**. However, additional tests may be conducted at other capacities. Any claims of performance for such test results shall be qualified with the **test load mass** used.

8 Tests for performance

8.1 General

This section sets out the test procedure for the determination of the following parameters for a cotton load or a synthetic/blend load:

- washing performance
- water extraction performance
- rinsing performance (soluble components)
- energy consumption
- water consumption
- programme time

For the assessment of washing performance and rinsing performance the result from the **test washing machine** is compared to the result from the **reference machine** which is operated in parallel.

NOTE The measurement and evaluation of wool shrinkage performance is specified in Clause 10.

While the text in this document is written from the perspective of a single **test washing machine** operating in parallel with the **reference machine**, more than one **test washing machine** may be operated in parallel with the **reference machine** during a **test run** or **test series**.

8.2 Test procedure for performance tests

8.2.1 Test conditions, materials and preparation for testing

For each **test run** the **reference machine** and **test washing machine** shall be conducted as follows:

- connected to an electricity supply specified in 5.2.1
- connected to a laboratory water supply system specified in 5.2.2
- in ambient conditions as specified in 5.2.3

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- with the **test washing machine** and the **reference machine** prepared in accordance with 6.2
- using a **base load** specified in 5.3.2 and a **test load** that has been prepared in accordance with the requirements of 6.4
- using the detergent specified in 5.3.5 and with the detergent dose and placement specified in 6.3.

Stain test strips and detergent (as applicable) used in the **test washing machine** and the **reference machine** shall be from the same batch for all **test runs** within a **test series**. **Test loads** shall have new stain test strips attached for each **test run** irrespective of whether a washing performance test is being conducted. Detergent shall be used in all performance tests except where otherwise specified (refer to 6.3).

8.2.2 Test load and loading

The **base load** type (refer to 5.3.2) and nominal **test load mass** shall be selected for each **test series**.

Prior to a **test series**, separate conditioned **base loads** to achieve the required **test load mass** (refer 6.4.6) shall be prepared for the **reference machine** and the **test washing machine**. The same **base load** shall be used in each **test washing machine** for all **test runs** in a **test series**.

Each **test washing machine** and the **reference machine** shall be loaded in accordance with the requirements of Annex H.

8.2.3 Programme

The **programme** selected on the **test washing machine** and any associated settings shall be in accordance with the manufacturer's instructions. The **programme** selected for the **reference machine** shall be the one recommended in Annex F.

In the case of a **manual washing machine**, the manufacturer's instructions regarding the settings and operation of the **washing machine** shall be followed. Where no specific instructions are provided, the test procedure for a manual washing machine in Annex M shall be followed.

The **programme** selected on the **test washing machine** (with any associated settings) and the **reference machine** shall be reported.

NOTE In order to minimise the influence of laboratory conditions and test materials, a reference **programme** should be selected that is intended for a similar purpose when compared to the **programme** on the **test washing machine** (load type, claimed wash temperature) – refer to Annex F for guidance.

8.2.4 Test procedure

This procedure applies to the **test washing machine** and the **reference machine** which shall be run in parallel**.**

NOTE The intent of "parallel" is to ensure that **test washing machines** are subjected to comparable variations in normal laboratory conditions as the **reference machine**.

Operate the **test washing machine** and the **reference machine** in parallel on the relevant **programmes** ensuring that no user selected delay is incorporated. Monitor and record all required parameters during the **programme**.

Any adverse warning indicators (eg. warnings or faults) shall be noted and considered when assessing test run validity.

Within 10 min of the completion of the **programme**, remove the **test load**. The stain test strips shall be carefully removed as quickly as possible. Proceed to follow the relevant re-

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quirements of each of the performance tests being performed in the **test series**. Assessment of water extraction performance and alkalinity can be affected by delays in subsequent measurements, so specific requirements regarding measurement (and where necessary, storage) of the **base load** after the completion of the **programme** and timing of measurements are specified for these tests.

8.2.5 Test series

A **test series** of five tests is carried out on the **test washing machine** and the **reference machine** in parallel. The first **test run** in a **test series** shall be done with a normalized and conditioned **base load** (refer 6.4.4 and 6.4.5).

At the completion of measurements for a **test run**, the **base load** shall be dried in a tumble dryer to a **remaining moisture content** of (0 ± 3) %. Do not adjust number of items or average age during a **test series**. Care is required to ensure that no **base load** items are lost or gained between **test runs**, so a system of accounting for all **base load** items should be used. After the last **test run** of a **test series** the **base load** may be normalized directly without drying in between.

