

AS/NZS 60335.2.107:2020
IEC 60335-2-107 Ed 2.1



Australian/New Zealand Standard™

Household and similar electrical appliances — Safety

Part 2.107: Particular requirements for robotic battery powered electrical lawnmowers



AS/NZS 60335.2.107:2020

This Joint Australian/New Zealand Standard™ was prepared by Joint Technical Committee EL-002, Safety of Household and Similar Electrical Appliances and Small Power Transformers and Power Supplies. It was approved on behalf of the Council of Standards Australia on 8 December 2020 and by the New Zealand Standards Approval Board on 7 October 2020.

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- Association of Accredited Certification Bodies
- Australian Industry Group
- Better Regulation Division (Fair Trading, Safework NSW, Testsafe)
- Business New Zealand
- Consumer Electronic Suppliers Association, Australia
- Consumers' Federation of Australia
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- Electrical consultants
- Engineers Australia
- JAS-ANZ
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- New Zealand Electric Fence Energizer Manufacturers' Standards Group
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This Standard was issued in draft form for comment as DR 20005.

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Australian/New Zealand Standard™

Household and similar electrical appliances — Safety

Part 2.107: Particular requirements for robotic battery powered electrical lawnmowers

Originated as AS/NZS 60335.2.107:2013.
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STANDARDS AUSTRALIA/STANDARDS NEW ZEALAND

AS/NZS 60335.2.107:2020

**HOUSEHOLD AND SIMILAR ELECTRICAL APPLIANCES –
SAFETY –****Part 2.107: Particular requirements for robotic battery powered electrical lawnmowers****Foreword**

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee EL-002 - Safety of Household and Similar Electrical Appliances and Small Power Transformers to supersede AS/NZS 60335.2.107:2013 three years from the date of publication of this Standard. During this period AS/NZS 60335.2.107:2013 will also remain current. Regulatory authorities that reference this Standard in regulation may apply these requirements at a different time. Users of this Standard should consult with these authorities to confirm their requirements.

The objective of this Standard is to provide manufacturers, designers, regulatory authorities, testing laboratories and similar organizations with safety requirements designed to give the user protection against hazards that might occur during normal operation and abnormal operation of the appliance and which may be used as the basis for approval for sale or for connection to the electricity supply mains in Australia and New Zealand.

The text of IEC 60335-2-107 Ed 2.1, prepared by IEC Technical Subcommittee TC 116, was submitted to the Standards Australia/Standards New Zealand Combined Procedure (dual public comment and committee vote) for adoption of the IEC standard as a Standards Australia/Standards New Zealand joint standard.

The principal changes in this edition as compared with the 2013 edition of AS/NZS 60335.2.107 are as follows (minor changes are not listed):

- the text has been aligned with the 2020 edition of Part 1;
- Clause 7: Markings and instructions, new requirements for markings, warnings and the instruction manual;
- Clause 8: Protection against access to live parts, new requirements for protection against electric shock for hazardous battery voltages;
- Clause 20: Stability and mechanical hazards, revised requirements for manual controller, manual stop, cutting means stopping time, traction drive stopping and restart procedures, as well as a new standing child foot probe test;
- Clause 22: Construction, revised requirements for disabling devices, working area, perimeter delimiter, sensors and manual controller, as well as new requirements for machine connectors used for charging and contact surfaces used as obstruction sensing devices;
- Clause 24: Components, revised requirements for switches;
- Clause 29: Clearances, creepage distances and solid insulation, revised requirements for the machine and non-mains-powered peripherals.

This Standard is an adoption with national modifications of the second edition of IEC 60335-2-107, *Household and similar electrical appliances – Safety – Part 2-107: Particular requirements for robotic battery powered electrical lawnmowers* including its amendment 1. It has been varied as indicated to take account of Australian and New Zealand conditions.

This part 2 has to be used in conjunction with the latest edition of AS/NZS 60335.1 *Household and similar electrical appliances – Safety – Part 1: General requirements* and its Amendments. It was established on the basis of AS/NZS 60335.1:2020.

COPYRIGHT

This part 2 supplements or modifies the corresponding clauses of AS/NZS 60335.1 so as to convert it into the Australian/New Zealand Standard: Safety requirements for robotic battery powered electrical lawnmowers.

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 of Part 1 is to be adapted accordingly.

NOTE 1 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.;
- figures, subclauses, notes and annexes that are additional to those in the IEC standard are prefixed with the letters AZ.

NOTE 2 The following print types are used:

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

Words in **bold** in the text are defined in Clause 3.

p NOTE 3 In this document, p is used in the margin to indicate instructions for preparing a consolidated version.

The essential safety requirements in AS/NZS 3820¹ that could be applicable to requirements for robotic battery powered electrical lawnmowers are covered by this standard.

The national variations to IEC 60335-2-107 Ed 2.1 form the Australian and New Zealand national variations for purposes of the IECEE scheme for recognition of results of testing to standards for safety of electrical equipment (the CB scheme).

¹ AS/NZS 3820 *Essential safety requirements for electrical equipment*

The text of the International Standard IEC 60335-2-107 Ed 2.1 was approved as a joint Australia/New Zealand Standard with the agreed national variations as given below.

AUSTRALIAN NATIONAL VARIATIONS

There are no national variations to this Part 2 other than those listed in the national variations in AS/NZS 60335.1:2020.

NEW ZEALAND NATIONAL VARIATIONS

There are no national variations to this Part 2 other than those listed in the national variations in AS/NZS 60335.1:2020.

Annex ANZ
(normative)
Normative references to international publications with their corresponding joint
Australia/New Zealand publications

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

NOTE When an international publication has been modified by national variations the relevant joint Australia/New Zealand publications applies if the national variations are needed to ensure the safety of the appliance for Australia/New Zealand conditions. These international publications are indicated by (mod). If an international publication is not so indicated, then either it or the listed Australia/New Zealand publication may be used.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>AS/NZS</u>	<u>Year</u>
IEC 60320 (all parts)		<i>Appliance couplers for household and similar general purposes</i>		
IEC 62133 (all parts)		<i>Secondary cells and batteries containing alkaline or other non-acid electrolytes – Safety requirements for portable sealed secondary cells, and for batteries made from them, for use in portable applications</i>		
ISO 354:	2003	<i>Acoustics – Measurement of sound absorption in a reverberation room</i>		
ISO 683-4	2014	<i>Heat-treatable steels, alloy steels and free-cutting steels – Part 4: Free-cutting steels</i>		
ISO 3744:	2010	<i>Acoustics – Determination of sound power levels and sound energy levels of noise sources using sound pressure – Engineering methods for an essentially free field over a reflecting plane</i>		
ISO 3767-1		<i>Tractors, machinery for agriculture and forestry, powered lawn and garden equipment – Symbols for operator controls and other displays – Part 1: Common symbols</i>		
ISO 3767-3		<i>Tractors, machinery for agriculture and forestry, powered lawn and garden equipment – Symbols for operator controls and other displays – Part 3: Symbols for powered lawn and garden equipment</i>		
ISO 4871	1996	<i>Acoustics – Declaration and verification of noise emission values of machinery and equipment</i>		
ISO 7000	2014	<i>Graphical symbols for use on equipment – Index and synopsis</i>		
ISO 7010:	2011	<i>Graphical symbols – Safety colours and safety signs – Registered safety signs</i>		

