
**Specifikacije za industrijske pralnice strojev - Definicije in preskušanje
zmogljivosti ter značilnosti porabe - 2. del: Rotacijski sušilniki**

Specifications for industrial laundry machines - Definitions and testing of capacity and
consumption characteristics - Part 2: Batch drying tumblers

Anforderungen an industrielle Wäschereimaschinen - Definition und Prüfung von
Kapazitäts- und Verbrauchsmerkmalen - Teil 2: Trockner

Spécifications pour les machines de blanchisserie industrielle - Définitions et contrôle
des caractéristiques de capacité et de consommation - Partie 2 : Séchoirs rotatifs

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Specifications for industrial laundry machines - Definitions and testing of capacity and consumption characteristics - Part 2: Batch drying tumblers

Spécifications pour les machines de blanchisserie
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caractéristiques de capacité et de consommation -
Partie 2 : Séchoirs rotatifs

Festlegungen für Wäschereimaschinen - Definition und
Prüfung der Beladung und Verbrauchsmerkmale - Teil
2: Trockner

This European Standard was approved by CEN on 17 September 2018.

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European foreword

This document (EN 17116-2:2018) has been prepared by Technical Committee CEN/TC 214 "Textile machinery and accessories", the secretariat of which is held by SNV.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by June 2019, and conflicting national standards shall be withdrawn at the latest by June 2019.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association.

This draft is based on ISO 9398-2 extended by the application of the state of the art methodology to measure performance and has been prepared by CEN/TC 214/WG 5.

The standard testing procedure for batch drying tumblers is based on ISO 9398-2. It includes among others the references EN ISO 10472-1 and EN ISO 10472-4.

EN 17116-2:2018 enhances the second edition of ISO 9398-2, i.e. ISO 9398-2:2003, to comply with European standard requirements.

ISO 9398-2:2003 is extended by state of the art methodology to measure performance. Significant technical differences from ISO 9398-2:2003 are:

- a) implementation of moisture controlled tumble dryers;
- b) test conditions under practical *in situ* laundry conditions;
- c) more detailed description of testing procedure;
- d) implementation of energy consumption of various heat sources;
- e) implementation of air compressor energy consumption;
- f) a test procedure for measuring power consumption also for steam heated and gas heated tumble dryers;
- g) introduction of a new type of test load;
- h) new initial and final moisture level introduced;
- i) implementation of air quantity measurements.

According to the CEN-CENELEC Internal Regulations, the national standards organisations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

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1 Scope

This document defines the characteristics of batch drying tumblers and gives the usual test methods for these characteristics with regard to machine capacity, power consumption and productivity. It is applicable for use as a reference in the drafting of purchasing orders for batch drying tumblers whose net usable cage volume is 1 000 dm³ (litres) resp. 40 kg and above. In addition, it is recommended for determination of energy consumption and productivity according to Directive 2009/125 EC. Furthermore, the standard describes standard methods for measuring principal performance characteristics of professional tumble dryers. It does not cover safety requirements (see EN ISO 10472-4).

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 746-2, *Industrial thermoprocessing equipment — Part 2: Safety requirements for combustion and fuel handling systems*

EN 50160, *Voltage characteristics of electricity supplied by public electricity networks*

EN 60038, *CENELEC standard voltages (IEC 60038)*

ISO 9398-1, *Specifications for industrial laundry machines — Definitions and testing of capacity and consumption characteristics — Part 1: Flatwork ironing machines*

3 Terms, definitions, symbols and abbreviations

3.1 Terms and definitions

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For the purposes of this document, the terms and definitions given in ISO 9398-1 and the following 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

laundry machine in which textiles are dried by tumbling in a rotating drum, through which air is passed, and in which the dryer draws in fresh or partly recirculated air which is passed over the textiles and the resulting moist exhaust air is vented outside

3.1.2

moisture-controlled 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 IR-temperature of the load or air temperature sensing.

