IEC 60312-2

Edition 1.0 2010-09

INTERNATIONAL STANDARD

Vacuum cleaners for household use –
Part 2: Wet cleaning appliances – Methods of measuring the performance

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INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

PRICE CODE S

ICS 97.080

ISBN 978-2-88912-155-7

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

VACUUM CLEANERS FOR HOUSEHOLD USE –

Part 2: Wet cleaning appliances – Methods of measuring the performance

FOREWORD

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International Standard IEC 60312-2 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:

CDV	Report on voting
59F/192/CDV	59F/194/RVC

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,
- withdrawn,
- replaced by a revised edition, or
- amended.

A bilingual version of this publication may be issued at a later date.

VACUUM CLEANERS FOR HOUSEHOLD USE –

Part 2: Wet cleaning appliances – Methods of measuring the performance

1 Scope

This part of IEC 60312 is applicable to wet cleaning appliances for household use in or under conditions similar to those in households.

The purpose of this standard is to specify essential performance characteristics of wet cleaning appliances being of interest to the users and to describe methods for measuring these characteristics and is complementary to the methods for dry cleaning vacuum cleaner in IEC 60312-1.

NOTE 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.

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 60312-1, *Vacuum cleaners for household use – Part 1: Dry vacuum cleaners – Methods for measuring the performance*

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, *Cement – Test methods – Determination of strength*

CIE 15.2:1986, *Colorimetry*

3 Terms and definitions

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

3.1
cleaning head
plain nozzle or a brush attached to a connecting tube, or a power nozzle, separate or part of the appliance housing, and that part of a vacuum cleaner which is applied to a surface to be cleaned

3.2
active nozzle
cleaning head provided with an 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)

3.3
self-propelled cleaning head
cleaning head provided with a propulsion mechanism

3.4
extractor
wet cleaning appliance with the cleaning head forming an integral part of or directly connected to the cleaner housing, the cleaning head may be 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

3.5
forward stroke
forward movement of a stroke pattern

NOTE On test carpets, forward strokes are normally carried out in the direction of the carpet pile (direction of manufacture) unless otherwise indicated.

3.6
return stroke
backward movement of a stroke pattern

3.7
stroke speed
speed of the cleaning head, moved as uniformly as possible, during a forward or a return stroke

3.8
stroke length
distance between the two parallel lines defining the limits of a stroke pattern

3.9
stroke pattern
arrangement of the forward and return strokes on the surface to be cleaned

3.10
cleaning cycle
for a given measurement, the sequence of forward and return strokes to be carried out at a specified stroke speed over the test area according to the appropriate stroke pattern

3.11
wet cleaning appliance
electrically operated appliance that applies cleaning solution and removes soil together with solution from the surface to be cleaned by an airflow created by a vacuum developed within the unit. The material and solution thus removed is separated in the appliance and the cleaned dry suction air is returned to the ambient

3.12
passive nozzle
cleaning head without any agitation devices

3.13
cleaning head width
the external maximum width of the cleaning head in millimetres

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.

If test procedures and measurements are carried out at other than standard atmospheric conditions, the ambient temperature shall be maintained at (23 ± 5) °C.

4.2 Test equipment and materials

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, soil, test dust etc.) to be used in a test shall, prior to the test, be kept for at least 16 h at standard atmospheric conditions according to 4.1.

NOTE It is recommended that carpets that are already being used shall be stored unbeaten at standard atmospheric conditions according to 4.1. When not in use they should be hanging free, not lying or rolled.

4.3 Voltage and frequency

Measurements shall be carried out at rated voltage with a tolerance of ±1 % and, if applicable, at rated frequency.

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

For wet cleaning appliances 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 wet cleaning appliance and attachments

Prior to the initial test, the wet cleaning appliances and their attachments, if any, shall be kept running with unrestricted air flow for at least 2 h to ensure adequate running-in. For extractors

with agitation or power nozzles, the agitation device shall be running but not in contact with the floor.

NOTE Clean water should be flushed through unit prior to testing (pump does not need to be run-in other than when flushing the unit with clean water.

