

INTERNATIONAL STANDARD



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

IECNORM.COM : Click to view the full PDF of IEC 60335-2-72:2021



THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2021 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester. If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

IEC Central Office
3, rue de Varembe
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigendum or an amendment might have been published.

IEC publications search - webstore.iec.ch/advsearchform

The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee, ...). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished

Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and once a month by email.

IEC Customer Service Centre - webstore.iec.ch/csc

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: sales@iec.ch.

IEC online collection - oc.iec.ch

Discover our powerful search engine and read freely all the publications previews. With a subscription you will always have access to up to date content tailored to your needs.

Electropedia - www.electropedia.org

The world's leading online dictionary on electrotechnology, containing more than 22 000 terminological entries in English and French, with equivalent terms in 18 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IECNORM.COM : Click to view the full PDF of IEC 60355-2-72:2021

INTERNATIONAL STANDARD



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

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 97.080

ISBN 978-2-8322-9995-1

Warning! Make sure that you obtained this publication from an authorized distributor.

CONTENTS

FOREWORD	4
INTRODUCTION	7
1 Scope	8
2 Normative references	9
3 Terms and definitions	10
4 General requirement.....	14
5 General conditions for the tests	14
6 Classification.....	15
7 Marking and instructions.....	15
8 Protection against access to live parts.....	19
9 Starting of motor-operated appliances	21
10 Power input and current.....	21
11 Heating.....	21
12 Charging of metal-ion batteries.....	21
13 Leakage current and electric strength at operating temperature.....	21
14 Transient overvoltages	22
15 Moisture resistance	22
16 Leakage current and electric strength.....	23
17 Overload protection of transformers and associated circuits	24
18 Endurance	24
19 Abnormal operation	24
20 Stability and mechanical hazards.....	25
21 Mechanical strength	30
22 Construction	32
23 Internal wiring.....	36
24 Components	37
25 Supply connection and external flexible cords	38
26 Terminals for external conductors.....	39
27 Provision for earthing	39
28 Screws and connections.....	39
29 Clearances, creepage distances and solid insulation	39
30 Resistance to heat and fire.....	40
31 Resistance to rusting.....	40
32 Radiation, toxicity and similar hazards.....	40
Annexes	46
Annex A (informative) Routine tests	47
Annex B (normative) Battery-operated appliances, separable batteries and detachable batteries for battery-operated appliances	48
Annex L (informative) Guidance for the measurement of clearances and creepage distances	53
Annex AA (normative) Precast paving slabs.....	54

Annex BB (normative) Requirements for internal combustion engine powered machines using liquefied petroleum gas (LPG)	55
Annex CC (normative) Falling-object protective structures (FOPS) – Dynamic test and performance requirements	58
Annex DD (informative) Emission of acoustical noise	61
Annex EE (informative) Emission of vibration	64
Bibliography	65
Index of defined terms	67
Figure 101 – Impact test apparatus	41
Figure 102 – Apparatus for testing the abrasion resistance of current-carrying hoses	42
Figure 103 – Apparatus for testing the resistance to flexing of current-carrying hoses	43
Figure 104 – Configuration of the hose for the freezing treatment	43
Figure 105 – Flexing positions for the hose after removal from the freezing cabinet	44
Figure 106 – Warning symbol: Do not inhale exhaust fumes	44
Figure 107 – Circuit for testing battery chargers (taken from IEC 60335-2-29)	45
Figure CC.1 – Satisfactory protection by the overhead guard	59
Figure CC.2 – Admissible deformation when the overhead guard is supported at all sides	60
Figure CC.3 – Admissible deformation when the overhead guard is supported at one side	60
Table 101 – Machine classification	15
Table 12 – Pull force and torque	39
Table DD.1 – Determination of uncertainty	63

IECNORM.COM : Click to view the full PDF of IEC 60335-2-72:2021

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**HOUSEHOLD AND SIMILAR ELECTRICAL APPLIANCES –
SAFETY –****Part 2-72: Particular requirements for floor treatment machines
with or without traction drive, for commercial use**

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as “IEC Publication(s)”). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

IEC 60335-2-72 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. It is an International Standard.

This fifth edition cancels and replaces the fourth edition published in 2016. It constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition (minor changes are not listed):

- editorial and technical alignment with IEC 60335-1:2020;
- rearrangement of subclauses to consistent numbering 22.101 to 22.113.

The text of this International Standard is based on the following documents:

CDV	Report on voting
61J/738/CDV	61J/744A/RVC

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

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/standardsdev/publications.

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 sixth edition (2020) 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: Particular requirements for floor treatment machines with or without traction drive, 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.

NOTE 4 The attention of National Committees is drawn to the fact that equipment manufacturers and testing organizations may need a transitional period following publication of a new, amended or revised IEC publication in which to make products in accordance with the new requirements and to equip themselves for conducting new or revised tests.

It is the recommendation of the committee that the content of this publication be adopted for implementation nationally not earlier than 12 months or later than 36 months from the date of publication.

The following differences exist in the countries indicated below.

- Annex AA: The CO-emission of LPG driven machines, intended to be used indoors, has to comply with the value specified in Annex BB. The result shall be documented (Germany).
- Annex BB: For machines intended to be used indoors, except single cylinder engines, the exhaust gas shall not contain more than 0,1 % volume of carbon monoxide (CO). If adjustments are necessary, the adjusting means shall be easily accessible. The measurement shall be carried out with a warm engine, idling, using 98 % propane. The revolution speed of the engine shall be documented (Germany).

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 document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

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

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.

IECNORM.COM : Click to view the full PDF of IEC 60335-2-72:2021

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 2-72: Particular requirements for floor treatment machines with or without traction drive, for commercial use

1 Scope

This clause of Part 1 is replaced by the following.

This part of IEC 60335 deals with the safety of powered ride-on and powered **walk-behind machines** intended for commercial indoor or outdoor use for the following applications:

- sweeping,
- scrubbing,
- wet or dry pick-up,
- polishing,
- application of wax, sealing products and powder-based detergents,
- shampooing

of floors.

These machines have a cleaning motion which is more linear than lateral or periodic.

NOTE 101 By contrast, the cleaning motion of machines covered by IEC 60335-2-67 is more lateral or periodic than linear.

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.

These machines may be equipped with a **traction drive** system. The following power systems are covered:

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

Battery-operated machines may be equipped with a **built-in battery charger**.

This standard does not apply to

- floor treatment appliances for household use (IEC 60335-2-10);
- floor treatment machines for **commercial use** (IEC 60335-2-67);
- spray extraction machines for **commercial use** (IEC 60335-2-68);
- wet and dry vacuum cleaners, including power brush, for **commercial use** (IEC 60335-2-69);

NOTE 103 IEC 60335-2-67, IEC 60335-2-68 and IEC 60335-2-69 cover only machines without **traction drive**.

– road sweepers;

NOTE 104 In Europe, EN 13019 covers road sweepers.

- machines designed for use on **slopes** with a gradient exceeding 20 %;
- machines equipped with a power take-off (PTO);
- machines designed for use in corrosive or explosive environments (dust, vapour or gas);
- machines designed for picking up hazardous dusts (as defined in IEC 60335-2-69), inflammable substances, or glowing particles;
- machines designed for use in vehicles or on board of ships or aircraft.

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;
- **ride-on machines** designed for transport over public roads can be subject to additional requirements (e.g. lighting, license plate etc.).

NOTE 106 Requirements for fuel-cells are under consideration.

2 Normative references

This clause of Part 1 is applicable except as follows.

Addition:

IEC 62061, *Safety of machinery – Functional safety of safety-related control systems*

IEC 62485-3:2014, *Safety requirements for secondary batteries and battery installations – Part 3: Traction batteries*

IEC TS 62885-1, *Surface cleaning appliances – Part 1: General requirements on test material and test equipment*

ISO 3411, *Earth moving machinery – Physical dimensions of operators and minimum operator space envelope*

ISO 5353, *Earth-moving machinery, and tractors and machinery for agriculture and forestry – Seat index point*

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

ISO 13849-1, *Safety of machinery – Safety-related parts of control systems – Part 1: General principles for design*

ISO 13857:2019, *Safety of machinery – Safety distances to prevent hazard zones being reached by the upper and lower limbs*

ISO 25119 (all parts), *Tractors and machinery for agriculture and forestry – Safety-related parts of control systems*

Replacement:

IEC 60068-2-78:2012, *Environmental testing – Part 2-78: Tests – Test Cab: Damp heat, steady state*

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, as intended by the manufacturer

It denotes the load corresponding to the **rated power input** or the highest obtainable load of all particular loads of the various functions that can be operated at the same time in accordance with the manufacturer's instructions. For machines provided with a seat or an **operator** platform, a mass of 75 kg secured in position at the appropriate height is used to simulate the **operator** in the most unfavourable position. Internal combustion engine driven machines are operated with the fuel specified by the manufacturer except where otherwise stated in this standard.

Operational functions include all treatment and driving functions.

