

# UL 745-3

## Portable Battery-Operated Tools

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UL Standard for Safety for Portable Battery-Operated Tools, UL 745-3

Second Edition, Dated October 8, 2007

### **Summary of Topics**

***This new Second edition of UL 745-3 was issued to clarify the UL effective date statement shown on the Preface page and to make other administrative changes. The technical content of the First edition has reproduced verbatim in this edition; the text of the standard has not been changed.***

***As noted in the Commitment for Amendments statement located on the back side of the title page, UL and CSA are committed to updating this IEC-based binational standard jointly. However, this Second edition dated October 8, 2007 will not be issued by CSA since it addresses UL only administrative changes.***

The UL Foreword is no longer located within the UL Standard. For information concerning the use and application of the requirements contained in this Standard, the current version of the UL Foreword is located on ULStandardsInfoNet at: <http://ulstandardsinfo.net/ulforeword.html>

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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that have been revised and that have a future effective date are located after the Standard, and are preceded by a "SUPERSEDED REQUIREMENTS" notice.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, Recognized and Follow-Up Services after the effective date, and understanding of this should be signified in writing.

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

| Page       | Date            |
|------------|-----------------|
| 1-42 ..... | October 8, 2007 |

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Canadian Standards Association  
CAN/CSA-C22.2 No. 745-3  
First Edition



Underwriters Laboratories Inc.  
UL 745-3  
Second Edition

## Portable Battery-Operated Tools

October 8, 2007

Approved  
by  
Standards Council  
of Canada

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## **Commitment for Amendments**

This Standard is issued jointly by Canadian Standards Association and Underwriters Laboratories Incorporated. Amendments to this Standard will be made only after processing according to the Standards writing procedures by both Canadian Standards Association and Underwriters Laboratories Incorporated.

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## Preface

This is the common CSA and UL Standard for portable battery-operated tools. It is the first edition of CSA Standard C22.2 No. 745-3 *Safety of portable battery-operated tools Part 3: General requirements* and the second edition of UL 745-3, *Safety of portable battery-operated tools Part 3: General requirements*. It is written in SI (metric) units.

This Standard was prepared by Canadian Standards Association and Underwriters Laboratories Inc. and is based on IEC Publication 745-1(1982) *Safety of hand-held motor-operated electric tools Part 1: General requirements*. Since no corresponding IEC document exists for battery-operated tools, these requirements are new and do not show deviations to IEC text.

This Standard contains general requirements and is intended to be used in conjunction with the appropriate particular requirements Standard (if available), which contains Clauses to supplement or modify the corresponding Clauses in the general requirements Standard, to provide the relevant requirements for each type of product.

If the functions of a tool are covered by different particular Standards, the relevant particular requirements Standard is applied to each function separately, so far as is reasonable. If applicable, the influence of one function on the other is taken into account.

This Standard was reviewed by the CSA Subcommittee on Portable Electric Tools of the Technical Committee on Consumer and Commercial Products under the jurisdiction of the Standards Steering Committee on the Canadian Electrical Code, Part II, and was formally approved by these Committees.

This Standard was processed and reviewed in accordance with the method of development, revision and implementation of UL Standards for safety.

This Standard has been approved by the Standards Council of Canada as a National Standard of Canada and has been approved by the American National Standards Institute (ANSI) as an American National Standard.

March 23, 1995

### UL Effective Date

The effective date for UL 745-3 is the date of publication.

### CSA Effective Date

The effective date for CSA will be announced through a *CSA Certification Notice*.

**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.*

## 1 Scope

1.1 This standard applies to portable battery operated tools rated 30 volts or less intended for indoor or outdoor use, in non-hazardous locations, in accordance with the Canadian Electric Code, Part 1 and the National Electrical Code (NFPA70).

This Part 3 is to be used in conjunction with the appropriate Part 4, which contains clauses which supplement or modify the corresponding clauses in Part 3 to provide the complete requirement for each sort of tool.

It also applies, as far as is reasonable, to tools not mentioned in Part 4 and to those designed on basically new principles.

Battery chargers are not within the scope of this standard.

This Standard applies to, but the scope is not limited to: portable battery operated tools, such as drills, screwdrivers, nut runners, hammers, impact wrenches, saws, sanders, polishers, buffers, shears, nibblers, grinders, and drain cleaners.

