

KODUMAJAPIDAMISES KASUTATAVAD  
PESUPESEMISMASINAD. TOIMIVUSE MÕÕTEMEETODID

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

## EESTI STANDARDI EESSÕNA

## NATIONAL FOREWORD

See Eesti standard EVS-EN 60456:2016 sisaldab Euroopa standardi EN 60456:2016 ingliskeelset teksti.	This Estonian standard EVS-EN 60456:2016 consists of the English text of the European standard EN 60456:2016.
Standard on jõustunud sellekohase teate avaldamisega EVS Teatajas	This standard has been endorsed with a notification published in the official bulletin of the Estonian Centre for Standardisation.
Euroopa standardimisorganisatsioonid on teinud Euroopa standardi rahvuslikele liikmetele kättesaadavaks 08.04.2016.	Date of Availability of the European standard is 08.04.2016.
Standard on kättesaadav Eesti Standardikeskusest.	The standard is available from the Estonian Centre for Standardisation.

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ICS 97.060

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English Version

## Clothes washing machines for household use - Methods for measuring the performance (IEC 60456:2010 , modified)

Machines à laver le linge pour usage domestique -  
Méthodes de mesure de l'aptitude à la fonction  
(IEC 60456:2010 , modifiée)

Waschmaschinen für den Hausgebrauch - Verfahren zur  
Messung der Gebrauchseigenschaften  
(IEC 60456:2010 , modifiziert)

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## European foreword

This document (EN 60456:2016) consists of the text of IEC 60456:2010 prepared by SC 59D "Home laundry appliances" of IEC/TC 59 "Performance of household and similar electrical appliances", together with the common modifications 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) 2016-12-14
- latest date by which the national standards conflicting with this document have to be withdrawn (dow) 2018-12-14

This document supersedes EN 60456:2011.

Significant technical differences are:

- a) the test procedure to measure power and energy consumption in left-on-mode and the referenced standard has been corrected; (Z.A. 4.9);
- b) deletion of RMS and two sided confidence level formulas (Z.A. 5.2);
- c) corrections in evaluation of water extraction performance (formulas) are integrated (Z.A. 5.4);
- d) corrections in evaluation of spin speed (formulas) are integrated (Z.A. 5.5);
- e) corrections in evaluation of power and energy consumption measurements in left-on-mode (formulas and references) are integrated (Z.A. 5.9);
- f) Table ZA17: Correction of the reported precision;
- g) Annex ZB is re-phrased;
- h) the normative references in Annex ZC are updated;
- i) new Annexes ZZA and ZZB.

This European Standard also specifies, as far as necessary, the test methods which shall be applied in accordance with the COMMISSION DELEGATED REGULATION (EU) No 1061/2010 implementing Directive 2010/30/EU of the European Parliament and of the Council with regard to energy labelling of household washing machines and in accordance with the COMMISSION REGULATION (EU) No 1015/2010 implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to ecodesign requirements for household washing machines.

Clauses, subclauses, notes, tables, figures and annexes which are additional to those in IEC 60456:2010 are prefixed "Z".

Annex ZA sets out the procedure to be applied for testing according to Commission Regulations with regard to energy labelling and ecodesign and provides all necessary links to all relevant clauses of this European Standard.

Annex ZB has been re-phrased and provides control procedures for checking measured values in comparison to values declared by the manufacturer and taking into account any permitted tolerances.

This document has been prepared under a mandate given to CENELEC by the European Commission and the European Free Trade Association, and supports Commission Regulation (EU) No. 1015/2010 and Commission Delegated Regulation (EU) No. 1061/201.

For the relationship with Commission Regulation (EU) No. 1015/2010 and Commission Delegated Regulation (EU) No. 1061/201 see informative Annex ZZA and ZZB, which are integral parts of this document.

## Endorsement notice

The text of the International Standard IEC 60456:2010 was approved by CENELEC as a European Standard with agreed common modifications.

### COMMON MODIFICATIONS

## 2 Normative references

*Add the following note:*

NOTE Z1 Normative references to the relevant European Standards are listed in Annex ZC (normative).

