PD CLC/TS 50640:2015

BSI Standards Publication

# Clothes washing machines for commercial use — Methods for measuring the performance

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## National foreword

This Published Document is the UK implementation of CLC/TS 50640:2015.

The UK participation in its preparation was entrusted to Technical Committee CPL/59, Performance of household electrical appliances.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.


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TECHNICAL SPECIFICATION

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# CLC/TS 50640

April 2015

ICS 97.060

English Version

# Clothes washing machines for commercial use - Methods for measuring the performance

Waschmaschinen für den gewerblichen Gebrauch - Verfahren zur Messung der Gebrauchseigenschaften

This Technical Specification was approved by CENELEC on 2015-01-26.

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Europäisches Komitee für Elektrotechnische Normung

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Ref. No. CLC/TS 50640:2015 E

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# Foreword

This document (CLC/TS 50640:2015) has been prepared by CLC/TC 59X "Performance of household and similar electrical appliances".

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC [and/or CEN] shall not be held responsible for identifying any or all such patent rights.

This document has been prepared under a mandate given to CENELEC by the European Commission and the European Free Trade Association.

This is a new Technical Specification, but it is based on portions from EN 60456:2011.

This Technical Specification is the main body of a forthcoming European Standard for measuring the performance of non-household washing machines. The content of this Technical Specification will be added with the Annex ZZ when the details regarding Ecodesign regulations are defined.

The procedures described in this Technical Specification are modified substantially compared to the procedures described in EN 60456. Therefore, results of tests according to this Technical Specification cannot and are bound not to be compared to results of similar procedures of EN 60456.

Significant technical differences from EN 60456 are:

a) test procedures for washing machines of any size on the market;

b) the method includes procedures for measuring steam heated and gas heated washing machines;

c) the introduction of a new type of base load;

d) a new reference programme.

NOTE CLC/TS 50640:2015 is planned to be a European Standard for the energy measurement of gas heated laundry equipment.

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

# 1 Scope

This Technical Specification specifies methods for measuring the performance of clothes **washing machines** for **commercial** use utilizing cold and/or hot water supply and without heating or with heating devices for electricity, steam or gas. It also deals with appliances for both washing and drying textiles (**washer-dryers**) with respect to their washing related functions. This Technical Specification covers top, front and side loaded non household **washing machines** with horizontal or vertical axis and with one or more wash compartments.

NOTE 1 Non household tumble dryer performance is assessed to CLC/TS 50594.

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

NOTE 2 This Technical Specification does not apply to continuous batch **washing machines** (e.g. tunnel washers) or **washing machines** only possible to operate with automatic loading and unloading.

NOTE 3 This Technical Specification does not specify safety requirements for **non-household washing machines**. Safety requirements are specified in EN 50571 and the EN ISO 10472 series.

# 2 Normative references

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

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

EN 12953-10, *Shell boilers — Part 10 : Requirements for feedwater and boiler water quality*

EN 50571, *Household and similar electrical appliances — Safety — Particular requirements for commercial electric washing machines*

EN 60734, *Household electrical appliances — Performance — Water for testing (IEC 60734)*

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

EN ISO 2061, *Textiles — Determination of twist in yarns — Direct counting method (ISO 2061)*

EN ISO 3759, *Textiles — Preparation, marking and measuring of fabric specimens and garments in tests for determination of dimensional change (ISO 3759)*

EN ISO 11664-2, *Colorimetry — Part 2: CIE standard illuminants (ISO 11664-2)*

EN ISO 80000-1:2013, *Quantities and units — Part 1: General (ISO 80000-1:2009 + Cor 1:2011)*

IEC 60456, *Clothes washing machines for household use — Methods for measuring the performance*

DIN 53923, *Testing of textiles; determination of water absorption of textile fabrics*

CIE 015:2004[1)], *Colorimetry (3rd edition)*

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IAPWS-IF97, *IAPWS Industrial Formulation 1997 for the Thermodynamic Properties of Water and Steam* [International Association for the Properties of Water and Steam]

# 3 Terms, definitions and symbols

## 3.1 Terms and definitions

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

**3.1.1**
**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 Technical Specification in order to determine its performance

Note 1 to entry: **Test washing machine** may include **washing machines** according to 3.1.6, 3.1.7.

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

Note 1 to entry: It 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 Technical Specification – refer to 5.5.2.

**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 1 to entry: This Technical Specification only covers the **operations** which relate to the **washing machine** function – see Clause 1.

**3.1.5**
**spin extractor**
separate water-extracting appliance in which water is removed from textiles by centrifugal action (**spin extraction**)

**3.1.6**
**vertical axis washing machine**
**washing machine** in which the load is placed in a drum which rotates around an axis which is vertical or close to vertical.

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

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

**3.1.7**
**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

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

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

**3.1.8**
**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

**3.1.9**
**top loaded machine**
**washing machine** where the load is placed in the wash compartment from the top, and which may be of a horizontal or vertical axis type

**3.1.10**
**side loaded machine**
**washing machine** where the load is placed in the wash compartment from the side, and which is of a horizontal axis type

**3.1.11**
**pullman machine**
**washing machine** where the wash compartment is divided in two compartments

**3.1.12**
**Y-pocket machine**
**washing machine** where the wash compartment is divided in three compartments

**3.1.13**
**test run**
single performance assessment as specified in Clause 8 of this Technical Specification

**3.1.14**
**test series**
group of **test runs** on a **test washing machine** which, collectively, are used to assess the performance of a **washing machine**

**3.1.15**
**operation**
each performance of a function that occurs during the **washing machine programme** such as pre-wash, washing, rinsing, draining or spinning

**3.1.16**
**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

**3.1.17**
**cycle**
complete washing process, as defined by the **programme** selected, consisting of a series of **operations** (wash, rinse, spin, etc.) and including any **operations** that occur after the completion of the **programme**

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

**3.1.18**
**spin extraction**
water-extracting function by which water is removed from textiles by centrifugal action, which is included as a function (built in **operation**) of an **automatic washing machine** but may also be performed in a **spin extractor**

**3.1.19**
**spin speed**
rotational frequency of a drum during **spin extraction**

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

**3.1.20**
**base load**
unsoiled textiles used for testing

**3.1.21**
**test load**
**base load** used for testing plus stain test strips

**3.1.22**
**test load mass**
actual mass of the **base load** including stain test strips

**3.1.23**
**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)

Note 1 to entry: Target value for the conditioned **test load mass**.

**3.1.24**
**rated capacity**
maximum mass in kilograms of dry textiles of a particular type which the manufacturer declares can be treated in the **washing machine** on the selected **programme**

**3.1.25**
**programme time**
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**

**3.1.26**
**end of programme**
completion of the **programme**, i.e. when the **washing machine** indicates the end of the **programme** and the load is accessible to the user

Note 1 to entry: Where there is no **end of programme** indicator and the door is locked during **operation**, the **programme** is complete when the load is accessible to the user. 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 2 to entry: An indication of the end of the **programme** may be in the form of a light (on or off), a sound, an indicator shown on a display or the release of a door or latch. In some **washing machines** there may be a short delay from an **end of programme** indicator until the load is accessible by the user.

**3.1.27**
**cycle time**
time from the initiation of the **programme** (excluding any user programmed delay) until all activity ceases, which is considered to be the case when the power consumption reverts to a steady state condition that persists indefinitely without user intervention

Note 1 to entry: If there is no activity after the end of the **programme**, the **cycle time** is equal to the **programme time**.

Note 2 to entry: **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.

**3.1.28**
**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 1 to entry: Variations in the laboratory water supply pressure may affect the **main wash duration**. This definition is only applicable to **test washing machines**. The **reference machine** wash time used for calibration of the **reference machine** is defined differently. Refer to Table E.1.

**3.1.29**
**remaining moisture content**
measure of 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 1 to entry: This equilibrium condition is defined as 0 % **remaining moisture content** in this Technical Specification. 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 F.

**3.1.30**
**rated voltage**
voltage assigned to the appliance by the manufacturer

**3.1.31**
**programme energy**
energy consumed during the programme time in one test run

## 3.2 Symbols

### 3.2.1 Symbols relating to 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**, $\overline{C}_{test}$ , and the **reference machine**, $\overline{C}_{ref}$

$s_q$ 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**

$t_{w-1, 0,05}$ 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

$x_{ij}$ 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 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 9.4 – 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)

$W_{gt}$ the total gas energy metered during the **operation** (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)

$W_{st}$ the total steam energy metered during the **operation** (kWh)

$W_{total}$ total energy (kWh)

### 3.2.4 Symbols relating to Annex F

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

### 3.2.5 Symbols relating to Annex G

$M_T$ the desired total load mass (kg)

$M_S$ the mass of a small sheet

$M_M$ the mass of a medium sheet

$M_L$ the mass of a large sheet

$M_{ST}$ the mass of a stain test strip .

$M_{M+ST}$ the mass of a medium sheet with a stain test strip attached

$X_S$ the number of small sheets

$X_M$ the number of medium sheets

$X_L$ the number of large sheets

$X_{M+ST}$ the number of medium sheets with stain test strips attached

# 4 Requirements

## 4.1 General

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

— washing performance;

— rinsing performance (under consideration);

— water extraction performance;

— water consumption;

— energy consumption;

— wash bath temperature;

— cycle time.

Any claims of performance referring to this Technical Specification for these parameters shall be measured in accordance with the requirements of this Technical Specification (refer to Clause 8 for details).

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

## 4.2 Rated Capacity

Either the manufacturer or supplier shall declare the **rated capacity** at 0,5 kg intervals for each relevant textile type. For **washing machines** with a capacity above 10 kg the **rated capacity** shall be declared at 1 kg intervals. Relevant textile types are cotton and synthetic/blends.

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

The **rated capacity** shall not exceed the maximum mass of dry laundry, in kilograms, to be used in the **test washing machine** in accordance with EN 50571.

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 K.

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

### 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 mm and shall be rounded up to the nearest whole mm.

Height $a_1$/ $a_2$ = 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 ($a_1$) and maximum ($a_2$) possible heights.

Height $a_3$/ $a_4$ = 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 ($a_3$) and maximum ($a_4$) possible heights.

Width $b_1$ = horizontal dimension, between the sides, as measured between two parallel vertical planes against the sides of the **washing machine** including all projections.

Width $b_2$ = horizontal dimension, between the sides, as measured between two parallel vertical planes against the sides of the **washing machine** including all projections including an open side mounted door/lid .

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,** where required, shall be determined in accordance with Annex K.

NOTE 1 Dimension $a_3$/ $a_4$ is generally only applicable to top loaded **washing machines** while dimension $c_2$ is generally only applicable to front loaded **washing machines**.

NOTE 2 Width $b_2$ is referring to **washing machines** with a loading door at the side of the machine.

NOTE 3 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.

## 5 Test conditions, materials, equipment and instrumentation

### 5.1 General

The tolerances specified for parameters within this Technical Specification, 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 M. If numbers have to be rounded, they shall be rounded to the nearest number according to EN ISO 80000-1:2013, B.3, Rule B. If the rounding takes place to the right of the comma, the omitted places shall not be filled with zeros. If a value to be reported is an intermediate required for use in the calculation of other values then rounding shall only apply to the format of the intermediate in the report; the rounding shall not apply prior to its use in subsequent calculations.

## 5.2 Reference machine

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

## 5.3 Ambient conditions

### 5.3.1 Electricity supply

The supply voltage to each **test washing machine** shall be maintained throughout the test at 230 V ± 2 % or at 400 V ± 2 % as defined by the manufacturer's installation guide. If more than one option for installation is available and no clear indication for testing is given, the supply voltage shall be 400 V ± 2 %. The supply voltage measured during the tests shall be recorded. For washing machines with a drum volume equal or larger than 400 l the voltage tolerance can be increased to ± 3 %.

In the case of a fixed cable, the plug (or the end of the cable) is the reference point at which the supply voltage shall be maintained.

The supply frequency to each **test washing machine** shall be maintained at 50 Hz ± 1 % throughout the test.

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

### 5.3.2 Water supply

#### 5.3.2.1 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 Technical Specification.

#### 5.3.2.2 Water hardness

For all treatments of the **base load** prior to a **test series** and all **washing machine test runs** in accordance with this Technical Specification soft water shall be used. The soft water 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 6.4.2) 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 EN 60734.

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

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

For washing machines with a drum volume equal or larger than 400 l the cold and hot water temperature tolerance can be increased to ± 5K.

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 water supply system shall be configured so that the temperature of all water entering the inlet hose of the **test washing machine** is within specified tolerance with the exception of up to 250 ml of each increment up to a test load mass of 10 kg and up to 500 ml of each increment up to a test load of 50 kg. For larger test load masses the exception for each increment is 1 000 ml. A temperature recording system shall record inlet water temperature at intervals of no less than once per second.

NOTE Clause 8 requires water temperatures and volumes to be recorded on a continuous basis during filling in order to determine weighted average temperature.

#### 5.3.2.4 Water pressure

The static (gauge) pressure of the laboratory supply water at the inlet to each **test washing machine** shall be maintained at (240 ± 50) kPa throughout the test, including during filling **operations**. The water supply to the reference machine shall be in accordance with D.3.1.

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 pressure measurement shall be made downstream of the last reduction in the supply pipe diameter before the washing machine and less than 3 m from the washing machine inlet. The measured pressure shall be rounded up to the nearest whole 10 kPa to compare with the allowed range.

### 5.3.3 Ambient temperature and humidity

#### 5.3.3.1 Ambient temperature and humidity for washing machine testing

The ambient temperature of the test room shall be (23 ± 2) °C at the start of the washing machine test. The ambient temperature shall not rise more than 4 K during the test run. The measured ambient temperature for washing machine testing shall be reported. It shall be rounded to the nearest 0,5 °C.The maximum and minimum ambient temperature during the test run shall be recorded. The measurement location shall be in the vicinity of machine under test. For washing machines with a drum volume equal or larger than 400 l the ambient temperature tolerance can be increased to (23 – 2 + 6) °C.

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

#### 5.3.3.2 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.

Specific requirements regarding conditioning of the **base load** are specified in 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.

## 5.4 Test materials

### 5.4.1 General

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

— **base load** (load items);

— stain test strips;

— detergent.

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

### 5.4.2 Base load

The base load shall consist of 3 sizes of sheets as specified in Annex C. The size and mass of each of the base load items are given in Table 1:

**Table 1 — Size and mass of the different base load items**

| Base load item | Size<br>mm | Nominal mass<br>g |
|---|---|---|
| Small sheet | (610 × 620) ± 20 | 105 ± 3 |
| Medium sheet | (910 × 1 240) ± 20 | 295 ± 10 |
| Large sheet | (1 410 × 1 870) ± 20 | 660 ± 20 |

### 5.4.3 Stain test strips

Stain test strips shall be 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.

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.

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 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.

#### 5.4.4 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).

The three components shall be stored separately. 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, lifetime after mixing, dosage and placement of detergent is specified in 6.3.

### 5.5 Equipment

#### 5.5.1 General

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

— reference machine;

— spectrophotometer;

— equipment for conditioning the **base load**;

— iron.

A checklist of other laboratory equipment which may be required for **washing machine** testing is provided in 5.5.6.

#### 5.5.2 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.

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

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

5,0 kg for the reference test **programme**.

### 5.5.3 Spectrophotometer

#### 5.5.3.1 General

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 015:2004);

— Illuminant / observer: D65 / 10° – EN ISO 11664-2;

— 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.

#### 5.5.3.2 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 sulfate 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.

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.

### 5.5.4 Equipment for conditioning the base load

This Technical Specification 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 standardized ambient conditions. The alternative methods of conditioning the **base load** items are:

— leaving the **base load** items in a room or chamber with a controlled ambient temperature and humidity (refer to 5.3.3.2) 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 F sets out the method and the specifications for a tumble dryer which is used for this method.

#### 5.5.5 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.

#### 5.5.6 Other equipment

Testing of **washing machines** according to this Technical Specification 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;

— time.

For some of the above measurements, the specifications of instruments used to take these measurements are not explicitly defined in this Technical Specification, 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** and mass of detergent (refer to 5.6.2).

### 5.6 Instrumentation and accuracy

#### 5.6.1 General

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

### 5.6.2 Instruments

| Parameter | Unit | Minimum Resolution | Minimum Accuracy | Additional requirements |
|---|---|---|---|---|
| Mass | | | | |
| Masses in the range up to 100 g | g | 0,05 g | ± 0,1 g | - |
| Masses in the range between 100 g and 2 000 g | g | 0,5 g | ± 1 g | - |
| Masses in the range from 2 kg to 50 kg | g | 10 g | ± 20 g | - |
| Masses in the range above 50 kg | g | 50 g | ± 100 g | - |
| Temperature | | | | |
| Ambient temperature | °C | 0,1 °C | ± 1 K | - |
| Water temperature | °C | 0,1 °C | ± 0,6 K | See Annex L |
| 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) | | | | Separate metering for hot and cold inlets, where applicable. Devices using viscosity should be calibrated at the actual nominal temperature ± 5 °C, and the nominal flow rate. |
| Water volumes up and equal to 100 L | L | 0,1 L | ±2 % | |
| Water volumes above 100 L | L | 0,5 L | ±2 % | |
| Water pressure | kPa | 10 kPa | ±5 % | - |
| Time | s | 5 s | ±1 % | - |
| Spin speed | rpm | 1 rpm | ±1 % | - |

#### 5.6.3 Measurements

| Parameter | Unit | Minimum Accuracy | Additional requirements |
|---|---|---|---|
| Total water hardness | mmol/L | ±2 % | - |
| Total Energy | | | |
| Electrical 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. EN 62053-21 for more information. |
| Gas energy | kWh | ±1 % | As a recommendation, see Annex I. |
| Steam energy | kWh | ±2 % | See Annex J. |

# 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 Technical Specification. 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 1 g per litre of drum volume of the reference detergent 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 5.3.2).

Any filters shall be thoroughly cleaned before each **test series**. Prior to the **test series** (not less than one day in advance but not more than two weeks in advance and without any other run before the **test series** is started) 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. After the cleaning run the machine shall stay standing at the stable laboratory ambient temperature until the **test series** is finished.

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

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 5 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. Before each **test run**, any detergent dispenser shall be clean and dry prior to the addition of detergent. Observe that after the automatic washing machine is started no action shall be taken to help dispensing the detergent.

### 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**.

Lint blocking the drain valve shall be removed completely before starting a **test series.** The water filter of the supply valve shall be cleaned. The reference **programme** without load and detergent shall be run to remove residues.

It is recommended not to use the reference machine for any other purpose (e.g. rinsing loads) between the **test runs** of a **test series**.

