

Subject 2595

March 23, 2018

SUMMARY OF TOPICS

The following changes in requirements to the Standard for General Requirements for Battery-Powered Appliances, UL 2595, are being proposed for preliminary review and comment only:

1. For Preliminary Review Only: Proposed Third Edition Of UL 2595/CSA C22.2 No. 0.23, General Requirements for Battery-Powered Appliances

COMMENTS DUE: May 4, 2018

This proposal is for review and comment only (no ballot at this time). Please note that comments on a preliminary review document will not receive a response from the proposal author through CSDS. Instead, the proposal author will be asked to review the comments and adjust the proposals and/or supporting rationale as the author determines to be appropriate. The preliminary review process is an informal mechanism that provides authors with the opportunity to refine their proposals before they advance to the next stage in UL's standards development process.

In some cases, the author of the proposals may choose to discontinue them. In this case, the author need not do anything after preliminary review has ended. Normally, the next step in the process is the more formal STP ballot and stakeholder review process. Only comments posted during the STP ballot and stakeholder review process will be provided with a response in CSDS.

For your convenience in review, proposed additions to existing requirements are shown underlined and proposed deletions are shown ~~lined-out~~.

1. For Preliminary Review Only: Proposed Third Edition Of UL 2595/CSA C22.2 No. 0.23, General Requirements for Battery-Powered Appliances

RATIONALE

Proposal submitted by: Joseph Harding, Power Tool Institute on behalf of the Technical Harmonization Committee (THC), Battery-Powered Appliances, responsible for UL 2595/C22.2 No. 0.23.

Summary of Technical Changes

The third edition of the Standard for General Requirements for Battery-Powered Appliances, UL 2595/CSA C22.2 No. 0.23 is being proposed. To help in the review process, the following is a summary of the technical changes. The technical changes have also been denoted by legislative marking (strikeout and underline.)

a) Revision to requirements with respect to the maximum rated voltage and use of general purpose batteries in Scope, Clause 1;

b) Update of Normative references, Section 2.2;

- c) New and clarified various definitions. New definitions include Artificial Source, External Flexible Cord, Insulation Touch Current, Power Switch, Replaceable Battery, Switched Circuit and Working Voltage;
- d) Clarification of general conditions and new Artificial Source requirements for replaceable batteries in General Conditions for the Tests, Clause 5;
- e) New and revised requirements for label testing markings and instructions for hazardous voltages, USB power sources and correlation, in Markings, Clause 6 and new and revised requirements in Instructions, Clause 7;
- f) Clarification with respect to hazardous voltage, protective impedance, uninsulated energized parts and electric strength in Protection Against Electric Shock, Clause 8;
- g) Clarifications of heating test requirements in Heating, Clause 9;
- h) Clarification of normal charging of lithium systems in Normal Charging of Lithium-Ion Systems, Clause 10;
- i) New and revised requirements for abnormal conditions for replaceable batteries and electronically commutated motors, Clause 11.1; Clarification on electronic circuit evaluations, Clause 11.2; Clarifications of electronic circuit fault evaluations, Clause 11.3; Clarification of safety critical function circuits in Clause 11.6 with electronic circuit fault conditions specified in Clause 11.7, and clarification that the functional safety of lithium-ion charging systems is specified in Clause 11.8; Clarification of lithium-ion charging systems where the electronic circuit fault conditions are specified in 11.9.1 where the analyses shall consider all possible output states and signals of the part independent of the internal functioning of the part, including software; Revision to requirements for lithium-ion battery short circuit, Clause 11.10; Clarification in requirements for batteries other than lithium-ion overcharging test, Clause 11.11; New requirements for USB powered battery or USB powered battery operated appliances where the tests are conducted to determine the effect of the charging circuit due to a faulty USB higher output voltage. New requirements for Backfeed protection, Clause 11.13;
- j) Clarification to Mechanical Hazards regarding venting of batteries, Clause 12;
- k) Revisions to mechanical strength requirements for attachments, batteries, and stability in mechanical strength in Mechanical Strength, Clause 15;
- l) Revisions for appliances that can accept general purpose batteries, exception to allow mains appliance coupler, exception where the connector is intended to be supplied by a class 2 power unit where higher voltages are introduced and additional tests required per Clause 10 if the connection is used for charging, clarification for harnesses and revisions for appliances having driving belts in Construction, Clause 16;
- m) Revisions to requirements for parts that move relative to each other in Internal Wiring, Clause 17;
- n) New requirements for power switches where it shall not be possible to achieve the two actions with a single grasping motion or a straight line motion, Clause 18.5; clarification of protective devices, Clause 18.10; coin cell batteries in Components, Clause 18.12; revisions to address PTC and NTC devices, Clause 18.13;
- o) New and revised requirements for external flexible cords and insulation of conductors for hazardous voltages in External Flexible Cords, Clause 19;

p) New and revised requirements for creepage and clearance distances for Working Voltages and for switched and non-switched circuits in Creepage Distance, Clearances and Distances Through Insulation, Clause 20;

q) Revised requirements for glow wire and new resistance to tracking requirements in Resistance to Heat and Fire, Clause 21;

r) Revised requirements for safety isolating transformers, Additional Requirements for Battery Operated Appliances with a Connection to Mains or a Non-isolated Source, Clause 22;

s) Revised requirements for Appliances Intended to be Powered or Charged by an Automotive Adapter, Clause 23;

t) New requirements for products (the appliance or charging system) intended to be powered or charged by a universal serial bus (USB) power source(s) in Charging System Powered by a Universal Serial Bus (USB) Power Source(s), Clause 24;

u) New requirements for products or battery pack(s) with USB outputs in Products or Battery Pack(s) With USB Outputs, Clause 25;

v) New requirements for moisture resistance for appliances with a working voltage that is a hazardous voltage in Moisture Resistance, Clause 26, and Measurement Of Insulation Touch Current For Battery Operated Appliances, Annex F.

Summary of Editorial Changes

This proposed third edition includes editorial changes as summarized below. To help in the review process, the editorial changes have not been denoted in the text of the standard.

- Standard renumbered
- References updated
- Changes for clarification, consistency and grammar.

PROPOSAL

1 Scope

1.1 This standard applies to **battery** operated **appliances**. This standard applies to **appliances** incorporating detachable, integral and **separable battery packs**. The maximum rated voltage for **appliances** and **battery packs** is 75 250V d.c.

1.2 This standard also applies to **battery**-powered **appliances** that are also operated and/or charged directly from the **mains** or a **non-isolated source**, including **appliances** provided with **integral battery chargers**. The additional considerations for these constructions are contained in Additional Requirements for Battery Operated Appliances with a Connection to Mains or a Non-isolated Source, Clause 22.

1.3 These requirements are structured so as to be used in conjunction with an end product standard. These requirements are not intended to provide comprehensive evaluation of a **battery** operated **appliance** independent of an end-product standard.

1.4 These requirements only address the potential risks unique to the utilization of a **battery** supply in a product. With the exception of **appliances** that also have a **mains** or **non-isolated source**, these requirements replace or modify the requirements associated with risk of fire and electric shock for **mains** powered versions of the **appliance** in the end product standard. See Indent A in Table D1.1.

1.5 Conditions of use of the product that are the basis for test and other evaluations in the standard are retained and applied, as far as practicable, to these products employing a **battery** supply.

1.6 **Battery** operated **appliances** not able to be connected to **mains** connected power covered by this standard are not considered to be **grounded (class I) or double-insulated (class II) appliances** and therefore are not required to have basic, supplementary or reinforced insulation. Electric shock hazard is considered to exist only between parts of opposite polarity.

~~1.7 **Battery** packs for **appliances** covered under this standard intended to be charged by a non-isolated **charger** are to be evaluated by this standard and the requirements for protection against electric shock of the end-product standard. When evaluating a **battery** pack for protection against electric shock, the construction and test requirements are to be assessed with the **battery** fitted to the intended **charger**.~~

1.7 When evaluating the risk of **fire** associated with **detachable battery packs**, consideration has been given to the fact that these **battery** packs are unattended energy sources and have been evaluated as such in this standard. **Detachable battery packs** evaluated by this standard are therefore considered to fulfill an effective protection against the risk of **fire** equivalent to that of the end-product standard.

