

CHAPTER 3
RIGGING AND DECK GEAR
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CHAPTER 3

RIGGING

03001. Introduction to Types of Rope

- a. Most ropes can be described as belonging to one of three main types:

Cordage made of natural fibres (NFC)
Cordage made of man-made fibres (MMFC)
Steel wire rope (SWR)

- b. In the Royal Navy, ropes are described by reference to the diameter of the rope measured in millimetres (mm), the type of construction and the material from which it is made - for example, 36mm braidline polyester. However, certain proprietary brand ropes contain a mixture of materials, either from two of the three main types, or from a mix of materials from one type, e.g. a combination of man-made fibres. These ropes are usually referred to by their proprietary name.

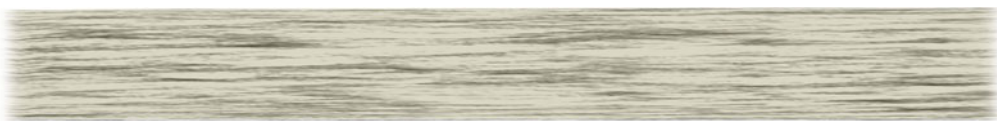
03002. Construction, Characteristics and Details of Supply of Natural Fibre Cordage

- a. Use in the Royal Navy of natural fibre cordage has dwindled in recent years, primarily because man-made fibre cordage is stronger, harder wearing, more cost effective, and in most circumstances, more functional than natural fibre cordage. However, natural fibre cordage is still required for certain tasks, and this requirement is likely to continue for the foreseeable future. All Natural Fibre Cordage supplied to the Royal Navy is supplied with a test certificate, and certificate of conformity, on which are listed the date of manufacture, the British standard to which the rope has been manufactured, and the guaranteed minimum breaking strength of the rope.

- b. **Construction.**

- (1) Natural fibre ropes are made from fibres of varying length dependent upon their source, and the first process is to comb out these fibres into a long, even ribbon shown in [Fig 3-1](#).

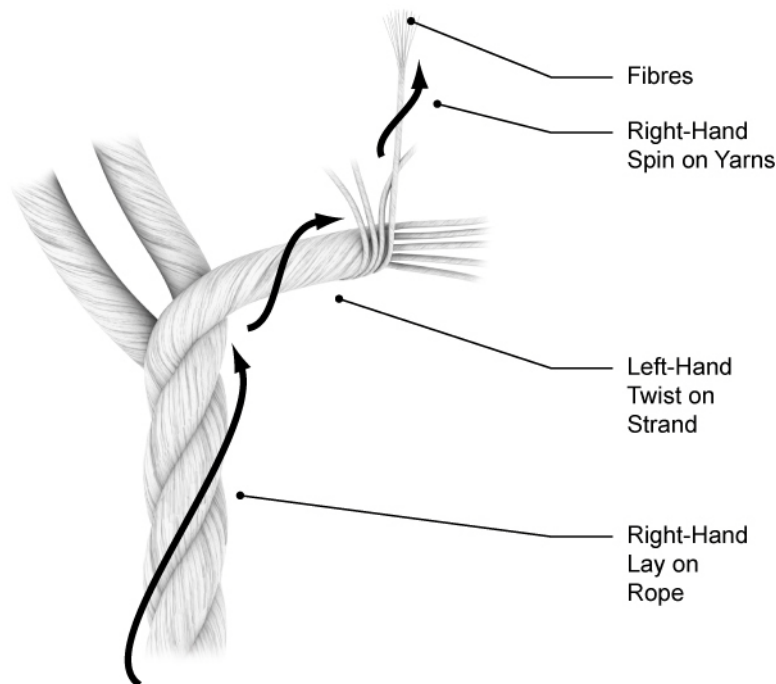
Fig 3-1. Fibres of a Natural Fibre Cordage Rope



- (2) The ribbons are then twisted up into yarns, and the twist given binds the fibres firmly together so that they hold by friction when the yarn is subjected to strain. This process is known as 'spinning', and the yarns are said to be spun left-handed or right-handed according to the direction of the twist. Next, a certain number of yarns are twisted together to form strands. The number and size of yarn to make each strand depends on the size of the rope to be made. This stage is known as 'twisting the strands', and again, the twist can be left-handed or right-handed. Three or four strands are now made up into a left-handed or right-handed rope. This process is called 'laying' or 'closing', and is always carried out in the direction opposite to that used in the previous stage of twisting the strands; it is, moreover, distinct from the simple spin or twist and is two-fold, in that:

- (a) The strands are twisted up together to form the rope.
- (b) At the same time the strands are rotated individually in the direction of the original twist.
 - i. Were this not done, laying the strands up together would tend to untwist the yarns in each strand.
 - ii. As the rope is laid up, its length contracts like a coiled spring, giving it certain elasticity. The harder the twist given to the strands in laying, the shorter will be the resultant rope and thus a rope is said to be **hard-laid**, **ordinary laid** or **soft-laid** rope. In practice, three strands of 275 metres lay up into a rope of about 220 metres in length. Three strands so laid up constitute a *hawser-laid* rope (Fig 3-2). Right-handed hawser-laid rope is the only type of natural fibre cordage now used in the Royal Navy.

Fig 3-2. Component Parts of a Natural Fibre Right-handed Hawser-laid Rope



c. **General Characteristics.** The strands tend to unlay unless the end of the rope is whipped (ie firmly bound) with twine. The rope will stretch under load and will not completely recover when the load is removed. The rope acquires a permanent and irreversible **set**; the higher the load in relation to the breaking strength, the greater the set. The set may be observed by the extension in length and reduction in diameter when the rope is slack and will eventually render the rope unfit for service. The older and more worn the rope, the less elasticity it will possess and the weaker it will become. Rope under load will tend to twist in the opposite direction to that of its lay and thereby tend to unlay itself, but it should regain its normal form when slack. When wet, Natural Fibre Cordage will usually shrink in length in proportion to the amount by which it swells in diameter, but it will recover its original length when dry and after use. Rope which is continually subjected to heat and damp - when in the tropics, for example - will lose its elasticity and strength sooner than rope used under normal conditions of temperature and humidity.

d. **Materials Used.** There are now only two natural fibre ropes supplied to the Royal Navy, **Manila** and **Sisal**. The fibres of the rope are treated with a water proofing solution during the first stage of rope making when the fibres are combed into ribbons.

(1) *Manila Rope.* This rope is made from the leaf fibre of the **Abaca** plant, which is grown in the Philippines and shipped from the port of Manila (whence its name), and also Sumatra and Borneo. When new and untreated, it is a deep golden-brown in colour. The rope is flexible, durable, strong when compared with other natural fibre ropes, impervious to salt water and stands up well to wear and tear. However, its advantages over man fibre cordage are that it stretches less, will surge more readily around a winch or capstan, and does not fuse when heated (ie when being surged under strain or used as a check stopper). It is currently used as a check stopper for towing operations. Manila rope is marked with one black yarn in each of two strands, and supplied in coils of 220 metres.

(2) *Sisal Rope.* This rope is made from the **Agave Sisalana** plant, which is a member of the cactus plant. It is grown in Brazil, Malagasay, Kenya, Tanzania, Haiti and Java; when new and untreated it is hairy, and of a pale straw colour. New sisal is as strong as manila, but is not as flexible, durable or resistant to wear and weather. Its principle use is as a slip rope during replenishment at sea, and its advantages over man-made fibre ropes are similar to those outlined for manila. Sisal rope is marked with one red yarn in one strand, and supplied in coils of 220 metres.

e. **Strength.** A method of finding the approximate breaking strength of manila and sisal cordage is to divide the square of the diameter of the cordage in millimetres by 200, the answer being in tonnes. This allows for a good margin of safety. To estimate the strength of a rope which is well worn but in good condition, apply the formula as for new rope, but use the **actual** and not the **nominal** diameter. However, the only really reliable method by which the strength of a rope may be determined is to test a sample of the worst part of the rope to destruction.

f. **Details of Natural Fibre Cordage Supplied to the Royal Navy.** Table 3-1 gives details of natural fibre cordage supplied to the Royal Navy.

Table 3-1. Details of Natural Fibre Cordage Supplied to the Royal Navy

Type	Size	Naval Stores No	Minimum breaking load	Supply denomination
Manila	8mm	0350/571-3074	0.45 tonnes	220m
	12mm	0350/125-0228	1.06 tonnes	220m
	16mm	0350/942-5025	2.03 tonnes	220m
	20mm	0350/571-3077	3.25 tonnes	220m
	24mm	0350/942-5026	4.57 tonnes	220m
Sisal	12mm	0350/942-5042	0.95 tonnes	220m
	16mm	0350/942-5044	1.80 tonnes	220m
	20mm	0350/942-5046	2.85 tonnes	220m
	24mm	0350/942-5048	4.07 tonnes	220m
	28mm	0350/942-5050	5.33 tonnes	220m
	72mm	0350/942-5060	32.7 tonnes	220m

g. **Care and Maintenance of Natural Fibre Rope.** Natural fibre rope does not have a permanent elastic limit. The life of a rope depends on the amount it is used under strain, because the fibres tend to slip a small amount under each load in spite of the twist given during manufacture. NFC should not be stowed away while it is wet; if this is unavoidable the rope must be brought out and dried at the first opportunity. Although any rope in good condition can be confidently expected to bear its full working load with ease, allowance for wear must be made in assessing the full strength of used rope, particularly when it has been subjected to hard conditions. Before estimating the strength of such a rope it should be examined for damage, chafe, rot and fatigue. Serious damage can be seen when the strands are distorted and bear unequal strain, or when the rope becomes opened. Rot can be detected by the smell of the rope and by opening out the strands and examining their inner surfaces. Should they be healthy and strong, all is well; if they are powdery, discoloured, weak or can be plucked out, rot exists and the rope should be condemned. Rope may also be subject to chemical attack. Many rust-removal compounds are based on phosphoric acid which has a disastrous effect on natural fibre, and for this reason cordage should always be protected from contamination. If doubt exists as to the serviceability of a rope, the rope should be condemned.

03003. Construction, Characteristics and Details of Supply of Man-made Fibre Cordage

a. Prior to 1939, natural fibres were the only materials available for cordage manufacture. In 1939 a new man-made yarn known as **Nylon**, invented earlier, became available to the cordage industry. From the outset it was evident that this synthetic fibre possessed such remarkable qualities that a great advance had been made in the cordage industry. The technical name for Nylon is **Polyamide**. Both names are interchangeable but the latter is preferred in the Royal Navy to distinguish it from other synthetic materials, which were subsequently developed and are used for cordage manufacture. These latter materials are **Polyester**, **Polypropylene**, **Polyethylene**, and the three most recently developed, **Aramid**, a derivative of **polyamide**, **polyolefin**, a derivative of polypropylene, and **High Modulus Polyethylene** (HMPE). The various man-made fibre ropes have different characteristics which make them especially suitable for specific tasks. For example, polyamide has greater elasticity than polyester and is therefore very suitable for use as towing hawsers and boat anti-shock stops. Polyester, because of its relatively low elasticity and excellent weather and abrasion resistance, is suitable for berthing ropes and replenishment lines, and staple spun polypropylene is appropriate when light, floating, easily handled ropes such as towing hawser messengers and swimmer recovery lines are required. Polyethylene in its basic form is used principally in ships' diving operations as a swim-line, because it is orange in colour and therefore easily visible. It has similar characteristics to, but is weaker than, polypropylene. Aramid is at present used only for dressing lines, where, because it is strong, non-inductive and has little elasticity, it is replacing steel wire rope. High Modulus Polyethylene (HMPE), a very high strength, low stretch fibre, is being introduced as a replacement for steel wire rope berthing springs. Polyolefin, introduced as a first generation plaited berthing hawser, is being replaced by rope blending polyester and polypropylene. Cordage made from man-made fibre is naturally rot-proof and almost impervious to water. Unless specially treated, this type of rope, except Aramid and HMPE, will stretch far more than natural fibre cordage. This stretch ranges from 25-30% for film-fibre polypropylene to 45-50% for polyamide at breaking load. All man-made fibre ropes can be considered non-flammable in that they do not readily ignite or burn with a flame. In the molten state these materials will burn but only at a temperature approximately twice that of their melting point.

b. **Construction.** Polyamide, polyester, polypropylene and polyethylene all fall into the **polymer** group. Polyamide is produced from coal whereas the remainder are produced from oil. Most man-made fibres are made from either continuous filaments, or yarns of staple fibres, but polypropylene ropes can be manufactured from **multifilament**, **monofilament**, **staple** or **film-fibre**. Details are as follows:

(1) *Staple.* These fibres vary in length and the processing machine on which they are to be used determines this length. For rope-making the staple length varies between 150mm and 1300mm. Although weaker than continuous filament cordage of equivalent size and material, staple spun cordage is ideal in applications where a good grip is required.

(2) *Multifilament.* These yarns are composed of a number of very fine filaments of circular cross-section twisted together, each filament being continuous throughout the yarn length.

(3) *Monofilament*. These are usually circular in cross-section and are continuous throughout their length. Micrometer-type gauges are used to measure their diameter, which, for rope making, can range from 0.125mm upwards.

(4) *Film-fibre*. Film-fibre is composed of **fibrils** produced by longitudinal splitting when an extruded tape or ribbon is twisted into a yarn.

(5) *3 Strand Hawser-laid*. Hawser-laid man-made fibre ropes are manufactured in the same manner as natural fibre ropes, with three strands laid up and a right-hand twist (Fig 3-2). Each strand is composed of a sufficient number of uniform filaments of specified polymer to give a rope the required strength. A higher twist is imparted to the strands than to those of natural fibre, and the ropes are subjected to a form of heat treatment to stabilise the lay and thereby reduce the tendency of the strands to separate in service. It is important that the twist and balance of the lay should be undisturbed, especially when being spliced.

(6) *Plaited Rope*. The rope is constructed of eight strands arranged in four pairs (Fig 3-3), two pairs of left-hand lay and two pairs of right-hand lay. This arrangement is known commercially as 'Squareline' but in naval use is commonly referred to as multi-plait. Its properties are very similar to hawser-laid except that it is a softer rope and does not kink.

Fig 3-3. Construction of Plaited Rope



(7) *Braided Rope*. This rope, known commercially as core/cover rope, is constructed by crossing and re-crossing the yarns or strands in 'maypole' fashion such that each yarn or strand passes alternatively over and under one or more of the others to form a circular tubular sheath, which may contain a core. The use of braided cordage in the Royal Navy is limited to certain specific applications. Braided construction gives the following advantages over hawser laid ropes; good flexibility and easy handling when wet or dry, new or worn; non-rotating and will not kink; more grip on capstans or warping drums because of the greater contact area. At present the only categories of braidline in use in the Fleet are a braided sheath around a core of either parallel strands, or a three-strand rope, or a multiplicity of three strand rope core members. All braided ropes fall into one of the following categories:

- (a) A braided sheath around a braided core having a heart of parallel strands (Fig 3-4).
- (b) A braided sheath around a hollow braided core (Fig 3-5).

(c) A braided sheath around a core of either parallel strands, or a three-strand rope, or a multiplicity of three strand rope core members. (Fig 3-6).

(d) A braided sheath with no core (hollow-centred rope).

(8) *Guardwire*. This type of rope is constructed of a load bearing core of densely packed parallel filaments, generally polyester, and encased within a tough durable polyethylene sheath. An example of this type of rope is parafil.

(9) *Aramid*. This type of rope has a braided polyester sheath around a three-stranded Aramid multifilament core. 95% of the strength of this rope comes from the Aramid core.

Note. Unlike other MMF cordage the Aramid core cannot be heat-sealed

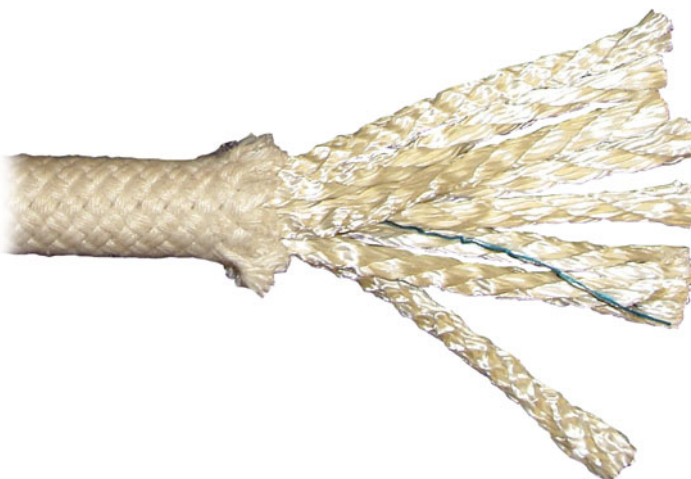
Fig 3-4. A Braided Rope with Braided Core and Heart of Parallel Strands



Fig 3-5. A Braided Rope with Hollow Braided Core



Fig 3-6. A Braided Rope with a Multiplicity of Three Strand Rope Core Members



c. Characteristics.

(1) *Polyamide*. This multifilament cordage is approximately two-and-a-half times as strong as manila of equivalent size. It stretches by almost half its length before parting and gives little, if any, warning that it is about to reach the limit of its stretch. Used within its safe working load it will stretch approximately 25% of its length and has excellent recovery. It does not float and it loses approximately 10% of its strength when wet. The melting point is 240-260°C and it is virtually unaffected by 80°C of frost. The working temperature range is -40°C to +100°C. Polyamide has a good weather and abrasion resistance and a high resistance to alkalis but low resistance to certain acids. Strong sulphuric acid, for example, will dissolve the fibres. The energy absorption qualities are excellent and are retained to a significant degree during repeat loading.

(2) *Polyester*. This multifilament cordage is nearly twice as strong as manila of equivalent size. It stretches approximately 36% before parting. Used within its safe working load it will stretch 14% of its length and has excellent recovery. The strength is virtually unchanged when wet, it does not float, the melting point is 240-260°C and it is virtually unaffected by 80°C of frost. The working temperature range is -40° to +100°C. Polyester has excellent weather and abrasion resistance and high resistance to acids but not alkalis.

(3) *Polypropylene*. This cordage is nearly twice as strong as manila of equivalent size and is the lightest in weight of the man-made fibres. It stretches up to 44% before parting. Used within its safe working load it will stretch 17% of its length. It retains its strength when wet and has a low water absorption. It will float indefinitely in water. The melting point is 160-170°C. The working temperature range is -40° to +80°C. Polypropylene has high resistance to acids and alkalis. Multifilament and monofilament polypropylene is not normally used for load-bearing ropes.

(4) *Polyethylene*. This cordage is about one-and-a-half times as strong as manila of equivalent size. It stretches 33% before parting, but used within its safe working load will stretch 14%. It floats, retains its strength when wet and has low water absorption. The melting point is 120-135°C. Because of its low softening temperature it is not recommended for load bearing application. High Modulus Polyethylene, a recently developed derivative of polyethylene, is size for size as strong as conventional steel wire rope.

(5) *Parallel Polyester Covered with Polyethylene Sheath (Guardwire)*. These ropes are light, thin and strong, require little maintenance and are resistant to creep and stretch. Tensile properties of parafil are close to those of steel wire rope, with the added advantage of electrical insulation and ultra-violet resistance. The dimensional and tensile properties are determined directly by the core yarn. As the polyethylene sheath is not a load-bearing component it follows that, provided the core yarn is undamaged, any damage to the sheath will not result in a loss of rope strength. These ropes are not affected by water, will not corrode or rot, and have an energy absorption two-and-a-half to three-and-a-half times that of steel wire rope of equivalent breaking load. These ropes are not suitable for winching or running through blocks because of the likelihood of sheath stripping, thereby exposing the core yarn to damage from abrasion. The smooth sheathing has excellent ice-shedding properties under severe conditions.

Note. Because of the requirement accurately to test new guardwires manufactured from parallel polyester covered with a polyethylene sheath, they can only be produced by shore side authorities. Damaged or broken guardwires onboard ship must be temporarily replaced with a spliced 12mm Polyester rope Patt No 0350/923-7143. Whenever possible the polyester rope should form the lower guardrail, if necessary by swapping guardrails.

(6) **Aramid.** These ropes are nearly six times as strong as manila of equivalent size. They require no maintenance and are highly resistant to stretch. However, Aramid has poor ultraviolet and abrasion resistance so the Aramid core is sheathed for protection in a braided polyester cover. Aramid ropes are very susceptible to damage if run through block sheaves or around winches that have a diameter less than thirty times that of the Aramid core of the rope.

d. **Identification.** Like Natural Fibre Cordage, all Man-made Fibre cordage supplied to the Royal Navy comes with a test certificate, and certificate of conformity, on which are listed the date of manufacture, the British Standard to which the rope has been manufactured, and the guaranteed minimum breaking strength of the rope **when new**. To prevent confusion, particularly between polyamide and polyester ropes whose external appearance is identical, identification yarns, where possible, are incorporated in man-made fibre ropes, in accordance with British Standard BS 6033; [Table 3-2](#) gives the details. However, with certain smaller ropes it is not possible for the manufacturer to include an identification mark, and in the most recently developed type of ropes and in certain ropes that contain a mixture of fibre types, no common standard of identification exists; therefore the test certificate and certificate of conformity supplied with the rope should be regarded as the only reliable guide to the breaking strength of the rope.

Table 3-2. Identification Yarns in Man-made Fibre Cordage

Material	Identifying colour	Identification marking
Polyamide	Green	One green yarn in one strand
Polyester	Blue	One blue yarn in one strand
Polypropylene*	Brown	One brown yarn in one strand or rope wholly coloured brown
Polyethylene	Orange	One orange yarn in one strand or rope wholly coloured orange

e. **Strength.** The rule-of-thumb method of calculating the breaking strain of man-made fibre rope is to divide the square of the diameter by a known factor. Table 3-3 gives the approximate strength of new cordage according to its diameter, d , in millimetres. However, it is emphasised that the test certificate supplied with the rope is the only accurate guide to the breaking strength.

Table 3-3. Calculation for Approximate Breaking Strength of Man-made Fibre Cordage

Cordage	Formula for Calculating Breaking Strength
High Modulus Polyethylene	$d^2/18$ tonnes
Aramid	$d^2/40$ tonnes
Polyamide (under 32mm)	$d^2/50$ tonnes
Polyamide (32mm and over)	$d^2/60$ tonnes
Polyester (under 32mm)	$d^2/64$ tonnes
Polyester (32mm and over)	$d^2/66$ tonnes
Polypropylene	$d^2/77$ tonnes
Polyethylene	$d^2/106$ tonnes
Berthing rope (under 32mm)	$d^2/60$ tonnes
Berthing rope (32mm and over)	$d^2/64$ tonne

f. **Uses.** The principle service uses of man-made fibre ropes are as follows:

- (1) *Polyamide*. Because of its elastic properties it is used for towing hawsers and anti-shock stops.
- (2) *Polyester*. Because of its low stretch, high strength, and excellent weather and abrasion resistance, these ropes are used as replenishment lines, safety nets, signal halyards and picking-up ropes.
- (3) *Polypropylene*. Being a floating rope it is used in its staple form for messengers associated with towing hawsers. It is also used for boat ropes, ammunition resupply whips, lifelines, and as the recovery line in Swimmer of the Watch rigs.
- (4) *Polyolefin*. Used to manufacture first generation of multi-plait berthing hawsers. See also [sub para \(8\)](#) below.
- (5) *Polyethylene*. This cordage, also a floating line and easily visible, is used principally in ships' diving operations.
- (6) *Aramid*. This cordage is at present used only for dressing lines.

(7) *Parallel Polyester Core with Polyethylene Sheath*. This cordage is used for standing rigging, principally guardrails.

(8) A Polyester/Polypropylene mix now specified for berthing hawsers.

(9) *High Modulus Polyethylene*. This cordage is a replacement for steel wire berthing springs. Its high cost is likely to limit its use in the Fleet.

g. **Details of Man-made Fibre Cordage Supplied to the Royal Navy.** Table 3-4 to Table 3-11 gives details of most man-made fibre cordage available through Naval stores.

Table 3-4. Polyamide Ropes and Lines Supplied to the Royal Navy

Type	Size	Naval Stores No	Minimum breaking load	Supply Denomination
Polyamide 3 strand	24mm	0350/923-7129	12.0 tonnes	220m
Polyamide 3 strand	28mm	0350/923-7130	15.8 tonnes	220m
Polyamide 3 strand	32mm	0350/923-7131	20.0 tonnes	220m
Polyamide 3 strand	36mm	0350/923-7132	24.8 tonnes	220m
Polyamide 3 strand	40mm	0350/923-7133	30.0 tonnes	220m
Polyamide 3 strand	44mm	0350/923-7134	35.8 tonnes	220m
Polyamide 3 strand	64mm	0350/923-7137	72.0 tonnes	220m
Polyamide braided	21mm	0350/549-1143	8.70 tonnes	220m
Polyamide braided	64mm	0350/251-4431	90.0 tonnes	65m*
Polyamide multi-plait	48mm	0350/794-8239	42.0 tonnes	220m
Polyamide multi-plait	64mm	0350/543-0143	72.0 tonnes	220m
Polyamide multi-plait	80mm	0350/543-0149	110.0 tonnes	220m
Polyamide cord gunline	1.5mm	0350/571-3024	64 kg	860m

* Braidline Bridle

Table 3-5. Polyester Ropes and Lines Supplied to the Royal Navy

Type	Size	Naval Stores No	Minimum Breaking Load	Supply Denom-ination
Polyester 3 strand	6mm	0350/923-7140	0.56 tonnes	220m
Polyester 3 strand	8mm	0350/923-7142	1.02 tonnes	220m
Polyester 3 strand	10mm	0350/879/5226	1.60 tonnes	220m
Polyester 3 strand	12mm	0350/923-7143	2.27 tonnes	220m
Polyester 3 strand	16mm	0350/923-7144	4.1 tonnes	220m
Polyester 3 strand	20mm	0350/923-7145	6.3 tonnes	220m
Polyester 8 plait blue	8mm	0350/529-7387	0.39 tonnes	220m
Polyester 16 plait blue	10mm	0350/529-7388	2.25 tonnes	220m
Polyester 16 plait blue	12mm	0350/529-7389	3.20 tonnes	220m
Polyester 16 plait blue	14mm	0350/529-7390	4.40 tonnes	220m
Polyester 16 plait blue	20mm	0350/529-7391	8.10 tonnes	220m
Polyester 8 plait red	6mm	0350/529-7392	0.30 tonnes	220m
Polyester 8 plait red	8mm	0350/529-7393	0.39 tonnes	220m
Polyester 16 plait red	10mm	0350/529-7394	2.25 tonnes	220m
Polyester 16 plait red	12mm	0350/529-7395	3.20 tonnes	220m
Polyester 16 plait red	14mm	0350/529-7396	4.40 tonnes	220m
Polyester 16 plait gold	12mm	0350/529-7397	3.20 tonnes	220m
Polyester 16 plait gold	14mm	0350/529-7398	4.40 tonnes	220m
Polyester 8 plait white	6mm	0350/529-7399	0.47 tonnes	220m
Polyester 8 plait white	8mm	0350/529-7400	0.56 tonnes	220m
Polyester 16 plait white	10mm	0350/529-7401	2.25 tonnes	220m
Polyester 16 plait white	12mm	0350/529-7402	3.20 tonnes	220m
Polyester 16 plait white	14mm	0350/529-7404	4.40 tonnes	220m
Polyester braided	5mm	0350/120-8768	0.40 tonnes	220m
Polyester braided	7mm	0350/571-3167	0.70 tonnes	220m
Polyester braided	9mm	0350/120-8692	0.79 tonnes	220m
Polyester cord	1.5mm	0350/520-9610	0.14 tonnes	500m

Table 3-6. Polypropylene Ropes Supplied to the Royal Navy

Type	Size	Naval Stores No	Minimum Breaking Load	Supply Denom-ination
Polypropylene 3 strand	24mm	0350/375-2994	7.6 tonnes	220m
Polypropylene 3 strand	8mm	0350/529-9737	0.96 tonnes	220m
Polypropylene 3 strand	10mm	0350/447-1147	1.42 tonnes	220m
Polypropylene 3 strand	12mm	0350/525-6204	2.03 tonnes	220m
Polypropylene 3 strand	16mm	0350/571-3172	3.5 tonnes	220m

Table 3-7. Polyethylene Lines Supplied to the Royal Navy

Type	Size	Naval Stores No	Minimum Breaking Load	Supply Denom-ination
Polyethylene H/L Orange	4mm	0350/571/3169	0.20 tonnes	220m
Polyethylene H/L Orange	8mm	0350/543-0141	0.70 tonnes	220m
Polyethylene H/L Orange	10mm	0350/571-3171	1.08 tonnes	220m

Table 3-8. Polyester/Polypropylene Blend Multiplait Rope Supplied to the Royal Navy

Type	Size	Naval Stores No	Minimum Breaking Load	Supply Denom-ination
Polyester/Polypropylene blend	24mm	0350/605-7959	9.92 tonnes	220m
	28mm	0350/807-3997	13.3 tonnes	220m
	32mm	0350/168-9190	17.1 tonnes	220m
	36mm	0350/810-3975	21.0 tonnes	220m
	40mm	0350/396-0753	26.1 tonnes	220m
	44mm	0350/244-7033	31.0 tonnes	220m
	48mm	0350/083-3184	36.5 tonnes	220m
	64mm	0350/513-8184	63.1 tonnes	220m

Table 3-9. HMPE Multiplait Ropes Supplied to the Royal Navy

Type	Size	Naval Stores No	Minimum Breaking Load	Supply Denomination
HMPE Multiplait	22mm	0350/481-9229	25 tonnes	220m
HMPE Multiplait	28mm	0350/657-6679	44 tonnes	220m

Table 3-10. Aramid (Kevlar) Ropes Supplied to the Royal Navy

Type	Size	Naval Stores No	Minimum Breaking Load	Supply Denomination
Aramid (Kevlar)	10mm	0350/801-0503	2.5 tonnes	500m

Table 3-11. Guardwire Ropes Supplied to the Royal Navy

Type	Size	Naval Stores No	Minimum Breaking Load	Supply Denomination
Guardwire rope	13.5mm	0350/635-1268	3.5 tonnes	300m

h. **Care and Maintenance of Man-made Fibre Rope.** The following advice is given for the care and maintenance of man-made fibre ropes.

- (1) *Exposure to Sunlight.* Although earlier experience of deterioration through exposure to sunlight, especially with polypropylene, has been mainly overcome by the use of inhibitors in the manufacturing process, man-made fibre ropes should not be exposed unnecessarily to sunlight.

- (2) *Exposure to Chemicals.* Avoid contamination by chemicals or fumes. Ropes that are inadvertently contaminated must be washed in cold running water.
- (3) *Handling.* Do not drag ropes over sharp or rough edges. Avoid penetration of abrading particles.
- (4) *Stowage.* Man-made fibre ropes are resistant to bacteriological attack, so they can be stowed for long periods without deterioration and may be stowed wet; however, when coiled, man-made fibre ropes should be stowed in bins or on raised boards in such a way as to allow free circulation of air beneath as well as around the rope. Ropes that are to be stowed on reels must be allowed up to six hours to recover their normal length before stowing if they have been under tension.
- (5) *Wear.* The presence of a fibre nap or whiskering fuzz distributed uniformly on strand surfaces is an indication of normal wear. Some disarrangement or breaking of the outside fibre is normally unavoidable, and, if it is not excessive, harmless.
- (6) *Crowsfooting.* Localised distortion of a strand by a back twist is known as 'crowsfooting' or 'cockling'. It occurs when the tension in a hawser laid rope is suddenly released and the balance of the twist does not recover in time, or when kinks are forced out of the line by pulling on the rope. The distortion is often so great that the strand is unable to return to its original lay thereby weakening the rope. Any section of rope with two or more strands 'cockled' must be cut out and the rope joined with a short splice.
- (7) *Chafing.* Chafing appears as a longitudinal line of heavy wear along the rope's surface and can be recognised by the tufted appearance of the rope. Avoid unnecessary chafing by protecting the parts concerned.
- (8) *Stretching.* The resistance of man-made fibre rope to repeated loading is good, but localised temporary elongation may occur. Measurement of the distance between regularly spaced indelible marks will indicate temporary elongation, and a reduction in diameter may be observed after loading.
- (9) *Rust.* Rope that has been in contact with corroding steel shows signs of yellow or brownish black. Stains that can be removed with soapy water have no adverse effect and those that persist only detract from the rope's appearance.
- (10) *Heat.* Ropes must not be stowed where there is excessive heat.
- (11) *Icing.* Although man-made fire ropes are virtually unaffected by very low temperatures (-80°C for polyamide and polyester) when a rope is iced it must be thawed at a **moderate** temperature before stowing.
- (12) *Oil and Grease.* Oil and grease may be removed with a mild solution of soap and water, followed by thorough rinsing in fresh water; strong detergent should not be used.

03004. Twines, Lines and Spunyarn

- a. **Twines** consist of a number of yarns twisted or laid to produce a balanced twisted structure of continuous length. Chalk line, used for marking material that is to be cut or stitched, is made from cotton. Seaming twine is made from flax and is used for whippings and sewing canvas gear; roping twine is also made from flax but is sturdier than seaming twine, and is used for whippings and sewing canvas and other heavy cloths where seaming twine is insufficiently robust.
- b. **Spunyarn** consists of a number of yarns twisted (spun) together. Originally it was made from any type of vegetable fibre or from yarns unlaied from any kind of old natural fibre rope; nowadays only three and six strand sisal spunyarn is available. It is used for servings, seizings, stops or any small work, and it has no specific strength.
- c. Details of twines, lines, and spunyarn supplied to the Royal Navy are in [Table 3-12](#).

Table 3-12. Twines Lines and Spunyarn Supplied to the Royal Navy

Type and Size	Naval Stores No	Minimum Breaking Load	Supply Denomination
Chalk line (cotton)	0350/571-3260	N/A	250gm Cops
Flax seaming twine	0350/571-3267	N/A	250gm Cops
Flax seaming twine	0350/571-3269	N/A	250gm Cops
Flax roping twine	0350/571-3270	N/A	250gm Cops
Sisal spunyarn 3 strand	0350/722-2646	N/A	4kg Spools
Sisal spunyarn 6 strand	0350/722-2649	N/A	4kg Spools

03005. Junk and Rounding

Junk consists of condemned cordage of 32mm size and above; Rounding is condemned cordage under 32mm in size. Junk and Rounding are used for lashings and other securing where the use of good rope is not necessary.

03006. Construction, Characteristics and Details of Supply of Steel Wire Rope (SWR)

- a. Improvements in the design and characteristics of man-made fibre cordage and slings, and the need in ships to reduce topweight, limit noise, and minimise interference to radar equipment has resulted in a reduction in recent years in the use of SWR throughout the fleet. However, steel wire rope still has many applications aboard warships and this requirement is likely to remain in the foreseeable future.
- b. **Construction.**
 - (1) A wire rope is constructed of a number of small wires, which extend continuously throughout the entire length; these wires are laid up into strands, and the strands themselves are laid up to form the rope. With the exception of certain special types described later, all wire rope used at sea is preformed, has a galvanised finish, and consists of six strands. The wires forming a strand are laid up left-handed round a fibre or wire core and the strands forming the rope are laid up right-handed round a fibre main core ([Fig 3-7](#)).

Fig 3-7. Construction of a Wire Rope



(2) During manufacture the individual strands are preformed to give the exact spiral they take up in the completed rope. Therefore the wires and strands lie in their true positions free from internal stress and will not spring out of place should the rope break or be cut. The main fibre core of a wire rope has two main functions:

(a) It acts as a cushion into which the strands bed, allowing them to take up their natural positions as the rope is bent or subjected to strain.

(b) It absorbs lubricant with which the rope should be periodically dressed, so that as the rope is stretched or flexed the lubricant is squeezed between the wires, thus lubricating them and reducing the friction between them.

(3) A wire rope can be made flexible in one of two ways:

(a) By replacing the centre wires of each strand with a large fibre core, in which case strength is sacrificed for flexibility,

(b) By making up each strand with a large number of small-gauge wires round a wire core, in which case the full strength is retained.

c. **Description.** In the Royal Navy the full description of steel wire rope states the diameter and construction of the rope followed by the construction of each strand, in brackets, eg 24mm 6X26 (15/9/Fibre) fibre-core steel wire rope. This indicates a diameter of 24mm, a construction of 6 strands around a central fibre main-core, each strand constructed from 26 wires, 15 of which are laid up around 9 which in turn are laid up around a fibre core (Fig 3-8). In practice a steel wire rope is identified simply by quoting the size and rope construction only and omitting the strand construction, eg 24mm 6X26 SWR. Ropes supplied to the Royal Navy are manufactured on the foregoing principles and fall into the following groups: 6X12, 6X19, 6X24, 6X26, 6X36, 6X41, 7X7 and 7X19. The degree of flexibility improves as the number of wires in the strands increases. Fig 3-8, Fig 3-9 and Fig 3-10 show the constructions of these groups. It will be seen that 7X7 and 7X19 constructions (Fig 3-9) can be misleading; here the main core is one of the seven strands with the other six strands laid up around it.

Fig 3-8. Construction of 6 Stranded Wire Rope

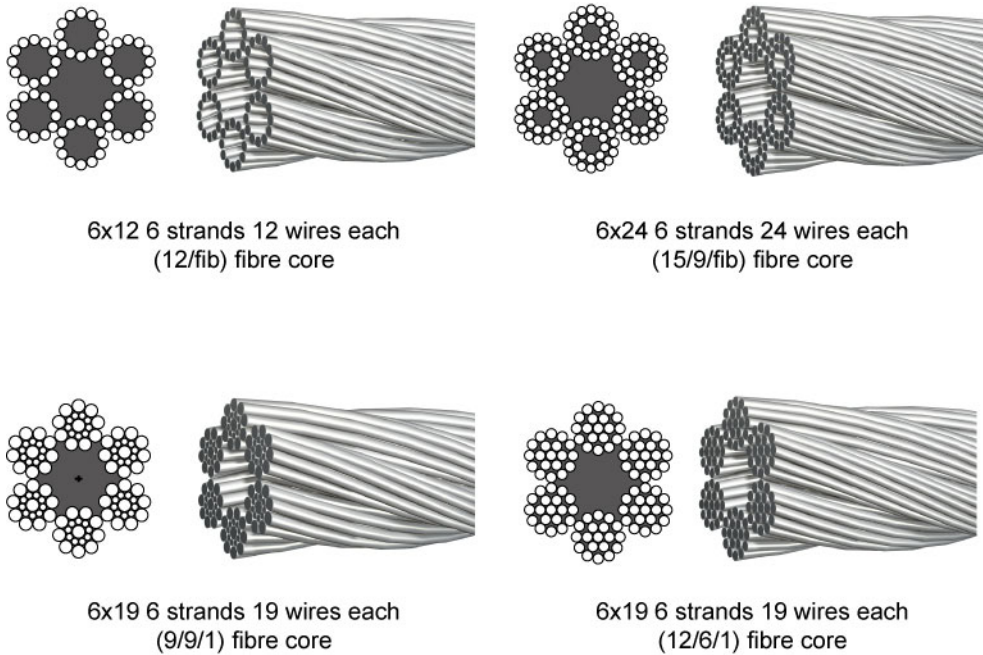


Fig 3-9. Construction of 7 Stranded Wire Rope

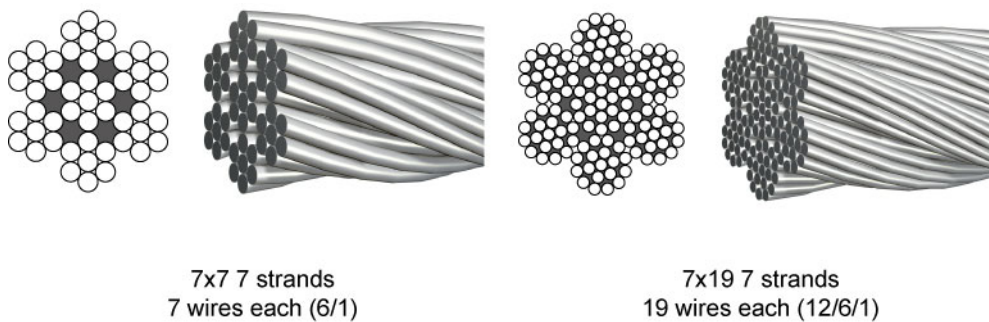
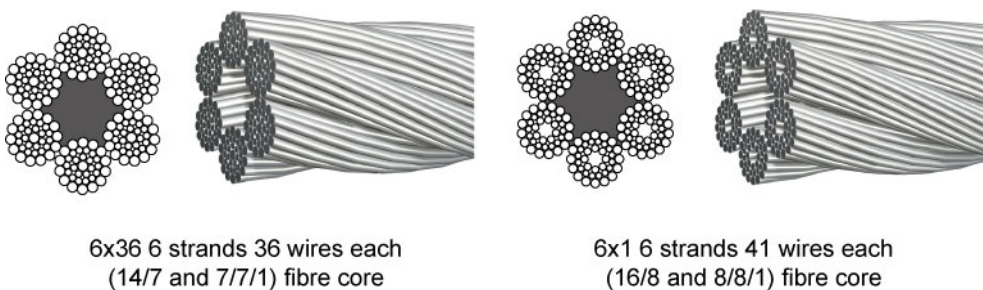


Fig 3-10. Construction of 6x36 and 6x41 Steel Wire Rope



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RIGGING AND DECK GEAR

d. **Uses.**

(1) *Steel Wire Rope, 7X7 and 7X19 Construction.* Suitable for standing rigging such as shrouds or guys, where it is not required to be as flexible as the wire rope used for running rigging. Its strands are made up of a small number of large-gauge wires wound round a wire core and the strands themselves are made up around a main core of similar construction to the strands.

(2) *Steel Wire Rope, 6X12 Construction.* Suitable for lashings, or temporary guardrails on a ship in refit or DRP. To make it flexible necessitates sacrificing a certain proportion of its strength and each strand consists of a certain number of medium-gauge wires wound round a large fibre core, the strands themselves being made up around a fibre main core.

(3) *Steel Wire Rope, 6X19, 6X24, 6X26, 6X36 and 6X41 Construction.* This range of ropes has greater strength and flexibility, and is used for running rigging, mooring, slinging, and towing in certain auxiliary craft. The strands are constructed of a number of small-gauge wires made up around a fibre core.

e. **Strength.** The rule-of-thumb method of calculating the breaking strain of conventional steel wire rope is to divide the square of the diameter by a known factor. [Table 3-13](#) gives the approximate strength of new steel wire rope according to its construction, and its diameter, d, in millimetres. However, the test certificate supplied with the rope is the most accurate guide to the breaking strength.

Table 3-13. Formula for Calculating Approximate Breaking Strength of Conventional SWR

Construction of Rope	Range of Sizes	Breaking Load
6X19	3-8mm	$d^2/17$ tonnes
6X26	10-12mm	$d^2/17$ tonnes
6X36	14-28mm	$d^2/17$ tonnes
6X41	32-52mm	$d^2/17$ tonnes
6X12	8-16mm	$d^2/34$ tonnes
6X24	12-36mm	$d^2/25$ tonnes
7X7	5-7mm	$d^2/15$ tonnes
7X7	12-28mm	$d^2/18$ tonnes
7X19	32mm	$d^2/19$ tonnes

f. **Details of Conventional Steel Wire Rope Supplied to the Royal Navy.** Details of conventional steel wire rope (SWR) supplied to the Royal Navy are given in [Table 3-14](#) to [Table 3-15](#).

Table 3-14. Details of Conventional SWR 6X12 to 6X36 Available Through Naval Stores

Construction	Size	Naval Stores No.	Minimum Breaking Load	Supply Denomination
6X12	8mm	0235/523-8624	1.91 tonnes	250 metres(m)*
6X12	12mm	0235/523-8625	4.28 tonnes	250m*
6X12	16mm	0235/523-8626	7.62 tonnes	250m*
6X19	3mm	0235/523-8627	0.49 tonnes	200m*
6X19	4mm	0235/523-8628	0.87 tonnes	200m*
6X19	5mm	0235/523-8629	1.36 tonnes	200m*
6X19	6mm	0235/523-8630	1.96 tonnes	450m*
6X19	8mm	0235/523-8631	3.75 tonnes	550m*
6X24	12mm	0235/523-8633	5.76 tonnes	550m*
6X24	14mm	0235/523-8634	7.83 tonnes	550m*
6X24	16mm	0235/523-8635	10.2 tonnes	550m*
6x24	18mm	0235/523-8636	13.0 tonnes	550m*
6X24	21mm	0235/523-8637	17.6 tonnes	550m*
6X24	22mm	0235/523-8638	19.4 tonnes	550m*
6X24	24mm	0235/523-8639	23.0 tonnes	660m*
6X24	28mm	0235/523-8640	31.3 tonnes	660m*
6X24	32mm	0235/523-8641	40.9 tonnes	660m*
6X24	36mm	0235/523-8642	51.8 tonnes	280m*
6X26	10mm	0235/523-8643	5.85 tonnes	550m*
6X26	12mm	0235/523-8644	8.41 tonnes	550m*
6X36	14mm	0235/523-8645	11.4 tonnes	550m*
6X36	16mm	0235/523-8646	15.0 tonnes	550m*
6X36	16mm	0235/523-8647	15.0 tonnes	1100m*
6X36	18mm	0235/523-8648	18.9 tonnes	550m*
6X36	20mm	0235/523-8649	23.4 tonnes	550m*
6X36	22mm	0235/523-7095	28.2 tonnes	310m*
6X36	24mm	0235/523-8650	33.7 tonnes	280m*
6X36	26mm	0235/537-0235	39.6 tonnes	280m*
6X36	28mm	0235/523-8651	45.9 tonnes	280m*

* Refers to length of full coil. Ropes can be demanded to length required in metres

Table 3-15. Details of Conventional SWR 6X41 to 7X19 Available Through Naval Stores

Construction	Size	Naval Stores No.	Minimum Breaking Load	Supply Denomination
6X41	32mm	0235/523-8652	59.8 tonnes	280 metres (m)*
6X41	32mm	0235/523-8653	59.8 tonnes	430m*
6X41	32mm	0235/523-8654	59.8 tonnes	920m*
6X41	32mm	0235/523-8655	59.8 tonnes	1010m*
6X41	36mm	0235/523-8656	75.8 tonnes	280m*
6X41	36mm	0235/523-8657	75.8 tonnes	450m*
6X41	36mm	0235/523-8658	75.8 tonnes	550m*
6X41	36mm	0235/523-8659	75.8 tonnes	1010m*
6X41	40mm	0235/523-8660	93.5 tonnes	280m*
6X41	40mm	0235/523-8661	93.5 tonnes	450m*
6X41	40mm	0235/523-8662	93.5 tonnes	650m*
6X41	44mm	0235/523-8663	113.0 tonnes	280m*
6X41	48mm	0235/523-8664	135.0 tonnes	280m*
6X41	52mm	0235/523-8665	158.0 tonnes	280m*
7X7	5mm	0235/523-8616	1.72 tonnes	350m*
7X7	7mm	0235/523-8617	3.38 tonnes	350m*
7X7	12mm	0235/523-8618	7.92 tonnes	350m*
7X7	16mm	0235/523-8619	14.2 tonnes	350m*
7X7	20mm	0235/523-8620	22.0 tonnes	350m*
7X7	24mm	0235/523-8621	31.8 tonnes	350m*
7X7	28mm	0235/523-8622	43.3 tonnes	250m*
7X19	32mm	0235/523-8623	53.0 tonnes	250m*

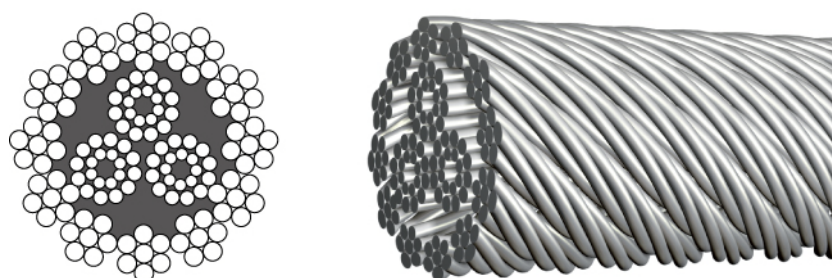
* Refers to length of full coil. Ropes can be demanded to length required in metres.

g. **Special Types of Steel Wire Rope.** In addition to conventional SWR, there are certain special types of wire ropes that are supplied to the Fleet. They are:

(1) *Dyform*. This is a high tensile, high-grade steel wire rope of 6X36 construction. The strands are compacted, which gives greater strength size for size than a conventional 6X36, but because of its greater density it is more difficult to splice. It is used to make berthing springs for certain warships. Dyform is not available through Naval Stores and can only be obtained by a local purchase order.

(2) *Non-rotating Wire*. This type of wire rope ([Fig 3-11](#)) has its strands laid up in the same direction as that in which their constituent wires are twisted. All the wires and strands are small, and the inner strands are arranged so that the tendency of the rope to rotate under load is reduced to a minimum. It is very flexible and is particularly suitable as a whip for cranes and single point davits, where strength and non-unlaying action are essential. The wire requires very careful handling before and during installation. It has no tendency to twist either way but it is so pliable that turns either way can be imparted. When making fast the plain end to the side of the drum or crane structure, ensure that the entire cross-section of the rope is firmly secured. At present, non-rotating wire rope whips are supplied as made-up items, details of which can be found in the ship's Rigging Warrant or spares documentation on board.

Fig 3-11. Non-rotating Wire Rope



(3) *Malleable Stainless Steel Wire*. This wire, Pattern No 0258-361-7273, is 1mm in diameter and supplied in 2 kilogram coils approximately 320 metres in length. It is used for mousing stainless steel shackles and slips.

03007. Handling of Natural and Man-made Fibre Cordage

a. **Elementary Rules.** The lessons which a seaman must learn before handling a rope are explained below:

(1) *The Seaman's Pocketknife.* The seaman's pocketknife is for issue to the Seaman Specialists sub branch only. It is supplied with a lanyard to enable the knife to be attached to a belt or belt loop and placed in the side or back pocket. The pocketknife is a tool and not a weapon and the edge of the blade should be sharpened like a chisel to avoid wearing away the thickness and strength of the blade, and the hinge should be kept lightly oiled.

(2) *Safety of Tools.* Whenever seaman work aloft, or over the side, they must secure whatever tools they may be using with a lanyard secured to a part of the rigging or passed round their body. This is a common-sense precaution for avoiding possible injury to personnel working below or loss of the tools over the side.

(3) *Axe, Maul and Baulk of Timber.* When working ropes during seamanship evolutions, an axe, maul and baulk of timber should be ready to hand to cut away ropes in an emergency.

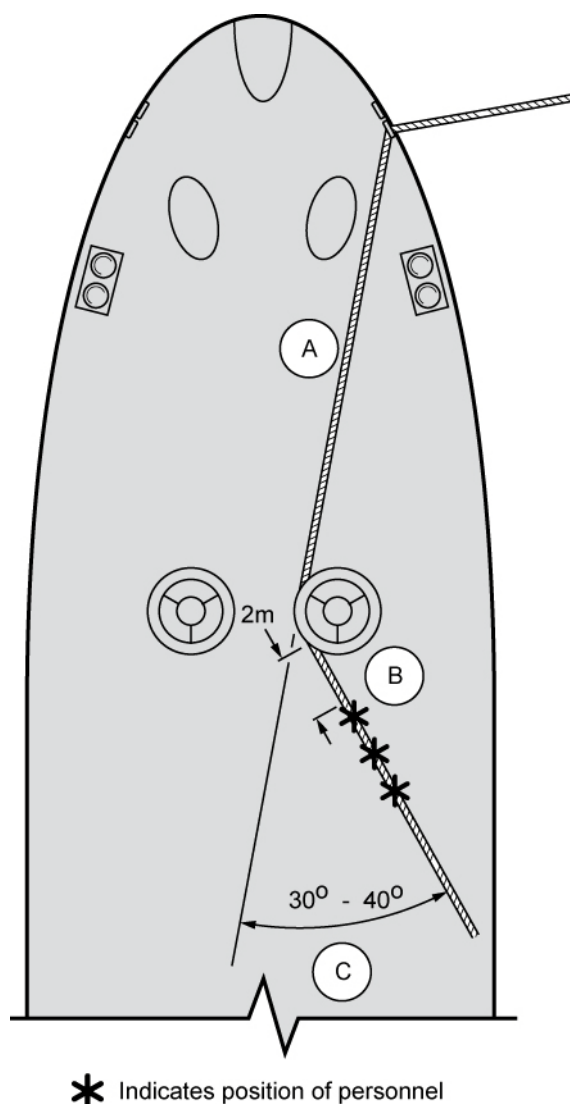
(4) *Rope Ends.* Before a rope is cut a whipping should be applied either side of the point at which the cut is to be made to prevent the rope unlaying. The different methods of whipping are described later in this chapter.

(5) *Coiling Down Ropes.* A heaving-line, or any line or rope, which is being hauled in, should be coiled either in the hand or on the deck as it is hauled inboard. This is an elementary precaution to ensure that the line or rope is immediately ready for further use.

b. **Special Precautions When Handling Man-made Fibre Cordage.** Although the rules for handling natural fibre cordage and man-made fibre cordage are generally similar, the properties and characteristics of man-made fibre necessitate greater care in its handling. Many of the advantages of using man-made fibre ropes can become serious liabilities if the seaman is not familiar with certain characteristics of these ropes. When a man-made fibre rope parts, it immediately tends to regain its original length. Polyamide when stretched over 40% is liable to part **suddenly without audible warning** and it then whips back along the line of tension and can kill or seriously injure anyone in its path. The following rules must be observed when handling man-made fibre ropes:

(1) Personnel backing-up a man-made fibre rope under tension on a capstan drum or any other holding surface must stand well back and out of the line of recoil of the rope. [Fig 3-12](#) shows the ideal position of personnel backing-up (B) a man-made fibre rope under tension (A), and the approximate angle (C), which is the ideal with respect to the line of recoil.

Fig 3-12. Backing-up a Man-made Fibre Rope under Tension



(2) When a man-made fibre rope is turned up on any holding surface, and is in tension, a certain amount of heat is generated by friction between the rope and the holding surface. Should this heat approach the melting point of the fibres of the rope, the outer fibre will melt and create a lubricant, whereupon the rope in tension **may surge violently**. It is essential therefore those personnel backing-up a man-made fibre rope in tension on a capstan drum, bollards or any holding surface must stand well back. The minimum distance between the first person backing-up the rope in tension and the holding surface should be two metres (Fig 3-12). Should the rope surge violently, this distance of two metres means that the first person backing-up will have some warning before being drawn dangerously close to the holding surface.

(3) Ropes that have been subject to local permanent elongation, eg, towing hawsers, should be given time to recover to achieve their natural length if they are to be reeled up. Recovery time may be as long as six hours for a towing hawser that has been under heavy load for long periods.

(4) Do not pass man-made fibre and steel wire ropes through the same fairlead. The stretch is incompatible and the resultant chafing of the man-made fibre will seriously weaken it.

c. **Handling All Cordage.** From the precautions listed above for the safe handling of man-made fibre cordage, the following points should always be practised when handling any ropes or lines:

(1) Avoid bad leads and sharp edges. Ensure thimbles or such fittings do not chafe or cut a rope.

(2) As a general rule rope should be veered rather than surged on a capstan or winch drum because surging induces friction and damages the surface of the rope. However, surging the slip rope during the final stages of a replenishment is accepted practice as it enables the Receiving ship to readily match the speed at which the Delivering ship is recovering the replenishment rig. **A rope should never be surged on a capstan or drum which is rotating in the same direction (turning to veer).** This is a dangerous practice and applies to steel wire rope as well as fibre rope.

(3) Three turns are usually sufficient when hawsers are being hove in on capstans or drum ends. However, for heavy loading it may be necessary to take an extra one or two turns, giving due regard to the size and strength of the rope and equipment involved.

(4) If surging around bollards is necessary, it should be done before the strain on the rope is heavy. Great care must be taken when easing out a rope around bollards if it is heavily loaded.

