UL 62841-2-1

STANDARD FOR SAFETY

Electric Motor-Operated Hand-Held Tools, Transportable Tools and Lawn and Garden Machinery – Safety – Part 2-1: Particular Requirements for Hand-Held Drills and Impact Drills

UL Standard for Safety for Electric Motor-Operated Hand-Held Tools, Transportable Tools and Lawn and Garden Machinery – Safety – Part 2-1: Particular Requirements for Hand-Held Drills and Impact Drills, UL 62841-2-1

First Edition, Dated April 30, 2018

Summary of Topics

This revision of ANSI/UL 62841-2-1 dated January 27, 2023 includes revisions to align with Amendment – IEC 62841-2-1/AMD1 ED1 issued November 2021. Revisions include Clause 1, 8.3, Table 4, 19.6, 19.102.1, 19.102.2, 19.102.3, 19.102.4, 21.18.1.2, Figure 105, Figure 106, Figure 107, I.2.4, I.2.5, Table I.101, Table I.102, Table I.103, I.2.9, I.3, I.3.5.1, I.3.5.3.101, Table I.104, Table I.105, I.3.5.3.102, Table I.106, I.3.5.3.103, Table I.107, Table I.108, Table I.109, I.3.6.1, K.18.8, K.19.102.1, K.19.102.2, K.19.102.3, K.19.102.4, K.21, L.19.102.1, L.21, and the Bibliography.

This standard is an adoption of IEC 62841-2-1, Edition 1 published June 2017. There are no technical national differences for this standard.

Text that has been changed in any manner or impacted by UL's electronic publishing system is marked with a vertical line in the margin.

The new requirements are substantially in accordance with Proposal(s) on this subject dated June 3, 2022.

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First Edition
(IEC 62841-2-1:2017, MOD)

Underwriters Laboratories Inc.
UL 62841-2-1
First Edition

Electric Motor-Operated Hand-Held Tools, Transportable Tools and Lawn and Garden Machinery – Safety – Part 2-1: Particular Requirements for Hand-Held Drills and Impact Drills

April 30, 2018

(Title Page Reprinted: January 27, 2023)

This national standard is based on publication IEC 62841-2-1, First Edition (2017), and IEC Amendment 1 (2021).

ANSI/UL 62841-2-1-2023

Commitment for Amendments

This standard is issued jointly by the Canadian Standards Association (operating as “CSA Group”) and Underwriters Laboratories Inc. (UL). Comments or proposals for revisions on any part of the standard may be submitted to CSA Group or UL at anytime. Revisions to this standard will be made only after processing according to the standards development procedures of CSA Group and UL. CSA Group and UL will issue revisions to this standard by means of a new edition or revised or additional pages bearing their date of issue.

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This Standard is subject to review within five years from the date of publication, and suggestions for its improvement will be referred to the appropriate committee. The technical content of the IEC and ISO publications is kept under constant review by IEC and ISO. To submit a proposal for change, please send the following information to inquiries@csagroup.org and include "Proposal for change" in the subject line: Standard designation (number); relevant clause, table, and/or figure number; wording of the proposed change; and rationale for the change.

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This ANSI/UL Standard for Safety consists of the First Edition including revisions through January 27, 2023. The most recent designation of ANSI/UL 62841-2-1 as an American National Standard (ANSI) occurred on January 27, 2023. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, Title Page (front and back), or the Preface. The National Difference Page and IEC Foreword are also excluded from the ANSI approval of IEC-based standards.

Comments or proposals for revisions on any part of the Standard may be submitted to UL at any time. Proposals should be submitted via a Proposal Request in UL's On-Line Collaborative Standards Development System (CSDS) at https://csds.ul.com.

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Preface

This is the harmonized CSA Group and UL Standard for Electric Motor-Operated Hand-Held Tools, Transportable Tools And Lawn And Garden Machinery – Safety – Part 2-1: Particular Requirements For Hand-Held Drills and Impact Drills. It is the First edition of CAN/CSA-C22.2 No. 62841-2-1 and the First edition of UL 62841-2-1. This harmonized standard has been jointly revised on January 27, 2023. For this purpose, CSA Group and UL are issuing revision pages dated January 27, 2023.

This harmonized standard is based on IEC Publication 62841-2-1: First edition Electric Motor-Operated Hand-Held Tools, Transportable Tools And Lawn And Garden Machinery – Safety – Part 2-1: Particular Requirements For Hand-Held Drills and Impact Drills, issued June 2017, as revised by Amendment No. 1 issued November 2021. IEC 62841-2-1 is copyrighted by the IEC.

This harmonized standard was prepared by CSA Group and Underwriters Laboratories Inc. (UL). The efforts and support of the International Harmonization Committee (IHC) for the adoption of the IEC series of standards for Hand-Held, Motor-Operated, and Transportable Tools and Lawn and Garden Machinery UL are gratefully acknowledged.

This standard is considered suitable for use for conformity assessment within the stated scope of the standard.

This standard was reviewed by the CSA Subcommittee on Safety of Hand-Held Motor-Operated Electric Tools, under the jurisdiction of the CSA Technical Committee on Consumer and Commercial Products and the CSA Strategic Steering Committee on Requirements for Electrical Safety, and has been formally approved by the CSA Technical Committee. This standard has been developed in compliance with Standards Council of Canada requirements for National Standards of Canada. It has been published as a National Standard of Canada by CSA Group.

Application of Standard

Where reference is made to a specific number of samples to be tested, the specified number is to be considered a minimum quantity.

Note: Although the intended primary application of this standard is stated in its scope, it is important to note that it remains the responsibility of the users of the standard to judge its suitability for their particular purpose.

CAN/CSA-C22.2 No. 62841-2-1 is to be used in conjunction with the First edition of CAN/CSA-C22.2 No. 62841-1. The requirements for hand-held drills and impact drills are contained in this Part 2 Standard and CAN/CSA-C22.2 No. 62841-1. Requirements of this Part 2 Standard, where stated, amend the requirements of CAN/CSA-C22.2 No. 62841-1. Where a particular subclause of CAN/CSA-C22.2 No. 62841-1 is not mentioned in CAN/CSA-C22.2 No. 62841-2-1, the CAN/CSA-C22.2 No. 62841-1 subclause applies.

This UL 62841-2-1 is to be used in conjunction with the First edition of UL 62841-1. The requirements for hand-held drills and impact drills are contained in this Part 2 Standard and UL 62841-1. Requirements of this Part 2 Standard, where stated, amend the requirements of UL 62841-1. Where a particular subclause of UL 62841-1 is not mentioned in UL 62841-2-1, the UL 62841-1 subclause applies.

Level of harmonization

This standard adopts the IEC text with editorial national differences.

This standard is published as an equivalent standard for CSA Group and UL.

An equivalent standard is a standard that is substantially the same in technical content, except as follows: Technical national differences are allowed for codes and governmental regulations as well as those recognized as being in accordance with NAFTA Article 905, for example, because of fundamental climatic, geographical, technological, or infrastructural factors, scientific justification, or the level of protection that the country considers appropriate. Presentation is word for word except for editorial changes.

All national differences from the IEC text are included in the CSA Group and UL versions of the standard. While the technical content is the same in each organization's version, the format and presentation may differ.

Reasons for Differences From IEC

National differences from the IEC are being added in order to address safety and regulatory situations present in the US and Canada.

Interpretations

The interpretation by the standards development organization of an identical or equivalent standard is based on the literal text to determine compliance with the standard in accordance with the procedural rules of the standards development organization. If more than one interpretation of the literal text has been identified, a revision is to be proposed as soon as possible to each of the standards development organizations to more accurately reflect the intent.

IEC Copyright

For CSA Group, the text, figures, and tables of International Electrotechnical Commission Publication IEC 62841-2-1 Electric Motor-Operated Hand-Held Tools, Transportable Tools And Lawn And Garden Machinery – Safety – Part 2-1: Particular Requirements For Hand-Held Drills and Impact Drills, copyright 2017, are used in this standard with the consent of the International Electrotechnical Commission. The IEC Foreword is not a part of the requirements of this standard but is included for information purposes only.

NATIONAL DIFFERENCES

National Differences from the text of International Electrotechnical Commission (IEC) Publication 62841-2-1, Electric Motor-Operated Hand-Held Tools, Transportable Tools And Lawn And Garden Machinery – Safety – Part 2-1: Particular Requirements for Hand-Held Drills and Impact Drills, copyright 2017 are indicated by notations (differences) and are presented in bold text. The national difference type is included in the body.

There are five types of National Differences as noted below. The difference type is noted on the first line of the National Difference in the standard. The standard may not include all types of these National Differences.

DR – These are National Differences based on the **national regulatory requirements**.

