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Hand-Held Motor-Operated Electric Tools – Safety – Part 2-1: Particular Requirements for Drills and Impact Drills

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UL Standard for Safety for Hand-Held Motor-Operated Electric Tools – Safety – Part 2-1: Particular Requirements for Drills and Impact Drills, UL 60745-2-1

Second Edition, Dated March 26, 2004

Summary of Topics

This is the Second edition of ANSI/UL 60745-2-1, the Standard for Safety for Hand-Held Motor-Operated Electric Tools – Safety – Part 2-1: Particular Requirements for Drills and Impact Drills, UL 60745-2-1 and is based on IEC 60745-2-1, Second edition.

The new requirements are substantially in accordance with UL's Bulletin(s) on this subject dated September 6, 2002, January 3, 2003, April 7, 2003, and January 16, 2004. The bulletin(s) is now obsolete and may be discarded.

As indicated on the title page (page 1), this UL Standard for Safety is an American National Standard. Attention is directed to the note on the title page of this Standard outlining the procedures to be followed to retain the approved text of this ANSI/UL Standard.

The master for this Standard at UL's Northbrook Office is the official document insofar as it relates to a UL service and the compliance of a product with respect to the requirements for that product and service, or if there are questions regarding the accuracy of this Standard.

Revisions of UL Standards for Safety are issued from time to time. A UL Standard for Safety is current only if it incorporates the most recently adopted revisions.

UL provides this Standard ″as is″ without warranty of any kind, either expressed or implied, including but not limited to, the implied warranties of merchantability or fitness for any purpose.

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If a single-user version electronic Standard was purchased, one copy of this Standard may be stored on the hard disk of a single personal computer, or on a single LAN file-server or the permanent storage device of a multiple-user computer in such a manner that this Standard may only be accessed by one user at a time and for which there is no possibility of multiple concurrent access.

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Electronic Standards are intended for on-line use, such as for viewing the requirements of a Standard, conducting a word search, and the like. Only one copy of the Standard may be printed from each single-user version of an electronic Standard. Only one copy of the Standard may be printed for each authorized user of a multiple-user version of an electronic Standard. Because of differences in the computer/software/printer setup used by UL and those of electronic Standards purchasers, the printed copy obtained by a purchaser may not look exactly like the on-line screen view or the printed Standard.

An employee of an organization purchasing a UL Standard can make a copy of the page or pages being viewed for their own fair and/or practical internal use.

The requirements in this Standard are now in effect, except for those paragraphs, sections, tables, figures, and/or other elements of the Standard having future effective dates as indicated in the preface. The prior text for requirements that have been revised and that have a future effective date are located after the Standard, and are preceded by a ″SUPERSEDED REQUIREMENTS″ notice.

New product submittals made prior to a specified future effective date will be judged under all of the requirements in this Standard including those requirements with a specified future effective date, unless the applicant specifically requests that the product be judged under the current requirements. However, if the applicant elects this option, it should be noted that compliance with all the requirements in this Standard will be required as a condition of continued Listing and Follow-Up Services after the effective date, and understanding of this should be signified in writing.

This Standard consists of pages dated as shown in the following checklist:

Page	Date
1-24	March 26, 2004

Canadian Standards Association
CAN/CSA-C22.2 No. 60745-2-1-04
Second Edition
(IEC 60745-2-1:2003, MOD)

Underwriters Laboratories Inc.
UL 60745-2-1
Second Edition

Hand-Held Motor-Operated Electric Tools – Safety – Part 2-1: Particular Requirements for Drills and Impact Drills

March 26, 2004

This national standard is based on publication IEC 60745-2-1, Second Edition (2003).

ANSI/UL 60745-2-1-2004

Approved
by
Standards Council
of Canada

Commitment for Amendments

This standard is issued jointly by the Canadian Standards Association (CSA) and Underwriters Laboratories Inc. (UL). Comments or proposals for revisions on any part of the standard may be submitted to CSA or UL at any time. Revisions to this standard will be made only after processing according to the standards development procedures of CSA and UL. CSA 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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Revisions of this Standard will be made by issuing revised or additional pages bearing their date of issue. A UL Standard is current only if it incorporates the most recently adopted revisions, all of which are itemized on the transmittal notice that accompanies the latest set of revised requirements.

