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Gospodinjski stroji in podobne električne naprave - Metode za merjenje lastnosti sušilnih strojev za komercialno uporabo

Household and similar electric appliances - Methods for measuring the performance of tumble dryers intended for commercial use

Elektrische Geräte für den Hausgebrauch und ähnliche Zwecke – Verfahren zur Messung der Gebrauchseigenschaften für Wäschetrockner für den gewerblichen Gebrauch

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Household and similar electric appliances - Methods for measuring the performance of tumble dryers intended for commercial use

Appareils électrodomestiques et analogues - Méthodes de mesure de l'aptitude à la fonction pour les sèche-linge à tambour à usage commercial

Elektrische Geräte für den Hausgebrauch und ähnliche Zwecke - Verfahren zur Messung der Gebrauchseigenschaften für Wäschetrockner für den gewerblichen Gebrauch

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CENELEC

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

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

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European foreword

This document (EN 50594:2018) 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)	2019-04-23
• latest date by which the national standards conflicting with this document have to be withdrawn	(dow)	2021-04-23

This document supersedes CLC/TS 50594:2015.

This document is based on portions of EN 61121:2013.

The procedures described in this European Standard are modified substantially compared to the procedures described in EN 61121. Therefore, results of tests according to this European Standard cannot and are bound not to be compared to results of similar procedures of EN 61121.

Significant technical differences from EN 61121 are:

a) test procedures for tumble dryers of any size on the market;

b) test procedure for measuring power consumption also for steam heated and gas heated tumble dryers;

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

d) the introduction of a new initial moisture content level.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC 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 is applicable to **tumble dryers** intended to be used by trained users e.g. in hotels, hospitals, factories, in light industry and on farms. It covers **tumble dryers** declared for commercial use in public areas and operated by lay persons e.g. in launderettes, apartment houses and communal laundry rooms. This European Standard covers **tumble dryers** which use electricity, gas or steam as a heating source.

The object is to state and define the principal performance characteristics of **tumble dryers** for commercial use of interest to users and to describe standard methods for measuring these characteristics.

NOTE It does not apply to **transfer tumble dryers** or **tumble dryers** only possible to operate with automatic loading and unloading.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 437:2003+A1:2009, *Test gases — Test pressures — Appliance categories*

CEN/TR 1749:2014, *European scheme for the classification of gas appliances according to the method of evacuation of the combustion products (types)*

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

EN 50570:2013, *Household and similar electrical appliances — Safety — Particular requirements for commercial electric tumble dryers*

EN 50640:2018, *Clothes washing machines for commercial use — Methods for measuring the performance*

EN 60456:2016, *Clothes washing machines for household use — Methods for measuring the performance (IEC 60456:2010, modified)*

EN 60734, *Household electrical appliances — Performance — 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 80000-1:2009, *Quantities and units — Part 1: General*

3 Terms, definitions and symbols

3.1 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at http://www.iso.org/obp

3.1.1
tumble dryer
appliance in which textiles are dried by tumbling in a rotating drum, through which air is passed

3.1.2
air vented tumble dryer
tumble dryer that draws in fresh air which is passed over the textiles and where the resulting moist air is exhausted into the room or vented outside

3.1.3
condenser tumble dryer
tumble dryer which includes a device for removing moisture from the air used for the drying process

3.1.4
automatic tumble dryer
tumble dryer which switches off the drying process when a certain **moisture content** of the load is reached

Note 1 to entry: This may include systems that use conductivity or temperature sensing.

3.1.5
non-automatic tumble dryer
tumble dryer which does not switch off the drying process when a certain **moisture content** of the load is reached, usually controlled by a timer, but may also be controlled manually

3.1.6
transfer tumble dryer
tumble dryer with automatic loading and unloading via conveyors or by other means

Note 1 to entry: The loading and unloading conveyers are often located on opposite sides of the drying basket.

3.1.7
test load
textile load used for testing

3.1.8
pre-treatment
processing of a new **test load** prior to its first use to avoid rapid changes of characteristics during the tests

3.1.9
conditioning
bringing the **test load** into thermodynamic equilibrium with the defined ambient air conditions of temperature and humidity

Note 1 to entry: The process of **conditioning** is not the same as 'wetting' which is described in 6.6.7.