ISO 8295	1995	<i>Plastics – Film and sheeting – Determination of the coefficients of friction</i>
ISO 11201:	2010	<i>Acoustics – Noise emitted by machinery and equipment – Determination of emission sound pressure levels at a work station and at other specified positions in an essentially free field over a reflecting plane with negligible environmental corrections</i>
ISO 11203	1995	<i>Acoustics – Noise emitted by machinery and equipment – Determination of emission sound pressure levels at a work station and at other specified positions from the sound power level</i>
ISO 11684,		<i>Tractors, machinery for agriculture and forestry, powered lawn and garden equipment – Safety signs and hazard pictorials – General principles</i>
ISO 11688-1,		<i>Acoustics – Recommended practice for the design of low-noise machinery and equipment – Part 1: Planning</i>
ISO 12100	2010	<i>Safety of machinery – General principles for design – Risk assessment and risk reduction</i>
ISO 13857:	2008	<i>Safety of machinery – Safety distances to prevent hazard zones being reached by upper and lower limbs</i>

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**HOUSEHOLD AND SIMILAR ELECTRICAL APPLIANCES –
SAFETY –****Part 2-107: Particular requirements for robotic battery
powered electrical lawnmowers**

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.
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- 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.

DISCLAIMER

This Consolidated version is not an official IEC Standard and has been prepared for user convenience. Only the current versions of the standard and its amendment(s) are to be considered the official documents.

This Consolidated version of IEC 60335-2-107 bears the edition number 2.1. It consists of the second edition (2017-12) [documents 116/350/FDIS and 116/354/RVD] and its amendment 1 (2020-02) [documents 116/429/FDIS and 116/443/RVD]. The technical content is identical to the base edition and its amendment.

This Final version does not show where the technical content is modified by amendment 1. A separate Redline version with all changes highlighted is available in this publication.

International Standard IEC 60335-2-107 has been prepared by IEC technical committee 116: Safety of motor-operated electric tools.

This second edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- a) Clause 7: Markings and instructions, new requirements for markings, warnings and the instruction manual;
- b) Clause 8: Protection against access to live parts, new requirements for protection against electric shock for hazardous battery voltages;
- c) Clause 20: Stability and mechanical hazards, revised requirements for manual controller, manual stop, cutting means stopping time, traction drive stopping and restart procedures, as well as a new standing child foot probe test;
- d) Clause 22: Construction, revised requirements for disabling devices, working area, perimeter delimiter, sensors and manual controller, as well as new requirements for machine connectors used for charging and contact surfaces used as obstruction sensing devices;
- e) Clause 24: Components, revised requirements for switches;
- f) Clause 29: Clearances, creepage distances and solid insulation, revised requirements for the machine and non-mains-powered peripherals.

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

This Part 2-107 is to be used in conjunction with the fifth edition (2010) of IEC 60335-1 and its amendments.

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

This Part 2-107 supplements or modifies the corresponding clauses in IEC 60335-1, so as to convert it into the IEC standard: Particular requirements for robotic battery powered electrical lawnmowers.

When a particular subclause of Part 1 is not mentioned in this Part 2-107, that subclause applies as far as is relevant. Where this standard states “addition”, “modification” or “replacement”, the relevant text in Part 1 is to be adapted accordingly.

The following print types are used:

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

The terms defined in Clause 3 are printed in **bold typeface**.

Subclauses, notes and figures which are additional to those in Part 1 are numbered starting from 101. Additional annexes are lettered AA, BB, etc.

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 the base publication and its amendment will remain unchanged until the stability date indicated on the IEC web site under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

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

- amended.

NOTE 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 36 months from the date of publication.

INTRODUCTION

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

This document recognizes the internationally accepted level of protection against hazards such as electrical, mechanical, thermal, fire and radiation of machines 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 machines.

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

If a machine within the scope of this document 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 machine in question over and above the general requirements.

This standard series is a product family standard series 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 documents.

A machine that complies with the text of this document 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.

A machine employing materials or having forms of construction differing from those detailed in the requirements of this document 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 document.

HOUSEHOLD AND SIMILAR ELECTRICAL APPLIANCES – SAFETY –

Part 2-107: Particular requirements for robotic battery powered electrical lawnmowers

1 Scope

Replacement:

This document specifies safety requirements and their verification for the design and construction of **robotic battery** powered electrical **rotary lawnmowers** and their **peripherals** with the **rated voltage** of the **battery** being not more than 75 V d.c.

EMC and environmental aspects, except noise, have not been considered in this standard.

This document does not apply to the additional risks associated with internal combustion engine(s), hybrid and fuel cell powered machines and associated charging systems.

This document deals with all the significant hazards presented by **battery** powered **robotic lawnmowers** and their **peripherals** when they are used as intended and under conditions of misuse which are reasonably foreseeable.

Throughout this document, the term machine is used to refer to the **robotic lawnmower**, separate from its **charging station**.

This document also provides requirements for the safety of mains powered **charging stations** and signal sources for **perimeter delimiters**.

Additional **battery** operation and charging requirements for **robotic lawnmowers**, including the charging of lithium ion batteries, are specified in Annex KK which replaces Annexes B and S (except for requirements for non-rechargeable **batteries**) of Part 1.

This document is not applicable to machines which are manufactured before the date of publication of this document by IEC.

NOTE Informative Annex FF is provided as a test code for convenience to the users of this document.

2 Normative references

This clause of Part 1 is applicable except as follows.

