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Interested committees:

Title: BS EN IEC 62841-4-12 Electric motor-operated hand-held tools, transportable tools and lawn and garden machinery - Safety

Part 4-12: Particular requirements for robotic lawnmowers

Please notify the secretary if you are aware of any keywords that might assist in classifying or identifying the standard or if the content of this standard

- i) has any issues related to 3rd party IPR, patent or copyright
- ii) affects other national standard(s)
- iii) requires additional national guidance or information

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Introduction

This draft standard is based on national and international discussions. Your comments on this draft are invited and will assist in the preparation of the consequent standard.

For international standards, comments will be reviewed by the relevant UK national committee before sending the consensus UK vote and comments to the international committee, which will then decide appropriate action. If the international standard is approved, it is usual for the text to be published as a British Standard.

For national standards, comments will be reviewed by the relevant UK national committee and the resulting standards published as a British Standard.

UK Vote

Please indicate whether you consider the UK should submit a negative (with supporting technical reasons) or positive vote on this draft. Please indicate if you are aware of any reason why this draft standard should not be published as a British Standard.

Submission of Comments

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Template for comments and secretariat observations

Date: xx/xx/20xx	Document: ISO/DIS xxxx
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1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex (e.g. 3.1)	Paragraph/Figure/ Table/Note	Type of comment	Commend (justification for change) by the MB	Proposed change by the MB	Secretariat observations on each comment submitted
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	



116/866/CD

COMMITTEE DRAFT (CD)

PROJECT NUMBER:
IEC 62841-4-12 ED1

DATE OF CIRCULATION:
2025-01-03

CLOSING DATE FOR COMMENTS:
2025-04-25

SUPERSEDES DOCUMENTS:
116/704/NP, 116/751/RVN

IEC TC 116 : SAFETY OF MOTOR-OPERATED ELECTRIC TOOLS	
SECRETARIAT: United States of America	SECRETARY: Mr Joseph Harding
OF INTEREST TO THE FOLLOWING COMMITTEES:	HORIZONTAL FUNCTION(S):
ASPECTS CONCERNED: Safety	

This document is still under study and subject to change. It should not be used for reference purposes.

Recipients of this document are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

Recipients of this document are invited to submit, with their comments, notification of any local regulations or technical reasons that may exist and should be considered should this proposal proceed, recognizing that failure to address such requirements could result in the need for new or existing "In Some Countries" clauses. (SEE [AC/22/2007](#) OR [NEW GUIDANCE DOC](#)).

TITLE:

Electric motor-operated hand-held tools, transportable tools and lawn and garden machinery - Safety - Part 4-12: Particular requirements for robotic lawnmowers

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CONTENTS

1		
2	FOREWORD	5
3	1 Scope	7
4	2 Normative references	8
5	3 Terms and definitions	9
6	4 General requirements	12
7	5 General conditions for the tests	13
8	6 Radiation, toxicity and similar hazards	13
9	7 Classification	13
10	8 Marking and instructions	13
11	9 Protection against access to live parts	15
12	10 Starting	15
13	11 Input and current	15
14	12 Heating	15
15	13 Resistance to heat and fire	17
16	14 Moisture resistance	17
17	15 Resistance to rusting	19
18	16 Overload protection of transformers and associated circuits	19
19	17 Endurance	19
20	18 Abnormal operation	19
21	19 Mechanical hazards	19
22	20 Mechanical strength	20
23	21 Construction	20
24	22 Internal wiring	20
25	23 Components	21
26	24 Supply connection and external flexible cords	21
27	25 Terminals for external conductors	21
28	26 Provision for earthing	21
29	27 Screws and connections	21
30	28 Creepage distances, clearances and distances through insulation	21
31	Annexes	26
32	Annex I (informative) Measurement of noise and vibration emissions	26
33	Annex K (normative) Battery tools and battery packs	32
34	Annex L (normative) Battery tools and battery packs provided with mains connection	
35	or non-isolated sources	84
36	Annex AA (normative) Product safety labels	85
37	Annex BB (normative) Test enclosure construction	89
38	Annex CC (normative) Base for thrown object test enclosure	94
39	Annex DD (normative) Target panel elevation zones and recommended test report for	
40	thrown object test	96
41	Annex EE (informative) Example of a material and construction for fulfilling the	
42	requirements for an artificial surface	98
43	Annex FF (normative) Calculation of kinetic energy of cutting elements	100

44	Annex GG (informative) Operation of the lift sensor, tilt sensor, obstruction sensor and	
45	rollover sensor.....	102
46	Bibliography.....	106
47		
48	Figure I.101 – Microphone positions on the hemisphere (see Table I.101)	26
49	Figure K.301 – Example of test cycles	44
50	Figure K.302 – Foot probe test	49
51	Figure K.303 – Foot probe for standing child.....	51
52	Figure K.304 – Foot probe for kneeling child.....	53
53	Figure K.305 – Foot probe for kneeling child test positions	55
54	Figure K.306 – Test probe for the hand probe test	57
55	Figure K.307 – Finger probe test – Illustrations showing application of probe, insertion	
56	depth limited according to the geometry of the enclosure.....	59
57	Figure K.308 – Cutting means impact test - Rod position for machines, using freely	
58	pivoting cutting means on a generally circular disc.....	63
59	Figure K.309 – Obstruction sensor test – Illustration showing typical arrangement.....	71
60	Figure K.310 – Measurement of clearances relied upon for protection against electric	
61	shock.....	81
62	Figure AA.1 – Product safety label illustrating – "WARNING – Beware of thrown	
63	objects - keep away from the machine when operating"	85
64	Figure AA.2 – Product safety label illustrating – "WARNING – Do not ride on the	
65	machine.....	86
66	Figure AA.3 – Product safety labels illustrating – "WARNING – Keep hands and feet	
67	away from the blades".....	86
68	Figure AA.4 – Product safety labels illustrating – "WARNING – Activate the manual	
69	stop before maintenance"	87
70	Figure AA.5 – Product safety labels illustrating – "WARNING – Disconnect battery	
71	before maintenance".....	88
72	Figure BB.1 – Thrown object test enclosure – General layout	90
73	Figure BB.2 – Thrown object test enclosure	91
74	Figure BB.3 – Test enclosure walls and base.....	92
75	Figure BB.4 – Test fixture for corrugated fibreboard penetration test	93
76	Figure CC.1 – Thrown object test enclosure – Base detail	94
77	Figure CC.2 – Nail plan of test enclosure base	95
78	Figure DD.1 – Recommended test data sheet.....	97
79	Figure EE.1 – Sketch of the measurement surface covered with an artificial surface.....	99
80	Figure FF.1 – Measurement of the reckonable length L	101
81	Figure GG.1 – Operation of a lift sensor and a tilt sensor.....	103
82	Figure GG.2 – Operation of an obstruction sensor	104
83	Figure GG.3 – Operation of a rollover sensor.....	105
84		
85	Table 12 – Minimum creepage distances and clearances.....	23
86	Table I.101 – Co-ordinates of microphone positions.....	29
87	Table I.102 – Values of the constant a	29
88	Table I.103 – Absorption coefficients	29
89	Table K.301 – Artificial source characteristics.....	33
90	Table 4 – Required performance levels	41

91	Table K.302 – Pull and torque value	75
92	Table K.303 – Minimum creepage distances and clearances between parts of different	
93	potential.....	78
94	Table K.304 – IEC 60664-3:2016 test parameters	79
95	Table K.305 – Minimum total sum of creepage distances and clearances to accessible	
96	surfaces.....	82
97		
98		

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**ELECTRIC MOTOR-OPERATED HAND-HELD TOOLS,
TRANSPORTABLE TOOLS AND LAWN AND GARDEN
MACHINERY – SAFETY –****Part 4-12: Particular requirements for robotic lawnmowers**

FOREWORD

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IEC 62841-4-12 has been prepared by IEC technical committee 116: Safety of motor-operated electric tools. It is an International Standard.

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

Draft	Report on voting
116/xxx/FDIS	116/xxx/RVD

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

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

This document is to be used in conjunction with the first edition of IEC 62841-1 (2014).