3.1.10
test run
single performance assessment

3.1.11
test series
group of **test runs** on a **tumble dryer** which, collectively, are used to assess the performance of that **tumble dryer**

3.1.12
operation
performance of a function that occurs during the **tumble dryer** drying process such as heating up, drying, cooling, anti-creasing

3.1.13
programme
series of **operations** which are pre-defined within the **tumble dryer** and which are declared by the manufacturer as suitable for drying certain types of textiles

3.1.14
end of cycle
when the load is accessible to the user and next programme can be started

3.1.15
cycle
complete drying process until the load is accessible to the user, as defined by the selected **programme**, consisting of a series of **operations**

3.1.16
cycle time
time from the initiation of the **programme** (excluding any user programmed delay) until the end of the **cycle**

3.1.17
normalization
processing of a **test load** after a pre-determined number of **cycles** to bring the **test load** to a normal state prior to testing

3.1.18
rated capacity
maximum mass in kilograms of dry textiles of a particular defined type, which the manufacturer declares can be treated in a specific **programme**

3.1.19
test load mass
actual mass of the **test load**

3.1.20
conditioned test load mass
mass of the **test load** when conditioned to correct humidity and temperature defined in 5.2.3.2

3.1.21
nominal test load mass
mass of dry textiles of a particular type for which the performance of the **tumble dryer** will be tested (**rated capacity** or part load)

Note 1 to entry: Target value toward which the **conditioned test load mass** will be adjusted.

3.1.22
moisture content
ratio of the difference between **test load mass** and the **conditioned test load mass** to the **conditioned test load mass** expressed in percent

3.1.23
initial moisture content
moisture content of a **test load** prior to a **test run**

3.1.24
final moisture content
moisture content of a **test load** at the end of a **test run**

3.1.25
rated voltage
voltage assigned to the appliance by the manufacturer

3.2 List of symbols

The symbols are listed in Table 1.

Table 1 — List of symbols

Symbol	Unit	Definition
a	-	constant part of the regression line
b	-	slope part of the regression line
C	%	arithmetical average of the condensation efficiency of all valid **test runs**
C_j	%	condensation efficiency for **test run** j
d	Kg/l	density of water
E	kWh	arithmetical average of the corrected energy consumption of all valid **test runs**
E_c	kg/min	evaporation capacity
HS,n	kWh/m^3	heating value referred to standard conditions
V_m	M^3	measured gas volume
W	kWh	average corrected energy consumption
W_j	kWh	corrected consumption for **test run** j
W_{mj}	kWh	measured consumption for **test run** j
W_{ej}	kWh	corrected electric energy consumption for **test run** j
W_{sj}	kWh	corrected steam energy consumption for **test run** j
W_{gj}	kWh	corrected gas energy consumption for **test run** j
W_{mej}	kWh	measured electric energy for **test run** j
W_{msj}	kWh	measured steam energy for **test run** j
W_{mgj}	kWh	measured gas energy for **test run** j
Wcs	kWh	*energy of the recovered condensate*
W_{gt}	kWh	*total gas energy consumption*
W_s	kWh/kg	specific corrected energy consumption
F_v	m^3/min	volumetric flow rate
F	-	Gas factor according to H.6.1
j	-	**test run** number
L	l	arithmetical average of the corrected water consumption of all valid **test runs**
L_j	l	corrected water consumption for **test run** j
L_{mj}	l	measured water consumption for **test run** j
L_s	l/kg	Specific water consumption
M_{dst}	kg	mass of supplied steam to the tumble dryer during a test run
n	-	number of **test runs**
p	Pa	static pressure
S	-	standard deviation of measured results
S_b	-	standard deviation of the measured **final moisture content** for all valid **test runs**
T	min	arithmetical average of the corrected **cycle time** of all valid **test runs**
T_s	min/kg	specific corrected **cycle time**
T_j	min	corrected **cycle time** for **test run** j

