

# INTERNATIONAL STANDARD

**Vacuum cleaners for household use –  
Part 1: Dry vacuum cleaners – Methods for measuring the performance**

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Part 1: Dry vacuum cleaners – Methods for measuring the performance**

INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**VACUUM CLEANERS FOR HOUSEHOLD USE –**

**Part 1: Dry vacuum cleaners –  
Methods for measuring the performance**

FOREWORD

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International Standard IEC 60312-1 has been prepared by subcommittee 59F: Floor treatment appliances, of IEC technical committee 59: Performance of household and similar electrical appliances.

The text of this standard is based on the following documents:

FDIS	Report on voting
59F/195/FDIS	59F/199/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all the parts in the IEC 60312 series, under the general title *Vacuum cleaners for household use*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
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## VACUUM CLEANERS FOR HOUSEHOLD USE –

### Part 1: Dry vacuum cleaners – Methods for measuring the performance

#### 1 Scope

This International Standard is applicable for measurements of the performance of dry vacuum cleaners for household use in or under conditions similar to those in households.

The purpose of this standard is to specify essential performance characteristics of dry vacuum cleaners being of interest to the users and to describe methods for measuring these characteristics.

NOTE 1 Due to influence of environmental conditions, variations in time, origin of test materials and proficiency of the operator, most of the described test methods will give more reliable results when applied for comparative testing of a number of appliances at the same time, in the same laboratory and by the same operator.

NOTE 2 This standard is not intended for battery-operated vacuum cleaners.

For safety requirements, reference is made to IEC 60335-1 and IEC 60335-2-2.

#### 2 Normative references

The following referenced documents are indispensable for the application 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.

IEC 60688, *Electrical measuring transducers for converting a.c. electrical quantities to analogue or digital signals*

IEC 60704-1, *Household and similar electrical appliances – Test code for the determination of airborne acoustical noise – Part 1: General requirements*

IEC 60704-2-1, *Household and similar electrical appliances – Test code for the determination of airborne acoustical noise – Part 2-1: Particular requirements for vacuum cleaners*

ISO 554, *Standard atmospheres for conditioning and/or testing – Specifications*

ISO 679, *Methods of testing cements – Determination of strength*

ISO 1763, *Carpets – Determination of number of tufts and/or loops per unit length and per unit area*

ISO 1765, *Machine-made textile floor coverings – Determination of thickness*

ISO 1766, *Textile floor coverings – Determination of thickness of pile above the substrate*

ISO 2424, *Textile floor coverings – Vocabulary*

ISO 2439, *Flexible cellular polymeric materials – Determination of hardness (indentation technique)*



ISO 3386-1, *Polymeric materials, cellular flexible – Determination of stress-strain characteristics in compression – Part 1: Low-density materials*

ISO 5167-1, *Measurement of fluid flow by means of pressure differential devices inserted in circular cross-section conduits running full – Part 1: General principles and requirements*

ISO 8543, *Textile floor coverings – Methods for determination of mass*

ISO 12103-1, *Road vehicles – Test dust for filter evaluation – Part 1: Arizona test dust*

### 3 Terms and definitions

For the purpose of this document, the following definitions apply:

#### 3.1

##### **dry vacuum cleaner**

electrically operated appliance that removes dry material (e. g. dust, fibre, threads) from the surface to be cleaned by an airflow created by a vacuum developed within the unit, the removed material being separated in the appliance and the cleaned suction air being returned to the ambient

#### 3.2

##### **upright cleaner**

self-standing and floor-supported vacuum cleaner with the cleaning head forming an integral part of or permanently connected to the cleaner housing, the cleaning head normally being provided with an agitation device to assist dirt removal and the complete cleaner housing being moved over the surface to be cleaned by means of an attached handle

#### 3.3

##### **cleaning head**

plain nozzle or a brush attached to a connecting tube, or a power nozzle, separate or part of the cleaner housing, and that part of a vacuum cleaner which is applied to a surface to be cleaned

#### 3.4

##### **active nozzle**

cleaning head provided with a driven agitation device to assist dirt removal

NOTE The agitation device may be driven by an incorporated electric motor (motorized nozzle), an incorporated turbine powered by the air flow (air-turbine nozzle) or an incorporated friction or gear mechanism actuated by moving the cleaning head over the surface to be cleaned (mechanical nozzle)

