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British Standard Methods of  
**Measuring the performance of household  
electrical appliances**

**Part 12. Vacuum cleaners**

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Méthodes de mesure des caractéristiques de fonctionnement des appareils électro-domestiques  
Partie 12. Aspirateurs

Verfahren zur Messung der Leistung von elektrischen Haushaltsgeräten  
Teil 12. Staubsauger

## CONTENTS

|                                                                                    | Page       |
|------------------------------------------------------------------------------------|------------|
| Foreword .....                                                                     | 1          |
| Cooperating organizations .....                                                    | Back cover |
| <br><b>Methods</b>                                                                 |            |
| <br><b>SECTION ONE — GENERAL</b>                                                   |            |
| 1. Scope .....                                                                     | 2          |
| 2. Object .....                                                                    | 2          |
| <br><b>SECTION TWO — DEFINITIONS</b>                                               |            |
| 3. Terms and definitions .....                                                     | 2          |
| <br><b>SECTION THREE — LIST OF TESTS AND GENERAL REQUIREMENTS FOR MEASUREMENTS</b> |            |
| 4. List of tests .....                                                             | 4          |
| 5. General conditions for measurements .....                                       | 5          |
| 5.1 Atmospheric conditions .....                                                   | 5          |
| 5.2 Test floor .....                                                               | 5          |
| 5.3 Voltage and frequency .....                                                    | 5          |
| 5.4 Equipment and operation of the vacuum cleaner .....                            | 5          |
| 5.5 Conditioning of vacuum cleaner and testing equipment prior to test .....       | 6          |
| 5.6 Running time of vacuum cleaner (and attachments) prior to measurement .....    | 6          |
| 5.7 Initial dust application to hose, extension tubes, etc. ....                   | 6          |
| 5.8 Special requirements for upright cleaners or power nozzles .....               | 6          |
| 5.9 Adjustment of controls .....                                                   | 6          |
| 5.10 Number of samples .....                                                       | 6          |
| <br><b>SECTION FOUR — METHODS OF MEASUREMENT</b>                                   |            |
| 6. Dust removal — General .....                                                    | 7          |
| 6.1 Object .....                                                                   | 7          |
| 6.2 Units of measurement .....                                                     | 7          |
| 6.3 Test procedure .....                                                           | 7          |
| 7. Dust removal from carpets .....                                                 | 9          |
| 7.1 Object .....                                                                   | 9          |
| 7.2 Test procedure .....                                                           | 9          |
| 8. Dust removal from hard flat floors .....                                        | 10         |
| 8.1 Object .....                                                                   | 10         |
| 8.2 Test procedure .....                                                           | 10         |
| 9. Dust removal from hard floors with crevices .....                               | 11         |
| 9.1 Object .....                                                                   | 11         |
| 9.2 Test procedure .....                                                           | 11         |
| 10. Dust removal along walls .....                                                 | 12         |
| 10.1 Object .....                                                                  | 12         |
| 10.2 Test procedure .....                                                          | 12         |
| 11. Cleaning under furniture .....                                                 | 13         |
| 11.1 Object .....                                                                  | 13         |
| 11.2 Test procedure .....                                                          | 13         |
| 12. Thread removal from carpets .....                                              | 13         |
| 12.1 Object .....                                                                  | 13         |
| 12.2 Test procedure .....                                                          | 13         |
| 13. Fibre removal from carpets .....                                               | 14         |
| 13.1 Object .....                                                                  | 14         |
| 13.2 Test procedure .....                                                          | 14         |
| 14. Radius of operation .....                                                      | 15         |
| 14.1 Object .....                                                                  | 15         |
| 14.2 Determination of the radius of operation .....                                | 15         |

**Amendment No. 1  
published and effective from 15 September 1993  
to BS 3999 : Part 12 : 1982**

**Methods of measuring the performance of  
household electrical appliances  
Part 12. Vacuum cleaners**

**Revised text**

AMD 7765  
September 1993

**Contents**

Delete the existing entry for clause 16 and substitute the following.