1.8 Since **battery packs** for **appliances** are subjected to different use patterns (such as rough use, high charging and discharging currents) their safety can be evaluated only by this standard and not by using other standards for **battery packs**, such as UL 2054, or IEC 62133 or UL 62133 and CAN/CSA E62133 unless otherwise indicated in this standard. All relevant aspects related to the safety of **batteries** are addressed in this standard, such that the requirements of IEC 62133 or UL 62133 and CAN/CSA E62133 need not be separately applied.

1.9 This standard does not apply to the safety of **battery chargers** themselves. However, this standard covers the safe functioning of lithium-ion **battery systems**.

1.10 This standard also addresses requirements covering the use of lithium-ion **cells** employed in **battery systems** in **appliances**. The following is considered within the context of these requirements:

- a) These requirements address the risk of **fire** or **explosion** of these **batteries** but do not cover any possible hazards associated with toxicity nor potential hazards associated with transportation or disposal.
- b) **Battery systems** covered by these requirements are not intended to be serviced by the end user.
- c) These requirements are intended to provide comprehensive evaluation of a **battery** only if used in products covered by this standard.
- d) These requirements refer to and require parameters supplied in reference to the **cells** that establish conditions for safe use of those **cells**. Those parameters form the basis of acceptance criteria for a number of tests contained herein. This standard does not independently evaluate the safety of **cells**. These parameters, taken as a set, constitute the “**Specified Operating Region**” for a **cell**. There may be several sets of **specified operating region(s)**.

1.11 This standard is ~~not~~ intended to apply to **appliances** using **general purpose batteries** installed by the user, ~~and this standard alone will not be sufficient to ensure all hazards are considered for these products’ “battery packs”.~~

1.12 These requirements do not consider the effect of special applications (such as medical **appliances**) or special environments (such as hazardous locations).

1.13 These requirements have not been assessed for their suitability for product categories other than **appliances** such as information technology equipment, telecommunications, laboratory equipment, fire alarm, security systems, emergency lighting, and audio-video apparatus, and may be incomplete with respect to those categories.

1.14 These requirements address the safety of **battery systems** during storage and use including discharge and charge. These requirements are only considered to be supplementary requirements with respect to the risk of **fire** and electric shock in **battery chargers**. The safety of **battery chargers** for **appliances** are covered by other standards such as UL 1012, UL 1564, CAN/CSA C22.2 No. 107.2, UL 1310, CAN/CSA C22.2 No. 223, or UL 60950-1 and CAN/CSA C22.2 No. 60950-1.

1.15 These requirements make frequent reference to the conditions and tests of the end-product standard while also providing minimum conditions or severity of tests. These minimum conditions are not to be construed to imply equivalence to end-product requirements. Conditions or requirements of end-product standards are to prevail over the conditions or requirements of this standard, unless otherwise indicated in this standard.

1.16 This standard is not intended to cover **appliances** using lithium-metal type **cells**, and this standard alone will not be sufficient to ensure all hazards are considered for these types of **cells**. Lithium-ion **cells** are not lithium-metal **cells**.

2 General

2.1 Units of measurement

2.1.1 The values given specified in SI (metric) units shall be normative. Any other values given shall be for information purposes only.

2.2 Normative references

2.2.1 The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. Where reference is made to any Standards, such reference shall be considered to refer to the latest editions and revisions thereto available at the time of printing, unless otherwise specified.

2.2.2 For products intended for use in Canada, general requirements are given in CAN/CSA-C22.2 No. 0.

CSA Group Standards

CAN/CSA C22.2 No. 0

General Requirements – Canadian Electrical Code, Part I

CAN/CSA C22.2 No. 0.17

Evaluation of Properties of Polymeric Materials

CSA C22.2 No. 14

Industrial Control Equipment

CSA C22.2 No. 66.1

Low Voltage Transformers – Part 1: General Requirements

CSA C22.2 No. 66.2

Low Voltage Transformers – Part 2: General Purpose Transformers

CSA C22.2 No. 66.3

Low Voltage Transformers – Part 3: Class 2 and Class 3 Transformers

CSA C22.2 No. 107.1

General Use Power Supplies

CAN/CSA C22.2 No. 107.2

Battery Chargers

CAN/CSA C22.2 No. 223

Power Supplies With Extra-Low-Voltage Class 2 Outputs

CAN/CSA C22.2 No. 60950-1

Information Technology Equipment – Safety – Part 1: General Requirements

CSA C22.2 No. 299

Switching and Metering Centres

CAN/CSA-C22.2 No. 62841-1

Electric Motor-Operated Hand-Held Tools, Transportable Tools And Lawn And Garden Machinery – Safety – Part 1: General Requirements

CAN/CSA E60384-14

Fixed Capacitors for Use in Electronic Equipment – Part 14: Sectional Specification – Fixed Capacitors for Electromagnetic Interference Suppression and Connection to the Supply Mains

CAN/CSA E60730-1Automatic Electrical Controls – Part 1: General Requirements

CAN/CSA E62133

Secondary Cells and Batteries Containing Alkaline or Other Non-acid Electrolytes – Safety Requirements for Portable Sealed Secondary Cells, and for Batteries Made from Them, for Use in Portable Applications

CSA Component Acceptance Notice No. 5A

Component Acceptance Service for Optocouplers and Related Devices

CSA TIL No. CA-3A

Component Acceptance Requirements for PTC Thermistors for Overcurrent Protection in Electrical and Electronic Equipment

UL Standards

UL 94

Tests for Flammability of Plastic Materials for Parts in Devices and Appliances

UL 508

Industrial Control Equipment

UL 746B

Polymeric Materials – Long Term Property Evaluations

UL 746E

Polymeric Materials – Industrial Laminates, Filament Wound Tubing, Vulcanized Fibre, and Materials Used in Printed Wiring Boards

UL 969

Marking and Labeling Systems

UL 1012

Power Units Other Than Class 2

UL 1310

Class 2 Power Units

UL 1434

Thermistor-Type Devices

UL 1564

Industrial Battery Chargers

UL 1577

Optical Isolators

UL 2054

Household and Commercial Batteries

UL 2089

Vehicle Battery Adapters

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UL 4200A

Products Incorporating Button or Coin Cell Batteries of Lithium Technologies

UL 5085-1

Low Voltage Transformers – Part 1: General Requirements

UL 5085-2

Low Voltage Transformers – Part 2: General Purpose Transformers

UL 5085-3

Low Voltage Transformers – Part 3: Class 2 and Class 3 Transformers

UL 60384-14

Fixed Capacitors for Use in Electronic Equipment – Part 14: Sectional Specification: Fixed Capacitors for Electromagnetic Interference Suppression and Connection to the Supply Mains

UL 60950-1

Information Technology Equipment – Safety – Part 1: General Requirements

UL 62133

Secondary Cells and Batteries Containing Alkaline or Other Non-Acid Electrolytes – Safety Requirements For Portable Sealed Secondary Cells, and for Batteries Made from Them, for Use in Portable Applications

UL 62841-1

Electric Motor-Operated Hand-Held Tools, Transportable Tools And Lawn And Garden Machinery – Safety – Part 1: General Requirements

IEC Standards

IEC 60065:2014

Audio, Video, and Similar Electronic Apparatus-Safety Requirements

IEC 60112:2009

Method For The Determination Of The Proof And The Comparative Tracking Indices Of Solid Insulating Materials

IEC 60384-14:2016

Fixed Capacitors for Use in Electronic Equipment – Part 14: Sectional Specification – Fixed Capacitors for Electromagnetic Interference Suppression and Connection to the Supply Mains

IEC 60384-16:2005

Sectional Specification: Fixed Metallized Polypropylene Film Dielectric D.C. Capacitors