This document supplements or modifies the corresponding clauses in IEC 62841-1, so as to convert it into the IEC Standard: Particular requirements for robotic lawnmowers.

Where a particular subclause of IEC 62841-1 is not mentioned in this document, that subclause applies as far as reasonable. Where this document states "addition", "modification" or "replacement", the relevant text in IEC 62841-1 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, tables and figures which are additional to those in IEC 62841-1:2014 as well as Annexes of IEC 62841-1:2014, except as described for Annex K below, are numbered starting from 101.

Subclauses, notes, tables and figures in Annex K which are additional to those in the main body of this document are numbered starting from 301.

A list of all parts in the IEC 62841 series, published under the general title *Electric motor-operated hand-held tools, transportable tools and lawn and garden machinery – Safety*, can be found on the IEC website.

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

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

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

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.

ELECTRIC MOTOR-OPERATED HAND-HELD TOOLS, TRANSPORTABLE TOOLS AND LAWN AND GARDEN MACHINERY – SAFETY –

Part 4-12: Particular requirements for robotic lawnmowers

1 Scope

Replacement:

This International Standard deals with the safety of

- electric motor-operated or magnetically driven rechargeable battery-powered rotary **robotic lawnmowers**;
- their **batteries**; and
- their **peripherals**.

Robotic lawnmowers are also referred to as “machines” in this document.

The maximum **rated voltage** for machines and their **battery** packs is 250 V d.c.

The **rated voltage** for **peripherals** is not more than

- 250 V single-phase a.c. or d.c.; and
- 480 V for three-phase a.c.

The **rated input** for mains-powered **peripherals** is not more than 3 700 W.

Robotic lawnmowers and battery-powered **peripherals** are not considered to be **class I tools**, **class II tools**, or **class III tools** and therefore are not required to have **basic insulation**, **supplementary insulation** or **reinforced insulation**. Electric shock hazard is considered to exist only between parts of different potential.

This document deals with the hazards presented by machines and **peripherals** which are encountered by all persons in the **normal use** and reasonably foreseeable misuse of the machines and **peripherals**.

When evaluating a rechargeable **battery** pack for protection against electric shock during charging, **creepage distances**, **clearances** and distances through insulation, the relevant requirements of this document are applicable with the **battery** pack fitted to the intended **charger**.

Since rechargeable **battery** packs for machines and **peripherals** are submitted to different use patterns (such as rough use, high charging and discharging currents) their safety can be evaluated only by this document and not by using other standards for rechargeable **battery** packs, such as IEC 62133-1:2017 or IEC 62133-2:2017, unless otherwise indicated in this document. All relevant aspects related to the safety of rechargeable **batteries** are addressed in this document, such that the requirements of IEC 62133-1:2017 or IEC 62133-2:2017 need not be separately applied.

When evaluating the risk of **fire** associated with rechargeable **battery** packs for machines and **peripherals**, consideration has been given to the fact that these **battery** packs are unattended energy sources and have been evaluated as such in this document. Requirements in other standards regarding the risk of **fire** due to the charging of these **battery** packs are therefore considered to be fulfilled.

This document also addresses requirements covering the use of lithium-ion **cells** employed in **battery systems** in **robotic lawnmowers** and **battery-powered peripherals**. The following is considered within the context of these requirements:

- These requirements address the risk of **fire** or **explosion** of these **batteries** and not any possible hazards associated with toxicity nor potential hazards associated with transportation or disposal.

NOTE 1 IEC 62281:2019 covers the safety aspects of lithium-ion **batteries** during transport.

- **Battery systems** covered by these requirements are not intended to be serviced by the end user.
- These requirements are intended to provide comprehensive evaluation of a **battery** only if used in products covered by this document.
- These requirements address the safety of **lithium-ion battery systems** during storage and use including discharge and charge. These requirements are only considered to be supplementary requirements in regards to battery **charger** fire and electric shock.
- These requirements refer to and require parameters supplied in reference to the **cells** that establish conditions for safe use of those **cells**. Those parameters form the basis of acceptance criteria for a number of tests contained herein. This document does not independently evaluate the safety of **cells**. These parameters, taken as a set, constitute the “**Specified Operating Region**” for a **cell**. There may be several sets of **specified operating region(s)**.

This document does not apply to **robotic lawnmowers** using **general purpose batteries** installed by the user and this document alone will not be sufficient to ensure all hazards are considered for these products.

This document does not apply to **battery-powered peripherals** powered by rechargeable **general purpose batteries**.

This document does not apply to the safety of battery **chargers** themselves.

NOTE 2 IEC 60335-2-29 covers a variety of **chargers**.

This document does not apply to machines with a provision for a person to ride on the machine for any purpose.

2 Normative references

IEC 62841-1:2014, Clause 2 is applicable, except as follows:

Addition:

IEC 60112:2020, *Method for the determination of the proof and the comparative tracking indices of solid insulating materials*

IEC 60664-3:2016, *Insulation coordination for equipment within low-voltage systems – Part 3: Use of coating, potting or moulding for protection against pollution*

IEC 60664-4:2005, *Insulation coordination for equipment within low-voltage systems – Part 4: Consideration of high-frequency voltage stress*

IEC 61672-1:2013, *Electroacoustics – Sound level meters – Part 1: Specifications*

IEC 62841-1:2014, *Electric motor-operated hand-held tools, transportable tools and lawn and garden machinery – Safety – Part 1: General requirements*

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

271 ISO 5395-1:2013, *Garden equipment – Safety requirements for combustion-engine-powered*
272 *lawnmowers – Part 1: Terminology and common tests*
273 ISO 5395-1:2013/AMD1:2017

274 ISO 5395-2:2013, *Garden equipment – Safety requirements for combustion-engine-powered*
275 *lawnmowers – Part 2: Pedestrian-controlled lawnmowers*

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

277 ISO 9773:2024, *Plastics – Determination of burning behaviour of thin flexible vertical specimens*
278 *in contact with a small flame ignition source*

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

281 *Replacement:*

282 IEC 60695-2-11:2021, *Fire hazard testing – Part 2-11: Glowing/hot-wire based test methods –*
283 *Glow-wire flammability test method for end-products*

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

287 **3 Terms and definitions**

288 IEC 62841-1:2014, Clause 3 is applicable, except as follows:

289 *Addition:*

290 **3.101**

291 **automatic mode**

292 autonomous operation of the machine in which all safety functions are ensured in its **working**
293 **area** without the use of a **manual controller**

294 NOTE 101 to entry: Operation of the machine without the use of a **manual controller** and without the **cutting**
295 **means** operating during set up of the **working area** is not considered to be operation in **automatic mode**.

296 **3.102**

297 **charging station**

298 automatic **battery** charging facility

299 **3.103**

300 **class II peripheral**

301 **peripheral** in which protection against electric shock does not rely on **basic insulation** only,
302 but in which additional safety precautions, such as **double insulation** or **reinforced insulation**,
303 are provided, there being no provision for protective earthing or reliance upon installation
304 conditions

305 **3.104**

306 **class III peripheral**

307 **peripheral** in which protection against electric shock relies on supply at **safety extra-low**
308 **voltage**, and in which voltages higher than those of **safety extra-low voltages** are not
309 generated

3.105**cutting means**

rotating mechanism or rotating part of the **lawnmower** that is designed to perform the cutting action, in which the **cutting means**, cutting by impact, rotate about an axis (axes) normal to the cutting plane

NOTE 101 to entry: The term “blade” can be used in warnings and instructions to denote “**cutting means**”.

3.106**cutting means enclosure**

part or assembly, including the **discharge chute** and **guard** for **grass catcher** opening, designed to prevent unintended contact with the **cutting means**

3.107**cutting means tip circle**

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

3.108**cutting position**

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

3.109**discharge chute**

portion of the **cutting means enclosure**, extending outward from the **discharge opening**, designed to control the ejection of material from the **cutting means**

3.110**discharge opening**

opening in the **cutting means enclosure** through which material such as grass clippings can be discharged

3.111**functional earth**

earthing of a point in equipment or in a system, which is necessary for a purpose other than safety

Note 101 to entry: Examples of the purpose of a **functional earth** include the reduction of the build-up of static electricity and the reduction of electromagnetic emissions.