Operation of the machine under following conditions:

- the battery is charged, the battery being initially discharged to such an extent that the appliance cannot operate;
- if possible, the appliance is supplied from the supply mains through its standalone battery charger, the battery being initially discharged to such an extent that the appliance cannot operate. The appliance is operated as specified in the main part of this standard;
- if possible, **built-in battery chargers** are connected to the circuit of Figure 107. The variable resistor is adjusted so that the current in the circuit is the **rated DC output current** when the battery charger is supplied at rated voltage. When the charging current is controlled by the state of charge of the battery, the variable resistor and the capacitor are replaced by a discharged battery of the type and having the largest capacity specified in the instructions.
- if the appliance incorporates inductive coupling between two parts that are detachable from each other, the appliance is supplied from the supply mains with the detachable part removed.

The **normal operation** related to the operational functions is specified in 3.1.9.101 to 3.1.9.103:

3.1.9.101 Scrubbing and sweeping machines are operated on a surface of hydraulically pressed concrete paving slabs (see normative Annex AA) intermittently at least 30 min switched on, and for a period of 5 min switched off.

An alternative is a smooth concrete area of a surface consistency comparable with hydraulically pressed concrete paving slabs.

3.1.9.102 Polishing and dry buffing machines are operated as follows.

PVC- or comparable flooring surfaces are considered to be suitable for establishing **normal operation**. The peak of input occurring during the drying process of the chemical applied to treat the surface is not taken as **normal operation** but is averaged by extending measurements over a period of at least 10 min.

3.1.9.103 Carpet shampooers are operated on a test surface consisting of a carpet, in accordance with IEC TS 62885-1, the carpet being fastened to the floor.

Prior to testing, the brush of the shampooing machine is conditioned by operating it for 15 min on a clean, dry concrete surface. After running on the concrete surface, the brush is immersed in a shampoo solution for at least 30 min.

The solution tank is filled and the machine is operated over a period of 10 min.

3.6.9 Addition:

Note 101 to entry: Sets of batteries are regarded as a single battery if they require tools to disconnect the individual battery interconnections.

3.101

traction drive

system used to propel the machine, e.g. by powered wheels

Note 1 to entry: Traction by the effect of rotating brushes is not included.

3.102

walk-behind machine

machine with or without a **traction drive** designed to be controlled by the **operator** walking behind the machine

It may be equipped with a detachable **sulky**.

3.103

ride-on machine

machine with a **traction drive** and with an **operator** seat or a platform on which the **operator** is sitting/standing during operation

3.104

sulky (trailer)

removable trailing seat or stand-on platform with wheels or skids designed to carry an **operator** in a sitting or standing position, while controlling a **walk-behind machine** with **traction drive**

3.105

wet cleaning machine

machine for applying and sucking up liquids

3.106

water-suction cleaning machine

machine for sucking up liquids

3.107

motorized cleaning head

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

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

3.108

hopper

container to store picked up debris

3.109

parking brake

means, actuated by the **operator** in the normal operating position, to prevent a stationary machine from moving

3.110

service brake

means for decelerating and stopping a machine, with a **traction drive**, from its ground travel speed

3.111
operator presence control
OPC

control device that automatically interrupts the power, e.g. to a drive or an engine, when the **operator's** actuating force is removed

Note 1 to entry: Such devices can be, for example, continuous action controls ("hold-to-run" controls) or seat switches.

3.112
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 moveable **guards** are required where frequent access is envisaged, while fixed **guards** can be used where frequent access is not envisaged.

3.113
operator

person in direct physical contact with the machine and performing one or more of the following tasks: installing, operating, adjusting, cleaning, moving, or performing user maintenance on the machine

3.114
gross vehicle weight
GVW

maximum allowable fully laden weight of the machine and its payload, as ready for use

Note 1 to entry: See 5.102 for further test conditions.

3.115
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 $C_{12}H_{25}NaSO_4$.

3.116
level surface

plane with a gradient up to and including 2 %

3.117
slope

inclined plane with a gradient greater than 2 % but not exceeding 20 %

3.118
maximum cleaning gradeability

maximum gradient according to manufacturer's instruction and as indicated on the machine, on which the machine can be used safely for cleaning purposes

3.119
maximum transport gradeability

maximum gradient according to manufacturer's instruction, on which the machine can be used safely for transport purposes

3.120**built-in charger**

charger mounted on or into the machine and designed to operate only on or into the machine

Note 1 to entry: **Built-in battery chargers** can also be called on-board chargers.

3.121**built-in charger with power supply function**

component intended to provide power for charging, operation or both

3.122**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.

3.123**battery low voltage****BLV**

battery-supplied floating DC working voltage in the range of >42 V and ≤60 V

Batteries of **BLV** systems may be charged with voltages up to 75 V DC. All voltages are regarded as DC if the peak-to-peak value does not exceed 10 % of the average value.

Note 1 to entry: **BLV** is not considered to be of class I, class II, or class III.

3.124**hazardous voltage**

voltage between parts having an average value exceeding 60 V DC or 42 V peak when the peak-to-peak ripple exceeds 10 % of the average value

3.125**battery connector**

plug connecting system applied for the connection of the battery either with the charging system, or with the machine, which can be engaged and disengaged without the use of any tools

3.126**BLV insulation**

insulation applied to **live parts** to provide basic protection against electric shock and which is identical with **basic insulation** in the voltage range defined by **BLV**

3.127**rated DC output voltage**

output voltage assigned to the battery charger by the manufacturer

3.128**rated DC output current**

output current assigned to the battery charger by the manufacturer

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 purposes 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.

5.8.1 Addition:

When measuring voltage, the peak value of any superimposed ripple exceeding 10 % of the average value shall be included. Transient voltages are ignored, such as a temporary increase of voltage, for example after the battery is disconnected from the charging circuit.

5.17 Modification:

Built-in chargers in compliance with IEC 60335-2-29 do not need to be retested, except for Clauses 6, 7, 11, 15, 19 and 22.

Clause 29 needs to be reevaluated if the pollution degree of the microenvironment for the battery charger is 1 or 2 unless the insulation is enclosed or located so that it is unlikely to be exposed to pollution due to normal use of the machine.

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

5.102 *The **GVW** includes, if applicable, full clean water tanks, empty dirty water tanks (half full for recycling systems), empty dust bags, **hopper** loaded at rated capacity, largest recommended batteries, all options such as cords, hoses, wands, cleaning agents, brooms and brushes.*

*For **ride-on machines**, the **GVW** includes a standard **operator**, weighing 75 kg.*

5.103 *Liquid containers of machines for wet scrubbing and shampooing are filled to the highest level indicated by the manufacturer.*

5.104 *Machines that are designed to have a **sulky** are tested with the **sulky** including the weight of a standard **operator** (75 kg) or without the **sulky**, whichever is the most unfavourable condition.*

5.105 *Combustion engine-powered machines shall be supplied with the fuel as specified by the manufacturer, except if stated elsewhere in this standard.*

6 Classification

This clause of Part 1 is applicable except as follows.

6.1 Replacement:

Machines shall be one of the following classes with respect to the protection against electric shock (see Table 101):

Table 101 – Machine classification

Working voltage DC	Working voltage AC	Classification mains-supplied circuits	Classification battery-supplied circuits
≤ 42 V (SELV)	≤ 42 V (SELV)	Class III	Not classified
≤ 42 V (ELV)	≤ 42 V (ELV)	Class I or II	Not classified
> 42 V and ≤ 60 V (≤75 V during charging mode) (BLV);		Class I or II	BLV; special conditions apply as given in normative Annex B.
> 60 V (> 75 V during charging mode)	> 42 V	Class I or II	Not classified

Compliance is checked by inspection and by the relevant tests.

6.2 Addition:

Mains supplied and battery powered machines for indoor use intended for dry cleaning only shall be at least IPX0. Other machines shall be at least IPX3.

7 Marking and instructions

This clause of Part 1 is applicable except as follows.

7.1 Modification:

Replace the fourth 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.

- **GVW** of the machine, in kg;

- the symbol indicating the **maximum cleaning gradeability**, with the value of x.

NOTE 103 I.e. the machine might be able to drive on a higher gradient (**maximum transport gradeability**). This additional information can be given also in the instructions for use.

Machines intended to be used indoors and powered by internal combustion engines shall be marked in addition with the symbol according to Figure 106. It is acceptable to show this symbol in monochrome colour.

7.1.101 Motorized cleaning heads shall be marked with

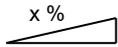
- **rated voltage** or **rated voltage range** in volts;
- **rated power input** in watts;
- name, trademark or identification mark of the manufacturer or responsible vendor;
- model or type reference;
- mass of the most usual configuration in kg.

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 (2012-09).

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

Compliance is checked by inspection.

7.6 Addition:



maximum cleaning gradeability 'x'



[symbol IEC 60417-5935 (2012-09)]

motorized cleaning head for water-suction cleaning

7.12 Modification:

Delete the first paragraph and the first warning.

Add after the Note the following new text:

NOTE 101 Alternative requirements for instructions in hard copy form are available in 7.12.9.

Replacement of the fourth 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 instructions before using the machine.

This wording may be replaced by symbols ISO 7000-0434A (2004-01) and 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 **GVW** of the machine in kilograms;
- the transportation weight of the machine in kilograms, which includes the batteries but excludes options (e.g. driver cabin, FOPS, second and third side broom, front mounted sweeping attachment for scrubbers), fresh water (in case of scrubbers or combined machines), and the weight of a standard **operator** (75 kg);
- 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 suction nozzles, spray bars, 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 **GVW**;
- 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 (such as flat tire or component failure);
- 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. If applicable, they shall give the specifications of the spare parts if they affect the health and safety of the **operator**.