#### 3.5

##### **passive nozzle**

cleaning head without any driven agitation devices

#### 3.6

##### **self-propelled cleaning head**

cleaning head provided with a propulsion mechanism

#### 3.7

##### **cleaning head width**

##### **B**

the external maximum width of the cleaning head in metres

**3.8****active depth of the cleaning head**

distance from the front edge of the cleaning head to its rear edge or a line 10 mm behind the rear edge of the suction opening on the underside of the cleaning head, whichever is the shortest

**3.9****cleaning cycle**

the sequence of five double strokes to be carried out at a specified stroke speed over the test area according to the appropriate stroke pattern

**3.10****stroke pattern**

arrangement of the forward and return strokes on the surface to be cleaned

**3.11****parallel pattern**

stroke pattern where the forward and the return strokes are congruent and are carried out in the direction of the carpet pile (direction of manufacture) unless otherwise specified

**3.12****stroke speed**

speed of the cleaning head, moved as uniformly as possible, during a forward or a return stroke

**3.13****stroke length**

distance between the two parallel lines defining the limits of a stroke pattern

**3.14****double stroke**

one forward and one backward movement of the cleaning head performed in a parallel pattern

**3.15****forward stroke**

forward movement of a stroke pattern

NOTE On test carpets, forward strokes are carried out in the direction of the carpet pile (direction of manufacturing).

**3.16****return stroke**

backward movement of a stroke pattern

**4 General conditions for testing****4.1 Atmospheric conditions**

Unless otherwise specified, the test procedures and measurements shall be carried out under the following conditions (in accordance with ISO 554):

*Standard atmosphere 23/50*

Temperature:	(23 ± 2) °C
Relative humidity:	(50 ± 5) %
Air pressure:	86 kPa to 106 kPa

NOTE Temperature and humidity conditions within the specified ranges are required for good repeatability and reproducibility. Care should be taken to avoid changes during a test.

For test procedures and measurements which may be carried out at other than standard atmospheric conditions, the ambient temperature shall be maintained at  $(23 \pm 5) ^\circ\text{C}$ .

## 4.2 Test equipment and materials

To minimize the influence of electrostatic phenomena, measurements on carpets shall be carried out on a flat floor consisting of a smooth untreated pine plywood or equivalent panel, at least 15 mm thick and of a size appropriate for the test.

Equipment and materials for measurements (devices, test carpets, test dust etc.) to be used in a test shall, prior to the test, be kept hanging free or laying flat for at least 16 h at standard atmospheric conditions according to 4.1.

NOTE It is recommended that carpets that are already being used should be stored unbeaten at standard atmospheric conditions according to 4.1. When not in use they should be preferably hanging free, or may be lying flat, pile upwards and uncovered but not rolled.

## 4.3 Voltage and frequency

Unless otherwise stated, measurements shall be carried out at rated voltage with a tolerance of  $\pm 1\%$  and, if applicable, at rated frequency.

Vacuum cleaners designed for d.c. only shall be operated at d.c.. Vacuum cleaners designed for both a.c. and d.c. shall be operated at a.c.. Vacuum cleaners not marked with rated frequency shall be operated at either 50 Hz or 60 Hz, as is common in the country of use.

For vacuum cleaners with a rated voltage range, measurements shall be carried out at the mean value of the voltage range if the difference between the limits of the range does not exceed 10 % of the mean value. If the difference exceeds 10 % of the mean value, measurements shall be carried out both at the upper and lower limits of the voltage range.

If the rated voltage differs from the nominal system voltage of the country concerned, measurements carried out at rated voltage may give test results misleading for the consumer, and additional measurements may be required. If the test voltage differs from the rated voltage, this shall be reported.

## 4.4 Running-in of vacuum cleaner

Prior to the first test on a new vacuum cleaner it shall be kept running with unrestricted air flow for at least 2 h to ensure adequate running-in. For active nozzles, the agitation device shall be running but not in contact with the floor.

Prior to conducting any series of tests, the age, condition, and history of the product shall be recorded.

