
**Cranes — Safety — Load lifting
attachments**

*Appareils de levage à charge suspendue — Sécurité — Accessoires
de préhension*

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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 meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: [Foreword - Supplementary information](#)

The committee responsible for this document is ISO/TC 96, *Cranes*, Subcommittee SC 9, *Bridge and gantry cranes*.

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Introduction

This International Standard covers a wide range of non-fixed load lifting attachments which have never previously been standardized by ISO. The lack of previous standards as a starting point, together with the wide scope of the equipment covered and the wide variety of current practices, among the established manufacturers made this International Standard particularly difficult to draft and to get agreement on. Nevertheless, considerable progress has been made up to the point where the parties involved are now sufficiently in agreement to enable the first draft of this International Standard to be prepared. The ISO technical subcommittee SC 9 which is responsible for the preparation of this International Standard is of the view that while further development may be required, this International Standard, in its present form, contains much useful information to guide the manufacturers and it represents an important step forward. Experience of applying this International Standard will doubtless reveal some matters which, with the benefit of hindsight, have not been adequately dealt with and will need to be reconsidered in the next edition. In particular, readers are advised to exercise a degree of caution about the rigour of some of the verification clauses.

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Cranes — Safety — Load lifting attachments

1 Scope

This International Standard specifies safety requirements for the following non-fixed load lifting attachments for cranes, hoists, and manually controlled load manipulating devices as defined in [Clause 3](#):

- plate clamps;
- vacuum lifters;
- self priming,
- non-self-priming (pump, venturi, turbine);
- electric lifting magnets (battery-fed and main-fed);
- permanent lifting magnets;
- electro-permanent lifting magnets;
- lifting beams/spreader beams;
- C-hooks;
- lifting forks;
- clamps.

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This International Standard does not specify the additional requirements for the following:

- a) load lifting attachments in direct contact with foodstuffs or pharmaceuticals requiring a high level of cleanliness for hygiene reasons;
- b) hazards resulting from handling hazardous materials (e.g. explosives, hot molten masses, radiating materials);
- c) hazards caused by operation in an explosive atmosphere;
- d) hazards caused by noise;
- e) electrical hazards;
- f) hazards due to hydraulic and pneumatic components.

This International Standard does not cover attachments intended to lift people.

This International Standard does not cover slings, ladles, expanding mandrels, buckets, grabs or grab buckets, and container spreaders.

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 4306-1, *Cranes — Vocabulary — Part 1: General*

ISO 4309, *Cranes — Wire ropes — Care and maintenance, inspection and discard*

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ISO 4778, *Chain slings of welded construction — Grades M (4), S (6) and T (8)*

ISO 7531, *Wire rope slings for general purposes — Characteristics and specifications*

ISO 7593, *Chain slings assembled by methods other than welding — Grade T (8)*

ISO 7731, *Ergonomics — Danger signals for public and work areas — Auditory danger signals*

ISO 8686, *Cranes — Design principles for loads and load combinations*

ISO 11428, *Ergonomics — Visual danger signals — General requirements, design and testing*

ISO 11429, *Ergonomics — System of auditory and visual danger and information signals*

ISO 12100:2010, *Safety of machinery — General principles for design — Part 1: Risk assessment and risk reduction*

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

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

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

EN 1492-1, *Textile slings — Safety — Part 1: Flat woven webbing slings made of man-made fibres for general purpose use*

EN 1492-2, *Textile slings — Safety — Part 2: Roundslings made of man-made fibres for general purpose use*

EN 1492-4, *Textile slings — Safety — Part 4: Lifting slings for general service made from natural and man-made fibre ropes*

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3 Terms and definitions

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

**3.1
adhesion force**
force required to remove the load from a *vacuum lifter* (3.21) at the upper limit of specified pressure range

**3.2
C-hook**
equipment in the form of a “C” used for lifting hollow loads

EXAMPLE Coils and pipes among others.

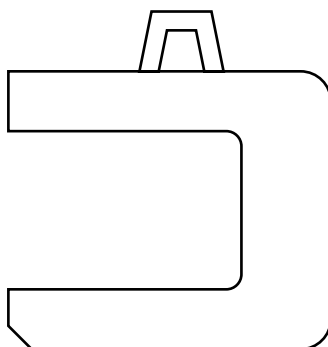


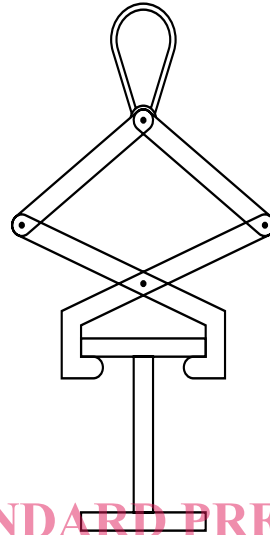
Figure 1 — Example of a C-hook

3.3**design factor**

arithmetic ratio between the minimum failure load of the lifting attachment and its *working load limit (WLL)* (3.22)

