Australian Standard™

Lifting components for Grade T chain slings

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PREFACE

This Standard was prepared by Standards Australia Committee ME-025, Lifting Tackle, to supersede AS 3758—1990.

In the preparation of this Standard, cognizance was taken of the following Standards:

(a) BS EN 1677-1:2000 Components for slings. Safety. Forged steel components, Grade 8.

(b) BS EN 1677-2:2000 Components for slings. Safety. Forged steel lifting hooks with latch, Grade 8.

(c) BS EN 1677-3:2001 Components for slings. Safety. Forged steel self-locking hooks, Grade 8.

(d) BS EN 1677-4:2000 Components for slings. Safety. Links, Grade 8.

Previously, quality grade was designated as T, 8, 80 or 800. International usage has focused on Grade 8 and, for the purposes of this Standard, Grade T or Grade 8 are the predominant description of quality grade.

The objective of this Standard is to provide requirements for lifting components for use in Grade T chain slings and ensure that product supplied meets its design intent. This Standard is for reference by manufacturers, suppliers, testers, users and regulators.

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.

Statements expressed in mandatory terms in notes to Tables are deemed to be requirements of this Standard.

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STANDARDS AUSTRALIA

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Lifting components for Grade T chain slings

SECTION 1 SCOPE AND GENERAL

1.1 SCOPE

This Standard specifies requirements for forged lifting components for use in chain sling assemblies with corresponding sizes of Grade T chain complying with AS 2321. The components include hooks with eyes, clevises and other joining devices, mechanical connecting devices, and any other terminal fittings used in a lifting system based on Grade T chain.

This Standard does not apply to welded components other than welded master links, welded multi-link assemblies, welded joining links nor does it apply to components subject to an existing Australian Standard.

NOTES:

1 AS 2321 specifies chain in terms of the ISO quality grade designation system. The ISO system also permits Grade T to be designated as Grade 8.

2 A list of standards applicable to components used in lifting systems is given in Appendix D.

1.2 REFERENCED DOCUMENTS

The following documents are referenced in this Standard:

AS

1171 Non-destructive testing—Magnetic particle testing of ferromagnetic products, components and structures

1442 Carbon steels and carbon-manganese steels—Hot-rolled bars and semifinished products

1444 Wrought alloy steels—Standard, hardenability (H) series and hardened and tempered to designated mechanical properties

2062 Non-destructive testing—Penetrant testing of products and components

2193 Calibration and classification of force-measuring systems

2318 Swivels for hoists

2321 Short-link chain for lifting purposes

3775 Chain slings—Grade T

3775.2 Part 2: Care and use

3998 Non-destructive testing—Qualification and certification of personnel

AS/NZS

1554 Structural steel welding

1554.4 Part 4: Welding of steel structures subject to high levels of fatigue loading

AS/NZS
3842 Guide 62: General requirements for bodies operating assessment and certification/registration of quality systems

4360 Risk management

AS/NZS ISO
9001 Quality management systems—Requirements

ISO
9712 Non-destructive testing—Qualification and certification of personnel

1.3 DEFINITIONS

For the purposes of this Standard the definitions below apply.

1.3.1 Breaking force (BF)

Maximum force reached during the static tensile test of the component, at which the component fails to retain the load.

1.3.2 Connectors

A mechanical joining device that is specifically designed for the use with chain.

1.3.3 Chain sling

An assembly of lifting components made in a configuration of one or more chain legs for attaching loads to be lifted by the hook of a crane or other lifting appliance.

1.3.4 Clevis

An integrated part of a lifting component, for direct connection to a chain, incorporating a fork or yoke integral with the end fitting, a load pin and a retaining mechanism (see also integral joining device).

1.3.5 Competent person

Designated person, suitably trained, qualified by knowledge and practical experience, and with the necessary instruction to enable the required test and examination to be carried out.

1.3.6 Cradle grab hook

A lifting component (usually attached to the upper end of a sling assembly) that is used to reduce the length of a sling leg, and which and may have no de-rating effect on the chain, (see Figure 7.2.1).

1.3.7 Grab hook

A lifting component (usually attached to the upper end of a sling assembly) that is used to reduce the length of a sling leg and which may have a de-rating effect on the chain (see Figure 7.2.1).

1.3.8 Integral joining device

Means of connection that does not depend on welding and is integrated with the component.

1.3.9 Intermediate link

Link used to connect one or two legs of a sling to a master link (see Figure 5.1(b)).

1.3.10 Latch

A spring-loaded or positive latch mechanism that ensures the load cannot become unintentionally disconnected.

1.3.11 Lifting component

A component used in a sling.

1.3.12 Lot

Total number of components from which samples are selected for testing purposes, and that have been manufactured from the same cast of steel and subjected to the same heat treatment process.

NOTE: This Standard uses the term 'lot'. The term 'batch' is used in other Standards.

1.3.13 Lower terminal

Link, hook or other device fitted at the end of a leg of a sling, remote from the master link or upper terminal.

1.3.14 Manufacturing proof force (MPF)

Force applied to the component during the manufacturing proof test.

1.3.15 Master link

Link forming the upper terminal of a sling by means of which the sling is attached to the hook of a crane or other lifting machine.

1.3.16 Master link assembly

Assembly consisting of a master link together with two intermediate links.

1.3.17 Mechanical joining device

A fitting for connection to an upper or lower terminal fitting or to another length of chain either directly or through an intermediate link (see Figure 4.1).

1.3.18 Multi-link assembly

See master link assembly.

1.3.19 Nominal size (of lifting component)

Equal to the nominal size of compatible Grade T chain complying with AS 2321.

NOTE: See Table A1, Appendix A which lists chain sizes with which lifting components must be compatible.

1.3.20 Self-coloured

A surface colour of closely adhering oxides resulting from heat treatment and subsequent handling during manufacture.

1.3.21 Self-locking hook

Hook containing a locking mechanism, capable of being activated by the action of the load, which, once correctly closed and locked, can only be opened in the unloaded condition by de-activation of the locking mechanism.

1.3.22 Shall

Indicates that a statement is mandatory.

1.3.23 Shortening clutch or hook

A lifting component usually attached to the upper end of a sling assembly that is used to reduce the length of a sling leg (see Figure 7.1.1).

1.3.24 Should

Indicates a recommendation.

1.3.25 Size

The nominal diameter of chain with which the component is designed to be used.

1.3.26 Sling

Assembly consisting of chain, wire rope or textile joined to upper and lower terminals suitable for attaching loads to the hook of a crane or other lifting machine.

1.3.27 Traceability code

Series of letters and/or numbers marked on a component that enables its manufacturing history.

1.3.28 Upper terminal fitting

A fitting or other lifting component forming the upper terminal fitting of a chain sling by means of which it is attached to the hook of a crane or other lifting appliance.

1.3.29 Upper terminal link

See master link.

1.3.30 Working load limit (WLL)

The maximum load that may be applied to the lifting component.

NOTE: The working load limit may be de-rated for particular conditions of use.

SECTION 2 GENERAL DESIGN, MANUFACTURING AND MECHANICAL PROPERTIES

2.1 DESIGN

2.1.1 Articulation

The dimensions of components shall be such as to ensure articulation so that the force applied is transmitted axially.

2.1.2 Load pin retention

A satisfactory retention method shall be provided for any load pin, which shall withstand failure of the clevis component under test loading conditions. The system should not be easily demountable.

Load pin and load-pin retention devices should not protrude beyond the body of the clevis.

2.2 MATERIALS AND HEAT TREATMENT

2.2.1 Forgings, links and load pins

2.2.1.1 *Quality of material*

The manufacturer shall select the type of steel to be used so that the finished component, when suitably heat-treated, conforms to the mechanical properties specified in this Standard.

2.2.1.2 *Type of steel production*

The steel shall be produced by an electric process or by an oxygen-blown process.

2.2.1.3 *Deoxidation*

The steel shall be fully killed and stabilized against strain age embrittlement. The austenitic grain size shall be 5 or finer.

NOTE: Protection from strain age embrittlement during service can be accomplished by ensuring that the steel contains sufficient aluminium (minimum 0.025%).

2.2.1.4 *Composition and heat treatment*

Lifting components shall be of heat-treated steel complying with Table 2.2.1.4.

Each component shall be hardened from a temperature above the AC3 point and tempered before being subjected to the manufacturing proof force. The tempering temperature shall be determined to ensure that all mechanical properties specified in this Standard are achieved.

Surface hardening shall not be permitted for load-bearing parts of the component.

TABLE 2.2.1.4

STEEL AND HEAT TREATMENT

1	2	3	4	5	6	7
Material specification	**Steel type**	**Welding of components**	**Maximum allowable cast analysis of elements, %**			**Heat treatment**
			Carbon	**Phosphorus**	**Sulfur**	
AS 1442 AS 1444	Fully-killed fine-grained	Welded	0.30	0.025	0.025	Harden and temper
		Non-welded	0.45			

2.2.2 Latches

Latches may be forged, cast or pressed metal.

