



BSI Standards Publication

Safety of household and similar appliances

Part 2-107: Particular requirements for robotic battery powered electrical lawnmowers (IEC 60335-2-107:2012, modified)

National foreword

This British Standard is the UK implementation of EN 50636-2-107:2015+A2:2020. It is derived from IEC 60335-2-107:2012. It supersedes BS EN 50636-2-107:2015+A1:2018, which is withdrawn.

The start and finish of text introduced or altered by amendment is indicated in the text by tags. Tags indicating changes to CENELEC text carry the number of the CENELEC amendment. For example, text altered by CENELEC amendment A1 is indicated by A1 A1.

The UK participation in its preparation was entrusted to Technical Committee CPL/116, Safety of motor-operated electric tools.

A list of organizations represented on this committee can be obtained on request to its secretary.

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30 November 2018	Corrections to Clauses 2 and 20.102.4.1.2, and to image resolution of Figures 102, 103, 107, BB.1, BB.3, BB.4, CC.1 and CC.2
31 January 2020	Implementation of CENELEC amendment A2:2020

This document includes Amendment 1, approved by CENELEC on 2017-08-09, and Amendment 2, approved by CENELEC on 2019-09-27.

The start and finish of text introduced or altered by amendment is indicated in the text by tags **A1** **A1** and **A2** **A2**.

English Version

**Safety of household and similar appliances - Part 2-107:
Particular requirements for robotic battery powered electrical
lawnmowers
(IEC 60335-2-107:2012 , modified)**

This European Standard was approved by CENELEC on 2014-12-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

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European foreword

This document (EN 50636-2-107:2015) has been prepared by CLC/TC 116, "Safety of hand-held motor-operated electric tools".

The following dates are fixed:

- latest date by which the standard has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2015-12-01
- latest date by which the national standards conflicting with the standard have to be withdrawn (dow) 2017-12-01

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC shall not be held responsible for identifying any or all such patent rights.

This document has been prepared under a mandate given to CENELEC by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directives.

For the relationship with EU Directive 2006/42/EC, see informative Annex ZZ, which is an integral part of this document.

The text of IEC 60335-2-107:2012 has been revised by CLC/TC 116/WG 5, "Garden appliances", to bring this European Standard in line with the European Machinery Directive 2006/42/EC.

This document was submitted to the UAP under the reference FprEN 60335-2-107:2013. CLC/TC 116 confirmed that EN 60335-1:2012 is Part 1 of this document.

This European Standard is to be used in conjunction with EN 60335-1:2012 "*Household and similar electrical appliances - Safety – Part 1: General requirements*" and its amendments.

When "Part 1" is mentioned in this standard, it refers to EN 60335-1:2012.

This European Standard supplements or modifies the corresponding clauses in Part 1, so as to convert that publication into the European Standard "*Particular requirements for robotic battery powered electrical lawnmowers*".

Where a particular subclause of Part 1 is not mentioned in this European Standard, 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.

Compliance with the relevant clauses of Part 1 together with this European Standard provides one means of conforming to the specified essential health and safety requirements of the Directive concerned.

This European Standard follows the overall requirements of EN ISO 12100:2010.

Warning: Other requirements arising from other EU Directives can be applicable to the products falling within the scope of this European Standard.

The following numbering system is used:

- subclauses that are numbered starting from 101 are additional to those in Part 1;
- additional annexes are lettered AA, BB, etc.

NOTE In this European Standard the following print types are used:

- requirements proper: in Roman type;

- *test specifications: in italic type;*
- explanatory matter: in smaller Roman type.

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

Introduction

This document is a type C standard as stated in EN ISO 12100:2010.

The machinery concerned and the extent to which hazards, hazardous situations and events are covered is as indicated in the scope of this document.

When provisions of this type C standard are different from those which are stated in type A or B standards, the provisions of this type C standard take precedence over the other standards, for machines which have been built and designed to the provisions of this type C standard.