4.5 Equipment of the wet cleaning appliance

If the wet cleaning appliance is provided with a permanent dirt receptacle, plastic receptacles may be washed and dried thoroughly.

4.6 Operation of the wet cleaning appliance

The wet cleaning appliance and its accessories shall be used and adjusted in accordance with the manufacturer's instructions for normal operation for the test to be carried out.

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.

4.7 Conditioning prior to tests

The wet cleaning appliance and attachments to be used shall then be kept running for at least 2 min under the provisions given in 4.4 to allow them to stabilise.

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

NOTE It is recommended that a minimum of three should be used to achieve statistically significant results.

Tests carried out to simulate stresses that 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.

4.8 In-house reference cleaner system(s)

It is 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 (new carpet batch)

5 Cleaning tests

5.1 Dry cleaning tests

For combined dry and wet cleaning appliances the performance related to dry cleaning shall be measured by applying the methods in IEC 60312-1.

Where appropriate dry cleaning tests are required, methods included in IEC 60312-1 shall be used.

5.2 Wet cleaning tests

5.2.1 Wet cleaning effectiveness on carpet

5.2.1.1 General

NOTE A new test is under active consideration.

The purpose of this test is to evaluate the cleaning action of a wet cleaning appliance and detergent and the wet cleaning functions of combined dry and wet cleaning appliances.

The cleaning effectiveness is determined from measurements of the brightness change in identically treated carpet samples.

In addition, cleaned carpet samples may be assessed visually in respect of fabric appearance, streaks and blotches.

5.2.1.2 Test carpet samples

At least five carpet samples, in accordance with 7.2.1, shall be used for a wet cleaning appliance test. The carpet samples shall be from the same production batch.

Prior to the test, the carpet samples shall be kept at standard atmospheric conditions for at least 24 h and then be vacuum cleaned using an electric power nozzle with horizontal brush roll. The whole surface of each sample shall be covered with 20 double strokes with the forward strokes in the direction of the pile and at a stroke speed of 0,5 m/s. The weight after vacuum cleaning of each of the unsoiled carpet samples shall be recorded.

For each of the unsoiled carpet samples the brightness values at five fixed measuring points shall be recorded in accordance with 5.2.1.9.22.

Each carpet sample shall then be artificially soiled according to 5.2.1.33 and undergo the cleaning procedure described in 5.2.1.44.

5.2.1.3 Soiling of carpet sample

5.2.1.3.1 Distribution and embedding of soil

Test soil, in accordance with 7.2.2, shall be distributed with a mean coverage of 145 g/m^2 as uniformly as possible over the carpet sample.

NOTE For uniform distribution of the soil a device similar to the one described in 7.2.3 should be used.

The soil shall then be embedded into the carpet pile by carrying out five double strokes along the direction of the warp with a roller, in accordance with 7.2.4 at a stroke speed of 0,2 m/s.

The test soil is worked in by carrying out 30 double strokes with a locked roller, according to 7.2.4, at a stroke speed of 0,2 m/s, the forward strokes being in the direction of the pile.

Ten double strokes are then carried out using a separate electric power nozzle with horizontal brush roll without suction applied (see Annex A). The forward strokes shall be in the direction of the pile and the stroke speed shall be 0,5 m/s.

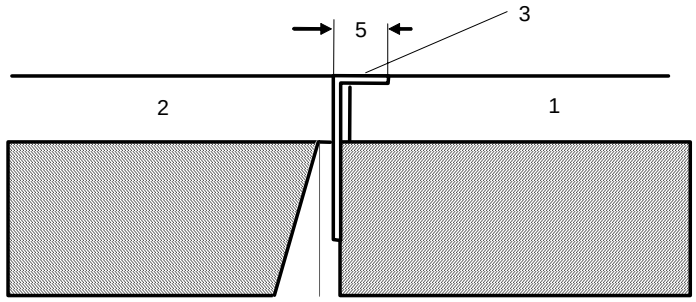
5.2.1.3.2 Removal of loose soiling material

Loose soiling material shall be removed from the carpet sample using the same power nozzle as in 5.2.1.3.1, however with suction applied. Double strokes, with the last stroke in the direction of the pile, shall be carried out, at a stroke speed of 0,5 m/s, until the difference in weight between soiled and unsoiled carpet sample is less than 2 g. The final weight of the soiled carpet sample shall be recorded.

