

Australian Standard™

**Steel wire rope—Use, operation and
maintenance**



This Australian Standard was prepared by Committee ME-025, Lifting Tackle. It was approved on behalf of the Council of Standards Australia on 14 May 2004. This Standard was published on 7 September 2004.

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Australian Standard™

Steel wire rope—Use, operation and maintenance

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PREFACE

This Standard was prepared by the Standards Australia Committee ME-025, Lifting Tackle, to supersede AS 2759—1985.

The objective of this Standard is to promote the use of procedures that will improve safety while selecting, storing, handling, maintaining, using, inspecting and discarding steel wire ropes.

This Standard includes the following changes from the superseded edition:

- (a) The inclusion of Clause 1.3, Innovations.
- (b) The inclusion of recently introduced rope constructions and deletion of those not in common use.
- (c) Drawings illustrating withdrawing a rope from a reel have been improved.
- (d) An acknowledgment that mechanical splicing has largely replaced hand splicing.
- (e) A major revision of Section 6, Poured sockets, including specific instructions for both molten metal and resin socketing.
- (f) Deletion of instructions for hand splicing of rotation-resistant ropes.
- (g) A substantial updating of the whole Standard, to bring it up-to-date with current practices.
- (h) The addition of new appendix covering aluminium alloy ferrules.

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

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

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STANDARDS AUSTRALIA

Australian Standard

Steel wire rope—Use, operation and maintenance

SECTION 1 SCOPE AND GENERAL

1.1 SCOPE

This Standard describes recommended procedures for the selection, storage, handling, maintenance, use, inspection, and discard of helically laid steel wire ropes.

1.2 APPLICATION

This Standard provides a guide to recommended and established practices for people who work with, handle, and maintain steel wire ropes.

1.3 INNOVATIONS

It is not intended that this Standard precludes the use of materials, designs, methods of manufacture or assembly, and the like, that vary from its specific requirements, or are not mentioned in it, but which can be shown to give results equivalent or superior to those specified.

1.4 REFERENCED DOCUMENTS

The following documents are referred to in this Standard:

AS

- 1138 Thimbles for wire rope
- 1418 Cranes, hoists and winches
- 1418.1 Part 1: General requirements
- 1666 Wire-rope slings
- 1666.1 Part 1: Product specification
- 1666.2 Part 2: Care and use
- 1735 Lifts, escalators and moving walks
- 1735.2 Part 2: Passenger and goods lifts—Electric
- 1735.4 Part 4: Service lifts—Power-operated
- 2076 Wire rope grips for non-lifting applications
- 2740 Wedge-type sockets
- 3569 Steel wire ropes

ISO

- 3189 Sockets for wire ropes for general purposes
- 3189-1 Part 1: General characteristics and conditions of acceptance
- 3189-2 Part 2: Special requirements for sockets produced by forging or machined from the solid
- 3189-3 Part 3: Special requirements for sockets produced by casting

BS

463 Specification for wire ropes

463.1 Part 1: Inch units

463.2 Part 2: Metric units

643 Specification for white metal ingots for capping steel wire ropes

DIN

3092-1 Socketing of wire ropes; casting in metal; safety requirements and testing

3093 Wrought aluminium alloy ferrules

3093-1 Part 1: Tubing blanks of oval cross section and constant wall thickness

3093-2 Part 2: Ferrule secured terminations—Safety requirements

Federal Specification

RR-S-550D Sockets, wire rope

1.5 DEFINITIONS

For the purpose of this Standard, the definitions given in Appendix A apply.

SECTION 2 SELECTION

2.1 GENERAL

Steel wire ropes for general lifting purposes (see definition in Appendix A) should comply with AS 3569.

The selection of the most suitable steel wire rope for any particular purpose is governed largely by practical experience and generally calls for the best compromise in rope qualities to cope with the loading, the type of equipment and the working conditions (e.g., corrosive conditions, accidental damage). Where long rope life is essential, a high design factor and high bending ratio (radius of bend to radius of rope) should be adopted. New generations of wire rope design incorporate plastic fillers between strands, compacted strands, double-parallel rope design and other means of increasing metallic content. A higher metallic content for a given diameter, resulting in a higher breaking force, may mean that smaller sheave and drum diameters can be used. Other characteristics of these features may improve the ability of the rope to withstand fatigue failures.

Where a rope is removed from service, the user should ensure that any replacement rope possesses properties at least equivalent to those of the rope being discarded.

Several desired qualities can be obtained in combination, but it is not always possible to develop all the qualities in the one rope. The following will assist in the correct choice of a rope:

- (a) Where very abrasive conditions are encountered, rope constructions with the largest possible outer wires or rope surface compatible with the required flexibility should be used.
- (b) Where the rope can be anchored at both ends to prevent rotation, the use of Lang's lay ropes is recommended for conditions of heavy wear and severe flexing, provided that the rope is not subjected to pinching or very heavy crushing conditions.
- (c) Where the rope is subject to heavy loading and flexing over small sheaves or drums, or to heavy crushing conditions or to high temperatures, a rope with a wire rope core should be used.
- (d) Where the rope operates under corrosive conditions or where ready and regular maintenance is difficult, galvanized wire ropes should be used.
- (e) Where environmental conditions tend to cause abnormal deterioration of fibre cores, rope with a corrosion-resisting synthetic core or wire rope core may be used.
- (f) An increased number of outer strands with smooth surfaces increases the number of contact areas between the rope and any sheaves and drums; thereby minimizing wear on sheaves, drums and rope.
- (g) Ropes with a plastic layer between the steel core and the outer strands combine the advantages of a fibre rope core (the soft bed for the outer strands) with benefits offered by steel wire rope core (e.g., higher breaking strength) and better geometric stability. Initially, the plastic layer seals the core and assists in the retention of its lubrication.

2.2 PHYSICAL PROPERTIES

The need for each of the following physical properties should be assessed whenever a rope is selected:

- (a) Size.

- (b) Breaking force
- (c) Resistance to abrasion.
- (d) Resistance to bending fatigue.
- (e) Resistance to distortion or crushing.
- (f) Resistance to corrosion.
- (g) Compatibility with atmospheric conditions.
- (h) Rotation under load.
- (i) Resistance to extremes of temperature.
- (j) Rope stretch.
- (k) Surface frictional characteristics.

2.3 TEMPERATURE

2.3.1 High temperature effects

High temperatures can affect wire ropes and higher design factors should be used where ropes are subjected to high temperatures. The rope manufacturer should be advised of the proposed loadings, the temperatures and the duration of operations at such temperatures.

The lubrication of ropes operating in high temperatures should be checked regularly, and in such cases special lubricants should be used.

Wire ropes used on hot metal cranes in foundries, smelting plants and rolling plants, and ropes used in drying ovens, annealing ovens and the like, may be subjected to excessive heat, which can reduce the strength and the performance of the ropes. Such heating can lead to damage of both the wires and the cores, unless suitable steps are taken to protect the ropes from the effects of the heat. Ways of overcoming this problem are to use ropes with a wire rope core, to shield the ropes, or to insulate the bottom sheave blocks with suitable insulation.

High outside ambient temperatures, or even sunny weather in snow country, will often lead to the draining off of rope and core lubricants on cableways, ropeways, chair-lifts, ski-tows, cranes, etc., and such losses should be replaced by periodical applications of new lubricant, if necessary, of higher viscosity.

2.3.2 Low temperature effects

Increases in tension due to contraction at low temperatures of fixed ropes is partly offset by the increased tensile strength of the wire at the lower temperatures.

Flexibility is not affected to any extent at temperatures down to -50°C .

2.4 WORKING LOAD LIMIT

2.4.1 General

The working load limit (WLL) should be based on the minimum breaking force, not the actual breaking force, which can vary from batch to batch. The actual breaking force may be taken into account when assessing the suitability of a rope for a particular application by a competent person. (See Appendix A for the definition of WLL.)

2.4.2 Design factors

The recommended minimum design factors for steel wire ropes under general conditions of use are as follows:

- (a) Running ropes 5.
- (b) Standing ropes.....4.

Ropes that are used on appliances complying with any of the Parts of the AS 1418 or AS 1735 series of Standards shall be subject to design factors specified by those Standards. AS 1666.2 specifies design factors for wire ropes used in wire rope slings.

Design factors less than the above may be used, subject to the appropriate risk assessment being done by a competent person for a particular application.

Due account should be taken of the number of parts and the efficiency whenever the design factor of a system is being determined.

Regulatory authorities or other Standards may require other design factors.

SECTION 3 STORAGE AND HANDLING

3.1 STORAGE

Ropes, reels and packaging should be checked for possible ingress of moisture, corrosion or physical damage, which may have occurred during transit or delivery.

Ropes should be stored, either on reels, or in coils, in a clean and dry environment. Ropes shall not be stored where they are liable to be affected by acid fumes, steam or other corrosive influences.

Ropes in store should be examined periodically, turned over to maintain an even dispersal of the lubricant and a suitable protective coating applied when necessary. After prolonged storage, it is advisable to inspect the ropes closely for signs of deterioration or damage, and to carry out a breaking force test where used in a critical application such as where lives may be endangered. (See also Clause 14.8 regarding corrosion.)

3.2 UNCOILING AND HANDLING (see Figure 3.2)

Careless uncoiling and handling can severely reduce the life of ropes. Every care shall be taken to avoid kinking, both before and during the operating life. Damage can seldom be entirely removed and can considerably reduce the effective life.

Ropes should be paid out without slack and in a straight line from its reel or coil so as to prevent any possibility of kinking or disturbance of the lay. Reeled ropes should be mounted on a suitable stand (see Figures 3.2(A)(a) and (b)). The reel should be efficiently braked to prevent overrun (see Figures 3.2(B)(a) and (b)). Coiled ropes should be paid out without slack, preferably from a turntable. Small coils may be rolled out along the floor (see Figure 3.2(A)(c)).

A rope should not be unwound by throwing off turns with the coil or reel flat on the ground, as illustrated in Figure 3.2(A)(d).

Ropes shall be re-reeled with the rope bending around the reel in the same direction, that is, passing from top to top or from bottom to bottom of the reels, as illustrated in Figures 3.2(C)(a) and (b).

