

BS EN 60312-1:2013

Incorporating corrigendum April 2015



BSI Standards Publication

Vacuum cleaners for household use

Part 1: Dry vacuum cleaners —
Methods for measuring the
performance

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National foreword

This British Standard is the UK implementation of EN 60312-1:2013. It is derived from IEC 60312-1:2010, incorporating amendment 1:2011. Together with BS EN 62885-3 it supersedes BS EN 60312:2008, which will be withdrawn upon publication of BS EN 62885-3.

The CENELEC common modifications have been implemented at the appropriate places in the text. The start and finish of each common modification is indicated in the text by C C.

The start and finish of text introduced or altered by amendment is indicated in the text by tags. Tags indicating changes to IEC text carry the number of the IEC amendment. For example, text altered by IEC amendment 1 is indicated by A1 A1.

BSI, as a member of CENELEC, is obliged to publish BS EN 60312-1 as a British Standard. However, attention is drawn to the fact that the UK committee voted against its approval as a European standard.

The principal reason is that parts of EN 60312-1:2013 are not using the same formulae or the same methods given in the draft European Commission Communication on the Measurement Methods to be used for Vacuum Cleaner Energy Label and Ecodesign. The UK committee requested that modifications to Clauses 5.2.3 and 5.3.4 bring EN 60312-1 into alignment with the European Commission's Annex on measurement and calculation methods, set out in draft Ecodesign and Energy labelling Regulations, which addresses full head width for pick up testing and the calculations for energy efficiency. This concern is only relevant to the CENELEC implementation of IEC 60312-1.

The UK committee also advises users that Clause 4.Z1, regarding a reference vacuum cleaner system, including its calibration and use, is, in the opinion of the committee, not sufficiently defined and therefore may lead to high repeatability and reproducibility variations.

The UK committee also notes that due to the modification to Clause 5.11.3, and omission of clauses 5.11.4 and 5.11.5 by CENELEC common modification, EN 60312-1 does not reflect the measurement methods agreed at IEC, creating divergence, and will reduce the reliability, accuracy and reproducibility of the Filtration Efficiency of the Vacuum Cleaner (Dust Re-emission) test method.

An issue that has not been addressed by the CENELEC implementation of IEC 60312-1 is that further development of the Wilton carpet specification is required, as at time of publication there are currently high reproducibility variations between carpet batches.

The UK participation in its preparation was entrusted by Technical Committee CPL/59, Performance of household electrical appliances, to Subcommittee CPL/59/6, Floor treatment appliances.

A list of organizations represented on this subcommittee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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Compliance with a British Standard cannot confer immunity from legal obligations.

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Amendments/corrigenda issued since publication

Date	Text affected
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NORME EUROPÉENNE
EUROPÄISCHE NORM

EN 60312-1

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Supersedes EN 60312:2008 (partially)

English version

**Vacuum cleaners for household use -
Part 1: Dry vacuum cleaners -
Methods for measuring the performance**
(IEC 60312-1:2010, modified + A1:2011, modified)

Aspirateurs de poussière à usage
domestique -
Partie 1: Aspirateurs à sec -
Méthodes de mesure de l'aptitude à la
fonction
(CEI 60312-1:2010, modifiée + A1:2011,
modifiée)

Staubsauger für den Hausgebrauch -
Teil 1: Trockensauger -
Prüfverfahren zur Bestimmung der
Gebrauchseigenschaften
(IEC 60312-1:2010, modifiziert + A1:2011,
modifiziert)

This European Standard was approved by CENELEC on 2013-03-04. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CENELEC member.

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 CENELEC 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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CENELEC

European Committee for Electrotechnical Standardization
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Foreword

This document (EN 60312-1:2013) consists of the text of IEC 60312-1:2010+A1:2011 prepared by SC 59F, "Surface cleaning appliances", of IEC TC 59, "Performance of household and similar electrical appliances", together with the common modifications 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 (dop) 2014-03-04
at national level by publication of an identical national standard or by endorsement
- latest date by which the national standards conflicting with this document (dow) 2016-03-04
have to be withdrawn

This document partly supersedes EN 60312:2008.

Clauses, subclauses, notes, tables and figures which are additional to those in IEC 60312-1:2010 are prefixed "Z".