2.3 MANUFACTURING METHODS AND WORKMANSHIP

2.3.1 Manufacture of forged components

Each forged part of a component shall be forged hot in one piece. Excess metal from the forging operation shall be removed cleanly, leaving the surface free from sharp edges. After heat-treatment, furnace scale shall be removed.

Edges of machined surfaces shall be rounded to eliminate cutting edges and to ensure attainment of mechanical properties of the component.

Welding shall not be used on forged components.

2.3.2 Surface finish

The surface finish shall be one of the following:

(a) Self-coloured.

NOTE: See Clause 1.3.20 for the definition of self-coloured.

(b) Painted coating.

(c) Any other surface finish that does not cause a degradation of the mechanical properties of the finished product.

2.4 MECHANICAL PROPERTIES

2.4.1 Permanent set

Each lifting component shall be capable of supporting a force equal to the minimum proof test force specified by Table A1, Appendix A, applied under the conditions specified in Appendix B without sustaining any permanent set of more than 1% of its original dimension after the load has been applied and removed.

2.4.2 Strength

Each lifting component in its finished condition shall be capable of achieving a minimum of 4 times the working load limit of the matching size Grade T chain under the conditions specified in Appendix B.

NOTE: Compliance with the requirements of Clauses 2.4.2 and 2.4.3 can be demonstrated on a lifting component that has previously been loaded to demonstrate compliance with the requirements of Clause 2.4.1.

2.4.3 Ductility

2.4.3.1 *General*

The ductility of lifting components shall be such that, in the event of a lifting component being loaded under the conditions specified in Appendix B until the lifting component meets or exceeds the minimum breaking load, it would not release the load. Any failure shall occur in a ductile manner. The failure should be away from any weld zone. Such a failure for a hook type of lifting component (excluding shortening and grab hooks) should be an opening out of the hook. Shortening hooks and grab hooks shall demonstrate deformation prior to release of the load.

On completion of the breaking force test, all links shall show evidence of elongation of not less than 20%.

2.4.3.2 *Bend tests for welded links*

The ductility of welded links shall be such that each link will pass the bend test for weld links given in Clause 5.5.2.

2.4.3.3 *Bend and impact tests for self locking hooks*

The ductility of self-locking hooks shall be such that each self-locking hook will pass the bend and impact tests given in Clause 8.6.1.2 and 8.6.1.4.

SECTION 3 TESTING AND VERIFICATION

3.1 TYPE TESTING OF MECHANICAL PROPERTIES

3.1.1 General

Compliance of each design with the requirements of Clause 2.4 shall be demonstrated.

NOTES:

1 The test of each design is known as the type test, which determines the adequacy of the design for achieving the required performance.

2 Each change in manufacturing process, grade of material, design, and size necessitates separate type testing, to demonstrate compliance with the requirements of Clause 2.4.

3 In addition to type testing, effective quality control necessitates systematic testing of each lot to ensure continuing compliance with the requirements of Clause 2.4.

3.1.2 Test for deformation

Three samples shall be tested, and each shall sustain the manufacturing proof force specified for the component in Table A1, Appendix A. Following the removal of the force, the dimensions shall comply with the manufacturer's specifications. Permanent set shall comply with Clause 2.4.1 after the manufacturing proof force has been applied and removed as described in Clause 3.2.2.

3.1.3 Static tensile test

Three samples shall be tested and each shall have a breaking force at least equal to the minimum value specified for the component in Table A1, Appendix A, and meet the requirements of Clauses 2.4.2 and 2.4.3.

NOTE: This test may be carried out on the same components subjected to the deformation test.

3.1.4 Bend test

The bend tests for welded links shall be in accordance with Clause 5.5.2.

The bend tests for self-locking hooks shall be in accordance with Clause 8.6.1.2.

3.1.5 Examination for articulation and relative movement

One sample of each design shall be visually examined for conformity to the requirements of Clauses 2.1 and 2.3.

3.1.6 Acceptance criteria for type tests

Where all three samples pass all the tests, the component of the size submitted for type testing shall be deemed to conform to this Standard.

Where one sample fails, two further samples shall be tested and both shall pass the test in order for the component of the size submitted for testing to be deemed to conform to this Standard.

Where two or three samples fail the test, the component of the size submitted for type testing shall be deemed not to conform to this Standard.

3.2 MANUFACTURING TESTS

3.2.1 Manufacturing examination

All finished components shall be visually examined for conformity to the requirements of Clauses 2.1 and 2.3.

3.2.2 Manufacturing proof test

Components in their finished condition (except they may be painted or unpainted) shall, under the conditions specified in Appendix B, be subjected to a proof force at least equal to the manufacturing proof force specified in Table A1 of Appendix A. After removal of the force, there shall be no visible defects, and the permanent set shall comply with Clause 2.4.1.

3.2.3 Non-destructive test

Where required by Clause 3.3, the forged surfaces of components, excluding load-bearing pins machined from drawn bar, shall, after heat treatment and de-scaling, be subjected to magnetic particle or dye penetrant examination in accordance with AS 1171 or AS 2062 (or international equivalent). Any such examination shall be undertaken by operators qualified in accordance with AS 3998/ISO 9712 (or international equivalent).

Indications greater than 2 mm in length shall not be permitted in areas of the component subjected to tensile stresses, in all foreseeable service conditions.

Where grinding is required to remove such indications then, after grinding, the component shall conform to the dimensions and tolerances specified by the manufacturer. A final examination shall show no indications greater than 2 mm in length.

NOTE: Care should be taken to ensure that the direction and roughness of grinding does not create starting points for fatigue failure and cause excessive heating, which may have a local effect on the heat-treated condition, or may cause cracks.

Load-bearing pins machined from drawn bar shall be tested (e.g., hardness testing or by using magnetic sorting techniques) to demonstrate that they have been satisfactorily heat-treated. They shall be examined following heat treatment and shall be free from visible defects.

3.3 MANUFACTURING TEST REGIME AND ACCEPTANCE CRITERIA

3.3.1 General

The manufacturing test regime shall depend on whether the manufacturer has a quality system conforming to AS/NZS ISO 9001 and is certified by a certification body accredited to AS/NZS 3842, or equivalent international Standard.

Where such a system is in place and operating, the manufacturer's test regime shall conform to Clause 3.3.2. Where no such system is in place or operating the manufacturer's test regime shall comply with Clause 3.3.3.

NOTE: Clause 3.3.2 specifies alternative testing regimes. It is permissible for load bearing pins to be tested to a different regime to that of the rest of the component.

3.3.2 Manufacturing test regime and acceptance criteria when a quality system conforming to AS/NZS ISO 9001 is in place and operating

Where a quality system conforming to AS/NZS ISO 9001 is in place and operating, the manufacturer shall have the choice of at least one of the following:

(a) Applying the manufacturing proof force test to all components in accordance with Clause 3.2.2. Components that fail the proof test shall be discarded.

(b) Applying the non-destructive test to all components in the lot specified in Table 3.3.2(A) in accordance with Clause 3.2.3 plus manufacturing proof force testing of 3% of the lot of components in accordance with Clause 3.2.2.

Where all of the 3% sample of components pass the manufacturing proof force test then all components in the lot that also pass the non-destructive test shall be deemed to conform to this Standard.

Where any of the 3% sample fail the manufacturing proof force test, then all components in the lot shall be subjected to both the non-destructive test and the manufacturing proof force test. All components that pass both tests shall conform to this Standard. The maximum size of a lot shall be as given in Table 3.3.2(A) for the ranges of chain sizes indicated.

TABLE 3.3.2(A)

NUMBER OF COMPONENTS IN A LOT

Chain size	Maximum number in a lot
3 to 10	1000
Over 10 to 18	500
Over 18	200

(c) Applying both a sampling plan and static tensile test, as follows:

(i) *Sampling plan* A sampling plan shall be applied with a random sample of minimum size complying with Table 3.3.2(B). The selected samples shall be submitted to proof-testing in accordance with Clause 3.2.2.

Where any components fail the proof test, every component in the lot from which the samples were selected shall be proof-tested in accordance with Clause 3.2.2.

Samples shall be tested. Each sample shall sustain the manufacturing proof force specified for the component in Table A1, Appendix A. Following the removal of the force, the permanent set shall comply with Clause 2.4.1. Components that fail the proof test shall be discarded.

TABLE 3.3.2(B)

SAMPLING PLAN FOR PROOF TESTING

Lot size	Minimum sample size
2 to 15	2
16 to 25	3
26 to 90	5
91 to 150	8
151 to 500	13
501 to 1200	20

(ii) *Static tensile test* A mechanical properties sampling plan shall be applied with a sampling frequency complying with Table 3.3.2(C). The lot shall be accepted if during the first sampling all the samples conform. The lot shall be rejected if during the first sampling there are two or more samples that do not conform. A second sampling shall be submitted where there is only one sample that does not conform to Clauses 2.4.2 and 2.4.3.

