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Underground mining — Winding suspension equipment



AS 3637:2022

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Underground mining — Winding suspension equipment

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Preface

This Standard was prepared by the Standards Australia Committee ME-018, Mining Equipment, to supersede the following:

- (a) AS 3637.1—2005, *Underground mining—Winding suspension equipment, Part 1: General requirements.*
- (b) AS 3637.2—2005, *Underground mining—Winding suspension equipment, Part 2: Detaching hooks.*
- (c) AS 3637.3—1997, *Underground mining—Winding suspension equipment, Part 3: Rope cappings.*
- (d) AS 3637.4—2002, *Underground mining—Winding suspension equipment, Part 4: Drawbars and connecting links.*
- (e) AS 3637.5—2005, *Underground mining—Winding suspension equipment, Part 5: Rope swivels and swivel hooks.*
- (f) AS 3637.6—2005, *Underground mining—Winding suspension equipment, Part 6: Shackles and chains.*

The objective of this document is to specify requirements for the design, manufacture, and testing of suspension equipment used in vertical mine shafts. This includes attachments for head ropes, balance ropes, guide ropes and rubbing ropes. It excludes conveyances, counterweights and ropes.

In the preparation of [Appendices A, D, E, F, G](#) and [H](#), reference was made to the 1983 British Coal document *Design Guide for Cage Suspension Gear*.

The major changes in this edition are as follows:

- (i) Amalgamation of six parts into one Standard.
- (ii) Inclusion of rope attachments for guide ropes and rubbing ropes.
- (iii) Addition of rope glands.
- (iv) New formulae for design of chain link, rope glands, rope clamps and bands for wedge-type capels.

The terms “normative” and “informative” are used in Standards to define the application of the appendices 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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Australian Standard®

Underground mining — Winding suspension equipment

1 Scope

This document specifies requirements for the design, manufacture, and testing of suspension equipment used in vertical mine shafts. This includes attachments for head ropes, balance ropes, guide ropes and rubbing ropes. It excludes conveyances, counterweights and ropes.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document.

NOTE Documents referenced for informative purposes are listed in the Bibliography.

AS 1065, *Non-destructive testing—Ultrasonic testing of carbon and low alloy steel forgings*

AS 1252.1, *High-strength steel fastener assemblies for structural engineering—Bolts, nuts and washers, Part 1: Technical requirements*

AS 1275, *Metric screw threads for fasteners*

AS 1391, *Metallic materials — Tensile testing — Method of test at room temperature*

AS 1442, *Carbon steels and carbon-manganese steels—Hot-rolled bars and semi-finished products*

AS 1544.2, *Method for impact tests on metals, Part 2: Charpy V-notch*

AS 1710, *Non-destructive testing—Ultrasonic testing of carbon and low alloy steel plate and universal sections—Test methods and quality classification*

AS 1733, *Methods for the determination of grain size in metals*

AS 2074, *Cast steels*

AS 2193, *Calibration and classification of force-measuring systems*

AS/NZS 1050.1, *Methods for the analysis of iron and steel, Part 1: Sampling iron and steel for chemical analysis*

AS/NZS 1567, *Copper and copper alloys—Wrought rods, bars and sections*

AS/NZS 3678, *Structural steel—Hot-rolled plates, floorplates and slabs*

AS/NZS 3679.1, *Structural steel, Part 1: Hot-rolled bars and sections*

ISO 4287, *Geometric Product Specifications (GPS) — Surface texture: Profile method — Terms, definitions and surface texture parameters*

ISO 9934-1, *Non-destructive testing — Magnetic particle testing — Part 1: General principles*

BS 643, *Specification for white metal ingots for capping steel wire ropes*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1 **balance rope**

wire ropes connecting the undersides of a pair of conveyances

Note 1 to entry: A balance rope may be made up of one or more wire ropes.

3.2 **catchplate**

apparatus in a headframe that operates a detaching hook in the event of an overwind and from which the detached conveyance is suspended

3.3 **conveyance**

vehicle in which persons, minerals or materials are wound through a shaft and any counterweight

Note 1 to entry: Examples of conveyances include a car, carriage, cage, skip, kibble or stage.

3.4 **competent person**

person who has acquired, through education, training, qualification or experience or a combination of these, the knowledge and skill enabling that person to perform the task required

3.5 **detaching hook**

device located between the end of a winding rope and a conveyance so that in the event of an overwind, an ascending drum wound conveyance is detached from the rope and held in the headframe

3.6 **fatigue reserve factor**

ratio of the allowable stress range for infinite life to the actual stress range, at the highest stressed location in the suspension component, for the loading cycle specified in [Table 1](#)

3.7 **rope capping**

capel or similar appliance fitted to the end of a wire rope for the purpose of attaching a conveyance to the rope

3.8 **rope socket**

capping consisting of a socket fastened to a rope by filling the body of the socket with white metal or resin (see [Figure 5](#))

3.9 **fluted wire rope socket**

capping consisting of a socket fastened to a rope by a precast fluted white metal plug and tail (see [Figure 4](#))

3.10 **shall**

indicates that a statement is mandatory

3.11 **should**

indicates a recommendation

3.12 **static design factor**

ratio of the ultimate load of the suspension equipment to the working load limit

3.13**test piece**

test specimen made by some mechanical operation and prepared for testing

3.14**test sample**

portion of material or product, or a group of items, selected from a batch or group by a sampling procedure

3.15**test specimen**

portion or a single item taken from the test sample for the purpose of applying a particular test

Note 1 to entry: For cast material, the test specimen is cast from the same melt of steel as the casting it represents and may be —

- (a) separately cast; or
- (b) cast integral with the casting.

3.16**thimble and rope clamps**

capping consisting of a thimble that is inserted in an eye formed at one end of a rope and fastened in position by means of wire rope clamps (see [Figure 6](#))

3.17**thimble-type capel**

capping that incorporates a wedge-shaped thimble between side plates and has provision for rope adjustment in situ (see [Figure 7](#))

3.18**Type A components**

critical load bearing components

Note 1 to entry: All Type A components are identified in [Section 5](#).

3.19**Type B components**

load bearing components that are not defined as Type A components

Note 1 to entry: Type B components are identified in [Section 5](#).

3.20**ultimate load**

minimum load that will produce a complete functional collapse of the component assembly when applied to a suspension component assembly

3.21**working load limit****WLL**

maximum static load permitted to be carried by the suspension equipment

3.22**wedge-type capel**

capping that incorporates a pair of interlocking wedges (see [Figure 8](#))

4 General requirements

4.1 Nominal size

The size designation for suspension equipment shall be the working load limit in tonnes.

4.2 Materials

4.2.1 Type A components

All Type A components shall be manufactured from steel conforming to the requirements of [Appendix C](#) and made by —

- (a) open hearth;
- (b) basic oxygen; or,
- (c) an electric process.

NOTE Additional refining by vacuum-arc-remelt (VAR), electroslag refining (ESR), or vacuum degassing is permitted.

4.2.2 Type B components

All Type B components shall be manufactured from steel conforming to either of the following:

- (a) AS/NZS 3678, Grade 350.
- (b) AS 1442, Grade S3.
- (c) AS 2074, Grade C3.
- (d) [Appendix C](#) (of this document).

4.3 Design

4.3.1 Design philosophy

There are, primarily, two ways in which suspension equipment can fail, including failure due to static overload or failure from cyclic loading (fatigue failure).

An acceptable design is achieved by utilizing the static design factor and the fatigue reserve factor for the corresponding relevant type of suspension equipment being designed.

Different types of suspension equipment may be subject to different potential overload scenarios, as well as different cyclic loading during normal operation. Therefore, unique static design factors and fatigue categories are to be applied, as specified in [Table 2](#).

4.3.2 Static design factor

The static design factor shall be not less than the value stated in [Table 2](#) for the relevant type of suspension equipment. The static design factor is the ultimate load divided by the working load limit.

4.3.3 Fatigue reserve factor

The fatigue reserve factor shall be not less than 1.3 when the relevant load cycle is applied. The load cycle corresponding to each fatigue category is specified in [Table 1](#). The applicable fatigue category for the relevant type of suspension equipment is specified in [Table 2](#).

Table 1 — Fatigue categories

Fatigue category	Load cycle	
1	$(0 \text{ to } 1.5) \times \text{WLL}$	The load alternates sinusoidally between 0 and 1.5 times the working load limit.
2	$(0.85 \text{ to } 1.15) \times \text{WLL}$	The load alternates sinusoidally between 0.85 times and 1.15 times the working load limit.

Table 2 — Static design factors and fatigue categories

Type of suspension equipment	Static design	Fatigue design
	Minimum permissible static design factor	Fatigue category
Headrope: All suspension equipment used for the single rope and multi rope suspension of conveyances in vertical shafts.	10	1
Balance rope: All suspension equipment used to suspend balance ropes beneath conveyances in vertical shafts.	10	1
Guide rope: All suspension equipment used to suspend the guide rope at the top of the shaft as well as suspension equipment used to tension the guidrope at the bottom of the shaft.	5	2
Rubbing rope: All suspension equipment used at the top and bottom of the rubbing rope.	5	2
Shackles and chains (without safety chains): All shackles and chains used for headropes or balance ropes where safety chains are not used.	12	1
Shackles and chains (with safety chains): All shackles and chains used for headropes and balance ropes where redundancy is provided by the means of safety chains.	10	1
Threaded components: All threaded components used in any type of suspension equipment.	15	1
Hanger rods: Hanger rods used to suspend cheese weights used to tension guide ropes.	10	2

NOTE 1 Design guidelines for holes and pins are given in [Appendix D](#).

