

Australian Standard™

Lifting devices

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- Australian Chamber of Commerce and Industry
- Australian Elevator Association
- Australian Industry Group
- Australian Institute for Non-Destructive Testing
- Bureau of Steel Manufacturers of Australia
- Construction and Mining Equipment Association of Australia
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Australian Standard™

Lifting devices

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PREFACE

This Standard was prepared by the Australian members of the Joint Standards Australia/Standards New Zealand Committee ME-005, Cranes. After consultation with stakeholders in both countries, Standards Australia and Standards New Zealand decided to develop this Standard as an Australian Standard rather than an Australian/New Zealand Standard.

The objective of this Standard is to provide the requirements that are additional to the requirements of other Parts of AS 1418.

During the preparation of this Standard reference was made to prEN 13155, *Cranes—Safety—Non-fixed load lifting attachments*.

Statements expressed in mandatory terms in notes to tables and figures are deemed to be requirements of this Standard.

The terms ‘normative’ and ‘informative’ have been used in this Standard to define the application of the appendix to which they apply. A ‘normative’ appendix is an integral part of a Standard, whereas an ‘informative’ appendix is only for information and guidance.

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STANDARDS AUSTRALIA

Australian Standard**Lifting devices**

SECTION 1 SCOPE AND GENERAL

1.1 SCOPE

This Standard specifies general requirements for the design, testing, marking and correct care and use of lifting devices that can be fitted directly or indirectly to the hook or any other coupling device on a crane, hoist or winch, as defined in AS 2549, without affecting its integrity.

This Standard does not cover lifting equipment such as slings, lifting gear, workboxes and items covered by other Australian Standards.

1.2 LOAD DESIGNATIONS

This Standard has been prepared to interface with the design methodology for cranes and the design methodology for lifting tackle. Cranes are specified by virtue of a group classification (C classification) and 'rated capacity'. Lifting tackles (slings, shackles, etc.) are specified by virtue of a 'working load limit' (WLL), which is varied by factors according to the manner and geometry of their application.

This Standard allows lifting devices to be specified by either a 'rated capacity' or a WLL. Items, such as bins that have a capacity that includes a 'tare' as well as a 'payload' and 'gross load', are described and marked with tare and gross load.

1.3 NEW DESIGNS AND INNOVATIONS

This Standard does not preclude the use of materials, designs, methods of assembly, procedures, and the like, that do not meet a specific requirement of the Standard, or are not mentioned in it, but which can be shown to give equivalent or superior results to those specified.

1.4 INTERPRETATIONS

Questions concerning the meaning, the application or effect of any part of this Standard may be referred to the Standards Australia Committee on Cranes. The authority of the Committee is limited to matters of interpretation and it will not adjudicate in disputes.

1.5 REFERENCED DOCUMENTS

The documents referred to in this Standard are listed in Appendix A.

1.6 DEFINITIONS

For the purpose of this Standard, the definitions in AS 2549 and those below apply.

For examples of lifting equipment, see Appendix B.

1.6.1 Bins

Equipment to take and contain materials, which are distinguished by the way they are filled or emptied, that is—

- (a) without tilting; or
- (b) with tilting (manual or powered).

NOTE: Items of equipment included under this definition are skips, bins, kibbles and tanks for material or fluid handling.

1.6.2 C-hooks

Equipment in the form of a 'C' consisting of a lower arm, an upright arm and an upper arm for lifting hollow loads, e.g., coils or pipes. The upper arm may incorporate a balancing or adjusting system so that it is balanced both in loaded and unloaded conditions (see Figure B1.1.1(d) and (e), Appendix B).

1.6.3 Cam

See plate clamps.

1.6.4 Capacity

The load which the lifting device is designed to lift.

NOTE: See Clause 1.2 for applicable load designation.

1.6.5 Clamps

Equipment that holds the loads between jaws or any other devices that are dedicated to the load.

1.6.6 Girder clamps

A simple, fast and portable gripping device used to attach a lifting point to a beam.

1.6.7 Gross load

The sum of the tare mass and the payload.