The most recent designation of ANSI/UL 60745-2-1 as an American National Standard (ANSI) occurred on March 10, 2004.

This ANSI/UL Standard for Safety, which consists of the Second edition is under continuous maintenance, whereby each revision is ANSI approved upon publication. Comments or proposals for revisions on any part of the Standard may be submitted to UL at any time. Written comments are to be sent to UL-RTP Standard Department, 12 Laboratory Dr., P.O. Box 13995, Research Triangle Park, NC, 27709-3995.

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Preface

This is the common CSA and UL standard for hand-held motor-operated electric tools. It is the second edition of CAN/CSA-C22.2 No. 60745-2-1 and the second edition of UL 60745-2-1. This standard is based on IEC 60745-2-1, second edition.

The first edition of this standard was designated CAN/CSA-C22.2 No. 745-2-1/UL 745-2-1. This Standard CAN/CSA-C22.2 No. 60745-2-1/UL 60745-2-1, second edition, supersedes:

a) the first edition CAN/CSA-C22.2 No. 745-2-1/UL 745-2-1 published in 1995; and

b) CAN/CSA-C22.2 No. 745-4-1/UL 745-4-1, (requirements for battery tools and battery packs are now incorporated into the requirements of CAN/CSA-C22.2 No. 60745-2-1, second edition, and UL 60745-2-1, second edition).

The standard number has been aligned to correspond with the equivalent IEC 60745-2-1 standard.

This common standard was prepared by the Canadian Standards Association (CSA) and Underwriters Laboratories Inc. (UL).

This standard was reviewed by the CSA Subcommittee on Portable 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 approved as a National Standard of Canada by the Standards Council of Canada and has been approved by the American National Standards Institute (ANSI) as an American National Standard.

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.

A UL standard is current only if it incorporates the most recently adopted revisions, all of which are itemized on the transmittal notice that accompanies the latest set of revised requirements.

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

Level of harmonization

This standard adopts the IEC text with national differences. This standard is published as an equivalent standard for CSA 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.

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 literal interpretation 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.

CSA effective date

The effective date for CSA International will be announced through CSA Informs or a CSA certification notice.

UL effective date

As of June 1, 2007, all products Listed or Recognized by UL must comply with the requirements in this Standard.

Between March 26, 2004 and June 1, 2007, new product submittals to UL must be evaluated under all requirements in this Standard or, if requested in writing, evaluated under presently effective requirements only. The presently effective requirements are contained in the first edition of UL 745-2-1.

Alternate constructions, currently Listed to UL 45, eighth edition, may be evaluated to the first edition of UL 745-2-1 as referenced in the June 7, 2002 bulletin.

General

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.

National Differences from the text of the International Electrotechnical Commission (IEC) publication 60745-2-1 (Hand-Held Motor-Operated Electric Tools – Safety – Part 2-1: Particular Requirements for Drills and Impact Drills) are indicated by the following notation:

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 based on **safety practices**. These are differences for IEC requirements that may be acceptable, but adopting the IEC requirements would require considerable retesting or redesign on the manufacturer's part.

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**.

Foreword (CSA)

The Canadian Standards Association (CSA) develops standards under the name Canadian Standards Association, and provides certification and testing under the name CSA International. CSA International provides certification services for manufacturers who, under license from CSA, wish to use the appropriate registered CSA Marks on certain products of their manufacture to indicate conformity with CSA Standards.

CSA Certification for a number of products is provided in the interest of maintaining agreed-upon standards of quality, performance, interchangeability and/or safety, as appropriate. Where applicable, certification may form the basis for acceptance by inspection authorities responsible for enforcement of regulations. Where feasible, programs will be developed for additional products for which certification is desired by producers, consumers, or other interests. In performing its functions in accordance with its objectives, CSA does not assume or undertake to discharge any responsibility of the manufacturer or any other party. The opinions and findings of the Association represent its professional judgement given with due consideration to the necessary limitations of practical operation and state of the art at the time the Standard is processed.