Addition:

IEC 60320 (all parts), *Appliance couplers for household and similar general purposes*

IEC 62133 (all parts), *Secondary cells and batteries containing alkaline or other non-acid electrolytes- safety requirements for portable sealed secondary cells, and for batteries made from them, for use in portable applications*

ISO 354:2003, *Acoustics – Measurement of sound absorption in a reverberation room*

ISO 683-4:2014, *Heat-treatable steels, alloy steels and free-cutting steels – Part 4: Free-cutting steels*

ISO 3744:2010, *Acoustics – Determination of sound power levels and sound energy levels of noise sources using sound pressure – Engineering methods for an essentially free field over a reflecting plane*

ISO 3767-1, *Tractors, machinery for agriculture and forestry, powered lawn and garden equipment – Symbols for operator controls and other displays – Part 1: Common symbols*

ISO 3767-3, *Tractors, machinery for agriculture and forestry, powered lawn and garden equipment – Symbols for operator controls and other displays – Part 3: Symbols for powered lawn and garden equipment*

ISO 4871:1996, *Acoustics – Declaration and verification of noise emission values of machinery and equipment*

ISO 7000:2014, *Graphical symbols for use on equipment – Index and synopsis*

ISO 7010:2011, *Graphical symbols – Safety colours and safety signs – Registered safety signs*

ISO 8295:1995, *Plastics – Film and sheeting – Determination of the coefficients of friction*

ISO 11201:2010, *Acoustics – Noise emitted by machinery and equipment – Determination of emission sound pressure levels at a work station and at other specified positions in an essentially free field over a reflecting plane with negligible environmental corrections*

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

ISO 11684, *Tractors, machinery for agriculture and forestry, powered lawn and garden equipment – Safety signs and hazard pictorials – General principles*

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

ISO 12100:2010, *Safety of machinery – General principles for design – Risk assessment and risk reduction*

ISO 13857:2008, *Safety of machinery – Safety distances to prevent hazard zones being reached by upper and lower limbs*

3 Terms and definitions

This clause of Part 1 is applicable except as follows.

3.5.1 Addition:

Note 101 to entry: Machines and **charging stations** are not considered to be **portable appliances**.

3.5.4 Addition:

Note 101 to entry: Machines are not considered to be **fixed appliances**. **Charging stations** are considered to be **fixed appliances**.

3.101

automatic mode

autonomous operation of the machine without the use of a **manual controller**

Note 1 to entry: Operation of the machine without the use of a **manual controller** and without the **cutting means** operating during set up of the **working area** is considered not to be operation in **automatic mode**.

3.102

battery

assembly of one or more **cells** intended to provide electrical current to the machine

3.103**cell**

basic functional electrochemical unit containing an assembly of electrodes, electrolyte, container, terminals, and usually separators, that is a source of electrical energy by direct conversion of chemical energy

3.104**charging station**

automatic **battery** charging facility located on or within the **working area**

3.105**control**

means or device which will control the operation of the machine or any specific operating function thereof

3.106**cutting means**

mechanism used to provide the cutting action

Note 1 to entry: The term “blade” can be used in warnings and instructions to denote “**cutting means**”.

3.107**cutting means enclosure**

part or assembly which provides the protective means around the **cutting means**

3.108**cutting means tip circle**

path described by the outermost point of the **cutting means** as it rotates about its shaft axis

3.109**cutting position**

any height setting of the **cutting means** designated by the manufacturer for cutting grass

3.110**disabling device****3.110.1****disabling device (removable)**

part, such as for example a key, which prevents operation of the **lawnmower** when it is removed

3.110.2**disabling device (code protected)**

device which, when operated, prevents operation of the **lawnmower** and requires a coded input (such as via a keypad) before it can operate

Note 1 to entry: See 22.103.

3.111**discharge chute**

extension of the **cutting means enclosure** from the **discharge opening**, generally used to control the discharge of material from the **cutting means**

3.112**discharge opening**

gap or opening in the **cutting means enclosure** through which grass may be discharged

3.113**fully charged (battery/cell)**

cell or **battery** charged to the maximum state of charge permitted by the **battery charging system** intended for use with the machine

3.114**fully discharged (battery/cell)**

battery or **cell** that has been discharged at **C₅ rate** until one of the following conditions occurs: discharge terminates due to protective circuitry or the **battery** (or **cell**) reaches a total voltage with an average voltage per **cell** equal to the end-of-discharge voltage for the **cell** chemistry being used unless a different end-of-discharge voltage is specified by the manufacturer

Note 1 to entry: The end-of-discharge voltages for common **cell** chemistries are provided in KK.5.10.

3.115**general purpose (batteries/cells)**

batteries and **cells** available from a variety of manufacturers, through a variety of outlets intended for a variety of different manufacturers' products

Note 1 to entry: 12 V automotive **batteries** and AA, C and D alkaline **cells** are examples of **general purpose**.

3.116**grass catcher**

part or combination of parts which provides a means for collecting grass clippings or debris

3.117**guard**

part of the machine or a component incorporated to provide protection for the operator and/or bystander by means of a physical barrier

3.118**hazardous voltage**

voltage between parts having an average value exceeding 60 V d.c. or exceeding 50 V peak when the peak-to-peak ripple exceeds 10 % of the average value

3.119**intended use**

any use of the machine which is reasonably foreseeable, as described in the instruction manual, and which is consistent with such activities as cutting grass, starting, stopping, or connecting to (or disconnecting from) a source of power

3.120**lawnmower**

grass-cutting machine where the **cutting means** operates in a plane approximately parallel to the ground and which uses the ground to determine the height of cut by means of wheels, air cushion or skids, etc., and which utilises an electric motor for a **power source**

3.121**manual controller**

device supplied by the manufacturer either connected by a wire or wireless that allows manual operation of the machine

3.122**manual stop**

manually actuated device using software-based or hardware-based components that overrides all other **controls** and removes power to the motor(s) and brings all moving parts to a stop

3.123**maximum operating motor speed**

the highest motor speed obtainable when adjusted in accordance with the manufacturers specifications and/or instructions, with the **cutting means** engaged

3.124**mulching lawnmower**

rotary lawnmower without **discharge openings** in the **cutting means enclosure**

3.125**operator control**

any **control** requiring operator actuation to perform specific functions

Note 1 to entry: This includes **controls** on a **manual controller**.

3.126**operator presence control**

control on a **manual controller** designed so that it will automatically interrupt the **cutting means** when the operator's actuating force is removed

3.127**perimeter delimiter**

device(s) that defines the perimeter of the **working area** within which the machine can operate automatically

Note 1 to entry: An example of a **perimeter delimiter** is a boundary wire that emits a signal to indicate the limit of the **working area**.

3.128**peripherals**

equipment additional to the machine itself that is provided by the manufacturer for intended use of the machine, e.g. charging station(s), manual controller, signal source for **perimeter delimiter**

3.129**power source**

motor which provides mechanical energy for linear or rotational movement

3.130**remote setting device**

setting device which is not connected by wire to the machine and designed to set the basic functions of the machine

Note 1 to entry: A **remote setting device** is not a **manual controller**.