3.4**clamp**

equipment used to handle loads by clamping on a specific part of the load



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Figure 2 — Example of a clamp

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3.5**exclusion area**

area from which persons are excluded for the purpose of safety whilst lifting operations are in progress

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3.6**exposure area**

area where personnel may be exposed to hazards arising from a lifting operation

3.7**individual verification**

verification carried out on every item produced

3.8**lifting beam**

equipment consisting of one or several members equipped with various attachment points in order to distribute the force as required by the characteristics of the handled loads

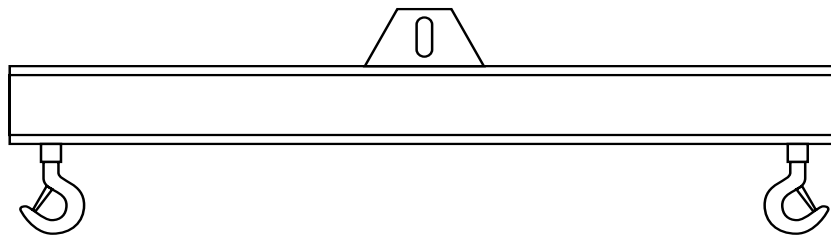


Figure 3 — Example of a lifting beam

**3.9
lifting forks**

equipment consisting of two or more arms connected to an upright with an upper arm used to lift palletized or similar loads

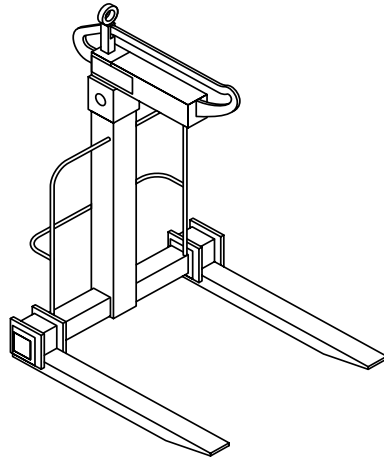


Figure 4 — Example of lifting forks

3.10 lifting magnet

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Figure 5 — Example of a lifting magnet

**3.10.1
electric lifting magnet**

equipment with a magnetic field generated by an electric current creating sufficient force for gripping, holding, and handling loads with ferro-magnetic properties

**3.10.2
permanent lifting magnet**

equipment with a permanent magnetic field which creates sufficient force for gripping, holding, and handling loads with ferro-magnetic properties

Note 1 to entry: The magnetic field or load holding is controlled by mechanical means.

**3.10.3
electro-permanent lifting magnet**

equipment with a permanent magnetic field which creates sufficient force for gripping, holding, and handling loads with ferro-magnetic properties

Note 1 to entry: The magnetic field is controlled by an electric current which is not required to sustain the magnetic field.

**3.11
minimum working load**

minimum load that the *non-fixed load lifting attachment* (3.13) is designed to lift under the conditions specified by the manufacturer

3.12**no-go area**

area from which persons are excluded during normal operation

3.13**non-fixed load lifting attachment**

lifting attachment which can be fitted directly or indirectly to the hook or any other coupling device of a crane, hoist, or manually controlled manipulating device by the user without affecting the integrity of the crane, hoist, or manually controlled manipulating device

3.14**plate clamps**

non-powered gripping device designed for lifting and turning plates or sections

Note 1 to entry: The gripping action or clamping force is achieved with a mechanical leverage or cam action enabling the cam to *clamp* (3.4) the section on to a pad.

Note 2 to entry: Vertical plate clamps are used to lift plates or sections in a vertical plane or from the horizontal to the vertical plane.

Note 3 to entry: Horizontal plate clamps are used to lift plates in a horizontal plane.



Figure 6 — Example of plate clamps

3.15**positive holding device**

device making a direct mechanical connection to hold the load and which does not rely solely on friction, suction, or magnetic adhesion to hold the load

3.16**secondary positive holding device**

device to hold loads if the primary holding means fails and which does not rely on friction, suction, or magnetic adhesion to the load

3.17**tear-off force**

force applied at a right angle to the plane of the magnet poles which is required to detach the load from the switched-on magnet

3.18**tongs**

equipment for lifting loads by clamping forces, positive locking, or by frictional connection and positive locking which act between gripping elements such as tongs arms or jaws, pressure plates, or centres

3.19**two-action control**

control which, in order to be operative, requires the performance of two separate actions with one or two hands, such as the following:

- a) operation of two separate hold-to-run controls;
- b) sequential operation of two movements of a control device;
- c) previous unlocking of the control with self-locking in the neutral position

3.20

type verification

verification carried out on one or more samples representative of a particular design and size of product before it is first placed on the market

Note 1 to entry: Although the term “type verification” is normally associated with series produced equipment, for the purpose of this International Standard, it also applies to single unit produced attachment.

