BSI Standards Publication

Electric clothes washer-dryers for household use — Methods of measuring the performance

National foreword

This British Standard is the UK implementation of EN 50229:2015. It supersedes BS EN 50229:2007 which is withdrawn.

The UK participation in its preparation was entrusted by Technical Committee CPL/59, Performance of household electrical appliances, to Subcommittee CPL/59/1, Dishwashers and washing machines.

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.

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 October 2015.

Amendments/corrigenda issued since publication

Date	Text affected

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 50229

October 2015

ICS 97.060

Supersedes EN 50229:2007

English Version

Electric clothes washer-dryers for household use - Methods of measuring the performance

Lavantes-séchantes électriques à usage domestique - Méthodes de mesure de l'aptitude à la fonction

Elektrische Wasch-Trockner für den Hausgebrauch - Prüfverfahren zur Bestimmung der Gebrauchseigenschaften

This European Standard was approved by CENELEC on 2015-06-30. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

Ref. No. EN 50229:2015 E

Contents

European foreword

This document (EN 50229:2015) has been prepared by CLC/TC 59X "Performance of household and similar electrical appliances".

The following dates are fixed:

• latest date by which this document has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2016-06-30
• latest date by which the national standards conflicting with this document have to be withdrawn	(dow)	2018-06-30

This document supersedes EN 50229:2007.

The major technical modifications compared to EN 50229:2007 are:

a) The structure has been revised to assure a better readability.
b) All references concerning EN 60456:2011 and EN 61121:2013 have been updated.
c) Precise instruction to determine the load capacity for drying.
d) Precise instruction of composition of partial loads – Splitting the base load.
e) Revision of 'Test report – data to be reported' tables.

Introduction of method for additional drying.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.

1   Scope

This European Standard specifies the test methods that has to be applied in accordance with the Commission Directive 96/60/EC of 19 September 1996 implementing Council Directive 92/75/EEC with regard to energy labelling of household combined washer-driers.

It deals with

– performance criteria for the **complete operation cycle** of a 60 °C cotton wash programme as specified in EN 60456:2011 and a **drying cycle** based on the "Dry cotton programme" as specified in EN 61121:2013,

– tolerances for the verification procedure.

This European Standard is concerned neither with safety nor with performance requirements.

NOTE **Washer-dryers** for communal use in blocks of flats or in launderettes are within the scope of this standard, but machines for commercial laundries are not included.

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 60335-2-7		*Household and similar electrical appliances - Safety - Part 2-7: Particular requirements for washing machines (IEC 60335-2-7)*
EN 60335-2-11	2010	*Household and similar electrical appliances - Safety - Part 2-11: Particular requirements for tumble dryers (IEC 60335-2-11:2008)*
EN 60456	2011	*Clothes washing machines for household use – Methods for measuring the performance (IEC 60456:2010)*
EN 60704-3		*Household and similar electrical appliances – Test code for the determination of airborne acoustical noise – Part 3: Procedure for determining and verifying declared noise emission values (IEC 60704-3)*
EN 60734		*Household electrical appliances - Performance - Water for testing (IEC 60734)*
EN 61121	2013	*Tumble dryers for household use – Methods for measuring the performance (IEC 61121:2012, modified)*
EN ISO 80000-1	2013	*Quantities and units - Part 1: General (ISO 80000-1:2009 + Cor 1:2011)*

3 Terms, definitions and symbols

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in 3.1 of EN 60456:2011, except for 3.1.15, 3.1.22, 3.1.25, 3.1.Z1 – 3.1.Z12, together with the following apply.

3.1.1
washer-dryer
washing machine which includes both a spin extraction function and also a means for drying the textiles, usually by heating and tumbling

3.1.2
rated washing capacity
maximum mass in kg of dry textiles which the manufacturer declares can be washed in the **washer-dryer**

3.1.3
rated drying capacity
maximum mass in kg of dry textiles which the manufacturer declares can be dried in the **washer-dryer**

3.1.4
complete operation cycle
complete washing and drying process, as defined by the required programmes, consisting of a **washing cycle** and a **drying cycle set**

3.1.5
washing cycle
complete washing process, as defined by the required programme, consisting of a series of different operations (wash, rinse, spin)

3.1.6
drying cycle
complete drying process, as defined by the required programme, consisting of a series of different operations (heat, spin, cool down)

3.1.7
drying cycle set
set of **drying cycles** in which a **rated drying load** and a **residual drying load** are dried

Note 1 to entry: Usually a **drying cycle set** consists of two or more **drying cycles** involving the **rated drying load** and the **residual drying load** but when a **washer-dryer** has a **rated drying capacity** equal to its **rated washing capacity** the term **drying cycle set** applies to the cycle in which the **rated drying load** is dried.

3.1.8
automatic drying
drying process which automatically switches off when a certain moisture content of the load is reached

3.1.9
partial load
part of the test load used during a single **drying cycle**

Note 1 to entry: Usually the **rated drying capacity** of a **washer-dryer** is smaller than its **rated washing capacity**. In this case, for a **complete operating cycle** the **test load** for washing has to be divided into **partial loads** to perform the drying tests.

Note 2 to entry: **Partial load** is a general term that means either **rated drying load** or **residual drying load**.

Note 3 to entry: If, for a particular **washer-dryer** the **rated drying capacity** is equal to the **rated washing capacity**, the term **partial load** means the entire **base load**.

3.1.10
rated drying load
part of the **base load** having a mass after conditioning equal to the **rated drying capacity** of the **washer-dryer** except for the case where the **rated drying capacity** is equal to the **rated washing capacity** in which case the **rated drying load** shall have the same mass as the **base load**

Note 1 to entry: Under circumstances where the **rated drying capacity** is less than half the **rated washing capacity**, more than one **rated drying load** will need to be prepared from the **base load**.

3.1.11
residual drying load
remaining part of the **base load** after the **rated drying load(s)** has been removed

Note 1 to entry: If, for a particular **washer-dryer** the **rated drying capacity** is equal to the **rated washing capacity**, there will be no **residual drying load**.

3.1.12
final moisture content
moisture content of a test load at the end of a **drying cycle**

3.1.13
additional drying
supplementary drying of the test load applied when the selected drying programme fails to achieve a **final moisture content** of 3,0 % or less

3.2   Symbols

The symbols used in this standard are listed in Table 1.

NOTE   The symbols in 3.2 of EN 60456:2011 and 3.2 of EN 61121:2013 do not apply to this European Standard.

Table 1 – List of symbols

Symbol	Unit	Definition
L	l	Water consumption
E	kWh	Energy consumption
t	min	Programme duration
T	°C	Temperature
W	g	Mass of load
μ	%	Moisture content
S	rpm	Maximum spin speed
K	kg	Rated capacity
X	%	Reflectance value
n	-	Number of test strips in a test run
s	-	Standard deviation
C	-	Sum of average reflectance for each soil for a single test run
M	-	Number of soil types per stain test strip
$\bar{C}$	-	Sum of average reflectance for all soils for all test runs
B	-	Number of test runs in a test series
Q	-	Ratio of sum of reflectance for the test washing machine against the sum of the reflectance for the reference machine.
P	-	Confidence interval

F	-	Student T factor $t_{w-1, 0,05}$
W	-	Number of degrees of freedom in the Student T factor
Index		**Definition**
w		**Washing cycle**
d		**Drying cycle**
wd		**Complete operation cycle**
i		Initial value
f		Final value
0		Conditioned
N		Nominal value for **partial load** amounts and target final moisture
p		**partial load**
m		Measured value
Add		result of **additional drying** program runs required to reach final moisture target
s		specific value calculated by division with the **rated washing capacity**
a		Soil type
j		Test strip
k		Test run
t		Machine on test
r		Reference machine
c		Cold water
h		Hot water
M		Main wash
Superscripts		**Definition**
$^{-}$ (Bar)		Average value for a test series (mean value).

4 Requirements

4.1 General

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

- Washing performance;
- Water extraction performance;
- Water consumption for washing;
- Water consumption for drying;
- Energy consumption for washing;
- Energy consumption for drying;
- Programme time for washing;
- Programme time for drying;
- Maximum spin speed.

NOTE   While this document describes the general procedure for the measurement of these parameters, much of the necessary and specific detail is contained in EN 60456:2011 and EN 61121:2013.

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

4.2   Rated capacity

The **rated washing capacity** shall be declared by the manufacturer or supplier as the maximum mass of cotton textiles, to be washed in the cotton programme, at 0,5 kg intervals given in any user information.

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

If the **rated washing capacity** is not declared, it shall be deduced from the volume of the drum according to EN 60456:2011, N.2.

The **rated drying capacity** shall be declared by the manufacturer or supplier as the maximum mass of cotton textiles, to be dried in either a drying only cycle or a combined washing and **drying cycle** without interruption, whichever is higher, at 0,5 kg intervals given in any user information.

The **rated drying capacity** for any textile type shall not exceed the maximum mass of dry laundry, in kilograms, to be used in the **washer-dryer** in accordance with 3.1.9 of EN 60335-2-11:2010.

If the **rated drying capacity** is not declared, it shall be deduced from the volume of the drum according to EN 61121:2013, Annex E.

4.3   Dimensions

See 4.3 of EN 60456:2011.

5   Test conditions, materials and instrumentation

5.1   General

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

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

5.2   Ambient conditions

5.2.1   Electricity supply

Supply voltage and frequency shall be in accordance with EN 60456:2011, 5.2.1.