03008. Preparing Natural Fibre and Man-made Fibre Ropes for Use

a. **Coiling and Uncoiling.** A rope laid out straight will have no tendency to twist or turn either way, whether its lay is left- or right-handed, and from this position it can be stowed on a reel or coiled down. When stowed on a reel, or hauled off a reel, a rope will not develop any twists or turns in its length. When coiling down a rope however, the part of the rope remaining uncoiled will be given one twist or turn as each loop in the coil is formed. When coiling down a rope the end should be kept free to allow the uncoiled length to rotate and thus keep it free from becoming snarled up with kinks or turns. Similarly, a rope which is run off a coil will acquire a twist or turn for every loop in the coil, but if the end is kept free the rope will usually free itself of these turns when hauled out straight. One method of avoiding these turns, should the end of the rope not be free, is to turn the coil round while coiling down the rope, thus turning the coil into a reel. Another method, as when coiling direct from a reel, is to allow as long a length as possible between reel and coil; this length will absorb the turns until the end of the rope is free from the reel, and so can be freed of its turns. Similarly, when coiling down a rope which is led through a block, the coil should not be made too near the block, otherwise a slight check may cause a kink to develop in the rope as it is running through and thus choke the luff ([Fig 3-13](#)).

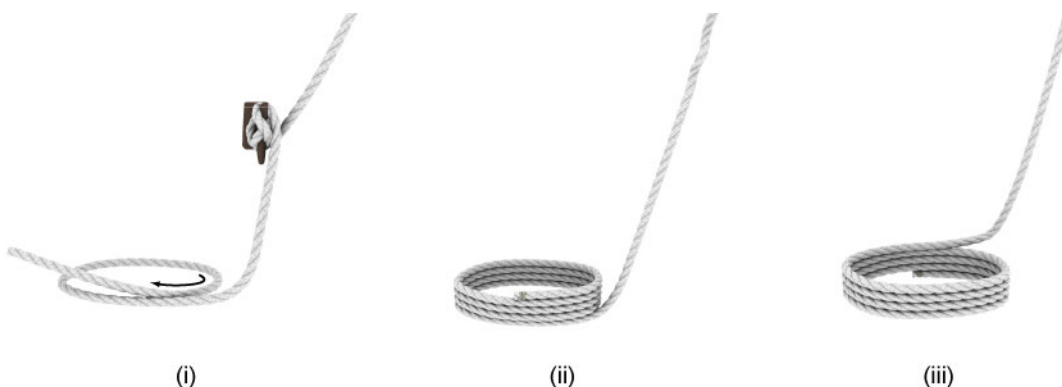
b. **Coiling Down (Fig 3-13).** Cordage is very resilient and will absorb a number of turns in its length without becoming snarled if the length is sufficient and the turns correspond with the lay of the rope; if the turns are against the lay, however, it will quickly become snarled. For this reason, rope of right-hand lay is always coiled down right handed, and rope of left-hand lay is always coiled down left-handed.

Fig 3-13. Mistakes in Coiling Down



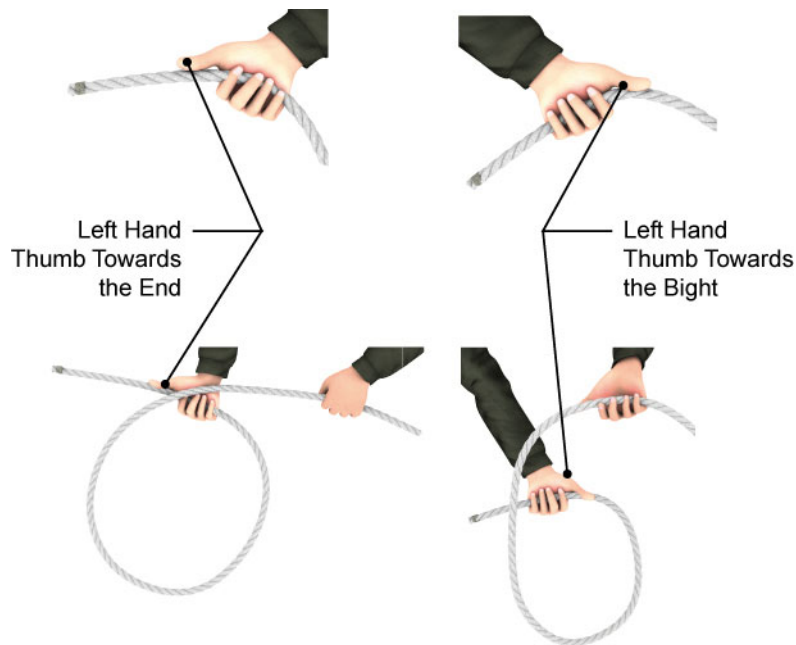
c. **To Coil a Rope for Running (Fig 3-14).** Lay the rope as straight as possible along the deck; begin coiling it down close to where the standing part is made fast, and lay each loop flat upon the other below it until the bare end is reached. The size of the loops should be as large as stowage space permits. The running part is now underneath the coil, so turn the coil over and the rope should then run out freely when required. Remember that the running part or end part should always be on top of any coil.

Fig 3-14. To Coil a Rope for Running



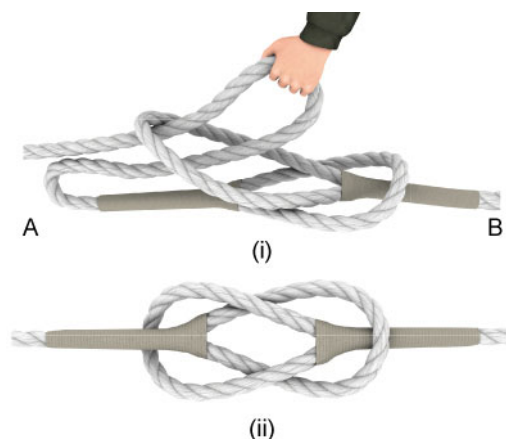
- d. **To Coil a Small Line in the Hand** (Fig 3-15). When coiling in the right hand the rope should be held with the right thumb pointing towards the end; and when coiling in the left hand the thumb should point towards the bight. The coil will then form correctly.

Fig 3-15. Coiling a Line



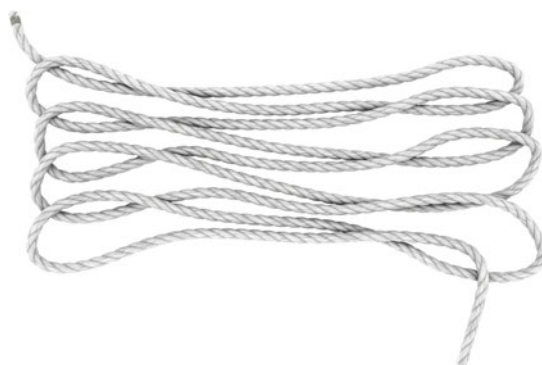
- e. **To Thoroughfoot a Rope.** This is the most effective way of taking a large number of turns out of a rope. First determine whether the turns to be removed are left- or right-handed. Then, to remove left-hand turns, coil down left-handed, dip the end through the coil and haul the coil out straight. To remove right-hand turns, coil down right-handed, dip the end through the coil and haul the coil out straight. If the bight of the rope is badly snarled, thoroughfoot the end for only a few metres at a time, repeating this operation as often as necessary. Thoroughfooting also describes the method of joining two ropes by their soft eyes (Fig 3-16). The eye of rope A is passed through the eye of rope B, and the bight of B is then hauled through the eye of A, thus joining the ropes by their eyes. This method is not used for joining two ropes temporarily, because it may take some time to unhitch them.

Fig 3-16. Thoroughfooting



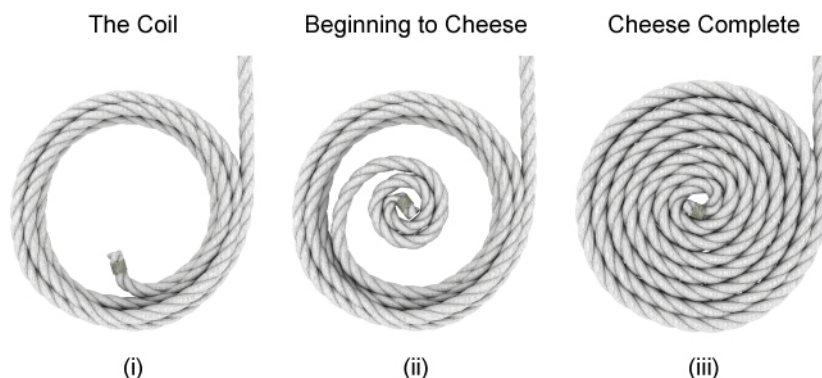
f. **To Fake Down a Rope (Fig 3-17).** A rope that may have to be paid out quickly should be faked down in as long fakes as space allows. When faked, a rope does not acquire as many turns as when coiled and it will, therefore, run out with less chance of becoming snarled. Care should be taken that each bight at the end of a fake is laid under that immediately preceding it to ensure a clear run.

Fig 3-17. Faking Down a Rope



g. **To Cheese Down a Rope (Fig 3-18).** When a neat stow is required for a short end of rope, it may be cheesed down. This method should never be used when the rope will be required to render quickly through a block.

Fig 3-18. Cheesing Down a Rope



h. **Belaying.** When a rope will have to be cast off while still under strain it cannot be secured with a bend or a hitch, except perhaps a slipping one. It is therefore belayed to a fitting made for the purpose, such as a cleat, staghorn or bollard. The action of belaying consists of taking sufficient turns round the fitting to hold the rope by friction when it takes the strain. Generally speaking, four complete turns should be sufficient, but the number of turns may have to be increased according to the degree of friction existing between rope and fitting. A wet and slippery rope or bollard, or a smooth cleat or staghorn and a well-worn rope may require extra turns.

i. **To Belay a Rope to a Cleat or Staghorn.** Take initial turns as shown in Fig 3-19, then continue with figure-of-eight turns round the horns of the cleat or staghorn as many times as required. It will be seen that when the figure-of-eight turns are removed the rope is ready to be checked under control. A rope belayed to a cleat or a staghorn must be ready for casting off at a moment's notice; therefore the turns should not be completed with a half hitch, because this may jam them. Cleats are not suitable for belaying wire rope.

Fig 3-19. Belaying a Rope to a Cleat or Staghorn



- j. **To Hang a Coil on a Belaying Pin or Cleat** ([Fig 3-20](#) and [Fig 3-21](#)). Whenever possible a coil of rope should be hung up clear of the deck so as to keep the deck clear and the rope dry.

Fig 3-20. Hanging a Small Coil on a Belaying Pin

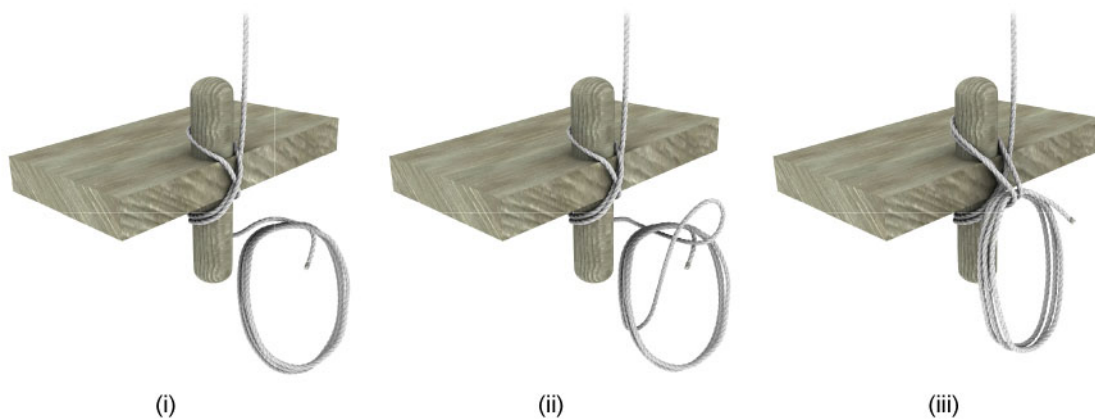
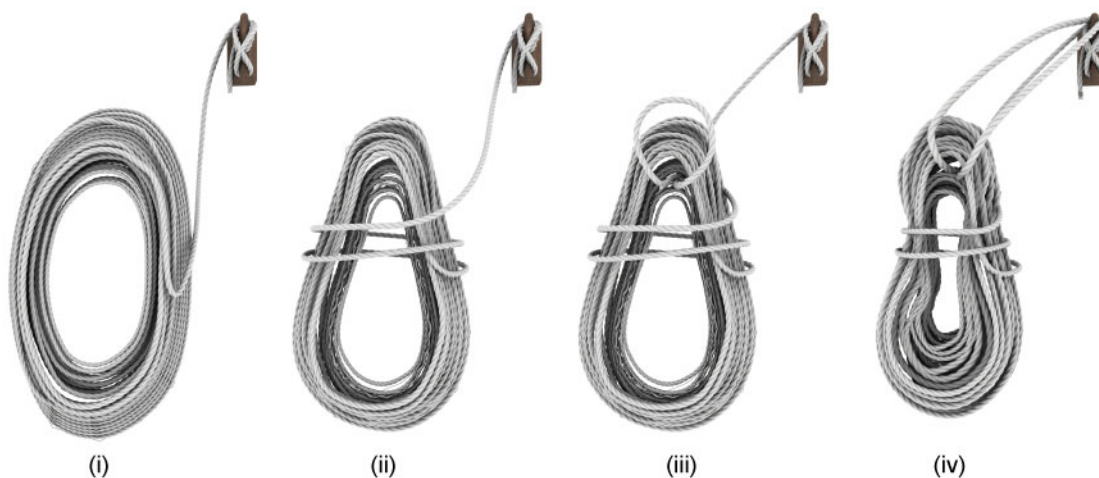


Fig 3-21. Hanging a Large Coil on a Cleat



k. **Making and Throwing a Heaving Line** (Fig 3-22).

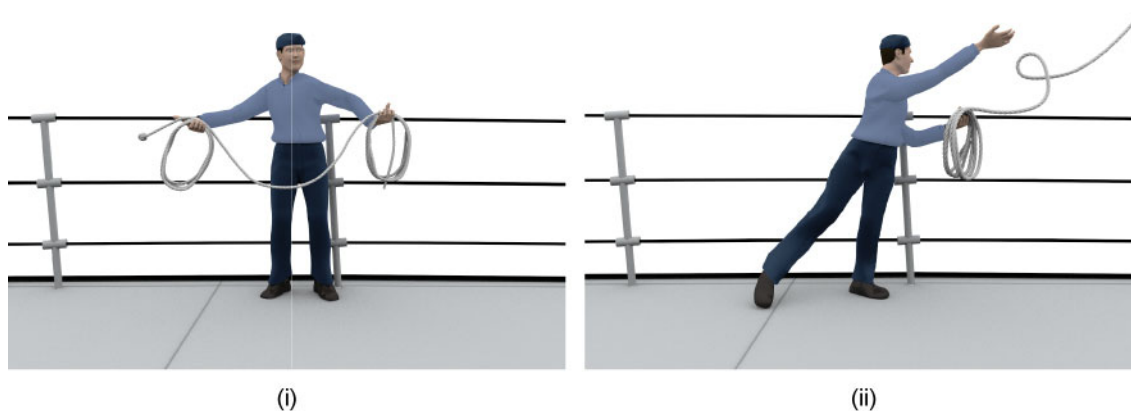
(1) As its name implies, a heaving line is a light flexible line that can be thrown. It is used as a messenger to pass hawsers from ship to shore, or vice versa. Braidline of 8mm is very flexible and makes excellent heaving lines, although any similar size cordage can be used. A heaving line consists of approximately 30 metres of 8mm cordage. One end should be whipped and the other end weighted with a monkey's fist (Fig 3-79), a small sandbag or a heaving line knot.

WARNING

HEAVING LINES MUST NOT BE WEIGHTED BY INSERTING A STEEL NUT OR LEAD WEIGHT INTO THE MONKEY'S FIST. NEITHER SHOULD THE MONKEY'S FIST BE PAINTED.

(2) To prepare a heaving line for throwing, it should be wetted and between 22 and 24 metres should be coiled carefully in the non-throwing hand, using small coils. One third of the line is taken in the throwing hand; the line is then thrown with the throwing arm straight, and it must be allowed to run out freely from the coil in the non-throwing hand. The most frequent cause of bad casts is failure to have this coil properly clear for running. There is more than one method of heaving a line and most good throwers have their own variations. Some take rather less than half the coil in the throwing hand and throw both halves together, letting go with the throwing hand before the non-throwing hand. This method is very effective but harder to learn. Before heaving a line the standing end must be anchored between the thumb and index finger of the non-throwing hand. Never secure the standing end to the wrist or any other part of the body; the turning propellers make this a dangerous practice. As soon as the heaving line has been caught, the standing end or a bight of the line should be bent with a bowline to the eye of the hawser and not before. Every effort should be made to keep the line out of the water.

Fig 3-22. Throwing a Heaving Line

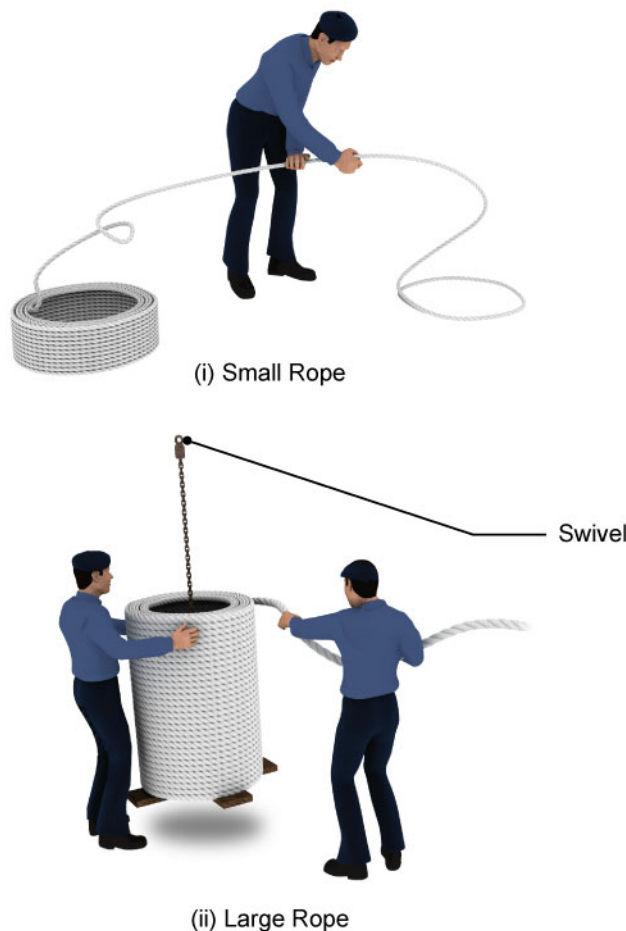


I. Handling New Cordage.

(1) *Opening a New Coil (Fig 3-23).* A length of rope is supplied to a ship in a compact, machine-wound coil, bound with yarns or strands. To open up a new coil of rope of less than 48mm diameter, a seaman should roll it over until the outside end of the rope is at the top and pointing directly at him. The user should then turn the coil over towards their left and lay it flat on its side. The lashings are now cut and the inner end of the rope is pulled out from the centre (Fig 3-23). The rope will then leave the coil correctly and can then be coiled down. With rope of 48mm diameter or larger, the twisting involved in the preceding method is not acceptable and the coil must be unreeled in the opposite way to that in which it was made up. The coil should be placed on a turntable, or slung so that it can be revolved (Fig 3-23). Cut the lashings and haul the rope off from the outside. If this method is not possible, stand the coil on its end, and lap the rope off the top of the coil, turn by turn. As each turn is removed, revolve the end of the rope to take out twists.

(2) *Cutting off a Length of Rope from a New Coil.* The required amount of rope is hauled from the coil, as previously described, and then the rope is whipped or taped at each side of the position at which it is to be cut. Whenever a length of rope is cut off a coil, a label, on which should be clearly stated either the length cut off or the length remaining should be attached to the coil.

Fig 3-23. Opening a New Coil



m. **Storage of Cordage.** Coils of new rope should be stowed clear of the deck, in a cool, well-ventilated, dry place, to allow the air to circulate freely around them. Used rope should be hung in loose coils if this is practicable. No cordage should be stowed in contact with bare steelwork. If cordage has to be stowed in the open it should be protected from sunlight because man-made fibres are susceptible to deterioration caused by the sun's rays.

03009. Handling of Wire Rope

Wire rope is much less resilient, and therefore much less tractable, than cordage. It resists being bent, does not absorb turns readily, and is therefore much more liable to kinking and snarling, and tends to spring out of a coil, or off a drum or bollard. If handled correctly however, it can be used for most of the purposes to which cordage is put, but bends and hitches should not be made in it.

a. **Kinking and Crippling.** Because of its construction and comparative lack of flexibility, wire rope requires more care in handling than cordage; if carelessly handled it may suffer serious damage through kinking and crippling.

(1) *Kinking.* Any loop or turn in a wire rope can all too easily be pulled into a kink, which permanently damages it. If a kink is seen to be about to develop it should be removed as indicated in Fig 3-24 and no attempt should be made to pull it out in the manner shown in Fig 3-25.

Fig 3-24. The Right Way to Remove a Kink in Wire Rope

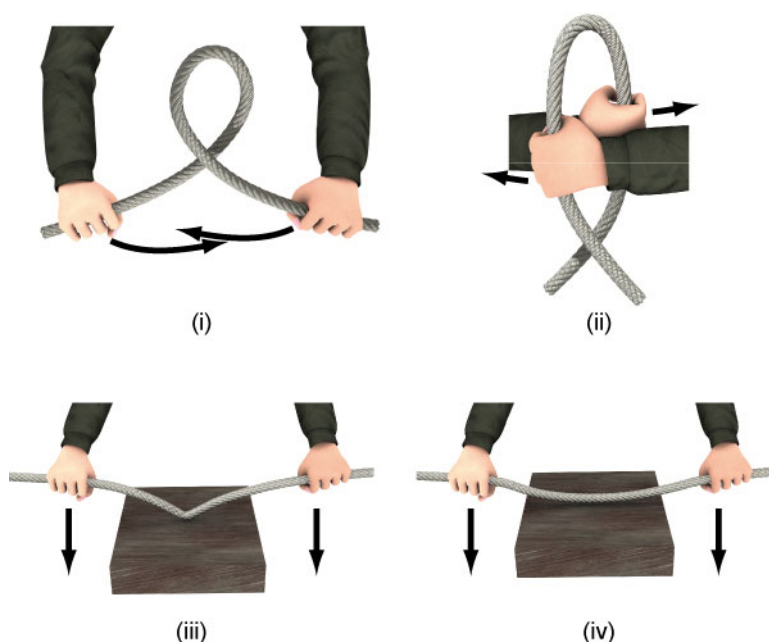
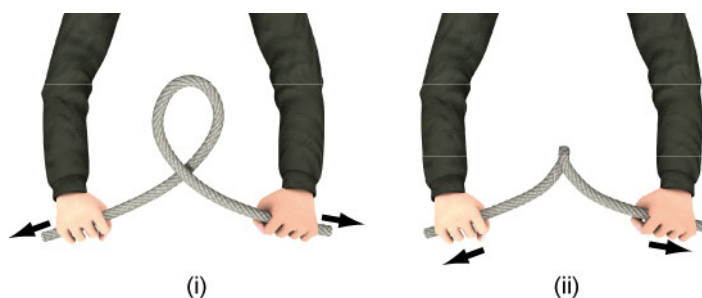
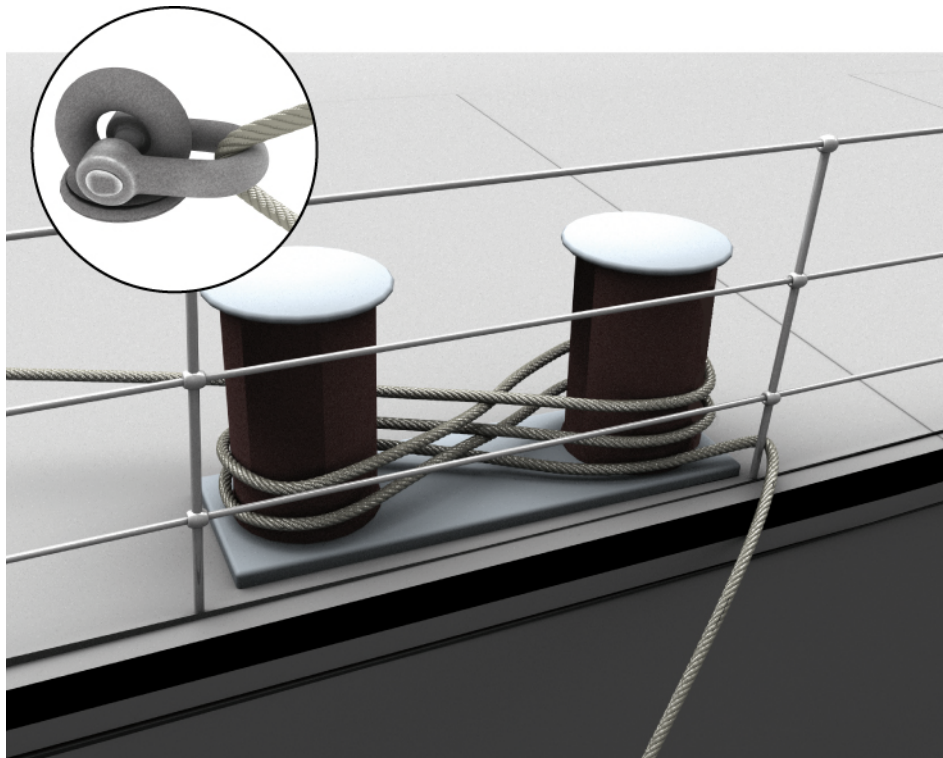


Fig 3-25. The Wrong Way to Remove a Kink in Wire Rope



(2) *Crippling (Bad Nips)* (Fig 3-26). If a wire rope is bent at too acute an angle, or led over a sharp edge, it will be seriously damaged by distortion of its strands, which may result in a permanent kink or even in the rope parting. A rope so led is said to form a bad nip and this results in it being crippled. (To freshen the nip is to veer or heave in a short length of rope that is under strain so as to bring a fresh portion of the rope to take the chafe where it passes through fairleads or around bollards). To prevent crippling, a wire rope, which will come under strain, should never be led through a shackle or eyeplate to alter the direction of its lead. In addition, it should not be round a bollard or drum of a diameter less than thirteen times the diameter of the rope; and if it has to run through a block, the diameter of the sheaves should be at least twenty times the diameter of the rope.

Fig 3-26. Examples of Bad Nips (Leads)



b. **Coiling and Uncoiling.** Wire rope, especially long lengths of it, should be stowed on reels, but where this is not practicable it must be coiled down. Wire rope is less able to absorb turns than fibre rope; when coiling down it is therefore all the more necessary to have the uncoiled length free to revolve. Where this is impossible, an alternative is to use left-handed loops, called **Frenchmen**, in the coil (Fig 3-27). These Frenchmen serve to counteract the twists put in by coiling down right-handed. Frenchmen are also necessary when coiling down a wire rope of which some portions have contracted a left-hand set (as will occur when a rope belayed left-handed round a bollard has been subjected to strain). Such portions will resist being coiled right-handed and each loop must be allowed to become a Frenchman. It is wise to stand clear when rope is being hauled off a coil containing Frenchmen; as such turns are very likely to jump off. A coil of wire rope should always be well stopped to prevent the coils from springing out of place. The best way to run out a coiled down wire is shown in Fig 3-28.

Fig 3-27. A Frenchman



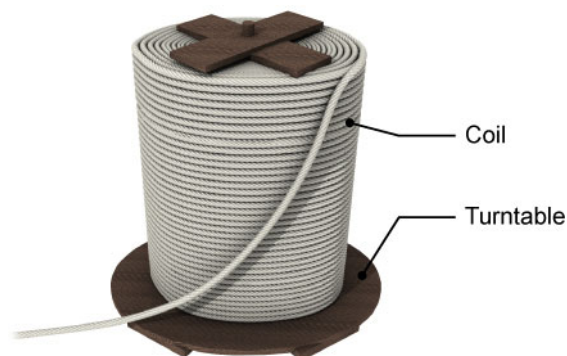
Fig 3-28. Running Out a Coiled Down Wire



c. **Handling New Steel Wire Rope.**

(1) *To Unreel or Uncoil a New Rope.* New wire ropes are supplied either in machine wound coils or on cable drums (reels). They must be taken off the coils or drums in the correct manner, or kinks will quickly develop. A small coil can be rolled along the deck, but if space does not permit, or the rope is heavy, place the coil on a turntable and lash down two strong battens crosswise on the top of the coil (Fig 3-29). This will prevent the rope springing up over the top of the coil and kinking. Then cut the stops, and haul the rope off the coil as it rotates on the turntable.

Fig 3-29. Uncoiling a New Wire Rope



(2) To unreel the rope from a drum, pass a shaft through the drum and support the shaft at either end, thus allowing the drum to revolve; then cut the outer stops and unreel the rope off the drum (Fig 3-30). To coil down a small rope from a drum, up-end the drum as shown in Fig 3-31, and lap the rope off the top of the drum, lapping off each turn anti-clockwise. The twist put in the rope as each turn is lapped off is cancelled automatically by coiling the rope down clockwise.

Fig 3-30. Unreeling a New Wire Rope

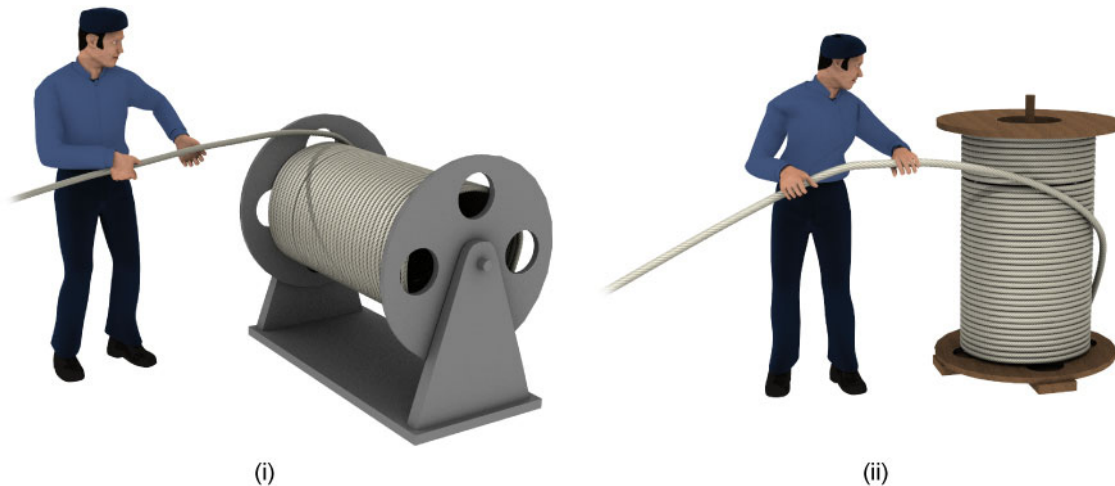
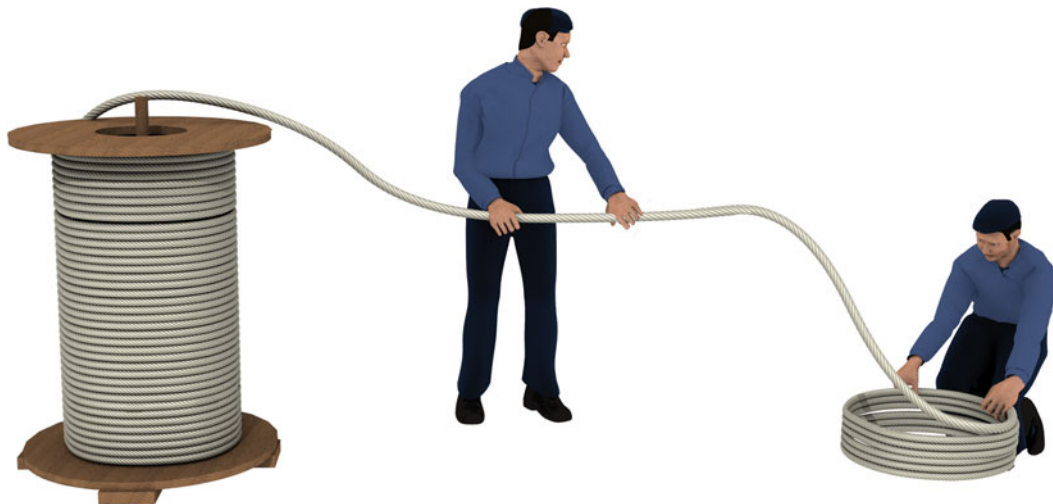


Fig 3-31. Lapping Off and Coiling Down a Small Wire Rope



(3) *To Cut Off a Length of Wire Rope.* The rope should be very firmly whipped about 25mm on each side of the position at which it is to be cut, then placed on the top of a bollard or similar hard surface. The strands should then be cut with a hammer and cold chisel or with a wire-cutter. Whenever a length of rope is cut off a coil or a drum, the coil or drum should be clearly marked, indicating either the length cut off or the length remaining.

d. **Care and Maintenance of Steel Wire Rope.** Wire ropes have a lubricant incorporated during manufacture. This serves a dual purpose; it provides corrosion protection and also minimises internal friction. The protection provided by this manufacturing lubricant is normally adequate to prevent deterioration due to corrosion during the early part of a rope's life. However, the lubricant applied during manufacture must be supplemented by lubrication in service. This lubrication is termed the 'dressing'. The kind of dressing used and the frequency of application vary with the type of rope and its usage. Details of the maintenance of steel wire rope carried by, or fitted in HM ships are laid down in the Maintenance Management in Ships system (MMS). Wire hawsers should be stowed on reels under a fitted cover whenever possible. When being reeled in or otherwise stowed, the surface of a wire hawser should be washed with fresh water to free it from salt, then dried with cloths and lightly smeared with the appropriate lubricant.

e. **Inspecting Steel Wire Rope.** Steel wires ropes carried or fitted in HM ships must be inspected periodically in accordance with the MMS system. When inspecting, the indications described below should be sought:

(1) *Distortion of Strands.* This is the result of damage by kinking, crushing, serious crippling round a bad nip, or other mistreatment. If likely to cause the strands to bear unequal stresses, they must be considered as reducing the strength of the rope by 30%; and should they be sufficiently serious to cause the heart to protrude, the rope must be discarded. A crushed rope may be restored to some extent by the careful use of a mallet.

(2) *Flattening of Some of the Outer Wires by Abrasion.* These flats are easily seen because the abrasion gives the flattened wires a bright and polished appearance, but they do not affect the strength of the rope unless they are very pronounced. Flats, which extend to three-quarters of the diameter of the wires, will reduce their cross-sections - and therefore their individual strengths - by 10%, and as only a limited number of wires will be affected the loss in strength of the whole rope will be very small. (These flats must not be confused with flattening of the whole rope, which indicates distortion of the strands and is therefore much more serious).

(3) *Broken Wires.* These are usually the result of fatigue and wear, and mostly occur in crane wires. It is generally accepted that a wire rope is coming to the end of its useful life when one wire of any strand breaks. To deal with a broken wire, grip the broken end with a pair of pliers and bend the wire backwards and forwards until the wire breaks inside the rope between the strands, where it can do no harm. A rope should be discarded if more than 5% of its wires are broken in a length equal to ten times the diameter of the rope; for example a 24mm diameter, 6X24 wire rope should be discarded if seven broken wires are found in a length of 240mm. Because of the danger to handlers, berthing wires should be discarded if any broken wires are discovered.

(4) *Corrosion.* Wire rope can be corroded by:

(a) The action of damp on the wires from which the galvanising has worn off; if this occurs to the inner wires first it causes rust to fall out of the rope and is therefore easily detected.

(b) The action of fumes and funnel gases, which attack the outside wires, the effect then becomes visible on inspection.

(c) Contact with acid, which soaks into the heart and attacks the inside wires; this is not necessarily noticeable on the outside of the rope, and can be the cause of parting without warning.

(5) Lack of lubrication is a frequent cause of corrosion. When a wire rope is under tension it stretches and becomes thinner, and during this process the individual wires are compressed and friction is set up; the fibre heart and cores are also compressed, releasing oil to overcome the friction. A wire rope of outwardly good appearance, but with a dry powdery heart or core, has not been properly maintained and should be treated with caution.

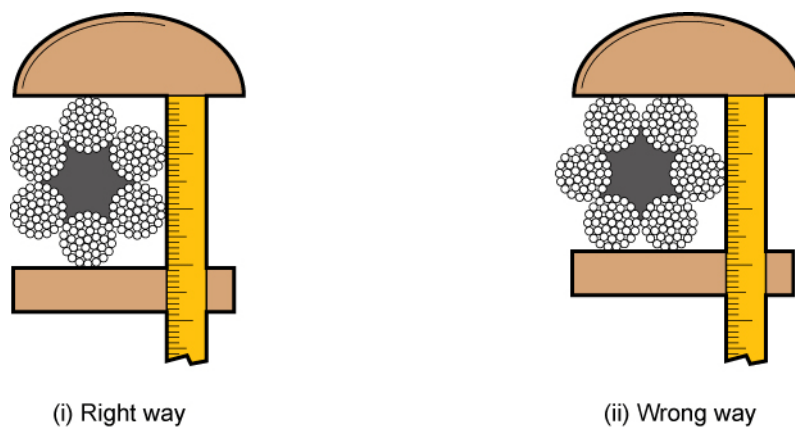
(6) *Effect of Extreme Cold.* When subjected to extreme cold a wire rope may become brittle and lose its flexibility, and an apparently sound rope may part without warning. The brittleness is not permanent and the rope will regain its resilience in a normal temperature, but the potential danger should be remembered when working wires in very cold climates.

f. **Testing of Steel Wire Rope.** The wire from which the rope is to be made is tested before manufacture of the rope to ensure it complies with the relevant British Standards Specification with regard to tensile strength, torsion and galvanising properties. After manufacture of each production length of rope, test samples are cut from the finished rope and strand. These samples are used for a tensile test to destruction, tests of preforming of the rope, and tests on a mixture of the individual wires with regard to diameter, tensile strength, torsion and quality of galvanising. A certificate of conformity and a test certificate showing the guaranteed minimum breaking strength of the wire when new accompany each coil of wire.

03010. General Remarks on Steel Wire Rope

a. **How to Measure the Size of a Rope.** The size of a wire rope is the diameter in millimetres of a true circle, which will just enclose all the strands (Fig 3-32). Measure at each of three places at least two metres apart. The average of these measurements is to be taken as the diameter of the rope.

Fig 3-32. How to Measure the Diameter of a Rope



b. **Sheaves for Wire Rope.**

(1) *Size of Sheave Required for a Wire Rope Hoist.* The diameter of sheave required for each type of six-strand wire rope supplied to the Royal Navy should be at least twenty times the diameter of the wire. The diameter of a sheave used for any wire rope will considerably affect the life of that rope. As the rope bends round a sheave the strands and wires farthest from the centre of curvature move apart and those nearest the centre of curvature move closer together. This results in the generation of considerable friction between these wires and strands, and the smaller the sheave the greater will be the friction. Friction also increases rapidly with the speed at which the rope is moving. While the rope is bent round a sheave the outer wires are also subjected to a marked additional stress, and the smaller the diameter of the sheave the greater will be the stress. For these reasons the **minimum** diameters of sheaves recommended from practical experience for various types of ropes at speeds not exceeding 60 metres per minute are twenty times the diameters of the ropes. For each increase in speed of 30 metres per minute, 5% must be added to these figures; this will give a rope a reasonable life, but it is emphasised that its life will be greatly increased if still larger sheaves are used. Similarly, if a smaller sheave than that recommended has to be accepted, it will shorten the life of the rope, and on no account should a sheave be used that is more than 20% smaller than that determined by reference to the above criteria.

(2) *Use of Correct Sheave.* The life of a rope used for hoisting can also be considerably shortened by using the wrong **type** of sheave. The groove in the sheave must fit and support the rope as it travels round the sheave, otherwise there will be increased internal friction and external wear. Fig 3-33(i) shows a sheave with too wide a groove, which results in a flattening of the rope and considerable distortion and internal friction. Fig 3-33(ii) shows a sheave with too narrow a groove, which results in the rope not being supported, the wires of the strands being subjected to considerable wear, and friction being set up between the rope and the sides of the groove. The groove of the correct sheave should be shaped in cross-section to the true arc of a circle for a distance equal to one-third of the circumference of the rope, and the radius of the groove should be 5-10% greater than the specified radius of the rope (Fig 3-34).

Fig 3-33. Examples of Incorrect Sheaves for Wire Rope

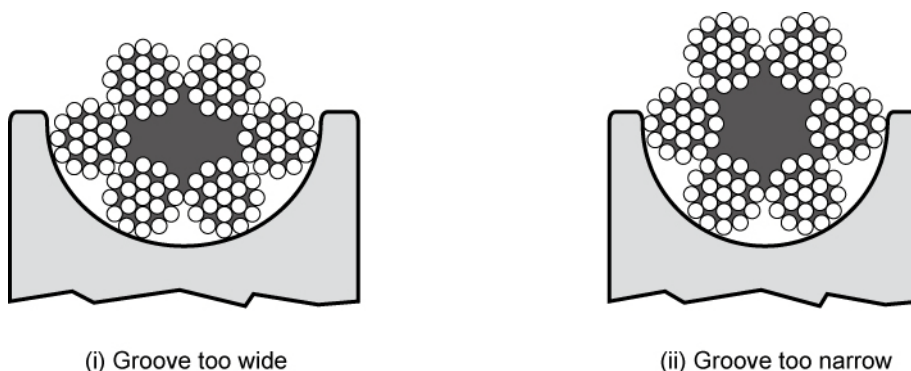
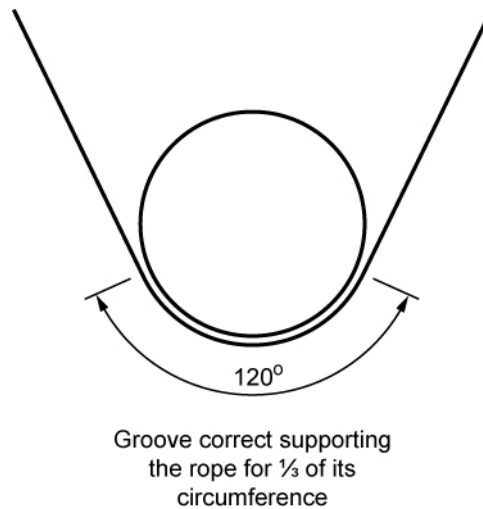


Fig 3-34. Diagrammatic Example of a Correct Sheave for Wire Rope



03011. End Terminals on Wire Rope

- a. Besides the soft, thimble and hawser eyes, other kinds of terminals are used for the ends of wire rope and some of them are explained below.
- b. **Sockets.** There are several types of socket ([Fig 3-35\(i\)](#)) but a standard method of attaching them to the end of a wire. The wires at one end of the rope are fluffed out like a shaving brush to fill the hollow conical head of the socket, the ends of the wire are then hooked over towards the centre and molten white metal is poured in to make the whole head solid. This skilled work is normally done by qualified dockyard personnel. A well-made socket should have the strength of the rope but the rope is subject to fatigue where it enters the socket because of the abrupt loss of flexibility. Frequent examination is essential and if a single broken wire is seen near the socket the rope should be recapped without delay.
- c. Swaged Terminals are a modern alternative to the sockets described above, and as with the socket there are various types. The end of the wire is inserted in the terminal and both are placed in a special swaging machine in which the terminal is hydraulically compacted on to the rope. This process, which is carried out cold, does not affect the temper or strength of the rope.

Fig 3-35. Example of Terminals for Wire Rope



03012. Factors of Safety, Safe Working Loads and Proof Loads

a. All lifting equipment fitted in, and carried by HM ships is of a proven and tested design and has a designated safe working load, which is the maximum load the equipment is designed to bear in practice. The required size and strength of all the components of the equipment has been calculated by the design authority, and the seaman will rarely be called upon to exercise his judgement on the subject. However, knowledge of the principles involved will give a greater understanding of equipment limitations, and assist in making accurate calculations should extempore rigging of lifting equipment be necessary. To determine the size of cordage or wire rope to be used for any working load a factor of safety is laid down for different conditions of working; it applies to the rope only, as other components within the rig, such as shackles, hooks and blocks are unlikely to be subjected to the same stresses as the rope, and in any case such items are marked with their safe working load and this information can be taken as reliable regardless of the application of the equipment. For SWR, MMFC and NFC the following formula is employed:

$$\text{Safe working load} = \frac{\text{breaking strength of rope}}{\text{factor of safety}}$$

b. The following factors of safety for rope are used generally in the Royal Navy:

(1) Lifts and hoists	12
(2) Running rigging and slings	8
(3) Other purposes	6

c. **Proof Load.** The proof load of lifting equipment is normally twice its safe working load and this information is required when equipment is tested. For example, a shackle with a safe working load of two tonnes is tested to a proof load of four tonnes. In the past it was usual to mark equipment with details of the proof load, but current practice is for the safe working load to be shown.

03013. Orders and Terms Used in Handling Hawsters, Ropes and Cables

The various orders and terms used by the seaman when handling hawsters, ropes and cables are listed below:

Order or Term
Heaving**Definition**

<i>A Heave</i>	A pull on a rope or cable; a throw or cast with a rope
<i>To Heave</i>	To throw a rope, or to pull on a rope or cable either by hand or power
<i>Heave</i>	The order to give a strong pull together
<i>Heave in</i>	The order to heave in on a capstan or winch
<i>Two six, heave</i>	An order to men hauling on a rope to make them heave together, repeated as necessary

Hauling

<i>A Haul</i>	A pull on a rope by hand
<i>To haul</i>	To pull by hand
<i>To haul hand over hand</i>	To haul a rope in quickly with alternate hands
<i>Haul taut</i>	An order to take down the slack and take the strain
<i>Haul away</i>	An order to haul in steadily
<i>Avast hauling! and Avast</i>	Order to stop hauling

STOP

THE WORD 'STOP' CAN BE USED AT ANY TIME DURING A SEAMANSHIP EVOLUTION. IT IS MADE TO INDICATE A SAFETY ISSUE. ON HEARING 'STOP' ALL PERSONNEL ARE TO STOP WHAT THEY ARE DOING IMMEDIATELY AND AWAIT FURTHER INSTRUCTIONS. NOT TO BE CONFUSED WITH AVAST.

<i>Hold fast</i>	An order to hold a rope under strain so as to keep it from moving
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Hoisting

<i>A hoist</i>	A system designed for lifting, or the load which is lifted
<i>To hoist</i>	To lift
<i>Hoist away</i>	The order to haul away on a rope when hoisting something with it
<i>High enough</i>	The order to stop hoisting
<i>Marry</i>	The order to bring two ropes together side by side and handle them as one. Also a term used in splicing, meaning to butt two ropes' ends together with their respective strands interlocking.

Lowering

<i>Lower away</i>	The order to lower steadily
<i>Avast lowering</i>	The order to stop lowering

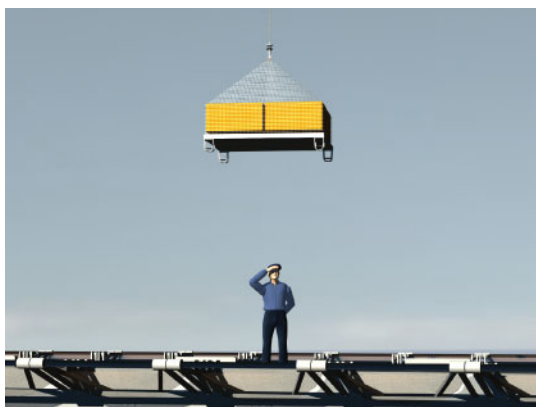
Order or Term General	Definition
<i>Avast!</i>	Stop immediately, especially heaving/hauling/veering.
<i>Handsomely!</i>	Slowly, with care (e.g. 'lower handsomely')
<i>Roundly!</i>	Smartly, rapidly
<i>Walk back!</i>	An order to ease a rope back or out while keeping it in hand
<i>Light to!</i>	The order to fleet a rope back along the deck so as to provide slack.
<i>Belay</i>	Make fast a rope by turning it up on a cleat/staghorn/bollard.
<i>Bring to</i>	Pass turns of a hawser or rope round a capstan or winch. (It is usual to specify the number of turns to be taken).
<i>To veer</i>	To pay or ease out a cable or hawser from the cable holder or capstan when these are connected to and controlled by their engines (veer on power); or to allow a cable to run out by its own weight or strain on the outboard end under control by the cable-holder brake (veer on the brake).
<i>Check away!</i>	The order to ease a rope steadily by hand while keeping a strain on it
<i>To snub</i>	Suddenly to restrain a rope or cable when it is running out. This may cause damage to a rope or cable and should be avoided if possible.
<i>To surge</i>	To allow a hawser to ease out by its own weight, or by the strain on the outboard end. A hawser slipping round the barrel of a capstan or winch is said to surge, whether the barrel is stopped or turning to heave in. Surging when the barrel is veering is dangerous.
<i>To render</i>	A rope is said to render when it surges under strain round a rotating drum.
<i>Well! or Enough!</i>	Orders to stop heaving, veering, hauling, lowering checking, etc. <i>Enough!</i> is usually applied only to hoisting and lowering, and is preceded by <i>High</i> or <i>Low</i> , respectively.
<i>To back up</i>	To haul on the hauling part of a rope when passed round a bollard or similar fitting so that you assist the bollard to hold it. Also, to reinforce men already handling a rope.

03014. Handling Hawsers

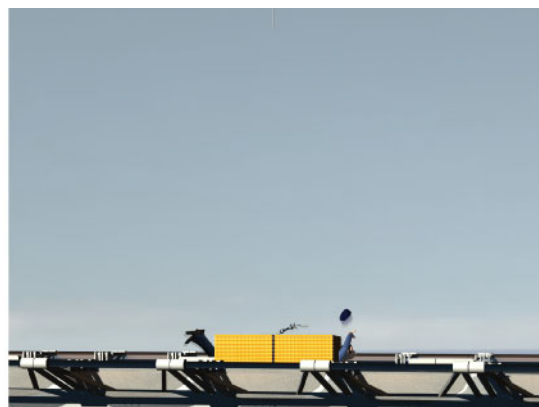
- a. As the name implies, a hawser was originally a heavy, natural fibre rope, which was led through a hawse-pipe for use in connection with the ship's anchors or for towing. Nowadays the term hawser is applied to any long length of heavy cordage or wire which is specially fitted and supplied to a ship as part of her outfit and used for heavy duties such as towing, berthing and working ship.
- b. **Summary of Safety Rules for Handling Man-made Fibre, Natural Fibre and Steel Wire Hawsers.** Before working hawsers, the user should learn the simple rules for safety, which are illustrated in [Fig 3-36](#) and [Fig 3-37](#) and described briefly below.

- (1) Look at the end of the rope or hawser and determine which is the running end, the standing part, the hauling part, and which part forms a bight or a coil.
- (2) The wearing of finger rings is strongly discouraged. Serious injury, including amputation, may result if a ring snags on a broken strand of a wire hawser. The practice of taping over the ring does little to reduce the chance of injury.
- (3) Don't turn up SWR and Cordage on the same bollard or cleat.
- (4) Always keep a good lookout aloft and remain alert to what is happening above you. If avoidable never stand below an object that is being hoisted or lowered. The warning cry to those below if something above them is about to be let fall is 'Stand from under!' or 'Under below!'
- (5) When working hawsers round equipment such as bollards, warping drums or capstans ensure there is a distance of at least two metres between the equipment and the first person manning the hawser. Other personnel manning the hawser should be spaced at least one metre apart.
- (6) Always look out for chafe, and take steps to prevent or minimise it.
- (7) Be aware that man-made fibre ropes and hawsers may surge round capstans and bollards without warning when in tension.
- (8) Never stand within a bight or coil. Never stand directly in the line of recoil of a man-made fibre rope or hawser under tension.
- (9) Wearing gloves whilst handling wires and ropes carries certain risks, for example if they snag on a broken strand in a wire, or become trapped in turns on a capstan or winch. However, in certain circumstances these risks are outweighed by other dangers, eg, frost bite in very cold weather, or the inability to grip with bare hands a greasy wire hawser. Therefore the wearing of gloves authorised in the [Note](#) to Para 06042 is left to the discretion of the OIC, who must take account of the prevailing conditions.
- (10) Whenever possible lines are to be tended from forward, this is particularly important during underway evolutions.

Fig 3-36. Never Stand Underneath a Hoist

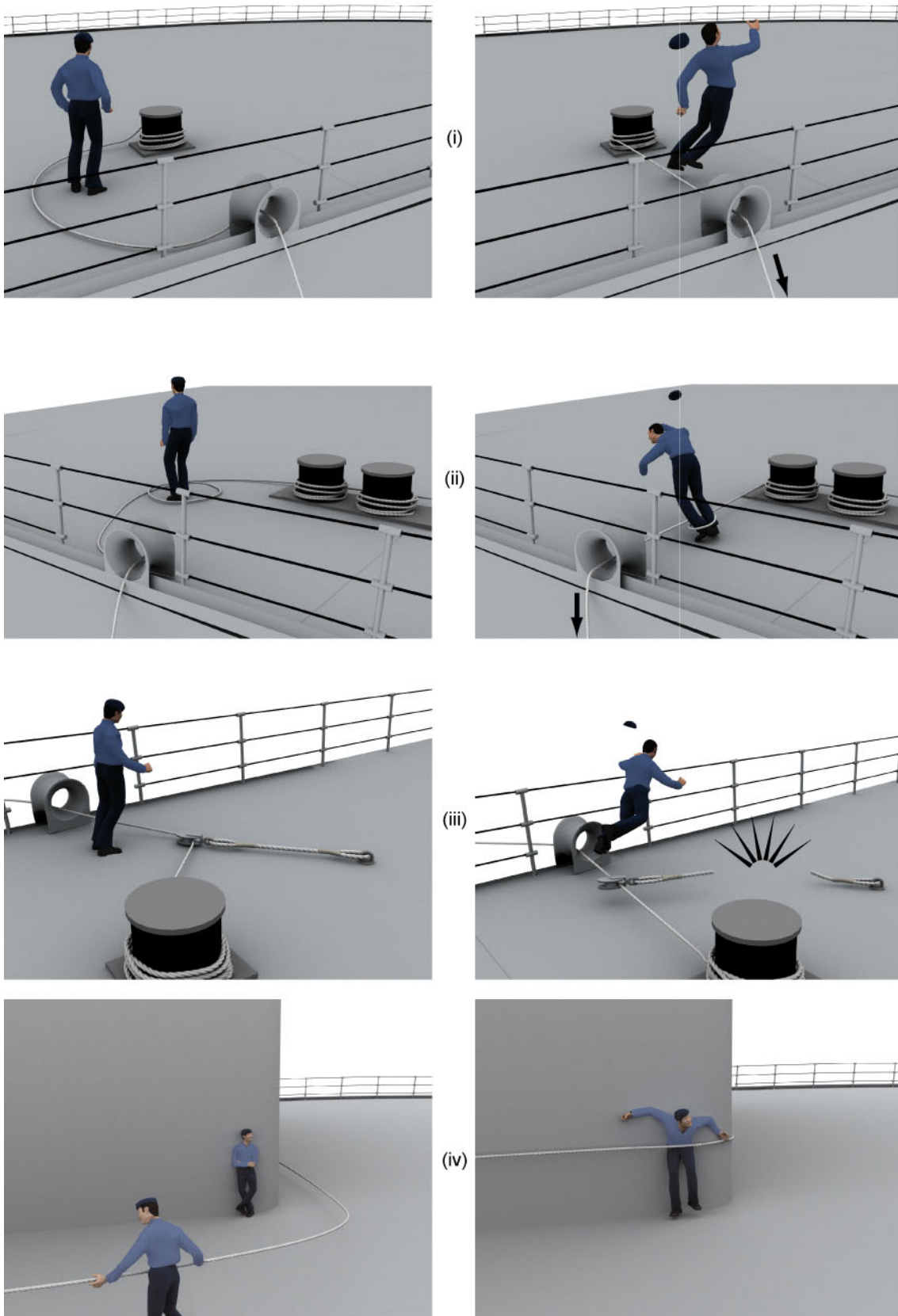


(i)



(ii)

Fig 3-37. Never Stand Within a Bight or Coil

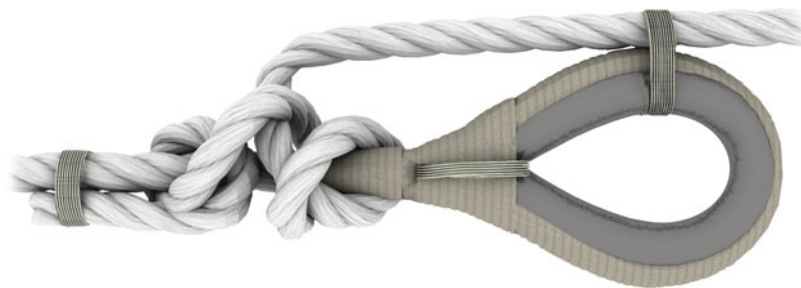


c. **Bending Ropes to Hawser.**

(1) *To Bend a Heaving Line to a Berthing Hawser* (Fig 3-38). Secure the heaving-line to the eye of the hawser with a long bowline. This will give the men hauling it a better grip as the bollard eye of the hawser comes to fairlead or bollard and will enable the line to be slid clear as the eye is placed over the bollards.