3.21

vacuum lifter

suction pad

equipment which includes one or more suction pads operating by vacuum

3.21.1

self-priming vacuum lifter

vacuum lifter (3.21) using the load to create the vacuum



Figure 7 — Example of a self-priming vacuum lifter

3.21.2

non-self-priming vacuum lifter

vacuum lifter (3.21) using an external source of energy

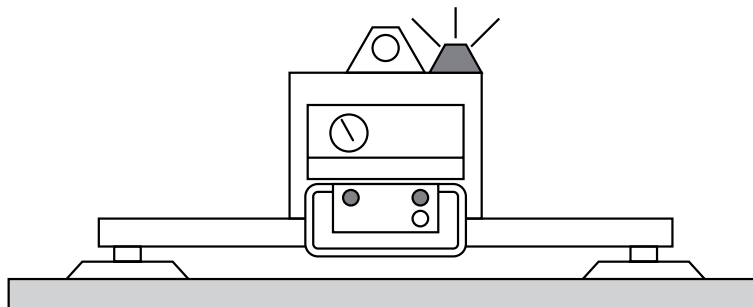


Figure 8 — Example of a non-self-priming vacuum lifter

3.22

working load limit

WLL

maximum load the load lifting attachment is designed to lift under the conditions specified by the manufacturer

4 Safety requirements and/or measures

4.1 General requirements

The attachment shall comply with the safety requirements and/or measures of this subclause. In addition, the attachment shall be designed according to the principles of ISO 12100 for relevant hazards which are not dealt with by this International Standard.

4.1.1 Mechanical load bearing parts

4.1.1.1 Requirements for static strength

The mechanical load bearing parts shall have a mechanical strength to fulfil the following requirements:

- a) the attachment shall be designed to withstand a static load of three times the WLL without releasing the load even if permanent deformation occurs;
- b) the attachment shall be designed to withstand a static load of twice the working load limit without permanent deformation.

Attachments shall be designed to function properly if tilted to an angle of at least 6°. Attachments designed to tilt shall be designed to function properly if tilted to an angle of at least 6° greater than the maximum working angle.

4.1.1.2 Requirements for fatigue strength

The proof of fatigue strength shall be based on the group classification for the load lifting attachment in accordance with ISO 8686. The class shall be marked in the lifting device or in the accompanying documentation together with the WLL. [ISO 17096:2015](https://standards.itech.ai/catalog/standards/sist/fcfd6302-64fe-475e-8ffe-abab7197e53c/iso-17096-2015)

The stress ranges used in the fatigue assessment shall be based on the following maximum loadings:

- a) vertical force is the gravity force related to the WLL plus the own weight of the lifting device multiplied with a dynamic coefficient typical for the application of the lifting device in question. This dynamic coefficient shall be specified in the documentation by the manufacturer;
- b) horizontal force is a typical horizontal force that may be applied to the lifting device or the lifted load simultaneously with the dynamic effect in vertical direction.

The minimum stresses for the stress ranges shall be taken as zero unless the lifting device's own weight is more than 20 % of the WLL and the weight of the lifting device is not placed on the lifted load or ground during normal work cycles.

The calculation of the limit fatigue strengths of structural details shall be in accordance with the appropriate part of ISO 8686 and ISO 20332.

4.1.2 Controls

The electrical controls of the attachment shall be in accordance with IEC 60204-32.

4.1.3 Handles

An attachment that is intended to be guided manually shall be equipped with handle(s) arranged so that finger injuries are avoided. Handles are not required where features exist to provide natural handholds.

4.1.4 Requirements for slings which are integrated

Slings which are an integrated part of the attachment shall be in accordance with ISO 4778, ISO 7531, EN 1492-1, EN 1492-2, and EN 1492-4 as appropriate.

4.1.5 Stability during storage

When not required for use, it shall be possible to set down the attachment so that it is stable during storage. To be regarded as stable, it shall not tip over when tilted to an angle of 10° in any direction. This can be achieved either by the shape of the attachment or by means of additional equipment such as a stand.

4.2 Specific requirements for each category of attachment

4.2.1 Plate clamps

4.2.1.1 Under the conditions specified by the manufacturer, it shall not be possible to unintentionally release the load, in particular, by the following influences:

- a) contact of the plate clamp particularly the locking mechanisms with an obstacle;
- b) mass of the crane hook, bottom block, or other connections bearing down on the device;
- c) intended tipping and/or turning.

