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Vozila za talni transport - Varnostne zahteve in preverjanje - 4. del: Vozila brez voznika in njihovi sistemi (ISO/DIS 3691-4:2018)

Industrial trucks - Safety requirements and verification - Part 4: Driverless industrial trucks and their systems (ISO/DIS 3691-4:2018)

Flurförderzeuge - Sicherheitstechnische Anforderungen und Verifizierung - Teil 4: Fahrerlose Flurförderzeuge und ihre Systeme (ISO/DIS 3691-4:2018)

Chariots de manutention - Exigences de sécurité et vérification - Partie 4: Chariots sans conducteur et leurs systèmes (ISO/DIS 3691-4:2018)

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Industrial trucks — Safety requirements and verification —

Part 4: Driverless industrial trucks and their systems

*Chariots de manutention — Exigences de sécurité et vérification —**Partie 4: Chariots sans conducteur et leurs systèmes*

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 110, *Industrial trucks*, Subcommittee SC 2, *Safety of powered industrial trucks*.

This first edition cancels and replaces the second edition (ISO 3691:1980), which has been technically revised.

A list of all parts in the ISO 3691- series can be found on the ISO website.

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Introduction

General

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

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 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.

The ISO 3691- series of standards covers safety requirements and their verification for industrial trucks as defined in ISO 5053-1.

This document is of relevance, in particular, 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);
- consumers (in case of machinery intended for use by consumers).

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.

Structure

An important step forward in the work on the ISO 3691- series of standards was the agreement to issue a new structure of International Standards for industrial trucks having on one side basic standards for all types of trucks (see Foreword) and on the other side independent standards to cover the respective specific functions of industrial trucks, e.g. visibility, noise, vibration, electrical requirements, etc.

Assessment of hazards

The product needs to be designed in such a way that it is fit for its purpose or function and can be adjusted and maintained without putting persons at risk when used under the conditions foreseen by the manufacturer.

In order to properly design a product and to cover all specific safety requirements, the manufacturer will have to identify the hazards that apply to his product and carry out a risk assessment. The manufacturer will then need to design and construct the product taking this assessment into account.

The aim of this procedure is to eliminate the risk of accidents throughout the foreseeable lifetime of the machinery, including the phases of assembling and dismantling where risks of accidents could also arise from foreseeable abnormal situations.

In selecting the most appropriate methods, the manufacturer will need to apply the following principles, in the order given here:

- a) eliminate or reduce risks as far as possible by design (inherently safe machinery design and construction);
- b) take the necessary protective measures in relation to risks that cannot be eliminated by design;
- c) inform users of any shortcoming of the protective measures adopted;
- d) indicate whether any particular training is required;
- e) specify any need to provide personal protection equipment;
- f) refer to the appropriate user's document for proper operating instructions.

Industrial trucks need to be designed to prevent foreseeable misuse wherever possible, if such would engender risk. In other cases, the manufacturer's instructions will need to draw the user's attention to ways shown by experience in which the machinery ought not to be used.

This part of ISO 3691 does not repeat all the technical rules which are state-of-the-art and which are applicable to the material used to construct the industrial truck. Reference will also need to be made to ISO 12100.

Legislative situation/Vienna Agreement

From the very beginning, the task of the working group was to revise ISO 3691:1980 and establish worldwide basic standards to comply with the major legislative regulations in, for example, the EU, Japan, Australia and North America.

Every effort was made to develop a globally relevant International Standard. That goal was achieved with most of the issues. For several potential problem areas compromises were needed and will be needed in the future. Where divergent regional requirements remain, these are addressed by ISO/TS 3691-7 and ISO/TS 3691-8.

In order to ensure that the revised International Standard will be actively used in the ISO member countries, worldwide, procedures are necessary to replace the existing national standards and technical regulations by the revised International Standard. In the European Community, ISO and the European Committee for Standardization (CEN) agreed on technical co-operation under the Vienna Agreement, with the aim of replacing European Standards (EN) by International Standards. Other countries are asked to make similar agreements to ensure that their national standards and technical regulations are replaced by this International Standard.

Only by these actions will there be the guarantee that products in accordance with International Standards can be shipped worldwide freely without any technical barriers.

Industrial trucks — Safety requirements and verification —

Part 4: Driverless industrial trucks and their systems

1 Scope

This part of ISO 3691 gives safety requirements and the means for their verification for driverless industrial trucks (hereafter referred to as trucks) and their systems.

It is not applicable to trucks solely guided by mechanical means (rails, guides, etc.).

For the purposes of this part of ISO 3691, a driverless industrial truck is a powered truck, which is designed to operate automatically. Remotely controlled trucks are not considered to be driverless trucks. A truck's system comprises the control system, which may be part of the truck and/or separate from it, guidance means and power system. Requirements for power sources are not covered in this standard.

The condition of the operating zone has a significant effect on the safe operation of the driverless industrial truck. The preparations of the operating zone to eliminate the associated hazards are specified in [Annex A](#).

This part of ISO 3691 deals with all significant hazards, hazardous situations or hazardous events during all phases of the life of the truck (ISO 12100:2010, Clause 5.4), as listed in [Annex B](#), relevant to the applicable machines when used as intended and under conditions of misuse which are reasonably foreseeable by the manufacturer.

It does not establish requirements for additional hazards that can occur:

- during operation in severe conditions (e.g. extreme climates, freezer applications, strong magnetic fields),
- during operation in nuclear environments,
- from trucks intended to operate in public zones (in particular ISO 13482:2012 "Robots and robotic devices — Safety requirements for personal care robots"),
- during operation on a public road,
- during operation in potentially explosive environments,
- during operation in military applications,
- during operation with specific hygienic requirements,
- during operation in ionizing and non ionizing radiation,
- during the transportation of (a) person(s) other than (a) intended rider(s),
- when handling loads the nature of which could lead to dangerous situations (e.g. molten metals, acids/bases, radiating materials),
- for persons moving towards a moving truck,

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- for persons stepping from the side into the truck path when it is impossible for the truck to stop before contact,
- for rider positions with elevation function not be than 1200 mm from the floor/ground to the platform floor.

This part of ISO 3691 does not contain safety requirements for trailer(s) being towed behind a truck.

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 3691-1:2011, *Industrial trucks — Safety requirements and verification — Part 1: Self-propelled industrial trucks, other than driverless trucks, variable-reach trucks and burden-carrier trucks*

ISO 3691-6:2013, *Industrial trucks — Safety requirements and verification — Part 6: Burden and personnel carriers*

ISO/TS 3691-7:2011, *Industrial trucks — Safety requirements and verification — Part 7: Regional requirements for countries within the European Community*

ISO/TS 3691-8:2012, *Industrial trucks — Safety requirements and verification — Part 8: Regional requirements for countries outside the European Community*

ISO 4413:2010, *Hydraulic fluid power — General rules and safety requirements for systems and their components*

ISO 4414:2010, *Pneumatic fluid power — General rules and safety requirements for systems and their components*

ISO 5053-1:2015, *Industrial trucks — Terminology and classification — Part 1: Types of industrial trucks*

ISO 6292:2008, *Powered industrial trucks and tractors — Brake performance and component strength*

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*

ISO 13850:2015, *Safety of machinery — Emergency stop function — Principles for design*

ISO 13851:2002, *Safety of machinery — Two-hand control devices — Functional aspects and design principles*

ISO 13856-1:2013, *Safety of machinery — Pressure-sensitive protective devices — Part 1: General principles for design and testing of pressure-sensitive mats and pressure-sensitive floors*

ISO 13856-2:2013, *Safety of machinery — Pressure-sensitive protective devices — Part 2: General principles for design and testing of pressure-sensitive edges and pressure-sensitive bars*

ISO 13856-3:2013, *Safety of machinery — Pressure-sensitive protective devices — Part 3: General principles for design and testing of pressure-sensitive bumpers, plates, wires and similar devices*

ISO 13857:2008, *Safety of machinery — Safety distances to prevent hazard zones being reached by upper and lower limbs*

ISO 14119:2013, *Safety of machinery — Interlocking devices associated with guards — Principles for design and selection*

ISO 14120:2015, *Safety of machinery — Guards — General requirements for the design and construction of fixed and movable guards*

ISO 15870:2000, *Powered industrial trucks — Safety signs and hazard pictorials — General principles*

ISO 22915-1:2016, *Industrial trucks — Verification of stability — Part 1: General*

ISO 22915-2:2008, *Industrial trucks — Verification of stability — Part 2: Counterbalanced trucks with mast*

ISO 22915-3:2014, *Industrial trucks — Verification of stability — Part 3: Reach and straddle trucks*

ISO 22915-4:2009, *Industrial trucks — Verification of stability — Part 4: Pallet stackers, double stackers and order-picking trucks with operator position elevating up to and including 1 200 mm lift height*

ISO 22915-5:2014, *Industrial trucks — Verification of stability — Part 5: Single-side-loading trucks*

ISO 22915-7:2016, *Industrial trucks — Verification of stability — Part 7: Bidirectional and multidirectional trucks*

ISO 22915-8:2008, *Industrial trucks — Verification of stability — Part 8: Additional stability test for trucks operating in the special condition of stacking with mast tilted forward and load elevated*

ISO 22915-9:2014, *Industrial trucks — Verification of stability — Part 9: Counterbalanced trucks with mast handling freight containers of 6 m (20 ft) length and longer*

ISO 22915-10:2008, *Industrial trucks — Verification of stability — Part 10: Additional stability test for trucks operating in the special condition of stacking with load laterally displaced by powered devices*

ISO 22915-11:2011, *Industrial trucks — Verification of stability — Part 11: Industrial variable-reach trucks*

ISO 22915-12:2015, *Industrial trucks — Verification of stability — Part 12: Industrial variable-reach trucks handling freight containers of 6 m (20 ft) length and longer*

ISO 22915-13:2012, *Industrial trucks — Verification of stability — Part 13: Rough-terrain trucks with mast*

ISO 22915-14:2010, *Industrial trucks — Verification of stability — Part 14: Rough-terrain variable-reach trucks*

ISO 22915-15:2013, *Industrial trucks — Verification of stability — Part 15: Counterbalanced trucks with articulated steering*

ISO 22915-20:2008, *Industrial trucks — Verification of stability — Part 20: Additional stability test for trucks operating in the special condition of offset load, offset by utilization*

ISO 22915-22:2014, *Industrial trucks — Verification of stability — Part 22: Lateral- and front-stacking trucks with and without elevating operator position*

[IEC 61496-1](#) 1st Edition, April 2012 *Safety of Machinery — Electro-sensitive Protective Equipment — Part 1: General Requirements and Tests*

[IEC 61496-2](#) 3rd Edition, January 1, 2013 *Safety of Machinery — Electro-sensitive protective equipment — Part 2: Particular requirements for equipment using active opto-electronic protective devices (AOPDs)*

[IEC 61496-3](#) 2nd Edition, February 1, 2008 *Safety of machinery — Electro-sensitive protective equipment — Part 3: Particular requirements for Active Opto-electronic Protective Devices responsive to Diffuse Reflection (AOPDDR)*

[IEC TS 61496-4-2](#) 1st Edition, June 1, 2014 *Safety of machinery — Electro-sensitive protective equipment — Part 4-2: Particular requirements for equipment using vision based protective devices (VBPD) — Additional requirements when using reference pattern techniques (VBPDPP)*

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[IEC TS 61496-4-3](#) 1st Edition, May 1, 2015 *Safety of machinery — Electro-sensitive protective equipment — Part 4-3: Particular requirements for equipment using vision based protective devices (VBPD) — Additional requirements when using stereo vision techniques (VBPDEST)*

IEC 60204-1:2016, *Safety of machinery — Electrical equipment of machines - Part 1: General requirements*

IEC 61558-1:2017, *Safety of power transformers, power supply units, reactors and similar — Part 1: General requirements and tests*

EN 1175-1:1998, + A1:2010, *Safety of industrial trucks — Electrical requirements — Part 1: General requirements for battery powered trucks*

EN 1175-2:1998, +A1:2010, *Safety of industrial trucks — Electrical requirements — Part 2: General requirements for internal combustion engine powered trucks*

EN 1175-3:1998, +A1:2010, *Safety of industrial trucks — Electrical requirements — Part 3: Specific requirements for the electric power transmission systems of internal combustion engine powered trucks*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 5053-1 and ISO 12100 and the following apply.

3.1

actuating force

force applied on the bumper which will initiate a stop signal

3.2

authorized person (personnel or individual(s))

person designated by the user and trained to operate or maintain the truck or system

3.3

automatic mode

operating mode where no operator intervention is required for operation

3.4

bumper

device that generates a signal to stop the truck on physical contact

3.5

virtual bumper

non-contact, sensing device having one or more detection zones that generates a signal prior to physical contact (e.g. active opto-electronic protective devices responsive to diffuse reflection (AOPDDRs))

3.6

driverless truck system

combination of one (or more) driverless truck(s) and ancillary components to control and manage the automatic operation of the truck(s)

Note 1 to entry: ancillary components may be integrated or external (e.g. guidance, traffic control, power system, communication system...)

3.7

driverless industrial truck

powered truck, designed to operate automatically to transport loads

3.8

escape route

path providing exit away from hazards