In circumstances where one of the five **test runs** on either the **test washing machine** or the **reference machine** is invalid (e.g. power failure, **test washing machine** or **reference machine** breaks down, instrumentation or control gear fault or failure), it is permitted to conduct a sixth **test run** on the **test washing machine(s)** and the **reference machine** (as required) in the **test series** under identical conditions. Similarly if evidence is provided that one of the **test runs** in the **test series** had problems due to abnormal conditions, a sixth **test run** may be added under identical conditions. The reason for the extra **test run** shall be reported. The incorrect **test run** is eliminated completely from any subsequent evaluation.

NOTE Refer to 9.1 regarding evaluation of results where more than 5 **test runs** are undertaken in a **test series**. The reason for rejection of a **test run** from a **test series** should be explained in the test report. Where an additional **test run** is required on a **test washing machine**, only the **test washing machine** of interest and the **reference machine** need be operated for a sixth **test run**. Where an additional **test run** is required on the **reference machine**, the **reference machine** and all **test washing machines** which were operated in parallel for the **test series** shall be subjected to a sixth **test run**. Only washing performance and rinsing performance requires results from both the **test washing machine** and the **reference machine**.

If more than one **test run** is invalid in a **test series**, then the whole **test series** is invalid, irrespective of the reason. In that case, the test runs completed shall be counted on load life and then the load is normalised as per 6.4.4 for use in the next test series.

A schematic representation of a **test series** is set out in Figure 4.

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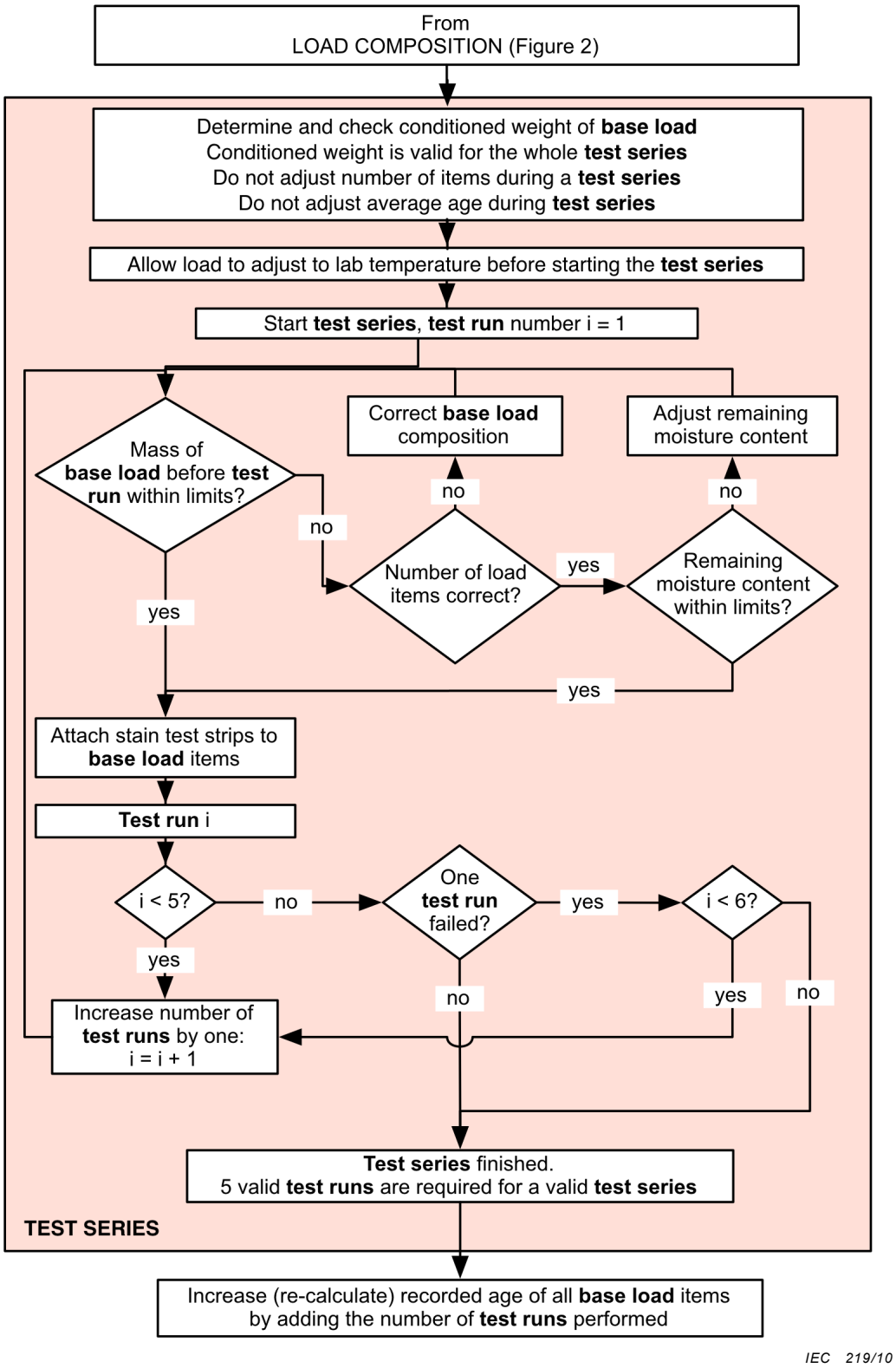

