IEC 60335-2-69

Edition 4.0 2012-02

INTERNATIONAL STANDARD

colour inside

Household and similar electrical appliances – Safety – Part 2-69: Particular requirements for wet and dry vacuum cleaners, including power brush, for commercial use

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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HOUSEHOLD AND SIMILAR ELECTRICAL APPLIANCES – SAFETY –

Part 2-69: Particular requirements for wet and dry vacuum cleaners, including power brush, for commercial use

FOREWORD

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International Standard IEC 60335-2-69 has been prepared by subcommittee 61J: Electrical motor-operated cleaning appliances for commercial use, of IEC technical committee 61: Safety of household and similar electrical appliances.

This fourth edition cancels and replaces the third edition published in 2002 and its Amendments 1 (2004) and 2 (2007). It constitutes a technical revision.

The principal changes in this edition as compared with the third edition of IEC 60335-2-69 are as follows (minor changes are not listed):

– the scope has been revised editorially to avoid misunderstandings;
– terms and definitions has been revised with regard to the requirements revised;
– the standard has been revised in general and updated regarding state-of-the-art, as far as necessary, in particular some changes have been made to Clauses 15, 22 and 25;

– Annex AA was revised and restructured;
– Annex CC was made informative;
– a new Annex EE 'Emission of acoustical noise' was added; and
– a new Annex FF 'Emission of vibration' was added.

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

FDIS	Report on voting
61J/481/FDIS	61J/494/RVD

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

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

This part 2 is to be used in conjunction with the latest edition of IEC 60335-1 and its amendments. It was established on the basis of the fifth edition (2010) of that standard.

NOTE 1 When “Part 1” is mentioned in this standard, it refers to IEC 60335-1.

This part 2 supplements or modifies the corresponding clauses in IEC 60335-1, so as to convert that publication into the IEC standard: Safety requirements for wet and dry vacuum cleaners, including power brush, for commercial use.

When a particular subclause of Part 1 is not mentioned in this part 2, that subclause applies as far as is reasonable. When this standard states “addition”, “modification” or “replacement”, the relevant text in Part 1 is to be adapted accordingly.

NOTE 2 The following numbering system is used:

– subclauses, tables and figures that are numbered starting from 101 are additional to those in Part 1;
– unless notes are in a new subclause or involve notes in Part 1, they are numbered starting from 101, including those in a replaced clause or subclause;
– additional annexes are lettered AA, BB, etc.

NOTE 3 The following print types are used:

– requirements: in roman type;
– *test specifications: in italic type;*
– notes: in small roman type.

Words in **bold** in the text are defined in Clause 3. When a definition concerns an adjective, the adjective and the associated noun are also in bold.

A list of all parts of the IEC 60335 series, under the general title: *Household and similar electrical appliances – Safety*, 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.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

It has been assumed in the drafting of this International Standard that the execution of its provisions is entrusted to appropriately qualified and experienced persons.

This standard recognizes the internationally accepted level of protection against hazards such as electrical, mechanical, thermal, fire and radiation of appliances when operated as in normal use taking into account the manufacturer's instructions. It also covers abnormal situations that can be expected in practice and takes into account the way in which electromagnetic phenomena can affect the safe operation of appliances.

This standard takes into account the requirements of IEC 60364 as far as possible so that there is compatibility with the wiring rules when the appliance is connected to the supply mains. However, national wiring rules may differ.

If an appliance within the scope of this standard also incorporates functions that are covered by another part 2 of IEC 60335, the relevant part 2 is applied to each function separately, as far as is reasonable. If applicable, the influence of one function on the other is taken into account.

When a part 2 standard does not include additional requirements to cover hazards dealt with in Part 1, Part 1 applies.

NOTE 1 This means that the technical committees responsible for the part 2 standards have determined that it is not necessary to specify particular requirements for the appliance in question over and above the general requirements.

This standard is a product family standard dealing with the safety of appliances and takes precedence over horizontal and generic standards covering the same subject.

NOTE 2 Horizontal and generic standards covering a hazard are not applicable since they have been taken into consideration when developing the general and particular requirements for the IEC 60335 series of standards. For example, in the case of temperature requirements for surfaces on many appliances, generic standards, such as ISO 13732-1 for hot surfaces, are not applicable in addition to Part 1 or part 2 standards.

An appliance that complies with the text of this standard will not necessarily be considered to comply with the safety principles of the standard if, when examined and tested, it is found to have other features that impair the level of safety covered by these requirements.

An appliance employing materials or having forms of construction differing from those detailed in the requirements of this standard may be examined and tested according to the intent of the requirements and, if found to be substantially equivalent, may be considered to comply with the standard.

HOUSEHOLD AND SIMILAR ELECTRICAL APPLIANCES – SAFETY –

Part 2-69: Particular requirements for wet and dry vacuum cleaners, including power brush, for commercial use

1 Scope

This clause of Part 1 is replaced by the following.

This International Standard deals with the safety of electrical motor-operated vacuum cleaners, including **back-pack vacuum cleaners**, and **dust extractors**, for wet suction, dry suction, or wet and dry suction, intended for commercial indoor or outdoor use with or without attachments.

It also deals with the safety of **centrally-sited vacuum cleaners**, excluding the installation of the system.

NOTE 101 Attention is drawn to the fact that additional requirements on the safe installation of **centrally-sited vacuum cleaners** are not addressed by this standard but need to be taken into account.

NOTE 102 This standard applies to machines for **commercial use**. The following list, although not comprehensive, gives an indication of locations that are included in the scope:

- public use areas such as hotels, schools, hospitals;
- industrial locations, for example factories and manufacturing shops;
- retail outlets, for example shops and supermarkets;
- business premises, for example offices and banks;
- all uses other than normal housekeeping purposes.

They are not equipped with a traction drive. The following power systems are covered:

- mains powered motors up to a **rated voltage** of 250 V for single-phase appliances and 480 V for other appliances,
- battery powered motors.

This standard also applies to machines handling **hazardous dust**, such as asbestos.

NOTE 103 Additional requirements for machines handling **hazardous dust** are given in Annex AA. Attention is drawn to the fact that in many countries additional requirements on hazardous substances might apply.

NOTE 104 Radioactive substances are not covered by definition of **hazardous dust** for the purposes of this standard.

This standard does not apply to

- vacuum cleaners and water-suction cleaning appliances for household use (IEC 60335-2-2);
- floor treatment machines for **commercial use** (IEC 60335-2-67, IEC 60335-2-72);
- spray extraction machines for **commercial use** (IEC 60335-2-68);
- hand-held mains-operated electrical garden blowers, vacuums and blower vacuums (IEC 60335-2-100);
- hand-held and transportable motor-operated electric tools (IEC 60745 series, IEC 61029 series);
- appliances for medical purposes (IEC 60601-1);

– machines designed for use in corrosive environments;
– machines designed for picking up liquids with a flash point below 55 °C;
– machines designed for use in explosive environments (dust, vapour or gas), except those designed for use in **zone 22**.

NOTE 104 Additional requirements for vacuum cleaners designed for collecting **combustible dust** in **zone 22** are given in Annex CC.

NOTE 105 Attention is drawn to the fact that in many countries additional requirements on the safe use of the equipment covered can be specified by the national health authorities, the national authorities responsible for the protection of labour, the national water supply authorities and similar authorities.

2 Normative references

This clause of Part 1 is applicable except as follows.

Addition:

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

ISO 2602, *Statistical interpretation of test results – Estimation of the mean – Confidence interval*

ISO 6344-2, *Coated abrasives – Grain size analysis – Part 2: Determination of grain size distribution of macrogrits P12 to P220*

ISO 7731, *Ergonomics – Danger signals for public and work areas – Auditory danger signals*

ISO 11428, *Ergonomics – Visual danger signals – General requirements, design and testing*

3 Terms and definitions

This clause of Part 1 is applicable except as follows.

3.1.9 *Replacement:*
normal operation
conditions under which the machine is operated in normal use, obtained at the following power input P_m of the vacuum motor:

$$P_m = 0{,}5\ (P_f + P_i)$$

where

P_f is the input, in watts, when the machine has been operated for 3 min, fitted with the nozzle and hose giving the highest input;

P_i is the input, in watts, when the machine has been operated for 20 s with the nozzle sealed, immediately following the 3-minute-period with the nozzle open. Any valve or similar device used to ensure a flow of air to cool the motor in the event of a blockage of a main air inlet is rendered ineffective.

P_f and P_i are measured with the supply voltage adjusted to **rated voltage**, or to a voltage equal to the mean value of the **rated voltage range** if the difference between the limits of the **rated voltage range** does not exceed 10 % of the mean value of the range. If the difference between the limits of the **rated voltage range** exceeds 10 % of the mean value, the tests are carried out with the supply voltage set to the upper limit of the range.

The measurements are made with the machine fitted with a clean dust bag and filter and with the water container, if any, empty. If the machine is intended for use only with a hose, detachable nozzles are removed and the hose is laid out straight. If the machine is provided with a hose as an optional accessory, it is operated without the hose.

Electrically driven devices, if any, are in operation but are not in contact with the floor or any other surface or with the means used to seal the air inlet.

The normal load is equal to the mean load P_r for the electrically driven agitating device such as a motor driven brush determined in accordance with the following:

– the agitating device operates on a carpet as specified in IEC 60312-1;

– the mean load P_r is determined when using the device in the following way:

  After setting the device, the device is moved twice over a distance of 5 m in the direction giving the highest load;

– the motor responsible for the airflow operates under the same conditions as for determining P_f , i.e. no airflow restrictions, and measurements are taken after 3 min;

– the device is adjusted to the carpet pile height;

– it is necessary to move the agitating device slowly across the carpet to avoid carpet damage.

Soiled water discharge pumps, if applicable, are operated as follows.

The pump delivers a continuous flow of water without any soiled water discharge hose attached to the soiled water outlet of the machines unless the discharge hose is permanently attached to the machine. The vacuum motor works during the test, unless an interlock device is provided to prevent combined operation of both motors.

3.101
water-suction cleaning machine
machine for sucking up a water-based cleaning solution

3.102
back-pack vacuum cleaner
vacuum cleaner designed to have the power source and collector carried on the **operator**'s back by means of a supporting device

3.103
motorized cleaning head
hand-held or hand-guided cleaning device connected to the machine, with an integrated electrical motor

Note 1 to entry: The permanently attached main cleaning head is not regarded as a **motorized cleaning head**.

3.104
hazardous dust
non-radioactive dust which is hazardous to health if inhaled, ingested or in contact with the skin

Note 1 to entry: EC Directive 79/831/EEC amending 67/548/EEC lists dusts for which the general indication of nature of risk is specified as very toxic, harmful, corrosive or irritant; some dusts can be subject to an exposure limit in the country of use; micro-organisms can be considered as dusts creating a hazard to the health of a person.

Note 2 to entry: Requirements for machines intended to pick up **hazardous dust** are specified in Annex AA.

3.105
combustible dust
dust with a particle size below 1 mm, able to undergo an exothermic reaction with air when ignited

3.106
explosive atmosphere (dust)
atmosphere where the dust will explode when simultaneously subjected to the following conditions:

– the dust must be combustible;
– the dust must be in suspension in the atmosphere which must contain sufficient oxygen to support combustion;
– the dust must have a particle size distribution that will propagate flame;
– the dust concentration in the suspension must be within the explosive range;
– the dust suspension must be in contact with an ignition source of sufficient energy.

Note 1 to entry: Minimum ignition energy values for common dusts can be found in Annex BB.

Note 2 to entry: Requirements for machines intended to pick up **combustible dust** in an **explosive atmosphere** are specified in Annex CC.

3.107
ESD protected area
EPA
area with a minimum risk for electrostatic discharge that could damage electronic devices, and in which people present in that area are not subjected to any additional risk

Note 1 to entry: Requirements for machines intended to pick up dust in **ESD protected areas** are specified in Annex DD.

3.108
dust extractor
stationary or portable equipment specifically designed to be connected to dust-generating machines

Note 1 to entry: A vacuum cleaner is designed to pick up already settled dust.

3.109
centrally-sited vacuum cleaner
vacuum cleaner that is connected to a ducting system installed in the building

Note 1 to entry: During use, the nozzle and its associated hose are connected to one of the suction inlets of the ducting system.

3.110
guard
part of the machine specifically designed to provide protection by means of a physical barrier, such as, for example, a casing, a shield, a cover, a screen, a door, an enclosure or a fence; other parts of the machine that fulfil a primarily operational function, such as, for example, the frame of the machine, may also fulfil a protective function but are not referred to as **guards**

Note 1 to entry: Three main kinds of **guards** can be distinguished: fixed **guards**, interlocking moveable **guards** and adjustable **guards**. Interlocking movable **guards** are required where frequent access is envisaged, while fixed **guards** can be used where frequent access is not envisaged.

3.111
operator
person installing, operating, adjusting, cleaning, moving, or performing **user maintenance** on the machine

3.112
test solution
solution which consists of 20 g of NaCl and 1 ml of a solution of 28 % by mass of dodecyl sodium sulphate in each 8 l of water

Note 1 to entry: The chemical designation of dodecyl sodium sulphate is $C_{12}H_{25}NaSO_4$.

3.113
commercial use
intended use of machines covered by this standard, i.e. not intended for normal housekeeping purposes by private persons but which may be a source of danger to the public

I.e. in particular that

– the machines may be used by cleaning contractors, cleaning staff, etc.;
– they are used in commercial or public premises (i.e. offices, shops, hotels, hospitals, schools, etc.) or in industrial (plants, etc.) and light industrial (workshops, etc.) environments.

Note 1 to entry: **Commercial use** is also called professional use.

4 General requirement

This clause of Part 1 is applicable except as follows.

Replacement of the first paragraph by the following:

Machines shall be constructed so that they function safely so as to cause no danger to persons or surroundings during normal use, even in the event of carelessness, and during installation, adjusting, maintenance, cleaning, repairing or transportation.

Addition:

For the purpose of this standard, the term ‘appliance’ as used in Part 1 is to be read as ‘machine’.

5 General conditions for the tests

This clause of Part 1 is applicable except as follows.

5.101 *The **test solution** is to be stored in a cool atmosphere and used within seven days after its preparation.*

6 Classification

This clause of Part 1 is applicable, except as follows.

6.1 *Replacement:*

Vacuum cleaners and their attachments shall be of one of the following classes with respect to the protection against electric shock:

– **class I**,
– **class II**, or
– **class III**.

Metal parts that may continuously contact the body shall be considered as handles for which 22.36 applies.

Compliance is checked by inspection and by the relevant tests.

6.2 *Addition:*

Water suction cleaning machines shall be at least IPX4.

7 Marking and instructions

This clause of Part 1 is applicable, except as follows.

7.1 *Replacement of the 4th dashed item as follows:*

– the business name and address of the manufacturer and, if applicable, his authorized representative; any address shall be sufficient to ensure postal contact;

Addition:

Machines shall be marked in addition with the following:

– serial number, if any;
– designation of the machine and series or type, allowing the technical identification of the product. This may be achieved by a combination of letters and/or numbers;

NOTE 101 Designation of machine, series or type includes the model or type reference as required in Part 1.

– year of construction, i.e. the year in which the manufacturing process is completed;

NOTE 102 The year of construction can be part of the serial number.

– machines equipped with wheels and other mobile machinery shall be marked with the mass of the most usual configuration in kg.

7.1.101 Motorized cleaning heads shall be marked with

– **rated voltage** or **rated voltage range** in volts;
– **rated power input** in watts;
– name, trade mark or identification mark of the manufacturer or responsible vendor;
– model or type reference;
– mass of the most usual configuration in kg.

Motorized cleaning heads for water-suction cleaning appliances except those of **class III construction** having a **working voltage** up to 24 V shall be marked with symbol IEC 60417-5935 (2002-10).

NOTE This symbol is an information sign and, except for the colours, the rules of ISO 3864-1 apply.

Compliance is checked by inspection.

7.1.102 Socket-outlets for accessories shall be marked with the maximum load in watts on the socket-outlet or close to it.

Compliance is checked by inspection.

7.6 *Addition:*

[symbol IEC 60417-5935 (2002-10)] **motorized cleaning head** for water-suction cleaning

7.12 *Modification:*

Replace the 4th paragraph by the following text.

This machine is not intended for use by persons (including children) with reduced physical, sensory or mental capabilities, or lack of experience and knowledge.

Addition:

The front cover of the instructions shall include the substance of the following warning:

CAUTION Read the instruction manual before using the machine.

This wording may be replaced by symbols ISO 7000-0434 (2004-01) and either ISO 7000-1641 (2004-01) or ISO 7000-0790 (2004-01).

The instructions shall contain at least the following:

– the business name and full address of the manufacturer and, if applicable, his authorized representative;
– designation of series or type of the machine as marked on the machine itself, except for the serial number;

NOTE 101 The designation of series or type can be abstracted, as long as the identification of the product is ensured.

– the general description of the machine;
– the intended use of the machine and the auxiliary equipment as covered by the scope of this standard;

NOTE 102 Examples of auxiliary equipment are **motorized cleaning heads** and lights.