1.6.8 Ladle handling equipment

Equipment consisting of hangers supported by a lifting beam, used for manoeuvring ladles, which may incorporate a tilting function.

1.6.9 Ladles

Containers to receive and transport molten materials.

1.6.10 Lifting beams

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

1.6.11 Mobile equipment lifting attachment

An item of equipment mounted on a frame, which may be attached to the load carriage on items of mobile equipment such as forklifts or loaders.

1.6.12 Lifting forks

Equipment consisting of two or more arms or tyres fixed to an upright mast with an upper arm, beam, or other lifting device incorporating lifting forks, essentially to lift palletized or similar loads. The upper arm may incorporate a balancing or adjusting system so that it is balanced both in loaded and unloaded conditions.

1.6.13 Lifting magnets

1.6.13.1 *Electric lifting magnets*

Equipment with a magnetic field created by an electrical current, which creates a force for holding and handling loads with ferromagnetic properties.

1.6.13.2 *Permanent lifting magnets*

Equipment with a permanent magnetic field, which creates a force for holding and handling loads with ferromagnetic properties. The magnetic field or load holding is controlled by mechanical means.

1.6.13.3 *Electro-permanent lifting magnets*

Equipment with a permanent magnetic field, which creates a force for gripping, holding and handling loads with ferromagnetic properties. The magnetic field is controlled by an electric current, which is not required to sustain the magnetic field.

1.6.14 Pad

See plate clamps.

1.6.15 Payload

The mass of the contents of a bin.

1.6.16 Plate clamps

A gripping device designed for lifting and turning steel plates or sections. The gripping action or clamping force is achieved with a mechanical leverage or cam action enabling the cam to clamp the steel section on to a pad. Vertical plate clamps are used to lift steel plates or steel sections in a vertical plane or from the horizontal to the vertical plane. Horizontal plate clamps are used to lift steel plates in a horizontal plane.

1.6.17 Rated capacity

The maximum gross load that may be applied to the crane or hoist or lifting attachment while in a particular working configuration and under a particular condition of use.

1.6.18 Tare mass

The mass of the lifting device and any permanent attachments in an unloaded condition.

1.6.19 Tongs

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

1.6.20 Two-action control

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

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

1.6.21 Vacuum lifters

Equipment with one or several suction pads operating by vacuum. Self-priming vacuum lifters generate their own vacuum, usually by mechanical means, e.g., a piston. Non-self-priming vacuum lifters have a vacuum generated by external power, e.g., electrical pump, pneumatic ejector/venturi.

1.6.22 Working load limit (WLL)

The maximum load that can be applied to a device. The working load limit may be re-rated for particular conditions of use.

SECTION 2 GENERAL DESIGN REQUIREMENTS

2.1 GENERAL

All steel lifting devices shall be designed in accordance with AS 3990, or other appropriate Australian Standard(s) for the material being used.

The effects of factors such as heat, dust, presence of lubricants, corrosion and similar in the working environment shall be considered in design.

2.2 LIFTING DUTY

2.2.1 Duty-specific application

Where a lifting device is being designed for a specific application, the lifting device shall be designed in accordance with the duty classifications of AS 1418.1.

2.2.2 Duty-general application

Where a lifting device is being designed for general application, the lifting device shall be capable of withstanding—

- (a) a minimum design load of 1.5 times the capacity;
- (b) a proof load in accordance with Section 12;
- (c) a minimum of 20 000 lifting cycles at the working load limit/rated capacity (see Note 1); and
- (d) induced horizontal forces.

NOTES:

- 1 A lifting cycle is considered to start when the load is lifted, and to end at the moment the limiting device is ready to start the next lifting operation.
- 2 Where elements of lifting devices exist in similar form to standard lifting tackle, for example shackles, turnbuckles, swivels and similar equipment, reference should be made to Australian Standards applicable to the design and manufacture of such devices.

2.2.3 Hazardous and dangerous goods handling (including molten metal)

For items of lifting equipment that will handle hazardous or dangerous goods, including molten metal, an additional design multiplication factor of 1.33 shall be applied to the load.

The effects due to elevated temperatures, e.g., creep and reduced material properties, shall be considered when designing lifting equipment that will handle molten metal.