Products in substantial accord with this Standard but which exhibit a minor difference or a new feature may be deemed to meet the Standard providing the feature or difference is found acceptable utilizing appropriate CSA International Operating Procedures. Products that comply with this Standard shall not be certified if they are found to have additional features which are inconsistent with the intent of this Standard. Products shall not be certifiable if they are discovered to contravene applicable laws or regulations.

Testing techniques, test procedures, and instrumentation frequently must be prescribed by CSA International in addition to the technical requirements contained in Standards of CSA. In addition to markings specified in the Standard, CSA International may require special cautions, markings, and instructions that are not specified by the Standard.

Some tests required by CSA Standards may be inherently hazardous. The Association neither assumes nor accepts any responsibility for any injury or damage that may occur during or as the result of tests, wherever performed, whether performed in whole or in part by the manufacturer or the Association, and whether or not any equipment, facility, or personnel for or in connection with the test is furnished by the manufacturer or the Association.

Manufacturers should note that, in the event of the failure of CSA International to resolve an issue arising from the interpretation of requirements, there is an appeal procedure: the complainant should submit the matter, in writing, to the Secretary of the Canadian Standards Association.

If this Standard is to be used in obtaining CSA Certification please remember, when making application for certification, to request all current Amendments, Bulletins, Notices, and Technical Information Letters that may be applicable and for which there may be a nominal charge. For such information or for further information concerning CSA Certification, please address your inquiry to Applications and Customer Service, CSA International, 178 Rexdale Boulevard, Toronto, Ontario, Canada M9W 1R3.

Foreword (UL)

A. This Standard contains basic requirements for products covered by Underwriters Laboratories Inc. (UL) under its Follow-Up Service for this category within the limitations given below and in the Scope section of this Standard. These requirements are based upon sound engineering principles, research, records of tests and field experience, and an appreciation of the problems of manufacture, installation, and use derived from consultation with and information obtained from manufacturers, users, inspection authorities, and others having specialized experience. They are subject to revision as further experience and investigation may show is necessary or desirable.

B. The observance of the requirements of this Standard by a manufacturer is one of the conditions of the continued coverage of the manufacturer's product.

C. A product which complies with the text of this Standard will not necessarily be judged to comply with the Standard if, when examined and tested, it is found to have other features which impair the level of safety contemplated by these requirements.

D. A product employing materials or having forms of construction which conflict with specific requirements of the Standard cannot be judged to comply with the Standard. A product employing materials or having forms of construction not addressed by this Standard may be examined and tested according to the intent of the requirements and, if found to meet the intent of this Standard, may be judged to comply with the Standard.

E. UL, in performing its functions in accordance with its objectives, does not assume or undertake to discharge any responsibility of the manufacturer or any other party. The opinions and findings of UL represent its professional judgment given with due consideration to the necessary limitations of practical operation and state of the art at the time the Standard is processed. UL shall not be responsible to anyone for the use of or reliance upon this Standard by anyone. UL shall not incur any obligation or liability for damages, including consequential damages, arising out of or in connection with the use, interpretation of, or reliance upon this Standard.

F. Many tests required by the Standards of UL are inherently hazardous and adequate safeguards for personnel and property shall be employed in conducting such tests.

INTERNATIONAL ELECTROTECHNICAL COMMISSION

HAND-HELD MOTOR-OPERATED ELECTRIC TOOLS – SAFETY – PART 2-1: PARTICULAR REQUIREMENTS FOR DRILLS AND IMPACT DRILLS

FOREWORD

1) The IEC (International Electrotechnical Commission) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the 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, the IEC publishes International Standards. Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. The 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 the 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 National Committees.

3) The documents produced have the form of recommendations for international use and are published in the form of standards, technical reports or guides and they are accepted by the National Committees in that sense.

4) In order to promote international unification, IEC National Committees undertake to apply IEC International Standards transparently to the maximum extent possible in their national and regional standards. Any divergence between the IEC Standard and the corresponding national or regional standard shall be clearly indicated in the latter.

5) The IEC provides no marking procedure to indicate its approval and cannot be rendered responsible for any equipment declared to be in conformity with one of its standards.

