



SLOVENSKI STANDARD

SIST EN 60456:2005

01-junij-2005

Nadomešča:

SIST EN 60456:2001

SIST EN 60456:2001/A11:2002

SIST EN 60456:2001/A12:2002

SIST EN 60456:2001/A13:2003

Gospodinjski pralni stroji - Metode za merjenje funkcionalnosti

Clothes washing machines for household use - Methods for measuring the performance

Waschmaschinen für den Hausgebrauch - Verfahren zur Messung der Gebrauchseigenschaften

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Machines à laver le linge pour usage domestique - Méthodes de mesure de l'aptitude à la fonction

Ta slovenski standard je istoveten z: EN 60456:2005

ICS:

97.060

Aparati za nego perila

Laundry appliances

SIST EN 60456:2005

en

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EUROPEAN STANDARD

EN 60456

NORME EUROPÉENNE

EUROPÄISCHE NORM

March 2005

ICS 97.060

Supersedes EN 60456:1999 + A11:2001 + A12:2001 + A13:2003
Incorporates corrigendum March 2008

English version

**Clothes washing machines for household use -
Methods for measuring the performance**
(IEC 60456:2003, modified)

Machines à laver le linge
pour usage domestique -
Méthodes de mesure de l'aptitude
à la fonction
(CEI 60456:2003, modifiée)

Waschmaschinen für den Hausgebrauch -
Verfahren zur Messung
der Gebrauchseigenschaften
(IEC 60456:2003, modifiziert)

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This European Standard was approved by CENELEC on 2004-10-01. 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 Central Secretariat 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 Central Secretariat has the same status as the official versions.

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

CENELEC

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

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Foreword

The text of the International Standard IEC 60456:2003, prepared by SC 59D, Home laundry appliances, of IEC TC 59, Performance of household electrical appliances, together with the common modifications prepared by the Technical Committee CENELEC TC 59X, Consumer information related to household electrical appliances, was submitted to the formal vote and was approved by CENELEC as EN 60456 on 2004-10-01.

This European Standard supersedes EN 60456:1999 + A11:2001 + A12:2001 + A13:2003.

Many of the changes in the new IEC 60456:2003 had already been included in EN 60456:1999/A12:2001 and A13:2003. Consequently, the only significant technical difference with the previous edition of the European Standard is the allowance of three alternative methods to condition the load.

It is not expected that this new version EN 60456 will influence energy label declaration in any way.

In this European Standard the common modifications to the International Standard are indicated by a vertical line in the left margin of the text.

The following dates were fixed:

- latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2005-10-01
- latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 2007-10-01

In this standard, the following print types are used:

- *test specifications: in italic type;*
- notes: in small roman type;
- other text: in roman type.
- words **in bold** in the text are defined in Clause 3.

Clauses, subclauses and notes that are additional to those in IEC 60456 are prefixed with the letter Z.

The contents of the corrigendum of March 2008 have been included in this copy.

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1 Scope

This International Standard deals with methods for measuring the performance of clothes **washing machines** for household use, with or without heating devices and for cold and/or hot water supply. It also deals with appliances for water extraction by centrifugal force and is applicable to appliances for both washing and drying textiles (called **washer-dryers**) with respect to their washing performance.

The object is to state and define the principal performance characteristics of household electric **washing machines** and spin extractors and to describe the standard methods for measuring these characteristics.

This standard is concerned neither with safety nor with performance requirements.

NOTE 1 This standard applies also to **washing machines** for communal use in blocks of flats or in laundrettes, but **washing machines** for commercial laundries are not included.

NOTE 2 While this standard includes testing requirements for all types of **washing machines**, to date there has been only limited testing and evaluation of other than **horizontal drum washing machines** to this standard.

This European Standard also specifies, as far as necessary, the test methods which shall be applied in accordance with the Commission's Directive 95/12/EC of 23 May 1995 implementing Council Directive 92/75/EEC with regard to energy labelling of household washing machines.