EN 60312 is divided into 3 parts:

- EN 60312-1, *Vacuum cleaners for household use – Part 1: Dry vacuum cleaners – Methods for measuring the performance*
- prEN 60312-2, *Vacuum cleaners for household use – Part 2: Wet cleaning appliances – Methods of measuring the performance*
- prEN 60312-3, *Vacuum cleaners for household use – Part 3: Cleaning robots for household use – Dry cleaning – Methods of measuring performance*

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

This European Standard also specifies, as far as necessary, the test methods which shall be applied in accordance with the standardisation mandate M353 related to Council Directive 92/75 of the European Commission.

Endorsement notice

The text of the International Standard IEC 60312-1:2010+A1:2011 was approved by CENELEC as a European Standard with agreed common modifications.

Annex ZA (normative)

Normative references to international publications with their corresponding European publications

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.

NOTE When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60688	-	Electrical measuring transducers for converting A.C. and D.C. electrical quantities to analogue or digital signals	EN 60688	-
IEC 60704-1	-	Household and similar electrical appliances - Test code for the determination of airborne noise - Part 1: General requirements	EN 60704-1	-
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	EN 60704-2-1	-
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)	EN ISO 2439	-
ISO 3386-1	-	Polymeric materials, cellular flexible - Determination of stress-strain characteristics in compression - Part 1: Low-density materials	EN ISO 3386-1	-
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	EN ISO 5167-1	-
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 	-	-

Annex ZB (normative)

Calculation of the number of double strokes X_{calc} to reach the reference level K_{ref} for hard floor with crevice and normalised reference level K_{calc} for carpet.

All dust pick up measurements from zero to ten will be plotted on a graph and the points connected by straight lines as shown in figure below. Each section is described by a linear equation as follows:

$$\text{dpu}_{\text{calc}} = mX + k$$

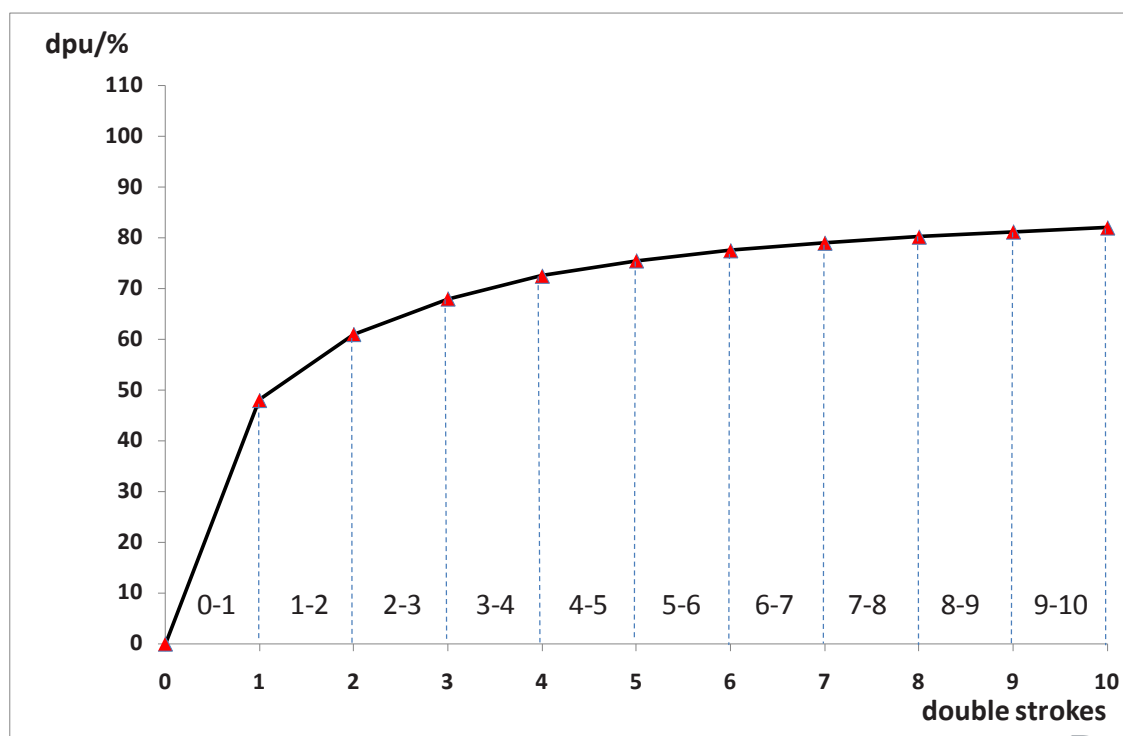
where

dpu_{calc} is the calculated dust pick up by linear equation in %

m is the slope of the linear equation

k is the intersection of each section with the y-axis

double stroke	dust pick up	section	slope	intersection	argument
1	dpu_1	0-1	m_1	k_1	X_1
2	dpu_2	1-2	m_2	k_2	X_2
3	dpu_3	2-3	m_3	k_3	X_3
4	dpu_4	3-4	m_4	k_4	X_4
5	dpu_5	4-5	m_5	k_5	X_5
6	dpu_6	5-6	m_6	k_6	X_6
7	dpu_7	6-7	m_7	k_7	X_7
8	dpu_8	7-8	m_8	k_8	X_8
9	dpu_9	8-9	m_9	k_9	X_9
10	dpu_{10}	9-10	m_{10}	k_{10}	X_{10}



C Calculation of all slopes, intersections and arguments as follow:

NOTE In case of carpet K_{ref} is to be replaced by k_{calc}

$m_1 = dpu_1$	$X_1 = (K_{ref} / m_1$	$k_1 = 0$
$m_2 = dpu_2 - dpu_1$	$X_2 = (K_{ref} - k_2) / m_2$	$k_2 = dpu_1 - m_2$
$m_3 = dpu_3 - dpu_2$	$X_3 = (K_{ref} - k_3) / m_3$	$k_3 = dpu_2 - 2 \times m_3$
$m_4 = dpu_4 - dpu_3$	$X_4 = (K_{ref} - k_4) / m_4$	$k_4 = dpu_3 - 3 \times m_4$
$m_5 = dpu_5 - dpu_4$	$X_5 = (K_{ref} - k_5) / m_5$	$k_5 = dpu_4 - 4 \times m_5$
$m_6 = dpu_6 - dpu_5$	$X_6 = (K_{ref} - k_6) / m_6$	$k_6 = dpu_5 - 5 \times m_6$
$m_7 = dpu_7 - dpu_6$	$X_7 = (K_{ref} - k_7) / m_7$	$k_7 = dpu_6 - 6 \times m_7$
$m_8 = dpu_8 - dpu_7$	$X_8 = (K_{ref} - k_8) / m_8$	$k_8 = dpu_7 - 7 \times m_8$
$m_9 = dpu_9 - dpu_8$	$X_9 = (K_{ref} - k_9) / m_9$	$k_9 = dpu_8 - 8 \times m_9$
$m_{10} = dpu_{10} - dpu_9$	$X_{10} = (K_{ref} - k_{10}) / m_{10}$	$k_{10} = dpu_9 - 9 \times m_{10}$

The choice of the right section, where the reference level K_{ref} for hard floor with crevice and normalised reference level K_{calc} for carpet is located has to be done as follows:

when $dpu_1 > K_{ref}$	then $X_{calc} = X_1$
when $dpu_2 \geq K_{ref}$ and $dpu_1 < K_{ref}$	then $X_{calc} = X_2$
when $dpu_3 \geq K_{ref}$ and $dpu_2 < K_{ref}$	then $X_{calc} = X_3$
when $dpu_4 \geq K_{ref}$ and $dpu_3 < K_{ref}$	then $X_{calc} = X_4$
when $dpu_5 \geq K_{ref}$ and $dpu_4 < K_{ref}$	then $X_{calc} = X_5$
when $dpu_6 \geq K_{ref}$ and $dpu_5 < K_{ref}$	then $X_{calc} = X_6$
when $dpu_7 \geq K_{ref}$ and $dpu_6 < K_{ref}$	then $X_{calc} = X_7$
when $dpu_8 \geq K_{ref}$ and $dpu_7 < K_{ref}$	then $X_{calc} = X_8$
when $dpu_9 \geq K_{ref}$ and $dpu_8 < K_{ref}$	then $X_{calc} = X_9$
when $dpu_{10} \geq K_{ref}$ and $dpu_9 < K_{ref}$	then $X_{calc} = X_{10}$
when $dpu_{10} \leq K_{ref}$	then $X_{calc} = X_{10}$ C

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A1 INTRODUCTION (to amendment 1)

The following changes to IEC 60312-1 concern Subclauses 5.5 and 5.9 and the related specifications in Subclauses 7.2.2 and 7.2.6.