## 3 Terms, definitions and symbols

### 3.1 Terms and definitions

*Add the following new definitions:*

#### 3.1.Z1

##### **full load**

**test load** to be used for a combined **test series** according to Annex ZA, having a nominal mass that is equal to the greatest amount of cotton textiles that may be washed using the standard 60 °C cotton **programme** or the standard 40 °C cotton **programme**, as stated by the manufacturer in the instruction manual or on the energy label supplied with the **test washing machine**, whichever is higher

#### 3.1.Z2

##### **partial load**

half of the **full load** for cotton textiles

#### 3.1.Z3

##### **treatment**

combination of **test load** and **programme** to be used for a **test run** within a combined **test series**

#### 3.1.Z4

##### **treatment 60½**

standard 60 °C cotton **programme** with **partial load**

#### 3.1.Z5

##### **treatment 40½**

standard 40 °C cotton **programme** with **partial load**

#### 3.1.Z6

##### **treatment 60**

standard 60 °C cotton **programme** with **full load**

#### 3.1.Z7

##### **unstable left on mode**

condition after opening the door, at the end of the **programme** where the power consumption may change without any intervention by the end-user

#### 3.1.Z8

##### **post programme phases**

phases after the end of **programme** defined to be used for the measurement of **left on mode**

**3.1.Z9****post programme phase LU**

phase after the end of **programme** defined to be used for the measurement of the **unstable left on mode**

**3.1.Z10****post programme phase LO**

phase after the end of **programme** defined to be used for the measurement of the **left on mode**

**3.1.Z11****left on mode duration**

time to revert automatically the machine to **off mode** after the end of the **programme** if the **test washing machine** is equipped with a **power management system**

**3.1.Z12****power management system**

system within the **test washing machine** which reverts it automatically to **off mode**

**3.1.Z13****rated value**

value declared by the supplier

Note 1 to entry: This may be a declared value and/or a ecodesign limit value. Declared values are the values required for the energy label and for the fiche.

**3.1.Z14****limit value**

**rated value** adjusted by the tolerance to give the maximum and/or minimum value to compare with the measured result



### 3.2 Symbols

Add the following new symbols:

#### 3.2.Z1 Symbols relating to Annex ZA

$[ ]$	rounding up/down to full integer values (no decimal places) as described in ISO 31-0
$\lfloor \rfloor$	always rounding up to full integer values (no decimal places)
$\lceil \rceil$	always rounding down to full integer values (no decimal places)
$AE_c$	Annual Energy Consumption (kWh)
$AW_c$	Annual Water Consumption (l)
$c$	rated capacity to calculate the Standard Annual Energy Consumption of the test washing machine
$C_k$	sum of the average reflectance values (Y-values) for each test run
$\overline{C_z}$	average value for the sum of the reflectance values for the treatments 40½ and 60½ with partial load
$\overline{C_{ref}}$	average sum of the reflectance values in each test run of the reference machine out of all 5 runs
$\overline{C_{60}}$	average value for the sum of the reflectance values for the treatment 60
$\overline{D}$	average value for the remaining moisture content for the combined test series (%)
$D_i$	remaining moisture content of test run i with full load (%)
$\overline{D_{max}}$	maximum remaining moisture (%)
$\overline{D_z}$	average value for the remaining moisture content for the treatments 40½ and 60½ with partial load (%)
$D_{z,part}$	is the remaining moisture content of test run with partial base load part (part = A, B) with treatment type z (z = 40½, 60½) in %
$\overline{D_{40\frac{1}{2}}}$	average for the remaining moisture content for treatment 40½ (%)
$\overline{D_{60\frac{1}{2}}}$	average value for the remaining moisture content for treatment 60½ (%)
$\overline{D_{60}}$	average value for the remaining moisture content for treatment 60 with full load (%)
$EEI$	Energy Efficiency Index of a test washing machine
$i$	test run

