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Safety of industrial trucks - Electrical/electronic requirements

Sicherheit von Flurförderzeugen - Elektrische/elektronische Anforderungen

Sécurité des chariots de manutention - Prescriptions électriques/électroniques

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Sécurité des chariots de manutention - Prescriptions
électriques/électroniques

Sicherheit von Flurförderzeugen -
Elektrische/elektronische Anforderungen

This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 150.

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prEN 1175:2023 (E)**European foreword**

This document (prEN 1175:2023) has been prepared by Technical Committee CEN/TC 150 “Industrial trucks - Safety”, the secretariat of which is held by BSI.

This document is currently submitted to the CEN Enquiry.

This document will supersede EN 1175:2020.

This document specifies up-to-date requirements for electric/electronic installations of industrial trucks. Requirements are mainly based on safety functions and not only on safety related parts and take into account exclusively electric/electronic elements.

The main changes compared to EN 1175:2020 are:

- updating of normative and informative references;
- correction of the specification in transport test for contactors in Annex B.

This document is intended to be used in conjunction with EN ISO 3691 and EN 16307.

This document has been prepared under a Standardization Request given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s) / Regulation(s).

For relationship with EU Directive(s) / Regulation(s), see informative Annex ZA, which is an integral part of this document.

[oSIST prEN 1175:2023](https://standards.iteh.ai/catalog/standards/sist/2ec625a1-772e-4e37-b7af-aa5b8892fa14/osist-pren-1175-2023)

<https://standards.iteh.ai/catalog/standards/sist/2ec625a1-772e-4e37-b7af-aa5b8892fa14/osist-pren-1175-2023>

Introduction

This document is a type-C standard as stated in EN ISO 12100.

This document is of relevance for the following stakeholder groups representing the market players with regard to machinery safety:

- machine manufacturers (small, medium and large enterprises);
- health and safety bodies (regulators, accident prevention organizations, market surveillance etc.).

Others can be affected by the level of machinery safety achieved with the means of the document by the above-mentioned stakeholder groups:

- machine users/employers (small, medium and large enterprises);
- machine users/employees (e.g. trade unions, organizations for people with special needs);
- service providers, e.g. for maintenance (small, medium and large enterprises).

The above-mentioned stakeholder groups have been given the possibility to participate at the drafting process of this document.

The machinery concerned and the extent to which hazards, hazardous situations or hazardous events are covered are indicated in the Scope of this document.

When requirements of this type-C standard are different from those which are stated in type-A or type-B standards, the requirements of this type-C standard take precedence over the requirements of the other standards for machines that have been designed and built according to the requirements of this type-C standard.

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prEN 1175:2023 (E)**1 Scope**

This document specifies the electrical requirements for the design and construction of the electrical installation in self-propelled industrial trucks that are within the scope of ISO 5053-1:2020, except variable reach trucks as defined in ISO 5053-1:2020, 3.21 and 3.22, straddle carriers as defined in ISO 5053-1:2020, 3.18 and 3.19, and specific functions, parts and/or systems utilized for the automatic operation of driverless industrial trucks as defined in ISO 5053-1:2020, 3.32. It provides the electrical/electronic and safety-related parts of control system requirements for those self-propelled industrial trucks identified above

NOTE 1 Reference is made to this document in other standards which cover the non-electrical requirements of the various industrial truck types.

This document deals with safety requirements for all electrical and electronic components of industrial trucks, including electrically actuated hydraulic/pneumatic valves. It specifies minimum performance levels required for safety functions realized by safety related parts of control systems. It is intended to be used to avoid or minimize hazards or hazardous situations listed in Annex I. These situations can arise during the operation in the area of use for which it is designed and during maintenance of trucks in accordance with the specifications and instruction given by the manufacturer.