Symbol	Unit	Definition
T_{mj}	min	measured **cycle time** for **test run** *j*
T_c	°C	the condensate temperature
T_{cs}	°C	the temperature recorded by the steam temperature sensor
t_{max}	°C	maximum drying temperature
t_{amax}	°C	maximum ambient temperature during a **test run**
t_{amin}	°C	minimum ambient temperature during a **test run**
t_{amean}	°C	average ambient temperature during a **test run**
V_c	l	clothes container volume
V	m^3	exhaust air volume
M	g	**rated capacity** for the type of load tested
M_0	g	mass of the conditioned **test load**
M_f	g	mass of the **test load** after drying
M_{fj}	g	mass of the **test load** after drying for **test run** *j*
M_i	g	mass of the **test load** after wetting
M_{ij}	kg	mass of the **test load** used after wetting but before drying
M_w	g	mass of water collected
M_{wj}	g	mass of water collected during **test run** *j*
M_S	kg	mass of the small sheet in a **test load**
M_L	kg	mass of the large sheet in a **test load**
M_T	kg	desired mass of the **test load**
x_i	-	*i*-th term of parameter *x*
$\overline{x_i}$	-	mean of all terms of parameter *x*
X_S	-	number of small sheets in a **test load**
X_L	-	number of large sheets in a **test load**
Y	-	performance parameter (energy consumption or **cycle time**)
μ	%	average measured **final moisture content** for a **test series**
μ_{f0}	%	target **final moisture content**
μ_{fj}	%	measured **final moisture content** after **test run** *j*
μ_{ij}	%	measured **initial moisture content** for **test run** *j*
μ_{i0}	%	nominal **initial moisture content**

4 Requirements

4.1 General

This European Standard does not specify minimum performance requirements for **tumble dryers**. This European Standard does however set methods for the measurement of following performance parameters:

- electric energy consumption;

- steam energy consumption;
- gas energy consumption;
- water consumption;
- **cycle time**;
- condensation efficiency;
- drying temperature of the textiles;
- volumetric flow rate of exhaust air.

Any claims of performance referring to this European Standard for these parameters shall be measured in accordance with the requirements of this European Standard. Any claims of performance referring to this document at other than **rated capacity** shall be qualified with load type and capacity used for the test (refer to Clause 7 for details).

4.2 Rated capacity

The manufacturer or supplier shall declare the **rated capacity** at 0,5 kg intervals

The **rated capacity** for any textile type shall not exceed the maximum mass of dry laundry, to be used in the appliance in accordance with EN 50570:2013, 3.1.9.

If the **rated capacity** is not declared by the manufacturer, the **rated capacity** shall be deduced from the clothes container volume (see 4.3) as described in Annex E.

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

For different textiles the **rated capacity** of an appliance may be different.

4.3 Dimensions

Where a manufacturer declares dimensions, these shall be in accordance with the following requirements, as applicable. The dimensions shall be given in mm and shall be rounded up to the nearest higher mm.

- Height = vertical dimension measured from the lower edge (on the floor) to the upper edge of the top, with the door/lid closed: if adjustable levelling feet are provided, they shall be moved to determine maximum possible height.
- Max height = maximum vertical dimension measured from the lower edge (on the floor) to a horizontal plane at the maximum height of the **tumble dryer** with the door/lid open: if adjustable levelling feet are provided, they shall be moved up and down to determine minimum and maximum possible heights.
- Width = horizontal dimension, between the sides, as measured between two parallel vertical planes against the sides of the **tumble dryer**, including all projections.
- Depth = horizontal dimension as measured from a vertical rear plane against the **tumble dryer** and the most prominent part of the front, knobs and handles not being taken into account, with the door/lid closed, including all projections.
- Max depth = horizontal **dimension** as measured from a vertical rear plane against the **tumble dryer** and the most prominent part of the front knobs and handles not being taken into account, with the door/lid open (generally when at right angles to the machine front), including all projections.
- Clothes container volume = the volume of the container in which textiles are placed, where required, shall be determined in accordance with Annex E.

5 Test conditions, materials, equipment and instrumentation

5.1 General

The tolerances specified for parameters within this European Standard, 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.

5.2 Ambient conditions

5.2.1 Electricity supply

The supply voltage to the test **tumble dryer** shall be 230 V or 400 V as defined by the manufacturer's installation guide. If more than one option for installation is available and no clear indication for testing is given, the supply voltage shall be 400 V. The supply voltages shall be maintained throughout the test within ± 2 %. For **tumble dryers** with a drum volume equal or larger than 1000 l the voltage tolerance is allowed to be ± 3 %.The supply voltage measured during the tests shall be recorded.

The electric supply cable shall not exceed 4 m of length unless a longer supply cable is delivered together with the **tumble dryer** from the manufacturer. The plug (or the end of the cable furthest from the dryer) is the reference point at which the supply voltage shall be maintained.