5.2.2   Water supply

5.2.2.1 General

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

5.2.2.2 Water hardness

For all treatments of the **test load** prior to a **test series** and all **test runs** in accordance with this document, water having a total water hardness of $(2,5 \pm 0,2)$ mmol/l shall be used.

Normalization of a **base load** prior to use in a **test series** (refer to EN 60456:2011, 6.4.4) shall always be done using laboratory supply water with the same total water hardness as that used for the subsequent **test series**.

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

If total water hardness needs to be adjusted, it shall be prepared according to EN 60734. Measurements of total water hardness shall be undertaken on water that is representative of the laboratory supply water used for tests.

5.2.2.3 Water temperature and water pressure

Water temperature and water pressure shall meet the requirements given in EN 60456:2011, 5.2.2.3 and 5.2.2.4.

5.2.3 Ambient temperature and humidity

The ambient temperature and ambient humidity shall be in accordance with 5.2.3 in EN 61121:2013.

5.3 Test materials

The specifications for base loads, stain test strips and detergent used for testing **washer-dryers** shall be in accordance with 5.3 of EN 60456:2011.

5.4 Equipment

The specification for the reference machine is given in 5.4.2 of EN 60456:2011. Only the type 1 reference machine according to EN 60456:2011, Annex D shall be used.

Specifications for other specialized test equipment required for **washer-dryer** testing to this document, including the spectrophotometer, equipment for conditioning the **base load** and the iron shall be in accordance with 5.4.3, 5.4.4 and 5.4.6 of EN 60456:2011 and in accordance with 5.5 of EN 61121:2013. Where these two standards give different values, the smaller value shall apply.

A checklist of other laboratory equipment which may be required for **washer-dryer** testing is provided in 5.4.8 of EN 60456:2011.

5.5 Instrumentation and accuracy

Instruments used and measurements made according to this document shall comply with the specifications given in 5.5.2 and 5.5.3 of EN 60456:2011 and EN 61121:2013, 5.5, whichever is more precise.

6 Preparation for testing

The **washer-dryer** shall be at laboratory ambient temperature at the beginning of each **complete operation cycle**. It shall be accepted that this requirement has been met if the **washer-dryer** has been left open and standing at the stable laboratory ambient temperature for not less than 10 h.

Prepare the **washer-dryer** for testing according to EN 60456:2011, 6.2.1 and 6.3 and 6.4 of EN 61121:2013.

Prepare the reference machine for testing according to EN 60456:2011, 6.2.2.

Prepare and place the detergent for the **washer-dryer** and the reference machine according to EN 60456:2011, 6.3.

Prepare cotton test loads for the **washer-dryer** and reference machine according to EN 60456:2011, 6.4.

If the **rated washing capacity** of the **washer-dryer** is greater than its **rated drying capacity**, it will be necessary after the washing performance test to divide the base load into two or more parts: the **rated drying load(s)** and the **residual drying load**. To enable this separation to be made in a timely manner, mark or otherwise identify the items in the base load that will be used to make up the **rated drying load(s)**. The compositions of **rated drying loads** shall be as described in EN 61121:2013, 6.5.6.1. If the base load does not contain all the items needed for the **rated drying load**, use the alternative compositions as described in Annex A.

If the **rated drying capacity** of the **washer-dryer** is equal to its **rated washing capacity**, the base load will not need to be split after the washing performance test; the whole base load shall be dried in a single **drying cycle**.

NOTE   It is recognised that in this special case, the base load will be slightly smaller than the **rated drying capacity**.

Determine the mass of the **rated drying load** and the **residual drying load** by conditioning according to EN 61121:2013, 6.5.5.

7   Performance measurement – General requirements

7.1   Outline

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

The general approach to the test procedure is as follows:

- the **washer-dryer** on test is used to wash and dry a test load five times;
- the reference machine is operated in parallel;
- after each washing cycle, the soiled test strips are removed and the base load is weighed and divided into **partial loads** consisting of one or more **rated drying loads** and a **residual drying load** if applicable;
- each of the **partial loads** is dried in turn;
- washing performance is evaluated from the reflectance of the soiled test strips;
- water extraction performance is determined by measuring the mass of the base load after conditioning and the mass of the base load after each wash;
- water consumption, energy consumption, programme time and maximum spin speed are determined by monitoring these parameters continuously throughout the whole washing and drying sequence.

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

7.2   Key test requirements

When performing a test series, the following key test requirements shall be met:

- the load type shall be cotton;
- all performance parameters listed in 7.1 shall be measured together;
- the programme to be tested for washing performance shall be the 60 °C cotton programme without prewash as identified by the manufacturer of the **washer-dryer**;
- the reference programme on the reference machine shall be '60 °C cotton EN 60456';
- the drying programme to be tested shall be one automatic setting identified by the manufacturer of the **washer-dryer** for drying cotton loads. If the **washer-dryer** does not have an **automatic drying** programme appropriate drying times shall be selected;
- the target final moisture content for all drying tests shall be (0,0 ± 3,0) %;
- the requirement given in EN 61121:2013, Table 6 for the average final moisture content for the test series shall be disregarded;
- the test load mass for washing performance tests shall be equivalent to the **rated washing capacity** of the **washer-dryer**;
- the test load for the drying test shall be the base load used for the washing performance test. If the **rated drying capacity** is smaller than the **rated washing capacity**, the test load shall be divided for drying tests according to Clause 6.

8 Tests for performance

8.1 General

This section sets out the test procedure for the determination of the parameters listed in 4.1 for a cotton load.

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

While the text in this document is written from the perspective of a single **washer-dryer** operating in parallel with the **reference machine**, more than one **washer-dryer** 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 **washer-dryer** shall be set up as follows:
- connected to an electricity supply specified in 5.2;
- connected to a laboratory water supply system specified in 5.2;
- operated in ambient conditions as specified in 5.2;
- with the **washer-dryer** and the **reference machine** prepared in accordance with Clause 6 using a cotton **base load** specified in 5.3 and a **test load** prepared in accordance with the requirements of Clause 6;
- using the detergent specified in 5.3 and with the detergent dose and placement specified in Clause 6.

Stain test strips and detergent (as applicable) used in the **washer-dryer** and the **reference machine** shall be from the same batch for all **test runs** within a **test series**.

8.2.2 Test load and loading

EN 60456:2011, 8.2.2 shall be followed, omitting any paragraphs that refer to Annex ZA.

8.2.3 Programme selection

8.2.3.1 General

Select a programme for the **washing cycle** according to 8.2.3.2 and a programme for the **drying cycle** according to 8.2.3.3.

The selected programmes shall be separate entities. Continuous programmes that wash and dry without interruption are not suitable for tests according to this standard.

8.2.3.2 Washing programme selection

Select a washing programme in accordance with EN 60456:2011, 8.2.3.

8.2.3.3 Drying programme selection

If the **washer-dryer** offers any **automatic drying programme**, the **programme** selected shall be an **automatic drying programme.**

The **automatic drying programme** selected on the **washer-dryer** and any associated settings shall initially be in accordance with the manufacturer's instructions.

In the absence of any instructions from the manufacturer, a suitable **automatic programme** shall be established by trial and error using a **rated drying load** before a full **test series** is carried out. An **automatic programme** setting shall be selected which aims to achieve final moisture content values that are as close as possible to the range -3 % to +3 %.

The same **automatic drying programme** shall be used for drying both the **rated drying load(s)** and the **residual drying load**.

The selected **automatic drying programme** settings from the first **complete operating cycle** shall be used for all **complete operating cycles** in a **test series** except where applicable in 8.2.4.4.

For **washer-dryers** without **automatic drying,** the duration of the drying shall be set using the timer of the **washer-dryer,** if available, otherwise a separate timer shall be used.

The drying time selected on the **washer-dryer** and any associated settings shall initially be in accordance with the manufacturer's instructions.

In the absence of any instructions from the manufacturer, a suitable drying time shall be established by trial and error before a full **test series** is carried out. A drying time setting shall be selected which aims to achieve final moisture content values that are as close as possible to the range -3 % to +3 % but no greater than +3 %.

The timer setting for tests with the **rated drying load** may be different to the timer setting for tests with the **residual drying load**.

The drying **programme** selected on the **washer-dryer** (with any associated settings) shall be reported.

8.2.4   Test procedure

8.2.4.1 General

This procedure is intended to be carried out in one continuous sequence so that the washing procedure is followed immediately by the drying procedure.

Washing performance, water extraction performance, water consumption, energy consumption, programme time and spin speed shall be measured in the same **complete operating cycle**.

8.2.4.2 Washing test procedure

Operate the **washer-dryer** 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**.

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

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

Within 10 min of the completion of the **washing cycle**, remove the **test load** and carefully separate the stain test strips from the load as quickly as possible.

Record the mass of the whole base load.

Follow the relevant requirements of each of the performance tests being carried out in the **test series** as described in 8.3, 8.4, 8.5 and 8.6.

Dry the **reference machine** base load in a tumble dryer to a moisture content of (0 ± 3) %.

8.2.4.3 Drying test procedure

Carry out the following procedures on the **washer-dryer** only.

Divide the base load into **partial loads** consisting of one or more **rated drying load(s)** and one **residual drying load** if applicable**,** according to the identifying marks on the load items prepared according to Clause 6. Record the mass of each **partial load**.