This document does not deal with hazards which could occur:

- a) during construction;
- b) when operating in potentially explosive atmospheres;
- c) because of malfunction of non-electric safety-related parts of control systems, e.g. hydraulic and pneumatic elements like pistons, non-electric valves, pumps, etc;
- d) when operating outside the range of 30 % to 95 % (not condensing) of relative humidity.

NOTE 2 The level of the defined required performance for electrical safety related control systems can be used as a guideline to determine the performance of non-electric systems.

NOTE 3 Hazards due to penetration of water and dust are covered by the definition of PL_r of safety functions, according to EN ISO 13849-1:2015.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 5053-1:2020, *Industrial trucks — Vocabulary — Part 1: Types of industrial trucks*

EN ISO 13849-1:2015, *Safety of machinery — Safety-related parts of control systems — Part 1: General principles for design (ISO 13849-1:2015)*

EN ISO 12100:2010, *Safety of machinery — General principles for design — Risk assessment and risk reduction (ISO 12100:2010)*

EN ISO 3691-1:2015¹, *Industrial trucks — Safety requirements and verification — Part 1: Self-propelled industrial trucks, other than driverless trucks, variable-reach trucks and burden-carrier trucks (ISO 3691-1:2011, including Cor 1:2013)*

EN 16307-1:2020, *Industrial trucks — Safety requirements and verification — Part 1: Supplementary requirements for self-propelled industrial trucks, other than driverless trucks, variable-reach trucks and burden-carrier trucks*

EN ISO 3691-3:2016², *Industrial trucks — Safety requirements and verification — Part 3: Additional requirements for trucks with elevating operator position and trucks specifically designed to travel with elevated loads (ISO 3691-3:2016)*

EN 60204-1:2018³, *Safety of machinery — Electrical equipment of machines — Part 1: General requirements*

EN 12895:2015+A1:2019, *Industrial trucks — Electromagnetic compatibility*

EN 50565-1:2014, *Electric cables — Guide to use for cables with a rated voltage not exceeding 450/750 V (U0/U) — Part 1: General guidance*

EN 60034-8:2007⁴, *Rotating electrical machines — Part 8: Terminal markings and direction of rotation (IEC 60034-8:2007)*

EN 60068-2-27:2009, *Environmental testing — Part 2-27: Tests — Test Ea and guidance: Shock (IEC 60068-2-27:2008)*

EN 60068-2-6:2008, *Environmental testing — Part 2-6: Tests — Test Fc: Vibration (sinusoidal) (IEC 60068-2-6:2007)*

EN 60332-1-2:2004⁵, *Tests on electric and optical fibre cables under fire conditions — Part 1-2: Test for vertical flame propagation for a single insulated wire or cable — Procedure for 1 kW pre-mixed flame (IEC 60332-1-2:2004)*

EN 60384-14:2013⁶, *Fixed capacitors for use in electronic equipment — Part 14: Sectional specification — Fixed capacitors for electromagnetic interference suppression and connection to the supply mains (IEC 60384-14:2013)*

EN 60529:1991⁷, *Degrees of protection provided by enclosures (IP Code) (IEC 60529:1989)*

EN IEC 60664-1:2020⁸, *Insulation coordination for equipment within low-voltage systems — Part 1: Principles, requirements and tests (IEC 60664-1:2020)*

¹ As impacted by EN ISO 3691-1:2015/A1:2020.

² As impacted by EN ISO 3691-3:2016/prA1:202X

³ As impacted by EN 60204-1:2018/prA1:202X

⁴ As impacted by EN 60034-8:2007/A1:2014.

⁵ As impacted by EN 60332-1-2:2004/A1:2015, EN 60332-1-2:2004/A11:2016 and EN 60332-1-2:2004/A12:2020.

⁶ As impacted by EN 60384-14:2013/A1:2016 and EN 60384-14:2013/AC:2016.

⁷ As impacted by EN 60529:1991/A1:2000, EN 60529:1991/A2:2013, EN 60529:1991/AC:2019-02, EN 60529:1991/AC:2016-12, EN 60529:1991/A2:2013/AC:2019-02.