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

International Standard IEC 60745-2-1 has been prepared by sub-committee 61F: Safety of hand-held motor-operated electric tools, of IEC technical committee 61: Safety of household and similar electrical appliances.

This second edition cancels and replaces the first edition published in 1989 and amendment 1 (1992), of which it constitutes a technical revision.

The text of this standard is based on the following documents:

FDIS	Report on voting
61F/451/FDIS	61F/471/RVD

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

Annexes A, B, C, D, E, F, G and I form an integral part of this standard.

Annex J is for information only.

The committee has decided that the contents of this publication will remain unchanged until 2003. At this date, the publication will be:

– reconfirmed;

– withdrawn;

– replaced by a revised edition; or

– amended.

A bilingual version of this publication may be issued at a later date

HAND-HELD MOTOR-OPERATED ELECTRIC TOOLS – SAFETY – PART 2-1: PARTICULAR REQUIREMENTS FOR DRILLS AND IMPACT DRILLS

1 Scope

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

1.1 Addition:

This standard applies to drills and impact drills.

2 Normative references

This clause of part 1 is applicable.

3 Definitions

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

Additional definitions:

3.101 drill : tool specifically designed to bore holes in various materials such as metal, plastics, wood, etc.

3.102 impact drill : drill specifically designed to bore holes in concrete, stone and other materials. It is similar, in appearance and construction, to a drill, but has a built-in percussion system which gives an axial percussion movement to rotating output spindle

It may have a device for rendering the percussion system inoperative, so that it may be used as a conventional drill.

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:

5.5 Addition:

For drills which have both a mechanical means of setting different ranges of speed and an electronic means of setting the speed within a given range, the mechanical device is adjusted to the lowest range possible and the electronic device is adjusted to the highest setting within the given range.

6 Void

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 in revolutions per minute.

– maximum capacity, in millimetres, of the chuck.

8.12.1 Addition:

The following additional warnings are given; if in English they shall be verbatim and if in any other official language they shall be equivalent

– **Wear ear protectors with impact drills.** *Exposure to noise can cause hearing loss.*

– **Use auxiliary handles supplied with the tool.** *Loss of control can cause personal injury.*

8.12.1DV D1 ***Modification: Add the following item:***

– Hold power tools by insulated gripping surfaces when performing an operation where the cutting tool may contact hidden wiring or its own cord. *Contact with a "live" wire will make exposed metal parts of the tool "live" and shock the operator.*

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 Addition:

Tools are operated continuously 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.

12.3 The temperature-rise limit specified for the external enclosure does not apply to the enclosure of the hammer mechanism.

13 Leakage current

This clause of part 1 is applicable.

14 Moisture resistance

This clause of part 1 is applicable.

15 Electric strength

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:

Impact drills are operated 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 supply voltage equal to 1,1 times rated voltage and then for 12 h at a supply voltage equal to 0,9 times rated voltage. The speed is adjusted to the highest value of the highest range.

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

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.

The impact drills are then mounted vertically in a test apparatus as shown in Figure 101 and are operated at rated voltage or at the mean value of the rated voltage range, 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 should remain engaged.

During these tests, impact drills are 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".

During the tests, an axial force, just enough to ensure steady operation of the impact mechanism is applied to the impact drill through a resilient medium.

If the impact mechanism fails mechanically during the test without causing an accessible part to become live it may be replaced by a new one.

During these tests, overload protection devices shall not operate.

NOTE In general, external temperatures are to be monitored for purpose of avoiding mechanical failure.

17.2DV D1 *Modification: Add the following sentence:*

During the test, replacement of the carbon brushes shall be allowed, and the tool shall be oiled and greased as in normal use.

18 Abnormal operation

This clause of part 1 is applicable.

19 Mechanical hazards

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

19.1 Addition:

Chuck keys shall be so designed that they drop easily 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.

19.101 The force on the hand due to the static stalling torque shall not be excessive.

Compliance is checked by the following test:

Static stalling torque or slip torque of a clutch is measured on the locked output spindle of the tool in the cold condition (M_R).

The tool is connected to rated voltage. The mechanical gears are adjusted to the lowest speed. Electronic regulators are adjusted to their maximum speed setting. The tool switch is to be in the full "on" position. The mean value of the torque measured shall not exceed the relevant maximum value in Figure 102 and Figure 103.