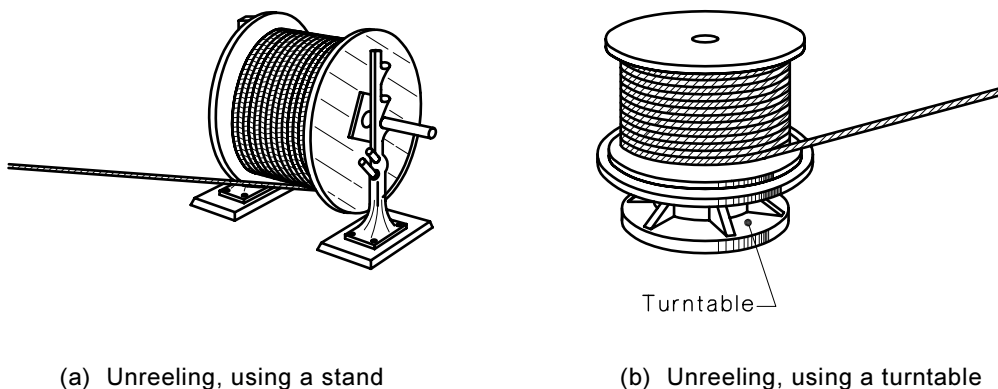
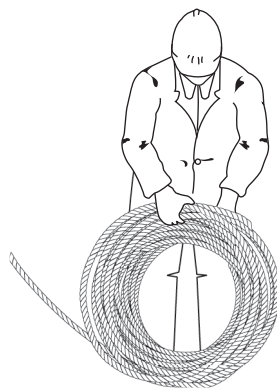


FIGURE 3.2(A) (in part) METHODS OF UNREELING AND UNCOILING A ROPE

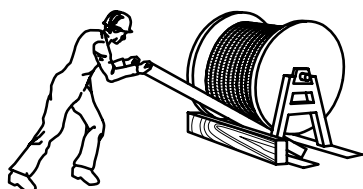


(c) Uncoiling

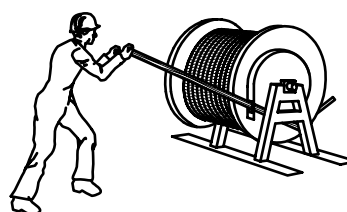


(d) Unacceptable methods

FIGURE 3.2(A) (in part) METHODS OF UNREELING AND UNCOILING A ROPE



(a) Braking with a plank against the reel flange



(b) Braking with an adjustable friction drum on the shaft or side plate

FIGURE 3.2(B) METHODS OF BRAKING ROPE REELS

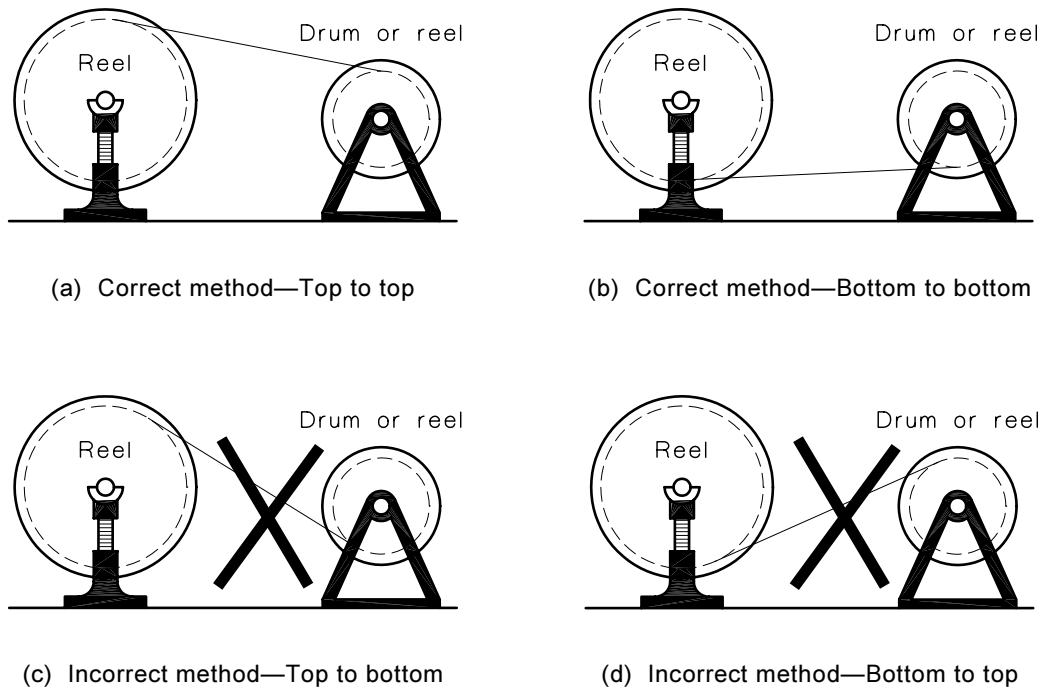


FIGURE 3.2(C) TRANSFERRING ROPE FROM A REEL TO A DRUM OR ANOTHER REEL

SECTION 4 CUTTING AND FITTING

4.1 ROPE END PREPARATION

Most six-stranded wire ropes are delivered without any special end preparations, as preforming on these wire ropes is adequate to prevent unlaying of strands and disturbance of the constructional balance. Such cut ends can normally be installed without further preparation; but in some cases, where ropes have to be reeved through restrictive openings (e.g., drum anchorages and block systems), the ends may require special preparation, to reduce or eliminate any disturbance of strands in the rope.

Rotation-resistant ropes, Lang's lay ropes and ropes that derive their higher strength from the nature of their construction, require seizings at all times, as any minor changes in lay length or constructional tension, balance or integrity will adversely affect the load-carrying capacity and performance of the rope.

Where a length of rope is to be cut from a longer length, a seizing shall be made on both sides of the cutting point, or a suitable technique shall be used to prevent the rope from unlaying when it is cut (see also Clause 4.2.4).

Tapered or fused ends provide ready entry into wedge-type sockets, drum anchorages and multi-reeving of block systems. Various end connections are used as a means for attachment of tow or winch lines and the hauling of heavy ropes into excavators, dredges and the like.

Examples of various rope end preparations are shown in Figure 4.1.

Fittings should be compatible with the force to be applied during installation.

4.2 SEIZING

4.2.1 Purpose

During the manufacture of steel wire ropes, care is taken so that all wires and strands are laid up together with tension and length of lay uniform, to ensure that loads applied to the rope will be equally distributed among the strands and by the wires within the strands. Any disturbance of the constructional tension, balance or integrity will adversely affect the load-carrying capacity and performance of the rope.

The balance is particularly important at the end connections on a rope and to maintain this balance it is essential that the rope is properly seized before it is cut in preparation for an end connection. Badly seized rope ends can result in a slackening of both wires and strands, with a resultant lengthening of the rope lay, which can reduce tensile efficiency and cause movement in rope lay in rotation-resistant ropes.

4.2.2 Seizing materials

The following materials are suitable:

- (a) Seizing wire.
- (b) Seizing strand.
- (c) Fibreglass tape.
- (d) Twisted polypropylene tape.
- (e) Marline.

NOTE: Items (c), (d) and (e) are generally used on wire ropes with a diameter of less than 32 mm.

The need for seizing wire and seizing strand becomes greater for larger diameter wire ropes and where inadequate seizing increases the vulnerability of the rope to damage.

4.2.3 Length

The length of an effective seizing depends upon the type of rope, the manner in which the material is applied and the degree of preforming. More extensive seizing is required for ropes that are less preformed.

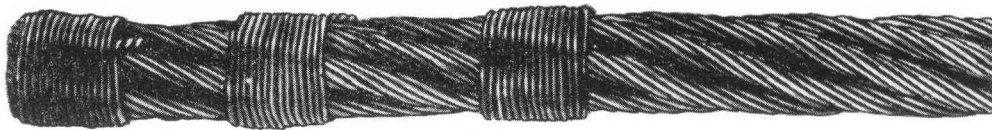
For Lang's lay ropes with six to 10 strands, a long seizing of three to four rope diameters long should be applied each side of the cut. A seizing mallet should be used for wire and strand seizing.

For rotation-resistant ropes, greater care shall be taken to prevent slackening of the outer wires or creeping of the centre strands. Three seizings, each with a length of two diameters, should be applied on each side of the cut or, alternatively, one seizing with a length of six diameters may be satisfactory. Wire seizings may need to be soldered.

Seizing of the type shown in Figures 4.2.3(A) and 4.2.3(B) should be used where permanent seizings are required.

4.2.4 Cutting

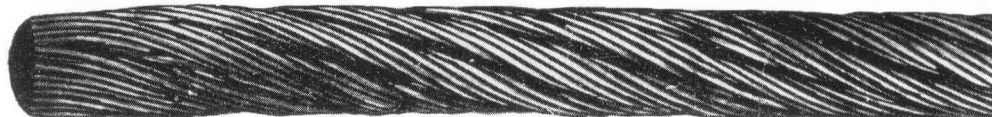
The preferred method is to use a high-speed disc cutter. Where flame cutting of rope is used, the heat-affected sections shall not be incorporated in the terminations or loaded parts of the rope and care shall be taken to avoid heat or splatter damage to other sections of the rope.



(a) Seized end

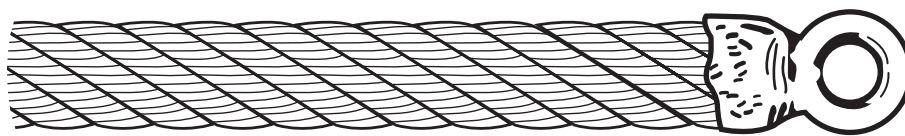


(b) Tapered and braided or welded end

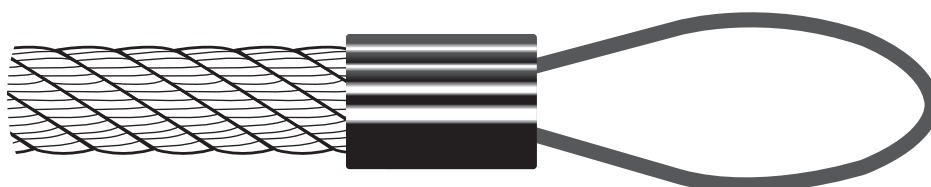


(c) Plain braided or welded end

FIGURE 4.1 (in part) ROPE END PREPARATION



(d) Welded link



(e) Swaged steel ferrule with pulling line.