- '16. Determination of the reduction in air flow with partly filled dust receptacle  
16.1 Object  
16.2 Test procedure  
16.3 Determination of the reduction in air flow'

After the title of clause 22, delete '(under consideration)'.

AMD 7765  
September 1993

**Foreword**

In paragraph 1, line 3, after the title of IEC 312, insert 'as amended by Amendment No. 1 published in December 1985 and Amendment No. 2 published in January 1993,'.

AMD 7765  
September 1993

**2. Object**

Delete 'BS 3456 : Section 3.3' and substitute 'BS 3456 : Section 202.2'.

AMD 7765  
September 1993

**3. Terms and definitions**

*Add, on page 4 the following definitions:*

**3.20 Test width**

The outside cleaning head width less 20 mm (10 mm per side).

**3.21 Active depth of cleaning head**

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



## 5.1 Atmospheric conditions

*Replace the existing text by:*

Unless otherwise specified, the measurements shall be carried out under the following conditions (in accordance with ISO 554: 1976, *Standard atmospheres for conditioning and/or testing – Specifications*).

Standard atmosphere 23/50

Temperature: (23 ± 2) °C

Relative humidity: (50 ± 5) %

Air pressure: 86 kPa to 106 kPa (860 mbar to 1 060 mbar)

Notes 1.- Constant temperature and humidity conditions within the specified range are required for good repeatability and reproducibility. Moreover, care should be exercised to avoid changes during testing.

2.- Reference for laboratories for setting the correct values:

Wet-bulb temperature: 16.3 °C

Vapour pressure: 1.41 kPa (14.1 mbar)

Water content: 8.8 g/kg dry air

## 5.4 Equipment and operation of the vacuum cleaner

*Add the following sentence to the end of the first paragraph:*

The grip of the extension tube of canister cleaners or the handle of other cleaners is held as for normal operation at a height of (80 ± 5) cm above the floor.

*Delete the last paragraph and substitute the following note:*

Note: If the cleaner has additional filter(s) and the manufacturer recommends periodic cleaning or replacement by the user in the instructions, the above requirements will also apply.

## 6.3 Test procedure

### 6.3.1 Test area and stroke length

*Replace the existing text of this subclause by the following two new subclauses:*

#### 6.3.1.1 Carpets

The width of the dust-covered area shall be equal to the test width. The length of the dust-covered area shall be 0,7 m.

The stroke length shall be 1,2 m by adding 0,2 m before and 0,3 m after the dust-covered area. These additional lengths are required for acceleration and deceleration of the cleaning head in order to achieve a constant speed over the dust-covered area.



Thus, at the start of the forward stroke, the front edge of the cleaning head is at the beginning of the acceleration area and at the end of the stroke the front edge of the cleaning head is at the end of the deceleration area. (For information on pile direction, see figure 2B.)

#### 6.3.1.2 *Hard floors*

The dust-covered part of the test area shall be 0,7 m x 1,0 m.

In the measurements, a part equal to the depth of the active part of the cleaning head submitted for the measurements is added at each end of the dust-covered part. The stroke length is equal to 0,7 m + twice the depth of the active part of the cleaning head (see figure 2A).

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AMD 7765  
September 1993

#### 6.3.2 *Distribution of test dust*

*Replace the existing text of this subclause by:*

##### 6.3.2.1 *Carpets*

Test dust, as specified in A1.2.4, shall be distributed, with a mean coverage of 125 g per square metre, as uniformly as possible over the test area.

*Note.*— The amount of test dust to be used is calculated from the formula  $T_w \times 0,7 \times 125$  g, where  $T_w$  equals the test width in metres. For uniform distribution of the test dust on the test area, it is recommended that a distribution device, as specified in A2.2.2, be used. The adjustment of the device is checked by visual examination of the test dust on the carpet.

##### 6.3.2.2 *Hard floors*

35 g of mineral dust, in accordance with A1.2.1, shall be distributed as uniformly as possible over the test area.