IEC 60417

DATABASE – Graphical Symbols For Use On Equipment

IEC 60529:2013

Degrees of Protection Provided by Enclosures (IP Code)

IEC 60664-1:2007

Insulation Coordination For Equipment Within Low-Voltage Systems – Part 1: Principles, Requirements And Tests

IEC 60664-3:2016

Insulation Coordination For Equipment Within Low-Voltage Systems – Part 3: Use Of Coating, Potting Or Moulding For Protection Against Pollution

IEC 60695-2-11:2014

Fire Hazard Testing – Part 2-11: Glowing/Hot-Wire Based Test Methods – Glow-Wire Flammability Test Method For End-Products (Gwept)

IEC 60695-2-13:2012

Fire Hazard Testing – Part 2-13: Glowing/Hot-Wire Based Test Methods – Glow-Wire Ignition Temperature (Gwit) Test Method For Materials

IEC 60695-11-10:2014

Fire Hazard Testing – Part 11-10: Test Flames – 50 W Horizontal And Vertical Flame Test Methods

IEC 60695-2-11:2014

Fire Hazard Testing – Part 2-11: Glowing/Hot-Wire Based Test Methods – Glow-Wire Flammability Test Method for End-Products

IEC 60695-2-12:2014

Fire Hazard Testing – Part 2-12: Glowing/Hot-Wire Based Test Methods – Glow-Wire Flammability Index (GWGI) Test Method For Materials

IEC 60695-2-13:2012

Fire Hazard Testing – Part 2-13: Glowing/Hot-Wire Based Test Methods – Glow-Wire Ignition Temperature (GWIT) Test Method for Materials

IEC 60695-10-2:2014

Fire Hazard Testing – Part 10-2: Abnormal Heat – Ball Pressure Test

IEC 60695-11-10:2013

Fire Hazard Testing – Part 11-10: Test Flames – 50 W Horizontal and Vertical Flame Test Methods

IEC 60730-1:2015

Automatic Electrical Controls – Part 1: General Requirements

IEC 60990:2016

Methods Of Measurement Of Touch Current And Protective Conductor Current

IEC 61000-4-2:2008

Electromagnetic Compatibility (Emc) – Part 4-2: Testing and Measurement Techniques – Electrostatic Discharge Immunity Test

IEC 6100-4-3:2008

Energy Power and Technology

IEC 61032:1997

Protection of Persons and Equipment by Enclosures – Probes for Verification

IEC 61056-1:2012

General Purpose Lead-Acid Batteries (Valve-Regulated Types) – Part 1: General Requirements, Functional Characteristics – Methods of Test

IEC 61951-1:2017

Secondary Cells and Batteries Containing Alkaline or Other Non-Acid Electrolytes – Portable Sealed Rechargeable Single Cells – Part 1: Nickel-Cadmium

IEC 61951-2:2017

Secondary Cells and Batteries Containing Alkaline or Other Non-Acid Electrolytes – Portable Sealed Rechargeable Single Cells – Part 2: Nickel-Metal Hydride

IEC 61960:2011

Secondary Cells and Batteries Containing Alkaline or Other Non-Acid Electrolytes – Secondary Lithium Cells And Batteries For Portable Applications

IEC 61960-3

Secondary Cells And Batteries Containing Alkaline Or Other Non-Acid Electrolytes – Secondary Lithium Cells And Batteries For Portable Applications – Part 3: Prismatic And Cylindrical Lithium Secondary Cells, And Batteries Made From Them

IEC 62133:2012

Secondary Cells And Batteries Containing Alkaline Or Other Non-Acid Electrolytes – Safety Requirements For Portable Sealed Secondary Cells, And For Batteries Made From Them, For Use In Portable Applications

IEC 62133-2:2017

Secondary Cells And Batteries Containing Alkaline Or Other Non-Acid Electrolytes – Safety Requirements For Portable Sealed Secondary Lithium Cells, And For Batteries Made From Them, For Use In Portable Applications – Part 2: Lithium Systems

ISO Standards

ISO 13849-1:2015

Safety Of Machinery – Safety Related Parts Of Control Systems – Part 1: General Principles For Design

ISO 3864-2:2016

Graphical Symbols – Safety Colours and Safety Signs – Part 2: Design Principles For Product Safety Labels

ISO 7000:2014

Graphical Symbols For Use On Equipment – Registered Symbols

ISO 7010:2017

Graphical Symbols – Safety Colours And Safety Signs – Registered Safety Signs

ISO 9773:2003

Plastics – Determination Of Burning Behaviour Of Thin Flexible Vertical Specimens In Contact With A Small-Flame Ignition Source

ISO 12100:2010

Safety of Machinery – General Principles for Design – Risk Assessment and Risk Reduction

ISO 13849-1:2015

Safety of Machinery – Safety-Related Parts of Control Systems – Part 1: General Principles for Design

3 Terms and Definitions

3.1 For the purpose of this standard, the following definitions apply. In this document, defined terms are show in bold type face.

3.2 **APPLIANCE** – A product, which is not a component of another product, whose primary output consists of heat, light, mechanical motion, or the movement of air. Within these requirements, **appliance** is assumed to refer to an **appliance** that derives its operating power from a **battery**. **Appliances** do not include products or vehicles intended for the transport of people or cargo.

3.3 **ARTIFICIAL SOURCE** – DC power source, comprised of either a dc power supply or specially constructed **battery**, which is used to facilitate testing of the **appliance** and where the output impedance is adjustable to represent the short circuit capability of the **battery** provided or the upper or lower limits of the short circuit capability of the **batteries** anticipated to be encountered in use.

3.4 **BATTERY** – Assembly of one or more **cells** intended to provide electrical current to the **appliance**.

3.5 **BATTERY SYSTEM** – Combination of a **battery**, the **charging system**, the **appliance** and the interfaces between them as existing during operation of the **appliance** or during charging.

3.6 **C₅ RATE** – Current, in amperes, that a **cell** or **battery** can be discharged at for 5 h to the voltage cut-off point specified by the **cell** manufacturer. This is equal to the C₅ capacity divided by 5 hours where C₅ is measured in accordance with IEC 61960, IEC 61960-3, IEC 61951-1 or IEC 61951-2.

3.7 **CELL** – Basic functional electrochemical unit containing an assembly of electrodes, electrolyte, container, terminals, and usually separators that is a source of electrical energy by direct conversion of chemical energy.

3.8 **CELL, SEALED** – **Cell** where the gases generated from within the **cell** may not escape to the atmosphere under normal use although they may escape under abnormal conditions through a pressure sensitive vent. Also known as “valve regulated **cell**”.

3.9 **CELL, VENTED** – **Cell** where the gases generated from within the **cell** may escape to the atmosphere under normal use. Also known as “flooded **cell**”.

3.10 **CHARGER** – Part or all of the **charging system** contained in a separate enclosure. As a minimum, the **charger** includes some of the power conversion circuitry. Not all **charging system** include a separate **charger** as in the case where an **appliance** may be charged utilizing a **mains** supply cord or may incorporate a plug for attachment to a **mains** receptacle.

3.11 **CHARGING SYSTEM** – Combination of circuitry intended to charge, balance and/or maintain the state of charge of the **battery**.

3.12 **CLASS I (GROUNDED) APPLIANCE** – **Appliance** in which protection against electric shock does not rely on basic, double or reinforced insulation only, but which includes an additional safety precaution in that conductive accessible parts or intermediate conductive parts (inaccessible dead metal parts) which are connected to the protective grounding (earthing) conductor in the fixed wiring of the installation in such a way that conductive accessible parts cannot become live in the event of a failure of the basic insulation. Also considered as **Class I appliances** are **appliances** with double insulation and/or reinforced insulation throughout, but also having a grounding (earthing) terminal or grounding (earthing) contact.

3.13 CLASS II (DOUBLE INSULATED) APPLIANCE – **Appliance** in which protection against electric shock does not rely on basic insulation only, but in which additional safety precautions, such as double insulation or reinforced insulation, are provided, there being no provision for protective grounding (earthing) or reliance upon installation conditions.

