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Sweepers - Part 2: Performance requirements and test methods

Kehrmaschinen - Teil 2: Anforderungen an die Leistung und Prüfverfahren

Balayeuses - Partie 2: Exigences de performance et méthodes d'essai

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Sweepers - Part 2: Performance requirements and test methods

Balayeuses - Partie 2: Exigences de performance et méthodes d'essai

Kehrmaschinen - Teil 2: Anforderungen an die Leistung und Prüfverfahren

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Foreword

This document (EN 15429-2:2012) has been prepared by Technical Committee CEN/TC 337 “Winter maintenance and road service area maintenance equipment”, the secretariat of which is held by AFNOR.

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of an identical text or by endorsement, at the latest by June 2013, and conflicting national standards shall be withdrawn at the latest by June 2013.

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

Generally, all surface cleaning machines – sweepers, are designed to clean paved surfaces of varying textures associated with areas exposed to vehicular traffic, pedestrians and those within industrial complexes.

Most of these sweepers are equipped with sweep gear to scarify debris with a pick-up system that collects and conveys the spoil into a hopper. This hopper can be discharged at dumping grounds, unloading stations, into containers or at refuse transfer stations.

Sweeping applications are mainly related to the physical size and dimensions of the sweeper. Sweepers of larger dimensions are designed to operate mainly on streets, highways, motorways, large parking areas and within industrial complexes.

Sweepers of smaller dimensions are designed for the cleaning of inner town streets, pedestrian zones, pavements, bicycle lanes, car parking facilities market places and within industrial plants etc. Manœuvrability is one of the main features of this category of sweeper.

Depending on the dimensions, sweeping attachment equipment (e.g. equipment temporally mounted on multi-purpose carrier vehicles or other machines) may be used in similar applications as above.

Additional equipment for specialised cleaning applications; that may be attached to a sweeper is not covered by this standard.

This document (EN 15429-2:2012) is part of a series of documents made up of the following parts:

— EN 15429-1, *Sweepers - Part 1: Classification and Terminology*;

— EN 15429-2, *Sweepers - Part 2: Performance requirements and test methods*;

— prEN 15429-3, *Sweepers - Part 3: Efficiency of particulate matter collection - Testing and Evaluation*;

— prEN 15429-4, *Sweepers - Part 4: Symbols for operator controls and other displays*.

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, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

1 Scope

This European Standard applies to surface cleaning machines for outdoor applications in public areas, roads, airports and industrial complexes. Cleaning machines for winter maintenance and/or indoor applications are not included within the scope of this European Standard. Surface cleaning machines in terms of this standard, are self-propelled, truck mounted, attached sweeping equipment or pedestrian controlled.

This European Standard deals with the performance and functional characteristics and the test methods applied to the sweeping equipment when used as intended and under the conditions foreseen by the manufacturer.

This European Standard does not include carrier vehicles (e.g. trucks). These are covered in national or EU Directives for vehicles.

This European Standard does not apply to road surface cleaning equipment that would be front mounted on tractors according to EN 13524, or other vehicles.

This European Standard does not apply to machines or components that are specifically designed for cleaning tramlines and rail tracks.

This European Standard does not cover noise emission or any overload protection as these are covered by regulatory requirements.

Industrial sweepers, within the scope of EN 60335-2-72 are excluded from this standard.

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 12281, *Printing and business paper — Requirements for copy paper for dry toner imaging processes*

EN 15429-1, *Sweepers — Part 1: Classification and Terminology*

ISO 612:1978, *Road Vehicles — Dimensions of motor vehicles and towed vehicles — Terms and definitions*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 15429-1, ISO 612 and the following apply.

3.1
performance
numerical value or meeting a criterion resulting from a defined test method or as a theoretical value from a calculation

Note 1 to entry: Additionally, performance may be stated as a value resulting from a calculation with no associated test conducted, in which case, the declaration shall be disclosed as a theoretical value.