NOTE 2 Design guidelines for the hook region of detaching hooks are given in [Appendix E](#).

NOTE 3 Design guidelines for chase blocks are given in [Appendix F](#).

NOTE 4 Design guidelines for threaded components are given in [Appendix G](#).

NOTE 5 Design guidelines for shackles are given in [Appendix H](#).

NOTE 6 Design guidelines for chain links are given in [Appendix I](#).

NOTE 7 Design guidelines for bands for wedge-type capels are given in [Appendix J](#).

NOTE 8 Design guidelines for rope glands including rope clamps are given in [Appendix K](#).

4.4 Manufacture

4.4.1 Type A and Type B components

All Type A and Type B components shall conform to the following:

- (a) Machining shall be carried out to ensure —
 - (i) smooth operation of the components and assembly;
 - (ii) the removal of stress-raisers and decarburization from highly stressed regions; and
 - (iii) smooth surface for any subsequent non-destructive examination.
- (b) Where machining is required, surfaces shall be fully machined and finished to $R_a = 1.6 \mu\text{m}$ for mating surfaces and $R_a = 3.2 \mu\text{m}$ for outside surfaces, measured in accordance with ISO 4287. Surfaces shall be free from harmful nicks, burrs, deep machining, and grinding marks.
- (c) Surfaces not requiring machining shall have surface finish of $R_a = 3.2 \mu\text{m}$ or better.

NOTE Machining should be done, where possible, in the direction of the service tensile stress.

4.4.2 Type A components — Additional requirements

All Type A components shall conform to the following requirements:

- (a) Plates shall be laid out so that the direction of service tensile stress is within 5° of the direction of rolling for the material.
- (b) For the profiling of plates by a burning or fusion process, the surface shall be machined or ground to remove all nicks and burrs. Profiling shall be carried out prior to heat treatment.
- (c) Components shall not be welded.
- (d) The components shall be heat treated in accordance with [Clause C.5.2](#).
- (e) Castings shall not be used for Type A components.
- (f) Where bushes are used in holes in a component the requirements in [Clause A.5\(c\)](#) shall be followed.

Additionally, the following recommendations apply for all Type A components:

- (i) Through-holes in matching components should be machined with the components clamped together to ensure true alignment.
- (ii) Hole and pin connections of assemblies should be machined to the following tolerance classes in accordance with ISO 286-2:
 - (A) Hole — A10.
 - (B) Pin — b11.

NOTE The hole and pin wear limits specified in [Table 10](#) are only applicable to hole and pin connections of fit A10/b11. Where fits other than A10/b11 are used, the wear limits are specified by the designer.

- (iii) Tongue and clevis connections of assemblies should be machined to give the clearances given in [Table 3](#).

Table 3 — Clevis/tongue clearance

Clevis width, mm	Clevis-to-tongue clearance, mm
≤ 50	1.5 to 2.0
> 50 ≤ 100	2.0 to 2.5
> 100	3.0 to 3.5

4.4.3 Threads and nut locking

Screw threads shall conform to AS 1275.

The portion of the shank adjacent to the shoulder shall have an undercut and fillet. Nuts that have to be removed to enable examination or repair shall be secured by means that prevent loosening, but which permit their ready removal.

4.4.4 Locking plates

If locking plates are used, their orientation should be such that any fixing bolts are located in low stress areas of the components.

4.4.5 Protective coatings

4.4.5.1 Type A components

Type A components may be covered by paint or other inorganic coating. Such coatings shall not restrict normal movement of components.

Application of coatings that may affect the heat treatment of the components, such as hot-dipped galvanizing, shall not be used.

4.4.5.2 Type B components

Type B components may be coated as desired.

4.4.5.3 Shear pin

Shear pins shall have no protective coating.

4.5 Testing

4.5.1 Proof load test

4.5.1.1 Procedure

Each assembly, which may consist of only one Type A component, shall be held between connectors of the correct size and a tensile force applied. The tensile force shall be 2.0 times the working load limit for suspension equipment for guide ropes and rubbing ropes. The tensile force shall be equivalent to 2.5 times the working load limit for all other types of suspension equipment.

4.5.1.2 Requirement

Components shall not have any deformation that may adversely affect the function or mechanical properties of the component or assembly.

4.5.2 Non-destructive test

4.5.2.1 Purpose

The non-destructive testing shall be carried out to ensure that each Type A component is free from defects that may affect the mechanical properties of the component.

4.5.2.2 Procedure

Components shall be examined for surface discontinuities by magnetic particle inspection in accordance with ISO 9934-1. The acceptance level shall be as defined in the relevant part of [Section 5](#).

4.6 Test certificates

4.6.1 Certificates required

The following certificates shall be provided:

- (a) A component certificate relating to each Type A component.
- (b) An assembly test certificate where applicable.

Each certificate shall include the name and address of the manufacturer and of the testing establishment, as well as the name, qualification, and status of the signatory, and the date of test. A copy of each certificate shall be retained by the manufacturer and the supplier.

4.6.2 Component certificates

The component certificate shall state the following:

- (a) Serial number of component.
- (b) Description of component.
- (c) Conformance of material grade, heat treatment, and mechanical properties with this document.
- (d) Details of any gauge marks provided for checking permanent deformation.
- (e) Details of magnetic particle inspection, as relevant.

The certificate shall declare that the component has been inspected by a competent person and conforms to the requirements of the non-destructive test.

4.6.3 Assembly test certificate

The assembly test certificate shall state the following information:

- (a) Type of equipment.
- (b) Working load limit, in tonnes.
- (c) Serial number of each component.
- (d) The proof load, in tonnes.
- (e) The total mass of the assembly, in kilograms.

The certificate shall confirm that the assembly has been inspected, has passed the proof load test and any other test required by the relevant equipment Standard. The certificate shall also confirm that the assembly has a static design factor and a fatigue reserve factor conforming to this document.

4.7 Marking

Each component shall be permanently and legibly marked with the serial number of the assembly. One prominent component of each assembly shall be marked with the following additional information:

- (a) Manufacturer's identification.
- (b) The working load limit, in tonnes.
- (c) Date of proof test.

Marking of a Type A component shall be in a low stress area. Care should be taken to ensure that the marks are neither too sharp nor too deep [see [Clause 4.4.1\(b\)](#)]. The marking shall be as large as practicable, but not less than 5 mm high.

4.8 Inspection and maintenance

Inspection and maintenance of winding suspension equipment for vertical shafts shall be carried out in accordance with [Appendix A](#).

5 Component-specific requirements

5.1 Detaching hooks

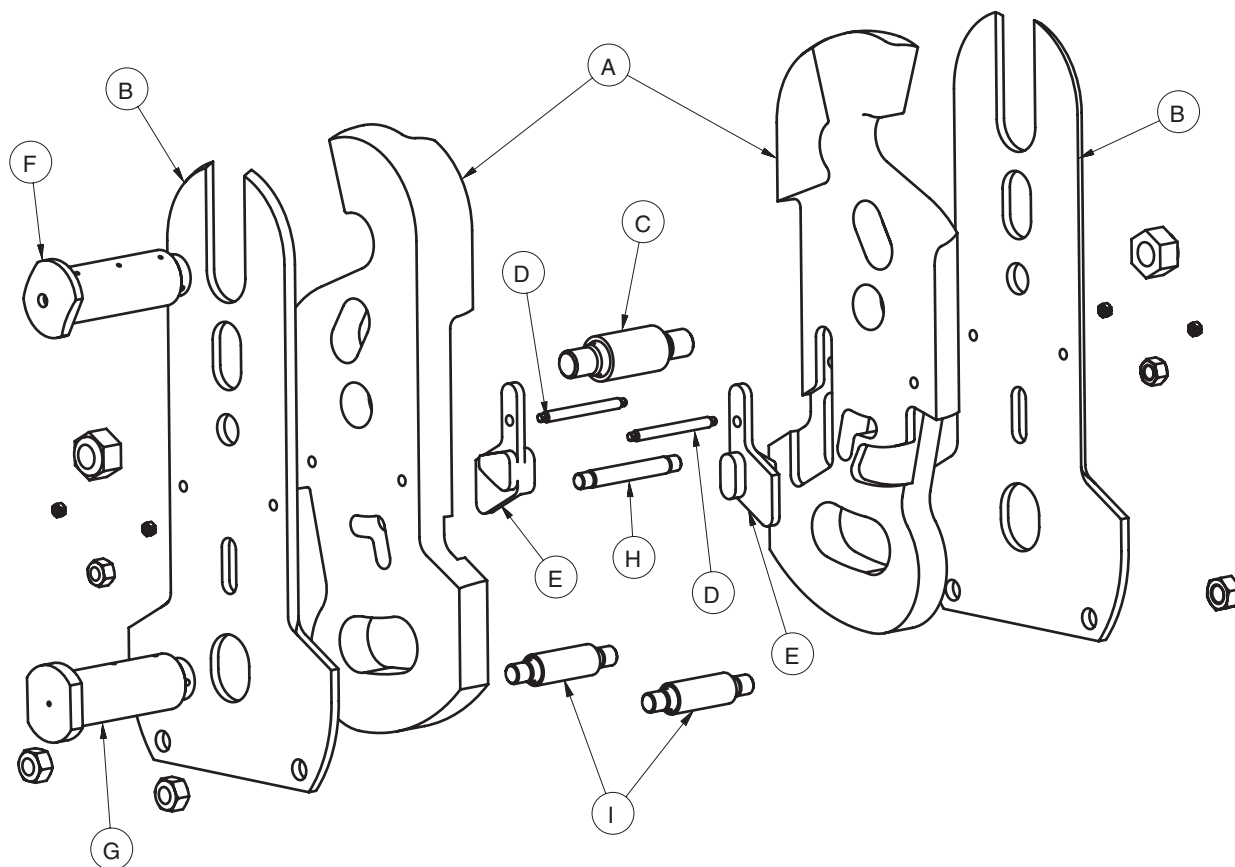
5.1.1 Size designation

The size designation for detaching hooks should be the working load limit in tonnes.