D1 – These are National Differences which are based on **basic safety principles and requirements**, elimination of which would compromise safety for consumers and users of products.

D2 – These are National Differences from IEC requirements based on existing **safety practices**. These requirements reflect national safety practices, where empirical substantiation (for the IEC or national requirement) is not available or the text has not been included in the IEC standard.

DC – These are National Differences based on the **component standards** and will not be deleted until a particular component standard is harmonized with the IEC component standard.

DE – These are National Differences based on **editorial comments or corrections**.

Each national difference contains a description of what the national difference entails. Typically one of the following words is used to explain how the text of the national difference is to be applied to the base IEC text:

Addition / Add - An addition entails adding a complete new numbered clause, subclause, table, figure, or annex. Addition is not meant to include adding select words to the base IEC text.

Modification / Modify - A modification is an altering of the existing base IEC text such as the addition, replacement or deletion of certain words or the replacement of an entire clause, subclause, table, figure, or annex of the base IEC text.

Deletion / Delete - A deletion entails complete deletion of an entire numbered clause, subclause, table, figure, or annex without any replacement text.

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FOREWORD

INTERNATIONAL ELECTROTECHNICAL COMMISSION

ELECTRIC MOTOR-OPERATED HAND-HELD TOOLS, TRANSPORTABLE TOOLS AND LAWN AND GARDEN MACHINERY – SAFETY – PART 2-1: PARTICULAR REQUIREMENTS FOR HAND-HELD DRILLS AND IMPACT DRILLS

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and nongovernmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.

2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.

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6) All users should ensure that they have the latest edition of this publication.

7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.

8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.

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

This consolidated version of the official IEC Standard and its amendment has been prepared for user convenience.

IEC 62841-2-1 edition 1.1 contains the first edition (2017-06) [documents 116/321/FDIS and 116/330/RVD] and its amendment 1 (2021-11) [documents 116/519/FDIS and 116/525/RVD].

In this Redline version, a vertical line in the margin shows where the technical content is modified by amendment 1.

International Standard IEC 62841-2-1 has been prepared by IEC technical committee 116: Safety of motor-operated electric tools.

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

This Part 2-1 is to be used in conjunction with the first edition of IEC 62841-1 (2014).

This Part 2-1 supplements or modifies the corresponding clauses in IEC 62841-1, so as to convert it into the IEC Standard: Particular requirements for hand-held drills and impact drills.

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

The following print types are used:

– requirements: in roman type

– *test specifications: in italic type;*

– notes: in small roman type

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

Subclauses, notes and figures which are additional to those in Part 1 are numbered starting from 101.

A list of all parts of the IEC 62841 series, 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.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under http://webstore.iec.ch in the data related to the specific publication. At this date, the publication will be

• reconfirmed,

• withdrawn,

• replaced by a revised edition, or

• amended.

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.

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

101DV DE *Modification: Add the following to the IEC Foreword:*

The numbering system in the standard uses a space instead of a comma to indicate thousands and uses a comma instead of a period to indicate a decimal point. For example, 1 000 means 1,000 and 1,01 means 1.01.

102DV DE *Modification: Add the following to the IEC Foreword:*

For this Standard, all references to "Part 1" refer to CAN/CSA C22.2 No. 62841-1 and UL 62841-1.

No Text on This Page

ELECTRIC MOTOR-OPERATED HAND-HELD TOOLS, TRANSPORTABLE TOOLS AND LAWN AND GARDEN MACHINERY– SAFETY – PART 2-1: PARTICULAR REQUIREMENTS FOR HAND-HELD DRILLS AND IMPACT DRILLS

1 Scope

This clause of Part 1 is applicable except as follows:

Addition:

This part of IEC 62841 applies to hand-held **drills** and **impact drills**, including **diamond core drills**. This document also applies to **drills** that can be used for driving screws by attaching screwdriver bits.

This document does not apply to rotary hammers, screwdrivers, impact wrenches and ratchet drivers even if they can be used as a **drill**.

NOTE 101 Rotary hammers are covered by IEC 62841-2-6.

NOTE 102 Screwdrivers, impact wrenches and ratchet drivers are covered by IEC 62841-2-2.

2 Normative references

This clause of Part 1 is applicable except as follows:

Addition:

ISO 185:2005
Grey cast irons – Classification

ISO 630-2:2011
Structural steels – Part 2: Technical delivery conditions for structural steels for general purposes

3 Terms and definitions

This clause of Part 1 is applicable except as follows:

Additional definitions:

3.101 **drill:** tool equipped with either a typical three jaw chuck or a machine taper, specifically designed to bore holes in various materials such as metal, plastics, wood, etc.

Note 1 to entry: Besides drill bits, it is possible that other **accessories** such as bits for deburring and screwdriving are used with **drills**.

3.102 **impact drill:** tool equipped with a chuck specifically designed to bore holes in concrete, stone and other materials, being similar in appearance and construction, to a **drill**, but which has a built-in percussion system which gives an axial percussion movement to rotating output spindle

Note 1 to entry: Some **impact drills** have a device for rendering the percussion system inoperative, so that they can be used as a conventional **drill**.

Note 2 to entry: Besides drill bits, it is possible that other **accessories** such as bits for deburring and screwdriving are used with **impact drills**.

3.103 **diamond core drill: drill** or **impact drill** designed to be equipped with a diamond core drill bit with or without a **liquid system** to drill into materials such as concrete or brick, see Figure I.103

4 General requirements

This clause of Part 1 is applicable.

5 General conditions for the tests

This clause of Part 1 is applicable except as follows

5.17 Addition:

The mass of the tool includes the drill chuck and the auxiliary handle, if any.

6 Radiation, toxicity and similar hazards

This clause of Part 1 is applicable.

7 Classification

This clause of Part 1 is applicable.

8 Marking and instructions

This clause of Part 1 is applicable except as follows:

8.1 *Addition:*

Drills and **impact drills** shall be marked with the following:

– **rated no-load speed**.

8.3 *Deleted*

8.14.1 *Addition:*

The additional safety instructions as specified in 8.14.1.101 shall be given. This part may be printed separately from the "General Power Tool Safety Warnings".

8.14.1.101 **Drill safety warnings**

1) Safety instructions for all operations

a) **Wear ear protectors when impact drilling.** *Exposure to noise can cause hearing loss.*

NOTE 1 The above warning applies only to **impact drills** and is omitted for **drills**.

b) **Use the auxiliary handle(s).** *Loss of control can cause personal injury.*

NOTE 2 The above warning applies only to tools that are provided with auxiliary handle(s).

c) **Brace the tool properly before use.** *This tool produces a high output torque and without properly bracing the tool during operation, loss of control may occur resulting in personal injury.*

NOTE 3 The above warning applies only for tools with a maximum output torque greater than 100 Nm measured in accordance with 19.102.

d) **Hold the power tool by insulated gripping surfaces, when performing an operation where the cutting accessory may contact hidden wiring or its own cord.** *Cutting accessory contacting a "live" wire may make exposed metal parts of the power tool "live" and could give the operator an electric shock.*

NOTE 4 For **drills** that can also be used as screwdrivers, the words "or fasteners" are added after "cutting **accessory**".

2) Safety instructions when using long drill bits

a) **Never operate at higher speed than the maximum speed rating of the drill bit.** *At higher speeds, the bit is likely to bend if allowed to rotate freely without contacting the workpiece, resulting in personal injury.*

b) **Always start drilling at low speed and with the bit tip in contact with the workpiece.** *At higher speeds, the bit is likely to bend if allowed to rotate freely without contacting the workpiece, resulting in personal injury.*

c) **Apply pressure only in direct line with the bit and do not apply excessive pressure.** *Bits can bend causing breakage or loss of control, resulting in personal injury.*

8.14.2 **a)** *Additional items:*

101) For **diamond core drills**: maximum diamond core bit diameter;

102) For tools with a maximum output torque greater than 100 Nm measured in accordance with 19.102: instructions on how to brace the tool;

103) For applications which produce a considerable amount of dust, such as impact and diamond core drilling: instruction on how to collect the dust.

9 Protection against access to live parts

This clause of Part 1 is applicable.

10 Starting

This clause of Part 1 is applicable.

11 Input and current

This clause of Part 1 is applicable.

12 Heating

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

12.2.1 Replacement:

__Drills__ and __impact drills__ are operated continuously until thermal equilibrium is reached with the impact mechanism, if any, disengaged, while the torque applied to the spindle is 80 % of the torque necessary to attain __rated input__ or __rated current__.

12.5 Addition:

For __impact drills__, the temperature-rise limit specified for the external enclosure does not apply to the enclosure of the impact mechanism.

13 Resistance to heat and fire

This clause of Part 1 is applicable.