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2 Normative references

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

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

EN 60704-2-4, *Test code for the determination of airborne acoustical noise emitted by household and similar electrical appliances – Part 2: Particular requirements for washing machines and spin extractors* (IEC 60704-2-4)

EN 60704-3, *Test code for the determination of airborne acoustical noise emitted by household and similar electrical appliances – Part 3: Procedure for determining and verifying declared noise emission values* (IEC 60740-3)

EN 60734, *Household electrical appliances – Performance – Hard water for testing* (IEC 60734)

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

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

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

ISO 3801, *Textiles – Woven fabrics – Determination of mass per unit length*

ISO 7211-2, *Textiles – Woven fabrics – Construction – Methods of analysis – Part 2: Determination of number of threads per unit length*

3 Terms, definitions, symbols and dimensions

3.1 Terms and definitions

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

3.1.1

washing machine

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

3.1.2

agitator washing machine

washing machine in which the textiles are substantially immersed in the washing water, the mechanical action being produced by a device moving about or along its vertical axis with a reciprocating motion (an agitator). This device usually extends above the maximum water level

3.1.3

horizontal drum washing machine

washing machine in which the textiles are placed in a horizontal or inclined drum and partially immersed in the washing water, the mechanical action being produced by rotation of the drum about its axis, the movement being either continuous or periodically reversed

3.1.4

impeller washing machine

washing machine in which the textiles are substantially immersed in the washing water, the mechanical action being produced by a device rotating about its axis continuously or which reverses after a number of revolutions (an impeller). The uppermost point of this device is substantially below the minimum water level

3.1.5

nutator washing machine

washing machine in which the textiles are placed in a vertical axis basket and partially immersed in the washing water, the mechanical action being produced by a nutation plate in the bottom of the basket, the movement being either continuous or periodically with or without reversion

3.1.6

washer-dryer

washing machine which includes both a water extraction (spin) function and also a means for drying the textiles, usually by heating and tumbling

3.1.7

spin extractor

water-extracting appliance in which water is removed from textiles by centrifugal action

3.1.8

spin extraction

water-extracting function by which water is removed from textiles by centrifugal action. This is usually included as a function of a **washing machine** but may also be performed in a **spin extractor**

3.1.9

base load

textile load without soiled test strips

3.1.10**test load**

base load plus soiled test strips or wool shrinkage specimens

3.1.11**programme**

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

3.1.12**cycle**

complete washing process, as defined by the **programme** selected, consisting of a series of different operations (wash, rinse, spin, etc.)

3.1.13**rated capacity**

maximum mass in kg of dry textiles of a particular defined type, declared by the manufacturer that can be treated in a **programme**

3.2 Symbols**3.2.1 Symbols relating to Clause 8**

C_k	the sum of the average reflectance values (Y-values) in each test cycle
\bar{C}	the average sum of the reflectance values (Y-values) for each of the four types of soiling, for all test cycles
$C_{k\text{ test}}$	the sum of the reflectance value in each test cycle of the washing machine under test
\bar{C}_{test}	the average sum of the reflectance values of the washing machine under test
\bar{C}_{ref}	the average sum of the reflectance values in each test cycle of the reference washing machine
m	the number of soiling types per test cycle
n	the number of soiled test strips per test cycle
p	confidence interval for q
q	ratio between the washing machine under test, \bar{C}_{test} , and the reference washing machine , \bar{C}_{ref}
s_q	standard deviation of the ratio q
s_C	the standard deviation of C_k
s_i	the standard deviation for each soiling within a given test cycle
$t_{w-1, 0,05}$	the "Student T" factor for $(w-1)$ degrees of freedom for a confidence of 95 % (i.e. 2,776 for five test cycles equals four degrees of freedom)
w	the number of test cycles
\bar{x}_i	the average reflectance values for each soil type
x_{ij}	the average reflectance value of the individual readings for each soiled test piece

3.2.2 Symbols relating to Clause 9

A_m	the amount of wash alkali remaining in the textiles
A_r	the increased concentration of alkalinity in extracted water
W_r	the concentration of alkalinity in extracted water

W_t	the concentration of alkalinity in tap water
$A_{m,test}$	measured in the washing machine under test
$A_{m,ref}$	measured in the reference washing machine with the relevant programme as described in Annex A
M	the mass of the conditioned base load (g)
M_r	the mass of base load after spin extraction (g)
R	rinsing index
\bar{R}	the mean of rinse indices for all cycles excluding the result of the first test cycle
R_k	the rinsing index from one test cycle
s	standard deviation between the test cycles

3.2.3 Symbols relating to Clause 10

RM	remaining moisture
M	the mass of the conditioned base load (g)
M_r	the mass of base load after spin extraction (g)