The brightness values for the soiled carpet sample shall be recorded in accordance with 5.2.1.9.22.

5.2.1.4 Cleaning procedure

The soiled carpet sample shall be fastened into a testing surface in accordance with 7.2.6 from which cleaning agent residues and dirt have previously been removed. The carpet sample shall be kept in place during the test by a clamping arrangement as indicated in Figure 1.



Dimensions in millimetres

Key

1 Carpet sample
2 Testing surface
3 Clamping frame

Figure 1 – Clamping arrangement for carpet sample

5.2.1.5 Cleaning liquid

Prior to the cleaning of the carpet sample, the cleaning liquid container of the appliance shall be filled to its maximum level mark with cleaning liquid according to the manufacturer's recommended detergent and dilution. The temperature of the water used for dilution shall be in accordance with the manufacturer's instructions. If not given, the water shall be at ambient temperature. The water hardness and the water temperature shall be recorded.

The water temperature shall not exceed 40 °C.

Unless the appliance is equipped with an automatic mixing feature, the cleaning liquid shall be mixed according to the manufacturer's instructions.

If equipped with an automatic mixing feature, this shall be set to standard cleaning mode.

5.2.1.6 Operation of the wet cleaning appliance

The appliance shall be assembled for wet cleaning in accordance with operation instructions and, unless otherwise specified, any input power control shall be set at maximum for all strokes. With suction applied, the strokes are of the following types:

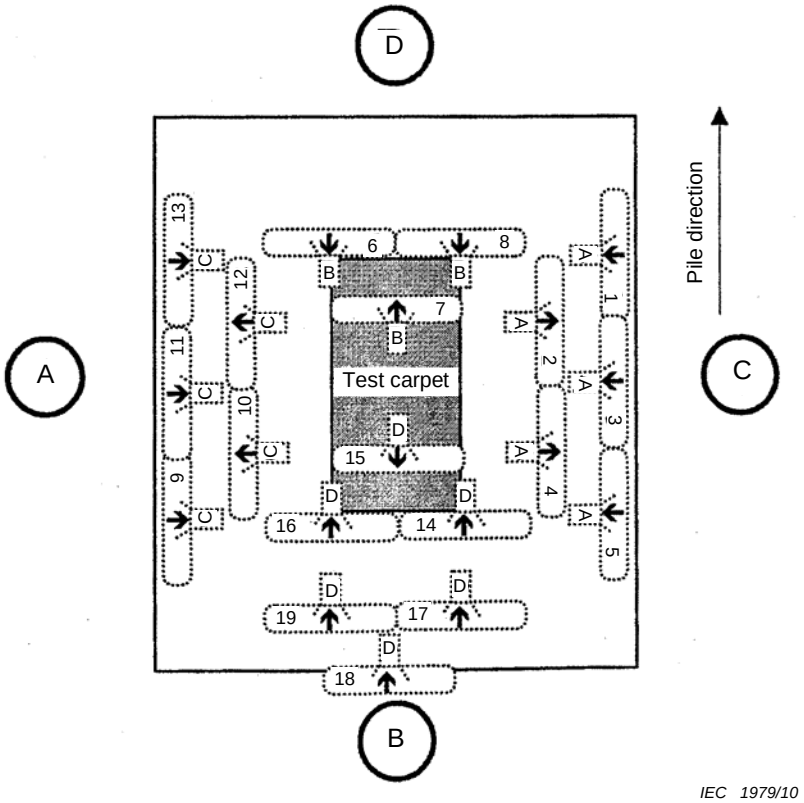
- wet stroke: while cleaning liquid is discharged, the cleaning head is moved over the testing surface at a stroke speed of (0,2 ± 0,05) m/s;
- dry stroke: without cleaning liquid being discharged, the cleaning head is moved over the testing surface at a stroke speed of (0,2 ± 0,05) m/s.