14 Moisture resistance

This clause of Part 1 is applicable.

15 Resistance to rusting

This clause of Part 1 is applicable.

16 Overload protection of transformers and associated circuits

This clause of Part 1 is applicable.

17 Endurance

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

17.2 *Replacement for __impact drills__:*

An __impact drill__ is operated intermittently with no-load and, if the impact mechanism can be engaged and disengaged at will, the impact mechanism shall remain disengaged for 12 h at a voltage equal to 1,1 times the highest __rated voltage__ or 1,1 times the upper limit of the __rated voltage range__ and then for 12 h at a supply voltage equal to 0,9 times the lowest rated voltage or 0,9 times the lower limit of the __rated voltage range__. The 12 h of operation need not be continuous. The speed is adjusted to the highest value of the highest range.

Each cycle of operation comprises an "on" period of 100 s and an "off" period of 20 s, the "off" periods being included in the specified operating time.

During the test, the tool is placed in three different positions, the operating time, at each voltage, being approximately 4 h for each position.

NOTE 101 The change of position is made to prevent abnormal accumulation of carbon dust in any particular place. Examples of the three positions are horizontal, vertically up and vertically down.

The same tool is then mounted vertically in a test apparatus. The apparatus is designed to apply sufficient axial force to the tool, through a resilient medium that absorbs impacts and vibration, to ensure steady operation of the impact mechanism. An example of a test apparatus is shown in Figure 101. The tool is then operated at __rated voltage__ for four periods of 6 h each, the interval between these periods being at least 30 min; if the impact mechanism can be engaged and disengaged at will, the impact mechanism shall remain engaged.

During these tests, the tool is operated intermittently, each cycle comprising a period of operation of 30 s and a rest period of 90 s during which the tool remains switched off.

The tool may be switched on and off by means of a switch other than that incorporated in the tool.

During these tests, replacement of the carbon brushes is allowed, and the tool is oiled and greased as in ***normal use****. If mechanical failure occurs and does not impair compliance with this standard, the part that failed may be replaced.*

If the temperature rise of any part of the tool exceeds the temperature rise determined during the test of 12.1, forced cooling or rest periods may be applied, the rest periods being excluded from the specified operating time. If forced cooling is applied, it shall not alter the air flow of the tool or redistribute carbon deposits.

During these tests, overload protection devices incorporated in the tool shall not activate.

NOTE 102 Monitoring of external temperatures will help avoid mechanical failures.

18 Abnormal operation

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

18.8 *Replacement of Table 4:*

Table 4
Required performance levels

Type and purpose of SCF	Minimum performance level (PL)
Power switch – prevent unwanted switch-on for tools with $M_{R,}$ ≤ 25 Nm measured in accordance with 19.102	a
Power switch – prevent unwanted switch-on for tools with M_R > 25 Nm measured in accordance with 19.102	b
Power switch – provide desired switch-off for tools with M_R ≤ 25 Nm measured in accordance with 19.102	b
Power switch – provide desired switch-off for tools with M_R > 25 Nm measured in accordance with 19.102	c
Power switch – provide desired switch-off for tools that require bracing in accordance with 8.14.1.101.	Shall be evaluated using the fault conditions of 18.6.1 without the loss of this **SCF**
Provide desired direction of rotation for tools that do not require bracing in accordance with 8.14.1.101	Not an **SCF**
Provide desired direction of rotation for tools that require bracing in accordance with 8.14.1.101	c
Any electronic control to pass the test of 18.3	a
For tools with a **rated no-load speed** of less than 3 500 min_{-1}, prevent output speed from exceeding 150 % of **rated no-load speed** as measured in 19.6	a
For tools with a **rated no-load speed** of 3 500 min_{-1} or greater, prevent output speed from exceeding 130 % of **rated no-load speed** as measured in 19.6	a
Prevent exceeding thermal limits as in 18.4	a
Prevent self-resetting as required in 23.3 for tools with M_R ≤ 25 Nm measured in accordance with 19.102	a

Table 4 Continued on Next Page

Table 4 Continued

Type and purpose of SCF	Minimum performance level (PL)
Prevent self-resetting as required in 23.3 for tools with M_R > 25 Nm measured in accordance with 19.102	b
Limit the torque to comply with 19.102	c
Prevent unwanted lock-on of the **power switch** function for tools with M_R ≤ 25 Nm measured in accordance with 19.102	b
Prevent unwanted lock-on of the **power switch** function for tools with M_R > 25 Nm measured in accordance with 19.102	c

19 Mechanical hazards

This clause of Part 1 is applicable except as follows:

19.1 Addition:

*The test with probe B of IEC 61032:1997 does not apply to the chuck and any **accessory** that may be inserted.*

19.6 *Replacement:*

The no-load speed of the spindle at **rated voltage** shall not exceed 120 % of the **rated no-load speed**.

*Compliance is checked by measuring the speed of the spindle after the tool has been operating for 5 min at no-load. During the test, separable **accessories** are not mounted.*

19.101 Chuck keys shall be so designed that they drop out of position when released. This requirement does not exclude the provision of clips for holding the key in place when not in use; metal clips fixed to the flexible cable or cord are not allowed.

Compliance is checked by inspection and manual test.

The key is inserted in the chuck and, without tightening, the tool is turned such that the key is facing down. The key shall fall out within 2 s.

19.102 Handles

19.102.1 General

The design of the handle(s) shall be such that the operator can control the static stalling torque during the operation of the tool. Depending on the handle design, the stalling torque shall not exceed the relevant maximum values as indicated in Figure 104 to Figure 107.

Figure 102 illustrates, for various handle designs, the location "S" where the operator naturally grasps the **power switch**. For **power switch** designs without a natural grasping location, "S" shall indicate the least favourable position on the **power switch** for the reactionary torque measurement. This location "S" is used in Figure 104 to Figure 107 to determine the moment arm for the torque calculation.

Figure 103 illustrates, for various auxiliary handle with flange designs, the location "F" where the operator naturally grasps the handle at the flange. This location "F" is used in Figure 106 and Figure 107 to determine the moment arm for the torque calculation.

Compliance is checked by the tests specified in 19.102.2 and 19.102.4 and by the calculations in Figure 104 to Figure 107.

19.102.2 **Test equipment**

The test equipment used for the test of 19.102.4 shall meet the following requirements a) to g):

a) The torque transducer and the rotational angle sensor shall continuously monitor the torque and the rotation produced by the output spindle of the tool during the test of 19.102.4.

b) The output of the torque transducer shall be connected to an oscilloscope or other data acquisition equipment capable of displaying the torque vs. time graph of the tool's output during the test of 19.102.4.

c) The torque transducer shall be rated to measure a torque of at least 150 % of the static stalling torque of the tool or slip torque of an overload clutch (M_R) with a measurement accuracy of ±1 %.

d) The rotational angle shall be measured with an accuracy of ±2°.

e) The data acquisition equipment used for measuring the torque signal during the test shall have a sampling rate of at least 15 kHz, but the bandwidth shall be limited by a first order low pass filter with a cut-off frequency of (1 ±0,1) kHz to minimise the effect of transients.

f) The joint that is connected to the tool during the test shall be capable of stalling the tool over a rotational angle of 30° to 60°. The joint that fulfils this requirement shall be a torsional element or other such device that remains in equilibrium during the test.

g) A regulated power supply that is connected to the tool during the test shall be capable of providing the **rated voltage** and **rated frequency** provided on the tool's nameplate (e.g. 120 V AC, 60 Hz). It shall also be suitably sized such that the voltage drop during the test shall not deviate from the **rated voltage** or the upper limit of the **rated voltage range** by more than 7 %.

Compliance is checked by inspection and by measurement.

19.102.3 **Assessment to determine tool configuration**

This assessment is only applicable for tools that employ an electronic circuit(s) that affects the output torque in the test of 19.102.4.

Prior to each measurement, the sample is operated for at least 5 min at no-load. After each 5 min operation period, the measurement shall be conducted within 20 min.

All measurements are made with the tool sample running in the forward position.

The sample is connected to the measurement fixture and is fixed during the test.

For tools with a soft start function, the test of 19.102.4 through steps 1) and 2) is conducted on the sample with the soft start function enabled and then repeated with the soft start function disabled. If analysis shows that the tool will not operate with the soft start function disabled, then the test with the soft start function disabled is not conducted. For tools employing electronically commutated motors, the configuration that results in the greatest output torque shall be used for the test of 19.102.4. For tools other than those employing electronically commutated motors, the configuration that results in the greatest output torque shall be used for the following test.