5.1.2 Materials

5.1.2.1 Component type designation

The components of detaching hooks shall be designated Type A or Type B in accordance with [Table 4](#). A typical example of a detaching hook is shown in [Figure 1](#).

**Key**

Item	Component
A	Hook plate
B	Outer plate
C	Hinge pin
D	Shear pin
E	Mancane latch
F	Upper connecting pin
G	Lower connecting pin
H	Drop pin
I	Spacer pin

Figure 1 — Typical example of a detaching hook**5.1.2.2 Shear pins**

Shear pins shall be manufactured from copper with mechanical properties conforming to AS/NZS 1567 Grade 102 temper designation O or equivalent.

Table 4 — Detaching hook and catchplate component types

Component	Component type designation ^a
Hook plates	A
Outer plates	A
Upper connecting pin	A
Lower connecting pin	A
Hinge pin and nut	A
Spacer pin	B
Drop pin	B
Mancane latch	B
Resetting pin	B
Catchplate	B
^a Components not included (except shear pins) are designated Type B.	

5.1.3 Design

5.1.3.1 Static factor of safety

The static design factor of detaching hooks shall be in accordance with [Clause 4.3.2](#).

5.1.3.2 Fatigue reserve factor

The fatigue reserve factor of detaching hooks shall be in accordance with [Clause 4.3.3](#).

5.1.3.3 Shear pins

The detaching hook shall incorporate at least one shear pin to prevent its detaching except when drawn into the catchplate.

5.1.3.4 Locking

The detaching hook shall remain open after detaching.

5.1.3.5 Integrity against unintended release

Activation of only one of the two striking horns should not cause the hook to detach from the head rope. This may be achieved by the use of mancane latches, as shown in [Figure 3](#), which use an arrangement of tongues and slots that stop the inner plates of the detaching hook from opening unless both latches are in the down position.

5.1.3.6 Geometry

The detaching hook shall self-energize to the closed position so that there is no load placed on the shear pin when suspended. This may be achieved by having the bend of the hook extend past the centreline.

5.1.4 Manufacture

5.1.4.1 General

The manufacture of detaching hooks shall conform to [Clause 4.4](#).

5.1.4.2 Gauge marks

Hook plates shall be provided with a method of gauging permanent deformation caused by attachment loads. This may consist of gauge marks located at the positions shown in [Figure 2](#). The distance between gauge marks on each load-carrying hook plate shall be permanently and legibly marked.

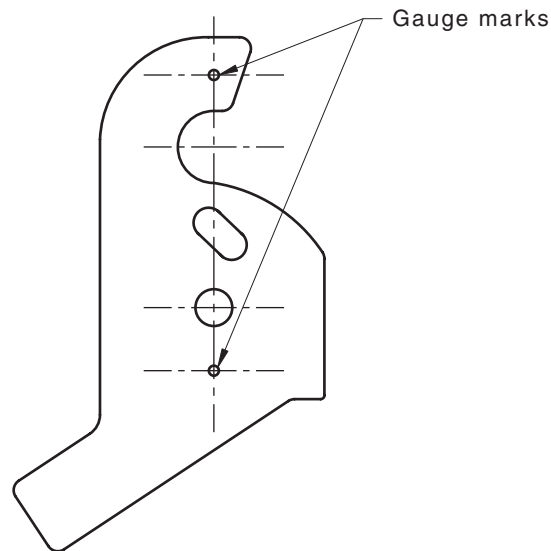


Figure 2 — Suggested location of gauge marks

5.1.4.3 Catchplates

Catchplates that are manufactured as welded fabrications shall be stress-relieved at 550°C to 600°C.

5.1.4.4 Hinge pin and shear pin

The clearance of the shearpin within its holes shall be larger than the clearance of the hinge pin within its holes. This can be achieved by the machining tolerances and ensures that translational movement of any of the hook plates and outer plates relative to one another do not place load on the shear pin.

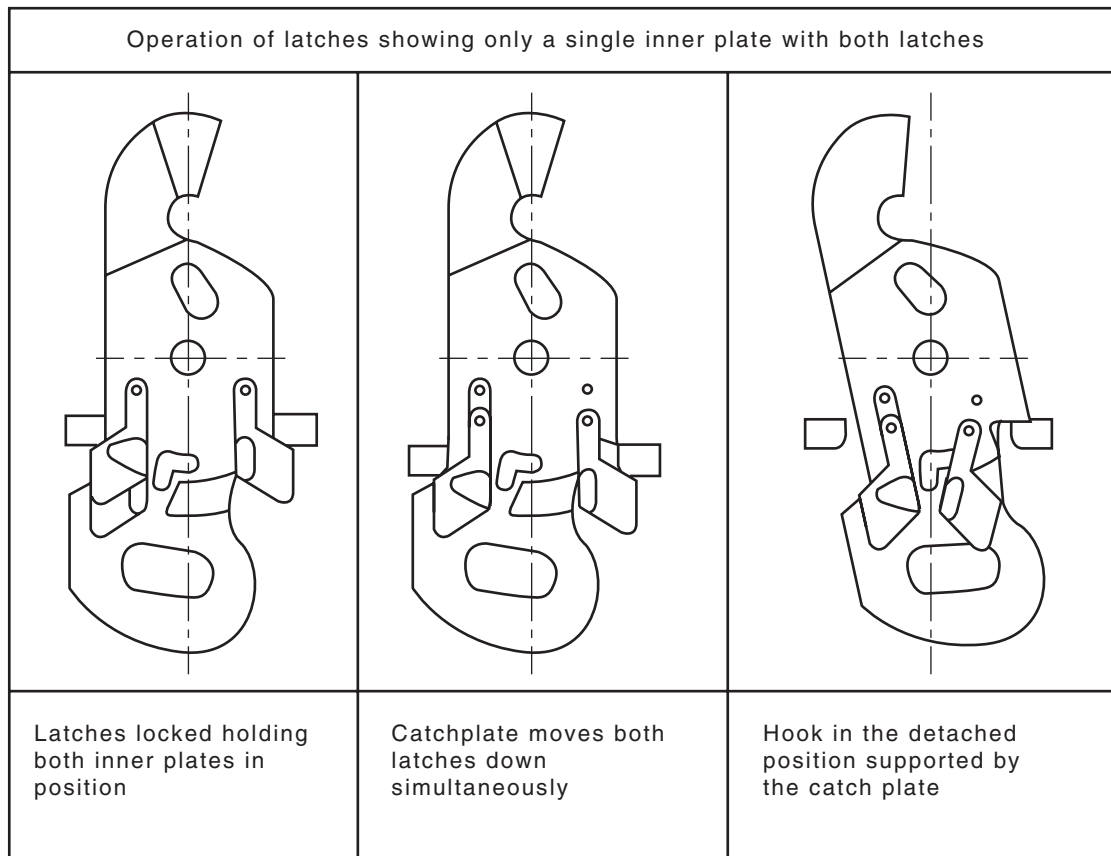


Figure 3 — Dual shear pin detaching hook with manecane latches

5.1.5 Permissible imperfections

Imperfections are permissible when in accordance with [Appendix L](#).

5.1.6 Testing

5.1.6.1 General

After manufacture, each detaching hook shall be subjected to the proof load test specified in [Clause 4.5.1](#). The detaching hook and the catchplate shall then be subjected to the detaching test. Subsequently, each Type A component shall be subjected to a non-destructive test as specified in [Clause 4.5.2](#).

5.1.6.2 Detaching test

5.1.6.2.1 Purpose

The detaching test is intended to determine whether each detaching hook will function correctly when pulled into a matching catchplate.

5.1.6.2.2 Procedure

The detaching hook shall be attached to its corresponding connector, of the correct size, at each end. The detaching hook shall then be pulled vertically into the catchplate for the purpose of causing the hook to operate.

Care should be taken to avoid damage to the detaching hook and the catchplate during this test.