For uniform distribution of the test dust on the test area, either a distribution hood, in accordance with A2.2.1 or a dust distribution device handled by a skilled test operator (in accordance with figure 4B) or any other equivalent method, may be used.

*Notes 1.*— When using a distribution hood, the 35 g of dust is fed into a the funnel for a period of 2 min. Each wall of the hood is then subjected to two blows from the lead shot filled pendulum. The dust is then allowed to settle for 5 min.

*2.*— In order to ensure that all the test is distributed within the test area, the use of a 0,7 m x 1,0 m frame is recommended when using a distribution device similar to that shown in figure 4B.

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AMD 7765  
September 1993

#### 6.3.3 *Determination of track width*

*Replace the first paragraph by:*

For testing cleaning heads on the hard floor, the mineral dust, as specified in A1.2.1, shall be distributed over the test area in accordance with 6.3.2.2 for testing cleaning heads on the hard floor. When testing cleaning heads on the carpet, the mineral dust shall be distributed over a similar area on the test carpet.



#### 6.3.4 *Determination of dust removal ability*

*Replace the existing text by:*

##### 6.3.4.1 *Carpets*

The cleaning head is positioned with the front edge at the beginning of the acceleration area and centered so that it overlaps the test area by 10 mm at either side.

The cleaning head is moved forwards over the test area at uniform standard stroke speed. The cleaning head is stopped when its front edge is at the end of the deceleration area and is then pulled backwards over the test area at uniform standard stroke speed until the front edge of the cleaning head is once more at the start of the forward stroke. This is one complete cycle.

It is important that the cleaning head be kept moving at uniform speed over the test area and that it follows a straight line by using carpet hold downs as guides (see A2.13). It is recommended that a mechanical operator which simulates the test as described be used for this test (see A2.14).

Notes 1.- The two metal hold downs described in A2.13 serve two purposes: first, to hold the test carpet in position throughout testing and second, to act as guides to keep the cleaning head in a straight line as it is operated over the test area.

2.- Self-propelled cleaning heads should be tested in accordance with the manufacturer's instructions. Hence the speed of movement will be determined by the cleaner itself.

##### 6.3.4.2 *Hard floors*

The stroke width of the cleaning head is marked on two scales, situated parallel to the upper and lower border lines of the dust-covered test area at a distance equal to the depth of the cleaning head as guides for the correct positioning of the strokes during the cleaning.

The cleaning head shall be moved over the test area in a zig-zag pattern in accordance with 3.8.

In order to obtain an approximately symmetrical distribution of forward and return strokes over the dust-covered area, each cleaning cycle is started with a (blind) forward stroke outside the dust-covered test area in the lower left corner of the working area.

The cleaning is carried out at standard stroke speed, unless the cleaning head is self-propelled, taking care that the cleaning head is in full contact with the surface and no extra pressure is exerted on it. The cleaning is continued until the entire test area is covered. The last strip to be cleaned is usually narrower than the stroke width of the cleaning head.

To check the average speed of the nozzle or brush it is recommended to use a metronome or similar device.



## 7.1 Object

*Replace the existing text of the note by:*

For the purpose of enabling internal or interlaboratory comparison of test results, a reference cleaner system is under consideration.

## 7.2 Test procedure

*Replace the existing text by:*

### 7.2.1 Test carpets

For the measurements, carpets in accordance with A1.1.1 and A1.1.2 shall be used. Due to the significant effects of humidity on this test it is important that any carpets being used for the test are left in the test environment at the correct ambient conditions for 48 h before testing is due to commence.

### 7.2.2 Removal of remaining dust from carpets

Before and between measurements, the test carpet shall be cleaned by beating and brushing.

When beating by hand, the test carpet should be placed upside down on a rigid mesh support. After beating by hand, four to six cleaning cycles with a vacuum cleaner having good dust removal ability should be carried out to remove the remaining dust. Test carpets designated for testing plain nozzles should only be cleaned with a plain nozzle on the face (although an agitator cleaner or a power nozzle may be used on the back).

However, it is recommended that a suitable carpet-beating machine such as described in A2.1 be used for cleaning the carpet.

