



UL 583

STANDARD FOR SAFETY

Electric-Battery-Powered Industrial Trucks

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UL Standard for Safety for Electric-Battery-Powered Industrial Trucks, UL 583

Tenth Edition, Dated August 15, 2012

Summary of Topics

This New Edition of ANSI/UL 583 is being issued to incorporate the following changes in requirements:

Removal of "New and Unusual" scope paragraph

Addition of marking requirements for Type E batteries

Addition of text for insulating barriers for motors

Revision of requirements for battery leads

Revisions to UL 60730-1A references

Revisions to Battery Compartment or Enclosure, Section 10

Addition of lithium batteries

Addition of Exceptions regarding barriers and liners for support of live parts

Revisions to Temperature, Section 20

Removal of 20.4.2

Revisions to Brakes, Section 21

Revisions to Dielectric Voltage Withstand Test

Reinstate Section 23.2, Switches controlling other than motor circuits

Revisions to Solid-State Circuitry, Section 25

Allowance of plastic enclosures for switches, controllers, contactors, or similar arcing part provided in the power circuit

Revisions to EX Truck Requirements

The requirements are substantially in accordance with Proposal(s) on this subject dated June 10, 2011 and February 17, 2012.

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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 note following the affected item. 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that have been revised and that have a future effective date are located after the Standard, and are preceded by a "SUPERSEDED REQUIREMENTS" notice.

The following table lists the future effective dates with the corresponding reference.

Future Effective Date	Reference
May 17, 2013	Paragraphs 10.1, 12.1(a) – (d), 12.2, 12.5, and 25.1.1; and Section 9
August 15, 2015	Paragraph 12.1(e) – (i); and Sections 25.2 and 25.3
August 15, 2017	Paragraphs 52.1, 52.3, 57.2, 57.3, 57.4, and 58.1; Tables 52.1 and 58.1; and Sections 41, 42, 43, 44, 45, 50, 53, and 54

AUGUST 15, 2012

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UL 583

Standard for Electric-Battery-Powered Industrial Trucks

The first edition was titled Industrial Gasoline-Tractors. The second and third editions were titled Power-Operated Industrial Trucks (Electric Battery-Powered & Gasoline-Powered). The fourth edition was titled Power-Operated Industrial Trucks.

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Seventh Edition – December, 1977
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Ninth Edition – June, 1996

Tenth Edition

August 15, 2012

This ANSI/UL Standard for Safety consists of the Tenth Edition.

The most recent designation of ANSI/UL 583 as an American National Standard (ANSI) occurred on August 15, 2012. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, Title Page, or effective date information.

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

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INTRODUCTION

1 Scope

1.1 These requirements cover electric-battery-powered industrial trucks, such as tractors, platform-lift trucks, fork-lift trucks, and other vehicles designed for specific industrial uses, with respect to a risk of fire, electric shock, and explosion. These requirements do not cover such electric-battery-powered industrial trucks with respect to other possible risks that may be associated with the use of such trucks.

1.2 These requirements cover batteries intended for use in the electric-battery-powered industrial trucks mentioned in 1.1, with respect to the risk of fire, electric shock, and explosion.

1.3 The Fire Safety Standard for Powered Industrial Trucks Including Type Designations, Areas of Use, Conversions, Maintenance, and Operations, NFPA 505, identifies electric-battery-powered industrial trucks as follows:

- a) Type E – An electrically powered unit that has minimum acceptable safeguards against inherent fire and electric shock hazards.
- b) Type ES – An electrically powered unit that, in addition to meeting all requirements for Type E units, is provided with additional safeguards to the electric system to prevent the emission of hazardous sparks and to limit surface temperatures.
- c) Type EE – An electrically powered unit that, in addition to meeting all requirements for Type E and ES units, has its electric motors and all other electric equipment completely enclosed.
- d) Type EX – An electrically powered unit in which the electric fittings and equipment are so designed, constructed, and assembled that the unit can be used in atmospheres containing specifically named flammable vapors, dusts, and, under certain conditions, fibers.

1.4 These requirements cover Types E, EE, ES, and EX electric-battery-powered industrial trucks powered by batteries supplying 150 volts or less.

2 Components

2.1 Except as indicated in 2.2, a component of a product covered by this standard shall comply with the requirements for that component. See Appendix A for a list of standards covering components generally used in the products covered by this standard.