5.1.6.2.3 Requirements

The detaching hook shall detach from the upper connector pin and become securely engaged in the catchplate. Each component, with the exception of the shear pin if it is fitted, shall have no deformation or defect that may adversely affect the function or mechanical properties of the detaching hook and the catchplate.

5.1.7 Test certificates

5.1.7.1 General

Test certificates shall be in accordance with [Clause 4.6](#).

5.1.7.2 Assembly test certificate

The assembly test certificate shall, in addition to the requirements of [Clause 4.6](#), include the following information:

- (a) Assembly type identification.
- (b) Statement that the detaching hook and the catchplate conform to the detaching test.

5.1.8 Marking

5.1.8.1 General

Detaching hooks shall be marked in accordance with [Clause 4.7](#).

5.1.8.2 Type identification

All detaching hooks and catchplates manufactured to the same drawings shall be marked with the same type identification.

5.1.9 Accompanying information

Manufacturer's instructions shall be provided, with details to enable proper alignment of the detaching hook and catchplate assembly. This information shall include concentricity and tolerances to be maintained at installation and checked during maintenance inspections.

5.2 Rope cappings

5.2.1 Designation

5.2.1.1 Size

The size designation for rope cappings shall be the safe working load in tonnes.

5.2.1.2 Component type

Components of rope cappings that are listed in [Table 5](#) shall be designated Type A. Except for filling and bolts, components of rope cappings that are not listed in [Table 5](#) shall be designated Type B. [Figures 4 to 9](#) illustrate the various types of rope cappings and their components.

Table 5 — Type A components of rope cappings

Rope capping	Component
Fluted wire rope socket (see Figure 4)	Main body Pin
Rope socket (see Figure 5)	Body Pin
Thimble and rope clamps (see Figure 6)	Thimble body Rope clamp body
Thimble-type capel (see Figure 7)	Cone wedge Side plates Jaws Pin
Wedge-type capel (see Figure 8)	Capel limb Bands

5.2.2 Materials

5.2.2.1 Types A and B components

For materials for Types A and B components, see [Clause 4.2](#).

5.2.2.2 Filling

Filling shall either be white metal conforming to BS 643 or resin. Refer to statutory requirements that may apply.

5.2.2.3 Bolts

Bolts shall conform to Class 8.8 as specified in AS 1252.1, or of a higher strength.

5.2.3 Design

5.2.3.1 Static factor of safety

For static factor of safety see [Clause 4.3.2](#).

5.2.3.2 Fatigue reserve factor

For fatigue reserve factor see [Clause 4.3.3](#)

5.2.3.3 Design of wedge-type capels

The following factors shall be taken into account in the design of wedge-type capels:

- (a) *Rope/capel interface* — The following rope factors shall be taken into account so that the capel is suitable for the selected rope:
 - (i) Size.
 - (ii) Construction.
 - (iii) Construction tolerance.
 - (iv) Likely change in condition.

- (v) Internal lubrication method.
- (vi) Surface finish.
- (vii) Performance under tensile loading.

- (b) *Friction coefficient* — The principle of operation for a wedge-type capel relies on friction. The ultimate capacity of a wedge-type capel is sensitive to the assumed coefficient of friction between wedges and limbs and between rope and wedges. The friction coefficient between wedge and limbs shall be lower than the friction coefficient between rope and wedges for correct capel function. This is typically achieved by the application of lubrication to the wedge/limbs interface. The coefficient values can change radically due to the type, amount, composition and durability of the selected lubricant. A design value of 0.08 should be used for wedge-to-limb interfaces when calculating the force applied to the bands.

NOTE An assumption in the design is that the band-to-limb friction coefficient is always higher than that of wedge-to-limb friction coefficient. Measures need to be taken in the design to ensure this is the case.

On the above mentioned interfaces, maximum operating temperatures, materials used and surface finish also contribute to the friction coefficient.

- (c) *Clamp force transfer* — The method of distribution and magnitude of the clamp force generated by the load carrying bands on the limbs has a bearing on the capel capacity. Limb taper, band fit, band sizing and material, and band installation method determine this force. The load carrying band dimensions and the number of these bands determine the force distribution.

The static factor of safety for load carrying bands shall be not less than 10, which is based on the ratio of the yield strength of the band material to the safe working load.

- (d) *Safety block* — A function of a safety block is to provide assistance by forcing the wedges into the body if rope slip occurs. As a secondary function, the safety block may be used as a visual indicator of any rope or wedge movement.

If wedge or limb movement occurs, the safety block shall not foul the limbs or the bands. This can be achieved by ensuring that the safety block dimensions are correct.

Where installed in accordance with the manufacturer's instructions, the safety block for head ropes should withstand a test load of 2.5 times the working load limit in its own right.

- (e) *Wedges* — The wedge halves shall not bottom out.

5.2.4 Manufacture

The manufacture of rope cappings shall conform to [Clause 4.4](#).

NOTE Guidance on procedures for fitting rope sockets is provided by suppliers of rope cappings and resin materials.

5.2.5 Testing

5.2.5.1 Proof load test

After manufacture, each rope capping shall be subjected to a proof load test as follows:

- (a) For capels of all types except wedge-type, the testing shall be in accordance with [Clause 4.5.1](#).
- (b) For wedge-type capels, the testing shall be in accordance with [Clause 5.2.5.2](#).

5.2.5.2 Proof loading of wedge-type capels

5.2.5.2.1 General

Every wedge-type capel shall be tested using a wire rope.

The proof load test shall be repeated for every change in rope construction or rope manufacture.

5.2.5.2.2 Apparatus

The tensile testing machine shall have an accuracy of Grade A as specified in AS 2193.

5.2.5.2.3 Procedure

The procedure shall be as follows:

- (a) Assemble the capel to the rope following the procedure specified in [Appendix M](#).
- (b) Hold the non-capel end of the rope in grips or with a rope socket in a manner that will minimize rope to anchor movement.
- (c) Fit the capel eye with the matching Type A specified pin. The pin shall be supported in a manner equivalent to how it is supported in service.
- (d) Apply to the capel assembly a test load of 2.5 times the working load limit of the capel.

5.2.5.2.4 Requirements

The assembly shall have failed the proof load test if any of the following occur:

- (a) Any movement of the safety block relative to a wedge end.
- (b) Any of the wedges move relative to the limb by more than 10 mm.
- (c) Any movement of the bands relative to the limbs.
- (d) Wedge halves are touching.
- (e) Any permanent distortion of the capel components, when disassembled.
- (f) The safety block fouls the inside of the limb or bands.

5.2.5.3 Non-destructive examination

Subsequent to the proof load test, each Type A component, as well as wedges of wedge-type capels, shall be subjected to magnetic particle examination as specified in [Clause 4.5.2](#). Each Type A component and wedges of wedge-type capels, shall also conform to [Appendix L](#).

5.2.6 Inspection and maintenance

5.2.6.1 General

Cappings shall be subjected to two levels of examination —

- (a) *in situ*, as set out in [Clause 5.2.6.2](#); and
- (b) detailed examination, as set out in [Clause 5.2.6.3](#).

The frequencies should be determined in accordance with the winder duty and application.

NOTE 1 The above mentioned examinations should be carried out during other planned shaft maintenance activities (e.g. rope cuts, rope changes and similar).

NOTE 2 See recommendations for inspection and maintenance in [Clause 4.8](#).

NOTE 3 A guide to examination frequencies is given in [Table 6](#).

Table 6 — Guide to examination frequencies

Type of examination	Examination frequency		
	Single-rope hoist	Multi-rope hoist	Balance rope
<i>In situ</i> examination	Weekly	Weekly	Weekly
Detailed examination	Once every 6 months	Once every 2 years	Once every 2 years

5.2.6.2 *In situ* examination

5.2.6.2.1 Wedge-type capels

The capel shall be inspected *in situ* for movement in the following areas:

- (a) The distance between the bottom of the wedges and the safety block.
- (b) The distance between the top of the wedges and the top of the capel limbs.
- (c) The gap between the wedge halves.
- (d) The position of each band relative to the limbs.

Where any movement is detected after initial bedding-in, a detailed examination shall be carried out in accordance with [Clause 5.2.6.3](#).

Every dimensional check shall be recorded.

5.2.6.2.2 Other types of cappings

The capping shall be inspected *in situ* for any movement or change in condition from installation.

Where any movement or change in condition is detected after initial bedding-in, a detailed examination shall be carried out in accordance with [Clause 5.2.6.3](#).

5.2.6.3 Detailed examination

The capping shall be removed from service, dismantled and cleaned to remove grease and associated impurities as set out in the manufacturer's instructions. The following shall then be performed:

- (a) *Dimensional checks* — Dimensional checks, including surface finish, shall be performed to determine whether components are within the tolerances specified by the manufacturer. Components found to be outside of the manufacturer's tolerance shall not be returned to service in such a condition. Every dimensional check shall be recorded.

NOTE Loss of area on the mating surfaces of the components due to pitting corrosion should not be excessive.

- (b) *Non-destructive examination* — Type A components shall be non-destructively examined in accordance with [Clause 5.2.5.3](#).

After completion of a detailed examination and reassembly, a trial run with the capping subjected to normal load shall be carried out, followed by an *in situ* examination in accordance with [Clause 5.2.6.2](#).