*For tools other than those employing electronically commutated motors, when all functions affecting the test value of the output torque, except for any soft start function, are not evaluated as **SCF**s according to 18.8 (e.g. current limit and stall detection), the tool configuration for the test of 19.102.4 shall be the configuration that results in the greatest output torque for one trial of the test of 19.102.4 through steps 1) and 2) as specified below:*

– all functions affecting the output torque enabled; or

*– each function not evaluated as an **SCF** affecting the output torque disabled one at a time.*

19.102.4 **Test procedure**

If applicable, the sample is configured as specified in 19.102.3.

Prior to the test, the sample is operated for at least 5 min at no-load. After the 5 min operation period, the test shall be conducted within 20 min.

All measurements are made with the tool sample running in the forward position.

The sample is connected to the measurement fixture and is fixed during the test. The measurement is conducted by using seven trial measurements of the same sample, each trial conducted as follows

1) Energize the tool to the full "on" position as quickly as possible and allow the joint to be tightened until it comes to a complete stop.

2) Record the measured output torque.

a) For tools without a mechanical overload clutch, the output torque is determined by either i) or ii):

i) For signals that are stable for a minimum of 2 ms after the initial peak (if present), the output torque value is determined by measuring over the stable region for an interval T not exceeding 100 ms. If there is variation during this interval, the average value shall be used. See Figure 108.

ii) For signals that are not stable for a minimum of 2 ms after the initial peak, the output torque value shall be the RMS value of the signal over the rotation from off until peak torque is achieved. See Figure 109.

NOTE 101 Torque signals can exhibit a transient peak with a relatively stable signal following the peak. The stable signal can exhibit relatively slow change due to, for example, heating of the windings. The stable signal can also exhibit periodic signal variation due to torque ripple. Averaging over this stable period provides a meaningful torque value. The transient peak and the stable region are not always present.

b) For tools with a mechanical overload clutch:

The output torque is determined by the peak value of the first peak that occurs after starting the trial. Later peaks, even if they appear to have greater values, are not taken into account. See Figure 110.

3) Before the next trial, disconnect the spindle from the test fixture and operate the tool under no-load for a minimum of 3 s. Allow the tool to cool for a minimum of 2 min before the next trial.

M_R is computed as the average of five of the measurements from each of the seven trials, with the highest and lowest measurement eliminated. The standard deviation of the five measurements shall also be

computed and shall be less than 5 %. If it is not, then the fixture shall be adjusted to achieve the required repeatability.

NOTE 102 It is recognized that disabling functions that affect the torque can result in a test where the tool is permanently impaired after the test.

20 Mechanical strength

This clause of Part 1 is applicable.

21 Construction

This clause of Part 1 is applicable except as follows:

21.18.1.1 *Addition:*

Tools with a maximum output torque greater than 100 Nm shall not be provided with a lock-on device.

Compliance is checked by measurement in accordance with 19.102 and inspection.

For tools with a maximum output torque of 100 Nm or less, a **power switch** lock-on device, if any, shall be located outside the grasping area, or so designed that it is not likely to be unintentionally locked on by the user's hand during intended left- or right-handed operation. This grasping area is considered to be the contact area between either hand and the tool while the index finger of that hand is resting on the **power switch** actuator of the tool.

*Compliance is checked by inspection or, for a **power switch** with a lock-on device within the grasping area, by the following test.*

*With the **power switch** in the "on" position, the lock-on device shall not be actuated by a straight edge 25 mm long when the straight edge is pushed down on the lock-on device. The straight edge shall be oriented in any direction and shall be applied to bridge the surface of the lock-on device and any surface adjacent to the lock-on device.*

21.18.1.2 This subclause of Part 1 is not applicable.

21.35 This subclause is not applicable.

NOTE 101 Dust collection is covered in 8.14.2 a) 103).

22 Internal wiring

This clause of Part 1 is applicable.

23 Components

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

23.3 *Replacement of the first paragraph:*

Protection devices or circuits shall be of the non-self-resetting type unless the tool is equipped with a **momentary power switch** with no provision for being locked in the "on" position.

24 Supply connection and external flexible cables and cords

This clause of Part 1 is applicable.

25 Terminals for external conductors

This clause of Part 1 is applicable.

26 Provision for earthing

This clause of Part 1 is applicable.

27 Screws and connections

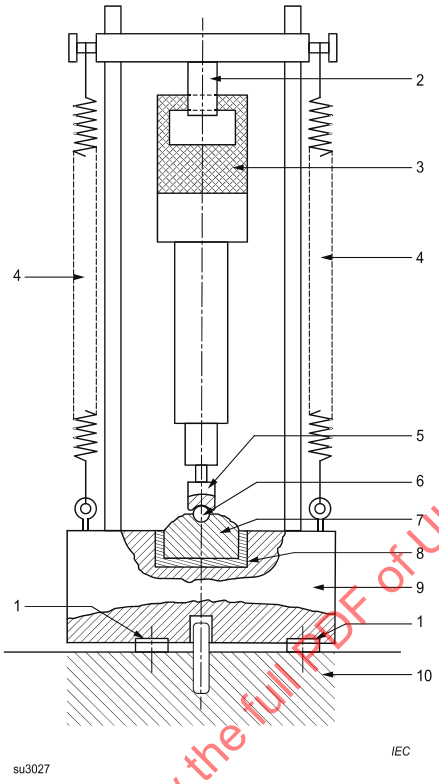
This clause of Part 1 is applicable.

28 Creepage distances, clearances and distances through insulation

This clause of Part 1 is applicable.

Figure 101

Example of a testing apparatus



Key

1 resilient material to absorb vibration and prevent resonance

2 yoke, adapted to suit the grip of the tool

3 sample

4 mechanical or pneumatical springs applying a force to the sample

5 punch

6 hardened steel ball with diameter 38 mm

7 hardened steel transfer plate of mass M_2 and diameter D

8 synthetic rubber disk or material having similar properties, Shore hardness 70 deg. to 80 deg, thickness 6 mm to 7 mm, fitting closely in cavity

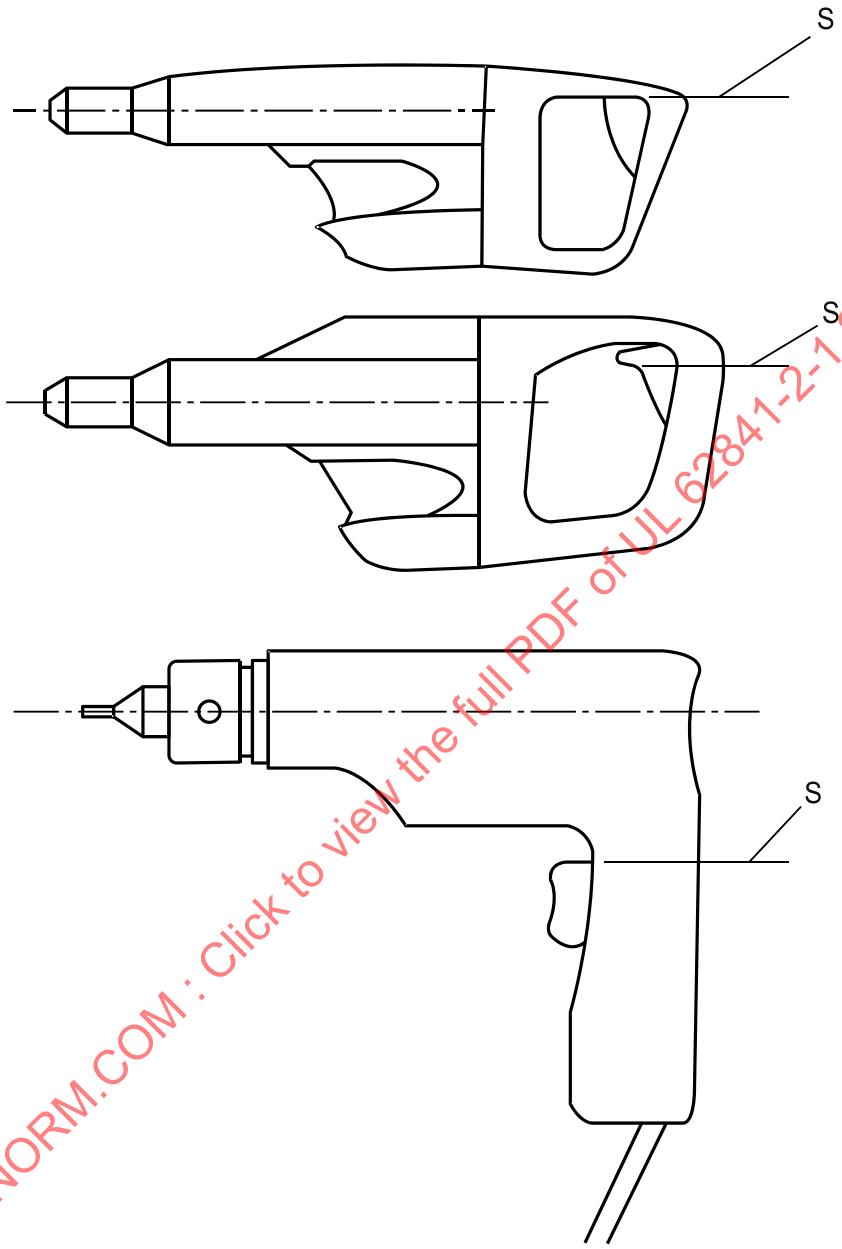
9 steel base at mass M_1, with circular cavity having a diameter 1 mm greater than that of the transfer plate