(2) *To Bend a Messenger to a Heavy Hawser.* A messenger is used instead of a heaving-line to pass the heavier hawsers between ships, or ship and shore, as it is made of heavier stuff. It should be bent to the neck of the eye of the hawser with a rolling hitch, and firmly stopped to the crown of the eye. The eye of the hawser can then be hauled through a fairlead and the stop cut, leaving the eye free for shackling on or putting on to a slip. The rolling hitch should be well secured and stopped, and the stop on the eye should be firmly secured to prevent the hitch sliding over the shoulders of the eye (Fig 3-38).

Fig 3-38. Bending a Messenger to a Heavy Hawser

d. **Belaying Hawsers to Bollards.**

(1) *A Fibre Rope to a Single Bollard* (Fig 3-39). Bring the rope to the bollard and belay it as shown in the illustration. The first turn round the bollard must be as low down as possible, and overlapping or riding turns should be avoided.

(2) *A Wire Rope to a Single Bollard* (Fig 3-40). Pass the rope round the bollard with sufficient turns to grip and then rack the end to the hauling part, as shown in the illustration. The method of racking the end of a rope belayed to a single bollard is as follows:

- (a) Middle the racking underneath the rope; pass both parts of the racking over the end and under the rope; take a turn round the end. Pass the racking under the rope, and repeat the process as often as required. To finish, separate the parts of the racking, bring them up each side of the cross, and secure them with a reef knot on the top.

Note. Cordage of at least 4mm size should be used for racking; Spunyarn is not strong enough.

Fig 3-39. Belaying a Fibre Rope to a Single Bollard

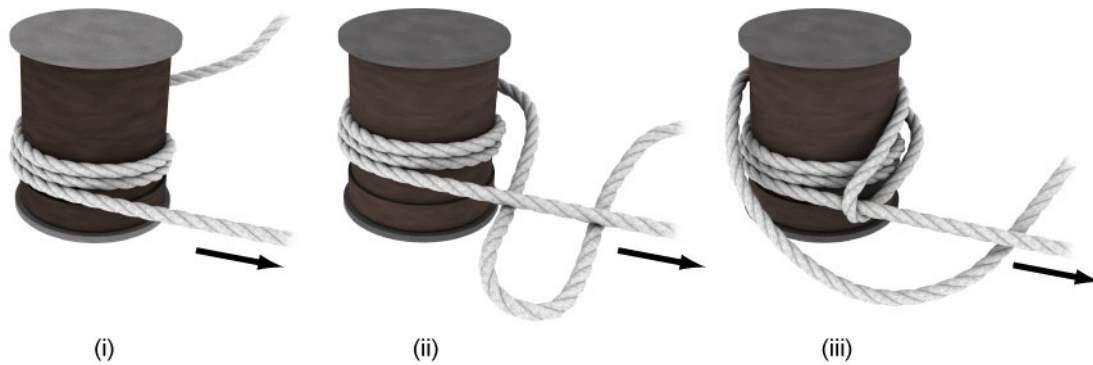
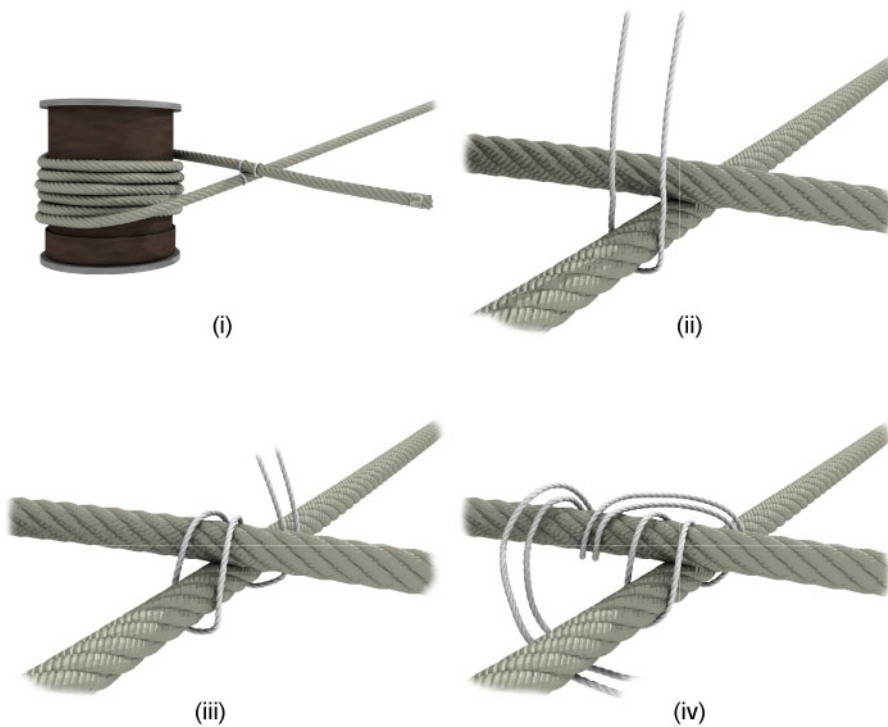


Fig 3-40. Belaying and Racking a Wire Rope to a Single Bollard



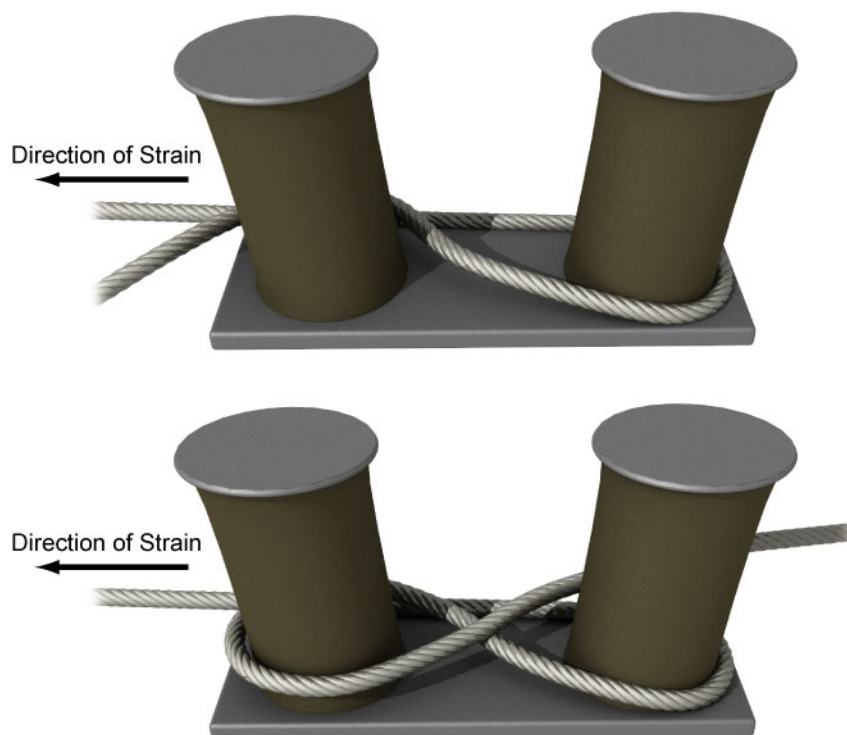
(3) *Two or More Berthing Hawser over a Single Bollard* ([Fig 3-41](#)). When two or more berthing hawsers have to be secured to the same bollard eye the eye of the second hawser must be passed up through the eye of the first before it is placed over the bollard. Similarly, the eye of a third hawser must be passed up through the eyes of the first two; this enables the hawsers to be cast off the bollard in any order. The term used for this procedure is called 'dipping the eye'.

Fig 3-41. Placing the Eyes of Two Berthing Hawasers on a Single Bollard (Dipping the Eye)



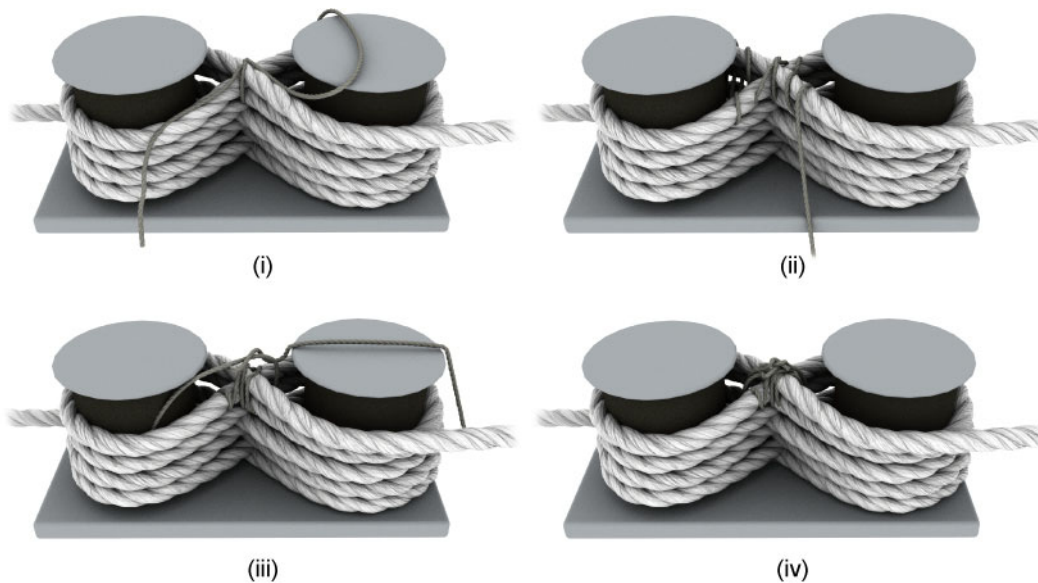
(4) *A Wire or Fibre Hawser to Twin Bollards.* Lead the hawser round the bollard farthest from the source of strain, from outboard to inboard; then belay it with figure-of-eight turns as shown in [Fig 3-42](#). If the hawser has to remain belayed for any length of time, rack the two upper turns as follows ([Fig 3-43](#)):

Fig 3-42. Belaying a Wire or Man-made Fibre Hawser to Twin Bollards



(5) Middle the racking and make an overhand knot round the cross of the two upper turns of the hawser; with each part of the racking, pass racking turns round both parts of the upper turns, working outward from the cross; when sufficient racking turns have been taken, knot both parts of the racking over the cross with an overhand knot. To finish off, pass the ends in opposite directions down and round all the turns of the hawser, haul the ends taut, and finish them off with a reef knot on the top.

Fig 3-43. Racking a Hawser at Twin Bollards



e. Handling Hawasers Under Strain.

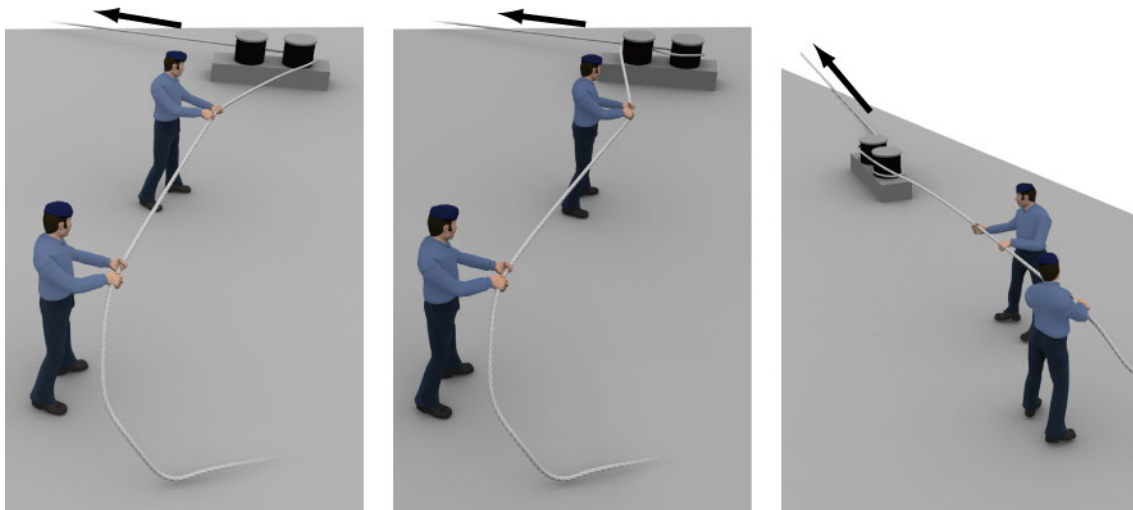
(1) *To Catch a Turn on a Single Bollard* (Fig 3-44). When a rope is under strain, catching an extra turn round a single bollard is difficult unless done correctly. Careful attention should be paid to the position of the hands and fingers to prevent them being nipped, especially if the hawser should render.

Fig 3-44. Catching a Turn on a Single Bollard



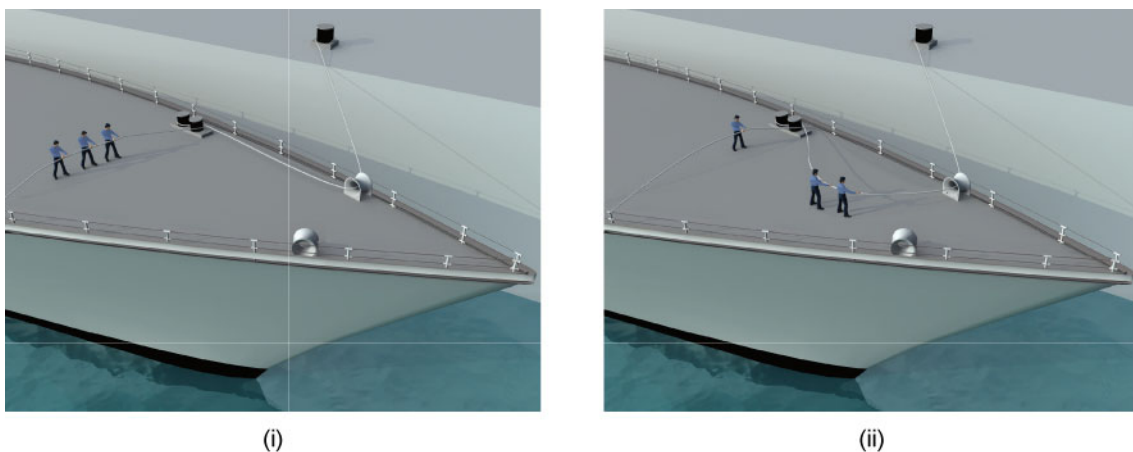
(2) *To Catch a Turn Round Twin Bollards.* Fig 3-45 shows how to catch turns with a hawser under strain round twin bollards. Note that the lead is first to the bollard farthest from the source of strain, and from outboard to inboard. Belaying turns of a hawser leading forward are taken right-handed on the starboard side of a ship and left-handed on the port side, and vice versa when the hawser is leading aft

Fig 3-45. Catching a Turn Round Twin Bollards



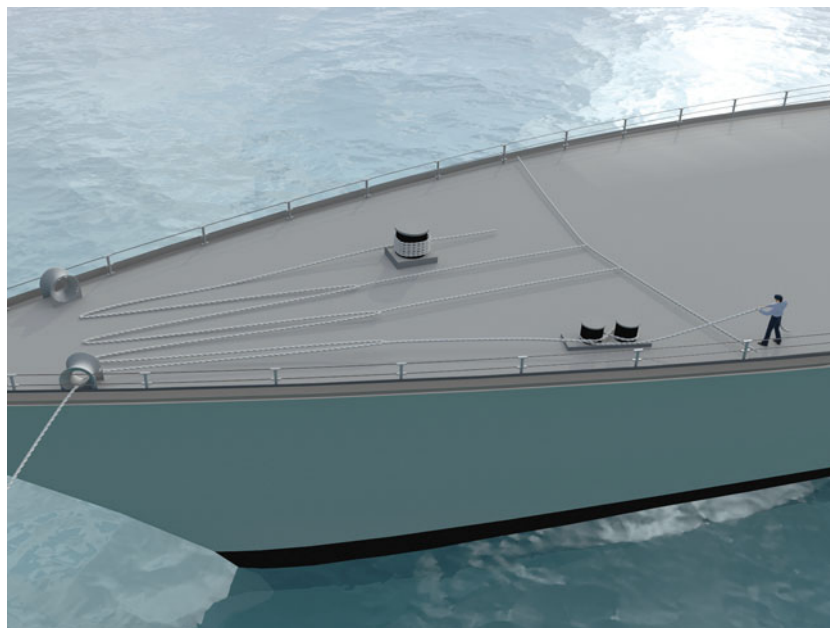
(3) *To Handle a Heavy Rope Which is Alternately Slack and Under Strain.* If space permits, it is best to keep one turn on the bollards and man the rope as shown in (Fig 3-46). As the slack comes in, one person (or two with a very large rope) can fleet it round the bollards, and at the same time be ready to back it up and take more turns when the strain comes on.

Fig 3-46. Handling a Hawser Which is Alternately Slack and Under Strain



(4) *Paying Out a Heavy Wire Hawser* (Fig 3-47). When a heavy hawser is being paid out it must be kept under control, otherwise the weight of its bight outboard may cause the hawser to take charge and run out. It should be faked in as long fleets as the deck space permits; and the bight of each fake should be secured. Each bight should be eased out in turn by an easing-out line surged round an adjacent set of bollards, and a chain check stopper should be provided near the fairlead for use if required. When paying out, the bight should be neither too taut nor too slack, so as to keep to a minimum the effort required to haul it in.

Fig 3-47. Paying Out a Heavy Hawser



(5) *Surging*. Essential rules for surging are to surge smoothly and not in jerks, and to keep sufficient control to be able to surge with the maximum safe strain on the hawser. A hawser with too many turns round the winch or bollards will not render smoothly and may therefore part, and with too few turns the hawser may take charge and run out. It should be remembered that catching an additional turn round a bollard or winch is easier than taking one off. When too many ratings back up a hawser they are apt to get in each other's way, with the result that efficient control of the hawser is lost. Success lies in taking a sufficient number of turns to reduce the strain on the hauling part to manageable proportions. Generally speaking, two or three turns should suffice for surging under normal conditions, and up to three ratings should be sufficient for backing up. An expert seaman can handle a 28mm rope by himself and keep it under complete control when surging by catching or removing turns as required. The precise number of turns for surging will always depend on the strain on the rope, the size of the rope and winch or bollards and the resultant friction between them, and the number of ratings backing-up on the hauling part. Under normal conditions when a rating exerts an approximate pull of 30kg when backing-up a wire, each turn round a bollard or winch reduces the strain required on the hauling part to one-quarter of the load, so that one rating will be able to hold:

One-eighth of a tonne with one turn.
 Half a tonne with two turns.
 Two tonnes with three turns
 Eight tonnes with four turns.

(6) Thirty kilograms is a very conservative estimate of the effort each person can apply; three persons, by backing-up, could easily part a 16mm steel wire rope with three turns round a bollard or winch, or 28mm steel wire rope with four turns. Similarly, a 32mm steel wire rope with five turns round a bollard or winch could easily be parted when backed-up by one person. It is emphasised that this rough rule applies only with normal conditions of friction between the rope and the bollard or winch. With a greasy or wet rope, or a polished bearing surface on the bollard or winch, more turns or personnel are required. Conversely, a rusty steel wire rope, or a painted or rusty bearing surface on the winch or bollard, may increase the frictional grip of each turn by as much as eight times. For this reason the bearing surfaces of winches, bollards and capstans should be kept free of rust or paint.

f. **Stoppers and Stoppering.** To belay a rope, which is under strain, the strain must be taken temporarily with a stopper. The type of stopper used depends on whether it is to hold a man-made fibre or a wire rope.

(1) *Man-made Fibre Cordage Stopper.* This is used for fibre hawsers only and consists of a length of polyester, middled to form two tails and made fast to an eyeplate or other fixture. The stopper is laid alongside the hawser with its tails pointing towards the source of strain; the tails are passed by crossing them under and over the hawser in the direction of the source of strain. The ends are kept in hand or stoppered to the hawser (Fig 3-48).

Fig 3-48. Man-made Fibre Cordage Stopper

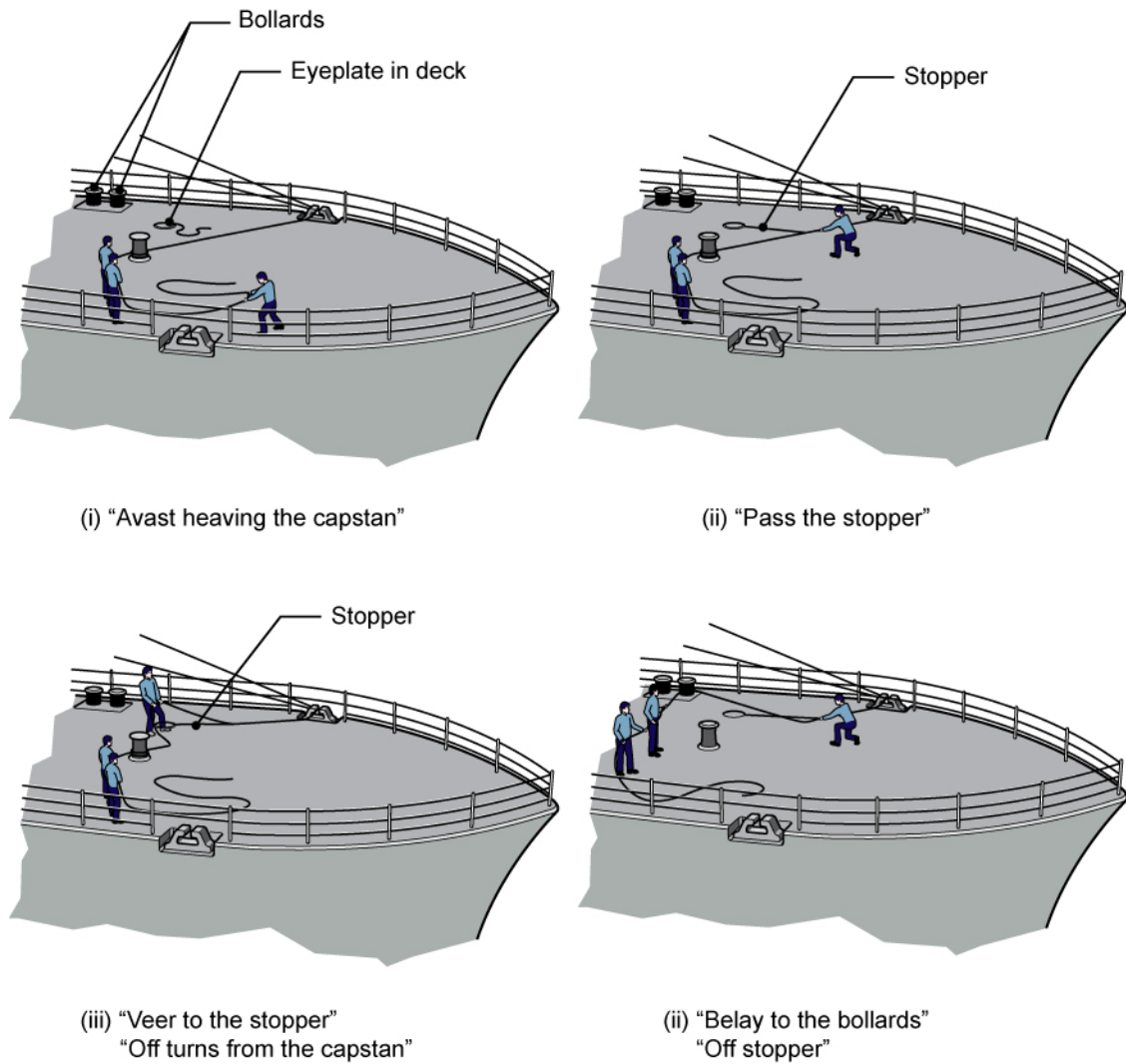


(2) *Chain Stopper.* This is used for wire hawsers only and consists of a length of chain made fast to an eyeplate or other fixture. The stopper is laid out alongside the hawser with the tail pointing towards the source of strain; the tail is half-hitched round the hawser **with** the lay, then dogged round the hawser **against** the lay; the end is then held by hand or stoppered to the hawser (Fig 3-49). Fig 3-50 shows an example of the use of a cordage or chain stopper. The hawser, which has been hove in by the capstan, is under strain, and it is desired to belay it to a pair of bollards. The stopper should be passed as close to the fairlead as possible, and as nearly as possible in the line between the fairlead and bollards, to avoid loss of slack as the hawser is transferred from the capstan to the bollards.

Fig 3-49. Chain Stopper



Fig 3-50. Use of a Stopper when Berthing Ship



CAUTION

At no time is the ship to be held only by a stopper. (Para 03078 [sub para d](#))

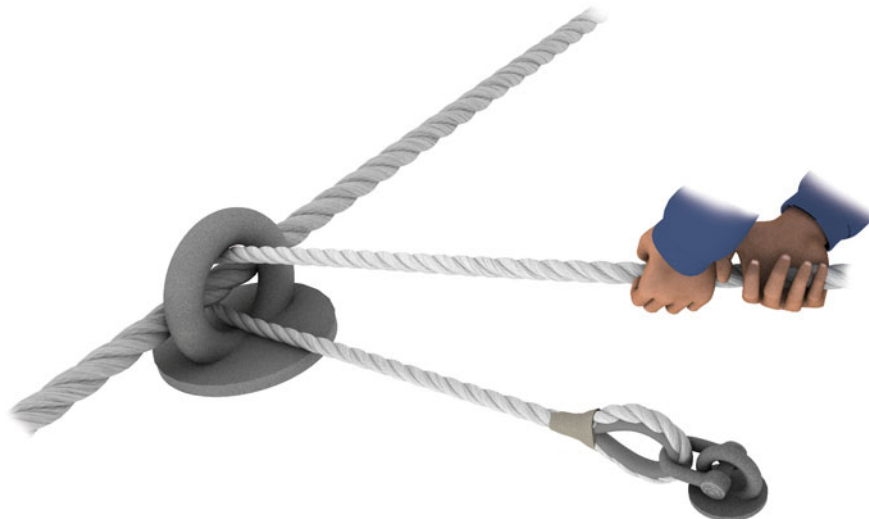
(3) *Chain Check Stopper* (Fig 3-51). This is used to control the speed at which a wire hawser is paid out. It is rove so that a pull on the tackle will jam the hawser against the eyeplate, thus operating as a brake and bringing it to rest.

Fig 3-51. A Chain Check Stopper



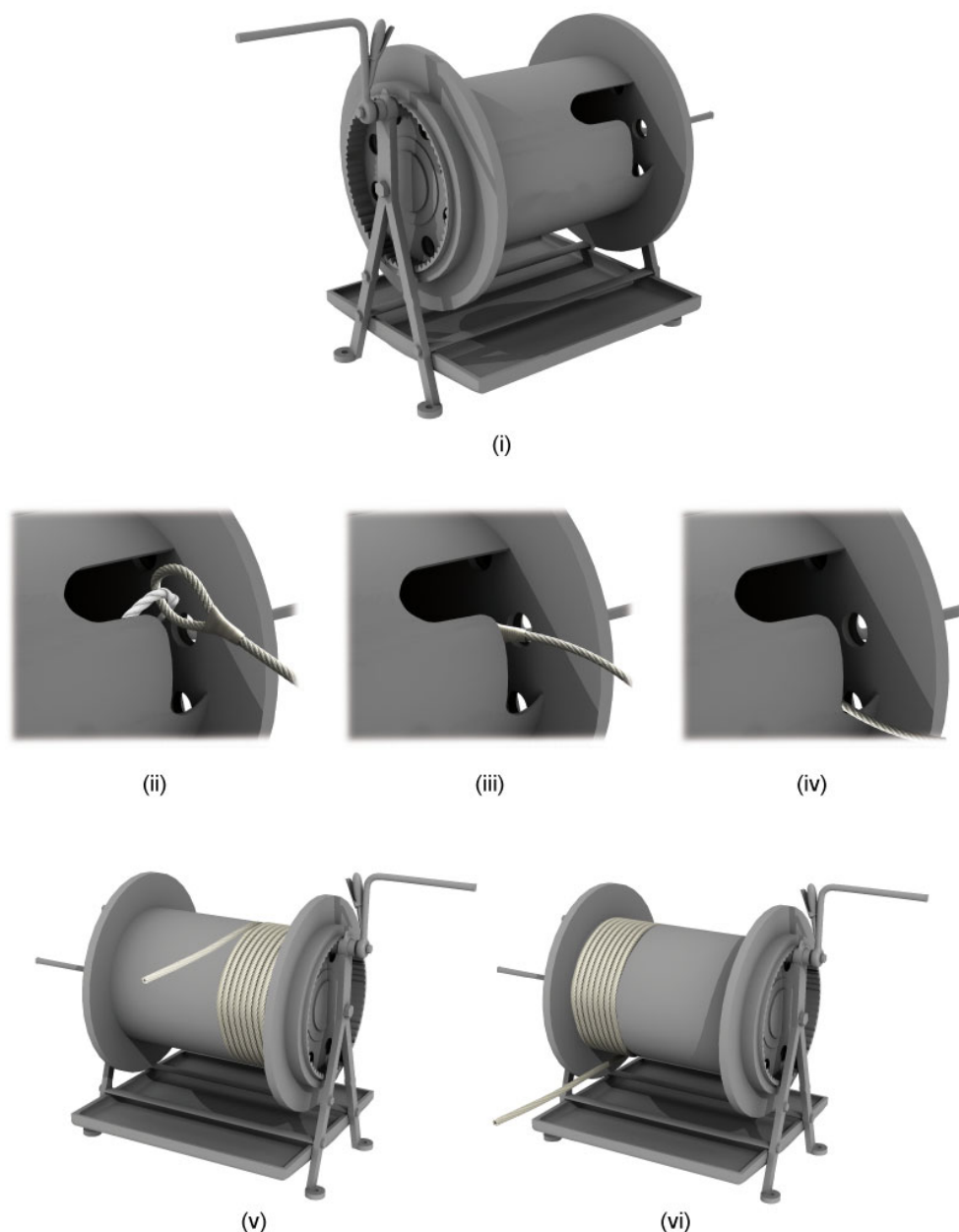
(4) *Cordage Check Stopper* (Fig 3-52). As with the chain check stopper, the cordage check stopper is used to control the speed at which a man-made fibre hawser is paid out. It is rove as a chain check stopper except that the hauling part is normally kept in hand. The stopper is made of manila.

Fig 3-52. A Cordage Check Stopper



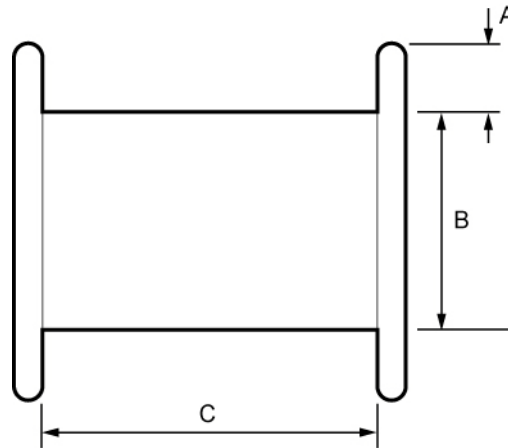
g. **Stowage of Hawser.** Hawser can be stowed on reels (Fig 3-53). In modern ships, a hawser store is usually sited directly below the fo'c'sle deck. The drum and flanges of a hawser reel should be of skeleton construction to allow air to circulate around the hawser and thus keep it dry. Both ends of the hawser should be stopped by their eyes to the drum and flange. The reel should be secured by a lanyard, fitted on the flange, to prevent it rotating when the hawser is stowed. Most ships have been fitted with ventilated bins made either of steel or timber, for the stowage of man-made fibre hawsers. With this type of stowage, man-made fibre hawsers that have been in tension can be stowed away directly, without the need to wait for the hawser to recover its length, a necessary requirement when such hawsers are stowed on reels. Cordage stowed in ventilated bins must be coiled or faked down in the bin on wooden duckboards to ensure adequate air circulation underneath as well as around the hawsers. Yet another type of hawser stowage is the bulkhead saddle, a circular or oval cluster of steel horns around which the hawser is wound.

Fig 3-53. Stowage of Hawsers on Reels



h. **Calculating the Capacity of a Reel or Drum.** The following formula, used in conjunction with the information in [Fig 3-54](#), gives an approximate indication as to what length, in metres, of rope of a given size can be placed on any reel or drum.

Fig 3-54. Calculation of Drum Capacity



$$\frac{(A + B) \times A \times C \times \pi \times 10^6}{d^2}$$

where A, B and C are quoted in metres and d , the diameter of the rope, is quoted in millimetres

Note. Ropes are normally manufactured to a maximum oversize tolerance of 4%; therefore the actual diameter 'd' could be nominal diameter + 4%.

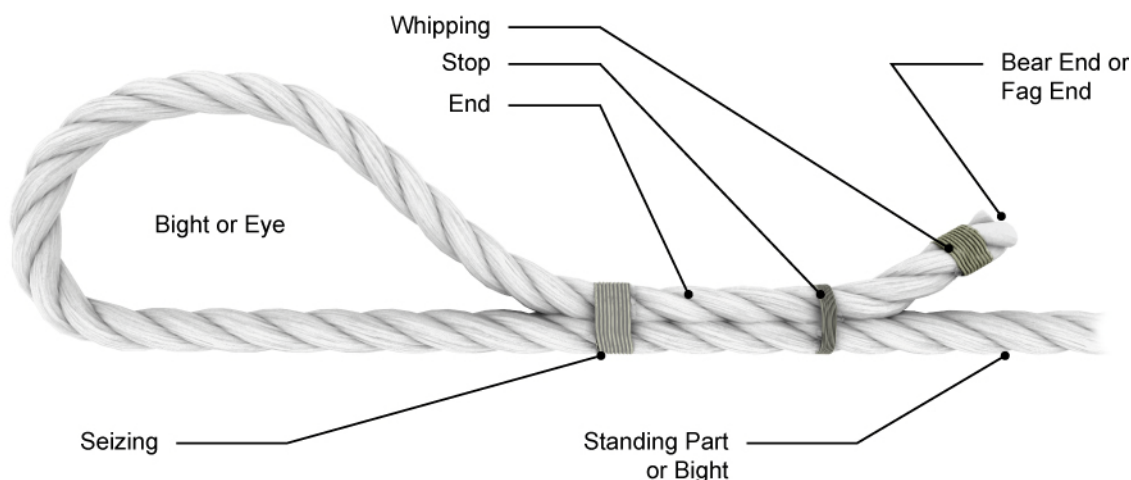
03015. Bends and Hitches

a. Strictly speaking, a bend is a method of temporarily joining two ropes, a hitch is a method of temporarily joining a rope to a structure or ring, and a knot is the intertwining of strands or smaller parts of rope(s) to prevent a rope unreeving, or to provide a handhold, a weight or a stopper on any part of a rope. These definitions have become blurred with time and all three terms are now virtually synonymous. Commonly used bends and hitches are described here, and knots and their uses are described in [Para 03016](#).

b. **Strength of Knotted Ropes.** All knots, bends and hitches reduce the strength of a rope in that portion of the rope where the knot, bend or hitch is made. This reduction varies from 40-60%, and it should be borne in mind when putting a load on a knotted rope.

c. **Terms Used.** The following terms are used when describing the formation of the various bends and hitches:

Fig 3-55. Terms Used in Describing Bends and Hitches



(1) *Bight*. The middle part of a length of rope. This term also refers to a loop of rope, and **to make a bight** is to form a loop.

(2) *End*. The short length at the end of a rope, which may be formed into an eye, or used for making a bend or a hitch with which to secure it. The end of a rope is also that length of rope left over after making such an eye, bend or hitch. The **bare end**, or **fag end**, is the extreme end of a length of rope.

(3) *Standing Part*. The part of the bight of a rope, which is nearest the eye, bend or hitch, in contrast to the end.

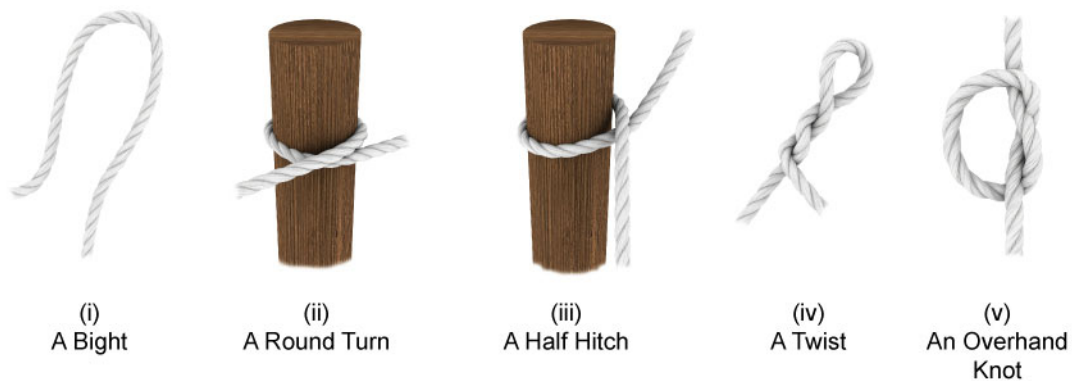
(4) *Stopping*. A light fastening for temporarily holding in place a rope or any other object. It is not meant to bear any strain other than that required to keep the rope or other object in place.

(5) *Seizing*. A seizing is used to fasten two ropes, or two parts of the same rope, securely together, to prevent them moving in relation to each other.

(6) *Whipping*. The binding round the bare end of a rope to prevent the strands from unlaying.

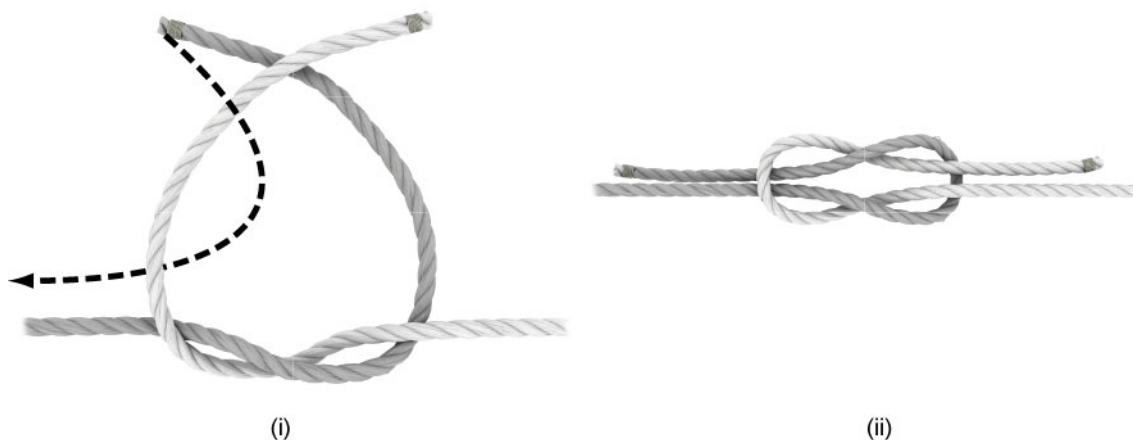
d. **Elements of Bends and Hitches.** Most bends and hitches consist of a combination of two or more of the elements illustrated in [Fig 3-56](#).

Fig 3-56. Elements of Bends and Hitches



e. **Reef Knot** (Fig 3-57). The reef knot consists of two overhand knots made consecutively, and is used as a common tie for bending together two ropes of approximately equal size. It is not likely to come undone when there is no strain on the knot, but it is not reliable if the ropes are of unequal size or very slippery unless the ends are seized back to their standing part. To form a reef knot care must be taken to cross the ends opposite ways each time they are knotted (ie right over left, then left over right, or vice versa), otherwise the result will be a **granny**, which will either slip or jam, depending upon whether it is made with or against the lay of the rope. A granny is also very likely to undo where there is no strain on the knot.

Fig 3-57. Reef Knot



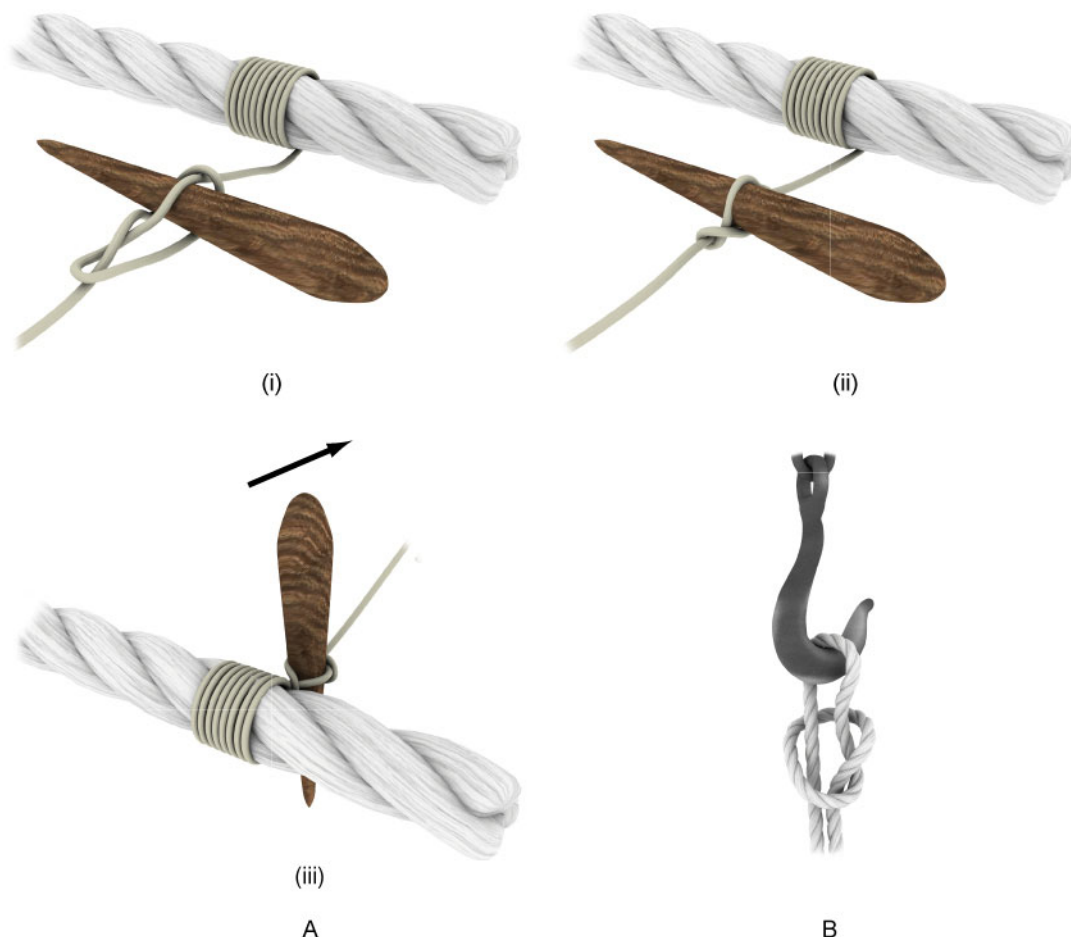
f. **Figure-of-eight Knot** (Fig 3-58). This knot is used to prevent a rope unreeving through a block.

Fig 3-58. Figure-of-eight Knot



g. **Marline Spike Hitch** (Fig 3-59). This hitch is for securing a marline spike, or hook, into the bight of a line. Fig 3-59(ii) and Fig 3-59(iii) show how it is used to haul taut a serving or lashing with a marline spike.

Fig 3-59. Marline Spike Hitch



h. **Marling Hitch** (Fig 3-60). For lashing long bundles such as awnings. It can be seen from the illustration that in each hitch the end is passed down through the bight, thus jamming that part against the bundle and enabling the lashing to be hauled taut. The operation of binding together ropes or yarns by a succession of closely spaced marling hitches is known as **marling down**. Marling is usually begun with a timber hitch if no eye is spliced into the end of the lashing.

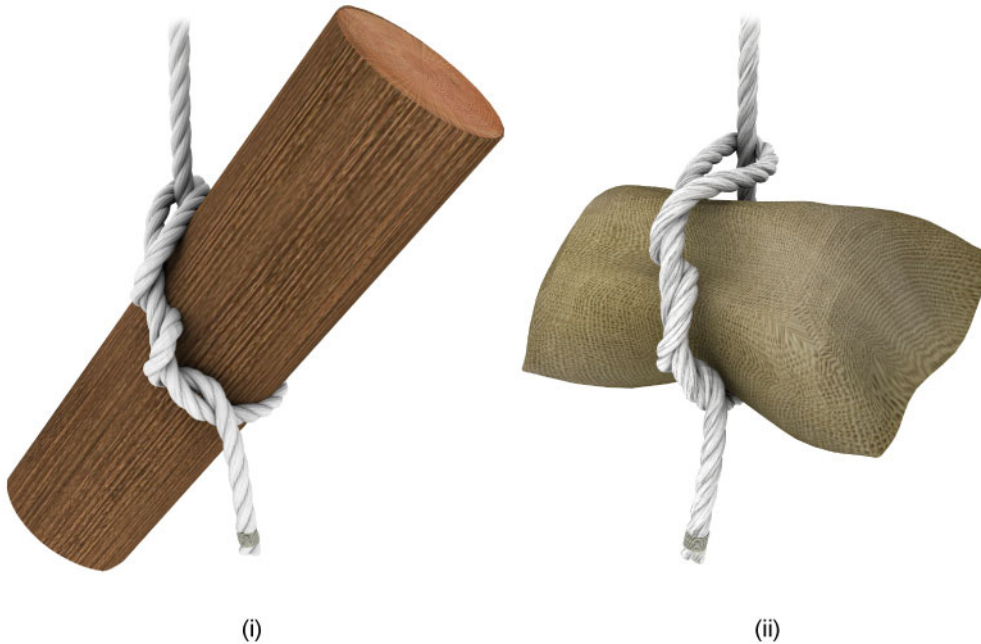
Fig 3-60. Marling Hitch



BR 67
RIGGING AND DECK GEAR

- i. **Timber Hitch** (Fig 3-61). This hitch is used to secure a rope's end to a spar or bale.

Fig 3-61. Timber Hitch



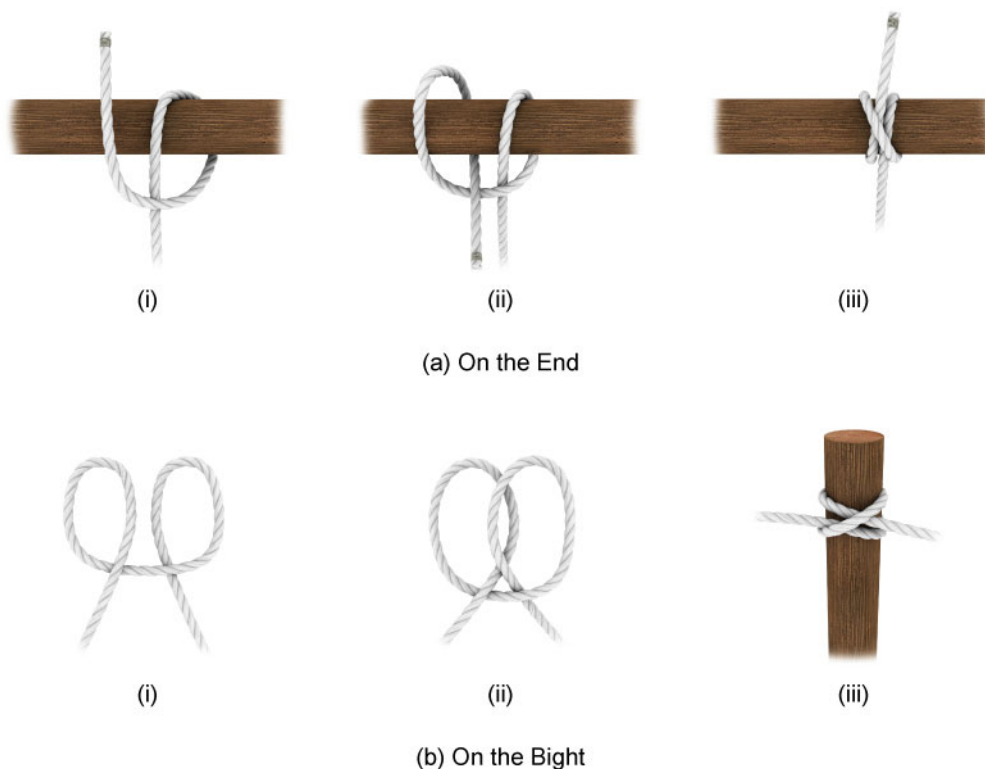
- j. **Timber Hitch and Half Hitch** (Fig 3-62). Used to tow, hoist or lower a spar. If the spar is tapered it should be towed or hoisted thick end first, with the timber hitch at the thin end and the half hitch at the thick end.

Fig 3-62. Timber Hitch and Half Hitch



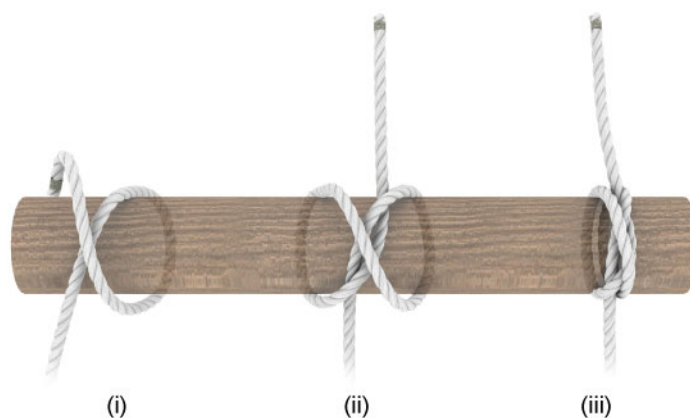
k. **Clove Hitch** (Fig 3-63). This hitch is used to secure a rope to a spar, rail or similar fitting; also for many other purposes. It will slip along the spar or rail if subjected to a sideways pull. It can be made with the end or with the bight of a rope, as illustrated in Fig 3-63(a) and Fig 3-63(b) respectively.

Fig 3-63. Clove Hitch



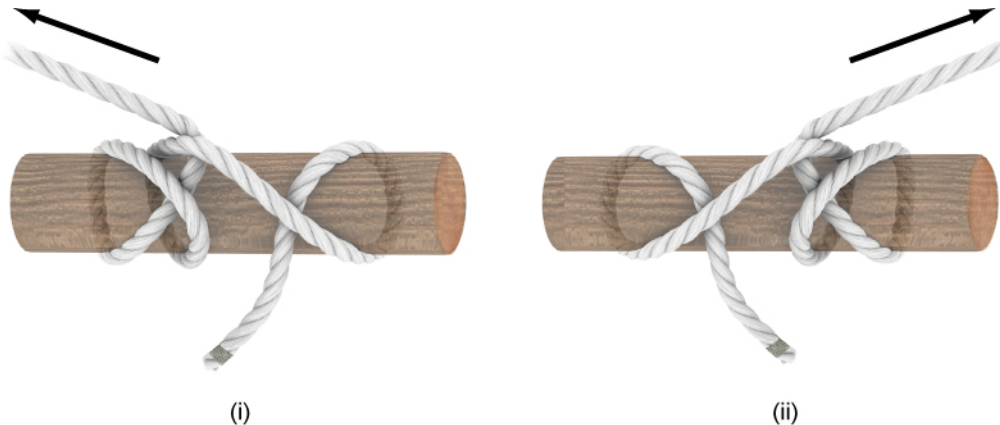
l. **Constrictor Knot**. The constrictor knot is a variation of the clove hitch, and is used when a firm grip is required, such as when holding a thimble in place prior to splicing a hawser eye. It is the most secure of all binding knots. Take a round turn, follow the arrow in Fig 3-64(i) and haul taut.

Fig 3-64. Constrictor Knot



m. **Rolling Hitch** (Fig 3-65). This hitch is also used for securing a rope to a spar, rail or similar fitting when the pull is expected to be from one side or the other, and to another rope under strain. It is made by passing the end twice round the spar or rope, each turn crossing the standing part. A half hitch on the opposite side completes the hitch. Always pass the two turns on the side from which the pull is expected.

Fig 3-65. Rolling Hitch

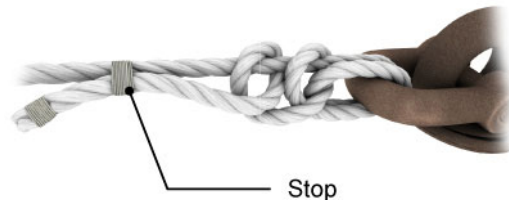


n. **Round Turn and Two Half Hitches** (Fig 3-66). This combination is used to secure a heavy load to a spar, ring or shackle such as the buoy shackle of a mooring buoy. It will never jam and can be cast off quickly. The end should be stopped to the standing part.

Fig 3-66. Round Turn and Two Half Hitches



Fig 3-67. Fisherman's Bend



o. **Fisherman's Bend** (Fig 3-67). An alternative to a round turn and two half hitches, and normally used for bending a rope or hawser to the ring of an anchor. It is more suitable for a jerking pull, but will tend to jam and is not easily cast off. The end should be stopped to the standing part.

p. **Sheet Bend or Swab Hitch** (Fig 3-68). This is used to secure a rope's end to a small eye, eg, the lazy painter of a boat at a boom to the Jacob's ladder. It is also used to bend a small rope to a large one.

q. **Double Sheet Bend** (Fig 3-69). A more secure method of achieving the same purpose as a single sheet bend. Used to secure a boat's painter to the eye of the lizard when at a boom.

Fig 3-68. Sheet Bend

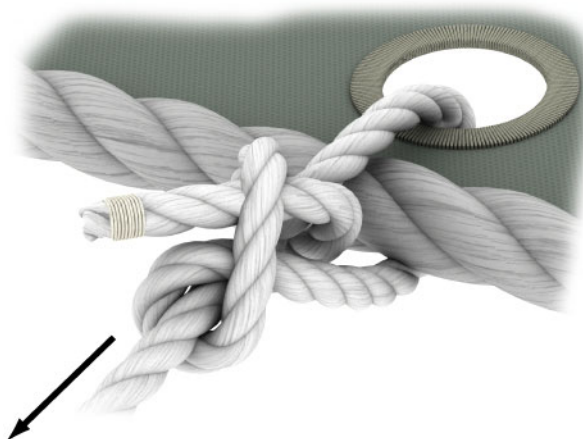


Fig 3-69. Double Sheet Bend



r. **Buntline Hitch** (Fig 3-70) This hitch is a clove hitch on the standing part, and is used to secure a rope's end to a cringle or a small eye. It is more difficult to cast off than a sheet bend.

Fig 3-70. Buntline Hitch



s. **Blackwall Hitch** (Fig 3-71). A quick means of attaching a rope to a hook. It is used when the rope and hook are of equal size and it is likely to slip if subjected to more than ordinary strain.