3.112**grass catcher**

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

3.113**lawnmower**

lawn cutting machine, where the **cutting means** cuts approximately parallel to the ground and which uses the ground to determine the **cutting height** by means of wheels or skids, etc.

3.114**lithium-ion battery system**

combination of a lithium-ion **battery**, the **charging system**, the machine and/or **peripheral(s)** and the interfaces between them as existing during operation of the machine and/or **peripheral(s)** or during charging

3.115**manual controller**

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

357 NOTE 101 to entry: A device not provided by the manufacturer, such as a smartphone or tablet, is not considered
358 to be a **manual controller**.

359 **3.116**
360 **manual mode**
361 manual control of the machine by use of a **manual controller**

362 **3.117**
363 **manual stop**
364 manually actuated device using software-based or hardware-based components that brings the
365 **traction drive** and **cutting means** to a stop

366 **3.118**
367 **maximum speed**
368 highest steady-state **cutting means** speed attainable under all conditions of **normal use**,
369 including no-load, when adjusted in accordance with the manufacturer's specifications and/or
370 instructions

371 Note 101 to entry: The steady-state **cutting means** speed excludes transients such as overshoot that may occur
372 before attaining a steady-state condition.

373 **3.119**
374 **operator control**
375 device requiring operator actuation to perform specific functions during **normal operation**

376 Note 101 to entry: This includes **controls** on a **manual controller**.

377 **3.120**
378 **operator presence control**
379 **control** on a manual controller designed so that it will automatically interrupt the **cutting means**
380 when the operator's actuating force is removed

381 **3.121**
382 **perimeter delimiter**
383 device(s) that defines the perimeter of the **working area** within which the machine can operate
384 automatically

385 Note 101 to entry: An example of a **perimeter delimiter** is a boundary wire that emits a signal to indicate the limit
386 of the **working area**.

387 Note 102 to entry: Devices that function as a reference for determining the machine position within a virtual map,
388 such as satellites, are not considered to be **perimeter delimiters**.

389 **3.122**
390 **peripheral**
391 equipment additional to the machine itself that is provided by the manufacturer for **normal use**
392 of the machine, e.g. charging station(s), manual controller, signal source for **perimeter**
393 **delimiter**

394 **3.123**
395 **remote setting device**
396 setting device, such as a smartphone or tablet, which is not connected by wire to the machine
397 and designed to set the basic functions of the machine

398 Note 101 to entry: A **remote setting device** is not a **manual controller**.

399 **3.124**
400 **robotic lawnmower**
401 unattended **lawnmower** that operates automatically

402 Note 101 to entry: When the term 'machine' is used in the text of this standard, it is used to denote a **robotic**
403 **lawnmower**.

3.125**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

3.125.1**lift sensor**

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

3.125.2**obstruction sensor**

device that senses a person or obstruction using either physical contact or non-contact means

3.125.3**rollover sensor**

device that senses when the machine is inverted

3.125.4**tilt sensor**

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

3.126**setup device**

setting device, such as a smartphone or tablet, which is designed to set the **working area** and basic settings of the machine as well as moving it in **setup mode**

3.127**setup mode**

mode of the machine for defining the **working area** parameters

3.128**stopping time**

time elapsed between the instant when a stop command occurs and the instant at which the machine or component comes to a stop

3.129**switched circuit**

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

Note 101 to entry: The requirements for a low-power circuit are given in IEC 62841-1:2014, Annex H.

3.130**traction drive**

means (system) used to transmit power to the ground drives means

3.131**working area**

any defined area in which the machine can function automatically

4 General requirements

IEC 62841-1:2014, Clause 4 is applicable, except as follows:

Addition:

All requirements for tools in the main body of this document are also applicable for mains powered **peripherals**, unless otherwise specified.

447 NOTE 101 A supervisory function in accordance with the Regulation (EU) 2023/1230 is not relevant, since the safety
448 of **robotic lawnmowers** does not depend on remote operation

449 5 General conditions for the tests

450 IEC 62841-1:2014, Clause 5 is applicable, except as follows:

451 **5.101** *The general test conditions specified in IEC 62841-1:2014, Clause 5, are also*
452 *applicable for mains-powered peripherals.*

453 6 Radiation, toxicity and similar hazards

454 IEC 62841-1:2014, Clause 6 is applicable.

455 7 Classification

456 IEC 62841-1:2014, Clause 7 is

- 457 – not applicable for **robotic lawnmowers**, non-mains powered **peripherals**, **setup devices**
458 and **remote setting devices**; and
 - 459 – applicable for mains-powered **peripherals**;
- 460 except as follows:

461 NOTE 101 Classification requirements for **robotic lawnmowers**, **battery-powered peripherals** and **remote setting**
462 **devices** are specified in Clause K.7.

463 7.1 Replacement:

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

465 NOTE 101 Machines and non-mains-powered **peripherals** covered by this document are limited to those where the
466 only power source is a **battery** and are therefore considered not to be a **class I tool** (machine), **class II tool**
467 (machine) or a **class III tool** (machine) and are not required to have **basic insulation**, **supplementary insulation**
468 or **reinforced insulation**. Electric shock hazard is considered to exist only between parts of different potential where
469 **hazardous voltage** is present.

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

- 472 – **class II peripheral**; or
- 473 – **class III peripheral**.

474 *Compliance is checked by inspection and by the relevant tests of IEC 62841-1:2014 for*

- 475 – **class II tools for class II peripherals**; and
- 476 – **class III tools for class III peripherals**.

477 7.2 Addition:

478 Enclosures of **charging stations** and other **peripherals** intended to be installed outdoors (e.g.
479 a signal source for a **perimeter delimiter**) shall be at least IPX4.

480 8 Marking and instructions

481 IEC 62841-1:2014, Clause 8 is

- 482 – not applicable for **robotic lawnmowers**, non-mains powered **peripherals**, **setup devices**
483 and **remote setting devices**; and

484 — applicable for mains-powered **peripherals**;

485 except as follows:

486 NOTE 101 Marking and instructions requirements for **robotic lawnmowers**, **battery-powered peripherals** and
487 **remote setting devices** are specified in Clause K.8.

488 **8.1 Addition:**

489 — the symbol IEC 60417-5018 (2011-07), for mains-powered **peripherals** incorporating a
490 **functional earth** only. **Class II peripherals** incorporating a **functional earth** may
491 alternatively be marked with the symbol IEC 60417-6092 (2013-03).

492 NOTE 101 In the United States of America, the addition above is not applicable.

493 **8.14** This subclause of IEC 62841-1:2014 is not applicable.

494 NOTE 101 Instruction manual requirements for mains-powered **peripherals** are covered in K.8.14.

495 **8.14.1** This subclause of IEC 62841-1:2014 is not applicable.

496 **8.14.1.1 to 8.14.1.3** These subclauses of IEC 62841-1:2014 are not applicable.

497 **8.14.2** This subclause of IEC 62841-1:2014 is not applicable.

498 **8.14.3** This subclause of IEC 62841-1:2014 is not applicable.

499 **8.14.1.101 Mains-powered peripheral safety warnings**

500  **WARNING** Read all safety warnings, instructions, illustrations and specifications
501 **provided with this product.** *Failure to follow all instructions listed below may result in electric*
502 *shock, fire and/or serious injury.*

503 **Save all warnings and instructions for future reference.**

504 a) **Do not operate devices in explosive atmospheres, such as in the presence of**
505 **flammable liquids, gases or dust.** *Devices create sparks which may ignite the dust or*
506 *fumes.*

507 NOTE 101 The term "devices" in item a) above can be replaced by appropriate terms for mains-powered
508 **peripherals.**

509 b) **Mains plugs must match the outlet. Never modify the plug in any way. Do not use**
510 **any adapter plugs with earthed (grounded) devices.** *Unmodified plugs and matching*
511 *outlets will reduce risk of electric shock.*

512 c) **Avoid body contact with earthed or grounded surfaces, such as pipes, radiators,**
513 **ranges and refrigerators.** *There is an increased risk of electric shock if your body is*
514 *earthed or grounded.*

515 d) **Do not abuse power cords. Never use the power cord for carrying, pulling or**
516 **unplugging a device. Keep power cords away from heat, oil, sharp edges or**
517 **moving parts.** *Damaged or entangled power cords increase the risk of electric shock.*

518 e) **If operating a mains-powered device in a damp location is unavoidable, use a**
519 **residual current device (RCD) protected supply.** *Use of an RCD reduces the risk of*
520 *electric shock.*

521 NOTE 102 The term "residual current device (RCD)" in item e) above can be replaced by the term "ground
522 fault circuit interrupter (GFCI)" or "earth leakage circuit breaker (ELCB)".