5.2.1.7 Cleaning pattern

The cleaning operation shall be performed from all four sides of the testing surface with wet strokes in parallel to the edges of the carpet sample.

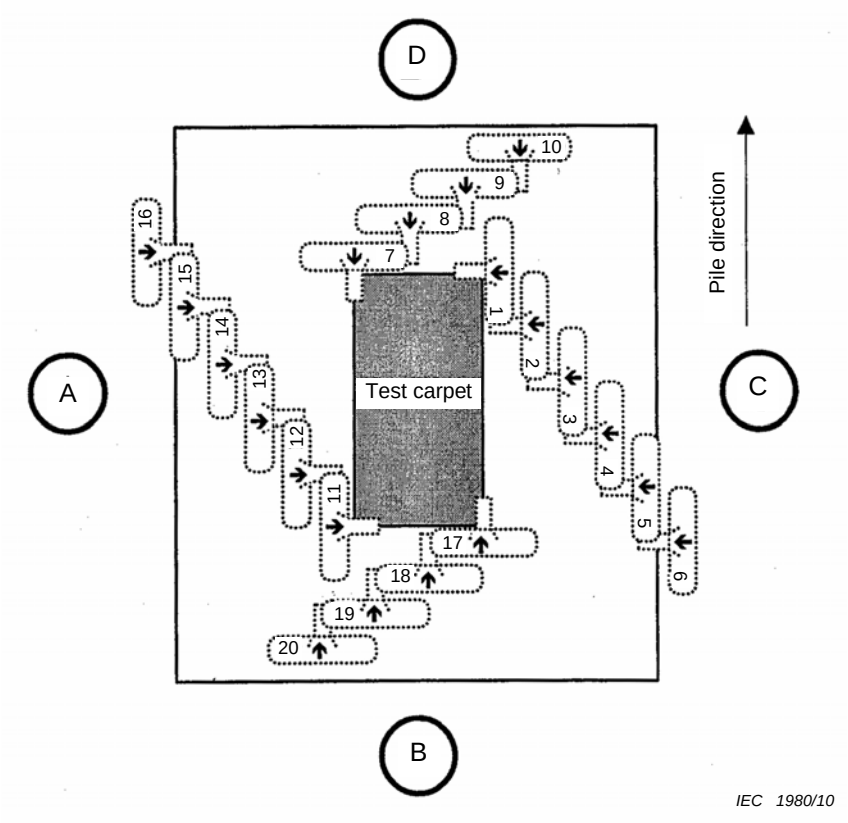
The first stroke shall be carried out such that half the cleaning head width is moved over the carpet sample. Subsequent strokes are then carried out with the cleaning head successively shifted by half the cleaning head width until it is no longer within the carpet sample.

If the appliance allows the cleaning head to be moved forward and backward, the direction of the wet strokes shall in turn be inverted (see Figure 2). If the cleaning head can be moved in one direction only, all strokes shall be carried out in that direction (see Figure 3). After the cleaning, dry strokes shall be carried out in the direction of the pile.



Strokes 17 to 19 are dry strokes.

Figure 2 – Cleaning pattern for appliances with cleaning head used in forward and backward strokes



For drying, repeat strokes 17 to 20 as dry strokes.

Figure 3 – Cleaning pattern for appliances with cleaning head only used in backward strokes

5.2.1.8 Drying of the carpet sample

After the cleaning, the carpet sample shall be left to dry on a level surface without any heat being applied.

The drying process shall be monitored by recording the weight of the carpet sample after the wet cleaning and after 24 h drying, the values being compared with the weights of the unsoiled and the soiled carpet samples (see 5.2.1.22 and 5.2.1.3.2).

The brightness values for the cleaned carpet sample shall be recorded in accordance with 5.2.1.9.2.

5.2.1.9 Determination of wet cleaning effectiveness

5.2.1.9.1 General

In order to minimize the influence of variable soiling level on a carpet sample, the mean of the values of cleaning effectiveness, determined at five fixed measuring points according to 5.2.1.9.22, shall be calculated.