3.2
functional characteristics
describes the operational requirements of a system or a mechanism

3.3
test method
discloses a procedure to achieve the performance criteria

3.4
calculation
equation and method of calculation to determine a performance numerical value

3.5
theoretical value
value derived from drawings and/or from calculation

Note 1 to entry: The value shall declare the absolute performance criteria, the criterion used in the calculation would be those given as advertised in the manufacturer's published data. As this value is purely theoretical, it may be unlikely to be achieved in use.

3.6
maximum sweeping speed
a speed expressed in m/s and/or km/h declared by the manufacturer related to a foreseen sweeping application and/or test

3.7
work mode
condition when the sweeper is conducting cleaning/sweeping activities when used as intended and under the conditions foreseen by the manufacturer

3.8
travel mode
condition when the sweeper is moving between work sites and being driven in a similar way to that of a typical automotive road vehicle

3.9
prime mover
primary power source be it; an internal combustion engine (diesel/petrol/gas), electric motor or hybrid drive system providing the principal power sources for work and travel mode functions.

Note 1 to entry: Some sweepers may employ separate prime movers for propulsion and for driving the sweeping mechanisms.

3.10
truck/carrier vehicle
base vehicle on to which the sweeper equipment is mounted, the sweeper equipment may be in some cases powered by the truck/carrier vehicle prime mover via power-take-off facilities or similar

4 Performance requirements and test methods

4.1 Theoretical sweeping capability

A theoretical value, expressed in m^2/h, derived from a calculation of the product of the maximum sweeping width and the manufacturer's declared maximum sweeping speed.

4.2 Sweep ability

4.2.1 Performance

Sweep ability is the maximum sweeping speed expressed in m/sec and/or km/h. The value is derived from a test method described in 4.2.2.

4.2.2 Test method

Sweep ability shall be derived from a sweeping test, where a test material; composing a dry mixture by weight of 65 % washed sand (< 2 mm), 15 % gravel/grit (2 mm to 8 mm) and 20 % calcium carbonate, shall be spread at a rate of 700 g/m^2 on to a dry smooth paved test surface in a zone extending at least 25 m long and

by 60% of the sweeper's maximum sweeping width wide (this sweeping width would be the same value as used for the calculation in 4.1). The maximum sweeping speed would be the speed where the sweeper collects at least 90 % of the test material, the performance assessment may be judged visually.

4.3 Air flow capability

4.3.1 Performance

Sweepers that use pneumatic means to collect and transport swept debris to the collection hopper require sufficient air velocity within the duct communicating with the pick-up device and hopper for satisfactory conveyance. Air movement is usually performed by an exhausting means, e.g. by a fan extracting air from the hopper. The air velocity within the duct and its cross sectional area has a direct correlation with the volume of air movement. Air velocity within the duct shall be expressed as m/sec. Volume of air movement within the duct shall be expressed as m^3/sec, calculated as the product of the average velocity and the duct's cross section expressed in m^2.

Air temperature, atmospheric pressure and the depression within the duct all affect the air density and flow characteristic, hence, any declared values shall be expressed in standard conditions of 20 °C and at 101,3 kPa atmospheric pressure.

The effects of changes in relative humidity also affect air density, but as the effect is minimal, variance affects can be disregarded. Performance shall be advertised at 50% relative humidity with the proviso that tests are conducted in dry weather conditions. If adverse weather conditions are expected then tests shall be aborted.

The following information shall accompany the air flow capability declaration:

- sweeper - model/type;
- declaration expressed in m^3/sec at 20 °C and at 101,3 kPa atmospheric pressure;
- settings and running speeds.

4.3.2 Test method

The average air velocity within the duct may be measured using suitable means. Prior to any test, the machine shall be inspected to ensure that it is in good working order, clean and that any filters and/or communicating ductwork are free of restrictions and or blockages. During tests, the machine shall be set up according to the manufactures recommended settings. In addition, a record of these settings and running speeds shall accompany the performance results.

Annex A describes a technique to measure duct velocity using the Pitot tube method.