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

At each **test run** it shall be checked that no detergent remains in the detergent dispenser. It shall be ensured that in the **reference machine** the detergent is totally dispensed during the water intake for the main wash. If detergent remains in the dispenser after the initial fill, then that **test run** shall not be valid.

## 6.3 Detergent

### 6.3.1 General

The detergent used for all **test runs** shall be as specified in 5.4.4. 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 Technical Specification 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 5.3.1) and a standard laboratory water supply system (refer 5.3.2).

NOTE 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.

### 6.3.2 Detergent dose

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

**Table 2 — Detergent Dose**

| Test washing machine dose | Reference washing machine dose |
|---|---|
| 5 g/kg of **rated capacity** +8 g/kg of **nominal test load** | 74 g |

NOTE 1 g/kg grams of detergent is per kg of **nominal test load mass**. Dosage for **reference machine** is fixed by **programme** and load type and is a different dose to the **test washing machine**. The **reference machine** is always operated at a fixed load size; refer to 5.5.2.

If a pre-wash is to be included, the total quantity of detergent used shall be 1,25 times the figures above. The total detergent quantity is to be split between pre-wash and main wash in accordance with the manufacturer's instructions. If there are no instructions, the split shall be 1:2 for pre-wash: main wash.

NOTE 2 The quantity of detergent specified in this Technical Specification is fixed by the **nominal test load mass**. The reference detergent and the quantity specified may not be reflective of some commercial detergents.

### 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 shall be 14 d. 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 according to 6.3.5 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 according to 6.3.5 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 according to 6.3.5 before the load is added.

### 6.3.5 Placing detergent into the drum base

If the dispenser is too small for the amount of detergent or no dispenser exists place the detergent into base of the drum according to following procedure:

– Cover the bottom of the drum with one small sheet from the **base load**. Place the detergent on the small sheet and cover the detergent with another small sheet from the **base load** prior to the loading of the other **base load** items.

## 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:

— determination of **test load mass**;

— maximum age requirements for **base load** items used in a **test series**;

— pre-treatment of new **base load** items prior to use in testing;

— normalization of the **base load** items between **test series**;

— 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**;

— 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 exclusively for a single **test washing machine** 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**. 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.

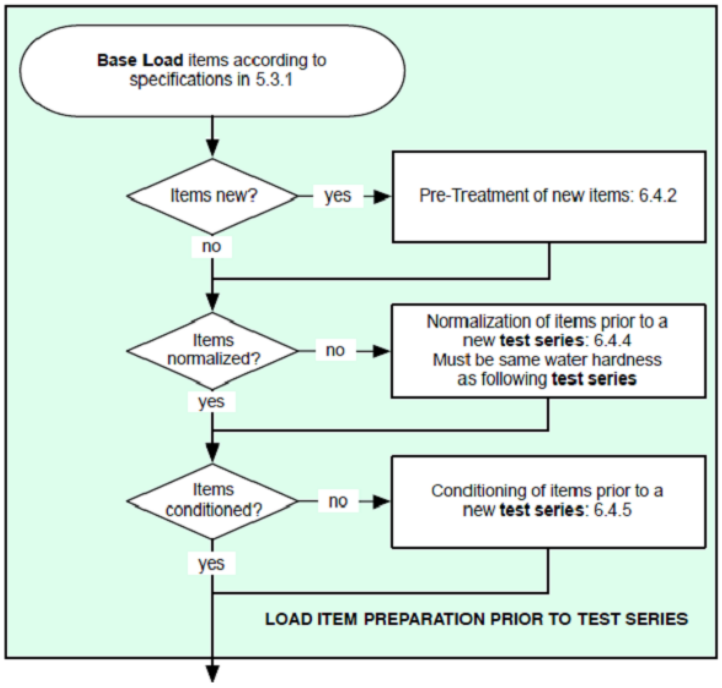



**Figure 1 — Load item preparation prior to a test series**

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

The **base load** items shall be treated before their first use by undergoing a normalization wash process five times, as defined in 6.4.4 but without intermediate drying and using 15 g/kg of the reference detergent A*. This shall be followed by normalization according to 6.4.4 and by conditioning according to 6.4.5.

### 6.4.3 Requirements regarding the maximum age of base load items

Any individual **base load** item shall not be used for more than 100 **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).

To meet the age requirements specified in this Technical Specification, a system of tracking the number of **test runs** for each load item is recommended.

### 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** 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.. 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 5.3.2.2) 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**.

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

All **base load** items shall be treated once without detergent in **a washing machine** of approximately the same size or bigger than the **test washing machine** and using **a 60°C programme** with a mechanical action similar to a cotton **programme** and with one main wash and 4 rinses. The water quantity in the process shall be approximately 5 l/kg load in main wash and 5l/kg load in each rinse. Intermediate spin between main wash and 1st rinse and between rinses to 50 % ± 5 % residual moisture and a final spin to 35 % ± 5 % residual moisture. 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 shall be less than 0 %.

### 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 normalization 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 5.3.3.2. 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 the load shall then be determined by taking the bone dry mass and multiplying it by factor which shall be determined by the dryer performance characteristics.

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 F.

### 6.4.6 Test load composition

#### 6.4.6.1 Test load composition

The **test load** consists of the **base load** as specified in Annex C and 5.4.2.1 and the stain test strips as specified in 5.4.3. Affixing stain test strips is specified in 6.4.8. 6.4.2 to 6.4.5 set out requirements regarding the preparation and maintenance for a **test series**.

#### 6.4.6.2 Determination of the test load mass

The **test load mass** shall be determined to nearest 0,5 kg for the **test load mass** up to 10 kg. Above 10 kg of **test load** the mass shall be determined to the nearest 1 kg. The **test load mass** shall be adjusted so that it corresponds to the required **test load mass** for the specified **programme** of the test machine. The numbers of small, medium and large sheets in the **base load** for various required **test load masses** are specified in Table 3. Final adjustment of the **test load mass**, which includes the mass of the stain test strips shall be made by adding or removing small sheets so that the total mass is as close as possible (±100 g) to the nominal required **test load mass** for **test loads** up to 10 kg and ± 200 g for **test loads** above 10 kg.

**Table 3 — Number of different load items in the test load for various test load masses**

| Required test load mass | Number of stain test strips and number of medium sheets to which stain test strips are attached | Number of small sheets [a] | Number of additional medium sheets | Number of large sheets |
|---|---|---|---|---|
| kg | | | | |
| 2 | 2 | 6 | 2 | 0 |
| 2,5 | 3 | 4 | 3 | 0 |
| 3 | 3 | 9 | 3 | 0 |
| 3,5 | 4 | 8 | 4 | 0 |
| 4 | 4 | 12 | 4 | 0 |
| 4,5 | 5 | 11 | 5 | 0 |
| 5 | 5 | 15 | 5 | 0 |
| 5,5 | 6 | 14 | 6 | 0 |
| 6 | 6 | 12 | 6 | 1 |
| 6,5 | 7 | 11 | 7 | 1 |
| 7 | 7 | 15 | 7 | 1 |
| 7,5 | 8 | 14 | 8 | 1 |
| 8 | 8 | 12 | 8 | 2 |
| 8,5 | 9 | 10 | 9 | 2 |
| 9 | 9 | 15 | 9 | 2 |
| 9,5 | 10 | 14 | 10 | 2 |
| 10 | 10 | 12 | 10 | 3 |
| 15 | 10 | 11 | 10 | 10 |
| 20 | 10 | 11 | 10 | 17 |
| 25 | 10 | 11 | 10 | 24 |
| 30 | 10 | 10 | 10 | 31 |
| 40 | 10 | 16 | 10 | 44 |
| 50 | 10 | 15 | 10 | 58 |
| 60 | 10 | 15 | 10 | 72 |
| 70 | 10 | 14 | 10 | 86 |
| 80 | 10 | 13 | 10 | 100 |
| 90 | 10 | 12 | 10 | 114 |
| 100 | 10 | 12 | 10 | 128 |
| 150 | 10 | 14 | 10 | 197 |
| 200 | 10 | 11 | 10 | 267 |
| 250 | 10 | 14 | 10 | 336 |
| 300 | 10 | 10 | 10 | 406 |

[a] The actual number of small sheets may differ from the number indicated above (which is intended to be indicative.

### 6.4.7 Calculation of loads not shown in Table 3

A description how to calculate the number of different load items for test load masses between or above the test load masses shown in the table is given in G.8.

### 6.4.8 Addition of stain test strips to the base load

#### 6.4.8.1 General

Stain test strips shall be attached to the **base load** in order to assess washing performance as set out in 6.4.8.2.

#### 6.4.8.2 Attachment of stain test strips to base load

**Stain test strips specified in 5.4.3 shall be affixed to base load as follows:**

**Stain test strips are attached to medium sheets.**

The number of stain test strips used for a performance test shall be as shown in Table 3 for the **base load** (refer to 6.4.6.1). The orientations described in the following text refer to a plan view of the medium sheet and stain test strip in Figure 3.

Medium sheets to which stain test strips are attached for a washing performance test shall be flattened by hand or iron prior to the attachment.

Attach the stain test strips to the medium sheet as follows:

— Place the stain test strip on top of the medium sheet 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 2.

— Move the stain test strip so that the right hand edge of the strip aligns with the right hand edge of the medium sheet 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 at least 2 fasteners per soiled piece shall be used to ensure that the strip is adequately secured along its length. Metallic fasteners of any type shall not be used.

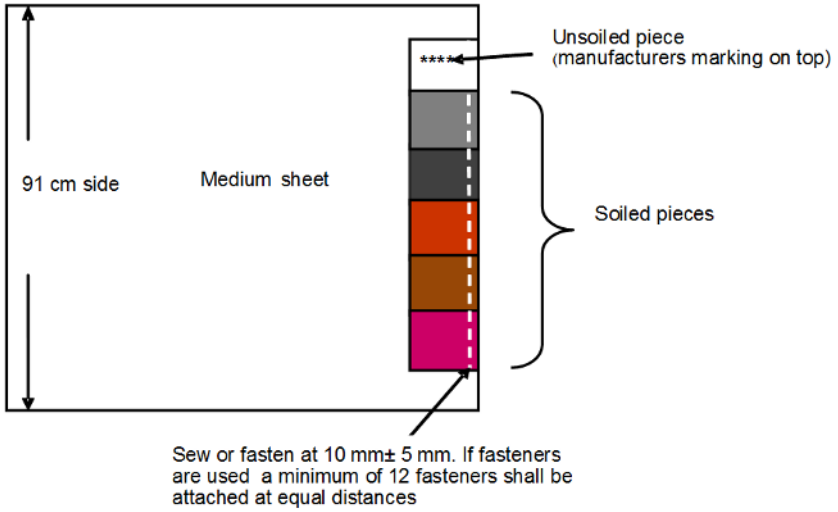



**Figure 2 — Attached test strip**

# 7 Performance measurements – general requirements

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

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;

— total energy consumption;

— bath temperature;

— water consumption;

— programme time.

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

NOTE A method for the assessment of rinse performance is under consideration.

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

— performance tests required (washing performance, water extraction performance, water and energy consumption, bath temperature and **programme time**);

— programme to be tested on the test washing machine;

— test load mass (rated capacity or part load).

The primary requirement of this Technical Specification is for the determination of performance at **rated capacity** for each relevant load type and set of test conditions. Any claim of performance to this Technical Specification 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:

— washing performance;

— water extraction performance;

— energy consumption;

— bath temperature;

— water consumption;

— programme time.

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

While the text in this Technical Specification 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 5.3.1;

— connected to a laboratory water supply system specified in 5.3.2;

— in ambient conditions as specified in 5.3.3;

— with the **test washing machine** and the **reference machine** prepared in accordance with 6.2;

— using a **base load** specified in 5.4.2 and a **test load** that has been prepared in accordance with the requirements of 6.4;

— using the detergent specified in 5.4.4 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 **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** (see 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 G.

### 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. In the case of a **programmable washing machine**, the manufacturer's instructions regarding the settings of the **washing machine** and **programme** description shall be followed. The **programme** selected on the **test washing machine** (with any associated settings) and the **reference machine** shall be reported.

### 8.2.4 Test procedure

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

Test procedures specific for gas and steam heated washing machines can be found in Annex I and Annex J.

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 (e.g. warnings or faults) shall be noted and considered when assessing **test run** validity.

Within 10 min of the **end of programme**, remove the **test load**. The **stain test strips** shall be carefully removed as quickly as possible. Proceed to follow the relevant requirements of each of the performance tests being performed in the **test series**. Assessment of water extraction performance 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

##### 8.2.5.1 General

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** (see 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 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 invalid **test run** is eliminated completely from any subsequent evaluation.

##### 8.2.5.2 Evaluation of results (reference to 9.1) where more than 5 test runs are undertaken in a test series

The reason for rejection of a test run from a test series shall 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 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 normalized as per 6.3.3 for use in the next **test series**.

### 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.

### 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 shall be 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 5.5.5 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 shall be stored in a dry dark place until the reflectance measurement is undertaken (refer to 8.3.3).

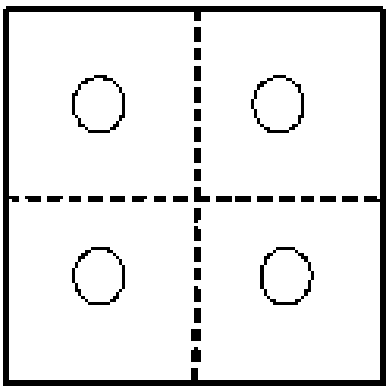
Residual humidity in the stain test strips will influence the measurement results, as will overheating during ironing. Exposure of the stain test strips to direct daylight at any shall be avoided as far as possible.

### 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 5.5.3.

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

Reflectance measurements shall be taken with not less than four layers of the same washed soil type as backing for the piece being measured. Every washed piece of soil shall be measured in four locations on the top side, 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 shall be 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 3 – Positions for measuring soiled test pieces**

## 8.4 Measurements to determine maximum spin speed

Maximum **spin speed** shall be tested during the same **test runs** in which washing performance, spinning extraction, time and water and energy consumption are tested. During the test, **spin speed** shall be recorded at intervals of 1 s or less. The maximum **spin speed** of each **test run** shall be determined during a period of 60 s when the highest **spin speed** values are reached. The maximum **spin speed** shall be recorded as the lowest speed measured during this period.

If it is necessary to remove or modify any parts of the **washing machine** in order to install a sensor for the measurement of **spin speed**, then all such parts and modifications shall be replaced as far as possible in their original position so that the installation does not significantly affect the performance of the **washing machine** in any way pertinent to the tests being carried out. The type, installation and accuracy of the instrument used shall be reported.

## 8.5 Measurements to determine water extraction performance

### 8.5.1 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 end of the **programme**. It is also intended to be used to assess the performance of separate **spin extractors.**

### 8.5.2 Washing machines

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

At the end of the test **programme** as set out in 8.5.1, without delay, remove the soiled **test strips** and weigh the **base load**. The mass of the moist **base load** at the end of the **programme** is recorded.

### 8.5.3 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.

## 8.6 Measurement to determine the bath temperature

Procedure for measuring the bath temperature is described in Annex H.

## 8.7 Measurements to determine water and energy consumption and programme time

### 8.7.1 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 9.4.

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

### 8.7.2 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**.

Commence the measurements when the **programme** is initiated (without any user programmed delay). Stop the measurement at the **end of programme**.

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

### 8.7.3 Measurement of energy supplied by electricity

The energy supplied to the machine under test via electricity shall be measured on the main electrical supply lines to the machine during the full programme time as defined in 3.1.25.

### 8.7.4 Measurement of energy supplied by steam

Measurement of steam energy is described in Annex J.

### 8.7.5 Measurement of energy supplied by gas

Measurement of energy supplied by gas is described in Annex I.

### 8.7.6 Measurement of energy consumed via compressed air

If the machine under test needs compressed air for the normal operation the energy consumed via the compressed air shall be measured as follows:

Immediately before the start of a test run load the compressed air tank until the compressor stops and shut of the compressor from the electrical supplies.

At the end of the test run when no more machine operation remains restart the compressor again and measure the amount of electrical energy consumed by the compressor until the compressed air tank is full again.

The compressor tank shall be sized in a way so the compressor can fill the tank to original pressure after the test run. No other use of compressed air from the compressed air tank is allowed during a test run.

# 9 Assessment of performance

## 9.1 General

This section sets out the primary evaluation methods for the assessment of **washing machine** performance under this Technical Specification. This section includes the evaluation of:

— washing performance;

— water extraction performance;

— energy consumption;

— bath temperature;

— water consumption;

— programme time.

For the evaluation of washing performance (9.2) the result from the **test washing machine** shall be compared to the result from the **reference machine** which is operated in parallel. In case of an invalid **test run** (in either the **test washing machine** or the **reference machine**) neither the **test run** result in the **test washing machine** nor the corresponding **test run** result from the **reference machine** shall be used for any evaluation of that **test washing machine** within the **test series**.

## 9.2 Evaluation of washing performance

The washing performance shall be evaluated below using the reflectance values (Y-values) measurements determined in 8.3.3.

Steps a) to d) below are calculated for both the **test washing machine** and the **reference machine** which have been operated in parallel.

a) The average reflectance values $\overline{x}_i$ for each soil type $i$ is given as the mean value per **test run** of the readings for each of the $n$ stain test strips used in the test, calculated as follows:

$$\overline{x}_i = \frac{\sum_{j=1}^{n} x_{ij}}{n}$$

where

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

$n$ is the number of stain test strips per **test run.**

NOTE 1 The standard deviation $s_i$ for each soil type $i$, i.e. $x_{ij}$, within a given **test run** may be calculated as:

$$s_i = \sqrt{\sum_{j=1}^{n} \frac{\left(x_{ij} - \overline{x}_i\right)^2}{n-1}}$$

b) The sum $C_k$ of the average reflectance values in each **test run** is calculated as follows:

$$C_k = \sum_{i=1}^{m} \overline{x}_i$$

where

$\overline{x}_i$ is the average reflectance value for each soil type, as calculated in a);

*m* the number of soil types per stain test strip.

c) The average sum $\overline{C}$ of the reflectance values for each of the five types of soil, for all **test runs** is calculated as follows:

$$\overline{C} = \frac{\sum_{k=1}^{w} C_k}{w}$$

where

$C_k$ is the sum of the average reflectance values in each **test run, as** calculated in b);

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

d) The standard deviation $s_C$ of $C_k$, is defined as:

$$s_C = \sqrt{\frac{\sum_{k=1}^{w} \left(C_k - \overline{C}\right)^2}{w-1}}$$

where

$C_k$ is the sum of the average reflectance values in each **test run**, as calculated in b);

$\overline{C}$ is the average sum of the reflectance values in each of the five types of soil, for all **test runs** in the **test series**. This is calculated in c);

*w* is the number of **test runs.**

e) The ratio *q* of the average sum is calculated as:

$$q = \frac{\overline{C}_{\text{test}}}{\overline{C}_{\text{ref}}}$$

where

$\overline{C}_{\text{test}}$ is the average sum of the reflectance values for the **test washing machine**, as calculated in c);

$\overline{C}_{\text{ref}}$ is the average sum of the reflectance values for the **reference machine**, as calculated in c).