4.2.1.2 Plate clamps intended to transport vertically suspended plate shall incorporate a device to prevent the load from unintentional detachment when it is set down.

4.2.1.3 The design factor to prevent the load from slipping shall be at least two.

4.2.1.4 The minimum working load of the plate clamp shall be equal to or less than 5 % of the WLL.

4.2.1.5 Plate clamps shall comply with the requirements specified in [4.2.1.3](#) using the following tolerances:

- a) for a minimum thickness less than or equal to 50 mm, 10 % of the minimum thickness;
- b) for a minimum thickness between 50 mm and 100 mm, 5 mm;
- c) for a minimum thickness more than 100 mm, 5 % of the minimum thickness.

4.2.1.6 Where the lifting attachment is designed to use more than one clamp, the WLL of each clamp shall take account of the share of the load which can foreseeably be imposed on it (including any inequality of share due to the rigidity of the load).

4.2.1.7 The method of connecting to the crane or intermediate equipment shall ensure that the forces are transmitted through the plate clamp in the correct alignment. Where this is not possible by design, the marking and/or operating instructions shall clearly indicate how it should be connected.

4.2.2 Vacuum lifters

4.2.2.1 Vacuum lifters shall be dimensioned to hold at least a load corresponding to twice the WLL at the end of the working range and the beginning of the fall range respectively at all intended angles of tilt. The maximum angles of tilt shall be increased in accordance with [4.1.1.2](#).

NOTE The pressure range with which it is possible to work is termed the working range. The fall range adjoins the working range. In some vacuum lifting systems, in particular self-priming vacuum lifters, the pressure decrease arising depends upon the mass of the load.

4.2.2.2 Non-self-priming vacuum lifters shall be equipped with a pressure measuring device showing the working range and the fall range of the vacuum.

4.2.2.3 Self-priming vacuum lifters shall be equipped with an indicator showing to the operator that the end of the working range is reached.

4.2.2.4 The measuring device or the indicator respectively shall be fully visible for the slinger or, where there is no slinger, for the operator of the crane in their normal working position.

4.2.2.5 Means shall be provided to prevent the risks due to vacuum losses. This shall be as follows.

- a) *In the case of vacuum lifters with a vacuum pump:* A reserve vacuum with a non-return valve between the reserve vacuum and the pump located as close as possible to the reserve vacuum.
- b) *In the case of vacuum lifters with venturi-system:* A pressure-reserve-tank or vacuum-reserve-tank with a non-return valve between the reserve vacuum and the venturi system located as close as possible to the reserve vacuum.
- c) *In the case of turbine vacuum lifters:* A supporting battery or an additional flywheel-mass.
- d) *In the case of self-priming vacuum lifters:* A reserve-stroke at least equal to 5 % of the total stroke of the piston.

NOTE Vacuum losses can occur, for example, due to leaks or in the case of non-self-priming vacuum lifters, due to a power failure.

4.2.2.6 There shall be a device to warn automatically that the fall range is reached when vacuum losses cannot be compensated. The warning signal shall be optical or acoustic depending upon the circumstances of use for the vacuum lifter and in accordance with ISO 11428, ISO 11429, and ISO 7731. The warning device shall work even when there is a power failure of the vacuum lifter.

NOTE The warning device is not the pressure measuring device of [4.2.2.2](#) or the indicator of [4.2.2.3](#).

4.2.2.7 In case of power failure, the vacuum lifter shall be able to hold the load for 5 min. This is not necessary in exclusion areas and this is not necessary for turbine vacuum lifters if all the following conditions are met.

- a) The operator maintains control of the load through steering handles which ensures that the operator is outside the fall zone in case of the load falling.
- b) In addition to [4.2.2.6](#), a warning device shall be activated as soon as the power fails.
- c) The manufacturer shall instruct that lifting of the geometric centre of the suction pads above 1,8 m is prohibited by appropriate marking and instructions for use.

4.2.2.8 For vacuum lifters intended to be used in an exposure area, a secondary positive holding device is required or there shall be two vacuum reserves each fitted with non-return valves. Each vacuum reserve shall be connected to a separate set of vacuum pads. Each set of vacuum pads shall fulfil the requirement of [4.2.2.1](#).

4.2.2.9 The releasing of the load shall be actuated by a two-action control. This is not necessary where the release of the load is not possible until the load has been put down or in exclusion areas.

4.2.2.10 Controls for tilting or turning movements shall be hold-to-run type.

4.2.2.11 The shape of the suction pad shall be matched to that of the intended load(s). Where more than one suction pad is used in conjunction with a lifting beam, the layout and working load limit of the suction pads shall be matched to that of the intended load(s). The share of the load which can foreseeably be imposed on each suction pad shall not exceed its WLL taking account of the rigidity of both the load and the vacuum lifter.