Fig 3-71. Blackwall Hitch



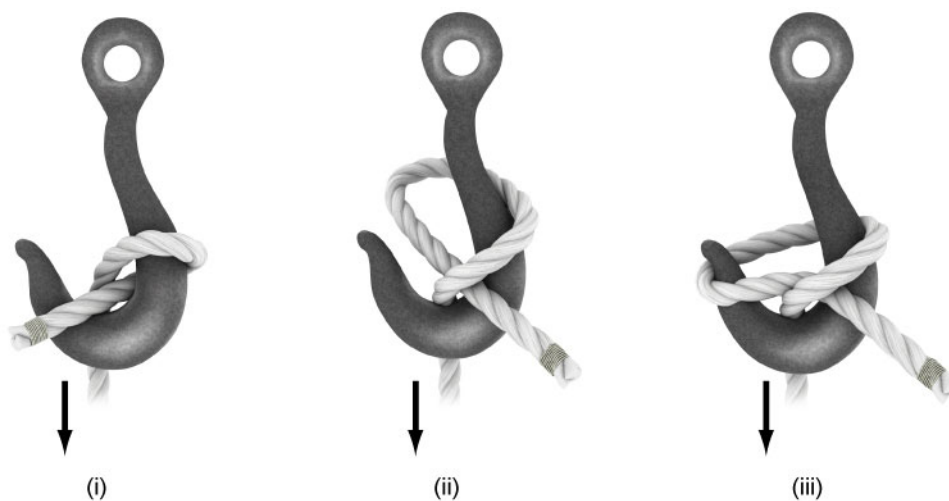
t. **Double Blackwall Hitch** (Fig 3-72). Used when the rope and hook are of unequal size. It is as secure as the midshipman's hitch (below).

Fig 3-72. Double Blackwall Hitch



u. **Midshipman's Hitch** (Fig 3-73). An alternative to the Blackwall hitch; it is preferred if the rope is at all greasy. It is made by first forming a Blackwall hitch and then taking the underneath part and placing it over the bill of the hook.

Fig 3-73. Midshipman's Hitch



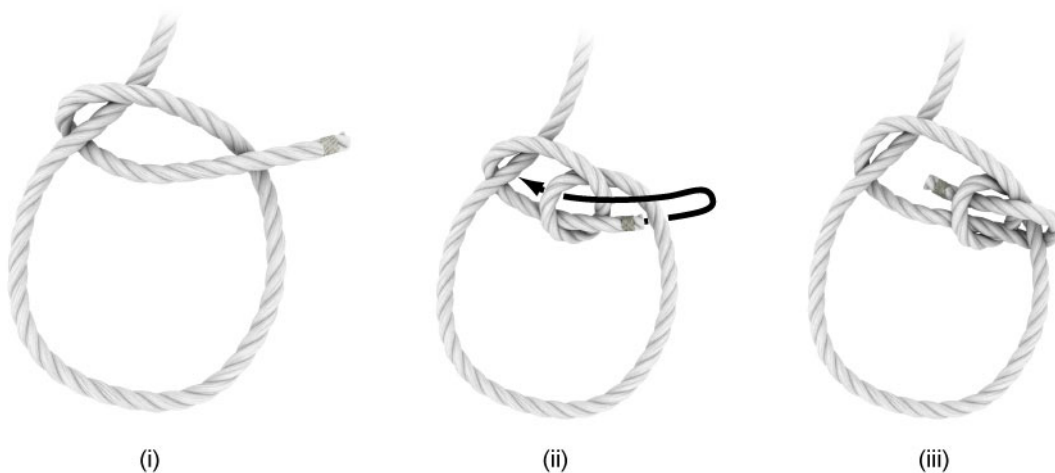
v. **Bowline** (Fig 3-74). This is the most useful knot for making temporary eyes in ropes of all sizes. It is used for bending a heaving-line to a hawser, as a lifeline round a person's waist and for a great variety of similar purposes. Every member of a ship's company should be able to tie a bowline round his waist with his eyes closed. The bowline is usually made in the following manner, which enables it to be formed while there is a strain on the rope. Take the end in the right hand and the standing part in the left. Place the end over the standing part and hold the cross thus formed between the index finger and thumb of the right hand, with the thumb underneath; the loop so formed becomes the bight of the bowline, and if required it can be formed round the body of the person making the knot. Then turn the wrist to the right, away from the body, and bring the end up through the loop so formed; this loop is sometimes called the gooseneck. Now hold the cross of the gooseneck in the left hand as shown in Fig 3-74, leaving the right hand free to manipulate the end, and complete the bowline by dipping the end under the standing part, bringing it up again, and passing it down through the gooseneck.

Fig 3-74. Bowline



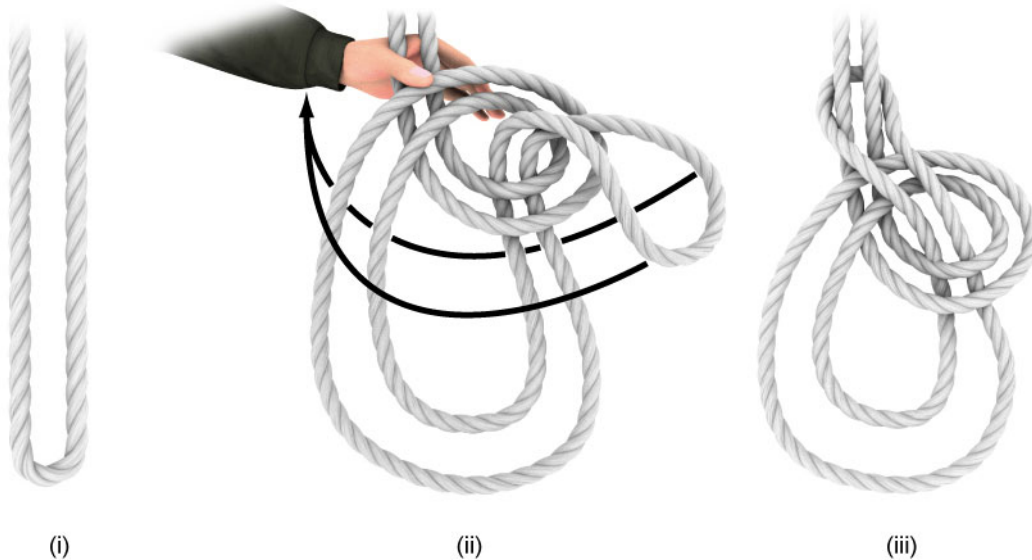
w. **Running Bowline** (Fig 3-75). Used to make a running eye in the end of a rope; it must never be placed round a person's body.

Fig 3-75. Running Bowline



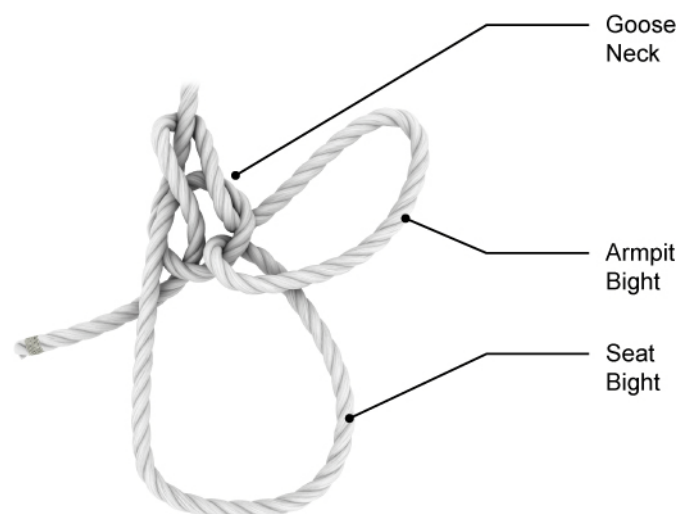
- x. **Bowline on the Bight (Fig 3-76).** As its name implies, this bowline is made on the bight, the first two operations in its formation being the same as for a simple bowline. It can be used for lowering a person from aloft or over the ship's side, the short bight being placed under the person's arms and the long one under their buttocks.

Fig 3-76. Bowline on the Bight



- y. **French Bowline (Fig 3-77).** An alternative to the bowline on the bight and usually more suitable. It is made in a similar manner to a bowline, except that after the gooseneck has been formed and the end passed up through it the end is brought round and up through it again, so as to form a large bight, which is passed, under the person's armpits. The knot is then completed as a simple bowline. The weight of the person sitting in the main bight keeps the arm bight taut, the knot lying roughly at their breast.

Fig 3-77. French Bowline



z. **Slip Knots** (Fig 3-78). The sheet bend, the bowline and the clove hitch are the three main knots, which can be released quickly by using a bight instead of an end in the last phase of making them. Such slipknots will hold steady strain fairly well, but cannot be trusted to stand a jerking pull.

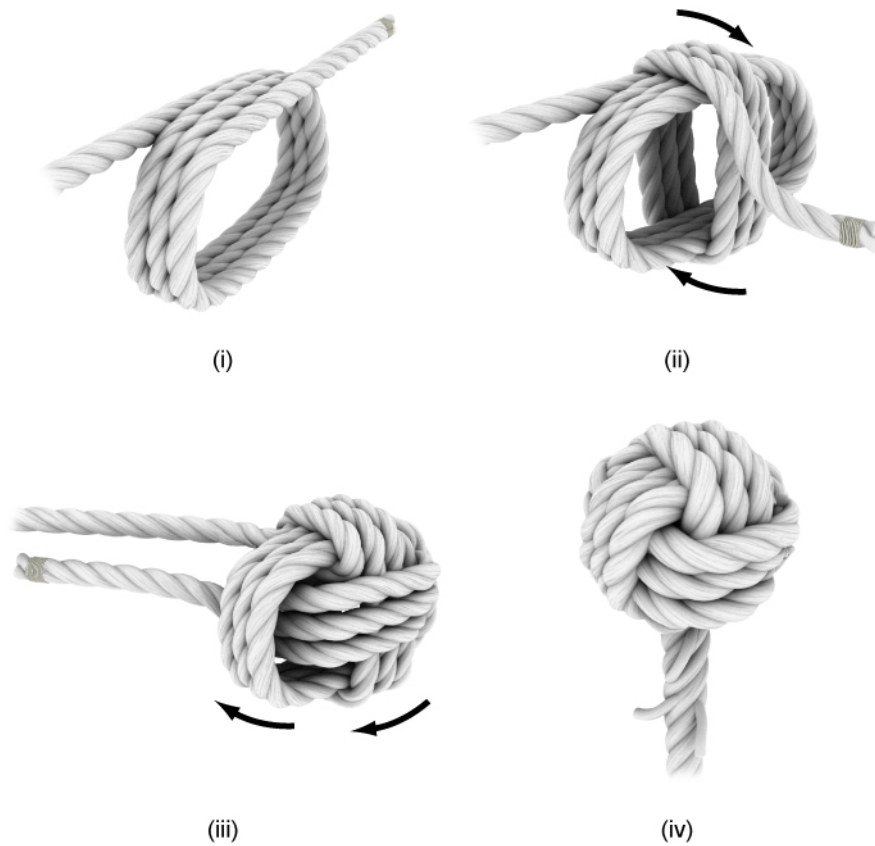
Fig 3-78. Slip Knots



aa. **Monkey's Fist** (Fig 3-79). This is used to weight the end of a heaving line so that it will carry when thrown against the wind. It is made as follows:

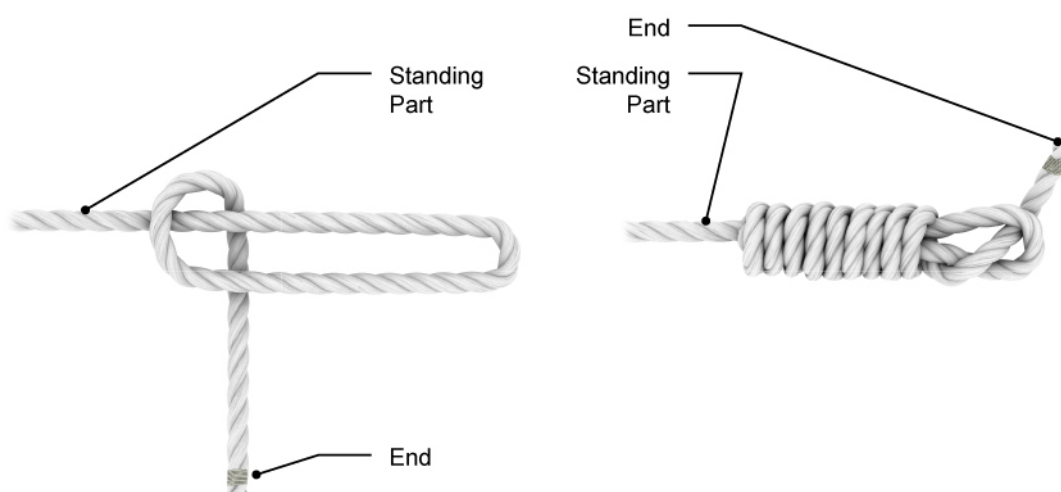
- (1) Wind three turns round the hand.
- (2) Pass a second set of three turns across and round the first three.
- (3) Pass a third set of three turns round and across the second set, but inside the first set and in the direction shown by the arrows; if the knot is correctly made the end will come out alongside the standing part.
- (4) To finish the knot, work all parts taut and splice the end into the standing part; alternatively, tie an overhand knot in the end and finish it by tucking it inside the monkey's fist, then work all parts taut as before.

Fig 3-79. Monkey's Fist



ab. **Heaving-line Knot** (Fig 3-80). This knot is used as an alternative to the monkey's fist and is quickly and easily made. Form a bight about 1.5 metres long at the end of the line. Start frapping the end round both parts of the bight at about 20cm from the actual bend of the bight, and continue until it is all but expended. Then pass the end through the small loop left and haul on the standing part.

Fig 3-80. Heaving-line Knot



ac. **Fisherman's Knots**

(1) *Bending a Line to a Hook* (Fig 3-81). Reeve the end of the line through the eye, form a bight along the shank of the hook, then take several turns round the bight, starting from the eye and finishing through the end of the bight, Haul taut. This is very similar to the heaving line knot.

Fig 3-81. Bending a Polyamide Line to a Fishing Hook



(2) *Joining a Polyamide Line* (Fig 3-82). Make a heaving-line knot at the end of one length, then pass the other length through the bight before making a similar knot in it. Haul taut. The lines must be moistened before the knot is tied.

Fig 3-82. Joining Polyamide Lines



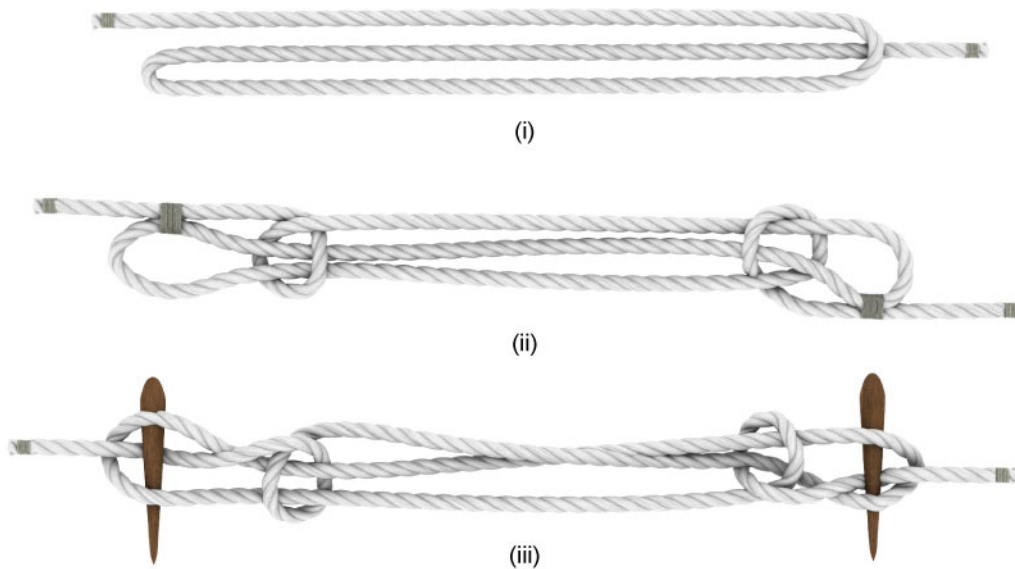
(i)



(ii)

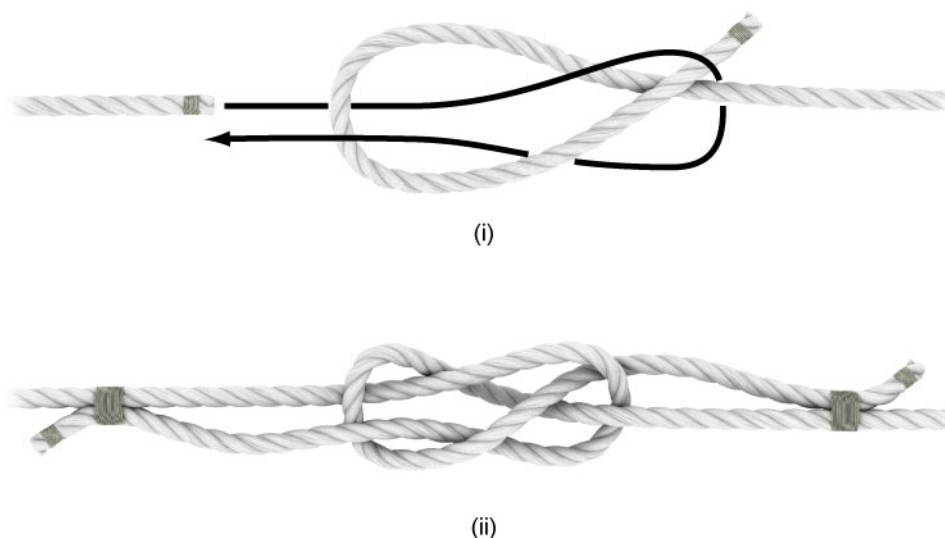
ad. **Sheepshank** (Fig 3-83). This is used to shorten the bight of a rope temporarily without cutting it. The strain on the rope will usually prevent the sheepshank from slipping, but if necessary the loops can be stopped to the standing parts or secured with a toggle.

Fig 3-83. Sheepshank



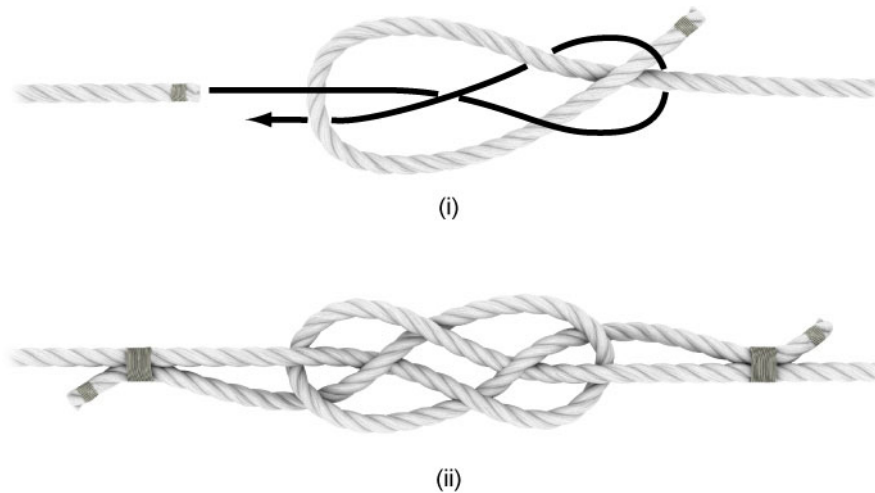
ae. **Single Carrick Bend** (Fig 3-84). Used for joining two hawsers together when the join will have to pass round a capstan or winch. The ends should be stopped to their standing parts. Make a cross in one end of rope with the fag end on top, then bring the other rope's end up through the bight of the first, over the cross, down between the standing part and fag end, and back up through the bight on the **opposite** side to the first fag end.

Fig 3-84. Single Carrick Bend



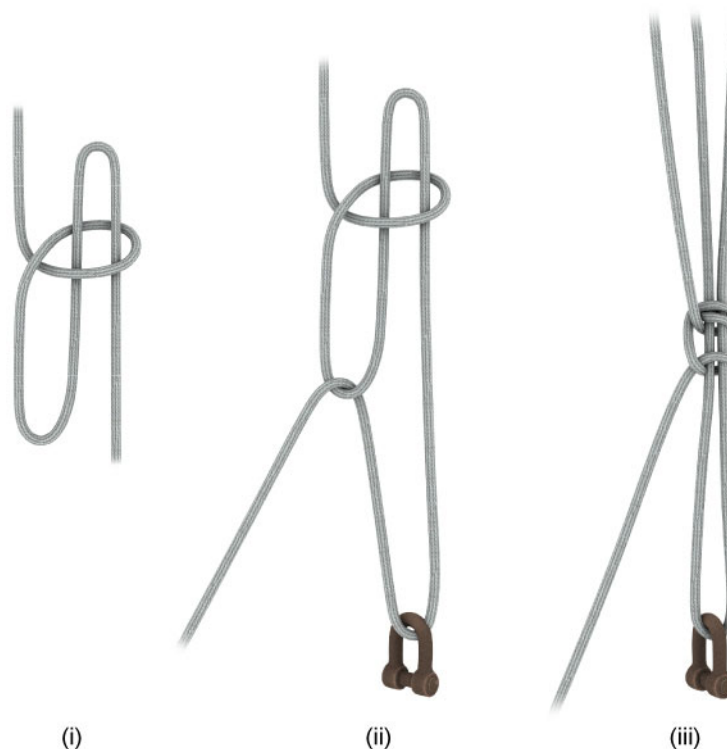
af. **Double Carrick Bend** (Fig 3-85). This is used when a more secure bend than the single carrick bend is required.

Fig 3-85. Double Carrick Bend



ag. **Lorry-driver's Hitch** (Fig 3-86). This hitch is useful as a means of gaining purchase on cover lanyards or frapping lines etc. Form an eye, as for one end of a sheepshank, at a convenient point on the bight of the rope (Fig 3-86(i)). Lead the end of the rope through or round the securing point, then through the formed eye on the bight of the rope (Fig 3-86(ii)). Haul the rope taut and secure with a rolling hitch (Fig 3-86(iii)).

Fig 3-86. Lorry Driver's Hitch

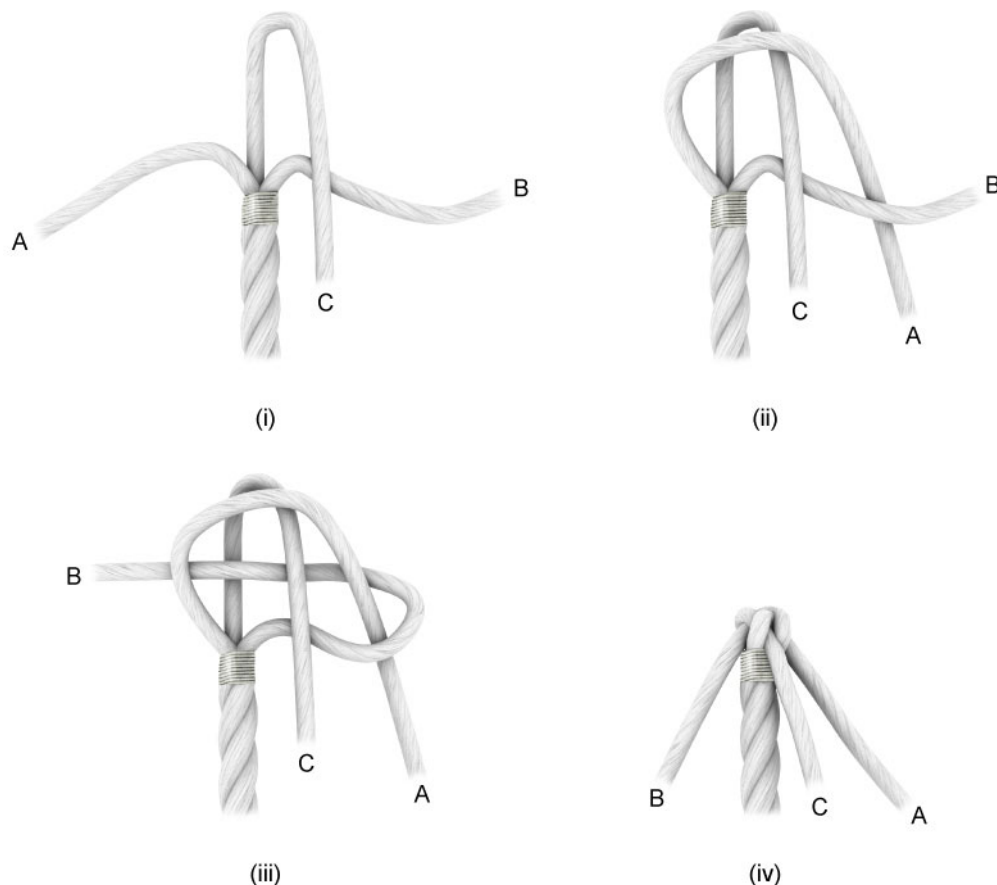


03016. Knots

a. The functions of a knot are described at [Para 03015](#). The following paragraphs described how a few commonly used knots are made. To assist in the description the strands are lettered A, B, C, etc., and their respective bights a, b, c, etc.

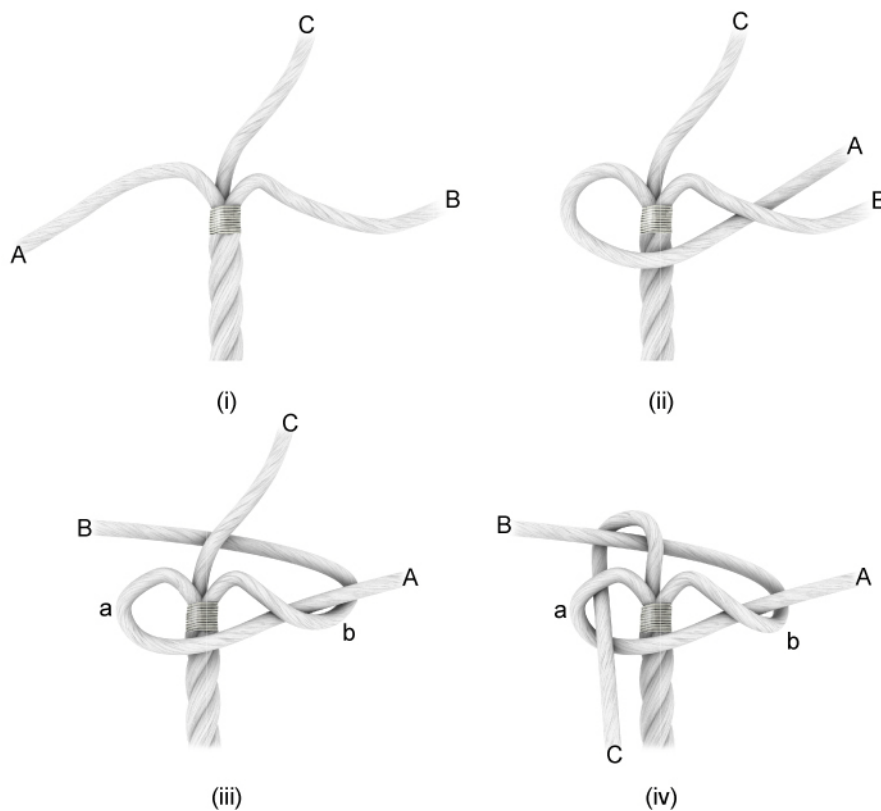
b. **Crown Knot** ([Fig 3-87](#)). When finished, the Crown Knot leaves the three strands pointing back along the rope. It is used to begin a back splice and as a basis for more complicated knots, but seldom on its own. To form a crown, whip the rope at a distance from its end equal to twelve times its diameter. Then unlay the strands to the whipping, whip their ends, and spread them out in the form of a star, with the centre strand farthest away from the body; and then ([Fig 3-87](#)) bring strand C to the front to form a loop [Fig 3-87\(i\)](#); place strand A over C and behind B [Fig 3-87\(ii\)](#); thread strand B through the loop of C [Fig 3-87\(iii\)](#); pull all strands taut until knot is tidy and uniform [Fig 3-87\(iv\)](#).

Fig 3-87. Making a Crown Knot



c. **Wall Knot** ([Fig 3-88](#)). When finished, the Wall Knot leaves all three strands pointing in the original direction. It is, in fact, a crown knot turned upside down. Prepare the rope as for a crown; then take strand A and pass it under B; take strand B round A so as to enclose it, and pass it under C; take strand C round B so as to enclose it and bring it **up** through the bight **a**. If the wall is to be used by itself to prevent a rope unreeving, the strands should be whipped together where they emerge from the knot and the ends should then be cut off.

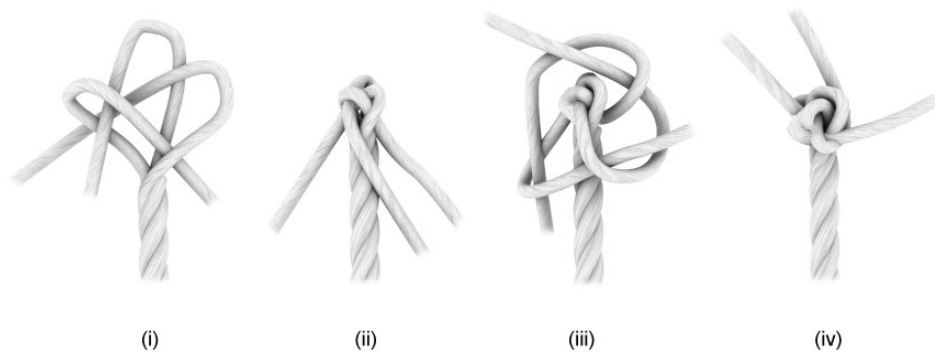
Fig 3-88. Making a Wall Knot



d. **Wall and Crown Knot.** This can be used to prevent a rope such as a rudder lanyard from unreeving, and also to form the foundation for more advanced knots. The whipping is placed at a distance from the end equal to 20 times the diameter of the rope, the wall being formed first and the crown made on top of it.

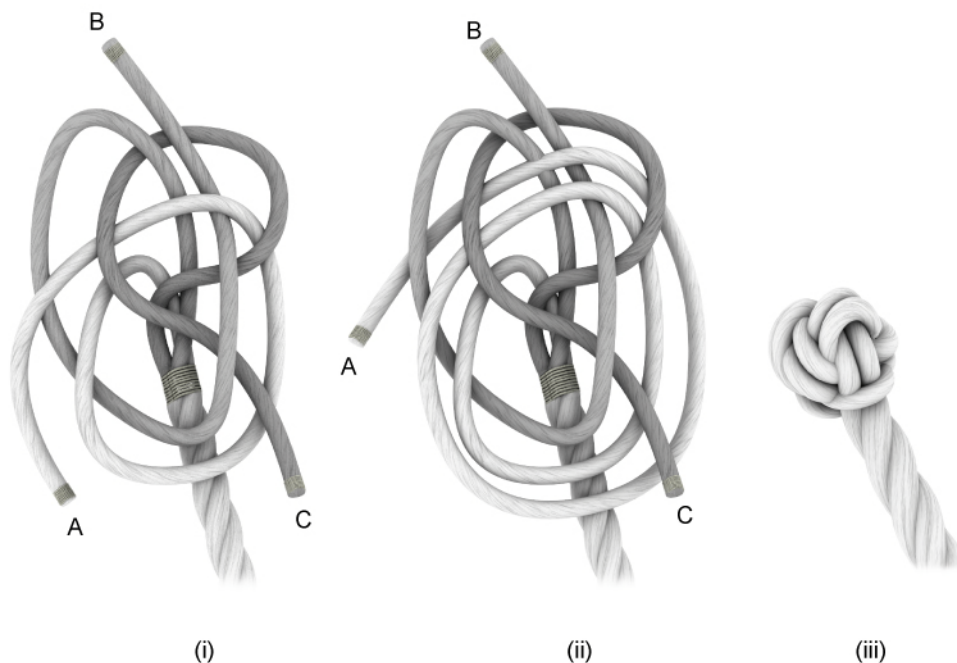
e. **Crown and Wall Knot** ([Fig 3-89](#)). This differs from the Wall and Crown Knot in that the crown is made first and the wall formed under it. It is used for finishing off the end of seizings to prevent them from unreeving. The strands are unlaid right down to the turns of the seizings, against which the crown is formed as close as possible. The wall is then made under it and hauled taut, thus jamming the knot in tightly.

Fig 3-89. Making a Crown and Wall Knot



f. **Manrope Knot** (Fig 3-90). The Manrope Knot is a decorative knot made at the ends of gangway manropes to prevent them unreeving, and to afford a handhold for anyone climbing aboard. To make the knot, whip the rope at a distance from its end equal to twenty times its diameter, unlay the strands to the whipping, and whip their ends. Make a wall and crown, keeping the knot fairly loose (Fig 3-90(i)). Then take strand A and follow it round its own part, thereby doubling-up strand A (Fig 3-90(ii)). Work the other two strands similarly, haul all parts taut, and cut off the ends where they protrude from the base of the knot (Fig 3-90(iii)).

Fig 3-90. Manrope Knot



g. **Turks Head.** The Turk's Head is an ornamental knot supposed to resemble the turban once worn in Turkey, and should consist of three or more parts followed round two or more times. It may be made either as a standing or a running knot, according to whether it is to be fixed to an end or a bight, or is to be formed round another part of rope or a stanchion for example. Four different forms of this knot are described below.

(1) *Standing Turk's Head.* Made at the End of a Rope. This is a manrope knot, but the ends are followed round a third or fourth time. Before starting the knot, however, the strands must be unlaid for a distance of not less than 25 times the diameter of the rope. (See Fig 3-91).

(2) *Running Turk's Head.* Made at the End of a Rope and Round its own Bight (as in a running lanyard), is similar to a standing Turk's head made at the end of a rope, except that the wall and crown with which it is begun are made round the bight of the rope. The strands are then followed round two or more times, thereby forming a knot, which will slide up and down the bight. (See Fig 3-92).

Fig 3-91. Standing Turk's Head

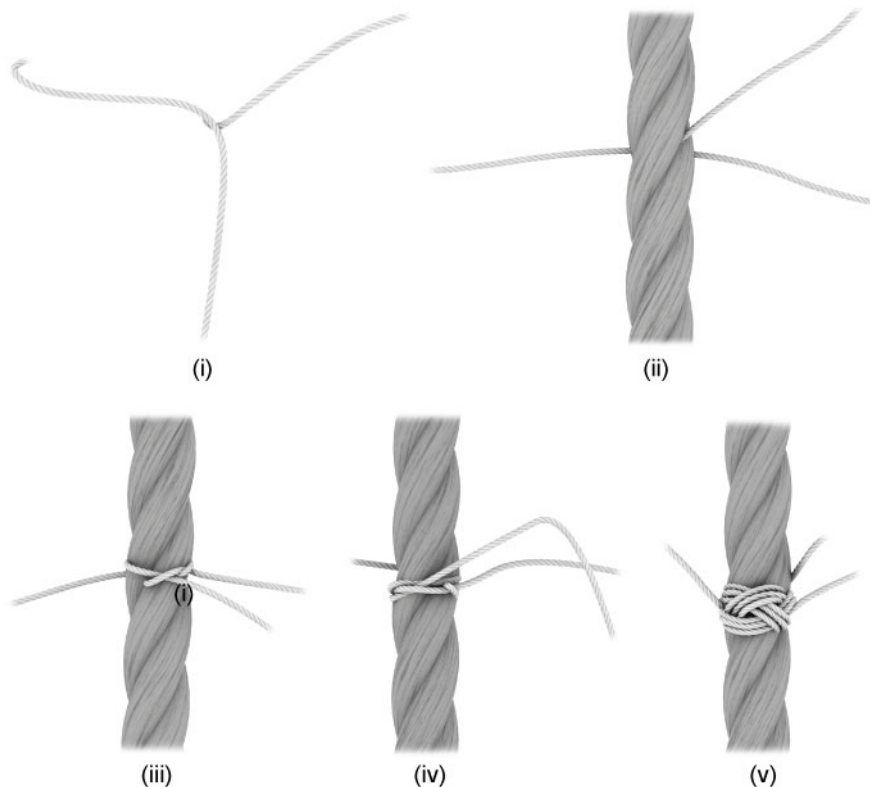


Fig 3-92. Running Turk's Head



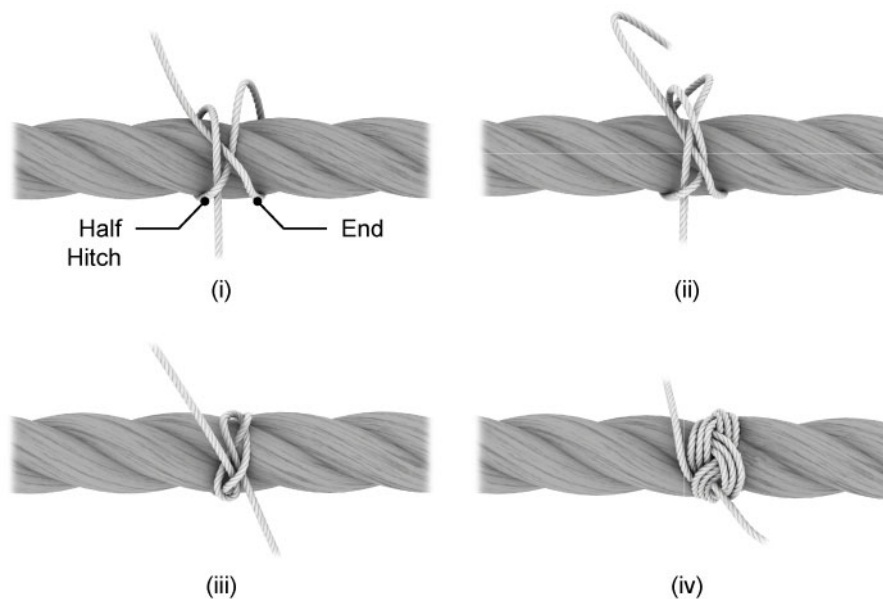
(3) *Standing Turk's Head*. Made on the Bight of a Rope. This is formed from a three parted length of line, called a **spider**, which is tucked into the centre of the rope so that its parts emerge from the strands equidistantly. The Spider is made up by tucking a length of line into the bight of another line (Fig 3-93(i)). The length of each leg should not be less than 20 times the combined diameters of the rope and line. Having inserted the Spider (Fig 3-93(ii)), crown the ends round the rope left-handed (Fig 3-93(iii)), and then turn round and crown them back right-handed (Fig 3-93(iv)). Now follow each part round with its own end two or more times (Fig 3-93(v)), work all parts taut, and cut off the ends.

Fig 3-93. Standing Turk's Head on a Bight



(4) *Running Turk's Head*. Made Round a Bight of Rope, a Stanchion or Other Fitting is formed out of a single length of rope. A half hitch is made round the rope or fitting, and then followed by a round turn; the end is then dipped under the bight of the half-hitch (Fig 3-94(i)). The bights round the rope are crossed, the bight which is on the same side as the end of the line being placed underneath. The end is then passed down between the bights (Fig 3-94(ii)) and brought over the other side. The second and third operations are repeated until the rope is encircled (Fig 3-94(iii)). The ends are then followed round as often as may be required, all parts are hauled taut (Fig 3-94(iv)) and the two ends finished off with a crown and wall.

Fig 3-94. Running Turk's Head on a Bight

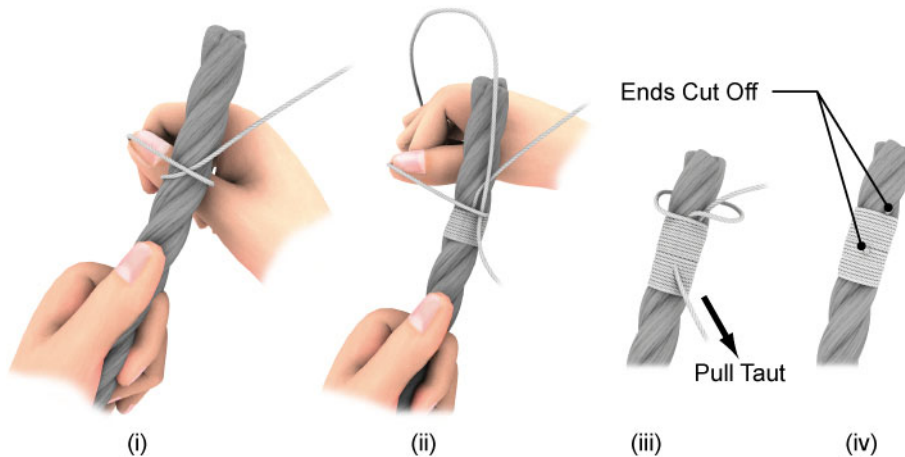


03017. Whippings

a. **Introduction.** A whipping is the binding round the bare end of a rope to prevent the strands unlaying. Four types of whipping are described below.

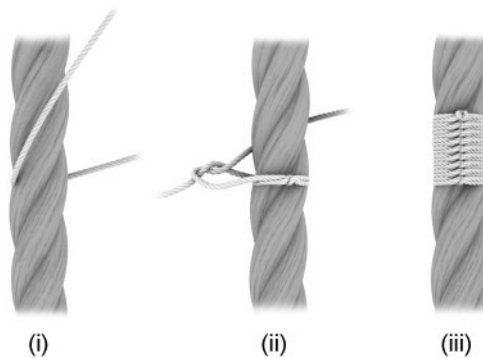
b. **Common Whipping** (Fig 3-95). Seaming or roping twine is used when the rope is not large, and small stuff is used on a large rope. Place the end of the twine along the rope as in Fig 3-95(i); pass turns of the twine over the rope against its lay, working towards the end of the rope, and haul each taut. Then lay the other end of the twine along the rope, as in Fig 3-95(ii), and pass the remaining turns over it, taking the bight of twine over the end of the rope with each turn. When the bight becomes too small to pass over the end of the rope, haul this second end of the twine through the turns which you have passed over it until taut, thus completing the last turn round the rope, and cut off the end (Fig 3-95(iii) and Fig 3-95(iv)). An alternative finish, which can be used when the whipping is on the bight of the rope, is to take the last three or four turns loosely over one finger and pass the end back through them. Work the turns taut, and haul the end taut as above.

Fig 3-95. Common Whipping



c. **West Country Whipping** (Fig 3-96). Middle the twine on the rope in the position required, pass the two ends round the rope in opposite directions and half-knot them on the other side (an alternative and more secure start is with a constrictor knot). Now bring the ends up and half-knot them again, and continue in this manner, making a half-knot every half turn so that the half-knots lie alternately on opposite sides of the rope. Finish off with a Reef knot.

Fig 3-96. West Country Whipping



d. **American Whipping** (Fig 3-97). This is similar to the common whipping except that the first end of twine is left out clear between the first and second half of the turns. The two ends are secured together with a Reef knot and cut off.

Fig 3-97. American Whipping

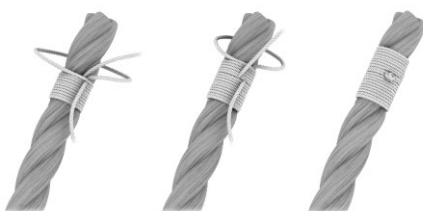
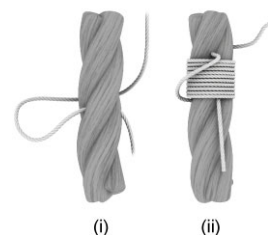


Fig 3-98. Sailmakers Whipping



e. **Sailmakers Whipping** (Fig 3-98). This whipping is the most secure, but of course it can only be used on hawser-laid rope. Unlay the end of the rope by about three times the diameter and hold it in the left hand pointing upwards, with the middle strand farthest away. Make a bight in the twine about 200mm long and pass this bight over the middle strand only, with the two ends towards you. With the bight of twine hanging down the back of the rope and the ends pointing down in front, lay up the rope with the right hand. Leave the short end of twine where it is and, with the long end, pass the turns of the whipping, working towards the end of the rope against the lay. When sufficient turns are on, take the bight of twine, pass it up outside the whipping, following the lay of the strand around where it was originally put, and pass it over that strand, where the latter comes out at the end of the rope (Fig 3-98(i)). Now haul on the short end so as to tighten the bight, then bring this end up outside the whipping, again following the lay of the rope, and then reef knot the two ends in the middle of the rope and out of sight (Fig 3-98(ii)).

03018. Mousing

a. **Introduction.** A mousing is used for keeping the pin of a screw shackle or slip in position, or to prevent inadvertent unhooking from an open hook. Shackles and slip pins must always be moused with seizing wire (Fig 3-99 and Fig 3-100). All hooks now in use in the Royal Navy incorporate a spring-loaded safety catch; however, should an open hook be encountered the method of mousing it with seizing wire is shown in Fig 3-101. NSN numbers for mild steel seizing wire are given in Table 3-15. The NSN number for stainless steel seizing wire is given in the sub para beneath Table 3-15.

b. To allow quicker transfer and greater use of working running rigging, whilst retaining basic safety, INSULOK ties may be used for non-standing parts. Ships may use INSULOK ties instead of wire mousing for screw shackle bolts on temporary working rigging. On completion of the evolution, temporary working rigging is to be derigged. Where rigging which is required to remain rigged for more than 24 hours, a wire mousing should replace INSULOKs. Where any doubt exists as to whether rigging is temporary or permanent, wire mousing should be used. Likewise INSULOKs are not to be used where there is a risk of personnel sustaining injuries or cuts, eg. on guardrails, gangway screens, hatch shackles and distance lines (cylume attachment) etc. INSULOKs come in four sizes and are easy to apply:

- (1) For screw shackles up to 3 tonnes proof load:

0262/746-8554 186mm x 4.7mm

0262/746-8555 360mm x 4.7mm

- (2) For screw shackles of 3 tonnes proof load and above:

0262/746-8556 339mm x 7.6mm

Note. To permit ease of access for damage control and fire-fighting teams, shackles attaching safety chains/wires to stanchions around internal hatches are not to be moused. However, these shackles must be regularly checked to ensure the pins are fully screwed home.

c. **Passing a Mousing.** To mouse a shackle pin with seizing wire ([Fig 3-99](#)) middle a 250mm length of the wire through the eye of the pin and twist the two parts together two or three times to attach the wire to the pin; then pass the two ends of the wire in opposite directions three or four times round the shank of the shackle and back through the eye of the pin, making sure that each turn is tight. Finish off by twisting the two parts tightly together two or three times, then cut off any surplus wire 20mm from the final twist and bend down the ends. When mousing a slip pin ([Fig 3-100](#)) attach one end of a 250mm length of seizing wire to the eye of the pin, then wind the wire tightly in figure-of-eights across the tongue of the slip and round the pin, locking the pin in position. Three or four turns of wire are normally required, but because of the possibility of an emergency breakaway, a mousing on a slip used in replenishment rigs and towing consist of one full figure-of-eight turn. A mousing on an open hook is applied as shown in [Fig 3-101](#). 'R' clips have replaced straight pins in slips; these do not require mousing.

Fig 3-99. Mousing a Shackle

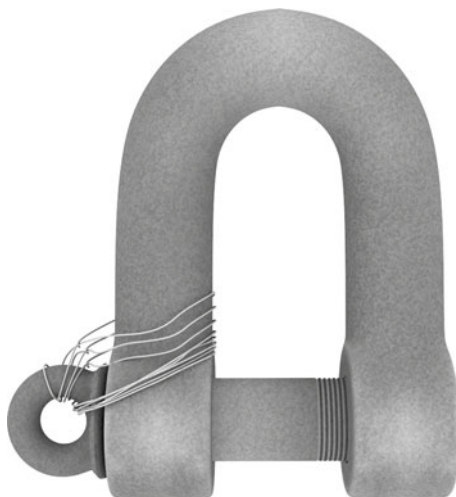
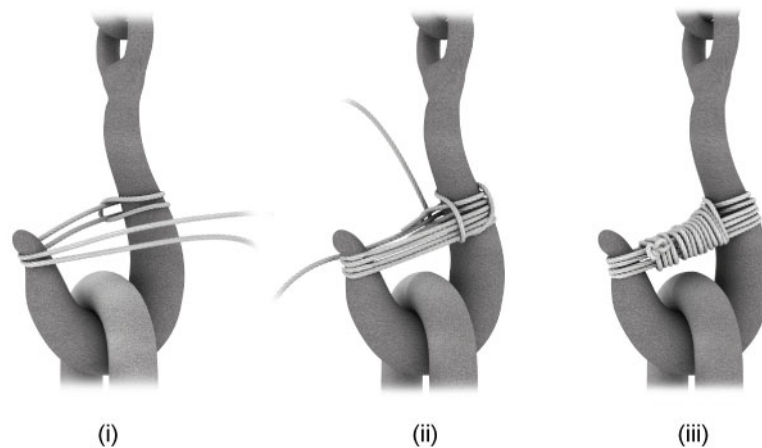


Fig 3-100. Mousing a Slip



Fig 3-101. Mousing an Open Hook



03019. Seizings

a. **Types of Seizings.** A seizing is a method of fastening together two parts of rope sufficiently strongly to stand a required strain. Three standard seizings designed to meet certain specific standards are employed in the Royal Navy. Although, on occasion, departure from them in detail may be made, they should be regarded as the basis of all round work of this description.

(1) *Flat Seizing.* A light seizing for use when the strain on the two parts of rope is equal. It consists of one layer of approximately eleven round turns.

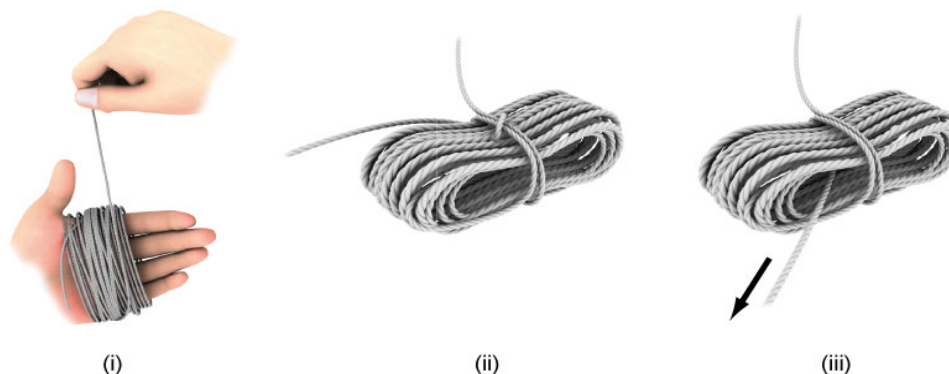
(2) *Round Seizing.* Also used when the strains on the parts of a rope are equal, but it is stronger than a flat seizing. It consists of approximately eleven round turns and ten riding turns; the number of riding turns is always one less than the number of round turns.

(3) *Racking Seizing.* When the strains on the parts of the rope are unequal or exerted in opposite directions a racking seizing is used. It is formed by passing one layer of racking turns, and then passing one of round turns so that they lie between the racking turns. The number of round turns is necessarily one less than the number of racking turns. Sufficient turns are taken for the length of the seizing to be equal to three times the diameter of the rope, eg, for racking two 24mm ropes, an overall length of seizing of 72mm is required.

b. **Strength of Seizings.** For seizing cordage it is usual to use small stuff (polypropylene line, size appropriate to the rope being seized), although Spun yarn is sometimes used for temporary seizings. When seizing wire ropes, flexible mild steel wire is used. The number of turns to be used for a seizing depends upon the strength of the seizing stuff and the strain to which the seizing will be subjected. For cordage, eleven and 21 turns are recommended for flat and round seizings respectively, and a width of seizing equal to three times the diameter of the rope is recommended for the racking seizing. These seizings are based on a size of seizing stuff of about one-seventh of the size of the rope, eg 6mm polypropylene line would be required for seizing a 40mm diameter polyamide rope.

c. **Making up Seizing Stuff** (Fig 3-102). Wind the seizing stuff round one hand, clockwise for left-hand lay, anti-clockwise for right-hand lay, with as many riding turns as are required, and finish with a clove hitch on the bight around the middle. Work with the first end which is drawn out through the opposite side of the coil, thus thorough-footing the seizing stuff and making it easier to work by taking the turns out of it. The turns in the coil are held in place by the clove hitch.

Fig 3-102. Making Up Seizing Stuff



d. **Use of a Heaving Mallet and a Spanish Windlass.** When seizing heavy rope the turns must be hauled more than hand-taut, and for this purpose the following mechanical aids may be used:

(1) **Heaving Mallet** (Fig 3-103). The lower turns of a seizing can be tautened with a Heaving Mallet as follows:

(a) Lay the mallet in the bight of the line, as shown in Fig 3-103(i), and as close up to the work as possible.

(b) Take a turn diagonally round the head of the mallet, bringing the end up the opposite side of the handle Fig 3-103(ii).

(c) Take half a turn round the handle, and take the end again behind the head Fig 3-103(iii).

(d) Jam the end between the head and the standing part, and bring it up over the handle, as indicated by the arrowed line in Fig 3-103(iii).

(e) Place the head against the rope and heave, using the handle as a lever Fig 3-103(iv).

(2) **Spanish Windlass** (Fig 3-104 and Fig 3-105). This can also be used for tautening the lower turns of a seizing. The windlass is formed by taking a turn round a suitable bar with the line to be tautened, and then turning the bar with a lever inserted through a bight of this line, as shown in Fig 3-104. A Spanish windlass can also be used to rack the two parts of rope together before putting on the seizing. for this purpose it is formed with a strand, well greased along its middle part, with a spike inserted at each end of the bar for use as levers, as shown in Fig 3-105.

Note. A metal heaving mallet is used for wire seizings, and after each heaving the mallet should be run up and down the part of the wire that has been round it, in order to straighten out the turns.