For a second sampling, the lot shall be accepted where all of the second samplings conform. The lot shall be rejected where any one of the second samplings does not conform.

NOTE: This test may be carried out on the same components subjected to the deformation test.

TABLE 3.3.2(C)

SAMPLING PLAN FOR MECHANICAL PROPERTIES

Lot size	Sample size
16 to 150	2
151 to 1200	3

3.3.3 Manufacturing test regime and acceptance criteria when a quality system conforming to AS/NZS ISO 9001 is not in place or not operating

Where a quality system conforming to AS/NZS/ISO 9001 is not in place or not operating, the manufacturer shall carry out a manufacturing proof test in accordance with Clause 3.2.2 and a non-destructive test in accordance with Clause 3.2.3 on every component, including load-bearing pins. Any component that fails the manufacturing proof test or the non-destructive test shall be deemed not conform to this Standard.

All components that pass both the manufacturing proof test and the non-destructive test shall conform to this Standard.

In addition, the manufacturer shall subject one sample per lot to the static tensile test as defined in Clause 3.1.2. Where the sample meets the appropriate requirements, the lot shall be deemed to conform to this Standard.

Where the sample fails to meet the requirements, two further samples shall be taken from the same lot. Both of these samples shall be subjected to the static tensile test. Where one or both of these samples fail to meet the appropriate requirements, the entire lot shall be deemed not to conform to this Standard.

SECTION 4 CONNECTORS AND MECHANICAL JOINING DEVICES

4.1 DESIGN

Parts of mechanical joining devices, such as pins and their securing elements, shall be so designed and manufactured that, after assembly, no unintended displacement can occur.

NOTE: See Figure 4.1 for illustrations of connectors and mechanical joining devices.

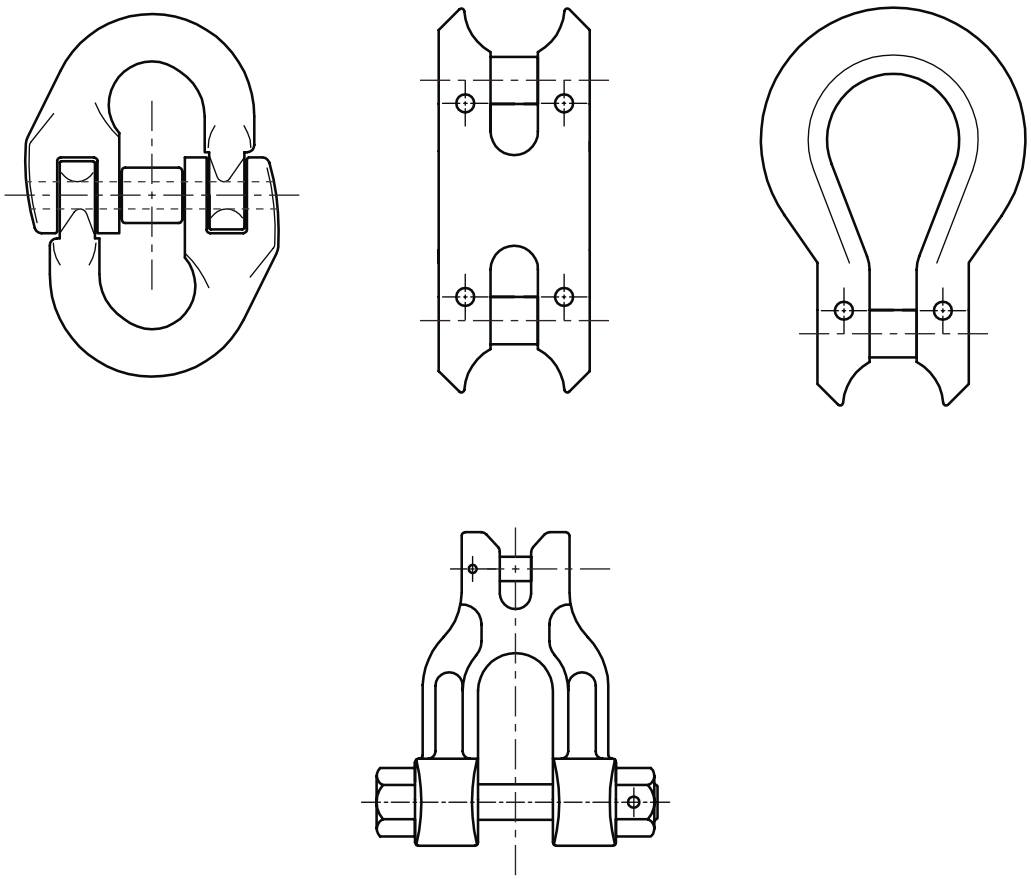


FIGURE 4.1 TYPICAL CONNECTORS AND MECHANICAL JOINING DEVICES

4.2 MATERIALS AND HEAT TREATMENT

The materials and heat treatment of all connectors and mechanical joining devices, including pins, shall be in accordance with Clause 2.2.

4.3 MANUFACTURING METHODS AND WORKMANSHIP

Manufacturing methods and workmanship shall be in accordance with Clause 2.3.

4.4 MECHANICAL PROPERTIES

The mechanical properties of all load-bearing parts of connectors and mechanical joining devices, including pins, shall be in accordance with Clause 2.4.

4.5 TYPE TESTING OF MECHANICAL PROPERTIES

Type tests and acceptance criteria shall be in accordance with Clause 3.1.

4.6 ASSEMBLY

Load pins and load pin-retention devices shall be in accordance with the component manufacturers specification.

NOTE: The effects of wear, corrosion of securing elements or rough usage should be considered.

SECTION 5 LINKS

5.1 DESIGN

Links shall be either—

(a) parallel-sided links produced by forging or welding; or

NOTE: Forged links may be with or without integral joining devices.

(b) pear-shaped links with integral joining devices (i.e., links with unequal radii at either end) produced by forging.

Parts of integral joining devices, such as pins and their securing elements, shall be so designed and manufactured that, after assembly, no unintended displacement can occur.

NOTE: The effects of wear, corrosion of securing elements or rough usage should be considered.

Dimensions of links shall ensure assembly and articulation with matching components so that forces are transmitted in the intended direction and meet the requirements of Clause 2.4.

NOTES:

1 This requirement permits a varying shape and area of cross-section.

2 See Figure 5.1 for illustrations of links.

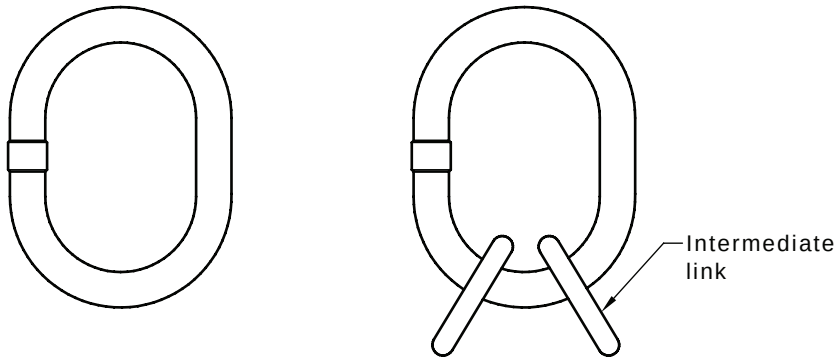
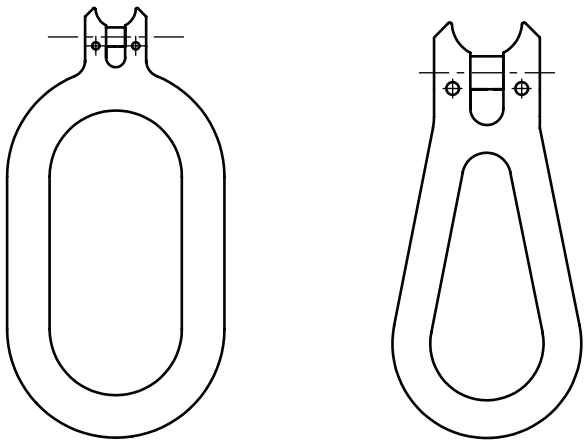


FIGURE 5.1 (in part) LINKS



(c) Master links with clevis

FIGURE 5.1 (in part) LINKS

5.2 MATERIALS AND HEAT TREATMENT

The materials and heat treatment of all links, including pins, shall be in accordance with Clause 2.2.

5.3 MANUFACTURING METHODS AND WORKMANSHIP

5.3.1 Manufacture

5.3.1.1 *Forged links*

Each forged link shall be hot-forged in one piece. Excess metal from the forging operation shall be removed cleanly leaving the surface free from sharp edges. After heat treatment, furnace scale shall be removed.

Edges of machined surfaces shall be rounded to ensure attainment of mechanical properties and to eliminate cutting edges.

5.3.1.2 *Welded links*

Each welded link shall be manufactured from steel of weldable quality.

Welds shall be produced using the resistance butt or flash butt processes and shall be positioned in the centre of the leg of the link.