NOTE: Suitable de-rating factors can be found in hot metal handling equipment Standards such as Technical Report No. 7—Specification for Ladle Hooks, which is produced by the American AISE (Association of Iron and Steel Engineers).

2.3 ATTACHMENT TO THE CRANE

Lifting devices shall be designed so that during coupling and uncoupling the risk of injury is minimized.

In particular—

- (a) the weight of any part to be handled manually shall not be excessive, taking account of the operator's position;
- (b) such parts shall be easily accessible without risk of the operator being trapped or crushed;

- (c) any moving parts that present a risk shall be immobilized in a safe position; and
- (d) there shall be no sharp edges on components to be handled.

2.4 ERGONOMICS

Ergonomics of the operation of the particular item of lifting equipment shall be taken into consideration.

2.5 HANDLES

Lifting devices that are intended to be guided manually shall be equipped with a handle(s) which shall be designed so that injuries are avoided.

Handles are not required if features have been built in to provide natural handholds.

2.6 MULTIPLE LOAD ATTACHMENT POINTS

If lifting equipment is designed to use more than one load attachment point, the working load limit/rated capacity of each load attachment point shall take account of the share of the load that can foreseeably be imposed on it including any inequality of load share due to the rigidity or flexibility of the load.

2.7 SAFETY MECHANISMS

Where there is a risk of the lifting devices becoming detached during operation, the lifting devices shall be provided with a mechanism to prevent inadvertent detachment.

2.8 RISK ASSESSMENT

A risk assessment shall be undertaken by a competent person before carrying out the operation required to be undertaken by the lifting device. The assessment shall be in writing and shall take into account the following:

- (a) The task to be carried out.
- (b) The range of methods by which the task can be done.
- (c) The type of lifting device that will be required or that can be used.
- (d) The hazards involved and the associated risks.
- (e) The actual method and the other requisite plant and material.
- (f) Emergency and rescue procedures.

NOTE: The risk assessment should address the proposed operation rather than each individual lift.

As a result of the risk assessment, the competent person shall formulate a safe work method procedure, which shall be monitored for ongoing effectiveness and modified whenever it is found to be deficient, when the task changes or when the associated risks change.

NOTE: Guidelines on hazard identification and risk assessment procedures are given in AS 4360.

SECTION 3 GRIPPING DEVICES

3.1 GENERAL

This Section covers lifting devices such as friction grip tongs, scissor action tongs, plate clamps and clamps.

NOTE: For illustrated examples of lifting equipment, see Appendix B.

General design requirements shall be in accordance with Section 2.

3.2 DESIGN

3.2.1 Design factor

The design factor to prevent the load from being released shall be at least 2 times WLL/rated capacities, taking into account the coefficient of friction between the gripper and the load.

3.2.2 Unintentional release

The design shall minimize the risk of unintentional release of the load by considering the following influences:

- (a) Vibration.
- (b) Lubrication.
- (c) Snagging of the device or its locking mechanism.
- (d) Contact with an obstacle.
- (e) Weight of the crane hook and block bearing down on the device.
- (f) Intended tipping and/or turning.
- (g) Adequacy of engagement.
- (h) Ability of load to withstand gripping pressure.
- (i) Hardness of the material to be handled.

Where required, a mechanism that prevents the load from unintentional detachment when it is set down shall be incorporated.

3.2.3 Loss of pneumatic or hydraulic pressure

Where there is a risk of injury to personnel, damage to the equipment or the environment, gripping devices that close hydraulically or pneumatically to maintain grip should be fitted with a means to compensate for any pressure drop below the working pressure. Where this is not possible, a risk assessment shall be undertaken to determine the hazards and the appropriate control mechanisms.

3.2.4 Multiple gripping devices

Where lifting equipment is designed to use more than one gripping device, the WLL/rated capacity of each gripping device shall take account of the share of the load that can foreseeably be imposed on it, including any inequality of load share due to the rigidity or flexibility of the load.

3.2.5 Self-latching gripping device

For gripping devices that open and close alternately under their own motion each time they are set down onto the load, the latch shall make a positive mechanical engagement for the direction required.