The reason for this is due to the tightening of the specification to the cotton linters used in the test dust. In order to reproduce the airflow restricting conditions expected during the development of this test it is necessary to use more test dust when Condition 3 is used as a stopping point. Further, it provides a specification for the cellulose dust.

In addition to this an updated specification of the cushion slip material is available. **A1**

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

3.Z1

reference vacuum cleaner system

electrically operated laboratory equipment used to measure the reference dust removal ability on carpets with given air flow and active brush bar related parameters to improve the reproducibility of test results

Note 1 to entry: reference vacuum cleaner system is not suitable for other tests than dust pick-up from carpets.

3.Z2

hybrid vacuum cleaner

vacuum cleaner that can be both mains and/or battery operated

3.Z3

battery operated active nozzle

cleaning head provided with an agitation device to assist dirt removal driven by a battery operated motor 

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: $(23 \pm 2) ^\circ\text{C}$
Relative humidity: $(50 \pm 5) \%$
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 hanging free. 

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 ± 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 ± 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.

4.21 Reference vacuum cleaner system

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 the reference vacuum cleaner system as defined in 3.17 be used to regularly check the carpet conditions as a verification of the test results obtained and being recorded.

The reference vacuum cleaner system is designed to obtain 75 % of dust removal after 5 double strokes, both with passive and active nozzle (only for carpet).

The reference vacuum cleaner system has to be tested on each carpet used prior to each sample testing and the test results shall be recorded, after correction according to 6.17.2.2 by using the calibrated dust removal ability K_c . The expected result should be near to the 75 % of dust removal ability after 5 double strokes, however a deviation of ± 5 % is allowed.

NOTE In case the deviation exceeds the ± 5 % limit, the test carpet can be replaced or the reference vacuum cleaner system can be calibrated by the manufacturer.

Due to the fact that dust pick-up ability may differ between carpets used for active or passive nozzles, the result from tests between active and passive nozzles shall 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 floors¹

5.1.1 Test equipment

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

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

5.1.2 Test area and stroke length

The length of the test area is (700 ± 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.

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 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 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;
- K_{Bi} is the dust removal for measurement i in per cent;
- m_D is the weight of the dust distributed on the test area in grams;
- $m_{DRe}(i)$ is the weight of the preconditioned dust receptacle in grams;
- $m_{DRf}(i)$ is the weight of the dust receptacle after cleaning in grams.

When the mean value is lower than 90 %: should the range of measurements be greater than 3 percentage units, two additional measurements are carried out and the mean value of all the measurements should be given as the result.

When the mean value is equal or higher than 90 %: should the range of the measurements be greater than $0,3 \times (100 \% - \text{mean value})$, two additional measurements are carried out and the mean value of all the measurements should be given as the result.

In both cases, consideration should be given to the control of repeatability within the laboratory and the design or manufacture of the cleaner or cleaning head in order to ascertain whether any factors not previously observed may affect the repeatability adversely.

5.2 Dust removal from hard floors with crevices

5.2.1 Test equipment

The surface, in accordance with 7.3.2, consists of a wooden test plate incorporating a removable insert with a crevice, the angle between the crevice and the direction of strokes being 45°.

The test plate may be fitted to the test rig according to 7.3.12 or, if being used for testing by hand, is placed upon the 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. The guides should have a distance of 10 mm from the surface to ensure an undisturbed flow.

5.2.2 Distribution of test dust

The insert is weighed and its crevice thereafter filled with mineral dust, in accordance with 7.2.2.1. After levelling the surface of the dust with a rubber scraper, the insert is again weighed and carefully replaced in the test plate, avoiding shaking.

☐ The linear density of the dust inside the crevice shall be between 0,0340 g/mm and 0,0290 g/mm crevice length. Otherwise, the filling has to be repeated.

NOTE The inserts are emptied from dust after the last measurement of each cleaning cycle. ☐

5.2.3 Determination of dust removal ability

During a measurement, the cleaning head is passed over the crevice by performing double strokes in a parallel pattern at a stroke speed of $(0,50 \pm 0,02)$ m/s, keeping the cleaning head to the centre of the test plate. The quantity of dust removed from the crevice after five double strokes is determined as the difference in weight of the insert before and after cleanings, both values being recorded.