3.131**robotic lawnmower**

unattended **lawnmower** that operates automatically

Note 1 to entry: When the term 'machine' is used in the text of this standard, it is used to denote a **robotic lawnmower**.

3.132**rotary lawnmower**

lawnmower in which the **cutting means**, cutting by impact, rotate about an axis (axes) normal to the cutting plane

3.133**sensor**

device that responds to physical stimuli (such as, but not limited to, heat, light, sound, pressure, magnetism, motion) and transmits the resulting signal or data providing a measurement, operating a **control**, or both

3.133.1**lift sensor**

device that senses when all or part of the machine is lifted from the ground

3.133.2**obstruction sensor**

device that senses when the machine contacts a person or an obstruction

3.133.3**tilt sensor**

device that senses when the machine is at or above a predetermined angle of incline

3.133.4**rollover sensor**

device that senses when the machine is inverted

3.134**stopping time**

time elapsed between the instant when either a **sensor** is activated or the actuator on a **manual controller** is released and the instant at which the machine or component comes to a stop

3.135**thrown object hazard**

potential for injury caused by object(s) propelled by the moving **cutting means**

3.136**traction drive**

means (system) used to transmit power from the **power source** to the ground drives means

3.137**working area**

any defined area in which the machine can function automatically

3.138**switched circuit**

circuit that is a low-power circuit when the **power switch** is in the “off” position

Note 1 to entry: The requirements for a low-power circuit are given in 19.11.1.

3.139**power switch**

device that electrically activates the **cutting means** and/or **traction drive** of the machine in the “on” position and deactivates the same function of the machine in its “off” position

Note 1 to entry: The device is comprised of all primary and ancillary components (e.g. tactile switch, relays, load switches) of the electrical control circuit that activates the **cutting means** and/or **traction drive** of the machine.

4 General requirement

This clause of Part 1 is applicable.

5 General conditions for the tests

This clause of Part 1 is applicable except as follows.

5.1 Addition:

Where an electronic speed **control** device can be adjusted, it is set for the highest speed.

5.2 Modification:

A new sample shall be used for each of the tests of Clause 21. However, at the manufacturer's discretion, fewer samples may be used.

Addition:

*The cumulative stress resulting from successive tests on the **battery** is to be avoided.*

If several tests are conducted on a single sample, then the results shall not be affected by previous tests.

5.8.1 Replacement:

*Unless otherwise specified, a **fully charged battery** shall be used for each test. Where for consecutive tests the same **battery** is specified, there shall be a minimum of 1 min rest time between tests.*

5.17 Replacement:

Machines and **peripherals** powered by rechargeable **batteries** are evaluated to the additional requirements in Annex KK.

Peripherals powered by **batteries** that are non-rechargeable are tested in accordance with Annex S.

6 Classification

This clause of Part 1 is applicable except as follows.

6.1 Replacement:

This subclause is not applicable for machines and non-mains-powered **peripherals**.

NOTE Machines and non-mains-powered **peripherals** covered by this standard are limited to those where the only power source is a **battery** and are therefore considered not to be a **class I appliance**, **class II appliance**, or a **class III appliance** and are not required to have **basic insulation**, **supplementary insulation** or **reinforced insulation**. Electric shock hazard is considered to exist only between parts of opposite polarity where **hazardous voltage** is present.

Mains-powered **peripherals** shall be of one of the following classes with respect to protection against electric shock:

- **class II appliance**;
- **class III appliance**.

Compliance is checked by inspection and by the relevant tests.

6.2 Addition:

Enclosures of machines shall be at least IPX1, except enclosures containing parts having a **working voltage** that is a **hazardous voltage**, which shall be at least IPX4. Enclosures of **charging stations** and other **peripherals** intended to be installed outdoors (e.g. a signal source for a **perimeter delimiter**) shall be at least IPX1 if of **class III construction**. Constructions other than **class III construction** shall be at least IPX4.

7 Marking and instructions

This clause of Part 1 is applicable except as follows.

7.1 Replacement:

Machines and **peripherals** shall be marked as indicated below and additionally, as required, by 7.1.101. Additional markings are allowed provided they do not give rise to misunderstanding. Warnings shall be located in easily visible positions. If the first numeral for the IP numbering is omitted, the omitted numeral shall be replaced by the letter X, for example IPX4.

On the machine:

- IP number according to degree of protection against ingress of water, other than IPX0;
- symbol IEC 60417-5180 (2003-02), for **class III appliances**, if treated as a **class III appliance** during charging. This marking is not necessary for machines that are operated only by batteries (primary batteries or secondary batteries that are recharged outside of the machine);
- business name and full address of the manufacturer and, where applicable, his authorized representative;
- year of construction;
- the mass of the machine if it is greater than 25 kg;
- designation of the machine, where designation of the machine may be achieved by a combination of letters and/or numbers provided that this code is explained by giving the explanation.

designation such as “battery powered robotic lawnmowers” etc. in the instructions supplied with the machine.

NOTE 1 An example of such code is “A123B”.

- designation of series or type, allowing the technical identification of the product. This may be achieved by a combination of letters and/or numbers and may be combined with the designation of the machine;

NOTE 2 The term “designation of series or type” is also known as model number.

- serial number, if any;
- other mandatory markings;

NOTE 3 For machines and their related products intended to be put on the market in the EEA, CE-marking as defined in the applicable European Directive(s), e.g. the Machinery Directive.

- cutting width in centimetres.
- “WARNING – Read instruction manual before operating the machine”.
- “WARNING – Keep a safe distance from the machine when operating”.
- “WARNING – Do not ride on the machine”.
- “WARNING – Remove (or operate) the **disabling device** before working on or lifting the machine”.

NOTE 4 Use “Remove” or “Operate” as appropriate to the type of **disabling device** that is fitted to the machine.

- “WARNING – Do not touch rotating blade”.
- where replaceable during normal use, the **cutting means** shall be marked to identify the part number(s) and the manufacturer, importer or supplier. This marking is not required to be clearly discernible from the outside of the machine;

NOTE 5 In Canada and the United States of America, the above **cutting means** marking is not applicable.

- if a **grass catcher** requires an adapter to be used, instructions shall be affixed to the machine near the **discharge opening** and to the **grass catcher** adapter stating that the machine shall not be operated without the adapter and **grass catcher** in place.