NOTES:

- 1 Rope with a properly wire-seized end.
- 2 Tapered end, produced by welding or by fusion in an electric parting machine.
- 3 Plain fused end of which the finished diameter is approximately that of the rope itself.
- 4 Low carbon steel link welded on to the rope end to provide a means of handling during installation.
- 5 Strand or rope loop, which has been laid into the valleys of the main rope and clamped by means of a pressed-steel ferrule, to provide a means of handling during installation.

FIGURE 4.1 (in part) ROPE END PREPARATION

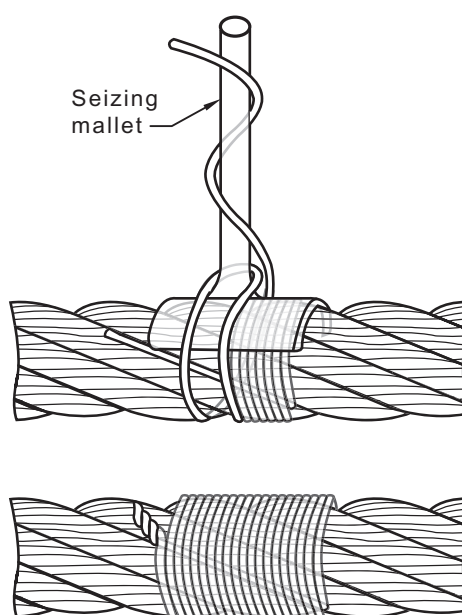


FIGURE 4.2.3(A) USE OF SEIZING Mallet

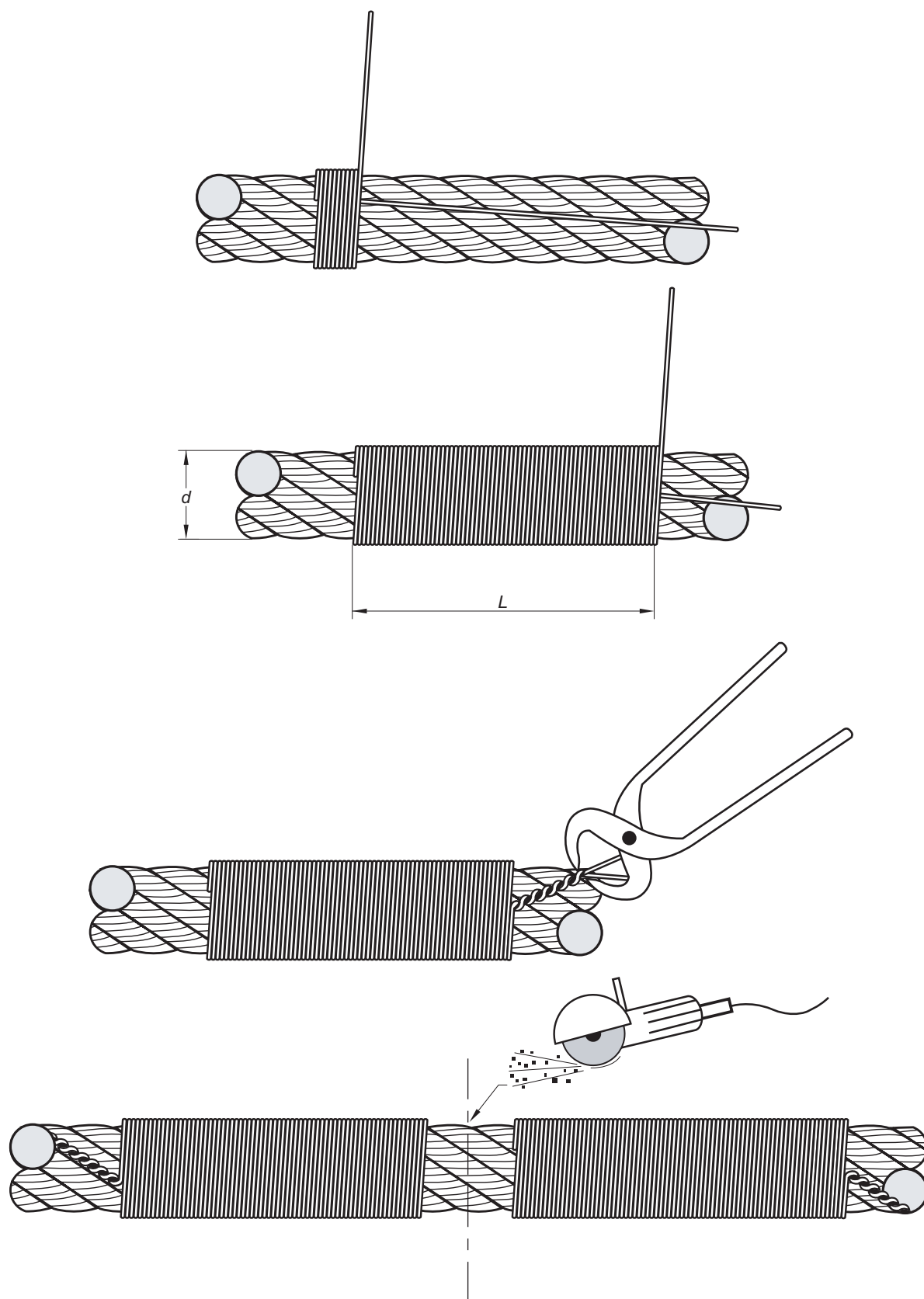


FIGURE 4.2.3(B) STEPS DURING SEIZING, PRIOR TO CUTTING

SECTION 5 ROPE FITTINGS AND THEIR EFFICIENCIES

5.1 SELECTION OF FITTINGS AND END ATTACHMENTS

Rope fittings shall be properly designed for the service expected of them, be manufactured from durable materials. They should comply with any relevant Australian Standard.

The fitting of end attachments to ropes should be carried out with the necessary care and skill to ensure that the load can be effectively transferred from the rope to the attachment, and when ropes are being replaced the end attachments should be inspected and put in good mechanical order before reuse. Not all end fittings are suitable for reuse.

The following operating needs should be considered in the determination of the type of rope fitting:

- (a) End use.
- (b) Construction and lay of the rope.
- (c) Design factor.
- (d) Speed of making the attachment.
- (e) Skill of the rope fitter or user and the facilities available to him for doing the job.

5.2 TYPES OF FITTINGS

5.2.1 General

Details of commonly used rope fittings and end attachments with an indication of their relative efficiencies and merits are shown in Table 5.2 and Figure 5.2. Fittings (a), (b) and (d) to (h) have a 90% to 100% tensile efficiency and require workshop facilities or specialized equipment, skill and care when being fitted to the rope. Fittings (i) to (k) can be applied in the field, with the use of the minimum of tools. They provide adequate tensile efficiency.

NOTE: Appendix B lists Australian Standards for components used in lifting systems.

5.2.2 Hand-spliced eyes

Figure 5.2(c) shows a hand-spliced eye. Seizing is not mandatory and does not improve the efficiency of the splice.

The tensile efficiency of hand-spliced eyes decreases as the rope size increases (see Table 5.2), because of the greater disturbance of the rope structure when the tucking strands are passed under and over one another to provide the necessary locking to prevent withdrawal of the tucks under load.

Hand-spliced eyes can be made in the field with a minimum of tools; however, considerable practice is required for a person to become a competent hand splicer.

5.2.3 Ferrule-secured rope attachments

Figures 5.2(a) and (b) show two forms of spliced eye for forming at the ends of slings. The rope is secured by steel, aluminium-alloy or copper-alloy ferrules or sleeves, using a hydraulic swaging press fitted with appropriate dies.

Figure 5.2(a) shows a swaged turnback eye splice with two parts of wire rope side by side. The ferrule used is normally aluminium alloy, but is available in copper.

Wrought (swaged) aluminium alloy ferrules shall be in accordance with Appendix C.

Figure 5.2(b) shows a swaged flemish eye splice, which is formed by marrying two ‘halves’ of a rope end, with the strand ends laying in the valleys of the parent rope. The rope is clamped by a metal (usually steel) sleeve pressed over the strand ends of the married eye, which provides a better resistance to corrosion due to electrolysis than eyes formed with an aluminium sleeve. A steel sleeve is also more suitable for high temperatures.

5.2.4 Swaged end fittings

Figures 5.2(d) and (e) show swaged end fittings. Such fittings are usually in the form of open or closed sockets, but include variations such as screwed ends, ball ends for self-alignment and flanged ends. They are neat and compact, and require minimum rope length to make the termination. Such fittings have greatest application in guys, stays, crane pendants, aircraft controls, automotive controls and yacht stays. They are swaged straight onto a rope or a strand by means of cold rolling or a hydraulic swaging press fitted with appropriate dies. These fittings have greater resistance to vibration than other terminations.

5.2.5 Poured sockets

Figures 5.2(f) and (g) show socket ends fitted with white metal, zinc or resin compounds (see also Section 6). Such fittings are used on a range of fixed and working ropes, particularly larger sizes.

5.2.6 Wedge grip capels

Figure 5.2(h) shows a wedge grip capel, which is used for cableway anchorages, ropeway anchorages and attaching mine hoisting ropes for the hoisting of men, materials and ore.

Wedge grips apply pressure to the rope through the series of tapered rings driven home, preferably by hydraulic means, on the slim taper of the outer strap.

A poured stop socket or safety block is attached to the rope, both as a safety measure against and as a gauge of possible movement of the rope within the wedge grips.

5.2.7 Wedge-type sockets

Where wedge-type sockets are used guidance should be sought from AS 2740.

Figure 5.2(i) shows a wedge-type socket, which is used to anchor rope ends because of the general ease with which it can be applied in the field.