For each measuring point, the cleaning effectiveness, in per cent, is calculated from the following formula (1):

$$\text{Cleaning effectiveness} = (1 - (\Delta R_{y1}/\Delta R_{y2})) \times 100 \quad (1)$$

where

ΔR_{y1} is the brightness change between the cleaned and the unsoiled carpet samples;

ΔR_{y2} is the brightness change between the soiled and the unsoiled carpet samples.

Finally, the cleaning effectiveness is calculated as the mean of the results obtained for all the carpet samples chosen to be used in the test (see 5.2.1.22).

5.2.1.9.2 Colorimetric measurements

For the colorimetric measurements a spectrophotometer in accordance with 7.2.7 shall be used.

The five measuring points shall be located along the diagonals of the carpet sample, four of them close to the corners of the sample. The positioning of the spectrophotometer on the measuring points shall be ±5 mm, preferably by utilizing a stencil plate with holes adapted to the measuring head of the spectrophotometer.

The gloss of the carpet sample is variable and influenced by handling. In order to minimize the influence of the variation of gloss on the measurements, a ruler or straight edged implement shall be passed gently over the surface of the carpet in the direction of the pile.

5.2.1.9.3 Visual assessment

The visual assessment of cleaned carpet samples shall be conducted in a light box suitable for accommodating at least three samples. One of the samples shall be unsoiled and one soiled. The assessment shall be carried out by three independent observers.

5.2.2 Re-soiling

A test to measure the effects of re-soiling after an initial cleaning is under consideration

5.2.3 Drying time

A test to measure time taken for drying after cleaning is under consideration.

5.2.4 Maximum usable capacity of dirt recovery receptacle

A test to measure the usable volume of the dirt recovery receptacle is under consideration.

5.2.5 Maximum usable capacity of cleaning liquid dispensing tank

A test to measure the maximum usable capacity of the cleaning liquid dispensing tank is under consideration.

5.2.6 Maximum flow rate of cleaning liquid

A test to measure the maximum flow rate of the cleaning liquid is under consideration.

5.2.7 Maximum pick up rate of soiled liquid

A test to measure the maximum pick up rate of soiled liquid is under consideration.

5.2.8 Wet cleaning of hard surfaces

A test to measure the wet cleaning performance on hard surfaces is under consideration.

5.2.9 Wet cleaning of upholstery

A test to measure the performance of wet cleaning of upholstery is under consideration.

6 Miscellaneous tests

6.1 General

The tests described in this section are intended for the determination of such characteristics of a wet cleaning appliance which relate to ease of handling or to the performance of the cleaner when it, its accessories or attachments have been subjected to stresses likely to appear during normal use. The ability of a cleaner to resist such stresses may be verified by submitting it to the appropriate tests of Clause 5 as applicable. Suitable tests from IEC 60312-1, Clause 6 may also be applied where appropriate.

6.2 Motion resistance

Under consideration.

6.3 Life test

Under consideration.

6.4 Mass

The mass of the wet cleaning appliance, attachments and accessories, if any, shall be determined and reported. The mass of the wet cleaning appliance includes the contribution of the power supply cord and the accessories placed inside the accessory compartment, if provided, and shall be reported in grams.

NOTE Standard atmospheric conditions according to 4.1 not required.

6.5 Weight in hand

This test method is under development and proposals are requested from National Committees or individual WG3 experts for the next edition.

6.6 Specific cleaning time

Under consideration.

6.7 Dimensions

Only those dimensions of importance for the storage of the appliance shall be reported. All dimensions shall be reported in millimetres.

6.8 Noise level

See IEC 60704-1 and IEC 60704-2-1.

6.9 Energy consumption

Under consideration for wet cleaning appliances.

7 Test material and equipment

7.1 General

This section contains information on material and on the principal designs of suitable equipment to be used in various tests. It should be noted that only as far as possible the composition of a material (see Annex A) has been specified.