3.2.6 Connection to the crane

The method of connecting to the crane or intermediate equipment shall ensure that the forces are transmitted through the gripping device in the correct alignment.

3.3 PLATE CLAMPS AND CLAMPS

3.3.1 Design

3.3.1.1 General

Plate clamps shall withstand a load of five times WLL without failure and without releasing the load.

3.3.1.2 Gripping range

The design factor given in Clause 3.2 shall apply across the specified gripping range.

3.3.1.3 Hardness of material to be lifted

The hardness of the material to be lifted shall be considered in the design of the gripping surfaces.

3.3.1.4 Sling angles

Details of the sling angles where more than one plate clamp is used in a lifting configuration shall be considered.

3.3.2 Testing

3.3.2.1 General

Testing shall be in accordance with Section 12.

Details of the test plates including their thickness and hardness shall be recorded on the test certificate.

3.3.2.2 Type tests

Each model of a plate clamp shall be loaded in the manner in which it is designed to perform and it shall achieve a load of five times WLL without failure and without releasing the load. The thickness of the test plate used shall be the minimum possible to achieve this load.

3.3.2.3 Proof testing

3.3.2.3.1 New plate clamps

New plate clamps shall be tested using a test plate with a thickness of the mean of the gripping range.

3.3.2.3.2 Repaired plate clamps

Repaired plate clamps shall be tested on a plate that is 20% to 40% of the maximum gripping range and at the maximum thickness of the range.

NOTE: The tolerance size specified is to accommodate standard plate sizes.

3.3.2.4 Testing acceptance criteria

The clamp shall perform in the manner it is intended to perform.

On completion of tests, there shall be no permanent set of the components or deleterious effect on the gripping surfaces of the clamps.

3.3.3 Markings

Markings shall be in accordance with Section 13.

3.3.4 Information to be supplied with plate clamps

Information supplied with plate clamps shall be in accordance with Section 14.

Specific information regarding the following shall also be supplied:

- (a) Vertical lifting for one part at a time.
- (b) Operation of the safety locking device.
- (c) Surface condition (grease, paint or coating) of the part to be handled.
- (d) Clamping ranges to be observed.
- (e) Sling angles for horizontal plate clamps.
- (f) Maximum hardness of plate that can be lifted.

3.3.5 Maintenance, inspection and repair

Maintenance, inspection and repair shall be in accordance with Section 15.

If the cam or pad is worn, the plate clamp shall be withdrawn from service.

When repairing plate clamps, only replacement parts approved by the manufacturer shall be used.

After repair, the plate clamp shall be tested in accordance with Clause 3.3.2.3.2.

3.3.6 Care and use

Care and use shall be in accordance with Section 16.

The following also applies to the care and use of plate clamps:

- (a) Plate clamps shall be lifted in accordance with the manufacturer's instruction.
- (b) An appropriate size clamp shall be selected for the intended lift(s).
- (c) Plate thickness shall be within the grip range shown on the clamp. In some cases with hardened plates or light plates (less than 20% of capacity marked on plate) and thin plates (less than 25% of the maximum clamping range) the clamping force will be reduced. In these cases, before lifting, it shall be confirmed that the clamp has a positive grip.
- (d) The load should be taken up slowly. Jerking the load shall be avoided.
- (e) The surfaces of the cam and pad shall be protected from weld spatters or other damaging contaminants.
- (f) The surface of the load shall be clean and free from scale.
- (g) Plate clamps should not be used to support suspended plates in power or break presses during operation.

3.4 GIRDER CLAMPS

3.4.1 Design

Girder clamps are designed for vertical suspension of loads unless otherwise noted. Girder clamps shall withstand a load of five times the WLL before the load is released.

3.4.2 Testing and verification requirements

3.4.2.1 General

Testing and verification shall be in accordance with Section 12.

3.4.2.2 *Proof testing*

3.4.2.2.1 *Conditions*

The test shall be conducted by applying a static force in a manner that replicates its intended use.

3.4.2.2.2 *Procedure*

Clamps shall be tested on a beam section within its specified range.

NOTE: This enables the test load to be achieved.