### 7.2.3 Verification and preconditioning of the test carpet

After cleaning the test carpet, the vacuum cleaner under test shall be fitted with a clean bag 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 dust quantity removed from the test area during five double strokes is less than 0,2 g. If the amount is greater than 0,2 g, repeat this step until the requirement is achieved.

Notes 1.- Even if the equipment for removing dust from the carpet before and between tests is known to be sufficiently reliable to leave the carpet in an acceptable condition, it is still important to carry out this procedure of preconditioning to ensure that the effects of humidity on the carpet is minimized.

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

### 7.2.4 Distribution of test dust

The dust is distributed according to 6.3.2.1.

The 0,7 m length of the test area shall be parallel with the direction of the warp (or direction of manufacture). See figure 2B.



### 7.2.5 Embedding the dust into the carpet

The dust is embedded into the carpet by making ten double strokes with the roller as specified in A2.3.2 over the test carpet in the same direction as the test. The speed of the roller shall be 0,5 m/s. It is important to ensure that the test area is completely and evenly rolled. The carpet is left for 10 min to recover from the rolling.

### 7.2.6 Preconditioning of dust receptacle

In order to minimize the effects of humidity on this test, the dust receptacle to be used for the test shall be preconditioned by fitting it to the vacuum cleaner under test and allowing the cleaner to run with an unimpeded air stream for 8 min as for instance, during the 10-min period of carpet recovery.

After this preconditioning, the dust receptacle is removed from the cleaner to be weighed. The weight is noted and the dust receptacle is replaced.

Note.- It should be noted that the cleaner airflow can have an effect on the bag weight during the required 8 min run-in period. Therefore, caution should be taken that the bag weight has stabilized before weighing.

### 7.2.7 Determination of dust removal ability with empty dust receptacle

Three separate measurements, each comprising five cleaning cycles, shall be carried out. Before and between the measurements the sequence of preparation outlined in 7.2.2 to 7.2.6 shall be performed in total. After the fifth cleaning cycle, lift the cleaning head between 20 mm and 100 mm clear of the carpet, switch the cleaner off and wait until the motor has stopped completely.

The weight of the removed dust is determined by removing and weighing the dust receptacle, then subtracting the weight of the empty dust receptacle recorded after the preconditioning described in 7.2.6.

The dust removal ability for five cleaning cycles is calculated as the mean value from the three measurements according to the following formulae:

$$D_r = W_i - W_f$$

$$K_{ct} = D_r / D_d \times 100 \%$$

$$K_m (3) = (K_{ct1} + K_{ct2} + K_{ct3}) / 3$$

where

$W_i$  is the initial (empty) weight of dust receptacle, in grams;

$W_f$  is the weight of dust receptacle after five cleaning cycles, in grams;

$D_r$  is the amount of test dust removed from carpet, in grams;

$D_d$  is the dust quantity distributed on the carpet, in grams;

$K_{ct}$  is the dust removal ability for five cleaning cycles;

$K_m (3)$  is the mean dust removal ability from three measurements.

Note.- If the range of results is greater than three percentage units, two extra measurements shall be made and the mean dust removal ability calculated from the five measurements

$$K_m (5) = (K_{ct1} + K_{ct2} + K_{ct3} + K_{ct4} + K_{ct5}) / 5$$

Example: 45 %, 47 %, and 49 % give a range of four percentage units and two extra measurements shall be carried out.



### 8.2.3 Determination of dust removal ability

Replace the first paragraph by the following:

For the determination of the dust removal ability - often higher than 98% - three separate measurements are carried out, each comprising one cleaning cycle, and the dust removal ability is calculated as the mean value of the three measurements.

Add the following note after this sub-clause:

*Note.- When the mean value is lower than 90%:* should the range of measurements be greater than 3 percentage units, two additional measurements shall be made and the mean value of all measurements be given as the result.