Figure 4 – Test series: process and decisions for load mass and age

8.3 Measurements to determine washing performance

8.3.1 General

This clause contains specific requirements for the measurement of washing performance. Evaluation of the measurements performed in this clause are set out in 9.2.

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8.3.2 Removal and drying of stain test strips

After completion of each **test run** in accordance with 8.2, the stain test strips are removed from the **test load** at the completion of the **programme.**

Before taking reflectance measurements (8.3.3), the test strips shall be dried and flattened. Any method of drying and flattening may be used provided it can be shown to produce the same reflectance result as one of the following options:

- air dry and flatten by placing the wet stain test strip under tension at ambient temperature in the dark; or
- air dry at ambient temperature in the dark, then flatten by ironing; or
- dry and flatten by ironing the wet stain test strip.

If an ironing appliance is used it shall comply with 5.4.6 and it shall be used in such a way that it does not cause a surface shine on the test strip. This can be achieved by placing a piece of fabric between the hot plate and the stain test strip.

Once dry, the stain test strips may be stored in a dry dark place until the reflectance measurement is undertaken (refer to 8.3.3).

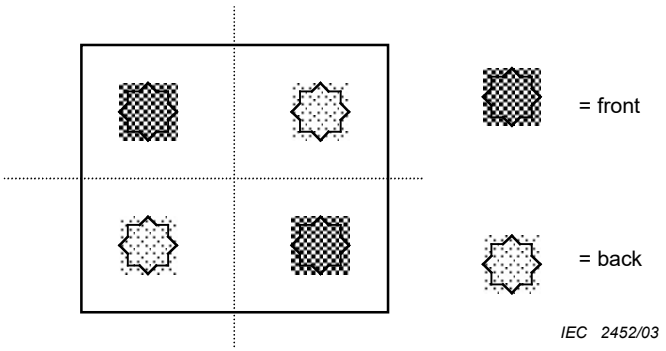
NOTE Residual humidity in the stain test strips will influence the measurement results, as will overheating during ironing. Exposure of the stain test strips to direct daylight at any time is not advisable.

8.3.3 Assessment of stain test strips

To assess washing performance, tristimulus Y reflectance measurements are carried out on each of the individual soil types and the unsoiled test piece which make up the stain test strip. Reflectance measurements shall be taken with a spectrophotometer as specified in 5.4.3.

For any complete set of tests, the reflectance of all stain test strips (reference machine and test machines) shall be measured under the same ambient conditions. The stain test strips shall be allowed to stabilise at these conditions before the reflectance measurements are undertaken.

Reflectance measurements are taken with not less than four layers of the same washed soil type as backing for the piece being measured. Every washed piece is measured twice on both sides, at the positions indicated in Figure 5. Each of the 4 individual readings shall be recorded. The average value of the four readings for each soil type is used in the subsequent evaluation for that soil type.



Positions for measuring each soil type are in the centre of the four square quadrants.

Figure 5 – Positions for measuring soiled test pieces

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8.4 Measurements to determine water extraction performance

8.4.1 General

This clause contains specific requirements for the assessment of water extraction performance, which is a measure of the residual water in the **base load**. Evaluation of the measurements performed in this clause are set out in 9.3.

The water extraction performance is expressed as the amount of remaining moisture in the **base load** after the final spinning operation at the end of the **programme** relative to the conditioned mass of the same **base load**.

This method is intended for the assessment of **automatic washing machines** that have spin **operation** at the completion of the **programme**. It is also intended to be used to assess the performance of separate **spin extractors** and **manual washing machines** that have a separate **spin extractor**.