The calculated ratio *q* shall be rounded to the nearest 0,001.

f) The standard deviation $s_q$ of the ratio $q$, is defined as:

$$s_q = \sqrt{\frac{\sum_{k=1}^{w} \left(\frac{C_{k\text{test}}}{\overline{C}_{\text{ref}}} - q\right)^2}{w-1}}$$

where

$C_{k\text{test}}$ is the sum of the reflectance value in each **test run** of the **test washing machine**, as calculated in b);

$\overline{C}_{\text{ref}}$ is the average sum of the reflectance value in each **test run** of the **reference machine**, as calculated in c);

$q$ is the ratio of the average sum, as calculated in e);

$w$ is the number of **test runs.**

g) The confidence interval $p$ for the ratio of the average sum is defined as:

$$p = q \pm \frac{s_q}{\sqrt{w}} \times t_{w-1,\ 0,05}$$

where

$s_q$ is the standard deviation of the ratio $q$, as calculated in f);

$t_{w-1,\ 0,05}$ is the "Student T" factor for ($w$-1) degrees of freedom for a confidence level of 95 % (i.e. 2,776 for 5 **test runs**, which equals 4 degrees of freedom);

$w$ is the number of **test runs.**

NOTE 2 The equation assumes parallel running of the **test washing machine** and the **reference machine**.

## 9.3 Evaluation of water extraction performance

The water extraction performance shall be evaluated below using the measurements determined in 8.5.

The **remaining moisture content** RMC is calculated for each **test run** in the **test series** and is expressed as a percentage:

$$ratio = \frac{M_r - M}{M}$$

where

$M$ is the mass of the conditioned **base load**;

$M_r$ is the mass of the **base load** at the end of the test run (i.e. after **spin extraction**).

The water extraction performance is the arithmetic mean of the RMC values obtained in the **test series**. It is expressed as a percentage, rounded to the nearest whole percent.

## 9.4 Evaluation of water and energy consumption and programme time

### 9.4.1 General

The water and energy consumption and **programme time** shall be evaluated using the measurements determined in 8.7.

The arithmetic mean of the measured values is calculated.

### 9.4.2 Water volumes

Water volumes are expressed in litres, and rounded to the nearest 0,1 l. Separate volumes for hot and cold water shall be reported, where applicable. Total water consumption shall be reported rounded to the nearest whole litre.

### 9.4.3 Bath temperature

The bath temperature is expressed in degrees Celsius and rounded to the nearest 1 °C. (See Annex H.)

### 9.4.4 Programme time

**Programme time** is the time from the initiation of the **programme** (excluding any user programmed delay) until the end of the **programme. Programme time** shall be determined as the average of values measured during each **test run** within a **test series. Programme time** shall be rounded to the nearest minute.

### 9.4.5 Energy consumption

#### 9.4.5.1 General

The energy consumed over a **programme** (called the **programme** energy), which is the energy consumption value determined under this Technical Specification, is the sum of the electrical, steam, gas and compressed air energy plus any cold water correction plus the hot water energy.

**Programme** energy: The **programme** energy is determined as follows:

$$W_{total} = W_{et} + W_{gt} + W_{st} + W_{ct} + W_{ht} + W_{ca}$$

where

$W_{et}$ is the total electrical energy metered during the test;

$W_{ca}$ is the electrical energy consumed for compressed air operation;

$W_{ct}$ is the total cold water energy correction determined below;

$W_{ht}$ is the calculated total hot water energy determined below.

$W_{gt}$ is the total gas energy determined below

$W_{st}$ is the total steam energy determined below.

**Programme** energy only includes energy consumed during the **programme.** Additional energy consumption may occur outside the **programme.** Electrical energy is expressed in kWh rounded to the nearest 0,05 kWh.

Gas energy is expressed in kWh rounded to the nearest 0,05 kWh and calculated from gas consumption according to Annex I.

Steam energy is expressed in kWh rounded to the nearest 0,05 kWh according to Annex J.

#### 9.4.5.2 Cold water energy correction factor

If the inlet temperature of the cold laboratory supply water deviates from 15 °C, the cold water energy correction factor shall be determined for those operations where the internal heater operates and/or where the test washing machine draws in external hot water using the following formula:

$$W_c = (V_c \times (t_c - 15)) / 860$$

where

$W_c$ is the cold water energy correction in kWh for the **operation**. The value of $W_c$ for each applicable **operation** shall be summed to give total cold water energy correction $W_{ct}$;

$T_c$ is the measured average inlet temperature of the cold laboratory supply water in degrees Celsius averaged on volume weighted basis for each **operation**;

$V_c$ is the volume of the cold water used during an **operation** where the internal heater operates and/or where the machine draws in external hot water using the following formula. For the calculation the volume of cold water $V_c$ shall be used as recorded (accuracy 0,1 l).

1/860 is the energy equivalent.

The correction should be done only when the temperature of the cold water supply is between 13 °C and 17 °C. Outside of this temperature range the test is invalid. Note the value $W_c$ may be positive or negative.

NOTE It is preferred that readings of temperature and volume are integrated over each **operation** to get an accurate average weighted temperature and volume for use in the determination of the cold water correction factor. This normally requires the use of a data logger to record temperature and water volume data at regular intervals throughout each **operation**.

#### 9.4.5.3 Hot water energy

When the unit is supplied with an external hot water source, the hot water energy shall be calculated using the following formula:

$$W_{ht} = (V_h \times (T_h - 15)) / 860$$

where

$W_{ht}$ is the calculated hot water energy in kWh for the **operation**;

$T_h$ is the measured average inlet temperature of the hot laboratory supply water in degrees Celsius averaged on volume weighted basis for each **operation**;

$V_h$ is the volume of external hot water used during the **operation**. For the calculation the volume of hot water $V_h$ shall be used as recorded (accuracy 0,1 l).

The value of $W_{ht}$ for each applicable **operation** (including any **operations** that occur after the completion of the **programme**) shall be summed to give the calculated total hot water energy, $W_{ht}$.

NOTE It is preferred that readings of temperature and volume are integrated over each **operation** to get an accurate average weighted temperature and volume for use in the determination of the hot water energy. This normally requires the use of a data logger to record temperature and water volume data at regular intervals throughout each **operation**.

## 10 Data to be reported

For each test, the relevant data that shall be reported are listed in Annex M. It is recommended that the data are presented in the format shown in Annex M.

# Annex A
(normative)

# Specification of stain test strips with standardized soiling

## A.1 Artificial soils

The washing performance of a household **washing machine** is the result of mechanical and chemical action, and a combination of both. Natural soils contain fatty matter, proteins and organic and inorganic pigments in complex mixtures. Some kinds of natural soil are more sensitive to mechanical action, and some to chemical action, such as oxidation (bleaching), solubilization and emulsification High temperatures increase the effect of mechanical and chemical action.

In this Technical Specification soil removal performance of a **washing machine** is determined by means of the following different types of standard artificial soils. These soils are based on specially developed stains that are intended to assess each of the main washing parameters. They have been found to be suitable for the assessment of washing performance:

– specimen based on artificial sebum enabling the measurement of the scouring effect, mainly due to mechanical and thermal action;

– specimen based on carbon black and mineral oil enabling the measurement of the scouring effect, mainly due to mechanical and thermal action;

– specimen based on blood enabling the measurement of the removal of protein pigments;

– specimen based on cocoa enabling the measurement of the removal of organic pigments;

– specimen based on red wine enabling the measurement of the bleaching effect.

## A.2 Supporting fabric for soil

### A.2.1 Material

The fabric used as support for the soil is of pure cotton.

### A.2.2 Weaving

Final textile characteristics (after pre-treatment – see A.2.3):

a) Mass (EN 12127): (200 ± 10) g/m$^2$

b) Yarn twist (EN ISO 2061):
   1) Warp: (700 ± 100) T/m
   2) Weft: (450 ± 100) T/m

c) Thread count:
   1) Warp: (34 ± 2) double thread /cm
   2) Weft: (20 ± 2) thread /cm

d) Yarn count (EN ISO 2060):
   1) Warp: (30 ± 1) Tex
   2) Weft: (50 ± 1) Tex

### A.2.3 Pre-Treatment

#### A.2.3.1 General

The fluidity index shall be between 0,4 Pa s and 0,5 Pa s. The pre-treatment may include singeing, desizing, scouring and calendering. Fluorescent and optical brightener shall not be used. The fabric is pre-treated through bleaching to obtain the following characteristics.

#### A.2.3.2 Reflectance

Tristimulus value *Y*: greater than 86 % for unsoiled cloth, measured with an instrument specified in 5.5.3.

### A.2.4 Reproducibility

Only specialized manufacturers, manufacturing large quantities of textiles, are likely to be able to supply this fabric with an adequate reproducibility.

## A.3 Artificial soil

### A.3.1 Soiling composition

#### A.3.1.1 Composition of soil based on sebum/pigment

a) Synthetic sebum:
   1) Cows fat : 32,8 %
   2) Wool fat : 18,3 %
   3) Free fatty acid : 18,0 %
   4) Cholesterol : 3,7 %
   5) Squalen : 8,9 %
   6) Coconut oil : 3,6 %
   7) Hard paraffin : 3,1 %

b) Pigment:
   1) Carbon black (see A.3.1.2)
   2) Kaoline
   3) Iron oxide (yellow and black)

The proportion of pigments and sebum shall be such as to obtain the reflectance specified in A.4.2.

#### A.3.1.2 Composition of soil based on carbon black and mineral oil

a) Pigment, carbon black:
   1) Average size of grains : 295 Å
   2) Average surface of grains : 94 $m^2/g$
   3) Carbon content : 96,0 %

b) Oil, paraffin oil:
   1) Specific mass : 0,885
   2) Ignition temperature : 221 °C
   3) Liquefaction temperature : −26 °C

The proportion of pigments and fatty materials shall be such as to obtain the reflectance specified in A.4.2.

#### A.3.1.3 Composition of soil based on blood

Pig's blood, fresh and stabilized by the addition of 10 g/l ammonium citrate.

#### A.3.1.4 Composition of soil based on chocolate with milk

Unsweetened cocoa (20/22 % fat, not alkalized) with sugar, full-cream cow's milk and water.

#### A.3.1.5 Composition of soil based on red wine

"Alicante"-type red wine treated with hot air.

## A.4 Stain test strips

### A.4.1 Application of soil

The application of soil by immersing the textile is recommended.

The treatment may include the following **operations**:

– immersion;

– calendering;

– drying;

– new immersion, if necessary;

– calendering;

– drying;

– ageing.

### A.4.2 Soil checking after deposition of soil

The manufacturer should make sure that soil is evenly and regularly deposited. At the end of preparation, the Y tristimulus reflectance measurements on a dry sample using an instrument specified in 5.5.3, shall be within the range specified below for each soil:

– Sebum /Pigment: (50 ± 3).
– Carbon Black/Mineral oil: (25 ± 3).
– Blood: (19 ± 3).
– Chocolate/Milk: (37 ± 3).
– Red wine: (44 ± 3).

The difference between front and back should be within the defined limits.

NOTE The unsoiled reflectance prior to soiling is given in A.2.3.1.

### A.4.3 Washed reflectance values

From each of the following **programmes**, five **test runs** in the **reference machine** using programmes described in Annex E shall be carried out:

– cotton 60 °C, 180 g detergent A*;

– cotton 40 °C, 180 g detergent A*;

– cotton 60 °C, 90 g detergent A*.

The optical reflectance is measured using an instrument specified in 5.5.3 and evaluated in accordance with 9.2.

The ratios and tolerances between the different **programmes** are defined in Table A.1 and shall be certified by the supplier of the material:

**Table A.1 — Ratios and tolerances of standardized soils: Reference Machine CLS**

| Soil type | Ratio cotton 40 °C/ cotton 60 °C | Cotton 60 °C<br>Ratio: 90 g /180 g |
|---|---|---|
| Sebum/pigment | 0,93 ± 0,03 | 0,98 ± 0,03 |
| Carbon black/oil | 0,88 ± 0,03 | 0,94 ± 0,03 |
| Blood | 0,91 ± 0,04 | 0,92 ± 0,05 |
| Chocolate/milk | 0,86 ± 0,04 | 0,88 ± 0,05 |
| Red wine | 0,86 ± 0,03 | 0,89 ± 0,03 |
| Sum (with Sebum) | 0,89 ± 0,02 | 0,92 ± 0,02 |

These ratios define the total test system of **reference machines**, **base load**, detergent, stain test strips (making up a **test load**) and reflectance measurement. Therefore ratios may be used as general qualification criteria for the test system within a laboratory, and can be used to assess the additional uncertainty from laboratory to laboratory.

## A.5 Marking of stain test strips and accompanying data

Each batch of stain test strips shall be marked with a batch number and delivered with the following information:

– batch number to permit checking date of manufacture;

– expiry date (the maximum period should be not more than one year from date of manufacture);

– reflectance value of the non-soiled fabric (see A.2.3.1);

– reflectance values of the soiled fabrics (unwashed) (see A.4.2);

– reflectance values after washing consisting of the tristimulus values Y for the individual soil types after washing in the reference washing machine at 60 °C and also for 40 °C and 60 °C with 90 g detergent A* together with the resulting ratios according to A.4.3.

## A.6 Advice for users

Follow manufacturer recommendations regarding storage and transport.

It is recommended that the user periodically check the reflectance values, given in A.4.2 and A.4.3.

## A.7 Suppliers

For suppliers, see Annex N.

# Annex B
(normative)

# Reference detergents — Reference detergent A*

Reference detergent A* is defined in Table B.1. The reference detergent is distributed as three separate components:

– base powder with enzyme and foam inhibitor;

– sodium perborate tetrahydrate;

– bleach activator tetra-acetylethylenediamine.

The proportions of components of the reference detergent used in tests are:

– 77 % base powder with enzyme and foam inhibitor;

– 20 % sodium perborate tetrahydrate;

– 3 % bleach activator tetra-acetylethylenediamine (TAED).

**Table B.1 — Composition of the reference detergent A***

| Ingredient | % | Tolerance (±) |
|---|---|---|
| Linear sodium alkyl benzene sulfonate | 8,8 | 0,5 |
| Ethoxylated fatty alcohol $C_{12/14}$ (7 EO) | 4,7 | 0,3 |
| Sodium soap (tallow soap) | 3,2 | 0,2 |
| Foam inhibitor concentrate (12 % silicon on inorganic carrier) | 3,9 | 0,3 |
| Sodium aluminium silicate zeolite 4 A (80 % active substance) | 28,3 | 1,0 |
| Sodium carbonate | 11,6 | 1,0 |
| Sodium salt of a copolymer from acrylic and maleic acid (granulate) | 2,4 | 0,2 |
| Sodium silicate ($SiO_2$:$Na_2O$ = 3,3:1) | 3,0 | 0,2 |
| Carboxymethylcellulose | 1,2 | 0,1 |
| Phosphonate (DEQUEST 2066, 25 % active acid) | 2,8 | 0,2 |
| Optical whitener for cotton (stilbene type) | 0,2 | 0,02 |
| Sodium sulfate | 6,5 | 0,5 |
| Protease (Savinase 8.0) | 0,4 | 0,04 |
| Sodium perborate tetrahydrate (active oxygen 10,00 – 10,40 %) | 20,0 | |
| Tetra-acetylethylenediamine (active content 90,0 – 94,0 %) | 3,0 | |
| It is recommended that the detergent manufacturer should indicate the pH of the product supplied. Further product specifications are under consideration. | | |
| NOTE For suppliers, see Annex N. | | |

The base powder with enzyme and foam inhibitor shall fulfil the following solubility requirements:

| **Solubility residues:**[a] | |
|---|---|
| Insoluble residue at 20°C: | ≤ 39 % after 2 min |
| | ≤ 37 % after 5 min. |
| [a] The solubility residues are determined using the following procedure: | |

**This operating procedure covers the IEC-A* solubility test which is used to determine the low temperature solubility of IEC**-A* reference base detergent.

Equipment:

- 1 000 ml glass beaker;
- magnetic stirrer;
- vacuum pump with trap;
- 3 Piece Glass Buchner funnel 9 cm diameter;
- 500 ml Pyrex side arm conical flask;
- knitted black cotton filter fabric circles, 9 cm diameter (e.g. fabric style EW-442 supplied by wfk Testmaterials or Swissatest Testmaterialen AG, see Annex N; EW-442 is 100 % cotton, swiss pique knit, circular, yarn count 37 tex; dyed direct black 22).

Procedure:

Carry out 3 replications and record the results as an average of the 3 replicates.

Fill beaker with 800 ml of deionized water and allow the temperature to equilibrate to 20 °C. Place beaker on the magnetic stirrer and set stirrer speed to 200 rpm. Sample IEC-A* base detergent to approximately 10 g and accurately weigh out 2 g. Add the product to the beaker, start stopwatch and stir for the specified time (2 min or 5 min, see solubility specifications below). Connect vacuum pump to conical flask and switch on vacuum pump.

Weigh the black fabric circle. Place black fabric into Buchner funnel smooth side up. Pour solution from the beaker onto the black fabric, and leave until all the solution has been sucked through the fabric and the residue remains. Remove black fabric from Buchner funnel, place on a sheet of paper and label sample.

Repeat for the remaining 2 replicates.

Allow black fabric to dry at ambient for 24 h. Re-weigh dried black fabric circles and record the % residue.