If the **rated drying capacity** of the **washer-dryer** is equal to its **rated washing capacity** the base load shall not be divided; it shall be dried in one single **drying cycle**.

Calculate the initial moisture content of each **partial load** according to the following formula:

$$\mu_{ip} = \frac{W_{ip} - W_{0p}}{W_{0p}} \times 100 \tag{1}$$

where

μ_{ip} is the actual initial moisture content of the **partial load**;
W_{ip} is the actual mass of the **partial load** after the **washing cycle**;
W_{0p} is the mass of the conditioned **partial load**.

Return the (first) **rated drying load** to the **washer-dryer**, loading each item one by one. Store the remaining **partial load(s)** in a water-tight container at ambient temperature as specified in 5.2.3.

Dry each **partial load** in turn using the drying programme selected in 8.2.3.3.

At the end of each **drying cycle**, record the mass of the **partial load**. Calculate the final moisture content of the **partial load** using the following formula:

$$\mu_{fp} = \frac{W_{fp} - W_{0p}}{W_{0p}} \times 100 \tag{2}$$

where

μ_{fp} is the final moisture content, of the **partial load;**
W_{fp} is the mass of the **partial load** after drying;
W_{0p} is the mass of the conditioned **partial load.**

If the moisture content of the **partial load** is greater than 3,0 %, follow the **additional drying** procedure given in 8.2.4.4.

If the moisture content of the **partial load** is not greater than 3,0 % then continue by drying the next **partial load**.

The time between the end of the wash cycle and the beginning of the first **drying cycle** shall not be more than 15 min.

The time between the end of drying one **partial load** and the beginning of drying the next **partial load** shall not be more than 5 min.

The time between the end of drying the last **partial load** and the beginning of the next **complete operation cycle** in a test series shall not be less than 10 h or more than 14 d.

Follow the relevant requirements of each of the performance tests being carried out in the **test series** as described in 8.5.

8.2.4.4 Additional drying procedure

This sub-clause only applies in cases where the programme or timer setting initially selected to dry a load fails to reach a final moisture content of 3 % or less.

The intention of this procedure is to make all drying tests valid in terms of the final moisture content. In the case of automatic drying programmes, this involves undertaking additional timed drying. For washer dryers that do not have an automatic drying programme, additional timed drying may be undertaken up to a maximum of four drying cycles in a test series. If the limit of four drying cycles is exceeded and the timer setting is not the maximum possible time setting for the washer dryer then it should be assumed that the time setting selected for the test series was too short. The test series should then be abandoned and re-started using a longer timer setting.

Figure 1 below is a flow chart which illustrates the rules for deciding if additional drying should be undertaken or if a **test series** needs to be abandoned and re-started using a different timer setting. The text which follows the flow chart describes the process step by step.
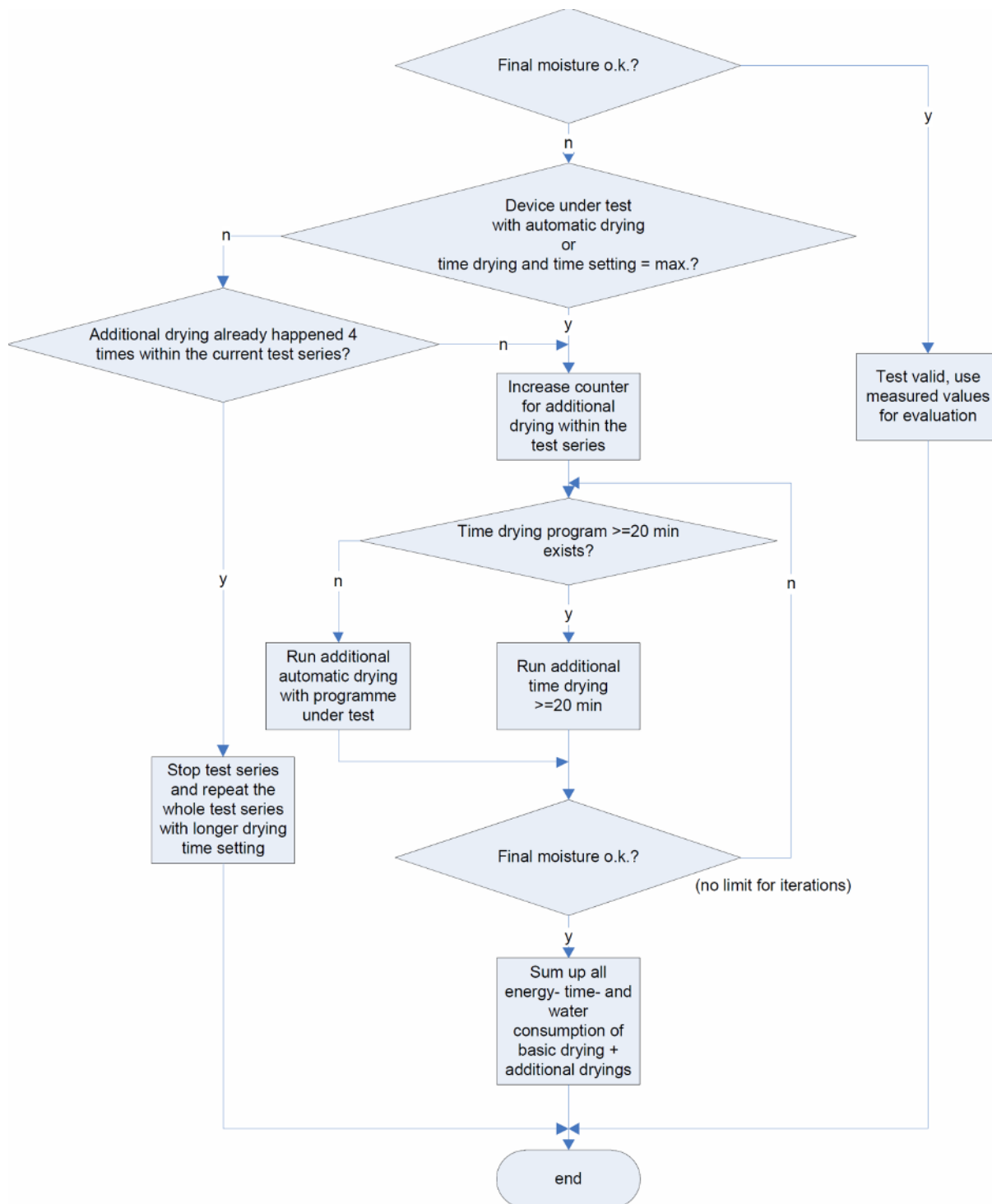
Figure 1 - Flowchart illustrating the additional drying procedure

When the selected programme fails to dry a **partial load** to a final moisture content of 3,0 % or less, either abandon the test series or subject the test load to **additional drying** according to the following two considerations:

a)   Abandon the current test series and start a new test series using an extended drying time setting if all the following criteria are met:

- the selected programme is a timer setting;

- the timer setting currently selected is not the longest drying time setting available on the **washer-dryer**;

- the **washer-dryer** has already failed to achieve a final moisture content of 3,0 % or less four times in the current test series.

b)   If all the above criteria are not met, continue to dry the load according to one of the following two options:

- If the **washer-dryer** has a drying timer setting of 20 min or more, select a timer setting of at least 20 min which is appropriate for the size and moisture content of the **partial load**. Continue drying the **partial load** using the selected setting. Repeat this process as many times as is necessary to achieve a final moisture content of 3,0 % or less in the **partial load**;

- If the **washer-dryer** does not have a drying timer setting of 20 min or more, continue drying the **partial load** using the automatic programme setting originally selected. Repeat this process as many times as is necessary to achieve a final moisture content of 3,0 % or less in the **partial load**.

Whenever any **additional drying** is necessary, always ensure that drying commences no more than 5 min after the previous drying operation has ended.

All water, energy and time associated with all **additional drying** shall be measured and included in the evaluation of water consumption, energy consumption and time for the relevant **partial load**.

8.2.5 Test series

8.2.5.1 General

A **test series** consisting of five valid test runs shall be carried out on the **washer-dryer** and the **reference machine.**

During the test series, base loads shall be managed as described in 8.2.5.2.

Rules concerning the validity of test runs in a test series are described in 8.2.5.3.

8.2.5.2 Management of base loads during a test series

The first **test run** in a **test series** shall be carried out with a normalized and conditioned **base load** (refer to EN 60456:2011, 6.4.4 and 6.4.5). All subsequent runs in the test series shall be carried out using the same **base load**. The **base load** shall not be rinsed or modified in any way during the test series. The conditioned mass of the **base load** shall be considered to remain constant throughout the test series. Care is required to ensure that no **base load** items are lost or gained between **test runs.** To this end it is recommended that a system is established for identifying each item in a base load so that all items can be accounted for at every stage of the test series.

NOTE   It is well known that the mass of a base load may vary throughout a test series due to the accumulation of limescale from the water and accumulation of solids originating from the detergent and due to the loss of lint. For the purposes of evaluating the final moisture content and the water extraction performance, the mass of the base load is considered to be constant throughout the test series.