– the meaning of the symbols used on the machine and in the instructions;
– drawings, diagrams, descriptions and explanations necessary for the safe use, maintenance and repair of the machine and for checking its correct functioning;
– technical data including the markings on the machine;
– information regarding putting into service, safe operation, handling, transportation, and storage of the machine taking into account its weight;
– instructions to enable adjustment and maintenance to be carried out safely, including the protective measures that should be taken during these operations;
– the conditions in which the machine meets the requirement of stability during use, transportation, assembly, dismantling when out of service, testing or foreseeable breakdowns;
– the procedure to be followed to prevent unsafe situations in the event of accident (e.g. contact with or spillage of detergents, battery acid, fuel or oil) or equipment breakdown;
– the substance of the following:

  This machine is intended for commercial use, for example in hotels, schools, hospitals, factories, shops, offices and rental businesses.

The instructions shall indicate the type and frequency of inspections and maintenance required for safe operation, including preventive maintenance measures. They shall, if applicable, give the specifications of the spare parts if they affect the health and safety of the **operator**, e.g. filter elements.

In addition, the instructions shall give the following information, if applicable:

– for battery powered machines, instructions regarding the precautions to be taken for safe charging;
– precautions to be taken when changing brushes or other attachments;
– information on the detergents or other liquids that may be used including the choice and use of personal protective equipment (PPE);
– essential characteristics of auxiliary equipment which may be fitted to the machine;
– information regarding safe disposal of batteries;
– purposes of the socket outlet on the machine;
– the precautions to be taken when using the machine under specific conditions such as handling flammable liquids or dusts and dusts hazardous to health;
– the intended use of the brushes specified for the machine.

7.12.101 The instructions shall include warnings concerning ways in which the machine shall not be used, which in the experience of the manufacturer are likely to occur. At least, it shall include the substance of the following warnings, if applicable.

– WARNING Operators shall be adequately instructed on the use of these machines.
– WARNING This machine is not suitable for picking up hazardous dust.
– WARNING This machine is for dry use only.
– CAUTION This machine is for indoor use only.
– CAUTION This machine shall be stored indoors only.
– A warning that the machine shall be disconnected from its power source during cleaning or maintenance and when replacing parts or converting the machine to another function:
  - for mains operated machines by removing the plug from the socket-outlet;
  - for battery powered machines by safely disconnecting at least the B+ or B− pole of the battery or an equivalent method (disconnecting device); for non-SELV both poles must be disconnected.

Instructions for mains operated machines shall also include the substance of the following:

– WARNING Do not allow the supply cord to come into contact with the rotating brushes.
– WARNING Only use the socket outlet on the machine for purposes specified in the instructions.

Instructions for water suction cleaning machines shall also include the substance of the following:

– WARNING If foam or liquid escapes from the machine, switch off immediately.
– CAUTION Clean the water level limiting device regularly and examine it for signs of damage.

Instructions for machines having a current-carrying hose for dry suction, operating at other than **safety extra-low voltage** shall also include the substance of the following:

– WARNING This hose contains electrical connections: do not use it to collect water and do not immerse in water for cleaning.

Compliance is checked by inspection.

7.12.102 Information on noise

NOTE The instructions can include information on airborne noise emission as indicated in EE.2.7.

7.12.103 Information on vibration

NOTE The instructions can include information on the vibration total value as indicated in Clause FF.2.

7.13 *Addition:*

The words “Original instructions” shall appear on the language version(s) verified by the manufacturer.

7.14 *Addition:*

The height of symbol IEC 60417-5935 (2002-10) shall be at least 15 mm.

Compliance is checked by measurement.

8 Protection against access to live parts

This clause of Part 1 is applicable except as follows.

8.1 *Addition:*

Water and water-borne cleaning agents are considered conductive.

9 Starting of motor-operated appliances

This clause of Part 1 is not applicable.

10 Power input and current

This clause of Part 1 is applicable.

11 Heating

This clause of Part 1 is applicable except as follows.

11.3 *Addition:*

If it is necessary to dismantle the machine for fitting thermocouples or other wiring, the input shall be measured before and after fitting at the lowest possible load, for example, with closed suction openings, with brushes not in contact with the floor, with declutched drive, etc. to check that the assembling has been accomplished properly.

11.4 Not applicable.

11.5 *Addition:*

For the heating test, the normal load P_r on the motor driving the moving brushes can be simulated by a brake or other means.

11.6 Not applicable.

11.7 *Addition:*

Machines are operated until steady conditions are established.

12 Void

13 Leakage current and electric strength at operating temperature

This clause of Part 1 is applicable except as follows.

13.2 *Addition:*

*For **class I appliances** where several motors operate at the same time, the leakage current shall not exceed 3,5 mA.*

14 Transient overvoltages

This clause of Part 1 is applicable.

15 Moisture resistance

This clause of Part 1 is applicable except as follows.

15.1.2 *Addition:*

***Water-suction cleaning machines** are operated for 10 min on a level surface wetted by the **test solution**.*

In practice, the pick-up consists largely of air such that there is no overloading of the suction motor; the input load should be observed to avoid overloading.

15.2 *Replacement:*

Machines having a liquid container shall be so constructed that

– spillage of liquid due to **normal operation**,
– filling including overfilling, and
– overturning of unstable machines

do not affect their electrical insulation.

Compliance is checked by the following tests:

The machine is placed on a support inclined at an angle of 10 ° to the horizontal, the liquid container being filled to half the level indicated in the instructions. A machine is considered to be unstable if it overturns when a force of 180 N is applied to the top of the machine in the most unfavourable horizontal direction.

*Machines having a liquid container and provided with an appliance inlet are fitted with an appropriate connector and flexible cable or cord; machines having a liquid container and **type X attachment** are fitted with the lightest cross-sectional area specified in Table 11. Other machines are tested as delivered.*

The liquid container of the machine is completely filled with a saline solution of water containing approximately 1 % NaCl and a further quantity, equal to 15 % of the capacity of the container or 0,25 l, whichever is the greater, is poured in steadily over a period of 1 min.

Machines which are unstable are then, with the container completely filled and with the cover or lid in place, overturned from the most unfavourable of the normal positions of use, and are left in that position for 5 min unless the machine returns automatically to its normal position of use.

*Nozzles and **motorized cleaning heads** of **water-suction cleaning machines** are placed in a tray, the base of which is level with the surface supporting the machine. The tray is filled with the **test solution** to a level of 5 mm above its base, this level being maintained throughout the test. The machine including the **motorized cleaning head** is operated until its liquid container is completely full and afterwards for a further 5 min.*

After each of these tests, the machine shall withstand the electric strength test of 16.3.

*There shall be no trace of liquid on insulation that reduces the **clearances** or **creepage distances** below the values specified in Clause 29.*

15.3 *Modification:*

The relative humidity shall be (93 ± 6) %.

15.101 Motorized cleaning heads of **water suction cleaning machines** shall be resistant to liquids that may come into contact with them during normal use.

The following test is not applicable to **motorized cleaning heads** of **class III construction** having a **working voltage** up to 24 V.

Compliance is checked by the following four tests.

*The **motorized cleaning head** is subjected to an impact test as described in IEC 60068-2-75, the value of the impact being 2 J. The **motorized cleaning head** is rigidly supported and three blows are applied to every point of the enclosure that is likely to be weak.*

It is then subjected to the free fall test procedure 1 of IEC 60068-2-31. It is dropped 4 000 times from a height of 100 mm onto a steel plate having a thickness of not less than 15 mm. It is dropped

- *1 000 times on its right side;*
- *1 000 times on its left side;*
- *1 000 times on its front face;*
- *1 000 times on its cleaning surface.*

*The **motorized cleaning head** is then subjected to the test described in 14.2.4 of IEC 60529, using the **test solution**.*

*The **motorized cleaning head** is to be operated in a flat-bottomed vessel filled with a saline solution of water containing approximately 1 % NaCl so that a depth of 3,0 mm of water is maintained. The vessel is to be a size such that the **motorized cleaning head** moves about freely, and is to be operated:*

- *without connection to the vacuum cleaner for 15 min, if applicable; and*
- *connected to the vacuum cleaner until the vacuum cleaner has picked up as much water as its capacity holds or for 5 min, whichever occurs sooner.*

*The **motorized cleaning head** shall then withstand the electric strength test of 16.3, the voltage being applied between the **live parts** and the **test solution**. There shall be no trace of saline solution on insulation that reduces the **clearances** or **creepage distances** below the values specified in Clause 29.*

16 Leakage current and electric strength

This clause of Part 1 is applicable except as follows.

16.3 *Addition:*

Current-carrying hoses, except for their electrical connections, are immersed for 1 h in a saline solution of water containing approximately 1 % NaCl, at a temperature of 20 °C ± 5 °C. While the hose is still immersed, a voltage of 2 000 V is applied for 5 min between each conductor and all the other conductors connected together. A voltage of 3 000 V is then applied for 1 min between all the conductors and the saline solution.

17 Overload protection of transformers and associated circuits

This clause of Part 1 is applicable.

18 Endurance

This clause of Part 1 is not applicable.

19 Abnormal operation

This clause of Part 1 is applicable except as follows.

19.1 *Addition:*

Machines are also subjected to the test of 19.101.

*The test of 19.7 is only carried out on **motorized cleaning heads** and fan motors of **centrally-sited vacuum cleaners**.*

NOTE 101 Separate fan motors are not intended for vacuuming, but for cooling the equipment. These motors are independent from the main vacuum motor.

***Dust extractors** are also subjected to the tests of 19.102, and 19.103 if applicable.*

***Centrally-sited vacuum cleaners** are also subjected to the tests of 19.104, and 19.105 if applicable.*

19.2 *Addition:*

The machine is tested without liquid in the container.

NOTE 101 The term restricted heat dissipation of Part 1 means without liquid in the container.

19.7 *Addition:*

***Motorized cleaning heads** are tested with the rotating brush or similar device locked for 30 s.*

*Unattended **dust extractors** are operated until steady conditions are reached.*

*Separate fan motors of **centrally-sited vacuum cleaners** are operated until steady conditions are reached.*

NOTE 101 Separate fan motors are not intended for vacuuming, but for cooling the equipment. These motors are independent from the main vacuum motor.

19.9 Not applicable.

19.10 *Addition:*

For this test, the lowest possible load for radial turbines is obtained with the air inlet sealed. For other types of turbines, the characteristics shall be taken into account.

In the case of cleaners driving a brush or agitator, the belt is removed.

19.13 *Modification:*

In the second paragraph, add "and 22.104" after "20.2".

19.101 *Machines having liquid containers that are provided with shut-off device(s) or valve(s) are again subjected to the test of 15.2.*

Stop valves or other fluid shut-off devices are made inoperative. If two or more independent shut-off devices are provided, only one of them is made inoperative at a time, provided that they have passed the test of operating 3 000 times satisfactorily. Otherwise all devices that failed are made inoperative.

Care should be taken to suck up an air-liquid mixture to prevent overloading of the motor of the suction unit. The input power should be observed to avoid overloading.

*After this test, the machine shall be subjected to the electrical strength test of 16.3. Inspection shall show that water has not entered the machine to any dangerous extent. In particular, there shall be no trace of water on the electrical insulation that reduces the **clearance** or **creepage distances** below the limits specified in Clause 29.*

19.102 ***Dust extractors** for which 30.2.3 applies are supplied at **rated voltage** and operated with the inlet for the suction hose closed.*

The temperatures of the windings shall not exceed the values specified in 19.9.

19.103 ***Dust extractors** for which 30.2.3 applies with separate ventilation for the motor are supplied at **rated voltage** and operated with the airflow through the motor blocked.*

The temperatures of the windings shall not exceed the values specified in 19.9.

19.104 ***Centrally-sited vacuum cleaners** are supplied at **rated voltage** and operated with the inlet for the suction hose open and then closed.*

The temperatures of the windings shall not exceed the values specified in 19.9.

19.105 ***Centrally-sited vacuum cleaners** with separate ventilation for the motor are supplied at **rated voltage** and operated with the airflow through the motor blocked.*

20 Stability and mechanical hazards

This clause of Part 1 is applicable except as follows.

20.1 *Addition:*

Motorized cleaning heads are not subjected to this test.

20.2 *Addition:*

These requirements do not apply to rotating brushes and similar devices, or to moving parts exposed during the fitting of accessories that allow conversion from one application to another.

20.101 Shaft ends and similar rotating parts shall be protected if they protrude by more than a quarter of their diameter. Shafts up to 50 mm diameter do not need to be protected if they are rotating at less than 5 revolutions per second, and their ends are rounded and smooth.

*Compliance is checked by inspection and measurement, the machine having all pads, brushes etc. in place for **normal operation**.*

The unintentional closing and lowering of doors, lids, covers etc., which could cause injury, shall be prevented.

Machines heavier than 20 kg (empty weight), except stationary machines and **back-pack vacuum cleaners**, shall be equipped with wheels or rollers for transport, which shall be located or protected so as to prevent injury to the feet of the **operator**.

Compliance is checked by inspection, measurement and by functional test.

21 Mechanical strength

This clause of Part 1 is applicable except as follows.

21.1 *Replacement of the first paragraph:*

Machines and their **components** and fittings shall have adequate mechanical strength and be constructed to withstand such rough handling as may be expected in normal use, during transportation, assembly, dismantling, scrapping and any other action involving the machine.

Modification in the third paragraph:

The impact value is increased to 1,0 J ± 0,04 J.

21.101 Those parts of the machine which are subjected to impact in normal use are tested as follows:

*If failure of the part subjected to impact would cause a failure to comply with this specification, any spot of the machine which may be exposed during **normal operation** to impacts or blows shall be subjected to a single blow with an impact energy of 6,75 Nm. The impact stress on the free-standing machines shall be exerted by a steel sphere with a diameter of 50,8 mm and a mass of 0,535 kg dropped from a height of 1,3 m or hanging on a string acting as a pendulum, falling from a height of 1,3 m.*

21.102 Current-carrying hoses shall be resistant to crushing.

Compliance is checked by the following test.

The hose is placed between two parallel steel plates each having a length of 100 mm, a width of 50 mm and the edges of the longer sides rounded with a radius of 1 mm. The axis of the hose is positioned at right angles to the longer sides of the plates. The plates are placed at a distance of approximately 350 mm from one end of the hose.

The steel plates are pressed together at a rate of 50 mm/min ± 5 mm/min until the applied force is 1,5 kN. The force is then released and the electric strength test of 16.3 is carried out between the conductors connected together and the saline solution.

21.103 Current-carrying hoses shall be resistant to abrasion.

Compliance is checked by the following test.

One end of the hose is attached to the connecting rod of the crank mechanism shown in Figure 102. The crank rotates at 30 revolutions per minute resulting in the end of the hose moving horizontally backwards and forwards over a distance of 300 mm.

The hose is supported by a rotating smooth roller over which a belt of abrasive cloth moves at a speed of 0,1 m/min. The abrasive is corundum grit size P100, as specified in ISO 6344-2.

A mass of 1 kg is suspended from the other end of the hose, which is guided to avoid rotation.

In the lowest position, the mass has a maximum distance of 600 mm from the centre of the roller.

The test is carried out for 100 revolutions of the crank.

*After the test, **basic insulation** shall not be exposed and the electric strength test of 16.3 is carried out between the conductors connected together and the saline solution.*

21.104 Current-carrying hoses shall be resistant to flexing.

Compliance is checked by the following test.

*The end of the hose intended to be connected to the **motorized cleaning head** is attached to the pivoting arm of the test equipment shown in Figure 103. The distance between the pivot axis of the arm and the point where the hose enters the rigid part is 300 mm ± 5 mm. The arm can be raised from the horizontal position by an angle of 40 ° ± 1 °. A mass of 5 kg is suspended from the other end of the hose or from a convenient point along the hose so that when the arm is in the horizontal position, the mass is supported and there is no tension on the hose.*

NOTE It may be necessary to reposition the mass during the test.

The mass slides against an inclined plate so that the maximum deflection of the hose is 3 °.

The arm is raised and lowered by means of a crank that rotates at a speed of 10 ± 1 r/min.

The test is carried out for 2 500 revolutions of the crank after which the fixed end of the hose is turned through 90 ° and the test continued for a further 2 500 revolutions. The test is repeated in each of the other two 90 ° positions.

After 10 000 revolutions, the hose shall withstand the electric strength test of 16.3.

If the hose ruptures before 10 000 revolutions are achieved, the flexing test is terminated. The hose shall still withstand the electric strength test of 16.3.

21.105 Current-carrying hoses shall be resistant to torsion.

Compliance is checked by the following test.

One end of the hose is held in a horizontal position with the remainder of the hose freely suspended. The free end is rotated in cycles, each cycle consisting of five turns in one direction and five turns in the opposite direction, at a rate of 10 turns per minute.

The test is carried out for 2 000 cycles.

After the test, the hose shall withstand the electric strength test of 16.3 and shall not be damaged to such an extent that compliance with this standard is impaired.

21.106 Current-carrying hoses shall be resistant to cold conditions.

Compliance is checked by the following test.

A 600 mm length of hose is bent as shown in Figure 104 and the ends are tied together over a length of 25 mm. The hose is then placed for 2 h in a cabinet having a temperature of –15 °C ± 2 °C. Immediately after the hose is removed from the cabinet it is flexed three times, as shown in Figure 105, at a rate of one flexing per second.

