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Incorporating corrigendum February 2016

BSI Standards Publication

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

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National foreword

This British Standard is the UK implementation of EN 50229:2015, incorporating corrigendum February 2016. It supersedes BS EN 50229:2007 which is withdrawn.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.

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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

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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- latest date by which the national standards conflicting with this document have to be withdrawn (dow) 2018-06-30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.

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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)*

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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**.

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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

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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**
$\bar{}$ *(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).

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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 ± 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.

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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.

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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.

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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.

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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) %.

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