Fig 3-103. How to Use a Heaving Mallet

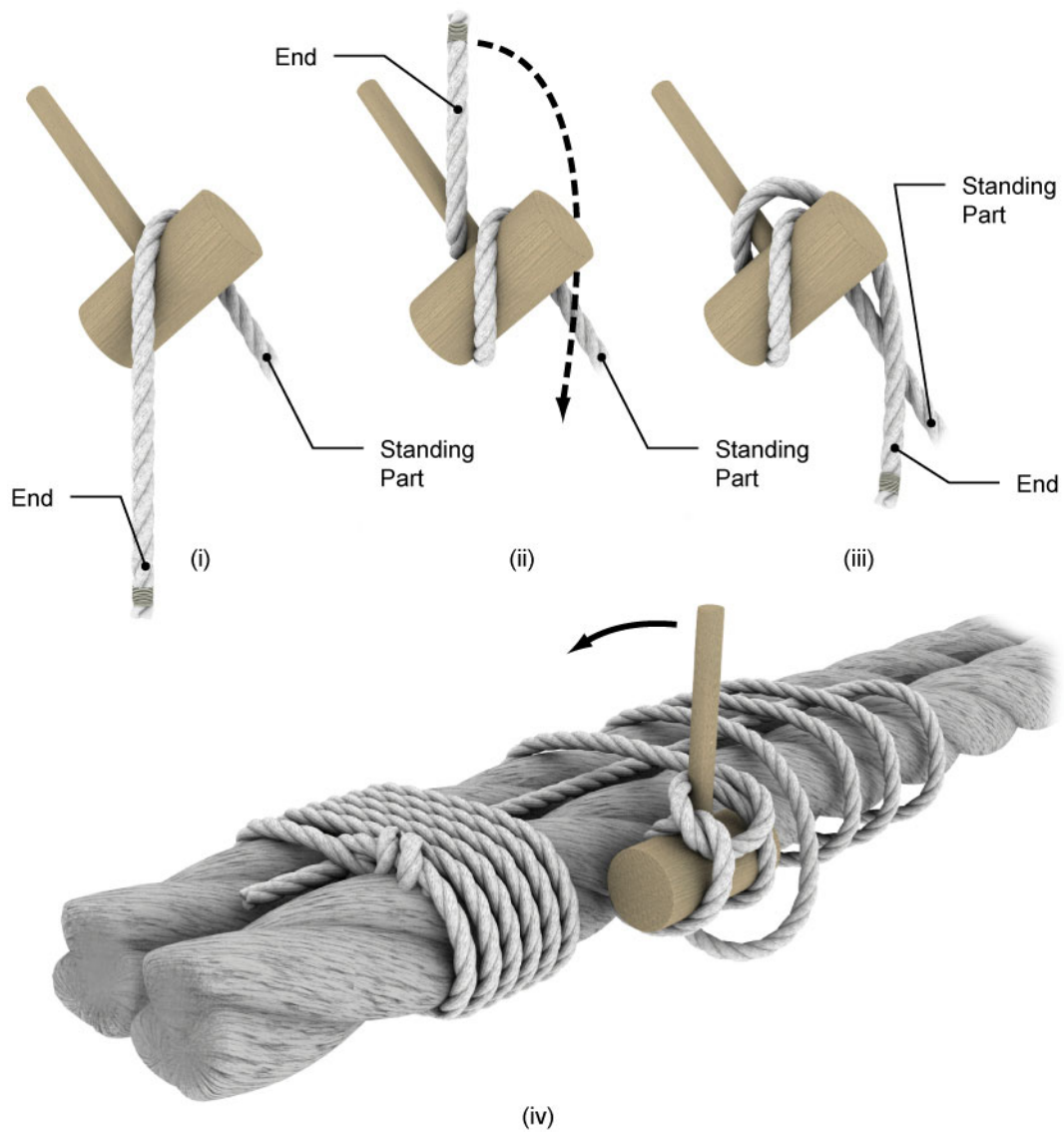
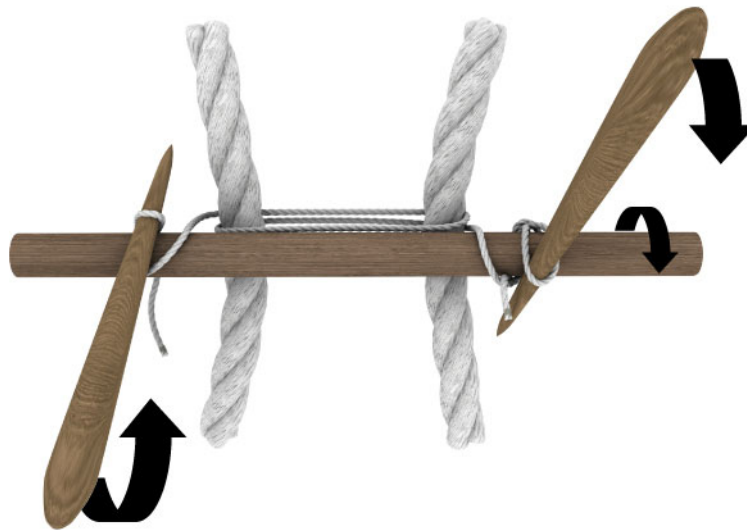


Fig 3-104. Spanish Windlass



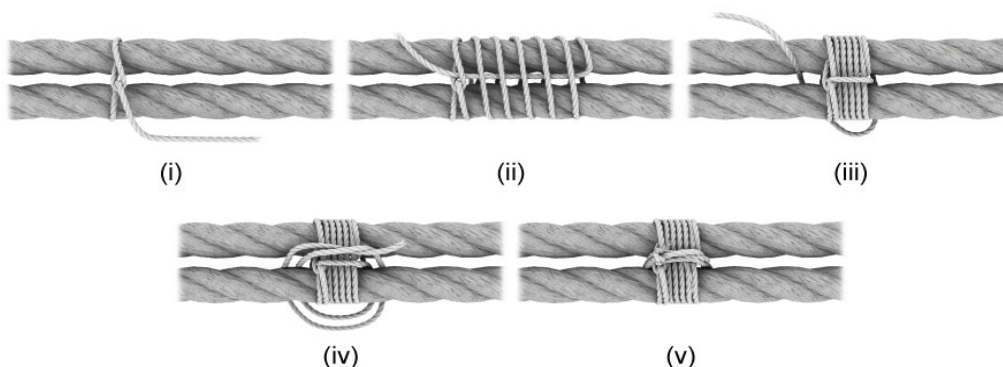
Fig 3-105. Racking Two Ropes with a Spanish Windlass



e. **Starting a Seizing.** Cordage seizings are begun by making a small eye in the end of the seizing stuff, wire seizings are started by taking the end round one of the ropes to be fastened and then half-hitching it round its own part. Take care to keep the eye or half-hitch in the centre and clear of both parts of the rope (Fig 3-106(i)).

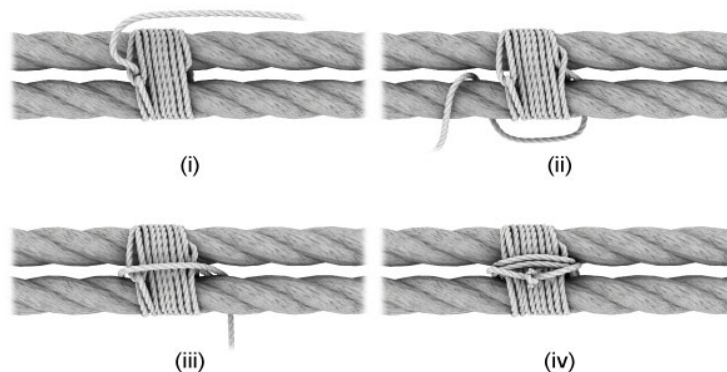
f. **Passing a Flat Seizing.** Having begun the seizing as described, take the round turns very loosely round both parts of the rope, then pass the end back, along and between the two parts of the rope, under the turns and through the eye or half hitch of the seizing as in Fig 3-106(ii). Then heave each turn taut and take a cross turn round the seizing between the two parts of the rope as in Fig 3-106(iii). Now haul the seizing taut and secure its end with a clove hitch, one part of the clove hitch being on each side of the round turn as in Fig 3-106(iv). Finally, unlay the seizing stuff and finish off with a crown and wall close up against the hitch, or, if a wire seizing, break off the wire close to the hitch, and tuck away the ends so no harm will result when the rope is handled.

Fig 3-106. Passing a Flat Seizing



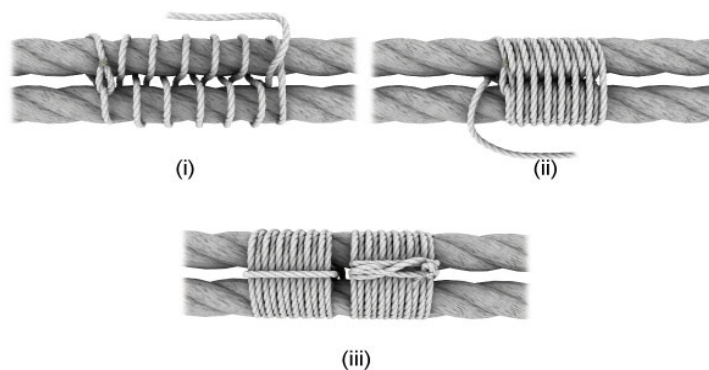
g. **Passing a Round Seizing.** Having begun the seizing as previously described, take the same round turns as in the flat seizing, pass the end down between the parts, up through the eye, and heave each turn taut with a heaving mallet or Spanish windlass as before (Fig 3-107(i)). The end is now in position to begin passing the upper or riding turns, which will become exactly between the parts of the lower turns. The number of riding turns is one less than the number of lower turns, and they are hove taut by hand. After passing the last riding turn, lead the end under the last turn of the lower turns and heave it hard taut (Fig 3-107(ii)). Then take a cross turn round all parts of the seizing (Fig 3-107(iii)), heave it well taut, and secure with a clove hitch each side of the round turn, as in the flat seizing (Fig 3-107(iv)). Finish off as for a flat seizing.

Fig 3-107. Passing a Round Seizing



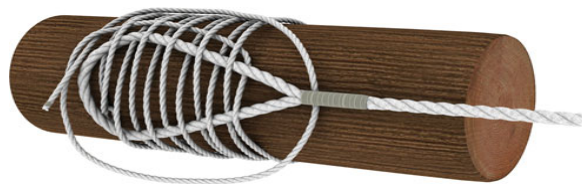
h. **Passing a Racking Seizing.** Start the seizing as already described in [sub para e](#). If the seizing slips when taken round both parts of the rope, take the end round one part only and reeve it through the eye. Then dip the end between the two parts of rope and take a number of figure-of-eight turns round each part alternately, taking care to have the same number round each part and to leave room between each racking turn for the round turn which will come later (Fig 3-108(i)). When the racking turns have been hove taut, dip the end under the last turn and pass the round turns back towards the eye, filling the spaces between the racking turns (Fig 3-108(ii)). When the last round turn has been passed, (see that there is one less than the racking turns), complete the seizing by taking one round turn around the whole seizing and forming a clove hitch between the two parts of the rope. Finish off as for a flat seizing.

Fig 3-108. Passing a Racking Seizing



- i. **Rose Seizing** (Fig 3-109). Used to secure an eye in a rope to a spar.

Fig 3-109. Rose Seizing



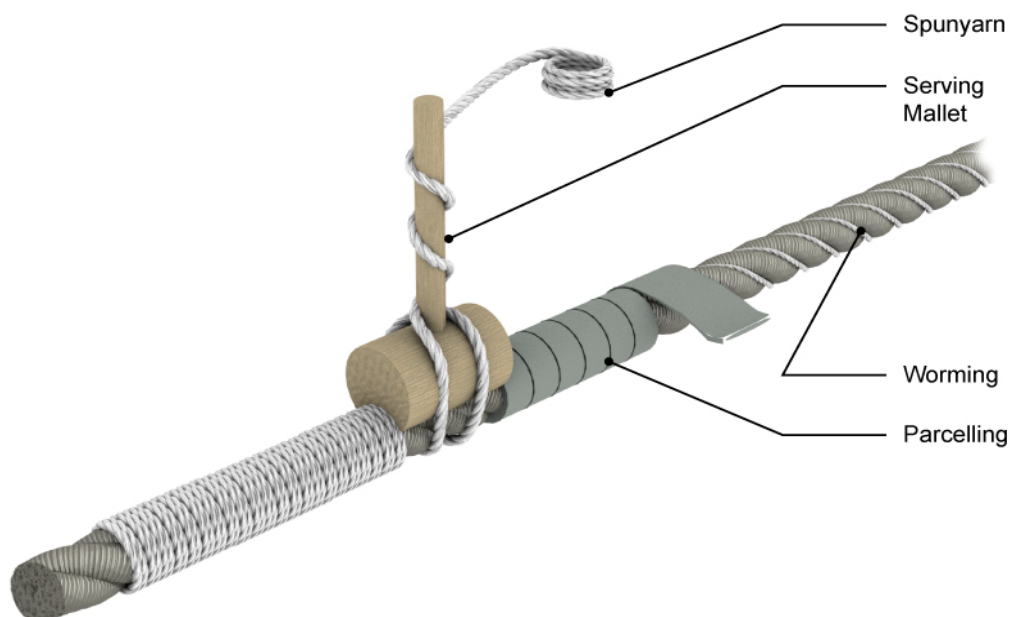
03020. Worming, Parcelling and Serving

a. A rope or part of a rope is wormed, parcellled and served (Fig 3-110) to protect its outer surface against wear from chafing; make its outer surface smoother, so as to prevent other ropes from chafing when led over it; and, in the case of a steel wire rope, to protect the hands of those using it from the sharp ends of wire projecting from any splice in it. Worming, parcelling and serving is not necessarily damp-proof, and there is a danger that a rope may rot underneath its covering. Ropes so treated should therefore be inspected frequently for deterioration.

b. **Worming.** This consists of filling in the spaces between the strands with lengths of spunyarn or small stuff laid along the lay of the rope, and its object is to make the rope smooth and round.

c. **Parcelling.** This consists of binding the rope with strips of rot-proofed canvas, hessian or similar material. The strips should be between 50-75mm wide and it is customary to bind them on in the direction of lay of the rope, working towards the eye. Each turn should overlap that preceding it by half the width of the strip, and the rope, if not man-made fibre, should first be well tallowed. When parcelling and serving a stay throughout its whole length the parcelling should be worked upwards from the eye of the lower splice to the eye of the upper splice, as this affords the maximum obstruction to the entry of water.

Fig 3-110. Worming, Parcelling and Serving



d. **Serving.** This consists of binding a splice or a length of rope with close turns of polypropylene line or spunyarn. (Flexible mild-steel wire rope can be used for serving steel wire rope). Each turn is hove taut with a special serving mallet, which has a score in its head, to fit the rope, and a wooden handle about 40cms long. A service is always bound on in the direction opposite to that of the parcelling, so as to avoid bunching up the latter. It is therefore put on against the lay of the rope, a rule which can be memorised thus: **Worm and parcel with the lay, turn and serve the other way.** A serving is begun as for a common whipping, although when serving with the larger sizes of flexible mild-steel wire it may be necessary to stop the first end down to the rope until sufficient turns have been applied to hold it firmly. The first few turns are put on by hand and hauled taut with a spike or heaving mallet. The serving mallet is then placed on the rope and the turns of the service are passed as follows:

(1) Take a half-turn round the handle; then one turn round the fore end of the head of the mallet and the rope; then dog the serving around the handle of the mallet.

(2) To put on a serving, stand with the rope on your left side while facing in the direction in which the turns are advancing. Then pass the ball of spunyarn round and round in step with the serving. Having completed the required length, finish off the service by passing the end back under the last four turns, hauling all parts taut, and making a crown and wall, or, if finishing a wire seizing, break off the wire close to the hitch, and tuck away the ends so no harm will result when the rope is handled. Also, it is customary to finish the serving of a wire serving on an eye splice in a similar manner to that of a seizing; a cross turn is therefore taken round the last few turns of the serving, inside the neck of the eye, and is followed by a clove hitch, the ends of the wires being then broken off and tucked away.

Note. *If serving over a restricted length of rope - up to an eye splice for example - which does not allow the mallet to advance ahead of the last turns; the serving stuff should be brought to the mallet as follows:*

(a) Up over the cut in the fore in the fore end of the head; one-quarter turn round the handle; one turn round the rope and rear end of the head (taken in the direction of the service, ie against the lay of the rope); and then dogged round the handle.

03021. Lashing

Two crossed spars can be secured together either with a **Square Lashing** or a **Diagonal Lashing**. Specific types of lashing are employed in rigging sheers or gyns and they are described later in this chapter. A Square Lashing is used when the spars are to be secured at right angles to each other and the Diagonal Lashing when they are to be secured at an acute angle to each other.

- a. **Square Lashing** (Fig 3-111). Make fast one end of the rope to one of the spars with a timber hitch and haul it taut. Then cross the spars with the smaller spar lying underneath. Bring the other end of the lashing up over the larger spar, down and under the smaller, up and over the larger, and so on until sufficient turns have been taken. To avoid riding turns, the turns on the larger spar should lie in succession outside those first applied, and those on the smaller spar should lie in succession inside those first applied. Finish by taking two or three frapping turns round the parts between the spars, and make fast with a clove hitch round all parts or round one of the spars.
- b. **Diagonal Lashing** (Fig 3-112). Make fast one end of the rope as for a square lashing, and pass as many turns as are required diagonally round both spars. Then bring the end up over one spar and take a few more turns across the opposite diagonal, finishing off as for a square lashing.

Fig 3-111. Square Lashing



Fig 3-112. Diagonal Lashing



03022. Splicing Hawser-laid and Multi-plait Cordage

a. Splicing is a method of joining the ends of two ropes together, or of making an eye in the end of a rope, by interlocking the strands. Unless otherwise stated it should be accepted that all splices reduce the strength of a rope by one eighth. The tools and equipment required for splicing hawser-laid or multiplait cordage are: a fid, which is a pointed wooden spike made of hardwood, a heaving mallet for heaving tucks into place, a sharp knife, and seaming twine, sailmaker's twine and PVC insulating tape for marling or taping up where necessary. A hot knife or candle should be available to heat-fuse the ends of man-made fibre cordage. When reference is made in the text on splicing to the left or right of a rope, imagine yourself to be looking along the rope towards the end which you are handling.

b. **Special Considerations When Splicing Man-made Fibre Cordage.** Special care is needed when splicing man-made fibre cordage because an unsatisfactory splice may be dangerous. When unlaying strands ensure that the yarns are disturbed as little as possible. Each strand should be marled, or taped every 50mm, along its length to maintain its form. Firm whippings of twine or tape must be used and the ends of the strands must be heat fused. When making an eye splice, a throat seizing is recommended. Serving a man-made fibre cordage splice is not recommended because it tends to loosen when the rope's diameter decreases under load; if such a rope has to be served it must be very tight. When splicing man-made fibre hawser-laid rope five full tucks should be made if the ends of strands are to be dogged; to complete the splice the ends of strands should be fused. Four full tucks reduced to two-thirds and one-third should be made if the splice is tapered. If the splice is then served the first three tucks should be left uncovered. When splicing man-made fibre cordage take care that:

- (1) Strands lifted for tucking are not kinked. To avoid strand distortion, use a small fid of oval cross-section; then follow this with larger fids until it is just possible to pass the strand without distorting it.
- (2) Strands are pulled back as far as possible.
- (3) The rope is kept level the whole time and strands are lifted only high enough for the tuck to take place.
- (4) The rope itself is not allowed to kink.

c. **Types of Splice.**

(1) *Back Splice.* For finishing the end of a rope, which is not required to be rove through a block; it is to prevent it from unlaying.

(2) *Eye Splice.*

(a) For making a permanent eye in the end of a rope. A soft eye is a small eye spliced in the end of a rope. A thimble eye is formed by fitting and splicing the end of the rope round a thimble, the splice holding the thimble in place. Thimble eyes are fitted in the ends of cordage and wire ropes, which are intended to be used in conjunction with a joining shackle or other rigging fittings. The hawser eye is an alternative to the thimble eye and just as efficient.

(b) The eye is first spliced larger than the thimble, then the thimble is fitted into the eye and secured in place by a strong seizing just below it. This enables the thimble to be easily removed and replaced, merely by cutting the seizing and then renewing it. A **bollard eye** is a long soft eye, 1.5 metres long from crown to splice, fitted in the ends of berthing hawsers so they can be placed over bollards.

- (3) *Short Splice*. For joining two ropes not required to pass through a block.
- (4) *Long Splice*. For joining two ropes which are required to pass through a block. A well-made long splice does not increase the diameter of the rope and should not reduce its strength.
- (5) *Cut Splice*. For making a permanent eye in the bight of a rope.
- (6) *Chain Splice*. For splicing a rope tail into a chain which has to be led through a block or fairlead. The chain splice is not more than two-thirds of the strength of the rope.

d. **Back Splice in Hawser-laid Rope** (Fig 3-113). If splicing man-made fibre cordage, read Para 03022 [sub para a](#). This method of finishing the end of a rope must not be used if the rope is to pass through a block, eyeplate or similar fitting. Whip the rope at a distance from its end equal to twenty times the diameter of the rope, then unlay the strands to the whipping and whip the end of each strand. Make a crown knot [Fig 3-113\(i\)](#), cut the whipping and then tuck each strand over one strand and under the next, to the left and against the lay of the rope, as shown in [Fig 3-113\(ii\)](#). After each strand is tucked, pull the strands taut and tidy up this first tuck until each strand is uniform. Repeat this tucking twice more in natural fibre cordage [Fig 3-113\(iii\)](#), four times more if splicing MMF cordage. Always tuck to the left, using the next strand to the left. If the splice is to be served, as shown in [Fig 3-114](#), taper it down after the third tuck (or fourth if splicing man-made fibre) as follows:

- (1) Take one-third of the yarns out of each strand and tuck the remaining two-thirds once, as already described; though discarded, the thirds should not be cut off until the splice is completed.
- (2) Halve the reduced strands, then tuck one-half of each and leave the other.
- (3) Haul all parts taut, including the discarded ends, which should now be cut off.

Fig 3-113. Making a Back Splice

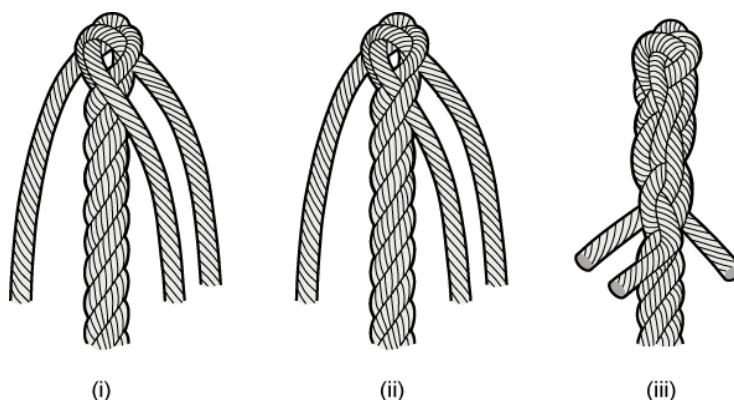
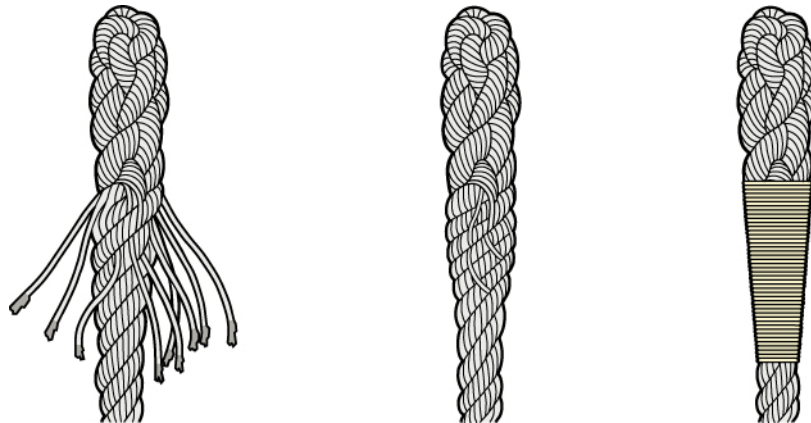


Fig 3-114. Tapering and Serving a Back Splice



e. **Soft Eye Splice in Hawser Laid Cordage.** If splicing man-made fibre cordage read Para 03022 [sub para b](#).

(1) Whip the rope at a distance from its end equal to twenty times the diameter of the rope, then unlay it to the whipping and whip the end of each strand.

(2) Mark the place intended for the crown of the eye, and bend the rope back from there so as to bring the unlaid strands alongside the standing part where the splice is to be made, with the left and middle strands lying on the top of the rope ([Fig 3-115](#)); the set of the splice will depend on selecting this middle strand correctly.

Fig 3-115. The Start of an Eye Splice in Hawser-laid Cordage

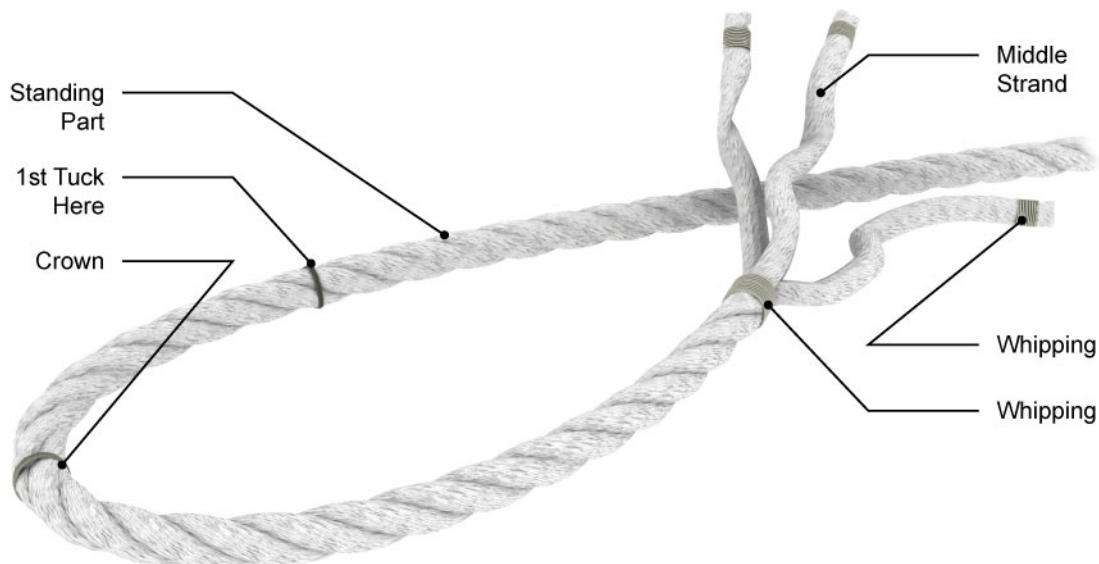
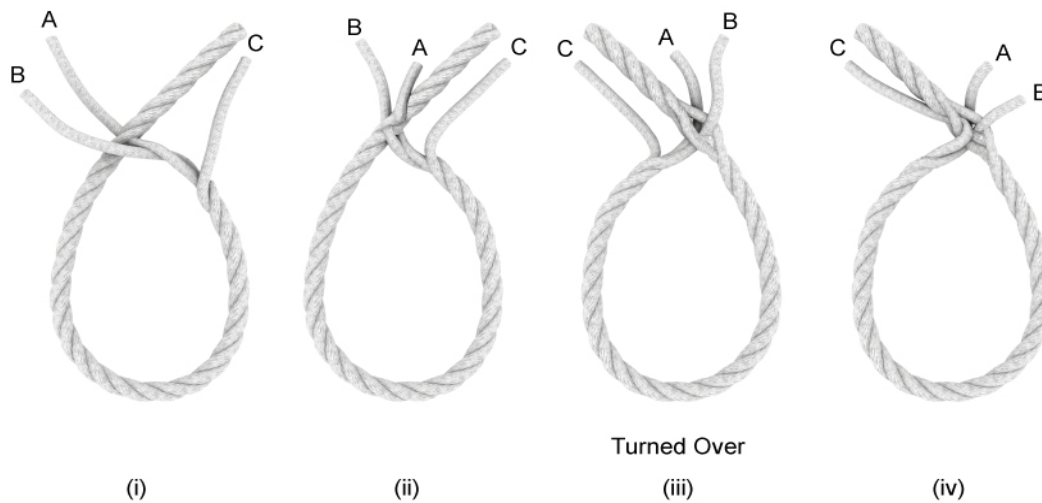


Fig 3-116. Making an Eye Splice



(3) Now refer to [Fig 3-116](#), in which the middle strand is marked A, the left-hand strand B, and the right-hand strand C, and make the splice as follows:

(a) Tuck A, from right to left, under the nearest strand of the standing part [Fig 3-116\(i\)](#).

(b) Tuck B, from right to left, under the next strand of the standing part [Fig 3-116\(ii\)](#)

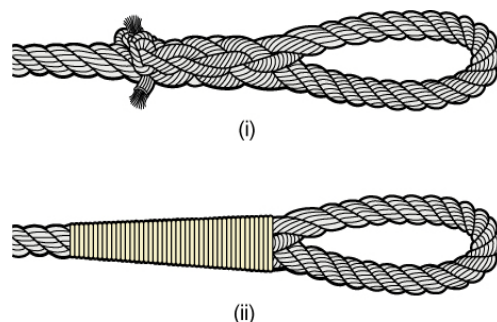
(c) Now turn the rope right over so as to bring the remaining strand C on the top [Fig 3-116\(iii\)](#), and then tuck C from right to left under the unoccupied strand of the standing part [Fig 3-116\(iv\)](#). Care must be taken to retain the lay of the rope in the last strand tucked, as this enables it to lie closer.

(d) Now, beginning with C, heave each strand taut with a heaving mallet. Then tuck all three strands a second and third time, (fourth and fifth time if splicing man-made fibre cordage).

(e) Finish off by tapering the splice as described for the back splice or, if the appearance of the splice is of secondary importance and maximum strength is required, dogging the ends by halving each of the three strands and whipping each half to its neighbour over the adjacent strand as shown in [Fig 3-117](#).

Fig 3-117. Finished Eye Splices

(i) Dogged; (ii) Tapered and Served



f. **Thimble Eye Splice in Hawser-laid Cordage.** A thimble eye is formed by fitting and splicing the end of the rope round a thimble, the splice holding the thimble in place. It is fitted in the ends of cordage and wire ropes, which are intended to be used in conjunction with a joining shackle or other rigging fittings. The procedure for seizing the thimble in place temporarily while the rope is spliced is similar to that when making a thimble eye in a wire, described later in [Para 03024](#). Splicing procedures are as described for a soft eye.

g. **Short Splice in Hawser-laid Rope** ([Fig 3-118](#) and [Fig 3-119](#)). If splicing man-made fibre cordage read [Para 03022 sub para b](#). The strands of each rope are tucked between the strands of the other rope against the lay, each strand being taken over the strand on its left, then under the next strand and emerging between this and the subsequent strand. In [Fig 3-118](#) the ends of the rope are lettered A and B, and their unlaid strands C, D and E, and F, G and H respectively. Certain whippings and stops have been omitted to show the tucking of the strands more clearly.

- (1) Whip each rope at a distance from its end equal to twenty times the diameter of the rope (this whipping has been omitted from rope A in the illustration).
- (2) Unlay the strands to the whipping and whip their ends (these whippings have also been omitted).
- (3) Marry the two ropes so that one strand of each lies between two strands of the other ([Fig 3-118\(i\)](#)).
- (4) Having ensured a close marry, whip the strands strongly around the join to prevent them slipping, and stop ends C, D and E to rope B with a strong stop (whipping and stops have been omitted).
- (5) Cut the whipping on A.
- (6) Take F over C, under E, and bring it out between D and E [Fig 3-118\(ii\)](#).
- (7) Take G over E, under D, and bring it out between D and C ([Fig 3-118\(ii\)](#) and [Fig 3-118\(iii\)](#)).
- (8) Take H over D, under C, and bring it out between C and E [Fig 3-118\(iii\)](#).
- (9) Stop G, F and H to A, cut the stop and whipping on B, and tuck C, D and E in similar manner.
- (10) Heave all six strands equally taut with a heaving mallet.
- (11) Again tuck each strand over the strand on its left and under the next one, and then repeat this operation a third time (fourth and fifth time if splicing MMF cordage).
- (12) Finish off as described for an eye splice.

Fig 3-118. Making a Short Splice

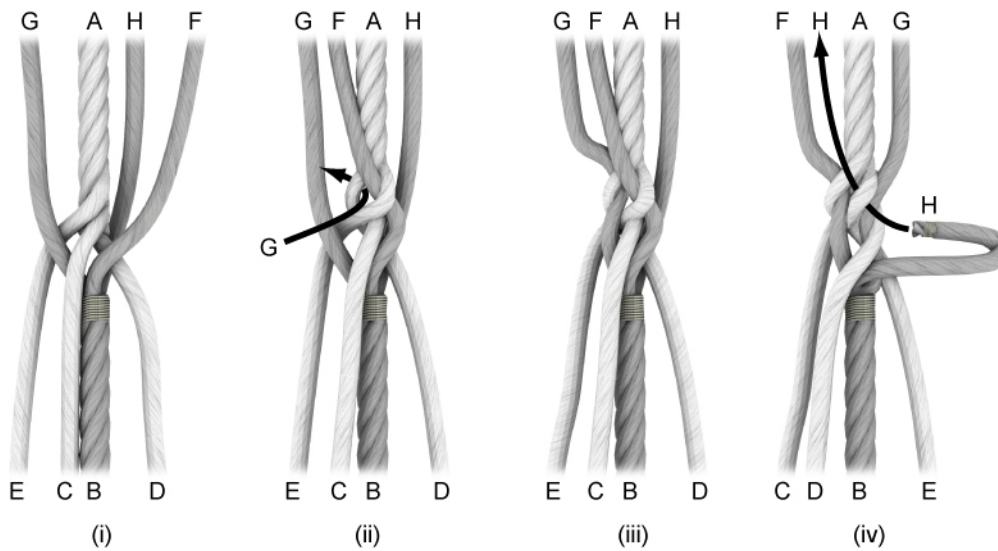
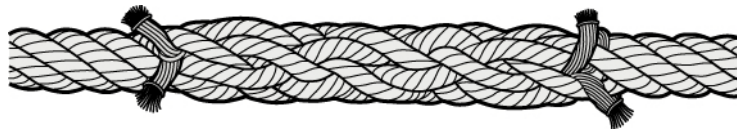
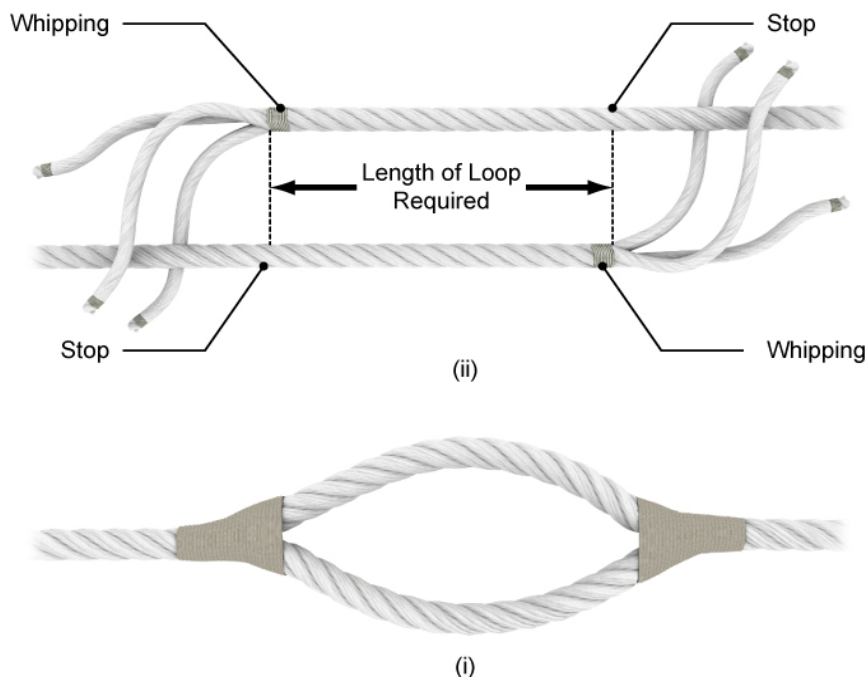


Fig 3-119. Finishing a Short Splice by Dogging



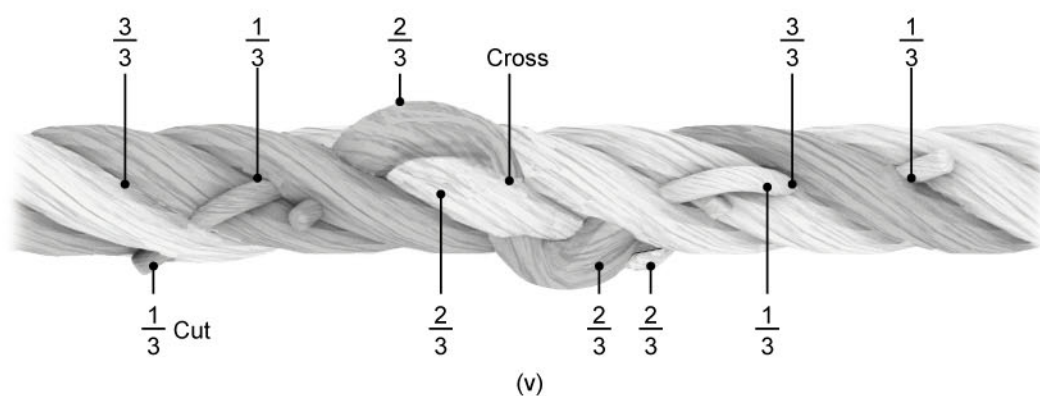
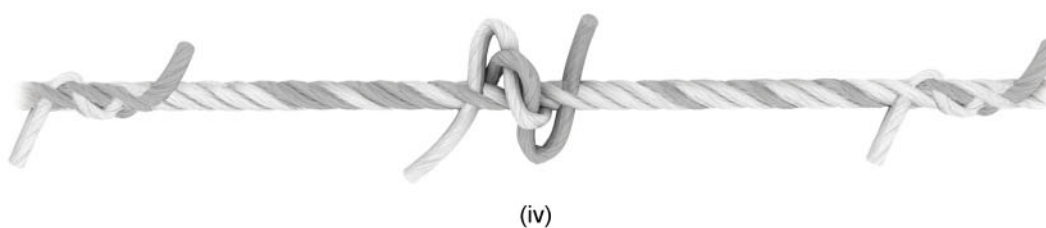
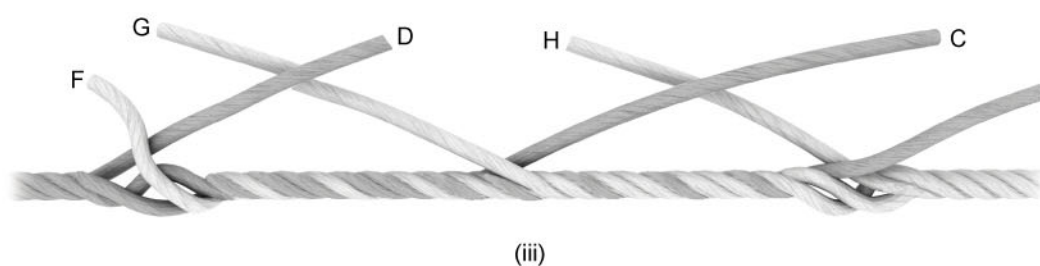
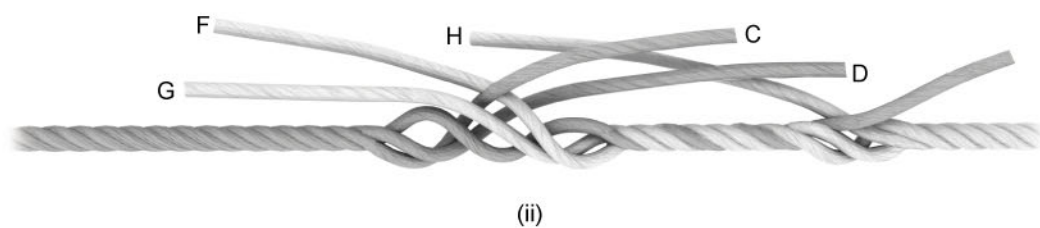
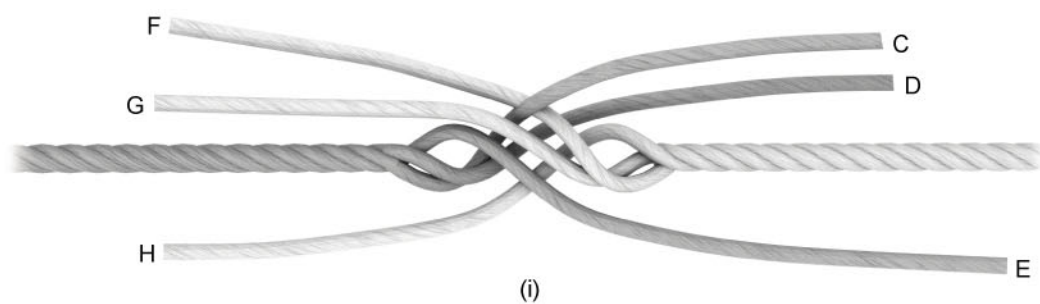
h. **Cut Splice in Hawser-laid Cordage.** If splicing man-made fibre cordage read Para 03022 [sub para b](#). This splice is used when it is required to make a permanent eye in the bight of a rope. Whip each rope at a distance from its end equal to twenty times the diameter of the rope, then unlay it to the whipping and whip the end of each strand, ([Fig 3-120\(i\)](#)). Place the ends of the two ropes alongside and overlapping each other, and stop them together. Tuck the unlaid strands of both ropes as for an eye splice and finish off as for an eye splice.

Fig 3-120. Making a Cut Splice



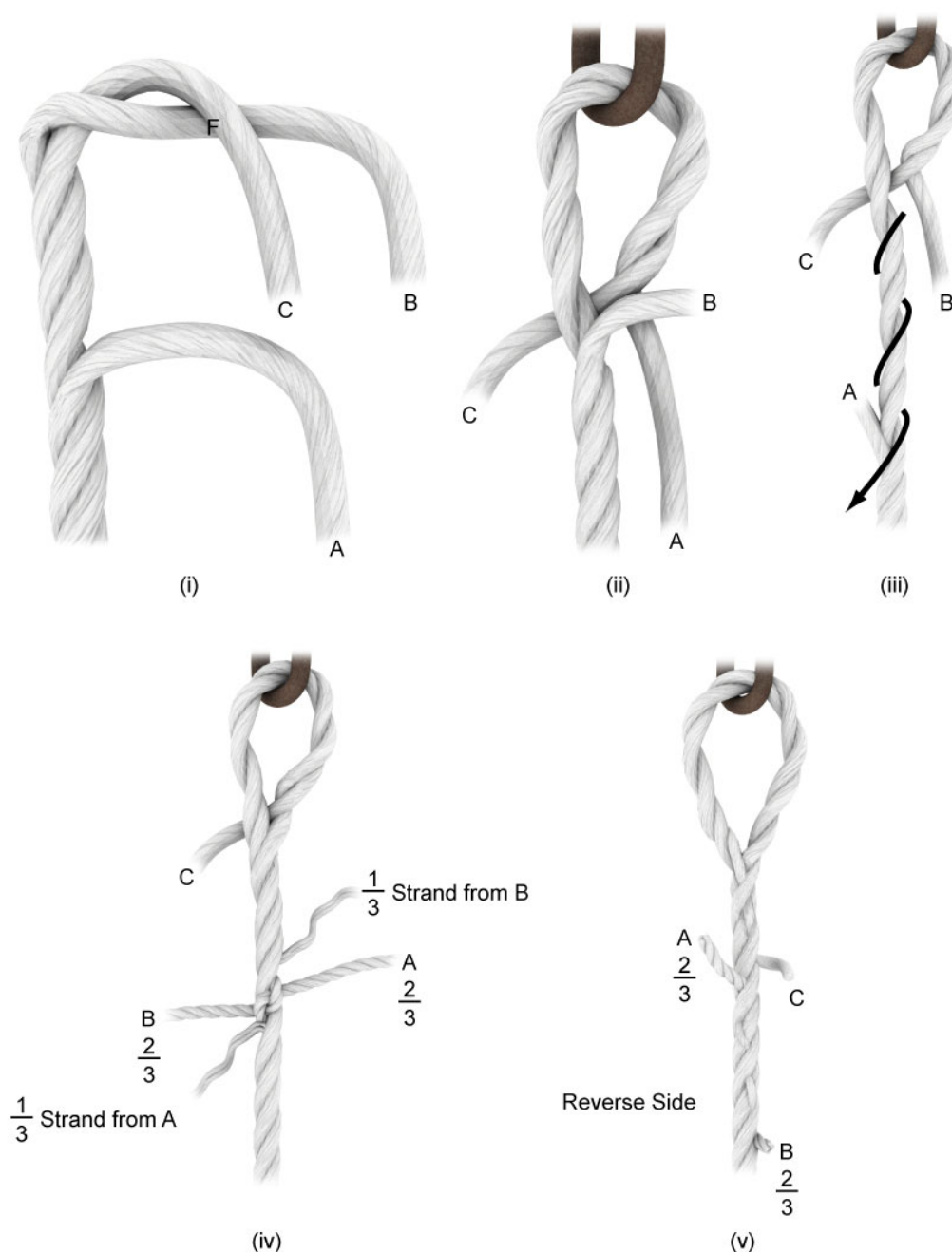
i. **Long Splice in Hawser-laid Cordage** (Natural fibre cordage only). This splice is used to join two ropes, which are required to pass through a block. Provided the splice is well made, it will not increase the diameter or weaken the rope. It is possible to make a long splice in man-made fibre cordage, but results are usually unsatisfactory. The principle of the long splice ([Fig 3-121](#)) differs radically from that of the short splice. One strand from each rope is unlaid, and the corresponding strand of the other rope is given a twist and laid up in its place; the remaining strand from each rope remains at the marry, resulting in three pairs of strands spaced equidistantly along the married ropes. One third of the yarns is now taken out of all strands (not shown in ([Fig 3-121\(iv\)](#))) and, though discarded, these yarns should not be cut off until the splice is completed. Each pair of strands is then tied in an overhand knot (left over right for a right-hand laid rope), and each strand is tucked over one strand and under the next, as for a short splice. Half of the yarns in each strand are now taken out and the remaining yarns tucked once more, to give a gradual taper [Fig 3-121\(v\)](#). The splice is finished off by stretching it, hauling all ends taut (including the discarded yarns) and then cutting them off. To make a long splice, whip each rope at a distance from its end equal to forty times the circumference of the rope, then unlaid the strands to the whipping and whip their ends. Marry the two ropes together, as in a short splice. Each strand unlaid as described above is followed up by the strand from the other rope which lies on its right in the marriage, so that H is unlaid and followed up by E, D is unlaid and followed up by F, and C and G remain at the marry. Each strand is unlaid until the length of the end of the strand following it up is reduced to twelve times the diameter of the rope. The splice is now finished off as described above.

Fig 3-121. Making a Long Splice



j. **Chain Splice in Hawser-laid Rope** (Natural fibre cordage only). This splice is used for splicing a cordage tail into a chain which is required to be led through a block or fairlead. Its strength is not more than two-thirds the strength of the rope. Prepare the rope as for an eye splice, but do not place a whipping round the rope, and unlay the strands to a length 30 times the diameter of the rope. Then unlay one strand, A, for another 150mm, or twice the intended length of the eye Fig 3-122(i). Now pass strands B and C through the link on the end of the chain and marry up with A, thus forming the eye Fig 3-122(ii). Then further unlay strand A and lay up B in its place for about 300mm, and finish off these two strands as for a long splice Fig 3-122(iii) and Fig 3-122(iv). Now tuck strand C into the standing part below the eye as for a short splice, with about three tucks, so as to meet strand A Fig 3-122(v). All ends are then hauled taut and cut off; the one-third strands of A and B are not shown in Fig 3-122(v).

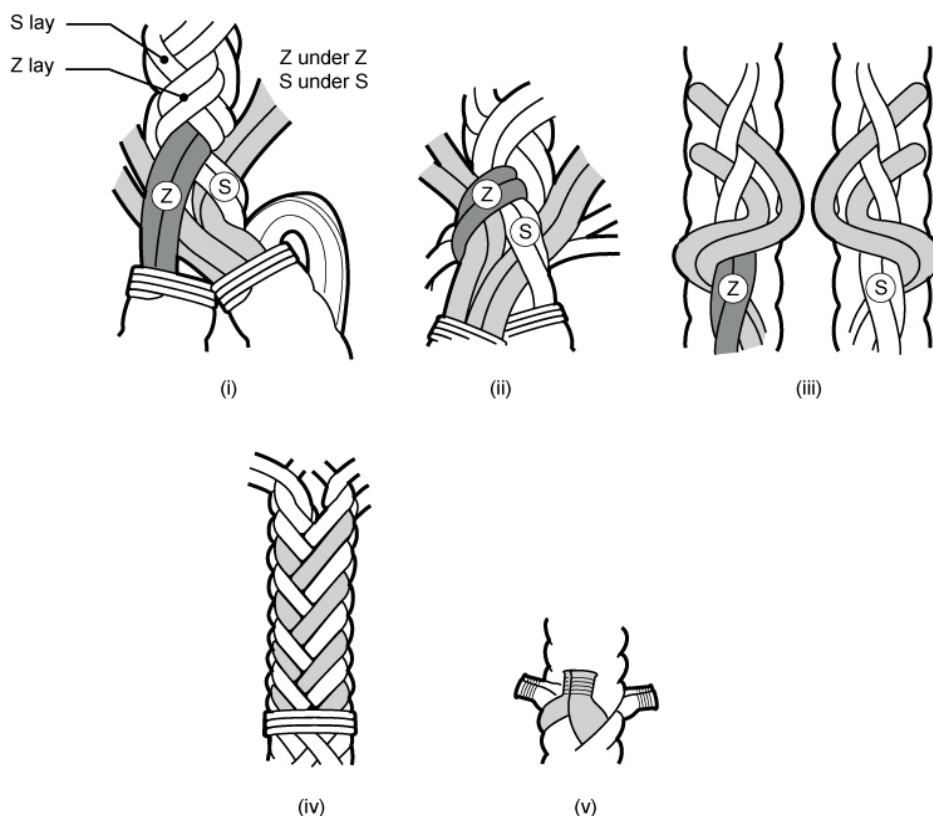
Fig 3-122. Making a Chain Splice



k. **Eye Splice in 8-strand Plaited Rope (Multi-plait).** The eye splice in multi-plait rope is governed by the construction, which has both Z (right-handed) lay strands and S (left-handed) lay strands. Fig 3-123 shows the stages of making the splice, as follows:

- (1) Read Para 03022 [sub para b](#).
- (2) Make a seizing at a distance of eight 'knuckles' from the end of the rope (point of splice), then unlay the strands. (See [Note](#)).
- (3) Marry pairs of Z strands and pairs of S strands making four pairs in all.
- (4) Commence the tucking sequence by passing a pair of Z strands under the nearest convenient pair of Z-lay strands in the standing part of the rope, followed by the adjacent pair of S strands, tucked under the pair of S-lay strands of the rope unoccupied adjacent to the Z lay. ([Fig 3-123\(i\)](#)).
- (5) Turn the rope right over and repeat (3) with the remaining two pairs of Z and S strands [Fig 3-123\(ii\)](#). This completes the first full tuck required using paired strands.
- (6) Divide all four pairs of Z and S strands and tuck these strands singly, one S strand under one S strand in the standing part and one Z strand under one Z strand in the standing part [Fig 3-123\(iii\)](#). Continue this tucking sequence for four tucks thus giving a total of five tucks to the splice [Fig 3-123\(iv\)](#). (See [Note](#))
- (7) The ends of the strands should now be dogged as shown in [Fig 3-119](#).

Fig 3-123. Eye Splice in Multi-plait Rope



l. **Thimble Eye Splice in 8 Strand Plaited Rope (Multi-plait).** A thimble eye is formed by fitting and splicing the end of the rope round a thimble, the splice holding the thimble in place. The procedure for seizing the thimble in place temporarily while the rope is spliced is similar to that when making a thimble eye in a wire, described later in this chapter. Splicing procedures are as described for a soft eye.

m. **Short Splice in 8-strand Plaited Rope (Multi-plait).** [Fig 3-124](#) shows the stages in the short splicing of multi-plait rope. For clarity the strands are numbered and referred to as black or white strands.

(1) Read Para 03022 [sub para b](#).

(2) Unlay each rope for a distance equal to eight 'knuckles' along its length, this ensures sufficient length of strand to complete the four tucks required (See [Note](#)). Separate the pairs of strands, and temporarily whip the ends of the pairs together. In [Fig 3-124\(i\)](#) the right-hand strands are black; left-hand strands are white. The pairs are designated 1R to 4R meaning right-hand lay (black) and 1L to 4L meaning left-hand lay (white).

(3) Marry the strands of the **same lay** in each rope together and tie off the ends. Tie together 2R and 3R, 2L and 4L, 1L and 3L, 1R and 4R [Fig 3-124\(ii\)](#). Tying together these strands ensures easy identification during the tucking sequence.

(4) Untie strands 1L and 3L and commence tucking 1L under the nearest convenient pair of (black) strands as shown in [Fig 3-124\(iii\)](#) and [Fig 3-124\(iv\)](#). Tuck 1L for 4 tucks, following the same direction as the white strands in the whole portion of the rope.

(5) Follow number 1L with 3L in the opposite direction and complete 4 tucks (v).

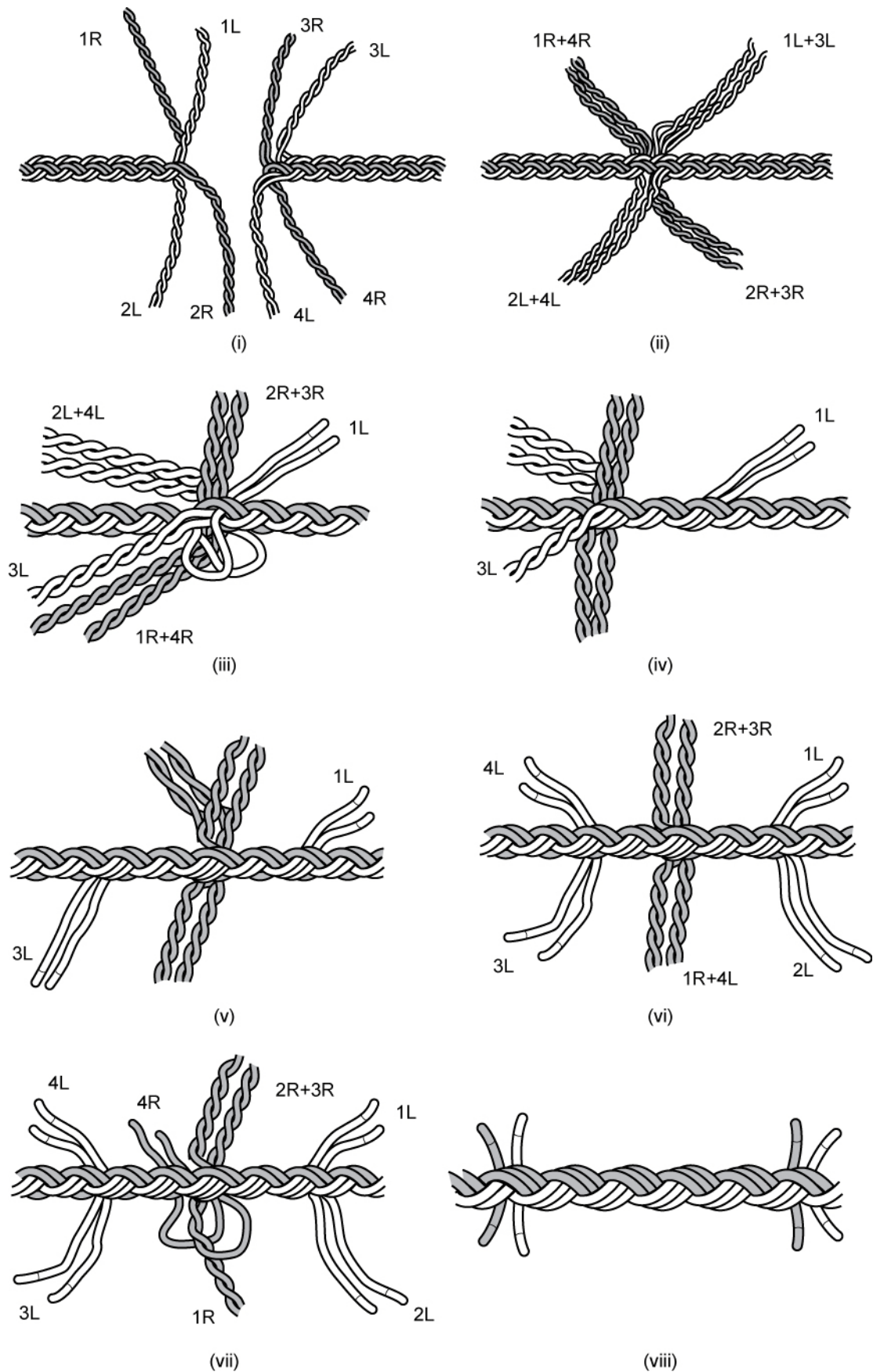
(6) Repeat the tucking sequence for 2L and 4L, thus completing the tucking of all white right-handed strands as shown in [Fig 3-124\(vi\)](#).

(7) Repeat sequence 3 to 5 with 1R and 4R, followed by 2R and 3R, for four tucks. (See [Note](#)).

(8) To finish off the splice remove the temporary whippings and dog the ends of the strands as shown in [Fig 3-119](#).

Note. When splicing HMPE an additional four full tucks must be taken, making a total of eight tucks. Therefore a length equal to twelve 'knuckles' must be unlayed before commencing the splice.

Fig 3-124. Making a Short Splice in Multi-plait Rope



03023. Splicing Braided Cordage

The splicing of braided cordage differs from orthodox splicing in the techniques and tools, which are employed. As explained in Para 03003b [sub para \(7\)](#), braided cordage falls into four main categories and by examining the end of any length of braidline cordage, the general construction of the rope can be identified. However, because all man-made fibre cordage must be spliced in accordance with the manufacturer's recommendations, and there are numerous variations to the construction of braided cordage within the four main categories, it is not practical in this publication to provide detailed guidance for splicing all versions that the seaman may encounter. Therefore the splicing of such cordage can only safely be carried out by the manufacturers of the rope, or by suitably trained personnel within a recognised rigging organisation. Damaged braidline ropes that cannot be readily replaced should be substituted temporarily with a suitable size and strength hawser-laid rope until a proper replacement can be obtained.