20 Mechanical strength

This clause of part 1 is applicable.

21 Construction

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

21.18 Addition:

A switch lock-on device 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.

Compliance is checked by inspection or by a manual test.

A switch with a lock-on button in a recess within the grasping area shall not be actuated by a straight-edged utensil when the utensil is made to pass back and forth across the device in any direction. The straight-edged utensil may be of any convenient length sufficient to bridge the surface of the lock-on device and any surface adjacent to the lock-on device.

22 Internal wiring

This clause of part 1 is applicable.

23 Components

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

23.2 Replacement:

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

23.2DV D1 *Replacement: Add the following sentence:*

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

24 Supply connection and external flexible 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.

29 Resistance to heat, fire and tracking

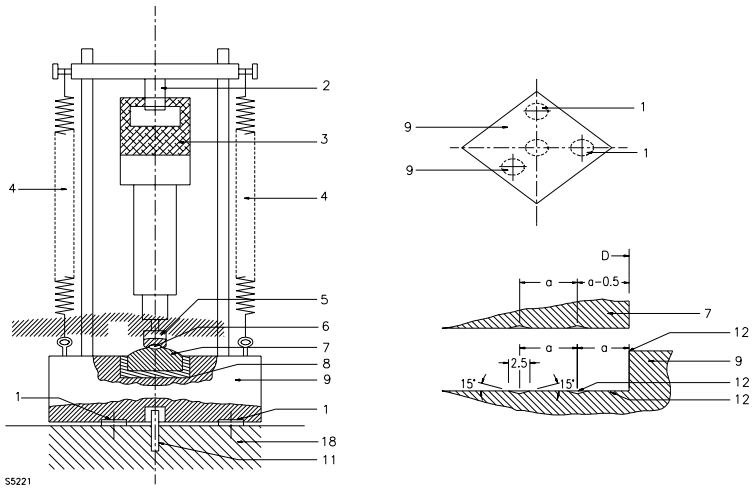
This clause of part 1 is applicable.

30 Resistance to rusting

This clause of part 1 is applicable.

31 Radiation, toxicity and similar hazards

This clause of part 1 is applicable.



Dimensions in millimetres

1. Synthetic rubber disk or material having similar properties, shore hardness 70° to 80°, thickness 10 mm, diameter 75 mm.
2. Polymide-lined 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, grooved on underside as shown in detail.
8. Synthetic rubber disk or material having similar properties, shore hardness 70° to 80°, 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. Bottom of cavity grooved, as shown in detail.
10. Concrete block supported by compacted ballast of earth.
11. Steel peg to prevent any horizontal movement.
12. Burnished surface and edge.

NOTE When submitting a tool, the applicant may supply, if necessary, a suitable punch and shank, the total mass of which is less than that specified in the following, for the steady operation of the impact mechanism.

Rated input of tool (W)	D Diameter of transfer plate (mm)	a Distance between centres of grooves (mm)	M_1 Mass of steel base (kg)	M_2 Mass of transfer plate (kg)	M_3 Total mass of punch and shank (kg)
Up to and including 700	100	6,5	90	1,0	0,7
Over 700 up to and including 1200	140	5,75	180	2,25	1,4
Over 1200 up to and including 1800	180	5,0	270	3,8	2,3
Over 1800 up to and including 2500	220	4,5	360	6,0	3,4