## 4.5 Equipment of the vacuum cleaner

If the vacuum cleaner is designed to be used with disposable dust receptacles, it shall, prior to each measurement, be equipped with a new dust receptacle of the type recommended or supplied by the manufacturer of the vacuum cleaner.

If the vacuum cleaner is provided with a reusable dust receptacle (as the sole original dust receptacle or as an enclosure for disposable dust receptacles), the dust receptacle and any additional filters removable without the aid of tools shall, prior to each measurement, be cleaned according to manufacturer's instructions until its weight is within 1 % or 2 g of its original weight whichever is the lower.

Some reusable receptacles consist of a rigid container and an integral filter. In this case the container and the filter are considered to be the receptacle and should be treated as if they were a single component.

Vacuum cleaners equipped with separation devices, being part of the appliance, used to separate the dust from the airflow and/or having additional filters to be changed or cleaned by the user, without the use of tools, the weight of such specific devices shall be taken into account for dust removal ability.

Vacuum cleaners with disposable or reusable dust receptacles may have secondary filtration stage devices which do not collect meaningful dust in removal ability tests but which do impact on filtration and life tests. Replacement and/or maintenance of such devices shall be in accordance with relevant sections and carried out according to manufacturer's instructions.

#### **4.6 Operation of the vacuum cleaner**

The vacuum cleaner and its attachments shall be used and adjusted in accordance with the manufacturer's instructions for normal operation for the test to be carried out. Height adjustment controls for the cleaning head shall be set as appropriate for the surface to be cleaned and the position noted. Any electrical controls shall be set for maximum continuous air flow and, unless the manufacturer's instruction states otherwise, any manually operated air by-pass openings for reduction of the suction power shall be closed, and if open, it shall be reported. Any safety-related device shall be allowed to operate.

The tube grip of cleaners with suction hose or the handle of other cleaners shall be held as for normal operation at a height of  $(800 \pm 50)$  mm above the test floor.

During measurements where the agitation device of an active nozzle is not used as in normal operation, the agitation device shall be running but not in contact with any surface.

#### **4.7 Conditioning prior to each tests**

If the vacuum cleaner is unused and de-energized for more than 1 h, then the vacuum cleaner and attachments to be used shall be kept running for at least 10 min under the provisions given in 4.4 to allow them to stabilise.

#### **4.8 Mechanical operator**

In order to achieve reliable results, certain measurements require the cleaning head to be moved at uniform speed over the test area and without exerting an additional force pressing the cleaning head against the test surface.

It is recommended to simulate the handling of the vacuum cleaner by using a mechanical operator such as described in 7.3.12. The tube grip of cleaners with suction hose or the handle of other cleaners shall then be attached to the linear drive so that its centre pivots at a height of  $(800 \pm 50)$  mm above the test surface. For nozzles without pivoting connectors, it shall be ensured that the bottom of the cleaning head be made parallel with the test surface by adjusting the handle height within the tolerances. If this is not possible, the length of a telescopic tube may be adjusted. Any adjustment shall be reported.

The linear drive may be motorized or operated by hand. The method of operation shall be reported.

#### **4.9 Number of samples**

All measurements of performance shall be carried out on the same sample(s) of the vacuum cleaner with its attachments, if any.

NOTE For increased confidence in the test results, it is recommended that a minimum of three samples of a vacuum cleaner should be tested.

Tests carried out to simulate stresses a vacuum cleaner may be exposed to during normal use, possibly causing impairment of the cleaner's performance, may require additional samples of replaceable parts. Such tests shall be carried out at the end of the test programme.

#### 4.10 In-house reference cleaner system(s)

NOTE 1 The reference cleaner referred to in this standard is a product designated within a laboratory for internal comparison and should not be used for inter-laboratory comparisons

Test carpets used in a laboratory for the determination of dust removal ability will, over time, change from their original conditions, for instance due to wearing or gradual filling with dust. It is therefore required that in-house reference cleaner system(s) be used to regularly check the carpet conditions as a verification of the test results obtained and being recorded.

NOTE 2 Due to the fact that pick-up ability may differ between carpets used for active or passive nozzles, the result from tests between active and passive nozzles may not be compared.