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;
- information on the seat adjustment and related parts;
- if split rims are used for pneumatic tyres, instructions shall be given for the safe change of tyres.

For machines having a **traction drive** and a **GVW** exceeding 100 kg, the instructions shall also include the substance of the following:

- in order to prevent unauthorized use of the machine, the power source shall be switched off or locked, for example by removing the key of the main switch or the ignition key.

For machines with a **traction drive** that are designed to be used on **slopes**, the instructions shall also include the substance of the following:

- machines left unattended shall be secured against unintentional movement.

7.12.9 Add the following text after the second paragraph:

Instead of hard copy, electronic form can be used if the following conditions are met:

- instructions for unpacking, installation and enabling access to the complete safety instructions on a suitable reading device shall be provided on paper or marked on the machine,
- the suitable reading device shall be provided with the machine or be necessary to operate the machine, and
- the content of the electronic instructions shall be provided with the machine.

For non-safety related functional use, the operational manual may be provided in electronic form either:

- on a suitable electronic display incorporated in the appliance, or
- on a separate electronic device provided with the appliance, or

from a provided link to a website, where they may be viewed and/or downloaded.

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** Always ensure that the safety support is installed before working beneath hopper.
- **WARNING** This machine is for dry use only.
- **WARNING** Do not inhale exhaust gas fumes. Only use indoors when adequate ventilation is provided, and when a second person has been instructed to look after you.
- **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 non frame connected pole of the battery or by an equivalent method (disconnecting device);
 - for internal combustion engine powered machines, by removing the ignition key and by disconnecting the battery.

NOTE 1 Where no ignition key and no battery exist, the disconnection can be achieved by equivalent means.

- **WARNING** Do not use for cleaning purposes on surfaces having a gradient exceeding that marked on the machine.

If the machine is marked for use on surfaces having a gradient up to and including 2 %, this warning can be replaced by the following:

- **WARNING** Do not use on **slopes**.

Instructions for **ride-on machines** fitted with hazardous exposed moving side brushes shall also include the substance of the following:

- **WARNING** Always ensure that the warning light is switched on when the hazardous exposed side brushes are moving.

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.

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.

Instructions for **ride-on machines** shall also include the substance of the following, if applicable:

- **WARNING** Do not use the machine without a falling object protective structure (FOPS) in areas where it is likely that the operator is hit by falling objects.

Instructions for internal combustion engine powered machines using LPG shall also include the substance of the following:

- **WARNING** Machines shall be parked safely.
- The machine shall be inspected by a qualified person regularly, in particular regarding the LPG container and their connections, as required for safe operation by regional or national regulations.

Compliance is checked by inspection.

7.12.102 Information on noise

NOTE The instructions can provide information on airborne noise emission as indicated in DD.2.7.

7.12.103 Information on vibration

NOTE The instructions can provide information on vibration emission as indicated in Clause EE.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 (2012-09) 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.

Addition after the first paragraph:

For **BLV** circuits, electric shock hazard is considered to exist only between parts of opposite polarity.

Addition after the second paragraph:

Battery connectors are not tested according 8.1.1 to 8.1.3, but, according to 8.1.101.

8.1.4 *Addition after "or":*

- the part is supplied with **BLV** and it shall be prevented, by at least basic insulation, to have two conductive, simultaneously accessible parts where the voltage between them is hazardous unless they are provided with protective impedance; or

8.1.101 Battery connectors for BLV

Test probe A of IEC 61032 is applied with a force not exceeding 1 N, the **battery connector** being unplugged. Through openings, the test probe is applied to any depth that the probe will permit during and after insertion to any position. It shall not be possible to touch **BLV** parts with the probe.

Test probe B of IEC 61032 is applied with a force not exceeding 1 N, the **battery connector** being unplugged. Through openings, the test probe is applied to any depth that the probe will permit and is rotated or angled before, during and after insertion to any position. If the opening does not allow the entry of the probe, the force on the probe in the straight position is increased to 20 N. If the probe then enters the opening, the test is repeated with the probe in the angled position. It shall only be possible to touch **BLV** parts if the touchable contact surface does not exceed 5 cm².

Test probe B of IEC 61032 is applied with a force not exceeding 1 N, the **battery connector** being plugged in. Through openings, the test probe is applied to any depth that the probe will permit and is rotated or angled before, during and after insertion to any position. If the opening does not allow the entry of the probe, the force on the probe in the straight position is increased to 20 N. If the probe then enters the opening, the test is repeated with the probe in the angled position. It shall not be possible to touch **BLV** parts with the probe.

Materials providing insulation from electric shock shall be adequate.

Compliance is checked by subjecting the insulating material to an electric strength test as specified in 16.3. This provision does not exclude the testing of the material as situated within the machine, providing care is taken to ensure that materials not under consideration are not subjected to the test voltage.

This test applies only to materials which, if they were to fail to insulate, would subject the user to a shock hazard from a **hazardous voltage**. This test does not apply to materials that provide only a physical barrier to contact. As such, an uninsulated energized part shall be within 1,0 mm of the material surface to be considered for this requirement.

8.3 *Addition before the last dash:*

This requirement is applicable only for machines having user replaceable **batteries**. If the machine cannot be operated without the **battery, basic insulation** shall be provided between **live parts** and the inner surface of the **battery** compartment.

If the machine can be operated without the **battery, double insulation** or **reinforced insulation** is not required between **live parts** and the inside surface of the **battery**

compartment if the machine has an interlock switch to prevent operation without the **battery** compartment cover in place.

9 Starting of motor-operated appliances

This clause of Part 1 is replaced by the following.

It shall only be possible to start the machine by intended actuation of a control device provided for the purpose. The same requirement applies when restarting the machine after a stoppage, whatever the cause. This requirement only applies to components where the unexpected starting might cause a hazard. It does not apply to components such as suction units, pumps, etc.

Compliance is checked by inspection and test.

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 disassemble the machine for fitting these thermocouples and related 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 if the assembling has been accomplished properly.

11.5 Addition:

*The **normal operation** may be simulated by applying appropriate braking equipment.*

11.7 Addition:

Machines are operated until steady conditions are established.

NOTE 101. A temperature is considered steady when readings taken during any continuous 1 h period of the test indicate an increase of no more than 3 K, or until the batteries have been discharged, whichever comes first.

11.8 Add the following to Table 3, at the end of footnote a.

Motors which are hermetically sealed are considered to be airtight.

12 Charging of metal-ion batteries

This clause of Part 1 is applicable.

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 Modification:

Replace the first sentence by the following:

The enclosure of the machine shall provide the degree of protection against moisture in accordance with the classification of the machine, except for batteries.

Addition:

For mains supplied machines used outdoors, the tests referred to in 15.1.1 shall be carried out with suction devices operating.

15.2 Addition:

For the following tests, detachable cords shall be removed.

Tanks for the following liquids are excluded from the tests:

- hydraulic oil;
- coolant;
- fuel (diesel, gasoline, LPG).

Mains supplied machines including liquid containers, with a **GVW** up to 100 kg, are tilted with the full container into the most unfavourable horizontal position, and left in this position for 5 min.

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.

After these tests:

- **wet cleaning machines**, except shampooing machines, are operated 10 min under **normal operation** on a floor of paving slabs with a smooth surface that are fastened to the bottom of a tray. At the beginning of the test, the tray is filled with the **test solution** to a level of approximately 5 mm above the surface of the floor;
- shampooing machines are operated 20 min under **normal operation**;
- the **water suction cleaning 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 Addition:

If it is not possible to place the whole machine in the humidity cabinet, and to comply with the requirements of 4.1 of IEC 60068-2-78:2012, it is also sufficient to monitor the required climate conditions at the relevant locations in the machine.

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 60529:1989, as amended by IEC 60529:1989/AMD2:2013 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 floor treatment machine for 15 min, if applicable; and
- connected to the floor treatment machine until the machine 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 liquid 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 other than **class III** or **BLV** construction, 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 tests of 19.101.

Machines with outlets are also subjected to the tests of 19.102.

*Machines with **built-in chargers** are also subjected to the tests of 19.103.*

19.5 Modification:

In the fourth paragraph, delete the following text:

“used in system with polarized plugs intended for connection to polarized socket outlets”.

19.7 Addition:

*Brush and **traction drive** motors are tested for 30 s.*

Fan blades are not regarded as parts liable to be jammed.

The requirements are deemed to be met if an overcurrent protection, fuse or any other safety device interrupts the circuit before the allowed temperature of the windings is reached.

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

19.9 This subclause is not applicable.

19.13 *In the second paragraph add “, and 22.110” after “20.2”.*

19.101 *Machines having 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 shall be taken to suck up an air-liquid mixture to prevent overloading of the motor of the suction unit. The input power shall 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 Machines with appliance outlets, complying with the standard sheets in IEC 60320-3 and socket outlets shall be operated under conditions of **normal operation**, except the appliance outlet or socket outlet is loaded with the maximum load corresponding to its configuration in accordance with IEC 60320-3 or IEC TR 60083, respectively. Machines with more than one appliance outlet or socket outlet are tested with each outlet loaded one at the time.