The nominal diameter of the wire rope shall be equal to the nominal size of the wedge-type socket and the loaded end of the rope shall enter the socket body so that when loaded it will not bend where it leaves the socket body.

5.2.8 Wire-rope grips

Where a wire-rope grip is used, guidance should be sought from AS 2076. Wire-rope grips shall not be used for lifting.

Figure 5.2(j) and (k) shows various forms of wire-rope grips of the compression type, which depend on gripping two parts of the rope together side by side. These types of fittings can be applied readily in the field with the use of wrenches. Rope decreases in diameter under loading; therefore, it is important that the nuts and bolts be retightened regularly after application, until the rope under the grip is stable under load.

Wire-rope grips shall be applied at all times as shown in Figure 5.2(l), with the saddle of the wire-rope grip on the loaded part of the rope and the u-bolt on the unloaded end of the rope. This ensures maximum efficiency. Other methods of attachment of wire-rope grips shall not be used.

The fist-type wire-rope grip shown in Figure 5.2(k) may be applied over two parts of the rope, without knuckling the rope and distorting it.

TABLE 5.2
EFFICIENCY OF TERMINAL ROPE ATTACHMENTS

1	2	3	4	5	6
Type of rope fitting or end attachment	Items in Figure 5.2	Typical tensile efficiency percent (Note 1)	Resistance to vibration and impact	Ease of fitting in field	Reference to Notes below
Turnback eye with pressed aluminium alloy ferrule:					
≤80 mm rope diameter	(a)	95	Good	—	2 and 3
>80 mm rope diameter	(a)	90	Good	—	
Flemish eye with pressed sleeve:					
≤80 mm rope diameter	(b)	95	Good	—	2 and 3
>80 mm rope diameter	(b)	90	Good	—	
Hand spliced eye:					
≥8 ≤20 mm rope diameter	(c)	90	Good	Good	1
>20 ≤60 mm rope diameter	(c)	80	Good	Good	1
>60 mm rope diameter	(c)	75	Good	—	1
Open swaged socket	(d)	100	Good	Fair	2 and 3
Closed swaged socket	(e)	100	Good	Fair	2 and 3
Open poured socket	(f)	100	Fair	Good	2
Closed poured socket	(g)	100	Fair	Good	2
Wedge grip capel	(h)	100	Fair	Good	—
Wedge-type socket	(i)	80	Fair	Excellent	—
Eye with wire rope grips	(j)	80	Good	Very good	4 and 5
Eye with fist grips	(k)	80	Good	Very good	4 and 5

NOTES:

- 1 Where Lang's lay rope is used, the efficiency is up to 15% less than that given.
- 2 Fitting in the field is not uncommon, but specialized equipment is necessary.
- 3 Fitting in the field is generally restricted to ropes with a diameter of not more than 20 mm.
- 4 Not to be used for lifting.
- 5 When fitted with the required number of wire rope grips, refer to AS 2076 or the manufacturer's recommendation.

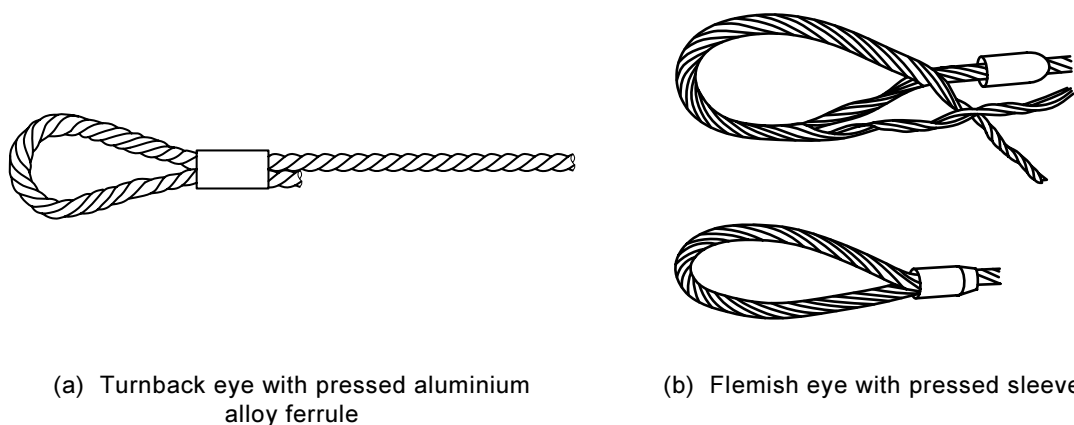
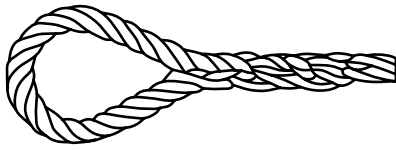
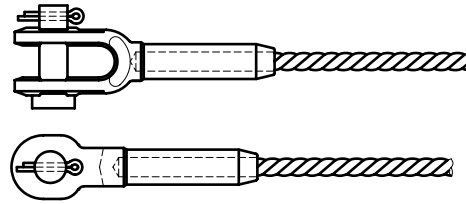


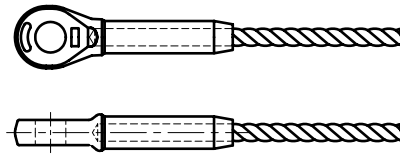
FIGURE 5.2 (in part) TERMINAL ROPE ATTACHMENTS



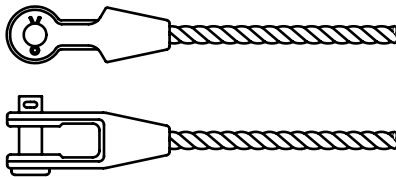
(c) Hand-spliced eye



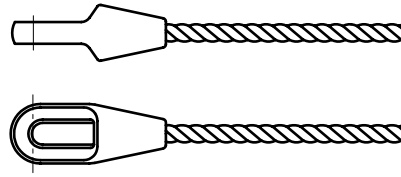
(d) Open swaged socket



(e) Closed swage socket

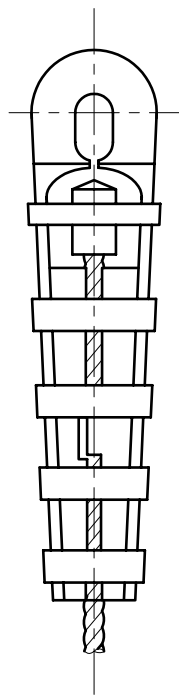


(f) Open poured socket

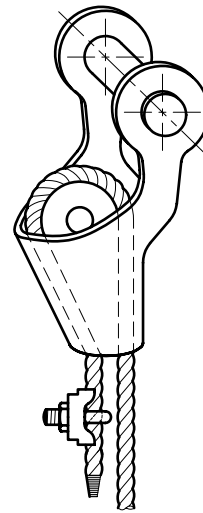


(g) Closed poured socket

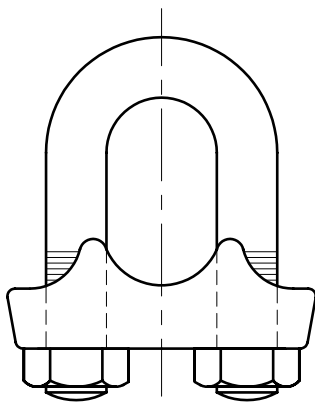
FIGURE 5.2 (in part) TERMINAL ROPE ATTACHMENTS



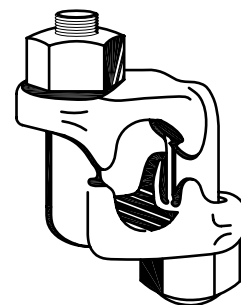
(h) Wedge grip capel



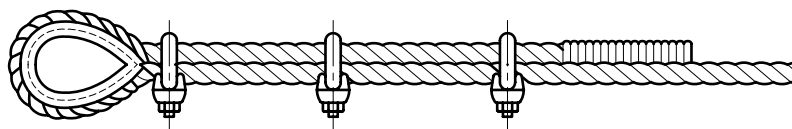
(i) Wedge-type socket



(j) Wire rope grip



(k) Fist-type wire rope grips



(l) Eye with wire rope grips

FIGURE 5.2 (in part) TERMINAL ROPE ATTACHMENTS

SECTION 6 POURED SOCKETS

6.1 GENERAL

Poured sockets attached by means of resin or metal are an efficient means of providing terminal attachments for wire ropes. The nomenclature of parts of sockets is illustrated in Figure 6.1.

The load is transferred between the rope and the socket forging or casting by means of adhesion between the rope wires and the metal or resin used in the socket bowl and subsequent wedging action provided by the conical socket bowl. The efficiency of socketing depends on the effectiveness of the bond between the rope's wires and the metal or resin in the socket. Care should be taken to follow the correct procedure. Properly applied poured socket attachments will withstand the actual breaking force of the wire rope.

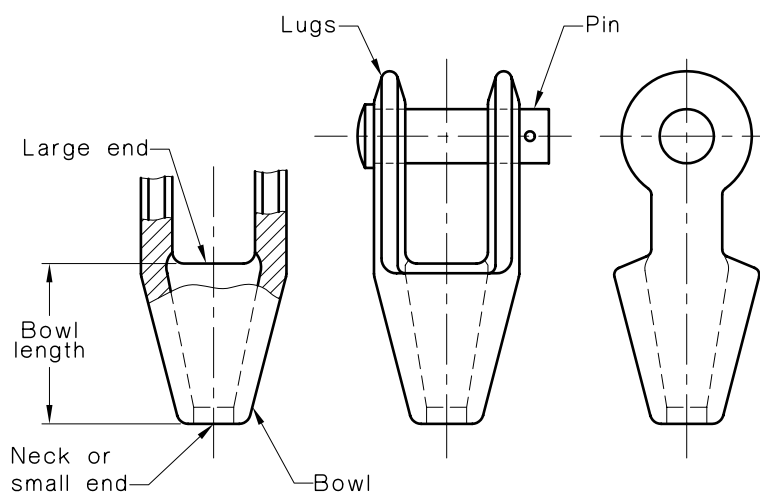


FIGURE 6.1 NOMENCLATURE OF PARTS OF SOCKETS

6.2 QUALIFYING AND QUALITY CONTROL

6.2.1 Personnel

Personnel carrying out qualifying or quality control shall have had adequate training in socketing and samples of their work shall be tested.