1 Scope

This clause of Part 1 is replaced by the following:

This European Standard 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. charged by mains electrical and/or alternative energies, e.g. solar power.

This European Standard does not apply to non-robotic machines such as **lawn trimmers, lawn edge trimmers, lawn edgers, ride-on lawnmowers or pedestrian controlled lawnmowers**.

This European Standard is not applicable to EMC and environmental hazards (except noise).

This European Standard does not apply to internal combustion engine(s), hybrid and fuel cell powered machines and associated charging systems.

This European Standard 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.

This European Standard is not applicable to machines, which are manufactured before the date of publication of this document by CENELEC.

NOTE This European Standard does not apply to battery chargers (EN 60335-2-29:2004).

A2 This standard covers all significant hazards, hazardous situations or hazardous events relevant for tools covered by this standard.

NOTE 101 Essential requirements not mentioned in **Table ZZ.1** are deemed to be not applicable, because the corresponding hazards are either not relevant for machines covered by this standard or do not require specific action by the designer. **A2**

2 Normative references

This clause of Part 1 is applicable except as follows.

Addition:

EN 60320-1:2001+ EN 60320-1:2001/A1:2007, *Appliance couplers for household and similar general purposes – Part 1: General requirements (IEC 60320-1:2001 + A1:2007)*

EN 60320-2-1:2000, *Appliance couplers for household and similar general purposes – Part 2-1: Sewing machine couplers (IEC 60320-2-1:2000)*

EN 60320-2-2:1998, *Appliance couplers for household and similar general purposes – Part 2-2: Interconnection couplers for household and similar equipment (IEC 60320-2-2:1998)*

EN 60320-2-4:2006 + EN 60320-2-4:2006/A1:2009, *Appliance couplers for household and similar general purposes – Part 2-4: Appliance couplers dependent on appliance weight for engagement (IEC 60320-2-4:2006 + A1:2009)*

EN 60335-1:2012, *Household and similar electrical appliances – Safety – Part 1: General requirements (IEC 60335-1:2010, mod.)*

EN 60335-2-29:2004, *Household and similar electrical appliances – Safety – Part 2-29: Particular requirements for battery chargers (IEC 60335-2-29:2002)*

EN 61032:1998, *Protection of persons and equipment by enclosures – Probes for verification (IEC 61032:1997)*

EN 62133:2003, *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 (IEC 62133:2002)*

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

EN 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 3744:2010)*

EN ISO 4871:2009, *Acoustics – Declaration and verification of noise emission values of machinery and equipment (ISO 4871:1996)*

EN ISO 7010:2012, *Graphical symbols – Safety colours and safety signs – Registered safety signs (ISO 7010:2011)*

EN ISO 8295:2004, *Plastics - Film and sheeting - Determination of the coefficients of friction (ISO 8295:1995) ^{A2}*

EN 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 11201:2010)*

EN ISO 11203:2009, *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 11203:1995)*

EN ISO 11688-1:2009, *Acoustics – Recommended practice for the design of low-noise machinery and equipment – Part 1: Planning (ISO/TR 11688-1:1995)*

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

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

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

ISO 3767-1:1998+A1:2008+A2:2012, *Tractors, machinery for agriculture and forestry, powered lawn and garden equipment – Symbols for operator controls and other displays – Part 1: Common symbols*

ISO 3767-3:1995, *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 7000:2014, *Graphical symbols for use on equipment – Index and synopsis*

ISO 11684:1995, *Tractors, machinery for agriculture and forestry, powered lawn and garden equipment – Safety signs and hazard pictorials – General principles*

3 Definitions

This clause of Part 1 is applicable except as follows.

3.101 Void

3.102 control

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

3.103 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**”.

3.104 cutting means enclosure

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

3.105 cutting means tip circle

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

3.106 cutting position

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

3.107 disabling device

a) removable

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

b) 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 Clause 22.103.