However, this test is not applied for machines with appliance outlets or socket outlets

- intended only to supply accessories supplied with the machine,
- inaccessible to the user, or
- provided with a **protective device** as specified in 22.61.

19.103 The battery charger is connected to a fully charged battery, the connections being in reverse to normal use. The battery shall have the largest capacity of the types specified in the instructions. The battery charger is operated while supplied at **rated voltage**. The charger is switched on after reverse connection of the battery. The test is repeated with the charger switched on before the battery is connected to the charger.

This test is not applicable when such a connection by the user is unlikely to occur due to the construction of the appliance.

20 Stability and mechanical hazards

This clause of Part 1 is applicable except as follows.

20.1 Replacement:

Machines and their components and fittings shall have adequate mechanical stability when in use.

The following test is not applicable to **motorized cleaning heads**.

Compliance is checked by inspection and by the following test.

Machines provided with doors or covers that can be opened without a tool are tested with the doors or covers open or closed, whichever is the more unfavourable. Doors or covers that can be opened only with the aid of a tool remain closed.

Machines intended to be filled with liquid by the user in normal use are tested empty and tested again completely filled with water.

The machine is placed with the motor switched off, in the normal position of use on a gradient of 10 % or the maximum climbing capacity as indicated on the machine, whichever is greater, in the most unfavourable direction. During the test, the **parking brake**, if any, shall be applied and the wheels or rollers shall be blocked. Cords shall be reeled and positioned on the machine at the normal storing place, if applicable.

The machine shall not overturn.

NOTE 101 Overturning is the point at which the machine completely tips over, not the point at which the wheels lift of the floor.

20.2 Replacement:

Moving parts of machines shall, as far as compatible with the use and working of the machine and depending on the risk, be positioned and/or guarded and/or enclosed and/or equipped with **protective devices** to provide adequate protection against personal injury in normal use.

NOTE 101 For some machines, complete protection is impracticable.

Protective enclosures, **guards** and similar parts shall be **non-detachable parts** and shall have adequate mechanical strength.

NOTE 102 Enclosures that can be opened by overriding an interlock by applying the test probe are considered to be **detachable parts**.

The unexpected reclosure of self-resetting thermal cut-outs and overcurrent **protective devices** shall not cause a hazard.

In particular

- cog and chain wheels and belt pulleys shall be enclosed and the inlet openings of chains or belts shall be guarded;
- slots, keys, screws, etc., on rotating or moving parts shall be enclosed or guarded by smooth and rounded **guards**;
- shaft ends and similar rotating parts shall be protected if they protrude by more than a quarter of their diameter, except rounded shaft ends shorter than 50 mm;
- places where crushing or cutting could occur shall be avoided or covered;
- protective covers or **guards** shall be sufficiently far from moving parts or shall be so designed that an access by hand or foot is prevented.

Covers or **guards** are not needed for the bristles of rotating brushes or brooms. The solid parts of rotating brushes that are accessible during operation shall, however, be protected. Covers or **guards** are also not needed for rotating brushes or similar devices and to moving parts of machines if they become accessible during converting the machine to another application by changing of attachments.

The unintentional closing or slamming of side walls, lids, covers, etc., which could cause injury shall be prevented.

Wheels or rollers for the **traction drive** or the transport of machines shall be located or protected as to prevent injury to the feet of the **operator**.

The safety distances given in ISO 13857:2019, except Table 5, shall be taken into account. In particular, it shall not be possible to touch moving parts from the **operator's** position.

Compliance is checked by inspection, by measurements, by the tests of 21.1 and by applying a force not exceeding 5 N by means of a test probe that is similar to test probe B of IEC 61032 but having a circular stop face with a diameter of 50 mm, instead of the non-circular face.

For machines provided with movable devices such as those intended for varying the tension of belts, the test with the test probe is carried out with these devices adjusted to the most unfavourable position within their range of adjustment. If necessary, belts are removed.

It shall not be possible to touch dangerous moving parts with this test probe.

20.101 Machines with **traction drive** and a **GVW** exceeding 100 kg shall be equipped with:

- a device to prevent unauthorised switching-on of the driving and the operational functions, for example a key-operated switch, mechanical locking means or removable control handles;
- a switch-off device for the driving operation, which can be operated rapidly without danger from the **operator's** position, in case the controls for **normal operation** fail. This switch-off device can be an interruption of the mechanical or electrical drive.

It is allowed to combine these devices into one device, for example a key-operated switch.

Compliance is checked by inspection and functional test.

20.102 Pedals shall be arranged so that they can be operated without risk of confusion. Their surface shall be slip-resistant and easy to clean.

Compliance is checked by inspection.

20.103 **Walk-behind machines** shall not exceed a maximum speed of 6 km per hour.

Compliance is checked by measurement on a level surface.

20.104 **Walk-behind machines** with **traction drive** that are designed to be used on **slopes** having a gradient exceeding 2 % shall be equipped with a **parking brake** function. This function may be realized by a separate **parking brake** or the switched-off **traction drive**.

The **parking brake** function shall be capable of holding the machine on a **slope** with a gradient of 10 %, or the maximum cleaning or transport gradeability, whichever is greater.

Compliance is checked by the following test:

*The machine, while traveling up a **slope**, is brought to a stop. The **parking brake** is applied and/or the **traction drive** is switched off.*

*The **slope** consists of dry paving slabs in accordance with normative Annex AA.*

*The **parking brake**, if any, is applied with a force not exceeding*

- 400 N, for hand operation, and
- 600 N, for foot operation.

*The machine is operated while loaded to the **GVW** rating. If the machine is designed for a **sulky**, the load shall be increased with an additional mass of 75 kg, replacing the **operator** on the **sulky**.*

*After all parking braking functions as described in the instructions for use have been engaged, the machine shall not travel down the **slope** more than 50 mm when measured at the point of the braking function(s).*

20.105 Fittings for the coupling of a **sulky** with a seat or a platform shall be so designed that they are easily operable and cannot become disconnected unintentionally. Towing bars shall be clear of the floor.

Compliance is checked by the following test:

The pulling force of the connection between the towing machine and the **sulky**, loaded with an additional mass of 150 kg, shall be measured on a **level surface** when accelerating the machine up to the maximum speed. This connection shall withstand five times the measured pulling force.

20.106 A **sulky** shall have non-slip foot rests and shall be so designed that if the machine reverses, the **operator** cannot become jammed between the machine and the **sulky**.

Compliance is checked by inspection and functional test.

20.107 Ride-on machines shall not exceed a maximum speed of 25 km per hour.

They shall be constructed so that

- the **traction drive** can only be started after the **operator** has taken place on the provided seat or platform;
- the **traction drive** cannot be started without an intentional action.

*Compliance is checked by inspection, by functional tests and by measurements on a **level surface**.*

20.108 Ride-on machines shall have a horn controlled by the **operator**. If fitted with hazardous exposed moving side brushes, they shall also have a warning light.

The warning light shall be of the appropriate colour (e.g. yellow), taking into account ISO 3864-1, national requirements, and the environment where the machine is to be used.

The construction of the machine shall, as far as possible, not impair the visibility of the **operator**.

Compliance is checked by inspection and by functional tests.

20.109 Ride-on machines shall be equipped with a **parking brake** function. This function may be realised by a separate **parking brake** or the switched-off **traction drive**.

When stated within the instructions for use, the traction or steering wheel(s) is allowed to be turned perpendicular to the **slope** to assist with braking.

The **parking brake** function shall be capable of holding the machine on a **slope** with a gradient of 10 %, or the maximum cleaning or transport gradeability, whichever is greater.

Compliance is checked by the following test.

*The machine, while traveling up a **slope** is brought to a stop. The **parking brake** is applied and/or the **traction drive** switched off.*

*The **slope** consists of dry paving slabs in accordance with normative Annex AA.*

*The **parking brake**, if any, is applied with a force not exceeding*

- 400 N, for hand operation, and
- 600 N, for foot operation.

*The machine is operated while loaded to the **GVW** rating.*

After all parking braking functions as described in the instructions for use have been engaged, the machine shall not travel down the **slope** more than 50 mm when measured at the point of the braking function(s).

20.110 Ride-on machines shall be equipped with a **service brake** function. This function may be realised by a separate **service brake** or the **traction drive**.

It shall not be possible for the **operator** to disconnect the **traction drive** motors when they are used as **service brakes**.

Compliance is checked by inspection and by the following test.

The machine, loaded with a mass of its maximum capacity including the **operator** (75 kg), is operated at maximum speed on a **level surface** of dry paving slabs with a smooth surface. The **service brake** function is applied.

If fitted with a **service break**, it is applied with a force not exceeding

- 400 N, for hand operation, and
- 600 N, for foot operation.

The machine shall stop at a distance S [m] less than $[m] \leq 0,684[s] \times v_{m/s} \left[\frac{m}{s} \right]$, where $V_{m/s}$ is the rated manual speed of the machine in $\left[\frac{m}{s} \right]$.