*When the mean value is equal to or higher than 90%:* should the range of measurements be greater than  $0.3 \times (100\% - \text{mean value})$ , two additional measurements shall be made and the mean value of all measurements 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 nozzle in order to ascertain whether there are any factors not previously observed which may be affecting repeatability adversely.

Replace the title and the text of the existing Clause 16 by the following:

## 16. Determination of the reduction in air flow with partly filled dust receptacle

### 16.1 Object

The object of the measurement is to determine the reduction in air flow when an amount of synthetic dust mixture related to the volume of the dust receptacle is introduced.

- Notes 1.-* The maximum usable volume of the dust receptacle according to Clause 15 gives an idea of the maximum value which can be used when in practice the natural dirt is of a fibrous nature.
- 2.-* The reduction in air flow is an indication to what extent that volume can be used in practice if the natural dirt is of a clogging nature.
- 3.-* When expressing the results for consumer information purposes, it is preferable to associate the reduction in air flow with the total quantity of test dust introduced. Example: 40% reduction with 250 g of test dust.



## 16.2 Test procedure

The maximum air flow of the cleaner is measured in accordance with Clause 21. An amount of mineral dust/wood flour mixture in accordance with Sub-clause A1.2.3 is introduced into the cleaner, when running in its normal operating position, at a rate of approximately 100 g/min.

The amount of mineral dust/wood flour mixture is 50 g per litre of receptacle volume measured in accordance with Clause 15.

The air flow is then measured again.

The vacuum cleaner shall be kept running throughout the above procedure.

*Note.* - For upright cleaners the synthetic dust mixture may be introduced using the nozzle adaptor shown in Figure 10A, page 69, or any suitable feeding device.

## 16.3 Determination of the reduction in air flow

The reduction in air flow is calculated from the formula:

$$\text{Reduction in air flow} = \frac{q_{\max} - q_c}{q_{\max}} \times 100\%$$

where:

$q_{\max}$  is the air flow with clean receptacle

$q_c$  is the air flow with the partly filled receptacle

Three separate measurements are carried out to establish a mean value.

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AMD 7765  
September 1993

### 17.4.1 Test methods

Replace the first paragraph of Method 1 by:

A quantity of mineral dust calculated in accordance with the following formula and in accordance with Sub-clause A1.2.1 of Appendix A is introduced into the dust receptacle by hand:

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AMD 7765  
September 1993

### 22. Noise level

Replace the text of this clause by:

See BS 6686 : Part 1 and BS 6686 : Section 2.1.



## **A1. Material for measurements**

### **A1.1 Standard test carpets**

#### **A1.1.1 Quantity and size of carpets**

*Replace the second paragraph by:*

For measurements of thread removal, fibre removal, motion resistance and dust removal along walls, a suitable size for the standard test carpet is 1,2 m weft and 2,0 m warp to provide sufficient test area and allow comfortable handling.

For measurements of dust removal from carpets, a suitable size for the standard test carpet is 0,5 m weft x 2,0 m warp to provide sufficient test area.

### **A1.2 Standard test dust**

#### **A1.2.2 Wood flour**

Add the following note after this sub-clause:

*Note.* - The wood flour is available from:

Hermann Braun  
Postfach 29  
D-3559 BATTENBERG/Eder  
Federal Republic of Germany  
Ordering information:  
Buchenholzmehl/Rotbuche Sichtung 120 feinst

*Add the following subclause:*

#### **A1.2.4 Test dust**

For the test to determine dust removal from carpets, use the following dust:

Test dust: Sieved from CEM 1 according to ISO 679: 1989, *Methods of testing cements – Determination of strength*

Grain size: 0,09 mm / 0,20 mm.

*Note.* - The dust is available from:

Normensand GmbH  
Postfach 1752  
Annastrasse 1  
D – 4720 BECKUM  
Germany



## **A2. Equipment for measurements**

*Add after the title:*

It is recommended that a reference cleaner be used to ensure the consistency and continuity of test results particularly when changing carpets.