$I_W$	Washing Efficiency Index for the combined test series
$I_{W,z}$	Washing Efficiency Index for the treatments 40½ and 60½ with partial load
$I_{W40½}$	Washing Efficiency Index for treatment 40½
$I_{W60½}$	Washing Efficiency Index for treatment 60½
$I_{W,60}$	Washing Efficiency Index for the treatment 60
$M$	mass of the conditioned base load (g)
$M_{det}$	mass of detergent used (g)
$M_{dry}$	mass of base load before each test run (without test strips) (g)
$M_{r,i}$	mass of the base load at the end of the test run $i$ ( $i = 1,2,3$ ) (g)
$M_{part}$	mass of the conditioned partial load (Part A or Part B) (g)
$M_{T_z,part}$	is the mass at the end of the test run with partial base load part (part = A, B) with treatment type $z$ ( $z = 40½, 60½$ ) in g
$Mn_{part}$	nominal partial test load mass (kg)
$n$	number of test runs per treatment
$n_{A,PC}$	number of pillowcases in Part A
$n_{A,SH}$	number of sheets in Part A
$n_{A,STS}$	number of stain test strips in Part A
$n_{A,T}$	number of towels in Part A
$n_{B,PC}$	number of pillowcases in Part B
$n_{B,SH}$	number of sheets in Part B
$n_{B,STS}$	number of stain test strips in Part B
$n_{B,T}$	number of towels in Part B
$n_{PC}$	number of pillowcases at rated test load mass
$n_{SH}$	number of sheets at rated test load mass
$n_T$	number of towels at rated test load mass

$part$	partial load identifier (part = A,B)
$p_c$	laboratory supply water pressure cold (kPa)
$p_h$	laboratory supply water pressure hot (if connected) (kPa)
$P_{LU,z}$	value for the average power for the 2 post programme phases (LU and LO) for the treatments 40½, 60½ and 60 (W)
$P_{LU}$	average power during post programme phase LU (W)
$P_{LO}$	average power during post programme phase LO (W)
$P_{LO,z}$	average power during post programme phase LO per treatment (W)
$P_{LX}$	average value for left on mode power during post programme phase X for the combined test series (W)
$P_{LX40½}$	average power in post programme phase X for treatment 40½ (W)
$P_{LX60½}$	average power in post programme phase X for treatment 60½ (W)
$P_{LX60}$	average power in post programme phase X for treatment 60 (W)
$P_O$	average value for left on mode power for the combined test series (W)
$P_{O,z}$	average power in the off mode per treatment (W)
$P_{O40½}$	average energy consumption for treatment 40½ (W)
$P_{O60½}$	average energy consumption for treatment 60½ (W)
$P_{O60}$	average energy consumption for treatment 60 (W)
$r_{40½,60½,60}$	sum of squared residuals per treatment
$r_x$	residual per treatment
$\overline{S}$	average value for the maximum spin speed for the combined test series (rpm)
$SAE_C$	Standard Annual Energy Consumption (kWh)
$S_i$	maximum spin speed of test run I with treatment type p (p = 60) (rpm)
$\overline{S_{max}}$	lowest value for the maximum spin speed (rpm)
$\overline{S_z}$	average value for the maximum spin speed for the treatments 40½ and 60½ with partial load (rpm)

$S_{z,i}$	maximum spin speed of test run i with treatment type z (z = 40½, 60½) (rpm)
$\overline{S_{40\frac{1}{2}}}$	average maximum spin speed for the treatment 40½ (rpm)
$\overline{S_{60\frac{1}{2}}}$	average maximum spin speed for the treatment 60½ (rpm)
$\overline{S_{60}}$	average value for the maximum spin speed for the treatment 60 with full load (rpm)
$s_x$	standard deviation per treatment
$Std_y$	standard deviation per test series
$t_a$	ambient temperature (test room) (°C)
$t_c$	measured average cold water inlet temperature (°C)
$t_h$	measured average hot water inlet temperature (°C)
$t_i$	programme time for test run i with treatment type z (z = 60) (min)
$t_{mLU}$	measurement time for post programme phase LU (min)
$t_{mLO}$	measurement time for post programme phase LO (min)
$t_{m,z}$	measurement time in off mode for each treatment (min)
$t_{MW}$	main wash duration (min)
$\overline{t_z}$	average value for the programme time for the treatments 40½ and 60½ with partial load (min)
$t_{z,i}$	programme time for test run i with treatment type z (z = 40½, 60½) (min)
$\overline{t_{40\frac{1}{2}}}$	average programme time for treatment 40½ (min)
$\overline{t_{60\frac{1}{2}}}$	average programme time for treatment 60½ (min)
$\overline{t_{60}}$	average programme time for treatment 60 (min)
$\overline{t_L}$	average value for left on duration (min)
$t_{L40\frac{1}{2}}$	left on duration for treatment 40½ (min)
$t_{L60\frac{1}{2}}$	left on duration for treatment 60½ (min)
$t_{L60}$	left on duration for treatment 60 (min)