On the **charging station** and other mains powered **peripherals**, even if of **class III**:

- **rated voltage** or **rated voltage range** in volts;
- symbol for nature of supply, unless the rated frequency is marked;
- **rated power input** in watts or **rated current** in amperes;
- symbol IEC 60417-5172 (2003-02) for **charging stations** having parts of **class II construction**;
- symbol IEC 60417-5180 (2003-02) for **charging stations** having parts of **class III construction**;
- business name and full address of the manufacturer and, where applicable, his authorized representative;
- year of construction;
- designation of the **charging station** or **peripheral**, where designation of the **charging station** or **peripheral** may be achieved by a combination of letters and/or numbers provided that this code is explained by giving the explicit designation such as “charging station” etc. in the instructions supplied with the machine;

NOTE 6 An example of such code is “A123B”.

- designation of series or type, allowing the technical identification of the product. This may be achieved by a combination of letters and/or numbers and may be combined with the designation of the **charging station** or **peripheral**;

NOTE 7 The term “designation of series or type” is also known as model number.

- serial number, if any;
- other mandatory markings;

NOTE 8 Void

On the **manual controller**, for machines equipped with a **manual controller**, except when permanently connected to the machine:

- symbol IEC 60417-5172 (2003-02) for **class II appliances** only;
- symbol IEC 60417-5180 (2003-02), for **class III appliances**. This marking is not necessary for **manual controllers** that are operated only by batteries (primary batteries or secondary batteries that are recharged outside of the **manual controller**);
- business name and full address of the manufacturer and, where applicable, his authorized representative;
- year of construction;
- designation of the **manual controller**, where designation of the **manual controller** may be achieved by a combination of letters and/or numbers provided that this code is explained by giving the explicit designation such as “manual controller” etc. in the instructions supplied with the machine;

NOTE 9 An example of such code is “A123B”.

- designation of series or type, allowing the technical identification of the product. This may be achieved by a combination of letters and/or numbers and may be combined with the designation of the **manual controller**;

NOTE 10 The term “designation of series or type” is also known as model number.

- serial number, if any;
- other mandatory markings;

NOTE 11 Void

- “WARNING – Read instruction manual before operating the machine”.
- “WARNING – Keep a safe distance from the machine when operating”.

The required markings on **manual controllers** may be incorporated into an electronic display, provided the markings are continuously displayed during manual control.

Compliance is checked by inspection.

7.1.101 Marking giving cautionary information shall be located as close as practicable to the relevant hazard. Such marking shall be in one of the official languages of the country in which the machine is to be sold. Instead of written markings, symbols according to Annex EE are allowed. Symbols according to ISO 3767-1, ISO 3767-3, ISO 11684 and ISO 7010:2011 may also be used as appropriate. Contrasting colours shall be used unless the symbols are cast, embossed or stamped when colours are not required.

Class II appliances and **class III appliances** incorporating a functional earth shall be marked with the symbol IEC 60417-5018 (2011-07).

Controls which may give rise to a hazard (e.g. **operator presence controls** in accordance with 20.101.1) when operated shall be marked or so placed as to indicate clearly which part of the machine they control.

Where a **guard** is designed to be opened or removed and which exposes a hazard, a safety sign warning of the hazard shall be located on the **guard** or adjacent to the **guard**.

Compliance is checked by inspection.

7.6 Addition:

Additional symbols are shown in Annex EE.

7.8 Addition:

If a **cell** or **battery** is intended to be replaced by the user and it is possible for it to be put in a reverse polarity then the correct location and polarity shall be marked at its intended location.

7.9 Modification:

Replace the first paragraph by the following:

Operator controls shall have the function, direction and/or method of operation clearly identified by a durable label or mark.

The **manual stop** shall be marked with the word "STOP" and be coloured red, no other externally visible **controls** shall be coloured red.

7.11 Replacement:

Controls intended to be adjusted during installation or **intended use** shall be provided with an indication for the direction of adjustment.

NOTE An indication of + and – is considered to be sufficient.

Compliance is checked by inspection.

7.12 Replacement:

An instruction manual shall be supplied with the machine, giving operating, servicing, maintenance and safety instructions that comply as appropriate with 6.4 of ISO 12100:2010. The words 'Original instructions' shall appear on the language version(s) verified by the manufacturer or his authorized representative. Where no 'Original instructions' exist in the official language(s) of the country where the machine is to be used, a translation into that/those language(s) shall be provided by the manufacturer or his authorized representative or by the person bringing the machine into the language area in question. The translations shall bear the words 'Translation of the original instructions', and they shall be accompanied by a copy of the 'Original instructions'.

This instruction manual shall include:

- a) a repeat of those warnings required to be marked on the machine together with further explanation, where appropriate. Where safety signs are used in the marking on the machine, their function shall be explained;
- b) a warning to never allow children, persons with reduced physical, sensory or mental capabilities or lack of experience and knowledge or people unfamiliar with these instructions to use the machine, local regulations may restrict the age of the operator;
- c) a warning, not to allow children to be in the vicinity or play with the machine when it is operating;
- d) a general description of the machine and its **peripherals**, the **intended use**, instructions for the proper use of the machine including advice on what the machine and its **peripherals** should be used for, how to use it for the intended purpose(s) and any reasonably foreseeable misuse thereof;
- e) warnings concerning ways – that experience has shown might occur – in which the machinery shall not be used;
- f) instructions for the proper assembly and disassembly of the machine and its **peripherals** for use, if the machine and/or its **peripherals** are not supplied in a completely assembled form;
- g) instructions for proper adjustment and any necessary **user maintenance** of the machine and its **peripherals**, including timescales and a warning of the danger of moving hazardous parts;
- h) instructions for the proper setting out the perimeter of the **working area**;
- i) instructions for the recommended replacement or repair of, or service attention to, critical components. Where parts are consumable, the spare part shall be clearly identified, e.g. by the use of a part number or other means;
- j) instructions on the operation of all **controls**;
- k) information how to start and operate the machine safely;