6.2.2 Poured socket systems

Poured socket systems shall have passed qualifying tests.

6.2.3 Type testing

Appropriate tests of poured socket systems for qualifying or quality control include the following:

- Destructive type testing of the terminations, by meeting the efficiency specified in Table 5.2.
- Routine sample type testing (which is recommended).
- The size, range and construction of wire rope and strand to be taken into consideration.
- A risk assessment for some applications (wherever appropriate).

6.2.4 Proof testing

Wire rope assemblies manufactured with poured sockets shall be proof-loaded in accordance with AS 1666.1. Where possible, any other socket terminations shall be proof-loaded to 40% of the minimum breaking force of the wire rope.

6.3 SPECIFICATIONS FOR SOCKETS

6.3.1 General purpose sockets

Open- and closed-type forged-steel sockets for 1770 grade wire ropes have been standardized for general engineering purposes by overseas Standards organizations.

Sockets should comply with one of the following relevant Standards, or another recognized Standard: ISO 3189-1, ISO 3189-2, ISO 3189-3, BS 463.1, BS 463.2, Federal Specification RR-S-550D.

BS 463 specifies sockets with proof loads based on approximately two-fifths of the minimum breaking load of ropes in the 6×19 group of Grade 1770 MPa. The working load for these sockets should not exceed one-half of the specified proof load. Pins of sockets complying with BS 463 have been designed on the assumption that the load is distributed over their length.

6.3.2 Sockets for strand and higher capacity wire rope

Sockets for strand and higher capacity wire rope are used in applications such as strand guys and pendants on crane booms in construction and on excavating equipment. These sockets are generally designed with increased dimensions (e.g., increased bowl lengths) to provide a greater area for bonding of the resin or metal. Socket manufacturers recommendations shall be considered.

6.3.3 Reuse of sockets

Where sockets are to be reused, it is necessary to prepare them by melting, pressing or burning out remaining socketing material; however, care shall be taken that the temperature used does not exceed 450°C. Normalizing or stress relieving should be considered. Sockets should be identified by size and suitability for their intended application. Visual inspections shall be carried out for defects, wear, damage and dimensional change. Magnetic particle inspections are commonly used to aid this process, particularly for larger sized sockets in highly loaded applications.

6.3.4 Inspection of sockets prior to socketing

Ensure that the socket selected is fit for its purpose. Sockets should be clean and free from defects. Ensure all dirt, grease and scale has been removed from the inside of the socket bowl.

6.4 SOCKETING MATERIAL

6.4.1 Resin socketing

For resin socketing of wire rope or strand, only specific resins for socketing purposes shall be used and resin manufacturer's instructions shall be followed.

6.4.2 Metal socketing

For metal socketing, metal complying with DIN 3092-1 or white metal complying with BS 643 should be used. When metal socketing strand, zinc of 99.99% purity should be used.

6.4.3 Lift applications

Special requirements for socketing material in lift installations are given in AS 1735.2.

6.5 PREPARATION OF WIRE ROPE OR STRAND AND SOCKET READY FOR FITTING

6.5.1 Temporary seizing

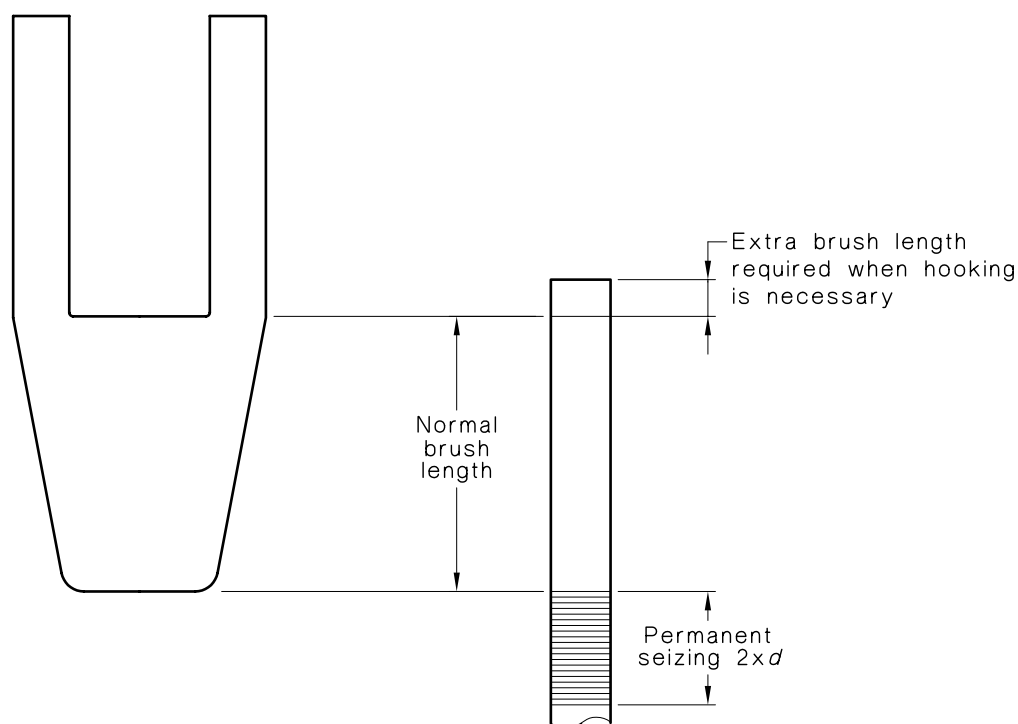
Temporary seizings should be used when cutting ropes and spiral strands; however, they are not always necessary when cutting preformed ropes. Where used, the temporary seizings should be applied to the rope on each side of the cut. They hold the strands and wires in position during the cutting operation.

6.5.2 Permanent seizing

Permanent seizings are applied to the rope where it is partly within or adjacent to the neck of the socket when the operation is completed (see Figure 6.5.2). Permanent seizings should ensure that the wires and strands are undisturbed during socketing operations and permit passage of the seized rope through the neck of the socket.

Tinned or galvanized soft wire should be used for permanent seizings. The diameter of the seizing wire should be small enough to allow the seized rope to be passed through the neck or small end of the socket, with a radial clearance between the seizing wire and the parallel part of the neck.

Alternative material to the above may be used, but care should be taken so that it does not cause detrimental electrolytic action in service and is capable of withstanding the socketing temperatures involved. Copper wires and brass wires should not be used. Plastics of proven suitability may be used.



NOTE: d is nominal diameter of rope.

FIGURE 6.5.2 LOCATION OF PERMANENT SEIZING

6.5.3 Cutting the wire rope

The wire rope or strand should be cut by any suitable method that does not disturb the position of the wires under the permanent seizing. Cutting with an abrasive wheel is preferred.

6.5.4 Forming the brush

Open up the strands and the wires in the strands, ensuring they are open right down to the permanent seizing, without attempting to straighten the wires. Form the brush, taking care not to bend the wires or strands to an excessive angle at the permanent seizing, as this may cause premature failure in a completed assembly (see Figure 6.5.4).

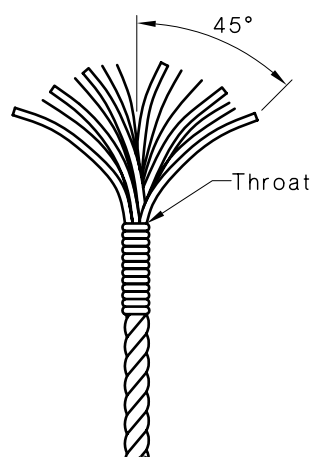


FIGURE 6.5.4 BRUSH

6.5.5 Cores

If a rope contains a steel core, the wires of the core should be completely unlaid to form an open brush.

If a rope contains a fibre core, the core should be cut back into the throat as far as possible.

6.5.6 Degreasing

The brush should be degreased to remove all traces of rope lubricant. When using liquid degreasing agents, the brush should be held downwards to prevent the degreasing fluid or water being trapped in the throat of the brush. The degreasing process may be accelerated by the use of an ultrasonic device. Liquid degreasing agents should be liberally used and worked well into the throat of the brush. Care should be taken to ensure that degreasing is confined to the brush and does not affect the rope beyond the brush.

It is essential to ensure that rope lubricant does not seep from beneath the permanent seizing and contaminate the degreased areas prior to pouring.

If a water soluble liquid degreasing agents is used, the residue should be completely removed by washing off in hot water. It is essential to ensure that any degreasing agent is completely removed and the brush is dried quickly and completely, before pouring.

Neither petrol nor paraffin should be used for degreasing.

Resin manufacturers' recommendations shall be adopted when selecting a cleaning agent.

6.5.7 Hooking

In general, hooking of wire ends is not recommended, but may be considered for coarse construction ropes. The length of any hooked portion should be such that it does not impede the flow of resin or molten metal during socketing nor significantly reduces the effective length of embedded wire.

6.5.8 Position of wires in socket

Position the wires at the large end of the socket, so that they are reasonably well distributed. Take care to prevent appreciable lengths of the outer wires from bearing against the socket wall, as this reduces the efficiency of the assembly.