3.14 CLEARANCE (SPACING THROUGH AIR) – Shortest distance between two conductive parts, or between a conductive part and the outer surface of the enclosure, considered as though metal foil were pressed into contact with accessible surfaces of insulating material, measured through air. Examples of the evaluation of **clearances** are given specified in Measurement of Creepage Distances and Clearances, Annex A.

3.15 CREEPAGE DISTANCE (SPACING OVER SURFACE) – Shortest path between two conductive parts, or between a conductive part and the outer surface of the enclosure, considered as though metal foil were pressed into contact with accessible surfaces of insulating material, measured along the surface of the insulating material. Examples of the evaluation of **creepage distance** are given specified in in Measurement of Creepage Distances and Clearances, Annex A.

3.16 BATTERY PACK, DETACHABLE BATTERY PACK – **Battery** which is contained in a separate enclosure from the **appliance** and is intended to be removed from the **appliance** for charging purposes.

3.17 DETACHABLE PART – ~~Part which can be removed or opened without the aid of a tool, or a part which is removed in accordance with the instruction for use, except externally accessible brush caps, even if removal requires the use of a tool.~~ Part, other than externally accessible brush caps, where either:

a) Its removal or opening is possible without the aid of a tool, unless it is fixed in a reliable manner; or

b) Its removal is intended in accordance with the instruction for use.

Note: The determination whether a part is fixed in a reliable manner is specified in Clause 5.19.

3.18 DUTY CYCLE – Intended operating cycle of an **appliance**, each cycle being composed of an “on” period of operation followed by an “off” period with the **appliance** switched off.

3.19 ELECTRONIC COMPONENT – Part in which conduction is achieved principally by electrons moving through a vacuum, gas or semiconductor, with the exclusion of neon indicators. Examples of **electronic components** are diodes, transistors, triacs, and monolithic integrated circuits. Resistors, capacitors and inductors are not considered **electronic components**.

3.20 EXPLOSION – Failure that occurs when an **appliance** enclosure or a detachable or **separable battery pack** opens violently and major components are forcibly expelled in a manner that could result in injury.

3.21 EXTERNAL FLEXIBLE CORD – Cord that is located on the exterior of the end product enclosure and is not a power cord intended to be connected to the mains, nor a cord connected to the charger.

3.22 FULLY CHARGED – Cell or battery charged to the maximum state of charge permitted by the **battery charging system** intended for use with the **appliance** and in accordance with the manufacturer's instructions.

3.23 FULLY DISCHARGED BATTERY/CELL – battery or cell that has been discharged at **C₅ rate** until one of the following conditions occurs: discharge terminates due to protective circuitry or the **battery** (or **cell**) reaches a total voltage with an average voltage per **cell** equal to the end-of-discharge voltage for the **cell** chemistry being used, unless a different end of discharge voltage is specified by the manufacturer. The end-of-discharge voltages for common **cell** chemistries are ~~provided in~~ specified in General Conditions for the Tests, Clause 5.

3.24 GENERAL PURPOSE BATTERIES/CELLS – Batteries and cells available from a variety of manufacturers, through a variety of outlets intended for a variety of different manufacturers' products. A 12-V automotive **battery** and AA, C, and D alkaline **cells** are examples of general purpose.

3.25 HAZARDOUS VOLTAGE – Voltage between parts having an average value exceeding 60 V d.c. or exceeding 42.4 V peak when the peak-to-peak ripple exceeds 10% of the average value. This value is 30 V d.c. or 21.2 V peak when the peak-to-peak ripple exceeds 10% of the average value for those **appliances** where the user's skin is likely to be wet a majority of time in use. See Indent B in Table D1.1.

Note: The lowered voltage limit for cases when the user's skin is likely to be wet is based upon the difference in impedance of the human body when wet.

3.26 HEATING ELEMENT – A device that produces heat as part of the normal, intended function of an **appliance**. Devices that produce heat as secondary effect of other functions are not considered **heating elements**.

3.27 INSULATION TOUCH CURRENT – Current which flows through a person upon contact with accessible parts of a **battery** operated **appliance** with a **working voltage** that is a **hazardous voltage**, where at least one accessible part is connected to internal circuitry other than through **protective impedance**.

3.28 BATTERY, INTEGRAL, BATTERY – Battery ~~Rechargeable **battery**~~ which is contained within the **appliance** and is not ~~intended to be~~ removed from the **appliance** for charging purposes. ~~A battery that is to be removed from the appliance for disposal or recycling purposes only is considered to be an integral battery.~~

3.29 ISOLATED SOURCE – Voltage source in which the output is isolated from the **mains** supply by means of safety isolation complying with CAN/CSA C22.2 No. 107.2, CAN/CSA C22.2 No. 223, UL 1012, UL 1310, UL 1564 or UL 60950-1 and CAN/CSA C22.2 No. 60950-1.

3.30 MAINS – The general purpose AC power distribution external to the equipment, provided within the premises to a service disconnecting means at least one pole of which is intended to be referenced to earth ground.

3.31 MAXIMUM CHARGING CURRENT – Highest current that a lithium-ion **cell** is permitted to pass during charging for a specified range of temperatures in the CAN/CSA E62133:17 or UL 62133.

3.32 **MEAN TIME TO DANGEROUS FAILURE (MTTF_d)** – A measure of system reliability expressed as an expectation of the mean time to failures that would result in loss of a **safety critical function**.

3.33 **NO LOAD** – Operation of the **appliance** with no additional loading being applied external to the **appliance**.

3.34 **NON-ISOLATED SOURCE** – Voltage source in which the output is not conductively isolated from the **mains** supply by means of a **safety isolating transformer**.

~~3.35 **NON-SELF-RESETTING THERMAL CUT-OUT** – Thermal cut-out which requires a manual operation for resetting, or replacement of a part, in order to restore the current. Manual operation also includes operation of the **power switch**.~~

3.35 **POWER SWITCH** – Device that electrically activates the primary function of the **appliance** in the “on” position and deactivates the same function of the **appliance** in its “off” position.

3.36 **PROTECTIVE DEVICE** – Device, the operation of which prevents a hazardous situation under abnormal operation conditions.

3.37 **PROTECTIVE IMPEDANCE** – Impedance connected between live parts and accessible conductive parts, and of value so that the current is limited to a safe value.

3.38 **REPLACEABLE BATTERY** – A non-rechargeable or **integral battery** that is intended to be removed and replaced by the user at end of **battery** life.

3.39 **SAFETY CRITICAL FUNCTION (SCF)** – Function(s) required by this standard provided by an electronic circuit, the loss of which would cause the **appliance** to function in such a manner as to expose the user to a risk that is in excess of the risk that is permitted by this standard or the end product standard under abnormal conditions.

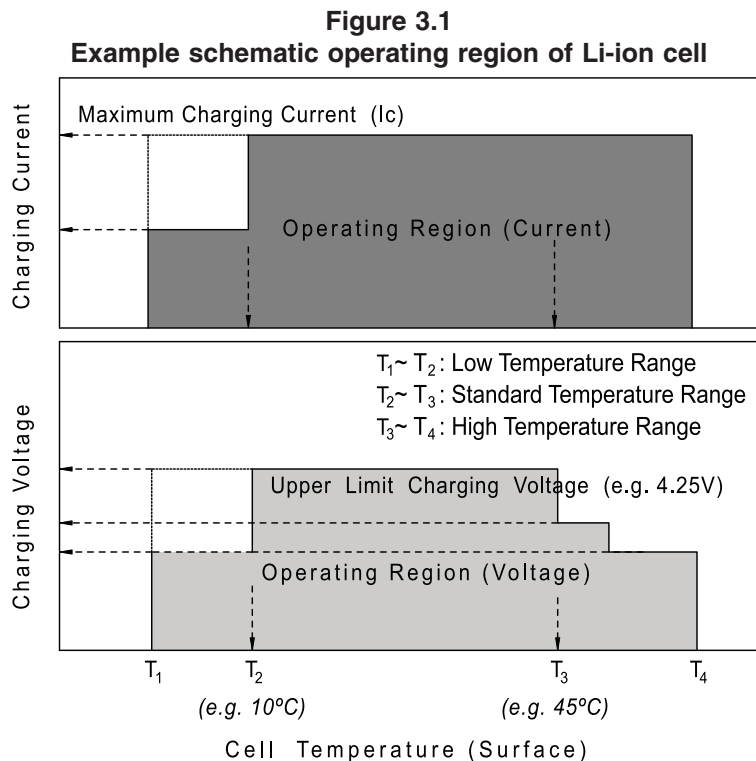
3.40 **SAFETY ISOLATING TRANSFORMER** – Transformer, the input winding of which is electrically separated from the output winding by an insulation at least equivalent to double insulation or reinforced insulation, and which is intended to supply a distribution circuit, an **appliance** or other equipment at safety extra-low voltage.