2.2 A component need not comply with a specific requirement that:

- a) Involves a feature or characteristic not needed in the application of the component in the product covered by this standard, or
- b) Is superseded by a requirement in this standard.

2.3 A component shall be used in accordance with its recognized rating established for the intended conditions of use.

2.4 Specific components are recognized as being incomplete in construction features or restricted in performance capabilities. Such components are intended for use only under limited conditions, such as certain temperatures not exceeding specified limits, and shall be used only under those specific conditions for which they have been recognized.

3 Units of Measurement

3.1 Values stated without parentheses are the requirement. Values in parentheses are explanatory or approximate information.

4 Undated References

4.1 Any undated reference to a code or standard appearing in the requirements of this standard shall be interpreted as referring to the latest edition of that code or standard.

5 Terminology

5.1 In the following text, the term truck is used to mean an electric-battery-powered industrial truck. The type or types of truck to which a specific requirement applies is identified by the heading under which the requirement is located and by specific references in the text to the applicable requirements.

5.2 **ARCING OR SPARKING COMPONENT** – A component that emits arcs or sparks under normal operating conditions (e.g. motor brushes or contactor).

5.3 **BATTERY** – One or more electrical cells, electrically connected so that the combination furnishes current as a unit. There is one positive and one negative externally accessible connection and no externally accessible inter-cell connections.

5.4 **BATTERY ASSEMBLY/MONOBLOC** – A multi-cell battery design that is ready for use, contains a common pressure vessel construction, a single vent line assembly, shared hardware and is furnished with a single connection cable that has electrical connector at the end. The connector should prevent accidental matings of mismatched voltages and polarities.

5.5 **LOW-VOLTAGE, LIMITED-ENERGY (LVLE) CIRCUIT** – A circuit considered to result in a reduced risk of fire and electric shock, characterized by the circuit limitations defined in Table 19.1.

5.6 **ULTIMATE ENCLOSURE** – Any exposed surface that could be subjected to impact or damage by external means.

6 Reference Standards

6.1 Other standards applying to power-operated industrial trucks are:

- a) Safety Standard for Low Lift and High Lift Trucks, ANSI/ITSDF B56.1, which contains requirements relating to the elements of design, operation, and maintenance of powered industrial trucks;
- b) Standard for Powered Industrial Trucks Including Type Designations, Areas of Use, Conversions, Maintenance and Operations, ANSI/NFPA 505, which relates to a classification of industrial trucks as to areas of use, maintenance, and operation; and
- c) Standard for Internal Combustion Engine-Powered Industrial Trucks, UL 558, which contains requirements relating to risk of fire.

7 Samples

7.1 Unless otherwise stated, compliance with the performance requirements for a truck shall be determined by testing a representative model of a new vehicle.

TYPE E TRUCKS

CONSTRUCTION

8 General

8.1 All electrical parts shall be mounted within the body of the truck.

8.2 All current-carrying parts of a truck shall be constructed and enclosed so as to reduce the likelihood of mechanical damage and to resist the abuses to which they may be subjected.

Exception: Current carrying parts in an LVLE circuit are not required to comply with 8.2.

8.3 No uninsulated current-carrying part shall be exposed on the outer surface of a truck.

8.4 No part of the frame or enclosure of a truck shall be in electrical contact with current-carrying parts or be used as a part of the electrical circuit.

Exception: For a truck having a nominal 24-volt or lower rating, the frame of the truck is permitted to be used as a part of the electrical circuit when the circuit is protected by:

- a) An overcurrent device (see Section 13, Overcurrent Protection); or*
- b) A disconnect switch or connector that is positive in action and readily and quickly operable by the driver from the normal driving position.*

8.5 A current-carrying part shall be of nonferrous metal.

Exception No. 1: As provided in the Exception to 8.4.

Exception No. 2: Ferrous metal is permitted to be used for a resistor terminal in the power circuit and for all parts of the lighting, warning-signal, and other auxiliary and motor-control circuits.

8.6 Steel, other than stainless, used in accordance with Exception No. 2 to 8.5 shall be zinc-coated or equivalently protected against corrosion.

8.7 Contactors and fuses shall be located so as to be readily accessible for servicing, such as complete replacement or the replacement of contacts and inspection after the removal of a cover or covers. Other arcing and operating parts shall be accessible for servicing and inspection.