NOTE: See Figure 5.3.1.2 for an illustration of a welded link.

Any other welding processes that meet the intent of this Standard are not precluded.

NOTE: The processes defined in AS 1554.4 meet the intent of this Standard.

The steel in the length affected by welding shall not be displaced at any point so as to undercut the contours of the link. The weld shall be smoothly finished all round.

The length affected by welding should not extend by more than 0.6 of the material diameter to either side of the centre of the weld.

Where the link has a flattened section this shall be on the leg of the link opposite to the weld.

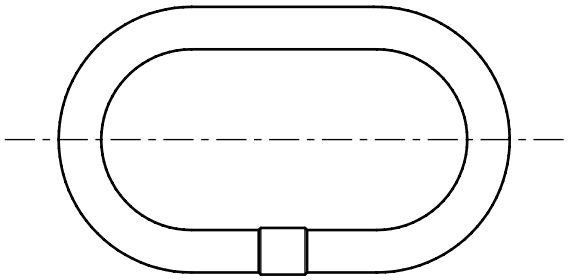


FIGURE 5.3.1.2 WELDED LINK

5.4 MECHANICAL PROPERTIES

5.4.1 Breaking force (*BF*) and elongation

The breaking force (BF), in kilonewtons, shall be the force calculated by the following:

$$BF = 4 \times 9.81 \times \text{WLL}$$

where the working load limit is given in Table A2, Appendix A.

Links shall exhibit elongation in accordance with Clause 2.4.3.1.

Links, including load-bearing pins, where used, shall have a breaking force at least equal to the breaking force (BF) as calculated above.

5.4.2 Proof force

The proof force (in kilonewtons) shall be the force calculated by the following:

(a) *Master-link* (one leg):

$$2 \times 9.81 \times \text{WLL}$$

where WLL is taken from Column 2 of Table A2, Appendix A

(b) *Master-link* (multi-leg):

$$2 \times 9.81 \times \text{WLL}$$

where WLL is taken from Column 3 of Table A2, Appendix A

Permanent set shall meet the requirements of Clause 2.4.1.

5.5 TYPE TESTING OF MECHANICAL PROPERTIES

5.5.1 Type tests

Type tests and acceptance criteria shall be in accordance with Clause 3.1.

5.5.2 Bend test for welded links

Test pieces taken from welded links shall withstand a minimum deflection of 0.8 times the link material diameter and shall be free from visible defects after bending.

Three test piece samples shall be tested and each shall be bent in a shock free manner in the bend test equipment shown in Figure 5.5.2(A).

Test pieces taken from the links to be tested shall contain a central weld and should have a length of 5 times the link diameter, as indicated in Figure 5.5.2(B). Where necessary, the test piece length may be shorter than 5*d* in which case the minimum deflection will be proportionately reduced to achieve the intent of this requirement.

The bend test equipment shall be as shown in Figure 5.5.2(A). The included angle of the V-block shall be 90° and the diameter of the mandrel shall be twice the link diameter.

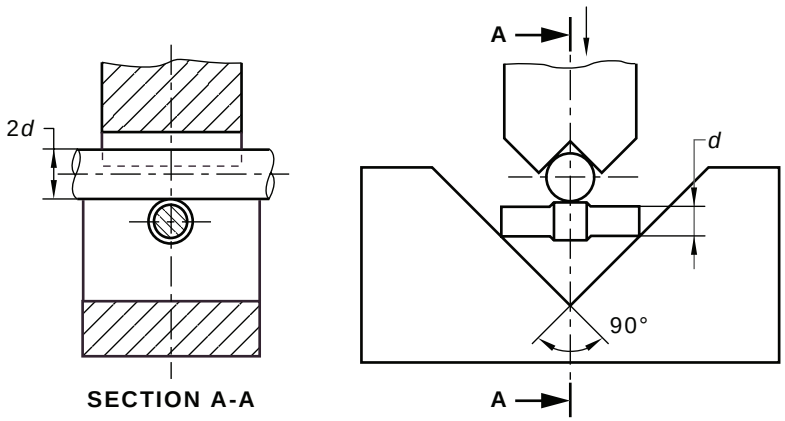


FIGURE 5.5.2(A) BEND TEST EQUIPMENT

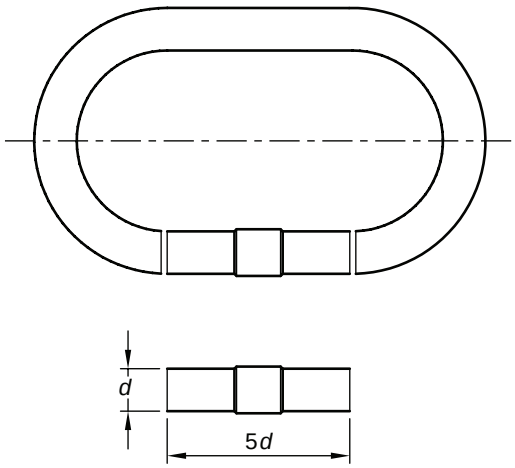


FIGURE 5.5.2(B) TEST PIECES

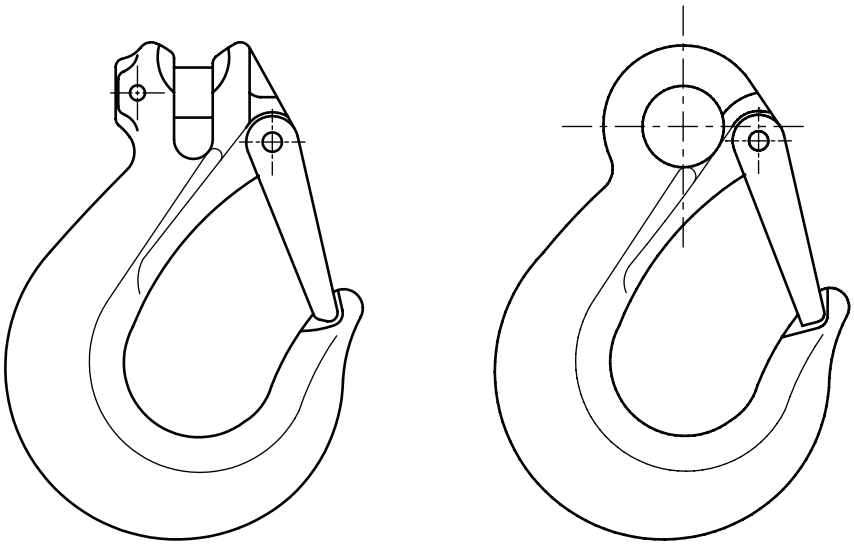
SECTION 6 LIFTING HOOKS WITH LATCH

6.1 GENERAL

This Section sets out requirements for design, manufacture and testing of lifting hooks with a latch to ensure specified levels of performance are met.

NOTE: See Figure 6.1 for illustrations of typical hooks with a latch.

Hazards associated with these components are detailed in Section 11.



(c) Clevis sling hook with latch

(b) Eye sling hook with latch

FIGURE 6.1 TYPICAL LIFTING HOOKS WITH A LATCH

6.2 DESIGN

6.2.1 General

The articulation and relative movement shall be in accordance with Clause 2.1.

The form of the upper end shall be of the eye type or clevis type.

Each hook shall have a spring-loaded latch conforming to Clause 6.2.2 to ensure that the load cannot become accidentally unhooked.

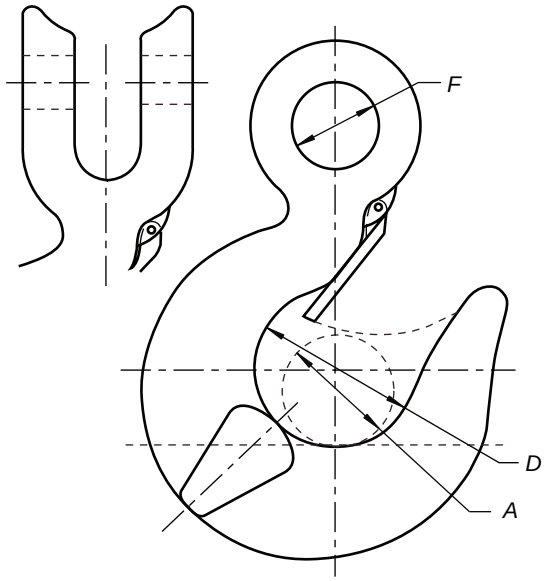


FIGURE 6.2.1 TYPICAL HOOK CONFIGURATIONS

6.2.2 Hook latches

The latch shall engage in the point of the hook to form a complete closure of mating surfaces. With the hook in any orientation, the spring shall ensure that the latch is held positively in a closed position. Latches operated solely by gravity shall not be used.

NOTE: The force required to fully open the latch should not exceed that which can be applied manually.

6.3 MATERIALS AND HEAT TREATMENT

The materials and heat treatment of all load-bearing parts of hooks with latches, including pins, shall be in accordance with Clause 2.2.