03024. Splicing Steel Wire Rope

a. Wire rope is spliced in roughly the same way as hawser-laid fibre rope; but wire is much less tractable and greater skill is required and particular care must always be taken with whippings and seizings. The bending of the wires during the process of splicing may injure their galvanised surface; therefore when possible splices should be dipped in a preservative, such as mineral tar or tallow, before being wormed, parcelled and served. Splicing reduces the strength of wire rope by approximately one eighth, but a badly made splice will reduce it appreciably more; the less the strands are distorted and disturbed when tucking, the less will be their loss of strength. A marline spike with a long tapered point should be used to open the strands; the correct way to use it is best demonstrated by an experienced wire-splicer, but proficiency will not come without practice. The spike should be inserted before each strand is tucked, and withdrawn after that tuck is complete. The tucking strand is passed through the rope in the same direction as, and beyond, the spike, and is then pulled into place in the splice. The twisting and pulling caused in tucking the strands tends to distort their natural set and must be reduced to a minimum. Distortion is greatest when the strands are inserted close to the point at which they emerge from the last tuck (eg. with a short nip), and it will be found that the strands go more readily into place if the spike is introduced under the correct strand but some distance farther down the rope. The tucking strand should then be passed through, as already described, and hauled into place while working the spike back along the lay of rope. In the Royal Navy all strands are tucked against the lay, as in cordage splicing.

b. Types of Wire Splice.

(1) *Eye Splice.* For making a permanent eye in the end of a rope. A soft eye is a small eye spliced in the end of a wire rope, and a thimble eye is formed by fitting and splicing the end of the wire rope round a thimble, the splice holding the thimble in place. It is fitted in the ends of wire ropes, which are intended to be used in conjunction with a joining shackle or other rigging fittings. The hawser eye is an alternative to the thimble eye and just as efficient. The eye is first spliced larger than the thimble, then the thimble is fitted into the eye and secured in place by a strong seizing just below it. This enables the thimble to be easily removed and replaced, merely by cutting the seizing and then renewing it. A bollard eye is a long soft eye 1.5 metres long from crown to splice, fitted in the ends of berthing hawsers so they can be placed over bollards.

- (2) *Short Splice*. For joining two wire ropes not required to pass through a block.
- (3) *Long Splice*. For joining two wire ropes which are required to pass through a block. A well-made long splice does not increase the diameter of the rope and should not reduce its strength.
- (4) *Cut Splice*. For making a permanent eye in the bight of a wire rope.
- (5) *Chain Splice*. For splicing a wire rope tail into a chain which has to be led through a block of fairlead. The chain splice is not more than two-thirds of the strength of the wire rope.

c. Tucking Sequence.

- (1) *For wires up to and including 32mm diameter.*
 - (a) One tuck with the core in each strand
 - (b) Two tucks after the core of each strand has been removed.
 - (c) One tuck with two-thirds of each strand.
 - (d) One tuck with half of each remaining strand.
- (2) *For wire above 32mm diameter.* A third tuck is made after the core of each strand has been removed. The gradual reduction in the size of each strand gives the splice its uniform taper.

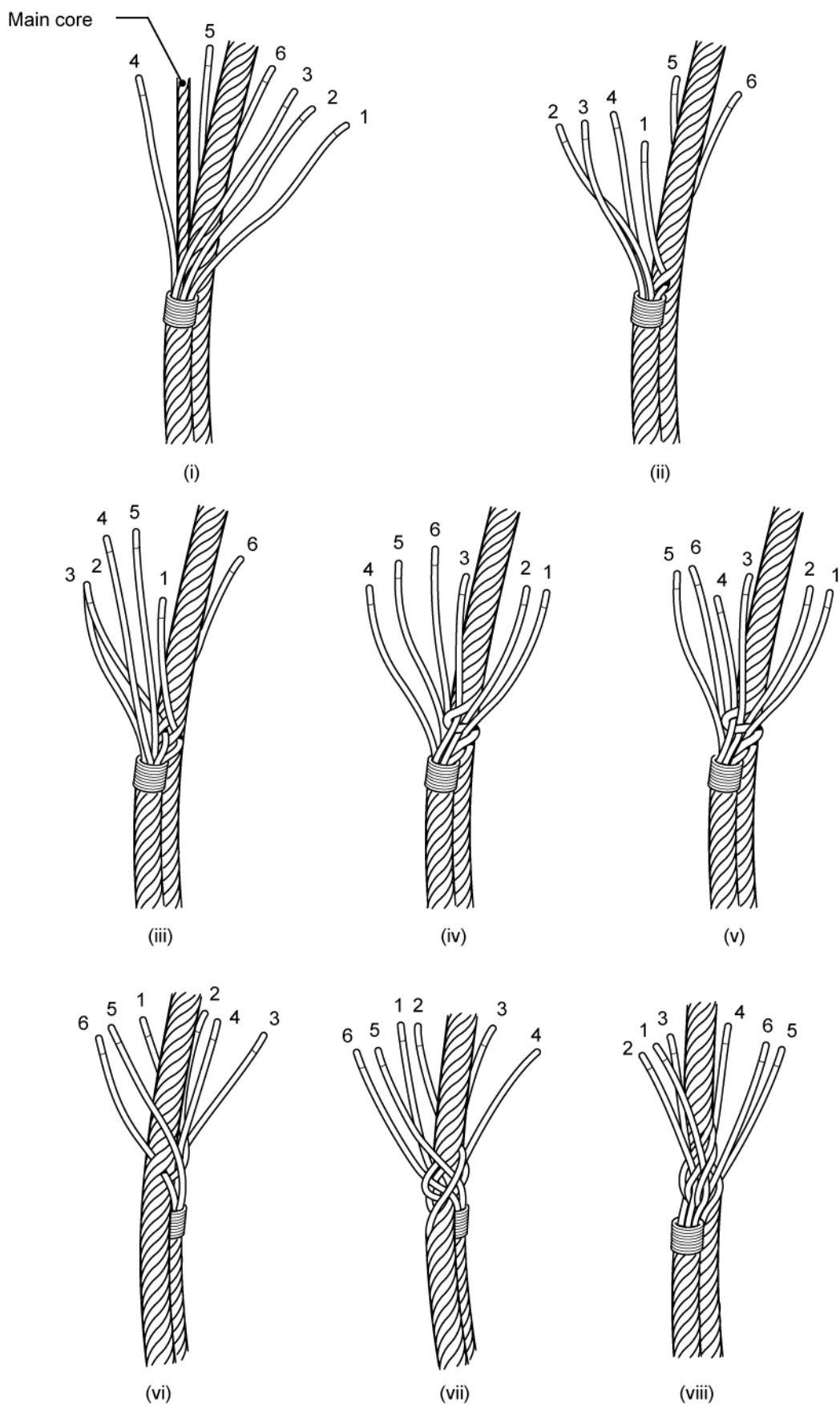
d. To Make an Eye Splice ([Fig 3-125](#)).

- (1) Put a stout whipping on the rope at a distance equal to forty times the diameter of the wire. The whipping should be put on with a serving mallet and the length of the serving should be equal to the circumference of the rope. Whip the end of each strand, unlay the strands to the whipping, and cut out the exposed main core of the rope [Fig 3-125\(i\)](#).
- (2) Form the size of eye required and stop the two parts of the wire firmly together to prevent movement during the tucking of the strands (stopping not shown here).
- (3) Place three strands on one side of the wire and the remaining three on the opposite side of the wire.

Note. For convenience in the following instructions the strands are numbered from 1 to 6, the top strand being No 1 as shown in [Fig 3-125\(i\)](#). The parts of the rope are distinguished by naming them the standing part and the tucking end (the terms are self-explanatory) and all reference to the right and left apply only when looking down the rope from the crown of the eye.

- (4) When ready for splicing, place the eye so that the tucking end lies to the left of the standing part, as shown in [Fig 3-125\(i\)](#), thus enabling No 1 strand to be inserted from the right-hand side and against the lay.
- (5) Tuck No 1 strand under the strand immediately below it [Fig 3-125\(ii\)](#).
- (6) Tuck Nos 2, 3 and 4 under successive strands of the standing part, as shown in [Fig 3-125\(iii\)](#) and [Fig 3-125\(iv\)](#) and [Fig 3-125\(v\)](#).
- (7) Tuck No 6 under the remaining two strands of the standing part [Fig 3-125\(vi\)](#).
- (8) Finally, tuck No 5 so that it emerges between the two strands under which No 6 lies and after passing under one strand only as shown in [Fig 3-125\(vii\)](#). This will result in the six strands emerging equidistantly around the standing part, the variation in the regular sequence of tucking being necessary for a locking tuck and to make a neat splice, as shown in [Fig 3-125\(viii\)](#).
- (9) Now pull the strands down towards the crown of the eye, taking care not to cripple the wire, and place a seizing outside the tucks to prevent them easing back during the subsequent stages. Then, if the strand cores are fibre, remove the whippings at the ends of the strands, cut out the cores, and then replace the whippings.
- (10) Tuck these coreless strands in regular sequence again, twice for rope up to and including 32mm, and three times for rope above 32mm. but remember to place a seizing outside each series of tucks. Then take one-third of the wires out of each strand and stop them back towards the crown of the eye. Tuck the remaining two-thirds once, and then stop back half the wires in each strand again. Tuck each of the one-third strands once, remove the seizings from each tuck, and then tap down all tucks with a hammer, starting from the first tuck and finishing off at the tail, to remove any slack and to round up the splice.
- (11) Using wire cutters or a hammer and chisel cut off all the tails, close to the body of the wire, and tap down the ends with a hammer.
- (12) If required, the splice can now be wormed, parcelled and served as described earlier in the chapter.

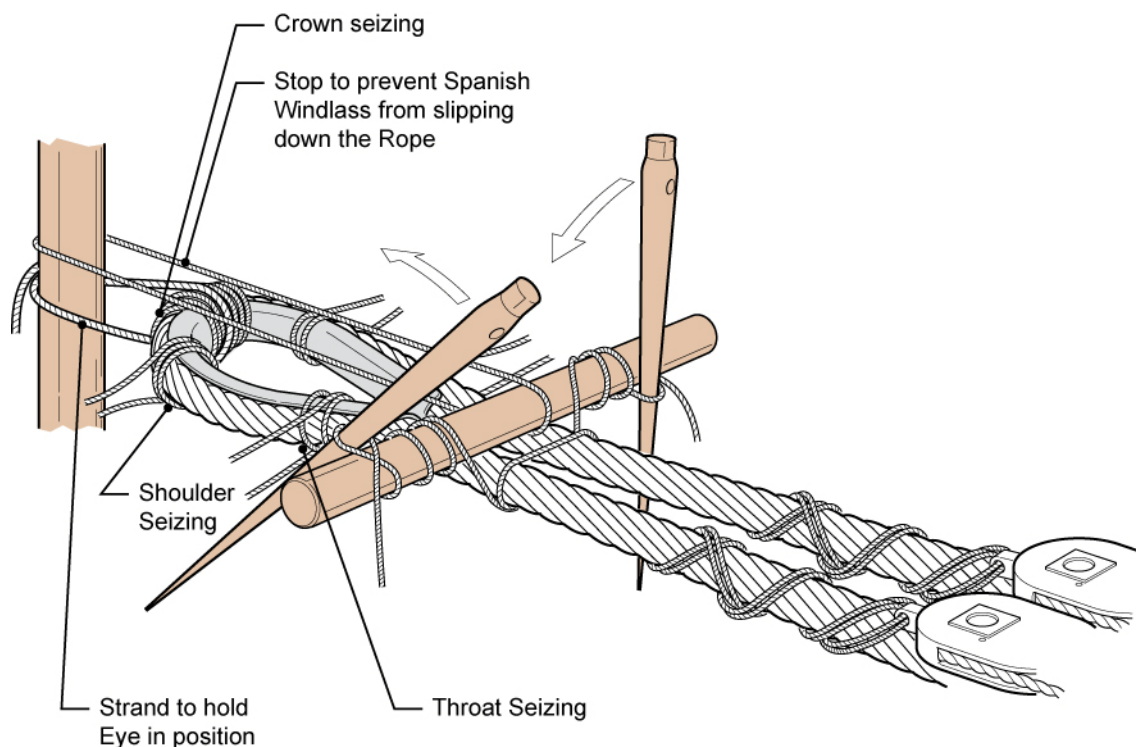
Fig 3-125. Making an Eye Splice in Wire



e. To Make a Thimble Eye.

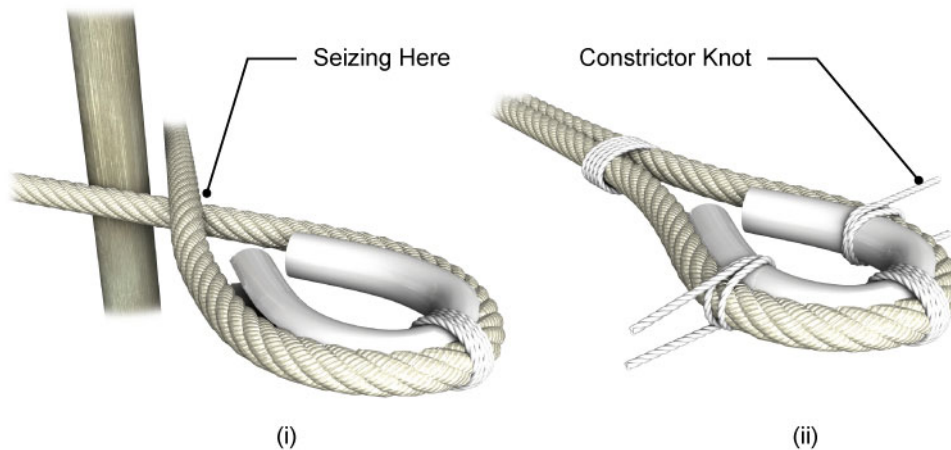
(1) Whip the wire at a distance from the end equal to forty times the diameter of the wire, as described for an eye splice. Measure with a piece of twine the outer perimeter of the thimble to be used, halve the twine, place it on the wire at the beginning of the whipping and leading away from the end of the wire, and make a chalk mark to denote the position where the crown of the thimble is to be seized to the wire, then break in the thimble. To do this, find the position on the rope, which will lie at the crown of the thimble and seize the rope firmly into the crown at this point. Then secure the thimble and haul the rope into the form of a U, as close round the thimble as possible. Rig a Spanish windlass ([Fig 3-126](#)) on the two parts of the rope below the neck of the thimble to haul them together. It will be necessary to put a light stop on the roller or bar of the Spanish windlass to counter the tendency of the windlass to slip down the rope as the parts come in. Bind the rope close in to the thimble at shoulder and throat with seizing stuff; each of these seizings should be secured with a constrictor knot. Haul the seizings taut with a heaving mallet, then walk back on the Spanish windlass and take it clear. **Sweat up** first the shoulder seizings and then the throat seizing with a heaving mallet, as follows: after every heave, take another turn round with each part round thimble and rope; heave again, and repeat until the seizing is of sufficient size and the rope lying snug against the thimble at that point; then secure it and sweat up the next seizing. An occasional tap with a maul during the final stages will help to settle the rope into its place round the thimble.

Fig 3-126. Breaking in a Large Wire Rope Round a Thimble



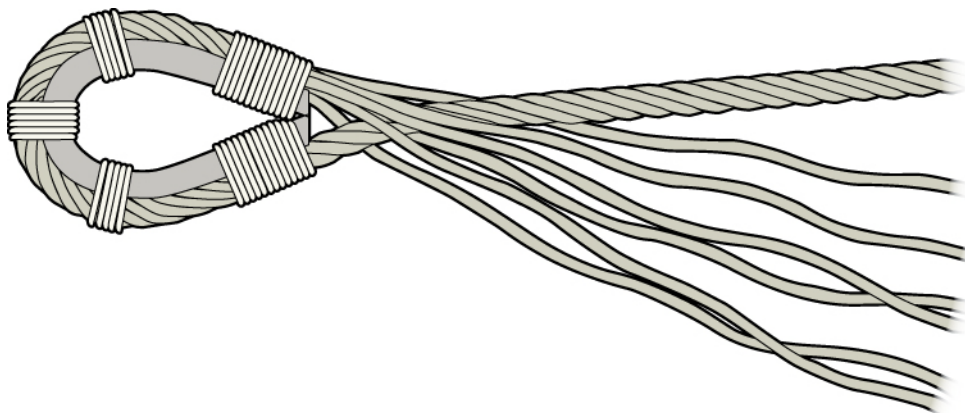
(2) An alternative to the Spanish Windlass when using small and medium wire rope is to cross the parts and press the cross against a fixed metal bar or other fixture, as in Fig 3-127(i). Having closed-in the parts as far as possible, pass a seizing round the cross. If the parts are now uncrossed and laid side by side, as in Fig 3-127(ii), the rope will be found to fit fairly snugly round the thimble. Finally, put on the two seizings and complete the join with a heaving mallet. When breaking-in small and medium sized wire ropes it is not necessary to use shoulder seizings, and an ordinary vice can be of great assistance.

Fig 3-127. Breaking-in a Small Wire Rope Round a Thimble



(3) When the thimble has been seized into position whip the end of each strand, unlay the strands to the original whipping, and cut out the heart of the wire. Place three strands on one side of the wire and the remaining three strands on the opposite side of the wire (Fig 3-128) and start to tuck the strands as for an eye splice. The first strand must be tucked under its proper strand in the standing part so as to give the eye a bowsing-in moment; otherwise, when the crown and throat seizings are removed after the completion of the tucking, it will be found that the thimble is loose within the eye. The splice is finished off as for an eye splice.

Fig 3-128. Preparation for a Thimble Eye



f. **To Make a Hawser Eye.** A Hawser Eye (Fig 3-129) is an alternative to the thimble eye and is just as efficient. The eye is first spliced larger than the thimble, and the thimble is then fitted into the eye and secured in place by a strong seizing just below it. This enables the thimble to be easily removed and replaced, merely by cutting the seizing and then renewing it. Thimble sizes should correspond to the size of the rope with which they are used; however, if the eye is parcelled and served, the thimble required for the larger diameter of the served wire must be that for a wire 4mm larger. It is no longer common practice to serve the eyes of wire, but it may occasionally be necessary. Having selected the correct thimble for the size of rope, whip the rope as for an eye splice, and from the whipping measure along the rope a distance equal to the circumference of the rope plus one and a half times the length of the grooves in the thimble. This gives the position for the first tuck. Form the eye and then tuck and finish as for an eye splice. If required, the splice itself may be parcelled and served, using three-yarn spun yarn for the serving if the rope is 32mm or less, and four-yarn spun yarn if more than 32mm. Insert the thimble and seize in place with a flat seizing, using the number of turns and size of seizing indicated in Table 3-16.

Fig 3-129. A Hawser Eye

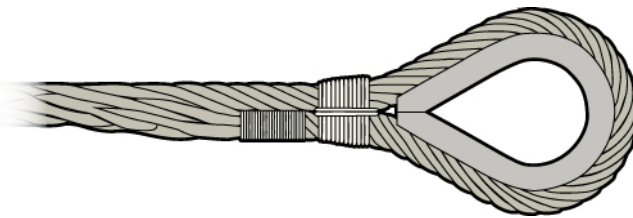


Table 3-16. Thimbles and Seizings for Unserved Hawser Eyes

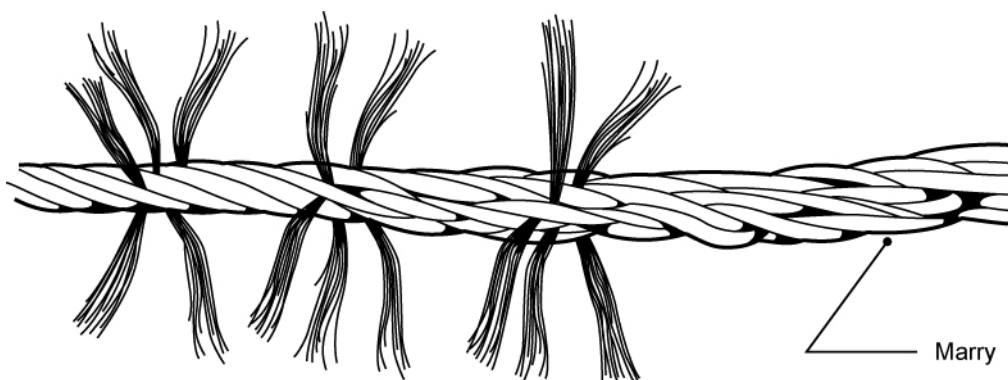
Size of SWR	Size of Thimble	Size of Seizing Wire	Size of Seizing Wire
20mm	20mm	2.7mm	12
24mm	24mm	2.7mm	12
28mm	28mm	2.7mm	14
32mm	32mm	2.7mm	14
36mm	36mm	2.7mm	14
40mm	40mm	4.8mm	18
44mm	44mm	4.8mm	18
48mm	48mm	4.8mm	18
52mm	52mm	4.8mm	18

g. **To Make a Short Splice** (Fig 3-130).

(1) Put a stout whipping on each wire rope at a distance from its end equal to 40mm for each millimetre of its diameter, securely whip the ends of the strands, unlay to the whippings, and cut out the hearts. Marry the two ropes so that each strand of one lies between two of the other, hitch a line to the strands of each rope and haul the marry as taut as possible with a tackle or Spanish Windlass, occasionally tapping the strands with a hammer to assist them to settle in. When married, the distance between the two whippings for a short splice in wire should be a little more than one and a half times the diameter of the rope. Seize the strands on one side of the marry to the standing part of the other with a strong seizing. Having hauled the first turns taut with a heaving mallet, it is advisable to put on the remainder with a serving mallet as for a serving.

(2) Cut the whipping on the opposite side of the marry and begin normal tucking. As with fibre rope, each strand is taken over the strand on its left and tucked under the next one, and it emerges between the latter and the subsequent one. Having tucked each strand on that side of the marry once, place a seizing outside these tucks to prevent them easing back during the subsequent stages, and then unlay each strand and cut out the core if of fibre; if of wire however, the cores are not removed. Then lay-up the strands again. Tuck these re-laid strands again, three times for rope of 32mm or less, and four times for rope of over 32mm. Then take one-third out of each strand and stop it back. Tuck the remaining two-thirds once, and then stop back half of each. Tuck each of the one-third strands once, and then tap down all strands with a hammer. Using hand-held wire cutters or a hammer and chisel cut off all the tails, close to the body of the wire, and tap down the ends with a hammer. Now remove the seizings and cut the whippings from the other side, and tuck the strands on that side in the same manner. On completion, round up the whole splice.

Fig 3-130. A Short Splice



h. **To Make a Bale-sling Strop.** Take a length of wire rope and join the two ends together with a Short Splice. Before marrying take a half-turn out of the rope, otherwise the strop will tend to form a figure-of-eight. If required, parcel and serve over the splice.

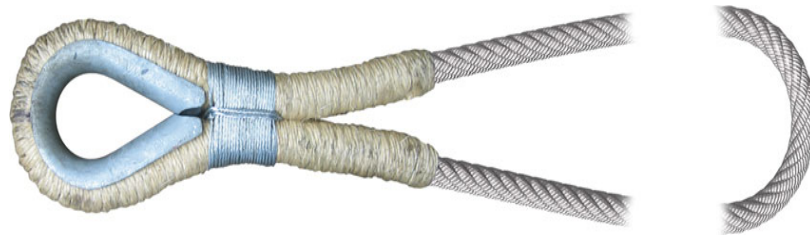
i. **To Make a Bollard Strop** (Fig 3-131).

(1) Work the rope as for a bale-sling strop, marrying at 4.25 metres. Tuck each side four times, breaking down the strands after each tuck, as follows:

- (a) Make the first tuck with the whole strands.
- (b) Make the second tuck with whole strands, less their cores.
- (c) Make the third tuck with two-third strands.
- (d) Make the fourth tuck with one-third strands.

(2) Serve the splice and then break it symmetrically round a thimble, which must be seized in place with a round wire seizing. The thimble selected should, if possible, be some four sizes larger than the normal thimble for the rope used to make the strop; a strop made from 28mm SWR, for example, would need a thimble designed for a 44mm SWR.

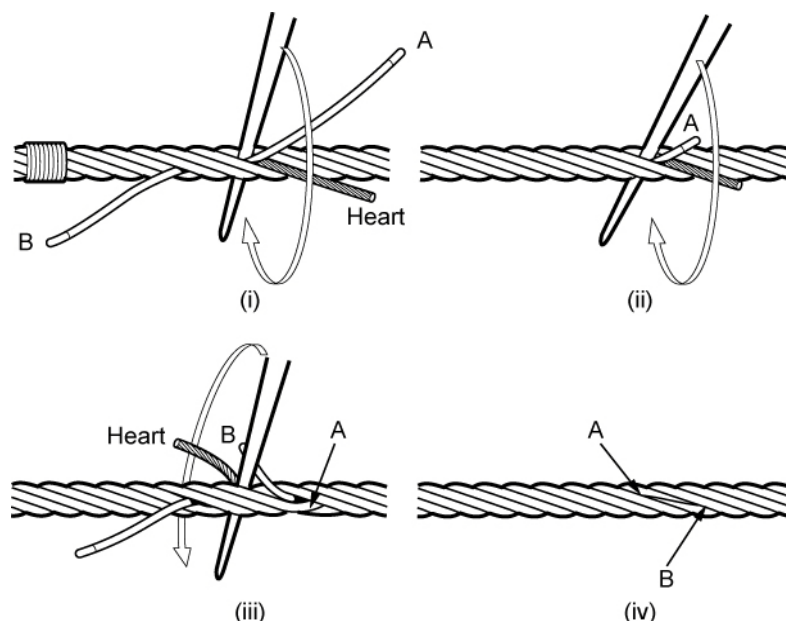
Fig 3-131. Making a Bollard Strop



j. **To Make a Long Splice.**

(1) Whip each rope at a distance from its end equal to 110mm for every millimetre of its diameter, unlay to the whippings and cut out the hearts. To assist in dealing with the long lengths of strands, some of which lengthen in the process of splicing, both ropes must be further prepared, before marrying, by whipping and cutting every other strand to a convenient length of 150-300mm. Marry the ropes so that each short strand has a long strand from the other rope on its right and a short one from the other rope on its left. As in the short splice, haul the marry very taut, seize the long strands on one side to the standing part, and cut the whippings on the other side. Unlay one short strand and follow it up with the long one from the opposite rope, which lay on its right in the marry, until reaching a distance from the marry equal to one hundred times the diameter of the rope. This requires more knack than with natural fibre cordage rope and, once started, it will help if each pair of ends is crossed so that each now has the other on its left instead of its right. Crossing a pair of strands also has the effect of locking them so that they will not unlay and will therefore remain in place when let go. Now take the second pair of strands, and then the third, and lay them up in the same manner, but lay up the second pair to a distance from the marry equal to sixty times, and the third pair to twenty times the diameter of the rope. Remove the seizing on the rope on the other side of the marry, cross each pair of strands to lock them, cut the whipping, and repeat the above operation on the rope on that side. The result will be six pairs of strands equally spaced from each other at a distance equal to forty times the diameter of the rope.

Fig 3-132. Finishing a Long Splice



(2) To finish off (Fig 3-132), the ends of the strands are buried inside the rope, the heart being cut out where each strand is buried and the buried strand taking its place; this finish requires skill. The following method is used for the six pairs of strands, working from the marry outwards. Take end A over its opposite number B and tuck it under three strands; the temporary whipping shown in Fig 3-132(i) will help hold the ends in place when the tuck is made. Insert the spike under the next three strands, pull out the end of the heart, and bring round the strand just tucked so that it lies on the underside of the spike Fig 3-132(i). (As it is very difficult to insert a spike under more than two strands a second spike must be used when tucking under three strands, the first being withdrawn after inserting the second under all three strands). Now work the spike along the lay, pulling out the heart, and it will be found that the end below the spike is forced into the centre of the rope in place of the heart Fig 3-132(ii). Repeat this operation with the end of the second strand, but instead of taking it over one strand and under three, cut the whipping, insert the spike under three strands, and bury this end as already described Fig 3-132(iii). On completion the two strands will be lying side by side where they disappear into the centre of the rope, making a very neat finish Fig 3-132(iv). Now treat the other five pairs of strands similarly, and, when completed, the buried ends should always have replaced the heart for the whole length of the splice, a distance 230 times the diameter of the rope. The lengths of the ends must be adjusted individually so that they should butt as near as possible.

k. **Making Wire Grommet Strops.** The simplest form of grommet strop is known as a **two-parted** strop and is made from a single strand formed into a ring and laid-up round its own part until the ends meet again. If the ends are taken round again the result is a **three-parted** strop, and so on until a **six-parted** strop is achieved. In practice only three-, four- and six-parted strops are used. To make any of the strops it is necessary to measure off accurately the length of wire required; otherwise wire will be wasted. The formula for finding the length of strand required is: the sum of twice the length of grommet required and twice the circumference of the wire used; multiply this sum by the number of strands in the strop, and finally add the tucking allowance for both ends. For example, if a four-parted grommet strop with a length of 1.5 metres and made up of a strand of 24mm wire is required, the strand length is calculated thus:

	Metres
Twice the size of grommet required	3.00
Twice the circumference of wire $2\pi \times 24\text{mm}$	<u>0.15</u>
Multiplied by four	3.15
Tucking allowance (40mm for every millimetre diameter of wire)	12.60
Total length of strand	<u>0.96</u>
	13.56

l. **Four-parted Strop.** Unlay the strand (after the wire has been measured off and cut) and mark it off from one end to a distance equal to the sum of twice the length of the grommet, twice the circumference of the wire, and half the tucking allowance. Therefore in the example above the distance would be 3.63 metres. Now make a second mark at a distance from the first mark equal to a sum of twice the length of the grommet and twice the circumference of the wire, ie, 3.15 metres. These two marks are married to give the correct length of the strop, and, for the purpose of this description, are called the **short** end and the **long** end. To make a strop, marry the strands at the marks so as to form a ring and lay-up the short end with the lay. Turn the strop round and lay-up the long end to form a three-parted grommet. This can be done with the fingers, but care must be taken to keep the strand in its natural lay, particularly the second time round. Take care that whenever the strands meet they are crossed as in a long splice. At any stage of these operations the end, which is not being laid-up, will have to be held in place, either by a stop or by hand, until the ends cross again. Laying-up the fourth part will require the use of a marlin spike. Stop the short end and insert the spike under two parts of the strop, close to where the ends cross, so that the third part and the long end lie beneath it ([Fig 3-133\(i\)](#)). Work the spike along with the lay and the fourth part will fall into place correctly. Both the three-parted and four-parted strops are finished off in the following manner: for wire up to and including 24mm each strand is tucked over one and under two, the core is cut out, and the strand tucked again over one and under two; for wire over 24mm each strand is tucked over one and under two, the core is cut out, the strand is tucked over one and under two, each strand is halved, and the remaining half-strand is finally tucked over one and under two. The ends of the strand are then cut off and that portion of the strop is served over.

m. **Five-parted Strop.** If a five-parted strop is required, it is necessary to introduce a false heart into the strop after the four-parted strop is completed but not tucked ([Fig 3-133\(ii\)](#) and [Fig 3-133\(iii\)](#) and [Fig 3-133\(iv\)](#)). A high degree of skill is required both for this strop and the six-parted strop described later. As when laying-up the fourth part, insert the spike under two parts of the strop. Take another length of strand equal to the circumference of the ring and insert one end into the centre of the strop, beneath the spike, to form the heart. The long end of the strop is also placed beneath the spike, but must always be kept outside the heart or it will tend to take its place. The short end is held in place by a stop. Work the spike along with the lay, and, with care, the heart will disappear inside the strop and the long end takes up its own place as the fifth part. Before its last end disappears it is important that the length of the heart should be adjusted so that the ends almost butt. If correctly laid-up, a gap will show between two of the parts of the five-parted strop, and this gap is filled in the six-parted strop.

n. **Six-parted Strop.** Proceed as for a five-parted strop; then fill the gap as follows: stop the short-end, then insert the spike under three parts, close to where the ends cross, and place the long end beneath it ([Fig 3-133\(v\)](#)). Work the spike along the lay, persuading the sixth part into place, and, at the same time, watch the heart carefully for any inclination to come out. It is a matter of choice whether to have the spike under or over the heart. The strop is now finished as for a long splice, the heart being pulled out and replaced by the remaining ends of the original strand ([Fig 3-133\(vi\)](#) and [Fig 3-133\(vii\)](#)). These ends must be of a length so that they almost butt.

o. **Strength of Grommet Strops.**

(1) The approximate breaking strength of the single leg of a grommet strop can be calculated from:

$$BS \text{ (strop)} = (n/ns) \times BS \text{ tonnes} \quad \text{where}$$

n is the number of parts of the strop;

ns is the number of strands in the original wire;

BS is the breaking strength of the original wire.

Example

What is the breaking strength of a four-parted grommet strop constructed from a strand taken from 12mm, 6x24 steel wire rope?

$$BS \text{ of } 12\text{mm } 6 \times 24 \text{ SWR} = d^2/25 = 144/25 = 5.75 \text{ tonnes}$$

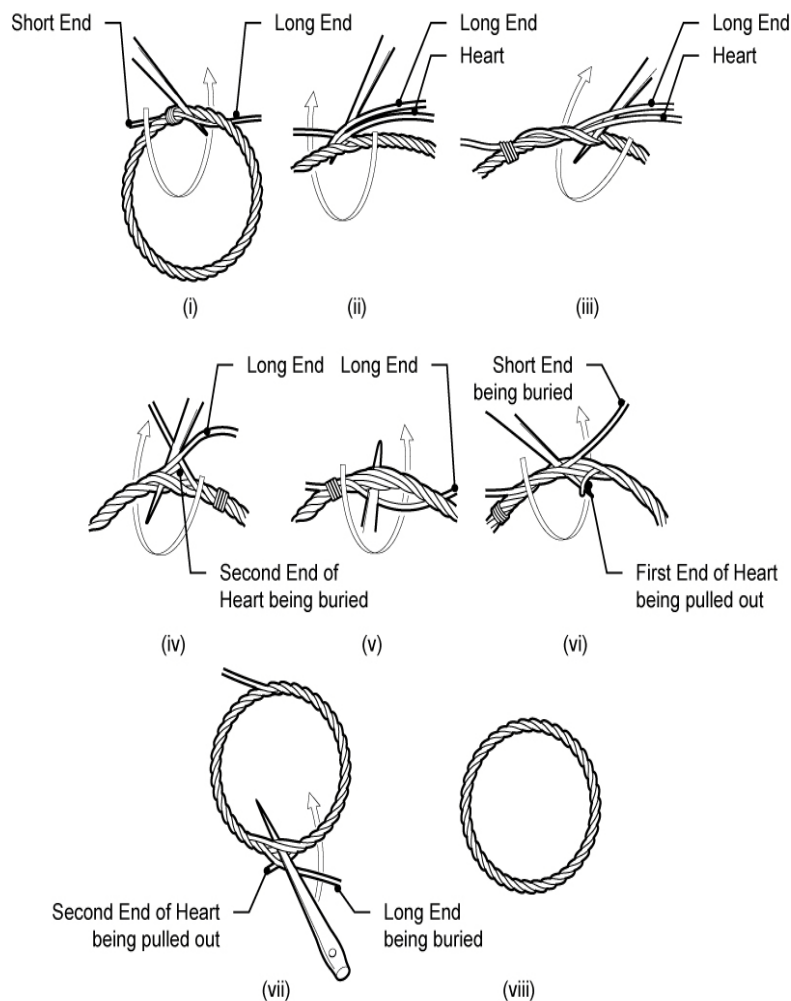
$$\text{Number of parts of strop} = 4$$

$$\text{Number of strands in the original wire} = 6$$

$$\text{Therefore } BS \text{ (strop)} = (4/6) \times 5.75 = 3.84 \text{ tonnes approx.}$$

(2) If the strop is to be used doubled, its breaking strength will be twice 3.84 = 7.68 tonnes approximately.

Fig 3-133. Making a Wire Grommet-Strop



03025. Splicing Cordage into Wire

To splice three-stranded cordage into wire, unlay the wire rope as for a short splice, keeping the strands in pairs, and remove the heart. Splice the wire and rope together as for three-stranded rope, inserting the appropriate number of tucks for natural fibre cordage or man-made fibre cordage. Taper the strands as for a short splice marl down and serve over. Splicing braidline cordage into wire is a more complicated procedure, which must be in accordance with methods specified by individual braidline manufacturers. For this reason such splicing is only undertaken by the manufacturers of the braidline, or by suitably trained personnel within a recognised rigging organisation. Damaged wire/braidline ropes that cannot be readily replaced should be substituted temporarily with a suitable size and strength hawser-laid rope until a proper replacement can be obtained.

03026. Mechanical Splicing

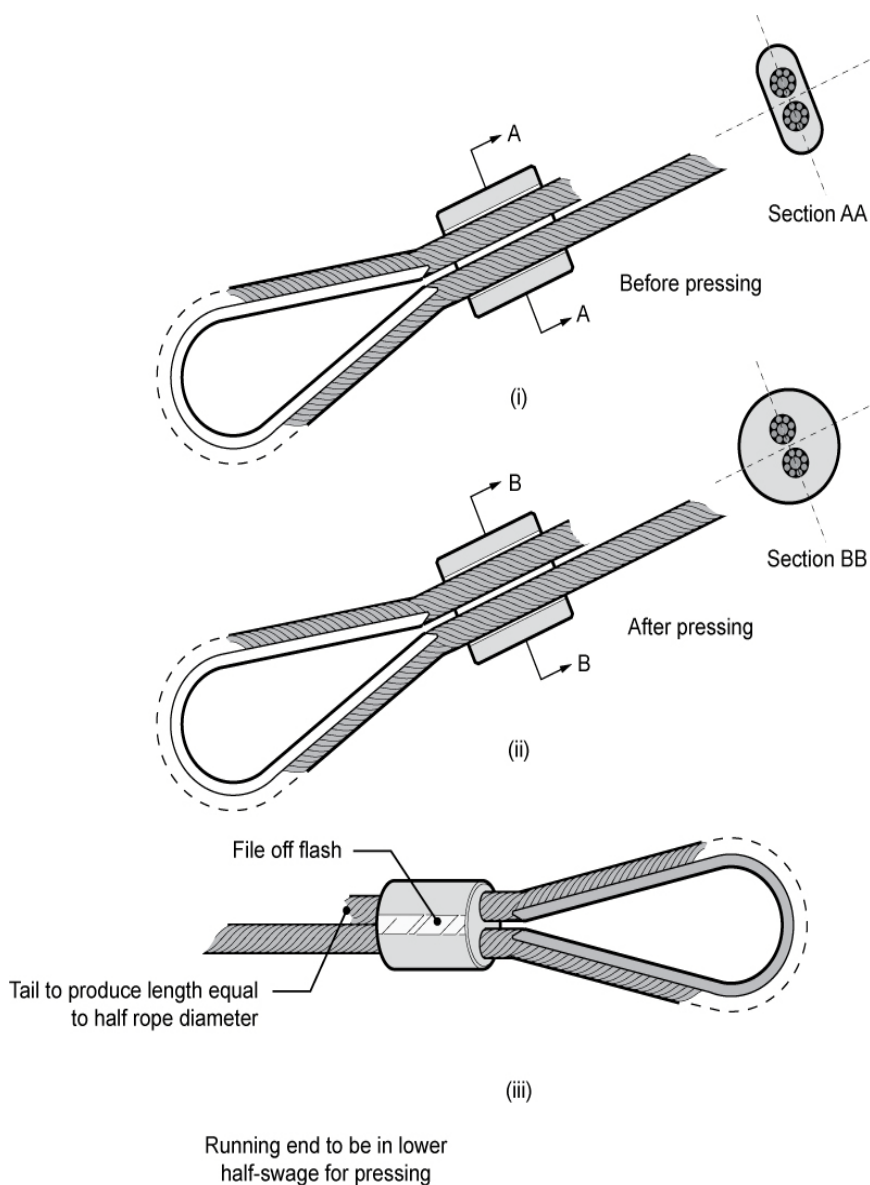
a. Mechanical splicing, known under various trade names including Marisplice, Superloop and Talurit is carried out by Naval Base authorities, commercially under contract, or in capital and repair ships. The splice gives comparable strength to a hand splice, and has the following advantages: it uses less wire, requires no worming, parcelling and serving, and is completed in much less time; in a great many cases it has superseded the hand splice. A mechanically spliced wire should be tested by a competent testing authority before use; however, if this is not possible, a local test is acceptable in the short term, but the splice must be properly tested at the first opportunity. The use of mechanical splicing machines in Royal Navy ships is to be controlled, and a list of all gear produced must be kept by the Boatswain or Chief Boatswain's Mate.

b. **Making a Mechanical Splice.** Ensure that any excessive oil or grease is cleaned off the wire in the position where the ferrule is to be fitted. Thread the end of the rope through an alloy ferrule of suitable size ([Table 3-17](#)) and back on itself through the ferrule to form a loop ([Fig 3-134\(i\)](#)). The bitter end of the rope must not terminate within the ferrule; it should extend past the end of the ferrule for a distance of at least one half of the rope diameter. If a thimble or other type of fitting is required, it is placed in the loop in the necessary position. The ferrule is then put in the hydraulic press between two swages, which are of a size to deal with that particular ferrule, and the swages are closed until they slightly grip the ferrule. The rope is then pulled through until a loop of the required size is fashioned or the tightest possible fit to the thimble or other fitting is obtained. Further pressure is then applied until the swages meet; the splice is then complete. The pressure exerted does not harm the rope in any way, neither is the lay disturbed - the metal of the ferrule flows round the rope strands, holding each strand firmly in position. ([Fig 3-134\(ii\)](#)). Mechanical splicing is occasionally used to splice man-made fibre and natural fibre ropes; however, such splices are not to be used where life and limb will be endangered if the rope parts.

Table 3-17. Size of Ferrules for use with SWR

Size of Rope	Naval Stores No of Ferrule	Size of Rope	Naval Stores No of Ferrule	Size of Rope	Naval Stores No of Ferrule
1mm	0263/411-9765	6.5mm	0263/411-9772	24mm	0263/411-9743
1.5mm	0263/411-9766	7mm	0263/411-9773	28mm	0263/411-9744
2mm	0263/411-9767	8mm	0263/411-9735	30mm	0263/411-9745
2.5mm	0263/411-9768	10mm	0263/411-9736	32mm	0263/411-9746
3mm	0263/411-9732	12mm	0263/411-9737	36mm	0263/411-9747
3.5mm	0263/411-9769	14mm	0263/411-9738	38mm	0263/411-9748
4mm	0263/411-9733	16mm	0263/411-9739	40mm	0263/411-9749
4.5mm	0263/125-0131	18mm	0263/411-9740	44mm	0263/411-9750
5mm	0263/125-0132	20mm	0263/411-9741		
6mm	0263/411-9734	22mm	0263/411-9742		

Fig 3-134. Making a Mechanical Splice



03027. Making a Temporary Eye Using Bulldog Grips

a. A temporary eye, either soft or thimble, can be made in wire rope by using bulldog grips ([Fig 3-135](#)), which are screwed clamps holding the two parts of the rope together. It is important that the grips should be fitted with the U-bolt over the tail end of the rope and the bridge on the standing part, as shown in [Fig 3-135](#). Grips should be spaced at a minimum distance of six times the diameter of the rope as follows:

SWR up to 19mm - 3 grips

20mm to 32mm - 4 grips

b. Grips are supplied in various sizes to fit each size of wire rope up to and including 32mm ([Table 3-18](#)). Bulldog grips for larger ropes are not available in the Royal Navy. It is essential that the correct sized grip is used and that grips are fully tightened to the effect that the wire is locally squeezed down to two-thirds of its normal diameter. Failure to comply with these requirements will greatly reduce the efficiency of the termination. Grips are apt to mark or crush the rope, and both grips and rope should be inspected for security and wear before and after use and grips retightened as necessary. Bulldog grips must not be used to join two wire ropes together.

WARNING

BULLDOG GRIPS ARE NOT TO BE USED FOR LIFTING PURPOSES OR JOINING TWO WIRE ROPES TOGETHER

Fig 3-135. Making a Temporary Eye with Bulldog Grips



Fig 3-136. Dimensions of Bulldog Grips

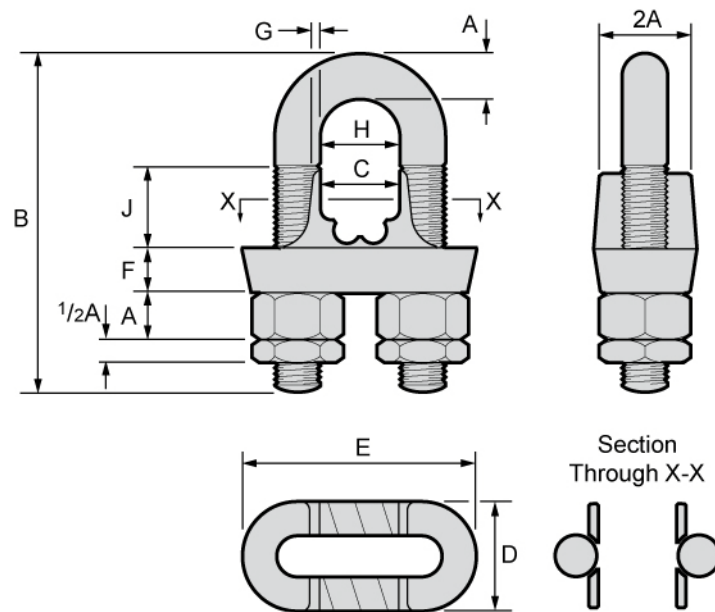


Table 3-18. Details of Bulldog Grips Available Through Naval Stores

Naval Stores No.	For Use with SWR Diameter	Dimensions								
		A	B	C	D	E	F	G	H	I
0263/571-	<i>mm</i>	<i>millimetres</i>								
5319	4	5	27	5	14	28	5	2	9	7
5320	6	6	30	7	14	25	6	-	7	5
5312	8	8	40	9	18	33	8	-	9	6
5313	11	12	58	12	28	48	12	-	12	10
5314	13	14	68	14.5	32	56	14	-	14.5	11
5315	14	14	70	16	32	58	14	-	16	11
5316	22	18	98	25	41	79	18	-	25	14
5317	29	20	118	32	46	92	20	-	32	16
5318	32	22	130	35	51	101	22	-	35	28

03028. Nets - Provision and Cargo

The nets most commonly used in the Royal Navy for handling provisions and stores in bulk are manufactured from polyester webbing, man-made fibre cordage or steel wire rope. The flat polyester webbing nets, usually associated with Vertrep, are discussed fully in [Chapter 6](#). Man-made fibre cordage and steel wire rope provision nets are available for general use and are obtainable through naval stores, sizes and NSN Numbers as follows:

Type of net	Dimensions	SWL	Naval stores No
SWR provision net	2.45m square	3 tonnes	0246/923-9438
MMFC provision net	2.5m square	1.5 tonnes	0246/923-3572

03029. Nets - Brow Safety

a. Whenever a brow is rigged into a ship, a brow safety net must be rigged beneath it. Each net must be secured by means of its fitted lanyards and positioned so that it is directly beneath the brow with the centre of the net lower than its edges. The net must extend from ship to ship or ship to dock wall and have sufficient spread on both sides to catch a person or object falling from the brow safely. Where no suitable securing positions are available on the jetty, a spreader bar of sufficient length is to be secured to or through the brow so that the net lanyards can be secured to it, thus achieving the correct spread. A length of 100mm x 100mm timber or other suitable material is to be used as a spreader. The nets must be inspected before and after use, and at frequent intervals whilst they are rigged; and they must be adjusted as necessary to allow for the rise and fall of tide. When longer than usual brows are put into a ship, for example if a frigate docks down in a large dry dock, nets suitable for the task should be requested from the shore-side authorities. In such circumstances, a ship's own brow safety nets can be securely lashed together for fitting beneath one of the brows.

b. The brow safety net is designed to capture the load by the breaking of the insulocks on each corner allowing the net to travel down the side jackstays. The brow safety net comes in three sizes, individually bagged and labelled with a Certificate of Conformance and are procured through the Naval Stores system. The following sizes are available:

- | | |
|---|---------------------------|
| (1) 3.0m x 3.0m (Small) MM/PP: | NSN F219-3940-99-968-4717 |
| (2) 7.62m x 4.5m (Medium) FF/DD | NSN F219-3940-99-888-3783 |
| (3) 12.2m x 7.62m (Large) Capital Ships | NSN F219-3940-99-742-7291 |

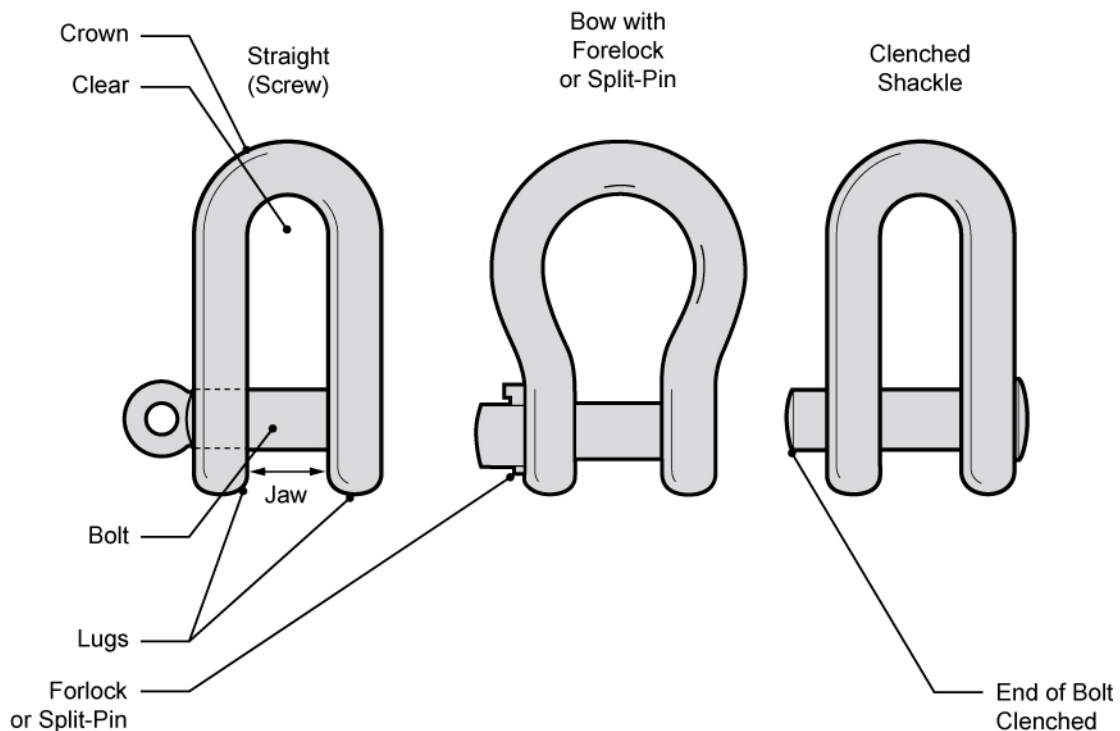
c. Further detailed instruction on rigging Brow safety nets are at [Para 03070](#)

03030. Rigging Shackles

a. Rigging Shackles are coupling links used for joining ropes, webbing and chain together or to some fitting, and are usually forged from carbon magnesium steel. This section deals only with shackles used with rigging; shackles, which form part of anchor and cable, or towing arrangements, are dealt with in the relevant Chapter. Details of rigging shackles available through naval stores are given in [Table 3-19](#) to Table 3-24. U-shaped shackles are called **straight** or **D shackles**, and those which have curved sides, are called **Bow shackles**. A bow shackle is weaker than a straight shackle, but is the more convenient to use with hooks or sling chains because a large hook may be used with such a shackle having a relatively short pin; bow rather than straight shackles are also used in conjunction with boats' webbing slings because the relatively greater width in the clear at the crown of the shackle prevents pinching of the webbing at the bearing point. The size quoted for a straight or bow shackle used with rigging is the diameter of the metal at the crown. The safe working load for each size and type of shackle is therefore included in the details given in [Table 3-19](#) to Table 3-24.

b. **Parts of a Shackle**([Fig 3-137](#)). The ends of a shackle are called the **lugs**, the space between them is called the **jaw**, and the part opposite the jaw is called the **crown**. The inside width or length of a shackle is called the clear; thus a shackle may be described as being 'long in the clear' or 'wide in the clear'; the jaw is closed by a removable **bolt** which passes through a hole in each lug. Rigging shackles are usually named by reference to the manner in which its bolt is secured in place.

Fig 3-137. Parts of a Shackle



c. **Types of Shackle.**

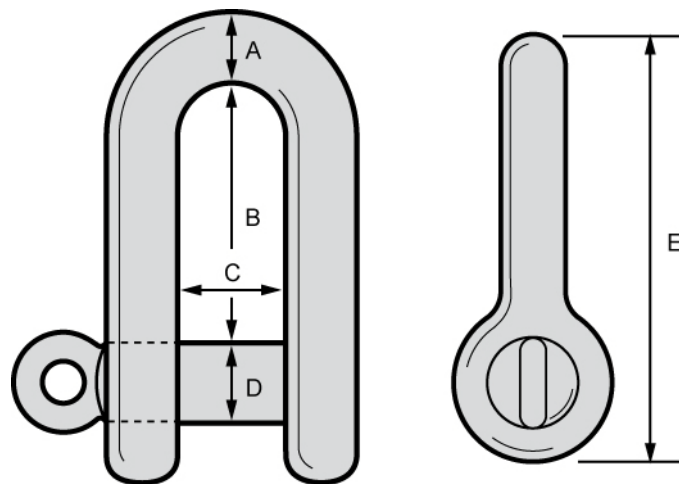
(1) *Screw Shackle.* May be a bow or straight shackle. The end of the bolt is screwed into one of the lugs, and the bolt is fitted with a flange at its head. This type of bolt should be moused.

(2) *Forelock Shackle.* May be a bow or straight shackle. The end of the bolt projects beyond one of the lugs, and a flat tapered split-pin (forelock) is passed through a slot in the end of the bolt. For most applications the forelock shackle has been superseded by a split-pinned shackle (see below), but the forelock method of securing the bolt is still used on moorings. The forelock may be attached to the shackle by a keep chain.

(3) *Split-pinned Shackle.* May be a bow or straight shackle. This type of shackle is of similar design to the forelock shackle, but is supplied with a galvanised split pin to serve the same purpose as a forelock. The split-pin is attached to the shackle by a keep chain.

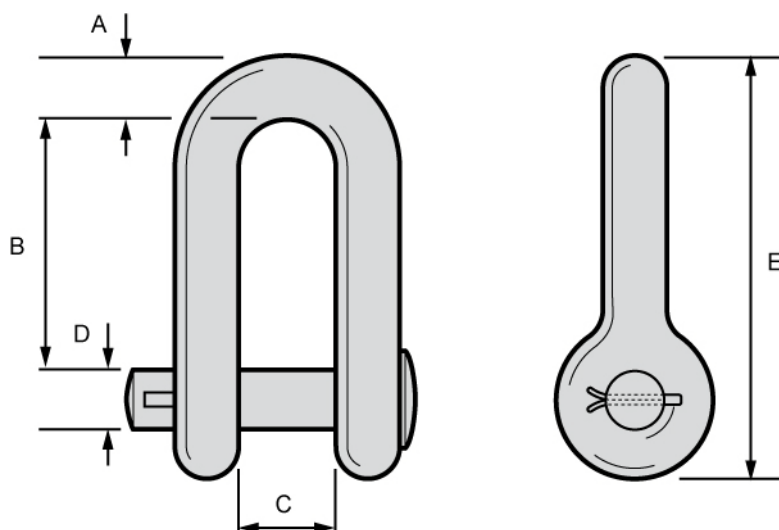
(4) *Pin and Pellet Shackle.* A tapered hole is drilled through one of the lugs and the end of the bolt. The bolt is secured in place by a similarly tapered pin being driven into this hole and held in place by a lead pellet hammered into the mouth of the hole over the head of the pin. This very secure method of locking the shackle bolt is a common arrangement on shackles that are part of anchor and cable outfits, but is also used on the shackle that attaches the hook to a picking-up rope. Details of these shackles are given with the details of the hooks used for picking-up ropes Para 02012 [sub para f](#).