523 NOTE 103 The term "device" in item e) above can be replaced by an appropriate term for a mains-powered
524 **peripheral.**

525 f) **Have your device serviced by a qualified repair person using only identical**
526 **replacement parts.** *This will ensure that the safety of the device is maintained.*

527 NOTE 104 The term "device" in item f) above can be replaced by an appropriate term for a mains-powered
528 **peripheral**.

529 **9 Protection against access to live parts**

530 IEC 62841-1:2014, Clause 9 is

- 531 – not applicable for **robotic lawnmowers, manual controllers, setup devices and remote**
532 **setting devices**; and
- 533 – applicable for mains powered **peripherals**.

534 NOTE 101 Protection against electric shock requirements for **robotic lawnmowers, battery-powered peripherals**
535 **and remote setting devices** are specified in Clause K.9.

536 **10 Starting**

537 IEC 62841-1:2014, Clause 10 is not applicable.

538 **11 Input and current**

539 IEC 62841-1:2014, Clause 11 is

- 540 – not applicable for **robotic lawnmowers, non-mains powered peripherals, setup devices**
541 **and remote setting devices**; and
- 542 – applicable for mains-powered **peripherals**.

543 NOTE 101 Input and current requirements for **robotic lawnmowers, battery-powered peripherals and remote**
544 **setting devices** are specified in Clause K.11.

545 **12 Heating**

546 IEC 62841-1:2014, Clause 12 is

- 547 – not applicable for **robotic lawnmowers, non-mains powered peripherals, setup devices**
548 **and remote setting devices**; and
- 549 – applicable for mains-powered **peripherals**;

550 except as follows:

551 NOTE 101 Heating requirements for **robotic lawnmowers, battery-powered peripherals and remote setting**
552 **devices** are specified in Clause K.12.

553 **12.101** Mains-powered **peripherals** shall not attain excessive temperatures in **normal use**.

554 *Compliance is checked by determining the temperature rise of the various parts under the*
555 *conditions specified in 12.102 to 12.106.*

556 **12.102** *Mains-powered peripherals are placed in a test corner as follows:*

- 557 – *mains-powered peripherals normally placed on a floor or table in use are placed on the*
558 *floor as near to the walls as possible;*
- 559 – *mains-powered peripherals normally fixed to a wall are fixed to one of the walls, as near to*
560 *the other wall and floor or ceiling as is likely to occur, taking into account the instructions;*
- 561 – *mains-powered peripherals normally fixed to a ceiling are fixed to the ceiling as near to the*
562 *walls as is likely to occur, taking into account the instructions.*

563 *Dull black-painted plywood approximately 20 mm thick is used for the test corner.*

For mains-powered **peripherals** provided with an automatic cord reel, one-third of the total length of the cord is unreeled. The temperature rise of the cord sheath is determined as near as possible to the hub of the reel and also between the two outermost layers of the cord on the reel.

For cord storage devices, other than automatic cord reels, which are intended to accommodate the **supply cord** partially while the mains-powered **peripheral** is in operation, 50 cm of the cord is unwound. The temperature rise of the stored part of the cord is determined at the most unfavourable place.

12.103 Temperature rises, other than those of windings, are determined by means of thermocouples having a diameter not exceeding 0,3 mm positioned so that they have minimum effect on the temperature of the part under test.

If it is necessary to dismantle the mains-powered **peripheral** to position thermocouples, verify that the mains-powered **peripheral** has been correctly reassembled. In case of doubt, remeasure the power input or input current as appropriate.

The temperature rise of electrical insulation, other than that of windings, is determined on the surface of the insulation at places where failure could cause

- a short circuit;
- contact between **live parts** and **accessible parts**;
- bridging of insulation; or
- a reduction of **clearances** or **creepage distances** below the values specified in Clause 28.

Temperature rises of windings are determined by the resistance method unless the windings are non-uniform or if it is difficult to make the necessary connections, in which case the temperature rise is determined by means of thermocouples. At the beginning of the test, the windings are to be at ambient temperature.

The temperature rise of a winding is calculated from the formula:

$$\Delta t = \frac{R_2 - R_1}{R_1} (k + t_1) - (t_2 - t_1)$$

where

Δt is the temperature rise of the winding;

R_1 is the resistance at the beginning of the test;

R_2 is the resistance at the end of the test;

k is equal to

- 225 for aluminium windings and copper/aluminium windings with an aluminium content ≥ 85 %,
- 229,75 for copper/aluminium windings with an copper content > 15 % to < 85 %,
- 234,5 for copper windings and copper/aluminium windings with an copper content ≥ 85 %;

t_1 is the room temperature at the beginning of the test;

t_2 is the room temperature at the end of the test.

NOTE 101 The resistance of windings at the end of the test can be determined by taking resistance measurements as soon as possible after switching off and then at short intervals so that a curve of resistance against time can be plotted for ascertaining the resistance at the instant of switching off.

12.104 Mains-powered **peripherals** are operated under **normal operation** and supplied with the most unfavourable voltage between 0,94 times and 1,06 times the **rated voltage**.

12.105 The mains-powered **peripheral** is operated for a duration corresponding to the most unfavourable conditions of **normal use**.

Mains-powered **peripheral** outlets accessible to the user and socket-outlets accessible to the user are loaded with a resistive load that gives the rated outlet load.

NOTE 101 The duration of the test can consist of more than one cycle of operation.

12.106 During the test, the temperature rises are monitored continuously and shall not exceed the values shown in IEC 62841-1:2014, Table 1 and Table 2.

Protective devices shall not operate and sealing compound, if any, shall not flow out.

13 Resistance to heat and fire

IEC 62841-1:2014, Clause 13 is

- not applicable for **robotic lawnmowers**, non-mains powered **peripherals**, **setup devices** and **remote setting devices**; and

- applicable for mains-powered **peripherals**;

except as follows:

NOTE 101 Resistance to heat and fire requirements for **robotic lawnmowers**, **battery-powered peripherals** and **remote setting devices** are specified in Clause K.13.

13.101 Mains-powered **peripherals** shall be adequately resistant to ignition and to spread of fire.

Compliance is checked by the following test.

*Non-metallic parts of a mains powered **peripheral** supporting connections that carry a current exceeding 0,2 A and non-metallic parts within a distance of 3 mm of such connections, are subjected to the glow-wire test of IEC 60695-2-11:2021, which is carried out at 850 °C.*

However, the tests are not applicable to:

- *parts supporting welded connections and parts within a distance of 3 mm of these connections;*

- *parts supporting connections in low-power circuits described in IEC 62841-1:2014, Annex H and parts within a distance of 3 mm of these connections;*

- *soldered connections on printed circuits boards and parts within a distance of 3 mm of these connections; and*

- *connections on small components on printed circuit boards, such as diodes, transistors, resistors, inductors, integrated circuits and capacitors, and parts within a distance of 3 mm of these connections.*

14 Moisture resistance

IEC 62841-1:2014, Clause 14 is

- not applicable for **robotic lawnmowers**, non-mains powered **peripherals**, **setup devices** and **remote setting devices**; and

- applicable for mains-powered **peripherals**;

except as follows:

NOTE 101 Moisture resistance requirements for **robotic lawnmowers**, **battery-powered peripherals** and **remote setting devices** are specified in Clause K.14.

14.2 Replacement:

The enclosure of mains-powered **peripherals** shall provide the degree of protection against moisture in accordance with the classification of the mains-powered **peripheral**.