The test is carried out three times.

There shall be no cracks or breaks in the hose and it shall withstand the electric strength test of 16.3. Any colour change of the hose is not considered as a failure.

22 Construction

This clause of Part 1 is applicable except as follows.

22.6 *Addition:*

Water-suction cleaning machines shall be so constructed that neither water nor foam from detergents can penetrate into the motor or come in contact with **live parts**.

22.35 *Addition:*

These parts are subject to the hammer test of Clause 21. If this insulation does not meet the requirement of 29.3, these are subject to the following impact test.

A sample of the covered part is conditioned at a temperature of 70 °C ± 2 °C for seven days (168 h). After conditioning, the sample is allowed to attain approximately room temperature.

Inspection shall show that the covering has not shrunk to such an extent that the required insulation is no longer given or that the covering has not peeled off, so that it may move longitudinally.

After this, the sample is maintained for 4 h at a temperature of –10 °C ± 2 °C.

While still at this temperature, the sample is then subjected to impact by means of the apparatus shown in Figure 101. The weight "A", having a mass of 0,3 kg, falls from a height of 350 mm on to the chisel "B" of hardened steel, the edge of which is placed on the sample.

One impact is applied to each place where the insulation is likely to be weak or damaged in ***normal operation****, the distance between the points of impact being at least 10 mm.*

After this test, it shall be shown that the insulation has not peeled off, and an electric strength test as specified in 16.3 is made between metal parts and metal foil wrapped round the insulation in the required area.

For **centrally-sited vacuum cleaners**, this clause of Part 1 is applicable.

22.101 Machines shall be constructed so as to prevent the penetration of objects from the floor, which may impair the safety of the machine.

Live parts of machines for wet use shall be at least 30 mm distance from the surface of the floor, measured in vertical direction through existing holes. This requirement does not apply to **motorized cleaning heads**.

Compliance is checked by inspection and measurements.

22.102 **Class I appliances** or **class II appliances** shall be equipped with a mains isolating switch that ensures **all-pole disconnection** according to overvoltage category III conditions.

For built-in battery chargers, this **all-pole disconnection** can be realised by pulling the plug.

Other switches may be of single pole construction.

The following circuits need not be disconnected by the supply disconnecting device:

– plug and socket-outlets;
– undervoltage protection circuits that are only provided for automatic tripping in the event of supply failure;
– phase rotating indicators;
– control circuits for interlocking.

It is recommended, however, that such circuits be provided with their own disconnecting device.

Compliance is checked by inspection.

22.103 For machines where the **operator** is required to use personal protective equipment (PPE), controls shall be designed in such a way that they can be operated safely.

Compliance is checked by inspection and by functional test.

22.104 If machines are provided with shut-off devices, the devices shall prevent the liquid level from exceeding the maximum allowed level.

Compliance is checked by inspection.

22.105 Harness of back-pack vacuum cleaners

All measurements are made with all filters in place, empty dust containers and without the weight of the **supply cord**.

Back-pack vacuum cleaners with a mass exceeding 6 kg shall be equipped with at least a single shoulder harness. A double shoulder harness shall be provided for **back-pack vacuum cleaners** exceeding a mass of 7,5 kg.

Single shoulder harnesses shall be designed so that the machine can be released quickly from the **operator** in the event of emergency. One way to fulfil this is to have a quick release mechanism on the harness.

Double shoulder harnesses shall always have a quick release mechanism. The quick release mechanism shall only allow separation by a deliberate action.

All harnesses shall be adjustable to the size of the **operator**. The harness shall distribute the load evenly on the **operator**'s back, shoulders, waist and/or hip.

Back-pack vacuum cleaners exceeding a mass of 7,5 kg shall be supplied with a pad at the points of contact between the machine and the body.

Compliance is checked by inspection and functional test.

22.106 Handgrip of back-pack vacuum cleaners

Back-pack vacuum cleaners shall be equipped with a handgrip with a surface or structure specifically designed for the **operator**'s hand to allow the **operator** to grasp the **back-pack vacuum cleaner** to place it on his back or take it off.

Compliance shall be checked by inspection and functional test.

23 Internal wiring

This clause of Part 1 is applicable.

24 Components

This clause of Part 1 is applicable except as follows:

24.1.3 *Addition:*

The main switch in vacuum cleaners shall be tested for 50 000 cycles of operations.

This test specification does not apply for **centrally-sited vacuum cleaners**.

24.2 *Addition:*

For **back-pack vacuum cleaners** with a switching device located at the end of an interconnecting cord, the switching device shall be designed so that it cannot come into contact with the floor in normal use.

The strain relieves on both sides of the interconnecting cord shall comply with 25.15.

24.101 Machines with motors provided with **self-resetting thermal cut-outs** shall work reliably under overvoltage conditions.

Compliance is checked by the following test.

*The machine is supplied at a voltage equal to 1,1 times the **rated voltage**, under locked rotor conditions so as to cause the **thermal cut-out** to operate within a few minutes, until the **thermal cut-out** has performed 200 cycles of operation.*

After the test, the machine shall withstand the tests of Clause 16.

25 Supply connection and external flexible cords

This clause of Part 1 is applicable except as follows.

25.1 *Addition:*

Machines classified as IPX7 shall not be provided with an appliance inlet.

Machines classified as IPX4, IPX5 or IPX6 shall not be provided with an appliance inlet, unless both inlet and connector have the same classification as the machine when coupled or separated, or unless inlet and connector can only be separated by the use of a **tool** and have the same classification as the machine when coupled.

Machines provided with an appliance inlet shall also be provided with an appropriate cord set.

25.7 *Replacement:*

Supply cords shall be one of the following types:

– Rubber sheathed

  Their properties shall be at least those of ordinary tough rubber sheathed cords (code designation 60245 IEC 53);

NOTE 101 These cords are not suitable for machines intended to be used outdoors or when they are liable to be exposed to significant amounts of ultraviolet radiation.

– Polychloroprene sheathed

  Their properties shall be at least those of ordinary polychloroprene sheathed cords (code designation 60245 IEC 57);

NOTE 102 These cords are suitable for machines intended to be used in low temperature applications.

– Cross-linked polyvinyl chloride sheathed

  Their properties shall be at least those of cross-linked polyvinyl chloride sheathed cords (code designation 60245 IEC 87);

NOTE 103 These cords are suitable for machines when they may come into contact with hot surfaces. Due to the composition of the conductors, the cords are suitable for applications where high flexibility is required.

– Polyvinyl chloride sheathed

  These cords shall not be used if they are likely to touch metal parts having a temperature rise exceeding 75 K during the test of Clause 11. Their properties shall be at least those of ordinary polyvinyl chloride sheathed cord (code designation 60227 IEC 53);

– Heat resistant polyvinyl chloride sheathed

These cords shall not be used for **type X attachments** other than specially prepared cords. Their properties shall be at least those of heat-resistant polyvinyl chloride sheathed cord (code designation 60227 IEC 57).

Compliance is checked by inspection.

25.14 *Addition:*

*For machines incorporating a **type X attachment** or **type Y attachment**, the number of flexings is 20 000.*

25.15 *Modification:*

Replace Table 12 by the following:

Table 12 – Pull force and torque

Mass of machine kg	**Pull force** N	**Torque** Nm
≤ 1	30	0,1
> 1 and ≤ 4	60	0,25
> 4	125	0,40

Addition:

The test is also applied to the cord in the cord set for machines classified as IPX4 or higher that are provided with an appliance inlet. The cord set is fitted to the appliance inlet prior to the commencement of the test.

26 Terminals for external conductors

This clause of Part 1 is applicable.

27 Provision for earthing

This clause of Part 1 is applicable.

28 Screws and connections

This clause of Part 1 is applicable.

29 Clearances, creepage distances and solid insulation

This clause of Part 1 is applicable except as follows.

29.2 *Addition:*

The microenvironment is pollution degree 3 unless the insulation is enclosed or located so that it is unlikely to be exposed to pollution due to normal use of the machine.

30 Resistance to heat and fire

This clause of Part 1 is applicable except as follows.

30.2 *Addition*:

For **centrally-sited vacuum cleaners**, 30.2.3 is applicable.

31 Resistance to rusting

This clause of Part 1 is applicable.

32 Radiation, toxicity and similar hazards

This clause of Part 1 is applicable, except as follows.

Addition:

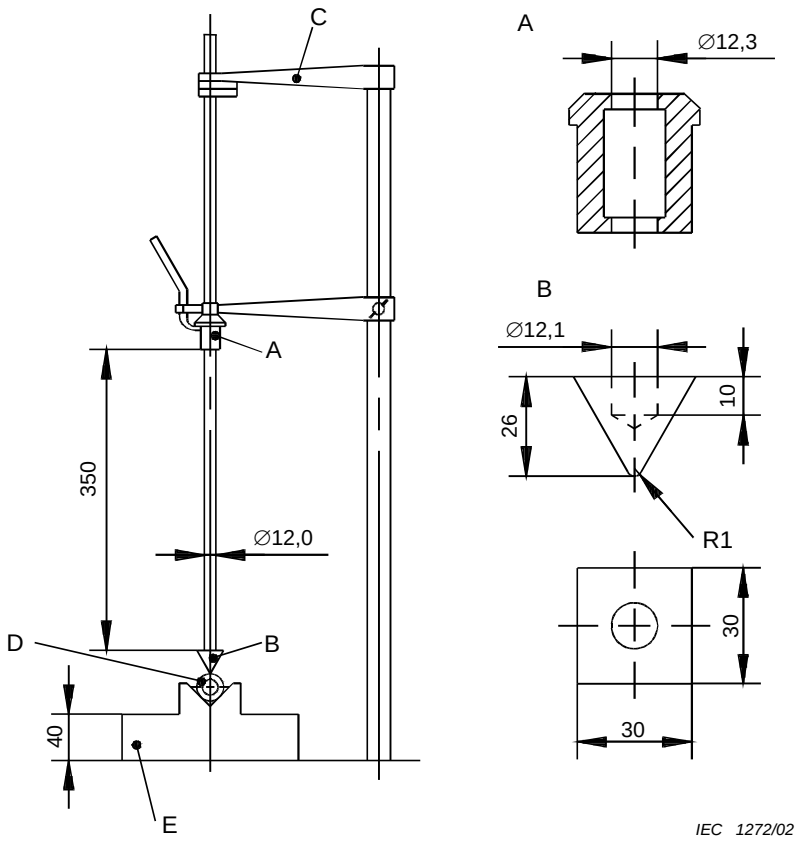
For machines intended to pick up **hazardous dust**, additional requirements are specified in Annex AA.

NOTE 101 Information on the explosion risk of certain dusts is given in Annex BB.

For machines intended to pick up **combustible dust** in an **explosive atmosphere**, additional requirements are specified in Annex CC.

For machines intended to pick up dust in **ESD protected areas**, additional requirements are specified in Annex DD.

Dimensions in millimetres

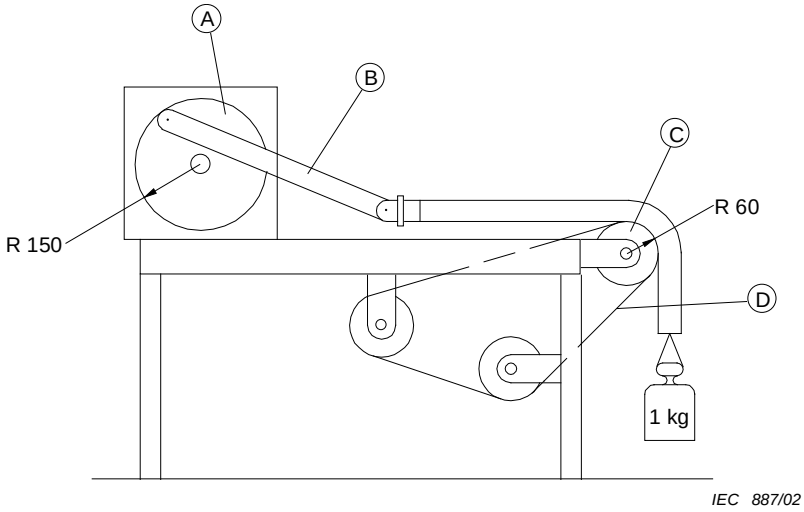


Key

A weight
B chisel
C fixing arm
D sample
E base having mass of 10 kg

Figure 101 – Impact test apparatus

Dimensions in millimetres



Key

A crank mechanism

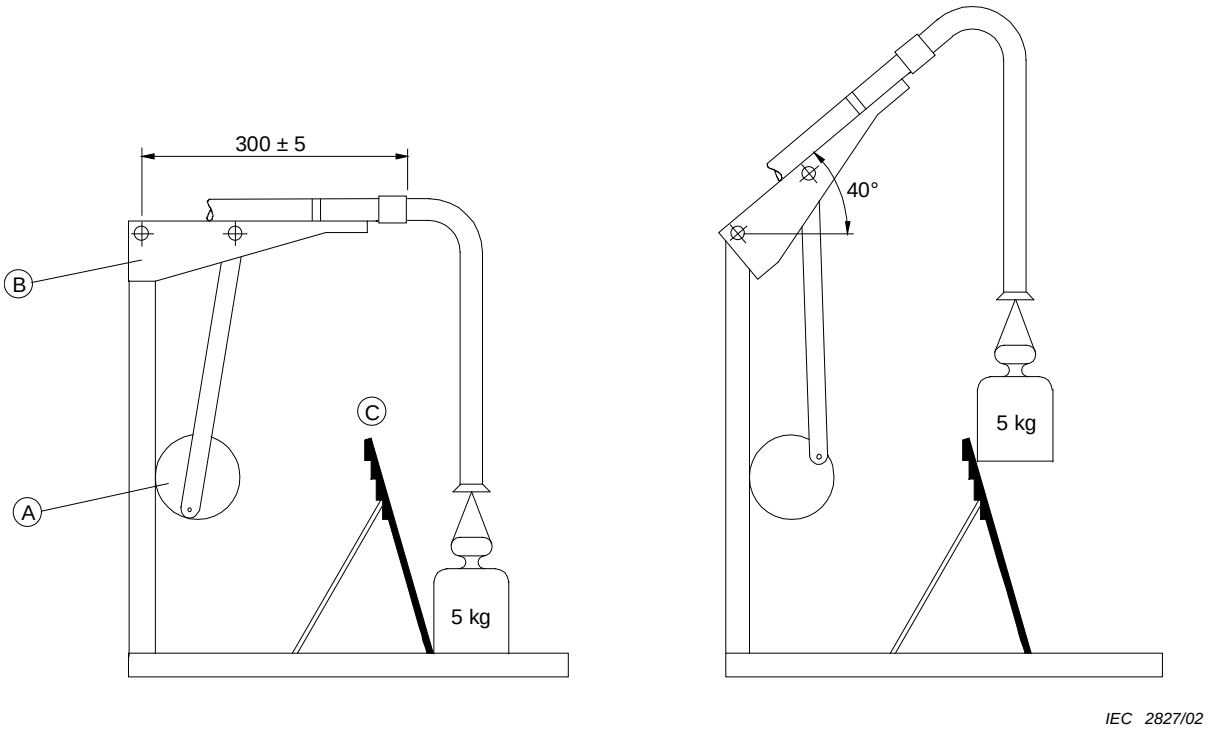
B connecting rod

C roller, diameter 120 mm

D abrasive cloth belt

Figure 102 – Apparatus for testing the abrasion resistance of current-carrying hoses

Dimensions in millimetres



Key

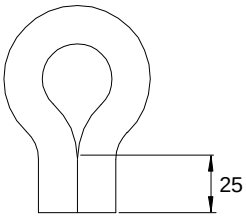
A crank mechanism

B arm

C inclined plane

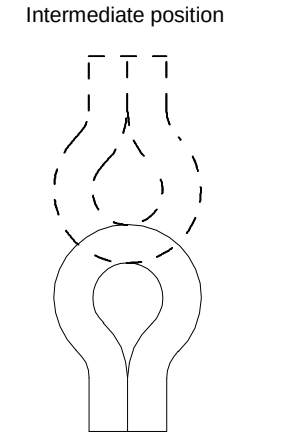
Figure 103 – Apparatus for testing the resistance to flexing of current-carrying hoses

Dimensions in millimetres



IEC 151/12

Figure 104 – Configuration of the hose for the freezing treatment



IEC 152/12

Figure 105 – Flexing positions for the hose after removal from the freezing cabinet

Annexes

The annexes of Part 1 are applicable except as follows.

Annex A
(normative)

Routine tests

For the purpose of this standard, this annex of Part 1 is considered normative.

A.3 *Addition:*

For machines of dust class H, compliance with the **penetration** requirement of Table AA.1 shall be shown either for the complete machine or for the **essential filter** element.

Annex AA
(normative)

Particular requirements for vacuum cleaners and dust extractors for the collection of hazardous dusts

The following modifications to this standard are applicable to vacuum cleaners and **dust extractors** specifically designed for wet and/or dry suction for **commercial use** and specify the requirements for collecting non-explosive **hazardous dusts**.

NOTE 1 Additional subclauses and notes in this annex are numbered starting with AA.201.