Table 3-19. Rigging Shackles - Straight Shackle with Forelock



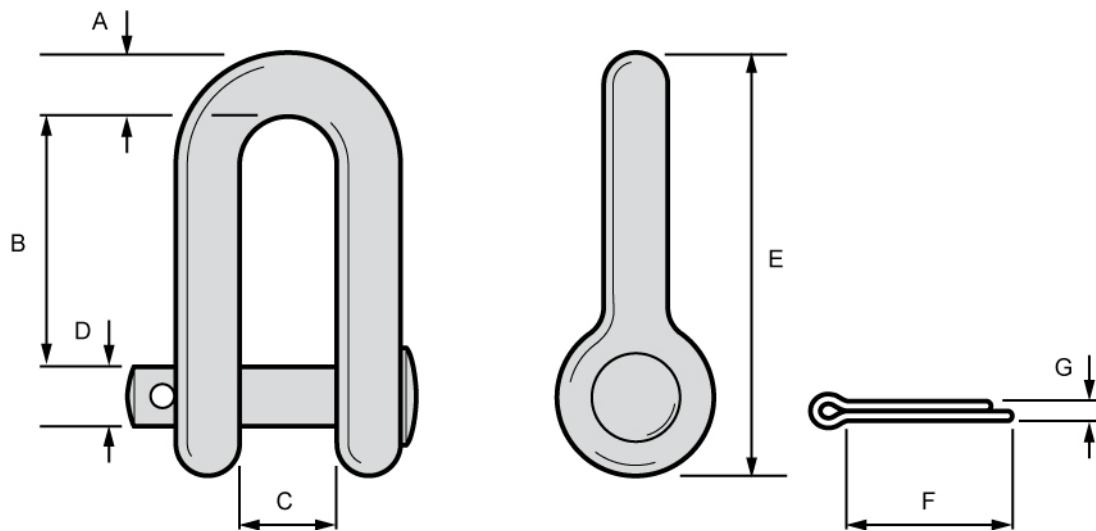
Naval Stores No.	Nominal Size	Dimensions				SWL
	A	B	C	D	E	
	mm	mm	mm	mm	mm	tonnes
0263/721-6087	6	24	10	10	45	0.3
0263/721-6088	10	35	16	13	64	0.6
0263/721-6089	13	46	21	16	83	1.05
0263/721-6090	16	57	25	19	102	1.8
0263/721-6091	19	68	31	25	125	2.55
0263/721-6092	22	81	36	29	146	3.55
0263/721-6093	25	92	41	32	165	4.6
0263/733-1299	29	103	46	35	184	5.6
0263/721-6094	32	114	51	38	203	7.1
0263/721-6095	35	125	56	44	226	8.15
0263/721-6096	38	138	61	48	248	10.9
0263/721-6097	41	149	67	51	266	13.2
0263/721-6098	44	160	71	54	285	15.0
0263/721-6099	48	171	76	57	305	17.0
0263/721-6100	51	183	82	64	330	19.5

Table 3-20. Rigging Shackles - Straight Shackle with Forelock



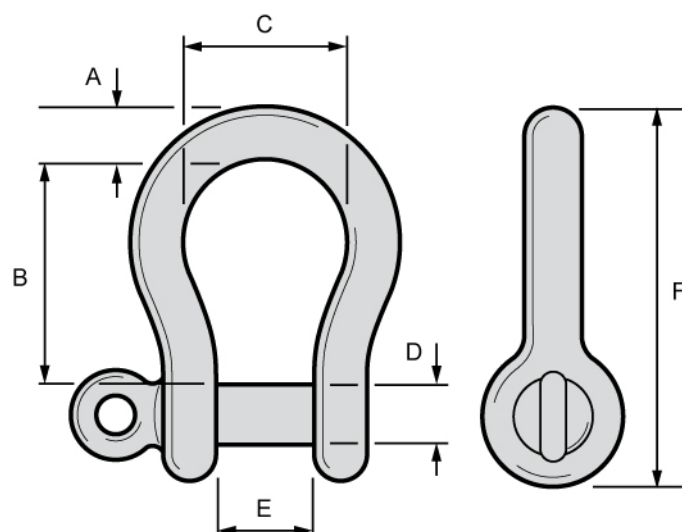
Naval Stores No.	Nominal Size	Dimensions				SWL
	A	B	C	D	E	
	mm	mm	mm	mm	mm	tonnes
0263-543-4298	13	46	21	16	83	1.05
0263-543-4299	19	68	31	25	125	2.55
0263-543-4300	25	92	41	32	165	4.6
0263-543-4301	32	114	51	38	203	7.1
0263-543-4302	38	138	61	48	248	10.9
0263-543-4303	44	160	71	54	285	15.0
0263-543-4304	50	183	82	64	329	19.5

Table 3-21. Rigging Shackles - Straight Shackle with Split Pin



Naval Stores No	Nominal Size	Dimensions						SWL
	A	B	C	D	E	F	G	
	mm	mm	mm	mm	mm	mm	mm	tonnes
0263-543-4528	6	24	10	10	45	15	2.5	0.3
0263-543-4529	10	35	16	13	64	20	4.0	0.6
0263-543-4530	13	46	21	16	83	25	4.0	1.05
0263-543-4531	16	57	25	19	102	30	4.0	1.8
0263-543-4532	19	68	31	25	125	40	5.0	2.55
0263-543-4533	22	81	36	29	146	45	5.0	3.55
0263-543-4534	25	92	41	32	165	50	5.0	4.6
0263-543-4535	29	103	46	35	184	55	6.3	5.6
0263-543-4536	32	114	51	38	203	60	6.3	7.1
0263-543-4537	35	125	56	44	226	70	6.3	8.15
0263-543-4538	38	138	61	48	248	75	8.0	10.9
0263-543-4539	41	149	67	51	266	80	8.0	13.2
0263-543-4540	44	160	71	54	285	85	13.0	15.0
0263-543-4541	48	171	76	57	305	90	13.0	17.0
0263-543-4542	51	183	82	64	330	100	13.0	19.5
0263-543-4543	54	216	87	67	349	105	13.0	20.5
0263-543-4544	57	228	92	70	372	110	13.0	23.0
0263-543-4545	60	241	97	73	395	115	13.0	25.5

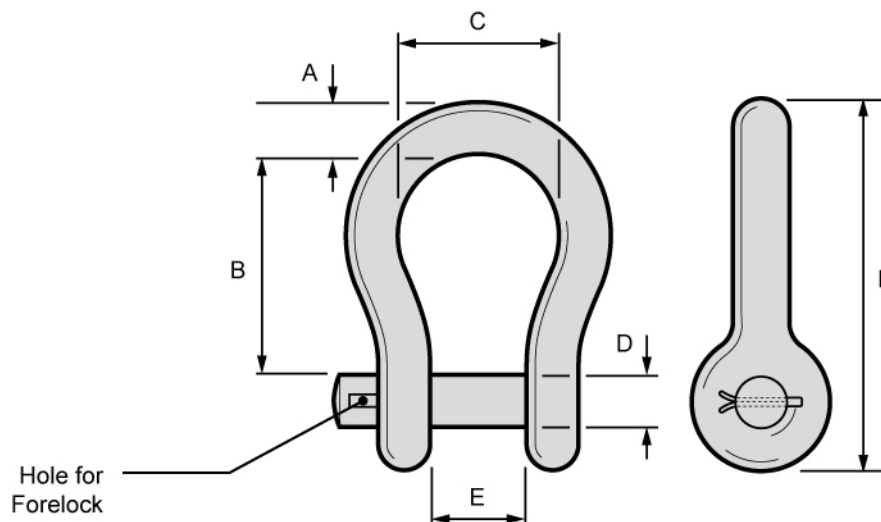
Table 3-22. Rigging Shackles - Bow Shackle with Screw Bolt



Naval Stores No.	Nominal size	Dimensions					SWL
	A	B	C	D	E	F	
	mm	mm	mm	mm	mm	mm	tonnes
0263/721-6101	6	25	19	10	13	46	0.15
0263/721-6102	10	38	29	13	17	67	0.45
0263/721-6103	13	51	38	16	24	88	0.75
0263/721-6104	16	64	48	19	29	109	1.25
0263/721-6105	19	76	57	25	35	133	2.05
0263/721-6106	22	89	67	29	41	154	2.80
0263/721-6107	25	102	76	32	46	175	3.80
0263/721-6108	29	114	86	35	52	195	4.85
0263/721-6109	32	127	95	38	57	216	5.85
0263/721-6110	35	140	105	44	64	241	7.35
0263/721-6111	38	152	114	48	70	262	8.65
0263/721-6112	41	165	124	51	75	282	9.65
0263/721-6113	44	178	133	54	81	303	11.7
0263/721-6114	48	191	143	57	86	326	13.2
0263/721-6115	51	203	152	64	92	350	15.25

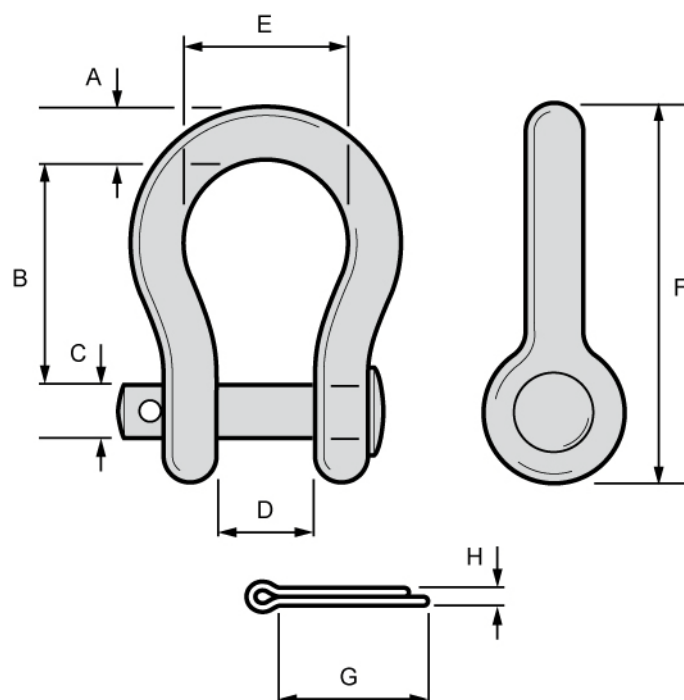
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RIGGING AND DECK GEAR

Table 3-23. Rigging Shackles - Bow Shackle with Forelock



Naval Stores No.	Nominal Size	Dimensions					SWL
	A	B	C	D	E	F	
	mm	mm	mm	mm	mm	mm	tonnes
0263-543-4291	13	51	38	16	24	88	0.75
0263-543-4292	19	75	57	25	35	132	2.05
0263-543-4293	25	102	76	32	46	175	3.80
0263-543-4294	32	127	95	38	57	216	5.85
0263-543-4295	38	152	114	48	70	262	8.65
0263-543-4296	44	178	133	54	81	303	11.70
0263-543-4297	51	203	152	64	92	349	15.25

Table 3-24. Rigging Shackles - Bow Shackle with Split Pin



Naval Stores No.	Nominal Size	Dimensions							SWL
	A	B	C	D	E	F	G	H	
	mm	mm	mm	mm	mm	mm	mm	mm	tonnes
0263-543-4546	6	25	10	13	19	46	15	2.5	0.15
0263-543-4547	10	38	13	17	29	67	20	4.0	0.45
0263-543-4548	13	51	16	24	38	88	25	4.0	0.75
0263-543-4549	16	64	19	29	48	109	30	4.0	1.25
0263-543-4550	19	76	25	35	57	133	40	5.0	2.05
0263-543-4551	22	89	29	41	67	154	45	5.0	2.8
0263-543-4552	25	102	32	46	76	175	50	5.0	3.8
0263-543-4553	29	114	35	52	86	195	55	6.3	4.85
0263-543-4554	32	127	38	57	95	216	60	6.3	5.85
0263-543-4555	35	140	44	64	105	241	70	6.3	7.35
0263-543-4556	38	152	48	70	114	262	75	8.0	8.65
0263-543-4557	41	165	51	75	124	282	80	8.0	9.65
0263-543-4558	44	178	54	81	133	303	85	13.0	11.7
0263-543-4559	48	191	57	86	143	325	90	13.0	13.2
0263-543-4560	51	203	64	92	152	350	100	13.0	15.25
0263-543-4561	64	254	76	114	191	432	115	13.0	22.85

03031. Roller Blocks

a. Roller blocks are very wide in the clear, and used for diverting the lead of a rope or line in situations where a conventional leading block is inappropriate. For example where two wires have been shackled together and the shackle is required to pass through the block. The three types of roller block commonly used in the Royal Navy are described below:

b. **Astern Fuelling Roller Block** ([Fig 3-138](#)). This roller block, NSN 0263/770-9716, is used during astern refuelling to provide the hose-line with a fair lead to the capstan. It has a Safe Working Load of 6.1 tonnes.

Fig 3-138. Astern Fuelling Roller Block



c. **Roller Block with Pivotal Cheek Plates** ([Fig 3-139](#)). This roller block, NSN W200/525-6391, is used with the easing-out recovery rope during ship-to-ship towing evolutions. The cheeks of the block can pivot around the centre sheave pin, enabling the block to be attached to the bight of a rope before the two cheeks are shackled together. It has a Safe Working Load of 1.5 tonnes.

Fig 3-139. Roller Shackle with Pivotal Cheek Plates



d. **Awning Roller Blocks** (Fig 3-140 and Fig 3-141). As their name implies, these roller blocks are used in the rigging of awnings. There are two types, the **short link roller block**, NSN 0263/766-7781, and the **long link roller block**, NSN 0263/767-2435. Ship's drawings specify the type to be used for particular applications.

Fig 3-140. Short Link Roller Block (Awnings)

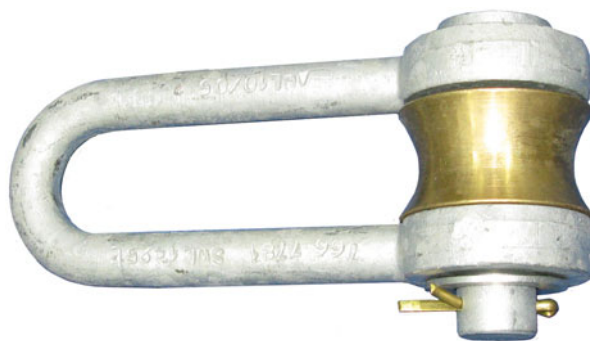
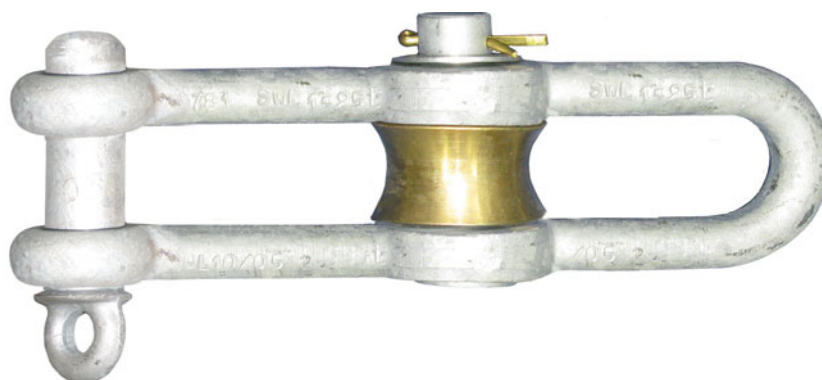


Fig 3-141. Long Link Roller Block (Awnings)



03032. Swivel Ring Shackles (Fig 3-142)

These shackles, also known as a swivel eye and jaw, are used predominantly on boat anti-shock stops. There are four sizes available, detail as shown in Table 3-25.

Table 3-25. Details of Swivel Ring Shackles

Naval Stores No.	Dimensions			SWL
	A	B	C	
	mm	mm	mm	tonnes
0263/414-9939	22.5	48	41.5	1.52
0263/414-9938	25	57.5	45	2.54
0263/414-9940	29	67.5	51	3.55
0263/414-9941	35	83.5	57.5	5.08

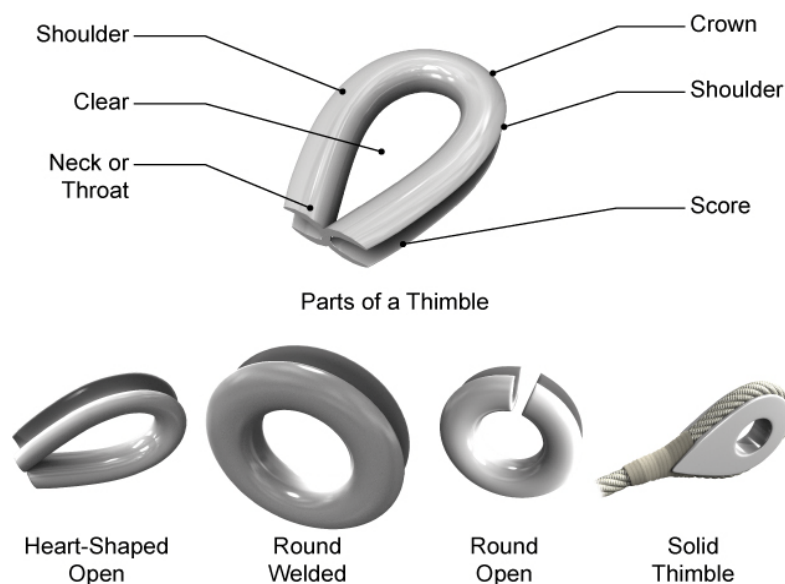
Fig 3-142. Swivel Ring Shackle



03033. Thimbles

a. Thimbles ([Fig 3-143](#)) are classified according to the diameter of the rope for which they are intended and also their shapes; most thimbles are manufactured from galvanised mild steel, although for certain applications stainless steel, phosphor bronze or polyamide thimbles are used. The latter three types are not available through Naval Stores and can only be obtained through local purchase. When an eye splice is formed at one end of a fibre or wire rope a thimble is inserted to take the chafe of a shackle or shackle bolt and also to support the eye formed in the rope. The support given by the thimble prevents a bad nip in the rope when under tension. Large thimbles are made from material of special section and bent to shape; small thimbles are cast in one piece. Thimbles are either round or heart-shaped and open or welded. The gap formed at the throat can be sprung open to allow the eye of a tackle hook or lug of a shackle to enter. Heart-shaped thimbles are preferable for thimble or hawser eyes, in both wire and fibre ropes, because the rope can be spliced close to the throat of the thimble. Details of thimbles available through naval store are given in [Table 3-26](#), [Table 3-27](#) and [Table 3-28](#).

Fig 3-143. Thimbles



b. **Types of Thimble.**

- (1) *Round Welded Thimbles.* These are used for the corners of awnings.
- (2) *Round Open Thimbles.* These are used when it is necessary to insert something in them; for example, the wire grommet at the end of a light jackstay, or the eye at the tail of a block.
- (3) *Heart-Shaped Open Thimbles.* These are the most commonly used thimble for forming a hard eye or hawser eye in the end of a rope or wire.
- (4) *Solid Thimbles.* These are fitted to the end of certain crane and davit whips. The thimbles are designed to accept a bolt or pin and are sufficiently robust not to collapse under stress. They are normally supplied commercially. They are not available through naval stores.

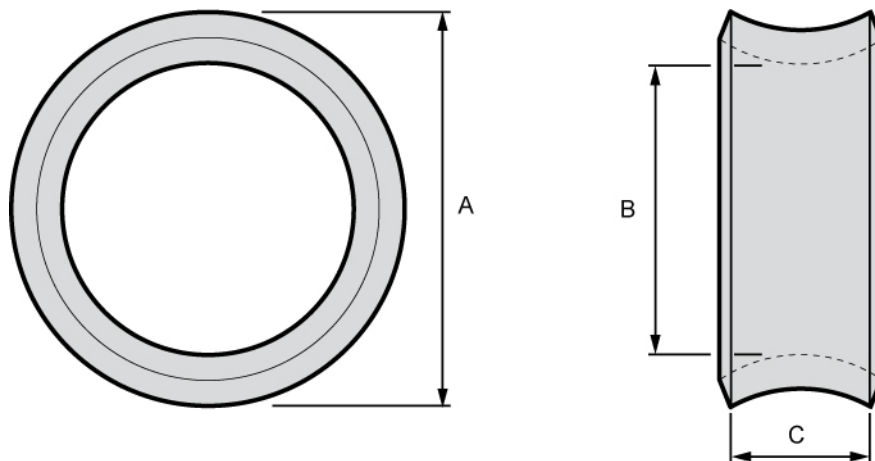
c. **Selecting the Correct Size Thimble.** The size of rope which a thimble will take depends on both the width and depth of the score, but for practical purposes the sizes are as follows:

Wire rope	$d = w$
Served wire rope	$d = 0.83w$
Fibre rope	$d = 0.91w$

Where d is the diameter of the rope in millimetres, and w is the width of the score in millimetres.

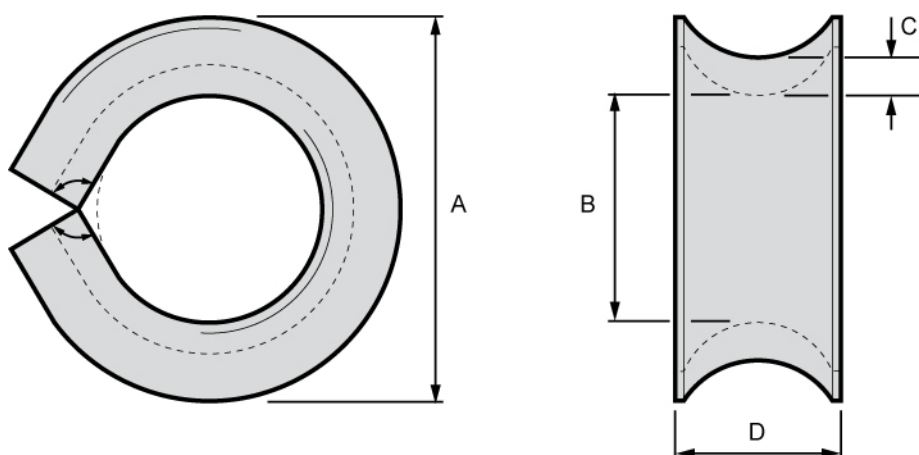
d. **Strength of a Thimble.** Thimbles have no specific strength, but a mild steel thimble should not be distorted by a pull of $d^2/128$ tonnes, where d is the diameter of the wire in millimetres for which the thimble is designed, and it will usually crush at about $d^2/85$ tonnes.

Table 3-26. Details of Round Welded Thimbles



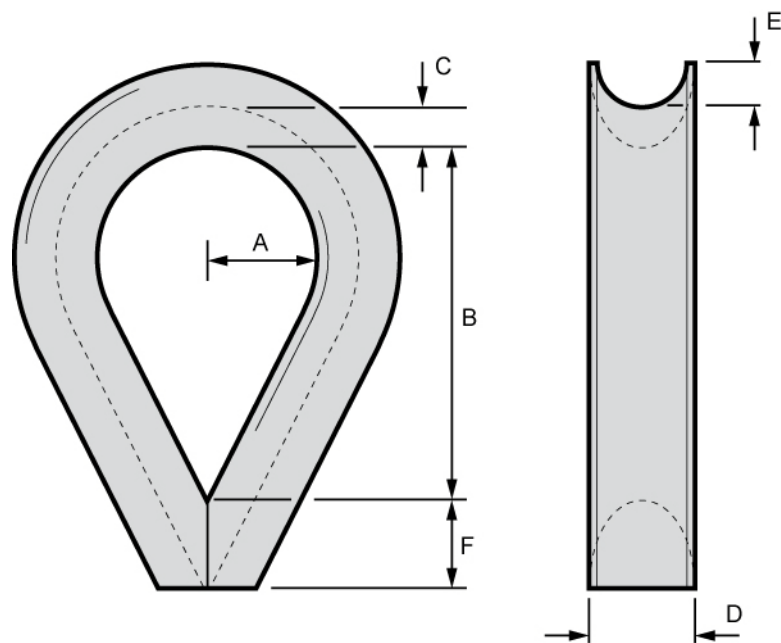
Naval Stores No.	A	B	C
	mm	mm	mm
0263/421-8799	35	20	13
0263/421-8800	45	25	16
0263/421-8801	50	30	19
0263/421-8802	65	45	22
0263/421-8803	75	50	25
0263/421-8804	75	50	29
0263/421-8805	90	64	32

Table 3-27. Details of Round Open Thimbles



Naval Stores No.	A	B	C	D
	mm	mm	mm	mm
0263/421-8807	30	15	3	12
0263/421-8808	45	25	5	16
0263/421-8809	50	30	5	19
0263/421-8810	60	35	6.5	26
0263/421-8974	100	57	10	39

Table 3-28. Details of Heart-shaped Open Thimbles



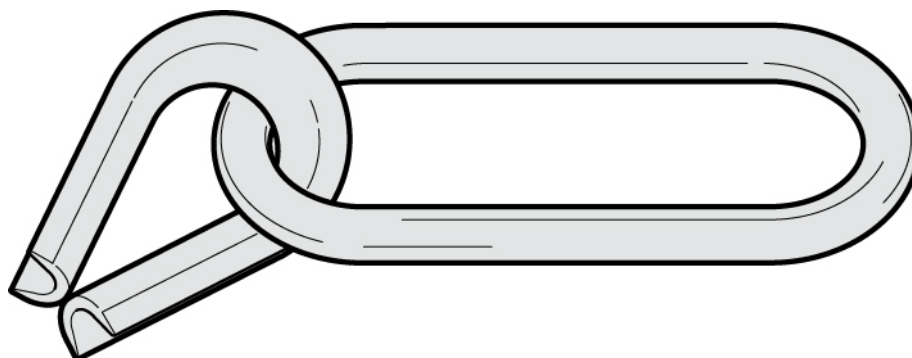
Naval stores No.	A	B	C	D	E	F
	mm	mm	mm	mm	mm	mm
0263/414-9630	8	25	4	8	3	6
0263/923-6988	11	40	4	10	4	8
0263/923-6987	13	50	5	11	5	10
0263/414-9633	17	60	5	14	6	12
0263/414-2980	20	70	6	16	7	14
0263/414-9635	22	80	8	18	8	16
0263/332-5187	27	95	8	23	10	20
0263/414-9637	32	110	10	27	12	24
0263/414-9638	37	130	11	31	14	28
0263/414-9639	40	140	13	35	16	32
0263/414-9640	45	155	20	42	18	36
0263/414-9641	50	180	20	42	20	40
0263/414-9642	55	195	25	55	22	44
0263/414-9643	60	205	25	55	24	48
0263/414-9644	65	225	27	57	36.5	52
0263/414-9645	80	280	29	60	38	54

03034. Thimble and Link Assembly for Towing Hawsers

To simplify connection to cable or towing slips, and to meet NATO requirements, polyamide towing hawsers and towing pendants are fitted at both ends with a Special Link and Thimble assembly. There are three sizes available; details are given in [Table 3-29](#).

Note. Survey of the Special Link and Thimble assembly should be recorded on the ship's S194.

Table 3-29. Details of Link and Thimble Assemblies for Towing Hawsers

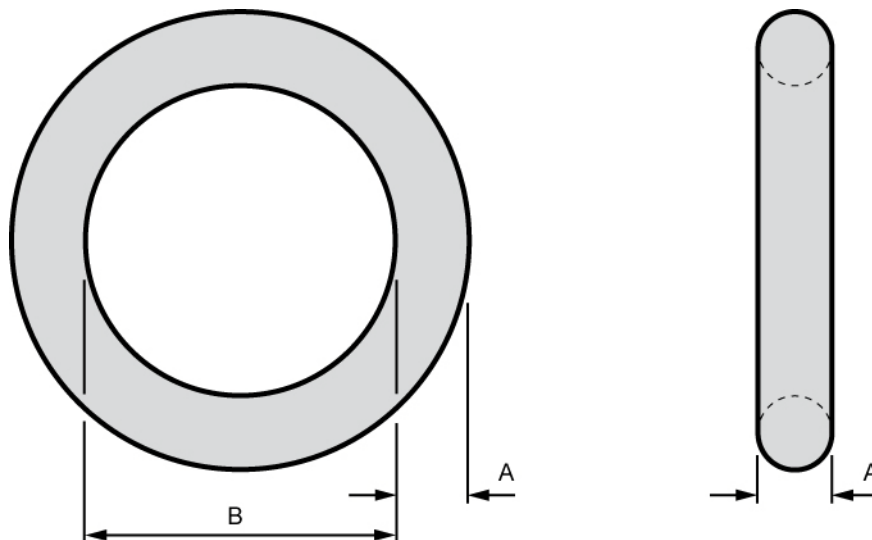


Naval Stores No.	Size of Towing Hawser
0263/529-0651	40mm and 48mm
0263/529-0649	64mm
0263/529-0648	72mm and 80mm

03035. Common Rings

Common rings are forged from carbon magnesium steel, and the size quoted for a ring is the diameter of the metal. It is intended that in the future all common rings will be marked with their safe working load; however it is likely that a number of rings not marked in such a manner will remain in service for many years to come, therefore the Safe Working Load for each size of common ring is included in the details given in [Table 3-30](#).

Table 3-30. Details of Common Rings

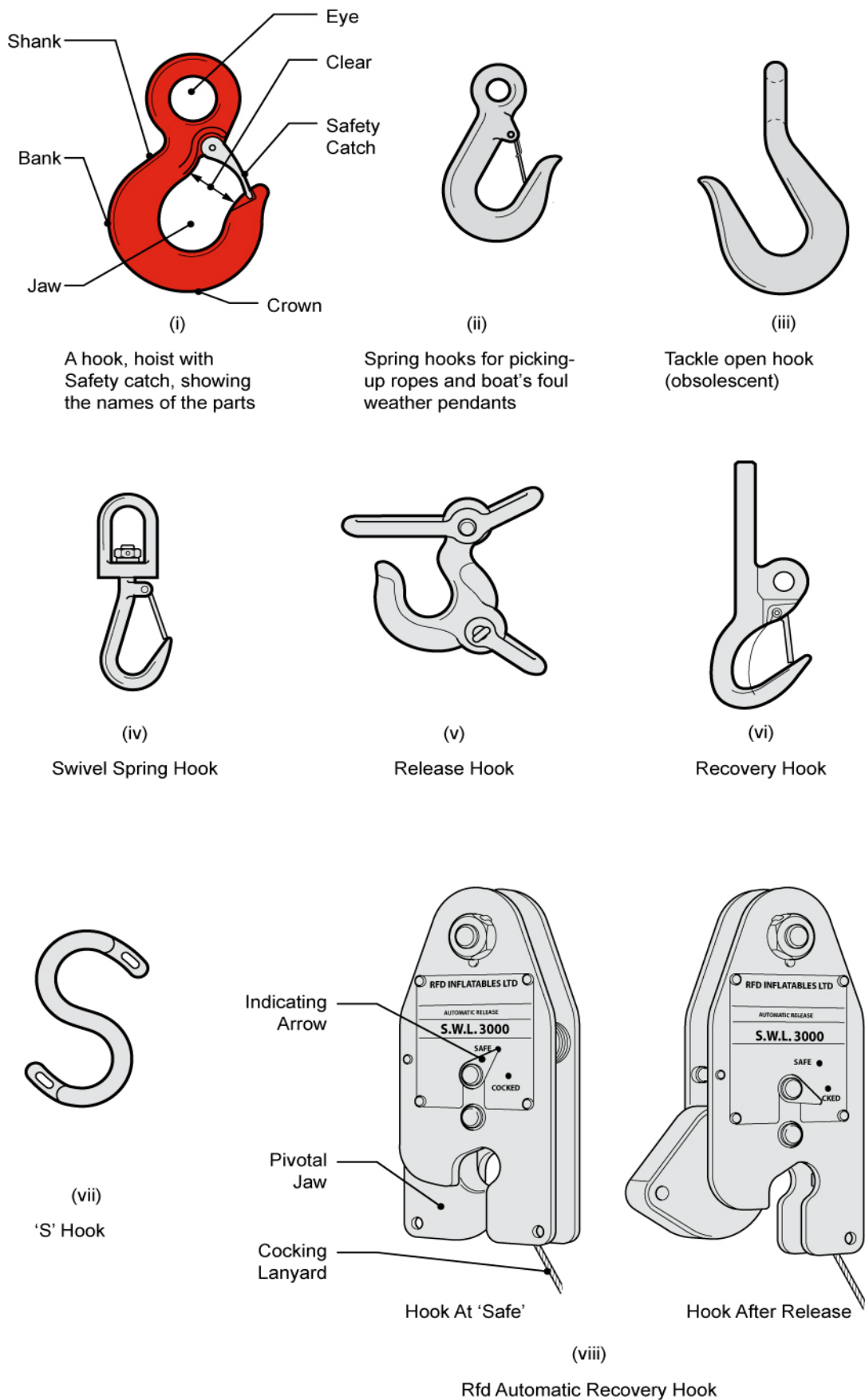


Naval Stores No.	A	B	SWL
	mm	mm	tonnes
0263/549-1952	76	260	23
0263/549-1953	70	241	19
0263/549-1954	64	222	15.75
0263/549-1955	57	228	12.7
0263/549-1956	50	178	10.15
0263/549-1957	44	165	7.6
0263/549-1958	41	165	6.6
0263/549-1959	38	152	5.6
0263/549-1960	35	140	4.85
0263/549-1961	32	127	3.9
0263/549-1962	29	114	3.05
0263/549-1963	25	102	2.55
0263/549-1964	22	89	2.05
0263/549-1965	19	76	1.55
0263/549-1966	10	57	0.25

03036. Hooks

a. There are various types of hooks used in the Royal Navy. They are usually made of carbon manganese steel, and are generally much weaker than shackles of similar size. All hooks used for lifting purpose in the Royal Navy must be fitted with a safety catch (spring-mousing). Open (tackle) hooks may still be encountered in certain roles, for example on awning tackles, but it is likely that all such hooks will eventually be replaced with a spring-moused equivalent. Open hooks must always be moused. It is intended that eventually all hooks in service will bear evidence of their safe working load. Details of hooks in regular use are given on the following page and in [Table 3-31](#) and [Table 3-32](#).

Fig 3-144. Hooks Used in the Royal Navy

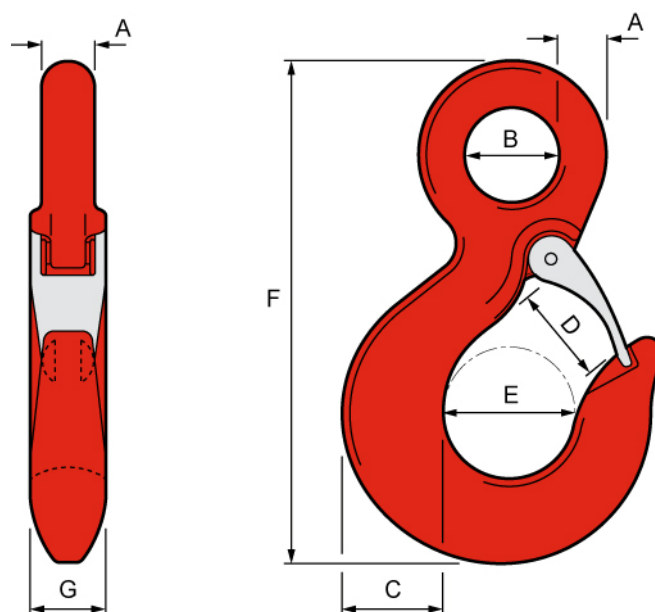


- (1) *Hook, Hoist, with Safety Catch* (Fig 3-144(i) and Table 3-31). This type of hook is the most commonly used in the Royal Navy; it has a safety catch in the form of a spring-operated tongue, which dispenses with the requirement for a mousing. The hook is designed for use in conjunction with an appropriate size shackle, although in certain applications it is acceptable to spring a thimble through the eye and splice the cordage or wire round the thimble. Cordage must not be spliced direct to the eye.
- (2) *Spring Hook for Picking-up Ropes and Boat's Foul Weather Pendants*. (Fig 3-144(ii)). This hook also has a safety catch to prevent accidental unhooking. It is used in conjunction with a pin and pellet shackle and has machined surfaces either side of the shackle bolthole to facilitate a snug fit between shackle and hook. Details of the hook and corresponding shackle are shown in Table 3-32.
- (3) *Tackle hook*. (Fig 3-144(iii)). As explained earlier, this hook, which is incorporated into the eye of metal and wooden tackle blocks, is gradually being replaced by the hook, hoist, with safety catch, which can be shackled to a synthetic resin bonded fibre block. The tackle hook is no longer available from naval stores.
- (4) *Swivel Spring Hook*. (Fig 3-144(iv)). These hooks, NSN 0263/414--9753, are fitted with a swivel, which prevents any twists in the whip being transmitted to the hook. They are specified for certain minesweeping and storing tasks. The hook has a Safe Working Load of 0.625 tonnes.
- (5) *Release Hook*. (Fig 3-144(v)) This hook, NSN 0263/414-9746, is designed for slipping a load in mid-air. An eye is forged at the back of the hook to which a tripping line is secured; this line is turned up when the load is to be released; by continuing to lower the load the hook is up-ended and the load released.
- (6) *Recovery Hook*. (Fig 3-144(vi)). This hook, NSN 0232/414-9748, is used in conjunction with an aluminium stave, Patt No 0573/529-6304, to attach the whip of a crane or derrick to an object in the water. The end of the crane whip is shackled to the eye of the hook, then the squared shank of the hook is inserted into the recess in the end of the stave, and held in place by maintaining light tension in the whip. The stave is then used to place the hook onto the object to be recovered. Once the hook is attached the tension is relaxed on the whip and the stave is pulled clear. The hook has a safe working load of 0.65 tonnes.
- (7) *'S' Hook or Awning Hook*. (Fig 3-144(vii)). This hook is used in certain awning configurations. The hook is available in two sizes, NSN 0263/414-9627 for frigates and destroyers, and 0263/414-9628 for larger ships. The hook has no specific safe working load.

(8) *RFD Automatic Release Hook Mk 5.* (Fig 3-144(viii)) This hook NSN F218/513-8208 is designed originally for the Merchant fleet to provide a method of automatically releasing davit-launched liferafts when they became waterborne; it has a safe working load of three tonnes and is used extensively in the Royal Navy for deploying RIB and Inflatable seaboats. The RFD hook is not to be used for lifting operations other than the launch and recovery of boats. If the boat davit is to be used for other lifting operations, the RFD hook must be removed and an appropriate end attachment fitted to the hard eye of the davit whip. Fitting and operating procedures for the hook are described in Chapter 5 [Para 05074](#).

(9) *Screw-gate Karabiner.* This hook is used during astern fuelling to attach the float assembly to the hose-line. It is illustrated in [Fig 7-46](#).

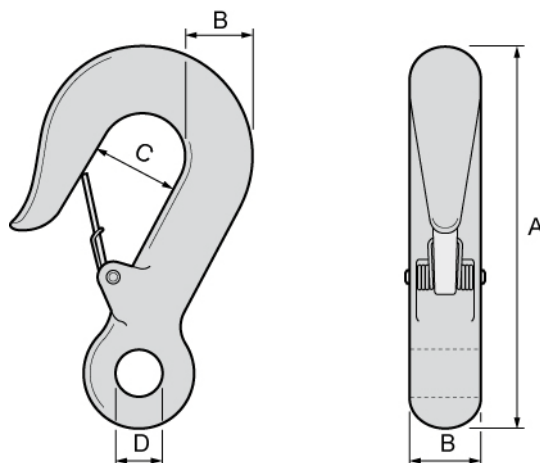
Table 3-31. Details of, Hook, Hoist, with Safety Catch



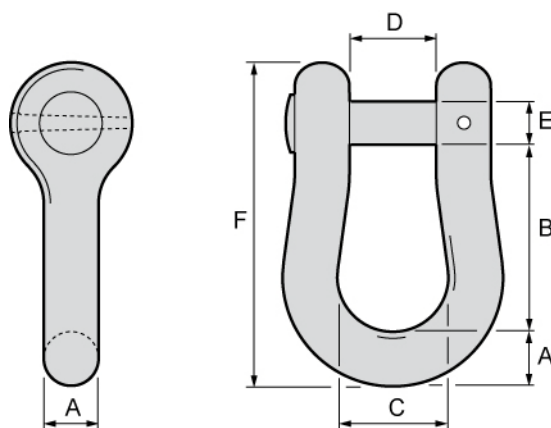
Naval Stores No.	A	B	C	D	E	F	G	SWL
	mm	mm	mm	mm	mm	mm	mm	tonnes
0263/539-3519	9.0	19	21	26	30	110.0	14.0	0.75
0263/539-3520	11.0	23	24	29	35	126.0	16.0	1.0
0263/539-3521	11.5	29	30	29	37	140.5	19.0	1.5
0263/539-3522	14.5	32	33	33	40	163.0	21.5	2.0
0263/539-3523	17.5	40	41	40	49	200.0	29.0	3.0
0263/539-3524	23.02	51	52	49	64	256.0	35.0	5.0
0263/539-3525	8.5	62	67	60	70	316.0	41.0	7.5

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Table 3-32. Details of Spring Hooks and Shackles for Picking-up Ropes and Boat's Foul Weather Pendants



Naval Stores No of Hook	For Use with SWR:		SWR	Dimensions			
	Diameter	Naval Stores No.		A	B	C	D
	mm		tonnes	mm			
0263/414-9774	20	0235/523-8649	3.03	303	38	44	27
0263/414-9773	28	0235/523-8640	6.09	241	44	60	33
0263/414-9775	32	0235/523-8641	7.62	286	51	64	46



Naval Stores No of Pin and Pellet Shackle	For Use with SWR:		SWR	Dimensions					
	Diameter	Naval Stores No.		A	B	C	D	E	F
	mm		tonnes	mm					
0263/2024	20	0235/523-8649	3.03	25	89	54	35	25	155
0263/414-9606	28	0235/523-8640	6.09	32	108	64	46	32	193
0263/414-9608	32	0235/523-8641	7.62	38	127	76	64	44	233

03037. Rigging Screws (Also Known as Turn-buckles or Bottlescrews)

- a. Rigging screws ([Fig 3-145](#)) are used to **set-up**, ie adjust rigging equipment for length or tension. There are two types;
- (1) A screw fitting into an internally threaded sleeve, with a swivel eye at the head of the screw and a standing eye on the sleeve.
 - (2) A similar assembly. but with the standing eye incorporating a slip.
- b. Details of both types are given in [Table 3-33](#) and [Table 3-34](#).

Fig 3-145. Rigging Screws



Table 3-33. Details of Rigging Screws Without Slips

Naval Stores No.	Suitable for SWR	SWL
0263/413-5784	40mm	14.62 tonnes
0263/413-5785	36-32mm	9.93 tonnes
0263/413-5786	28mm	6.12 tonnes
0263/414-9745	20mm	3.25 tonnes
0263/413-5787	16mm	1.81 tonnes
0263/413-5788	14-12-10-8-6mm	1.25 tonnes

Table 3-34. Details of Rigging Screws With Slips

Naval Stores No.	Suitable for SWR	SWL
0263/413-5781	36-32mm	9.93 tonnes
0263/413-5782	28mm	6.12 tonnes
0263/414-9743	20mm	3.25 tonnes
0263/413-5783	16mm	1.81 tonnes
0263/414-9744	14-12-10-8-6mm	1.25 tonnes

03038. Guardrail Turnbuckle Assemblies

Turnbuckle assemblies are designed for tightening and slipping guardrails. The turnbuckle is available with a slip (Fig 3-146(ii)), and without a slip (Fig 3-146(iii)). The Naval Stores Numbers for the stainless steel turnbuckles are given in Table 3-35.

Fig 3-146. Guardrail Turnbuckle Assemblies

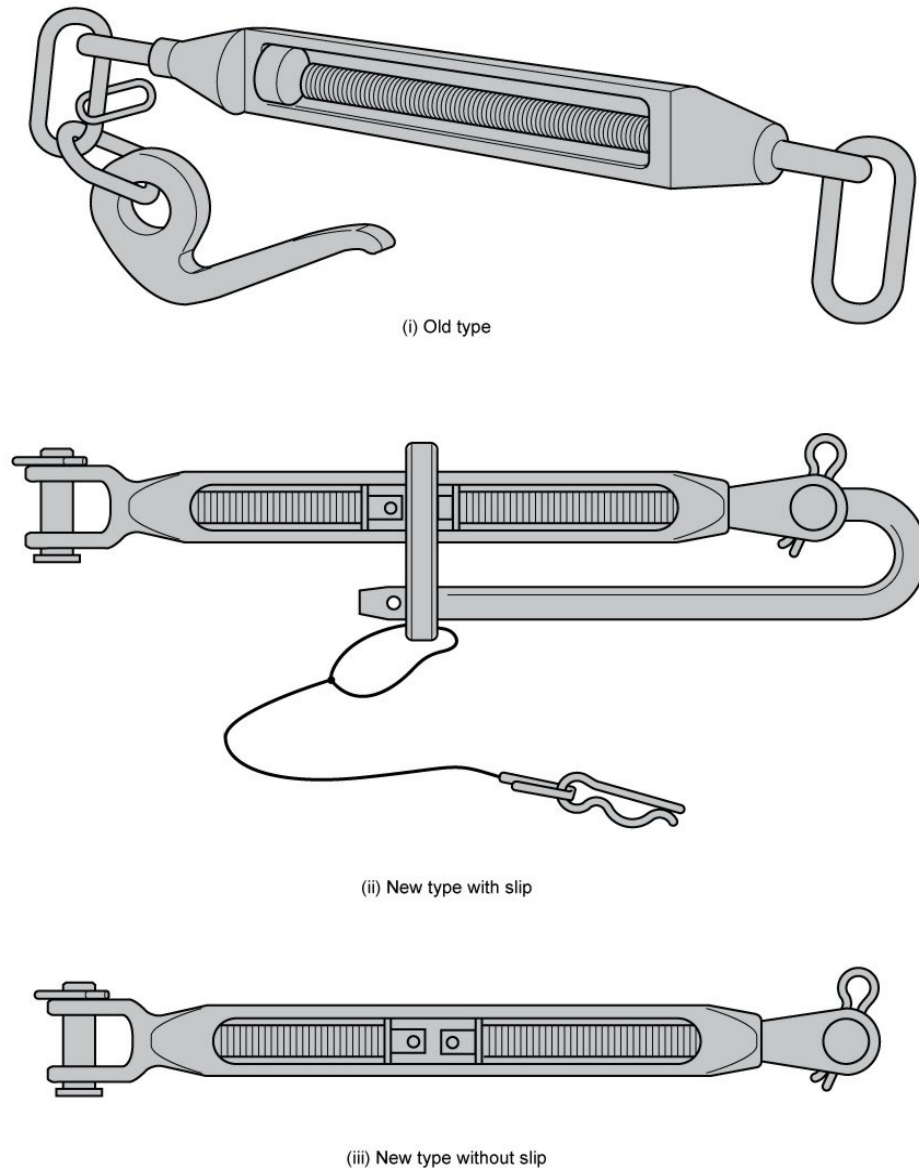


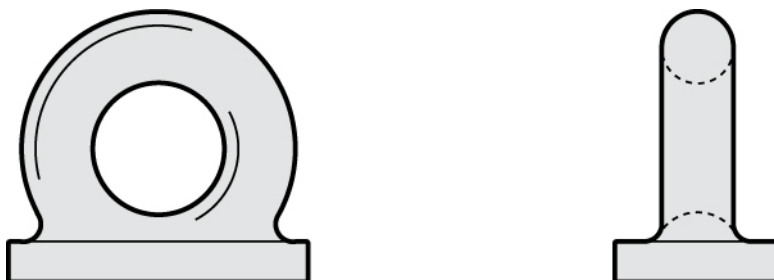
Table 3-35. Details of Stainless Steel Guardrail Turnbuckle Assemblies

Description	Naval Stores No.	SWL
Turnbuckle assembly with slip	0263/539-6386	0.75 tonnes
Turnbuckle assembly without slip	0263/539-6387	0.75 tonnes

03039. Eyeplates and Eyebolts

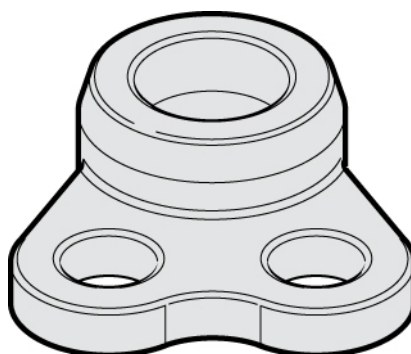
Steel eyeplates ([Fig 3-147](#)) are used for securing an eye to a structure. In steel ships they are usually welded permanently in position, but in certain instances they may be bolted in place when required for a specific task, then removed on completion. Eyeplates in GRP ships may be bolted to a backing plate, or screwed to a plate set in the gel, or glued in position with a special adhesive. It must never be assumed that the strength of an eyeplate is necessarily determined by its size, because the strength of the structure to which it is attached is equally important. For this reason there is a requirement that a tally plate giving details of the testing and safe working load of eyeplates must be fastened to the adjacent structure. Details of eyeplate sizes and their safe working loads are given in ship's 'As Fitted' drawings. Eyebolts are often employed for lifting heavy concentrated loads such as machinery. They are fully described in BR 3027.

Fig 3-147. Eyeplate

**03040. Union Plates ([Fig 3-148](#))**

These are triangular or square metal plates with a hole drilled at each corner. They are used as links for shackling the ends of three or four ropes or lengths of chain together; the triangular plates are usually known as **monkey faces** or **shamrock plates**.

Fig 3-148. Union Plate or Monkey Face

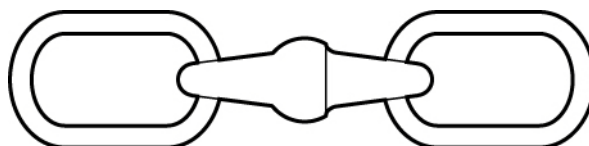


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03041. Swivels

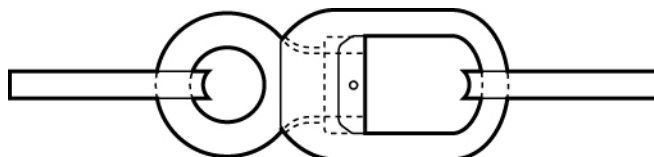
A swivel is a connection allowing revolution between component parts, usually wires or ropes, either when slack or under strain. There are two types of swivel; the general-purpose swivel, (Table 3-36), used for target towing operations, and the swivel assembly incorporating thimbles in the end links (Table 3-37) used with dressing lines.

Table 3-36. Details of General Purpose Swivels



Size of Swivel	Naval Stores No.	SWL	Dimensions			
			A	B	C	D
<i>mm</i>		<i>tonnes</i>	<i>mm</i>			
10	0573/422-9985	0.89	11	19	54	190
13	0573/422-9974	1.52	14	25	76	258
19	0263/422-9924	3.05	19	29	89	364

Table 3-37. Details of Swivels for Dressing Lines



Size of Swivel	Naval Stores No.	SWL
		<i>tonnes</i>
For use with 8mm SWR	0263/414-9624	1.01
For use with 12mm SWR	0263/414-9625	1.01

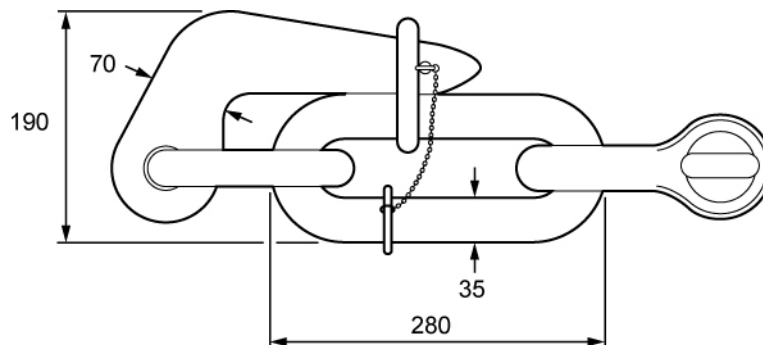
03042. Rigging Slips

a. A Rigging Slip is a quick-release link used for joining the end of a rope or chain to a fitting when the end may have to be cast off frequently or rapidly; all such slips are properly called senhouse slips, with the tongue of the slip passing through an end link in the rope or chain. There are three types of rigging slip used in the Royal Navy and they are described below, they differ little in design, and although certain slips are specified for certain evolutions, the main criterion for their use is that the safe working load of the slip must not be exceeded.

b. Types of Rigging Slip.

(1) *Slip and Shackle for General Use.* (Fig 3-149). This slip, NSN 0263/414-9835, is always used with a straight screw shackle Pattern No 0263/721-6096. The slip has a Safe Working Load of nine tonnes and is predominantly used for replenishment at sea (RAS) heavy jackstay and RAS jackstay refuelling.

Fig 3-149. Slip and Shackle for General Use



All measurements are in millimetres

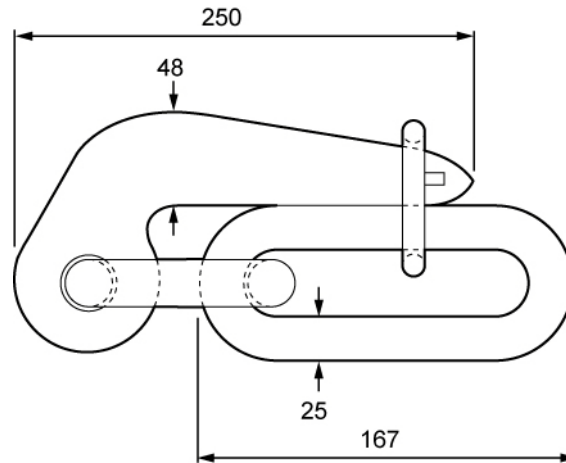
Note. To ensure the slip operates correctly, the clearance between the pin hole and the buckler link (end link) when the slip is rigged must not exceed 15mm. If this distance can be exceeded the slip must be removed from service.

(2) *Slip for Replenishment Rigs.* (Fig 3-150). This slip, NSN 0263/414-9747 with shackle 0263/721-6093 (for MM's F905/867-8379 with shackle F219/132-6804), is primarily used in replenishment operations, where it is used to secure the light jackstay, and during certain refuelling operations, the sliprope and hose-hanging pendant.

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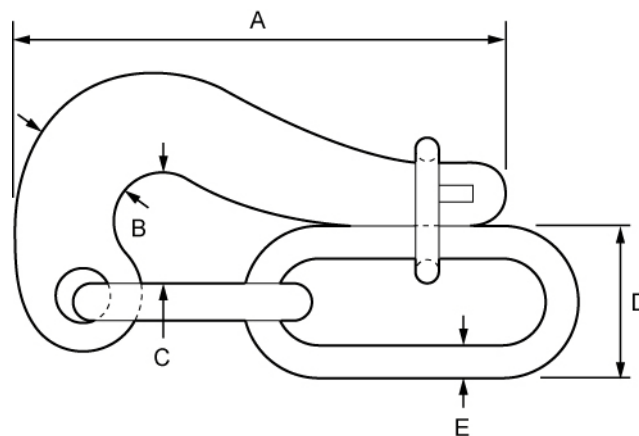
Note. To ensure the slip operates correctly the clearance between the pin hole and the buckler link (end link) when the slip is rigged must not exceed 15mm. If this distance can be exceeded the slip must be removed from service.

Fig 3-150. Slip for Replenishment Rigs



(3) *Slip for Rigging.* (Table 3-38). This type of slip, available in four sizes, is now not used often but still has certain specific applications, for example in minesweeping operations.