6.5.9 Preparation procedures

The following preparation procedures should be followed:

- (a) Ensure that the socket body selected is fit for its purpose.
- (b) Select the rope, measure and mark it for cutting.
- (c) If necessary, apply temporary seizing on either side of the cutting mark.
- (d) Apply a length of permanent seizing equal to two rope diameters (see Figure 6.5.2).
- (e) Cut the rope.
- (f) Clean the length of the rope to be threaded through the socket. A clean dry cloth or cloth dipped in solvent may be used.
- (g) Remove all dirt, grease and scale from the inside of the socket bowl.
- (h) Thread the cut end of the rope through the socket, taking care that the bowl walls do not come into contact with the uncleaned part of the rope.
- (i) Remove the temporary seizing at the point of cut and unlay the strands as far back as the permanent seizing.
- (j) Open up the strands as shown in Figure 6.5.4.
- (k) Open out the individual wires right down to the seizing.
- (l) Cut back any fibre core or unlay the wires of a steel core, as applicable.
- (m) Degrease the open brush.
- (n) If considered necessary due to envisaged difficulty in positioning a socket over a brush, place a turn of wire around the brush near its top end, to draw the brush slightly together.
- (o) If required, remove the turn of wire required by Item (n).
- (p) Position the socket over the brush, until the ends of the wires are flush with or up to 2 mm above the top or large end of the bowl of the socket.
- (q) Check that the wires are, as far as possible, evenly distributed at the top or large end of the bowl of the socket.
- (r) Clamp the rope in a suitable support, centralize and align the axes of the rope and the socket. The rope below the socket should be straight for at least 30 rope diameters. For strand, this should be 90 rope diameters. Correct alignment of the socket and wires is important and will avoid premature failure of the termination and socket assembly due to unequal loading of the wires.
- (s) Seal the neck of the socket with suitable material, to prevent leakage of the socketing material. Care should be taken to ensure that the sealing material is not pushed into the socket bowl.
- (t) Follow the procedures in Clause 6.6 for resin socketing, or Clause 6.7 for molten metal socketing.

6.6 RESIN SOCKETING

6.6.1 Resin systems

Resin systems are in general use. These systems may vary considerably and are mainly based on polyesters. It is essential to refer to the manufacturer's instructions before using them.

Resin systems cure more slowly at low temperatures. If the ambient or socket temperature at the time of socketing is less than 8°C, the manufacturer's special recommendations should be followed.

For any resin-socketing system, the manufacturer should provide adequate information on its use, including upper and lower socketing temperature, upper and lower service temperature and storage temperature. Resin systems should be of the thermosetting type.

Do not use any resin packs that are unsealed or are out of date.

6.6.2 Resin socketing procedure

The following resin socketing procedure applies:

- (a) Prepare the rope and socket in accordance with Clause 6.5. Fluxing shall not be used.
- (b) Mix the resin system in a suitable clean container that does not react with the components. Polystyrene containers shall not be used.
- (c) Mix the resin system in accordance with the manufacturer's instructions.
- (d) Mix sufficient resin, to ensure that the basket is completely filled, including any topping up needs.
- (e) Immediately after it has been mixed, pour the resin system.
- (f) Pour the mixture down the inside face of the basket, until the basket is full. During the pouring and topping-up operation and early stages of gelling, it is essential that any leaks are identified and stopped, as they may result in cavities being formed in the neck region or excessive loss of resin.
- (g) Puddle with a stiff wire, to remove any entrapped air, and top up from the original mix.
- (h) After pouring the resin and topping up, allow the assembly to completely cure, before being disturbed or any attempt is made to move it, normally 1 h after gelling.
- (i) When fully cured, the surface will be hard enough to take a fine scratch from a piece of sharp metal.
- (j) Remove the permanent seizing up to the neck of the socket.
- (k) Inspect the socketed assembly in accordance with Clause 6.8.
- (l) Apply a suitable corrosion preventative compound to the cleaned length of rope, taking care to cover all exposed wires and to seal the neck of the socket.

6.7 METAL SOCKETING

6.7.1 Socketing metals

The metal used for metal socketing should be white metal complying with BS 643.1, or BS 643.2, zinc of 99.99% purity, or have passed qualifying tests.

6.7.2 Containers

Containers used for melting and pouring socketing metal should be of a material that does not react with the molten socketing metal.

Do not use galvanized containers to hold white metal.

The crucible used for melting the socketing metal and the pouring ladle, if it is not the same container, should hold at least 20% more metal than is required to fill the socket body.

6.7.3 Metal socketing procedure

The following metal socketing procedure applies:

- (a) Prepare the rope and socket in accordance with Clause 6.5.
- (b) Ensure sufficient socketing metal is heated.
- (c) Heat the socket metal. The heating should be even. The pouring temperature is 350–360°C for white metal or 470–500°C for zinc.
- (d) Sockets should be preheated.

Where using white metal and zinc, the preheating temperature of the socket should be in the range of 120°C to 200°C, preferably nearer to the upper limit.

The socket preheat temperature should be achieved by gradually applying heat evenly around the outer surface, taking care not to overheat any part of the socket. It is essential that the preheating flame does not come into contact with the wires of the rope. Butane or propane torches are preferred.

- (e) Where sockets have been preheated, check the socket reheat temperature. Methods to check the socket preheat temperature include a suitable thermometer, pyrometer, temperature-sensitive sticks or marks.
- (f) Immediately prior to pouring, stir the molten metal to prevent separation of the constituents and to even out the temperatures within the container. Any dross should also be removed from the surface of the molten metal, and if a pouring ladle is to be used it should be preheated by immersing it in the melting pot.
- (g) Flux the wires in the socket with powdered resin or a suitable proprietary compound, ensuring that all the wires are covered with the fluxing compound.
- (h) Immediately after fluxing, pour the molten metal slowly and continuously down the inside face of the basket until the basket is full.
- (i) To facilitate escape of gases, the molten metal should be poured down one side of the inside face of the basket, and pouring should be slow and continuous until the basket is full.
- (j) As the metal cools and shrinkage occurs at the top, top up the basket from the main pouring by melting the surface metal and pouring in sufficient additional metal to fill the depression.
- (k) Allow the metal to solidify without being disturbed. Forced cooling shall not be used until the metal has completely solidified.
- (l) Once the metal has solidified, forced air cooling may be used. Water quenching shall not be used.
- (m) Remove the permanent seizing up to the neck of the socket.
- (n) Inspect the socketed assembly in accordance with Clause 6.8.
- (o) Apply a suitable corrosion preventative compound to the cleaned length of rope, taking care to cover all exposed wires and seal the neck of the socket.

6.8 INSPECTION

After completion, the socketed assembly should be checked visually to ensure that—

- (a) the socket and rope axes are aligned;
- (b) the annulus between the rope and socket neck is even and filled with socketing material;
- (c) the larger end of the socket is completely filled; and
- (d) corrosion preventative lubrication has been reapplied to the cleaned section of the rope, where it enters the socket.

6.9 IN-SERVICE INSPECTION ADVICE

At regular intervals, the socketed wire rope should be inspected for in-service defects.

In particular, the following aspects should receive attention:

- (a) Bending or other damage of the pin.
- (b) Elongation or other damage at the socket lugs or pin.
- (c) Distortion of the lugs of the socket.
- (d) Cracks or other distortion, significant abrasion, nicks, etc. of the socket body.
- (e) Corrosion of the socket body.
- (f) Corrosion of the wire rope.
- (g) Broken wires adjacent to the socket.
- (h) Movement of the wires projecting above the top of the socketing material.
- (i) Unusual movement of the rope at the neck of the socket.

6.10 FLOW CHART PRESENTATION OF SOCKETING PROCEDURES FOR STRANDED STEEL WIRE ROPES

Table 6.10(A) details the sequential procedure for cutting and preparing rope for socketing.

Tables 6.10(B) and 6.10(C) detail the subsequent resin socketing procedure and metal socketing procedure respectively.

TABLE 6.10(A)
CUTTING AND PREPARING ROPE FOR SOCKETING

Sequential steps	Action	Comment
1	Select a rope. Measure and mark it for cutting	—
2	Apply a temporary seizing on each side of the cutting mark	Multi-strand and non-preformed ropes shall be seized before being cut. For multi-strand ropes, the length of each seizing should be 3.5 rope diameters
3	Cut	Preferably cut with an abrasive wheel
4	Mark to show the limits for permanent seizing	See Figure 6.5.2
5	Select the correct socket and seizing material	The seizing should be tinned or galvanized wire or strand. It has to be of suitable size to secure the rope but small enough to allow the seized part of the rope to pass through the socket neck
6	Clean surfaces	Ensure the inside of the socket bowl is clean and free from contamination
7	Apply a permanent seizing	—
8	Remove the temporary seizing	—
9	Prepare a length of rope to be threaded through the socket, so that it does not contaminate the inside of the socket with dirt or grease	For lightly lubricated ropes, it is usually sufficient to wipe the surface of the rope with a rag containing a solvent. For heavily lubricated ropes, it may be necessary to wrap the length of rope concerned
10	Slide socket onto rope and if considered necessary, fit a stopper to the rope	—
11	Open the wires to form a brush	Bend the rope strands outwards to an angle of not more than 45° and unlay them to form a brush. Steel cores should be similarly brushed. Fibre cores should be cut back into the throat, as far as possible. See Figure 6.5.4
12	Clean the brush	Thoroughly clean the open brush with an approved degreasing fluid. Hold the brush downwards while it is being cleaned. Where a degreasing fluid is used, it should be removed by hot running water, surplus water being removed by draining and, if possible, shaking. Where water is used, it is recommended that it be removed by draining, shaking or using compressed air
13	Hook the wires only where considered necessary (e.g., where using 6 × 7 and similar coarse rope or strand constructions)	—
14	Reform the brush	After cleaning, the brush should be reformed into the same shape as the inside of the socket bowl. Evenly distribute the wires throughout the brush
15	Draw the socket over the brush	—

(continued)

TABLE 6.10(A) *(continued)*

Sequential steps	Action	Comment
16	Position and align the brush, socket and rope. Ensure the socket is correctly aligned in accordance with the customer's requirements	The axis of the brush, the socket and the rope should be in line. Draw the socket over the brush, until the ends of the wires are flush with or up to 2 mm above the top of the bowl. The rope below the socket should be straight for at least 30 rope diameters. A clamp may be fitted to assist in aligning the items being connected
17	Add the socketing material	Where using resin, refer to Table 6.10(B). Where using metal, refer to Table 6.10(C)