6.4 MANUFACTURING METHODS AND WORKMANSHIP

Manufacturing methods and workmanship shall be in accordance with Clause 2.3.

6.5 MECHANICAL PROPERTIES

The mechanical properties of all load-bearing parts of lifting hooks with latches, including pins, shall be in accordance with Clause 2.4.

6.6 TYPE TESTING OF MECHANICAL PROPERTIES

Type tests and acceptance criteria shall be in accordance with Clause 3.1.

SECTION 7 OTHER HOOKS

7.1 SCOPE OF SECTION

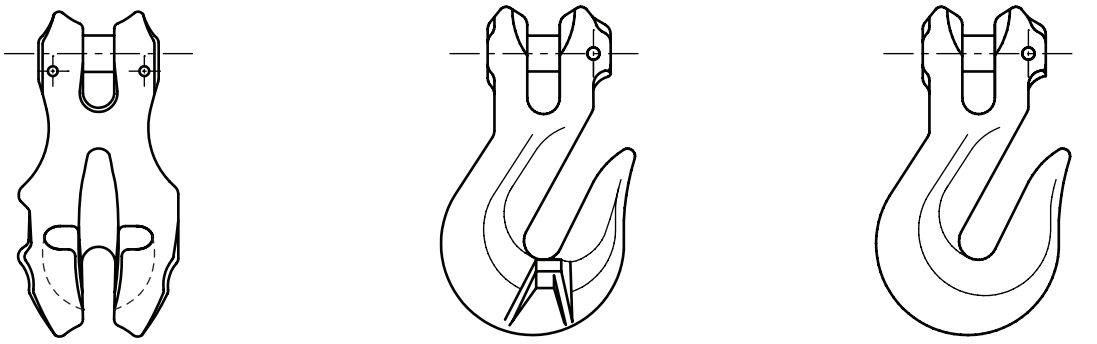
This Section specifies requirements for design, manufacture and testing of others tools to ensure specified levels of performance are met. Hazards associated with these components are detailed in Section 11.

7.2 SPECIFIC TYPES OF HOOKS

7.2.1 Shortening clutches and grab hooks

Shortening clutches and grab hooks are usually used to reduce the length of a chain sling leg. Some shortening devices, such as grab hooks, de-rate the WLL of the sling by 25%. Other devices, such as shortening clutches or cradle grab hooks, may not de-rate the WLL of the sling. Advice regarding the appropriate de-ration should be available from the manufacturer.

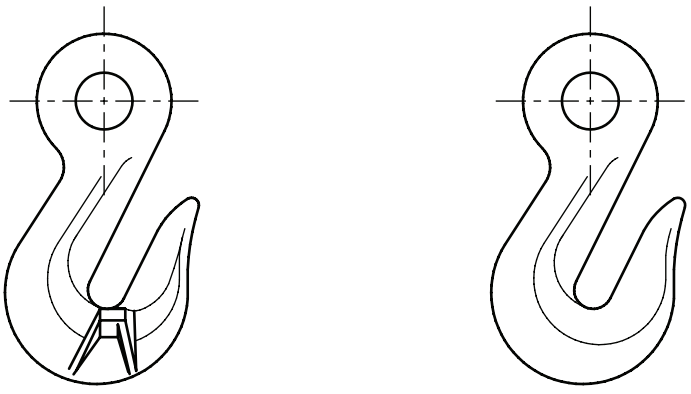
NOTE: See Figure 7.2.1 for illustrations of shortening clutches and grab hooks.



(a) Shortening clutch or hook

(b) Clevis cradle grab hook

(c) Clevis grab hook



(d) Eye cradle grab hook

(e) Eye grab hook

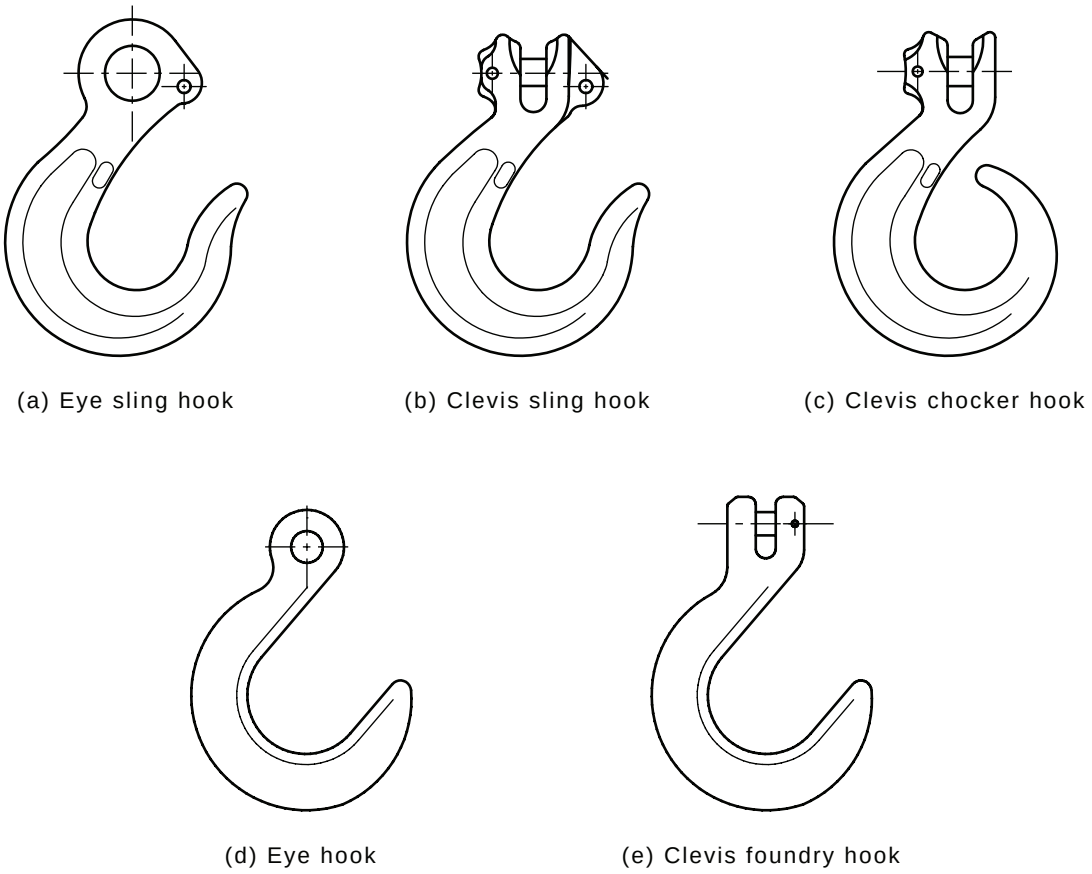
FIGURE 7.2.1 SHORTENING CLUTCHES AND GRAB HOOKS

7.2.2 Hooks without a latch

Hooks without a latch are usually used for specific applications, i.e., non-general use. Where there is a risk of the hooks becoming detached during use, a risk assessment should be conducted in accordance with Section 11.

A variety of hooks used for a range of applications may not have some form of latch. Hooks used on chain slings for logging and foundry applications are within this category.

NOTE: See Figure 7.2.2 for illustrations of hooks without a latch.



(a) Eye sling hook (b) Clevis sling hook (c) Clevis chocker hook

(d) Eye hook (e) Clevis foundry hook

FIGURE 7.2.2 HOOKS WITHOUT A LATCH

7.3 DESIGN

The articulation and relative movement shall be in accordance with Clause 2.1.

7.4 MATERIALS AND HEAT TREATMENT

The materials and heat treatment of all load-bearing parts, including pins, shall be in accordance with Clause 2.2.

7.5 MANUFACTURING METHODS AND WORKMANSHIP

Manufacturing methods and workmanship shall be in accordance with Clause 2.3.

7.6 MECHANICAL PROPERTIES

The mechanical properties of all load-bearing parts, including pins, shall be in accordance with Clause 2.4.

7.7 TYPE TESTING OF MECHANICAL PROPERTIES

Type tests and acceptance criteria shall be in accordance with Clause 3.1.

7.8 ASSEMBLY

Load pins and load-pin retention devices shall be in accordance with the component manufacturer's specification.

NOTE: The effects of wear, corrosion of securing elements or rough usage should be considered.

7.9 INSTRUCTIONS FOR USE

Instructions for use shall be in accordance with Section 10.

SECTION 8 SELF-LOCKING HOOKS

8.1 SCOPE OF SECTION

This Section specifies requirements for design, manufacture and testing of self-locking hooks to ensure specified levels of performance are met.

Hazards associated with these components are detailed in Section 11.