# Annex C
(normative)

# Specifications for base load — Cotton/synthetics base loads

The Cotton/ synthetics/blends **base load** shall consist of 3 sizes: Small, medium and large sheets conforming to the specifications given in Table C.1 (measured at (20 ± 2) °C, (65 ± 5) % relative humidity and certified by the supplier):

**Table C.1 — Specification of the Cotton/synthetics base loads**

| **Criteria for conditioned new items** | **Size1 (Small sheet)** | **Size 2 (Medium sheet)** | **Size 3 (Large sheet)** |
|---|---|---|---|
| **Substrate** | (50 ± 1) % polyester<br>(50 ± 1) % cotton (extra long staple) | | |
| **Yarn** | ring spun | | |
| **Yarn twist** (T/m)<br>Warp<br>Weft | 610 ± 20 (Z-twisting)<br>610 ± 20 (Z-twisting) | | |
| **Weave type** | twill (3/1 S-twill) | | |
| **Pick count** (pick/cm)<br>Warp<br>Weft | 48 ± 2<br>32 ± 2 | | |
| **Mass per unit area** (g/m$^2$) | 245 ± 10 | | |
| **Dimensions, unwashed** (mm)<br>Length<br>Width | 620 ± 20 (warp)<br>610 ± 20 (weft) | 1 240 ± 20 (warp)<br>910 ± 20 (weft) | 1 870 ± 20 (warp)<br>1 410 ± 20 (weft) |
| **Mass per piece** (g) | 110 ± 5 | 315 ± 10 | 720 ± 20 |
| **Finish** | Singeing, desizing, boiling off, bleaching without resin | | |
| **Water uptake** [a] in % | Not tested yet | Not tested yet | Not tested yet |
| **Shrinkage** [b, c] **warp** in %<br>After 5th **test run** as compared to new item | 3,5 ± 1,0 | 3,5 ± 1,0 | 3,5 ± 1,0 |
| After 25th **test run** as compared to after 5th **test run** | 3,5 ± 1,0 | 3,5 ± 1,0 | 3,5 ± 1,0 |

| Criteria for conditioned new items | Size1 (Small sheet) | Size 2 (Medium sheet) | Size 3 (Large sheet) |
|---|---|---|---|
| **Shrinkage** [b, c] **weft** in % | | | |
| After 5th **test run** as compared to new item | 0 ± 1,0 | 0 ± 1,0 | 0 ± 1,0 |
| After 25th **test run** as compared to after 5th **test run** | 0 ± 1,0 | 0 ± 1,0 | 0 ± 1,0 |

All 4 edges are double hemmed, hem size 10 mm. Sewing material polyester cotton, single lock stitch, distance of seam on edges is 7 mm, stitch length 3 mm.

Description of preparation of seams and yarns:

**Small, medium and large sheets:** All 4 edges are double hemmed, hem size is 10 mm. Sewing material is polyester, single seam, lock stitch, distance of seam from edge is 7 mm, stitch length 3 mm.

[a] The procedure used (DIN 53923) is established for the determination of water absorption capacity of textiles with high water absorption capacity. Water absorption capacity is the amount of water that a textile fabric, conditioned at (20 ± 2) °C / (65 ± 2) % relative humidity, takes up during storage in water of 20 °C for 60 s. The sample with the conditioned mass, *mc*, is fixed on a sieve of stainless steel and dipped into a flat dish with 20 °C water. After 60 s the sample is taken out of the water, drop dried for 120 s and then weighed again ($m$60). The water absorption capacity *wac* is ($m$60 – *mc*) × 100: *mc*. The data are measured after 25 **test runs** as specified in Footnote [b].

[b] In order to qualify the suitability of the textiles for use to this Technical Specification the manufacturer of the textiles should carry out **test runs** on samples from the production batch in the **reference machine**. The following wash **test runs** should be carried out in the **reference machine**:

- **Test runs** 1 to 5: pre-treatment according to 6.4.2;
- **Test runs** 6 to 25: perform **test runs** according to 8.1 in **reference machine** using the 60 °C cotton reference **programme** (without prewash but including rinsing and spinning) but without any normalization between **test runs**.

[c] Determination of shrinkage according to EN ISO 3759 after the washing process as defined in Footnote [b].

# Annex D
(normative)

# Reference machine specification — Specification of the reference washing machines and method of use

## D.1 General

Reference **washing machine** “Wascator FOM 71CLS” is equipped with a control system designed to measure very small tolerances on measured parameters. See Table D.1 for specifications.

## D.2 Further Information

Procedures and programming information for the **reference machine** can be found in Annex E.

## D.3 Reference machine: Method of use

### D.3.1 Installation of the reference machine

– Ensure that there is an air gap between the drain hose and the laboratory drainage system.

– Ensure that the machine is properly connected to the laboratory’s mains system (supply voltage) according to the manufacturer’s instruction.

– Calibrate the level control and perform a zero calibration of the weighing scale according to instructions in the manufacturer’s installation manual.

– Ensure that the laboratory water supply system can deliver (15 ± 2) l of water per min into the **reference machine**.

### D.3.2 Regular maintenance

Once a year calibrate the machine according to certified procedures or the manufacturer’s calibration instructions. Once a year midway between two calibrations make a maintenance check according to Maintenance and programming manual for **reference machines**.

NOTE Maintenance and programming manual for **reference machines** can be obtained from the manufacturer or via the manufacturer’s website (see Annex N).

**Table D.1 — Description of the reference washing machine and method of use**

| **Front loading horizontal rotating machine** | | **Wascator FOM 71 CLS** | |
|---|---|---|---|
| Inner drum | Diameter | | (520 ± 1) mm |
| | Depth | | (315 ± 1) mm |
| | Volume | | 61 l |
| | Lifting vanes | Number | 3 |
| | | Height | (50 ± 1) mm |
| | | Length | Extended the depth of the inner drum |
| | | Spacing | 120° |
| | Perforation | Diameter | 5 mm |
| | Material | | 18/8 stainless steel |
| Outer drum | Diameter | | (554 ± 1) mm |
| | Material | | 18/8 stainless steel |
| Timer | | | Programmable |
| Drum speed | Wash speed | Range | Programmable (20–59) rpm, step size 1 rpm |
| | | Tolerance at test load 5 kg, 26 l of water | ±1rpm |
| | Water extraction (spin) | Range | Programmable 200 – 1 100 rpm |
| | | Tolerance | ±20 rpm |
| Heating system | Heating power | | 5,4 kW ± 2 % |
| | Thermostat | Range | (4 – 97) °C |
| | | Accuracy at switch off temperature | ±1 °C |
| | | Switch on temperature | ≤ 4 °C below switch-off temperature |
| Reversing rhythm | Normal/Gentle ON<br>Normal/Gentle OFF | Programmable | (0 – 250) s<br>(0 – 250) s |
| | | Step size | 1 s |
| Water system | Cold water supply | At water pressure 240 kPa | (20 ± 2) litre/min |
| | Level sensing | Step size | ≤ 3 mm |
| | | Repeatability | ±5 mm (±1 l) |
| | Mass sensing | | Standard (Mass) |
| | | Step size | 0,1 kg |
| | | Dosing accuracy | ±0,2 kg |
| | | Weighing accuracy | ±0,1 kg |
| | Drain system | Drain valve | > 30 l/min |

### D.3.3 Before test series

Perform a **test run** on the reference **programme** without **test load**.

If the measured values for temperature, fill volume and total water quantity are outside the prescribed range in Table E.2 perform a new calibration or maintenance check.

NOTE Maintenance and programming manual for **reference machines** can be obtained from the manufacturer or via the manufacturer's website (see Annex N).

Perform a mass check in accordance with the maintenance and programming manual for **reference machines** and if it is out of machine specification recalibrate the scale.

### D.3.4 During a test series

Be sure not to lean or place or change any items on the machine during the weighing sequence (filling sequence) as this will influence the accurate weighing system within the **reference machine**.

After each **test run** verify that the **reference machine** complies with all requirements specified in Table E.2.

# Annex E
(normative)

# Reference machine programme definitions

## E.1 General

This annex describes the reference **programme** for the **reference machine**. The **programme** is described in Table E.1.

## E.2 Programming instructions

Ready-made memory cards containing the reference program can be obtained from the manufacturer of the **reference machine**. These cards are locked and the content cannot be exchanged or altered.

## E.3 Tolerances

Some process parameters related to the **reference machine** parameters have prescribed tolerance limits. These limits are shown in Table E.2.

## E.4 Start up programme

In order to normalize the conditions within the **reference machine** prior to each **test run**, a special Start up **programme** shall be run (refer to 6.2.2) if the **reference machine** has not been in use for more than 2 h (from the end of the last **programme** to the start of the next **test run**). All **reference machines** have a factory installed Start up programme. The Start up **programme** takes about 8 min to complete and is always run without load and without detergent.

The Start up **programme** consists of:

— 1: 1st cold rinse at a water level of 130 mm for 2 min;

— 2: drain;

— 3: 2nd cold rinse at a water level of 200 mm for 2 min;

— 4: drain;

— 5: extraction 500 RPM for 30 s.

**Table E.1 — Specification of reference washing programme**

| Programme sequence | Water supply [a] | On/off action during heating | On/Off action during wash | Heating **Y**es /**N**o | Temp | Time at temp. | Rinse/Drain /Spin time |
|---|---|---|---|---|---|---|---|
| | litres | | | | °C | Min | Min |
| Main wash 1 | 6 | | | N | | | |
| Main wash 2 [b] | 20 | 12 s on/3 s off | 12 s on/3 s off | Y | 20 | 2:00 | |
| Main wash 3 | | 12 s on/3 s off | 12 s on/3 s off | Y | 39 | 0:10 | |
| Main wash 4 | | 240 s on/0 s off [c] | 12 s on/3 s off | Y | 40 | 0:10 | |
| Main wash 5 | | | 12 s on/3 s off | N | | 4:40 | |
| Main wash 6 | | 12 s on/3 s off | 12 s on/3 s off | Y | 59 | 0:10 | |
| Main wash 7 | | 240 s on/0 s off [c] | 12 s on/3 s off | Y | 60 | 0:10 | |
| Main wash 8 | | | 12 s on/3 s off | N | | 4:40 | |
| Drain1 | | | 12 s on/3 s off | | | | 1:00 |
| Rinse 1 | 18 | | 12 s on/3 s off | | | | 3:00 |
| Drain2 | | | 12 s on/3 s off | | | | 1:00 |
| Rinse 2 | 18 | | 12 s on/3 s off | | | | 3:00 |
| Drain3 | | | 12 s on/3 s off | | | | 1:00 |
| Rinse 3 | 18 | | 12 s on/3 s off | | | | 2:00 |
| Drain4 | | | 12 s on/3 s off | | | | 1:00 |
| Rinse 4 | 18 | | 12 s on/3 s off | | | | 2:00 |
| Drain5 | | | 12 s on/3 s off | | | | 1:00 |
| Spin 1 | | | | | | | 5:00 |

[a] All fillings are static

[b] Flushing of detergent is made in Main wash 2 after a pre-fill of 6litre of water into the drum.

[c] The On/Off action of 240 s on/0 s off is made to ensure that a drum rotation exists when the heating elements are switched off. This will increase the accuracy of the water max temperature.

**Table E.2 — Tolerances given for some procedure parameters**

| **Procedure** | **Temperature tolerance at set temperature ° C** | **Water quantity tolerance per fill for each operation litre/fill** | **Total water quantity and tolerance litre** |
|---|---|---|---|
| Reference programme | ±1 | ±0,5 | 98 ± 2,5 |

NOTE 1 The tolerances given in the table for temperature and water are valid both for full and empty **reference machines**.

Specified supply flow rate for the **reference machines** is (15 ± 2) l per min. For the **reference machines** this flow rate corresponds to a filling time for first fill of 127 ± 14 s.

NOTE 2 The first filling time is defined as time from start of **operation** (press of start button) until end of filling in detergent compartment 4.

# Annex F
(normative)

# The bone-dry method of conditioning

## F.1 General

This annex sets out the specification for the tumble dryer and the method when the bone dry method of conditioning is used under 6.4.5.3.

When using the bone dry method, there are specified limits regarding the maximum load that can be conditioned in a dryer. When the bone dry method is the usual method used, a large capacity dryer with manual or timer control is generally recommended. Dryers with electronic controls or that have auto-sensing capability may cut the power input before load has reached a fully bone dry state and can be difficult to control, so are not recommended for this purpose.

## F.2 Tumble Dryer Specifications

The tumble dryer used to determine the bone-dry mass shall comply with the following requirements:

The nominal bone-dry mass of the items being dried as a single load shall not be more than 1 kg for each 20 l of measured rated drum volume. The mass of the load in kg shall be less than 3,3 times the heating element rating of the tumble dryer (expressed in kW).

The above describes the limit case. If faster drying times are desired, the use of larger element to mass ratios, or reversing tumble dryers, or both, are recommended.

An electric tumble dryer used shall be equipped with a temperature sensor able to read the temperature of the outlet air. The average temperature reading during the last step is recorded as $T_{outletair}$. Electric dryers used to bring a load to the bone dry condition shall have an average temperature of the outlet air during the final 10 min of **operation** of not less than 65 °C.

Gas dryers are permitted, but special rules regarding their calibration are set out in F.4.

## F.3 Bone Dry Procedure – Electric Dryers

If necessary, the **base load** shall be divided into portions and the procedure below applied separately to each portion.

If possible, the **base load** should be brought to the bone-dry condition as one portion and not divided.

The procedure is as follows:

a) Place the dry items in the tumble dryer and operate on the hottest temperature/ **programme** for at least 30 min.

b) Every 10 min the items shall be manually reshuffled and checked to ensure that no item has rolled up or rolled inside another, thus trapping moisture. This process, including opening and closing the door, shall be completed in as quick as possible.

c) After 30 min, stop the tumble dryer and determine the mass of the items before it cools down. If the items have to be removed from the tumble dryer to determine the mass, this shall be done as quickly as possible.

d) Repeat steps b) and c) above, except operate the tumble dryer for 20 min only.

e) If the mass of the **base load** is within 1 % of the previous measurement, record this value as bone-dry mass $M_{bd}$.

f) If not, repeat steps d) and c) until it is within 1 %.

g) The bone dry factor (or function) shall be determined across a range of typically used load sizes when compared against a conditioned base load prepared in accordance with 6.4.5.2.

The conditioned mass of the **base load** shall be as follows:

1) for the base load, the conditioned mass is taken as the bone dry factor times the bone-dry mass $M_{bd}$ determined in e) above. Only dryers which yield a calculated bone dry factor in the range 1,03 to 1,04 are valid.

h) After drying the **base load** items to determine the bone dry mass the dryer shall be unloaded and the **base load** items shall be spread out and left to cool prior to use in performance tests until they have reached ambient temperature.

NOTE This can be done by leaving textiles in ambient for 5 h.

## F.4 Bone Dry Procedure – Gas Dryers

Gas dryers may also be used to bring a **base load** to the bone dry condition. The procedure is as set out in a) to f) for electric dryers above.

However, as the gas combustion products normally pass through the load and the composition of gas may vary, to qualify a gas dryer for use with the bone dry method it is necessary to undertake one of the following calibrations in order to determine the bone dry factor for a gas dryer:

– determination of a bone dry factor (or function) across a range of typically used load sizes when compared to an electric dryer; or

– determination of a bone dry factor (or function) across a range of typically used load sizes when compared against a conditioned **base loads** prepared in accordance with 6.4.5.2.

The provisions of g) and h) for electric dryers also apply to gas dryers.

# Annex G
(normative)

# Folding and loading the test load

## G.1 General

This annex sets out the method for folding of the **test load** and loading it into the **test washing machine** and the **reference machine**. Experience has shown that the way that a **washing machine** is loaded can influence the results obtained, especially with respect to washing performance. To achieve reproducible results it is therefore necessary to specify both the loading sequence and the position and placement of all load items in the **test washing machine** and the **reference machine** for all performance tests.

## G.2 Folding the items prior to loading the washing machine

### G.2.1 General

This clause sets out the folding of load items before they are placed into the **washing machine** as specified in G.3.

### G.2.2 Test load

#### G.2.2.1 Medium sheet with a stain test strip attached

Medium sheet with a stain test strip attached shall be folded in accordance with Figure G.1.

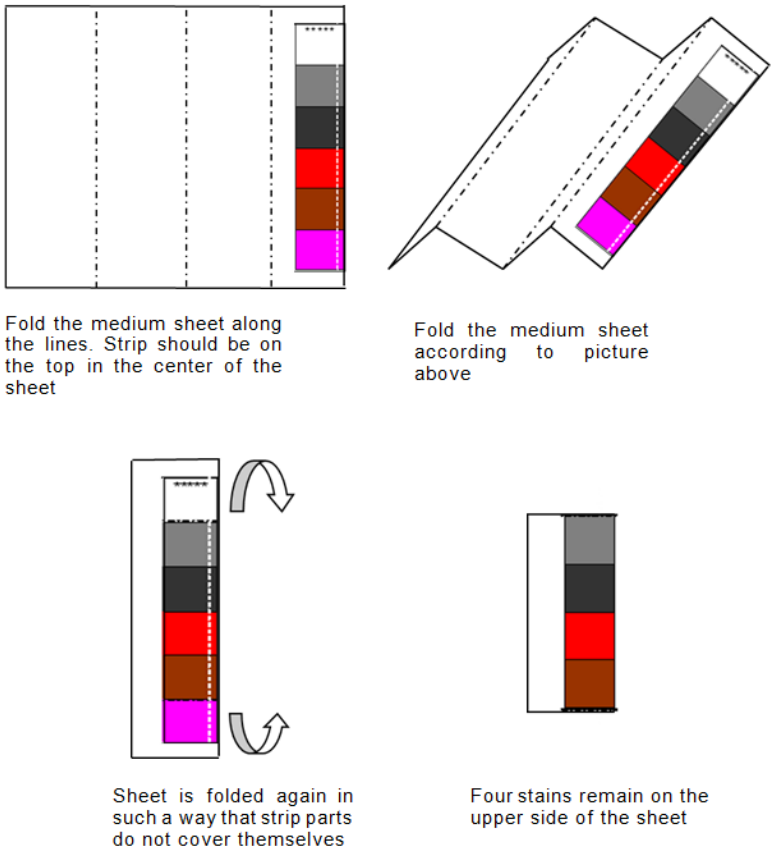



**Figure G.1 — Folding medium sheet with a stain test strip attached**

### G.2.2.2 Small sheet

Small sheets shall be folded in accordance with Figure G.2.

**Figure G.2 — Folding small sheet**

### G.2.2.3 Medium sheet without a stain strip attached

Medium sheets shall be folded in accordance with Figure G.3.