8.2.5.3 Rules concerning the validity of test runs in a test series

A test run shall be considered to be invalid if one or more of the following conditions occur:

- laboratory conditions fail to remain within the tolerances specified in this European Standard during the **complete operation cycle;**

- laboratory test equipment or recording systems fail during the **complete operation cycle;**
- the **reference machine** operated in parallel fails to perform within the tolerances specified in this European Standard;
- a relevant test procedure specified in this European Standard has not been followed correctly.

If an invalid **test run** occurs then the following rules shall be followed:
- If an invalid **test run** occurs on the **reference machine**, then that **reference machine** run and all parallel **wash dryer complete operation cycles** shall be repeated;
- If an invalid **test run** occurs on a **washer-dryer** then that test machine **complete operation cycle** shall be repeated in parallel with an additional run on the **reference machine**;
- If a **test run** is interrupted before the rinsing process is finished, then before the **base load** is used again for testing, it shall be rinsed using the selected wash **programme** without detergent;
- The maximum number of repeat **test runs** carried out on the **reference machine** in a **test series** shall be one. If more than one repeat **test run** is required on the **reference machine** due to invalid test runs then the **test series** for the **washer-dryers** concerned shall be invalid;
- The reason for carrying out an additional **test run** shall be reported;
- The results from any invalid **test run** shall be eliminated completely from any subsequent evaluation;
- All **test runs** started shall be included when recording the age of the load.

8.3 Measurements to determine washing performance

Determine washing performance according to EN 60456:2011, 8.3.

8.4 Measurements to determine water extraction performance

This subclause contains specific requirements for the assessment of water extraction performance, which is a measure of the water remaining in the **base load** at the end of the **washing cycle**.

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

The **test load** shall be subjected to the performance test procedure specified in 8.2 in which it is washed on the 60 °C cotton programme using reference detergent.

Immediately after the wash programme has finished, remove the test strips and record the mass of the whole base load.

The water extraction performance is calculated from the mass of the conditioned base load as determined in Clause 6 and the mass of the whole base load at the end of the wash cycle.

A **test series** consisting of five valid **complete operating cycles** shall be carried out using the **programmes** selected in 8.2.3.

The evaluation of the measurements performed in this subclause is set out in 9.3.

8.5 Determination of water consumption and energy consumption and programme time

8.5.1 General

This subclause specifies the procedure for the determination of water consumption, energy consumption and programme duration for the **washing cycle**, the **drying cycle set** and the **complete operating cycle**.

The evaluation of the measurements performed in this subclause is set out in 9.4.

8.5.2   Procedure

The **test load** shall be subjected to the performance test procedure specified in 8.2 in which it is washed on the 60 °C cotton programme using reference detergent. During these tests instrumentation for the measurement of water volume, water temperature and electrical energy shall record the required parameters. Data for all parameters shall be recorded at intervals of 1 s or less 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 the **complete operation cycle**.

Make separate measurements for the wash cycle and each **drying cycle**. Commence measurements when the **programme** is initiated (without any user programmed delay). Halt measurements when the **end of programme** is reached.

Water consumption, energy consumption and programme time shall all be measured in the same **complete operating cycle** as washing performance, water extraction performance and spin speed.

A **test series** consisting of five valid **complete operating cycles** shall be carried out using the **programmes** selected in 8.2.3.

8.6   Determination of maximum spin speed

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

If it is necessary to remove or modify any parts of the **washer-dryer** 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 **washer-dryer** in any way pertinent to the tests being carried out. The type, installation and accuracy of the instrument used shall be reported.

The evaluation of the measurements performed in this subclause is set out in 9.5.

A **test series** consisting of five valid **complete operating cycles** shall be carried out using the **programmes** selected in 8.2.3.

9   Assessment of performance

9.1   General

This section sets out the primary evaluation methods for the assessment of **washer-dryer** performance under this document.

This section includes the evaluation of:
- washing performance;
- water extraction performance;
- energy consumption;
- water consumption;
- programme time.

For the evaluation of washing performance (9.2) the result from the **washer-dryer** is compared to the result from the **reference machine** which is operated in parallel.

Measurements from invalid **test runs** (in either the **test washer-dryer** or the **reference machine**) shall not be used for any evaluation.

Energy consumed by the **washer-dryer** between cycles and time that elapses between cycles (during loading and unloading for example) shall not be included in any evaluation.

Rounding shall only be applied to reported values in Annex B. 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 reported in Annex B is an intermediate required for use in the calculation of other values then rounding shall only apply to the format of the intermediate in Annex B; the rounding shall not apply prior to its use in subsequent calculations.

9.2 Evaluation of washing performance

Washing performance shall be evaluated using the reflectance values (Y-values) determined in 8.3.

Follow Formulae (3) to (7) below for both the **washer-dryer** and the reference machine which have been operated in parallel.

The average reflectance value $\overline{x}_a$ for each soil type a 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:

$$\overline{x}_a = \frac{\sum_{j=1}^{n} x_{aj}}{n} \tag{3}$$

where

x_{aj} 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_a for each soil type a, i.e. x_{aj} within a given test run may be calculated as

$$s_a = \frac{\sqrt{\sum_{j=1}^{n}(x_{aj} - \overline{x}_a)^2}}{n-1} \tag{4}$$

Calculate the sum C_k of the average reflectance values in each test run as follows:

$$C_k = \sum_{a=1}^{m} \overline{x}_a \tag{5}$$

where

$\overline{x}_a$ is the average reflectance value for each soil type, as calculated in Formula (3);

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

Calculate the average sum $\overline{C}$ of the reflectance values for each of the five types of soil, for all test runs as follows:

$$\overline{C} = \frac{\sum_{k=1}^{B} C_k}{B} \tag{6}$$

where

C_k is the sum of the average reflectance values in each test run, as calculated in Formula (5);

B is the number of washing test runs in the washing test series.

The standard deviation s_C of C_k, is defined as

$$s_C = \frac{\sqrt{\sum_{k=1}^{B}(C_k - \overline{C})^2}}{B-1} \tag{7}$$

where

C_k is the sum of the average reflectance values in each test run, as calculated in Formula (5);

$\overline{C}$ is the average sum of the reflectance values in each of the five types of soil, for all test runs in the test series as calculated in Formula (6);

B is the number of test runs.

Calculate the ratio Q of the average sum as

$$Q = \frac{\overline{C_t}}{\overline{C_r}} \tag{8}$$

where

$\overline{C_t}$ is the average sum of the reflectance values for the test washing machine, as calculated in Formula (6);

$\overline{C_r}$ is the average sum of the reflectance values for the reference machine, as calculated in Formula (6).

For reporting, the calculated ratio Q shall be rounded to the nearest 0,001.

Calculate the standard deviation s_Q of the ratio Q, as

$$s_Q = \sqrt{\frac{\sum_{k=1}^{B}\left(\frac{C_{kt}}{\overline{C_r}} - Q\right)^2}{B-1}} \tag{9}$$

where

C_{kt} is the sum of the reflectance value in each test run of the test washing machine, as calculated in Formula (5);

$\overline{C_r}$ is the average sum of the reflectance values of the reference machine, as calculated in Formula (6);

Q   is the ratio of the average sum, as calculated in Formula (8);

B   is the number of test runs.

The confidence interval *p* for the ratio of the average sum is defined as

$$p = Q \pm \frac{S_Q}{\sqrt{B}} \times F$$

(10)

where

s_Q is the standard deviation of the ratio *Q*, as calculated in Formula (9);

F   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);

B   is the number of test runs.

NOTE 2 If for the reference wash programme cotton 60 °C the ratio $\frac{S_c}{c}$ (data calculated in Formulae (6) and (7)) is higher than 0,0175 (or 1,75 %) it is advised to check the laboratory conditions.

NOTE 3 The formula assumes parallel running of the test washing machine and the reference machine.

9.3 Evaluation of water extraction performance

Water extraction performance shall be evaluated using the measurements determined in 8.4.

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

$$ratio = \frac{M_r - M}{M} \times 100$$

(11)

where
μ_{fw} is the remaining moisture content after the wash;
W_{w0} is the mass of the conditioned **base load**;
W_{wf} 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 shall be expressed as a percentage, rounded to the nearest whole per cent.

9.4 Evaluation of water and energy consumption and programme time

9.4.1 General

This subclause describes how the water and energy consumption and **programme time** for each **wash cycle** and each **complete operating cycle** shall be calculated from the measurements made in 8.5.

9.4.2 Water consumption

9.4.2.1 General procedure for evaluating water consumption

Evaluate water consumption for the wash cycle and the **drying cycle** for each **partial load** separately.

For each **partial load** that has been dried, add the total water consumption (including hot water if applicable) recorded for the initial **drying cycle** to the water consumption recorded for all **additional drying** where any **additional drying** has taken place according to the formula:

$$L_{dmp} = L_{dpi} + L_{dp\ add1} + L_{dp\ add2} + \ldots L_{dp\ addn} \tag{12}$$

where

L_{dmp} is the total measured water consumption for drying the partial load;

L_{dpi} is the measured water consumption for the initial drying of the **partial load;**

$L_{dp\ add1} + L_{dp\ add2} + \ldots L_{dp\ addn}$ is the measured water consumption for all **additional drying** of the **partial load** (if required).

Apply the appropriate correction to the total measured water consumption for drying each **partial load** according to 9.4.2.2.

Add together the corrected water consumptions for drying each **partial load** to give the corrected water consumption for the **drying cycle set**.

$$L_d = \sum L_{dp} \tag{13}$$

where

L_d is the corrected water consumption for a **drying cycle set;**

L_{dp} is the corrected water consumption for drying an individual **partial load**.