- l) instructions for the operating position and the correct and safe operation of the machine and its **peripherals** such as moving, safe positioning, handling, clearing blockages, and if a collecting facility is provided keeping the **discharge chute** clear of processed material, for use, preparation, maintenance and storage of the machine;
- m) an advice during manual control to not overreach and to maintain balance at all times, to always be sure of footing on slopes and to walk, never run while operating the machine or its **peripherals**, if applicable;
- n) a warning not to touch moving hazardous parts before these have come to a complete stop;
- o) details of the **battery** charger to be used and advice on the safe disposal of **batteries** at the end of their life;
- p) if designed for use with an extension cord, an advice on the use, length and type of extension cords to be used (not lighter than required by Subclause 25.7);
- q) if a collecting facility is provided with the machine, instructions for when and how to attach and detach the collection device to and from the machine;
- r) instructions for fitting and use of attachments, if any;
- s) information about the residual risks that remain despite the inherent safe design measures, safeguarding and complementary protective measures adopted;
- t) instructions to always wear substantial footwear and long trousers while operating the machine with a **manual controller**;
- u) instructions to disconnect the supply (e.g. remove the plug from the mains or remove/operate the **disabling device**)
 - before clearing a blockage on the machine;
 - before checking, cleaning or working on the machine or **charging station**;
 - after striking a foreign object to inspect the machine for damage;
 - if the machine starts to vibrate abnormally, and to check for damage before restarting;
- v) instructions when, where and how to inspect the machine and its **peripherals**, the supply and extension cord for signs of damage or ageing and, if permitted, how to make repairs;
- w) a warning never to operate the machine and/or its **peripherals** with defective **guards** or shields, or without safety devices, or if the cord is damaged or worn;
- x) an advice not to connect a damaged cord to the supply or touch a damaged cord before it is disconnected from the supply for the reason that damaged cords can lead to contact with **live parts**;
- y) advice to keep any supply and/or extension cords away from the **working area** to avoid damage to the cords which can lead to contact with **live parts**;
- z) instructions on the action to take in the event of accident or breakdown;
- aa) instructions on the action to take in the event of leakage of electrolyte;
- bb) instructions how to disconnect the **peripherals** from the mains, if the cord becomes damaged during use;
- cc) recommendations
 - to connect the **peripherals** only to a supply circuit protected by a residual current device (RCD) with a tripping current of not more than 30 mA;

NOTE It is possible to replace the term “residual current device (RCD)” with a tripping current of not more than 30 mA” with the term “class A ground fault circuit interrupter (GFCI)”.

 - to avoid using the machine and its **peripherals** in bad weather conditions especially when there is a risk of lightning;
- dd) information about airborne noise emissions of the machine according to Annex FF. This includes:

- the A-weighted emission sound pressure level L_{pA} and its uncertainty K_{pA} as determined according to Annex FF, where this exceeds 70 dB(A); where this level does not exceed 70 dB(A), this fact shall be indicated;
 - the A-weighted sound power level emitted by the machinery L_{WA} and its uncertainty K_{WA} as determined according to Annex FF, where the A-weighted sound pressure level L_{pA} exceeds 80 dB(A);
- ee) instructions how to proceed in case of abnormal vibrations;
- ff) mass in kilograms;
- gg) information for machines used in public areas, that warning signs shall be placed around the **working area** of the machine. They shall show the substance of the following text:

"Warning! Automatic lawnmower! Keep away from the machine! Supervise children!"

7.12.1 This subclause of Part 1 is applicable.

7.12.2 This subclause of Part 1 is not applicable.

7.12.3 This subclause of Part 1 is not applicable.

7.12.4 This subclause of Part 1 is not applicable.

7.12.5 This subclause of Part 1 is applicable.

7.12.6 This subclause of Part 1 is applicable.

7.12.7 This subclause of Part 1 is not applicable.

7.12.8 This subclause of Part 1 is not applicable.

8 Protection against access to live parts

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

8.1 This subclause of Part 1 is

- applicable for **charging stations** and **perimeter delimiter**; and
- not applicable for machines, **manual controllers** and **remote setting devices**.

8.2 This subclause of Part 1 is

- applicable for **charging stations** and **perimeter delimiter**; and
- not applicable for machines, **manual controllers** and **remote setting devices**.

8.101 Protection against electric shock

8.101.1 Machines and their **battery** packs shall be so constructed and enclosed that there is adequate protection against electric shock.

Compliance is checked by inspection and by the requirements of 8.101.2 and 8.101.3, as applicable.

8.101.2 It shall not be permissible to have two conductive, simultaneously **accessible parts** where there is **hazardous voltage** between them unless they are provided with an impedance that limits current to a safe value.

In the case of an impedance that limits current to a safe value, the short circuit current between the parts shall not exceed 2 mA for d.c. or 0,7 mA peak for a.c. and there shall not be more than 0,1 μ F capacitance directly between the parts.

Compliance for accessibility is checked by applying the test probe B of IEC 61032:1997 to each conductive part.

The test probe B of IEC 61032:1997 is applied with a force not exceeding 5 N through openings to any depth that the test probe will permit, and it is rotated or angled before, during and after insertion to any position.

If the opening does not allow the entry of the probe, a rigid test probe with the dimensions of the test probe B of IEC 61032:1997, but without any articulation, is used, the force on the probe is increased to 20 N and the test with the articulated test probe B of IEC 61032:1997 is repeated.

Contact with the test probe is determined with all **detachable parts** removed and the machine operated in any position of **intended use**.

Lamps located behind detachable covers are not removed, providing the lamp may be de-energized by means of a user operable plug, **battery** pack disconnection or a switch.

8.101.3 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, but with a test voltage of 750 V. 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.*

9 Starting of motor-operated appliances

This clause of Part 1 is not applicable.

10 Power input and current

This clause of Part 1 is not applicable.

11 Heating

This clause of Part 1 is not applicable, except for mains-powered **peripherals**.

12 Void

13 Leakage current and electric strength at operating temperature

This clause of Part 1 is not applicable, except for mains-powered **peripherals**.

14 Transient overvoltages

This clause of Part 1 is not applicable, except for mains-powered **peripherals**.

15 Moisture resistance

This clause of Part 1 is applicable except as follows.

15.1 Addition:

*The machine shall be tested according to its IP rating both separately and while in its **charging station**.*

*The **charging station** shall be tested according to its IP rating both separately and while the machine is in its charging position.*

*Compliance for the machine and **charging station** is assessed individually according to its IP rating. The test of 16.3 is not performed on the machine.*

15.1.2 Modification:

*Machines or **peripherals** classified as IPX4 shall be rotated during the test along its vertical axis. The rate of rotation shall be $1,2 \pm 0,2$ r/min.*

15.2 Addition:

*Machines or **peripherals** fitted with an appliance inlet or cable coupler shall be tested with the appropriate mating connector in place.*

Air filters are not removed.

15.3 This subclause is not applicable, except for mains-powered **peripherals**.

16 Leakage current and electric strength

This clause of Part 1 is applicable except as follows.

16.1 This subclause is not applicable, except for mains-powered **peripherals**.

16.2 This subclause is not applicable, except for mains-powered **peripherals**.

16.3 Replacement of the first paragraph:

*For mains-powered **peripherals**, immediately after the test of 16.2, the insulation is subjected to a voltage having a frequency of 50 Hz or 60 Hz for 1 min in accordance with IEC 61180-1. The values of the test voltage for different types of insulation are given in Table 7.*

*For machines and non-mains powered **peripherals**, as required by the test of 8.101.3, the insulation is subjected to a voltage having a frequency of 50 Hz or 60 Hz for 1 min in accordance with IEC 61180-1. The values of the test voltage are given in 8.101.3.*

17 Overload protection of transformers and associated circuits

This clause of Part 1 is not applicable, except for mains-powered **peripherals**.