The dust removal ability, in per cent, is calculated according to the following formula as the ratio of the quantity of dust removed to the quantity of dust in that part of the crevice which is determined by the cleaning head width (see 3.2.5) and accounting for the oblique angle of 45°

☐ The mean value of dust removal ability for 2 cleaning cycles is calculated as follows:

$$K_{cr}(2) = (k_{cr}(1) + k_{cr}(2)) / 2$$

$$k_{cr} = \frac{m_L - m_r}{m_L} \frac{L}{B} \cos 45^\circ \times 100 \quad \text{☐}$$

$$k_{cr} = \frac{m_L - m_r}{m_L} \frac{L}{B} \cos 45^\circ \times 100$$

where

k_{cr} ☐ is the dust removal ability for a single cleaning cycle, in per cent; ☐

m_L is the dust quantity in the crevice before cleaning, in grams;

m_r is the dust quantity remaining in the crevice after cleaning, in grams;

L is the length of the crevice, in metres;

B is the cleaning head width, in metres.

Two separate measurements shall be carried out to establish a mean value of the dust removal ability for five double strokes, k_{cr5} , to be reported separately.

5.3 Dust removal from carpets

5.3.1 Test carpet

A test carpet, in accordance with 7.2.1, shall be used; the type of carpet selected shall be recorded. It shall have been prepared in accordance with 7.2.1.4. Due to the significant influence of humidity on this test, the carpet shall be left in the test environment at standard atmospheric conditions for at least 16 h before the test is due to commence.

The preferred carpet for comparative testing purposes is the Wilton Carpet (see 7.2.1.3.2). If additional carpet(s) are desired for testing, the carpet(s) shall be selected from those specified in Subclause 7.2.1.3.

During measurements the carpet is kept in position on the test floor by the use of carpet hold-downs (see 7.3.4). The carpet is to be fixed on the test floor at the end where the forward stroke starts. A force of 60^{+10}_{-0} N shall be applied at the other end of the test carpet to define the tension on the carpet during testing.

5.3.2 Test area and stroke length

The direction of the stroke on the test area shall be in the direction of the carpet pile. The length of the test area is $700 \text{ mm} \pm 5 \text{ mm}$. 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 added after the test area in order to allow for 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.

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.

NOTE 1 For optimum control of the double stroke movement it is recommended that an mechanical operator (see 4.8) be used.

NOTE 2 The two carpet hold-downs serve the purpose of holding the test carpet in position during measurement and of acting as guides to keep the cleaning head in a straight line as it is moved over the test area. The guides should have a distance of 10 mm from the carpet surface to ensure an undisturbed flow.

5.3.3 Conditioning of test carpet

5.3.3.1 General

Prior to each measurement, the test carpet shall be cleaned to remove remaining dust and preconditioned as described below.

5.3.3.2 Removal of remaining dust

For cleaning of the test carpet, it is recommended to use a suitable carpet-beating machine such as described in 7.3.3.

If a carpet-beating machine is not used, the carpet shall be placed upside down on a rigid mesh support and be beaten by hand or with an active nozzle. After the beating, one cleaning cycle with a vacuum cleaner having good dust removal ability should be carried out to remove remaining dust. Test carpets designated for testing of passive nozzles shall only be cleaned with a passive nozzle on the face (although an active nozzle may be used on the back).

5.3.3.3 Verification and preconditioning

After cleaning of the test carpet, the vacuum cleaner under test shall be equipped with a clean dust receptacle (see 4.5) and be used to verify that the carpet has been cleaned to the point where no dust pick-up is discernible. This point is considered to be reached if the amount of dust removed from the carpet during five cleaning cycles is less than 0,2 g. If the amount is greater than 0,2 g, this step is repeated until the requirement is achieved.

NOTE 1 Even if the equipment for removing remaining dust from the carpet is known to be sufficiently reliable to leave the carpet in acceptable condition, it is still important to carry out this procedure of preconditioning to ensure that the effect of humidity on the carpet is minimized.

NOTE 2 To prevent a gradual filling of the carpet with dust, the weight of the test carpet should be maintained as close as possible to that of the initially clean carpet.

5.3.4 Distribution of test dust

Test dust, in accordance with 7.2.2.2, shall be distributed with a mean coverage of $125 \text{ g/m}^2 \pm 0,1 \text{ g/m}^2$ as uniformly as possible over the test area.