3.41 ~~BATTERY PACK~~, **SEPARABLE BATTERY PACK** – **Battery** which is contained in a separate enclosure from the **appliance** and is connected to the **appliance** by a cord.

3.42 **SINGLE CHANNEL** – A structure in which a single functional means is used to execute specified operations.

3.43 **SPECIFIED OPERATING REGION** – Range of permissible operation of lithium-ion **cells**, expressed by **cell** parameter limits.

3.44 **SPECIFIED OPERATING REGION FOR CHARGING** – Conditions for voltage and current during charging in which the lithium-ion **cell** is permitted to operate as specified by the **cell** manufacturer and evaluated in accordance with in the CAN/CSA E62133 or UL 62133. In general, the permissible ranges of voltage and current are dependent upon temperature (see Figure 3.1).



su0631a

3.45 SWITCHED CIRCUIT – A circuit that is a low-power circuit when the **power switch** is in the “off” position. The requirements for a low-power circuit are given specified in Determination of a Low-Power Circuit, Annex B.

3.46 TEMPERATURE LIMITER – Temperature-sensing device, the operating temperature of which may be either fixed or adjustable, and which, during normal operation, operates by opening or closing a circuit when the temperature of the controlled part reaches a predetermined value. It does not reverse this operation of opening or closing a circuit during the normal **duty cycle** of the **appliance**.

3.47 THERMAL CUT-OUT – Device which, during abnormal operation, limits the temperature of the controlled part by automatically opening the circuit, or by reducing the current, the setting of which cannot be altered by the user.

3.48 THERMAL LINK – Thermal cut-out which operates only once, and then requires partial or complete replacement.

3.49 UPPER LIMIT CHARGING VOLTAGE – Highest voltage that a lithium-ion **cell** is permitted to attain during normal charging for a specified range of temperatures in CAN/CSA E62133 or UL 62133.

3.50 VENTING – Condition that occurs, when a **cell** releases excessive internal pressure intended by design to preclude **explosion**. Venting can cause the cell to release gases and/or liquids.

3.51 WORKING VOLTAGE – Voltage, without the effect of transient voltages, across any insulation or between any parts of different potential when the **appliance** is supplied by (a) **fully charged battery(ies)** and operating at **no-load** or with the **appliance** in the “off” condition, whichever is greater.

4 Classification

4.1 LOW TEMPERATURE (LT) – Detachable or Separable battery pack evaluated for resistance to impact under low ambient temperatures as described specified in Mechanical Strength, Clause 15. See Indent C in Table D1.1.

4.2 EXTRA LOW TEMPERATURE (ELT: t) – Detachable or Separable battery pack, evaluated for resistance to impact under extreme low ambient temperatures as described specified in Mechanical Strength, Clause 15 shall be evaluated to a particular temperature below 0°C and shall be designated ELT: t , where t is the test temperature. (e.g. ELT: -35°C). See Indent C in Table D1.1.

5 General Conditions for the Tests

5.1 Some of the tests may result in fire or **explosion**. It is therefore important that personnel be protected from the flying fragments, explosive force, sudden release of heat, chemical burns, intense light and noise that may result from such **explosion**. The test area shall be well ventilated to protect personnel from possible harmful fumes or gases.

5.2 Appliances having more than one rated voltage shall be tested on the basis of the most unfavorable voltage.

5.3 Unless otherwise specified, a **fully charged battery pack** shall be used for each test.

5.4 ~~When measuring voltage, Unless otherwise specified, voltage measurements are r.m.s. values except when measuring peak voltages, where the peak value includes the peak value of any superimposed ripple exceeding 10% of the average value shall be included.~~ Transient voltages are ignored, such as a temporary increase in voltage, for example after the **battery pack** is removed from the **charger**. Unless otherwise specified, current measurements shall be r.m.s. values.

5.5 Measurements of **cell** voltages during the tests of lithium-ion systems shall be made using a single pole resistive-capacitive low pass filter with a cut-off frequency of 5 kHz $\pm$ 500 Hz. If charging voltages have been exceeded, the peak value of the voltage measured after this network shall be used. The measurement shall have measurement tolerance within $\pm$ 1%.

5.6 Unless otherwise specified, all **batteries** shall be fully conditioned as follows:

- a) **Batteries** shall be either discharged at a rate not to exceed ten times the **C₅ rate** to the end of discharge voltage; or
- b) If discharged in the **appliance**, until the **appliance** ceases normal operation and then charged in accordance with the manufacturer's instructions.

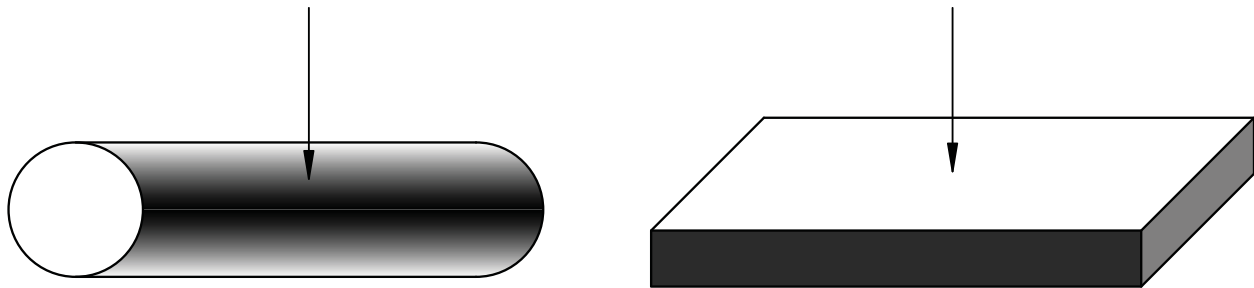
and then charged in accordance with the manufacturer's instructions. The sequence shall be repeated one more time with an interval of at least two hours after each discharge. This procedure is performed only once for any individual battery.

Note: The end-of-discharge voltages for common cell chemistries are specified in Clause 5.15.

5.7 The tests shall be made in a draught-free location and at an ambient temperature of $20 \pm 5^{\circ}\text{C}$ ($68 \pm 9^{\circ}\text{F}$), unless otherwise specified. All test samples shall be stabilized to the ambient temperature prior to the test. If the temperature attained by any part is limited by a temperature sensitive device, the ambient temperature shall be, in case of doubt, maintained at $23 \pm 2^{\circ}\text{C}$ ($73.4 \pm 3.6^{\circ}\text{F}$).

5.8 The location of thermocouples for lithium-ion **cell** temperature measurements shall be on the outer surface, half way along the longest dimension, of the **cell** that results in the highest temperature. Refer to Figure 5.1 for typical **cell** configurations and thermocouple locations.

Figure 5.1
Thermocouple location on cell



su0526

5.9 Temperatures shall be measured by thermocouples consisting of wires not larger than 24 AWG (0.21 mm^2) and not smaller than 30 AWG (0.05 mm^2) and a potentiometer-type instrument.