5.2.7 Assembly test certificates for wedge-type capels

In addition to the requirements of [Clause 5.2.7](#), the assembly test certificate for wedge-type capels shall state the following information:

- (a) The type of lubricant used between the wedges and the capel limb.
- (b) The rope size and rope construction used for the test.

For general test certificate requirements, see [Clause 4.6](#).

5.2.8 Marking wedge-type capels

In addition to the requirements of [Clause 5.2.8](#), the capel wedges of wedge-type capels shall be marked with the rope size and construction.

For general marking requirements, see [Clause 4.7](#).

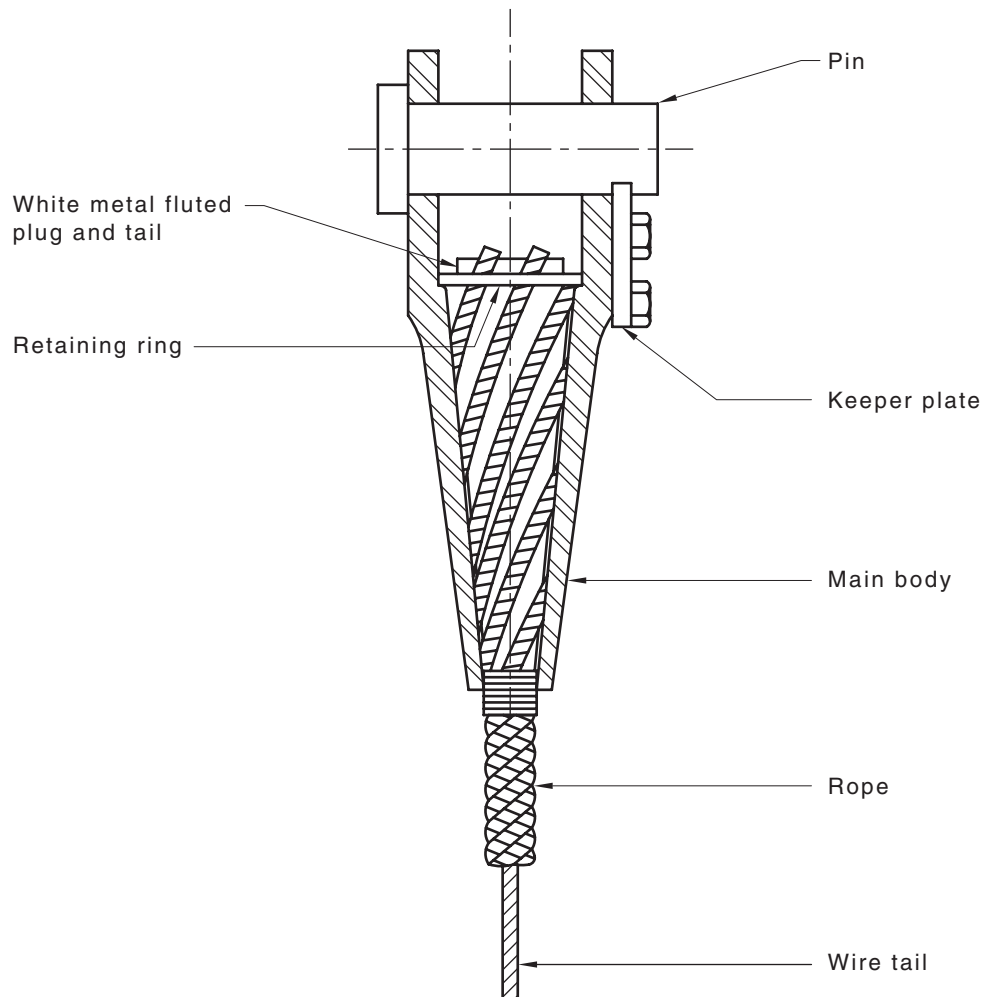


Figure 4 — Fluted wire-rope socket

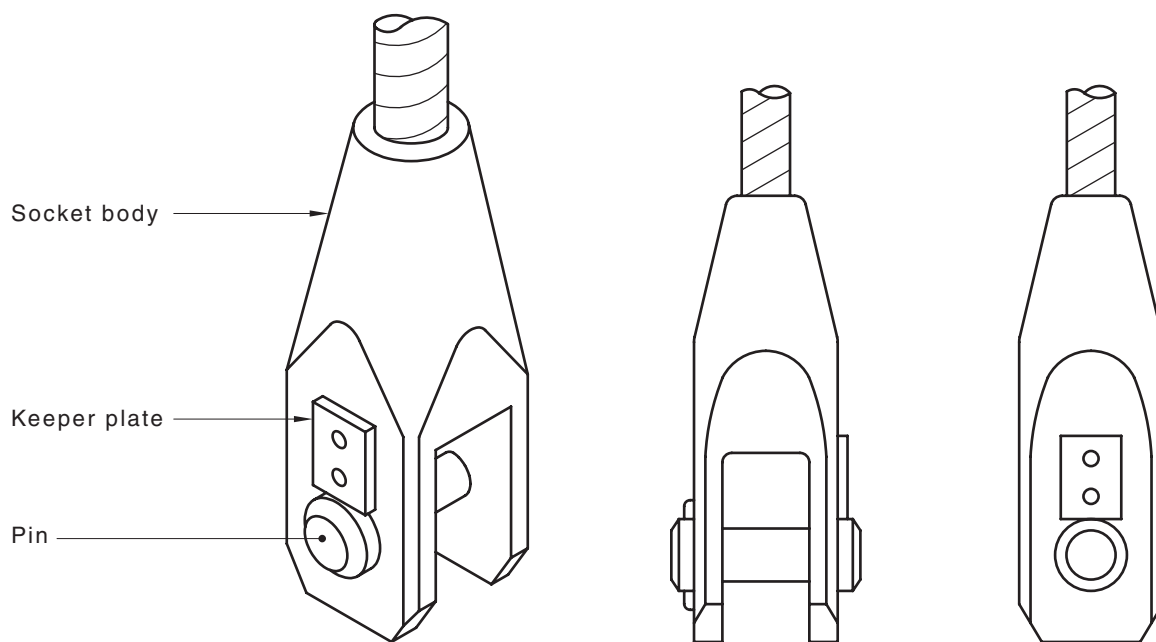


Figure 5 — Rope socket

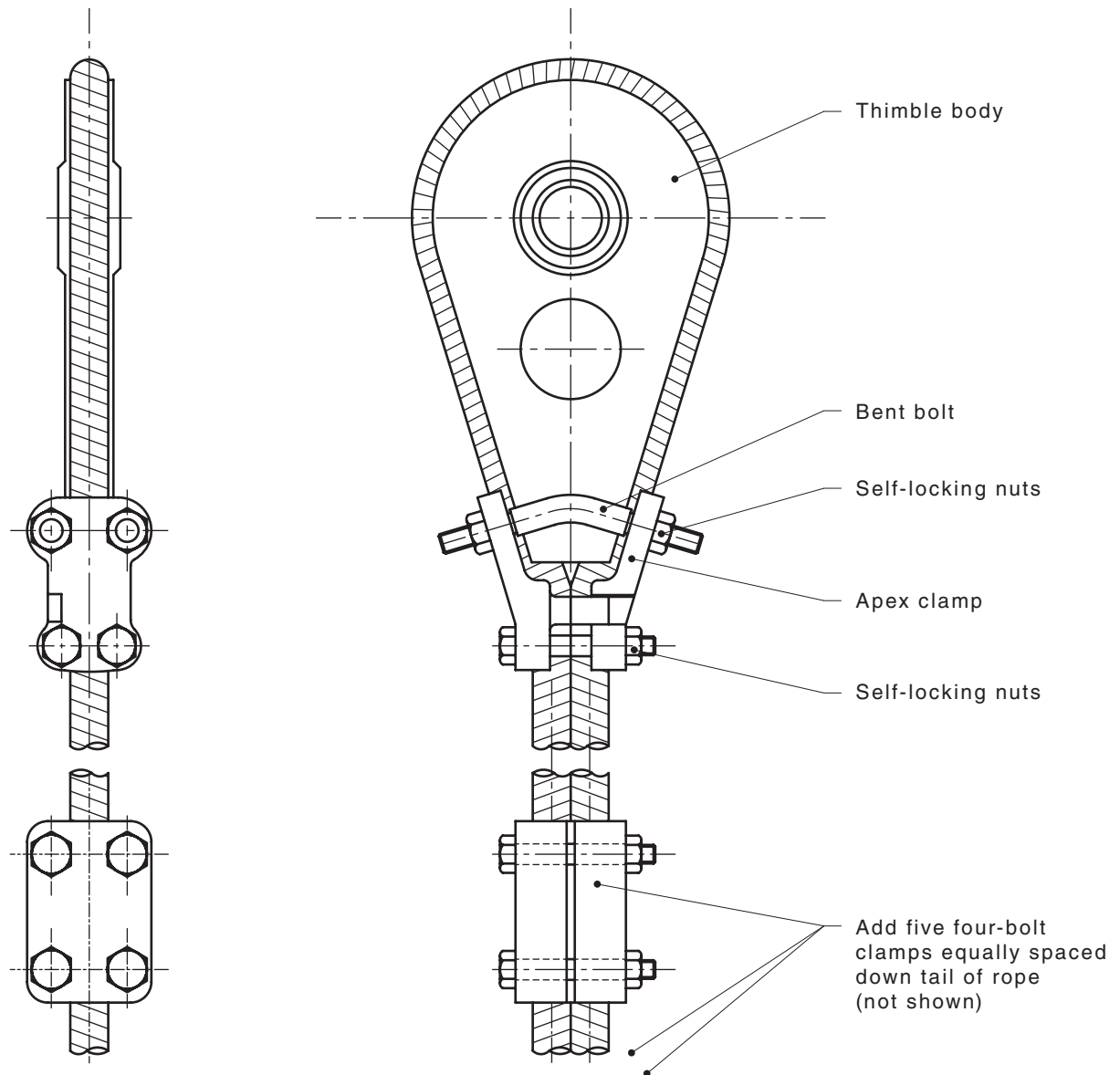


Figure 6 — Thimble and rope clamps

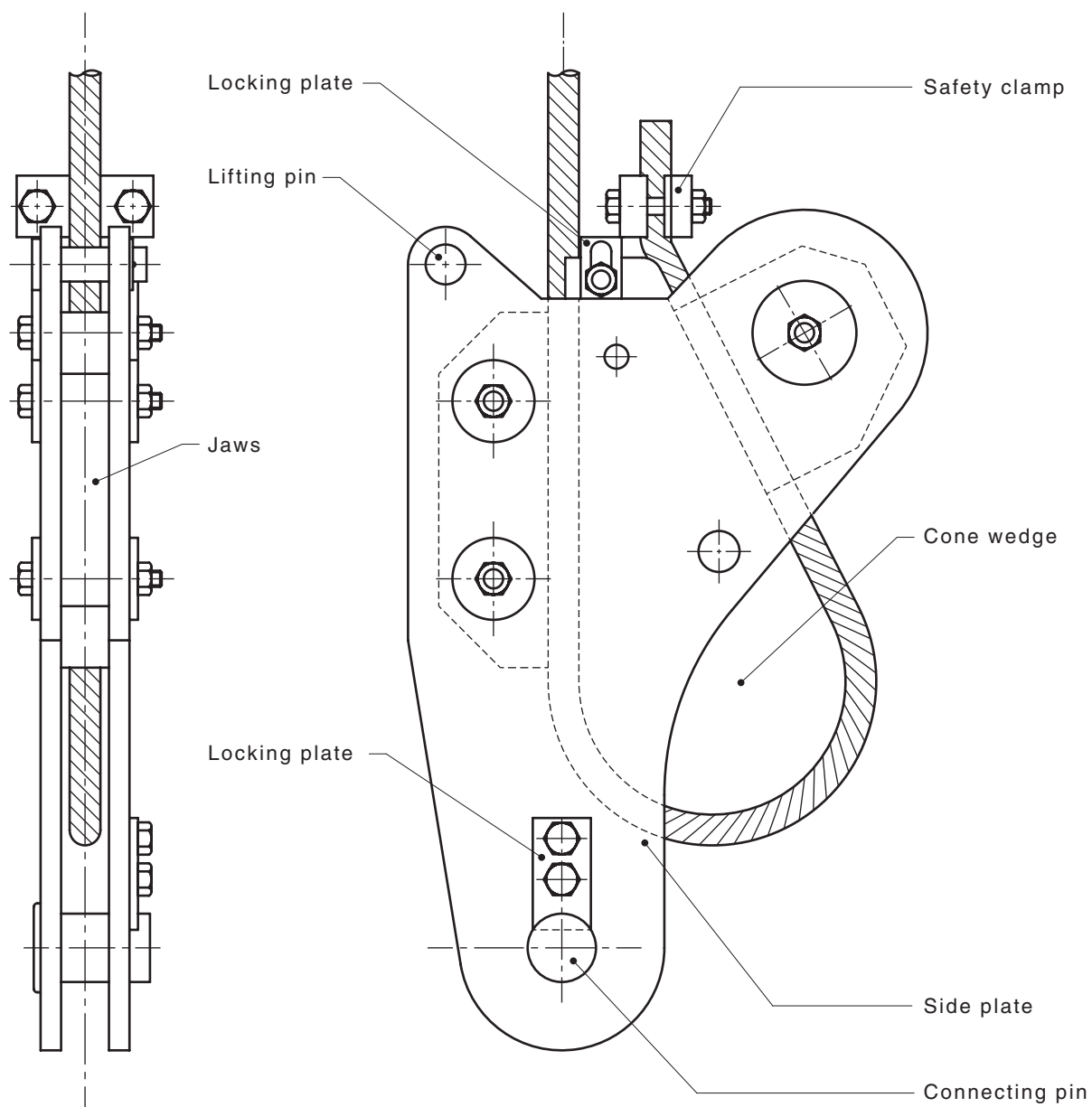
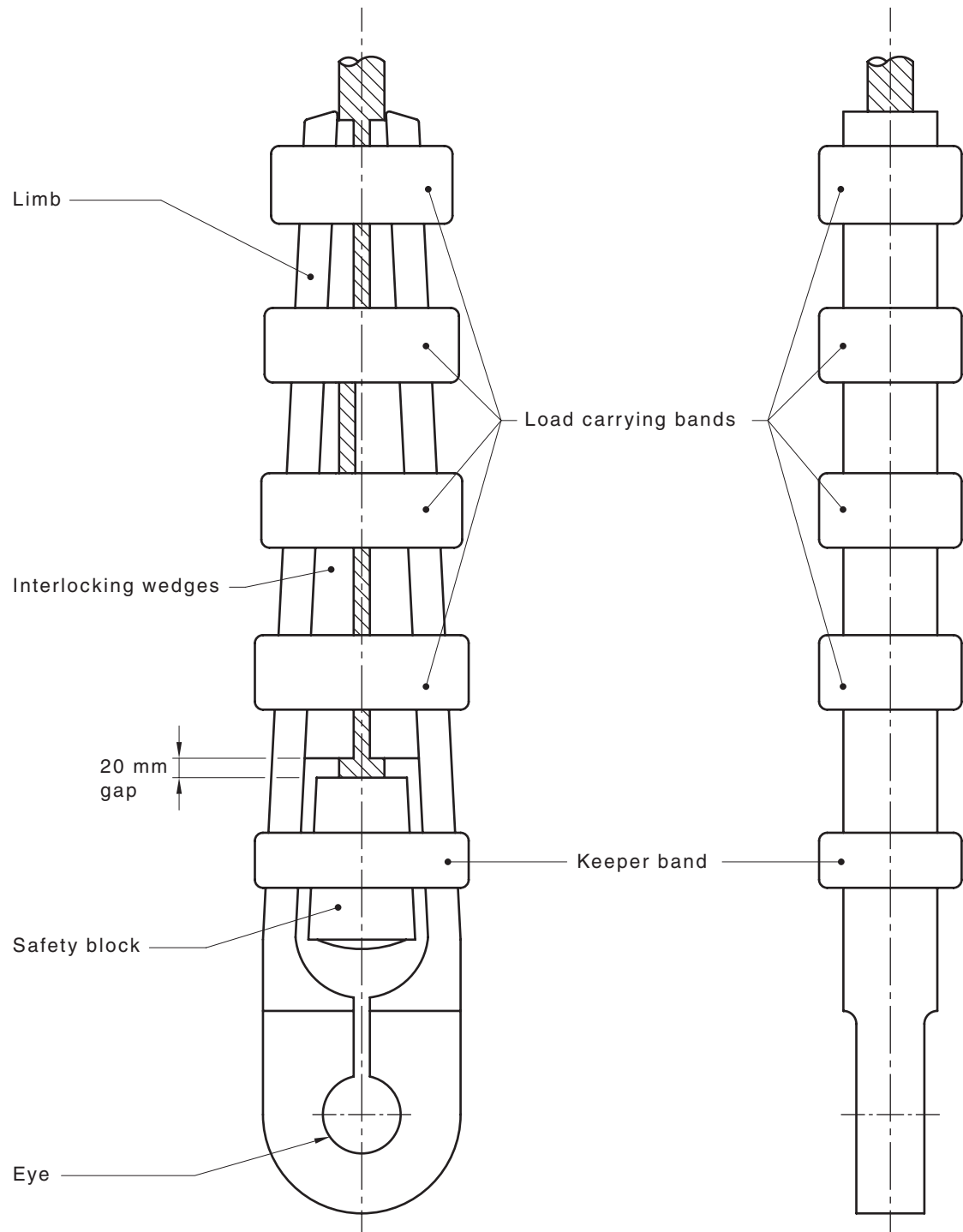
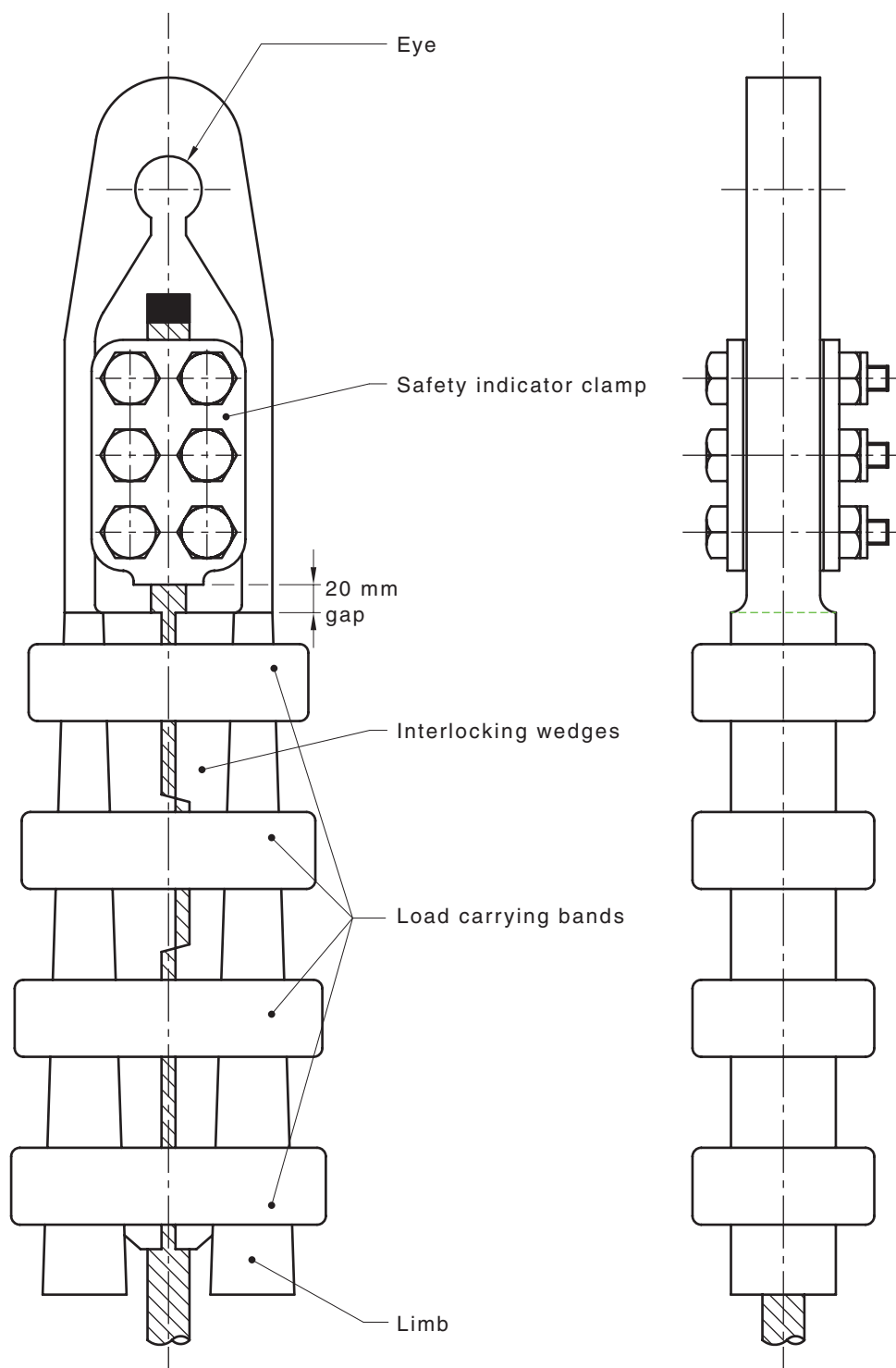