NOTE S [m] can also be calculated by the following formula $S[m] \leq 0,19 \left[\frac{h \times m}{km} \right] \times v_{km/h} \left[\frac{km}{h} \right]$, where $V_{km/h}$ is the rated manual speed of the machine in $\left[\frac{km}{h} \right]$.

The result is taken as the mean of three measurements, in which the **operator** reaction time is excluded.

20.111 On **ride-on machines** with a **traction drive** and with accessible moving parts, switches shall be so located that inadvertent switching-on is unlikely to occur.

Compliance is checked by inspection.

20.112 Ride-on machines with an **operator** platform shall have adequate front and side protection for the **operator**, either by the location and arrangements of the platform or by **guards**, etc. The handles of the controls shall be located inside the protected area unless a special protection is provided for the hands. The platform shall be non-slip and shall have protection against slipping off.

Compliance is checked by inspection.

20.113 Ride-on-machines with an **operator** seat shall enable the **operator** to maintain a stable position on the seat, shall have strong foot rests, and, if necessary, a mounting step.

If the machine has a mounting step, the machine shall provide sufficient hold for the **operator** to reach the seat easily.

Compliance is checked by inspection.

20.114 Hopper

Elevating equipment shall be constructed or designed so that any unintentional lowering of the **hopper** is prevented. Unintentional lowering resulting from interruption of the power supply shall be also prevented.

This requirement is met by

- check valves or similar functions within the control valves of hydraulic or pneumatic lifting equipment;
- self-locking actuators or automatically engaging latches;
- mechanical safety mechanisms.

During **normal operation**, the **hopper** shall not drop faster than 0,6 m/s.

If persons have to enter beneath the elevated or tilted **hopper** when used as intended and under conditions foreseen by the manufacturer (e.g. maintenance, cleaning, inspection), it is necessary to provide a safety device to prevent unintentional lowering.

This requirement is considered to be met by

- pilot-operated non-return valves integrated into the lifting cylinder;
- mechanical safety mechanisms which can be operated from outside the hazard zone.

It shall be prevented that objects are ejected by the main-broom when the **hopper** is lifted. Objects ejected by side brushes are not considered to be a risk.

The emptying operation of a **hopper** that is designed to be emptied by mechanical force shall not cause a danger to the **operator**.

*Compliance is checked by inspection and functional test. The machine shall be operated while loaded to the **GVW** rating.*

20.115 Fuel tank

If a fuel tank is within or contiguous to the engine compartment and excessively high temperatures are likely to occur, the tank and/or filling arrangement shall be isolated from the electrical and exhaust systems by suitable protection, e.g. a separate enclosure or baffles.

The tank location and facilities for filling shall be such that spillage or leakage will not drain onto electrical or exhaust system parts.

Fuel spillage shall not be possible under **normal operation**.

Compliance is checked by inspection.

20.116 Internal combustion engine powered machines using liquefied petroleum gas

Internal combustion engine powered machines using liquefied petroleum gas (LPG) shall be constructed in accordance with the additional requirements specified in normative Annex BB. Requirements for the LPG container itself are not part of this standard.

Compliance is checked by inspection and measurement.

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 that 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 that are subjected to impact in normal use are tested as follows.

*If failure of the part subject to impact would cause a failure to comply with this specification, any spot of the machine that may be exposed during **normal operation** to impacts or blows is subjected to a single blow with an impact energy of 6,75 J. The impact stress on the free-standing machines is exerted by a steel sphere with a diameter of 50,8 mm and 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 $300 \text{ mm} \pm 5 \text{ mm}$. The arm can be raised from the horizontal position by an angle of $40^\circ \pm 1^\circ$. 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 can 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 $(10 \pm 1) \text{ r/min}$.

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 revolutions 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 $-15^\circ\text{C} \pm 2^\circ\text{C}$. 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:

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

Replacement of the second sentence:

The electrical insulation of class II appliances, **class II** constructions and **BLV** circuits shall not be affected if a hose ruptures or a seal leaks.

22.7 Replacement:

Pressurized hoses, lines and components shall be located or shielded so that in the event of rupture, the fluid cannot be discharged directly on to and cause a hazard for the **operator** when in the operating position.

Compliance is checked by inspection.

22.32 Addition:

Machines applying vacuum for picking up of dirt shall be so constructed that windings, internal wiring and electrical connections are not subjected to deposition of dust or dirt entering with the air that is drawn in.

Compliance is checked by inspection.

22.35 Modification:

*Add to "For other than **class III constructions**" the wording "or **BLV**,".*

Addition after the second paragraph:

These parts are subject to the hammer test of 21.1. 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 $70\text{ °C} \pm 2\text{ °C}$, 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 $-10\text{ °C} \pm 2\text{ °C}$. 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 show 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.

22.36 Modification:

Add to "For appliances other than **class III appliances**" the wording "or **BLV**".

22.40 *Modification:*

Delete the second paragraph and the note.

22.54 This subclause is not applicable.

22.61 *Add at the following at the end:*

The **protective device** is not necessary for appliances for which 30.2.2 is applicable, fitted with a supply cord or cord set, having a plug of the identical maximum current rating as the socket-outlet or appliance outlet integrated into the appliance.

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 shall be at least 30 mm distance from the surface of the floor, measured in vertical direction through existing holes.

Compliance is checked by inspection and measurements.

22.102 Class I and 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 chargers with power supply function**, this **all-pole disconnection** can be realised by pulling the plug.

Other switches may be of single pole construction.

The following circuits need not to 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 Machines shall be constructed so that parts related to the driving operation, such as the seat, steering wheel and controls, are in accordance with the relevant ergonomic principles of ISO 3411. The distance between the seat, if any, and the control devices shall be suitable or capable of being adapted for the **operator**.

Compliance is checked by inspection and measurement.

22.104 Machines shall be constructed so that **operator** cabins are adequately ventilated in order to avoid the accumulation of exhaust gases or lack of oxygen. It shall be possible to evacuate the cabin rapidly. An emergency exit shall also be provided in an appropriate direction which is different from the one of the normal exit.

NOTE Examples of suitable exits are a second door, a window designed specifically for this purpose or an aperture in the cabin roof.

The opening to permit passage of a person shall be at least 400 mm by 600 mm.

Compliance is checked by inspection and measurement.

22.105 Where it is likely for the **operator** to be hit by falling objects, **ride-on machines** shall be provided with a falling objects protection system (FOPS). This system shall have an adequate deformation limit volume (DLV).

Compliance is checked in accordance with normative Annex CC.

NOTE It is not the intention that FOPS are required. The use of these systems will depend on the user and the place where the machine will be used.

22.106 When split rims are used with pneumatic tyres, the machine shall be provided with devices to prevent the user from separating the rims of the wheel before removing the wheel from the axle, e.g. by welded nuts or screws removable with the aid of a special tool only.

Compliance is checked by inspection.

22.107 Guards

Fixed **guards** shall be secured by systems that can be opened or removed only with tools, and shall be incapable of remaining in place without their fixings, if applicable.

Their fixing systems shall remain attached to the **guards** or to the machine when the **guards** are removed, with the exception of fixing systems that can remain detachable without impairing safety. This does also not apply if, after removal of the fixing systems, or if the component is incorrectly repositioned, the machine becomes inoperative or is obviously incomplete.

NOTE This requirement does not necessarily apply to fixed **guards** that are only liable to be removed, for example, when the machine is completely overhauled, is subject to major repairs or is dismantled for transfer to another site. For the same reason, it is not necessary to apply the requirement to the casings of machinery intended for use by laymen, where the manufacturer's instructions specify that the repairs requiring removal of these casings are only to be carried out in a specialist repair workshop. In that case, fixing systems can be used that are not easy to remove.

If movable **guards** are interlocked, the interlocking devices shall prevent the start of hazardous machine functions until the **guards** are fixed in their position, and give a stop command whenever they are no longer closed.

Interlocking movable **guards** shall, as far as possible, remain attached to the machine when open and they shall be designed and constructed in such a way that they can be adjusted only by means of an intentional action.

Interlocking movable **guards** shall be designed in such a way that the absence or failure of one of their components prevents starting or stops the hazardous functions of the machine.

Adjustable **guards** may be used only to restrict access to those areas of the moving parts strictly necessary for the work. They shall be manually or automatically adjustable based on the type of work involved and shall be adjustable without the aid of a tool.

Compliance is checked by inspection.

22.108 Machines shall be designed in such a way to avoid incorrect mounting, if this can lead to an unsafe situation. If this is not possible, information on the correct mounting shall be given directly on the part and/or the enclosure.

Compliance is checked by inspection.

22.109 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.

22.110 On machines with combustion engines, the engine exhaust shall not be directed towards the **operator**.

On machines equipped with a cabin for the **operator**, the engine exhaust shall not be directed towards the cabin or the air inlet to the cabin.

Compliance is checked by inspection.

22.111 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.

22.112 Machines with **traction drive** shall be provided with an **OPC** to prevent unintentional movement of the machine.

Compliance is checked by inspection and functional test.