Add together the water consumption for the **wash cycle** and the corrected water consumption for the **drying cycle set** to give the water consumption for the **complete operating cycle**.

$$L_{wd} = L_w + L_d \tag{14}$$

Where

L_{wd} is the water consumption for a **complete operating cycle;**

L_w is the water consumption for a **wash cycle;**

L_d is the corrected water consumption for a **drying cycle set.**

Calculate the arithmetic average water consumption for the wash cycle from the individual corrected water consumption values for each of the five valid runs in the test series.

$$\overline{L_w} = \frac{\sum_1^B L_w}{B} \tag{15}$$

where

$\overline{L_w}$ is the average water consumption for a **wash cycle** for a test series;

L_w is the water consumption for an individual **wash cycle;**

B is the number of test runs in a test series.

Calculate the arithmetic average water consumption for the **drying cycle set** from the individual corrected water consumption values for each of the five valid runs in the test series.

$$\overline{L_d} = \frac{\sum_1^B L_d}{B} \tag{16}$$

where

$\overline{L_d}$ is the average water consumption for a **drying cycle set** for a test series;

L_d is the corrected water consumption for an individual **drying cycle set;**

B is the number of test runs in a test series.

Calculate the arithmetic average water consumption for the **complete operating cycle** from the water consumption values for each of the five valid runs in the test series.

$$\overline{L_{wd}} = \frac{\sum_1^B L_{wd}}{B}$$
(17)

where

$\overline{L_{wd}}$ is the average water consumption for a **complete operating cycle** for a test series;

L_{wd} is the corrected water consumption for a **complete operating cycle** for a single test run;

B is the number of test runs in a test series.

Report volumes for hot and cold water separately, where applicable. Report total water consumption rounded to the nearest whole litre.

9.4.2.2 Calculation of corrected water consumption

If the **final moisture content** of a valid drying **test run** for a **partial load** is within the target range of (0,0 ± 3,0) % then the corrected water consumption shall be evaluated using the measurements determined in 8.5 using Formula (18).

$$L_{dp} = L_{dmp} \frac{\left(\mu_{ip} - \mu_{fN}\right)}{\left(\mu_{ip} - \mu_{fp}\right)} \times \frac{W_{Np}}{W_{0p}}$$
(18)

Otherwise, the corrected water consumption shall be evaluated using Formula (19).

$$L_{dp} = L_{dmp} \times \frac{W_{Np}}{W_{0p}}$$
(19)

where

μ_{ip} is the actual initial moisture content of the **partial load** in %;

W_{0p} is the mass of the conditioned **partial load** in kg;

L_{dp} is the corrected water consumption for drying the **partial load** in l;

L_{dmp} is the total measured water consumption for drying the **partial load** in l;

μ_{fN} is the nominal final moisture content (0 %),

μ_{fp} is the final moisture content after the last **additional drying** cycle calculated according to Formula (2) in %;

W_{Np} is the nominal **partial load** mass in kg.

Calculate the total corrected water consumption L_{wd} for the **complete operation cycle** as the sum of the corrected water consumption L_{dp} of all **partial loads** and the water consumption for the wash cycle.

9.4.3   Energy consumption

9.4.3.1 General procedure for evaluating energy consumption

Evaluate energy consumption for the wash cycle and the drying test runs for each **partial load** separately.

For each **partial load** that has been dried, add the electrical energy consumption recorded for the initial **drying cycle** to the electrical energy consumption recorded for all **additional drying** where any **additional drying** has taken place according to the formula:

$$E_{md} = E_{dpi} + E_{dp\ add1} + E_{dp\ add2} + \ldots E_{dp\ addn} \qquad (20)$$

where

E_{md}	is the total measured electrical energy consumption for drying the **partial load;**
E_{dpi}	is the measured electrical energy consumption for the initial drying of the **partial load;**
$E_{dp\ add1} + E_{dp\ add2} + \ldots E_{dp\ addn}$	is the measured electrical energy consumption for all **additional drying** of the **partial load** (if required).

Calculate the corrected energy consumption for the **wash cycle** as the sum of the electrical energy consumption, the cold water correction as described in 9.4.3.2 and the hot water energy as described in 9.4.3.3.

Apply the appropriate correction to the total measured electrical energy consumption for **drying** each **partial load** according to 9.4.3.3 and 9.4.3.4.

Add together the corrected energy consumptions for drying each **partial load** to give the corrected energy consumption for the **drying cycle set**.

$$E_d = \sum E_{dp} \qquad (21)$$

where

E_d	is the corrected energy consumption for the **drying cycle set;**
E_{dp}	is the corrected energy consumption for **drying** an individual **partial load.**

Add together the corrected energy consumption for the **wash cycle** and the corrected energy consumption for the **drying cycle set** to give the energy consumption for the **complete operating cycle.**

$$E_{wd} = E_w + E_d \qquad (22)$$

where

E_{wd}	is the energy consumption for the **complete operating cycle;**
E_w	is the corrected energy consumption for the **wash cycle;**
E_d	is the corrected energy consumption for the **drying cycle set**.

Calculate the arithmetic average energy consumption for the **wash cycle** from the individual corrected energy consumption values for each of the five valid runs in the test series.

$$\overline{E_w} = \frac{\sum_1^B E_w}{B} \qquad (23)$$

where

$\overline{E_w}$	is the average corrected **wash cycle** energy consumption for a test series;
E_w	is the corrected **wash cycle** energy consumption for a single test run;
B	is the number of test runs in a test series.

Calculate the arithmetic average energy consumption for the **drying cycle set** from the individual corrected energy consumption values for each of the five valid runs in the test series.

$$\overline{E_d} = \frac{\sum_1^B E_d}{B} \qquad (24)$$

where

$\overline{E_d}$	is the average **drying cycle set** energy consumption for a test series;
E_d	is the corrected energy consumption for individual drying **cycle sets**;
B	is the number of test runs in a test series.

Calculate the arithmetic average energy consumption for the **complete operating cycle** from the individual corrected energy consumption values for each of the five valid runs in the test series.

$$\overline{E_{wd}} = \frac{\sum_1^B E_{wd}}{B}$$ (25)

where

$\overline{E_{wd}}$ is the average energy consumption for a **complete operating cycle** for a test series;

E_{wd} is the **complete operating cycle** energy consumption for a single test run;

B is the number of test runs in a test series.

Report total energy consumption rounded to the nearest 0,01 kWh.

9.4.3.2 Calculation of the cold water correction for wash cycles

A cold water energy correction shall be calculated for all quantities of cold water that are heated by the internal heater of the **washer-dryer** during the wash cycle.

This correction compensates for water supply temperatures which are not exactly 15 °C, but lie between 13 °C and 17 °C.

Calculate the cold water energy correction E_C according to the following formula

$$E_c = (L_{cM} \times (T_c - 15))/860$$ (26)

where

E_c is the cold water energy correction, in kWh;

T_c is the volume-weighted average inlet temperature, in degrees Celsius, of all cold water supplied to the **washer-dryer** during the wash cycle which is subsequently heated by the internal heater of the **washer-dryer**;

L_{cM} is the total volume of the cold water in litres, supplied to the **washer-dryer** during the wash cycle which is subsequently heated by the internal heater of the **washer-dryer**.

Calculate the corrected wash cycle energy consumption according to the following formula:

$$E_{cw} = E_{mw} + E_c$$ (27)

where

E_{cw} is the corrected cold water wash cycle energy consumption;

E_{mw} is the measured total electrical energy consumption for the wash cycle.

9.4.3.3 Calculation of hot water energy

Calculate the hot water energy if the **washer-dryer** uses any hot water from an external source at any time during the **complete operation cycle**.

Calculate hot water energy for the wash cycle and the **drying cycle** for each **partial load** separately.

Hot water energy for the wash cycle shall be calculated as the energy contained in the externally supplied hot water relative to the cold water temperature of 15 °C according to the following formula:

$$E_{hw} = (L_{hw} \times (T_{hw} - 15))/860$$ (28)

where

E_{hw} is the hot water energy for the wash, in kWh;
T_{hw} is the volume-weighted average inlet temperature, in degrees Celsius, of all hot water supplied to the **washer-dryer** during the wash cycle;
L_{hw} is the total volume of hot water, in litres, supplied to the **washer-dryer** during the wash cycle.

NOTE   The hot water energy, so calculated, includes only the energy embodied in the hot water, relative to the nominal cold water temperature and does not take into account any losses associated with the conversion and distribution of hot water that occur in different households and different countries.

Calculate the total wash cycle energy consumption according to the following formula:

$$E_w = E_{cw} + E_{hw} \tag{29}$$

where

E_w is the corrected **wash cycle** energy consumption for a single test run;
E_{cw} is the corrected cold water wash cycle energy consumption;
E_{hw} is the hot water energy consumption for the wash cycle.

Hot water energy for each **drying cycle** shall be calculated as the energy contained in the externally supplied hot water relative to the cold water temperature of 15 °C according to the following formula:

$$E_{hdp} = (L_{hdp} \times (T_{hdp} - 15))/860 \tag{30}$$

where

E_{hdp} is the hot water energy for drying the **partial load**, in kWh;
T_{hdp} is the volume-weighted average inlet temperature, in degrees Celsius, of all hot water supplied to the **washer-dryer** during the **drying cycle**;
L_{hdp} is the total volume of hot water, in litres, supplied to the **washer-dryer** during the **drying cycle**.