TABLE 6.10(B)
RESIN SOCKETING PROCEDURE

Sequential steps for resin	Action	Comment
18	Read the manufacturer's instructions before use	Only use specific resins for socketing
19	Select the correct sized resin kit for the size of socket. Make sure the expiry date has not been passed	Where the minimum kit size is too big for a single socket, several sockets may be poured together. However, make sure that all of the sockets are prepared and that all the pouring takes place before the resin thickens
20	Seal the neck of the socket with clay, plasticine or a similar suitable material, to prevent resin leakage	For very large ropes, presealing using a small resin pack may be an advantage Fluxing shall not be used with resin socketing
21	Pour all the resin into a suitable clean container and add all of the catalyst, hardener and filler. Stir until the mix is uniform	Polystyrene-based containers are not suitable
22	As soon as the mix is uniform, pour it down the inside face into the socket until the socket is full. Puddle if necessary to remove trapped air	—
23	Allow the resin to harden naturally without moving the socket or the rope	Hardening normally takes about 1 h and can be checked by scratching the surface of the resin. Refer to the manufacturer's instructions for hardening times
24	Remove the permanent seizing, up to the neck of the socket	—
25	Check for: (a) Alignment of the socket and the rope (b) Alignment of the socket lugs (c) Wire protrusion	—
26	Relubricate the rope below the socket	—
27	Proof load the assembly, whenever possible	See Clause 6.2.4

TABLE 6.10(C)
METAL SOCKETING PROCEDURE

Sequential steps for metal	Action	Comment
18	Seal the neck of the socket with yarn or a similar suitable material, to prevent metal leakage	—
19	Prepare the white metal or the zinc	White metal should comply with BS 643. Zinc should be of 99.99% purity. The pot should be fed with new ingots and the temperature maintained at $350^{\circ} \pm 10^{\circ}\text{C}$ for white metal and 470 to 500°C for zinc Immediately before pouring, the temperature should be checked by a pyrometer, with the dross skimmed off
20	Preheat the socket to between 120°C and 200°C , preferable nearer to the upper limit, applying heat evenly and gradually to the outer surfaces	Use a temperature-sensitive crayon to check the temperature. Take care not to overheat the socket, especially where the rope has a man-made fibre core Do not allow flames to touch wires of the rope
21	As soon as the preheating temperature is reached, flux thoroughly with a non-corrosive flux	—
22	Immediately after fluxing, pour the molten metal in one continuous stream down the inside face into the socket until the socket is full. This shall be carried out in one operation	—
23	Allow rope and socket to air-cool without being disturbed	If metal sinks below the rim of the socket, either it should be blown over or after melting the surface with a torch, additional molten metal should be added
24	Remove the permanent seizing up to the neck of the socket	—
25	Check for: (a) Alignment of the socket and the rope (b) Alignment of the socket lugs (c) Wire protrusion	—
26	Relubricate the rope below the socket	—
27	Proof load the assembly, whenever possible	See Clause 6.2.4

SECTION 7 SPLICING

7.1 SPLICING TOOLS

Tools of a suitable size, type and quality should be used. Typical tools are shown in Figure 7.1(A).

Care should be taken while entering spikes to ensure that the core is not cut, and strands and wires are not distorted or damaged by careless spike work or hammer work.

With most flexible ropes, the point of the spike may be entered by pressing the point down and into the rope with the thumb and simultaneously pulling the butt end of the spike down and into the rope (see Figure 7.1(B)).

With stiffer and larger ropes, it is better to use a small pilot spike to provide an entry for the working spike. Flat tapered or sword spikes are handy for such work.

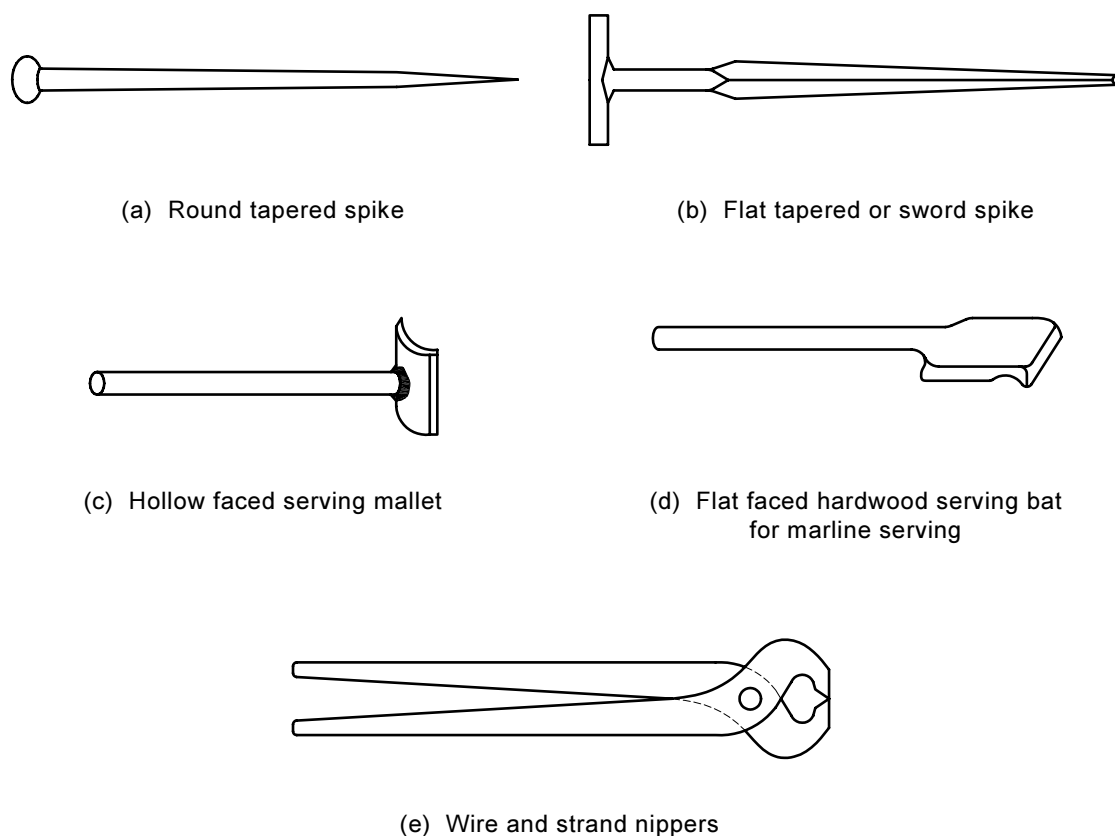


FIGURE 7.1(A) TYPICAL TOOLS FOR SPLICING

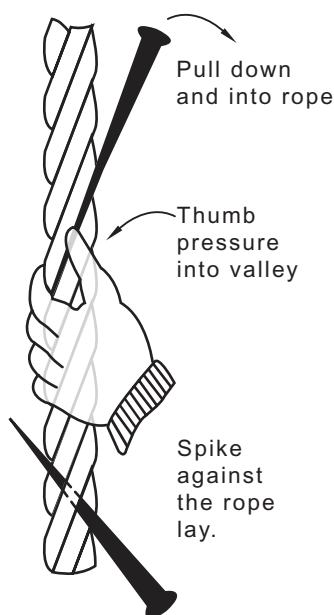


FIGURE 7.1(B) ENTERING SPIKE FOR TUCKING

7.2 TUCKING LENGTHS FOR EYE SPLICES

Table 7.2 shows the tucking lengths that should be allowed for eye splices in 6-strand ropes.

TABLE 7.2
TUCKING LENGTH FOR EYE SPLICES IN 6-STRAND ROPES

Number of tucks per strand	Tucking length allowance
5	40 rope diameters
6	45 rope diameters
7	50 rope diameters
8	55 rope diameters
9	60 rope diameters

7.3 NUMBER OF TUCKS FOR EYE SPLICES

7.3.1 Cores of the rope

For both ordinary and Lang's lay ropes having wire rope cores, the core shall not be cut out at the commencement of the splice.

For small ropes up to 16 mm diameter, the steel core may be left intact, laid along the rope and taken under a suitable strand, thus forcing the steel core into the centre of the rope and securing it against creep in the rope.

For larger ropes with wire rope cores, the core should be unlaid and each core strand laid up with one of the outer rope strands for a minimum of three full sets of tucks in splices with five or six sets of tucks, and for five full sets of tucks in splices with eight or nine sets of tucks.

7.3.2 Le Blanc splices

When correctly made, the Le Blanc splice meets the intent of this Standard.

7.3.3 Ordinary lay—Slings, anchorages and standing rigging

Splicing of slings, anchorages and standing rigging using 6-strand ordinary lay rope should be made in accordance with the procedure shown in Table 7.3.3.

7.3.4 Ordinary lay—Crane ropes

Splicing of crane ropes using 6-strand ordinary lay rope should be made in accordance with the procedure shown in Table 7.3.4.

7.3.5 Lang's lay ropes

Because Lang's lay ropes generally have longer lays, somewhat lower frictional gripping and a greater tendency to unlay, splices in 6-strand Lang's lay rope should be made using an increased number of tucks as shown in Table 7.3.5.

7.4 PREPARATION OF ROPE FOR SPLICING AN EYE

Ropes may be spliced vertically ('up and down') or horizontally ('on the level').

In vertical splicing, the running or tucking end is normally set up on the left of the main or standing part of the rope when looking at the rope, whereas in horizontal splicing the running part is normally on the right-hand side of the standing part of the rope, when looking towards the thimble or throat of the eye.

For thimble splices, particularly on multi-layer strand ropes, and on large-sized ropes, the rope may need to be well seized around the eye to prevent chafing between the rope and the thimble, and to avoid undue distortion of the rope when bent round the thimble.

Seizings are best applied to the rope with seizing mallets or seizing bats as shown in Figure 7.1(A)(c) and (d).

At a distance AB in Figure 7.4 equal to the length required for tucking (see Table 7.2) place a short seizing on the rope to prevent springing of the rope at this point when the strands are unlaidd.

Place a second short seizing at D, the length BD being equal to the perimeter of the thimble or eye. The outer ends of the two seizings at B and D should just meet the point of the thimble when the rope is bent round the thimble to form an eye.

Make the length of the seizings at B and D equal to two rope diameters.

When a thimble splice is being made, seize the centre of the crown of the thimble to the rope at C, midway in the length BD.

After the rope has been bent round the eye, securely seize the rope to the thimble at E and F.

This procedure is suitable for the splicing of flexible and small-sized ropes. For stiffer constructions and larger sizes, however, it is advisable to seize the whole length BD with marline or wire strand to prevent undue distortion of the rope when it is bent round the eye and to prevent chafing between the rope and the thimble.