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 to the first paragraph:

This includes leakage of electrolyte from the **battery**.

19.7 This subclause is not applicable.

19.8 This subclause is not applicable.

19.9 This subclause is not applicable.

19.10 This subclause is not applicable.

19.11 Addition:

The first fault may be applied at any time. If an additional fault in a protective electronic circuit has to be applied, it shall not be applied before a new operating cycle of the machine. This sequence of applied failures is also applicable for the tests specified in Clause 20 and 22 if tests according 19.11.2 are required.

This subclause is not applicable for lithium-ion **charging systems**.

NOTE 101 The requirements for lithium-ion **charging systems** are specified in KK.19.1.

19.11.1 This subclause is not applicable for lithium-ion **charging systems**.

19.11.2 This subclause is not applicable for lithium-ion **charging systems**.

19.11.3 *Addition:*

*However the test is not repeated, if the **protective electronic circuit** provides a non-self-resetting interruption of the supply of the machine's part that would render the machine unsafe during the relevant test.*

This subclause is not applicable for lithium-ion **charging systems**.

19.11.4 This subclause is not applicable for lithium-ion **charging systems**.

19.11.4.1 to 19.11.4.8 These subclauses are not applicable for lithium-ion **charging systems**.

19.14 This subclause is not applicable, except for mains-powered **peripherals**.

19.15 This subclause is not applicable, except for mains-powered **peripherals**.

20 Stability and mechanical hazards

This clause of Part 1 is applicable except as follows.

20.1 This subclause is not applicable.

20.2 *Replacement:*

To prevent unexpected operation which may result in a hazard, the **cutting means** shall not start until either,

- a) the machine is restarted as described in the restart procedure in 20.102.6; or
- b) the **cutting means** start-up indication procedure as described in 22.110 is completed; or
- c) for manual control, as described in 20.101.1.

All power driven components except the **cutting means** and the ground contacting parts shall be guarded to prevent inadvertent contact. Any apertures or safety distances shall comply with 4.2.4.2 and 4.2.4.3 of ISO 13857:2008.

To prevent inadvertent access to the **cutting means** these are guarded by the **cutting means enclosure**. The **cutting means enclosure** shall comply with the requirements of 20.102.1 and 20.102.4.

All **guards**, including the **cutting means enclosure** as specified in 20.102.1, shall be permanently attached to the machine and shall not be detachable without the use of **tools**. Exceptions to this are the opening of or removing interlocked **guards** which disable the protected moving parts, as specified in 20.102.1.2.

Fixed **guards** that the user is instructed to remove for regular maintenance shall have their fixing means retained on either the **guard** or the body of the machine.

After restoring an interlocked **guard** to its normal position, restarting the **cutting means** and **traction drive** shall only be possible by fulfilling the requirements of the restart procedure in 20.102.6.

Compliance is checked by inspection and by measurement.

20.101 Controls

20.101.1 Manual controller

Manual controllers, if any, shall be fitted with an **operator presence control** on the **manual controller** which will automatically stop rotation of the **cutting means** when the operator's hands are removed. This may be accomplished either by stopping the drive motor or by an intermediate clutch/brake mechanism. Starting of the **cutting means** shall require two separate and dissimilar actions, one of which shall be the actuation of the **operator presence control**. If these actions can be carried out by using the same hand then the actions shall be totally distinct thus to prevent accidental "switch on".

Any actuator on the **manual controller** for the **traction drive** shall automatically stop or disengage the **traction drive** when the operator releases the actuator.

During manual operation, the **obstruction sensor** and the **sensor** detecting when the machine is outside the **working area** may be deactivated, the **lift sensors**, **tilt sensors** and **rollover sensors** shall remain functional.

If a **manual controller** is provided, it shall meet the requirements of 22.107 and 21.101.5.

Compliance is checked by inspection, by practical tests and by the tests of 22.107 and 21.101.5.

20.101.2 Remote setting device

If a **remote setting device** is provided it may be used to carry out "off-machine" adjustments of the settings, movement within the **working area**, as well as starting and stopping the machine in **automatic mode**.

A **remote setting device** shall maintain all of the requirements for automatic operation.

Compliance is checked by inspection and by practical test.

20.101.3 Void

20.101.4 Manual stop

A single action clearly identifiable **manual stop** shall be provided on the machine in a prominent position on the top surface. The actuator of the **manual stop** shall have at least 20% of its surface raised at least 5 mm above the immediate surrounding area. The minimum width of the immediate surrounding area shall be not less than 15 mm. The geometric minor dimension of the actuator of the **manual stop** shall be not less than 35 mm and the surface area of the actuator shall be not less than 700 mm².

The operating force of the actuator of the **manual stop** shall not exceed 30 N on any part of its surface that is raised at least 5 mm above the immediate surrounding area.

The **manual stop** shall override all other **controls** and cause the **traction drive** to stop as specified in 20.102.5.2 and the **cutting means** in accordance with 20.102.2.

*Compliance is checked by inspection and by measurement, and if the compliance relies on the operation of an **electronic circuit**, it is checked under the following conditions applied separately:*

- 1) *the fault conditions in a) to g) of 19.11.2 applied one at a time to the **electronic circuit**;*
- 2) *the electromagnetic phenomena tests of Clause 19.11.4.1 and 19.11.4.2 applied to the machine.*

*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 Annex R.*

Restarting of the mower following a **manual stop** shall only be possible after the restart procedure in 20.102.6 is completed.

Compliance is checked by inspection and by practical tests.

20.102 Safety requirements

20.102.1 Cutting means enclosure

20.102.1.1 General

Except as allowed below, the **cutting means enclosure** shall extend at least 3 mm below the plane of the **cutting means tip circle**. The bolt heads of **cutting means** securing screws may extend below the **cutting means enclosure** providing these are located within the inner 50 % **cutting means tip circle** diameter.

Openings may be provided in the **cutting means enclosure**.

NOTE Requirements for inadvertent access to the **cutting means** are specified in 20.102.4.

Compliance is checked by inspection and by measurement.

This requirement shall not apply to machines where the **cutting means** is a generally circular drive unit on which is mounted one or more pivoting cutting elements or filament lines. These cutting elements shall rely on centrifugal force to achieve cutting and have a kinetic energy not exceeding 2 J per cutting element.