8.8 A gasket employed between a cover and a box shall be cemented or otherwise secured to one of the gasketed surfaces.

8.9 A drip pan shall not permit the collection of oil.

8.10 When charging, it shall not be possible to energize the truck movement circuits. This does not apply to trucks designed for permanent charging during operation.

9 Motors and Electromechanical Brakes

9.1 Motors shall comply with the spacing requirements in the Standard for Rotating Electrical Machines – General Requirements, UL 1004-1.

Exception: A motor located in an LVLE circuit is not required to comply with this requirement.

9.1 effective May 17, 2013

9.2 Motors shall comply with the performance requirements in Section 10, Motors.

Exception No. 1: A motor located in an LVLE circuit is not required to comply with this requirement.

Exception No. 2: A motor that complies with the requirements within the Standard for Rotating Electrical Machines – General Requirements, UL 1004-1, is acceptable when used within its acceptable insulation systems ratings.

9.2 effective May 17, 2013

9.3 When lead wires of a motor do not pass out of the motor directly into an acceptable raceway, or when they are brought out through the motor case, they shall pass through openings as defined in 12.10.

9.3 effective May 17, 2013

9.4 Electromechanical brakes shall comply with Part XVI, Miscellaneous Devices, of the Standard for Industrial Control Equipment, UL 508.

Exception: An electromechanical brake located in an LVLE circuit is not required to comply with this requirement.

9.4 effective May 17, 2013

9.5 A terminal for a motor or an electromechanical brake shall comply with the requirements in 11.3 and 11.4.

9.5 effective May 17, 2013

10 Motors

10.1 A motor shall comply with the requirements in Section 24, Dielectric Voltage Withstand, immediately after being removed from an air circulating oven for a period of 7 hours and maintained at a temperature of 175°C (347°F). The potential shall be applied between the terminals and the motor frame.

10.1 effective May 17, 2013

10.2 Motors complying with 10.1 need not comply with the barrier requirements of 18.2.

11 Electric Controls

11.1 An arcing part in a power circuit shall be enclosed or installed so as to reduce the possibility of flame or molten metal reaching surrounding combustible material on the truck.

11.2 A reversing controller shall be interlocked, either mechanically, electrically, or both, to prevent reversal of the motor when power is applied to the motor being reversed.

Exception: A controller tested for the reversing arrangement provided is considered to meet the intent of the requirement.

11.3 A terminal shall be of such size and shape as to provide the necessary capacity and mechanical support for the conductors connected to it. A terminal employing a threaded screw or bolt for securing the conducting lug to a terminal plate shall provide a minimum of two full threads in the metal. A terminal nut shall be fastened by a lock washer or equivalent means to prevent loosening of the conductor.

11.4 A base for the support of a live part shall be made of:

- a) Treated fiber;
- b) Molded-phenolic composition;
- c) Sheet-phenolic composition;
- d) Silicone-melamine-, or polyester-impregnated glass-fiber laminated sheet;
- e) Cold-molded composition; or
- f) Other material investigated in accordance with 11.5.

11.5 In determining the acceptability of a material other than one specifically mentioned in 11.4 for the support of a live part, consideration shall be given to:

- a) Its resistance to moisture,
- b) Its mechanical strength if it is exposed or otherwise subject to mechanical damage,
- c) Its combustibility,

- d) The means for securing it in place, and
- e) Its location with respect to possible adverse effects from operation of the equipment in service – particularly from arcing. The performance of a material with respect to these properties is to be investigated in comparison to the performance of one of the materials mentioned in 11.4.

12 Wiring

12.1 All wiring shall comply with one of the following, as applicable to the intended use:

- a) The Standard for Appliance Wiring Material, UL 758;
- b) The Standard for Thermoplastic-Insulated Wires and Cables, UL 83;
- c) The Standard for Flexible Cords and Cables, UL 62;
- d) The Standard for Low Voltage Primary Cable, SAE J1128;
- e) Outline for Battery Leads, UL 2726;
- f) The Standard for Low Voltage Battery Cable, SAE J1127;
- g) Outline for Welding Cable, UL 1276;
- h) The Standard for Electrical Cables for Boats, UL 1426; or
- i) The Standard for Machine-Tool Wires and Cables, UL 1063.

Exception: This requirement does not apply to wiring located in a LVLE circuit.

