

SVENSK STANDARD

SS-EN 15429-3:2015

Fastställt/Approved: 2015-03-22
Publicerad/Published: 2015-03-31
Utgåva/Edition: 1
Språk/Language: engelska/English
ICS: 43.160

Sopmaskiner – Del 3: Effektivitet i partikeluppsamling – Provning och utvärdering

Sweepers – Part 3: Efficiency of particulate matter collection – Testing and Evaluation

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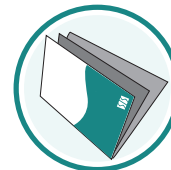
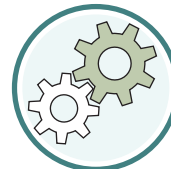
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EUROPEAN STANDARD

EN 15429-3

NORME EUROPÉENNE

EUROPÄISCHE NORM

March 2015

ICS 43.160

English Version

Sweepers - Part 3: Efficiency of particulate matter collection - Testing and Evaluation

Balayeuses - Partie 3: Efficacité de la collecte des matières
particulaires - Essai et évaluation

Kehrmaschinen - Teil 3: Aufnahmefähigkeit von Feinstaub -
Prüfung und Bewertung

This European Standard was approved by CEN on 3 January 2015.

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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 CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

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Foreword

This document (EN 15429-3:2015) has been prepared by Technical Committee CEN/TC 337 "Road operation equipment and products", 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of an identical text or by endorsement, at the latest by September 2015, and conflicting national standards shall be withdrawn at the latest by September 2015.

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.

This document (EN 15429-3:2015) 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*;
- EN 15429-3, *Sweepers — Part 3: Efficiency of particulate matter collection — Testing and Evaluation*;
- EN 15429-4, *Sweepers — Part 4: Symbols for operator controls and other displays*.

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Introduction

Road sweepers are designed to clean transportation surfaces of varying textures. These surfaces exist in many forms, including roadways, sidewalks, and parking lots throughout urban and rural areas. Different size fractions of debris, dirt, and fine dust that originate from various sources accumulate on these surfaces. Fine road dust components, including particulate matter classified as PM_{10} and $PM_{2,5}$, are of particular interest due to the respiratory health hazards that have been associated with these fine particulates.

The European air quality directive requires municipalities throughout Europe to monitor airborne particulate levels, and initiate action plans when prescribed limits are exceeded. Since transportation surfaces are significant accumulators of fine particulate, regular sweeping of these surfaces has been identified as a method that can potentially reduce particulate matter pollution.

Different road sweeper technologies and configurations are available for various sweeping applications. However, the ability of the different technologies and configurations to remove and capture particulate matter from the road surface, and minimize the level of airborne particulates resulting from sweeping, has not been thoroughly evaluated for adequate technical information on this issue to be available. As a result, municipalities may have difficulty selecting a sweeper best suited to a particular sweeping application when making purchasing decisions.

The test method for determining PM_{10} and $PM_{2,5}$ efficiency of road sweepers has been developed to provide an objective and quantitative procedure for assessing the ability of a road sweeper to remove fine particulate from typical paved asphalt surfaces and to reduce the amount of airborne fine particulate generated as a result of the sweeping process.

1 Scope

This European Standard establishes a method to assess the PM₁₀ and PM_{2,5} efficiency of road sweepers. PM₁₀ and PM_{2,5} efficiency includes a sweeper's ability to:

- Remove and capture PM₁₀ and PM_{2,5} particulate matter, and coarse size fractions, from typical urban road surfaces;
- Minimize the amount of airborne and entrained PM₁₀ and PM_{2,5} particulate matter resulting from the sweeping process.

The sweeper's ability to remove and capture particulate matter and coarse size fractions is assessed using procedures and equipment to determine the amount of a test material (consisting of particulate matter and coarser size fractions) the sweeper is able to remove from a test surface during a controlled test run. This test measurement is used to calculate the removal efficiency for the sweeper.

The sweeper's ability to minimize the amount of airborne and entrained particulate matter is also assessed using procedures and equipment to determine the airborne concentrations of PM₁₀ and PM_{2,5} resulting from the sweeping of a test material (consisting of particulate matter and coarser size fractions) during a controlled test run. The test measurements are used to calculate PM₁₀ and PM_{2,5} emission ratings for the sweeper.

This test allows the use of dust suppression water. Sweepers configured as flushing machines, or equipped with front-mounted spray bars which are not part of a dust suppression water system are not within the scope of this test.

The road sweeper's performance results are reported in a quantitative numerical format that will allow comparative assessments of similarly classified sweepers. This test does not specify pass/fail criteria for the PM₁₀ and PM_{2,5} efficiency measurements specified in the test procedure.

This test is applicable to truck mounted, self-propelled, towed and attached sweeping equipment as defined in EN 15429-1:2007, Clause 2.

This test is a model/type test, requiring the sweeper being tested to be representative of all factory production of that particular sweeper model.