7.2 Material for measurements

7.2.1 Test carpet for wet cleaning

A carpet with the following features is suitable for wet cleaning test on carpets:

type: tufted velour, untreated for stain protection

wear layer: 100% polyamide

base: polypropylene – fleece

backing: non-coated textile

pile height: (5 ± 0,5) mm

thickness: (8 ± 0,5) mm in total

colour: light beige

size: 300 mm × 200 mm with the longer side in parallel with direction of the pile

7.2.2 Test soil

Soil for test of wet cleaning effectiveness on carpet shall be a homogeneous mixture of

1 part by weight: grease-free grey pigment

3 parts by weight: sieved carpet dirt, collected from household vacuum cleaners

25 parts by weight: sieved from CEM 1 according to ISO 679, grain size: 0,09 mm/0,20

For each series of tests, the test soil shall be from the same production batch and mixed at one time.

The test soil is prepared in two steps, using a soil mixer in accordance with 5.2.1.7. First, the grease-free grey pigment and sieved carpet dirt are mixed at 20 r/min for 15 min. Then the carpet test dust is added and mixed at 60 r/min for 30 min.

NOTE 1 The test soil should be handled carefully in order to prevent components from separating.

NOTE 2 It is recommended to mix a minimum batch of 500 g.

7.2.3 Dust spreader

The device consists of a tray extending across the width of the test area and mounted on a trolley, which can be moved along the length of the test area without impinging upon it. When the trolley is moved back and forth over the test area, a vibratory action causes the test dust, which has been placed evenly along the tray, to emerge from a line of suitably sized holes along the base of the tray, equally spaced and sufficient in number to cover the test area uniformly with test dust.

The vibratory action may be brought about by an incorporated vibrator or by the trolley running on spur racks as indicated in Figure 4.