Details of the test beam shall be recorded on the test certificate.

3.4.2.2.3 *Testing acceptance criteria*

The clamp shall perform in the manner in which it is intended to perform.

On completion of tests there shall be no permanent set of the components or deleterious effect on the gripping faces of the clamps.

3.4.2.3 *Type tests*

3.4.2.3.1 *Conditions*

Each model of a girder clamp shall be loaded by applying a static force in a manner that replicates its intended use.

3.4.2.3.2 *Procedure*

Clamps shall be tested on a beam section within its specified range.

NOTE: This enables the required load of the specified clamps to be obtained.

3.4.2.3.3 *Testing acceptance criteria*

The clamp shall sustain a load of five times WLL without failure and without releasing the load.

3.4.3 *Maintenance, inspection and repairs*

Maintenance, inspection and repair shall be in accordance with Section 15.

Particular attention shall be paid to worn threads.

3.4.4 *Care and use*

Care and use shall be in accordance with Section 16.

Lifting shall be in accordance with the manufacturer's instructions.

The girder clamp used shall have an appropriately specified range for the flange width of the beam being lifted.

The clamp shall be securely fitted to the beam and the centre-line of the lifting point shall be aligned to the centre web of the beam.

3.5 *TONGS*

Tongs shall be suitably matched, in respect of size and shape, to the loads to be transported. When designing tongs to be used as load-carrying means, the following additional data shall be specified:

- (a) Numerical values for the range of opening of the tongs and for the vertical closing lift (related to the centre point of the tongs suspension).
- (b) Load on the tongs and tare mass of the tongs.

SECTION 4 BINS

4.1 DESIGN

4.1.1 General

General design requirements for bins shall be in accordance with Section 2.

NOTE: For illustrated examples of bins, see Appendix B.

4.1.2 Volume

Where a bin is designed for a particular application, the volume shall be limited to prevent overloading when filled to capacity.

4.1.3 Bin discharge

4.1.3.1 *Discharge mechanism*

Discharge mechanisms for the bin may include tipping lugs, self-disengaging arms or discharge slides.

Any self-disengaging mechanisms shall be arranged so as to prevent inadvertent disengagement.

4.1.3.2 *Discharge slides*

Discharge slides may be fitted to enable control of the rate of material discharge.

Discharge slides shall incorporate devices or features that prevent unintended opening.

NOTE: This can be achieved by a locking device at the opening mechanism.

Discharge slides shall incorporate devices or features that prevent unintended tilting or swivelling at each loading state.

NOTE: This can be achieved, for example, by—

- (a) a manually activated locking device;
- (b) the tilting mechanism being irreversible; or
- (c) an additional braking device.

4.1.4 Baffling

Where there is a possibility of a sudden change in the stability of the load during transport or lifting of fluids, baffling should be included.

4.2 SET DOWN

Bins shall be designed so that they can be set down in a stable manner in each loading state.

4.3 TESTING AND VERIFICATION

Testing and verification of bins shall be in accordance with Section 12.

4.4 MARKING

Bins shall be marked with the following information:

- (a) Gross load or WLL or rated capacity.
- (b) Tare mass.
- (c) Identification number.
- (d) Material to be lifted (if applicable).

4.5 INFORMATION TO BE SUPPLIED WITH BINS

The information to be supplied with bins shall be in accordance with Section 14.

4.6 MAINTENANCE, INSPECTION AND REPAIR

Maintenance, inspection and repair of bins shall be in accordance with Section 15.

4.7 CARE AND USE

Care and use of bins shall be in accordance with Section 16.

SECTION 5 VACUUM LIFTING DEVICES

5.1 GENERAL

General design requirements for vacuum lifting devices shall be in accordance with Section 2.

NOTE: For illustrated examples of vacuum lifting devices, see Appendix B.

The design of lifting devices shall take into consideration material type, its thickness, surface condition and porosity.

5.2 VACUUM SYSTEMS

5.2.1 Design factor

Vacuum lifting systems shall provide an adhesion force not less than 1.5 times the rated capacity/WLL in all the load holding configurations and foreseeable accelerations.