*If compliance relies on the operation of an electronic circuit and the **traction drive** is controlled by an **OPC**, the functional test is repeated under the following conditions applied separately:*

- *the fault conditions in a) to g) of 19.11.2 applied one at a time to the **electronic circuit**;*
- *the electromagnetic phenomena tests of 19.11.4.2 and 19.11.4.5 applied to the appliance.*

*It shall not be possible to activate the **traction drive** unintentionally.*

*If the **electronic circuit** is programmable, the software shall contain measures to control the fault/error conditions specified in Table R.1 and is evaluated in accordance with the relevant requirements of normative Annex R.*

*Alternatively, the **OPC** shall provide an adequate performance level, determined according to ISO 13849-1 or ISO 25119, or an adequate safety integrity level, determined according to IEC 62061. In this case, compliance is checked by inspection and functional test, without the repetition as required above. It shall not be possible to activate the **traction drive** unintentionally.*

22.113 Live parts shall be recessed from the face of a **battery connector** to reduce the possibility of shorting.

Compliance is checked by inspection.

23 Internal wiring

This clause of part 1 is applicable except as follows:

23.101 Individual conductors having flexible stranding and enclosed in flexible tubing are permitted to be used in place of flexible cord. The tubing is not required on exposed moving

conductors that are readily visible to the **operator** and are therefore subject to replacement when damaged.

Compliance is checked by inspection.

24 Components

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

24.1.3 Addition:

*Switches for frequent operation are for example the main power switch if the main circuit is not also controlled by an **OPC** and the **OPC (operator presence control)** shall be tested for 50 000 cycles of operation.*

24.1.10 Addition:

Lights like work light, dipped headlights, high beam, parking light, brake light, reverse lights etc. are exempted from this requirement.

Lights according to UN/ECE regulations for vehicle lights are exempted from this requirement.

24.101 Components for machines with a **traction drive** shall be of adequate construction so that they are able to withstand any impact or vibrations occurring during operation, without impairing their performance. Switches or other controls shall not change their switching position under the effects of impacts or vibrations.

Compliance is checked by inspection and functional test.

24.102 Arc-rupturing – Motor controllers and contactors in motor circuits shall be able to withstand locked rotor overload conditions.

Compliance is checked by the following test:

*If applicable, a fully charged **battery** of the nominal voltage and maximum ampere-hour capacity is to be used as the supply source.*

A switch and a current-rupturing device connected in the motor circuit, such as a contactor and a speed controller, shall show no welding or complete disintegration of the contact material; and the device shall make the load circuit.

When subjected to 100 cycles of making and breaking the stalled rotor current of the motor that it controls, there shall be no arcing to the frame or enclosure nor other manifestation of a risk of fire, such as the burning or melting of the lead insulation. Temperature-limiting devices and current-limiting devices (such as electronic monitoring circuits) of a power controller are to be allowed in the power circuit to limit the current or open the circuit to prevent a risk of fire and electric shock under the test conditions. When one of those devices causes an interruption of the power (i.e. speed reduction), the test shall be continued.

If two or more current-rupturing devices are connected in series and operate in a sequence so that normally one device is intended to make and break the circuit, all but that one are to be shunted out of the circuit in order that, in turn, all switches in that circuit may be tested under stalled-rotor conditions.

If the frame of the cleaning machine is not normally connected to the current-carrying parts, the frame is to be connected through an ordinary – non-time-delay – 30 A cartridge fuse to the

positive pole of the battery for the first 50 cycles of operation and to the negative pole for the remaining 50 cycles. The rate of operation is to be one complete make-and-break operation every 10 s, with the device remaining energized for approximately 1 s per cycle.

If the frame of the cleaning machine is normally connected to the current-carrying parts, the following test is to be conducted. The rate of operation and the duration of the on period are to be as specified above. If the battery is protected by a fuse having a current rating not more than 125 % of the current drawn by the motor under locked-rotor conditions, the performance is not acceptable if the fuse opens.

The test is permitted to be interrupted at not less than 25 operations to permit cooling of the motor.

A contactor that is not tested in the machine is to be mounted in a metal enclosure of the minimum size in which it is intended to be used. The limiting impedance for the test may consist of resistors or direct-current motors.

For a speed controller, the test is to be conducted with the speed control handle moved from the off position through all running positions to the full-speed position and then back to the off position. This is to be counted as 1 cycle of operation.

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:

- Polychloroprene sheathed
Their properties shall be at least those of ordinary polychloroprene sheathed cords (code designation 60245 IEC 57);
- 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 attachment** other than specially prepared cords. Their properties shall be at least those of heat-resistant polyvinyl chloride sheathed cord (code designation 60227 IEC 57).
- Halogen-free, low smoke, thermoplastic insulated and sheathed
Their properties should at least be those of ordinary duty halogen-free free, low smoke flexible cable (code designation 62821 IEC 102 for circular cable).

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 except as follows.

28.101 A terminal employing a threaded screw or bolt for securing the conducting lug to a terminal plate shall provide a minimum of two full threads in the metal.

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.

30.1 Addition after the third dash:

The cabin and its fittings are considered to be external parts.

30.2 Addition:

Subclause 30.2.2 is applicable for

- mains supplied machines;
- parts of battery powered machines not energized during charging process;
- appliances that have to be kept switched on by hand or foot or are controlled by an **OPC**.

Subclause 30.2.3 is applicable for

- parts of battery powered machines energized during charging process.

30.2.2 Replace the third dashed item of the last paragraph by

- appliances that have to be kept switched on by hand or foot or are controlled by an **OPC**;

31 Resistance to rusting

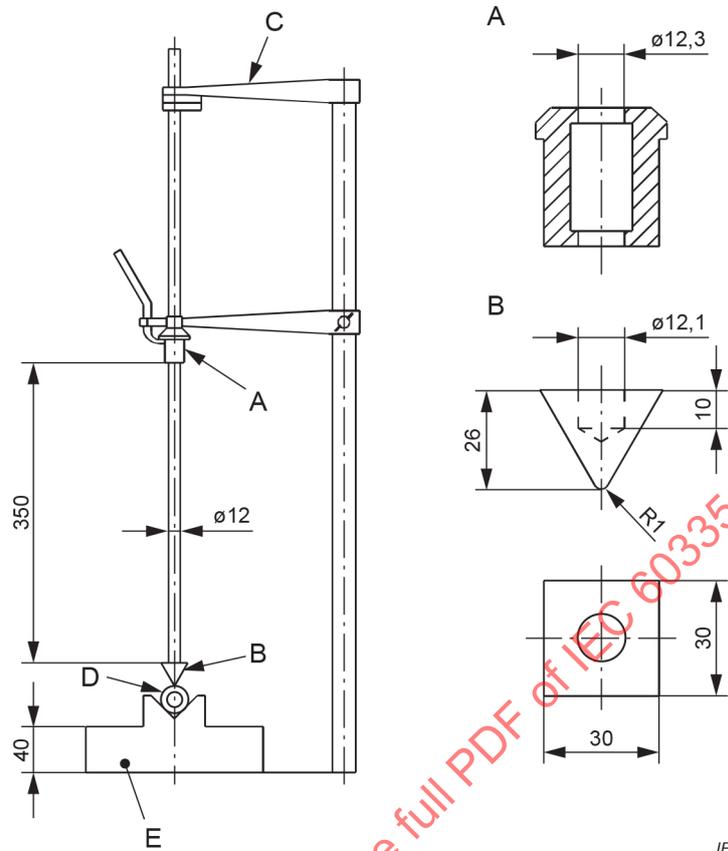
This clause of Part 1 is applicable.

32 Radiation, toxicity and similar hazards

This clause of Part 1 is applicable.