3.1.3**time-controlled 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 process controlled

3.1.4**transfer tumble dryer****pass-through tumble dryer**

tumble dryer with automatic loading and unloading, e.g. via conveyers or by other means, and in which the loading and unloading is located on opposite sides of the drying basket

3.1.5**tumble dryer with process air recirculation**

tumble dryer by which partly re-used air is applied in the circulation system

Note 1 to entry: The amount of re-used air is controlled by the position of a flap positioned within the recirculating air channel. The position of the flap — corresponding to the amount of recirculated air — may be automatically or manually controlled.

Note 2 to entry: This may include systems that use fixed positions of the flap, depending on the drying phase, or variable flap position systems which are controlled by sensors.

Note 3 to entry: Details concerning industrial thermos-processing equipment — safety requirements for combustion and fuel-handling systems — are given in EN 746-2.

3.1.6**pre-treatment**

processing of the test load prior to its first use to avoid rapid changes of characteristics during the tests, e.g. washing for removal of textile finishes

3.1.7**bone dry-conditioning**

bringing the test load (see 3.1.19) into a state without moisture content (bone dry) by multiple drying until a steady-state weight is achieved (identical weight for minimum three replicating drying cycles)

3.1.8**test run**

single performance assessment

3.1.9**test series**

number of test runs on a tumble dryer which, collectively, are used to assess the performance of that tumble dryer

3.1.10**operation**

stage or function that occurs during the tumble dryer drying process such as loading, heating up, drying, cooling

3.1.11**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

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EN 17116-2:2018 (E)**3.1.12****end of the programme**

moment in time when the tumble dryer indicates the programme is complete and the load is accessible to the user (includes cool-down)

3.1.13**total drying duration**

period of time from the initiation of the programme (excluding any user programmed delay) until the end of the programme (includes cool-down)

Note 1 to entry: The drying programme starts with the start signal (closed door) and ends after cool-down.

3.1.14**cycle**

complete drying process, as defined by the selected programme, consisting of a series of operations including any operations that occur after the end of the programme, e.g. anti-creasing, unloading

3.1.15**cycle time**

period of time for one cycle according to 3.1.14

Note 1 to entry: If there is no activity after the end of the programme, the cycle time is equal to the programme time.

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3.1.16**nominal load**

maximum weight of the load in kg of dry cotton (100 %) terry fabrics (including (9 ± 2) % residual moisture content, related to bone dry load) that may be dried in the tumbler under the specified test conditions

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3.1.17**cage (basket) volume**

net usable volume of the cage, expressed in cubic decimetres (litres), equivalent to the inside volume minus all the inwardly projecting volumes, except those of baffles or bars

3.1.18**load ratio**

ratio of the nominal load of the tumbler, expressed in kilograms, to the cage volume, expressed in cubic decimetres (litres), and the value of which is 1:25 if no other value is declared by the manufacturer

3.1.19**test load weight**

weight of the test load (bone dry $+9 \pm 2$ %), test load is equal to nominal load

3.1.20**moisture content of test load**

ratio of the difference between test load weight and the conditioned test load weight (bone dry) to the conditioned test load weight (bone dry) expressed in percent

3.1.21**initial moisture content**

moisture content of a test load prior to a test run

3.1.22**final moisture content**

moisture content of a test load at the end of a test

3.1.23**rated voltage**

voltage assigned (to the appliance) by the manufacturer

3.1.24**total energy consumption**

consumption that includes energy for heating up the air (by steam or gas), the electricity used by the tumbler motors, burner, controls, etc., the electricity for compressed air (e.g. activation of valves) in tumbler and the heat energy adoption from hot rinse water

3.2 Symbols and abbreviations

The symbols are listed in Table 1.