This standard applies to accessories and mechanical attachments for use with portable battery operated tools. These requirements are outlined in Appendix F.

These requirements do not cover gardening appliances, garage equipment, soldering irons or guns, painting equipment, floor-finishing machines, or other equipment covered by individual requirements.

## 2 Definitions

2.1 Where in this standard the expressions "With the aid of a tool," "Without the aid of a tool," and "requires the use of a tool" occur, the word "tool" means a screwdriver, a coin or any other object which may be used to operate a screw or similar fixing means.

2.2 The following definitions apply for the purpose of this standard:

1. **Rated voltage** denotes the voltage assigned to the tool by the manufacturer.
2. **Rated no-load speed** denotes the no-load speed at rated voltage.
3. **Detachable flexible cable or cord** denotes a flexible cable or cord intended to be connected to the tool and/or separable battery by means of a suitable appliance coupler.
4. **Non-detachable part** denotes a part which can only be removed with the aid of a tool.
5. **Detachable part** denotes a part which can be removed without the aid of a tool.
6. **Thermal cut-out** denotes a device which, during abnormal operation, limits the temperature of a tool, or of parts of it, by automatically opening the circuit or by reducing the current, and which is so constructed that its setting cannot be altered by the user.
7. **Non-self-resetting thermal cut-out** denotes a thermal cut-out which requires resetting by hand, or replacement of a part, in order to restore the current.
8. **Clearance** denotes the shortest distance between two conductive parts, or between a conductive part and the bounding surface of the tool, measured through air.

The bounding surface of the tool is the outer surface of the enclosure, considered as though metal foil are pressed into contact with accessible surfaces of insulating material.

9. **Accessible part or accessible surface** denotes a part or surface which can be touched by means of the standard test finger shown in Figure 1. For accessible metal parts, it includes any other metal which is in electrical contact with such parts.

10. The term **body** includes all accessible metal parts, shafts of handles, knobs, grips and the like and metal foil in contact with all surfaces of insulating material; it does not include inaccessible metal parts.

11. A **Type Test** is testing of a representative sample of the equipment with the objective of determining if the equipment, as designed and manufactured, can meet the requirements of this standard.

12. **Routine Servicing** denotes servicing of or replacement of motor brushes or fuses and other servicing that is recommended in the instruction manual to be performed by the user. It does not include maintenance that the instruction manual recommends be done by authorized service personnel.

13. **Detachable Battery** denotes a battery which is contained in a separate enclosure from the tool and is intended to be removed from the tool for charging purposes.

14. **Integral Battery** denotes a battery which is contained within the tool and is not removed from the tool for charging purposes. A battery that is to be removed from the tool for disposal or recycling purposes only is considered to be an integral battery.

15. **Separable Battery** denotes a battery which is contained in a separate enclosure from the tool and is connected to the tool by a cord.

### 3 General requirement

3.1 Tools shall be so designed and constructed that in normal use they function so as to reduce the risk of injury.

*In general, compliance is checked by confirming the tool meets the relevant construction requirements and by carrying out all the relevant tests.*

### 4 General notes on tests

4.1 *Tests according to this standard are type tests.*

4.2 *The recommended sequence of tests is given in Appendix G.*

If it is evident from the design of the tool that a particular test is not applicable, this test is not made. The testing of components may necessitate the submission of additional samples of these components.

When the submission of such samples is necessary, they should be submitted together with the tool.

*4.3 Unless otherwise specified, the tests are carried out with fully charged batteries and each test may be conducted on a new sample.*

Before testing is started, the tool is operated at rated voltage in order to verify that it is in working order.

*4.4 Unless otherwise specified, the tests are carried out at an ambient temperature of  $20 \pm 5^{\circ}\text{C}$ , with the tool being placed in the most unfavorable position which may occur in normal use.*

*4.5 Unless otherwise specified, tools for which alternative accessories are available shall be tested with that accessory within the manufacturer's specification which gives the most unfavorable results.*

*For accessories performing a function which is within the scope of one of the Part 4's, the tests are made in accordance with that of Part 4.*

*4.6 Unless otherwise specified, tools provided with a regulating device or a similar control shall be tested with these controls adjusted to their most unfavorable setting within the range specified by the manufacturer for the particular application, if the setting can be altered by the user.*

If the adjusting means of the control is accessible without the aid of a tool, this sub-clause applies whether the setting can be altered by hand or with the aid of a tool; if the adjusting means is not accessible without the aid of a tool, this sub-clause applies only if the setting can be altered by hand.