4.4 Conveyor or elevator capability

4.4.1 Performance

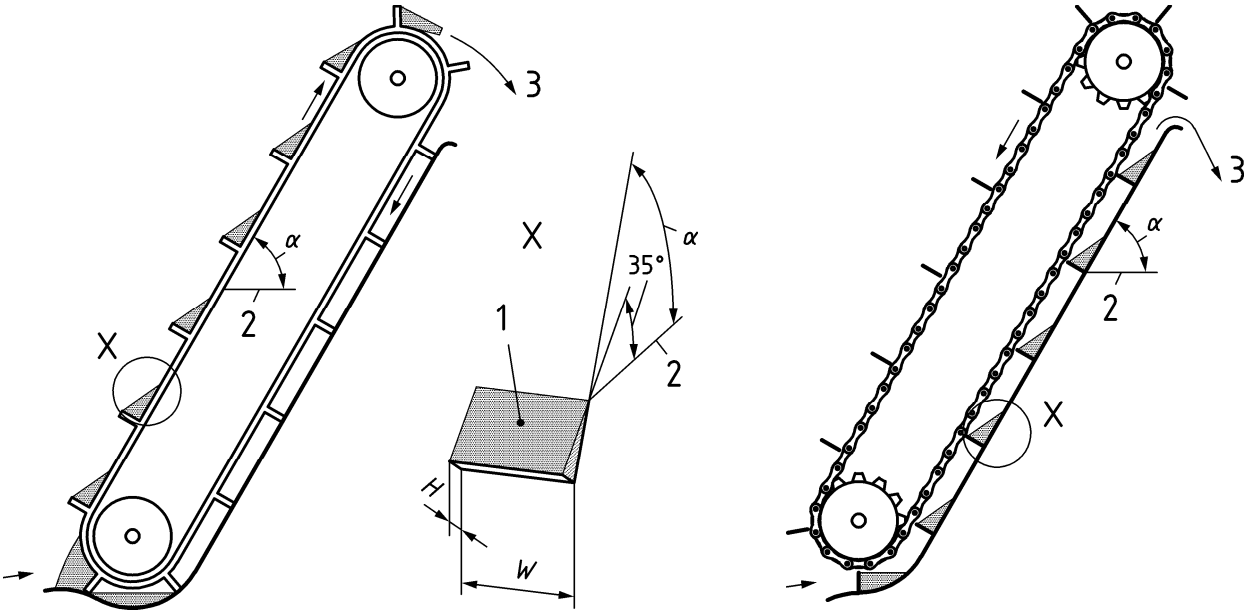
Machines that employ a mechanical means to transfer swept debris to the collection hopper may use a conveyor or elevator system (see figure 1). These systems may be of typical designs arranged vertically or inclined using a number of elevating catchments, e.g. flights/ribs on a conveyor belt, flights dragging up an inclined ramp or other similar mechanisms. In each case, the catchment (C) has a calculated volume in its transfer position, gauged when loaded with dry sand having an angle of repose of 35°. The conveyor system will have an operating speed where the catchment discharge (C_d) rate and its volume can be equated to a maximum loading capability – V_{MLC}, expressed in m^3/min. Performance is assessed by calculation.

The following information shall accompany the conveyor or elevator capability declaration:

- sweeper - model/type;

— capability declaration expressed in m^3/min;

— catchment dimensions and running speed/discharge rate per min.



a) Belt conveyor **b) Flight elevator**

Key

H catchment height
W catchment width
1 catchment (volume)
2 horizontal plane
3 discharge
35° angle of repose (dry sand)
α elevator inclination

Figure 1 — Conveyor/elevator load catchment volume

4.4.2 Calculation

Maximum loading capability V_{MLC} is determined by calculation and disclosed as a theoretical value, thus:

$$V_{MLC} = \frac{H^2 \times W \times C_d}{\tan(\alpha - 35°) \times 2} \quad (1)$$

where

V_{MLC} is the maximum loading capability in (m^3/min);

C_d is the number of catchments discharging per minute (1/min);

H is the catchment height in metres;

W is the catchment width in metres.