Figure 7 — Thimble-type capel



(a) Winding rope

Figure 8 — Wedge-type capels



(b) Balance rope

Figure 9 — Wedge-type capels

5.3 Drawbars and connecting links

5.3.1 Designation

5.3.1.1 Size

The designated size of drawbars and connecting links should be the working load limit in tonnes.

5.3.1.2 Component type

The following components of drawbars and connecting links shall be designated Type A:

- (a) Chase blocks.
- (b) Connecting links
- (c) Pins.
- (d) Drawbar pins.
- (e) Drawbars.

Other components of drawbars and connecting links shall be designated Type B. [Figures 10](#) to [15](#) illustrate the various types of drawbars and connecting links and their components.

5.3.2 Materials

The materials of Types A and B components shall conform to the relevant requirements of [Clause 4.2](#).

5.3.3 Design and manufacture

The design and manufacture of drawbars and connecting links shall conform to the relevant requirements of [Section 4](#).

5.3.4 Testing

After manufacture, each drawbar assembly and each connecting link assembly shall be subjected to the proof load test specified in [Clause 4.5.1](#).

Subsequently, each Type A component shall be subjected to a non-destructive test as specified in [Clause 4.5.2](#).

Imperfections detected by magnetic particle inspections are permissible when in accordance with [Appendix L](#).

5.3.5 Test certificates

For general test certificate requirements, see [Clause 4.6](#).

5.3.6 Marking

For general marking requirements, see [Clause 4.7](#).