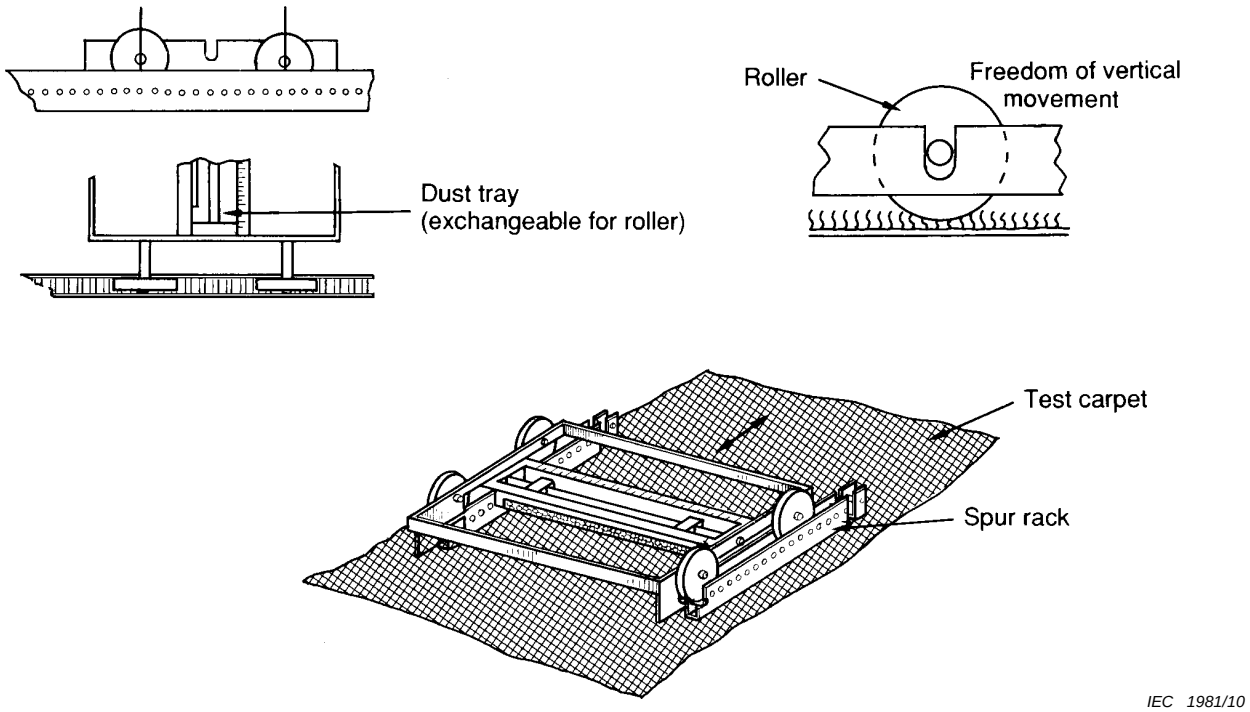


Figure 4 – Dust spreader and roller for embedding dust into carpets

7.2.4 Roller for embedding

The roller shall have a diameter of 50 mm and a length of at least 380 mm such that it is at least 20 mm longer than the cleaning head width. The roller is preferably made of steel and polished. It can be provided with a handle for rolling by hand or be driven by a motorized unit. It shall be equipped with a means for locking for use in Subclause 7.2.4.

The mass of the roller, if applicable, shall be 10 kg per metre length.

7.2.5 Weighing machine

The weighing machine used in connection with tests on dust removal ability and for verification of the pre-cleaning of the test carpet shall have an accuracy of 0,01 g.

7.2.6 Testing surface for wet cleaning tests

The testing surface consists of a carpet template, on a level test floor, with a centrally placed cut out to encompass a carpet sample. The material of the carpet template shall be similar to the carpet samples used for the test. In order that the cleaning head will remain on similar material during the test, the size of the template shall be at least 1 200 mm × 1 100 mm.

7.2.7 Spectrophotometer

The spectrophotometer shall provide brightness (reflectance) data at a minimum of 16 wavelengths spaced at 20 nm intervals or closer between 400 nm and 700 nm in accordance with the following conditions:

parameter:	tristimulus value Y (CIE 15.2:1986)
illuminant/observer:	D65 / 10°
measuring geometry:	d / 8º – 10º

UV-filter:	UV barrier at 420 nm, i.e. without UV radiation
gloss / specular:	excluded, i.e. measurements with open gloss / specular trap
measuring diameter:	minimum 20 mm

Each time the spectrophotometer is switched on, or at least once per working day, the instrument shall be calibrated using as white standard a barium sulphate tablet or a certified white ceramic tile, and as black standard a black body, a light trap or a certified black ceramic tile. The calibration procedure may also be specified by the instrument manufacturer.

The spectrophotometer shall be tested at least once a year for its operating efficiency.

7.2.8 Test soil mixer

The mixer consists of a drum, with a horizontal axis, which can be operated at 20 r/min to 100 r/min. The inside diameter of the drum shall be 200 mm and the inside length shall be 300 mm.

8 Instruction for use

It shall be checked whether the manufacturer's instructions for use contain information about the use of the appliance and its accessories, if any, and about the cleaning necessary to ensure the proper performance of the appliance.

Annex A
(informative)

Information on materials

For the convenience of users of this International Standard, information on suppliers of test materials and details of test equipment are available on the IEC website. This information can be accessed via a link that can be found in the abstract of IEC 60312-2 on the IEC web – www.iec.ch. This information is given for the convenience of users of this International Standard and does not constitute an endorsement by IEC of the suppliers named.

This information will be continuously updated.

Annex B
(informative)

Information at the point of sale

The following information for the consumer shall be provided at the point of sale, if applicable:

a) type of cleaner;
b) voltage/voltage range (V);
c) frequency (Hz);
d) power input (W);
e) cord length (m);
f) weight (g) (the weight of the vacuum cleaner, attachments and accessories);
g) dimensions (dimensions concerning the storage of the vacuum cleaner);
h) noise level;
i) energy consumption (kWh);
j) filtration specification.

Bibliography

IEC 60335-1:2010, *Household and similar electrical appliances – Safety – Part 1: General requirements*

IEC 60335-2-2:2009, *Household and similar electrical appliances – Safety – Part 2-2: Particular requirements for vacuum cleaners and water-suction cleaning appliances*

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