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 12341, *Ambient air — Standard gravimetric measurement method for the determination of the PM₁₀ or PM_{2,5} mass concentration of suspended particulate matter*

EN 15429-1:2007, *Sweepers — Part 1: Classification and Terminology*

EN 60335-2-69, *Household and similar electrical appliances — Safety — Part 2-69: Particular requirements for wet and dry vacuums, including power brush, for industrial and commercial use (IEC 60335-2-69)*

3 Terms and definitions

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

SS-EN 15429-3:2015 (E)

3.1

PM₁₀

particulate matter which passes through a size-selective inlet as defined in the reference method for the sampling and measurement of PM₁₀, EN 12341, with a 50 % efficiency cut-off at 10 µm aerodynamic diameter

3.2

PM_{2,5}

particulate matter which passes through a size-selective inlet as defined in the reference method for the sampling and measurement of PM_{2,5}, EN 12341 with a 50 % efficiency cut-off at 2,5 µm aerodynamic diameter

3.3

dust suppression water

water of high-pressure mist sprayed to knock down the fine airborne dust, as dust gets heavy when in contact with the fine water mist

3.4

dust suppression water system

spraying system for dust suppression water consisting e.g. in a pump, a spray bar and nozzles

3.5

front-mounted spray bar

tube with an arrangement of nozzles, holes or slashes as part of a dust suppression water system or flushing system

3.6

flushing system

system for cleaning road surfaces with flushing water

4 Test method features

A test facility (see Figure A.1) is utilized for performing the sweeper test to create a controlled test environment that provides some isolation from the variable effects and influences of the ambient environment. This controlled test environment results in testing conditions that are consistent and repeatable, which translates into more credible test results.

The controlled test environment is created within the test facility using two end wall assemblies to enclose a centrally located, 20 m long sweeper test area. All measurements used to establish test sweeper performance results are performed within the confines of the sweeper test area.

The test facility configuration and sweeper test methodology capture and evaluate performance of the test sweeper while it is in a steady-state operating mode under controlled and consistent test conditions. As the test sweeper travels through the test facility in full operational mode, a representative sampling of test sweeper performance is taken as it sweeps a test material that simulates road dirt within the controlled conditions of the sweeper test area.

A known amount of test material is applied to the test surface to determine the removal efficiency of the test sweeper. The amount of applied test material, although much greater than typical street loading conditions, promotes confidence and repeatability in the test measurements performed.

A sweeper test consists of four valid, individual test runs performed over a period of one or more consecutive days. If weather conditions disrupt testing on an individual day, or prevent testing over consecutive days, the next test run can be postponed and performed when weather and/or test course conditions permit testing to resume. Postponement due to adverse weather conditions will not void the sweeper test.

Of the four individual test runs performed, only the three most consistent test runs yielding the lowest PM emission ratings and highest removal efficiency results will be used to establish the final sweeper test performance results. The results from these three test runs will be averaged to determine the final sweeper test performance results for both removal efficiency and PM emission rating.

A test sweeper can be tested under various operational settings, as it is logical to assume that a change in operational settings will have a positive or negative influence on the test sweeper's emission rating and/or removal efficiency performance. It is also reasonable to assume that a sweeper manufacturer will have identified the operational settings required for optimum sweeper performance in the specified test conditions. Once the optimum operational settings are established, the settings shall remain unchanged throughout the series of four individual test runs that comprise a sweeper test. If an operational setting change is required to improve sweeper performance, a new series of four test runs shall be performed. The operational settings shall be fully documented for each series of test runs.

Dust suppression water can be used to achieve optimum emission rating and removal efficiency results. Since the amount of dust suppression water applied will affect both, emission rating and removal efficiency results, the dust suppression water application rate selected for a series of test runs shall be measured and reported with the results of a sweeper test.

Vacuuming of the test surface in the sweeper test area is performed to determine the amount of test material not captured by the test sweeper during the test run. The use of high efficiency filter and fine dust filter bag equipped vacuums is an effective method for thoroughly capturing the remaining test material, especially the particulate matter component of the test material. This allows for an accurate determination of the test sweeper's removal efficiency.

Aerosol dust monitors centrally located in the sweeper test area and sampling at a height representative of an average adult's nose height, record PM₁₀ and PM_{2,5} concentration levels. The concentration levels are recorded prior to the test sweeper entering the sweeper test area, as the test sweeper sweeps through the sweeper test area and after the test sweeper has exited the sweeper test area. The concentration data is used to determine the PM₁₀ and PM_{2,5} emission ratings for the test sweeper.

The intent of the test procedure is to provide quantitative numerical performance results, and not impose pass/fail criteria for the PM₁₀ and PM_{2,5} efficiency measurements that the test sweeper shall satisfy. The test sweeper's performance results will be reported in a format that allows comparative assessments of similarly classified sweepers tested under the conditions and procedures specified in this test method.

5 Technical requirements

5.1 Test facility

The test facility shall be configured to minimize, to the greatest degree possible, any external disturbances resulting from ambient wind and precipitation conditions. This is critical for creating and maintaining a controlled and consistent test environment in the test facility.

The test facility shall either exist, or be assembled, on a surface that meets the requirements of the test surface specified in 5.3.

The test facility shall accommodate a test course that has minimum dimensions of 40 m long and 7,5 m wide.

The test facility shall have an overall cross-sectional area of 300 m², with an allowable variance of ± 10 %.

The test facility shall include a sweeper test area that is 20 m in length and centrally located along the overall length of the test facility. The sweeper test area should be created with two end walls spaced 20 m apart. The end walls shall be configured with door openings and functioning doors. The end walls and doors shall be configured to minimize, to the greatest degree possible, air movement and disturbances inside the sweeper test area resulting from ambient wind conditions acting on the exterior envelope of the test facility.