3.108 discharge chute

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

3.109 discharge opening

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

3.110 charging station

automatic battery charging facility located on or within the delimited or pre-programmed area

3.111 manual stop

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

3.112 grass catcher

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

3.113**guard**

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

3.114**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

3.115**lawn edge trimmer**

powered grass cutting machine for trimming lawn edges usually in a vertical plane

3.116**lawn edger**

powered machine suitable for cutting lawn and soil, usually in a vertical plane

3.117**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 utilizes an electric motor for a **power source**

3.118**lawn trimmer**

powered grass-cutting machine where the operator determines the plane of operation of the **cutting means** and the height of cut, possibly assisted by a wheel or skid, etc.

3.119**manual controller**

device either connected by a wire or wireless that allows manual control of the movement and **cutting means** operation of the machine

3.120**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

3.121**mowing attachment**

cutting means designed to be easily detached from the machine, generally to allow the machine to be used for other purposes

3.122**mulching lawnmower**

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

3.123**no load**

the minimum load attainable at **rated voltage**

3.124**operator control**

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

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

3.125**operator presence control**

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

3.126

pedestrian controlled lawnmower

grass-cutting machine, either pushed or self-propelled, normally controlled by the operator holding a handle walking behind the unit

3.127

perimeter delimiter

a device(s) that define the perimeter of the area within which the machine can operate automatically

3.128

power source

motor which provides mechanical energy for linear or rotational movement

3.129

ride-on lawnmower

self-propelled **lawnmower** on which an operator rides and which is designed primarily for cutting grass

3.130

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**.

3.131

rotary lawnmower

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

3.132

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:

a) lift sensor

device that senses when the machine is lifted bodily from the ground

b) obstruction sensor

device that senses when the machine contacts an obstruction

c) tilt sensor

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

d) rollover sensor

device that senses when the machine is inverted

3.133

stopping time

the 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

3.134

thrown object hazard

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

3.135

traction drive

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

3.136

remote setting device

a setting device which is not connected by wire to the **lawnmower** and designed to set the basic functions of the **lawnmower** but not for controlling the **lawnmower**

3.137**working area**

any defined area in which the machine can function automatically

3.138**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

4 General requirement

This clause of Part 1 is applicable except as follows:

4.101 Attachments

Where attachments are available from the original manufacturer which modify the use of a **robotic lawnmower**, the complete machine shall still comply with the safety requirements of this standard.

Compliance is checked by inspection and by the relevant tests, where 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 Replacement:

A new machine shall be used for each of the tests of Clause 21.

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.

6 Classification

This clause of Part 1 is applicable except as follows:

6.1 Replacement:

Machines shall be of one of the following classes with respect to protection against electric shock:

- machines and charging **stations** with a rated voltage above 42 V shall be **class II**;
parts of machines with an integrated mains powered charger shall be **class II**; other parts complying with **SELV** shall be at least **class III**;
- **charging stations** supplied with **SELV** shall be at least **class III**;
- other machines shall be at least **class III**.

Compliance is checked by inspection and by the relevant tests.

6.2 Addition:

Class II parts of machines shall be at least IPX4.

Class III machines shall be at least IPX1.

7 Marking and instructions

This clause of Part 1 is applicable except as follows:

7.1 Replacement:

Replace the third indent by:

- rated power in kilowatts or rated current in amperes for mains supplied chargers

7.1 Addition:

Add the following indents:

- business name and full address of the manufacturer and, where applicable, his authorized representative;
- year of construction;
- mass in kilograms;
- designation of the machine,
designation of machine may be achieved by a combination of letters and/or numbers provided that this code is explained by giving the explicit 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 machine;

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

- serial number, if any;
- 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.

- symbol IEC 60417-5172 for class II machines only;
- symbol IEC 60417-5180 (2003-02), for class III machines. 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);
- cutting width in centimetres.

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

The following warnings shall be located in easily visible positions, indicating:

On the machine:

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.

CAUTION – Do not touch rotating blade.

For machines equipped with a **manual controller**, the **manual controller** shall be marked with:

WARNING – Read instruction manual before operating the machine.