IECNORM.COM : Click to view the full PDF of IEC 60335-2-72:2021

Dimensions in millimetres



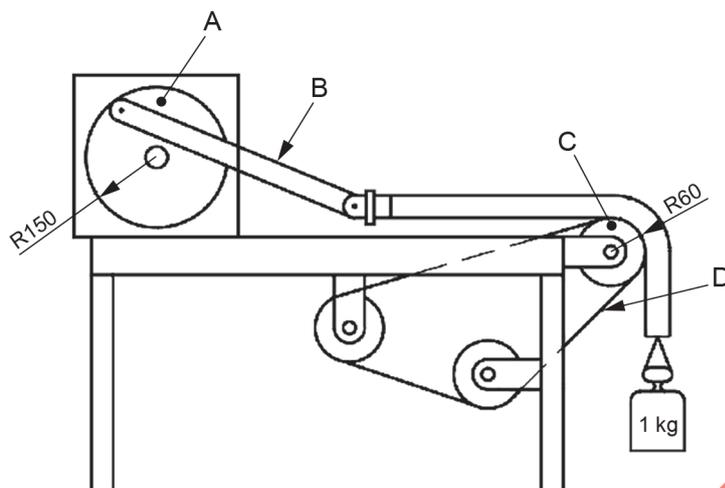
IEC

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

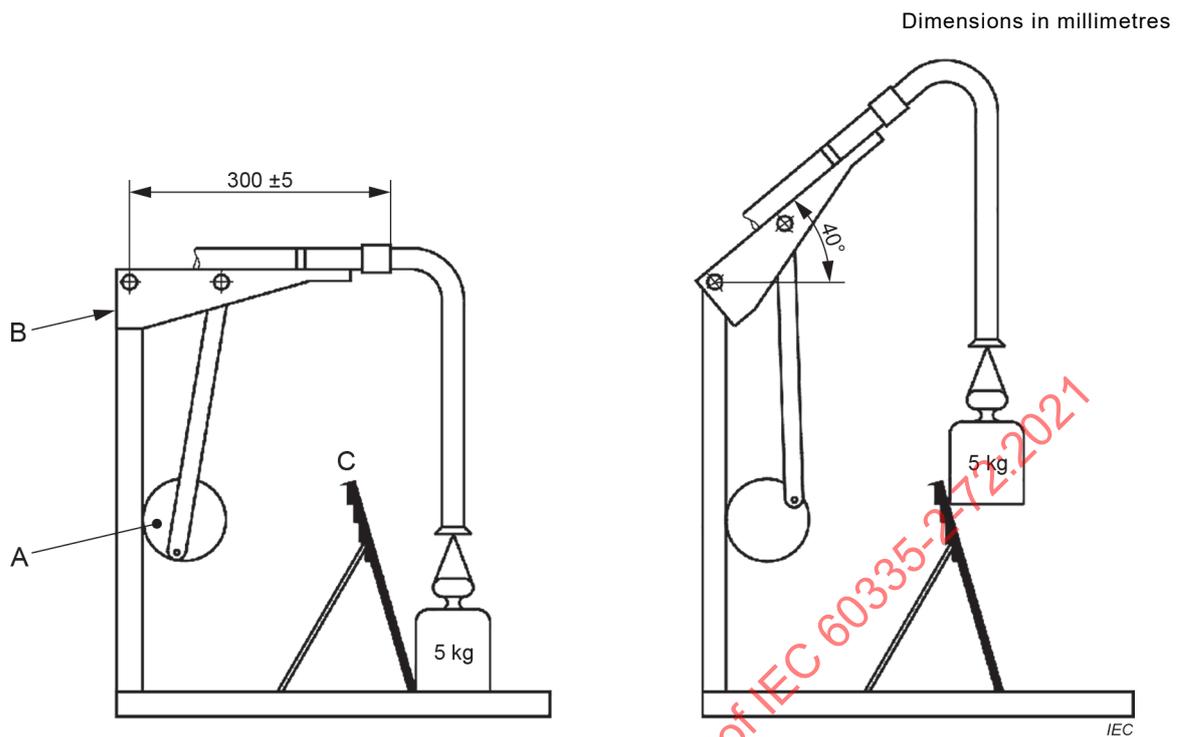


Key

- 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

IECNORM.COM : Click to view the full PDF of IEC 60335-2-72:2021



Key

- A crank mechanism
- B arm
- C inclined plane

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

IECNORM.COM : Click to view the full PDF of IEC 60335-2-72:2021

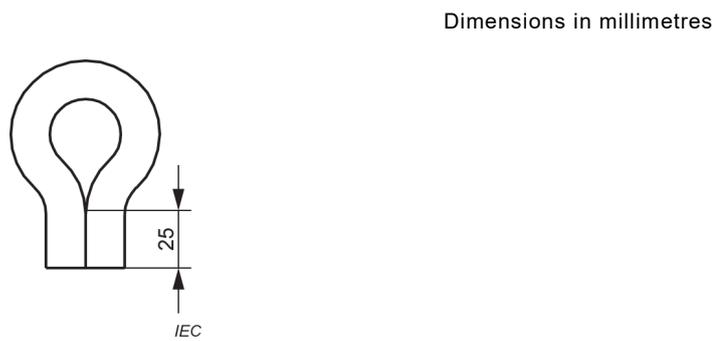
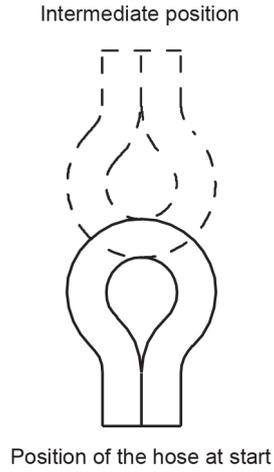


Figure 104 – Configuration of the hose for the freezing treatment

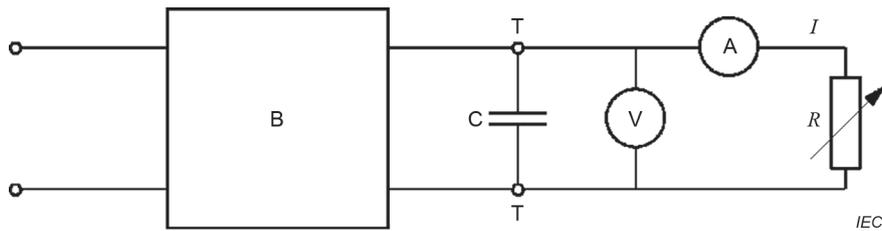


IEC

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



**Figure 106 – Warning symbol:
Do not inhale exhaust fumes**

**Key**

A mean reading ammeter

B battery charger

C capacitor having a capacitance, in farads, given by: $12,5 \frac{I_r}{p \times f \times U_r}$

where

 I_r is the **rated DC output current**, in amperes; $p = 1$, for half-wave rectification and 2, for full-wave rectification; f is the supply frequency, in hertz; U_r is the **rated DC output voltage**, in volts. I output current R variable resistor

T output terminals of the battery charger

V mean reading voltmeter

NOTE 1 The capacitor can have a capacitance deviating from the calculated values of $\pm 20\%$.

NOTE 2 The capacitor can have to be precharged before the battery charger can operate.

**Figure 107 – Circuit for testing battery chargers
(taken from IEC 60335-2-29)**

IECNORM.COM : Click to view the full PDF of IEC 60335-2-72:2021

Annexes

The annexes of Part 1 are applicable, except as follows:

IECNORM.COM : Click to view the full PDF of IEC 60335-2-72:2021

Annex A (informative)

Routine tests

Annex A of Part 1 is applicable except as follows.

A.3 Electric strength test

For **battery-operated machines**, Clause A.3 is not applicable.

Add the following Note:

NOTE Dielectric strength testing of **built-in chargers** need not to be repeated.

A.101 *Each internal combustion engine powered machine using liquefied petroleum gas shall be tested for leaks of an LP-Gas system.*

All fuel-system connections, including the container with associated valves and fittings, shall be tested for leaks with a soap-and-water or equivalent solution while the system is under LP-Gas pressure of not less than 621 kPa. All leaks detected shall be repaired.

The fuel container and associated valves and fittings are permitted to be tested separately using air pressure.

IECNORM.COM : Click to view the full PDF of IEC 60335-2-72:2021

Annex B (normative)

Battery-operated appliances, separable batteries and detachable batteries for battery-operated appliances

Annex B of Part 1 is applicable except as follows.

Addition:

For machines powered by **batteries** that are recharged in the machine by **built-in chargers**, the **battery** charger is not incorporated within the machine, but is mounted on the machine and may be located within the enclosure of the machine. The charging circuitry is electrically independent from the machine's electrical system (see Figure B.1g)).

NOTE 101 For **battery-operated appliances** without a supply connection and being charged by an external battery charger (see Figure B.1e)), the **battery** is typically not removed out of the machine due to weight constraints.

3 Terms and definitions

B.3.1.1 *Addition:*

Note 101 to entry: Details on normal operation of machines according to this standard are to be found in 3.1.9.

6 Classification

6.1 This subclause is not applicable.

7 Marking and instructions

7.12 *Modification of the fifth paragraph of part 1 to read:*

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

7.15 *Addition:*

Markings, other than those associated with the battery, shall be placed on the part of the appliance that is connected to the supply mains.

The marking specified in 7.1 related to the battery charger input and output ratings shall be on the type plate of the machine itself if they do not comply with this clause of Part 1.

11 Heating

B.11.1 *Add at the end:*

*If machines are operating by the simultaneous use of multiple **separable** or **detachable batteries**, after depletion the first set of **separable** or **detachable batteries** is replaced by a second set of fully charged **separable** or **detachable batteries**.*

13 Leakage current and electric strength at operating temperature

This clause is not applicable.

16 Leakage current and electric strength

This clause is not applicable.

17 Overload protection of transformers and associated circuits

B.17.101 For **battery-operated machines**, the following requirements apply:

- each circuit shall be protected against short-circuit or overload by a **protective device**, for example by fuses, overcurrent switches, protectors with relays or contactors;
- a single **protective device** may be used for more than one circuit if the sum of the working currents of the connected circuits does not exceed 16 A;
- for **traction drive** motors denoted for switching in series or in parallel, a single protective device may be used;
- the **protective device** shall be located close to the point of feeding the circuit. If this is impossible, the unprotected length of the wiring shall be as short as possible.

Protective devices may be used also for switching and control purposes in **normal operation** if their construction is adequate (allowable current capacity for inrush-current, switching rate, etc.).

No **protective device** is needed to protect the main battery wiring from the battery terminal to the distribution terminal of the appliance.

Compliance is checked by inspection.

19 Abnormal operation

B.19.2 Addition

This subclause is not applicable for machines

- which require tools
 - to access **battery** compartments, or
 - to disconnect **battery** interconnecting cables, or
- with hardwired battery sets.

NOTE 101 Handling of commercial batteries is done by trained personnel only.

B.19.101 **Battery-operated machines** and their electrical components shall be capable of being supplied at 0,7 times the voltage of a **fully charged battery** without impairing the safety requirements of this standard.