3.2.4 Symbols relating to Clause 11

t_c	the measured cold water inlet temperature (°C)
t_h	the measured hot water inlet temperature (°C)
V_c	the volume of the cold water used during an operation (l)
V_h	the volume of external hot water used during operation (l)
W_c	the cold water energy correction for the operation (kWh)
W_{ct}	the total cold water energy correction determined during the test (kWh)
W_{et}	the total electrical energy metered during the test (kWh)
W_h	the calculated hot water energy for the operation (kWh)
W_{ht}	the calculated total hot water energy determined during the test (kWh)
W_{total}	total energy (kWh)

3.2.5 Symbols relating to Clause 12

LS	the percentage of the length shrinkage (%)
SR	the shrinkage rate
SR_i	the shrinkage rate index
$W_{(k-1)}$	the mean measurements (width or length), of the washed wool shrinkage specimens of the previous wool programme test cycle
W_k	the mean measurements (width or length) of the washed wool shrinkage specimens, after each wool programme test cycle
WS	the percentage of the width shrinkage (%)
\bar{y}	the arithmetic mean of the individual readings for each set of three measurements
y_i	the individual readings for each set of three measurements

3.2.6 Symbols relating to C.6

\bar{A}	weighted average age of the load as number of test cycles
a_i	age of item; (after conditioning)
n_i	number of items; (of the same type and age)
w_i	weight per piece given in Table B.1

3.3 Dimensions

Height a_1	= vertical dimension measured from the lower edge (on the floor) to a horizontal plane at the maximum height of the appliance, with the door/lid closed. If adjustable levelling feet are provided, they shall be moved up and down to determine minimum and maximum possible heights.
Height a_2	= maximum vertical dimension measured from the lower edge (on the floor) to a horizontal plane at the maximum height of the appliance with the door/lid open. If adjustable leveling feet are provided, they shall be moved up and down to determine minimum and maximum possible heights.
Width b	= horizontal dimension, between the sides, as measured between two parallel vertical planes against the sides of the appliance including all projections.
Depth c_1	= horizontal dimension as measured from a vertical rear plane against the appliance and the most prominent part of the front, knobs and handles not being taken into account, with the door/lid closed.
Depth c_2	= horizontal dimension as measured from a vertical rear plane against the appliance and the most prominent part of the front, knobs and handles also being taken into account, with the door/lid open.
Drum volume	= the volume of a horizontal drum washing machine, nutator type washing machine or spin extractor is determined as the inside volume, in litres, of the drum or basket in which the textiles are placed, after the subtraction of ribs or other inward protrusions, etc. The volume of an impeller or agitator washing machine is the volume of the bowl, after the subtraction of ribs, agitator and/or other inward protrusions, to the maximum water level of the washing machine when filled without a load.

NOTE The method of measurement of the drum volume is under consideration.

4 Rated capacity

The **rated capacity** for measurements to determine values to be declared for the 60 °C cotton **cycle** according to the Commission's Directive on energy labelling is the value declared by the manufacturer as highest amount of cotton textiles to be washed, given in the instruction manual or on the energy label supplied with the machine, whatever is higher.

If the **rated capacity** is not declared, the **rated capacity** for a cotton load shall be deduced from the volume of the drum according to the following ratios:

– horizontal drum washing machine	1 kg / 13 l;
– agitator washing machine	1 kg / 15 l;
– impeller washing machine	1 kg / 20 l;
– nutator washing machine	1 kg / 10 l;
– spin extractor	1 kg / 4,6 l.

If the **rated capacity** for easy care textiles and woollens is not specified by the manufacturer, the load shall be respectively 40 % and 20 % of that for cotton.

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

NOTE For different textile types the **rated capacity** of an appliance is usually different.

5 General conditions for measurements

5.1 General

The measurements shall generally be carried out on a new machine installed and used in accordance with the manufacturer's instructions, except as required by this standard. If there is more than one option for installation, the one chosen for testing shall be reported. Before commencing measurements the machine shall be run for two complete test **cycles** at maximum temperature, the first without load and with 50 g of the reference detergent and the second without load and without detergent.

Washing performance, **spin extraction**, time and water and energy consumption shall be tested in the same **cycle**.