Adequate sealing is regarded as preventing alteration of the setting by the user.

## 5 Rating

5.1 The maximum rated voltage is 30 V d.c.

*Compliance is checked by inspection of the marking.*

## 6 Reserved

## 7 Marking

7.1 Tools shall be marked with:

- rated voltage(s), in volts;
- symbol for direct current;
- manufacturer's name, trade mark, or identification mark;

The manufacturer's identification may be in a traceable code if the tool is identified by the brand or trademark of a private labeler.

- manufacturer's model or type reference;
- date of manufacture;

The date of manufacture may be a dating period not exceeding any one month. The date of manufacture may be abbreviated or in established, accepted code or a code affirmed by the manufacturer. The code shall not require reference to the manufacturer's records to determine when the product was manufactured.

- rated no-load speed;

Applies only to tools with a rotating output means. A tool provided with more than one speed (by mechanical or electrical means) shall be marked with the no load speed with the unit in the highest possible speed setting. This does not apply to nut setters, screwdrivers, drain cleaners, belt sanders, and tools with predominately linear work function motion.

- Warning – To reduce the risk of injury, user must read and understand instruction manual.

The word "Warning" shall be in capital letters not less than 2.4 mm high.

The statement shall be verbatim except the term "Operator's manual" or "User guide" may be used for the term "instruction manual."

The word "Warning" shall not be separated from the cautionary statement.

If a nameplate that must be removed for normal servicing of the tool carries a required marking, the construction shall be such that the nameplate must be returned to its proper location for the tool to be operable;

A required marking shall be permanent and shall be located on a part permanently attached to the tool or on a part that cannot be removed without impairing the operation or the appearance of the tool;

7.1.1 Cautionary markings shall be used verbatim as stated. Optional cautionary statements may be added to the markings, as deemed necessary, by the manufacturer. Cautionary statements having the same signal word may be combined into one paragraph under one signal word. The order of statements shall be markings required by Part 3, Markings required by the applicable Part 3, and any optional markings.

7.1.2 In cases where danger, warning, and caution appear together, the cautionary markings shall be in the order of severity, i.e., danger, warning, and caution.

7.2 Enclosures containing separable or detachable batteries shall be marked with:

- rated voltage(s), in volts;
- symbol for direct current;
- manufacturer's name, trade mark, or identification mark;

The manufacturer's identification may be in a traceable code if the tool is identified by the brand or trademark of a private labeler.

- manufacturer's model or type reference.

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

7.4 When symbols are used, they shall be as follows:

|                                                                                   |       |                                         |
|-----------------------------------------------------------------------------------|-------|-----------------------------------------|
| V                                                                                 | ..... | volts                                   |
|  | ..... | direct current                          |
| $n_0$                                                                             | ..... | no load speed                           |
| .../min                                                                           | ..... | revolutions or reciprocation per minute |

The symbol for nature of supply shall be placed next to the marking for rated voltage.

7.5 A push-button shall be colored red only if it serves to open the circuit to be controlled and has no other function.

This requirement does not apply to push-buttons used for locking the mains switch. This requirement refers to emergency-off switches only and does not preclude the use of red trigger, rocker, toggle, or other switches and controls.

For tools which might result in a risk of injury when started unexpectedly, the "off" position of the mains switch shall be indicated, unless this position is obvious; the indication, if required, shall be the figure 0.

The figure 0 shall not be used for any other indication.

This requirement does not preclude the use of the figure 0 for the minimum setting of a variable speed control, 0 degree, 0 depth of cut, or similar indication.

7.6 Regulating devices and the like, intended to be adjusted during operation shall be provided with an indication for the direction of adjustment to increase or to decrease the value of the characteristic being adjusted.

An indication of + and - is considered to be sufficient.

If figures are used for indicating the different positions, the "off" position shall be indicated by the figure 0 and the position for a greater output, input, speed, or the like, shall be indicated by a higher figure.

The first requirement does not apply to regulating devices provided with an adjusting means, if its "fully-on" position is opposite to its "off" position.

The indications for the different positions of the operating means of a control device need not be placed on the device itself.

7.7 Cautionary markings shall be written in the official language(s) of the country in which the tool is to be sold. See Appendix H for translations.