NOTE 2 When power sources other than electricity (e.g. compressed air, internal combustion engine etc.) or a **negative pressure unit** are used, the use of classification for filtration of dust given in this annex can be useful.

3 Terms and definitions

3.AA.201
penetration
D
degree of **penetration** of a filter material, a filter or a machine, determined as follows:

$$D = \frac{\dot{m}_{\text{out}}}{\dot{m}_{\text{in}}} \times 100\ \%$$

where

$\dot{m}_{\text{out}}$ is the average mass concentration of the test aerosol in the downstream air during the sampling time;

$\dot{m}_{\text{in}}$ is the average mass concentration of the test aerosol in the upstream air during the sampling time.

3.AA.202
air change rate
acr
number of hourly fresh air changes, calculated as follows:

$$acr = \frac{Q}{V}\ [1/\text{h}]$$

where

V is the room air volume (m^3);

Q is the flow rate of the air exchanger of the room (m^3/h).

3.AA.203
safe change filter
filter which can be changed without atmospheric or **operator** contamination, such as by means of handling the filter from the exterior of an impervious membrane and by the use of a double sealing method of withdrawal, removal and replacement without exposing the interior of the filter housing

3.AA.204
dust class x machine
machine designed to comply with requirements specified for dust class L, M or H in accordance with 6.AA.201

3.AA.205
essential filter
principal filter in a system which may use multiple filters and is a filter which ensures that the **penetration** limits of Table AA.1 are met

3.AA.206
dust collection means
container having means of safe dust disposal to be undertaken when handled in accordance with the manufacturer's instructions

3.AA.207
negative pressure unit
extraction unit used to ensure that the pressure within a working enclosure is below atmospheric

6 Classification

6.AA.201 The machines are classified according to dust classes:

– L (light hazard) suitable for separating dust with a limit value of occupational exposure of greater than 1 mg/m^3;
– M (medium hazard) for separating dust with a limit value of occupational exposure not less than 0,1 mg/m^3;
– H (high hazard) for separating all dusts with all limit values of occupational exposure, including carcinogenic and pathogenic dusts.

NOTE 1 The use of an **essential filter** of a specified dust class does not allow the complete machine to be classified with that dust class.

NOTE 2 In some countries, national regulations exist concerning disposal of **hazardous dusts**.

7 Marking and instructions

7.1 *Addition:*

The model or type reference marked on the machine shall include the dust class letter. Safety relevant spare parts, such as filters, **dust collection means** and disposable devices (e.g. rigid containers or plastic bags), when provided with the machine, shall be marked with an indication to ensure use of the correct spare parts.

7.12 *Addition:*

In addition, the instructions shall include the substance of the following:

– The most important operational data of the machine as specified in 3.1.9 of this Part 2, its dust class, its intended use and, if applicable, any limitations of use.
– Specification of spare parts relating to safety, such as filters and **dust collection means**, and information of where they can be obtained.
– Maximum flow rate (m^3/h) and maximum underpressure (hPa).
– Before use, **operators** shall be provided with information, instruction and training for the use of the machine and the substances for which it is to be used, including the safe method of removal and disposal of the material collected.

– For user servicing, the machine must be dismantled, cleaned and serviced, as far as is reasonably practicable, without causing risk to the maintenance staff and others. Suitable precautions include decontamination before dismantling, provision for local filtered exhaust ventilation where the machine is dismantled, cleaning of the maintenance area and suitable personal protection.

– The manufacturer, or an instructed person, shall perform a technical inspection at least annually, consisting of, for example, inspection of filters for damage, air tightness of the machine and proper function of the control mechanism. In addition, on class H machines, the machine filtration efficiency should be tested at least annually, or more frequently as may be specified by national requirements. The test method that can be used to verify the machine's filter efficiency is specified in 22.AA.201.2. If the test fails, it shall be repeated with a new **essential filter**.

– When carrying out service or repair operations, all contaminated items which cannot be satisfactorily cleaned are to be disposed of; such items shall be disposed of in impervious bags in accordance with any current regulation for the disposal of such waste.

– The method by which covers of non-dust proof compartments should be removed for cleaning.

In addition, the instructions shall include the substance of the following, if applicable.

– for class M and class L machines, the meaning of the relevant warning label according to Figure AA.2;

– for class H and class M machines, the outside of the machine should be decontaminated by vacuum cleaning methods and wiped clean or treated with sealant before being taken out of a hazardous area. All the machine parts shall be regarded as contaminated when removed from the hazardous area and appropriate action taken to prevent dust dispersal;

– for class H machines, the meaning of the warning label according to Figure AA.1, including the corresponding warning text according to 7.14;

– for **dust extractors**, it is necessary to provide for an adequate **air change rate** L in the room if the exhaust air is returned to the room. Reference to National regulations is necessary.

In addition, the instructions may recommend the following:

– **operators** should observe any safety regulations appropriate to the materials being handled.

7.14 *Addition:*

Class H machines shall be fitted with the label according to Figure AA.1.

Class M and class L machines shall be fitted with the relevant label according to Figure AA.2.

The following warning shall be given on the label for class H machines:

WARNING: This machine contains dust hazardous to health. Emptying and maintenance operations, including removal of the dust collection means, must only be carried out by authorised personnel wearing suitable personal protection. Do not operate without the full filtration system fitted.

For class L, class M and class H machines, covers and **guards** which do not require **tools** for removal shall be fitted with an additional label worded: REMOVE FOR CLEANING.

7.15 *Addition:*

Lettering in warning notices on the machine shall have a minimum height of 3 mm.

The warning notices shall be so positioned that they can easily be seen by the **operator** when switching the machine on or off.

22 Construction

22.AA.201 Dust collecting machines shall be designed and constructed in accordance with the dust classes given in 6.AA.201 and meet the values given in Table AA.1:

Table AA.1 – Penetration limits

Dust class	**Suitability for hazardous dust with limit values for occupational exposure** mg × m^{-3}	**Degree of penetration** ***D*** %	**Essential filter material test**	**Essential filter element test**	**Assembled machine test method**
L (light hazard)	> 1	< 1	22.AA.201.1 or 22.AA.201.2	Not required	22.AA.201.3 if **essential filter material test** is not carried out
M (medium hazard)	≥ 0,1	< 0,1	22.AA.201.1 or 22.AA.201.2	Not required	22.AA.201.3
H (high hazard)	< 0,1 , including carcinogenic dusts and dusts contaminated with carcinogens and/or pathogens	< 0,005	Not required	22.AA.201.2	22.AA.201.3
Machines of similar construction and with identical **essential filter** and mountings and with an identical airflow velocity may be treated equally.					

Machines designed for picking up wood dust and mineral dust (containing quartz) shall be at least of dust class M.

Compliance is checked by the following tests, if applicable as stated in Table AA.1, and taking into account the flow chart as shown in Figure AA.6.

22.AA.201.1 Essential filter material test

*For dust class L and M machines, the degree of **penetration** of the filter material is determined as follows:*

Compliance is tested using apparatus similar to Figure AA.3. An integrally measuring photometer or a suitable particle measuring system can be used. The test is carried out using 6 new material samples.

The dust laden air is sucked through the filter material for 1 h, the air flow velocity at the measuring point P being the same as the air flow velocity at the filter in the machine.

The test dust used is a wide spectrum quartz dust in a concentration of (200 ± 20) mg/m³, where 90 % of the particle diameters at the measuring point P are between 0,2 μm and 2 μm, based on Stokes diameter.

*The degree of **penetration** is calculated by means of the following formula:*

$$D = \frac{C_H - C_o}{C_V - C_o} \times 100\ \% \qquad \text{[AA.1]}$$

where

C_H is the light-scattering signal downstream of the filter;

C_O is the blank value of the apparatus for ambient air;

C_V is the light scattering signal upstream of the filter.

*The degree of **penetration** is averaged over the duration of the test, the first readings being taken 5 min after the commencement of the flow of dust laden air through the filter sample material.*

*The degree of **penetration** D is determined for 6 samples.*

The arithmetic mean of the 6 values, plus twice the standard deviation, shall be less than the required value of D according to Table AA.1.

22.AA.201.2 Essential filter element test

*For dust class H machines, the degree of **penetration** of the **essential filter** element shall be determined as follows:*

Compliance is checked by using apparatus similar to Figure AA.4.

On machines with a ducted outlet, Figure AA.3 can be used.

*All dust filters are removed, except the **essential filter** element.*

*It shall be ensured that the **essential filter** element is evenly loaded with the test aerosol.*

*The test is carried out with a new **essential filter** element.*

The test aerosol is a narrow spectrum mist of paraffin oil, dispersed oil particulate (DOP) or NaCl, in a concentration between 10 mg/m³ and 200 mg/m³. To maintain the concentration between these limits, adjustments may be made after 5 min, if necessary.

According to Stokes diameter, 90 % of the number of particles is below 1 μm.

An integrally functioning photometer or a suitable particle counter is used to measure D continually.

After a second delay of 20 min, D is calculated with equation [AA.1]. The effect of carbon brush dust shall be taken into consideration.

D is not allowed to exceed the limit value given in Table AA.1.

22.AA.201.3 Assembled machine test

For dust class M and class H machines, a polydisperse limestone dust of particle size distribution 10 % < 1 μm, 22 % < 2 μm, 75 % < 5 μm is used for testing, in an apparatus as specified in Figure AA.5.

For machines equipped with a built-in filter cleaning mechanism, before this test, carry out a minimum of 1 cleaning cycles as described under 22.AA.202.

For machines equipped with collection bags, replace any clogged bags to restore the airflow rate.

When the airflow velocity has fallen to 20 m/s in the nominal suction hose diameter, with a maximum measuring time of 8 h, D is determined, either gravimetrically with a 95 % one-sided confidence level according to ISO 2602, or with an equivalent measuring system.

If the fan of the vacuum cleaner under test is strong enough to maintain the required airflow rate, QE may be reduced to zero.

The upstream concentration of the test substance during the entire test shall be 5 g/m^3 airflow.

The influence of air temperature, humidity and density shall be taken into consideration.

D shall not exceed the values given in Table AA.1.

22.AA.201.4 Burst strength test

If the machine is equipped with a safety switch to protect the motor and filter system, the safety switch shall be made inoperable.

*Any parts, with the exception of the **essential filter** itself, shall be dried to facilitate the flow of the clogging medium. All pre-filters that can be removed without the use of a **tool** shall be removed from the machine to ensure that the **essential filter** is subjected to the full loading of the clogging medium and to the pulsing effect of blocking the inlet as described below.*

Suck up a clogging medium (e.g. French chalk) until a differential pressure corresponding to 90 % of the maximum vacuum generated by the machine has been reached, or until the differential pressure stabilises for a minimum of 2 h. Cover the inlet to the machine for 5 s followed by opening for 1 s to achieve a pulsing effect.

The pulsing test shall be repeated 30 times over a period of 3 min.

*The **essential filter** shall not show any damage (e.g. rip up, loosening, holes cracking).*

22.AA.202 Filtration efficiency

Dust class M and dust class H machines may be provided with a **safe change filter** if a dust free filter exchange cannot be guaranteed. If dust class M and dust class H machines are provided with a built-in filter cleaning mechanism for the **essential filter**, the cleaning process shall not affect the filtration efficiency.

Compliance is checked by the following test.

Collect a suitable dust so that the airflow velocity is reduced below 20 m/s. The filter cleaning is carried out 50 times according to the instructions. The clogged bags are then emptied if necessary to restore the airflow according to 22.AA.203.

22.AA.203 Suction performance

If machines are provided with a built-in cleaning mechanism, it shall restore the required suction performance.

Compliance is checked by comparing the suction airflow with the desired value after operating the cleaning device according to the instructions. The cleaning operation shall be performed when the minimum suction airflow has been reached. The following performance, after the cleaning, shall be reached:

– for suction-sweeping machines, the reduction of pressure in the brush area is at least 50 N/m^2;

– for other machines, the suction airflow is 20 % greater than the minimum airflow volume as specified in 22.AA.205.

22.AA.204 'Upholstery tacks' test

Dust class M and dust class H machines shall be designed and constructed so that the **essential filter** will not be damaged when collecting sharp objects such as broken glass or nails which may be sucked up.

*Compliance is checked during **normal operation** by collecting 1 kg per kW **rated power input**, with a maximum of 1 kg, of upholstery tacks, 13 mm long. The filter shall show no damage.*

If there is no visible damage, the tests of 22.AA.201 shall be carried out.

22.AA.205 Indication regarding dust removal

All machines shall be capable of achieving an adequate removal of dust, and an indication shall be given as follows.

a) Vacuum cleaners of dust class M and class H shall be provided with an indicator which operates before the air velocity, through the largest hose (or tube) supplied by the manufacturer, falls below 20 m/s, referring to the largest section in the hose. If airflow indicator adjustments are necessary, they shall be adjustable without **tools**.

b) For suction-sweeping machines, the indicator shall operate before the reduction of pressure in the suction region of the brush area becomes less than 50 N/m^2. This also applies to the side brush area.

c) For **dust extractors** (excluding **negative pressure units** and dust class L machines), the indicator shall operate before the suction velocity becomes less than that stated by the manufacturer or 20 m/s, whichever is greater, referring to the largest section in the hose, or the dust source is shut off by a mechanism in the dust collector. If airflow indicator adjustments are necessary, they shall be adjustable without **tools**. If the dust source cannot be shut off automatically (e.g. when the **dust extractor** is connected to a circular saw), then at least one of the following warning signals shall be given:

   – an acoustic warning signal, if used, shall comply with ISO 7731;

   – a visual warning signal, if used, shall comply with ISO 11428;

   – a pair of voltage-free contacts and installation instructions for their use as a warning signal switching device.

Compliance is checked by inspection and the following test.

*Operate the machine at nominal voltage, at **rated voltage** +6 %, and at **rated voltage** –10 %; and, if necessary, compare the values with the specified values. No leaking of dust shall occur.*

22.AA.206 Disposable collection means

Dust class M machines (except suction sweeping machines) and dust class H machines shall be fitted with a disposable collection means.

For dust class M and dust class H machines, it shall be possible to remove the collection means with a minimum of dust release.

Compliance is checked by inspection and functional test.

22.AA.207 Removability of the essential filter

In dust class H machines, the **essential filter** shall only be removable by the use of a **tool**. This requirement does also apply to filter elements which are relevant for the first numeral of the IP protection designation.

Compliance is checked by inspection.

22.AA.208 Air speed of the dust exhaust

The air speed of the exhaust of dust class M and dust class H machines shall not unduly disturb dust lying on the floor.

Compliance is checked by the following test:

The machine shall be at least 2 m from any wall or vertical surface. The humidity of the air in the test area shall not exceed 60 % and the test shall be carried out in still air conditions. The working hose shall be fitted to the inlet and the intake end shall be positioned in an upward direction at a minimum height of 2 m above floor level. The exhaust velocity shall not exceed 1 m/s at a height of 50 mm above floor level.

22.AA.209 Upstream location of the essential filter

In dust class H machines, the **essential filter** shall be at less than atmospheric pressure.

For dust class L machines, if the **essential filter** is on the positive side, then the **penetration** test of 22.AA.201.3 shall be conducted.

Compliance is checked by the relevant test.

22.AA.210 Guard

Dust class M and dust class H machines shall be constructed so as to **guard** against accidental entry and the release of **hazardous dust** from any part of the machine when not in use.

Compliance is checked by inspection and the use of test probe B of IEC 61032.

22.AA.211 Easy cleaning

Dust class H machines and dust class M machines shall be designed and constructed in such a way that they can be easily cleaned, without impairing their safety. They shall comply with the following:

– covers which are not protecting against both mechanical and electrical hazards and behind which dust can deposit shall be removable without **tools**;

– **guards** which are protecting against mechanical and electrical hazards shall have electrical interlocks which disconnect the mains supply on removal, or shall be removable only by using **tools**. **Guards** fitted with electrical interlocks shall be removable without **tools**. The interlock shall be double pole if protecting against electrical hazard, and double or single pole if protecting against mechanical hazard only.

Compliance is checked by inspection.