10 ground support such as a concrete block being large and solid enough to ensure the stability of the test apparatus during the test

Rated input of tool	***D*** **Diameter of transfer plate (nominal)**	M_1 **Minimum mass of steel base**	M_2 **Mass of transfer plate**	M_3 **Total mass of punch and shank (nominal)**
W	**mm**	**kg**	**kg**	**kg**
Up to and including 700	100	90	1,0 to 1,25	0,7
Over 700 up to and including 1 200	140	180	2,25 to 2,81	1,4
Over 1 200 up to and including 1 800	180	270	3,8 to 4,75	2,3
Over 1 800 up to and including 2 500	220	360	6,0 to 7,5	3,4

Figure 102

Locating point "S" on different power switch and handle designs



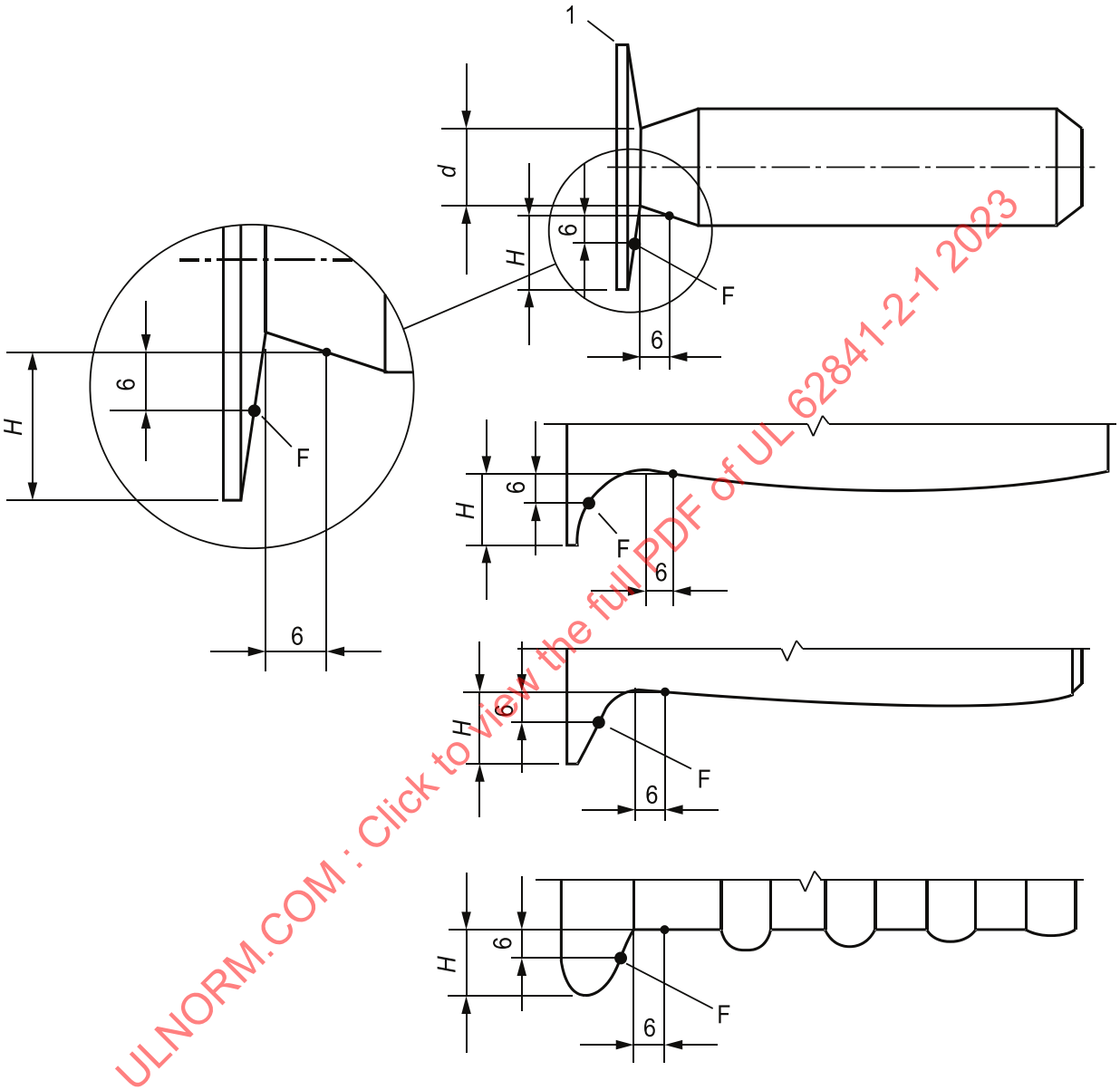
Key

S location of the hand on the **power switch** where the operator naturally grasps and/or the least favourable position on the **power switch** for the reactionary torque measurement

Figure 103

Locating point "F" on different flange designs

Dimensions in millimetres



IEC

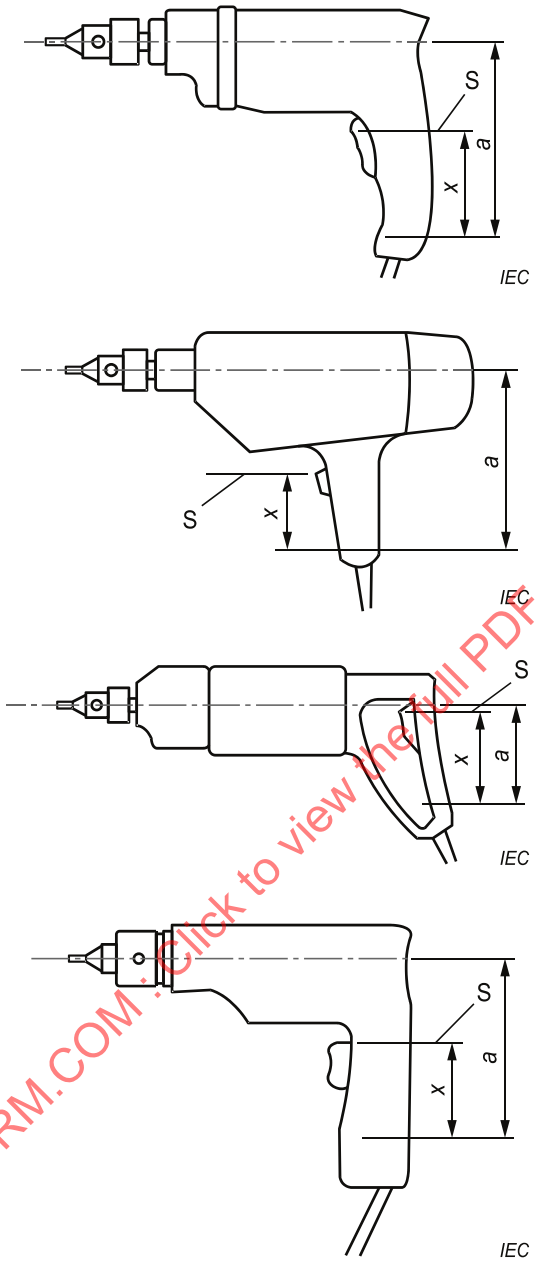
su3029

Key

1	flange
F	location of the hand on the flange where the operator naturally grasps
d	minor diameter
H	height of the flange

Figure 104

Reaction torque measurement of single handle tools (1)

