

UL 583

Electric-Battery-Powered Industrial Trucks



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

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Revisions: This Standard contains revisions through and including August 31, 2007.

Summary of Topics

The revisions dated August 31, 2007 were issued to incorporate the following changes in requirements:

- ***Addition of a definition for an arcing or sparking component.***
- ***Editorial revisions to 3.1.***
- ***Clarification of the construction requirement in 5.6.***
- ***Revision to address requirements for cables that have abrasive resistant sleeves in 6.2.***
- ***Revision to make the requirements identical for Type E, EE and ES trucks in 8.1.***
- ***Revision to add more cord types to 8.8.***
- ***Clarification of 9.1 and 9.4.***
- ***Revision to modify the requirements for the wire size in 9.2.***
- ***Addition of requirements for nonmetallic battery covers to 10.7.***
- ***Revisions to the requirements for batteries in 11.1 and 11.3.***
- ***Revisions to the requirements for battery leads in 12.1.***
- ***Addition of requirements for external charging cables in 13.6.***
- ***Replacement of the requirements for power circuits with requirements for low-voltage limited energy circuits in Section 16.***
- ***Revision to the abnormal operation test requirements in 19.1.***
- ***Revisions to clarify the requirements in 19.2.***
- ***Clarification of the abnormal operation requirements in 19.3.***
- ***Revision to specify the duration of the temperature test in 20.1.4.***
- ***Deletion of 20.1.5.***
- ***Revisions to add requirements regarding thermal cut-back features in 20.1.6.***

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- *Clarification of the temperature test requirement in 20.1.7.*
- *Editorial correction for 21.1.*
- *Revisions to add requirements for protective devices in 21.2, 23.1.1 and 25.2.*
- *Revisions to the dielectric voltage withstand test requirements in 22.1.*
- *Revisions to the burnout requirements in 24.7.*
- *Editorial revision to 31.3.*

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The new and revised requirements are substantially in accordance with UL's Proposal(s) on this subject dated July 14, 2006 and March 16, 2007.

The revisions dated August 31, 2007 include a reprinted title page (page1) for this Standard.

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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 Classification and Follow-Up Services after the effective date, and understanding of this should be signified in writing.

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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 Electric-battery-powered industrial trucks covered by these requirements are identified as follows:

- a) Type E – An electric truck having minimum acceptable safeguards against an inherent risk of fire and electric shock.
- b) Type ES – An electric truck that in addition to having all of the safeguards of a Type E truck is provided with additional safeguards to the electrical system to prevent emission of hazardous sparks and to limit surface temperatures.
- c) Type EE – An electric truck provided with safeguards in addition to those required for Type E electric trucks.
- d) Type EX – An electric truck for use in hazardous locations, Class I, Group D and Class II, Group G, as defined in Article 500 of the National Electrical Code.

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

1.5 A product that contains features, characteristics, components, materials, or systems new or different from those covered by the requirements in this standard, and that involves a risk of fire, electric shock, or injury to persons shall be evaluated using the appropriate additional component and end-product requirements as determined necessary to maintain the acceptable level of safety as originally anticipated by the intent of this standard. A product whose features, characteristics, components, materials, or systems conflict with specific requirements or provisions of this standard cannot be judged to comply with this standard. Where considered appropriate, revision of requirements shall be proposed and adopted in conformance with the methods employed for development, revision, and implementation of this standard.

2 General

2.1 Components

2.1.1 Except as indicated in 2.1.2, 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.

2.1.2 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.

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

2.1.4 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.

2.2 Units of measurement

2.2.1 If a value for measurement is followed by a value in other units in parentheses, the first stated value is the requirement.

2.3 Undated references

2.3.1 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.

2.4 Terminology

2.4.1 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.

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

2.4.2 added January 31, 2006

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

2.4.3 added August 31, 2007

2.4.4 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 16.1.

2.4.4 added August 31, 2007

3 Reference Standards

3.1 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.

3.1 revised August 31, 2007

4 Samples

4.1 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

5 General

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

Exception: As provided for wiring in 8.6 – 8.8.

5.2 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. See 8.6 – 8.8.

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

5.4 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, 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.

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

Exception No. 1: As provided in the Exception to 5.4.

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.

5.6 Steel, other than stainless, used in accordance with (2) of the Exception to 5.5 shall be zinc-coated or equivalently protected against corrosion.

5.6 revised August 31, 2007

5.7 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.

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

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

5.10 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.