Dimensions in millimetres (± 0,5 mm)

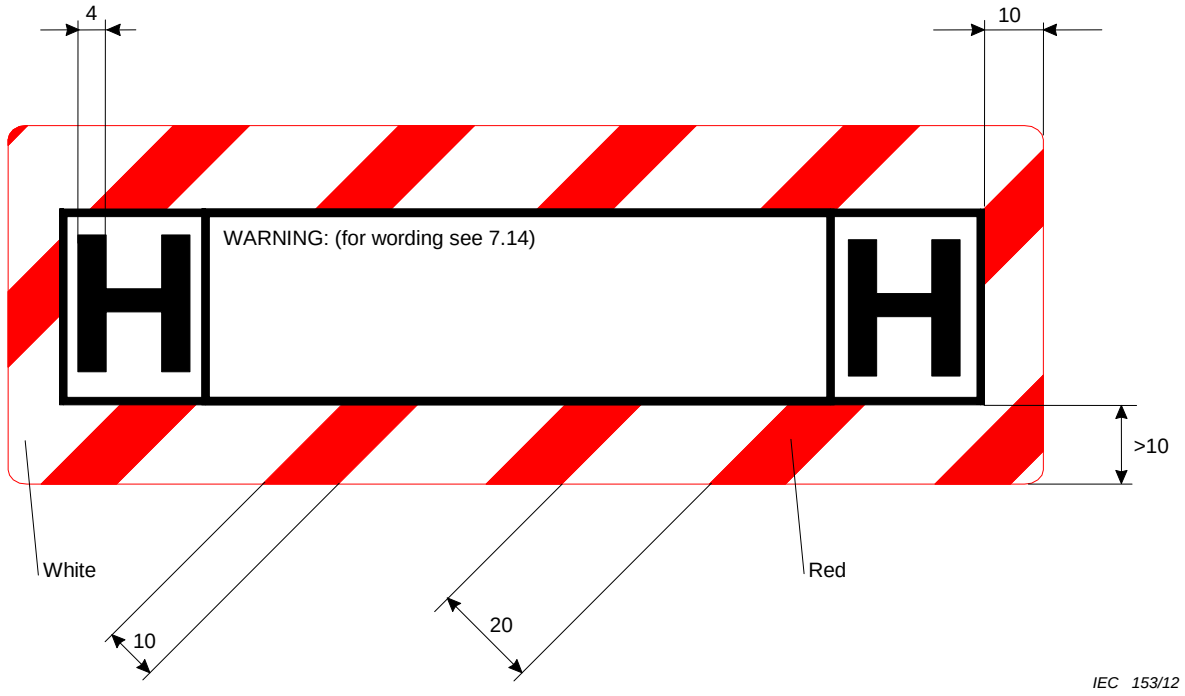


Figure AA.1 – Warning label for dust class H machines

Dimensions in millimetres (± 0,5 mm)

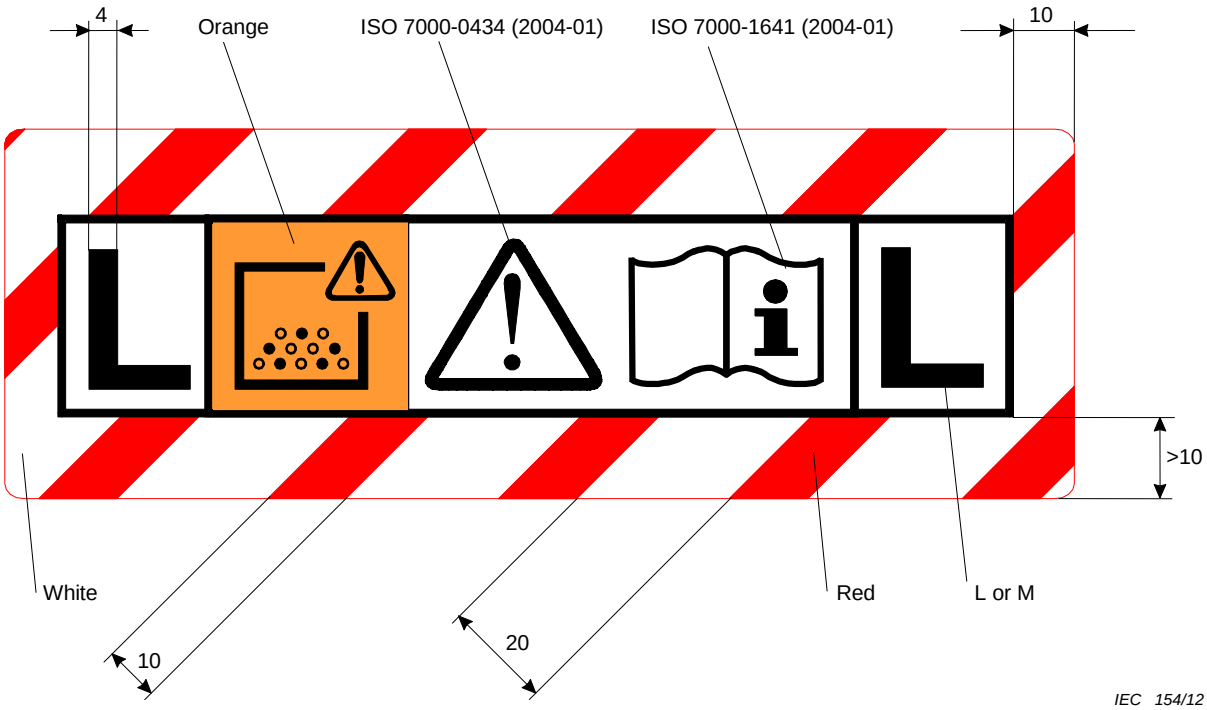


Figure AA.2 – Warning label for dust class L and dust M machines

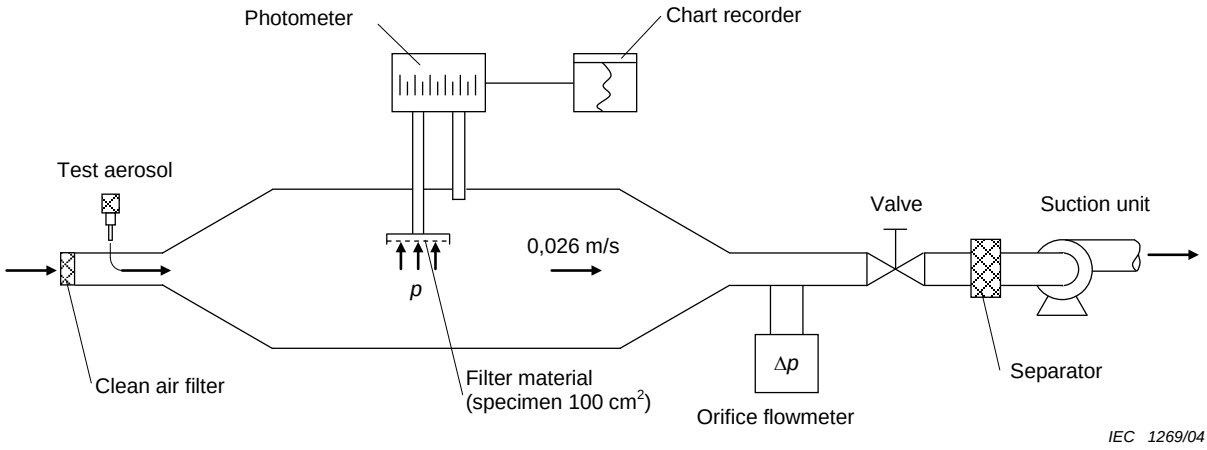


Figure AA.3 – Test method for essential filter material

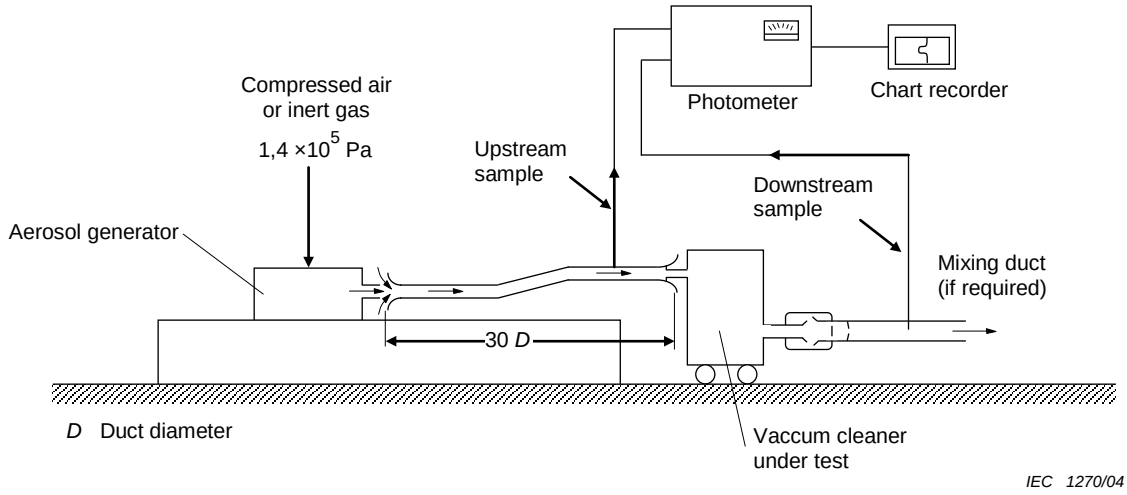
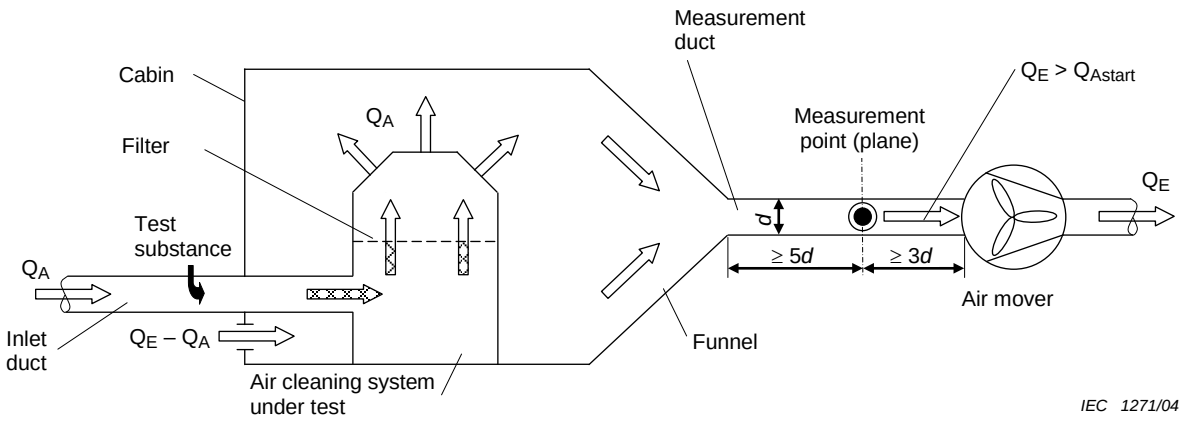


Figure AA.4 – In situ essential filter element test



The air entering at Q_E should be filtered. The filter used shall be of dust class M.

Figure AA.5 – Assembled machine test

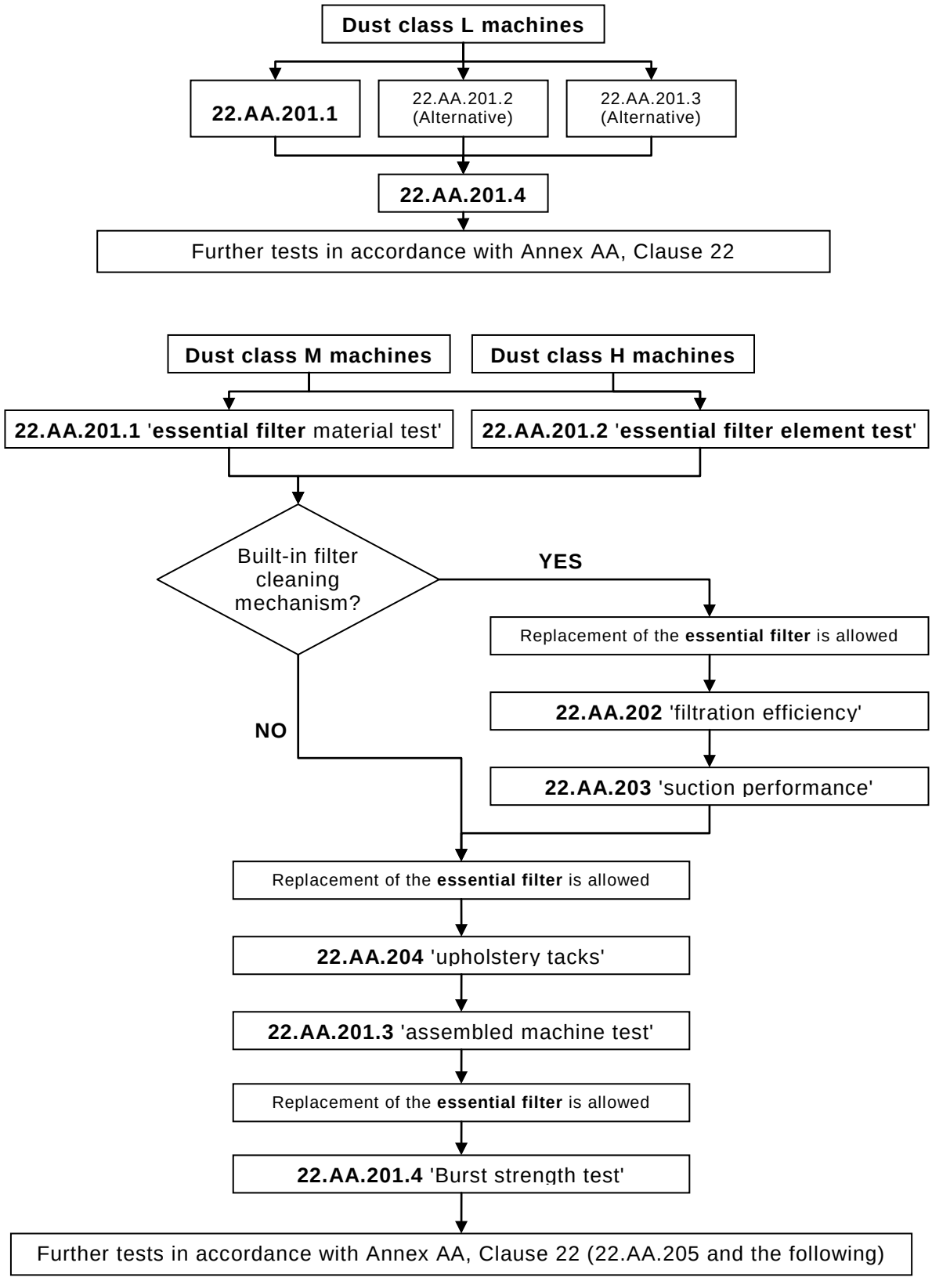


Figure AA.6 – Sequence and selection of tests according to Clause 22

Annex BB
(informative)

List of dusts which present an explosion risk when subject to ignition conditions

Values of explosion parameters are given in Table BB.1 as a guide for those concerned with the design and operation of dust-handling machines. The dust samples are not necessarily in the most hazardous form that could arise in industry. In addition, the design of the machine, the quantity of material and the methods for handling should all be taken into account when considering explosion hazards.

NOTE Attention is drawn to the fact that in many countries particular information on explosion parameters may be specified by the national health authorities, the national authorities responsible for the protection of labour, or similar authorities. This information might be available online, e.g.

– for Germany [cited 2011-11-04]: http://www.dguv.de/ifa/en/gestis/expl/index.jsp

Table BB.1 – Explosion parameters

Dust	Minimum ignition temperature °C	Minimum explosible concentration kg/m^3	Minimum ignition energy mJ
Acetamide	560	-	-
Acetoparaphenetidine	-	-	11,5
Acetyl-p-nitro-o-toludine	450	-	-
Acetyl salicylic acid (Aspirin)	550	0,015	16
Acrylonitrile-butadiene-styrene copolymer	400	-	-
Acrylonitrile-vinylidene chloride copolymer	-	0,05	70
Alkyd powder coatings	360	0,028	22
Aluminium, 6 μm	-	0,03	13
Aluminium, <1 400 μm	420	-	-
Aluminium, cuttings and buffings	480	-	-
Aluminium, fibres	610	-	-
Aluminium, linishings	600	-	-
Aluminium, polishings	460	-	-
Aluminium, swarf	590	-	-
Aluminium octoate	460	-	-
Animal feed stuff	450	-	-
Anthracene	-	-	7
Anthraquinone	670	-	-
Asbestos, resinated	480	-	-
Azodicarbonamide	-	0,6	130
Barley, milled	370	-	-
Battery case dust	400	-	-
Benzoic acid	600	0,011	12
Benzoyl peroxide	-	-	31
Benzoyl peroxide 44 %, gypsum 56 %	-	-	12

Dust	Minimum ignition temperature °C	Minimum explosible concentration kg/m^3	Minimum ignition energy mJ
Bleach powder, 60/100 μm	580	-	-
Bone flour, steamed	540	-	-
Boron carbide	640	-	-
Bread	450	-	-
Bronze	440	-	-
Brunswick green	360	-	-
Cadmium sulphide	700	-	-
Cadmium sulphoselenide	710	-	-
Cadmium yellow	390	-	-
Cadmium zinc sulphide	660	-	-
Calcium citrate	470	-	-
Calcium gluconate	550	-	-
Calcium pantothenate	430	-	-
Calcium propionate	530	-	-
Calcium silicide	-	-	< 4,6
Calcium stearate	450	-	24
Caprolactam	430	0,07	60
Carbon, 13 % volatile	590	-	45
Casein	460	-	-
Casein meal, steamed	460	-	-
Cellulose, bleached	410	-	-
Cellulose acetate	340	-	-
Cellulose acetate, fibres	430	-	-
Cellulose acetate butyrate	380	-	-
Cellulose triacetate	390	-	-
Charcoal, wood	470	-	-
Chicken manure	680	-	-
Chloro-amino-toluene sulphonic acid	650	-	-
p-Chloro o-toluidine hydrochloride	650	-	-
Coal, 30 % volatile	530	-	-
Coal, 36 % volatile	490	-	-
Coal, anthracite < 63 μm	530	-	-
Coal, Pittsburgh < 74 μm	530	0,03	-
Coal, pulverized < 150 μm	550	-	-
Coal, silkstone	490	-	-
Cocoa, bean husk	400	-	-
Coconut shell	490	-	-
Coffee	360	-	-
Coffee 55 %, chicory 45 %	370	0,1	140
Cork	400	-	-
Cornflour	390	-	-