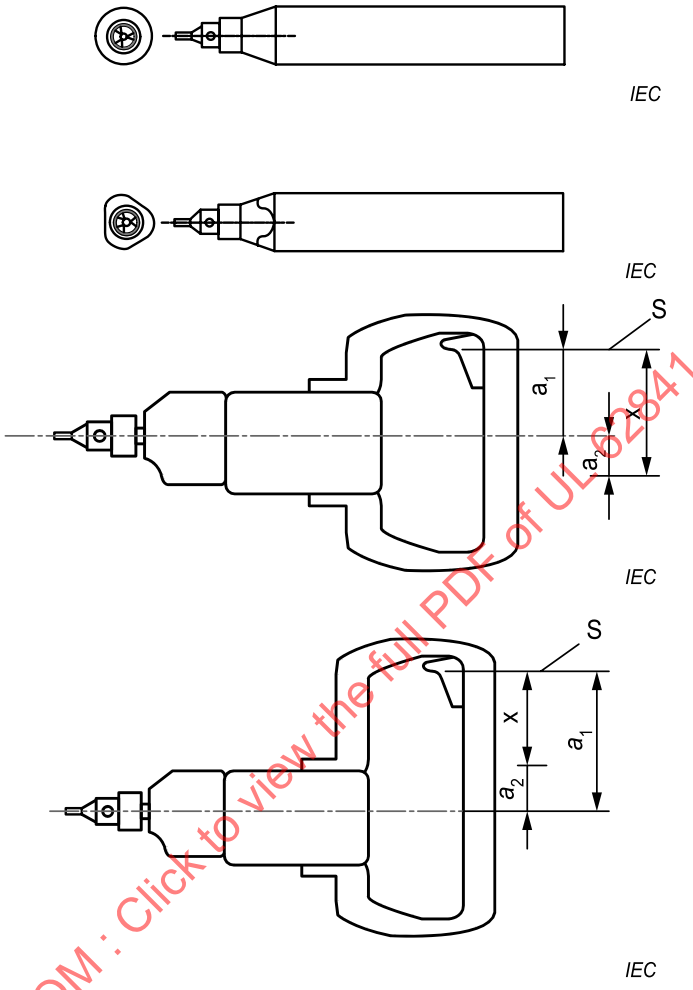


Key

S	location of the hand on the **power switch** where the operator naturally grasps and/or the least favourable position on the **power switch** for the reactionary torque measurement
x	measurement point that is 80 mm or the remaining length of the handle, whichever is less, from S in the direction of where the hand grasps the tool
a	lever arm distance
$M_{R,max}$	maximum reaction torque

Figure 105

Reaction torque measurement of single handle tools (2)



$M_{R,max}$ = 8 Nm (For round handle tools)

$M_{R,max}$ = 10 Nm (For non-round handle tools)

Choose whichever is greater:

$M_{R,max} = 400\ N \times a_1$

or

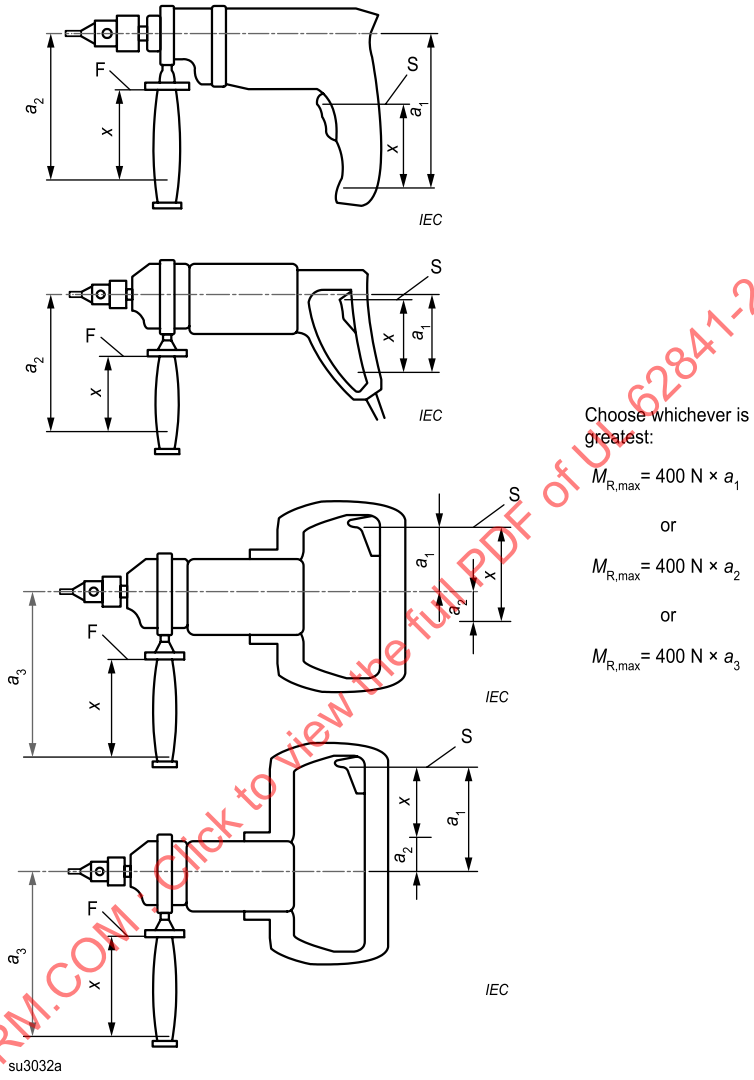
$M_{R,max} = 400\ N \times a_2$

Key

S	location of the hand on the **power switch** where the operator naturally grasps and/or the least favourable position on the **power switch** for the reactionary torque measurement
x	measurement point that is 80 mm or the remaining length of the handle, whichever is less, from S in the direction of where the hand grasps the tool
a_1, a_2	lever arm distances
$M_{R,max}$	maximum reaction torque

Figure 106

Reaction torque measurement of multi handle tools (1)



Choose whichever is greatest:

$M_{R,max}$ = 400 N × a_1

or

$M_{R,max}$ = 400 N × a_2

or

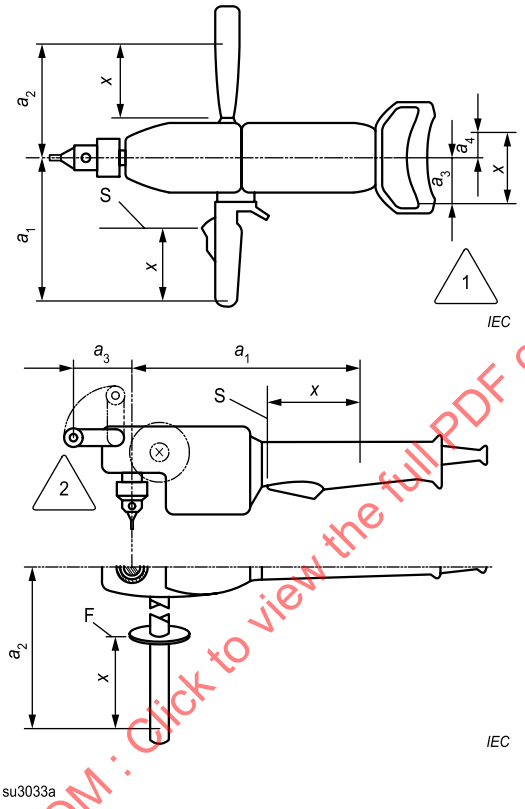
$M_{R,max}$ = 400 N × a_3

Key

S	location of the hand on the **power switch** where the operator naturally grasps and/or the least favourable position on the **power switch** for the reactionary torque measurement
F	location of the hand on the flange where the operator naturally grasps
x	measurement point that is 80 mm or the remaining length of the handle, whichever is less, from “S” or “F” in the direction of where the hand grasps the tool
a_1, a_2, a_3	lever arm distances
$M_{R,max}$	maximum reaction torque

Figure 107

Reaction torque measurement of multi handle tools (2)

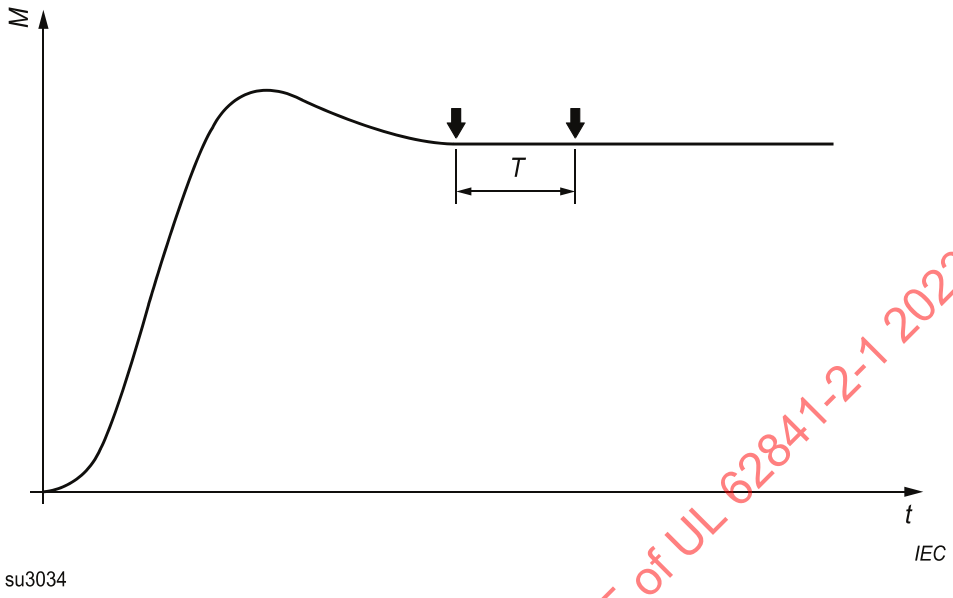


Key

1	the value of a_3 or a_4 is used only, if the handle can be locked in position and is referenced for use in 8.14.2 b) 6)
2	measure from a point on the centreline of the grasping surface that offers greatest mechanical advantage
S	location of the hand on the **power switch** where the operator naturally grasps and/or the least favourable position on the **power switch** for the reactionary torque measurement
F	location of the hand on the flange where the operator naturally grasps
x	measurement point that is 80 mm or the remaining length of the handle, whichever is less, from “S” or “F” in the direction of where the hand grasps the tool
a_1, a_2, a_3, a_4	lever arm distances
$M_{R,max}$	maximum reaction torque