Calculate the total energy consumption for drying each **partial load** according to the following formula:

$$E_{dmp} = E_{mdp} + E_{hdp} \tag{31}$$

where

E_{dmp} is the total energy consumption for drying the **partial load**;
E_{mdp} is the measured total electrical energy consumption for drying the partial load;
E_{hdp} is the hot water energy used for drying the **partial load**.

9.4.3.4 Calculation of corrected energy consumption for drying cycles

If the **final moisture content** of a valid drying **test run** for a **partial load** is within the target range of (0,0 ± 3,0) %, then the corrected energy consumption shall be evaluated using the measurements determined in 8.5 using Formula (32).

$$E_{dp} = E_{dmp} \frac{\left(\mu_{ip} - \mu_{fN}\right)}{\left(\mu_{ip} - \mu_{fp}\right)} \times \frac{W_{Np}}{W_{0p}} \tag{32}$$

Otherwise, the corrected energy consumption shall be evaluated using Formula (33).

$$E_{dp} = E_{dmp} \times \frac{W_{Np}}{W_{0p}}$$
(33)

where

μ_{ip} is the actual initial moisture content of the **partial load** in %;

W_{0p} is the mass of the conditioned **partial load** in kg;

E_{dp} is the corrected energy consumption for drying the **partial load** in kWh;

E_{dmp} is the total energy consumption for drying the **partial load** in kWh;

μ_{fN} is the nominal final moisture content (0 %);

μ_{fp} is the final moisture content after the last **additional drying cycle** calculated according to Formula (2);

W_{Np} is the nominal **partial load** mass in kg.

Calculate the total corrected energy consumption E_{wd} for the **complete operation cycle** as the sum of the corrected energy consumption E_{dp} of all **partial loads** and the total corrected energy consumption for the wash cycle E_w.

9.4.4 Programme time

9.4.4.1 General procedure for evaluating programme time

Evaluate programme time for the wash cycle and the **drying cycle** for each **partial load** separately.

For each **partial load** that has been dried, add the time recorded for the initial **drying cycle** to the time recorded for all **additional drying** where any **additional drying** has taken place according to the formula:

$$t_{dmp} = t_{dpi} + t_{dp\ add1} + t_{dp\ add2} + \dots t_{dp\ addn}$$
(34)

where

t_{dmp} is the total measured programme time for drying the partial load;

t_{dpi} is the measured programme time for the initial drying of the **partial load;**

$t_{dp\ add1} + t_{dp\ add2} + \dots t_{dp\ addn}$ is the measured programme time for all **additional drying** of the **partial load** (if required).

Apply the appropriate correction to the programme time for drying each **partial load** according to 9.4.4.2.

Add together the corrected programme times for drying each **partial load** to give the corrected drying time for the **drying cycle set**.

$$t_d = \sum t_{dp}$$
(35)

where

t_d is the corrected drying time for a **drying cycle** set;

t_{dp} is the corrected drying time for drying an individual **partial load.**

Add together the corrected programme time for the **drying cycle** set and the programme time for the wash cycle to give the programme time for the complete operating cycle.

$$t_{wd} = t_w + t_d$$
(36)

where

t_{wd} is the time for an individual **complete operating cycle;**

t_w is the corrected time for a **washing cycle;**

t_d is the corrected time for a **drying cycle set.**

Calculate the arithmetic average programme time for the **wash cycle** from the individual corrected programme time values for each of the five valid runs in the test series.

$$\overline{t_w} = \frac{\sum_1^B t_w}{B} \tag{37}$$

where

$\overline{t_w}$ is the average time for a **complete operating cycle** for the test series;

t_w is the time for an individual **complete operating cycle**;

B is the number of test runs in a test series.

Calculate the arithmetic average programme time for the **drying cycle set** from the individual corrected programme time values for each of the five valid runs in the test series.

$$\overline{t_d} = \frac{\sum_1^B t_d}{B} \tag{38}$$

where

$\overline{t_d}$ is the average time for a **drying cycle** set for the test series;

t_d is the time for an individual **drying cycle** set;

B is the number of test runs in a test series.

Calculate the arithmetic average programme time for the **complete operating cycle** from the programme time values for each of the five valid runs in the test series.

$$\overline{t_{wd}} = \frac{\sum_1^B t_{wd}}{B} \tag{39}$$

$\overline{t_{wd}}$ is the average time for a **complete operating cycle** for the test series;

t_{wd} is the time for an individual **complete operating cycle**;

B is the number of test runs in a test series.

Report average programme time for a complete operating cycle for the test series in min, rounded to the nearest whole min.

9.4.4.2 Calculation of corrected programme time

If the **final moisture content** of a valid **drying cycle** for a **partial load** is within the target range of (0,0 ± 3,0) % then the corrected programme time shall be evaluated using the measurements determined in 8.5 using Formula (40).

$$t_{dp} = t_{dmp} \frac{\left(\mu_{ip} - \mu_{fN}\right)}{\left(\mu_{ip} - \mu_{fp}\right)} \times \frac{W_{Np}}{W_{0p}} \tag{40}$$

Otherwise, the corrected programme time shall be evaluated using Formula (41).

$$t_{dp} = t_{dmp} \times \frac{W_{Np}}{W_{0p}}$$

$$\tag{41}$$

where

μ_{ip} is the actual initial moisture content of the **partial load** in %;

W_{0p} is the mass of the conditioned **partial load** in kg;

t_{dp} is the corrected programme time for drying the **partial load** in min;

t_{dmp} is the measured programme time for drying the **partial load** in min;

μ_{fN} is the nominal final moisture content (0 %);

μ_{fp} is the final moisture content after the last **additional drying cycle** calculated according to formula (2) in %;

W_{Np} is the nominal **partial load** mass in kg.

Calculate the total corrected programme time t_{wd} for the **complete operation cycle** as the sum of the corrected programme time t_{dp} of all **partial load**s and the programme time for the wash cycle.

9.5 Spin speed

Calculate the arithmetic average of the five valid spin speed measurements made according to 8.6.

$$\overline{S_w} = \frac{\sum_1^5 S_w}{B}$$
(42)

where

$\overline{S_w}$ is the average maximum spin speed for the test series;

S_w is the maximum spin speed for an individual cycle;

B is the number of test runs in a test series.

Report spin speed in rpm to the nearest whole number.

10 Tolerances and control procedures to be used for verification purposes

10.1 General

The tolerances described in this clause are intended solely for use in verifying claims made by the manufacturer or supplier of the **washer-dryer**. The tolerances shall not be applied to results of tests on which manufacturers or suppliers of **washer-dryer**s base performance claims.

10.2 Energy consumption

10.2.1 Washing cycle

The energy consumption measured according to 9.4.3 shall not be greater than the value declared by the manufacturer plus 15 %. If the result of the test carried out on the first appliance is greater than the declared value plus 15 % ,the test shall be carried out on a further three appliances, which shall be randomly selected from the market. The arithmetic mean of the values of these three appliances shall not be greater than the declared value plus 10 %.

10.2.2 Complete operation cycle

The energy consumption measured according to 9.4.3 shall not be greater than the value declared by the manufacturer plus 15 %. If the result of the test carried out on the first appliance is greater than the declared value plus 15 %, the test shall be carried out on a further three appliances, which shall be randomly selected from the market. The arithmetic mean of the values of these three appliances shall not be greater than the declared value plus 10 %.

10.3   Water consumption

10.3.1   Washing cycle

The water consumption measured according to 9.4.2 shall not be greater than the value declared by the manufacturer plus 15 %. If the result of the test carried out on the first appliance is greater than the declared value plus 15 %, the test shall be carried out on a further three appliances, which shall be randomly selected from the market. The arithmetic mean of the values of these three appliances shall not be greater than the declared value plus 10 %.

10.3.2   Complete operating cycle

The water consumption measured according to 9.4.2 shall not be greater than the value declared by the manufacturer plus 15 %. If the result of the test carried out on the first appliance is greater than the declared value plus 15 %, the test shall be carried out on a further three appliances, which shall be randomly selected from the market. The arithmetic mean of the values of these three appliances shall not be greater than the declared value plus 10 %.

10.4   Spin speed

The spin speed, determined according to 9.5, shall not be less than the value declared by the manufacturer minus 10 % or 100 rpm whichever is the smaller tolerance. If the result of the test carried out on the first appliance is less than the declared value minus 10 % or 100 rpm whichever is the smaller tolerance, the test shall be carried out on a further three appliances, which shall be randomly selected from the market. The arithmetic mean of the values of these three appliances shall not be less than the declared value minus 10 % or 100 rpm whichever is the smaller tolerance.

10.5   Spin extraction

The value of the spin extraction measured according to 9.3 shall not be higher than the value declared by the manufacturer plus 15 %. If the result of the test carried out on the first appliance is higher than the declared value plus 15 %, the test shall be carried out on a further three appliances, which shall be randomly selected from the market. The arithmetic mean of the values of these three appliances shall not be higher than the declared value plus 10 %.

10.6   Washing performance

The washing performance, determined according to 9.2, shall not be less than the value declared by the manufacturer minus 0,03. If the result of the test carried out on the first appliance is less than the declared value minus 0,03, the test shall be carried out on a further three appliances, which shall be randomly selected from the market. The arithmetic mean of the values of these three appliances shall not be less than the declared value minus 0,02.

