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Cranes — Safety requirements for loader cranes

Appareils de levage à charge suspendue — Exigences de sécurité pour les grues de chargement

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Contents

Page

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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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.

ISO 15442 was prepared by Technical Committee ISO/TC 96, *Cranes*, Subcommittee SC 6, *Mobile cranes*.

Introduction

This International Standard has been considered necessary because of the lack, so far, of specific requirements accepted worldwide for loader cranes.

Even though a loader crane, when mounted on a vehicle, may be considered as a particular type of mobile crane, current ISO Standards developed for mobile cranes do not include, with very few exceptions, specific requirements for loader cranes.

Therefore this International Standard has been designed to:

a) identify specific safety requirements for loader cranes;

b) when applicable, refer to existing International Standards which contain provisions that can be applied to loader cranes;

c) promote loader crane safety by both identifying specific requirements and referring to existing applicable standards, so that incorporating all such provisions into the design and use of loader cranes will guard against and minimize injury to workers and damage to equipment;

d) facilitate the work of everyone in the field of loader cranes (designers, supervisors and other personnel as well as people directly or indirectly responsible for their safe use and maintenance) who need to consult the current International Standard for loader cranes;

e) contribute to further international harmonization of loader crane standards.

Cranes — Safety requirements for loader cranes

1 Scope

This International Standard specifies minimum requirements for design, calculation, examinations and tests of hydraulic powered loader cranes and their mountings on to vehicles or static foundations.

This International Standard applies to all new loader cranes manufactured one year after its publication. It is not the intent of this International Standard to require the retrofitting of existing loader cranes.

This International Standard does not apply to loader cranes used on board ships or floating structures and to articulated boom system cranes which are designed as total integral parts of special equipment such as forwarders.

The hazards covered by this International Standard are identified in Clause 4.

This International Standard does not cover hazards related to the lifting of persons.

NOTE 1 Hoists will be covered by a special standard.

NOTE 2 The use of cranes for the lifting of persons may be subject to specific national regulations.

2 Normative references

The following referenced documents are indispensable for the application 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 4306-1, *Cranes — Vocabulary — Part 1: General*

ISO 4310, *Cranes — Test code and procedures*

ISO 4413, *Hydraulic fluid power — General rules relating to systems*

ISO 5353, *Earth-moving machinery, and tractors and machinery for agriculture and forestry — Seat index point*

ISO 7000:2004, *Graphical symbols for use on equipment — Index and synopsis*

ISO 7296-2:1996, *Cranes — Graphical symbols — Part 2: Mobile cranes*

ISO 7752-1, *Lifting appliances — Controls — Layout and characteristics — Part 1: General principles*

ISO 8566-1, *Cranes — Cabins — Part 1: General*

ISO 8566-2, *Cranes — Cabins — Part 2: Mobile cranes*

ISO 8686-1, *Cranes — Design principles for loads and load combinations — Part 1: General*

ISO 9927-1, *Cranes — Inspections — Part 1: General*

ISO 9928-1, *Cranes — Crane driving manual — Part 1: General*

ISO 9942-1, *Cranes — Information labels — Part 1: General*

ISO 10245-1, *Cranes — Limiting and indicating devices — Part 1: General*

ISO 11660-1, *Cranes — Access, guards and restraints — Part 1: General*

ISO 11660-2, *Cranes — Access, guards and restraints — Part 2: Mobile cranes*

ISO 12100-1, *Safety of machinery — Basic concepts, general principles for design — Part 1: Basic terminology, methodology*

ISO 12100-2:2003, *Safety of machinery — Basic concepts, general principles for design — Part 2: Technical principles*

ISO 12478-1, *Cranes — Maintenance manual — Part 1: General*

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

ISO 13852, *Safety of machinery — Safety distances to prevent danger zones being reached by the upper limbs*

ISO 13853, *Safety of machinery — Safety distances to prevent danger zones being reached by the lower limbs*

ISO 13854, *Safety of machinery — Minimum gaps to avoid crushing of parts of the human body*

ISO 15513, *Cranes — Competency requirements for crane drivers (operators), slingers, signallers and assessors*

IEC 60068-2-64:1993, *Environmental testing — Part 2: Test methods — Test Fh: Vibration, broad-band random (digital control) and guidance*

IEC 60204-32:1998, *Safety of machinery — Electrical equipment of machines — Part 32: Requirements for hoisting machines*

IEC 61000-6-2, *Electromagnetic compatibility (EMC) — Part 6-2: Generic standards — Immunity for industrial environments*

IEC 61000-6-4, *Electromagnetic compatibility (EMC) — Part 6: Generic standards — Section 4: Emission standard for industrial environments*

3 Terms and definitions

3.1 Definitions

For the purposes of this document, the terms and definitions given in ISO 4306-1 and the following apply.

NOTE For convenience of reference the definitions are, with the exception of 3.1.1 Loader crane, grouped in alphabetical order in the English language version.

1) To be published. (Revision of ISO 13849-1:1999)

3.1.1
loader crane
powered crane comprising of a column that slews about a base, and a boom system that is attached to the top of the column and which is usually fitted on a vehicle (including trailer) and designed for loading and unloading the vehicle

NOTE 1 A crane, as defined above, installed on a static foundation is still considered a loader crane.

NOTE 2 Annex B gives examples of configuration and mountings.

3.1.2
articulated boom
boom consisting of members that pivot in the vertical plane

3.1.3
boom extension, hydraulic
part of the boom which is capable of hydraulic telescopic movement to vary its length

3.1.4
boom extension, manual
part of the boom which can be manually extended or retracted

3.1.5
boom system
complete system, consisting of booms, boom extensions and cylinders

3.1.6
column
slewing structural member which supports the boom system

3.1.7
control station
position from which the loader crane may be operated

3.1.8
control system
interface between the operating levers and the actuating components which provide movements of the loader crane

3.1.9
danger zone
any zone within and/or around the machinery in which a person is exposed to risk of injury or damage to health

3.1.10
dead loads
forces due to the masses of the fixed and movable crane parts which act permanently on the structure while the crane is being used

3.1.11
dynamic pressure
pressure in a hydraulic system component or part of hydraulic system caused by dynamic forces on actuators when handling the load

3.1.12
flow sensitive check valve
valve that stops the flow when a preset pressure drop level is exceeded

3.1.13
high seat
control station connected to the column, consequently rotating with the crane

3.1.14
hydraulic line rupture
failure of a hydraulic line which results in a loss of pressure in the line

3.1.15
limiting device
device which initiates stopping or restricting crane motion or function

NOTE The majority of these devices will operate automatically when the respective motion or function reaches its limiting position.

3.1.16
load holding valve
valve that is normally closed and is opened by an external force to allow the flow of fluid out of a hydraulic actuator

3.1.17
main relief valve
valve that limits the pressure supplied to the hydraulic system of the crane

3.1.18
maximum working pressure
maximum pressure in pump circuit or individual working function

3.1.19
mounting base
housing incorporating anchoring points and bearings for the slewing column

3.1.20
port relief valve
valve that limits the pressure supplied to a hydraulic actuator

3.1.21
pressure relief valve
valve that automatically releases the hydraulic oil to the tank when the pressure exceeds a specified value

3.1.22
radius, hydraulic
radius that can be obtained with hydraulically actuated parts of the boom system

3.1.23
raised control station
control station at a height above the ground level, i.e. a high seat attached to the column of the loader crane or a platform positioned above the base of the loader crane (see Annex K)

3.1.24
rated capacity
load that the crane is designed to lift for a given operating condition (e.g. configuration, position of the load)

3.1.25
rated capacity indicator
device that gives, within specified tolerance limits, at least a continuous indication that the rated capacity is exceeded, and another continuous indication (on certain crane types) of the approach to the rated capacity

3.1.26
rated capacity limiter
device that automatically prevents the crane from handling loads in excess of its rated capacity, taking into account the dynamic effects during normal operating use

3.1.27
setting-up function
crane function used to prepare the crane for lifting

3.1.28
sink rate
distance in a given time at which the load lowers due to internal leakage of hydraulic components

3.1.29
stabilizer
aid to the supporting structure connected to the base of the crane or to the vehicle to provide stability, without lifting the vehicle from the ground

3.1.30
stabilizer extension
part of the stabilizer capable of extending the stabilizer leg laterally from the transport position to the operating position

3.1.31
stabilizer leg
part of a stabilizer capable of contacting the ground to provide the required stability

3.1.32
static foundation
fixed support incorporating mounting points for a crane

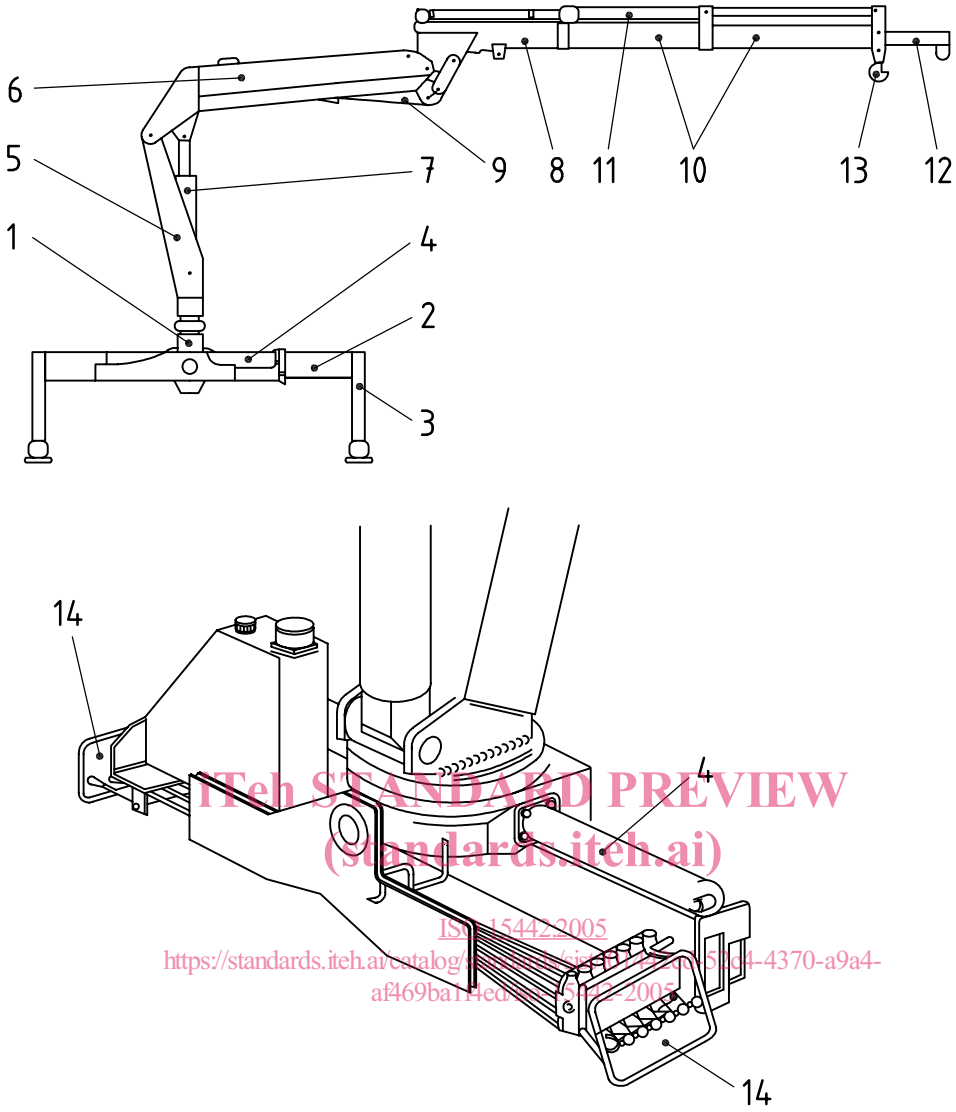
3.1.33
timber handling crane
loader crane specifically designed, manufactured and equipped with a grapple for loading/unloading of unprepared timber (e.g. tree trunks, branches)

NOTE The operator controls the crane from a high seat or from a cabin.

3.1.34
total lifting moment
sum of the load moment and the moment produced by dead loads

3.2 Terminology

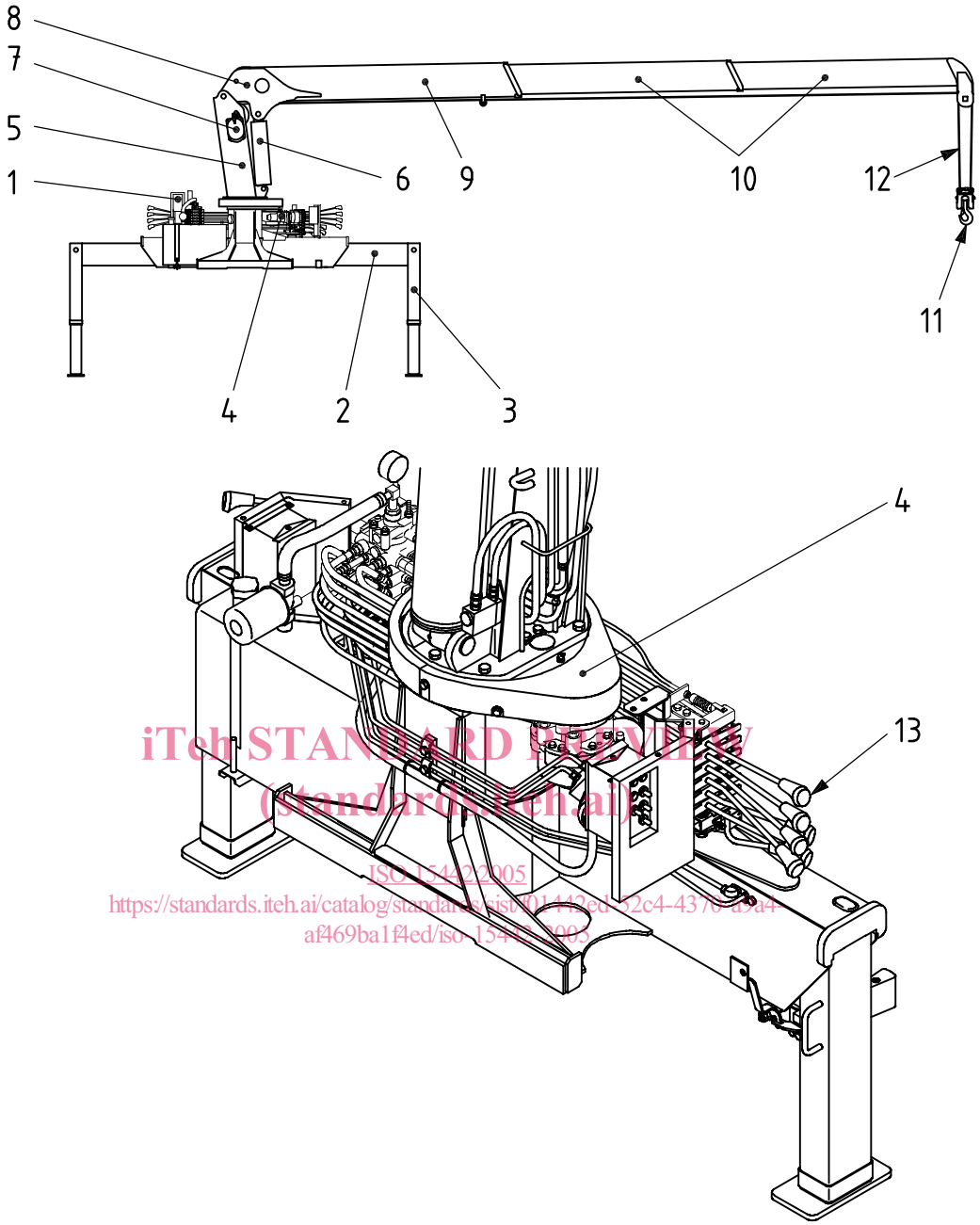
The terms that are used in this International Standard for the main parts of a loader crane are indicated in Figures 1 a) and 1 b).



Key

1	mounting base	8	2nd boom
2	stabilizer extension	9	2nd boom cylinder
3	stabilizer leg	10	boom extension, hydraulic
4	slewing mechanism	11	boom extension cylinders
5	column	12	boom extension, manual
6	1st boom	13	hook
7	1st boom cylinder	14	controls

a) Articulated boom system



Key

1 mounting base
2 stabilizer extension
3 stabilizer leg
4 slewing mechanism
5 column
6 1st boom cylinder
7 winch
8 boom extension cylinders
9 1st boom
10 boom extension, hydraulic
11 hook
12 wire rope
13 controls

b) Straight boom system

Figure 1 — Main parts of a loader crane

4 List of significant hazards

The list of hazards that have been considered significant during the preparation of this International Standard is given in Annex A.

5 Safety requirements and/or safety measures

5.1 General

Machinery shall conform to the safety requirements and/or measures of this clause. In addition, the machine shall be designed according to the principles of ISO 12100 for hazards relevant but not significant which are not dealt with by this International Standard.

The rated capacity shall be calculated from the following:

a) the working pressure in the cylinders;

b) the area of the load-carrying cylinders;

c) the kinematics;

d) dead loads;

e) load combinations;

f) hoist loads.

For the purpose of the calculations rated capacity is equal to gross load.

5.2 Structural calculation

5.2.1 General

For structural calculation, the provisions given in ISO 8686-1 apply. For forces due to acceleration/deceleration of the slewing drive, additional requirements given in 5.2.2 shall apply.

5.2.2 Forces due to acceleration/deceleration of the slewing drive

The horizontal force F_h, in newtons, shall be calculated according to the following equation:

$$F_h = \frac{M}{R} \times \Phi_{5h} \quad (1)$$

where

Φ_{5h} is the dynamic factor:

Φ_{5h} = 1,05 for hook duty,

Φ_{5h} = 1,3 for bucket or grapple duty;

M is the gross theoretical slewing moment (with 100 % efficiency), in newton metres;

R is the radius at calculated position, in metres.

If $R < R_{max}/2$, then the value $R = R_{max}/2$ shall be used, where R_{max} is the maximum hydraulic radius, in metres.

As an alternative, the value of F_h may be based on practical tests.

5.3 Stress analysis

A partial list of national and regional standards giving information about calculations and stress analysis is presented in the Bibliography.

5.4 Mechanical arrangements

5.4.1 Stabilizers

Stabilizers shall be provided when needed to fulfil the stability requirements (see 5.10.3) when loader cranes are fitted on vehicles.

5.4.1.1 Stabilizer leg

The stabilizer leg shall have means (e.g. feet) for ground support.

Stabilizer foot plate shall be constructed to accept ground unevenness of at least ± 5°.

When the stabilizer leg has a tilting device, locking means that can withstand normal operational forces (e.g. pins) shall be provided to secure the leg in both the working and transport position (see 5.4.3).

5.4.1.2 Stabilizer extension

Stabilizer extensions shall be marked to show when they are correctly deployed.

Manually operated extensions shall be fitted with:

a) handles for the manual operation;

b) devices for locking in the working and transport positions (see 5.4.3);

c) pull-out stops.

Locking means in the working position shall be fitted if the hydraulic cylinders are not able to resist the forces during the load handling.

5.4.2 Manual boom extensions

Manual boom extensions shall have pull-out stops and mechanical locking means for their retracted and extended positions.

5.4.3 Securing for transport

Mechanical means shall be provided to prevent uncontrolled movements of the crane and stabilizers installed on vehicles when travelling. The stabilizers shall be locked in the transport position by two separate locking devices for each stabilizer, at least one of these shall be automatically operated, e.g. a spring operated cam lock and an automatic spring latch. These shall be attached to the crane and/or stabilizers and be protected against unintentional removal, e.g. by locking pins with spring clips.

For hydraulically operated stabilizer extensions, a single mechanical locking device is sufficient.