For the purposes of this clause, the kinetic energy of a pivoting cutting element shall be calculated according to Annex AA.

Compliance is checked by inspection, by measurement and by calculation.

20.102.1.2 Guards and grass catchers

Guards which have to be displaced in order to fit the **grass catcher** shall be interlocked to meet the requirements of 20.102.2. The **guards** shall be considered as forming part of the **cutting means enclosure**.

Compliance is checked by inspection and by practical tests.

20.102.2 Cutting means stopping time

The **cutting means** shall stop from their maximum rotational speed within 2 s if a **cutting means** stopping command is generated from any of the following:

- **tilt sensor**;
- **lift sensor**;
- **obstruction sensor** (when activated for more than 3 s according to 22.105.2);
- **manual stop** is activated;
- after the operator releases the **cutting means operator presence control**; or
- the opening of or removing interlocked **guards**, which disable the protected moving parts.

Compliance is checked by the tests of 20.102.2.1 to 20.102.2.3.

*If compliance relies on the operation of an **electronic circuit**, the compliance is checked under the following condition:*

- 1) *the fault conditions in a) to g) of Clause 19.11.2 applied one at a time to the **electronic circuit**;*

*The total **stopping time**, as a result of condition 1) and an attempted **cutting means** stopping command, shall either*

- *comply with the **stopping time** limit value above; or*
- *not exceed 0,1 joules (J) of rotational energy at the end of an interval of twice of the value given above. In this case, the test is repeated and either the **cutting means** stopping command shall comply with the **stopping time** limit value above or the **cutting means***

shall be permanently disabled such that the **cutting means** cannot be reactivated by the operator and requires repair by qualified service personnel.

The calculation of rotational energy shall be made using Annex AA or $E = \frac{1}{2}I\omega^2$ as appropriate.

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 Annex R.

For machines where the **cutting means stopping time** is not monitored by an **electronic circuit**, the durability test according to 20.102.2.2 and 20.102.2.3 shall be carried out.

20.102.2.1 Cutting means stopping time test

Prior to the test, the machine shall be assembled and adjusted according to the manufacturer's instructions for use. The machine shall be started and stopped 10 times before commencing the test. If possible, machines shall be powered from an external source of power to simulate a **fully charged battery**.

The time recording measurement system shall have a total accuracy of 25 ms and any tachometers used shall have an accuracy of $\pm 2,5$ %. The ambient test temperature shall be $20\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$. The machine shall be mounted and instrumented in such a manner that the results of the test are not affected.

Stopping time is measured from the moment of actuation of a **sensor** until either

- the last time a **cutting means** passes the sensing device of the test equipment; or
- the residual energy of the **cutting means** is below 0,1J;

whichever is sooner.

The means of initiating the **cutting means** stopping procedure during the test shall be such that:

- for the **operator presence control** for the **cutting means** – the **control** shall be released abruptly from the full "on" position so that it returns to the "idle" or "**off**" position by itself;
- for the **obstruction sensors** – each **sensor** is activated such that a **cutting means** stopping command is generated as specified in 22.105.2;
- for **tilt sensors** – the machine shall be tilted to activate and deactivate the **sensor** in the directions as required in 22.105.1;
- for **lift sensors** – the machine shall be lifted to activate and deactivate the **sensor** as required in 22.105.3;
- for **manual stops** – the **manual stop** shall be activated.

Individual **cutting means stopping times** shall be measured five times from the moment of each of the following:

- release of the **cutting means operator presence control**,
- activation of the **obstruction sensor** by contact with the solid object according to 22.105.2,
- operation of the **tilt sensor**. The primary direction giving the longest average value shall be the orientation used for measuring the **cutting means stopping time** of the machine,
- actuation of the **manual stop**, and
- **lift sensor** is actuated.

The sensor or manual action giving the longest average value from these options shall be the method used for measuring the **cutting means stopping time** of the machine according to 20.102.2.2.

20.102.2.2 Cutting means stopping time durability test – Method

For machines where the **cutting means stopping time** is not monitored by an **electronic circuit**, the machine shall be subjected to a sequence of 5 000 stop/start cycles. The 5 000 test cycles are not required to be continuous and the machine shall be maintained and adjusted during the test in accordance with the manufacturers published instructions for use. There shall be no maintenance or adjustment after 4 500 cycles have been completed.

Figure 101 gives a schematic representation of two cycles. Each cycle shall consist of the following sequence:

- accelerate the **cutting means** from rest to the **maximum operating motor speed** (n) – (time = t_s);
- hold it at this speed for a short time to ensure that it is stable – (time = t_r);
- operate the machine and allow the **cutting means** to come to rest – (time = t_b);
- allow a short time at rest before commencing the next cycle – (time = t_o).

If the total time for one cycle is t_c then $t_c = t_s + t_r + t_b + t_o$. The test cycle times for "on" ($t_s + t_r$) and "off" ($t_b + t_o$) shall be decided by the manufacturer but shall not exceed 100 s "on" and 20 s "off".

NOTE This test is not representative of normal use and therefore the cycle times are specified by the manufacturer to avoid unnecessary wear or damage to the machine.

20.102.2.3 Cutting means stopping time durability test – Verification

For machines subjected to the test of 20.102.2.2, the **cutting means stopping time** shall be measured for the following:

- each of the first five cycles of the 5 000 cycle test sequence (i.e. not including the preparatory operations nor the trial stops used to determine which stop initiator to test);
- each of the last five cycles prior to any brake maintenance or adjustment carried out during the test;
- each of the first 5 cycles of each 500 cycles of operation; and
- each of the last five cycles of the 5 000 test cycles.

No other **stopping times** shall be recorded.

Each of the measured **stopping times** (t_b) shall comply with the requirement of 20.102.2. If the test sample fails to complete the full number of cycles but otherwise meets the requirements of this test, either:

- the machinery may be repaired, if the brake mechanism is not affected and the test continued;
- if the machine cannot be repaired, one further sample may be tested which shall then comply fully with the requirements.

20.102.3 Thrown object hazard

Robotic lawnmowers shall be so constructed to provide adequate protection against risk of injury to persons from foreign objects that may be thrown out by the rotating **cutting means**.

Compliance is checked by the following test:

When conducting this test, personnel should either be kept out of the test area or otherwise protected from the hazard of thrown objects.

The machine is placed in the test enclosure described in Annex BB with the base of the enclosure being as described in Annex CC. The target panel construction used shall be checked by the tests contained in Clause BB.3 of Annex BB immediately before and after this test. The target panels shall be divided into elevation zones by horizontal lines as indicated in Figure BB.1 and described in Annex DD.