The supply frequency to each **test tumble dryer** shall be maintained at 50 Hz ± 1 % throughout the test. Voltage stabilizers should be designed such that the normal **operation** of the **tumble dryer** does not cause undue distortion of the voltage waveform.

5.2.2 Water supply

5.2.2.1 General

This section describes the specifications for water to be used for preparing **test loads**, wetting **test loads** and for water used as cooling fluid.

In all cases the water supply shall meet the requirements given in 5.2.2.2. Water used for normalizing **test loads** and wetting **test loads** shall meet the requirements of 5.2.2.2 and 5.2.2.3.

Water used for wetting **test loads** for testing conductivity controlled **automatic tumble dryers** shall meet the requirements of 5.2.2.2, 5.2.2.3 and 5.2.2.4.

NOTE The performance of a **tumble dryer** may differ when water of different quality is used to wet the **test load**.

5.2.2.2 Water temperature and pressure

The temperature of the cold water supply shall be (15 ± 2) °C.

The pressure of the water supply during water intake at the appliance water inlet shall be maintained at (240 ± 50) kPa.

The measured water temperature and pressure shall be reported.

5.2.2.3 Water hardness

Standard soft water with a total hardness of (0,5 ± 0,2) mmol/l shall be used for all procedures within this European Standard. If available, naturally occurring water of the correct total hardness may be used. Alternatively, water of the correct total hardness shall be prepared according to EN 60734.

The total hardness of the water used shall be reported.

5.2.2.4 Water alkalinity, pH and conductivity

When testing conductivity controlled **automatic tumble dryers**, the characteristics of the water used for wetting the **test load** can have a large influence on the test results. The water characteristics are defined in terms of hardness, alkalinity, pH and conductivity.

For the purpose of testing **automatic tumble dryers** the water for wetting the **test load** shall have the characteristics of water prepared according to Method B of EN 60734 for soft water (0,5 ± 0,2) mmol/l.

If water characteristics need to be adjusted, Method B or Method C3 of EN 60734 shall be followed.

If applicable the alkalinity, pH and conductivity of the water used shall be reported.

5.2.3 Ambient temperature and humidity

5.2.3.1 Ambient temperature and relative humidity for tumble dryer testing

The ambient temperature of the test room shall be (23 ± 2) °C at the start of the drying test. The ambient temperature shall not rise more than 4 K during the **test run**. The ambient temperature during tumble dryer testing shall be recorded. The maximum, minimum and average temperature during the **test run** shall be reported. The temperature measurement location shall be in the vicinity of the air intake and the temperature shall be rounded to the nearest 0,5 °C.

For dryers with a drum volume equal or larger than 1000 l the ambient temperature tolerance can be increased to (23 °C + 6 °C / - 2 °C) at the start of the drying test. If the starting ambient temperature is above the normal temperature range of (23 ± 2) °C a correction shall be made according to K.5.6.11.

The ambient relative humidity of the test room shall be maintained at (55 ± 10) % throughout the **tumble dryer** test. The ambient relative humidity shall be measured in the vicinity of the **tumble dryer** being tested. The maximum and minimum measured ambient relative humidity for **tumble dryer** testing shall be reported rounded to the nearest whole percentage.

Care should be taken to ensure that the ambient temperature and relative humidity are not influenced by the appliance itself or other appliances in the laboratory.

5.2.3.2 Ambient temperature and ambient relative humidity for conditioning of test load items

Where an ambient controlled room or chamber is used for **conditioning** the **test load**, the following conditions shall be maintained:

- ambient temperature: (20 ± 2) °C;
- ambient relative humidity: (65 ± 5) %.

The measured ambient temperature and relative humidity for **conditioning test load** items shall be reported. The ambient temperature shall be rounded to the nearest 0,5 °C, the ambient relative humidity shall be rounded to the nearest whole percentage.

NOTE Requirements for **conditioning** the **test load** are specified in 6.6.5.2.

5.3 Test materials

5.3.1 General

This section sets out the specifications for test materials required for **tumble dryer** testing to this European Standard, including **test loads** and detergent.

5.3.2 Test load

The **test load** shall consist of small and large sheets as specified in A.2.

5.3.3 Detergent

The specification for the IEC Standard Powder Detergent 2016 (IEC-P) base powder as defined in A.1. Detergent dosage is specified in 6.6.4.2.

5.4 Equipment

5.4.1 Equipment for normalization

The specification for a washing machine which is used for the **normalization** of **test loads** is defined in A.5.