Where symbols are used, they shall be those indicated in this standard.

*Compliance with the requirements of Sub-clauses 7.1 to 7.7 is checked by inspection.*

## 7.8 Required markings shall be easily visible, legible and durable.

To comply with this clause a required marking shall be etched, molded, die-stamped, paint-stenciled; permanently secured, stamped, or etched metal; or indelibly stamped lettering on pressure-sensitive labels secured by adhesive. Ordinary usage, handling, storage, and the like, of the tool will be considered in determination of the permanence of the required marking.

Required marking specified in Sub-clauses 7.1 to 7.7 shall be on a main part of the tool in such a way that it is clearly discernible when the tool is ready for use.

Marking on, and indications for, switches, thermostats, thermal cut outs and other control devices shall be placed in the vicinity of these components; they shall not be placed on removable parts if these parts can be replaced in such a way that the marking is misleading.

*Compliance is checked by inspection and, if a label has not been evaluated in accordance with the relevant standard in Appendix E, the following tests:*

*After being subjected to the conditions described below, a pressure sensitive label or a label secured by cement or adhesive is considered to be of a permanent nature if (1) immediately following removal from each test medium and (2) after being exposed to room temperature for 24 hours following removal from each medium:*

- A. Each sample demonstrates good adhesion and the edges are not curled.*
- B. The label resists defacement or removal as demonstrated by scraping across the test panel with a flat steel blade, held at right angles to the test panel. The blade is to be 1/32 inch (0.8 mm) thick and of any convenient width.*
- C. The printing is legible and is not defaced by rubbing with thumb or finger pressure.*

### Label heating test

*Three samples of the label applied to test surfaces as in the intended application are to be placed for 240 hours in an oven maintained at the temperature specified in the following table.*

| <b>Temperatures, heating</b>                                                      |                           |
|-----------------------------------------------------------------------------------|---------------------------|
| <b>Maximum Temperature During Temperature Test of Surface to Which Applied °C</b> | <b>Oven Temperature°C</b> |
| 60 or less                                                                        | 87                        |
| 80 or less                                                                        | 105                       |
| 100 or less                                                                       | 121                       |
| 125 or less                                                                       | 150                       |
| 150 or less                                                                       | 180                       |
| over 150                                                                          | a                         |

Table Continued

| Temperatures, heating                                                                                                                                                                                                                                         |                     |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|
| Maximum Temperature During Temperature Test of Surface to Which Applied °C                                                                                                                                                                                    | Oven Temperature °C |
| <sup>a</sup> A label that is applied to a surface attaining a temperature greater than 150°C during the temperature test, is to be heated at a temperature representative of the temperatures attained by the appliance during intended use and abnormal use. |                     |

*Label immersion tests*

Six samples of the labels applied to test surfaces as in the intended application are to be placed in a controlled atmosphere maintained at  $23.0 \pm 2.0^\circ\text{C}$  with a  $50 \pm 5$  percent relative humidity for 24 hours. Three samples are then to be immersed in water and three samples immersed in IRM 903 (Calumet Oil No. 3) as specified in Tests for Rubber Property – Effect of Liquids ANSI/ASTM D 471-1979 at a temperature of  $21.0 \pm 2.0^\circ\text{C}$  for 48 hours in each case.

*Label standard atmosphere test*

Three samples of the label applied to test surfaces as in the intended application are to be placed for 72 hours in a controlled atmosphere maintained at  $23.0 \pm 2.0^\circ\text{C}$  with a  $50 \pm 5$  percent relative humidity.

After all the tests of this standard, the required marking shall be easily legible; it shall not be easily possible to remove the required marking plates and they shall show no curling.

**8 Protection against electric shock**

8.1 Handles and grasping surfaces containing switch operating means, shall be formed of insulating material or, if of metal, shall be adequately covered by insulating material.

Compliance is checked by inspection and the test of Clause 15.

**9 Reserved****10 Reserved****11 Heating**

11.1 Tools shall not attain excessive temperatures under a no-load condition.

Compliance is checked by determining the temperature rise of the various parts under the following conditions.

The tool is operated at no load until thermal equilibrium is reached or battery is totally discharged. At the manufacturer's option, the tool may be tested under a normal load condition based on normal use as recommended in the instruction manual.