☐ The amount of test dust to be used is calculated from the formula $(B-0,02) \text{ m} \times 0,7 \text{ m} \times 125 \text{ g/m}^2$, where B is the cleaning head width in metres and the length of the test area is 0,7 m. For uniform distribution of the test dust over the test area minus 10 mm on each side, it is recommended that a dust spreader as described in 7.3.5 be used. The adjustment of the device is checked by visual examination of the test dust on the carpet. ☐

5.3.5 Embedding of dust into carpet

The dust shall be embedded into the test carpet by carrying out 10 double strokes over the carpet parallel with the direction of the pile with a roller, in accordance with 7.3.6.1. The speed of the roller over the test area shall be a uniform $0,5 \text{ m/s} \pm 0,02 \text{ m/s}$ with the forward stroke being in the direction of the pile. It is important to ensure that the test area is completely and evenly rolled. The carpet is then left for a period of 10 min to recover from rolling.

5.3.6 Preconditioning of dust receptacle

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

Since the cleaner air flow may cause an electrostatic build-up and can have an effect on the scales weighing the dust receptacle during the 2 min preconditioning, caution shall be taken that the weight of the dust receptacle has stabilised before recording the weight. Grounding the receptacle may help the electrostatic build-up to discharge and thus allow a more accurate weight to be taken.

The vacuum cleaner under test is equipped with a clean or reconditioned dust receptacle and/or filters shall be run with an unimpeded air flow for 2 min, for instance during the 10 min period the carpet recovers from rolling.

After the preconditioning, all dust receptacle(s) and removable filters are removed from the cleaner to be weighed. The weights are noted and the items are replaced.

5.3.7 Determination of dust removal ability

Prior to each cleaning cycle, the sequence of preparations outlined in 5.3.4 to 5.3.6 shall be performed in total.

Three separate cleaning cycles, each comprising five double strokes, shall be carried out. After the fifth double stroke, the cleaning head shall be lifted at least 50 mm clear of the carpet. At the end of each cleaning cycle all hoses and tubes of the vacuum cleaner shall be agitated 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(s) and removable filters are 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 and removable filters as defined in 4.5 during the 5 double strokes to the weight of the test dust distributed on the test area. The mean value for 3 cleaning cycles is calculated as follows:

$$K_T(3) = (K_{T1} + K_{T2} + K_{T3})/3$$

where

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

and

$K_T(i)$ is the mean dust removal for i cleaning cycles in per cent;

K_{Ti} is the dust removal for a single cleaning cycle i in per cent;

m_D is the weight of the dust distributed on the test area in grams;

$m_{DRe}(i)$ is the total weight of the preconditioned dust receptacle(s) and removable filter(s) in grams;

$m_{DRf}(i)$ is the total weight of the dust receptacle(s) and removable filter(s) after 5 double strokes in grams.

If the range of values for K_{Ti} is greater than three percentage units, two additional cleaning cycles shall be performed. In this case, the mean dust removal ability shall be calculated as follows:

$$K_T(5) = (K_{T1} + K_{T2} + K_{T3} + K_{T4} + K_{T5})/5$$

NOTE 1 As an example, the values for K_{Ti} of 45 %, 47 % and 49 % give a range of 4 percentage units. Thus, two additional cleaning cycles shall be carried out.

NOTE 2 If a problem with the repeatability continues and a downward trend is observed with the results, refer to Subclause 4.5 and consider the equipment being weighed during the test.