5.10 Currents measured during **battery** charging shall be average current with an averaging period of 1 – 5 s.

5.11 If not otherwise specified, a **fully charged battery** shall be used which has been allowed to rest for at least 2 hours but no more than 6 hours at an ambient temperature of $20 \pm 5^{\circ}\text{C}$ ($68 \pm 9^{\circ}\text{F}$) after removal from the **charging system**. ~~and before starting a test, the fully charged battery shall be allowed to rest for at least 2 h but no more than 6 h at an ambient temperature of $20 \pm 5^{\circ}\text{C}$ ($68 \pm 9^{\circ}\text{F}$) prior to use and after removal from the charging system.~~

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5.12 When a **battery** comprised of a single **cell** is employed, instructions in this standard referring to special preparations of a **cell** in a series configuration shall be ignored.

5.13 For **battery** designs where there is a series arrangement of parallel clusters of **cells**, the cluster shall be treated as a single **cell** for those tests that require altering the amount of charge on a single **cell** prior to conducting the test.

5.14 Wherever "cheesecloth" is mentioned in the abnormal tests, the cloth shall be bleached cheesecloth, running 26 – 28 m²/kg (approximately 14 – 15 yd²/lb) and having what is known in the trade as a "count of 32 by 28", that is, for any square inch, 32 threads in one direction and 28 threads in the other direction (for any square centimeter, 13 threads in one direction and 11 in the other direction).

5.15 The end of discharge voltages are 0.9 V/**cell** for nickel cadmium or nickel metal-hydride, 1.75 V/**cell** for lead acid and 2.5 V/**cell** for lithium-ion unless the **cell** manufacturer specifies a different voltage.

5.16 Where it is specified in the requirements that the **battery** provided with or intended for the **appliance** may be replaced with an **artificial source**, that source shall consist of resistance(s) provided in series with either a d.c. power supply or a specially constructed **battery**, the output of each having the characteristics specified in Table 5.1 for the relevant **battery** type.

Note: The purpose of the resistance is to limit the **artificial source** short circuit current (I_{sc}) to a specific value.

Table 5.1
Artificial source requirements for replaceable batteries

Type	Initial open circuit voltage (V) $\pm 10\%$	I_{sc}^a (low) (A) $+0\%, -25\%$	I_{sc}^a (high) (A) $+25\%, -0\%$	Minimum capacity (Ah)	IEC References
AAA non-rechargeable	1.5	3	10	0.5	LR03
AA non-rechargeable	1.5	5	15	1.0	LR6
C non-rechargeable	1.5	5	15	3.0	LR14
D non-rechargeable	1.5	6	20	10	LR20
9V non-rechargeable	9.0	0.6	6	0.5	6LR61
Other non-rechargeable batteries	Nominal battery voltage	0.5 I_{sc} of battery provided	2.0 I_{sc} of battery provided	200% of capacity of battery provided measured at 1A and 0.9 V/cell cutoff	n/a
Integral battery	Battery voltage	0.5 I_{sc} of battery provided	2.0 I_{sc} of battery provided	300% of capacity of battery provided measured at 1A and 0.9 V/cell cutoff	n/a

^a The short circuit current is measured at 1 s $\pm$ 0.2 s into a resistance of 10 m Ω $\pm$ 2 m Ω . Care shall be taken to insure that self-heating of the resistances is managed to minimize the variability on the current during the tests.

NOTE 1: I_{sc} limits are specified for those **batteries** likely to be interchanged with others of the same type but of differing performance.

NOTE 2: The specified A_h values are based upon nominal 1 A and 0.9 V/cell cutoff discharge current except for 9 V, which is based upon 0.1 A and 0.9 V/cell cutoff.

5.17 Unless otherwise specified, all tests are performed with the most unfavourable **separable battery pack** or **detachable battery packs** as specified in Clause 7.6 (b).

5.18 For the purpose of determining whether the marking in Clause 6.3 is required, voltage measurements are conducted with the **battery packs** separated/detached from the **appliance**. **Appliances** with **integral batteries** are evaluated with the **power switch** in the "off" position.

5.19 Parts which provide the necessary degree of protection against electric shock, moisture, or contact with moving parts, shall either require removal with the aid of a tool or be fixed in a reliable manner.

Snap-in devices used for fixing such parts shall have an obvious locked position. The fixing properties of snap-in devices used in parts which are likely to be removed shall not deteriorate.

Compliance is checked by inspection and by the following tests.

Parts which are likely to be removed are disassembled and assembled 10 times before the test is carried out.

The tool is at ambient temperature. However, in cases where compliance may be affected by temperature, the test is also carried out immediately after the tool has been operated under the conditions specified in Mechanical Hazards, Clause 12.

A force is applied without jerks for 10 s in the most unfavourable direction to those areas of the cover or part which are likely to be weak. The force is as follows:

- | | |
|--|------|
| – push force | 50 N |
| – pull force | |
| a) if the shape of the part is such that the fingertips cannot easily slip off | 50 N |
| b) if the projection of the part which is gripped is less than 10 mm in the direction of removal | 30 N |

The push force is applied by means of a rigid test probe with the dimensions of the test probe B of IEC 61032, but without any articulation.

The pull force is applied by a suitable means such as a suction cup, so that the test results are not affected.

While the pull test of (a) or (b) is being applied, the test fingernail shown in Figure 5.2 is inserted in any aperture or joint with a force of 10 N. The fingernail is then slid sideways with a force of 10 N; it is not twisted or used as a lever.

If the shape of the part is such that an axial pull is unlikely, no pull force is applied, but the test fingernail shown in Figure 5.2 is inserted in any aperture or joint with a force of 10 N, and is then pulled for 10 s by means of the loop with a force of 30 N in the direction of removal.

If the cover or part is likely to be subjected to a twisting force, a torque as detailed below is applied at the same time as the pull or push force:

- for major dimensions up to and including 50 mm
- for major dimensions over 50 mm

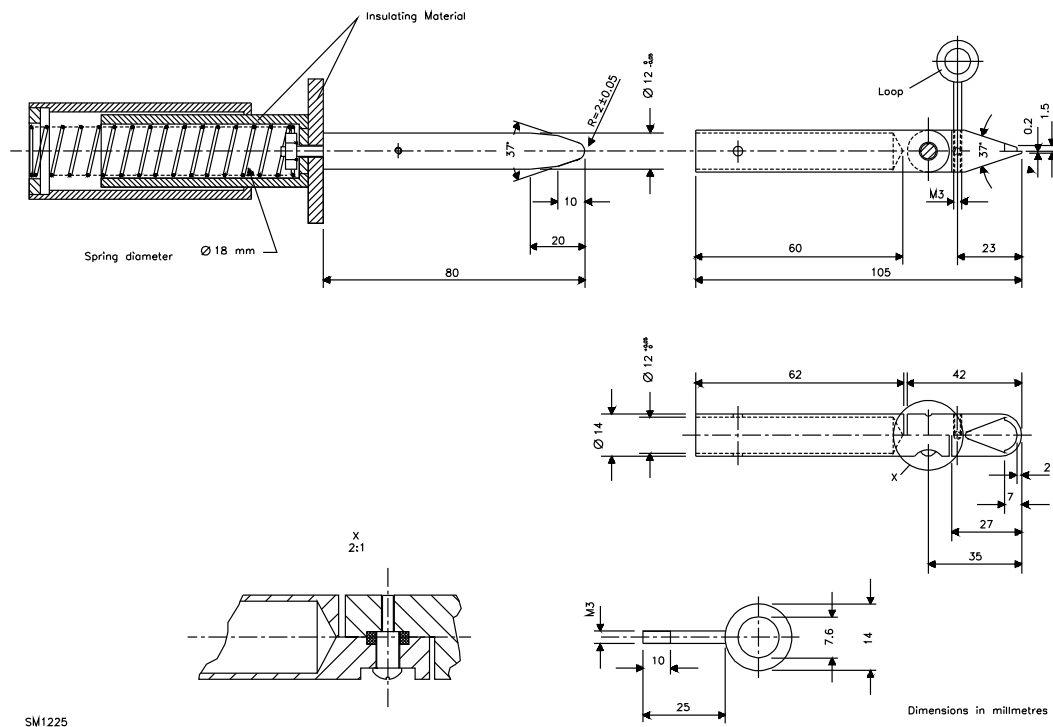
- 2 N m;
- 4 N m.