Test carpets designated for testing of passive nozzles shall only be cleaned with a passive nozzle on the face. Test carpets designated for testing active nozzles shall only be cleaned with an active nozzle on the face.

### 5 Dry vacuum cleaning tests

#### 5.1 Dust removal from hard flat floors<sup>1</sup>

##### 5.1.1 Test equipment

A floor test plate in accordance with 7.3.1 shall be used.

##### 5.1.2 Test area and stroke length

The length of the test area is  $(700 \pm 5)$  mm. The width of the test area is equal to the cleaning head width (see 3.7).

A length of at least 200 mm shall be added before the beginning of the test area and at least 300 mm after the end of the test area in order to allow acceleration and deceleration of the cleaning head.

Thus, the stroke length is at least 1200 mm for the given test length of 700 mm. The centreline of the front edge of the cleaning head is aligned to the centre line of the beginning of the acceleration area at the commencement of the stroke allowing the distance of 200 mm to be used for acceleration. The cleaning head shall reach the end of the stroke when the rear edge of the active depth of the cleaning head is at least 200 mm past the end of the test area, thus allowing a suitable distance for deceleration. The reverse stroke is carried out in the same manner until the front edge of the cleaning head is once again lined up with the beginning of the acceleration length in front of the test area.

The active depth of the cleaning head shall move at uniform stroke speed  $0,50 \text{ m/s} \pm 0,02 \text{ m/s}$  and in a straight line over the test area.

For optimum control of the double stroke movement it is recommended that an electromechanical operator (see 4.8) be used.

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<sup>1</sup> This test is under review and may be substituted by a debris pick-up test from hard floor.

Two hold-downs in accordance with 7.3.4 serve the purpose of acting as guides to keep the cleaning head in a straight line as it is moved over the test area and to ensure an undisturbed flow.

Vacuum cleaners equipped with a self drive device shall be operated at the prescribed stroke speed of  $0,5 \text{ m/s} \pm 0,02 \text{ m/s}$  if possible. Otherwise, the stroke speed will be determined by the vacuum cleaner.

### 5.1.3 Removal of remaining dust

The hard surface shall be dry cleaned so that no dust remains prior to any subsequent test.

### 5.1.4 Distribution of test dust

Test dust, Type 1 in accordance with 7.2.2.1, shall be distributed with a mean coverage of  $50 \text{ g/m}^2$  per square metre as uniformly as possible over the test area.

The amount of test dust to be used is calculated from the formula  $B \times 0,7 \text{ m} \times 50 \text{ g/m}^2$ , where  $B$  is the cleaning head width in meters and the length of the test area is  $0,7 \text{ m}$ .

### 5.1.5 Preconditioning of dust receptacle

In order to minimize the effects of humidity, the dust receptacle shall be preconditioned as follows.

The vacuum cleaner under test is equipped with a clean dust receptacle and allowed to run with an unimpeded air flow with the nozzle clear of the surface for 2 min or until input power has stabilised.

After the preconditioning, the dust receptacle and any filters removable without tools are removed from the cleaner to be weighed. The weight shall be noted and the items are replaced.

NOTE Since the cleaner air flow can have an effect on the weight of the dust receptacle during the 2 min preconditioning, caution should be taken so that the weight of the dust receptacle has stabilised before weighing.

### 5.1.6 Determination of dust removal ability

Three separate measurements, each comprising one double stroke, shall be carried out. After the double stroke, the cleaning head shall be lifted at least 50 mm clear of the surface before the vacuum cleaner is switched off. The dust receptacle shall not be removed before the motor has completely stopped.

Once the cleaner has completely stopped, the receptacle is carefully removed and reweighed. Due to effects of possible static charge build-up during the time the vacuum cleaner is picking up dust, it is necessary to ensure that the receptacle has completely stabilised prior to recording the weight.

The dust removal ability is calculated as the ratio of the weight increase of the dust receptacle during the double stroke to the weight of the test dust distributed on the test area. The mean value for 3 measurements is calculated as follows:

$$K_B(3) = (K_{B1} + K_{B2} + K_{B3})/3$$

where  $K_{Bi} = 100 \times (m_{DRf} - m_{DRe})/m_D$

and

$K_B(i)$  is the mean dust removal for  $i$  measurements in per cent;