5.2.2 Vacuum hoses and lifting tubes

Vacuum hoses shall be designed to avoid any crushing, shearing, puncture, implosion or leakage under the specified conditions of use.

Means shall be provided at the lifting tube upper end to prevent any risk of uncoupling (e.g., hook with safety catch).

The fully extended lifting tube shall not lose its cylindrical shape under the following conditions:

- (a) If the minimum working pressure is equal to or over 0.4 bar absolute, the vacuum hose shall withstand a pressure of 0.75 times the minimum working pressure.
- (b) If the minimum working pressure is below 0.4 bar absolute, the vacuum hose shall withstand a pressure of 0.6 times the minimum working pressure.

The hose shall be connected to the non-contractable parts in such a way that the hose is not damaged.

For vacuum tube lifters, the effective surface area of the suction foot shall be equal to a minimum of two times the cross-sectional area of the lifting tube.

Both ends of the lifting tube shall be attached in such a way that it cannot slip off the connections.

5.2.3 Structure of the vacuum lifter

The support structure of the vacuum pads shall be designed in accordance with Section 2.

5.3 VACUUM INDICATORS

5.3.1 General

The vacuum indicator shall show the operating range and shall be fully visible to the operator(s), or to the dogger if the indicator is not visible to the operator in the normal operating position. This Clause does not apply to vacuum tube lifters.

NOTE: The non-operating range adjoins the operating range and signals that the pressure is insufficient in the range.

5.3.2 Non-self-priming vacuum lifters

Non-self-priming vacuum lifters shall be equipped with a vacuum indicator clearly showing the operating range and the non-operating range of the vacuum.

‘Operating range’ is the range of working pressure specified by the manufacturer for operation.

‘Non-operating range’ is outside the working pressure.

NOTE: The operating range may be in green and the non-operating range be in red, but other methods of indication are acceptable.

5.3.3 Self-priming vacuum lifters

Self-priming vacuum lifters shall be equipped with a vacuum indicator to warn the operator of leakage.

5.4 VACUUM LOSS CONTROL AND MONITORING

Where a system is provided to control and monitor vacuum losses, it shall be as follows:

- (a) In the case of vacuum lifters with a vacuum pump, a vacuum reservoir with a non-return valve between the vacuum reservoir and the pump located as close as possible to the vacuum reservoir shall be provided.
- (b) In the case of vacuum lifters with a venturi-system, a positive pressure reservoir or a vacuum reservoir with a non-return valve between the vacuum reservoir and the venturi-system located as close as possible to the vacuum reservoir shall be provided.
- (c) In the case of turbine (side channel blower) vacuum lifters, a supporting battery or a flywheel mass shall be provided. This does not apply to vacuum tube lifters.
- (d) In the case of self-priming vacuum lifters, a reservoir equal to a minimum of 50% of the total piston volume shall be provided. The ratio of the surface area of the suction plate to the surface area of the piston shall be equal to or greater than 2. An excess vacuum thus exists when the rated load is reached and this is regarded as a vacuum reserve.

A device that gives an optical or acoustic indication, or both, shall be provided to indicate the danger level when the control device cannot balance the loss in vacuum. This indication shall be automatic and clearly perceptible to the operator.

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

5.5 DESIGN FOR USE IN PROXIMITY TO PEOPLE

For vacuum lifters that are intended for use in areas where people may be present and subject to risks associated with inadvertent release of the load, the requirements of Clause 5.3 shall apply. The following additional requirements shall also be fulfilled.

- (a) *Operation* The operating elements with which the load can be released shall be secured against erroneous operation. This does not apply to vacuum tube lifters.
NOTE: This can be achieved by two-action control.
- (b) *Tilt angle* If the vacuum lifter is intended to lift the load horizontally, it shall tolerate a tilt of up to 6° from the horizontal.

5.6 TESTING

Testing shall be in accordance with Section 12, except that—

- (a) a proof load shall take place which demonstrates that the vacuum lifter can perform its intended function; and
- (b) in addition, the supporting structure excluding the lifting tube, shall achieve a static proof load of two times the WLL.

NOTE: This proof load does not require the lifting of any load by means of the vacuum.