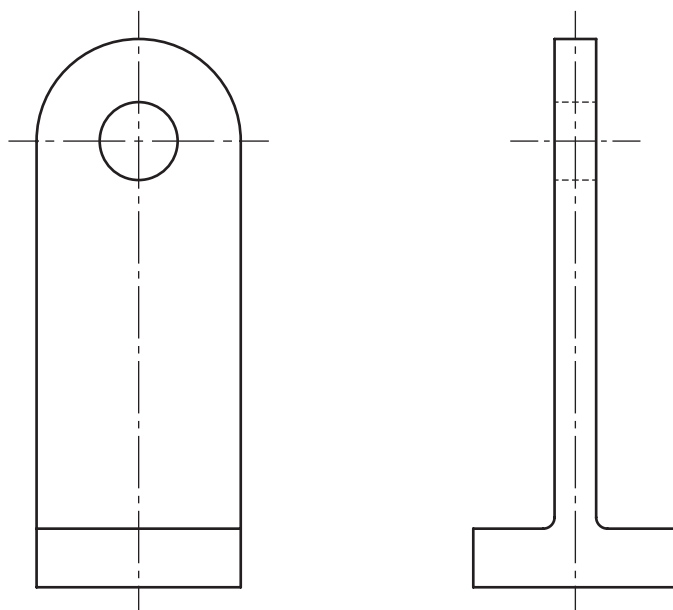


Figure 10 — Transom drawbar

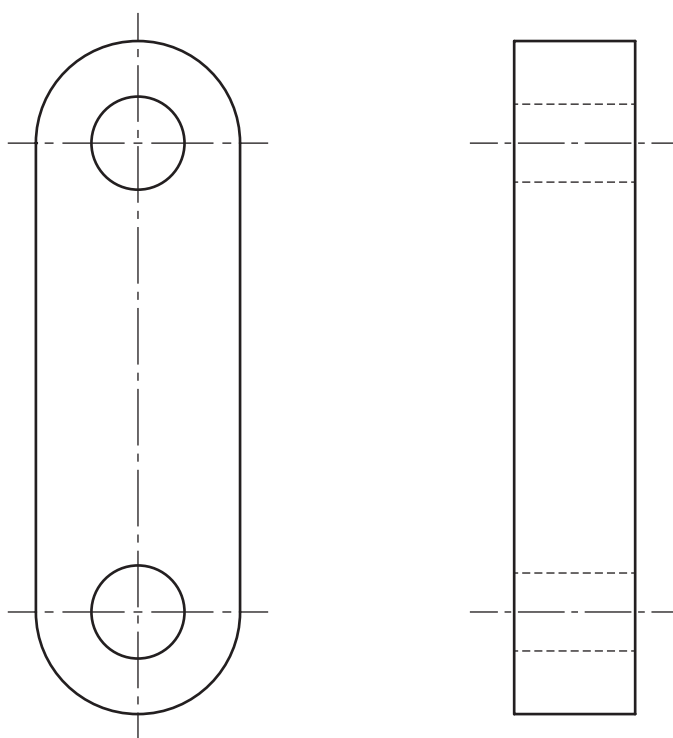


Figure 11 — Straight drawbar

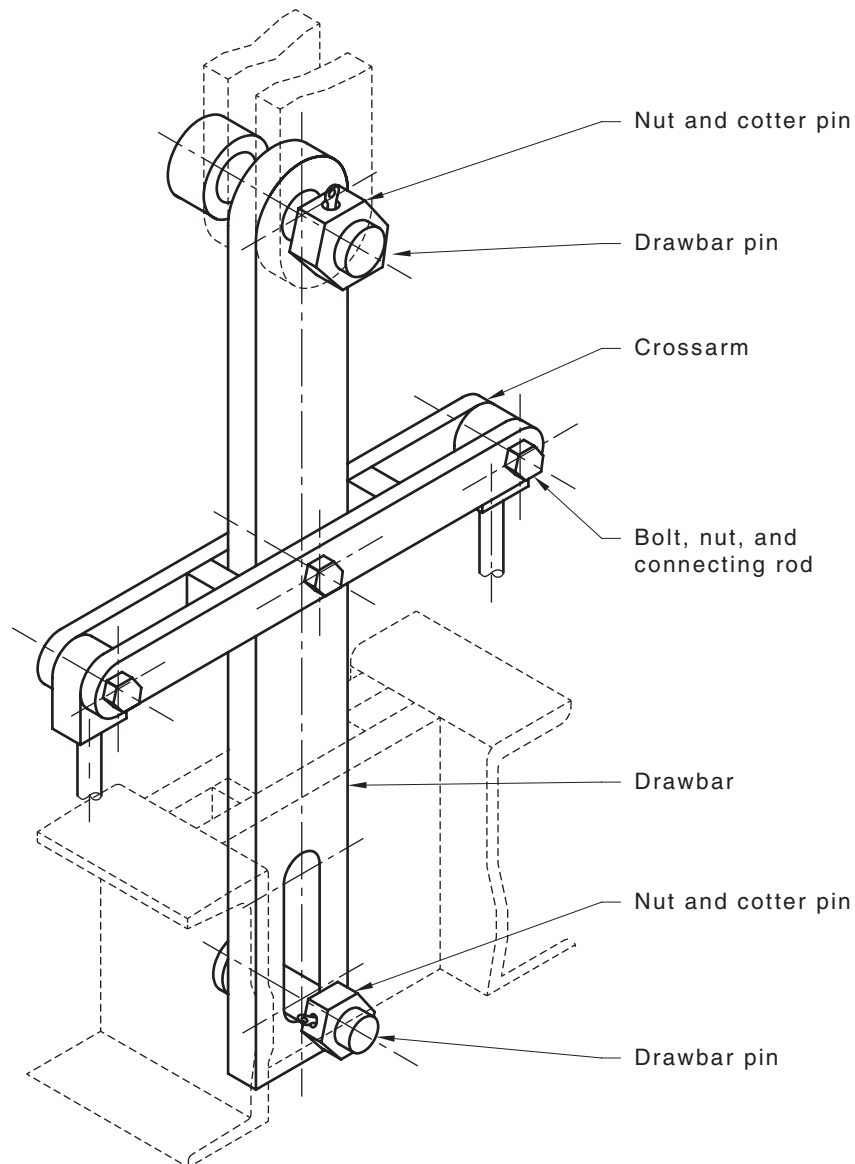


Figure 12 — Typical slotted transom drawbar with connecting rods for attachment to conveyance arrestors in timber guided shafts

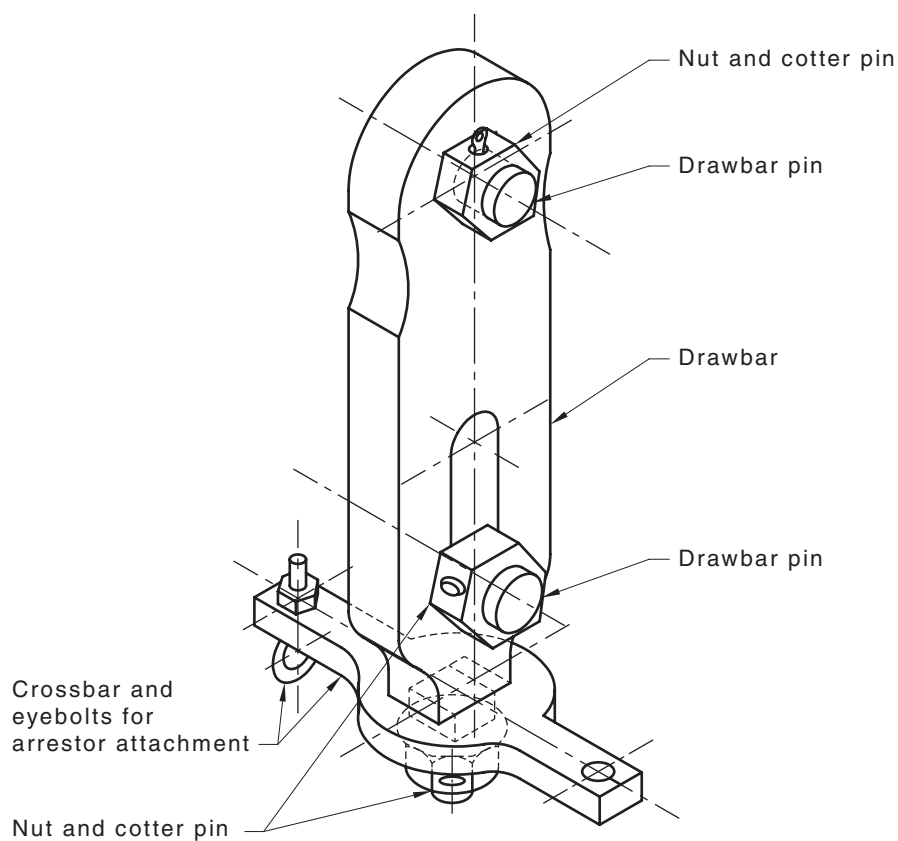


Figure 13 — Typical slotted drawbar with threaded connection for attachment to conveyance arrestors in timber guided shafts

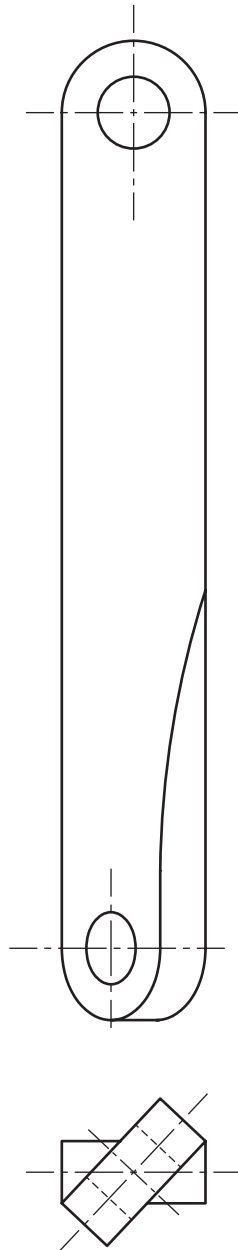


Figure 14 — Twisted connecting link

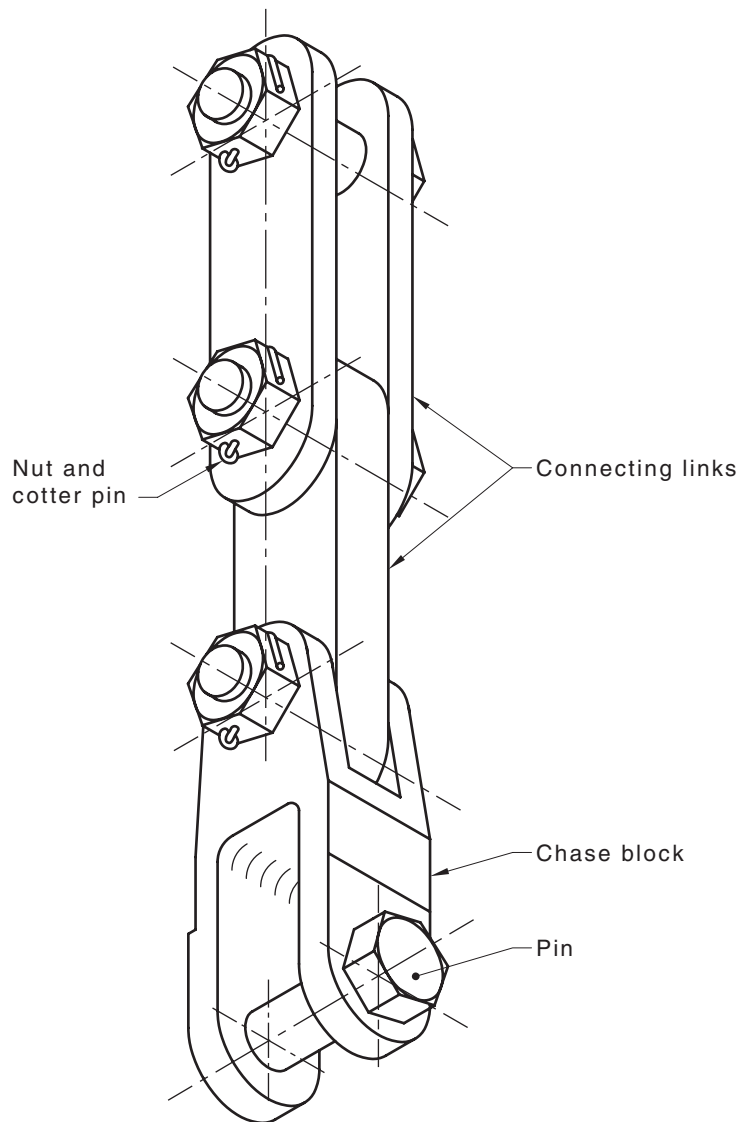


Figure 15 — Typical connecting link assembly

5.4 Rope swivels and swivel hooks

5.4.1 Size designation

The size designation for rope swivels and swivel hooks shall be the working load limit in tonnes.

5.4.2 Materials

5.4.2.1 Component type designation

The components of each of the various types of rope swivels and swivel hooks shall be designated Type A or Type B in accordance with [Table 7](#). [Figures 16](#) to [20](#) illustrate the various types of rope swivels and swivel hooks.

Components not listed in [Table 7](#) shall be designated Type B.