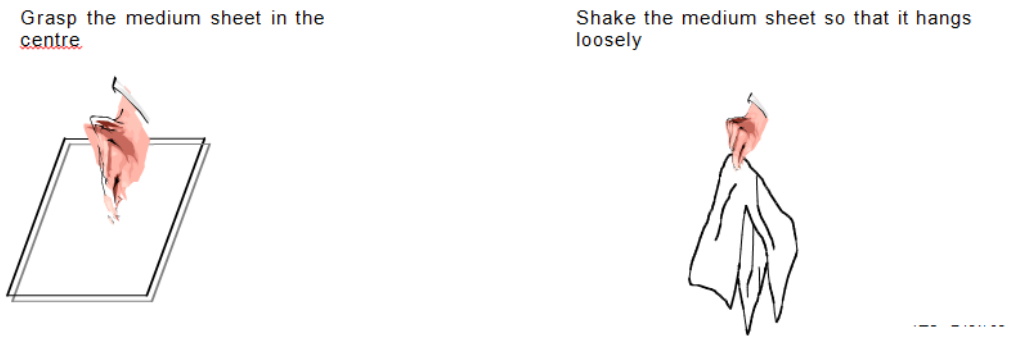



**Figure G.3 — Folding medium sheets**

#### G.2.2.4 Large sheets

Large sheets shall be folded into thirds to form letter “Z” in accordance with Figure G.4.

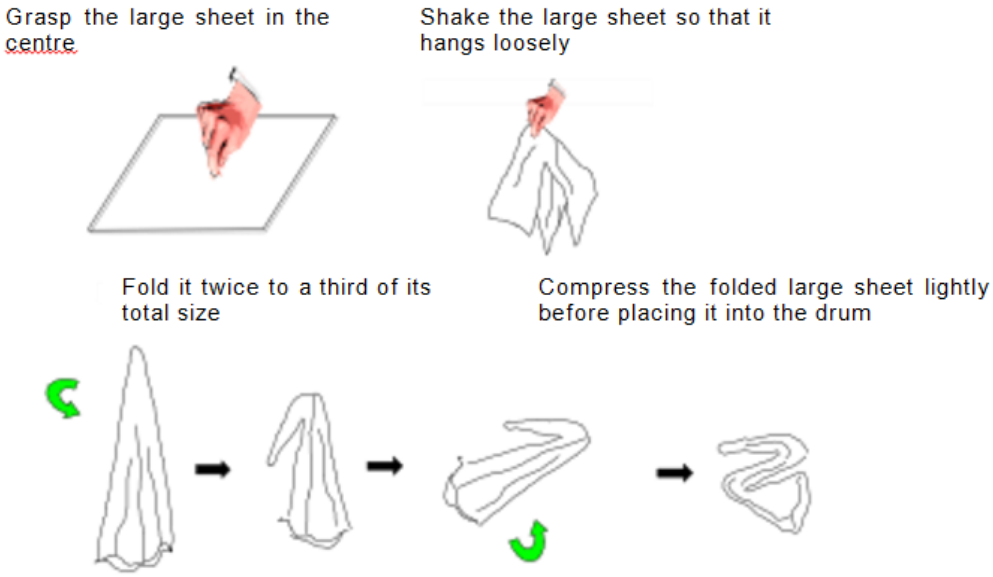



**Figure G.4 — Folding large sheets**

## G.3 Loading Items into the washing machine – general rules

### G.3.1 Machine type

#### G.3.1.1 General

For the purposes of loading, all **washing machines** shall be classified as either **horizontal axis washing machine** or **vertical axis washing machines** as specified below.

#### G.3.1.2 Horizontal axis washing machines

In a **horizontal axis washing machine** the load is placed in a drum which rotates around an axis which is usually horizontal or close to horizontal (see definition). This is illustrated in Figure G.5. In most cases, the drum rotates around this axis for washing and spinning **operations**.

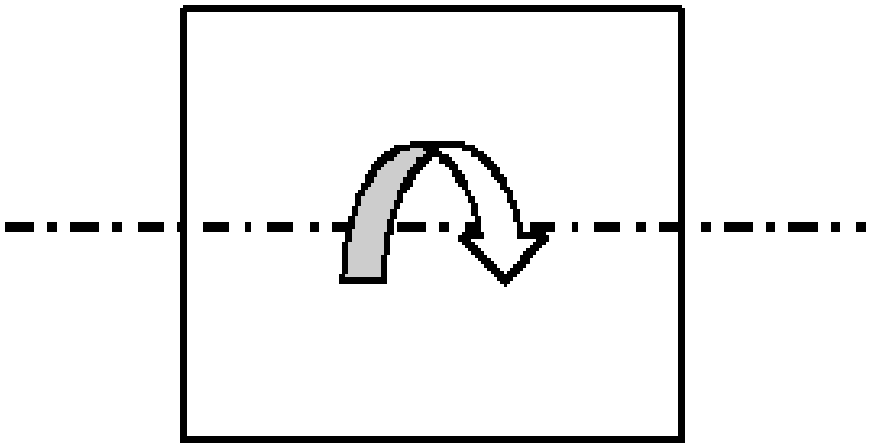


**Figure G.5 — Illustration of horizontal axis washing machine**

#### G.3.1.3 Vertical axis washing machines

In a **vertical axis washing machine** the load is placed in a drum which rotates around an axis which is usually vertical or close to vertical (see definition). This is illustrated in Figure G.6. In cases where the drum does not rotate for any **operation** (i.e. no spinning function available and no rotation during washing) then the **washing machine** is classified as a **vertical axis washing machine**.

Components, protrusions or mechanical devices of different style (e.g. agitator, impeller) inside the drum in a **vertical axis washing machine** may cause slight variations in the loading scheme described. These variations are covered in the loading sequence for **vertical axis washing machines.**

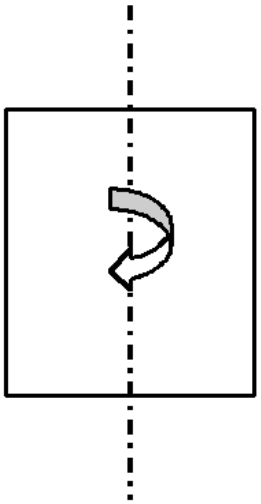


**Figure G.6 — Illustration of vertical axis washing machine**

## G.3.2 Loading sequences

### G.3.2.1 General rules

**Washing machines** shall always be loaded item by item in layers from bottom to top. All items shall be placed into the drum in the orientation described below.

### G.3.2.2 Items with attached strip

#### G.3.2.2.1 General

Load items which have stain test strips attached (e.g. medium sheets) are always laid flat in the **washing machine** with the 5 soils of the stain test strip facing upwards. Load items with stain test strips attached shall not be placed one top of each other.

#### G.3.2.2.2 Loading for horizontal axis washing machines

**Horizontal axis washing machine** shall be loaded as described in this section.

The folded medium sheet with the stain test strip shall be placed in the drum with the Sebum/Carbon Black/Blood/Cocoa stains facing upwards and the side of the sheet folded twice facing to the front of the **washing machine** drum as illustrated in Figure G.7.

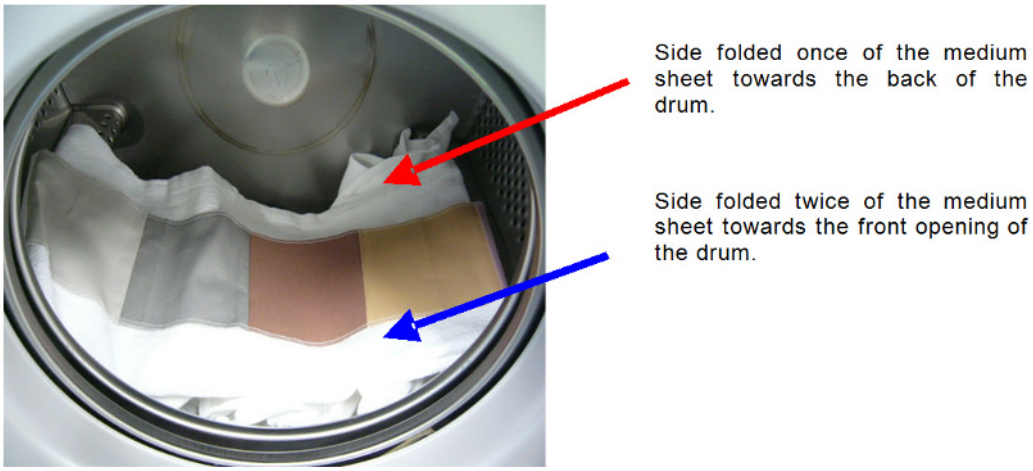



**Figure G.7 — Horizontal axis washing machine: placement of items in the drum**

#### G.3.2.2.3 Loading for vertical axis washing machines

**Vertical axis washing machine** shall be loaded as described in this section.

The folded medium sheet shall be placed in the drum with the Sebum/Carbon Black/Blood/Cocoa stains facing upwards and the side of the sheet folded twice facing the drum wall as illustrated in Figure G.8.

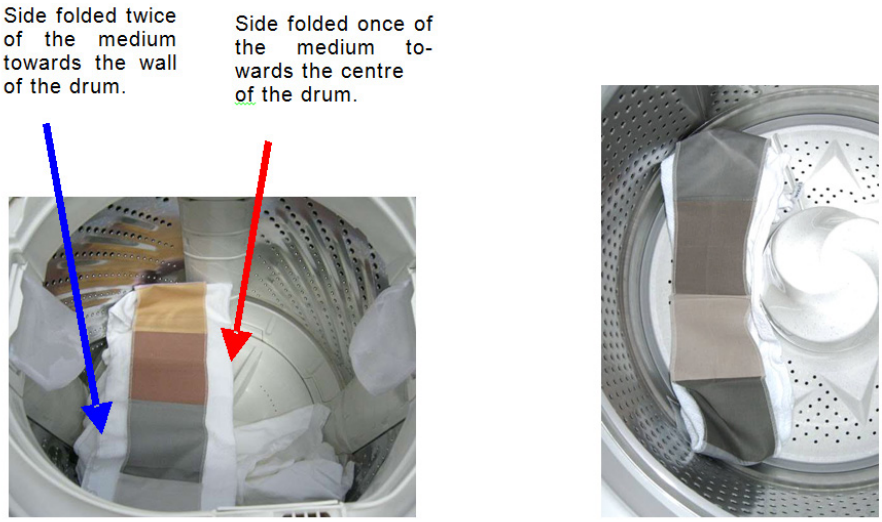



**Figure G.8 — Vertical axis washing machine: placement of items in the drum**

## G.4 Loading requirements for the test load – horizontal axis washing machines

### G.4.1 General loading directions

#### G.4.1.1 General

A, **horizontal axis washing machine** shall be loaded in steps from bottom to top. The sequence step by step is given in G.4.2.

#### G.4.1.2 Amount of test load and soiled strips

The amount of **test load** (small, medium and large sheets) as well as the number of soiled strips for a given machine size is given in Table 3.

### G.4.2 Horizontal axis washing machine: loading step by step

#### G.4.2.1 General

Divide the load as defined in 6.4.6.2 or G.8 in part loads. The number of part loads shall be equal to **the number of medium sheets with attached stain test strips**. Divide the different **test load** items (small, medium and large sheets) as equally as possible and sort each part load according to Table G.1.

**Table G.1 — Orientation of test load items within a part load**

| Order of loading | Sorting layer | Type of test load per layer |
|---|---|---|
| **1** | **1** | All small sheets |
| **2** | **2** | First row of large sheets (if any) |
| **3** | **3** | The medium sheet with stain test strip |
| **4** | **4** | The medium sheet without any attachment |
| **5** | **5** | Second row of large sheets (if any) |

### G.4.2.2 Sorting rules

For large sheets the first row of sheets shall be filled in all part loads before any large sheets are placed in the second row.

If the number of items cannot be divided equally between the part loads the items shall be divided as equal as possible starting with part load number 1.

### G.4.2.3 Example showing how a 15 kg load shall be divided into part loads and then loaded into a horizontal axis washing machine

Example showing the division of the **test load** into part loads and the order they are loaded into the machine. The example shows the procedure for a 15 kg machine.

Reference to Table 3 shows that the **test load** for the 15 kg machine shall consist of 10 medium sheets with a stain test strip attached, 10 additional medium sheets, 11 small sheets and 10 large sheets.

Table G.1 shows how the **test load** shall be sorted within a **part load**. The number of part loads for a 15 kg machine is 10 (equal the number of stain test stripes. (G.4.2))

The **test load** will then be sorted as follows:

Small sheets (11 units). The 11 small sheets shall be sorted in layer number 1 of each part load. Sixteen sheets will then be divided according to G.4.2.2 giving 2 sheets per layer in part loads 1 and 1 sheet in part loads 2 – 10.

Large sheets (10 units) 10 large sheets shall be placed in layer number 2 (the first row) of each part load. Medium sheets with attached stain test strip (10 units) shall be placed in layer number 3 in part loads 1-10.

Medium sheets without any attachment (10 units) shall be placed in layer number 4 in part loads 1-10.

Thus the part load sorting will be according to the attached table.

**Table G.2 — Part load items for a 15 kg test load**

| Sorting layer | Load items (15 kg load) | Number of test load items in each part load | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Part load number | | | | | | | | | |
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 1 | All small sheets | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 2 | First row of large sheets (if any) | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 3 | The medium sheet with stain test strip | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 4 | The medium sheet without any attachment | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 5 | Second row of large sheets (if any) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

The items shall be folded according to the scheme in G.2.2.1 – G.2.2.4.

The **test load** items shall be loaded according to G.4.3.

### G.4.2.4 Example of part load compositions

Examples of part load compositions for some **test load** masses can be found in Table G.3. to G.6.

**Table G.3 — Part load items for a 5 kg test load**

| Order of loading | Sorting layer | Load items (5 kg load) | Number of test load items in each part load | | | | |
|---|---|---|---|---|---|---|---|
| | | | Part load number | | | | |
| | | | 1 | 2 | 3 | 4 | 5 |
| 1 | 1 | All small sheets | 3 | 3 | 3 | 3 | 3 |
| 2 | 2 | First row of large sheets (if any) | 0 | 0 | 0 | 0 | 0 |
| 3 | 3 | The medium sheet with stain test strip | 1 | 1 | 1 | 1 | 1 |
| 4 | 4 | The medium sheet without any attachment | 1 | 1 | 1 | 1 | 1 |
| 5 | 5 | Second row of large sheets (if any) | 0 | 0 | 0 | 0 | 0 |

**Table G.4 — Part load items for a 10 kg test load**

| Order of loading | Sorting layer | Load items (10 kg load) | Number of test load items in each part load | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Part load number | | | | | | | | |
| | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 1 | 1 | All small sheets | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 2 | 2 | First row of large sheets (if any) | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3 | 3 | The medium sheet with stain test strip | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 4 | 4 | The medium sheet without any attachment | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 5 | 5 | Second row of large sheets (if any) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Table G.5 — Part load items for a 20 kg test load**

| Order of loading | Sorting layer | Load items (20 kg load) | Number of test load items in each part load | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Part load number | | | | | | | | | |
| | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 1 | 1 | All small sheets | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 2 | 2 | First row of large sheets (if any) | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 3 | 3 | The medium sheet with stain test strip | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 4 | 4 | The medium sheet without any attachment | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 5 | 5 | Second row of large sheets (if any) | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 |

**Table G.6 — Part load items for a 100 kg test load**

| Order of loading | Sorting layer | Load items (100 kg load) | Number of test load items in each part load | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Part load number | | | | | | | | | |
| | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 1 | 1 | All small sheets | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 2 | 2 | First row of large sheets (if any) | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 6 | 6 |
| 3 | 3 | The medium sheet with stain test strip | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 4 | 4 | The medium sheet without any attachment | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 5 | 5 | Second row of large sheets (if any) | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 |

### G.4.2.5 Part load items for loads sizes not shown in Table G.2 to G.6

For **test load** sizes not shown in Table G.2 to Table G.6 select the correct number of **test load** items from Table 3 or calculate the correct number from formula in G.8. Sort the part loads according to Table G.1 and sorting rules in G.4.2.2.

## G.4.3 Loading the horizontal axis machines

Load the sorted part loads into the machine starting with part load number 1. Within a part load the items shall be loaded starting with layer number 1.

All items shall be folded according to G.2.2.1 to G.2.2.4.

Place each layer of a part load horizontally in the drum. If a part load not is filling the drum horizontally continue with the first layer of next part load before placing the **test load** items on top of each other. For large machines be sure to keep the load within the drum horizontal and if necessary place two layers beside each other in order to fill the drum depth. Figure G.9 shows in a schematic way how the different part loads can be placed within a large **washing machine** drum.

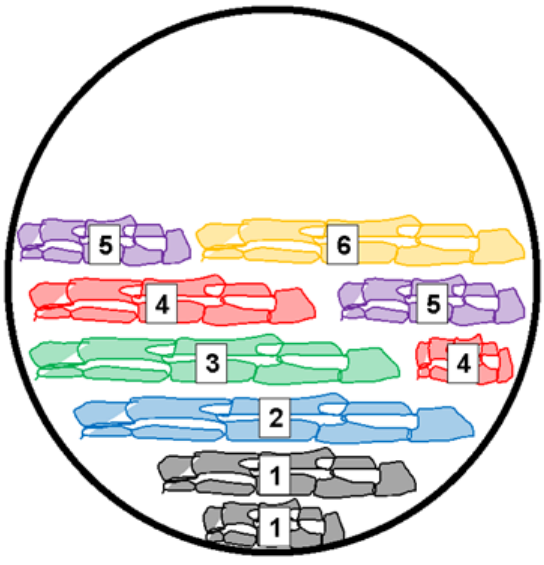



**Figure G.9 — Schematic view of part loads within a large drum**

## G.5 Loading requirements for vertical axis washing machines

### G.5.1 General loading directions

**Vertical axis washing machines** shall be loaded in layers from bottom to top in the same way as horizontal axis machines.

### G.5.2 Vertical axis washing machine: loading step by step

The loading of vertical axis machines shall be done in the same way as for horizontal axis machines. Loading shall start with items from part load number 1 and layer number 1. Place the load items folded according to Subclauses G.2.2.1 to G.2.2.5 horizontally in the drum. Start from the bottom of the drum and go clockwise round and distribute the load items evenly into the drum.

## G.6 Loading of multi compartment machines

### G.6.1 General loading information

**Washing machine**s with multiple of wash compartments like **Pullman** and **Y-pocket machine**s shall be loaded in the same way as for single compartment machines.

### G.6.2 Loading procedure

Calculate the number of **test load** items in the same way as for horizontal axis machines according to Table 2 and 3 and Subclauses G.2.2.1 to G.2.2.5 and divide the part loads as equally as possible between the wash compartments.