This torque is also applied when the test fingernail is pulled by means of the loop.

If the projection of the part which is gripped is less than 10 mm, the above torque is reduced to 50 % of the value.

Parts shall not become detached, and they shall remain in the locked position.

Figure 5.2
Test fingernail



6 Markings

Advisory Note: In Canada, there are two official languages, English and French. French Translations and Markings, Annex E lists acceptable French translations of the markings specified in this standard. All markings required by this standard might have to be in other languages to conform with the language requirements where the product shall be used.

6.1 In addition to the safety warnings required in accordance with the applicable end-product standard, a **battery-operated appliance** shall comply with the applicable marking requirements in Clauses 6.2 – 6.10. If the end product standard has a similar required warning or safety sign, then that may be used to comply with the requirement of Clause 6.5. Additional markings are allowed in addition to required markings, provided they do not give rise to misunderstanding.

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6.2 If **battery** operated **appliances** and **detachable or separable battery packs** are marked with voltage information as one means of complying with the requirements of Clause 6.7, the markings shall be as follows:

- a) Voltage(s) or voltage range(s), in volts;
- b) Symbol for nature of supply, either “DC” or the following symbol direct current for battery sources

⎓ – symbol for direct current (symbol 5031 of IEC 60417)

6.3 Separable battery packs, detachable battery packs and appliances with integral batteries containing parts that have potentials greater than **hazardous voltage** between them, shall be marked as specified below:

⚠ Symbol for “Warning: Electricity” (Symbol W012 of ISO 7010)

Note: The method for measuring voltage for this Clause is specified in Clause 5.4.

6.4 Appliances and battery packs with USB input and output connections in accordance with Products (Appliance or Charging System) Intended to be Powered or Charged by a Universal Serial Bus (USB) Power Source(s), Clause 24 and Products Or Battery Pack(s) With USB Outputs, Clause 25 shall be marked in proximity to any USB connection point as to the type of source as follows:

- a) The USB symbol “” (for USB 1 or 2);
- b) The USB symbol “” (for USB 3); or
- c) The abbreviation “USB X.X”, where X.X is the USB version number.

6.5 Appliances shall be marked with “WARNING – To reduce the risk of injury, user must read instruction manual” or the equivalent, or the safety sign specified below. The warning marking, or any other additional warning markings specified in the end-product standard, shall not be on a **detachable part** of the **appliance** and shall be clearly discernible from the outside of the **appliance** with any **detachable battery pack** installed and without removal of any cover. An explanation of the safety signs and symbols required by this standard and used on the **appliance** shall be specified in either the instruction manual or the safety instructions.

ⓘ Safety sign for “Refer to instruction manual/booklet” (Safety sign M002 of ISO 7010)

6.6 The word “WARNING” shall be in capital letters not less than 2.4 mm (0.1 in) high and shall not be separated from the cautionary statement. It may be preceded by alert symbol 0434A or 0434B of ISO 7000. The term “operator’s manual” or “user guide” may be used for the term “instruction manual”.

~~6.5 If the end product standard has a similar required warning, then that may be used to comply with the requirement of Clause 6.3. Additional markings are allowed in addition to required markings, provided they do not give rise to misunderstanding.~~

6.7 A **battery-operated appliance** provided with a **detachable battery packs** or a **separable battery pack** shall be marked: "For use only with ____ battery (battery pack, etc.)," or the equivalent where the underlined space is completed with:

- a) Manufacturer's name or trademark, and
- b) Catalog number or series identification, or the equivalent

of the **battery pack**. Alternatively, the statement "See Instruction Manual for Additional Battery Packs," or the equivalent may be employed in addition to at least one **battery pack** referenced by catalog number.

6.8 A **battery-operated appliance** intended to be operated with a replaceable non-rechargeable **battery(ies)** shall be marked: "Replace only with ____ non-rechargeable **battery(ies)**," or the equivalent where the underlined space is completed with:

- a) The type of non-rechargeable battery (e.g. AA, AAA, etc.); or
- b) Catalog number or series identification, or the equivalent of the battery(ies).

Alternatively, the statement "See Instruction Manual for Additional Battery(ies)," or the equivalent may be employed in addition to at least one battery referenced by catalog number.

6.9 A **detachable battery packs**, a **separable battery pack**, or a **battery-operated appliance** provided with an **integral battery** shall be marked "For use only with ____ **charger**," or the equivalent where the underlined space is completed with:

- a) Manufacturer's name or trademark, and
- b) Catalog number or series identification, or the equivalent

of the **charger**. Alternatively, the statement "See Instruction Manual for Additional Chargers," or the equivalent may be employed in addition to at least one **charger** referenced by catalog number.

6.10 **Detachable or separable battery packs** shall be marked with additional information as follows:

- a) The manufacturer's name, trade name, or trademark, which may be in a traceable code when the **appliance** is identified by the brand or trademark owned by a private labeler;
- b) A distinctive catalog number or the equivalent; and
- c) The date or other dating period of manufacture not exceeding any three consecutive months. A date-code repetition time cycle shall not be less than 10 years. The date of manufacture may be abbreviated or in an 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 **appliance** was produced.

6.11 **Separable and detachable battery packs** shall also be marked with additional information as follows:

- a) The capacity assigned by the manufacturer in Ah or mAh, based on the rated capacity of the **cells** determined in accordance with IEC 61056-1, IEC 61960, IEC 61960-3, IEC 61951-1, or IEC 61951-2, as applicable;
- b) For alkaline or other non-acid electrolyte **batteries**, the type of **battery** such as Li-Ion, NiCd and NiMH.

6.12 Markings required by this standard for **detachable or separable battery packs** shall be legible and durable. Signs shall be in contrast such as color, texture, or relief, to their background such that the information or instructions provided by the signs are clearly legible when viewed with normal vision from a distance of (500 + 50) mm. Signs need not be in accordance with the blue color requirements of ISO 3864-2 If markings are embossed, stamped or molded, contrasting colors are not required.

6.13 Compliance with Clause 6.12 shall be checked by inspection and by rubbing the marking by hand for 15 s with a piece of cloth soaked with water and again for 15 s with a piece of cloth soaked with petroleum spirit. After the tests, the marking shall be easily legible, and it shall not be easily possible to remove markings. The petroleum spirit to be used for the test shall be a reagent grade hexane with a minimum of 85% as n-hexane. The designation "n-hexane" is the chemical nomenclature for a "normal" or straight chain hydrocarbon. An example of this petroleum spirit is also known as a certified ACS (American Chemical Society) reagent grade hexane (CAS #110-54-3).

6.14 In considering the durability of the marking, the effect of normal use shall be taken into account. Thus, for example, marking by means of paint or enamel other than vitreous enamel on containers that are likely to be cleaned frequently is not considered to be durable.

6.15 If a marking required by this standard for **detachable or separable battery packs** has an adhesive backing, the adhesive backing shall be durable.

6.16 Compliance with Clause 6.15 shall be checked by either meeting the requirements in UL 969 under the conditions of occasional exposure to oil, humidity and water, and appropriate for the surface to which it is applied, or by the following tests specified in (a) – (c).