*Compliance is checked by the appropriate treatment specified in 14.2.2, with the mains-powered **peripheral** conditions as in 14.2.1.*

14.2.1 Replacement:

*Mains-powered **peripherals** are not connected to the supply.*

***Detachable parts** which can be removed without the aid of a tool are removed and subjected, if necessary, to the relevant treatment with the main part. Mains-powered **peripherals** fitted with an appliance inlet, plug or other connector are tested without the mating connector in place. Air filters are not removed.*

14.2.2 Replacement:

*Mains-powered **peripherals** other than IPX0 are subjected to tests of IEC 60529:1989, as follows:*

- IPX1 mains-powered **peripherals** are subjected to the test described in IEC 60529:1989, 14.2.1;*
- IPX2 mains-powered **peripherals** are subjected to the test described in IEC 60529:1989, 14.2.2;*
- IPX3 mains-powered **peripherals** are subjected to the test described in IEC 60529:1989, 14.2.3 a);*
- IPX4 mains-powered **peripherals** are subjected to the test described in IEC 60529:1989, 14.2.4 a), except as follows:*
 - the test is conducted with a circular horizontal unperforated support having a diameter of twice the oscillating tube radius minus 15 cm. The support is placed at the level of the pivot axis of the oscillating tube. During the test, the support is rotated about its vertical axis at a rate of $(1 \pm 0,1)$ r/min; and*
 - the mains-powered **peripheral** is placed on the unperforated support; and*
 - the horizontal centreline of the mains-powered **peripheral** is aligned with the pivot axis of the oscillating tube at the start of test. The movement of the oscillating tube is limited to 90° either side from the vertical, the time for one complete oscillation ($2 \times 90^\circ$) being (6 ± 1) s; and*
 - the duration of the test is 10 min.*
- IPX5 mains-powered **peripherals** are subjected to the test described in IEC 60529:1989, 14.2.5. For this test, the water stream is applied from all practicable directions, including the underside of the mains-powered **peripheral**;*
- IPX6 mains-powered **peripherals** are subjected to the test described in IEC 60529:1989, 14.2.6. For this test, the water stream is applied from all practicable directions, including the underside of the mains-powered **peripheral**;*
- IPX7 mains-powered **peripherals** are subjected to the test described in 14.2.7. For this last test, the mains-powered **peripheral** is immersed in water containing approximately 1,0 % NaCl.*

*Immediately after the appropriate treatment, the mains-powered **peripheral** shall withstand the electric strength test of IEC 62841-1:2014, Annex D between **live parts** and **accessible parts**,*

690 *the test voltage being 2 500 V. Afterwards, having carefully wiped the external enclosure to*
691 *remove any surplus water, inspection shall show that there is no trace of water on insulation*
692 *which could result in a reduction of **creepage distances** and **clearances** below the values*
693 *specified in 28.1. Water drops on an appliance inlet, plug or other connector are not considered.*

694 *The mains-powered **peripheral** is then evaluated for the risk of fire in accordance with of 18.6.1,*
695 *item a).*

696 **14.3 to 14.5** Subclauses 14.3 to 14.5 of IEC 62841-1:2014 are not applicable.

697 **15 Resistance to rusting**

698 IEC 62841-1:2014, Clause 15 is applicable, except for **remote setting devices**.

699 **Sec. Note:** Should **setup devices** be not applicable as well?

700 **16 Overload protection of transformers and associated circuits**

701 IEC 62841-1:2014, Clause 16 is

- 702 – not applicable for **robotic lawnmowers**, non-mains powered **peripherals**, **setup devices**
703 and **remote setting devices**; and
- 704 – applicable for mains-powered **peripherals**.

705 NOTE 101 Overload protection of transformers and associated circuits requirements for **robotic lawnmowers**,
706 **battery-powered peripherals** and **remote setting devices** are specified in Clause K.16.

707 **17 Endurance**

708 IEC 62841-1:2014, Clause 17 is not applicable.

709 **18 Abnormal operation**

710 IEC 62841-1:2014, Clause 18 is applicable.

711 **19 Mechanical hazards**

712 IEC 62841-1:2014, Clause 19 is

- 713 – not applicable for **robotic lawnmowers**, non-mains powered **peripherals**, **setup devices**
714 and **remote setting devices**; and
- 715 – applicable for mains-powered **peripherals**;

716 except as follows:

717 NOTE 101 Mechanical hazards requirements for **robotic lawnmowers**, **battery-powered peripherals** and **remote**
718 **setting devices** are specified in Clause K.19.

719 **19.3** Subclause 19.3 of IEC 62841-1:2014 is not applicable.

720 **19.4 Replacement:**

721 Mains-powered **peripherals** shall have adequate grasping surfaces to ensure safe handling
722 during use.

723 *Compliance is checked by inspection.*

724 **19.5 to 19.8** Subclauses 19.5 to 19.8 of IEC 62841-1:2014 are not applicable.

725 **20 Mechanical strength**

726 IEC 62841-1:2014, Clause 20 is

- 727 – not applicable for **robotic lawnmowers**, non-mains powered **peripherals**, **setup devices**
- 728 and **remote setting devices**; and
- 729 – applicable for mains-powered **peripherals**;

730 except as follows:

731 NOTE 101 Mechanical strength requirements for **robotic lawnmowers**, **battery-powered peripherals** and **remote**
732 **setting devices** are specified in Clause K.20.

733 **20.3 Replacement:**

734 For

- 735 – **charging stations**; and
- 736 – other ground supported mains-powered **peripherals**

737 that are classified as a **class II peripheral** in accordance with 7.1, IEC 62841-1:2014, 20.3.2
738 applies.

739 **21 Construction**

740 IEC 62841-1:2014, Clause 21 is applicable, except as follows:

741 **21.17** Subclause 21.17 of IEC 62841-1:2014 is not applicable.

742 **21.17.1** Subclause 21.17.1 of IEC 62841-1:2014 is not applicable.

743 **21.17.1.1 to 21.17.1.3** Subclauses 21.17.1.1 to 21.17.1.3 of IEC 62841-1:2014 are not
744 applicable.

745 **21.18** Subclause 21.18 of IEC 62841-1:2014 is not applicable.

746 **21.18.1** Subclause 21.18.1 of IEC 62841-1:2014 is not applicable.

747 **21.18.1.1 to 21.18.1.2** Subclauses 21.18.1.1 to 21.18.1.2 of IEC 62841-1:2014 are not
748 applicable.

749 **21.18.2** Subclause 21.18.2 of IEC 62841-1:2014 is not applicable.

750 **21.18.2.1 to 21.18.2.4** Subclauses 21.18.2.1 to 21.18.2.4 of IEC 62841-1:2014 are not
751 applicable.

752 **22 Internal wiring**

753 IEC 62841-1:2014, Clause 22 is

- 754 – not applicable for **robotic lawnmowers**, non-mains powered **peripherals**, **setup devices**
- 755 and **remote setting devices**; and
- 756 – applicable for mains-powered **peripherals**.

757 NOTE 101 Internal wiring requirements for **robotic lawnmowers**, **battery-powered peripherals** and **remote**
758 **setting devices** are specified in Clause K.22.

759 **23 Components**

760 IEC 62841-1:2014, Clause 23 is

- 761 – not applicable for **robotic lawnmowers**, non-mains powered **peripherals**, **setup devices**
762 **and remote setting devices**; and
- 763 – applicable for mains-powered **peripherals**, except as follows:.

764 NOTE 101 Components requirements for **robotic lawnmowers**, **battery-powered peripherals** and **remote setting**
765 **devices** are specified in Clause K.23.

766 **23.3** Subclause 23.3 of IEC 62841-1:2014 is not applicable.

767 **24 Supply connection and external flexible cords**

768 IEC 62841-1:2014, Clause 24 is

- 769 – not applicable for **robotic lawnmowers**, non-mains-powered **peripherals**, **manual**
770 **controllers**, **setup devices** and **remote setting devices**; and
- 771 – applicable for mains-powered **peripherals**.