$t_t$	average value for the programme time for the combined test series (min)
$t_{4,1-\alpha/2}$	"Student T" factor for 4 degrees of freedom for a confidence level of 95 %, is 2,776
$V$	pooled mean (weighted mean) per test series
$V_{cm}$	volume of cold water used during the main wash (l)
$V_{hm}$	volume of supply hot water used during the main wash (l)
$V_{ct}$	volume of cold water used in the test (l)
$V_{ht}$	volume of supply hot water used in the test (l)
$V_i$	total water consumption for test run i with treatment type p (p = 60) in min
$V_m$	water consumption during the main wash (l)
$V_{z,i}$	total water consumption for test run i with treatment type z (l)
$\overline{V_z}$	average value for the total water consumption for the treatments 40½ and 60½ with partial load (l)
$\overline{V_{60}}$	average value for the total water consumption for the treatment 60 with full load (l)
$\overline{V_{40\frac{1}{2}}}$	average water consumption for treatment 40½ (l)
$\overline{V_{60\frac{1}{2}}}$	average water consumption for treatment 60½ (l)
$V_{total}$	average value for the total water consumption for the combined test series (l)
$\bar{x}$	average value per treatment
$x_i$	value for each test run of the treatment
$\bar{x}_{40\frac{1}{2},60\frac{1}{2},60}$	average value per treatment
$W_{et}$	is the total electrical energy metered during the test (kWh)
$\overline{W_z}$	average value for the total energy consumption for the treatments 40½ and 60½ with partial load (kWh)
$W_{z,i}$	total energy consumption for test run i with treatment type z (z = 40½, 60½) (kWh)
$W_i$	total energy consumption for test run i with treatment type z (z = 60) (kWh)
$\overline{W_{60}}$	average value for energy consumption for treatment 60 (kWh)

$\overline{W}_{40\frac{1}{2}}$	average value for energy consumption for treatment 40½ (kWh)
$\overline{W}_{60\frac{1}{2}}$	average value for energy consumption for treatment 60½ (kWh)
$W_{total,cold}$	average value for total energy consumption without hot water (kWh)
$W_{total}$	average value for total energy consumption for the combined test series (kWh)
$W_{LU,z}$	energy consumption during post programme phase LU per treatment (Wh)
$W_{LO,z}$	energy consumption during post programme phase LO per treatment (Wh)
$W_{O,z}$	energy consumption in off mode per treatment (Wh)
$z$	treatment type

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## 5 Test conditions, materials, equipment and instrumentation

### 5.1 General

#### **Add**

Rounding rules that are given in the regulation supersede standardization.

### 5.2 Ambient conditions

#### 5.2.1 Electricity supply

*Replace the text under 5.2.1 as follows:*

The supply voltage to each **test washing machine** shall be maintained throughout the test at  $230\text{ V} \pm 1\%$  or at  $400\text{ V} \pm 1\%$  as defined by the manufacturer's installation guide. If more than one option for installation is available and no clear indication for testing is given, the supply voltage shall be  $230\text{ V} \pm 1\%$ . The supply voltage measured during the tests shall be recorded.

NOTE Z1 In the case of a fixed cable, the plug (or the end of the cable) is the reference point at which the supply voltage shall be maintained.

The supply frequency to each **test washing machine** shall be maintained at  $50\text{ Hz} \pm 1\%$  throughout the test.

#### 5.2.2 Water supply

##### 5.2.2.2 Water hardness

*Add after the first paragraph the following new paragraph:*

For the combined **test series** according to Annex ZA water with a total hardness of  $(2,5 \pm 0,2)\text{ mmol/l}$  (hard water) shall be used.

##### 5.2.2.3 Water temperature

*Add after NOTE 1 the following new paragraph:*

For the combined **test series** according to Annex ZA the temperature of the hot water supply (if applicable) shall be set according to declaration given by the manufacturer ( $\pm 2\text{ K}$ ) in the instruction manual. If no clear indication is given, the hot water supply temperature shall be set at  $(60 \pm 2)\text{ }^\circ\text{C}$ .