## G.7 Performance testing with loads other than a full load — General information

This Technical Specification also permits performance testing with loads other than rated capacity **test loads**. The **test load** items shall be selected from Table 2 and Table 3 or from calculations shown in Clause G.8 using the reduced load as the base for the number of **test load** items. (Example: 40 kg machine: Load to be tested 3/4 of rated capacity. Select or calculate the number of **test load** item at 3/4* 40 kg = 30 kg.)

## G.8 Calculation of the composition of test load items for load sizes above 10 kg and not shown in the Table 2 or Table 3

### G.8.1 General

If a **test series** shall be performed with a **test load** mass not in the 0,5 kg intervals (between 2 and 10 kg or in the 1 kg interval (10 kg and up) select the **test load** items according to the nearest of the 0,5 kg loads (interval 2 to 10 kg) or 1 kg loads (10 kg and up) and add or subtract small sheets until the desired **test load** is achieved

If the composition of the **test load** not can be found in Table 3 the composition of the number of small, medium and large sheets can be calculated according to the formula shown in G.8.2.

### G.8.2 Calculation of the load composition is done according to following formula:

Calculations for test loads above 10 kg. Load composition for test loads below 10 kg is found in Table 3.

$$Number\ of\ large\ sheets\ (X_L) = Integer(\frac{M_T - 10 * M_M - 10 * M_{M+st} - 10 * M_s}{M_L})$$

$$Number\ of\ small\ sheets\ (X_s) = Integer(\frac{M_T - 10 * M_M - 10 * M_{M+st} - X_L * M_L}{M_S})$$

$$Number\ of\ medium\ sheets\ with\ or\ without\ staintest\ strips = 10\ for\ all\ test\ loads\ above\ 10\ kg$$

where:

$M_T$ = *the total test load mass (kg)*

$M_S$ = *the mass of a small sheet*

$M_M$ = *the mass of a medium sheet*

$M_{M+st}$ = *the mass of a medium sheet with a stain test strip attached*

$M_L$ = *the mass of a large sheet*

$X_S$ = *number of small sheets*

$X_M$ = *number of medium sheets*

$X_{M+ST}$ = *number of medium sheets with stain test strips attached*

$X_L$ = *number of large sheets*

Defined values according to **Annex C**:

– $M_S$ = *0,110 kg (nominal mass)*

– $M_M$ = *0,310 kg (nominal mass)*

– $M_L$ = *0,720 kg (nominal mass)*

– $M_{M+st}$ = *0,336 kg (nominal mass)*

The mass of the individual **test load** items as defined in Table 2 is a nominal value. Therefore the number of small and large sheets for a certain load as defined in **Table 3** may differ. If adjustments need to be done the number of **small sheet** shall not be selected lower than 10 and not above 20.

# Annex H
(normative)

# Measuring the bath temperature

## H.1 General

The temperature shall be measured by temperature loggers placed among the **test load** in the wash basket and following the load during the wash procedure.

## H.2 Specification of the loggers

The specification of the temperature logger is given in Table H.1.

**Table H.1 — Specification of temperature logger suitable for temperature measurement for both washing and drying**

| | |
|---|---|
| Temperature range[a] | (0 – 100) °C ((0 – 150) °C) |
| Accuracy | ≤ 0,5 °C over full range |
| Resolution | ≤ 0,1°C |
| Response time TC (10 – 90 %)[b] water | ≤ 2 min |
| Response time TC (10 – 90 %)[b] moving air(2 m/sec) | ≤ 5 min |
| Sampling rate | ≤ 10 s |
| Max mass | 70 g |

[a] The wider temperature range applies when the temperature logger is used for both washing machine and tumble dryer performance tests.

[b] TC (10 %–90 %) is the time it takes for the sensor to traverse between 10 % and 90 % of its final value. Response time can also be expressed as a TC 63 % value. The 63 % figure is the time for the sensor to reach 63 % of its final value. TC (10 %–90 % and the TC 63 % value are of approximately the same magnitude for a given sensor.

## H.3 Preparation of the loggers before measurement

The temperature logger shall be placed in a textile pocket made of the same fabric as the **test load**. The size of the pocket shall not be excessively larger than the logger. By doing this the logger will be protected from extensive shocks when hitting the drum walls and also any damage to the **test load** will be minimized. The pocket shall be closed by plastic clips or by any other means.

In order to make the logger to follow the motion pattern of the **test load** as close as possible the pocket shall be attached to one of the medium-sized test sheets without any attached test soil strip.

## H.4 Number of loggers

Following number of temperature loggers shall be placed in the washing machine depending on the size of the **washing machine**.

**Table H.2 — Number of temperature loggers for bath temperature measurement**

| Size of wash basket | Number of temperature loggers |
|---|---|
| < 100 l | 2 |
| 100 l – 400 l | 3 |
| < 400 l to 1 500 l | 4 |
| > 1 500 l | 5 |

## H.5 Measuring the temperature

The loggers shall be placed at different locations within the drum after loading the drum with the test load. One logger shall be placed in the middle of the drum. The loggers shall follow the textiles throughout the wash process until the end of the programme. Directly after the **programme** end the loggers shall be removed and the logged data loaded to a computer.

## H.6 Presenting the result

The temperature data obtained by the logger shall preferably be presented as a curve showing the temperature during the whole wash process. The result can be presented as individual temperature profiles for each logger or as a mean value of the loggers for each time point.

If max wash temperature shall be reported max wash temperature shall be defined as: the mean value of the maximum temperature recorded by each logger during a time interval of one minute located one minute after the logger has reached the maximum temperature recorded during the wash process.

$$T_{max} = \frac{\sum_1^n T_{nmax[tn1,tn2]}}{n}$$

where

$n$ = number of loggers

$T_{nmax[tn1,tn2]}$ = $T_{nmax}$ in the interval $[tn1,tn2]$

$T_{nmax}$ maximal temperature in °C recorded by logger *n*

$t_{n1}$ = ($t_{n0}$ + 1) *min*

$t_{n2}$ = ($t_{n0}$ + 2) *min*

$t_{n0}$ = process time when $T_{nmax}$ is reached

# Annex I
(informative)

# Performance testing of gas fired washing machines

## I.1 General

This annex gives references to CEN standards related to the safety and measurement of gas fired **washing machines**.

## I.2 Installation, testing procedure and calculation of supplied gas energy

The washing machine shall be installed according to reference given in a future standard, EN ZZZZZ.

NOTE At the time of introducing this Technical Specification, the concerned document was not ready for publication, nor given an EN number.

The test results shall be reported according to tables given in Annex M.

All safety issues required shall be followed.

Specification for the gas energy measurement is given in 5.6.3.

The testing procedure shall follow the procedure given in Clauses 6, 7 and 8.

Formulae for calculating the supplied gas energy can be found in EN 1458-2.

# Annex J
(normative)

# Performance testing of steam heated washing machines

## J.1 General

This annex specifies the instrumentation, installation, test procedure and calculation of energy consumption for steam heated washing machines.

## J.2 Types of steam heating

### J.2.1 Direct steam heating

Steam heated washing machines are mostly direct heated by the steam. Direct heating means that the steam is injected direct into the wash water. The energy of the steam will heat up the wash water. The steam condensate will be added to the amount of supplied water and the amount of condensate should be added to the total amount of wash water to be reported.

### J.2.2 Indirect steam heating

Indirect steam heating means that the steam energy is transferred to the water via a heat exchanger (steam battery). The condensate will not be added to the wash water but can be transferred back to the steam boiler feed tank. The energy of the condensate water can be recovered and shall be reduced from the total steam energy.

## J.3 Specification of steam properties

### J.3.1 Type of steam

The steam shall be dry saturated steam. Required steam pressure is set by the washing machine manufacturer instructions. Maximum pressure for any test is limited to 1,4 MPa and with a corresponding temperature of 198 °C.

### J.3.2 Steam generator

The steam generator shall be large enough to supply dry saturated steam to the machine under test at the given steam pressure and flow specified by the manufacturer throughout the full test procedure. If dry saturated steam not can be guaranteed a super heater shall be added to the steam boiled so slightly superheated steam is produced.

The inlet water quality to the steam boiler shall be in accordance to EN 12953-10.

## J.4 Equipment and instrumentation

### J.4.1 Test equipment for measuring the characteristics of steam

#### J.4.1.1 Flow meter for measurement of steam velocity and mass flow

Flow meter intended for measurement of steam flow. The flow meter shall be able to tolerate the required pressure and temperature range of supplied steam.

#### J.4.1.2 Pressure sensor for measurement of the steam pressure

Pressure transducer intended for measurement of steam and with a pressure range from 0 MPa to 1,4 MPa.

#### J.4.1.3 Temperature sensor for measurement of the steam and condensate temperature

Temperature sensor intended for incoming steam temperature measurement. Temperature range from 0°C to 200°C.

Temperature sensor intended for condensate temperature measurement. Temperature range from 0°C to 200°C.

#### J.4.1.4 Scale for measurement of the mass of the condensate

Scale to be used for mass measurement of the condensate.

#### J.4.1.5 Steam calculator

To calculate the steam energy transferred to the washing machine a steam calculator shall be used.

The calculator shall follow and support following standard: Formulation IAPWS IF 97 for calculation of the energy (IAPWS Industrial Formulation 1997 for the Thermodynamic Properties of Water and Steam).

The calculator shall be able to correct calculate the steam energy for dry saturated steam and for superheated steam. The calculator shall also preferably be equipped with a wet steam alarm.

### J.4.2 Instruments

| Parameter | Unit | Minimum resolution | Minimum accuracy |
|---|---|---|---|
| Steam flow | m/sec | ± 0,1 % | ± 1 % |
| Temperature | °C | ± 0,1K | ± 1K |
| Pressure | kPa | ± 0,05 % of set range | ± 0,2 % of set range |
| Masses | g | See 5.6.2 | |

### J.4.3 Measurements

| Parameter | Unit | Minimum accuracy | Additional requirements |
|---|---|---|---|
| Steam energy | kWh | ±2 % | The combined minimum accuracy refers to the steam calculation using the steam calculator, temperature and pressure sensor described above |
| Condensation water mass | g | ±1 % | |

NOTE It is probably not possible to find one set of equipment that covers the full required pressure and flow ranges for all kind of machines under test.

If the maximum steam pressure is set lower than 1,4 MPa the requirements for the equipment regarding max pressure and temperature may be lowered as long as it is in line with the pressure and steam temperature delivered by the boiler.

## J.5 Installation

### J.5.1 General

It is very important that all instrumentation is installed according the manufacturers exact instructions.

### J.5.2 Installation of the measure equipment for direct steam heated washing machines

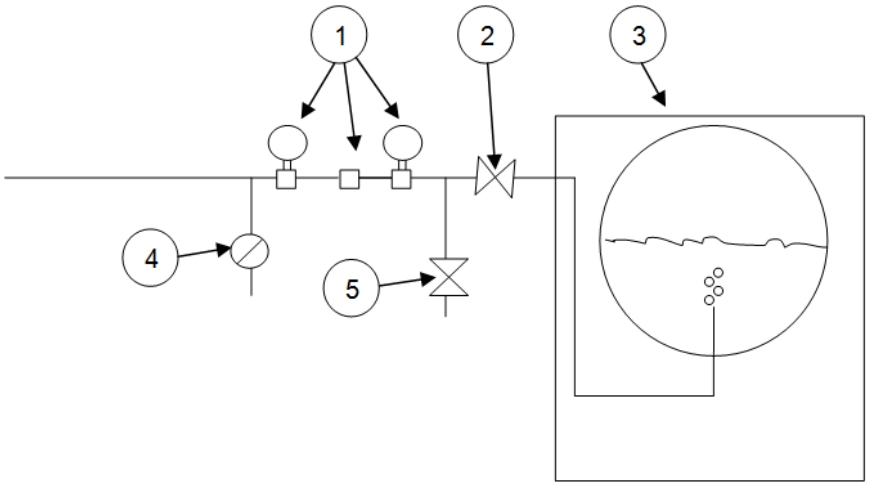
Figure J.1 shows a schematic installation of the measurement equipment for direct steam heated washing machines.

The steam flow entering the measurement instruments shall be as undisturbed as possible and therefore the steam measurement equipment (1) shall be placed together and with a straight part of the steam supply pipe prior and after the instruments according to the instrument suppliers instruction.

Also the tube diameter shall be according to the instructions and shall not change in diameter from where the straight supply steam tube starts and ends.

The steam trap (4) shall be placed so condensed water can be drained from the supply steam tube.

The shut off valve (2) and the steam measurement equipment (1) shall be placed as close as possible to the machine under test. The steam supply pipe from the steam measurement equipment (1) to the machine under test shall not be longer than 1,5 m.




**Key**

1 supply steam measurement equipment consisting of steam flow meter, temperature sensor and pressure transducer

2 shut off valve

3 direct steam heated washing machine

4 steam trap

5 drain valve

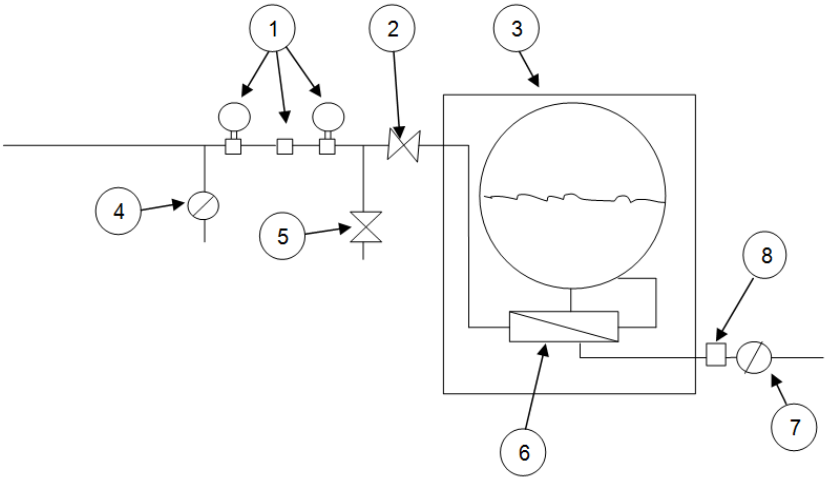
**Figure J.1 — Schematic installation of the measurement equipment for direct steam heated washing machines**

### J.5.3 Installation of the measurement equipment for indirect steam heated washing machines.(Alternative 1)

Figure J.2 shows a schematic installation of the measurement equipment for indirect steam heated washing machines.

The instrumentation for the measurement of the supplied steam energy shall be installed in the same way as for direct stem heated washing machines.

After the steam battery (6) a temperature sensor (8) shall be installed and close to the sensor a steam trap (7) shall be placed.




**Key**

1 supply steam measurement equipment consisting of steam flow meter, temperature sensor and pressure transducer.

2 shut off valve

3 indirect steam heated washing machine

4 steam trap

5 drain valve

6 steam battery

7 steam trap

8 temperature sensor

**Figure J.2 — Schematic installation of the measurement equipment for indirect steam heated washing machine (Alternative 1)**

## J.5.4 Installation of the measurement equipment for indirect steam heated washing machines. (Alternative 2)

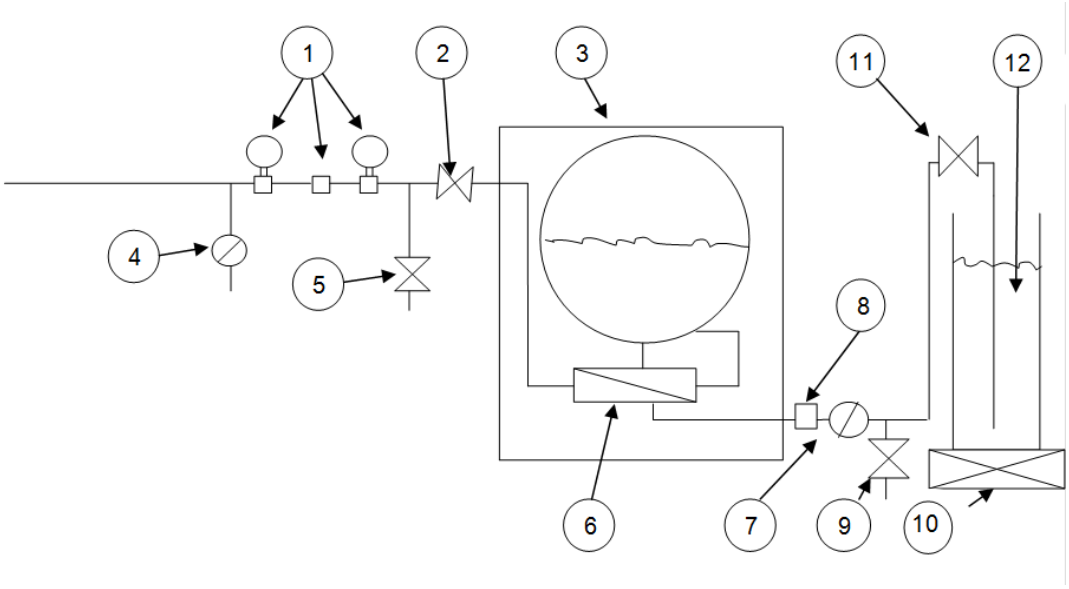
Figure J.3 shows an alternative schematic installation of the measurement equipment for indirect steam heated washing machines. This installation will give a possibility to compare the amount of steam supplied to the machine with the amount of condensate water recovered in the tank.

The instrumentation for the measurement of the supplied steam energy shall be installed in the same way as for direct stem heated washing machines.

After the steam battery (6) a temperature sensor (8) shall be installed and close to the sensor a steam trap(7) shall be placed.

The condensate is recovered in a water tank (12) placed on a scale (10).

The condensate water hose from the steam trap to the tank is equipped with a drain valve (9) and a shut off valve (11). The hose shall not have any physical connection with the tank in order not to disturb the mass measurement of the condensate water.




**Key**

1 supply steam measurement equipment consisting of steam flow meter, temperature sensor and pressure transducer.

2 shut off valve

3 indirect steam heated washing machine

4 steam trap

5 drain valve

6 steam battery

7 steam trap

8 temperature sensor

9 drain valve

10 scale

11 shut off valve

12 water tank

**Figure J.3 — Schematic installation of the measurement equipment for indirect steam heated washing machine (Alternative 2)**

## J.6 Preparation for testing

### J.6.1 General

The ambient conditions shall follow the specifications given in 5.2. The washing machine shall be installed according to the manufacturer's instructions. The dimension of the steam hoses shall be in accordance with the installation instructions.