772 NOTE 101 Supply connection and external flexible cords requirements for **robotic lawnmowers**, **battery-powered**
773 **peripherals** and **remote setting devices** are specified in Clause K.24.

774 **25 Terminals for external conductors**

775 IEC 62841-1:2014, Clause 25 is

- 776 – not applicable for **robotic lawnmowers**, non-mains-powered **peripherals**, **manual**
777 **controllers**, **setup devices** and **remote setting devices**; and
- 778 – applicable for mains-powered **peripherals**.

779 NOTE 101 Terminals for external conductors requirements for **robotic lawnmowers**, **battery-powered peripherals**
780 **and remote setting devices** are specified in Clause K.25.

781 **26 Provision for earthing**

782 IEC 62841-1:2014, Clause 26 is

- 783 – not applicable for **robotic lawnmowers**, non-mains-powered **peripherals**, **manual**
784 **controllers**, **setup devices** and **remote setting devices**; and
- 785 – applicable for mains-powered **peripherals**.

786 NOTE 101 Provision for earthing requirements for **robotic lawnmowers**, **battery-powered peripherals** and **remote**
787 **setting devices** are specified in Clause K.26.

788 **27 Screws and connections**

789 IEC 62841-1:2014, Clause 27 is applicable.

790 **28 Creepage distances, clearances and distances through insulation**

791 IEC 62841-1:2014, Clause 28 is replaced as follows:

28.1 For mains-powered **peripherals**, **creepage distances** and **clearances** shall not be less than the values in millimetres shown in Table 12. The values specified in Table 12 do not apply to cross-over points of motor windings.

The values in Table 12 are equal to or larger than the values required by IEC 60664-1, when

- an overvoltage category II;
- a material group III;
- a pollution degree 1 for parts protected against deposition of dirt and for lacquered or enamelled windings;
- a pollution degree 3 for other parts;
- inhomogeneous electric field; and
- transient overvoltages originating in the equipment not exceeding 4 000 V

are applied.

Protection against deposition of dirt may be achieved through the use of

- encapsulation with a minimum thickness of 0,5 mm; or
- protective coatings that prevent the combined deposition of fine particles and moisture on surfaces between conductors. Requirements for these types of protective coatings are described in IEC 60664-3:2016; or
- enclosures that prevent the ingress of dust by means of filters or seals, provided that no dust is generated within the enclosure itself.

NOTE 1 An example of encapsulation is potting.

If a resonance voltage occurs between the point where a winding and a capacitor are connected together, and metal parts which are separated from **live parts** by **basic insulation** only, the **creepage distance** and **clearance** shall not be less than the values specified for the value of the voltage imposed by the resonance, these values being increased by 4 mm in the case of **reinforced insulation**.

Compliance is checked by measurement.

*For mains-powered **peripherals** provided with an appliance inlet, the measurements are made with an appropriate connector inserted. For other machines, they are made on the machine as delivered.*

*For mains-powered **peripherals** provided with belts, the measurements are made with the belts in place, and the devices intended for varying the belt tension adjusted to the most unfavourable position within their range of adjustment, and also with the belts removed.*

Movable parts are placed in the most unfavourable position; nuts and screws with non-circular heads are assumed to be tightened in the most unfavourable position.

*The **clearances** between terminals and accessible metal parts are also measured with the screws or nuts unscrewed as far as possible, but the **clearances** shall then be not less than 50 % of the value shown in Table 12.*

Table 12 – Minimum creepage distances and clearances

Dimensions in millimetres

Distances	Class III mains-powered peripherals		Other mains-powered peripherals					
			Working voltage ≤ 130 V		Working voltage > 130 V and ≤ 280 V		Working voltage > 280 V and ≤ 480 V	
	Creepage distance	Clearance	Creepage distance	Clearance	Creepage distance	Clearance	Creepage distance	Clearance
Between parts of different potential ^a :								
– if lacquered or enamelled windings or if protected against deposition of dirt	1,0	1,0	1,0	1,0	2,0	2,0	2,0	2,0
– if not protected against deposition of dirt	2,0 ^c	1,5	2,0 ^b	1,5	3,0 ^b	2,5	8,0 ^e	3,0
Between live parts and other metal parts over basic insulation :								
– if the live parts are lacquered or enamelled windings ^d or if protected against deposition of dirt	–	–	1,0	1,0	2,0	2,0	2,0	2,0
– if not protected against deposition of dirt	–	–	2,4 ^c	1,5	4,0 ^c	3,0	8,0 ^e	3,0
Between live parts and other metal parts over reinforced insulation :								
– if the live parts are lacquered or enamelled windings or protected against deposition of dirt	–	–	5,0	5,0	6,0	6,0	10,0 ^e	6,0
– for other live parts not protected against deposition of dirt	–	–	5,0	5,0	8,0	8,0	16,0 ^e	8,0
Between metal parts separated by supplementary insulation	–	–	2,5	2,5	4,0	4,0	8,0 ^e	4,0
^a The clearances specified do not apply to the air gap between the contacts of thermal controls, protective devices, switches of micro-gap construction, and the like, or to the air gap between the current-carrying members of such devices where the clearance varies with the movement of the contacts. ^b These creepage distances are slightly lower than suggested by IEC 60664-1. Creepage distances between parts of different potential (functional insulation) are only associated to fire hazard, not to electric shock hazard. As products in the scope of IEC 62841 are products supervised during normal use, lower distances are justified. ^c These creepage distances may be reduced to values in accordance with IEC 60664-1, if the insulation parts are of material group II or lower. ^d Windings are considered to have basic insulation if they are wrapped with tape and then impregnated, or if they are covered with a layer of self-hardening resin, and if, after the test of 14.1, an electric strength test as specified in IEC 62841-1:2014, Clause D.2 is withstood, the test voltage being applied between the conductors of the winding and metal foil in contact with the surface of the insulation. It is sufficient that the wrapping and impregnation, or the layer of self-hardening resin, cover the windings only at places where it is not possible to obtain the creepage distance or clearance specified for lacquered or enamelled windings. ^e These creepage distances are valid for frequencies up to 30 kHz. For higher frequencies, creepage distances shall be in accordance with IEC 60664-4:2005. Creepage distances can be reduced in accordance with IEC 60664-1 if the insulation parts are of material group II or lower and/or for working voltages ≤ 400 V, however they shall not be lower than the values required in the column "Working voltage > 130 V and ≤ 280 V".								

Distances through slots or openings in external parts of insulating material are measured to metal foil in contact with the accessible surface; the foil is pushed into corners and the like by means of the test probe B of IEC 61032:1997, but it is not pressed into openings.

If necessary, a force is applied to any point on internal wiring and bare conductors, other than those of heating elements, to any point on uninsulated metal capillary tubes of **thermostats** and similar devices, and to the outside of metal enclosures, in an endeavour to reduce the **creepage distances** and **clearances** while taking the measurements.

The force is applied by means of the test probe B of IEC 61032:1997, and has a value of:

- 2 N for internal wiring and bare conductors and for uninsulated capillary tubes of **thermostats** and similar devices;
- 30 N for enclosures.

The way in which **creepage distances** and **clearances** are measured is indicated in IEC 62841-1:2014, Annex A.

For mains-powered **peripherals** having parts with **double insulation** where there is no metal between **basic insulation** and **supplementary insulation**, the measurements are made as though a metal foil were present between the two insulations.

Means provided for fixing the machine to a support are considered to be accessible.

Creepage distances and **clearances** within optocouplers are not measured if the individual insulations are adequately sealed, and if air is excluded between individual layers of the material.

For parts of different potential, including conductive patterns on printed circuit boards, except for external mains connection, **creepage distances** and **clearances** smaller than the minimum values specified

- in Table 12; or
 - for conductive patterns on printed circuit boards as specified below
- are allowed, provided
- the requirements of Clause 18 are met if these **creepage distances** and **clearances** are short-circuited in turn; or
 - for **electronic circuits**, such **electronic circuits** comply with 18.6.