4.5 Fuel consumption

4.5.1 Performance

Sweepers may be powered by a single prime mover – known as single-engine machines, providing power for propulsion and for driving the sweeping/collection mechanisms during work mode. Alternatively, separate prime movers may be used solely for propulsion and solely for driving the sweeping/collection mechanisms, typically in the case of truck mounted sweepers – these are known as twin-engine machines. The former single-engine variety is typical of self propelled sweepers though there are also varieties of truck mounted sweeper that are single-engine machines where the sweeping mechanisms are driven via power-take-off systems that are engaged in work mode.

In the case of attached sweeping equipment, the sweeping/collection mechanisms may have their own prime mover or be driven by power-take-off facilities from the carrier vehicle. Fuel consumption declaration in these cases shall be according to the closest similarity to either of the other two other classification type of sweeper.

An example test report of the fuel consumption is given in Annex B.

Table 1 shows prime mover configuration according to machine type.

Table 1 — Classification of sweeper – according to EN 15429-1

Sub-Type	Machine Type	Prime Mover Configuration Single (S) Engine Twin (T) Engine
Large	Truck mounted sweeper	Mainly T / Some S
Small	Truck mounted sweeper	Mainly T / Some S
Maxi-Compact-Sweeper	Self propelled sweeper	S
Compact-Sweeper	Self propelled sweeper	S
Midi-Compact-Sweeper	Self propelled sweeper	S
Mini-Compact-Sweeper	Self propelled sweeper	S
with hopper	Attached sweeping equipment	Mainly S / Some T

Fuel consumption(s) shall be declared in litres per hour (l/h) rounded to the first decimal point and derived from the quantity of fuel used from an average of three test cycles as defined in Figure 2.

In the case of truck mounted sweepers and attached sweeping equipment of the twin-engine variety, the fuel usage of each internal combustion engine shall be declared separately. The fuel used by the non-propulsion internal combustion engines would only be recorded during the sub-test 2) with the quantity used representing the hourly consumption. The following information shall accompany the fuel consumption declaration:

- Sweeper - model/type (and truck/carrier vehicle details if applicable);
- maximum travel speed (km/h) and work speed (km/h);
- details of sweeping-gear, swept width, number and details of brushes in use;
- power setting(s) specifically declared by manufacturer in their operator's manuals;
- total fuel consumption expressed in litres per hour (l/h).

Annex B shows a test report template recording the required information for a fuel consumption declaration.

4.5.2 Test method

The test shall be conducted under the following conditions and method shown in Figure 2:

— Prior to the test, the sweeper shall be prepared in a 'ready for work' condition and laden to at least 75% of its maximum permitted mass - inc. fuel, water, driver and with the hopper partially loaded with suitable material. All internal combustion engines and associated driven equipment shall be at their normal operating temperatures prior to test.

— During the work mode sub-test 2) all sweeping/collection mechanisms shall be in their working positions and work at their specific power ratings stated by the manufacturer in their operator's manual. No sweeping performance requirement is required.

— The test shall be conducted on a flat, paved, clean test track with any gradients less than 2 %.

— Maximum speeds of sub-test 1) and maximum work speed of sub-test 2) shall be constant within a tolerance of ± 10 % and recorded in the test report (see Annex B).

— Acceleration activity shall be conducted as quickly as possible.

— Braking activity shall be conducted rapidly and in a safe manner.

— Fuel used by each prime mover shall be measured with a ± 3 % accuracy for example using flow meters or graduated containers. Measurements before and after test shall be conducted on a level surface.

NOTE Fuel density, calorific values and temperature can effect fuel consumption and may lead to variation in results

— Weather conditions shall be within an ambient temperature range 10 °C to 25 °C.

— In the case of the prime movers driving solely the sweeping/collection mechanisms, fuel usage measurement is only recorded during the work mode sub-test 2).