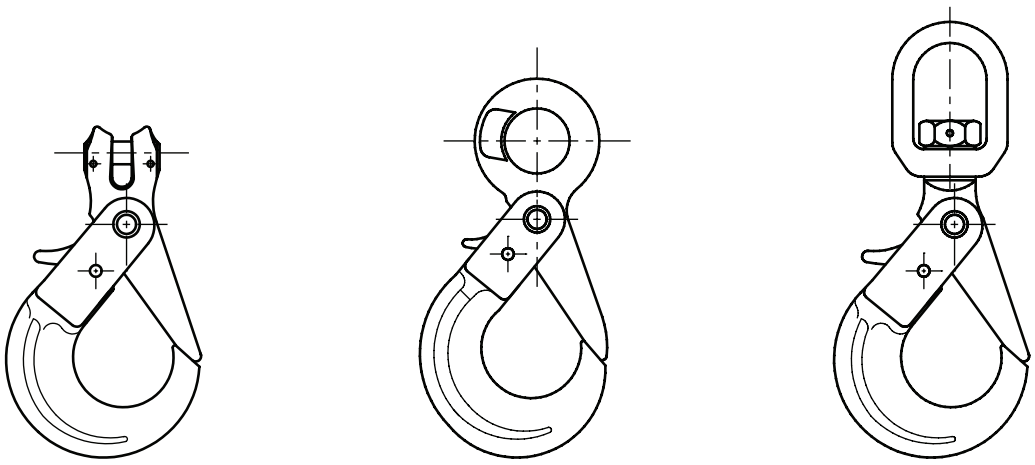
8.2 DESIGN

The articulation and relative movement shall be in accordance with Clause 2.1.

NOTES:

1 See Figure 8.2(A) for illustrations of typical self-locking hooks.

2 See Figure 8.2(B) for typical self-locking configurations.



(a) Clevis self-locking hook (b) Eye self-locking hook (c) Swivel self-locking hook

FIGURE 8.2(A) TYPICAL SELF-LOCKING HOOKS

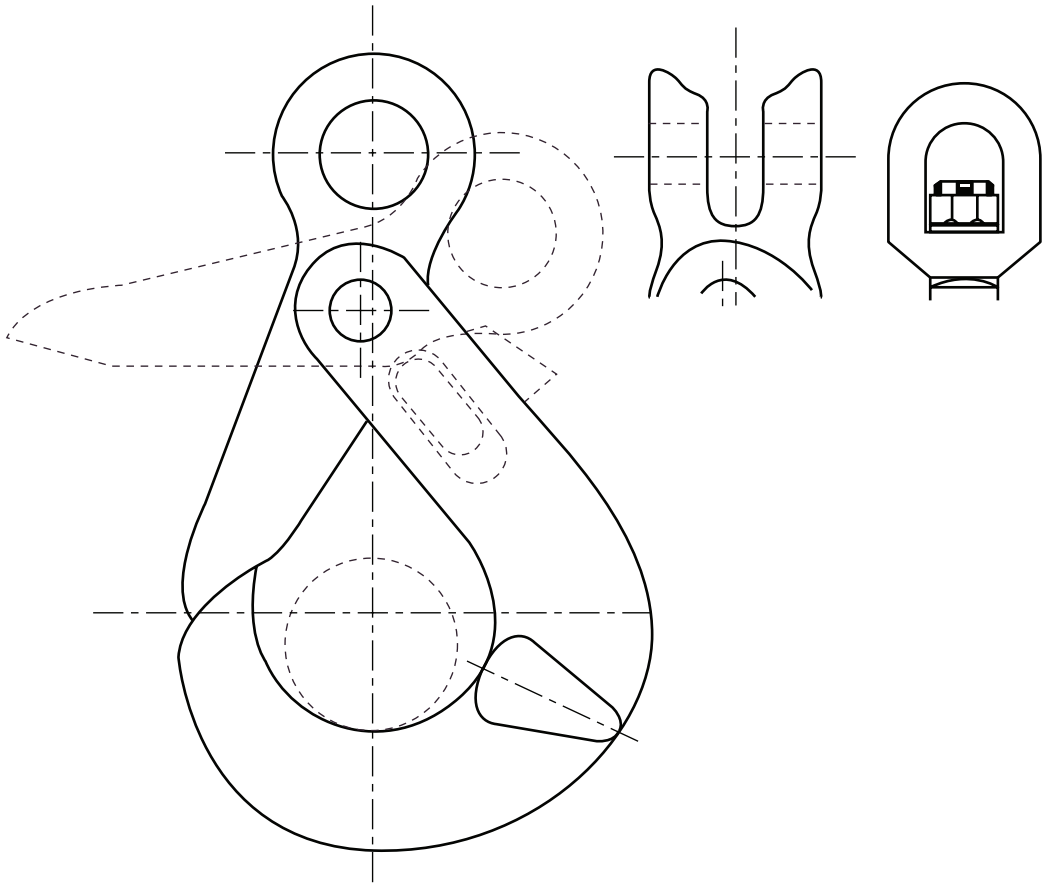


FIGURE 8.2(B) TYPICAL SELF-LOCKING HOOK CONFIGURATIONS

8.3 MATERIALS AND HEAT TREATMENT

The materials and heat treatment of all load-bearing parts of self-locking hooks, including pins, shall be in accordance with Clause 2.2.

8.4 MANUFACTURING METHODS AND WORKMANSHIP

8.4.1 General

Manufacturing methods and workmanship shall be in accordance with Clause 2.3.

8.4.2 Hook tip clearance

For self-locking hooks in the finished condition, clearance between the tip of the hook and the latch in the closed condition shall be not greater than specified in Table 8.4.2.

TABLE 8.4.2

CLEARANCE BETWEEN HOOK TIP AND LATCH

Chain sizes	Maximum clearance, mm
6 to 10	1
11 to 14	1.5
16 to 18	2
19 to 26	3

8.5 MECHANICAL PROPERTIES

The mechanical properties of all load-bearing parts of self-locking hooks, including pins, shall be in accordance with Clause 2.4.

A closed hook in the finished condition shall be able to withstand a bend test in accordance with Clause 8.6.1.2.

NOTE: See Figure 8.6.1.2.1 for an illustration of a bend test device.

The latch shall be able to withstand a force f_1, of 3000 N or equivalent to 20% of the WLL of the hook, whichever is the greater, when applied equidistant between the point of the hook and the center of rotation of the latch, as shown in Figure 8.6.1.3.

When the hook is correctly closed and locked, the latch shall be able to withstand a force f_2, as close as practicable to the tip of the latch (see Figure 8.6.1.3), of 3000 N or equivalent to 10% of the working load limit, whichever is the greater.

The locking mechanism shall be activated by the application of the load and shall be replaceable.

When tested in accordance with Clause 8.6.1.4, the hook shall be able to withstand an impact to the eye or clevis of the latch, without opening. The forces transmitted between the lock and the latch shall not be such that an impact on the latch causes a moment in the direction of rotation that opens the lock.

The surface hardness of the lock shall be greater than that of the latch.

The swivel self-locking hook shall have the swivel component disassembled for a bend test. The completed swivel self-locking hook shall be in accordance with AS 2318.

8.6 TYPE TESTING OF MECHANICAL PROPERTIES

8.6.1 Type tests

8.6.1.1 *General*

Type tests and acceptance criteria for self-locking hooks shall be in accordance with Clause 3.1.

8.6.1.2 *Bend test*

8.6.1.2.1 *General*

A closed hook in the finished condition shall be bend-tested in a 120° V-die by application of a force (*f*), to verify the lateral ductility of the structure and the load-bearing pivot pin. Where the hook is not symmetrical due to the locking mechanism or the method of securing the pivot pin, both sides shall be tested, using different hooks for each test side.

NOTE: See Figure 8.6.1.2.1 for an illustration of a bend test device.

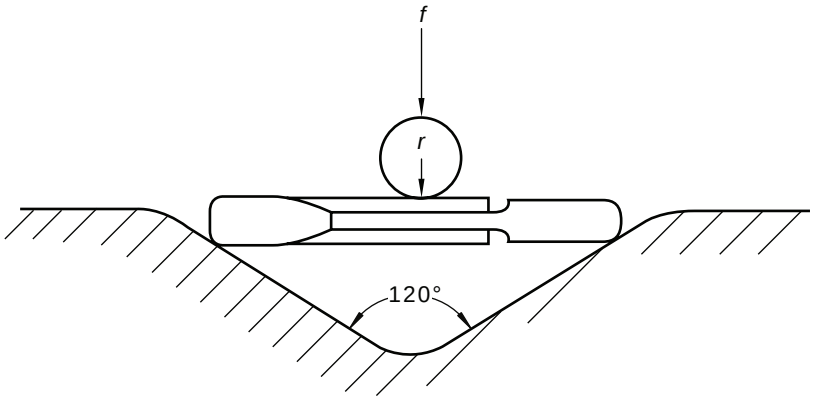


FIGURE 8.6.1.2.1 BEND TEST DEVICE

8.6.1.2.2 *Acceptance criteria for the bend test*

After application and removal of a force (*f*) equivalent to 40% of the working load limit, it shall be possible to freely open the hook by hand.

After application and removal of a force (*f*) equivalent to the working load limit, there shall be no visible sign of cracking or fracture.