During the test, thermal cut-outs shall not operate. The temperature rises shall not exceed the values shown in the following table.

| Parts                                                                                                        | Temperature Rise °C |
|--------------------------------------------------------------------------------------------------------------|---------------------|
| External enclosure, except handles held in normal use                                                        | 60                  |
| Handles, knobs, grips, and the like which, in normal use, are continuously held:                             |                     |
| – of metal                                                                                                   | 30                  |
| – of porcelain or vitreous material                                                                          | 40                  |
| – of molded material, rubber, or wood                                                                        | 50                  |
| Handles, knobs, grips, and the like, which in normal use are held for short periods only (e.g. of switches): |                     |
| – of metal                                                                                                   | 35                  |
| – of porcelain or vitreous material                                                                          | 45                  |
| – of molded material, rubber, or wood                                                                        | 60                  |
| Parts in contact with oil having a flash point of t °C                                                       | t-50                |

*Thermal cut-outs and overload releases shall not operate during the heating test.*

## 12 Reserved

## 13 Reserved

## 14 Reserved

## 15 Electric strength

15.1 The electric strength of handles and grasping surfaces shall be adequate.

*Compliance is checked by inspection and by the following test.*

*The insulation is subjected for 1 min to a voltage of substantial sine-wave form, having a frequency of 50 Hz or 60 Hz. Test voltage of 1000 V is applied between the output shaft and handles or grasping surfaces.*

*Initially not more than half the prescribed voltage is applied, then it is raised rapidly to the full value.*

*No flashover or breakdown shall occur during the test.*

Care is taken that the metal foil is so placed that no flashover occurs at its edges. This test is only conducted on tools having an output shaft, cutting blade, or bit.

## 16 Reserved

## 17 Abnormal operation

17.1 Tools shall be so designed to reduce the risk of fire as a result of an abnormal condition.

*Compliance is checked by the following tests.*

*The tool or battery pack is to be placed on a soft wood surface covered by two layers of tissue paper; the tool or battery pack is covered by one layer of cheese cloth. The tests are to be conducted with the battery pack fully charged and the on-off switch fully actuated. No charring or burning of the cheesecloth or tissue paper shall result when a tool and battery pack are subjected to any one of the following fault conditions.*

1. *The terminals of any capacitor open or shorted.*
2. *Any two terminals of any semiconductor open or shorted.*
3. *A short is introduced in any accessible cord between tool and charger.*

The cord is to be shorted at the point most likely to produce adverse affects. The cord is to be covered with a 12.7 mm layer of dry absorbent surgical cotton.

4. *The motor terminals are shorted.*
5. *The motor rotor is locked.*
6. *The terminals of a removable battery pack with exposed terminals are shorted.*

Battery pack terminals that can be contacted using either Figure 1 or Figure 2 probes are considered exposed. The means of shorting shall not attain excessive temperatures so as to char or ignite the tissue paper or cheese cloth.

7. *Any two uninsulated live parts of opposite polarity not in accordance with the spacings given in Clause 27.*
8. *A short circuit is introduced between the tool and the separable battery pack.*

The cord is to be shorted at the point most likely to produce adverse affects. The cord is to be covered with a 12.7 mm layer of dry absorbent surgical cotton.

*One shot, non-resettable thermal cut-outs and overload releases may operate during the above tests. In this case, the same test is to be repeated 3 more times, using 3 additional samples.*

*Resettable thermal cut-outs and overload releases may operate during the above tests. In this case, the device shall comply with Appendix A.*

*Shorts are to be introduced in such a manner as to provide negligible additional resistance to the circuit.*

The conditions above are to be maintained until ultimate results occur, using one fully charged tool or pack. A new sample may be used for each test.

Charring is defined as a blackening of the cheesecloth caused by combustion. Discoloration of the cheesecloth caused by smoke is acceptable.

17.2 Switches or other devices for reversing the motor shall withstand the stresses occurring when the direction of rotation is changed under running conditions, if such a change is possible in normal use.

*Compliance is checked by the following test.*

*The tool is operated with a fully charged battery, with no load, the device for reversing the direction of rotation being in a position such that the rotor rotates in one direction at full speed. The device is then placed in the position in which the direction of the rotation is reversed, without stopping in an intermediate "off" position.*

*This sequence of operating is performed 25 times.*

*During the test, no electrical or mechanical failure of the device and no burning or undue pitting of the contacts shall occur.*

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