12.1 (a) - (d) effective May 17, 2013. 12.1 (e) - (i) effective August 15, 2017

12.2 The wiring of a truck shall be rated for the particular application with respect to the temperature and voltage, exposure to oil or grease, and other conditions of service to which the wiring is subjected.

12.2 effective May 17, 2013

12.3 A bare conductor is permitted to be insulated with insulating tubing or with noncarbonizable beads.

12.4 A short length of rubber-insulated conductor exposed to temperatures that normally are in excess of the maximum acceptable temperatures for the compound involved – for example, at a resistor terminal – is acceptable if supplementary heat-resistant insulation having the dielectric strength required by 21.1 is employed on the individual conductor to protect against breakdown of the insulation resulting from deterioration of the rubber. An insulating sleeve shall be secured in place.

12.5 Wiring shall be protected against mechanical damage by:

- a) Enclosing it in the body of the truck; or when mounted on masts, booms, lifts or similar parts, the wiring shall be installed so as to reduce the likelihood of mechanical damage and kinking;
- b) Enclosing it in metal raceway, such as armored cable, rigid metal conduit, or electrical metallic and nonmetallic tubing, flexible nonmetallic conduit or nonmetallic insulated tubing; or

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- c) Other suitable method in which the wiring is protected sufficiently against mechanical damage.

Exception: This requirement does not apply to wiring located in a LVLE circuit.

12.5 effective May 17, 2013

12.6 Protection for insulated leads located within the operator's compartment is not required if:

- a) The walls and floor of this compartment are of metal, phenolic composition, or other thermosetting material having equivalent mechanical strength and resistance to impact; and
- b) The leads are not likely to be subjected to mechanical damage by the operator.

12.7 Wiring connections to a continuously moving part, or a part for which the degree of movement is appreciable shall be a Type such as S, SJ, SJE, SJO, SEO, SJT, SJTO, SJEO, SO, ST, SE, or STO flexible cord.

Exception No. 1: Individual conductors having flexible stranding, such as Type FFH-2, TFF, or SFF-2, enclosed in flexible tubing are permitted to be used in place of flexible cord. The tubing is not required on exposed moving conductors that are readily visible to the operator and are therefore subject to replacement when damaged.

Exception No. 2: Cords determined to be equivalent to those within the Standard for Flexible Cords and Cables, UL 62, but with an increased number of conductors, may be acceptable.

12.8 All of the splices and connections shall be mechanically secure and shall provide electrical contact without stress on connections and terminals. A splice shall be provided with insulation equivalent to that on the wires involved.

12.9 A hole by means of which insulated conductors pass through a sheet-metal wall shall be provided with a smooth, rounded bushing, or shall have smooth, rounded surfaces upon which the insulated conductors may bear.

12.10 Wireways shall be smooth and free from sharp edges, burrs, fins, or moving parts that may damage wiring.

12.11 An internal-wiring connection shall be made with a solder lug or a pressure terminal connector.

Exception: Control wiring and other small conductors which are connected by crimped or soldered special-type lugs or eyelets.

12.12 A terminal lug shall be arranged so that in any position it cannot contact either the frame of the truck or other electrical circuits, or the shank of the lug shall be provided with insulation equivalent to that on the conductor.

13 Overcurrent Protection

13.1 Power, control and auxiliary circuits shall have overcurrent protection that is sized to prevent overheating of the smallest size conductor.

13.2 An overcurrent device rated or set for 15 amperes is acceptable for protection of a 18 AWG (1 mm²) and larger conductors.

13.3 The need for overcurrent protection in the power circuit is to be determined on the basis of the burnout test described in Burnout, Section 26 and not by the need for protecting the wiring against overloads of short duration. Also, an overcurrent device may be required on the basis of the construction described in the exception to 8.4.

13.4 Overcurrent devices in the control and power circuit shall be as close as practicable to the power supply or battery. Non-resettable overcurrent devices shall be identified as to the replacement rating of the device. Required marking shall be provided with the truck separate from the overcurrent device.

13.5 The need for overcurrent protection in the LVLE circuits is to be determined on the basis of the testing described in Low-Voltage Limited Energy Circuit, Section 19.

13.6 The overcurrent protective device specified in 19.5 shall be either a circuit breaker, fuse or positive temperature coefficient device.

13.7 A fuse or circuit breaker shall be either:

- a) Acceptable for branch circuit use; or
- b) A supplementary type.