Figure 108

Example torque of a tool with a stable signal region

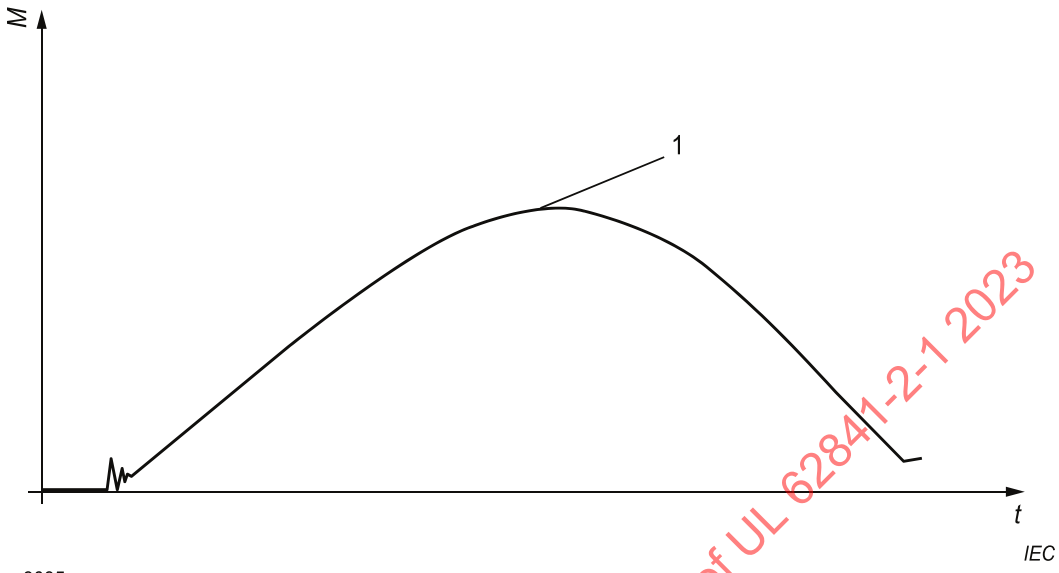


Key

M	torque
t	time
T	measurement interval in stable region, 2 ms < *T* < 100 ms

Figure 109

Example torque of a tool without a stable signal region

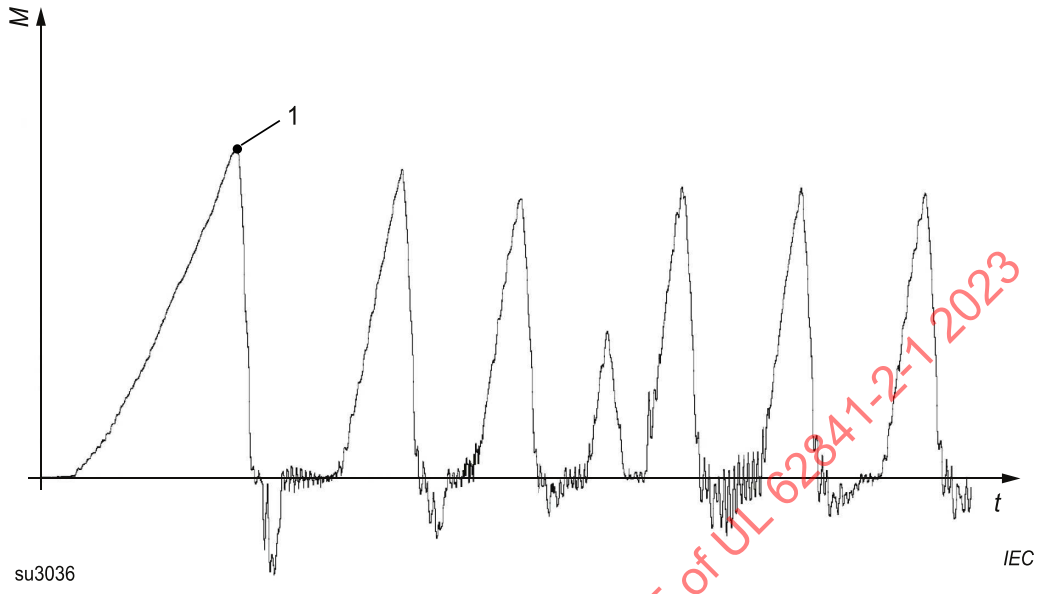


Key

1	peak torque
M	torque
t	time

Figure 110

Example torque of a tool with an overload clutch



Key

1	first peak
M	torque
t	time

Annexes

The annexes of Part 1 are applicable except as follows.

Annex I
(informative)

Measurement of noise and vibration emissions

NOTE In Europe (EN 62841-2-1), Annex I is normative

I.2 Noise test code (grade 2)

This clause of Part 1 is applicable except as follows:

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

Addition:

Drills, except for impact drills and diamond core drills, are suspended.

Impact drills and **diamond core drills** are held by the operator for drilling vertically down in accordance with I.2.5.

I.2.5 Operating conditions

Addition:

Drills, except for impact drills and **diamond core drills**, are tested at no-load without any **accessory** mounted, all speed setting devices adjusted to the highest value.

NOTE 101 Experimental investigations have shown that the noise emission values of **drills**, except for **impact drills** and **diamond core drills**, at no-load and under load are very similar. For reasons of simplification, the noise emission is therefore measured at no-load.

For **impact drills**, the speed setting shall be that recommended by the manufacturer for an 8 mm bit for drilling into concrete.

Impact drills are tested under load as shown in Figure I.101 and in accordance with the conditions shown in Table I.101 and Table I.102.

Diamond core drills are tested under load and in accordance with the conditions shown in Table I.103.

Table I.101
Concrete formulation for impact drills (per cubic metre)

Cement	Water	Aggregate [b]	
		1 450 kg	
		Particle size mm	Fraction %
450 kg [a]	220 l [a]	0 to 0,25	12 ± 3
		0 to 0,50	50 ± 5
		0 to 1,00	80 ± 5
		0 to 4,00	100
The minimum compressive strength after at least 28 days shall be 40 N/mm^2.			
[a] The water/cement mass ratio shall be 0,49 ± 0,02 (the mass tolerance of cement and water is + 10 % to enable the concrete manufacturer to ensure compressive strength with local cement). [b] Very hard aggregates such as flint or granite and very soft aggregates such as limestone shall not be used.			

NOTE 102 In some parts of the world, concrete with a minimum compressive strength of 40 N/mm^2 after 28 days is readily available. In other parts of the world, it is possible that readily available concrete will take longer than 28 days to achieve a minimum compressive strength of 40 N/mm^2.

Table I.102
Noise test conditions for impact drills

Orientation	Drilling vertically down into a concrete block having the formulation specified in Table I.101 and having the minimum dimensions 500 mm × 500 mm and 200 mm in height and supported on resilient material. The concrete block, its support and the tool shall be so oriented that – the geometric centre of the tool is 1 m above the reflecting plane. – the centre of the concrete block is located under the top microphone "5"; and – the sides of the concrete block are parallel to the square formed by the microphones "1" to "4".
Tool bit	New 8 mm drill bit for the entire series of tests as specified for drilling in concrete with a usable length of approximately 100 mm
Feed force	(150 ± 30) N in addition to the weight of the **drill**
Test cycle	Measurement starts when the drill bit has reached a depth of approximately 10 mm and stops when the depth has reached approximately 80 mm

Table I.103
Noise test conditions for diamond core drills

Orientation	If the tool is suitable to drill into concrete with a **liquid system**: Drilling vertically down into a concrete block having the formulation specified in Table I.108 and having the dimensions 500 mm × 500 mm and 200 mm in height, supported on resilient material. If the tool is designed to drill without liquid only: The test is conducted drilling vertically down into a sand-lime-stone or brick with a minimum thickness of 200 mm, supported on resilient material. The workpiece, its support and the tool shall be so oriented that – the geometric centre of the tool is 1 m above the reflecting plane; – the centre of the workpiece is located under the top microphone "5"; and – the sides of the workpiece are parallel to the square formed by the microphones "1" to "4".
Tool bit	New or sharpened diamond core bit for the entire series of tests, with 75 % of the maximum diamond core bit diameter in accordance with 8.14.2 a) 101), but not more than 100 mm.
Feed force	The feed force applied to the tool shall be determined as follows: Drill with the tool increasing the feed force until either the speed is significantly reduced by the load or a torque limiting device operates. Reduce the feed force slightly until a feed force is reached enabling stable operation. Use this feed force for the test or 250 N, whichever is less.
Test cycle	The measurement starts when the diamond core bit has reached a depth between 5 mm and 10 mm and stops after – 1 min, or – when the hole is completed, or – when the maximum drilling depth of the core bit is reached, whichever is achieved first.