5.10 added August 31, 2007

6 Motors and Resistors

6.1 Unless it is enclosed, a power-circuit resistor – a resistor used to directly control motor current – shall be located to provide free circulation of air about the resistance elements. A power-circuit resistor shall be installed so as to reduce the possibility of mechanical damage.

6.2 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 8.10.

6.2 revised August 31, 2007

6.3 A bushing of neoprene rubber or rubber-like composition provided to comply with the requirement in 6.2 shall not have a wall thickness less than:

- a) 1/16 inch [1.6 millimeters (mm)] for a No. 10 AWG [5.3 square millimeters (mm²)] or smaller conductor.
- b) 1/8 inch (3.2 mm) for a conductor larger than No. 10 AWG up to and including No. 4 AWG (21.2 mm²).
- c) 3/16 inch (4.8 mm) for a conductor larger than No. 4 AWG up to and including No. 1/0 AWG (53.5 mm²).
- d) 1/4 inch (6.4 mm) for a conductor larger than No. 1/0 AWG.

6.4 A bushing of insulating material other than as mentioned in 6.3 shall be acceptable for the purpose and shall not be less than 0.045 inch (1.14 mm) thick.

6.5 A terminal for a motor or for a power-circuit resistor shall comply with the requirements in 7.3 – 7.5.

7 Electric Controls

7.1 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.

7.2 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.

7.3 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.

7.4 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 7.5.

7.5 In determining the acceptability of a material other than one specifically mentioned in 7.4 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 7.4.

8 Wiring

8.1 The internal wiring of a truck shall consist of general-use wire specified in the National Electrical Code, ANSI/NFPA 70, or appliance-wiring material of one or more of the types specified in Table 8.1. The wiring shall be considered with respect to the temperature and conditions of service to which the wiring is to be subjected as determined by test on the truck.

Exception: At the connection to a component, wiring is permitted to extend beyond the braid/harness for a length of not more than 3 inches (76.2 mm) for Types ES and EE, and a length of not more than 10 inches (254 mm) for Type E trucks.

8.1 revised August 31, 2007

Table 8.1
Appliance-wiring material

Wire insulation	Minimum acceptable average insulation thickness, Inch (mm)
Rubber, Neoprene or Thermoplastic (PVC)	0.015 (0.38) plus an impregnated braid, or 0.030 (0.76) without a braid.

8.2 Appliance-wiring material having a thickness of insulation less than the minimum acceptable value specified in Table 8.1 is permitted for a particular application, provided the insulation is considered with respect to temperature and conditions of service, and is equivalent to one of the materials specified in that table.

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

8.4 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 22.1 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.

8.5 Wiring shall be protected against mechanical damage by:

- a) Enclosing it in the body of the truck;
- b) Enclosing it in metal raceway, such as armored cable, rigid metal conduit, or electrical metallic tubing; or
- c) Protecting it with metal, phenolic composition, or other thermosetting material having equivalent mechanical strength and resistance to impact. Electrical wiring mounted on booms, lifts, and similar parts shall be installed so as to reduce the likelihood of mechanical damage and kinking.

8.6 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.

8.7 A conductor connected to a moving or movable part that cannot be protected as indicated in 8.6 shall be designed for the intended use and shall comply with the test requirements in this standard. Consideration shall be given to the resistance of the conductor to damage resulting from flexing, abrasion, or impact. Flexible metallic conduit is to be used only for flexible connections subject to small and infrequent movements.

8.8 Wiring connections to a continuously moving part, or a part for which the degree of movement is appreciable shall be Type S, SJ, SJO, SJT, SJTO, SO, ST, or STO flexible cord.

Exception: 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.

8.8 revised August 31, 2007

8.9 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.

8.10 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.

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

8.12 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.

8.13 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.

9 Overcurrent Protection

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

9.1 revised August 31, 2007

9.2 An overcurrent device rated or set for 15 amperes is acceptable for protection of a No. 18 AWG (1 mm²) and larger conductors.

9.2 revised August 31, 2007

9.3 The need for overcurrent protection in the power circuit is to be determined on the basis of the burnout test described in Burnout, Section 24 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 5.4.

9.4 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.

9.4 revised August 31, 2007

9.5 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 16.

9.5 revised August 31, 2007

9.6 The overcurrent protective device specified in 16.5 shall be either a circuit breaker, fuse or positive temperature coefficient device.

9.6 added August 31, 2007

9.7 A fuse or circuit breaker shall be either:

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

9.7 added August 31, 2007

9.8 If the protective device consists of a fuse, the unit shall be marked in accordance with 27.6.

9.8 added August 31, 2007

9.9 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 60730-1A.

9.9 added August 31, 2007