For conductive patterns on printed circuit boards, except at their edges, the minimum **creepage distances** and **clearances** in Table 12 between parts of different potential may be reduced, as long as the peak value of the voltage stress does not exceed:

- 150 V per mm with a minimum value of 0,2 mm, if protected against the deposition of dirt;
- 100 V per mm with a minimum value of 0,5 mm, if not protected against the deposition of dirt.

When the limits mentioned above lead to higher values than those of Table 12, the values of Table 12 apply.

NOTE 2 The above values are equal to or larger than the values required by IEC 60664-3:2016.

28.2 For mains-powered **peripherals**, depending on the **working voltage**, the distance through insulation shall be sufficient:

- For **working voltages** up to and including 130 V, the distance through insulation between metal parts shall not be less than 1,0 mm, if they are separated by **supplementary insulation**, and not be less than 1,5 mm, if they are separated by **reinforced insulation**.

875 – For **working voltages** over 130 V, the distance through insulation between metal parts shall
876 not be less than 1,0 mm, if they are separated by **supplementary insulation**, and not be
877 less than 2,0 mm, if they are separated by **reinforced insulation**.

878 – For all **working voltages**, the distance through **reinforced insulation** used between
879 enamelled or lacquered windings and accessible metal shall not be less than 1,0 mm.

880 The required distance through insulation may be achieved through several thicknesses of solid
881 insulation layers that may have intervening air between the layers such that the sum of the
882 thicknesses of the solid insulation equals the required thickness.

883 This requirement does not apply, if either a) or b) is fulfilled.

884 a) The insulation is applied in thin sheet form, other than mica or similar scaly material, and
885 consists:

886 – for **supplementary insulation**, of at least two layers, provided that any one of the layers
887 withstands the electric strength test specified for **supplementary insulation**;

888 – for **reinforced insulation**, of at least three layers, provided that, when any two of the
889 layers are placed in contact, they withstand the electric strength test specified for
890 **reinforced insulation**.

891 The test voltage is applied between the outer surfaces of the layer, or of the two layers, as
892 applicable.

893 b) The **supplementary insulation** or the **reinforced insulation** is inaccessible and meets the
894 following condition:

895 The insulation, after having been conditioned for seven days (168 h) in an oven maintained
896 at a temperature equal to 50 K greater than the maximum temperature rise determined
897 during the test of Clause 12 withstands an electric strength test as specified in Annex D,
898 this test being made on the insulation both at the temperature occurring in the oven, and at
899 approximately room temperature.

900 *Compliance is checked by inspection and by measurement.*

901 *For optocouplers, the conditioning procedure is carried out at a temperature of 50 K in excess*
902 *of the maximum temperature rise measured on the optocoupler during the tests of Clause 12*
903 *and Clause 18, the optocoupler being operated under the most onerous conditions which occur*
904 *during these tests.*

905

Annexes

The annexes of IEC 62841-1:2014 are applicable, except as follows:

Annex I (informative)

Measurement of noise and vibration emissions

NOTE In Europe (EN IEC 62841-4-12), Annex I is normative.

I.2 Noise test code (grade 2)

IEC 62841-1:2014, Clause I.2 is applicable except as follows:

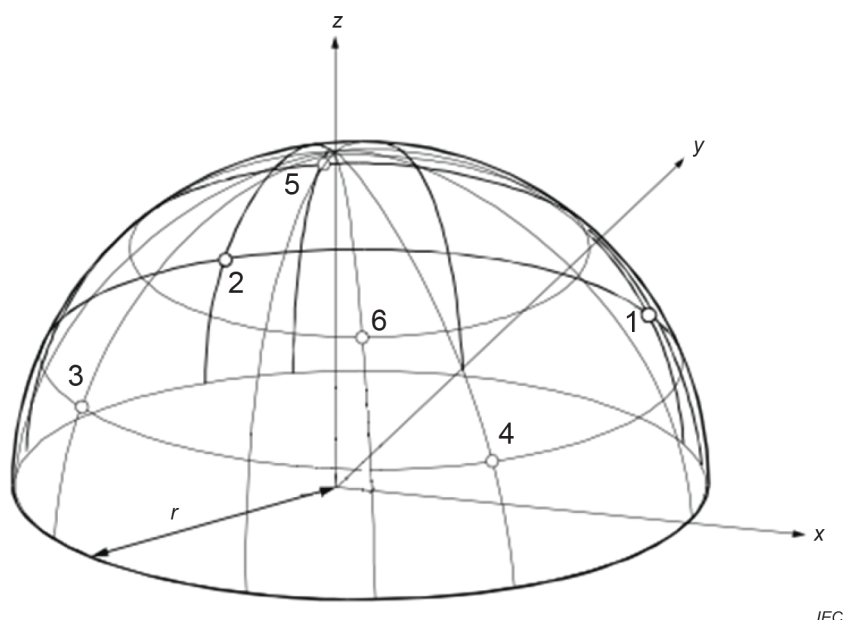
I.2.2 Sound power level determination

I.2.2.1 General

Replacement:

The sound power level shall be measured using a hemispherical measurement surface according to Figure I.101. The acoustic environment, instrumentation, quantities to be measured, quantities to be determined, and the measurement procedure are specified in ISO 3744:2010.

The sound power level shall be given as A-weighted sound power level in dB reference 1 pW. The A-weighted sound pressure levels, from which the sound power is to be determined, shall be measured directly, and not calculated from frequency band data. Measurements shall be made outdoors or indoors in an essentially free field.



Key

r radius of hemisphere

Figure I.101 – Microphone positions on the hemisphere (see Table I.101)

I.2.2.2 Hand-held power tools

Subclause I.2.2.2 of IEC 62841-1:2014 is not applicable.

I.2.2.3 Transportable power tools

Subclause I.2.2.3 of IEC 62841-1:2014 is not applicable.

I.2.2.4 Lawn and garden machinery

Replacement:

The test environment outdoors shall be a flat open space (a slope, if any, not exceeding 5/100), visibly free of sound-reflecting objects (e.g. buildings, trees, poles, sign boards) within a circular area with a radius equal to approximately three times the radius of the hemispherical measurement surface used.

For the determination of sound power level, ISO 3744:2010 shall be used subject to the following modifications:

- the microphone array shall be six microphone positions according to Figure I.101 and Table I.101;
- for outdoor and indoor measurements, the reflecting surface shall be replaced by an artificial surface according to I.2.2.101 or a natural ground surface according to I.2.2.102. Reproducibility of results using natural grass or other organic material is likely to be worse than that required for Grade 2 of accuracy. In case of dispute, measurements shall be carried out in the open air and on the artificial surface according to I.2.2.101;
- the measurement surface shall be a hemisphere with a radius, r , which depends on the **cutting width** of the machine under test and which shall be:
 - $r = 4$ m for machines with a **cutting width** up to 1,2 m; and
 - $r = 10$ m for machines with a **cutting width** exceeding 1,2 m. A smaller radius is permitted if it is demonstrated that the results are within 0,5 dB compared with measurements with a hemisphere of $r = 10$ m;
- for measurements outdoors, $K_{2A} = 0$ dB;
- for measurements outdoors, the environmental conditions shall be within the limits specified by the manufacturers of the measuring equipment. The ambient air temperature shall be in the range from 5 °C to 30 °C and the wind speed shall be less than 5 m/s. A wind screen shall be used whenever the wind speed exceeds 1 m/s;
- for measurements indoors, the environment shall be according to ISO 3744:2010 and the value of K_{2A} , determined without artificial surface and in accordance with ISO 3744:2010, Annex A shall be ≤ 2 dB, in which case K_{2A} shall be disregarded;
- measurements shall be made using an integrating-averaging sound level meter as defined in IEC 61672-1:2013; alternatively, instruments with the time-weighting characteristics "slow", as defined in IEC 61672-1:2013, may be used.

The machine is placed on the surface in such a way that the projection of the geometrical centre of the main parts (excluding **grass catcher**, etc.,) coincides with the origin of the coordinate system of the microphone positions. The longitudinal axis of the machine is aligned with the x-axis.

The measurement is carried out without an operator.

NOTE It is likely that the results from conducting tests using an operator will not achieve Grade 2 accuracy.