For the purpose of energy labelling according to the Commission Directive mentioned in Clause 1, the 60 °C cotton **programme** shall be used without pre-wash in accordance with the manufacturers instruction.

5.2 Resources and ambient conditions

5.2.1 Electricity supply

The supply voltage shall be maintained at $230\text{ V} \pm 1\%$.

The supply frequency shall be $50\text{ Hz} \pm 1\%$.

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

5.2.2 Water supply

For all processes on the **test load** a water hardness of $(2,5 \pm 0,2)$ mmol/l shall be used for all **programmes**. If water hardness needs to be adjusted, it shall be prepared according to IEC 60734.

When carrying out measurements to determine values to be declared for the 60 °C cotton **cycle** according to the Commission Directive on energy labelling the temperature of the water supply shall be (15 ± 2) °C.

The temperature of the water supply shall be:

- for cold water (15 ± 2) °C;
- for hot water temperature indicated by the manufacturer ± 2 °C, or (60 ± 2) °C, if no value is given.

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

The static (gauge) pressure of the water supply at each water inlet shall be maintained at (240 ± 50) kPa throughout the test, including filling.

The measured water temperature and pressure shall be reported.

For appliances without heating elements the use of hot water is permitted.

5.2.3 Ambient temperature

The ambient temperature of the room shall be maintained at (23 ± 2) °C throughout the test. The measured ambient temperature shall be reported.

5.3 Reference washing machine

A reference **washing machine** shall run in parallel with the **washing machine** being tested, applying the same procedure to both machines to provide a measure of relative performance and reproducible results. Specifications for the reference **washing machine** are given in Annex A.

NOTE The ratios and tolerances of optical reflectance between the different **programmes** given in E.4.3 may be used as general qualification criteria for the test system.

At each run it shall be checked that no detergent remains in the detergent dispenser.

6 Materials

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6.1 Base loads

6.1.1 Cotton base load

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The cotton **base load** shall consist of sheets, pillowcases and hand-towels as specified in Annex B.

The **test load** consists of the **base load** and the soiled test strips as specified in 6.4. The **test load** is adjusted so that it corresponds to the **rated capacity** for the specified **programme** of the test machine. The number of sheets, pillowcases and hand-towels in the cotton **base load** for various **rated capacities** is given in Table 1. Final adjustment of the **test load** including the soiled test strips is made by adding the required number of hand towels so that the total mass is as close as possible to the **rated capacity**, using the weight as measured during the last conditioning of the textiles at the commencement of the present series of test **cycles**.

Table 1 – Number of items in the cotton test load for various rated capacities

Rated capacity kg	Number of sheets ^a	Number of pillowcases ^a	Number of hand-towels
2	1	2	Number required to make the test load after the addition of the soiled test strips of 6.4 as close as possible (± 60 g) to the rated capacity .
2,5	1	3	
3	1	4	
3,5	2	3	
4	2	4	
4,5	2	6	
5	2	6	
5,5	2	8	
6	2	8	
6,5	2	10	
7	2	12	
7,5	3	12	
8	3	14	
8,5	3	16	
9	3	18	
9,5	3	20	
10	3	22	

^a For **rated capacities** other than those specified in Table 1, the number of sheets and pillowcases in the **test load** shall be equal to that specified for the next lower capacity, with the balance of the **rated capacity** made up with hand-towels.

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6.1.2 Easy-care textile base load

The easy-care textile **base load** shall consist of men's shirts and pillowcases as defined in Annex B.

The easy-care textile **base load** consists of an equal number of shirts and pillowcases. Final adjustment of the **test load** is made after adding the soiled test strips in 6.4, by adding or subtracting one shirt or one pillowcase whichever adjusts the **test load** to be closest to the **rated capacity**.

If the manufacturer declares the easy-care textile load as a "number of shirts", the **rated capacity** (kg) shall be the number of shirts multiplied by 0,2.

6.1.3 Polyester textile base load for wool programme

The **base load** shall consist of double knitted polyester textile test pieces as defined in Annex B.

The **test load** consists of the **base load** and three wool shrinkage specimens as defined in 12.2. The **test load** should be adjusted by adding or subtracting the number of **base load** items to be closest to the **rated capacity**.

6.2 Usage

An item shall not be used for more than 80 test **cycles**, not counting pre-treatment and the normalization **cycles** between two test series.