WARNING – Keep a safe distance from the machine when operating.

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 3767-1:1998+A1:2008+A2:2012, ISO 3767-3:2003, ISO 11684:1995 and EN ISO 7010:2012 may also be used as appropriate. Contrasting colours shall be used unless the symbols are cast, embossed or stamped when colours are not required. If symbols are used, their significance shall be described in the instruction manual.

Also:

- the **cutting means** shall be marked for identification;
- 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 either the entire **grass catcher** or **guard** in place.

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.

7.12 Replacement:

An instruction manual shall be supplied with the machine, giving operating, servicing, maintenance and safety instructions that comply as appropriate with EN ISO 12100:2010, Clause 6.4. 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 to not overreach and to keep the balance at all times, to always be sure of the footing on slopes and to walk, never run while operating the machine or its peripherals;
- 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 Clause 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;
- u) instructions to disconnect the supply (e.g. remove the plug from the mains or remove the disabling device)
 - before clearing a blockage;
 - before checking, cleaning or working on the machine;
 - 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) an advice to keep extension cords away from moving hazardous parts 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 machine or its peripherals from the mains, if the cord becomes damaged or entangled during use;
- cc) recommendations
 - to connect the machine and/or its peripherals only to a supply circuit protected by a residual current device (RCD) with a tripping current of not more than 30 mA,
 - 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 at the operator position 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 as determined according to Annex FF;
 - the uncertainties surrounding the determined noise emission values according to Annex FF;
- 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! 

NOTE Examples of safety instructions are given Annex HH.

Compliance shall be checked by inspection.

7.12.1 This clause of Part 1 is applicable.

7.12.5 to 7.12.6 These clauses of Part 1 are applicable.

8 Protection against access to live parts

This clause of Part 1 is applicable.

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 only applicable for **class II charging stations** and machines with an integrated mains operated charger.

11 Heating

This clause of Part 1 is only applicable for **class II charging stations** and machines with an integrated mains operated charger.

12 Void

13 Leakage current and electric strength at operating temperature

This clause of Part 1 is only applicable for **class II charging stations** and machines with an integrated mains operated charger.

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 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.*

15.1.2 Modification:

*Machines or **charging stations** classified as IPX4 shall be rotated during the test along its vertical axis. The rate of rotation shall be $1,2 \pm 0,2$ revolutions per minute.*

15.2 Addition:

Machines or **charging stations** fitted with an appliance inlet or cable coupler shall be tested without the appropriate mating connector in place.

Air filters are not removed.

16 Leakage current and electric strength

This clause of Part 1 is only applicable for **class II** parts of machines or **charging stations**.

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 Modification:

Addition to the first paragraph:

This includes leakage of electrolyte from the battery.

19.7 Modification:

Replacement of last paragraph:

During the test, the temperatures of the windings are not measured but the machine shall not emit flames, molten metal or liquids, or poisonous or ignitable gas in hazardous amounts.

19.9 Modification:

Replacement of last paragraph:

During the test, the temperature of the windings are not measured but the machine shall not emit flames, molten metal or liquids, or poisonous or ignitable gas in hazardous amounts.

19.10 Not applicable.

19.11 Modification:

Addition after last paragraph:

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.

NOTE This sequence of applied failures is also applicable for the test given in Clause 20 and 22 if tests according Clause 19.11.2 are required.

19.11.3 Modification:

Addition after last paragraph:

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.

20 Stability and mechanical hazards

This clause of Part 1 is applicable except as follows:

20.2 Replacement:

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

- a) manually reset; or
- b) the startup procedure as described in Clause 22.110 is completed.

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 Clause 4.2.4.2 and 4.2.4.3 of EN 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 Clauses 20.102.1 and 20.102.4.

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**.

All **guards** shall be permanently attached to the machine and shall not be detachable without the use of **tools**. The opening of **guards** shall require the use of a **tool**. Exceptions to this are the opening of or removing interlocked **guards** which disable the protected moving parts.

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.