8.6.1.3 *Testing the latch*

A type test to verify conformity to Clause 8.5 shall be carried out with the latch fitted or in a test device allowing application of forces f_1 and f_2, as shown in Figure 8.6.1.3.

The latch shall show no signs of permanent deformation.

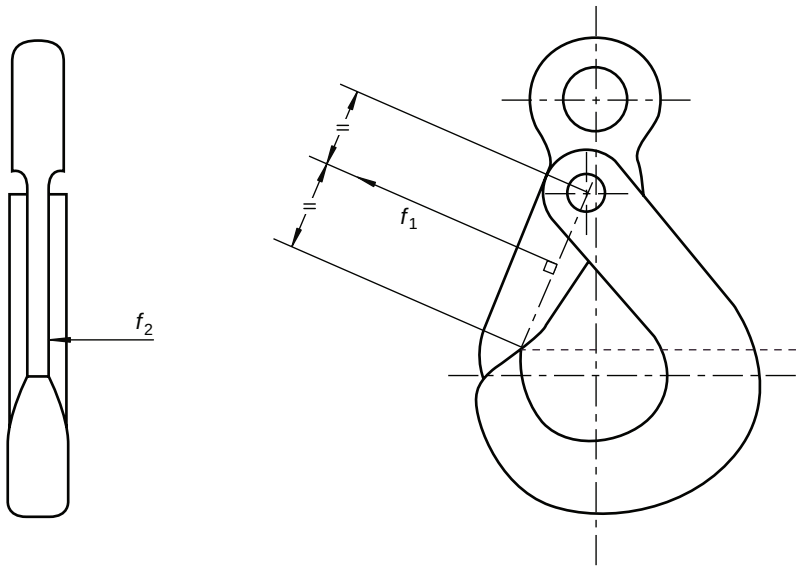


FIGURE 8.6.1.3 POINTS OF APPLICATION OF FORCES TO THE LATCH

8.6.1.4 *Impact testing of lock*

The hook shall be supported so that it is held in a fixed position with the eye or clevis of the latch at the bottom of a pendulum. The eye or clevis shall be impacted by a mass attached to the end of the pendulum such that the impact occurs in the direction of opening of the latch. The test shall be carried out in accordance with either Item (a) or Item (b) as follows:

(a) The pendulum shall be released from an angle of 60° to the vertical and the mass attached to the pendulum shall be greater than or equal to the mass of the hook. The effective pendulum length shall be 1 m.

(b) A suitable combination of test mass, pendulum length and release angle, having an equivalent impact energy greater than or equal to the method in Item (a) shall be used. The corresponding impact velocity shall be at least 1.5 m/s.

Prior to a series of tests on any hook, grease shall be applied to the surface of the lock where it bears onto the latch. Prior to each test, the latch shall be opened and closed manually.

Five tests shall be carried out on each of three hooks of either eye, clevis type or swivel type, at each size in the range. No hook shall open in any test. Tests shall be repeated for any variation in latch or locking device design, or method of manufacture.

SECTION 9 MARKING

Each lifting component shall be legibly and indelibly marked in a place where the marking will not be removed by use and in a manner that will not impair the mechanical properties.

The marking shall include at least the following information.

(a) The manufacturer's identification.

(b) Quality grade: T, 8, 80 or 800.

(c) Nominal size.

(d) The traceability code.

NOTES:

1 Care should be taken to ensure that the marking cannot be mistaken for the working load limit.

2 Item (a) should relate to the manufacturer's literature for the WLL and applications for which the component is suitable.

SECTION 10 INSTRUCTIONS FOR USE

10.1 GENERAL

Instructions for use should accompany the components and should be in accordance with AS 3775.2. Advice should be given on how to assemble and disassemble forged steel components and how to ensure the correct fit of any pin.

Load pins and load-pin retention devices shall be in accordance with the component manufacturer's specification.

The effects of wear, corrosion or rough usage of securing elements should be considered.

AS 3775.2 gives requirements for inspection of defects requiring withdrawal from service.

10.2 CRADLE GRAB HOOKS

The WLL for an adjustable sling shall be as follows:

(a) Where a cradle grab hook that fully supports the chain link and attains a 100% efficiency is used, the WLL shall be not more than the WLL for the chain to which it is attached.

NOTE: Clause 7.1.1 also gives information that should be considered when determining the WLL of cradle grab hooks.

(b) Where the requirements of Item (a) above do not apply, the WLL shall be not more than 0.75 times the WLL for the chain to which it is attached (e.g., choke hitch with cradle grab hook fitted to the lower end of the chain).

10.3 LINKS

Instructions for the use should accompany the links, master links or master link assemblies and should conform to the relevant clauses of AS 3775.2, and include a description of the applications (applications includes WLL and number of legs). Advice should be given on how to assemble and disassemble forged links with integral joining device and how to ensure the correct fit of the pin.

10.4 HOOKS WITH LATCH

Instructions for the use of hooks with latch should accompany the hooks and should conform to the relevant clauses of AS 3775.2. Advice should be given on how to assemble and disassemble forged steel clevis hooks and how to ensure the correct fit of the pin.

10.5 SELF-LOCKING HOOKS

Instructions for the use of self-locking hooks should accompany the hook(s) and should conform to the relevant clauses of AS 3775.2. Advice should be given on how to assemble and disassemble forged steel self-locking clevis hooks and how to ensure the correct fit of the pin.

Instructions should be given on how to—

(a) close the latch manually by the operator; and

(b) use the locking mechanism.

SECTION 11 HAZARDS

11.1 HAZARD IDENTIFICATION

Accidental release of a load, or release of a load due to failure of a component puts at risk, either directly or indirectly, the safety or health of those persons within the danger zone.

In order to provide the necessary strength and durability of components this Standard gives requirements for their design, manufacture and testing to ensure the specified levels of performance are met.

Since failure can be caused by the incorrect choice of grade and specification of component, this Standard also gives requirements for marking and test certificates.

Any risk of injury during handling due to sharp edges, sharp angles or rough surfaces should be identified.

Aspects of safe use associated with good practice are given in AS 3775.2.

11.2 RISK ASSESSMENT

A risk assessment should be undertaken by a competent person before carrying out the operation required to be undertaken by the component or sling assembly. The assessment should 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 component or sling assembly 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.

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

As a result of the risk assessment, the competent person should formulate a safe work method procedure, which should 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/NZS 4360.

APPENDIX A

MECHANICAL PROPERTIES

(Normative)

Table A1 lists the required mechanical properties for lifting components corresponding to the nominal chain sizes.

Table A2 lists working load limits for the nominal chain sizes in various configurations.

TABLE A1

MECHANICAL PROPERTIES

1	2	3	4
Chain size	**Working load limit (WLL)**	**Manufacturing proof force (MPF)**	**Breaking force (BF)**
mm	**t**	**kN (min)**	**kN (min)**
4	0.5	9.8	19.6
5	0.8	15.7	31.4
6	1.1	21.6	43.2
7	1.5	29.4	58.9
8	2.0	39.2	78.5
10	3.2	62.8	126
13	5.3	104	208
16	8.0	157	314
18	10.0	196	392
19	11.2	220	439
20	12.5	245	491
22	15.0	294	589
26	21.2	416	889
32	31.5	618	1236
36	40.0	785	1570
40	50.0	981	1962
45	63.0	1236	2472

TABLE A2
WORKING LOAD LIMITS

1	2	3
Chain size **mm**	**Master link 1 leg WLL** **t**	**Master and intermediate links 2, 3 and 4 legs WLL (see Note 3)** **t**
4	0.5	0.87
5	0.8	1.38
6	1.1	1.9
7	1.5	2.6
8	2.0	3.5
10	3.2	5.5
13	5.3	9.2
16	8.0	13.8
18	10.0	17.3
19	11.2	19.4
20	12.5	21.6
22	15.0	26.0
26	21.2	36.7
32	31.5	54.5
36	40.0	69.2
40	50.0	86.5
45	63.0	109p

NOTES:

1 Includes preferred and non-preferred sizes.

2 These loads have been determined in accordance with the minimum requirements of AS 3775.2—2004, Table A1.

3 WLL for multi-leg slings is rated for sling angles at 60°, i.e., 1 leg WLL × 1.73.

4 The working load limit (WLL) shall be determined in accordance with Appendix C.

APPENDIX B

TESTING

(Normative)

B1 CONDITIONS FOR APPLICATION OF TEST FORCES

The following conditions apply to the application of test forces to lifting components:

(a) The testing machine shall be calibrated in accordance with AS 2193 and shall be capable of Class A results when testing mechanical properties (see Clause 3.1) and Class C results when proof testing (see Clause 3.2.2).

(b) Manufacturing processes, excluding any proof loading and any application of temporary protective coatings for storage purposes, shall be completed.

(c) Upper and lower terminal components or links having parallel sides shall be loaded by pins not exceeding two-thirds of the internal width of the component or link being tested.

(d) Hook-type lifting components shall be loaded by means of a pin having a diameter (D) of not more than two-thirds of dimension E in Figure B1 and able to be moved freely in the hook.