### J.6.2 Direct heated washing machines and indirect heated washing machines installed according to alternative 1

The washing machine shall be prepared for testing according to Clause 6 with following additions:

After the cleaning run of the test washing machine according to 6.2.1.3 a test series shall start within 2 d of the cleaning run but not sooner than 1 d after the cleaning run. Any remaining condensate

within the test machine itself shall not be removed between the cleaning run and the start of a test series.

### J.6.3 Indirect heated washing machines installed according to alternative 2

The washing machine shall be prepared for testing according to Clause 6 with following additions.

After the cleaning run of the test washing machine according to 6.2.1.3 a test series shall start within 2 d of the cleaning run but not sooner than 1 d after the cleaning run. After the cleaning run the drain valve (9) shall be opened in order to drain the condensate collected in the condensate hose. The amount of water (see J.7.4) in the tank (12) shall be reset to the start level. Any other remaining condensate within the test machine itself may not be removed between the cleaning run and the start of a test series.

## J.7 Tests for performance

### J.7.1 General

This clause contains information about the test procedure for performance measurements on steam heated washing machines and the additional requirements needed.

### J.7.2 Performance testing of direct steam heated washing machines

All performance tests shall be according to Clause 8 and according to following additional requirements:

The tests shall be performed with the steam pressure and flow rate recommended by the manufacturer.

Before each test run the steam hoses outside the machine under test shall be flushed with steam ensuring that the steam is as dry as possible when entering into the machine under test. Close the shut off valve (2) and open the drain valve (5) and flush the steam until no condensate is visible in the valve outlet. The flushing shall occur immediate before the start of the test run. Close drain valve (5) and open the shut off valve (2) and start the test run.

The measured values from the steam measurement equipment (steam pressure, steam flow rate and steam temperature shall be recorded by the steam energy calculator and required output data shall be calculated and reported according to J.8.2.1.

The mass of steam (kg) calculated by the Steam energy calculator shall be recorded and reported according to J.8.2.3.

### J.7.3 Performance testing of indirect steam heated washing machines installed according to alternative 1

All performance tests shall be according to Clause 8 and according to following additional requirements:

The tests shall be performed with the steam pressure and flow rate recommended by the manufacturer.

Before each test run the steam hoses outside the machine under test shall be flushed with steam ensuring that the steam is as dry as possible when entering into the machine under test. Close the shut off valve (2) and open the drain valve (5) and flush the steam until no condensate is visible in the valve outlet. The flushing shall occur immediate before the start of the test run. Close drain valve (5) and open the shut off valve (2) and start the test run.

The measured values from the steam measurement equipment (steam pressure, steam flow rate and steam temperature shall be recorded by the steam energy calculator and required output data shall be calculated and reported according to J.8.2.1.

The mass of steam (kg) calculated by the Steam energy calculator shall be recorded and reported according to J.8.2.3.

The average temperature of the condensate shall be recorded via the temperature sensor (8).

### J.7.4 Performance testing of indirect heated washing machines installed according to alternative 2

#### J.7.4.1 General

All performance tests shall be according to Clause 8 and according to following additional requirements:

The tests shall be performed with the steam pressure and flow rate recommended by the manufacturer.

The Tank (12) shall be filled with water. The amount of water shall be approximately 4 times the expected amount of condensate and the vertical water distance between the steam outlet in the tank and the water surface shall be so high that all steam not yet condensed will condensate before breaking the water surface. The mass of the tank (12) with water shall be recorded.

Before each test run the steam hoses outside the machine under test shall be flushed with steam ensuring that the steam is as dry as possible when entering into the machine under test. Close the shut off valve (2) and open the drain valve (5) and flush the steam until no condensate is visible in the valve outlet. The flushing shall occur immediate before the start of the test run. Close drain valve (5) and open the shut off valve (2) and start the test run.

The measured values from the steam measurement equipment (steam pressure, steam flow rate and steam temperature shall be recorded by the steam energy calculator and required output data shall be calculated and reported according to J.8.3.1.

The average temperature of the condensate shall be recorded via the temperature sensor (9).

After each test run shut off valve (11) shall be closed and valve (9) shall be opened. The water in the condensate water hose shall be collected and poured into the tank (12) When the condensate water hose is empty the shut off valve (11) shall be opened again so any remaining water in the condensate water hose can flow into the tank (12).

The total mass of the tank (12) shall now be recorded.

#### J.7.4.2 Control of accuracy

The mass of the steam supplied to the washing machine as calculated by the steam energy calculator can be compared with the mass of the condensate calculated as the difference of the mass of the tank after and before the test run. If the mass values differ more than 10 % the run shall be regarded as not valid.

## J.8 Assessment of performance

### J.8.1 General

This section sets out the evaluation methods for the assessment of the energy performance of steam heated washing machines.

## J.8.2 Evaluation of performance of direct steam heated washing machines

### J.8.2.1 Evaluation of supplied steam energy

The steam energy supplied to a direct heated washing machine $W_{dst}$ is the energy measured by the steam energy calculator.

### J.8.2.2 Evaluation of total energy supplied to the washing machine by steam

The total steam energy $W_{st}$ for a direct steam heated washing machine is equal to $W_{dst}$

### J.8.2.3 Evaluation of the supplied mass of steam to main wash

The mass of the supplied steam $M_{dst}$ is the mass of the steam calculated by the steam energy calculator.

where

$M_{dst}$ is the mass of steam supplied to the washing machine during a test run.

## J.8.3 Evaluation of performance of indirect heated washing machines installed according to Alternative 1

### J.8.3.1 General

This section sets out the evaluation of supplied steam energy, energy recovered in the condensate and the total steam energy supplied to indirect heated washing machines installed according to Alternative 1.

### J.8.3.2 Evaluation of supplied steam energy

The steam energy supplied to an indirect heated washing machine $W_{ist}$ is the energy measured by the steam energy calculator.

### J.8.3.3 Evaluation of the energy to be recovered through the condensate

The recovered energy of condensate water is calculated as:

$W_{cs} = M_{dst} \times T_c / 860$

$T_c = T_{cs}$ if $T_{cs}$ is < 100°C

$T_c$ = 100°C if $T_{cs}$ is ≥ 100°C

where

$M_{dst}$ is the mass of steam supplied to the washing machine during a test run.

$T_c$ is the condensate temperature

$T_{cs}$ is the temperature recorded by the temperature sensor (8)

$W_{cs}$ is the energy of the recovered condensate

1/860 is the energy equivalent

### J.8.4 Evaluation of performance of indirect heated washing machines installed according to Alternative 2

#### J.8.4.1 General

This section sets out the evaluation of supplied steam energy, energy recovered in the condensate and the total steam energy supplied to indirect heated washing machines installed according to Alternative 2.

#### J.8.4.2 Evaluation of supplied steam energy

The steam energy supplied to an indirect heated washing machine $W_{ist}$ is the energy measured by the steam energy calculator.

#### J.8.4.3 Evaluation of the energy to be recovered through the condensate

The recovered energy of condensate water is calculated as:

$M_{cw} = M_{T1} - M_{T2}$

$T_c = T_{cs}$ if $T_{cs}$ is < 100°C

$T_c$ = 100°C if $T_{cs}$ is ≥ 100°C

$W_{cs} = M_{cw} \times T_c / 860$

where

$M_{cw}$ is the recovered amount of condensate water

$M_{T1}$ is the mass of the tank (12) at the end of the procedures described in J.7.3

$M_{T2}$ is the mass of the tank (12) at the start of the test run

$T_c$ is the condensate temperature

$T_{cs}$ is the temperature recorded by the temperature sensor (8)

$W_{cs}$ is the energy of the recovered condensate

1/860 is the energy equivalent

### J.8.5 Evaluation of total energy supplied to the washing machine by steam

The total steam energy $W_{st}$ for an indirect steam heated washing machine is equal to:

$W_{st} = W_{ist} - W_{cs}$

## J.9 Data to be reported

The value of the total steam energy $W_{st}$ and the mass of the supplied steam $M_{dst}$ shall be reported in Table M.2.1.

# Annex K
(normative)

# Procedure to determine test load size when rated capacity is not declared

## K.1 General

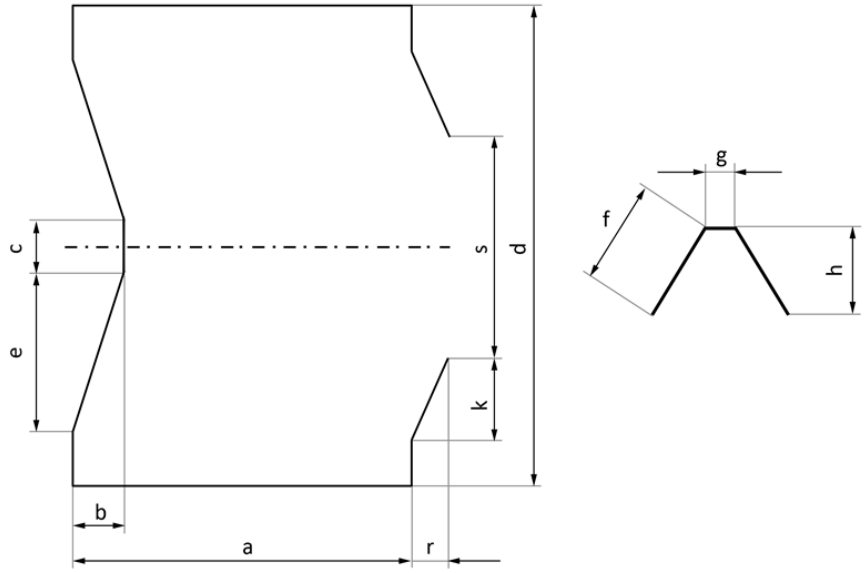
This annex sets out a method for the determination of **test load mass** when **rated capacity** is not declared.

## K.2 Determination of the test load mass

The **test load mass** shall be (in kg) 1/10 of the inner drum volume (in litre) calculated according to K.3.

## K.3 Determination of the drum volume

If the **test load mass** not is declared by the manufacturer the drum volume of the **washing machine** shall be calculated. The calculation of the drum volume shall follow the procedure and formula described in text and in Figure K.1 to Figure K.4 below:




**Key**

a = the horizontal depth of the inner drum

b = the depth of the back gable cone

c = the diameter of the drum shaft

d = the inner diameter of the drum (Definition of how d is measured: see Figure H.2.)

e = the vertical length of the coned part of back gable.

f = the width of a side of a lifter.

g = the horizontal part of a lifter

h = the vertical height of a lifter

r = the horizontal length of the front cone

s = the diameter of the inner drum front opening

k = the vertical length of the coned part of the front cone

$n_L$ = number of lifters

**Figure K.1 — Cross section of drum and lifter**

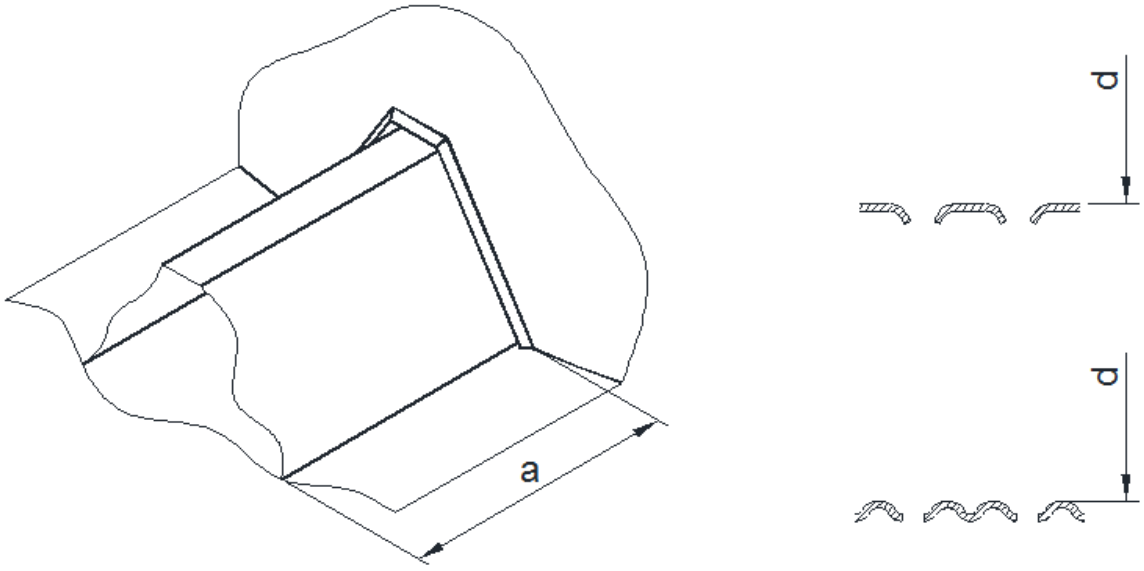



**Figure K.2 — Figure showing how the drum diameter d shall be measured for different kind of drum perforation**

**Calculation of the inner drum volume V.**

The volume $V$ shall be calculated according to the formulas below and with definition of the volumes and other measures according to Figure K.1, Figure K.2, Figure K.3.and Figure K.4.

$$V = V_1 - n_L \cdot V_2$$

$$V_1 = V_3 - V_4 - V_5 + V_6$$

$$V_3 = \pi \frac{a \cdot d^2}{4}$$

$$V_4 = \pi \frac{b \cdot c^2}{4}$$

$$V_5 = \pi \frac{3 \cdot b \cdot c \cdot e + 2 \cdot b \cdot e^2}{6}$$

$$V_6 = \pi \frac{3 \cdot i \cdot j \cdot k + 2 \cdot j \cdot k^2}{6}$$

$$V_2 = a \cdot \left( g + \sqrt{f^2 - h^2} \right) \cdot h$$

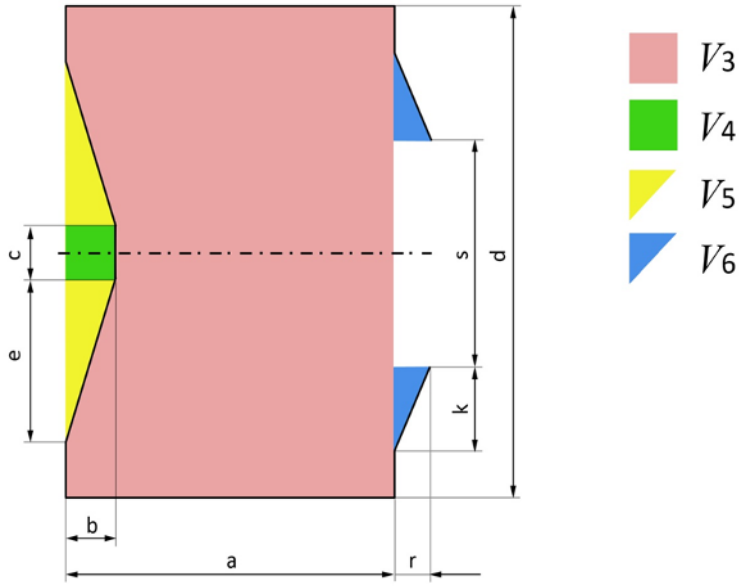



**Figure K.3 — Definition of volumes $V_3$ to $V_6$**

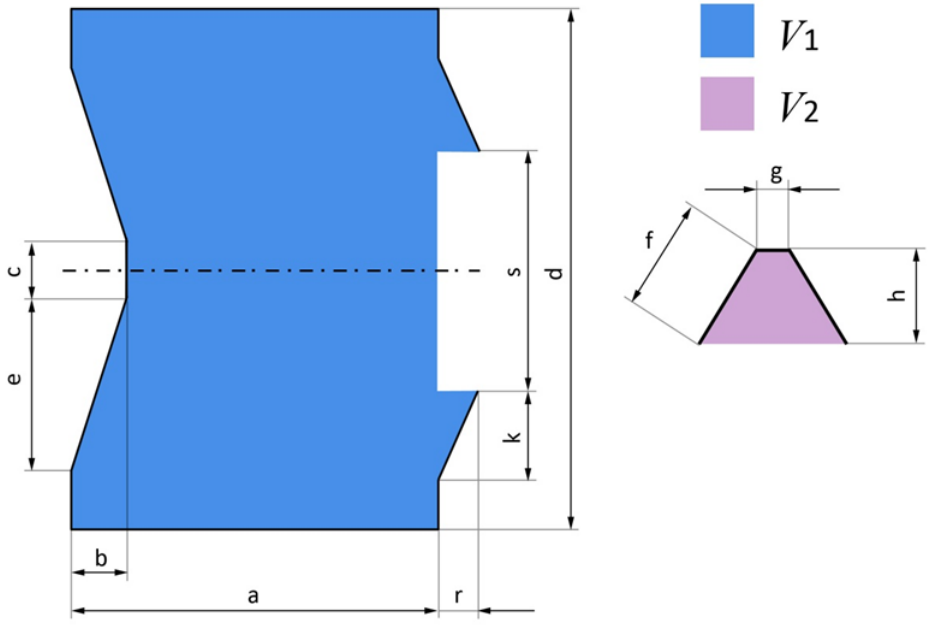



**Figure K.4 — Definition of volume $V_1$ and $V_2$**

# Annex L
(informative)

# Uncertainty of measurements in the present document

## L.1 Why is uncertainty important?

When a measurement has been performed giving a figure as a result for some quantity (also known as the measurand) we may ask how sure can we be about this figure. In other words:

— If we repeat the measurement will we then get the same result?

— If another group or another laboratory performs the measurement how close will we expect the results to be?

By means of an uncertainty budget we may calculate an uncertainty interval $y \pm U$, where $y$ is the measurement result and $U$ the expanded uncertainty that is estimated to give the interval a high probability (often 95 %) to cover the true value, $Y$, of the measurand. $U$ is said to be the uncertainty associated with the result $y$.

The uncertainty interval of a measurement is therefore a basis for qualifying the measurement. The more narrow we want the confidence interval i.e. the smaller we want the value of the uncertainty $U$, the more careful we often have to be about the measurement method, the measuring equipment, the training of the operators and the number of repetitions of the same experiment.

## L.2 Documents referenced in this annex

The following documents are included in the Bibliography of this Technical Specification and should be consulted when examining the issue of uncertainty of measurement in any detail:

— ISO/IEC Guide to the Expression of Uncertainty in Measurement (also known as “GUM”);

— ISO 5725 (all parts);

— IEC/TR 61923.

## L.3 Ways to access uncertainty

### L.3.1 General

There are in principle two ways to estimate uncertainty: a bottom up method and a top down method. It is generally recommended that the two methods be used in parallel to achieve a reliable estimate of the uncertainty budget.

### L.3.2 The bottom up method

This method is set out in the ISO/IEC Guide to the Expression of Uncertainty in Measurement.

In this method the test result *y* is expressed as a function of input quantities. This function is often the formula used for the calculation of the result.