Compliance is checked by inspection and measurement

20.101 Controls**20.101.1 Operator presence control**

Manual controllers, if supplied by the manufacturer, 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. For starting rotation of the **cutting means**, the **operator presence control** shall require two separate and dissimilar actions. 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 **manual control** for the **traction drive** shall automatically stop or disengage the **traction drive** when the operator releases the **control**.

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

Compliance is checked by inspection and practical tests.

20.101.2 Remote setting device

If a **remote setting device** is provided it may only be used to carry out “off-machine” adjustments of the settings as well as starting and stopping the normal operation when the machine is operating in automatic mode.

Compliance is checked by inspection and practical test.

20.101.3 Manual controller

If a **manual controller** is supplied by the manufacturer, it shall meet the requirements of Clause 22.107.

If a **remote setting device** is provided, it may not be used for remote manual control of the machine.

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

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 **manual stop** shall have at least 20% of its surface raised at least 5 mm above the immediate surrounding area. The **manual stop** shall have a minimum dimension of 40 mm.

The operating force of the **manual stop** shall not exceed 30 N.

The **manual stop** shall override all other **controls** and cause all moving parts to stop.

Restarting of the mower following a **manual stop** shall only be possible by completing a separate manual action.

Compliance is checked by inspection, practical test and if the compliance relies on the operation of an electronic circuit, the test is repeated under the following conditions applied separately:

- 1) *the fault conditions in a) to g) of Clause 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 compliance during the test of conditions 1) relies on the operation of an electronic circuit, this circuit is considered to be a protective electronic circuit and test 1) is repeated with an additional single fault simulated, as indicated in a) to g) of Clause 19.11.2 applied to the protective electronic circuit. 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.

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.

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**.

Compliance is checked by inspection and 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, measurement and 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 or shall automatically return to the full **guard** position when the **grass catcher** is removed. The **guards** shall be considered as forming part of the **cutting means enclosure**.

Compliance is checked by inspection and practical tests.

20.102.2 Cutting means stopping time

The **cutting means** shall stop from their maximum rotational speed within 2 s if a **tilt sensor**, **lift sensor**, **obstruction sensor** (when activated for more than 3 s according to Clause 22.105.2), or **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.

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), shall not exceed twice of the value given above. Under this condition, a manual operation shall be required to restart the **cutting means**, such a restart shall only be allowed for one attempt.*

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 total **cutting means** stopping time is not monitored by the electronic circuit, the test according to Clause 20.102.2.1 has to 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.

Devices shall be provided to detect:

- *the moment of release of the **cutting means operator presence control**;*
- *the moment of activation of the **obstruction sensor** according to Clause 22.105.2;*
- *the moment of activation of the **tilt sensor**;*
- *the movement of the **cutting means**;*
- *the moment of actuation of the **manual stop**;*
- *the direction and speed of traction wheels or elements;*

- the moment a lifting action is completed.

Stopping time is measured from the moment of actuation of a **sensor** until the last time a **cutting means** passes the sensing device of the test equipment.

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** shall be contacted by a solid object approaching the sensor at the normal speed of travel of the machine when operating under normal conditions;
- for **tilt sensors** – the machine shall be tilted to activate and deactivate the **sensor** in the directions as required in Clause 22.105.1;
- for **lift sensors** – the machine shall be lifted to activate and deactivate the sensor as required in Clause 22.105.3;
- for **manual stops** – the **manual stop** shall be activated.

Individual **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 Clause 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 Clause 20.102.2.2.

20.102.2.2 Cutting Means Stopping Time Test – Method

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 Test – Verification

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 Clause 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.

The projectiles used in the test shall be 6,35 mm diameter balls of hardened steel 45 HRC minimum (e.g. balls used as ball bearings).

*Injection points for the steel balls shall be provided as positioned in Figure BB.2 and located midway along the **cutting means** cutting edge.*

The injection tube outlets shall be fixed and flush with the upper surface of the coconut mat see Annex CC (Figure CC.1) and the system shall be so arranged that the ball may be ejected with variable velocity.