⁸ As impacted by EN IEC 60664-1:2020/AC:2020-12.

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EN 60695-11-10:2013⁹, *Fire hazard testing — Part 11-10: Test flames — 50 W horizontal and vertical flame test methods (IEC 60695-11-10:2013)*

EN IEC 60947-4-1:2019¹⁰, *Low-voltage switchgear and controlgear — Part 4-1: Contactors and motor-starters — Electromechanical contactors and motor-starters*

EN 60947-5-5:1997¹¹, *Low-voltage switchgear and controlgear — Part 5-5: Control circuit devices and switching elements — Electrical emergency stop device with mechanical latching function (IEC 60947-5-5:1997)*

EN 61643-11:2012¹², *Low-voltage surge protective devices — Part 11: Surge protective devices connected to low-voltage power systems — Requirements and test methods (IEC 61643-11:2011)*

EN IEC 62281:2019¹³, *Safety of primary and secondary lithium cells and batteries during transport (IEC 62281:2019)*

EN 62485-3:2014, *Safety requirements for secondary batteries and battery installations — Part 3: Traction batteries (IEC 62485-3:2014)*

EN 62620:2015, *Secondary cells and batteries containing alkaline or other non-acid electrolytes — Secondary lithium cells and batteries for use in industrial applications (IEC 62620:2014)*

EN IEC 62619:2022, *Secondary cells and batteries containing alkaline or other non-acid electrolytes — Safety requirements for secondary lithium cells and batteries, for use in industrial applications (IEC 62619:2022)*

EN IEC 62902:2019, *Secondary batteries — Marking symbols for identification of their chemistry (IEC 62902:2019)*

EN ISO 6743-4:2015, *Lubricants, industrial oils and related products (class L) — Classification — Part 4: Family H (Hydraulic systems) (ISO 6743-4:2015)*

ISO 3287:1999, *Powered industrial trucks — Symbols for operator controls and other displays*

ISO 7000:2019, *Graphical symbols for use on equipment — Registered symbols*

IEC 60417:2002 DB, *Graphical symbols for use on equipment*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 5053-1:2020 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- IEC Electropedia: available at <https://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp/ui>

⁹ As impacted by EN 60695-11-10:2013/AC:2014.

¹⁰ As impacted by EN IEC 60947-4-1:2019/AC:2020-05 and EN IEC 60947-4-1:2019/AC:2021-04.

¹¹ As impacted by EN 60947-5-5:1997/A1:2005, EN 60947-5-5:1997/A11:2013 and EN 60947-5-5:1997/A2: 2017.

¹² As impacted by EN 61643-11:2012/A11:2018.

¹³ As impacted by EN IEC 62281:2019/A1:2021 and EN IEC 62281:2019/prA2:2022.

3.1 U_n **nominal voltage of the truck system**

designated value of the voltage of the electrical system and to which its characteristics are referred

3.2**nominal battery voltage**

number of battery cells connected in series multiplied by the nominal cell voltage, relative to the chemical technology of the cell

Note 1 to entry: If the battery consists of cells connected in series and in parallel, the nominal voltage is defined by the number of cells, which are arranged in one line of cells connected in series.

3.3**drive system**

electrically controlled system moving truck on ground, generating torque with effect on one or more drive wheels

3.4**low speed**

travel speed below 0,4 m/s for pedestrian trucks and below 0,7 m/s for all other types of trucks

3.5**LHS****electrical load handling system**

system for electrical or electronically controlled load handling

3.6**electrical steering**

electrical or electronic system controlling the angular position of the wheel(s) of the truck with respect to its vertical longitudinal centre plane

Note 1 to entry: See Annex F for examples.

3.7**assistance system**

system intended to improve the operational performance, the ergonomics of industrial trucks, or to warn the operator about hazards due to improper use in the specific operation related to the work environment and application

Note 1 to entry: Assistance systems are not necessary for the safe operation of industrial trucks and must be clearly distinguished from safety functions.