Dust	Minimum ignition temperature °C	Minimum explosible concentration kg/m^3	Minimum ignition energy mJ
Cornstarch	380	0,15	-
Cyclohexanone peroxide	-	-	21
Detergent, high non-ionic	410	-	-
Detergent, low non-ionic	560	-	-
Detergent, standard ABS	520	-	-
Dextrine	440	-	-
Dextrose monohydrate	350	-	-
Diamino stilbene disulphonic acid	450	-	-
Dibutyl tin maleate	600	-	-
Dibutyl tin oxide	530	0,012	7
Dihydro streptomycin sulphate	670	-	-
Dimethyl acridan	540	-	-
Dimethyl diphenyl urea	490	-	-
Dinitroaniline	470	-	-
Dinitrobenzoyl chloride	380	-	-
Dinitro stilbene disulphonic acid	450	-	-
Diphenyl guanidine + 1,5 % de-dusting powder	540	-	28
Diphenyol propane	-	0,012	11
Epoxide resin	-	-	9
Epoxy powder, semi-gloss coating	-	0,013	-
Epoxy resin	490	0,012	12
Esparto grass	-	-	-
Face powder	440	-	-
Farina starch, 20 % H_2O	-	-	-
Ferrochrome	600	-	-
Fish meal	520	-	-
Flour, English 13 % H_2O	-	-	-
Flour, wheat	390	-	100
Grain, distillers dried solubles	420	0,06	128
Grain, dried brewers	440	0,009	-
Grass	380	-	-
Gum, arabic, 250/1 400 μm	550	-	-
Hoof and horn, hydrolysed	460	-	-
Hops, ground	340	-	-
Hydroxy ethyl cellulose	420	-	-
Hydroxy ethyl methyl cellulose	410	-	-
Irish moss	540	-	-
Isinglass	520	-	-
Jaborandi leaf	470	-	-
Lauryl peroxide	-	-	12
Lead stearate, dibasic	-	-	12

Dust	Minimum ignition temperature °C	Minimum explosible concentration kg/m^3	Minimum ignition energy mJ
Leather, < 420 μm	520	-	-
Liquorice root	-	0,2	-
Magnesium swarf	610	-	-
Maize gluten meal	430	-	-
Maize husk	430	-	-
Male fern, crushed	510	-	-
Malt, coarse	390	-	-
Manganese ethylene bis-dithio carbamate	270	0,07	35
Manioc flour	430	-	-
Meat meal	500	-	-
Meat and bone meal	440	-	-
Melamine formaldehyde resin	410	0,02	68
Methyl cellulose	480	-	-
2,2 Methylene bis-4-ethyl-6-tertiary butyl phenol	310	-	-
Methyl methacrylate	-	-	13
Milk powder	440	-	-
Milk powder, skimmed	-	-	-
Monochloracetic acid	620	-	-
Monosodium salt of tri-chloroethyl phosphate	540	-	-
β-Naphthol	670	-	-
Nigrosine hydrochloride	630	-	-
p-Nitro o-anisidene	400	-	-
Nitrocellulose	-	-	30
Nitrodiphenylamine	480	-	-
Nitrofurfural semi-carbazone	240	-	-
m-Nitro p-toluidine	470	-	-
p-Nitro o-toluidine	470	-	-
Nylon, ground flock	450	-	-
Nylon 11	-	0,005	32
Paper	400	0,03	-
Paper tissue, < 1400 μm	-	-	39
Peat	450	-	-
Peat, dried	-	0,1	-
Pectin, powdered	390	-	-
Penicillin, N-ethyl, piperidine salt of	310	-	-
Phenol formaldehyde	520	-	-
Phenol formaldehyde resin	450	0,015	-
Phenothiazine	590	-	-
Polyester resin < 1 400 μm	400	-	-
Polyethylene	390	0,02	38
Polyethylene, commercial	-	-	57

Dust	Minimum ignition temperature °C	Minimum explosible concentration kg/m^3	Minimum ignition energy mJ
Polyethylene, ground	400	-	-
Polyethylene glycol	320	-	-
Polyethylene high density < 90 µm	-	-	17
Polypropylene	380	-	43
Polyurethane	460	-	-
Polyvinyl acetate	450	-	-
Polyvinyl acetate, beads	-	-	70
Polyvinyl chloride	510	-	-
Polyvinyl chloride, dispersion resin	550	-	-
Polyvinylidene chloride	670	-	-
Poppy flower	410	0,4	600
Potato, dried, < 200 µm	450	-	-
Propyliodine	470	-	-
Protein	480	-	-
Protein, groundnuts	460	-	-
Protein concentrate	390	-	-
Provender	370	-	-
Quillaia bark	450	-	-
Rag, < 1 400 µm	470	-	-
Rayon, viscose	420	-	-
Rayon flock	-	0,03	-
Rayon flock, 8 denier, 1,5 mm	425	0,15	-
Resin, rubber	400	-	-
Resin, synthetic	400	-	-
Rubber	380	-	-
Rubber, latex	450	-	-
Rubber, synthetic	410	-	-
Rubber accelerator	310	-	-
Rubber crumb	440	-	-
Sawdust	430	-	-
Senna	440	0,01	105
Silicon	900	-	-
Soap	570	0,02	25
Sodium acetate	560	0,15	-
Sodium carboxy methyl cellulose	320	1,1	440
Sodium salt of 2,2 dichloropropionic acid	520	-	-
Sodium salt of 2,2 dihydroxy naphthalene disulphonic acid	510	-	-
Sodium glucaspaldrate	600	-	-
Sodium glucoheptonate, dried	600		
Sodium monochloracetate	550	-	-

Dust	Minimum ignition temperature °C	Minimum explosible concentration kg/m^3	Minimum ignition energy mJ
Sodium propionate	470	-	-
Sodium toluene sulphonate	530	-	-
Sodium xylene sulphonate	490	-	-
Sorbic acid	440	-	-
Soya bean	390	0,23	370
Soya meal	410	0,18	330
Starch	470	-	-
Starch, cold water	490	-	-
Starch, maize 10 % H_2O	-	0,15	-
Stearic acid	330	-	-
Steel	450	-	-
Streptomycin sulphate	700	-	-
Sugar	330	0,015	48
Sulphur	220	0,02	-
Tallow, hydrogenated	620	-	-
Tartaric acid	350	-	-
Tea	500	-	-
Tobacco, dried	320	-	-
Urea	900	-	-
Urea formaldehyde moulding powder	450	0,04	-
Urea formaldehyde moulding powder, paper filled	430	0,07	49
Wax, paraffin	340	-	-
Whey flour	480	-	-
Wood	360	-	-
Wood, flour	380	0,06	100
Wood, flour, < 1400 μm	410	-	100
Wood, ground fluffed	450	-	-
Wood, shavings	400	0,1	-
Wood pulp, dehydrated	450	-	-
Wood pulp, flock	470	-	-
Zinc stearate	420	-	14

Annex CC
(informative)

Particular requirements for vacuum cleaners and dust extractors for the collection of dusts which present an explosion risk

The following modifications to this standard are applicable to vacuum cleaners and **dust extractors** for the collection of dusts which present an explosion risk.

NOTE Additional subclauses and notes in this annex are numbered starting with CC.201.

1 Scope

Replacement of the first paragraph:

This standard deals with the safety of electrical motor-operated vacuum cleaners, including **dust extractors** and **back-pack vacuum cleaners**, for wet suction, dry suction, or wet and dry suction, intended for commercial indoor or outdoor use with or without attachments, to pick up **combustible dust** in an **explosive atmosphere** specified as **zone 22**.

3 Terms and definitions

3.CC.201
type 22 machine
vacuum cleaner or **dust extractor** suitable for suction of **combustible dust** in **zone 22**

The inner part of suction hoses and nozzles is considered to be **zone 22**.

3.CC.202
zone 20
place in which an explosive atmosphere in the form of a cloud of combustible dust in air is present continuously, or for long periods or frequently

3.203
zone 22
place in which an explosive atmosphere in the form of a cloud of combustible dust in air is not likely to occur in normal operation but, if it does occur, will persist for a short period only

3.CC.204
electrostatic earthing
connection to earth with a maximum resistance of 1 MΩ

3.CC.205
conductive parts
parts made of materials with a specific resistance of not more than 10 000 Ω·m

4 General requirement

4.CC.201

Machines of type 22 shall comply with dust class L, class M or class H according to Annex AA. For dust class L, an indicator is required in accordance with 22.CC.205 (indicator). **Machines of type 22** and class L shall comply with the requirements of 22.CC.204 ('upholstery tacks' test). For all machines, flow-through collector motors are not allowed.

4.CC.202

The temperature of the surfaces of a **type 22 machine** that are in contact with **combustible dust** shall not exceed 135 °C.

Lower temperatures can be stated by the manufacturer.

Compliance is checked by the tests of Clauses 11 and 19.

6 Classification

6.1 *Addition:*

Type 22 machines shall be of **class I**.

6.2 *Addition:*

Type 22 machines shall be at least IP54 according to IEC 60529.

The test is carried out with air-moving fans working.

Data lead connectors are not required to be IP54 if they are SELV and their current is limited to 20 mA.

Compliance is checked by inspection and by the relevant tests.

6.CC.201 The machines are classified as follows:

– Type 22: Machines suitable for operation in **zone 22**.

7 Marking and instructions

7.1 *Addition:*

Machines shall be marked in accordance with IEC 61241-1-1, for example "Ex II 3D T135°C".

Appliance inlets shall be marked with the essence of the statement: "Do not plug or unplug under load."

7.6 Type 22 vacuum cleaners shall be clearly and permanently marked with the symbol of Figure CC.1.

Type 22 dust extractors shall be clearly and permanently marked with the symbol of Figure CC.2.

7.12 *Addition:*

In addition, the instructions shall include the substance of the following for all **type 22 machines**:

– The dust container has to be emptied when necessary, but also after every use.
– Extension cords shall not be used.
– The correct rotation sense shall be ensured if necessary, to avoid blowing and high temperatures caused by rotation in the wrong sense.

– For dusts with ignition energy less than 1 mJ, additional restrictions of the labour authorities may apply.

NOTE Typical values for ignition energy can be found in Annex BB.

– During **normal operation**, surface temperatures may rise to (T_{max}) °C, if T_{max} exceeds 80 °C.

– **Type 22 machines** are not suitable to pick up dusts or liquids of high explosion risk, nor mixtures of **combustible dust** with liquids.

– WARNING – Only use accessories approved by the manufacturer for type 22 use. The use of other accessories may cause explosion hazard.

– The machine shall only be operated when all filters, including filters for motor cooling air, are in position and undamaged.

In addition, the instructions shall include the substance of the following for suction sweeping machines:

– Type 22 suction sweeping machines are suitable for picking up **combustible dust** in **zone 22**.

In addition, the instructions shall include the substance of the following for vacuum cleaners:

– Type 22 vacuum cleaners are suitable for picking up **combustible dust** in **zone 22**. They are not suitable to be connected with dust-generating machines.

In addition, the instructions shall include the substance of the following for **dust extractors**:

– Type 22 **dust extractors** are suitable to be connected to dust-generating machines in **zone 22**. It has to be ensured that no ignition sources will be picked up. Conductive machine parts, including suction hoods and conductive parts of **Class II** machines, shall be electrostatically earthed. **Electrostatic earthing** can be accomplished through the **dust extractor** or through a separate electrostatic earthing means.

– Type 22 **dust extractors** are not suitable for machines where ignition sources are produced.

Information shall be given about the national regulations that apply for the installation of data lead wiring and power sockets in **zone 22**.

The meaning of the symbols according Figure CC.1 or Figure CC.2 shall be explained, including the substance of the following warnings:

– Do not pick up glowing dust or other ignition hazards (Figure CC.1).

– Do not pick up glowing dust or other ignition hazards. Do not use with spark-generating machines (Figure CC.2).

11 Heating

Addition to Table 3 (Maximum normal temperature rises):

NOTE 101 For parts that come into contact with **combustible dust**, the values in the table are based on an ambient temperature of 40 °C.

19 Abnormal operation

19.7

Delete Note 101 of this Part 2.

Addition:

The machine shall be tested until stable conditions are reached.

19.8 *Addition:*

The test is repeated after interchanging two of the three-phase leads in the plug to induce rotation in the wrong sense, if possible, and if there is no warning signal for incorrect rotation sense.

22 Construction

22.CC.201 The suction fan shall be on the clean air side and shall be protected against intake of particles greater than 8 mm.

Compliance is checked by inspection and measurement.

22.CC.202 Machines shall be so constructed that a minimum of dust will deposit in or on the machine.

Compliance is checked by inspection.

22.CC.203 Outer parts of the machine, parts enclosing collected dust, nozzles and dust conduits shall not be made from aluminium containing more than 7,5 % of magnesium and not be coated with aluminium coating.

Nozzles made of cast aluminium containing more than 7,5 % of magnesium have to be protected against impact by steel or resilient protectors.

Compliance is checked by inspection.

22.CC.204 Dust deflectors shall not be made of materials that generate sparks on impact.

Compliance is checked by inspection.

22.CC.205 Downstream of the **essential filter**, the air is considered to be free of **combustible dust**.

23 Internal wiring

23.CC.201 Cables and wires not within the IP54 compartment shall not be lighter than 60245 IEC 66.

This requirement does not apply to external data wiring.

NOTE For external data wiring, national regulations can apply.

Compliance is checked by inspection.

24 Components

24.1 *Addition:*

Components located within enclosures containing collected **combustible dust** shall be suitable for **zone 20**.

Compliance is checked by inspection.

24.CC.201 Cooling air filters which are needed to make the machine compliant with 6.2 as specified in this Annex CC shall be removable only by using **tools**.

Compliance is checked by inspection.

25 Supply connection and external flexible cords

25.1 *Addition:*

Appliance inlets shall be so arranged that the plug is inserted from below. When disconnected, the appliance inlet shall be protected against deposition of dust by a permanently attached dust cover.

Compliance is checked by inspection.

25.7 *Replacement:*

Power **supply cords** for **type 22 machines** shall not be lighter than 60245 IEC 66.

This requirement does not apply to external data wiring.

NOTE For external data wiring, national regulations can apply.

Compliance is checked by inspection.

30 Resistance to heat and fire

30.2 *Addition:*

Non-metallic parts surrounding collected **combustible dust** shall be resistant to ignition and spread of fire. This requirement does not apply to removable dust-collection media placed within the flame-resistant enclosure, e.g. paper disposal bags.

Compliance is tested as follows:

The following test is not carried out on machines exclusively intended to pick up wood dust, having a maximum rated power of 1 200 W and with the volume of the dust container not exceeding 50 dm^3.

*Non-metallic parts covering but not supporting the collected **combustible dust** are subjected to the glow-wire test according to IEC 60695-2-11, the test being made at a temperature of 550 °C.*

*Non-metallic parts supporting the collected **combustible dust** shall have a glow-wire flammability index of at least 850 °C according to IEC 60695-2-12, the test sample being no thicker than the relevant part and are subjected to the glow-wire test according to*

IEC 60695-2-11, the test being made at a temperature of 750 °C. Parts that withstand the glow-wire test of IEC 60695-2-11, but which, during the test, produce a flame that persists for longer than 2 s, are subjected to the needle-flame test of Annex E.

The needle-flame test is not carried out on parts which are made of material classified as V-0 or V-1 according to IEC 60695-11-10, provided that the test sample was not thicker than the relevant part.

30.CC.201 Type 22 machines shall not create any ignition source.

All **conductive parts** that are in contact with **combustible dust** shall be electrostatically earthed.

The requirement for **electrostatic earthing** does not apply to small **conductive parts**, when their time constant (resistance to earth times capacity) is below 0,02 s.

Filter materials are not required to be conductive.

Compliance is checked as follows:

*The **electrostatic earthing** is measured with minimum 100 V DC, with an electrode surface not exceeding 20 cm^2. The electrode is applied with a force of 10 ± 2 N.*

Figure CC.1 – Marking – Type 22 vacuum cleaners

IEC 2309/07

Figure CC.2 – Marking – Type 22 dust extractors

Annex DD
(normative)

Particular requirements for vacuum cleaners for use in ESD protected areas

The following modifications to this standard are applicable to vacuum cleaners for use in **ESD protected areas**.

NOTE Additional subclauses and notes in this annex are numbered starting with DD.201.

1 Scope

Replacement of the first paragraph:

This standard deals with the safety of electrical motor-operated vacuum cleaners, including **back-pack vacuum cleaners**, for wet suction, dry suction, or wet and dry suction, intended for **commercial use** with or without attachments in **ESD protected areas**.