13.8 A positive temperature coefficient device shall comply with Manufacturing Deviation and Drift, Clause 15; Endurance, Clause 17; and Requirements for Controls Using Thermistors, Annex J, in the Standard for Automatic Electric Controls for Household and Similar Use, Part 1: General Requirements, UL 60730-1.

14 Battery Compartment or Enclosure

14.1 Support and protection shall be provided for the battery by means of a compartment that is an integral part of the truck or a separate enclosure, such as a tray and cover.

14.2 A metal compartment or separate enclosure that houses a battery shall be at least 0.053 inch (1.35 mm) thick.

Exception: See 14.4.

14.3 The cover of a compartment or separate enclosure that houses a battery shall remain closed by the force of gravity or shall be provided with a fastener.

14.4 A metal cover for a compartment or separate enclosure that houses a battery shall have:

- a) Such strength and rigidity that, in conjunction with an air spacing provided between it and the battery terminals, the battery terminals are not short-circuited when a 250-pound (1110-N) force is applied to any 1-square-foot (930-cm²) area of the cover; or
- b) Insulation secured to the inner surface to reduce the likelihood of short-circuiting of the battery terminals.

14.5 The compartment or separate enclosure that houses a battery shall be provided with means for ventilation that reduces the likelihood of accumulation of explosive hydrogen-air mixtures.

14.6 Means shall be provided as a part of the truck to restrain a battery of nominal voltage rating and representative of maximum ampere-hour capacity rating from moving more than a total of 1/2 inch (12.7 mm) in a horizontal direction.

14.7 A nonmetallic cover of a battery enclosure shall comply with the following requirements for Path II in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C:

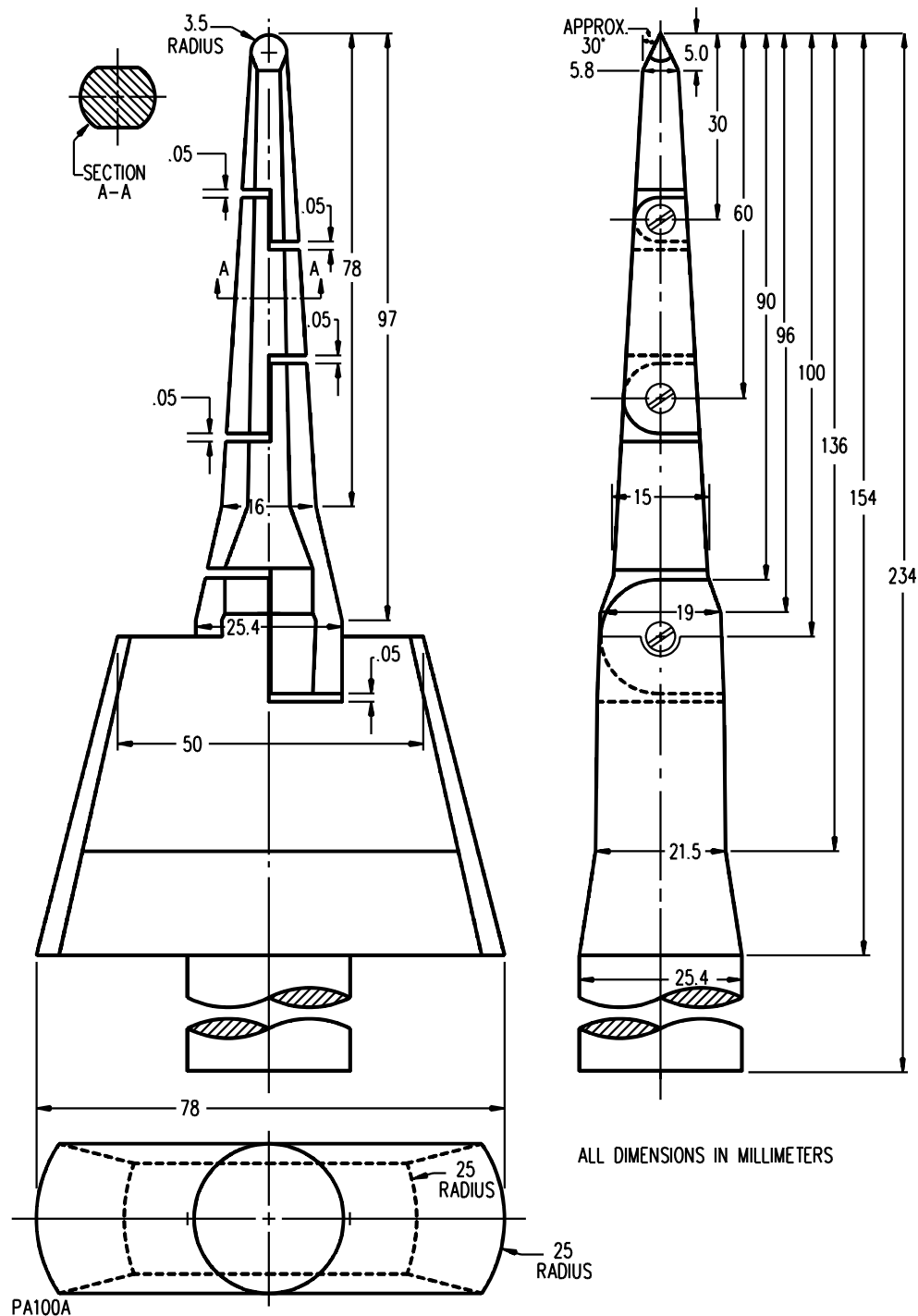
- a) 20 mm (3/4 inch) flame test;