When the manufacturer specifies a hot water temperature range, which includes  $(60 \pm 2)\text{ }^\circ\text{C}$ , the hot water temperature shall be set at  $(60 \pm 2)\text{ }^\circ\text{C}$ . When the manufacturer specifies a hot water temperature range, which does not include  $(60 \pm 2)\text{ }^\circ\text{C}$ , the hot water temperature shall be set at the end of the temperature range which is closest to  $(60 \pm 2)\text{ }^\circ\text{C}$ . When the manufacturer specifies a single temperature with a tolerance, then that temperature shall be used.

The hot and cold water inlet supply temperature (as applicable) shall be determined as close as possible to the point of connection of each **test washing machine** to the laboratory water supply system.

*Add at the end the following new paragraph and replace NOTE 2 as follows:*

For the combined **test series** according to Annex ZA the water supply system shall be configured so that the temperature of all water entering the inlet hose of the **test washing machine** is within specified tolerance with the exception of up to 250 ml of each increment. A temperature recording system shall record inlet water temperature at intervals of no less than once per second.

NOTE 2 Clause 8 requires water temperatures and volumes to be recorded on a continuous basis during filling in order to determine weighted average temperature.

#### 5.4.2 Reference machine

**Add** after NOTE 1 the following new paragraph:

For the combined **test series** according to Annex ZA **only** type 1 shall be used.

### 5.5 Instrumentation and accuracy

#### 5.5.2 Instruments

**Add** a new row at the end of the table below:

Parameter	Unit	Minimum resolution	Minimum accuracy	Additional requirements
Mass				
Full <b>test load mass</b> or <b>base load mass</b> above 3 kg	g	2 g	± 5 g	-
Individual load items, full <b>test load mass</b> or <b>base load mass</b> less than or equal to 3 kg	g	0,5 g	± 1 g	-
Detergent mass	g	0,05 g	± 0,1 g	-
Titration mass	g	0,005 g	± 0,01 g	-
Temperature				
Ambient temperature	°C	0,1 °C	± 1 K	-
Water temperature	°C	0,1 °C	± 0,6 K	-
Ambient humidity	% (RH)	1 % (RH)	± 3 % (RH)	The specifications shall be met over a temperature range of 15 °C to 25 °C.
Water volume (water inlet)	L	0,1 L	± 2 %	Separate metering for hot and cold inlets, where applicable  NOTE Devices using viscosity should be calibrated at the actual nominal temperature ± 5 °C, and the nominal flow rate. Liquid volumes for titration are covered by the specification for mass in 5.4.1.
Water pressure	kPa	10 kPa	± 5 %	-
Time	s	5 s	± 1 %	-
Spin speed	rpm	1 rpm	± 1 %	-



### 5.5.3 Measurements

Replace the fifth row in the following table as follows:

Parameter	Unit	Minimum accuracy	Additional requirements
Total water hardness	mmol/L	± 2 %	-
Electrical energy			
<b>Programme energy</b>	kWh	± 1 %	Due to distortion of the voltage and current wave forms caused by inductive devices such as motor controls specific requirements for energy meters are necessary. See e.g. EN 62053-21 for more information.
<b>Off mode and left on mode power</b>	W		Measurement instrumentation for off mode and left on mode power are described in EN 50564
pH	-	± 0,05	The accuracy requirement shall be met over a temperature range of 15 °C to 25 °C.

## 6 Preparation for testing

### 6.2 Test washing machine and reference machine preparation

#### 6.2.1.3 Preparation of the test washing machine for a test series

Replace the second paragraph by:

Any filters shall be thoroughly cleaned before each **test series**. Prior to the **test series** (not less than one day in advance but not more than two week in advance and without any other run before the **test series** is started) a cleaning run shall be undertaken on a **programme** with the maximum wash temperature set and setting maximum main wash water level if applicable without load and without detergent. After the cleaning run the machine shall stay standing at the stable laboratory ambient temperature until the **test series** is finished.

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

Replace the second paragraph by:

The **test washing machine** shall be at laboratory ambient temperature at the beginning of each **test run**. It shall be accepted that this requirement has been met if the internal surface temperature of the **test washing machine** drum is at ambient air temperature of the test room, or if the **test washing machine** has been left open and standing at the stable laboratory ambient temperature for not less than 2 h.

Add after the second paragraph the following note:

NOTE Z1 Refer to Annex ZA for the exact order and timing of the combined test series.

#### 6.2.2 Reference machine

Add after the second paragraph the following: