INTERNATIONAL STANDARD

ISO 15442

Second edition
2012-11-15

Cranes — Safety requirements for loader cranes

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

Reference number
ISO 15442:2012(E)

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

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*.

This second edition cancels and replaces the first edition (ISO 15442:2005), which has been technically revised.

Introduction

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.

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

This International Standard

— identifies specific safety requirements for loader cranes,

— when applicable, refers to existing International Standards which contain provisions that can be applied to loader cranes,

— promotes 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,

— facilitates 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 needs to consult currently available International Standard for loader cranes, and

— contributes to the further international harmonization of loader crane standards.

Cranes — Safety requirements for loader cranes

1 Scope

This International Standard specifies the minimum requirements for the design, calculation, examination and testing of hydraulic powered loader cranes and their mountings onto chassis or static foundations.

It is applicable 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.

It is not applicable to loader cranes used on board ships or floating structures or to articulated boom system cranes designed as a total integral part of special equipment such as forwarders.

It deals with all significant hazards, hazardous situations or hazardous events relevant to loader cranes, with the exception of hazards related to the lifting of persons, when used as intended and under conditions of misuse which are reasonably foreseeable by the manufacturer. See Annex A for a list of the significant hazards.

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

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 3744, *Acoustics — Determination of sound power levels and sound energy levels of noise sources using sound pressure — Engineering methods for an essentially free field over a reflecting plane*

ISO 3864-1, *Graphical symbols — Safety colours and safety signs — Part 1: Design principles for safety signs and safety markings*

ISO 4302, *Cranes — Wind load assessment*

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 7752-1, *Cranes — Control layout and characteristics — Part 1: General principles*

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

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

ISO 11201, *Acoustics — Noise emitted by machinery and equipment — Determination of emission sound pressure levels at a work station and at other specified positions in an essentially free field over a reflecting plane with negligible environmental corrections*

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

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

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

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

ISO 20332, *Cranes — Proof of competence of steel structures*

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

IEC 60204-32:2008, *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

For the purposes of this document, the terms and definitions given in ISO 4306-1, ISO 12100 and the following apply.

3.1 Definitions

3.1.1
loader crane
powered crane comprising 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

[SOURCE: ISO 4306-2:2012, 5.2, modified — Note 3 is not included in the source definition.]

NOTE 1 ISO 3833:1977 defines *commercial vehicle* as a motor vehicle which, on account of its design and appointments, is used mainly for conveying goods, and which may also tow a trailer. An example of one type of commercial vehicle equipped with a loader crane is shown in ISO 4306-2:2012, Figure 9.

NOTE 2 A loader crane installed on another type of vehicle or on a static base is still considered a loader crane.

NOTE 3 Annex B gives examples of boom system configurations and installations.

3.1.1.1
recycling crane
loader crane specifically designed, manufactured and equipped with a grapple for loading/unloading of recycling materials (e.g. scrap metal)

NOTE Recycling cranes are designed to operate at higher speeds and with higher dynamic loads than other types of loader crane and these differences are reflected in some of the requirements of this International Standard.

3.1.1.2
timber crane
loader crane specifically designed, manufactured and equipped with a grapple for loading/unloading of unprepared timber (e.g. tree trunks, branches)

NOTE 1 The operator controls the crane from a high seat or from a cabin.

NOTE 2 Timber cranes are designed to operate at higher speeds and with higher dynamic loads than other types of loader crane and these differences are reflected in some of the requirements of this International Standard.

3.1.2
articulated movement
movement of boom members pivoting about a pin joint

3.1.3
base
housing incorporating anchoring points and bearings for the slewing column

3.1.4
boom
structural member in the boom system of the loader crane

3.1.4.1
hydraulic boom extension
part of the boom which is capable of hydraulic telescopic movement to vary its length

3.1.4.2
manual boom extension
part of the boom which can be manually extended or retracted

3.1.4.3
boom system
complete system, consisting of booms, boom extensions and cylinders

3.1.5
column
structural member which supports the boom system

3.1.6
control system
interface between the operating levers and the actuating components which provide movements of the loader crane

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

3.1.7.1
raised control station
control station at a height above the ground level, comprising a high seat attached to the column of the loader crane or a platform positioned above the base of the loader crane

NOTE See Annex K.

3.1.8
crane inclination
angle between the slewing axis and a vertical line, due to working on slanted or uneven ground

3.1.9
danger zone
hazard zone
any space within and/or around machinery in which a person can be exposed to a hazard

[SOURCE: ISO 12100:2010, 3.11.]

3.1.10
dead load
force due to masses of 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
fixed load lifting attachment
equipment from which the net load may be suspended and which is fitted directly to the boom head as an integral part of the crane

3.1.13
flow-sensitive check valve
valve which stops the flow when a pre-set pressure drop level is exceeded

3.1.14
gross load
sum of payload, lifting attachments and if applicable a portion of the hoist rope

3.1.15
high seat
control station connected to the column, consequently rotating with the crane

3.1.16
hoist
machine for lifting and lowering suspended loads over predetermined distances, using ropes, chains or belts

3.1.17
hydraulic line rupture
failure of a hydraulic line which results in a loss of pressure in the line

3.1.18
load holding valve
valve which is normally closed and is opened by an external force to enable flow of fluid out of a hydraulic actuator

3.1.19
main relief valve
valve which limits the pressure supplied to the hydraulic system of the crane

3.1.20
maximum working load
maximum load that may be lifted

NOTE It is the largest load appearing in the load plate.

3.1.21
maximum working pressure
maximum pressure in pump circuit or individual working function

3.1.22
net lifting moment
rated capacity multiplied by outreach

3.1.23
non-fixed load lifting attachment
lifting accessory which can be fitted directly or indirectly to the hook or any other coupling device of a crane by the user without affecting its integrity

3.1.24
outreach
horizontal distance between the axis of rotation of the column and point of load attachment

3.24.1.1
hydraulic outreach
outreach which can be obtained with hydraulically actuated parts of the boom system

3.1.25
payload
load which is lifted by the crane and suspended from the non-fixed load-lifting attachment(s) or, if such an attachment is not used, directly from the fixed load-lifting attachment(s)

3.1.26
port relief valve
valve which limits the pressure supplied to a hydraulic actuator

3.1.27
pressure relief valve
valve which automatically relieves the hydraulic oil to the tank when the pressure exceeds a specified value

3.1.28
rated capacity
load that the crane is designed to lift for a given operating condition (e.g. configuration, position of the load)

3.1.29
rated capacity indicator
device which gives, within tolerance limits specified in 4.6.3.2, 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

3.1.30
rated capacity limiter
system that automatically prevents the crane from handling loads in excess of its rated capacity

NOTE See also Annex C.

3.1.32
setting-up function
crane function used to prepare the crane for lifting

3.1.33
sink rate
distance in a given time at which the load lowers due to internal leakage of hydraulic components

3.1.34
slewing
rotational movement of the column and boom system about the axis of the column

3.1.35
stabilizer
aid to the supporting structure connected to the base of the crane or to the chassis to provide stability, without lifting the chassis from the ground

3.1.35.1
stabilizer extension
part of the stabilizer capable of extending the stabilizer leg laterally from the transport position to the operating position

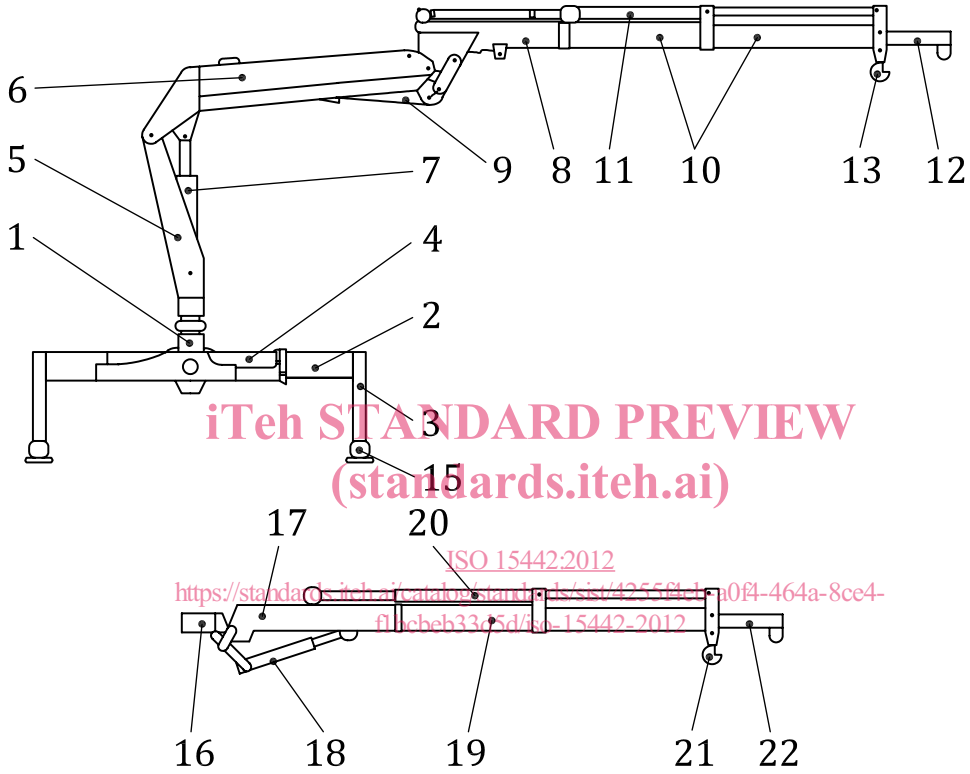
3.1.35.2
stabilizer leg
part of the stabilizer capable of contacting the ground to provide the required stability

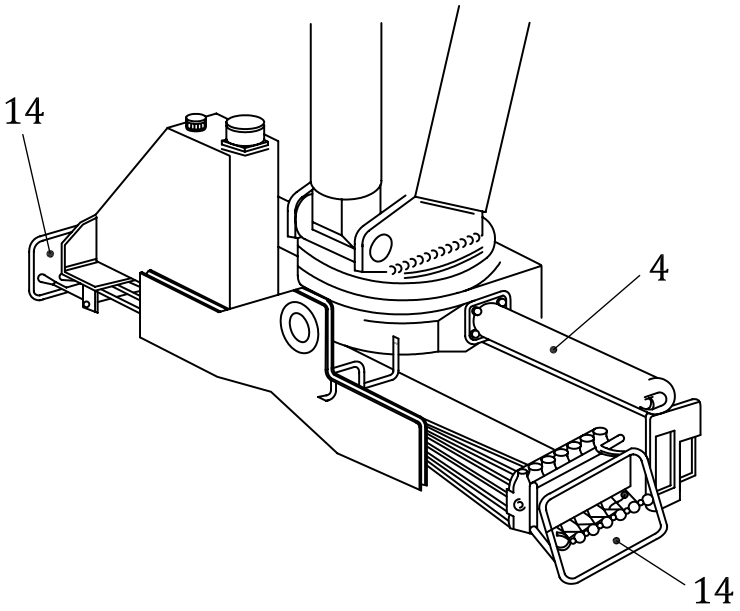
3.1.36
static foundation
fixed support incorporating mounting points for a crane

3.1.37
total lifting moment
sum of net lifting moment and the moment produced by dead loads

3.2 Terminology

See Figure 1.





Key

1	base	12	2nd manual boom extension
2	stabilizer extension	13	load hook
3	stabilizer leg	14	controls
4	slewing mechanism	15	stabilizer foot
5	column	16	3rd boom attachment
6	1st boom	17	3rd boom
7	1st boom cylinder	18	3rd boom cylinder
8	2nd boom	19	3rd hydraulic boom extension
9	2nd boom cylinder	20	3rd boom extension cylinders
10	2nd hydraulic boom extension	21	load hook
11	2nd boom extension cylinders	22	3rd manual boom extension

Boom systems consist of items 6 to 12 plus items 16 to 22, as applicable.

Figure 1 — Main parts of loader crane

4 Safety requirements and/or protective measures

Machinery shall comply with the safety requirements and/or protective measures of this clause.

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

4.1 Calculation of rated capacity

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.

4.2 Structural calculation

4.2.1 Information to be given in the calculation

The following information shall be given in the calculation:

a) type of crane and method of operation;

b) the assumed number of all load or working cycles;

c) details of the load-carrying system reflecting actual service conditions, including outline drawings and principal dimensions;

d) the assumed loading conditions, including maximum crane inclination;

e) the governing hoisting class, hoist drive class and stress history classes or stress history parameters;

f) the material for the individual components and joints;

g) the shapes, dimensions and static cross-section values of all load-carrying members;

h) the analyses, separately for the individual structural components and essential connections.

4.2.2 Dynamic factors

4.2.2.1 Hoisting and gravity effects of the mass of the crane

The dynamic effects due to vibrations of the structure when raising or lowering a load shall be included in the loading by applying the factor, ϕ_1, to the gravitational forces due to the masses of the crane. It shall be used for the design of the crane structure itself and its supports. For load combinations A1, B1 and C1, the value of ϕ_1 shall be the lowest of the two values 1,1 and ϕ_2, expressed as

$$\phi_1 = \min(1{,}1;\phi_2) \tag{1}$$

For load combinations A2 and B2, the value of ϕ_1 shall be 0,95.

Although generally ϕ_1 = 1,1, it shall not exceed the value of ϕ_2 (see 4.2.2.2) when ϕ_2 is less than 1,1.

4.2.2.2 Hoisting and gravity effects of the gross load

In the case of hoisting or grounding a load as well as starting or stopping a vertical motion, the vibration effects shall be included in the loading by multiplying the gravitational force due to the mass of the hoist load by a factor, ϕ_2.

Factor ϕ_2 shall be taken as

$$\phi_2 = \phi_{2\min} + \beta_2 \times v_h \tag{2}$$

$\phi_{2,\min}$ and β_2 are given in Table 1 for the appropriate hoisting class. Loader cranes are assigned to hoisting classes HC1 and HC2 in accordance with their dynamic and elastic characteristics:

— HC1 for crane mounted on a chassis or structures of equivalent flexibility;

— HC2 for rigidly mounted cranes.

Rigidly mounted cranes equipped with a device that limits the peak pressure (e.g. an accumulator) in the first boom cylinder may be assigned to HC1.

Table 1 — Values of β_2 and $\phi_{2,\min}$

Hoisting class of appliance	β_2	$\phi_{2,\min}$
HC 1	0,17	1,05
HC 2	0,34	1,10

v_h is the steady vertical hook speed, in metres per second, related to the lifting attachment. Values of v_h are given in Table 2.

Table 2 — Values of v_h

Load combination	Type of hoist drive and its operation method		
	HD1	HD4	HD5
A1, B1	$v_{h,max}$	$0,5v_{h,max}$	$v_h = 0$
C1	$v_{h,max}$	$v_{h,max}$	$0,5v_{h,max}$
HD1 is the hoist drive can only be operated at a fixed speed HD4 is the start of the lift is performed with continuously increasing speed HD5 is the hoist drive control is automatic and ensures that the speed influence on the dynamic force is negligible $v_{h,max}$ is the maximum vertical hook speed			

In load combinations A1 and B1, $v_{h,max}$ is the maximum vertical hook speed that is given by any single hydraulic drive action.

In load combination C1, $v_{h,max}$ is the maximum vertical hook speed from all articulation hydraulic drives acting simultaneously.

NOTE 1 In load combinations A and B it is assumed that the dynamic peaks from simultaneous movements do not coincide. The unlikely event that the dynamic peaks coincide and are superimposed is covered by load combination C1.

NOTE 2 Dynamic factor ϕ_2 can be calculated using rigid body kinetics or determined by experimental means.

4.2.2.3 Effect of sudden release of a part of the gross load

For cranes that release or drop a part of the gross load as a working procedure during intended use, such as when grabs or magnets are used, the peak dynamic effect on the crane can be simulated by multiplying the gross load by a factor, ϕ_3, the value of which is given by

$$\phi_3 = \frac{\Delta m \times (1 - \beta)}{m} \tag{3}$$

where

m is the mass of the gross load;

Δm is the released or dropped part of the gross load;

$\beta = 0,5$ for cranes equipped with grabs or similar slow-release devices;

$\beta = 1,0$ for cranes equipped with magnets or similar rapid-release devices.