*Compliance is checked by operation of all functions by testing at 70 % of the voltage of a **fully charged battery** in cases when this may impair the safety requirements of this standard.*

21 Mechanical strength

B.21.1 *In the first paragraph of the test specification, replace 0,5 J by 1,0 J.*

22 Construction

B.22.3 *Replace all entries of "42,4 V" by "**hazardous voltage**".*

Add the following text after the sixth paragraph of the test specification:

NOTE 101 Appliances according to this standard are not regarded as being intended to be installed in an area open to the public.

NOTE 102 During this test, two test probes are applied simultaneously.

B.22.4 Replace all entries of "42,4 V" by "**hazardous voltage**".

Delete the penultimate paragraph.

Add the following text after the fifth paragraph of the test specification:

NOTE 101 Appliances according to this standard are not regarded as being intended to be installed in an area open to the public.

NOTE 102 During this test, two test probes are applied simultaneously.

B.22.5 Replace "42,4 V" by "**hazardous voltage**".

B.22.101 Battery charging circuitry within a separate enclosure shall be constructed so that it can be securely fixed to a support.

Keyhole slots, hooks and similar means, without any further means to prevent the **battery** charging circuitry from being inadvertently lifted off the support, are not considered to be adequate means for fixing the **battery** charging circuitry securely to the support.

Compliance is checked by inspection.

B.22.102 For **battery-operated machines**, secondary circuits like steering and braking shall not rely upon the chassis for electrical continuity.

Bare conductors and terminations shall be installed so that short-circuiting is considered unlikely to occur.

Circuits for lighting or signalling may be installed with single-pole wiring and using the body if such circuits are firmly isolated from circuits of operational functions.

Compliance is checked by inspection.

B.22.103 The **batteries** of **battery-operated machines** shall be located in a compartment separated from components liable to produce sparks, open flames, electric arcs or glowing objects (maximum surface temperature 300 °C). If this is not the case, adequate ventilation shall ensure that no explosive atmosphere can build up in the area of spark producing components.

Plug connection devices are considered to produce sparks only if they are employed for emergency switching.

Compliance is checked by inspection.

B.22.104 Battery-operated machines shall not cause a hydrogen gas explosion risk during charging of **batteries**. This requirement is met by the following:

- all power-consuming circuits shall be positively interrupted, or
- **batteries**, except those which produce no hydrogen or other explosive gases, such as gel **batteries**, shall have **all-pole disconnection** from all power consuming circuits either by

a changeover switch or by disconnecting the plug that connects the **battery** to the machine, or

- **battery** compartments, except those in machines which contain only **batteries** that do not produce hydrogen or other explosive gases, shall have ventilation openings that comply with the size requirements of IEC 62485-3:2014, Subclause 6.6.2. The minimum safety distances in the close vicinity of the **battery** according to IEC 62485-3:2014, Subclause 6.5 are not relevant. The air inlet and outlet shall be located at a location to create best conditions for exchange of air, taking into account that the hydrogen-air gas mixture is lighter than air.

This requirement is not applicable if the charging circuitry is also used as a power source to operate the machine when mains connected.

Compliance is checked by inspection, calculation and by manual test.

B.22.105 It shall not be possible to drive **battery-operated** machines during charging of **batteries**, except those with **built-in battery chargers with power supply function**.

Compliance is checked by inspection.

NOTE This requirement is considered to be fulfilled by the requirements of B.22.104.

B.22.106 Machines with **batteries** shall be designed in such a way that electrolyte leakage from the **battery** does not impair compliance with this standard; in particular there shall be no trace of electrolyte on insulation that reduces clearances or creepage distances below the values specified in Clause 29.

The **battery** housing shall be designed and constructed in such a way as to prevent the electrolyte being ejected on to the **operator** and to avoid the accumulation of vapours in places occupied by **operators**.

Compliance is checked by inspection and measurement.

B.22.107 Appliances having parts of **BLV** construction shall be constructed so that the insulation between parts operating at **BLV** and other **live parts** complies with the requirements for **double insulation** or **reinforced insulation**.

Compliance is checked by inspection and measurement.

B.22.108 Current-carrying parts shall be recessed from the face of a **battery connector** to reduce the possibility of shorting.

Compliance is checked by inspection.

24 Components

24.1.3 Addition:

*Switches for frequent operation are for example the main power switch if the main circuit is not also controlled by an **OPC** and the **OPC (operator presence control)** shall be tested for 50 000 cycles of operation instead of 10 000.*

25 Supply connection and external flexible cords

25.13 Addition:

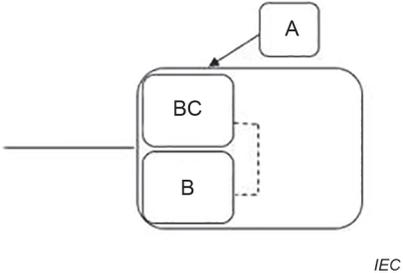
An additional lining or bushing is not necessary for **interconnection cords** in **class III appliances** or **class III constructions**, or **BLV constructions** that do not contain **live parts**.

Figures

Figure B.1 (2 of 2)

Addition of a new entry:

g)

 <p>IEC</p>	<p>Built-in charger: Tested to IEC 60335-2-29 taking into account 5.17</p> <p>Appliance: Tested to the main part of the standard while operated by or charged by mains or renewable energy source</p> <p>Tested to normative Annex B when operated on battery power</p>
--	---

IECNORM.COM : Click to view the full PDF of IEC 60335-2-72:2021

Annex L
(informative)

Guidance for the measurement of clearances and creepage distances

Figure L.1 – Sequence for the determination of clearances

Modification:

Replace "**Class I, II, III appliances**", by "**Class I, II, III, or BLV appliances**".

IECNORM.COM : Click to view the full PDF of IEC 60335-2-72:2021

Annex AA (normative)

Precast paving slabs

The cement in the manufacturing of these paving slabs shall be of, or similar to, one of the following:

- Portland cement (ordinary or rapid hardening);
- Portland blast furnace cement.

The fine and coarse aggregate shall consist of either naturally occurring materials, crushed or uncrushed, or alternatively of coarse aggregate to meet the following requirements:

- 10 % fines test: not less than 10 tons;
- flakiness index: not more than 35 %.

The normal maximum size of the aggregate shall not exceed 14 mm.

The total sulphate content of the concrete mix shall not exceed 4,0 % as SO₃ by weight of the cement. The sulphate of the cement shall be calculated from the known sulphate contents of the cement, aggregates (where applicable) and pulverised fuel ash, as determined by tests.

The slabs may be made by any process. The escape of the finer particles of mortar during the process of manufacture shall be prevented as far as practicable. A slab described as "pressed" shall only be made by employing a pressure of not less than 7 MN/m² over the entire surface.

After casting, the slabs shall be stored so as to prevent undue loss of moisture, particularly during the early stages of curing.

Slabs shall be manufactured to the following size: 65 mm × 600 mm × 750 mm.

The maximum deviation from a 750 mm straight edge placed in any position on the wearing surface shall not exceed 2 mm. There shall be no special preparation for smoothing of the test surface. The slab should be made under normal production conditions for **commercial use**.

Annex BB (normative)

Requirements for internal combustion engine powered machines using liquefied petroleum gas (LPG)

BB.1 Containers

BB.1.1 General

Containers for LPG shall be either permanently fixed on the machine or removable.

Pipe fittings and accessories on containers shall be protected against mechanical damage when used as specified by the manufacturer.

The fuel take-off on the container shall be equipped with an easily and quickly accessible manually operated valve. The position and method of operation of this valve shall be clearly marked on the outside of the machine, near the valve or on each removable container.

It shall be mechanically ensured that the fuel take-off is in a liquid form unless the container and engine are specially equipped for a direct vapour withdrawal. In this case, the direct vapour withdrawal shall also be mechanically ensured.

If containers are installed in a compartment, this compartment shall have permanent openings at the bottom. The total surface area of these ventilation openings shall be at least 200 cm² allowing adequate ventilation to the outside atmosphere and without risk to the **operator**.

Containers shall be positioned in such a way that they are not exposed to the damaging effects of heat, particularly heat from the engine and the exhaust system. This requirement is deemed to be met if the distance between the container and the exhaust system is at least 300 mm or if a suitable heat shield is fitted which shall not inhibit ventilation under any circumstances.

Containers shall be fitted on the machine in such a way that they are not unduly exposed to abrasion or shock nor to the corrosive action of the products handled by the machine.

Containers and their connections shall be installed in such a way that there are no projections outside the plan view outline of the machine.

If an additional container is carried on the machine, it shall be secured in the same manner as the main container.

BB.1.2 Containers to be filled by the user

Containers to be filled by the user shall have the following fitted:

- A safety pressure relief valve shall be connected to the vapour space of the container. Where such containers are fitted inside compartments of machines, the discharge side of the relief valve shall be piped to atmosphere. The gas shall be led away safely outside of the motor compartment.
- It shall not be possible to fill containers more than 80 % of the container capacity. Where containers are fitted inside compartments of machines, the discharge side of any maximum level indicating device which relies on bleeding gas to atmosphere shall terminate at a readily visible position on the outside of the machine.