10.7   Programme time

The programme time of the complete operating cycle, measured and determined according to 9.4.4 shall not be greater than the value declared by the manufacturer plus 15 %.
If the result of the test carried out on the first appliance is higher than the declared value plus 15 %, the test shall be carried out on a further three appliances, which shall be randomly selected from the market. The arithmetic mean of the values of these three appliances shall not be higher than the declared value plus 10 %.

10.8   Noise emission

Noise emission values, when declared, shall be determined and verified according to EN 60704-3.

11   Data to be reported

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

Annex A
(normative)

Splitting the base load

A.1   Introduction

In a **complete operation cycle**, the whole of the base load used for the washing test has to be dried. The **rated drying capacity** of a **washer-dryer** is usually smaller than its **rated washing capacity**. This means that after the washing test, the load has to be split into two or more parts. One part or more should be equal in mass to the **rated drying capacity** of the **washer-dryer** and is / are referred to as **rated drying load(s)**. The last part consists of all the remaining items from the base load and is referred to as the **residual drying load**.

This annex explains how to split a base load used for a washing test into **rated drying load(s)** and a **residual drying load**.

The default procedure for splitting the load as described in A.2 shall be used whenever possible. If the default procedure cannot be followed because the base load does not contain enough of a particular item to make the **rated drying load** then the alternative procedure described in A.3 shall be used.

A.2   Default procedure

Start with the base load, which has been prepared according to Clause 6 and has a composition as described in EN 60456: 2011, 6.4.6.1. Prepare the **rated drying load** using only items from the base load, so that it has the composition defined in EN 61121: 2013, 6.5.6.1. Adjust the load by adding or subtracting towels until the load mass is within the range ± 0,06 kg of the **rated drying capacity**.

If, after the preparation of the rated drying load a sufficient quantity of the base load remains, prepare a further rated drying load. Use default procedure A.2 if possible, otherwise use procedure A.3.

If, after preparing the rated drying load, there is insufficient base load remaining to make a further rated drying load, prepare a **residual drying load** using all the items from the base load that were not used to make the **rated drying load(s)**.

An example of how a base load can be split into a **rated drying load** and a **residual drying load** is given in Table A.1.

Table A.1 − Load compositions for a washer-dryer with a rated washing capacity of 8 kg and a rated drying capacity of 5 kg

Load	Approximate load mass (kg)	Number of sheets	Number of pillowcases	Number of towels
Base load for washing	7,84	3	12	25
Rated drying load	5,00	2	6	18
Residual drying load	2,84	1	6	7

NOTE   The number of towels in all loads is approximate.

A.3   Alternative procedure

Under certain circumstances, the original cotton base load may contain fewer towels or pillowcases than are needed to construct the **rated drying load** in the proportions specified in EN 61121:2013.

When this situation arises for a **washer-dryer** with a **rated drying capacity** K_d kg, prepare the **rated drying load** as follows:

  (i)   build a load consisting of the number of sheets and pillowcases specified for a rated capacity K_d according to Clause 6 of EN 61121:2013;
  (ii)   add all the available towels;
  (iii)   add pillowcases until a total mass greater than or equal to $(K_d - 0,06)$ kg is reached;
  (iv)   if the load mass is greater than $(K_d + 0,06)$ kg, remove towels until the load mass is equal to $(K_d \pm 0,06)$ kg;
  (v)   if a load mass of $(K_d \pm 0,06)$ kg cannot be achieved by following steps (i) to (iv), replace three of the pillowcases with one more sheet and repeat steps (iii) and (iv).

This procedure can be illustrated by the following two examples. In the first, the base load used for the washing test has too few towels to make the **rated drying load** according to EN 61121:2013. In the second the base load used for the washing test has too few pillowcases to make the **rated drying load** according to EN 61121:2013.

Example 1: Insufficient towels

From Table A.2 it can be seen that there are not enough towels in the 9 kg base load to make the 8 kg test load according to Clause 6 of EN 61121:2013.

By following the alternative procedure described above, an 8 kg load can be prepared which has the alternative composition shown in Table A.3.

Table A.2 – Load compositions for a washer-dryer with a rated washing capacity of 9 kg and a rated drying capacity of 8 kg

Load	Approximate load mass (kg)	Number of sheets	Number of pillowcases	Number of towels
Composition of base load for washing according to EN 60456	8,82	4	14	23
Composition of **rated drying load** according to EN 61121	8,00	3	12	27

NOTE 1 The number of towels in the base load is approximate.

Table A.3 – Alternative load composition for a rated drying capacity of 8 kg

Required test load mass (kg)	Number of sheets	Number of pillowcases	Number of towels
8	3	13	23

Example 2: Insufficient pillowcases

From Table A.4 it can be seen that there are not enough pillowcases in the 11 kg base load to make the 10 kg test load according to Clause 6 of EN 61121:2013.

By following the alternative procedure described above, an 8 kg load can be prepared which has the alternative composition shown in Table A.5.

Table A.4 – Load compositions for a washer-dryer with a rated washing capacity of 11 kg and a rated drying capacity of 10 kg

Load	Approximate load mass (kg)	Number of sheets	Number of pillowcases	Number of towels
Composition of base load for washing according to EN 60456	10,78	5	15	32
Composition of **rated drying load** according to EN 61121	10,00	4	16	30

NOTE 2 The number of towels is approximate.

Table A.5 – Alternative load composition for a rated drying capacity of 10 kg

Required test load mass (kg)	Number of sheets	Number of pillowcases	Number of towels
10	4	15	32

NOTE 3 Because of small differences in the weights of the load items the exchange rule (v) can in some cases lead to different load compositions in different testing laboratories. The effect on the reported results according to the test procedure described in this standard is still under investigation and needs to be verified within a round robin test.

Annex B
(normative)

Test report – data to be reported

This annex presents the data that shall be reported for the **washer-dryer**.

The layout of the following Tables B.1 to B.7 is recommended. Only the tables and parameters that are relevant for the **test series** need be included.

Table B.1 – Identification data

Laboratory name and address:	**Project reference no:**
Brand:	**Model:**
Country of manufacture (if indicated):	
Model number:	**Serial number:**
Source of machine:	**Internal heater (yes/no):**
Machine dimensions declared (mm) (if required) **Height:** **Width:** **Depth (door closed):** **Depth (door open):**	**Machine dimensions measured (mm)** (if required) **Height:** **Width:** **Depth (door closed):** **Depth (door open):**
Rated capacity, washing (kg):	**Rated capacity, drying (kg):**
Condensation technology (water, air, heat pump, none):	**Drum volume measured(l):** (if required)
Axis (vertical/horizontal):	**Loading (top/front):**
Dryer type (automatic / time controlled / manual):	**Water connections** **Hot (yes / no):** **Cold (yes/no):**
Rated voltage:	**Rated frequency:**
Additional information:	

Data, parameters and results for the test series

The following data (Tables B.2, B.3, B.4, B.5 and B.6) shall be reported for a **test series** used to determine the performance of **a test washer-dryer** when using a cotton **base load**.

Table B.2 – General test data and parameters for the washing and drying cycles

GENERAL TEST DATA FOR THE WASHING AND DRYING CYCLES	
Laboratory	
Checked / approved by	
Machine identification	
Internal test identifier	
Reference machine test series identifier	
Programme and options selected for washing cycle	
Programme and options selected for drying cycle	
Test runs for which **additional drying** was necessary	
Reason for extra test run (if applicable)	
'End of programme' indications (see subclause 3.1.24 of EN 60456:2011)	Washing cycle:
	Drying cycle:
Number of items included in the **residual drying load**	Sheets: Pillowcases: Towels:

Table B.3 – Data, parameters and performance results for the wash cycles

WASHING CYCLE TEST DATA											
Parameter	Symbol	Unit	Data type	Reported precision	Run 1	Run 2	Run 3	Run 4	Run 5	Mean	s
Date of test run	-	yyyy mm.dd	n	-							
Start time washing	-	hh.mm	n	00:01							
Mass of conditioned base load (without test strips) (see note 2)		g	m	1							
Mass of base load before each test run (without test strips) (see note 2)	W_{wl}	g	m	1							
Mass of detergent used	-	g	m	0,01							
Cold water consumption during main wash (see note 1)	L_{cM}	l	m	0,1							
Hot water consumption during main wash (see note 1) (if connected)	L_{hM}	l	m	0,1							
Water consumption during main wash (cold + hot if connected) (see note 1)	L_M	l	c	0,1							
Total cold water consumption	L_{cw}	l	m	0,1							
Total hot water consumption (if connected)	L_{hw}	l	m	0,1							
Total water consumption (cold + hot if connected)	L_w	l	c	1							
Specific water consumption	L_{wS}	l/kg	c	0,1							
Total electrical energy metered during the test	E_{mw}	kWh	m	0,01							
Total cold water energy correction determined during the test (see note 1)	E_{cw}	kWh	c	0,01							
Calculated total hot water energy determined during the test (see note 1)	E_{hw}	kWh	c	0,01							
Total energy (programme energy)	E_w	kWh	c	0,01							
Specific total energy / kg	E_{ws}	kWh/kg	c	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 (volume-weighted average) (see note 1)	T_c	°C	m	0,1								
Laboratory supply hot water inlet temperature (volume-weighted average) (see note 1) (if connected)	T_{hw}	°C	m	0,1								
Main wash duration (see note 3)	t_M	min	m	1								
Programme time	t_w	min	m	1								
Specific programme time	t_{ws}	min/kg		1								
Spin speed	S	rpm	m	1								
Mass of base load after spin extraction	W_{wf}	g	m	1								
Remaining moisture content	μ_{fw}	%	c	1								
Reflectance after wash: Sebum	X_a	-	m	0,01								
Reflectance after wash: Carbon black/Oil	X_a	-	m	0,01								
Reflectance after wash: Blood	X_a	-	m	0,01								
Reflectance after wash: Cocoa	X_a	-	m	0,01								
Reflectance after wash: Red Wine	X_a	-	m	0,01								
Reflectance after wash: Sum	C_k	-	c	0,01								
Reflectance after wash: Sum for the reference machine	C_{kr}	-	c	0,01								
Washing Efficiency Index	Q	-	c	0,001								

Note 1: temperature and water volume to be integrated for each relevant operation to give total cold water correction and calculated total hot water energy

Note 2: 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).