(e) Test forces shall be applied gradually to the lifting component in tension along the intended axis of loading.

(f) To determine the permanent set property of a component (before any loading has been applied) a centre punch mark, A, shall be applied and an arc, B, centered on A shall be scribed, as shown in Figures B1 to B5. The punch mark shall be applied to the opposite side of the weld or flat part of the component or link. The minimum proof test force specified in Appendix A shall then be applied and removed. After removing the force, an arc C of the same radius shall be similarly scribed.

NOTE: For acceptance criteria see Clause 2.4.1.

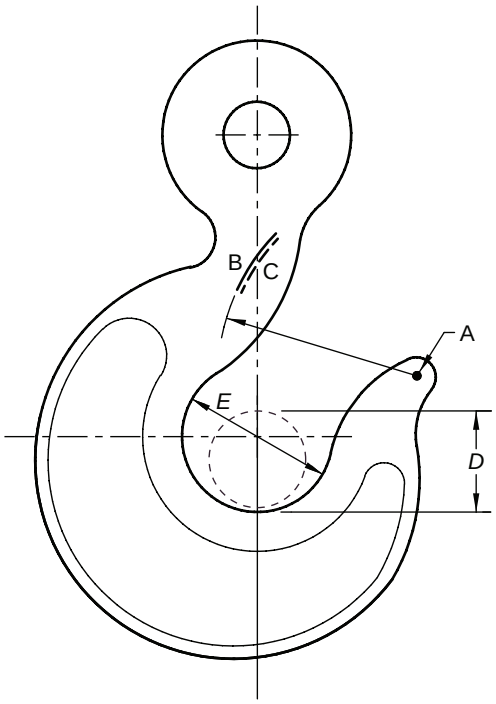


FIGURE B1 TYPICAL MARKS FOR DETERMINATION OF PERMANENT SET—
HOOK WITHOUT LATCH

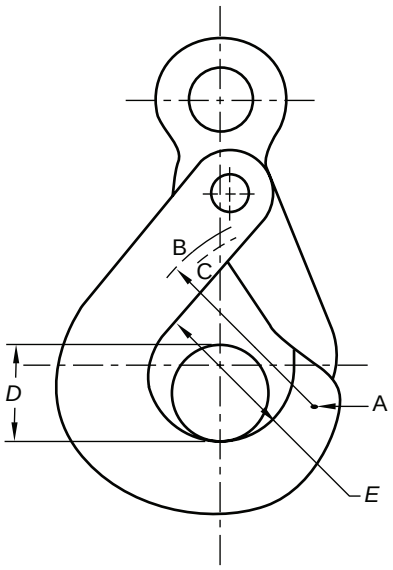


FIGURE B2 TYPICAL MARKS FOR DETERMINATION OF PERMANENT SET—
SELF-LOCKING HOOK

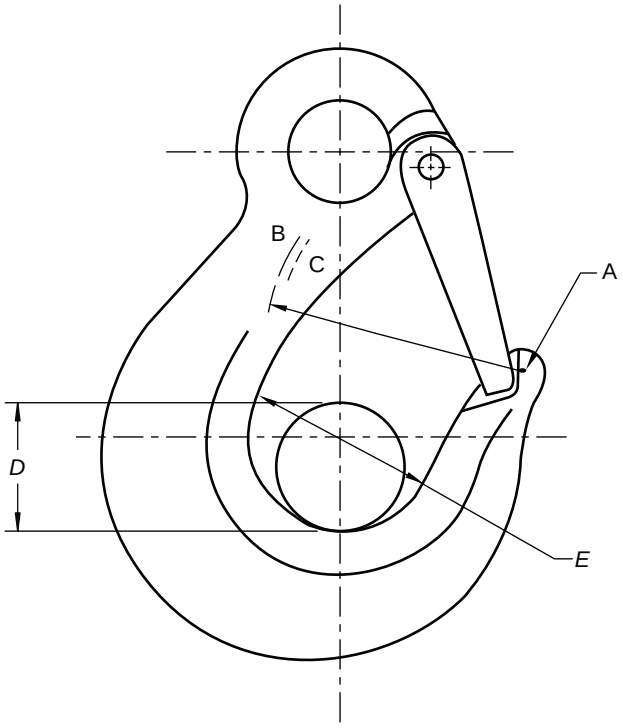


FIGURE B3 TYPICAL MARKS FOR DETERMINATION OF PERMANENT SET—HOOK WITH LATCH

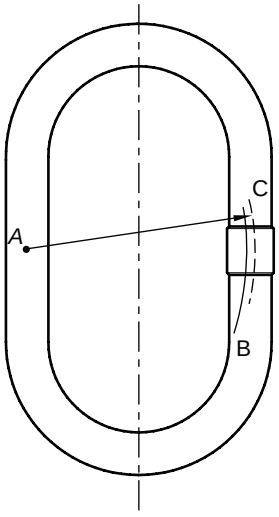


FIGURE B4 TYPICAL MARKS FOR DETERMINATION OF PERMANENT SET—OBLONG LINK

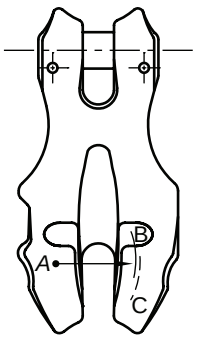


FIGURE B5 TYPICAL MARKS FOR DETERMINATION OF PERMANENT SET—SHORTENING CLUTCH OR HOOK

B2 TEST CERTIFICATE

Testing of components or links shall be recorded on a test certificate, which shall bear the following information:

(a) Type of lifting component.

(b) Quality grade: T, 8, 80 or 800.

(c) Nominal size.

(d) Surface finish where other than self colour or painted.

(e) Working load limit.

(f) Proof force.

(g) Date of proof test.

(h) Number tested.

(i) Identification marking correlating with the lifting components.

(j) A declaration that the components or links comply with this Standard.

(k) The name and address of the manufacturer or supplier.

(l) The name and address of the testing establishment.

(m) The name and signature of the signatory.

(n) Type of certificate (e.g., NATA, certifying authority, supplier).

NOTE: The manufacturer or supplier should retain a copy of the test certificate for not less than 10 years.

APPENDIX C

DETERMINATION OF WORKING LOAD LIMIT (WLL)

(Normative)

The WLL for each application of lifting components shall be derived as follows:

(a) *Maximum load* The maximum load that may be supported by a lifting component under general conditions of use.

(b) *General conditions of use* General conditions of use are equivalent to a group classification of crane mechanisms of M3 as specified in AS 1418.1.

(c) *Non-general-use* Under other than general conditions of use (e.g., severe conditions, hazardous conditions, conditions directly involving the safety of personnel), the WLL shall be de-rated to conform to the group classification of crane mechanisms as specified in AS 1418.1 for the conditions of use that apply.

(d) *Multiple attachments* For applications involving more than two attachments to a lifting component (which would apply non-linear forces), the WLL should be determined in consultation with the manufacturer.

NOTE: Under specified or unusual conditions of use (e.g., a high temperature environment, handling dangerous substances), the regulatory body may require the use of a de-rating that is greater than the relevant de-rating specified in AS 1418.1.

The term ‘normative’ has been used in this Standard to define the application of the appendix to which it applies. A ‘normative’ appendix is an integral part of a Standard.

APPENDIX D

STANDARDS FOR COMPONENTS USED IN LIFTING SYSTEMS

(Informative)

The following is a list of Standards for components that are used in lifting systems:

AS	
1138	Thimbles for wire rope
1353	Flat synthetic-webbing slings
1353.1	Part 1: Product specification
1353.2	Part 2: Care and use
1380	Fibre-rope slings (of natural or synthetic rope)
1380.1	Part 1: Product specification
1380.2	Part 2: Care and use
1438	Wire-coil flat slings
1438.1	Part 1: Product specification
1438.2	Part 2: Care and use
1666	Wire-rope slings
1666.1	Part 1: Product specification
1666.2	Part 2: Care and use
2076	Wire rope grips
2089	Sheave blocks (including ships' cargo blocks) of maximum lift 60 t
2317	Collared eyebolts
2318	Swivels for hoists
2319	Rigging screws and turnbuckles
2321	Short-link chain for lifting purposes (non-calibrated)
2740	Wedge-type sockets
2741	Shackles
2759	Steel wire rope—Application guide
2841	Galvanized steel wire strand
3569	Steel wire ropes
3585	End fittings for flat-webbing slings
3775	Chain slings—Grade T
3775.1	Part 1: Product specification
3775.2	Part 2: Care and use
3776	Lifting components for Grade T chain slings
3777	Shank hooks and large-eye hooks—Maximum 25 t
4142	Fibre ropes
4142.1	Part 1: Care and safe usage
4142.2	Part 2: Three-strand hawser-laid and eight-strand plaited
4497	Roundslings—Synthetic fibre
4497.1	Part 1: Product specification
4497.2	Part 2: Care and use