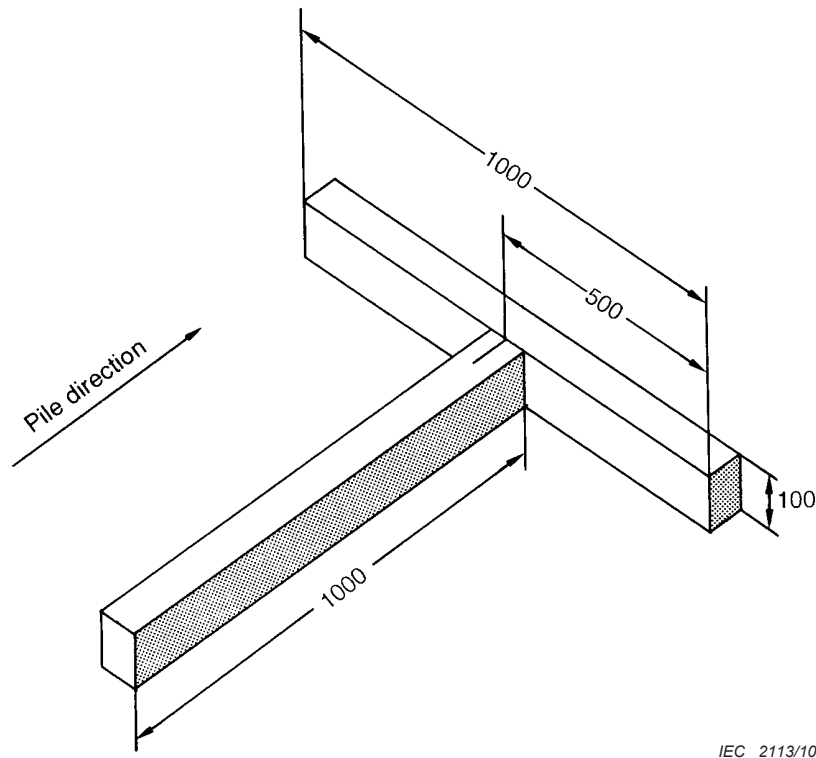
NOTE 3 If the results of the first cleaning cycle differ by more than 3% from the following two tests, it is permissible to repeat that test before applying the 2 additional tests rules.

For the dust removal ability the mean value, the value range and the number of cleaning cycles shall be recorded as well as the type of carpet used.

5.4 Dust removal along walls

5.4.1 Test equipment and materials

A right-angled T in accordance with Figure 1, formed by two pieces of wood or other suitable material, shall be used for this test. It shall be sufficiently heavy to remain in position during the measurements or be kept in position by the use of clamps or weights.



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Dimensions in millimetres

Figure 1 – Right-angled T

For measurements on carpets, a Wilton test carpet in accordance with 7.2.1.3.2 shall be used. For measurements on hard flat floors, a floor test plate in accordance with 7.3.1 shall be used.

5.4.2 Distribution of test dust

A sufficient amount of mineral dust, in accordance with 7.2.2.1, shall be distributed over an area of the test surface corresponding to the extremities of the T to ensure good visible coverage.

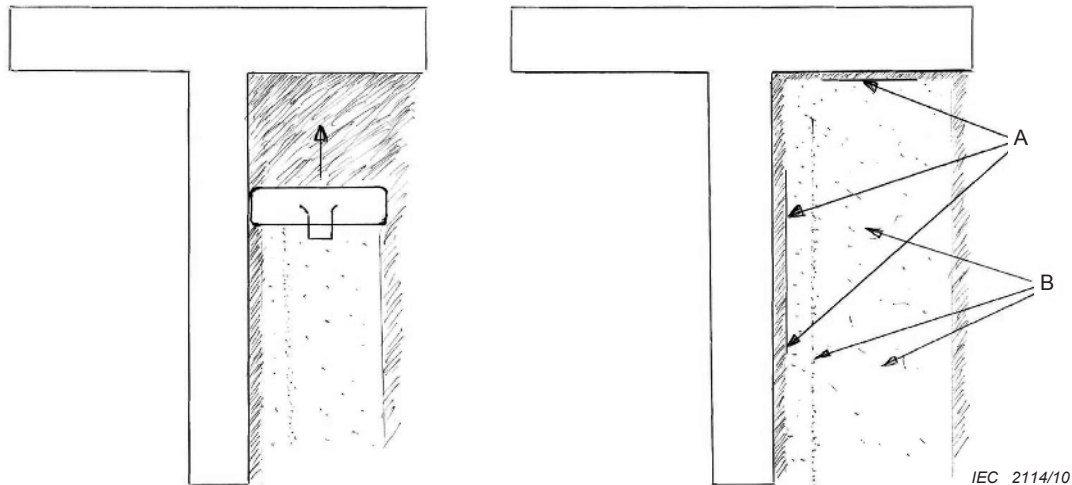
5.4.3 Determination of dust removal ability along walls

The T is placed over the dust-covered area of the test surface and, if necessary, secured by clamps or weights. When placed on a test carpet, the leg of the T shall be located parallel with the direction of the carpet pile (see Figure 1).