### **A2.2 Dust distribution hood**

*Replace the existing title and text by:*

#### **A2.2 Dust distribution**

##### **A2.2.1 Dust distribution hood**

The hood consists of a box-shaped device to be placed over the test area so as to cover it. A fan in the upper part of the hood blows air mixed with dust against a baffle in the hood, thus spreading the dust which is left to settle.

The design of the hood is shown in figure 4A.

The inner dimensions of the hood at the height of the test area surface are 0,7 m x 1,0 m. As shown in the figure, a closed circulation is obtained by the return feeder fitted on the top of the hood. This arrangement restricts the dust to the test area.

Some of the dust injected into the hood adheres to the inside walls. This dust should be removed after each completed dust distribution cycle using a pendulum consisting of a leather bag filled with lead shot (2 mm to 3 mm) suspended by a cord. The weight of the leather bag filled with lead shot is 150 g. The length of the pendulum is 350 mm (half the height of the walls of the device). The dust removal is affected by releasing the pendulum weight from the horizontal position and with the blow directed against the centre of the walls.

With a new hood, two to three preliminary tests are carried out prior to the actual tests so as to stabilize the conditions of adhering dust.

##### **A2.2.2 Dust spreader**

The device consists of a tray extending across the width of the test area. The tray is mounted upon a trolley which can be moved freely along the length of the test area, but does not impinge upon it. The trolley is so designed as to provide a vibratory action to the tray causing the test dust, which has been placed uniformly along the tray, to emerge from a line of suitably sized holes equispaced along the base of the tray and of sufficient number to cover the test area evenly when the trolley is moved to and fro over the test area. See figure 4C.

Drawings are available from:

Vorwerk & Co. Elektrowerke KG  
Rauental 28-38  
D – 5600 WUPPERTAL 2  
Germany



**A2.3 Roller for embedding of dust**

*Replace the existing title and text by:*

**A2.3 Rollers for embedding**

**A2.3.1 Threads into carpets**

The roller shall have a diameter of 70 mm and a weight of 30 kg per metre length. The roller is preferably to be made of steel and polished. It can be provided with a handle for rolling by hand or driven by a motor unit. A convenient weight for rolling by hand is 15 kg.

**A2.3.2 Dust into carpets**

The roller shall have a diameter of 50 mm and a length of 380 mm. 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.

The roller and handle, if applicable, shall exert a weight of 3,8 kg on the carpet. The roller may be incorporated into the dust spreader (see figure 4C).

**A2.9.3 Air flow meter**

Replace the reference to ISO Recommendation R 541 with BS 1042 : Section 1.1.

*Add after A2.12, the following subclauses:*

**A2.13 Carpet hold downs and guides**

The two carpet hold downs shall be 1,4 m x 0,05 m x 0,05 m in dimension and weigh 10 kg each. They shall be designed in such a way so as not to obstruct the air flow at the sides of the cleaning head (see figure 2C). It is recommended that the edges of the hold downs adjacent to the cleaning head are treated to reduce friction.

The hold downs should be placed on either side of the test area with a clearance of not more than 1 mm on either side of the cleaning head.

**A2.14 Mechanical operator**

Details of suitable equipment for measurement of dust removal from carpets (see figure 4D) are available from:

SLG  
Prüf- und Zertifizierung GmbH  
Markt 5  
D – 9016 Chemnitz  
Germany



Figure 2

Renumber figure 2 to figure 2A and replace the title by:

Stroke length in the measurements of dust removal from hard floors and of thread removal.

Add the following figures 2B and 2C:

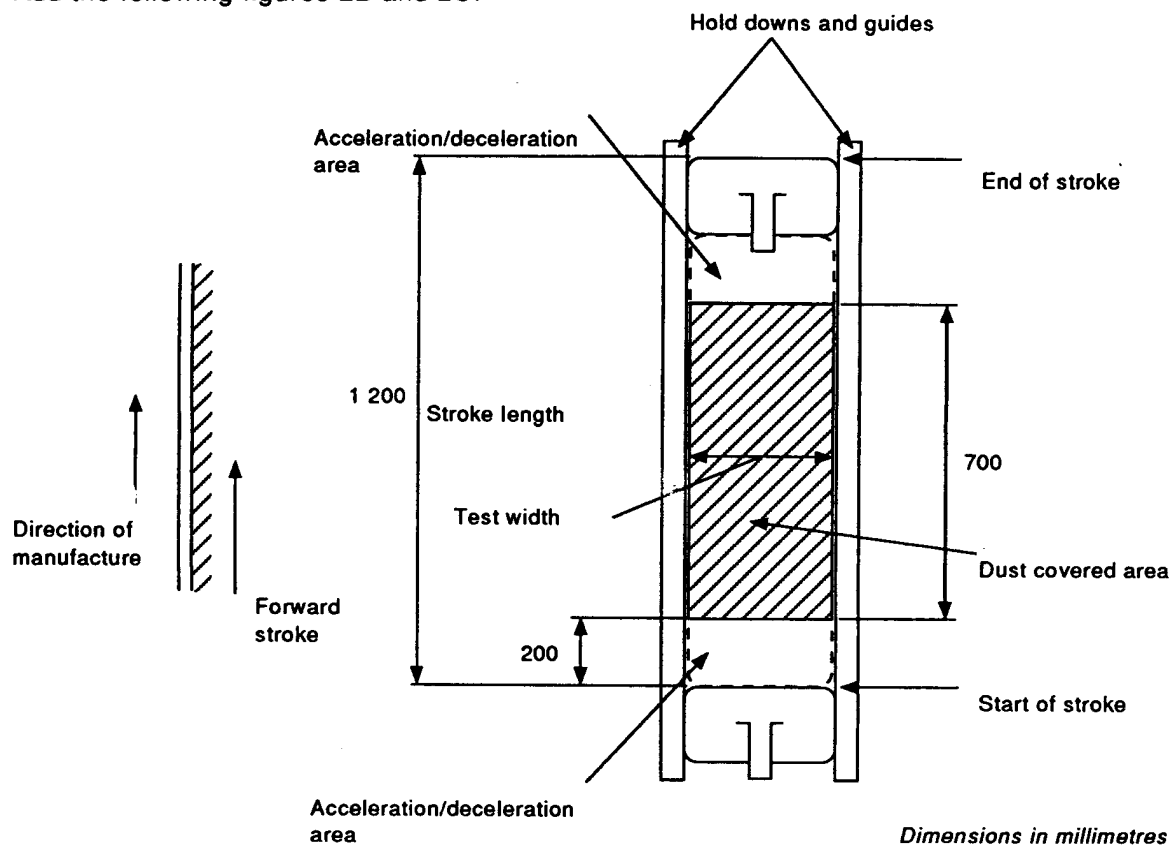


Figure 2B – Stroke length in the measurement of dust removal from carpets

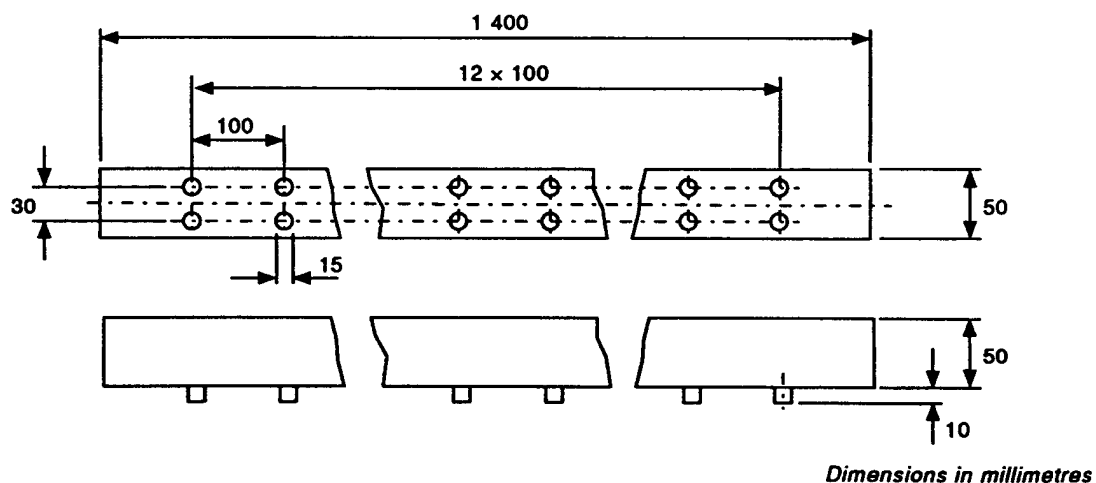


Figure 2C – Carpet hold downs and guides



Add, after figure 4B, the following figures 4C and 4D:

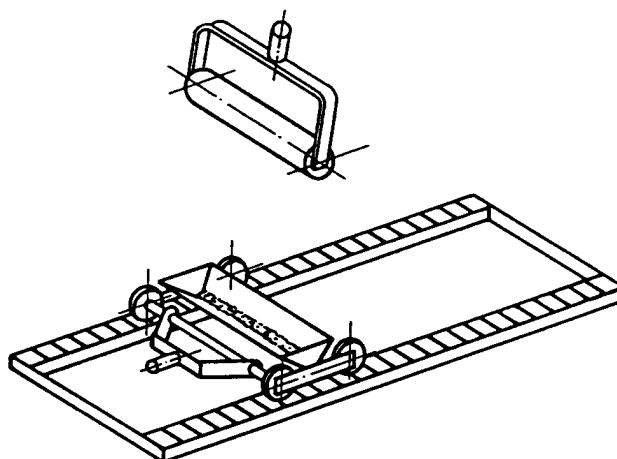


Figure 4C — Dust spreader and roller for embedding dust into carpets

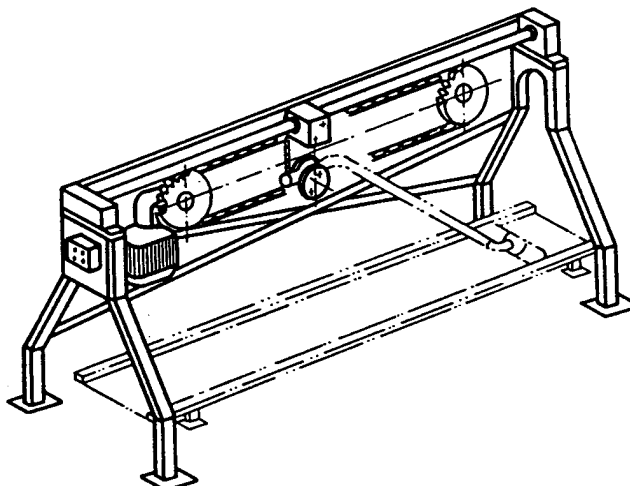


Figure 4D — Principle construction of a mechanical operator  
for the measurement of dust removal from carpets

#### Publications referred to

Delete the existing publications referred to and insert the following.

#### 'Publications referred to

|          |                                                                                                                                                                                               |
|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| BS 800   | Specification for limits and methods of measurement of radio interference characteristics of household electrical appliances, portable tools and similar electrical apparatus                 |
| BS 1042  | Measurement of fluid flow in closed conduits<br>Section 1.1 Specification for square-edged orifice plates, nozzles and Venturi tubes inserted in circular cross-section conduits running full |
| BS 6686  | Methods for determination of airborne acoustical noise emitted by household and similar electrical appliances<br>Part 1 General requirements for testing<br>Section 2.1 Vacuum cleaners       |
| BS 3456  | Specification for safety of household and similar electrical appliances<br>Part 202 Particular requirements<br>Section 202.2 Vacuum cleaners and water suction cleaning appliances            |
| ISO 554  | Standard atmospheres for conditioning and/or testing — Specifications                                                                                                                         |
| ISO 679  | Methods of testing cements — Determination of strength                                                                                                                                        |
| IEC 312* | Methods of measurement of performance of vacuum cleaners for household and similar use                                                                                                        |

\*Referred to in the foreword only.