In our case the *y* may be one of the final test results like water consumption, energy consumption, washing performance, **spin speed**, spin drying performance, program duration or rinsing efficiency. The input quantities may be temperature, masses, times, power, etc.

The magnitude of all the uncertainty contributions of each input quantity is estimated. The maximum permitted uncertainty is normally defined in the standard. However, the actual uncertainty of measurement for the equipment used during the test should be used.

By combining the uncertainties of the input quantities according to the law of propagation of uncertainty (see the ISO/IEC Guide to the Expression of Uncertainty in Measurement for details), the uncertainty of the result $y$ can be calculated.

With this calculation it can be seen how a specific uncertainty contribution from an input quantity influences the combined uncertainty of the final result and therefore how a reduction in an uncertainty contribution from an input quantity will influence the combined uncertainty of the final result. Uncertainties may usually be reduced through a number of strategies including making more measurements, using other methods or other equipment, but these usually have an additional cost associated with them. We can use this information to put our effort into those aspects that reduce the uncertainty of the final result in the most cost effective way.

### L.3.3 The top down method

This method is set out in IEC/TR 61923.

In this method the reproducibility standard deviation is estimated from testing of the same machine (or the same model) in different laboratories using the same standard method. This type of testing is normally called a “ring-test” or “round-robin test”. The reproducibility standard deviation of the test results can then be seen as the inherent uncertainty of the measurement method as it may be influenced by remaining differences in the ambient, the people and whatever else may be different between different measurements at different laboratories. In principle it is only valid for the machine investigated in this ring-test, but results may also be extended to similar types of machines. It is important to note that this type of estimate also includes the inherent variability of the **test washing machine**, which can be particularly problematic if there are sophisticated electronic controls or fuzzy logic programmes in operating during tests. Factors such as overloading can also increase the variability (and increase uncertainty) of the results. Where different machines are tested for comparison in different laboratories, there will also be some differences arising from production variability, so great care needs to be exercized.

Therefore the two methods “bottom up” and “top down” may be used in parallel to achieve a reliable estimate of the uncertainty budget. But both methods depend on the validity of the model or the data used.

## L.4 Uncertainty of measurement in the present document

Reviewing actual round-robin test results, where machines are tested in different laboratories, will allow an estimate of the relative expanded uncertainties to be made. This data illustrates the best achievable result in using this standard in selected laboratories.

| Measured property | Relative expanded uncertainty of measured value (k = 2) |
|---|---|
| Washing performance<br>Energy consumption<br>Water consumption<br>Final moisture<br>Programme time<br>Wool shrinkage | values can be reported in a Technical report after actual tests involving different laboratories |

The values in the Technical Report define the level of uncertainty of the measurement when the same machine is tested in a number of laboratories which follow this standard. They are only valid for those type of machines assessed in the Technical Report; other machine types may behave different, also affecting these uncertainty values.

It is critical that laboratories meet the requirements of the relevant standard whenever results are reported. Additional details may need to be reported during round robin tests. Laboratories are encouraged to check their alignment with other laboratories through participation in inter-laboratory testing whenever possible.

## L.5 Reporting uncertainty

In summary, the uncertainty of measured results has two sources:

1) The statistical uncertainty of what is measured as expressed in the sample standard deviation as calculated below, showing the accuracy of the measurement in the laboratory having done the measurement (noting that this measurement also includes machine variability). The calculation of standard deviation for a number of parameters is set out in Clause 9.

2) The uncertainty of the measuring method itself. This is expressed as expanded uncertainty, where it is common to set the borders at a 95 % confidence interval, which gives the minimum and maximum value within which the average measured result undertaken at any other laboratory following this standard could be expected to fall.

Standard deviation of any parameter is set out as follows:

$$s = \sqrt{\sum_{i=1}^{n} \frac{\left(x_i - \overline{x}_i\right)^2}{n-1}}$$

where:

$x_i$ is the $i^{\text{th}}$ term of parameter $x$

$\overline{x}_i$ is the mean of all n terms of parameter $x$

$n$ is the number of measurements of parameter $x$

Reporting of test results needs to have all of this information to allow a full judgement of the measured result: average measured value, standard deviation (across all **test runs**) and expanded uncertainty.

As an example, where the expanded uncertainty on energy consumption was found to be 10 %, the data should be reported in the following form:

| | |
|---|---|
| Average energy measured | 1,44 kWh |
| Standard deviation of measurement: | 0,05 kWh |
| Expanded uncertainty: | 10 % of 1,44 kWh = 0,14 kWh |
| Reporting: Energy consumption: | |
| Average measured: | 1,44 kWh |
| Standard deviation: | ± 0,05 kWh |
| Expanded uncertainty: | ± 0,14 kWh |

Interpretation: Testing the same machine in another laboratory following this standard, the expected average value (at 95 % confidence) should lie between 1,30 kWh and 1,58 kWh.

# Annex M
(normative)

# Test report – Data to be reported

## M.1 General

This annex presents the data to be reported for the **reference machine** and the **test washing machine**.

The layout of the following Table M.1 to Table M.6 is recommended. Only the tables and parameters that are relevant for the **test series** need be included.

Title: "**Test Report of TS XXXX**" (state edition and year used)

## M.2 Data for test washing machine

**Table M.1 — Data for test washing machine**

| | |
|---|---|
| **Brand:** | **Model:** |
| **Country of manufacture (if indicated):** | |
| **Product number code:** | **Serial number:** |
| **Source of machine:** | **Heating source:** |
| **Appliance dimension declared:** | **Appliance dimension measured:** |
| **Rated capacity** | |
| **Drum volume declared:** | **Drum volume measured:** (if required) |
| **Washer axis** (see 3.1.6, 3.1.7 and G.3.1): | **Washer loading (top/front):** |
| **Water connections (hot, cold, hot and cold):** | **Rated input power:** |
| **Rated voltage:** | **Test voltage:** |
| **Rated frequency:** | **Test frequency:** |
| **Rated current:** | |
| **Additional information:** | |

## M.3 Data, parameters and results for the test series

The following data (Table M.2.1 and Table M.2.2) shall be reported for a **test series** used to determine the performance of a **test washing machine**. The same table may be used for the **reference machine** and the **test washing machine**.

**Table M.2.1 — Data, parameters and results**

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Laboratory | | | | | | | | | | | | |
| Checked / approved by | | | | | | | | | | | | |
| Machine identification | | | | | | | | | | | | |
| Internal test identifier | | | | | | | | | | | | |
| Reference machine test series identifier | | | | | | | | | | | | |
| Programme and options selected | | | | | | | | | | | | |
| Nominal required test load mass | | | | | | | | | | | | |
| Reason for extra test run (if applicable) | | | | | | | | | | | | |

| **Number of items** | **Small sheets** | **Medium sheets** | **Large sheets** | **Test soil strips** | |
|---|---|---|---|---|---|
| | | | | | |

| **Test runs** | | | | | | **1** | **2** | **3** | **4** | **5** | **Average** | **Standard deviation** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **symbol** | **unit** | **Noted (n) measured (m) calculated (Calc)** | **Accuracy 10 kg and below** | **Accuracy above 10 kg** | | | | | | | |
| Date of test run | | yyyy.mm.dd | n | - | | | | | | | | |
| Mass of conditioned base load (without test strips)[b] | $M$ | g | m | 10 | 100 | | | | | | | |
| Mass of base load before each test run (without test strips) [b] | $M_{dry}$ | g | m | 10 | 100 | | | | | | | |
| Mass of detergent used | $M_{det}$ | g | m | 0,01 | 0,1 | | | | | | | |
| Cold water consumption during main wash [a] | $V_{cm}$ | l | m | 0,1 | 1 | | | | | | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hot water consumption during main wash [a] (if connected) | $V_{hm}$ | l | m | 0,1 | 1 | | | | | | | |
| Water consumption during main wash (cold + hot if connected) [a] | $V_m$ | l | calc | 0,1 | 1 | | | | | | | |
| Total cold water consumption | $V_{ct}$ | l | m | 0,1 | 1 | | | | | | | |
| Total hot water consumption (if connected) | $V_{ht}$ | l | m | 0,1 | 1 | | | | | | | |
| Total water consumption (cold + hot if connected) | $V_{total}$ | l | calc | 1 | 1 | | | | | | | |
| Total electrical energy metered during the test | $W_{et}$ | kWh | m | 0,01 | 0,1 | | | | | | | |
| Total cold water energy correction determined during the test [a] | $W_{ct}$ | kWh | calc | 0,01 | 0,01 | | | | | | | |
| Total energy without hot water | $W_{total,}$ cold | kWh | calc | 0,01 | 0,1 | | | | | | | |
| Calculated total hot water energy determined during the test [a] | $W_{ht}$ | kWh | calc | 0,01 | 0,1 | | | | | | | |
| Total steam energy metered during the test | $W_{st}$ | kWh | m | 0,01 | 0,1 | | | | | | | |
| Total gas energy metered during the test | $W_{gt}$ | kWh | m | 0,01 | 0,1 | | | | | | | |
| Total electric energy consumed by compressed air operation | $W_{ca}$ | kWh | m | 0,01 | 0,1 | | | | | | | |
| Total energy (programme energy) | $W_{total}$ | kWh | calc | 0,01 | 0,1 | | | | | | | |
| Ambient temperature (test room) | $t_a$ | °C | m | 0,1 | 0,1 | | | | | | | |
| Laboratory supply water pressure cold | $p_c$ | kPa | m | 10 | 10 | | | | | | | |
| Laboratory supply water pressure hot (if connected) | $p_h$ | kPa | m | 10 | 10 | | | | | | | |
| Laboratory supply water total hardness cold | | mmol/l | m | 0,01 | 0,01 | | | | | | | |
| Laboratory supply water total hardness hot (if connected) | | mmol/l | m | 0,01 | 0,01 | | | | | | | |
| Date of water preparation cold (if appropriate) | | yyyy.mm.dd | n | - | | | | | | | | |
| Date of water preparation hot (if appropriate) | | yyyy.mm.dd | n | - | | | | | | | | |
| Laboratory supply cold water inlet temperature [a] | $T_c$ | °C | m | 0,1 | 0,1 | | | | | | | |
| Laboratory supply hot water inlet temperature [a] (if connected) | $T_h$ | °C | m | 0,1 | 0,1 | | | | | | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Main wash duration [c] | $t_{MW}$ | min | m | 1 | 1 | | | | | | | |
| Programme time | $t_t$ | min | m | 1 | 1 | | | | | | | |
| Spin speed | $S$ | rpm | m | 1 | 1 | | | | | | | |
| Mass of base load after spin extraction | $M_r$ | g | m | 10 | 100 | | | | | | | |
| Remaining moisture content | $D$ | % | calc | 1 | 1 | | | | | | | |
| Reflectance after wash: Sebum | $x_i$ | | m | 0,01 | 0,01 | | | | | | | |
| Reflectance after wash: Carbon black/Oil | $x_i$ | | m | 0,01 | 0,01 | | | | | | | |
| Reflectance after wash: Blood | $x_i$ | | m | 0,01 | 0,01 | | | | | | | |
| Reflectance after wash: Cocoa | $x_i$ | | m | 0,01 | 0,01 | | | | | | | |
| Reflectance after wash: Red Wine | $x_i$ | | m | 0,01 | 0,01 | | | | | | | |
| Reflectance after wash: Sum | $C_k$ | | calc | 0,01 | 0,01 | | | | | | | |
| Washing Efficiency Index | $I_W$ | | calc | 0,01 | 0,01 | | | | | | | |

The figures for reported precision specify the rounding and reporting of values. As an example, a reported precision of 0,001 means that the result shall be reported rounded to 3 decimal places.

[a] Temperature and water volume to be integrated for each relevant operation to give total cold water correction and calculated total hot water energy.

[b] Mass of conditioned base load (without test strips) is recorded before the first test run in a test series – values prior to subsequent test runs would be after drying (but not necessarily the conditioned mass).

[c] Main wash duration refer to 3.1.28.

**Table M.2.2 — Performance results of the test washing machine**

| | | | | | |
|---|---|---|---|---|---|
| Laboratory | | | | | |
| Checked / approved by | | | | | |
| Machine identification | | | | | |
| Internal test identifier | | | | | |
| Reference machine internal test series identifier | | | | | |
| Programme and Options selected: | | | | | |
| Nominal required test load mass | | | | | |
| Reason for extra test run (if applicable) | | | | | |
| | | | | | |
| | Symbol (refer to 3.2) | Unit | Reported precision [a] | Average | Standard deviation |
| Average Washing Efficiency Index | $I_W$ | - | 0,001 | | |
| Average remaining moisture content | $D$ | % | 1 | | |
| Maximum remaining moisture | $D_{max}$ | % | 1 | | |
| Average value for the maximum spin speed | $S$ | rpm | 1 | | |
| Lowest value for the maximum spin speed | $S_{max}$ | rpm | 1 | | |
| Average total water consumption (cold + hot if connected) | $V_{total}$ | l | 1 | | |
| Average total energy consumption | $W_{total}$ | kWh | 0,01 | | |
| Average Programme time | $t_t$ | min | 1 | | |
| [a] The figures for reported precision specify the rounding and reporting of values. As an example, a reported precision of 0,001 means that the result shall be reported rounded to 3 decimal places. | | | | | |

## M.4 Materials used for the test series

The following data (Table M.3) is recommended for inclusion in the test report.

**Table M.3 — Materials**

| **Base load** | Supplier | | Batch | | Number of items used in this **base load** | |
|---|---|---|---|---|---|---|
| Small sheets | | | | | | |
| Medium Sheets | | | | | | |
| Large sheets | | | | | | |
| **Conditioning method.** | | | | | | |
| **Detergent** | Supplier | Batch | Date of delivery | Storage condition | Target mass in g for this **test load** (**nominal test load mass**) | |
| Base detergent A* | | | | | | |
| Perborate | | | | | | |
| TAED | | | | | | |
| **Stain test strips and additional soiled items.** | Supplier | Batch | Date of delivery | Storage condition | Identification of test strips used for this **test load** | |
| Stain test strips | | | | | | |
| | | | | | | |
| **Water hardness preparation** | Natural | EN 60734 Type A | EN 60734 Type B | EN 60734 Type C1 | EN 60734 Type C2 | Other (specify) |
| | | | | | | |

## M.5 Standard Equipment used for the test series

The following data (Table M.4) is recommended for inclusion in the test report.

**Table M.4 — Equipment**

| | Brand | Model | Accuracy | Laboratory Registration No | Calibrated until |
|---|---|---|---|---|---|
| **Reference washing machine** | | | | | |
| **Spectral photometer** | parameter:<br>optical geometry:<br>wavelength resolution:<br>spectral range:<br>light source: | | UV-filter<br>gloss/specular:<br>aperture:<br>measuring time:<br>calibration: | | |
| **Variable voltage regulator (test-system)** | | | | | |
| **Energy meter** | | | | | |
| **Steam energy measurement equipment** | | | | | |
| **Gas energy measurement equipment** | | | | | |
| **Temperature recorder** | | | | | |
| **Water meter** | | | | | |
| **Scale (loads)** | | | | | |
| **Scale (detergent)** | | | | | |
| **pH-meter** | | | | | |
| **Moisture meter** | | | | | |
| **Conditioning room / chamber details** | | | | | |
| **Dryer used for drying between test runs** | | | | | |
| **Dryer used for bone-dry (where applicable)** | | | | | |
| **Iron (where applicable)** | | | | | |

# Annex N
(informative)

# Sources of materials and supplies

## N.1 General

NOTE The information given is for the convenience of users of this Technical Specification and does not constitute an endorsement by CENELEC of these products.

## N.2 Suppliers for Reference Machine

Suppliers for reference machines, reference programmes:

Electrolux Laundry Systems Sweden AB
SE-341 80 Ljungby
Phone +46 372 66100
Fax +46 372 13390
E-mail els.info@electrolux.com
Website www.electrolux.com/professional

## N.3 Suppliers for Test Materials

Swissatest Testmaterialen AG
Mövenstrasse
CH-9015 St.Gallen
Switzerland
Phone +41 71311 8055
Fax +41 71311 8057
E-mail info@swissatest.ch
Website http://www.swissatest.ch

WFK – Testgewebe GmbH
Christenfeld
D-41379 Brüggen
Germany
Phone +49 2157 871977
Fax +49 2157 90667
E-mail info@testgewebe.de
Web Site http://www.testgewebe.de

# Bibliography

[1] EN 1458-2, *Domestic direct gas-fired tumble dryers of types B22D and B23D, of nominal heat input not exceeding 6 kW — Part 2: Rational use of energy*

[2] EN 50229, *Electric clothes washer-dryers for household use — Methods of measuring the performance*

[3] CLC/TS 50594, *Tumble dryers for commercial use — Methods for measuring the performance*

[4] EN 60704-1, *Household and similar electrical appliances — Test code for the determination of airborne noise — Part 1: General requirements (IEC 60704-1)*

[5] EN 60704-2-4, *Household and similar electrical appliances — Test code for the determination of airborne acoustical noise — Part 2-4: Particular requirements for washing machines and spin extractors (IEC 60704-2-4)*

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

[7] EN *ZZZZZ*, *Energy measurement of gas heated laundry equipment*

[8] EN ISO 10472 (all parts), *Safety requirements for industrial laundry machinery (ISO 10472, all parts)*

[9] EN ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories (ISO/IEC 17025)*

[10] IEC 61121, *Tumble dryers for household use — Methods for measuring the performance*

[11] IEC/TR 61923, *Household electrical appliances — Method of measuring performance — Assessment of repeatability and reproducibility* [Technical Report type 3]

[12] IEC/TR 62617, *Home laundry appliances — Uncertainty reporting of measurements*

[13] ISO/IEC *Guide to the expression of uncertainty in measurement,* 1. ed. 1995

[14] ISO/IEC Guide 43-1, *Proficiency testing by interlaboratory comparisons — Part 1: Development and operation of proficiency testing schemes*

[15] ISO/IEC Guide 43-2, *Proficiency testing by interlaboratory comparisons — Part 2: Selection and use of proficiency testing schemes by laboratory accreditation bodies*

[16] ISO 4319, *Surface active agents — Detergents for washing fabrics — Guide for comparative testing of performance*

[17] ISO 5725 (all parts), *Accuracy (trueness and precision) of measurement methods and results*

[18] ISO/TR 22971, *Accuracy (trueness and precision) of measurement methods and results — Practical guidance for the use of ISO 5725-2:1994 in designing, implementing and statistically analysing interlaboratory repeatability and reproducibility results*

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