Where necessary, the machine may be elastically restrained to prevent horizontal movement.

*During the tests, the machine shall be operated at **maximum operating motor speed** (as defined by Clause 3.120) and supplied, if possible, by an external power supply having the same characteristics as a fully charged battery.*

*Tests shall be conducted for each **cutting means** assembly.*

The machine shall be tested in all operational configurations (e.g. both with and without attachments and accessories such as grass collectors or mulching parts).

*The **cutting means** shall be adjusted to a 30 mm cut height or the next higher **cutting position** when set on a hard level surface. Machines with a maximum height setting of 30 mm or less shall be set at their maximum height setting.*

Before the test, adjust the velocity with which the ball is ejected so that the ball rises not less than 30 mm above the surface of the coconut matting and within an angle of 10° of the vertical axis. Then with the machine in place, allow balls one at a time into the machine. Increase the velocity of the balls in small

increments until each ball is hit by the machine **cutting means**. Start the test when this minimum velocity is established. Chipped or damaged balls shall be replaced.

Inject 500 steel balls into each injection point for each test. On multi-spindle machines, the test shall be run for each spindle with the results evaluated for each test. A new set of **cutting means** shall be used for each test.

During any of the tests, in the event of excessive hits in a localized area, it may be necessary to repair or replace a target panel before continuing with the tests. Replace the target panels if hits from previous tests leave holes that cannot be covered by a 40 mm square gummed label. Not more than one thickness of gummed labels (patch) shall be placed over any one area.

Balls remaining within the test enclosure (on test surface) may be removed at the option of the tester to minimize ricochet hits. Balls passing over the top of the test enclosure shall be ignored.

Count and record hits on data sheet shown in Annex DD. A test projectile passing completely through all layers of the target material is counted as a hit. Steel balls that hit and damage the centreline of the target area height line shall be scored with the target area below that line.

For each test (500 steel balls), there shall be no hits above the 300 mm line (top elevation area) and not more than two hits in each target panel between the base and the 300 mm line.

The test does not require that the machine shall be suitable for use after test.

In the event of a test failure, two additional machines may be tested both of which shall then pass the test.

20.102.4 Inadvertent access to the cutting means

20.102.4.1 Inadvertent foot access to the cutting means

20.102.4.1.1 General

Inadvertent access to the **cutting means** by the feet during operation shall be prevented, so far as reasonably practicable by the **cutting means enclosure**.

Compliance is checked by the tests of 20.102.4.1.2, 20.102.4.1.3 and 20.102.4.1.4.

The tests are made with the **cutting means** in the most unfavourable **cutting position**. If the **cutting means** path height is different at different **cutting means** speeds, the test is conducted so as to include the extremes of **cutting means** height.

20.102.4.1.2 Adult foot probe test

The machine shall be placed on a hard, flat surface. The **guards** shall be in the normal operating position on the **cutting means enclosure** and the machine support members in contact with the supporting surface. Components of machines, such as wheels and frames, are where relevant considered as part of the **cutting means enclosure** for the purpose of these tests. The tests are conducted under static conditions."

The foot probe of Figure 102 shall be inserted towards the **cutting means** around the machine's external enclosure. The base of the probe is held horizontally at any height and then inclined up to 15° forward or backward from the horizontal (see Figure 102). The probe is applied around the entire machine as described in Figure 102 until a horizontal force of 20 N maximum is reached, or until the machine's enclosure lifts or moves from the original position, or until contact is made with the **cutting means** path, whichever occurs first.

The test probe shall not enter the path of the **cutting means** assembly.

20.102.4.1.3 Foot probe test for standing child

The machine shall be placed on a hard, flat surface. The **guards** shall be in the normal operating position on the **cutting means enclosure** and the machine support members in contact with the supporting surface. Components of machines, such as wheels and frames, are where relevant considered as part of the **cutting means enclosure** for the purpose of these tests. The tests are conducted under static conditions.