One double stroke is carried out at a speed of $(0,25 \pm 0,05)$ m/s with the cleaning head guided along one side of the leg of the T, pausing for 2 s to 3 s at the end of the forward stroke to define the limit of the front edge cleaning.

The width of the visible uncleaned area is measured at three equally spaced points along the leg and along the cross-bar of the T to establish, to the nearest millimetre, two mean values representing the dust removal ability along walls, at the side and in the front of the cleaning head, both values being reported. See Figure 2 for guidance.

If the cleaning head is not symmetrically constructed, the test is repeated along the other side of the leg of the T.



Shows cleaning head being moved forward through applied dust until the cross of the “T” is reached.

After cleaning head is removed measurements are made to where the dust is most undisturbed “A”. Random remaining dust particles or where possibly a belt guard is situated, are ignored “B”.

Figure 2 – Determination of cleaning area

5.5 Fibre removal from carpets and upholstery

5.5.1 General

The vacuum cleaner shall be equipped with the cleaning head designed for the surface to be cleaned.

5.5.2 Fibre removal from carpets

5.5.2.1 Test carpet

A Wilton test carpet, in accordance with 7.2.1.3.2, shall be used. Test carpets designated for fibre removal tests shall not be used for other tests.

Prior to each measurement, the surface of the test carpet shall be cleaned thoroughly until the carpet surface is visually free of remaining fibres.

5.5.2.2 Distribution of fibres

For the distribution of fibres, a stencil, in accordance with Figure 3, shall be used. The stencil shall be 3 mm in thickness, have 95 holes, 30 mm in diameter, and be free from burrs. The stencil shall be placed on the test carpet with its 1000 mm long sides parallel to the warp.

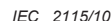


Figure 3 – Stencil for distribution of fibres on test carpets

5.5.2.3 Determination of fibre removal ability from carpets

Remaining fibres may then be removed by carrying out strokes in the direction of the pile not following a specific pattern. The stroke speed shall be $0,5 \text{ m/s} \pm 0,05 \text{ m/s}$ and care shall be taken that the cleaning head is in full contact with the test carpet during the cleaning.

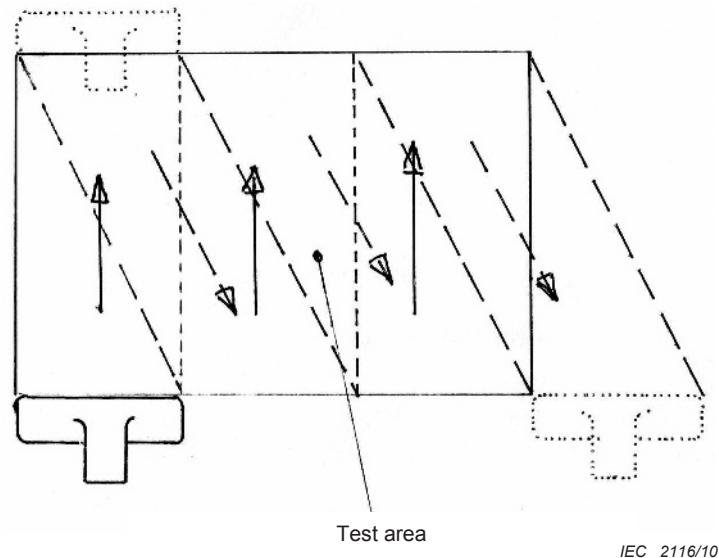


Figure 4 – Zig Zag stroke pattern

The time to remove all fibres (judged visually by the operator from a standing position) shall be recorded. If the cleaning time exceeds 180 s, the cleaning is discontinued.

Three separate measurements shall be carried out to establish a mean value of the fibre removal ability. The time to remove fibres sticking to the cleaning head shall not be taken into account.

5.5.3 A1 Fibre removal from upholstery A1

5.5.3.1 Test cushion

A test cushion, in accordance with 7.2.6, shall be used. Prior to each measurement, the surface of the test cushion shall be cleaned thoroughly until the cushion surface is visually free of remaining fibres.

The test cushion shall be placed in a wooden frame, in accordance with Figure 5, to give a working height of about 480 mm above the floor. The frame shall be provided with an adjustable stop strip, which shall rest on the test cushion and be immovable during the measurements.