Table 1 — List of symbols

Symbol	Unit	Definition
A	m^2	calculated area of exhaust tube at air velocity measurement position
c_{corr}	—	coefficient considering energy losses during heating up
E_E	kWh	measured electric energy consumption for the test run
E_H	kWh	measured energy for heating up for the test run
E_A	kWh	measured energy for air compression for the test run
E_{HF}	kWh	calculated energy embedded in hot fresh water
$E_{E,spec}$	kWh	specific electric energy consumption for the test run
$E_{H,spec}$	kWh	specific energy for heating up for the test run
$E_{A,spec}$	kWh	specific energy for air compression for the test run
$E_{HF,spec}$	kWh	specific energy embedded in hot fresh water
$E_{H,gas}$	kWh	gas heating energy
E_i	kWh	measured energy consumption for single aggregates, etc.
$E_{spec,load}$	kWh/kg	specific energy consumption per kg load
$E_{spec, load, tot}$	kWh/kg	total energy consumption per kg load
$E_{spec, water, tot}$	kWh/kg	total energy consumption per kg evaporated water
$E_{tumbler, tot}$	kWh	measured total energy consumption of tumble dryer for the test run
F_{mc}	%	moisture content of test load at end of drying process

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Symbol	Unit	Definition
H_{gas}	kWh/m ³	heating value of the gas under laundry conditions
$H_{\text{gas,ss}}$	kWh/m ³	heating value of the gas related to standard state conditions (0 °C, 1 013 mbar)
Imc	%	moisture content of test load after wetting/at start of drying process
m_{hour}	kg/h	treated weight per h
$m_{\text{water,hour}}$	kg/h	weight of evaporated water during 1 h drying
$m_{\text{load, hour}}$	kg/h	weight of dried textiles during 1 h
m_{testload}	kg	test load weight, bone dry plus (9 ± 2) % residual moisture
$m_{\text{testload,bd}}$	kg	weight of the bone dried test load
m_{water}	kg	weight of evaporated water during drying
mc_{sl}	%	moisture content of soiled test load under ambient conditions in the laundry
$M_{\text{HF,dw}}$	kg/kg	weight of the specific fresh water per kg dry load
p_{baro}	mbar	atmospheric pressure
p_{gas}	mbar	gas pressure at metering system
Rmc	%	residual moisture content of test load
t	min	total drying duration
t_{woCD}	min	drying duration without cool down
t_0	min	by machine manufacturer recommended duration of drying process
θ_{gas}	°C	gas temperature
V	m/s	mean value of air velocity
V_{c}	l	net cage usable volume of dryer
V_{gas}	m ³	consumption of gas
V_{H}	m ³ /h	volumetric flow rate in exhaust
W_{bd}	kg	weight of the bone dried test load
W_{bdi}	kg	weight of the bone dry (conditioned) items
W_{c}	kg	weight of the test load, related to ambient conditions 20 °C, 65 % r.h.
W_{d}	kg	weight of the partially dried load
W_{f}	kg	weight of the test load at end of drying test
W_{aw}	kg	weight of the test load after wetting
W_{i}	kg	weight of the selected items under ambient conditions in the laundry

Symbol	Unit	Definition
W_{sl}	kg	weight of the nominal load under ambient conditions in the laundry
δ_E	°C	temperature of exhaust air
δ_H	°C	hot air temperature
δ_{HF}	°C	medium fresh water temperature during wetting
δ_T	°C	textile surface temperature

4 Requirements

4.1 General

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

- drying performance;
- energy consumption;
- hourly productivity.

This also includes the determination of

- ambient air temperature,
- electrical energy consumption of the whole dryer (drive motor, fan motor, gas burner and control system),
- electrical energy consumption of connected separate air compressor,
- gas energy consumption of the dryer,
- steam energy consumption,
- energy consumption of thermal fluid,
- exhaust airflow volume,
- drying temperature of the textiles,
- temperature of exhaust air,
- temperature of airflow after gas burner.

Any claims of performance referring to this standard for these parameters shall be measured in accordance with the requirements of this standard. Any claims of performance referring to this document at other than nominal load shall be qualified with load type and weight used for the test (refer to 5.2.8 for details).