I.2.9 Declaration and verification of noise emission values

Addition:

NOTE 102 In order to include the noise emission under load, the values for the uncertainties K_{pA} and K_{WA} for drills can be expected to be up to 5 dB.

I.3 Vibration

This clause of Part 1 is applicable except as follows:

I.3.3.2 Location of measurement

Addition:

Figure I.102 and Figure I.103 show the positions for different types of tools.

I.3.5.1 General

Addition:

For battery operated tools, except for **diamond core drills**, the tests are conducted with the lightest **battery** in accordance with K.8.14.2 e) 2) that has a sufficient capacity to complete fifteen measurements as specified in Table I.104 and Table I.106.

For **diamond core drills**, the tests are conducted with the lightest battery in accordance with K.8.14.2 e) 2). Multiple **batteries** may be used for the test.

I.3.5.3 Operating conditions

Addition:

Impact drills where the impact mechanism can be switched off to have a rotary function only are tested as described under I.3.5.3.101 and I.3.5.3.102.

Diamond core drills are tested as described under I.3.5.3.103.

I.3.5.3.101 Drills

Drills, except **diamond core drills**, are tested under load observing the conditions shown in Table I.104 and Table I.105, all speed setting devices adjusted to the highest value.

Table I.104
Vibration test conditions for drills

Orientation	Drilling vertically down into a plate of either 20 mm thick grey cast iron as specified in ISO 185:2005, grade 250, or mild steel similar to type S235 in accordance with ISO 630-2:2011. The workpiece shall be clamped or adequately fixed on a wooden board at a height giving the operator a comfortable posture.
Tool bit	Each operator uses a new or newly sharpened drill bit, type HSS-R, for his series of tests. **Drills** shall be equipped with a standard drill bit suitable for the speed of the machine and of a diameter in accordance with Table I.105. The 10 mm drill bit shall be run in predrilled holes with a diameter of 3 mm.
Feed force	In accordance with Table I.105 applied to the handle of the tool.
Test cycle	A test series shall consist of the drilling of five holes. Measurement starts when the drill bit has contact with the plate and stops after 8 s or just before the hole is completed.
NOTE This test is also representative for drilling into other materials without impact.	

Table I.105
Drill bit diameter and feed force for drills

Rated no-load speed min^{-1}	Drill bit diameter mm	Feed force N
> 5 500	1,5	10 ± 2
3 100 to 5 499	3	50 ± 10
1 000 to 3 099	6	150 ± 30
< 1 000	10	200 ± 30

I.3.5.3.102 Impact drills

For **impact drills**, the speed setting shall be that recommended by the manufacturer for an 8 mm bit for drilling into concrete.

Impact drills are tested under load as shown in Figure I.101 drilling into a concrete block in accordance with Table I.101 and with the conditions shown in Table I.106.

Table I.106
Vibration test conditions for impact drills

Orientation	Drilling vertically down into a concrete block having the minimum dimensions 500 mm × 500 mm and 200 mm in height and supported on resilient material
Tool bit	New 8 mm drill bit for drilling in concrete with a usable length of approximately 100 mm
Feed force	150 ± 30 N in addition to the weight of the **drill**
Test cycle	Measurement starts when the drill bit has contact to the concrete block and stops at a drilling depth of 80 mm before the drill bit is removed from the hole

I.3.5.3.103 Diamond core drills

Diamond core drills are tested under load as described in Table I.107.

The machine settings (speed, **liquid system**, impact, etc.) shall be correctly adjusted for drilling into the material specified for the test and for the type and diameter of the drill bit specified in Table I.107.

If the tool is designed to drill with a dust collection device, the dust collection device shall be in place during the operation of the tool.

If the tool is suitable to drill into concrete with a **liquid system**, the liquid collection device, if any, shall be in place during the operation of the tool.

Table I.107
Vibration test conditions for diamond core drills

Orientation	If the tool is suitable to drill into concrete with a **liquid system**: Drilling vertically down into a concrete block having the formulation specified in Table I.109 and having the dimensions 500 mm × 500 mm and 200 mm in height, supported on resilient material. If the tool is designed to drill without liquid only: The test is conducted drilling horizontally into a sand-lime-stone or brick wall with a minimum thickness of 200 mm.

Table I.107 Continued on Next Page

Table I.107 Continued

Tool bit	New or sharpened diamond core bit for the entire series of tests, with 75 % of the maximum diamond core bit diameter in accordance with 8.14.2 a) 101), but not more than 100 mm.
Feed force	The feed force applied to the tool shall be determined as follows: Drill with the tool increasing the feed force until either the speed is significantly reduced by the load or a device that affects the torque operates. Reduce the feed force slightly until a feed force is reached enabling stable operation. Use this feed force for the test or 250 N, whichever is less.
Test cycle	The measurement starts when the diamond core bit has reached a depth between 5 mm and 10 mm and stops – after 1 min, or – when the hole is completed, or – when the maximum drilling depth of the core bit is reached, whichever is achieved first.

Table I.108
Concrete specifications

Minimum compressive strength (after at least 28 days)	Largest particle size of aggregate [a]
40 N/mm^2	Within a range of 32 mm to 40 mm
[a] The aggregate fraction distribution shall be aligned to the largest particle size of the aggregate. Very hard aggregates such as flint or granite and very soft aggregates such as limestone shall not be used.	

NOTE 101 In some parts of the world, concrete with a minimum compressive strength of 40 N/mm^2 after 28 days is readily available. In other parts of the world, it is possible that readily available concrete will take longer than 28 days to achieve a minimum compressive strength of 40 N/mm^2.

NOTE 102 A more detailed example of a concrete formulation that fulfils the requirements of Table I.108 is shown in Table I.109.

Table I.109
Detailed example of a concrete formulation that fulfils the requirements of Table I.108

Cement	Water	Aggregate [b]	
		1 844 kg	
		Particle size mm	Fraction %
330 kg [a]	183 l [a]	0 to 2	38 ± 3
		0 to 8	50 ± 5
		0 to 16	80 ± 5
		0 to 32	100
The minimum compressive strength after at least 28 days shall be 40 N/mm^2.			
[a] The water/cement mass ratio shall be 0,55 ± 0,02 (the mass tolerance of cement and water is + 10 % to enable the concrete manufacturer to ensure compressive strength with local cement).			
[b] Very hard aggregates such as flint or granite and very soft aggregates such as limestone shall not be used.			

I.3.6.1 Reported vibration value

Addition:

If more than one operating mode was measured, the result a_h for each operating mode applicable shall be reported.

$a_{h,D}$ = mean vibration "drilling" in accordance with I.3.5.3.101 (representative for steel and other materials);

$a_{h,ID}$ = mean vibration "impact drilling" in accordance with I.3.5.3.102;

$a_{h,DD}$ = mean vibration "diamond drilling" in accordance with I.3.5.3.103.

I.3.6.2 Declaration of the vibration total value

Addition:

The vibration total value of the handle with the highest emission and the uncertainty *K* shall be declared:

– for **drills**

the value of $a_{h,D}$, with the work mode description "drilling into metal";

– for **impact drills** with drill only function

the value of $a_{h,ID}$, with the work mode description "impact drilling into concrete" and the value of $a_{h,D}$, with the work mode description "drilling into metal;

– for **impact drills** without drill only function

the value of $a_{h,ID}$, with the work mode description "impact drilling into concrete";

– for **diamond core drills** without impact mechanism

the value of $a_{h,DD}$, with the work mode description "drilling into concrete";

– for **diamond core drills** with impact mechanism

the value of $a_{h,ID}$, with the work mode description "impact drilling into concrete" and the value of $a_{h,DD}$, with the work mode description "drilling into concrete".