Exception: This test is not required for material having a minimum flammability rating of V-1 or better.

b) Impact Test consisting of 3, 100 foot-pounds (136 J) impacts. The test is to be conducted by dropping a steel sphere 4 inches (101.6 mm) in diameter and weighing 10 pound (4.5 kg) from a height of 10 feet (3.0 m) onto at least 2 corners and onto the center of the enclosure. To reduce the likelihood of unintentional contact that may involve a risk of electric shock from an uninsulated live part, an opening in an enclosure shall comply with either of the following:

- 1) For an opening that has a minor dimension less than 1 inch (25.4 mm), such that an uninsulated live part shall not be contacted by the probe illustrated in Figure 14.1; or
- 2) For an opening that has a minor dimension of 1 inch (25.4 mm) or more, such that an uninsulated live part shall be spaced from the opening as specified in Table 14.1.

Figure 14.1
Articulate probe with web stop



When the battery is located under an overhead guard the impact on the battery cover is reduced to 50 foot-pounds (68 J) produced by dropping a steel sphere weighing 10 pounds from a height of 5 feet (1.5 m).

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Table 14.1
Minimum acceptable distance from an opening to a part that may involve a risk of electric shock

Minor dimension of opening ^a		Minimum distance from opening to part ^a	
Inches	(Millimeters)	Inches	(Millimeters)
3/4	(19.1)	4-1/2	(114.0)
1	(25.4)	6-1/2	(165.0)
1-1/4	(31.8)	7-1/2	(190.0)
1-1/2	(38.1)	12-1/2	(318.0)
1-7/8	(47.6)	15-1/2	(394.0)
2-1/2	(54.0)	17-1/2	(444.0)
b		30	(762.0)

^a Between 3/4 inch and 2-1/8 inches, interpolation is to be used to determine a value between values specified in the table.
^b More than 2-1/8 inches, but not more than 6 inches (152 mm).

14.8 The probe mentioned in 14.7 and illustrated in Figure 14.1 shall be applied to any depth that the opening will permit; and shall be rotated or angled before, during, and after insertion through the opening to any position that is necessary to examine the enclosure.

14.9 With reference to the requirements in 14.7, the minor dimension of an opening is the diameter of the largest cylindrical probe having a hemispherical tip that can be inserted through the opening.

15 Battery

15.1 Only insulated batteries shall be used.

15.2 The connections shall be such that the potential between any two adjacent cells cannot be more than 24 volts nominal.

15.3 For battery terminals, measures shall be taken to reduce the risk of a connection coming loose causing arcing or overheating.

15.4 On a truck equipped with a built-in battery charger, battery terminals shall be protected by insulating boots or covers.

Exception No. 1: A terminal that is intentionally connected to ground on the truck frame need not be provided with a boot or cover.

Exception No. 2: This requirement does not apply to a built-in battery charger equipped with a ground-fault circuit interrupter or an isolated secondary.

15.5 Lithium batteries shall comply with the requirements in the Standard for Batteries for Use in Electric Vehicles, UL 2580. The battery compartment and enclosure shall comply with the requirements in Section 14.