3 Terms and definitions

3.DD.201
type ESD vacuum cleaner
vacuum cleaner for use in **ESD protected areas**

3.DD.202
electrostatic earthing
connection to earth with a maximum resistance of 1 MΩ

3.DD.203
conductive parts
parts made of materials with a specific resistance of not more than 10 000 Ω·m

4 General requirement

Addition:

Type ESD vacuum cleaners shall comply with dust class L, class M or class H according to Annex AA.

6 Classification

6.1 *Addition:*

Type ESD vacuum cleaners shall be **class I**.

6.2 *Addition:*

Type ESD vacuum cleaners shall be at least IP54 according to IEC 60529.

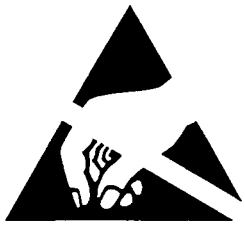
The test is carried out with air moving fans working.

Compliance is checked by inspection and by the relevant tests.

7 Marking and instructions

7.1 *Addition:*

Type ESD vacuum cleaners shall be clearly and permanently marked with the following symbol:



7.12 *Addition:*

In addition, the instructions shall include the substance of the following for all **type ESD vacuum cleaners**:

– Extension cords shall be **Class I**.

– **Type ESD vacuum cleaners** are not suitable to pick up dusts or liquids of high explosion risk, nor mixtures of **combustible dust** with liquids.

– WARNING – Only use accessories approved for Type ESD use. The use of other accessories may cause electrostatic discharges.

– The machine shall only be operated when all filters, including filters for motor cooling air, are in position and undamaged.

NOTE National regulations may contain requirements for the installation of data lead wiring and power sockets in **EPA**s.

22 Construction

22.DD.201 Machines shall be so constructed that a minimum of dust will deposit in or on the machine.

22.DD.202 **Type ESD vacuum cleaners** shall not generate or keep electrostatic charge. All **conductive parts** shall be electrostatically earthed.

The requirement for **electrostatic earthing** does not apply to small **conductive parts**, when their time constant (resistance to earth times capacity) is below 0,02 s.

Compliance is checked as follows.

*The **electrostatic earthing** is measured with 100 V DC, with an electrode surface not exceeding 20 cm^2. The electrode is applied with a force of 10 N $\pm$ 2 N.*

22.DD.203 The surface resistance of chargeable shell parts and accessories shall not exceed 10^9 Ω.

Compliance is checked as follows.

The surface resistance is measured between 2 parallel electrodes, each 100 mm long, in a distance of 10 mm to each other, making contact to the measuring surface. The applied voltage shall be 500 V ± 10 V. The measurement shall be done on standard conditions (23 °C ± 2 °C; 50 % ± 5 % air humidity).

24 Components

24.1 *Addition:*

Components located within enclosures shall be suitable for **EPA**'s.

Compliance is checked by inspection.

24.DD.201 Cooling air filters which are needed to make the machine compliant with 6.2 as specified in this Annex DD shall be removable only by using **tools**.

Compliance is checked by inspection.

30 Resistance to heat and fire

30.2 *Addition:*

Non-metallic parts surrounding collected dust shall be electrically conductive.

Annex EE
(informative)

Emission of acoustical noise

EE.1 Noise reduction

Noise reduction from vacuum cleaners is an integral part of the design process and shall be achieved by applying measures at source to control noise, see for example ISO/TR 11688-1. The success of the applied noise reduction measures is assessed on the basis of the actual noise emission values in relation to other machines of the same type with comparable non-acoustical technical data.

The major sound sources in vacuum cleaners are: motors and fans.

EE.2 Noise test code

EE.2.1 Emission sound pressure level determination

The emission sound pressure level for all vacuum cleaners except for **back-pack vacuum cleaners** is determined in accordance with ISO 11203 applying the method described in 6.2.3 d) with the measurement distance d = 1 m.

NOTE In this case, the emission sound pressure level is equal to the surface sound pressure level used for calculating the sound power level according to ISO 3744 when applying a rectangular parallelepiped measurement surface at a distance of 1 m from the reference box.

The emission sound pressure level for **back-pack vacuum cleaners** is determined in accordance with ISO 11201, grade 2. The microphone is placed at a height of 1,65 m ± 0,05 m, and at a distance of 0,10 m ± 0,025 m in y direction from the ear of the **operator** on the louder side, and at a distance of 0,00 m ± 0,025 m in x direction from the ear of the **operator**. The microphone shall be pointed towards the ear.

EE.2.2 Sound power level determination

The sound power level is measured in accordance with ISO 3744, or with ISO 3743-1 if a suitable hard-walled test room is available, or with ISO 9614-2. The direction of the x-axis in Figures EE.1 and EE.2 must be the same as the x-axis defined for the microphone configurations in ISO 3744.

EE.2.3 Operating and mounting conditions

The operating condition shall be identical for the determination for both sound power and emission sound pressure level at the specified positions.

In addition to **normal operation** in accordance with 3.1.9, the following requirements for different types of vacuum cleaners shall be taken into account. The measurement time shall be at least 15 s.

EE.2.3.1 Canister vacuum cleaners

The vacuum cleaner shall be installed on the reflecting plane.

Immediately before each series of measurements, the machine shall be operated for at least 10 min; battery powered machines shall be operated for at least 2 min, starting with a fully charged battery. The noise emission of the non-motorised suction nozzle shall be excluded

from measurement so that it does not interfere with the measurement result, e.g. by placing the nozzle outside of the measurement area.

NOTE Figures are not considered to be necessary for **canister vacuum cleaners** without **motorized cleaning head**. Figures EE.1 and EE.2 show the **motorized cleaning head** as well as the upright vacuum cleaners according to EE.2.3.2.

EE.2.3.2 Upright vacuum cleaners and motorized cleaning heads

Before starting the measurement procedure, the cleaning head shall be adjusted correctly in accordance with the manufacturer's instructions for cleaning carpets.

If the cleaning head is equipped with a device to put out brushes or other retractable parts for cleaning carpets, the cleaning head shall be adjusted so that the bristles of rotating brushes or other retractable parts go beyond the theoretical supporting plane of the cleaning head on a hard floor from $(2^{+0,2}_{-0})$ mm or, if not possible, from at least 2 mm.

All parts intended for hard floor treatment only shall be removed or retracted. For upright vacuum cleaners, crevice nozzles or similar accessories, if applicable, shall not be taken into account.

The upright vacuum cleaner shall be fixed directly without any resilient means on the Wilton carpet (according to IEC 60312-1) of a size 2 m x 1 m, placed on the floor of the test room. If the measurement is done in a reverberation test room or a hard-walled test room, a minimum **clearance** of 1 m between any part of the machine or attachments and the nearest wall shall be observed. The vacuum cleaner shall be positioned in accordance with Figures EE.1 or EE.2.

The hose and connecting tube(s) or the handles of hand-supported and upright vacuum cleaners shall be resiliently suspended or supported in normal position of use (middle of the handles at (80 ± 5) cm above the carpet, if possible), the cleaning head being in full contact with the carpet.

If necessary, the cleaning head shall be resiliently fastened to prevent self-propulsion.

Sound radiation due to possible vibrations of the standard test carpet shall be prevented.

The test carpet is considered to be a part of the machine to be tested and its possible influence on the acoustical characteristics of the test environment, for example of the hard reflecting plane, or on the absorption (reverberation time) of the reverberant test room or hard-walled room shall not be taken into account.

EE.2.3.3 Back-pack vacuum cleaners

Before starting the measurement procedure, the nozzle intended for cleaning carpets shall be adjusted correctly in accordance with the manufacturer's instructions for cleaning carpets.

If the nozzle is equipped with a device to put out brushes or other retractable parts for cleaning carpets, the nozzle shall be adjusted so that the bristles or other retractable parts go beyond the theoretical supporting plane of the nozzle on a hard floor from $(2^{+0,2}_{-0})$ mm or, if not possible, from at least 2 mm.

All parts intended for hard floor treatment only shall be removed or retracted. Crevice nozzles or similar accessories, if applicable, shall not be taken into account.

The **back-pack vacuum cleaner** shall be carried by an **operator**. The **operator** shall stand upright and look straight ahead. The **operator** shall be 1,75 m ± 0,05 m tall. The harness of the **back-pack vacuum cleaner** shall be adjusted to the size of the **operator**.

The handle is held by the **operator** in the right hand in 0,80 m height with inclination of 45 ° to the floor and the suction nozzle is placed with no pressure on the Wilton carpet (according to IEC 60312-1) of a size 2 m x 1 m, placed on the floor of the test room. The vacuum cleaner and the **operator** shall be positioned in accordance with Figure EE.3.

If the measurement is done in a reverberation test room or a hard-walled test room, a minimum **clearance** of 1 m between any part of the machine or attachments and the nearest wall shall be observed.

Sound radiation due to possible vibrations of the standard test carpet shall be prevented.

The test carpet is considered to be a part of the machine to be tested and its possible influence on the acoustical characteristics of the test environment, for example of the hard reflecting plane, or on the absorption (reverberation time) of the reverberant test room or hard-walled room shall not be taken into account.

EE.2.3.4 Centrally-sited vacuum cleaners

The airflow through the machine shall be adjusted so that the power consumption is according to the rated power.

When carrying out free field measurements, the machine may be operated with the mounting side on the reflecting floor. A suction hose shall be used, long enough to avoid measuring suction noise. Carpets are not required.

EE.2.4 Measurement uncertainties

A standard deviation of reproducibility σ_{RO} of less than 1,5 dB is expected for both the A-weighted emission sound pressure level according to ISO 11203 and the A-weighted sound power level determined according to ISO 3744 or ISO 3743-1.

EE.2.5 Information to be recorded

The information to be recorded covers all of the technical requirements of this noise test code. Any deviations from this noise test code or from the basic standards upon which it is based are to be recorded together with the technical justification for such deviations.

EE.2.6 Information to be reported

The information to be included in the test report is at least that which the manufacturer requires for a noise emission declaration or the user requires to verify the declared values.

EE.2.7 Declaration and verification of noise emission values

The declaration of the emission sound pressure level shall be made as a dual-number noise emission declaration according to ISO 4871, where it exceeds 70 dB(A). Where the emission sound pressure level does not exceed 70 dB(A), this fact may be stated in place of the emission value and uncertainty, e.g. by declaring $L_{pA} \leq 70$ dB(A).

It shall declare the noise emission value L_{pA} and separately the respective uncertainty K_{pA}.

The sound power level shall be given as a dual-number noise emission declaration according to ISO 4871, where the emission sound pressure level exceeds 80 dB(A).

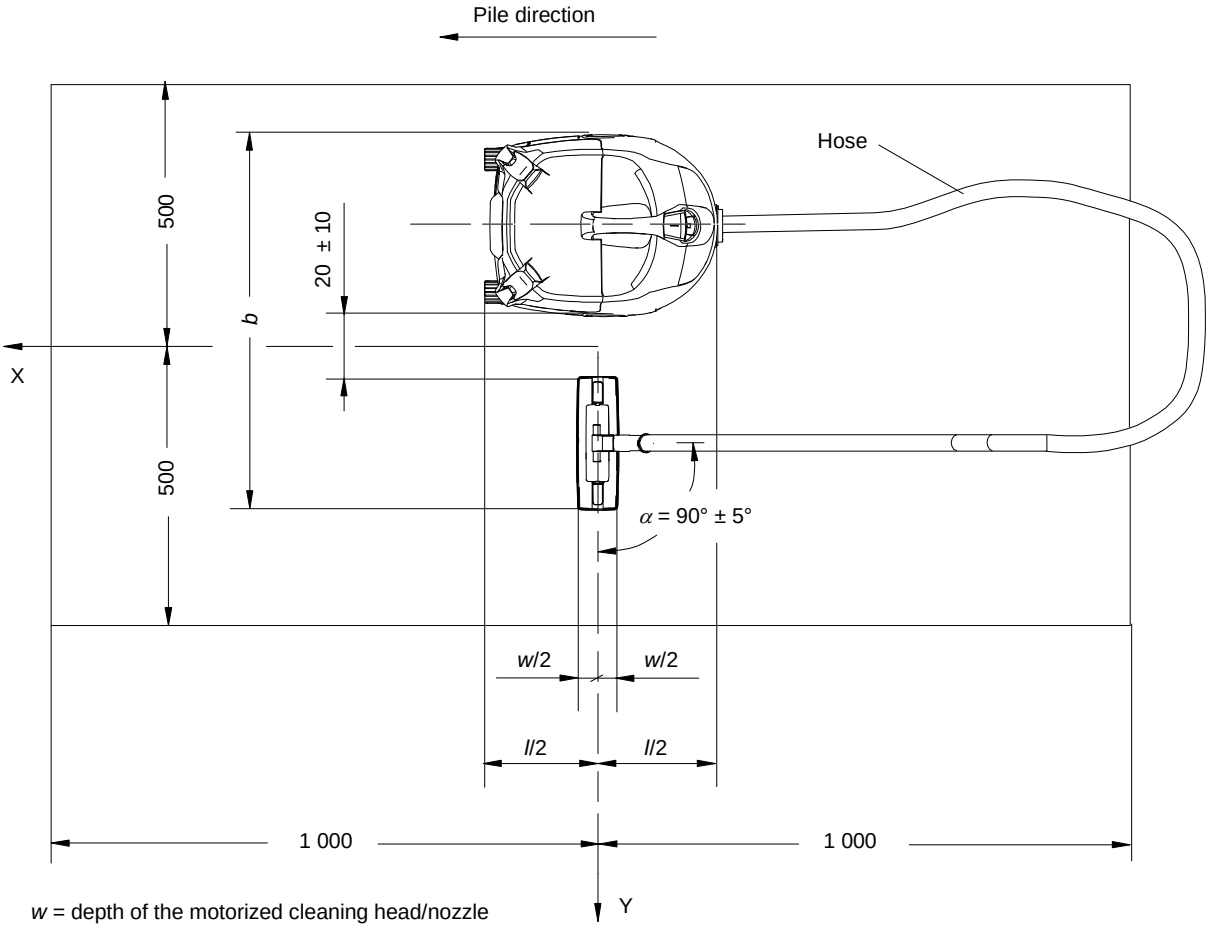
It shall declare the noise emission value L_{WA} and separately the respective uncertainty K_{WA}.

NOTE K_{pA} and K_{WA} are expected to be 2 dB.

The noise declaration shall state that the noise emission values have been obtained according to this noise test code. If this statement is not true, the noise declaration shall indicate clearly what the deviations from this standard, and from the basic standards, are.

If undertaken, verification shall be conducted according to ISO 4871 by using the same mounting, installation and operating conditions as those used for the initial determination of the noise emission values.

Dimensions in millimetres



w = depth of the motorized cleaning head/nozzle

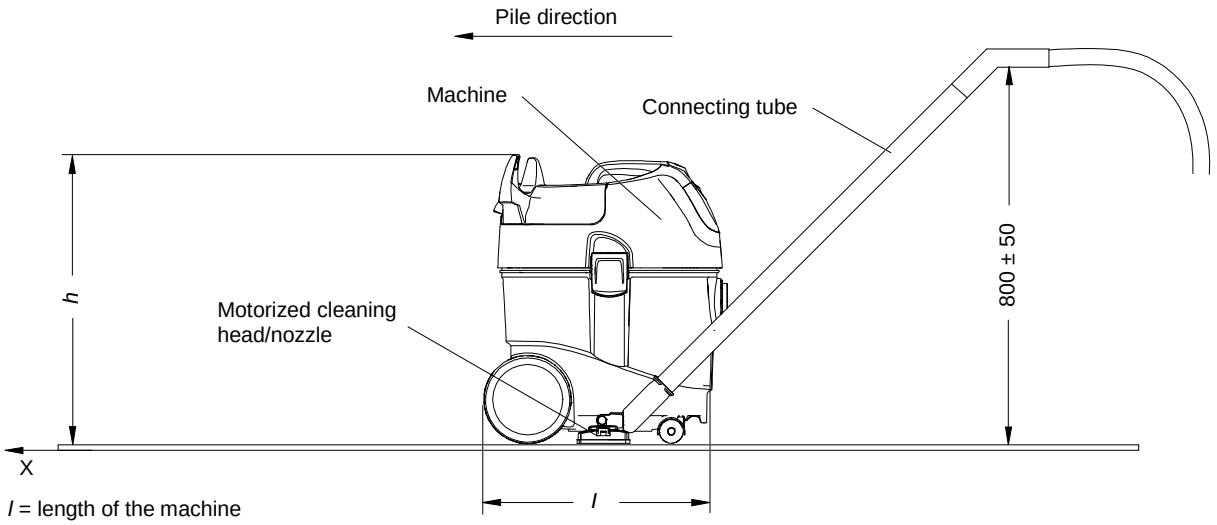
l = length of the machine

b = width of machine including nozzle

IEC 156/12

Figure EE.1a – Machine with cleaning head connected by hose and connecting tube (top view)