NOTE The **spin extraction** of **manual washing machines** with a spinning **operation** (including **washing machines** with a separate spinning device such as twin tubs) can be assessed using this method. While this method could also be used for assessment of hand operated wringing machines, this is not generally recommended as the results are somewhat dependent on the skill of the operator. However, the method could provide some qualitative assessment of such a device.

8.4.2 Washing machines

The **test load** shall be subjected to the performance test procedure specified in 8.2.

At the completion of the test **programme** as set out in 8.4.1, without delay, remove the soiled **test strips** and weigh the **base load**. The mass of the moist **base load** at the completion of the **programme** is recorded.

NOTE The final mass of the **base load** has to be measured prior to any subsequent water extraction to assess rinse performance, see 8.4.

8.4.3 Spin extractors

For the measurement of water extraction performance of separate **spin extractors** the washing and rinsing **operations** are performed in accordance with 8.2 but without a final spin **operation**. The **programme** selected shall be suitable for the **base load** to ensure repeatable conditions. At the completion of the **programme**, without delay, weigh the **base load**.

The **spin extractor** shall be loaded evenly, with the items placed along the drum wall of the **spin extractor**. When the items reach about one-third of the height of the drum, the items are pushed from the circumference to the centre so as to fill the hollow in the centre of the drum. This is repeated once or twice as the drum gets filled further. The **base load** is finally covered at the top with the last **base load** item, which is folded over double for this purpose.

The water is extracted from the **base load** for the time recommended by the manufacturer or for 4 min if instructions are not given.

8.5 Measurements to determine rinsing performance

8.5.1 General

This clause contains specifications for a test using the residual alkalinity of the detergent solution in a base load after **spin extraction** as a measure of the rinsing performance. The purpose is to evaluate how well a typical textile load is rinsed as regards water-soluble residues. This clause contains specific requirements for the measurement of rinsing performance. Evaluation of the measurements performed in this clause are set out in 9.4.

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This test is conducted in accordance with Clause 8.2. At least five complete **test runs** shall be carried out using the selected **programme** (refer to 8.2.4).

After the completion of the **programme**, the **spin extraction** and sampling is carried out in accordance with 8.5.2.

This method is intended for **automatic washing machines** that have spin operation at the completion of the **programme**. It is not intended to be used to assess separate spin extractors or **manual washing machines** that have a separate spin extractor.

8.5.2 Spin extraction and sampling

Before each spin extraction the standard extractor (refer to 5.4.5) shall be thoroughly cleaned from alkalinity remaining from previous spin operations by flushing it with laboratory supply water, tilting it – if possible – and dried by running it for an appropriate time.

NOTE 1 Ensuring that the standard extractor is empty is critical to avoid dilution of the water subsequently extracted from the base load.

A sample of approximately 1 l is taken from the laboratory supply water used for the **test washing machine**.

After a complete **programme** including washing, rinsing and spinning, the **test load** shall be removed from the washing machine, then the mass of the **base load** (with any stain test strips removed) is determined (noting that the mass of the **base load** is also required for determination of the water extraction index in Subclause 8.4).

Without delay the **base load** shall be split into bundles. Each bundle of cotton load shall contain one sheet, two pillowcases and six towels. Each bundle of synthetic/blend shall contain four pillowcases and four shirts. The mass of each bundle is determined.

Every bundle shall be spun in separate spin extractors immediately.

NOTE 2 The measurement of alkalinity is seriously affected by interactions of the **base load** with the atmosphere.

Each bundle shall be treated in the following way:

For cotton load bundles: Treat one sheet in the same way as described in J.3 and place it flat on the base of the standard extractor. Treat two pillowcases (separate) in the same way as described in J.3 and place them along the wall of the standard extractor. Treat five towels (separate) in the same way as described in J.3 and place them along the wall of the standard extractor. Finally fold one towel in the middle of the longer side and place it flat at the top. Each bundle is spun separately in the standard extractor for 10 min or the spin time determined in 5.4.5. Each bundle and the extracted water is weighed after extraction.

If no bundle can be formed due to the number of items requested (i.e. < 3,5 kg) proceed as follows:

Bundle specifications for cotton loads			
Nominal load size (kg)	Number of sheets	Number of pillowcases	Number of towels
Greater than 3,5 kg	1	2	6
3,0 kg to 3,5 kg	1	2	up to 6
Less than 3,0 kg	all items		

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For synthetic/blend load bundles: Treat shirts and pillowcases as described in J.3 and distribute them evenly along the wall of the standard extractor and spin it for 5 min. The bundles and the extracted water are weighed after extraction.