Figure 101 – Testing apparatus for hammers

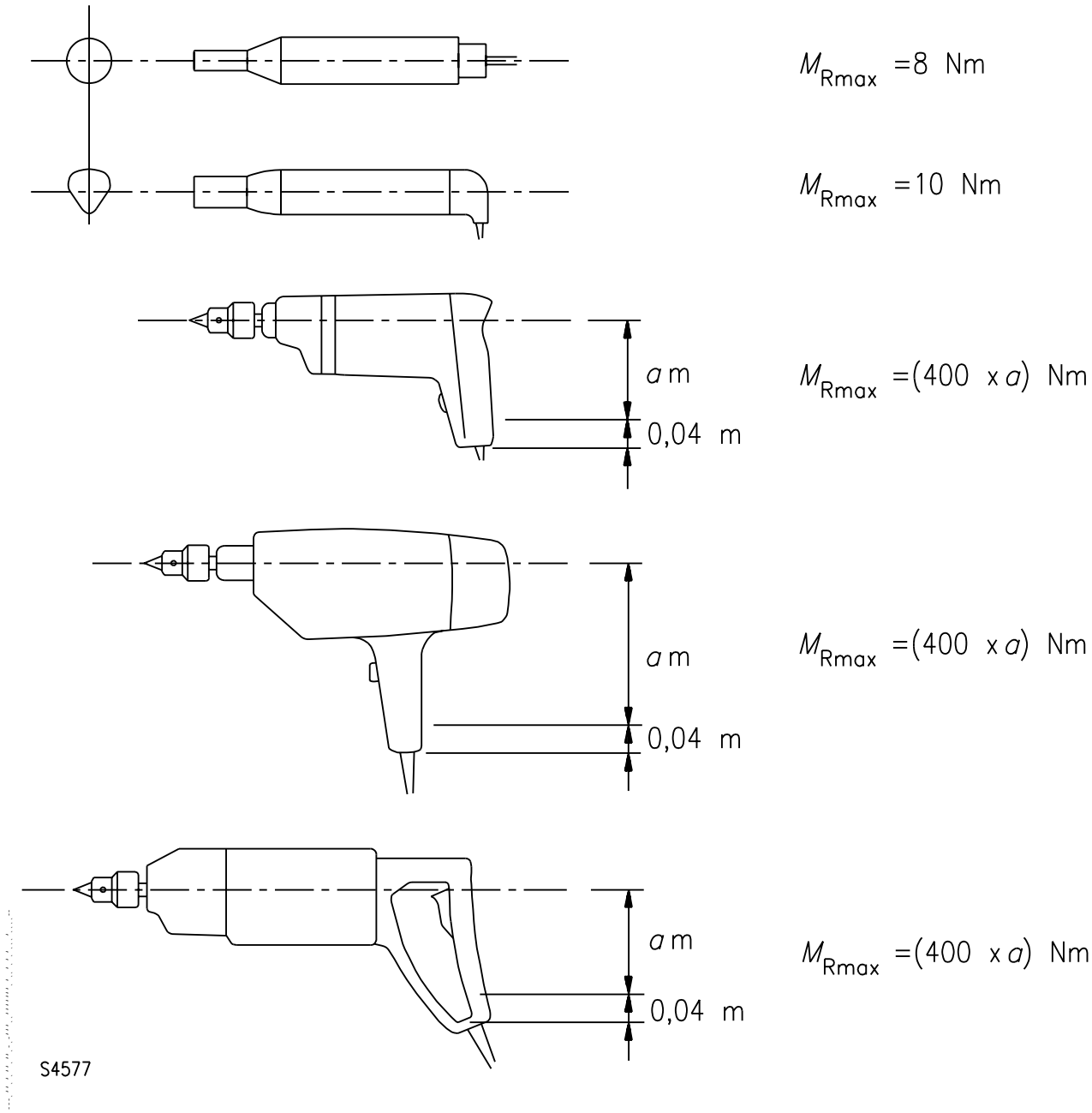


Figure 102 – Single-hand support

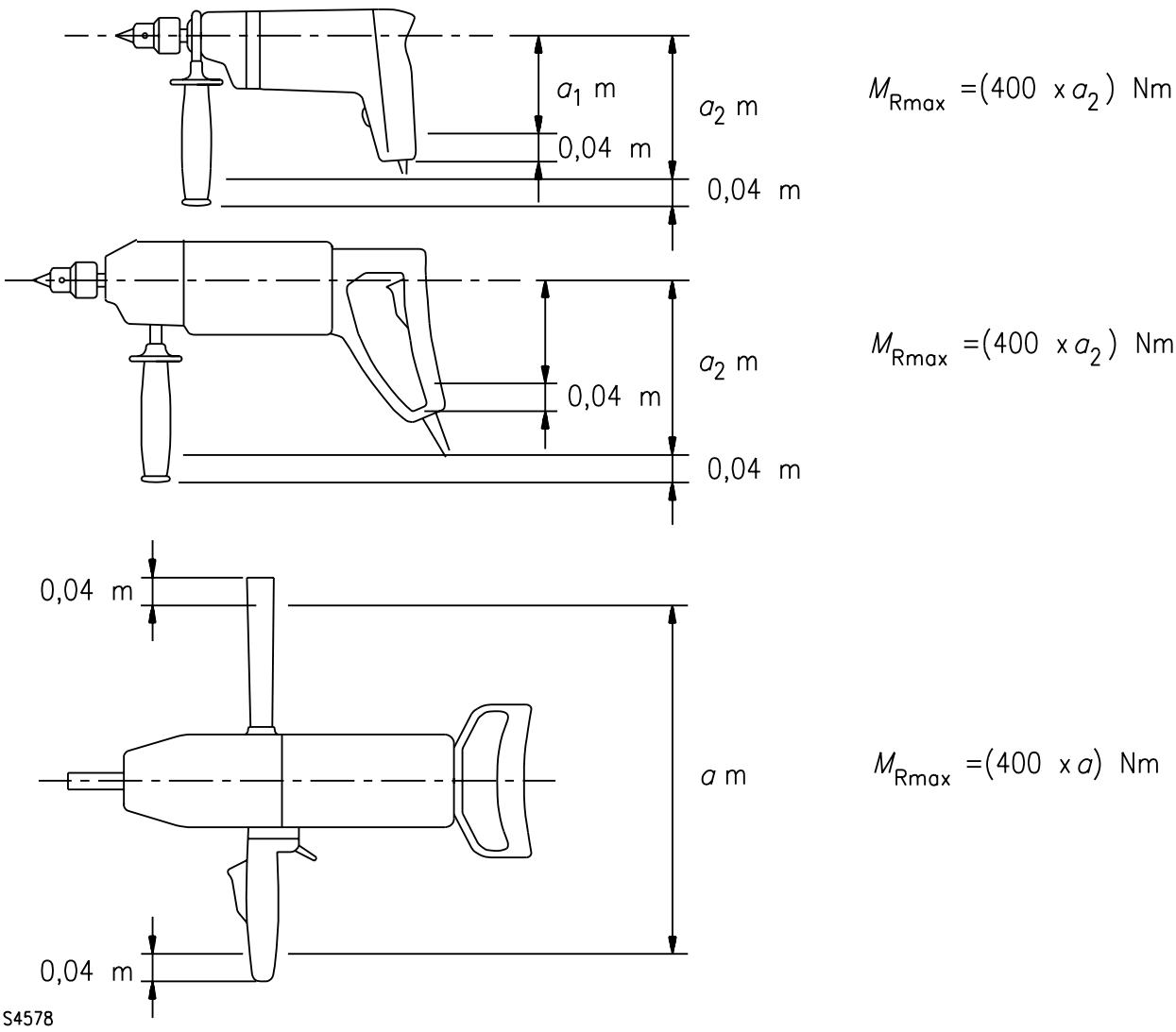


Figure 103 – Double-hand support

Annexes

The annexes A through J of part 1 are applicable.

Annex K – Battery Tool and Battery Packs

This annex of part 1 is applicable except as follows:

K.1.1 Addition:

All clauses of this Part 2 apply unless otherwise specified in this annex.

K.12.2 Replacement:

This sub-clause of Part 2 is not applicable.

K.17.2 Replacement :

This sub-clause of Part 2 is not applicable.

Annex L – Battery Tools and Battery Packs Provided with Mains Connection or Non-Isolated Sources

This annex of part 1 is applicable except as follows:

L.1.1 Addition:

All clauses of this Part 2 apply unless otherwise specified in this annex.

Annex 1.DVL – List of National Differences

Annex 1.DVL DE *Addition: Add the following Annex:*

Reference	National Difference Type
8.12.1DV	D1 Modification
17.2DV	D1 Modification
23.2DV	D1 Replacement
Annex 1.DVL	DE Addition

Bibliography

This bibliography of part 1 is applicable.