The A-weighted sound power level, L_{WA} , in dB, shall be calculated in accordance with ISO 3744:2010, 8.2.5, as follows:

975
$$L_{WA} = \overline{L_{pA}} + 10 \lg \left(\frac{S}{S_0} \right) \text{ dB} \quad (\text{I.101})$$

976 with $\overline{L_{pA}}$ determined from

977
$$\overline{L_{pA}} = 10 \lg \left[\frac{1}{6} \sum_{i=1}^6 10^{0,1 L'_{pA,i}} \right] - K_{1A} - K_{2A} \text{ dB}$$

978 where

$\overline{L_{pA}}$ is the surface time averaged sound pressure level according to ISO 3744:2010, 8.2.4, in dB;

$L'_{pA,i}$ is the A-weighted emission sound pressure level measured at the i^{th} microphone position, in dB;

K_{1A} is the background noise correction, A-weighted;

K_{2A} is the environmental correction, A-weighted, according to the requirements of this noise test code $K_{2A} = 0$ dB;

S is the area of the measurement surface, in m^2 ;

$S_0 = 1 \text{ m}^2$.

979

980 For the hemispherical measurement surface, the area S of the measurement surface is
981 calculated as follows:

982
$$S = 2\pi r^2$$

983 So, from equation (I.101)

984 where the radius of the hemisphere, $r = 4 \text{ m}$

985
$$L_{WA} = \overline{L_{pA}} + 20 \text{ dB}$$

986 where the radius of the hemisphere, $r = 10 \text{ m}$

987
$$L_{WA} = \overline{L_{pA}} + 28 \text{ dB}$$

988 Three consecutive tests shall be carried out and the result of the test L_{WA} shall be the arithmetic
989 mean, rounded to the nearest decibel, of the three tests.

Table I.101 – Co-ordinates of microphone positions

Position No.	x/r^1	y/r^1	z/r	z
1	+0,707 a	+0,707 a	-	1,5 m
2	-0,707 a	+0,707 a	-	1,5 m
3	-0,707 a	-0,707 a	-	1,5 m
4	+0,707 a	-0,707 a	-	1,5 m
5	-0,27	+0,65	0,71	-
6	+0,27	-0,65	0,71	-

¹ The constant a depends on the measurement radius and is taken from Table I.102.

Table I.102 – Values of the constant a

Measurement radius r m	Constant a
4	0,927
10	0,989

If a non-preferred hemisphere radius is used, microphone positions 1 to 4 shall be maintained at a height z of 1,5 m and the value of the constant a shall be determined from

$$a = \frac{\sqrt{r^2 - 1,5^2}}{r}$$

I.2.2.101 Requirements for an artificial surface

The artificial surface shall have absorption coefficients as given in Table I.103, measured in accordance with ISO 354:2003.

Table I.103 – Absorption coefficients

Frequencies Hz	Absorption coefficients	Tolerance
125	0,1	±0,1
250	0,3	±0,1
500	0,5	±0,1
1 000	0,7	±0,1
2 000	0,8	±0,1
4 000	0,9	±0,1

The artificial surface shall be placed on a hard, reflecting surface and have a size of at least 3,6 m × 3,6 m placed at the centre of the test environment. The construction of the supporting structure shall be such that the requirements for the acoustic properties are also met with the absorptive material in place. The structure shall support the weight of an operator during the test and when positioning the machine on the structure and the weight of the machine to avoid compression of the absorbing material.

NOTE 101 See Annex EE for an example of a material and construction which can be expected to fulfil these requirements.

1010 The artificial surface is placed so that the geometrical centre coincides with the origin of the
1011 coordinate system of microphone positions.

1012 **I.2.2.102 Requirements for a natural ground surface**

1013 The test environment, within a circular area with a radius equal to approximately the radius of
1014 the hemispherical measurement surface used, shall be covered with high-quality natural grass.
1015 Before the measurements are taken, the grass shall be cut with a lawnmower to a height of cut
1016 as near as possible to 30 mm. The surface shall be clean of grass clippings and debris and
1017 shall be visibly free of moisture, frost, or snow.

1018 **I.2.3 Emission sound pressure level determination**

1019 Subclause I.2.3 of IEC 62841-1:2014 is applicable, except as follows:

1020 **I.2.3.1 Hand-held tools**

1021 Subclause I.2.3.1 of IEC 62841-1:2014 is not applicable.

1022 **I.2.3.2 Transportable tools**

1023 Subclause I.2.3.2 of IEC 62841-1:2014 is not applicable.

1024 **I.2.3.3 Lawn and garden machinery**

1025 *Replacement:*

1026 The A-weighted emission sound pressure level at the **robotic lawnmower**, L_{pA} , shall be
1027 determined in accordance with ISO 11203:1995 as follows:

$$1028 \quad L_{pA} = L_{WA} - Q \text{ dB}$$

1029 Where $Q = 8 \text{ dB}$.

1030 NOTE This value of Q has been determined, during experimental investigations, to be applicable to **robotic**
1031 **lawnmowers**. The resulting A-weighted emission sound pressure level at the **robotic lawnmowers** is equivalent to
1032 the value of the surface sound pressure level at a distance of 0,7 m from the **robotic lawnmowers**. This distance
1033 has been chosen to give satisfactory reproducibility of results, and to permit comparison of the acoustic performance
1034 of different **robotic lawnmowers**.

1035 **I.2.4 Installation and mounting conditions of the power tools during noise tests**

1036 *Replacement:*

1037 The machine under test shall be a new, normal production machine equipped with **attachments**
1038 which affect the acoustic properties, as specified in 8.14.2. If a **grass catcher** is provided or
1039 available for the machine, it shall be fitted and empty.

1040 If the maximum cutting height of the machine is greater than 30 mm, the cutting height shall be
1041 adjusted to the lowest position provided, but not lower than 30 mm. If the maximum cutting
1042 height of the machine is less than 30 mm, the cutting height shall be adjusted to the highest
1043 position provided. The cutting height shall be adjusted with the machine resting on a hard, flat
1044 surface.

1045 The machine is tested in a stationary position without engaging the **traction drive**. If the
1046 **traction drive** cannot be disengaged, the machine shall be raised on support blocks sufficient
1047 to just ensure ground clearance. The blocks shall be as small as is practicable consistent with
1048 safety during the test and shall be well clear of the **cutting means**.

1049 Noise measurements shall be started with **fully charged batteries** as specified by the
1050 manufacturer but shall not be continued when the **battery** voltage under load drops to lower
1051 than 0,9 times the **battery** voltage under load at the beginning of the measurements for lead-
1052 acid **batteries**, or to lower than 0,8 times for other **batteries**;

1053 The **battery** voltage shall be measured at the **battery** terminals.

1054 During the test, the **cutting means** shall be engaged and unloaded.

1055 The test shall be carried out at the **maximum speed**.

1056 A motor speed indicator shall be used to check the speed of the motor. It shall have an accuracy
1057 of $\pm 2,5\%$ of the reading. The indicator and its engagement with the machine shall not affect
1058 the operation during the test.

1059 **I.2.5 Operating conditions**

1060 *Replacement:*

1061 The machine is operated at **maximum speed** at no-load for at least 1 min before the test is
1062 commenced. The machine is tested with the **cutting means** engaged and at **maximum speed**
1063 at no-load.

1064 Three consecutive tests shall be carried out and the result of the test L_{WA} shall be the arithmetic
1065 mean, rounded to the nearest decibel, of the three tests.

1066 During measurements, the machine shall operate under stable conditions. Once the noise
1067 emission is steady, the measurement time interval shall be at least 15 s. If measurements are
1068 made in octave or one-third octave frequency bands, the minimum period of observation shall
1069 be 30 s for the frequency bands centred on or below 160 Hz, and 15 s for the frequency bands
1070 centred on or above 200 Hz.

1071 NOTE As it is difficult to apply or simulate load to **robotic lawnmowers** in laboratories and test results have shown
1072 that the process noise has no significant influence on the noise results, the measurements are conducted with no
1073 load only.

1074 **I.3 Vibration**

1075 IEC 62841-1:2014, Clause I.3 is not applicable.