All the extracted water from the bundles is collected, the last amount, if possible, by tilting the standard extractor towards the outlet. It is thoroughly mixed and a sample is transferred into a dry and clean bottle and closed tightly if the sample is not titrated within 1 h.

Remaining items after the splitting into bundles are weighed. They are spun separately in the standard extractor for 10 min for cotton and 5 min for synthetic/blends or the spin time determined in 5.4.5. The extracted water of this spin extraction is weighed and rejected. The remaining items are weighed after extraction.

If a **spin extractor** other than one complying with the primary **standard extractor** specification in 5.4.5 is used, the actual spin time above shall be adjusted (reduced) as specified in 5.4.5 to meet the specified **remaining moisture content** requirements.

A large **standard extractor** may be used in which several bundles may be spun simultaneously. The large **standard extractor** shall be loaded according to the procedure described in Annex J. If the load size exceeds the capacity of the large **standard extractor** the load shall be divided into two equal bundles.

NOTE 3 Recorded weights are used to check validity of the spin extraction process (see Annex K).

8.5.3 Alkalinity measurements

8.5.3.1 General

The residual alkalinity in the **base load** is defined as the milliequivalents alkali per kilogram of **base load**. It is determined by titration with 0,1 N hydrochloric acid to a pH of 4,5. The corresponding value of the laboratory supply water is subtracted.

The titration itself is performed by one of two alternative methods: manual or automatic. Automatic titration is preferred for reasons of precision and reproducibility.

8.5.3.2 Alkalinity measurement

Two samples of the extracted water shall be titrated. The temperature of the samples shall be at (20 ± 5) °C. If the values of alkalinity concentration found are different by more than 2 %, a third sample shall be titrated and the average of the values obtained.

A sample of the laboratory supply water collected as described in 8.5.2 shall be tested for alkalinity in the same way as the extracted water.

8.5.3.3 Titration

The alkalinity shall be determined through titration as set out in Steps (A) to (C) below.

Step (A): after mixing the sample, put an amount of about 50 g to 100 g (see note) of the sample into a titration beaker and weigh the exact amount of sample on a scale. Record sample name and mass.

NOTE Amount depending on the expected alkalinity and on the volume of sample available; if necessary add reverse osmosis, distilled or demineralised water up to about 100 g.

Step (B): prepare the measurement equipment as needed for your specific device and start the automatic measurement. While stirring the sample titrate with HCl 0,1N to a steady (10 s) pH 4,5 endpoint. Near to the endpoint, ensure the titration speed is reduced to avoid overshooting. In case of automatic titration set speed profile accordingly.

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Step (C): once terminated record all further data like titration volume n_e (alkalinity of extracted water), n_s (alkalinity of the laboratory supply water) (in ml, two decimal places) and titration time for each sample. The normal titration time should be around 2 min to 10 min per sample. If possible add a record printout.

8.6 Measurements to determine water and energy consumption and programme time

8.6.1 General

This clause specifies the procedure and measurements required for the determination of water and energy consumption during typical **operations** such as washing, rinsing and **spin extraction**. It also specifies the method for determination of the duration of the complete **programme** and total water and energy consumption.

The purpose is to obtain reproducible data for the calculation of environmental impacts and cost of operation based on water and energy consumption.

Evaluation of the measurements performed in this clause are set out in 9.5.

Determination of power consumption in **off mode** and **left on mode** is specified in Annex L.

NOTE 1 This clause is applicable also to **washing machines** without **spin extraction**.

NOTE 2 Information on other low power mode energy consumption of **washing machines** is also contained in Annex L.

8.6.2 Procedure

The **test load** shall be subjected to the performance test procedure specified in 8.2. During these tests instrumentation for the measurement of water volume, water temperature and electrical energy shall record the required parameters. It is recommended that data for all parameters be recorded at regular intervals throughout the test using a data logger or computer. Data collection should commence well before the programme is initiated and continue after the **end of programme**.

Measurements are commenced when the **programme** is initiated (without any user programmed delay). They are stopped at the **end of programme**.

A **test series** consisting of five complete **test runs** shall be carried out using the selected **programme.**

9 Assessment of performance

9.1 General

This section sets out the primary evaluation methods for the assessment of washing machine performance under this document. While these methods are intended as the main basis for **washing machine** comparisons, a range of other methods and approaches for evaluation of measured test data are included in Annex O which can yield more useful information in some cases.

This section includes the evaluation of

- washing performance
- water extraction performance
- rinsing performance (soluble components)
- energy consumption
- water consumption

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