Note 3: main wash duration refer to Subclause 3.1.26 of EN60456: 2011

Note 4: Data types: n=noted, m=measured, c = calculated.

Table B.4 – Data, parameters and performance results for the drying cycles

Complete a separate copy of this table for each **partial load** and for **additional drying** as applicable.

DRYING CYCLE TEST DATA											
Drying cycle type (tick as applicable)			Rated:		Residual:		Additional:		2nd Additional:		
Parameter	Symbol	Unit	Data type[2]	Reported precision	Run 1	Run 2	Run 3	Run 4	Run 5	Mean	s
Timer setting (applicable only for additional drying cycles)	-	mm	n	-							
Start time drying	-	hh.mm	n	00:01							
Hot water inlet temperature (volume-weighted average)	T_{hdp}	°C	m	0,1							
Hot water inlet pressure	-	kPa	m	10							
Mass of conditioned partial test load[1]	W_{0p}	g	m	1							
Initial mass of partial test load	W_{ip}	g	m	1							
Initial moisture content of partial test load	μ_{ip}	%	c	0,1							
Final mass of partial test load	W_{fp}	g	m	1							
Final moisture content of partial test load	μ_{fp}	%	c	0,1							
Measured hot water consumption	L_{hw}	l	m	0,1							
Measured total water consumption	L_{dmp}	l	m	0,1							
Corrected water consumption	L_{dp}	l	c	0,1							
Measured electrical energy	E_{md}	kWh	m	0,01							
Hot water energy (if applicable)	E_{hdp}	kWh	c	0,01							
Corrected electrical energy	E_{dp}	kWh	c	0,01							
Measured programme time	t_{dmp}	min	m	1							
Corrected programme time	t_{dp}	min	m	1							
Note 1: Mass of partial load 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											
Note 2: Data types: n=noted, m=measured, c = calculated.											

Table B.5 – Drying cycle set test data and complete operating cycle test data

DRYING CYCLE SET TEST DATA AND COMPLETE OPERATION CYCLE TEST DATA										
Parameter	Symbol	Unit	Reported precision	Run 1	Run 2	Run 3	Run 4	Run 5	Mean	s
Total water consumption (drying cycle set)	L_d	l	0,1							
Specific total water consumption (drying cycle set)	L_{ds}	l/kg	0,1							
Total energy consumption (drying cycle set)	E_d	kWh	0,01							
Specific total energy consumption (drying cycle set)	E_{ds}	kWh/kg	0,01							
Total drying time (drying cycle set)	t_d	min	1							
Specific total drying time (drying cycle set)	t_{ds}	min/kg	1							
Water consumption complete operation cycle	L_{wd}	l	1							
Specific water consumption complete operation cycle	L_{wds}	l/kg	1							
Electrical energy complete operation cycle	E_{wd}	kWh	0.01							
Specific electrical energy complete operation cycle	E_{wds}	kWh/kg	0,01							
Programme time complete operation cycle	t_{wd}	min	1							
Specific programme time complete operation cycle	t_{wds}	min/kg	1							

Table B.6 – Summary of test results

SUMMARY OF TEST RESULTS				
Sample identification				
Machine identification				
Internal test identifier				
Supplier's name or trademark				
Supplier's model identifier				
Test results				
Parameter	Symbol	Unit	Reported precision	Value
Energy consumption per complete operating cycle using the standard 60° Cotton washing cycle and the dry cotton drying cycle	$\overline{E_{wd}}$	kWh	0.01	
Energy consumption per complete washing cycle using standard cotton 60°C cycle	$\overline{E_w}$	kWh	0.01	
Maximum spin speed obtained for the standard cotton cycle	$\overline{S}$	rpm	1	
Water extraction efficiency for a standard 60°C cotton washing cycle	$\overline{\mu_{fw}}$	%	1	
Water consumption for washing spinning and drying per complete operating cycle	$\overline{L_{wd}}$	l	1	
Washing and drying time. Programme time for a complete operating cycle (60°C cotton washing and dry cotton drying) for rated washing capacity	$\overline{t_{wd}}$	min	1	

Table B.7 – Conditions maintained and materials used during the test series

CONDITIONS AND MATERIALS			
Parameter	Unit	Maximum during test series	Minimum during test series
Supply voltage	V		
Supply frequency	Hz		
Ambient temperature	°C		
Ambient humidity	%		
Cold water inlet temperature	°C		
Cold water inlet pressure	kPa		
Cold water hardness	mmol/l CaCO$_3$		
Hot water inlet temperature	°C		
Hot water inlet pressure	kPa		
Hot water hardness	mmol/l CaCO$_3$		
Material		**Batch number**	**Expiry date**
Soil test strips			
IEC A* base detergent			
Sodium perborate bleach			
TAED bleach activator			

Bibliography

Council Directive 92/75/EEC of 22 September 1992 on the indication by labelling and standard product information of the consumption of energy and other resources by household appliances Official Journal L 297, 13/10/1992

Commission Directive 96/60/EC of 19 September 1996 implementing Council Directive 92/75/EEC with regard to energy labelling of household combined washer-driers Official Journal L 266, 18/10/1996

British Standards Institution (BSI)

BSI is the national body responsible for preparing British Standards and other standards-related publications, information and services.

BSI is incorporated by Royal Charter. British Standards and other standardization products are published by BSI Standards Limited.

About us

We bring together business, industry, government, consumers, innovators and others to shape their combined experience and expertise into standards-based solutions.

The knowledge embodied in our standards has been carefully assembled in a dependable format and refined through our open consultation process. Organizations of all sizes and across all sectors choose standards to help them achieve their goals.

Information on standards

We can provide you with the knowledge that your organization needs to succeed. Find out more about British Standards by visiting our website at bsigroup.com/standards or contacting our Customer Services team or Knowledge Centre.

Buying standards

You can buy and download PDF versions of BSI publications, including British and adopted European and international standards, through our website at bsigroup.com/shop, where hard copies can also be purchased.

If you need international and foreign standards from other Standards Development Organizations, hard copies can be ordered from our Customer Services team.

Subscriptions

Our range of subscription services are designed to make using standards easier for you. For further information on our subscription products go to bsigroup.com/subscriptions.

With **British Standards Online (BSOL)** you'll have instant access to over 55,000 British and adopted European and international standards from your desktop. It's available 24/7 and is refreshed daily so you'll always be up to date.

You can keep in touch with standards developments and receive substantial discounts on the purchase price of standards, both in single copy and subscription format, by becoming a **BSI Subscribing Member**.

PLUS is an updating service exclusive to BSI Subscribing Members. You will automatically receive the latest hard copy of your standards when they're revised or replaced.

To find out more about becoming a BSI Subscribing Member and the benefits of membership, please visit bsigroup.com/shop.

With a **Multi-User Network Licence (MUNL)** you are able to host standards publications on your intranet. Licences can cover as few or as many users as you wish. With updates supplied as soon as they're available, you can be sure your documentation is current. For further information, email bsmusales@bsigroup.com.

Revisions

Our British Standards and other publications are updated by amendment or revision.

We continually improve the quality of our products and services to benefit your business. If you find an inaccuracy or ambiguity within a British Standard or other BSI publication please inform the Knowledge Centre.

Copyright

All the data, software and documentation set out in all British Standards and other BSI publications are the property of and copyrighted by BSI, or some person or entity that owns copyright in the information used (such as the international standardization bodies) and has formally licensed such information to BSI for commercial publication and use. Except as permitted under the Copyright, Designs and Patents Act 1988 no extract may be reproduced, stored in a retrieval system or transmitted in any form or by any means – electronic, photocopying, recording or otherwise – without prior written permission from BSI. Details and advice can be obtained from the Copyright & Licensing Department.

Useful Contacts:

Customer Services
Tel: +44 845 086 9001
Email (orders): orders@bsigroup.com
Email (enquiries): cservices@bsigroup.com

Subscriptions
Tel: +44 845 086 9001
Email: subscriptions@bsigroup.com

Knowledge Centre
Tel: +44 20 8996 7004
Email: knowledgecentre@bsigroup.com

Copyright & Licensing
Tel: +44 20 8996 7070
Email: copyright@bsigroup.com

BSI Group Headquarters

389 Chiswick High Road London W4 4AL UK

bsi.

...making excellence a habit.™