Dimensions in millimetres



l = length of the machine

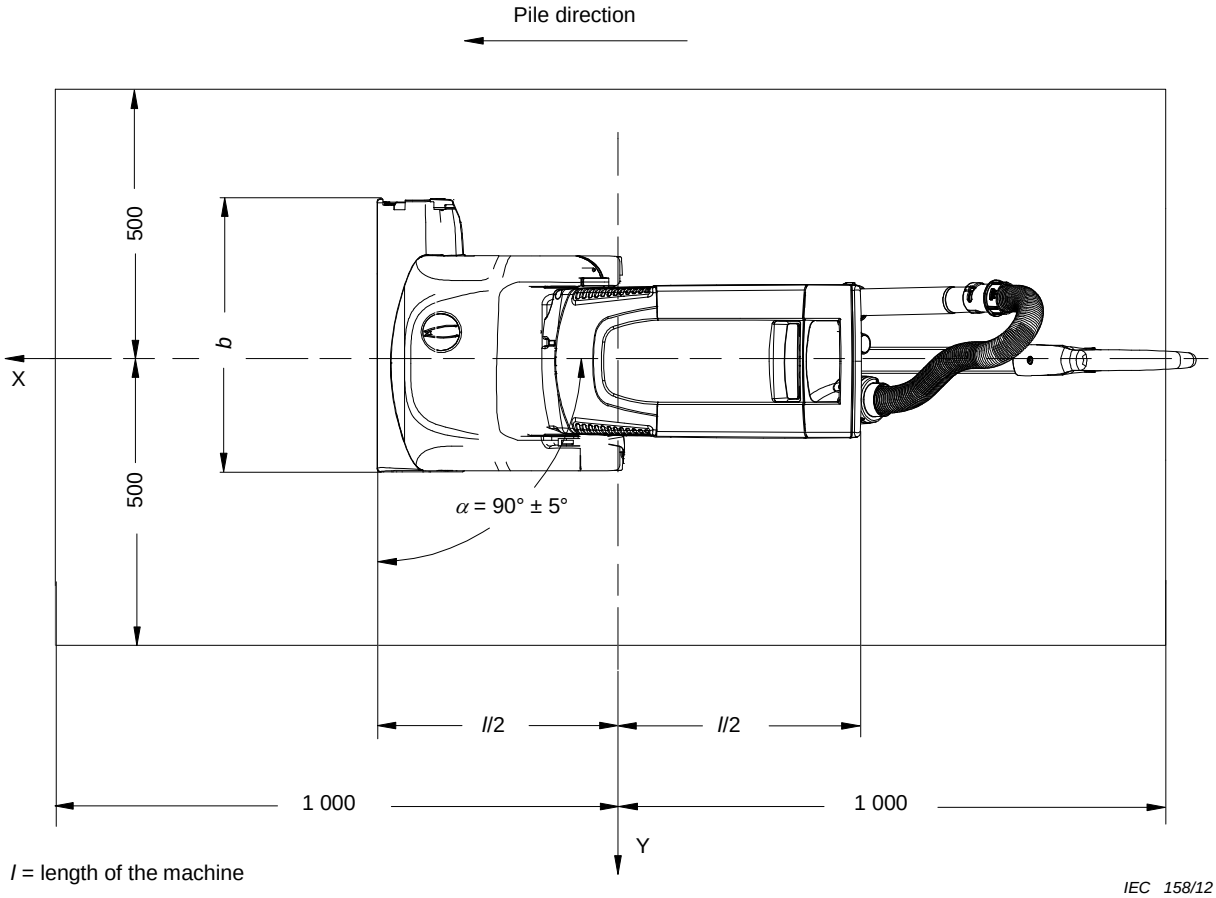
h = height of the machine

IEC 157/12

Figure EE.1b – Machine with cleaning head connected by hose and connecting tube (side view)

Figure EE.1 – Position of vacuum cleaners and its accessories

Dimensions in millimetres

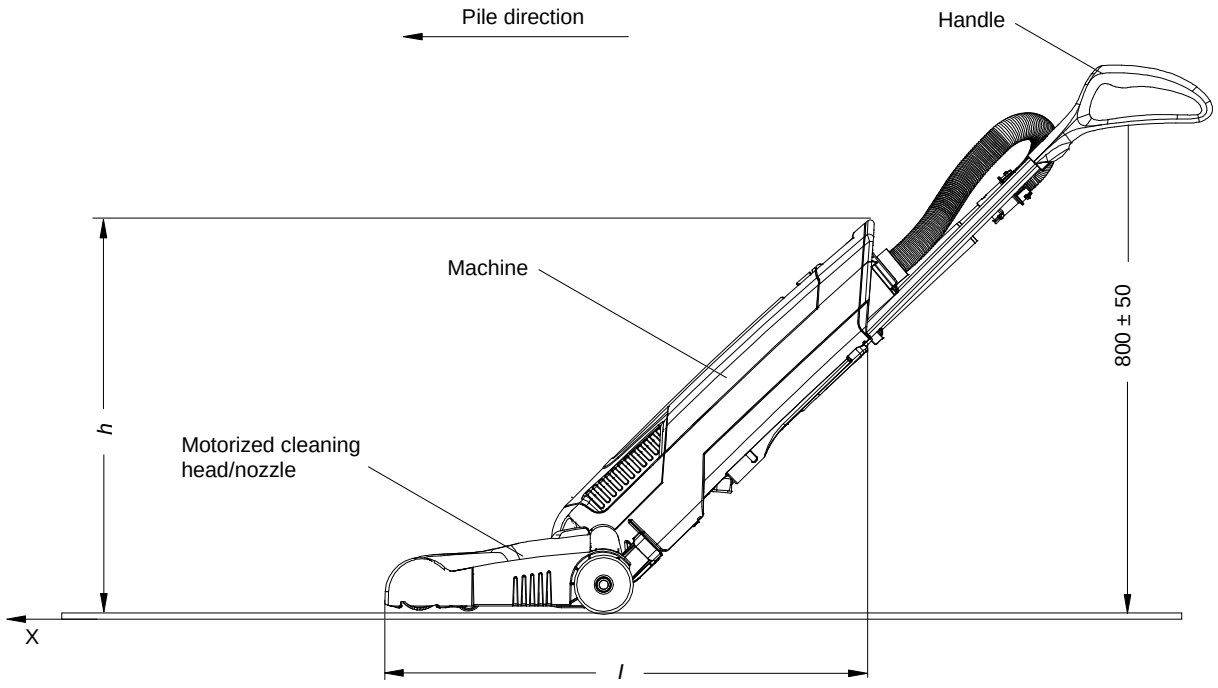


l = length of the machine

IEC 158/12

Figure EE.2a – Machine with cleaning head connected directly (top view)

Dimensions in millimetres



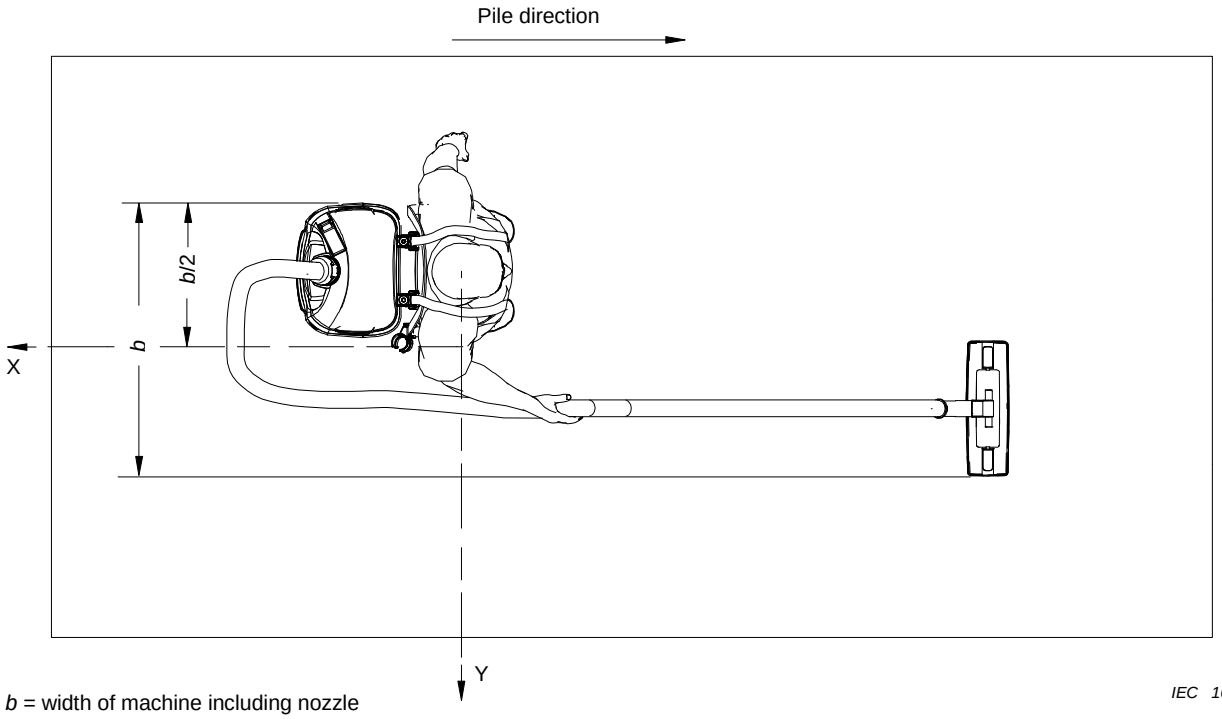
l = length of the machine

IEC 159/12

Figure EE.2b – Machine with cleaning head connected directly (side view)

Figure EE.2 – Position of upright machines

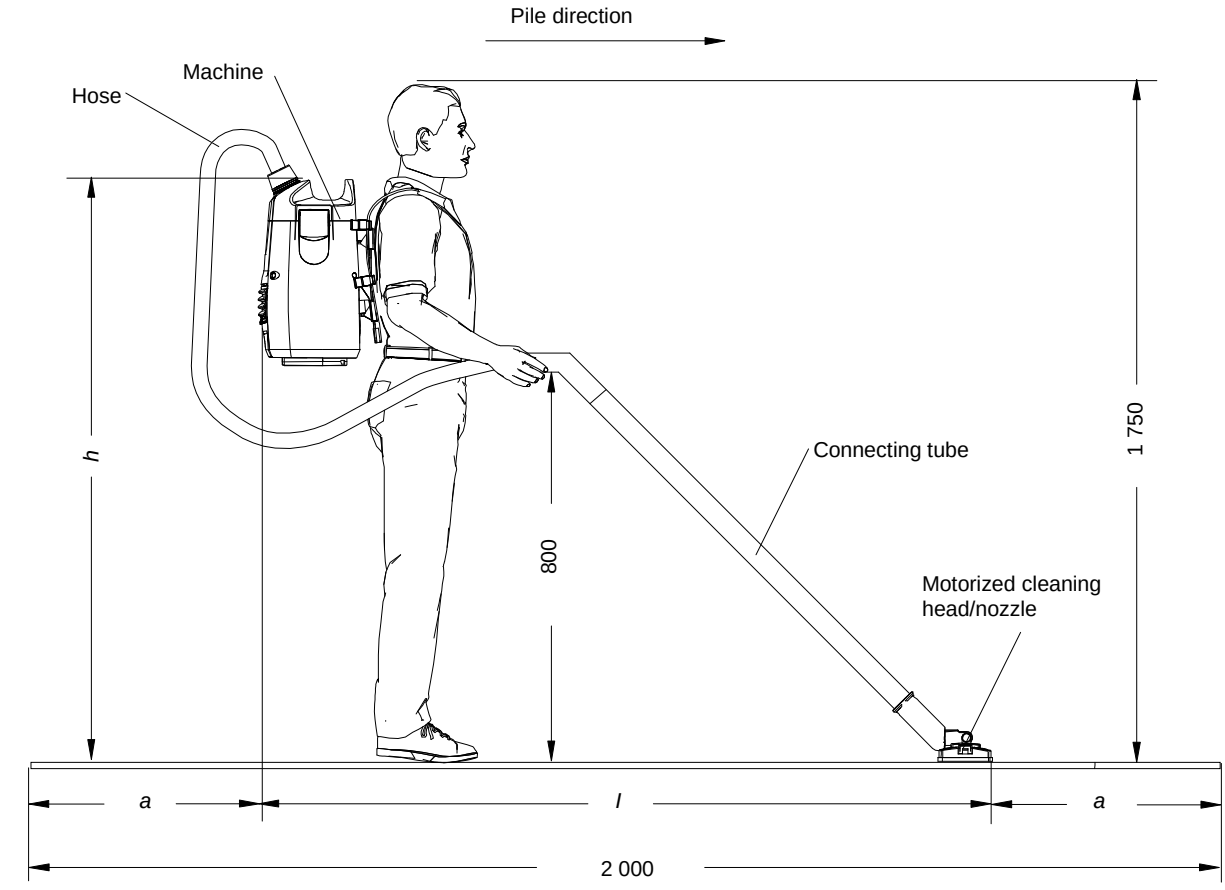
Dimensions in millimetres



b = width of machine including nozzle

Figure EE.3a – Back-pack vacuum cleaners (top view)

Dimensions in millimetres



h = height of machine *l* = length of the machine incliding nozzle *a* = distance to carpet border

Figure EE.3b – Back-pack vacuum cleaners (side view)

Figure EE.3 – Position of back-pack vacuum cleaners

Annex FF
(informative)

Emission of vibration

FF.1 Reduction of vibration

The machine shall be designed and constructed in such a way that risks resulting from vibrations produced by the machine are reduced to the lowest level, taking account of technical progress and the availability of means of reducing vibration, in particular at source.

The handles shall be designed and constructed in such a way as to reduce the vibrations transmitted to the upper limbs of the **operator** to the lowest level that is reasonably possible.

FF.2 Information on vibration emission

The instructions for hand-held and walk-behind machines and hand-held parts of other machines shall give the following information:

– the vibration total value to which the hand-arm system is subjected, measured in accordance with ISO 5349-1 for arm vibrations, the machine being supplied at **rated voltage** or at the maximum **rated voltage** for machines with a range of voltages, if the vibration total value exceeds 2,5 m/s^2. Where this value does not exceed 2,5 m/s², this fact may be stated in place of the emission value and uncertainty, e.g. by declaring $a_h \leq 2{,}5$ m/s^2;

– the uncertainty surrounding these values, in accordance with the above given standards.

These values shall be either those actually measured for the machine in question or those established on the basis of measurements taken for a technically comparable machine which is representative of the machine being produced.

Regarding operating conditions during measurement and the methods used for measurement, the reference of the standard applied (IEC 60335-2-69) must be specified.

NOTE Experience has shown that for these machines the magnitude of hand-arm vibration is in general significantly below 2,5 m/s^2. Therefore, unless the equipment concerned has a technical specification that renders this experience inapplicable, it is sufficient to mention that the emission value is below 2,5 m/s^2.

Bibliography

The bibliography of Part 1 is applicable except as follows.

Addition:

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

IEC 60335-2-67, *Household and similar electrical appliances – Safety – Part 2-67: Particular requirements for floor treatment machines, for commercial use*

IEC 60335-2-68, *Household and similar electrical appliances – Safety – Part 2-68: Particular requirements for spray extraction appliances, for commercial use*

IEC 60335-2-72, *Household and similar electrical appliances – Safety – Part 2-72: Particular requirements for floor treatment machines with or without traction drive, for commercial use*

IEC 60335-2-100, *Household and similar electrical appliances – Safety – Part 2-100: Particular requirements for hand-held mains-operated garden blowers, vacuums and blower vacuums*

IEC 60601-1, *Medical electrical equipment – Part 1: General requirements for basic safety and essential performance*

IEC 61241-1-1, *Electrical apparatus for use in the presence of combustible dust – Part 1-1: Electrical apparatus protected by enclosures and surface temperature limitation – Specification for apparatus*

ISO 3743-1, *Acoustics – Determination of sound power levels and sound energy levels of noise sources using sound pressure – Engineering methods for small movable sources in reverberant fields – Part 1: Comparison method for a hard-walled test room*

ISO 3744, *Acoustics – Determination of sound power levels and sound energy levels of noise sources using sound pressure – Engineering methods for an essentially free field over a reflecting plane*

ISO 3864-1, *Graphical symbols – Safety colours and safety signs – Part 1: Design principles for safety signs and safety markings*

ISO 4871, *Acoustics – Declaration and verification of noise emission values of machinery and equipment*

ISO 5349-1, *Mechanical vibration – Measurement and evaluation of human exposure to hand-transmitted vibration – Part 1: General requirements*

ISO 9614-2, *Acoustics – Determination of sound power levels of noise sources using sound intensity – Part 2: Measurement by scanning*

ISO 11201, *Acoustics – Noise emitted by machinery and equipment – Determination of emission sound pressure levels at a work station and at other specified positions in an essentially free field over a reflecting plane with negligible environmental corrections*

ISO 11203:1995, *Acoustics – Noise emitted by machinery and equipment – Determination of emission sound pressure levels at a work station and at other specified positions from the sound power level*

ISO/TR 11688-1, *Acoustics – Recommended practice for the design of low-noise machinery and equipment – Part 1: Planning*

EC Directive 79/831/EEC, *Council Directive of 18 September 1979 amending for the sixth time Directive 67/548/EEC on the approximation of the laws, regulations and administrative provisions relating to the classification, packaging and labelling of dangerous substances*

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