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Rough-terrain trucks — Safety requirements and verification

Part 7: Longitudinal load moment systems

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National foreword

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Foreword

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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).

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The committee responsible for this document is ISO/TC 110, *Industrial trucks*, Subcommittee SC 4, *Rough-terrain trucks*.

A list of all parts in ISO 10896 series can be found on the ISO website.

Introduction

This document is one of a set of International Standards produced by ISO/TC 110/SC 4 as part of its program of work regarding standardization of terminology, general safety, performance and user requirements for rough-terrain trucks (hereafter also referred to as trucks).

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.

INTERNATIONAL STANDARD ISO 10896-7:2016(E)

Rough-terrain trucks — Safety requirements and verification —

Part 7: Longitudinal load moment systems

1 Scope

This document specifies design, safety and verification requirements for longitudinal load moment systems which can be used on rough-terrain trucks (hereafter referred to as trucks). This document provides requirements for both the longitudinal load moment indicator (hereafter referred to as LLMI) and the longitudinal load moment control (hereafter referred to as LLMC) used on rough-terrain trucks, defined in ISO 10896-1, in a stationary position performing loading or placing functions on consolidated, stable and level ground.

It is not applicable to the following:

— lorry-mounted trucks as defined in ISO 20297-1;

— slewing variable-reach trucks as defined in ISO 10896-2.

This document deals with significant hazards, hazardous situations or hazardous events relevant to longitudinal load moment systems when used as intended and under conditions of misuse which are reasonably foreseeable by the manufacturer.

This document does not cover the risk due to lateral instability or instability due to the travelling of the truck. The longitudinal load moment system is not intended for warning of the overturning risk while the truck is travelling.

This document is not applicable to longitudinal load moment systems manufactured before the date of its publication.

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 10896-1:2012, *Rough-terrain trucks — Safety requirements and verification — Part 1: Variable-reach trucks*

ISO 12100, *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 22915-14:2010, *Industrial trucks — Verification of stability — Part 14: Rough-terrain variable-reach trucks*

IEC 60529, *Degrees of protection provided by enclosures (IP Code)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 12100, ISO 10896-1 and the following apply.

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

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at http://www.iso.org/obp

3.1
longitudinal load moment
sum of the moments in the longitudinal plane forward of the tipping line (for example, wheels, stabilizing devices) produced by the load, the attachment and the lifting means of the truck

3.2
longitudinal load moment indicator
LLMI
device that warns the operator of a change to the *load-handling geometry* (3.4) which would increase the *longitudinal load moment* (3.1) beyond pre-determined limit(s)

3.3
longitudinal load moment control
LLMC
device that prevents the operator changing the *load-handling geometry* (3.4) in direction(s) which would increase the *longitudinal load moment* (3.1) beyond the allowable limit(s)

3.4
load-handling geometry
relationship of points, lines and angles, described by the position of the load centre of gravity (the position of the boom, carriage and attachment) and tipping line (front wheels or stabilizing devices, if equipped)

4 Safety requirements and/or protective/risk reduction measures

4.1 General

4.1.1 Trucks shall comply with the safety requirements and/or protective/risk reduction measures of this clause.

4.1.2 In addition, the truck shall be designed according to the principles of ISO 12100 for relevant but not significant hazards which are not dealt with by this document.

4.2 Longitudinal load moment systems

4.2.1 General

4.2.1.1 Longitudinal load moment systems shall comply with the safety requirements and/or measures of this clause for all actual capacities and all configurations described in the operating manual supplied by the truck manufacturer.

4.2.1.2 Longitudinal load moment systems shall be designed taking the following into account:

— the operating environment, for example, relative humidity, temperature, condensation, dust;

— the truck rated capacity;

— electromagnetic compatibility;

— maintenance activities (for example, cleaning, washing).

4.2.1.3 The dynamic loading resulting from the operation of the LLMC shall be taken into consideration in the truck design.

4.2.1.4 Longitudinal load moment systems shall be capable of withstanding the shock loads and vibrations transmitted to them during normal usage and maintenance of the truck.

4.2.1.5 Painting or other corrosion protection shall not affect the correct functioning of limiters and indicators.

4.2.2 Protection against modification of the calibration setting

All adjustments affecting the calibration settings of the longitudinal load moment system shall be so designed that it can only be carried out by authorized persons (for example, using a special tool, a dedicated key, sequence of operations).

4.2.3 Verification of the correct function

4.2.3.1 Verification of the correct function of the longitudinal load moment system shall be possible without any special tools. If a special procedure is required, this procedure shall be described in the operator manual.

4.2.3.2 Longitudinal load moment systems shall enable periodic functional checks to be carried out for verification that systems are operating correctly.

4.2.4 Warning and prevention

The longitudinal load moment system shall function in accordance with this document for all combination of attachments and motions of the load handling means and attachments authorized by the manufacturer.

4.2.5 Malfunction of the longitudinal load moment system

Any malfunction or functional damage of any part of the system shall be indicated to the operator until the fault is rectified (that is, continuous illumination of warning lamps, or continuous buzzer or both).

4.2.6 Additional requirements for protection

In addition to requirements in ISO 10896-1:2012, 4.4.2, the components of the longitudinal load moment system which are exposed to harsh conditions shall be installed on the truck's exterior or directly exposed to the environment shall have a minimum degree of protection corresponding to IP67 in accordance to IEC 60529.

4.2.7 Electrical

4.2.7.1 Power supply

4.2.7.1.1 The power supply shall be protected against voltage variations, supply voltage reversal, overloading, short circuit, and earth faults.

4.2.7.1.2 In case of power supply failure, the longitudinal load moment LLMC system shall either continue to function correctly or return to a safe condition.

4.2.7.2 Voltage recovery

The longitudinal load moment system shall operate correctly in the event of voltage recovery unless the safe condition is maintained.

4.2.8 Interconnecting of units

All signals and power supplies transmitted between units of the LLMI and LLMC shall be protected against interference, for example, discrete insulated conductors, CANbus. The chassis of the truck shall not be used to transmit power, signals or the functional signal return.

4.2.9 External components

Components forming part of the longitudinal load moment system (for example, proximity sensors) mounted externally (that is, without removing any guard or part of the truck, shall be so arranged and protected as to minimize the potential for tampering.

4.3 Longitudinal load moment indicator (LLMI)

4.3.1 General

While there are no performance level requirements covering the LLMI in this document, the performance level principles of ISO 13849-1 can be applied to the LLMI which is intended to warn the operator of a possible hazard and requires action from the operator to prevent such a hazard.

4.3.2 Warning

4.3.2.1 The LLMI shall give continuous warnings, both visible and audible, each starting at its own pre-determined limit, and based on the limits determined by the stability test T1 of ISO 22915-14. It shall continue and be maintained with activation of the LLMC. The warnings shall continue to signal until the longitudinal load moment returns below the pre-determined limits at which the warning was initiated.

4.3.2.2 There shall be a clear difference between the warnings, both visible, for example, a visible warning may be one colour for the approach and another colour for the stability limit and audible, for example, an intermittent audible warning may increase frequency for the approach and fix when limits have been reached, for approaching and reaching the stability limit.

4.3.2.3 The LLMI shall give a progressive warning starting at a pre-determined limit which gives the operator time to react to the warning.

4.3.2.4 These warnings shall be clearly distinguishable at the operator position within the expected operating conditions (see 4.2.1.2).

4.3.2.5 No provision shall be made for the truck operator to cancel a warning.

4.3.3 Displays

The LLMI display shall

— be positioned so that the operator has a clear view of the warnings and indications,

— not interfere with the operator's view of the load and the working area,

— be clearly distinguishable under all conditions, including bright sunlight, and

— provide indication by movement from left to right, bottom to top or clockwise rotation.

4.4 Longitudinal load moment control (LLMC)

4.4.1 General

4.4.1.1 In addition to the requirements of 4.1, the LLMC shall

— operate automatically and without the need for resetting when activated, and

— once activated, remain activated until the overload condition has been removed or the overturning moment has been lessened within the limits permitted by the manufacturer.

4.4.1.2 It is permitted to automatically disconnect the LLMC and audible warning of the LLMI only when LLMC is set for using buckets and when the boom is raised less than 10° and extended less than 1 m.

4.4.2 Prevention of movement

4.4.2.1 The LLMC shall stop movements of the load-handling geometry which would increase the longitudinal load moment beyond the limits determined in the stability test T1 required by ISO 10896-1.

4.4.2.2 Movements after the stop which will reduce the longitudinal load moment shall be possible.

4.4.2.3 The stopping of the movement shall not in itself give rise to instability.

4.4.2.4 The function of the LLMC shall comply with performance level PLc of ISO 13849-1.

NOTE ISO 12100 was used to determine the appropriate PL levels.

4.4.3 Override of the LLMC

4.4.3.1 It shall be possible to override the LLMC.

4.4.3.2 The LLMC enabling device shall not be located on the joystick.

4.4.3.3 The overriding function shall be automatically cancelled under any of the following conditions:

— no more than 60 s of activity;

— the engine has stopped;

— the operator is not in the normal operating position.

4.4.3.4 It shall only be possible to override the LLMC when input from the operator has been received (for example momentary switch).

4.4.3.5 An audible, visible, or both, signal shall be used to alert the operator that the LLMC system has been overridden until such time it has been automatically cancelled.

5 Verification of safety requirements and/or protective/risk reduction measures

5.1 General

5.1.1 The requirements stated in Clause 4 shall be verified using either one or a combination of the following:

— measurement;

— visual examination;

— tests;

— by design or calculation.

5.1.2 Compliance with these requirements can be verified by other methods giving equivalent results.

5.1.3 Testing may be performed by operating the truck in the manner prescribed in 5.2 or, where practicable, may be simulated by any method giving an equivalent effect and substantially the same results.

5.2 Verification

5.2.1 General

5.2.1.1 Verifications shall be carried out on a representative sample of series production of every different model of truck fitted with a longitudinal load moment system. The tests shall be conducted with the truck on its wheels and also on stabilizing devices, if equipped.

5.2.1.2 The LLMI and LLMC shall function correctly during and after the test, and the truck shall remain stable throughout.

NOTE These tests can involve overloading the truck and extreme caution combined with a suitable system of work is essential.

5.2.2 Verification of LLMI

Compliance with the requirements in 4.3 shall be checked while using motions which could cause the LLMI to be activated.

5.2.3 Verification of LLMC

5.2.3.1 Compliance with the requirements in 4.4 shall be checked with a variety of load and various reaches including the trucks rated capacity and maximum reach according to the load chart.

5.2.3.2 The following test procedure shall be used.

a) Set engine speed to low idle.

b) Fully actuate the lowering control.

c) Accelerate the engine to maximum speed.

d) Allow the LLMC to stop the descent at various lift points.

5.2.3.3 It shall be possible to bring the load to ground in safe condition after triggering of the LLMC.

NOTE Temporary lifting of the rear wheels is permitted during the test.

6 Information for use (operating instructions)

6.1 The truck manufacturer shall include, with each longitudinal load moment system, information for use, including any special limitations (for example, the override system) or requirements for the system to function properly.

6.2 The operator's manual of the truck shall identify the residual hazards of longitudinal load moment system and shall integrate the following information:

a) a warning that the LLMI/LLMC will work properly only:

   — when the truck is static;

   — when the truck is on stable and level ground;

   — when the truck is performing loading or placing functions;

   — when the LLMI/LLMC is activated;

   — when the boom is raised more than 10° and extended more than 1 m.

b) information that the LLMI will only warn the operator in the event of inadequate stability in the longitudinal plane in the forward direction;

c) information that the longitudinal load moment system is not intended for warning of the risk of overturning in the case of

   — a sudden overload,

   — travelling with the load in the elevated position,

   — travelling on rough terrain or on grounds with obstacles and holes,

   — travelling across a slope or turning on a slope, and

   — cornering or turning too fast or sharply.

d) information about how to recognize a failure and subsequent actions to be taken to resolve the failure prior to placing the truck into service;

e) information for checking the proper function of the longitudinal load moment system and the frequency of these checks, if necessary, and highlighting the importance of undertaking these checks at the frequency specified;

f) information that the longitudinal load moment system shall be maintained, including any adjustments affecting the settings, according to the truck manufacturer's instructions and only by authorized personnel.

Bibliography

[1] ISO 20297-1, *Industrial trucks — Lorry-mounted trucks — Part 1: Safety requirements and verification*

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