- a) Three labels applied to the tool **appliance** or a panel of the test surface material shall be placed in an oven for a minimum of 24 hours with the oven is maintained at a temperature of $120 \pm 2^{\circ}\text{C}$ ($248 \pm 3.6^{\circ}\text{F}$), or alternatively for a minimum of 200 hours at a temperature of $90 \pm 2^{\circ}\text{C}$. Following the exposure, the labels are then allowed to cool to ambient temperature $\pm 5\text{ K}$ for a minimum of 1 hour.
- b) Six additional labels applied to the tool **appliance** or a panel of the test surface material shall be placed in a controlled atmosphere maintained at 21°C to 30°C (69.8°F to 86°F) with a relative humidity of minimum 45% for at least 24 hours. After this conditioning, immerse three labels in water and the other three labels in IRM 903 oil at a temperature of 21°C to 30°C (69.8°F to 86°F) for 48 hours. The samples are then removed from the water and the oil, and allowed to drain for 5 minutes.
- c) Three additional labels applied to the tool or a panel of the test surface material shall be placed in a controlled atmosphere maintained at 21°C to 30°C (69.8°F to 86°F) with a relative humidity of minimum 45% for 72 h. The samples are to be evaluated immediately after removal from the cabinet.

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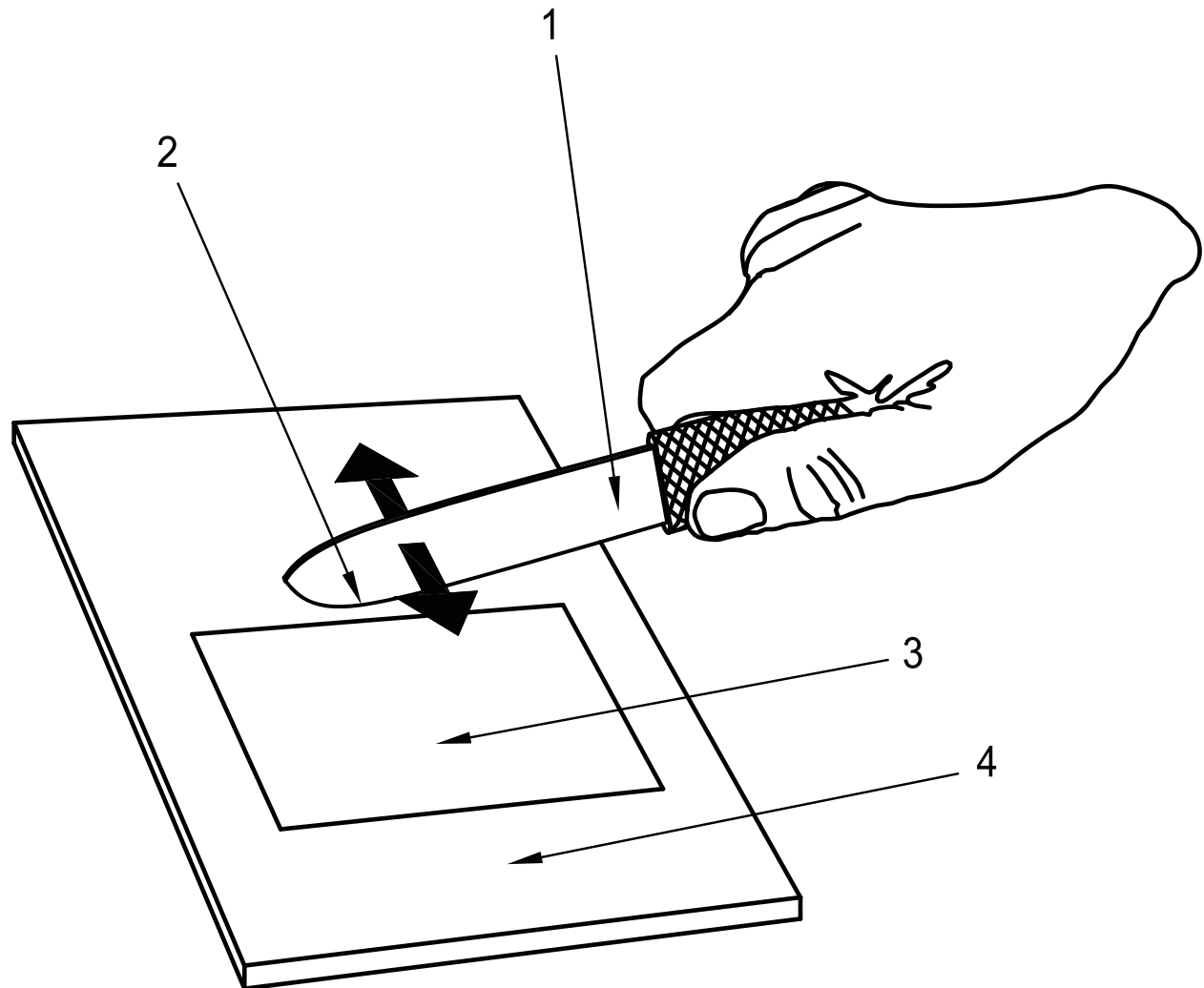
6.17 After these conditionings in Clause 6.16 (a) – (c), the label shall show no signs of curling, and it shall not be easy to remove the label by scraping across the label with a flat steel blade of 0.8 mm (0.03 in) thickness and any convenient width, the label back and forth ten times across printed areas and edges with a downward force of between 7.2 and 9 N (1.6 and 2.0 lb) using the edge of a 1.6 to 2.5 mm (0.065 to 0.100 in) thick steel blade held at a right angles to the test surface, and the label shall show no signs of curling. The portion of the blade contacting the test surface shall have a radius of curvature of 25.4 to 33.0 mm (1.0 – 1.3 in) and the edges of the blade shall be rounded to a radius of 0.41 ± 0.08 mm (0.016 ± 0.003 in). See Figure 6.1.

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Figure 6.1
Defacement test



s3459a

Key

1 blade

2 radius

3 label

4 panel (surface)

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7 Instructions

7.1 A **battery-operated appliance** and **detachable or a separable battery pack** shall be provided with operating instructions in the instruction manual or the equivalent. The instruction manual shall contain the specific applicable instructions ~~described~~ specified in Clauses 7.2 – 7.6 in addition to the instructions required in the end-product standard. The lettering height used for the signal word “WARNING,” and the other wording of the instructions shall be in accordance with the requirements of the end-product standard as applicable to basic cautionary type instructions.

7.2 Instructions shall be legible and contrast with the background. They shall include the name and address of the manufacturer or supplier or any other agent responsible for placing the **appliance** or **battery** on the market.

7.3 Instructions may be provided on a blister pack packing card provided the product can be removed without damaging the card containing the instructions.

7.4 The instructions in Clause 7.5 shall be grouped together and be preceded with “WARNING: Read all safety warnings and instructions. Failure to follow the warnings and instructions may result in electric shock, fire and/or serious injury.” or equally definitive statement.

7.5 The instruction manual for all **battery-operated appliances** shall contain the following or equivalent warnings as applicable immediately following any other safety instructions required by the end-product standard. The term “appliance” may be substituted with the name of the actual type of product.

a) Prevent unintentional starting. Ensure the power switch is in the off-position before connecting to battery pack, picking up or carrying the appliance. Carrying the appliance with your finger on the power switch or energizing the appliance that has the power switch on invites accidents.

~~b) Disconnect the battery pack from the appliance before making any adjustments, changing accessories, or storing appliance. Such preventive safety measures reduce the risk of starting the appliance accidentally.~~

~~Note: This warning is not applicable for batteries that cannot be disconnected from the appliance in normal use.~~

b) Make sure the power switch is off and the battery pack is removed before clearing jammed material, making adjustments, changing accessories, storing or servicing the appliance. Unexpected actuation of the appliance while clearing jammed material or servicing may result in serious personal injury.

Note: For appliances with integral batteries, the text “and the battery pack is removed” is deleted.

c) Recharge only with the charger specified by the manufacturer. A charger that is suitable for one type of battery pack may create a risk of fire when used with another battery pack.

d) Use appliances only with specifically designated battery packs. Use of any other battery packs may create a risk of injury and fire.

e) When battery pack is not in use, keep it away from other metal objects, like paper clips, coins, keys, nails, screws or other small metal objects, that can make a connection from one terminal to another. Shorting the battery terminals together may cause burns or a fire.