3.8**PL_r****required performance level**

performance level (PL) applied to achieve the required risk reduction for each safety function

[SOURCE: EN ISO 13849-1:2015, 3.1.24]

3.9**setpoint**

operator's physical actions on the intended control device

Note 1 to entry: For travelling, the actuation of the accelerator control.

prEN 1175:2023 (E)**3.10****actpoint**

actual physical value of the system output

Note 1 to entry: Examples of actpoint are: truck speed, position of truck steered wheel(s) energised solenoid and the combination of voltage, current and frequency applied to a drive motor.

3.11**service brake**

braking system allowing the operator to control, directly or indirectly, the speed of the truck or to bring the truck to a halt

[SOURCE: ISO 6292:2020, 3.9, modified by substituting “braking system” with “brake” in the terminological entry]

Note 1 to entry: The service brake can also be activated by the electronic control system of the truck.

Note 2 to entry: The service brake can also serve as a parking brake.

3.12**parking brake**

braking system allowing a vehicle to be held stationary mechanically, even on an inclined surface, particularly in the absence of the operator

[SOURCE: ISO 6292:2020, 3.8, modified by substituting “braking system” with “brake” in the terminological entry]

3.13**safety function**

function of the machine whose failure can result in an immediate increase of the risk(s)

[SOURCE: EN ISO 12100:2010, 3.30]

3.14**risk**

combination of the probability of occurrence of harm and the severity of that harm

[SOURCE: EN ISO 12100:2010, 3.12]

3.15**type test**

test to the requirements of this document of an example of devices, systems or complete trucks representative of the production, including the relevant range of options provided by the manufacturer of the truck, as part of the verification of compliance with this document

3.16**routine test**

tests carried out during series production necessary to maintain compliance with this document

3.17**control circuit**

electrical circuit used for the control, including monitoring, of the truck and its electrical equipment

3.18**auxiliary circuit**

electrical circuit that controls lights, fans and other accessories

3.19**power circuit**

circuit that supplies power from the energy source to units of equipment used for truck operation

3.20**energy source**

unit for energizing equipment of the truck used for productive operation

Note 1 to entry: Energy sources for trucks can be:

- batteries based on different technologies;
- liquid or gaseous fuel combined with internal combustion engine or fuel cell;
- AC power sources.

3.21**frame fault**

accidental connection of a live part to the truck frame or exposed conductive parts

3.22**IC truck**

truck equipped with an internal combustion engine of which the power is transferred to a mechanical, hydraulic or electrical system

3.23**normal operating position**

position in which the operator is able to control all functions for driving and load handling as defined by the manufacturer

Note 1 to entry: Additional positions are permitted to be defined by the manufacturer if it is not possible to control all the functions of the truck from a single position. A rotating seat or stand-up end-control truck with more than one operating direction is considered as being or having a single operating position.

[SOURCE: EN ISO 3691-1:2015, 3.8]

3.24**high voltage truck**

truck whose U_n is greater than 120 V DC or 50 V AC and less than or equal to 1 500 V DC or 1 000 V AC under idle or fully charged condition

3.25**OPC****operator-presence control**

device that detects the presence of the operator in the normal operating position

3.26**electric powered assisted steering system**

mechanical and/or hydraulic steering system powered by an electrical system

prEN 1175:2023 (E)**4 Requirements****4.1 Introduction**

Trucks shall comply with the safety requirements and/or protective measures of this clause. In addition, the truck shall be designed according to the principles of EN ISO 12100:2010 for relevant but not significant hazards which are not dealt with by this document.

4.2 Validation of safety functions

The design of safety functions shall be validated in accordance with EN ISO 13849-1:2015, Clause 8.

4.3 General requirements**4.3.1 Low voltage/high voltage**

Safety shall not be compromised at any voltage level that can occur.