The length AB for tucking varies with the construction of the rope and the number of tucks called for, the lengths shown in Figure 7.4 being those normally used for standard 6-strand rope eye splices made with five sets of tucks (three with full strands and two with half strands).

The rope should be secured round the thimble at points C, E and F, and then mounted vertically in the vice as shown in the figure, with the tucking end of the rope on the splicer's left when looking at the rope.

Particularly where a lot of splicing is done, the vice should be mounted on a pivoted plate set up on a vertical post (see Figure 7.4). This allows the splicer to take some turn out of the rope before starting to splice and gives him the freedom to work right round the splice without reversing it in the vice.

Cut off the end seizing at A and open the strands right back to the seizing at B as shown.

Pull the core down well into the throat of the splice, clear of the strands, and ready to be tucked away with No. 1 strand to prevent 'sinking' of the splice at the throat and to anchor the core.

TABLE 7.3.3
TUCKING DETAILS FOR SLINGS, ANCHORAGES
AND STANDING RIGGING

Rope diameter mm	Tucking length allowance	Sets of tucks	Tucking sequence
≤26	40 rope diameters	5	3 sets using 6 full strands 2 sets using 3 alternate full strands, with the other 3 cut out
>26 ≤36	45 rope diameters	6	4 sets using 6 full strands 2 sets using 3 alternate full strands, with the other 3 cut out
>36	45 rope diameters	6	4 sets using 6 full strands 1 set using 6 split, reduced or tapered strands with one-third of each strand cut out 1 set using 6 split, reduced or tapered strands with two-thirds of each strand cut out

TABLE 7.3.4
TUCKING DETAILS ON CRANES

Rope diameter mm	Tucking length allowance	Sets of tucks	Tucking sequence
≤26	40 rope diameters	5	3 sets using 6 full strands 2 sets using 3 alternate full strands, with the other 3 cut out
>26	45 rope diameters	6	4 sets using 6 full strands 1 set using 6 split, reduced or tapered strands with one-third of each strand cut out 1 set using 6 split, reduced or tapered strands with two-thirds of each strand cut out

TABLE 7.3.5
TUCKING DETAILS FOR LANG'S LAY ROPES

Rope diameter mm	Tucking length allowance	Sets of tucks	Tucking sequence
≤32	50 rope diameters	7	5 sets using 6 full strands 1 set using 6 split, reduced or tapered strands with one-third of each strand cut out 1 set using 6 split, reduced or tapered strands with two-thirds of each strand cut out
>32	55 rope diameters	8	6 sets using 6 full strands 1 set using 6 split, reduced or tapered strands with one-third of each strand cut out 1 set using 6 split, reduced or tapered strands with two-thirds of each strand cut out

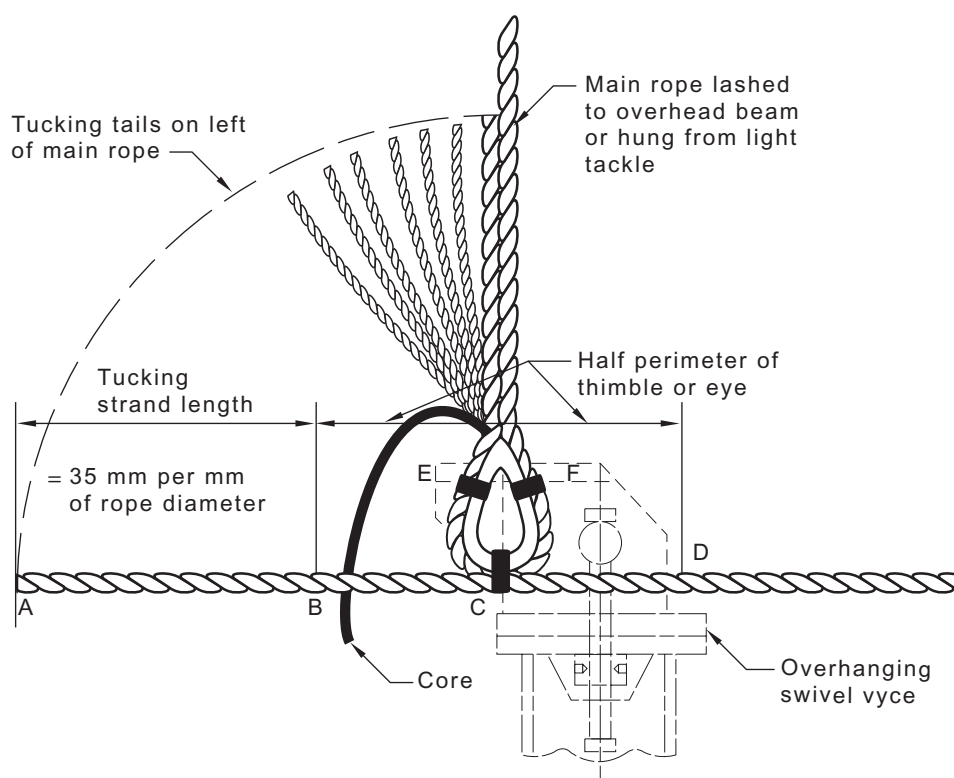


FIGURE 7.4 PREPARATION OF ROPE FOR SPLICING AN EYE

7.5 TUCKING METHOD

7.5.1 General

The following procedure should be followed whenever an eye is hand spliced in a wire rope:

- (a) For each strand, the distance between the first tuck and the point where the strand passes into the lay of the rope should be as short as possible.
- (b) For the first set of tucks, the tucking strands should emerge from the valleys of the main rope in their correct position and as uniformly as possible, so that the load applied to the rope through the eye splice will be applied evenly to all strands. For standard 6-strand ropes, one tucking strand should come out through each valley in the main or standing part of the rope.
- (c) The tension applied to each of the tucking strands, when they are being pulled into their final position, should be as uniform as is possible.
- (d) After correctly placing the first set of tucks, the splicing is continued with each tucking strand being taken over the adjacent strand to the left (for right-hand laid ropes), then under the next strand and continued thus in turn for the required number of tucks.

For larger or stiffer ropes, the tucks subsequent to the first set are taken over one strand and under the next two strands, to provide a smoother splice.

As the rope will always tend to unlay itself under load, unless such unlaying tendency can be controlled, the tucks shall be made against the lay of the rope so that they will be nipped and held. For this reason, it has become standard practice to make all eye splices for slings or hoisting ropes against the lay. Such splices are commonly known as 'over-and-under-against-the-lay' splices or 'cross-tucked' splices.

Splices made with the lay, commonly known as Liverpool splices or spiral splices, shall not be used for general purposes; as where the rope rotates, the tucks have a tendency to withdraw under load.

The following apply to hand splicing of wire ropes:

- (i) Some splicers have a tendency to do too much spike rolling on all classes of rope. However with larger rope, the spike should be worked up the rope, away from the eye or thimble, then, after passing the tuck under the point of the spike and pulling it tight, the spike should be rolled back to the eye forcing the tuck right home, snug and tight into its final position. Each tuck should be pulled home until it is as nearly as practicable at right angles to the axis of the rope. While large or stiff strand tucks are being pulled home, the end of the strand should be taken firmly in both hands, pushed away from the body and then smartly jerked hard home and worked into its final position with the spike.
- (ii) Tucking may be assisted by taking some turn out of the main rope, but at all times the amount of turn taken out should only be sufficient to allow the spikes to run without undue forcing of the strands. It should be remembered that ropes are laid up as uniformly in shape and tightness of laying as possible, and neither should be upset more than is necessary to make a good neat and sound splice.
- (iii) Rope strands, particularly those of the larger and stiffer ropes, should not be allowed to kink while the tucks are being passed through the rope. Strands that have been kinked should be withdrawn and repassed without a kink.
- (iv) Where the rope has a fibre core, the core should be tucked into the main part along with No. 1 strand and then cut off where it emerges from the main or standing part of the rope.

Where the rope has a wire rope core or a wire strand core, the core should be run up with the other strands for at least three tucks. It should never be cut out at the start of the splice. Some splicers run steel cores up in one piece along with the other strands, this practice being satisfactory for smaller ropes, but in most cases the core is split up and the strands or wires are distributed as evenly as possible among the main strands and tucked away with them.

- (v) Splices that require protection for hands or other adjacent materials should be served only over the tail of the splice so as to protect the hands from protruding wires, thus allowing the remainder of the splice to be visually inspected.
- (vi) A thimble or loop splice made in any wire rope shall have at least three sets of tucks with a whole strand of the rope, and two sets of tucks with one-half of the wires cut out of each strand.

7.5.2 First set of tucks

For over-and-under-against-the-lay or cross-tucked splices, there are several ways of making the first set of tucks, each with its reputed advantages.

Three of the accepted methods of making the first set of tucks are shown in Table 7.6.1 and details for carrying out the first method are given in Clause 7.6.2, which describes the making of a five-tuck splice.

The aim of the various systems of making the first set of tucks is to get a neat splice with the least displacement of the rope strands, and which will provide a tight fit on the thimble when thimbles are used to form the eye.

7.6 TUCKING SEQUENCE FOR FIVE-TUCK EYE SPLICES

7.6.1 Different methods

There are several ways of making the first set of tucks in a cross-tucked splice.

Three accepted methods are shown in Figures 7.6.1(a), (c) and (d), which are detailed in Table 7.6.1.

Figures 7.6.1(c) and (d) show two alternative accepted methods of making the first set of tucks in a five-tuck cross-tucked splice.

These systems of tucking are quite suitable and safe for the majority of 6-strand ordinary lay ropes, particularly for ropes up to 32 mm diameter, and nothing is gained in the tensile efficiency of such splices by increasing the number of sets of tucks beyond five in this range. However, in larger-sized ropes, special applications, Lang's lay ropes and non-rotating ropes, the number of sets of tucks should be increased to ensue maximum efficiency of operation.

Clause 7.2 and Table 7.2 give recommendations for the number of sets of tucks and estimated length of rope required for tucks in various ropes. A good splicer will always endeavour to keep such lengths to a minimum, but the lengths quoted cater for average splicers.

No. 1 method is described in detail by Clause 7.6.2.