Electrical systems of trucks powered by lead-acid batteries shall be designed so that all functions operate in the voltage range from 70 % up to 120 % of the nominal battery voltage. These limits shall be adapted to other energy sources technologies by the manufacturer.

NOTE Limits set by the manufacturer for other energy sources are outside the scope of this document.

4.3.2 Frame fault

The electric circuits shall be so designed or protected, that frame faults shall not cause hazardous inadvertent movements that cannot be corrected or compensated by the operator. Compliance shall be verified by means of the type test of 4.10.4.

4.3.3 Protection from ingress of water and dust

The electrical installation of the trucks in operating condition shall be designed and constructed such that the protection from harmful ingress of water and dust is in accordance with the environmental conditions in which the truck is designed to operate, including reasonably foreseeable misuses, as defined in the instruction handbook (see EN ISO 3691-1:2015, 6.2.2).

NOTE Standardised degrees of protection provided by the enclosure of the electrical equipment are given in EN 60529:1991.

4.3.4 Protection against electric shock

Non-insulated live parts of trucks in the operating condition shall be protected to a degree of IPXXB preventing direct contact. For top surfaces, the minimum degree shall be IPXXD in accordance with EN 60529:1991.

Access to an electrical enclosure containing uninsulated live parts in excess of nominal voltage 60 V DC or 25 V AC shall be possible only using a tool.

Indirect contact with live parts shall be avoided by electric separation of the protection devices in accordance with EN 60204-1:2018, 6.3.2.3.

It shall be possible to electrically disconnect the energy sources for maintenance and replacement operations. An easily accessible switch, connector or disconnectable battery terminals meets the intent of this requirement.

For energy sources with nominal voltage greater than 60 V DC or 25 V AC live parts shall be protected against direct contact.

4.3.5 Connection to the frame

4.3.5.1 Battery powered trucks

There shall be no electrical connection to the truck frame, except for:

- a) frame fault detection system;
- b) electric/electronic circuits with a nominal voltage not greater than 60 V DC which are galvanically separated from the energy source;
- c) connection to the earthing terminal of on-board chargers;
- d) suppression capacitors. If the nominal battery voltage exceeds 60 V DC, minimum requirement for the capacitor shall be Class Y in accordance with EN 60384-14:2013;
- e) the screen of shielded cables and components. This condition shall meet the requirements of the insulation resistance testing in 4.10.2;
- f) suppression resistor for ESD reduction, the system shall meet the requirements of 4.10.2.

4.3.5.2 IC trucks

- a) Electrical system with nominal voltage not greater than 48 V (starter battery):
 - one pole of the electrical system may be connected to the truck frame;
 - all conductors not connected to the truck frame shall be effectively insulated and where necessary protected against thermal and mechanical damage;
 - there shall be means to disconnect both poles of the starter battery from the truck for service purposes;
- b) electrical system with nominal voltage greater than 48 V (hybrid drive system):
 - electrical systems with nominal voltage greater than 48 V shall be electrically insulated and galvanically separated from frame, with the exceptions listed in 4.3.5.1 a), b), d), e) and f);
 - control and auxiliary circuits shall have a maximum voltage not greater than 120 V DC or 50 V AC. Where the energy source maximum voltage is greater, control and auxiliary circuits shall be electrically and galvanically separated from the energy source;
 - for maximum voltages greater than 120 V DC and 50 V AC, equipotential bonding shall be provided between the frame of the vehicle and conductive enclosures, e.g. motor frames.

4.3.6 Protection from residual voltages

After disconnecting energy sources, the voltage of the capacitors in power circuits shall be less than 60 V DC after 10 s.

If the above condition is not technically achievable or practicable a warning/safety label shall be provided. This warning label shall be permanent and indelible and shall be affixed on, or in close to, the enclosure containing the capacitors.

NOTE Safety signs EN ISO 7010:2020 W001 and EN ISO 7010:2020 W012 can be used.