Table 3-38. Details of Slip for Rigging



Naval Stores No.	A mm	B mm	C mm	D mm	E mm	SWL tonnes
0263/414-9831	145	30	32	45	10	0.825
	190	40	43	60	15	1.525
	230	45	50	70	20	2.350
	295	50	52	75	20	3.430

03043. Blocks

a. A block is a pulley, made of metal, metal and synthetic-resin bonded fibre (SRBF) or, in some cases, wood and metal. Only SRBF and metal blocks are used in the Royal Navy, and Naval Stores Numbers for those in common use are given in [Table 3-39](#) and [Table 3-40](#).

b. **Parts of a Block** ([Fig 3-151\(i\)](#)). The main parts of a block are called the **shell** or body; the **sheave** or wheel over which the rope runs; the **pin** on which the sheave turns; the **bush** or bearing between the sheave and the pin; and the **head fitting**, usually an eye, by which the block is secured in the required position. The top of the block is called the **crown**; the bottom of the block is the **tail**; the sides of the shell are called the **cheeks**, the opening between the sheave and shell through which the rope passes is the **swallow**; and the eye sometimes fitted at the tail is called the **becket**. Blocks may have more than one sheave: a single block has one sheave, a double has two, a triple block has three, and so on. A **snatch block** is a single block, metal or SRBF, in which part of the shell is hinged to form a 'gate' which allows a bight of rope to be inserted into the swallow from one side. Snatch blocks should not be used when a solid block is suitable for the job. They should never be used when the safety of life depends on them, because the gate may open if a sideways pull is exerted. [Fig 3-151\(ii\)](#) and [Fig 3-151\(iii\)](#) show an SRBF snatch block with the gate open and closed (see [Note](#)).

c. **Classification and Description of Blocks.** Blocks are classified and described by their type (SRBF or metal); the number of sheaves; the head fitting (the means of attachment, usually a swivel eye); the size and type of rope for which they are designed and the safe working load (SWL) of the block. The SWL, stock number, maker's name and year of manufacture is usually marked on the block by stamping on the metal **binding**, but see also [sub para e](#).

d. **Types of Block.**

(1) *Synthetic Resin-bonded Fibre (SRBF) Block.* This block is built up of steel bindings, and its means of attachment and sheave pins are of steel; the cheek plates and sheave(s) are made of synthetic-resin bonded fibre. SRBF blocks are for use with man-made fibre and natural fibre ropes, and can be single, double or triple blocks or snatch blocks with safe working loads of one, two or four tonnes. They are designed to accept a maximum size of cordage and must not be used for wire rope. Details of those SRBF blocks in common use are given in [Table 3-39](#).

Fig 3-151. Parts of a Block

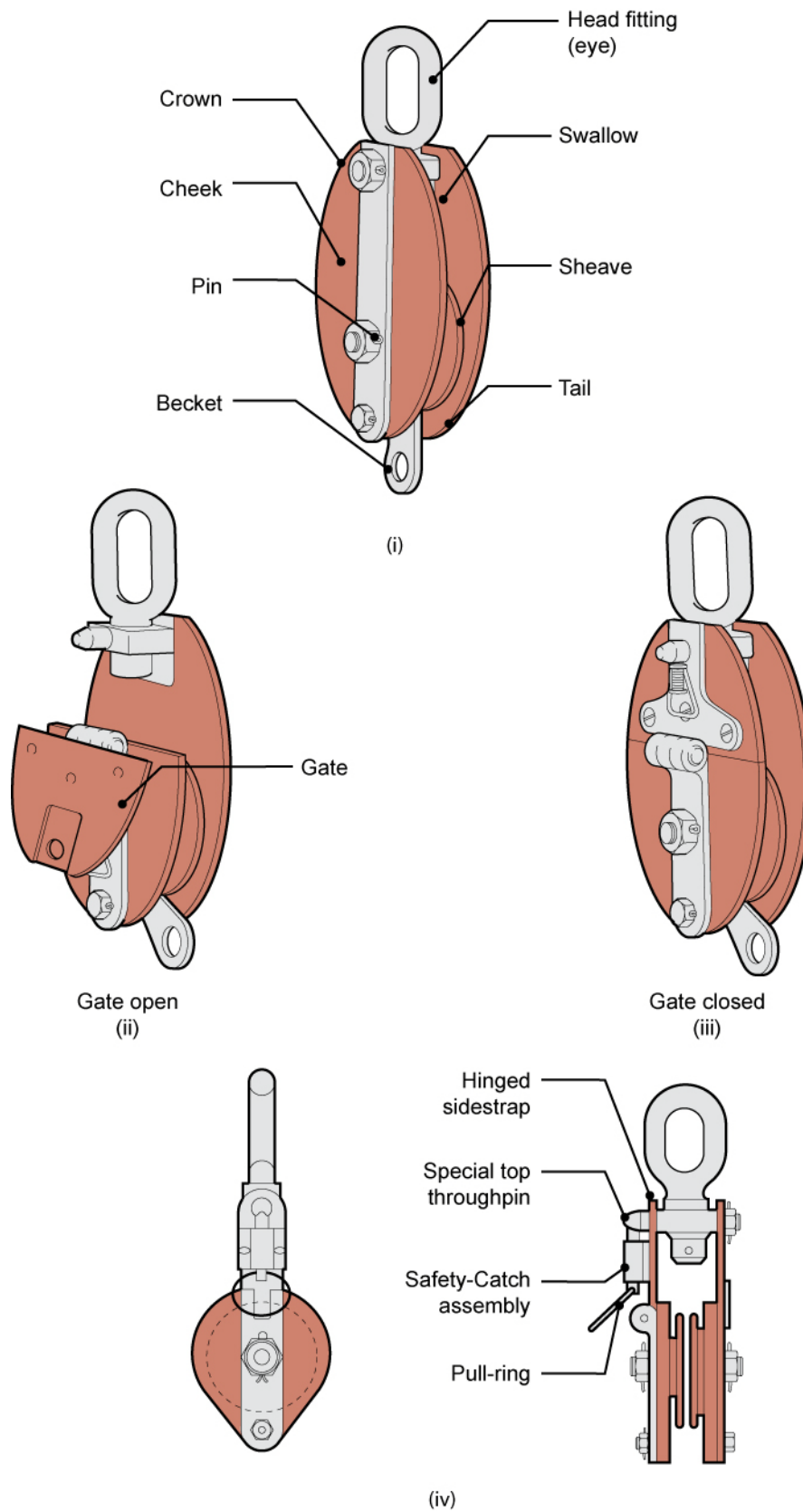
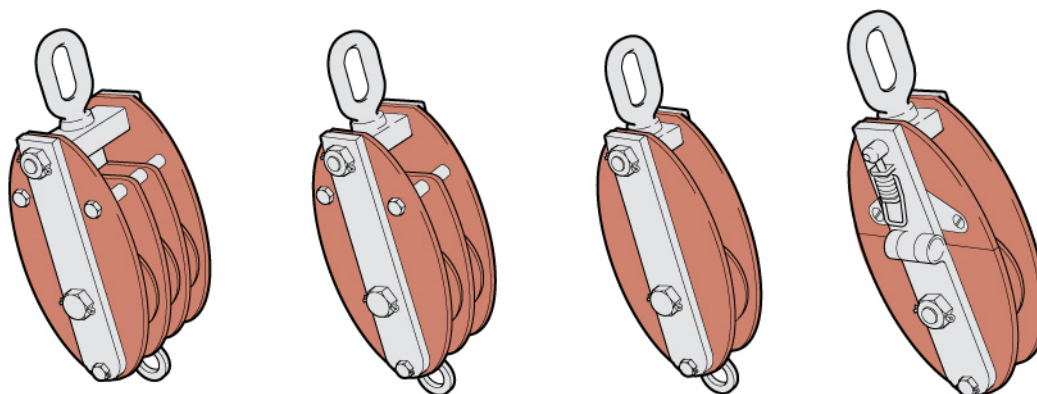


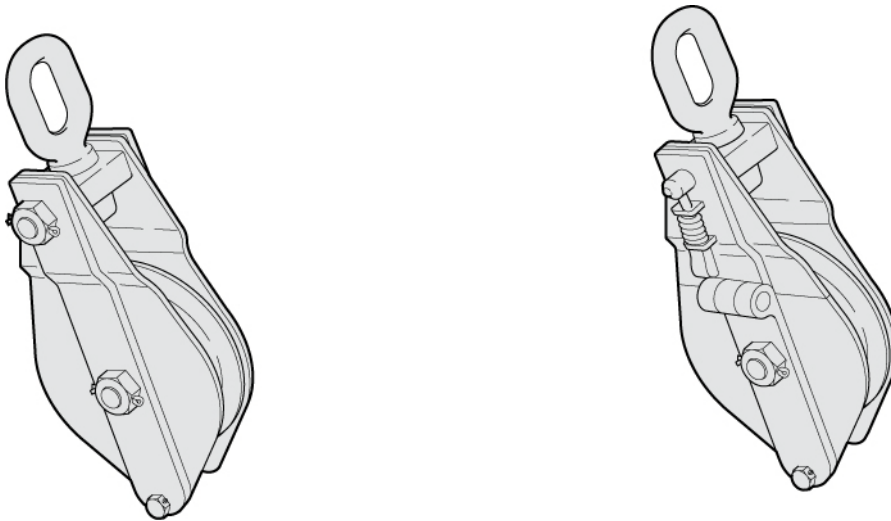
Table 3-39. Details of Synthetic Resin Bonded Fibre Blocks in Common Use



Description of Block	Naval Stores No.	Maximum Size of Rope	SWL
	0246/521-	mm	
Treble with swivel oval eye and becket	2725	20	See Annex 3A
	2726	20	See Annex 3A
	2727	36	See Annex 3A
Double with swivel oval eye and becket	2791	20	See Annex 3A
	2792	20	See Annex 3A
	2793	36	See Annex 3A
Single with swivel oval eye and becket	2797	20	See Annex 3A
	2798	20	See Annex 3A
	2799	36	See Annex 3A
Snatch with swivel oval eye	2794	20	See Annex 3A
	2795	20	See Annex 3A
	0246/190- 6915	36	See Annex 3A

(2) *Metal Blocks*. These blocks are usually made up from steel plates and fittings, their shells have a binding, which supplies the strength, but the cheeks, etc., are of light plating. However, some types of metal block have their shells cast in one piece. Certain special-purpose blocks are made entirely of gunmetal or phosphor bronze, which do not corrode as easily as steel when exposed to the weather and are unlikely to cause sparks when working. Details of metal blocks in common use are given in [Table 3-40](#).

Table 3-40. Details of Metal Blocks in Common Use

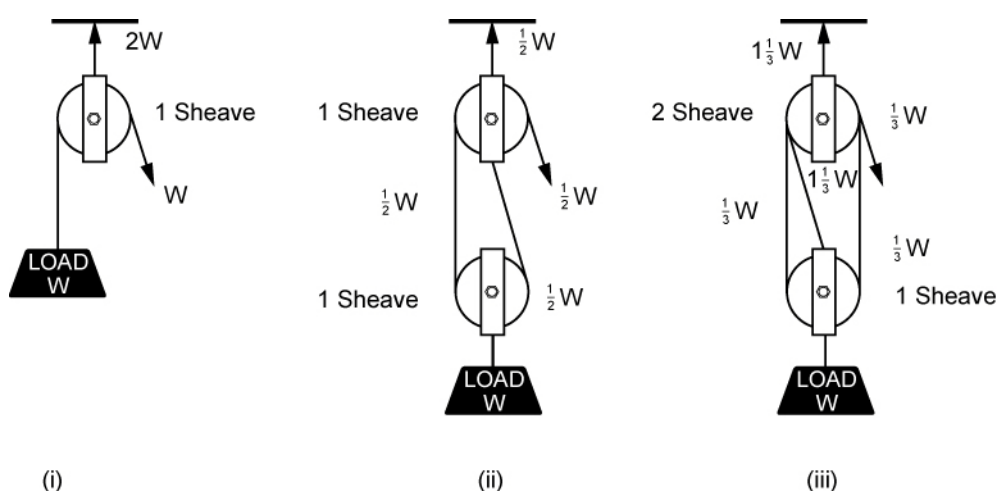


Description of Block	Naval Stores No.	Size of SWR Rope	SWL
	0246/521-	<i>mm</i>	
Single with swivel oval eye and becket	0660	12	See Annex 3A
	0661	16	See Annex 3A
	0662	20	See Annex 3A
Snatch with swivel oval eye	0663	12	See Annex 3A
	0664	16	See Annex 3A
	0665	20	See Annex 3A

e. **Safe Working Load of Blocks.** The safe working load (SWL) of a block is the maximum load that can be safely applied to the head fitting of the block, but the seaman must be aware that this loading depends on the way the block is used; for example, the loading on the head fitting of a block used as the standing or upper block of a purchase is not the same when it is used as the lower or moving block of the same purchase. This principle is illustrated in Fig 3-152. In Fig 3-152(i), ignoring friction, angle and weight of block, the head fitting of the single block is subjected to a load equal to twice the weight of the load being lifted. Therefore in such circumstances a single block with a SWL at the head fitting of at least two tonnes must be used to lift a one tonne load if rigged as shown in Fig 3-152(i). Similarly, a single sheave block with a SWL at the head fitting of 1.5 tonnes is adequate to lift a one tonne weight if rigged as the standing block in the configuration shown in Fig 3-152(ii). The Table at Annex 3A to this Chapter gives the SWL of the head fitting for all blocks in use in the Royal Navy and shows the maximum load that can be lifted with each block in its various tackle configurations (See also Para 03045).

Note. At present blocks are marked with a variety of data. Some bear only the proof load, others show the SWL at the head fitting. To avoid errors and confusion when using blocks the seaman should refer to the information given at Annex 3A. This information is accurate. (See also Para 03044).

Fig 3-152. Examples of Different Loading on a Block



03044. Marking and Identifying Portable Rigging Fittings

a. It is MOD (N) policy that, where possible, all portable items of rigging equipment (often referred to as loose gear), will be marked with the following information:

- (1) The safe working load of the equipment.
- (2) The date of test.
- (3) Test authority's unique mark (if different from manufacturer).
- (4) Markings and symbols which indicate the manufacturer of the equipment and means of identifying the equipment with the manufacturers certificate of test and examination.
- (5) The NATO stock number.

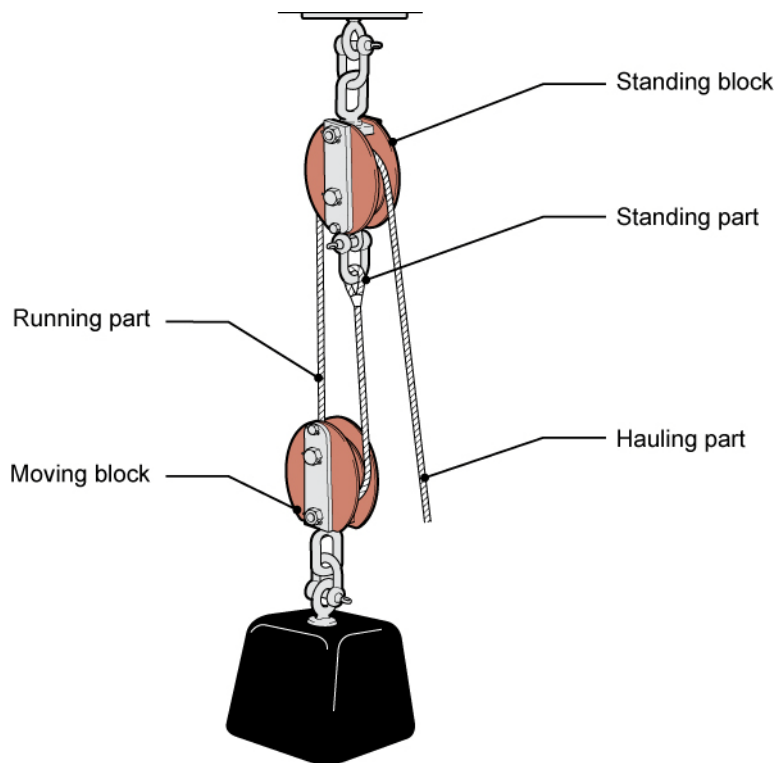
03045. Purchases and Tackles – Introduction

a. A purchase is a mechanical device by means of which an applied pull or force is increased; it may be a system of levers, a system of revolving drums or wheels geared to one another, or a combination of blocks or pulleys rove with rope or chain. A tackle (pronounced 'taycle') is a purchase consisting of a rope rove through two or more blocks in such a way that the force of any pull applied to its hauling part is increased by an amount depending upon the number of sheaves in the blocks and the manner in which the rope is rove through them.

b. **Parts of a Tackle** (Fig 3-153). The blocks of a tackle are termed the standing block and the moving block; the rope rove through them is called the fall, which has its standing, running and hauling parts. The size of a tackle is described by the size of its fall; a 24mm luff, for example, would be rove with a 24mm fall.

c. **Mechanical Advantage.** The amount by which the pull on the hauling part is multiplied by the tackle is called its Mechanical Advantage (MA) and, if friction is disregarded, this is equal to the number of parts of the fall at the moving block. In Fig 3-154 for example, there are two parts at the moving block, therefore the MA is two; in other words, a pull on the hauling part of 50kg, would, if friction were disregarded, hold a weight of 100kg. Friction has been taken into account when determining the SWL of a block. However, when calculating the effort (pull) required to lift a weight using a block or tackle the general approximate rule for estimating the amount of friction set up in a tackle is to allow one-tenth for every sheave in the tackle. Therefore if one tonne is to be lifted and there are six sheaves in the tackle, the total allowance for friction will amount to six-tenths of a tonne. The formula for this calculation is given on the following page in [sub para f](#).

Fig 3-153. Parts of a Tackle



d. **Velocity Ratio.** MA is gained only at the expense of the speed of working. In Fig 3-154, for example, the weight will be raised only half a metre for every metre of movement of the hauling part. The ratio between the distance moved by the hauling part and that moved by the moving block is known as the Velocity Ratio (VR) and is always equal to the number of parts of the fall at the **moving** block.

e. **Reeving a Tackle to Advantage and Disadvantage.** The number of parts at the moving block, and therefore the MA, is always greater when the hauling part comes away from the moving block, and such a tackle is said to be **rove to advantage**. Conversely, a tackle in which the hauling part comes away from the standing block is said to be **rove to disadvantage** (see Fig 3-155). Where practicable, it is beneficial to rig a tackle so that the hauling part leads from the moving block, and the block with the greater number of sheaves is the moving block.

f. **Calculating the Effort (Pull) Required to Lift a Weight with a Tackle.**

(1) To calculate the effort (pull) to lift a given load using a tackle the following formula should be used

$$P = \frac{W}{V} \left(1 + \frac{N}{10} \right)$$

P = Pull required (in Kgs)
 W = Weight to be lifted (in Kgs)
 V = Velocity Ratio
 N = Number of sheaves in tackle

(2) The average man can comfortably exert a pull of 25kgs. Therefore to determine the number of personnel required to man the hauling part of the tackle divide the answer to the equation above by 25.

Fig 3-154. Mechanical Advantage and Velocity Ratio of a Tackle

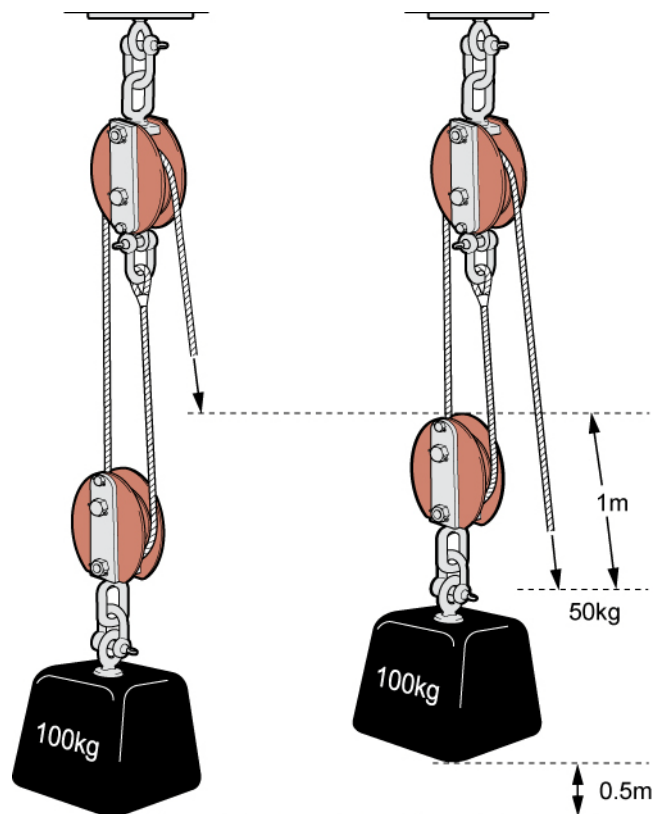


Fig 3-155. Reeving a Tackle to Advantage and Disadvantage

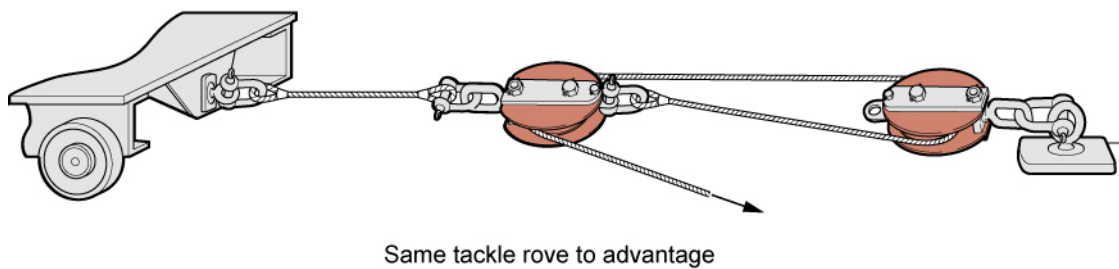
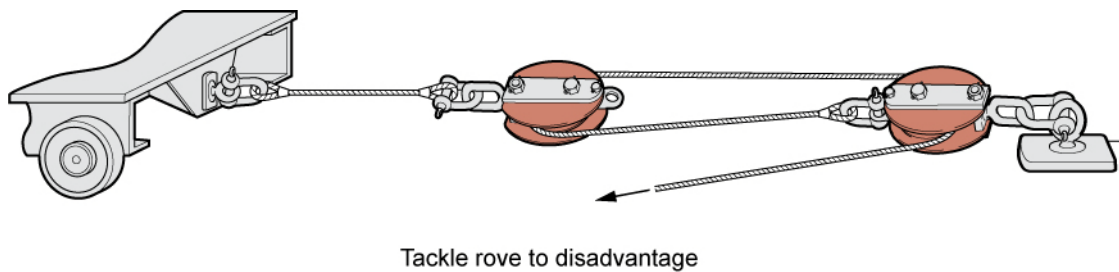
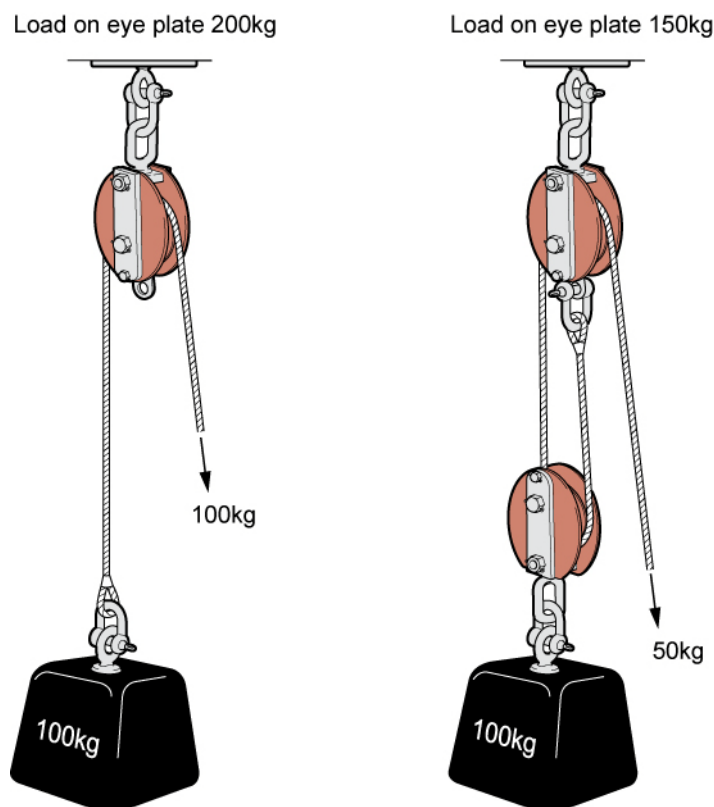


Fig 3-156. Load on the Standing Block



03046. Examples of Tackles and Purchases

a. Examples of whips, tackles and purchases, together with their velocity ratio (VR) and mechanical advantage (MA) are given below; in each the approximate loss of MA due to friction has been taken into account. Tackles should be rove as illustrated; this is particularly important for the three fold purchase to prevent turns forming in the tackle and avoid any tendency for the block to cant sideways as the load comes on it.

b. **Single Whip** (Fig 3-157). This consists of a fall rove through a single standing block; no MA is gained. It is used for hoisting light loads, and where speed of hoisting is an important factor.

c. **Runner** (Fig 3-158). This consists of a rope through a single moving block. As there are two parts of the fall in the moving block, the VR is 2 and the MA is 1.82.

d. **Double Whip** (Fig 3-159). This is a purchase used for hoisting and consists of two single blocks with the standing part of the fall made fast near, or to, the upper block, and it cannot be rove to advantage. The VR is 2 and the MA is 1.67.

e. **Gun Tackle** (Fig 3-160). This is the term usually applied to a purchase consisting of two single blocks, but which is not used for hoisting; it cannot then be called a double whip, a term applied only when it is used for hoisting. In the gun tackle the standing part of the fall is always made fast to one of the blocks. The name originates from the small tackle, which was used to run out the old muzzle-loading guns after they had recoiled. The VR is 3 if rove to advantage, or 2 if rove to disadvantage, and the MA is respectively 2.5 or 1.67.

Fig 3-157. Single Whip

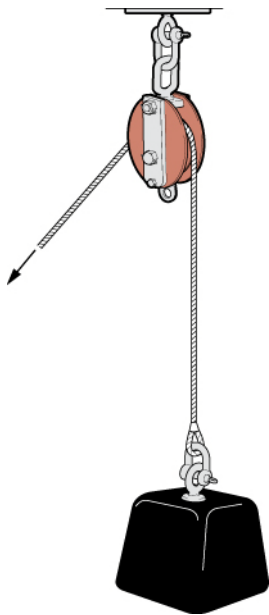


Fig 3-158. Runner

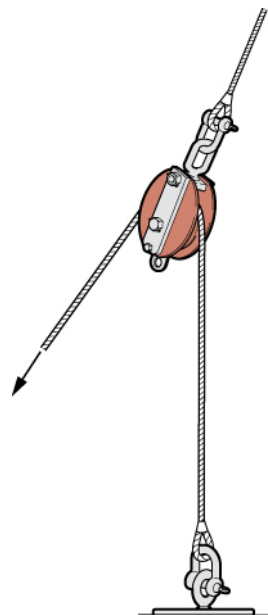


Fig 3-159. Double Whip

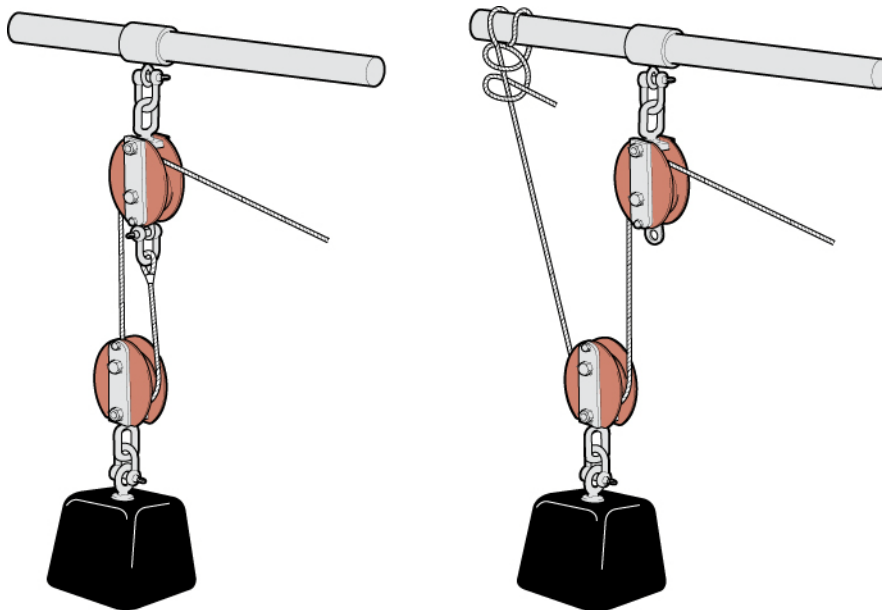
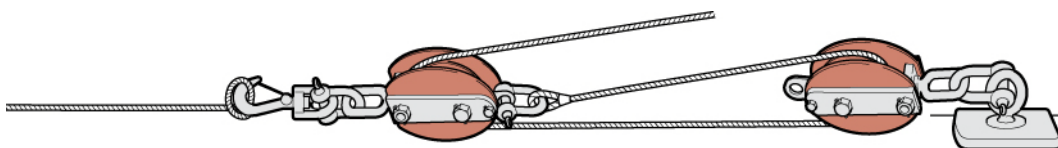


Fig 3-160. Gun Tackle



f. **Luff** (Fig 3-161). This is a purchase of size 24mm or greater. It consists of a double and a single block, with the standing part of the fall made fast to the single block. The VR is 4 if rove to advantage, or 3 if rove to disadvantage, and the MA is respectively 3.08 or 2.3.

g. **Jigger**. This is similar to a luff, but is from 16mm to 20mm in size.

h. **Handy Billy**. This is a small tackle of less than 16mm in size; it is usually rove as a jigger but can be rove as a small gun tackle.

i. **Two-fold Purchase** (Fig 3-162). This consists of two double blocks and is a useful general-purpose tackle. The VR is 5 if rove to advantage, or 4 if rove to disadvantage, and the MA is respectively 3.57 or 2.86.

j. **Three-fold Purchase** (Fig 3-163). This consists of two treble blocks; the VR is 7 if rove to advantage, or 6 if rove to disadvantage, and the MA is respectively 4.37 or 3.75. Tackles having more than three sheaves are not provided because they are too cumbersome to handle efficiently and because the friction in their sheaves reduces their gain in mechanical advantage. If additional mechanical advantage is required it is better to combine two simple tackles.

Fig 3-161. Luff

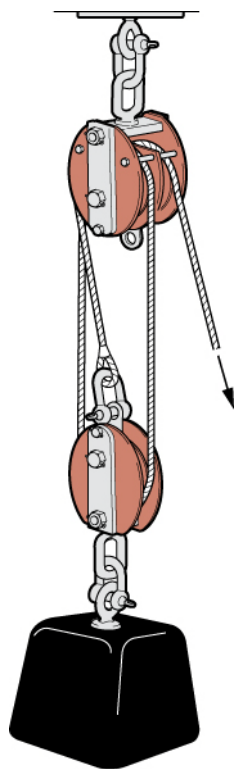


Fig 3-162. Two-fold Purchase

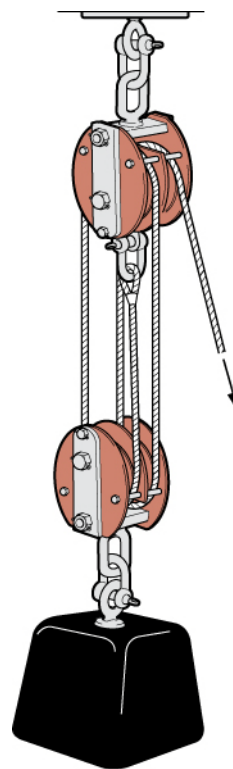
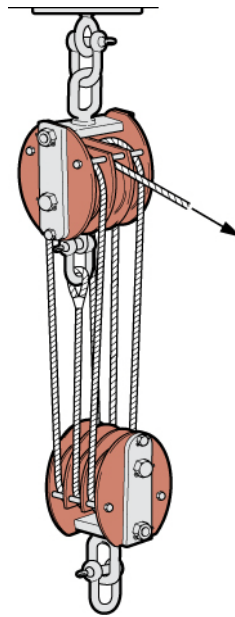
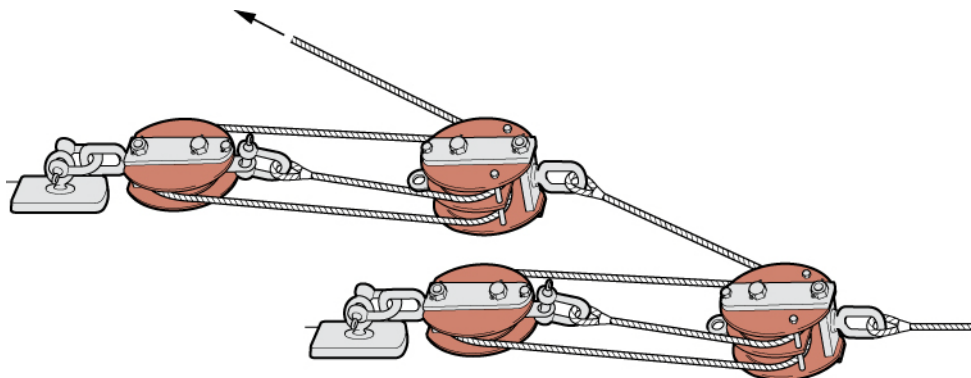


Fig 3-163. Three-fold Purchase



k. **Luff Upon Luff.** This is a general term used to describe the combined use of two tackles in which the moving block on one is **clapped on** (secured) to the hauling part of the other; its mechanical advantage is the product of the mechanical advantage of each tackle. Fig 3-164 shows two luffs rove to advantage and as a luff upon luff whose $VR = 4 \times 4 = 16$; its MA is 9.49.

Fig 3-164. Luff Upon Luff

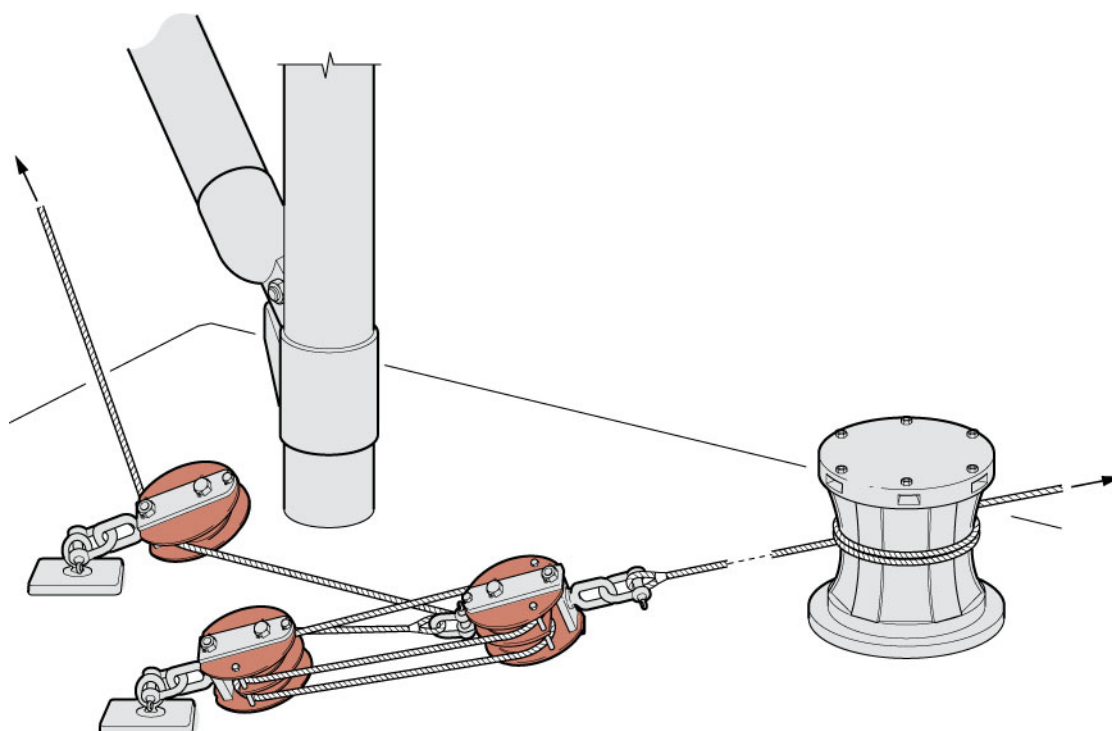


l. **Dutchman's Purchase.** This is a tackle used in reverse to take advantage of the velocity ratio of the tackle; an example of its use is to drive a light whip at fast speed from a slow but powerful capstan. In the example illustrated in Fig 3-165 the whip would move a distance of five metres for every metre travelled by the moving block. When using a tackle in this manner the pull exerted by the capstan must be equal to the product of the weight to be hoisted and the velocity ratio of the tackle, plus the friction in the tackle and its leading blocks; in this case a pull of at least 5.6 times the weight to be hoisted.

CAUTION

Ensure the tackle and pendant are strong enough for the job.

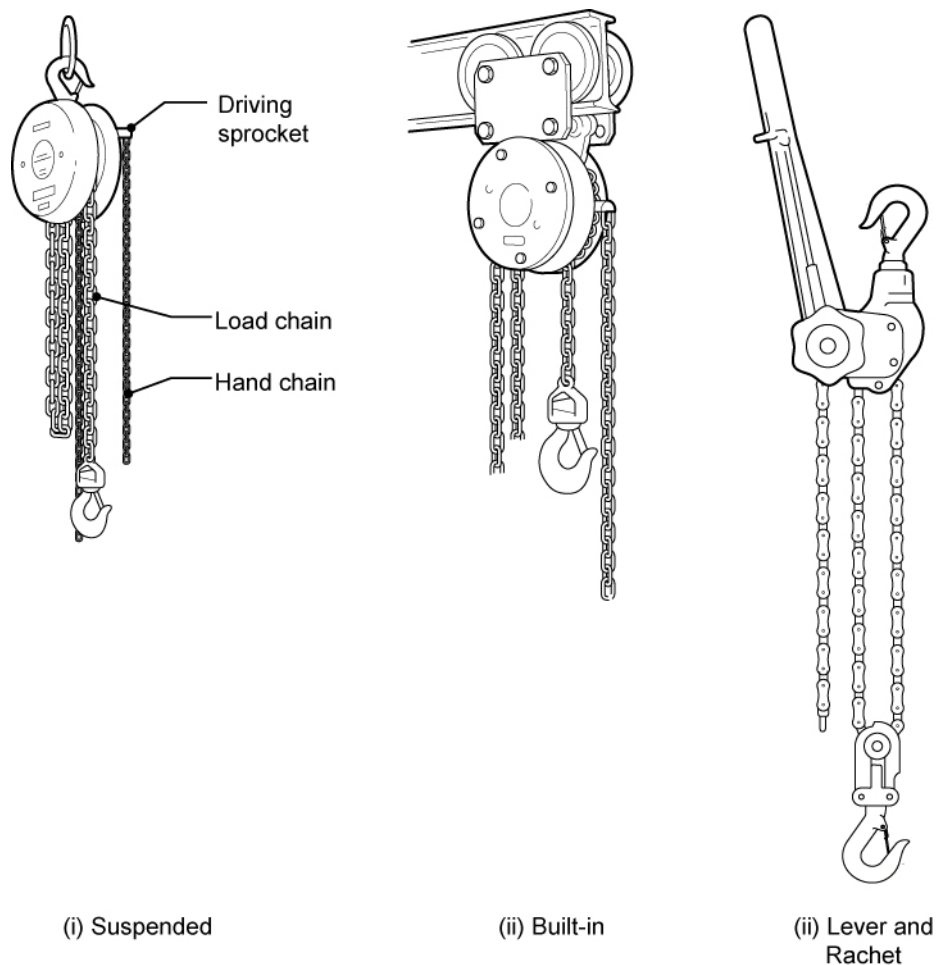
Fig 3-165. Dutchman's Purchase



03047. Hand Operated Chain Blocks (Fig 3-166)

Hand operated chain blocks are mechanical purchases designed for lifting weights and have a number of advantages over the simple tackle. They usually consist of a sprocket, worked by an endless hand chain, which operates the load sprocket through gearing; the load sprocket carries the load chain, to which the hoisting hook is attached. The blocks may be of a suspended or a built-in pattern. Suspended types Fig 3-166(i) have a top hook, shackle, or eye from which the block is hung and which allows a degree of articulation between the block and the supporting structure. Built-in types Fig 3-166(ii) are usually combined with a purpose made travelling trolley. Chain blocks supplied for use in confined spaces have a lever and ratchet Fig 3-166(iii) instead of the endless chain. Geared blocks have a very large mechanical advantage and little friction, so that the full safe working load of the gear equipment can be raised by one man. Blocks supplied to the Royal Navy have safe working loads from 0.25 tonnes to as much as ten tonnes, but those of over four tonnes are not widely used.

Fig 3-166. Types of Chain Block



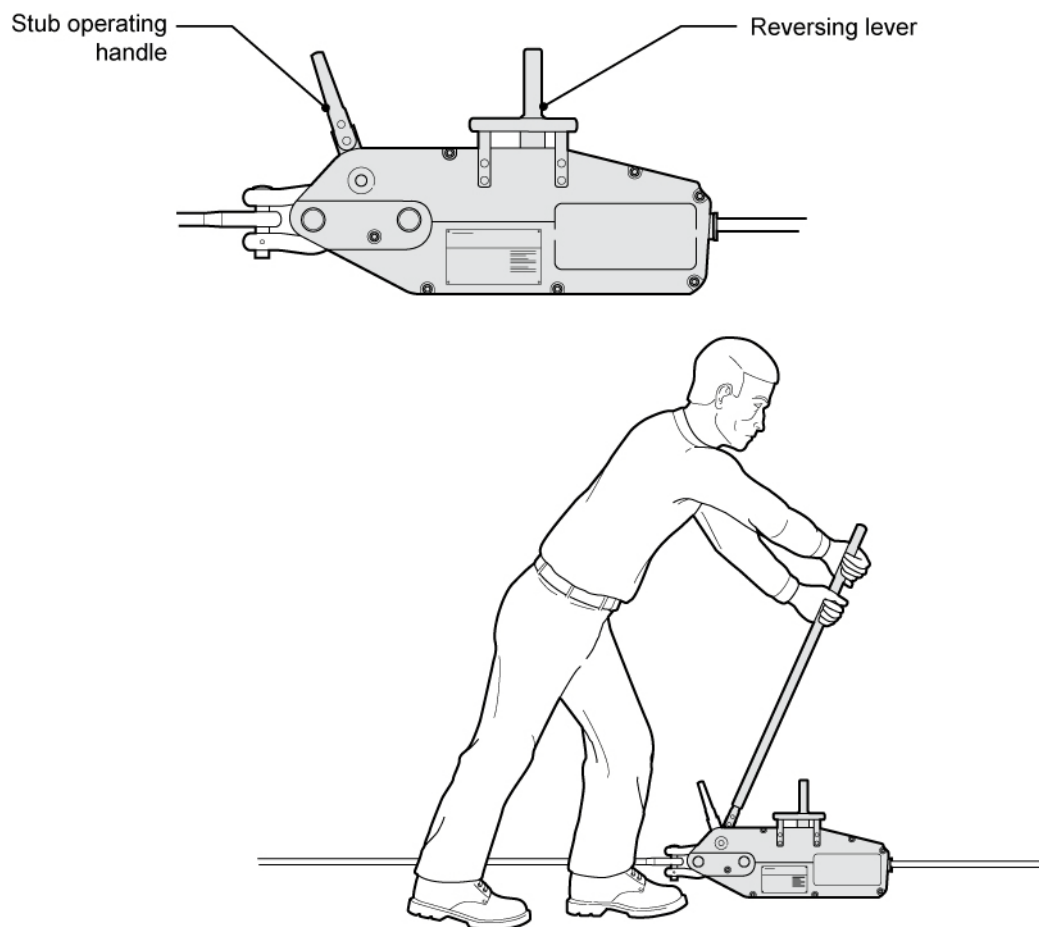
03048. Tirfor Pulling and Lifting Machines (Fig 3-167)

The Tirfor is a patented hand operated pulling and lifting machine similar in operation to the lever and ratchet chain block, although wire rope rather than chain is used as the fall. It works by pulling directly on the rope, the pull being applied by means of two pairs of self-energising smooth jaws which exert a grip on the rope in proportion to the load being lifted or pulled. The initial pressure, which causes the jaws to grip the rope and give the self-energising action, is provided by powerful springs. Each machine has a stub operating handle over which an operating handle fits and by pumping the handle back and forth the hook is drawn towards the block (hoisting the load); shear pins that activate when the safe working load of the machine is exceeded by 60% are fitted to the handle stub of the two smallest type of machine. To reverse the process, ie, to move the hook away from the block (lower the load), the operating handle is placed over the reversing lever and pumped as described above. To release the jaws from the rope, the rope release lever is operated. This must never be attempted when the machine is under load. Maxiflex wire rope falls are supplied with each machine; other types of wire must not be used. There are three sizes of machine available through Naval Stores, details of NSNs for the machines and the wire whips are given in [Table 3-41](#). An operator's handbook is supplied with each machine.

Table 3-41. Details of Pulling and Lifting Machines

Pattern No of Machine	SWL	Pattern No of Wire Whip
0246/202-9035	0.762 tonne	0246/202-9037 (10m length)
0246/137-2655	1.625 tonne	0246/202-9038 (18m length)
0246/137-1594	3.04 tonne	0246/202-0013 (10m length) 0246/137-1595 (37m length)

Fig 3-167. Pulling and Lifting Machine (Tirfor Block)

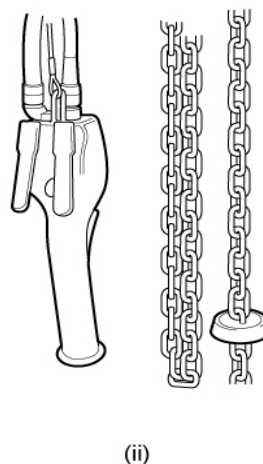
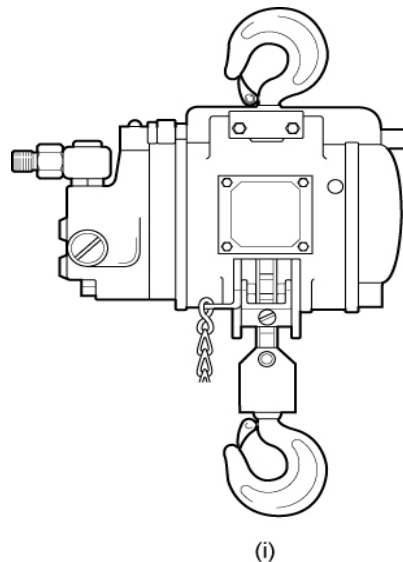


03049. Air-powered Hoist (Fig 3-168(i))

The air-powered hoist relies on compressed air for power. The unit is connected to a low pressure (LP) air supply, and operated by a **pendant control handle** (Fig 3-168(ii)). The pendant handle control is fitted with separate levers for raising or lowering the load, and a safety lever which must be depressed by gripping the handle, before the hoist becomes operative. Depression of the 'up' or 'down' levers on the control handle causes air pressure to be released on the appropriate side of the throttle valve so that it moves to one side of the chamber and air passes to the motor. The brake is held in the 'off' position by air pressure, so that if the operator releases the pendant control, the brake is automatically applied and will safely hold the maximum load until the 'down' lever is operated. The hoist, which has a maximum lifting distance of six metres, has a safe working load of 400 kgs and is available from Naval Stores on NSN F205/772-9185.

WARNING

AIR-POWERED HOISTS ARE NOT TO BE USED FOR THE LOWERING OR HOISTING OF PERSONNEL.

Fig 3-168. Air-powered Hoist

03050. Slings

a. The information given here provides an introduction to slinging, and is sufficiently comprehensive to enable the seaman to carry out routine slinging tasks safely. More information on slinging is given in **BR 6004 Slingers Handbook**, and **BR 3027 Manual of Inspection and Test of Lifting Plant**. Slings are used for hoisting, lowering or supporting loads; they may be directly attached to (or passed round) the load, and, depending on the nature of their duty, can be of chain or steel wire rope, or proprietary man-made fibre lifting slings made of polyester or polyamide. Hawser-laid cordage slings are no longer used in the Royal Navy. The choice of sling and the manner in which it is used depends upon whether one or a number of objects are to be slung in one hoist, the weight of those objects and whether they are robust or fragile. If a number of loads are to be slung in one hoist the load is called a **set**. The main requirement when slinging is that the sling should be sufficiently strong to hold the load securely without crushing it, and the simpler the sling the easier it will be to handle.

b. The duties and responsibilities of a slinger are:

- (1) To prepare the set or load.
- (2) To select and prepare the appropriate slings, pass them round or connect them to the set or load.
- (3) To hook or shackle the sling or slings to the crane, derrick or lifting appliance correctly.
- (4) To tend and steady the load before lifting and to control by line while the load is slung; and to tend, steady and position the load on lowering.
- (5) To be fully responsible for the safe transfer of the load from one position to the other.
- (6) To be solely responsible for giving the orders to the crane driver, derrick winchman, or man tending the lifting appliance. (Second slinger).
- (7) To be conversant with the Standard Crane Signals and to use them at all times. (See [Fig 3-190](#)).
- (8) To inspect the lifting gear before use to ensure it is in a satisfactory condition and suitable for the job. Also to inspect the gear after use and report any defects.
- (9) To check that each item of lifting gear employed is marked with its safe working load and identification number.
- (10) To make sure that the outriggers of mobile cranes are extended **before** lifting operations commence.

c. **Slings Constraints.** The constraints that apply to safe slinging are:

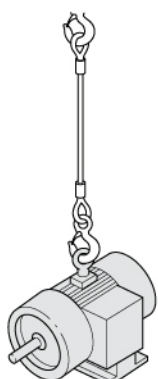
- (1) All slings must be registered in the lifting plant record. The use of unregistered slings is unlawful.
- (2) A load label is attached to all registered slings showing the total weight (safe working load) the complete sling is designed to lift with the legs at an inclined angle of not more than 90° (90° angle between sling legs), and with all legs in use. If only one leg of a double-leg sling is used then only half the weight indicated by the load label can be lifted. If the angle between the sling legs is greater than 90° then the weight lifted must be less than that indicated on the load label (see [Fig 3-172](#)).
- (3) A sling must not be used to lift a weight greater than that indicated on the label. Therefore the weight of the load must be determined prior to slinging.
- (4) Use long slings whenever possible to reduce the angle of the sling. It is important to remember that the lifting capacity of the sling is affected by the angle of the sling legs.
- (5) Always use two or more legs of a wire rope sling with hook and spliced eye. A single wire can untwist allowing the splice to open and slip.
- (6) When an object with sharp corners or rough edges is to be lifted, slings must be protected by pads of suitable thickness and material.
- (7) Do not rest a load on a sling. If necessary use suitable supports to avoid trapping the sling.
- (8) Slings must not be knotted.
- (9) Slings must not be dragged either loaded or unloaded across the deck. This is particularly important with fibre slings.
- (10) Ensure the crane hook is placed centrally over the load to prevent swinging when the load is being raised.
- (11) Stow slings in their designated stowage; don't leave them lying about.

d. **Sling Configuration.** Each of the different types of material may be encountered in any one of five basic configurations for general purpose slings, eg. single leg, two leg, three leg, four leg and endless sling.

- (1) *Single Leg Sling.* This sling may be used to connect a lifting appliance to a load with a single lifting point such as the eyebolt on an electric motor ([Fig 3-169\(i\)](#)). It may also be used as a choke hitch, either by back hooking [Fig 3-169\(ii\)](#) or reeving one end of the sling through the other [Fig 3-169\(iii\)](#), [Fig 3-169\(iv\)](#) and [Fig 3-169\(v\)](#). Or, where possible, it may be passed as a basket hitch through the load to be lifted [Fig 3-169\(vi\)](#). Two single leg slings may be used to form, in effect, a two leg sling ([Fig 3-170](#)).

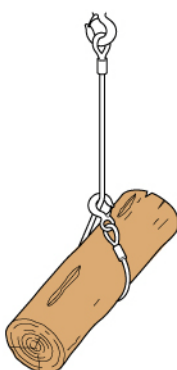
(2) Where this is done, the included angle between the sling legs should not exceed 90° and care must be taken to ensure that the hook is not overcrowded. The method of attaching the sling to the crane hook should ensure that the sling's eyes, links or rings are not damaged. Two single legs slings used as a two leg sling must be treated as a two leg sling for rating purposes and the combined safe working load when used at all angles between 0 and 90° must be considered at 1.4 times the safe working load of the single sling.

Fig 3-169. Single Leg Sling in Various Configurations



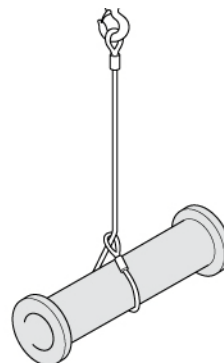
Note 1. The total load that may be lifted is that marked on the sling
Note 2. A vertical or straight lift is only suitable for lifting a load which is stable when suspended from a single lifting point

(i) Vertical or straight lift



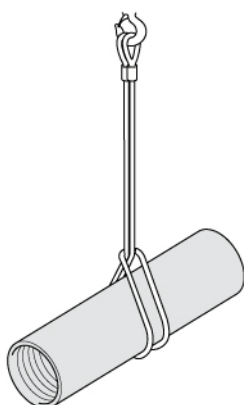
Note. The total load that may be lifted is 0.8 of that marked on the sling

(ii) Backing hooking



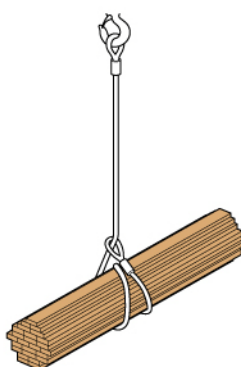
Note. The total load that may be lifted is 0.8 of that marked on the sling

(iii) Simple choke hitch



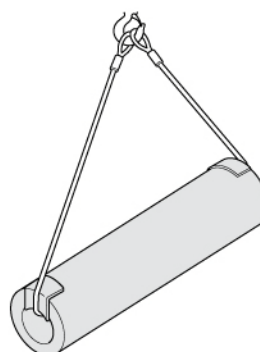
Note. The total load that may be lifted is 1.5 of that marked on the sling

(iv) Double and choked



Note. The total load that may be lifted is 0.8 of that marked on the sling

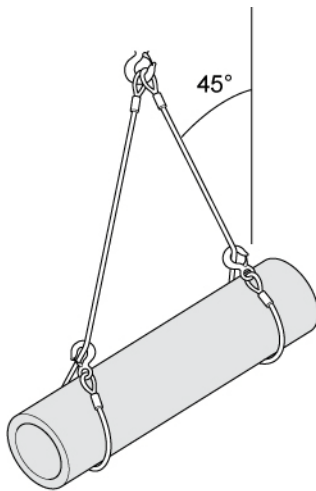
(v) Choke hitch double wrapped



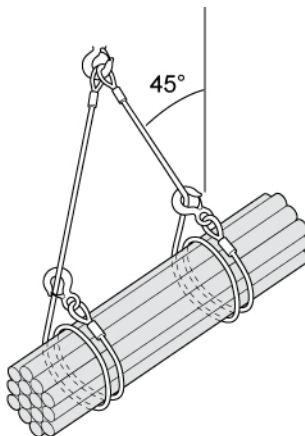
Note. The total load that may be lifted when the included angle does not exceed 90° is 1.4 of that marked on the sling

(vi) Basket hitch

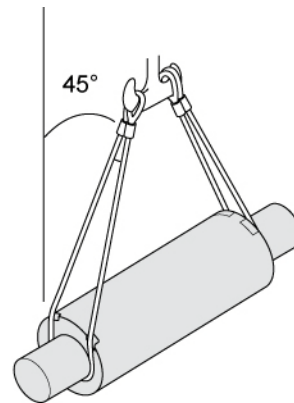
Fig 3-170. Two Single Leg Slings in Various Configurations



Note: the total load that may be lifted when the angle to the vertical does not exceed 45° is 0.8 X 1.4 times that marked on the single sling



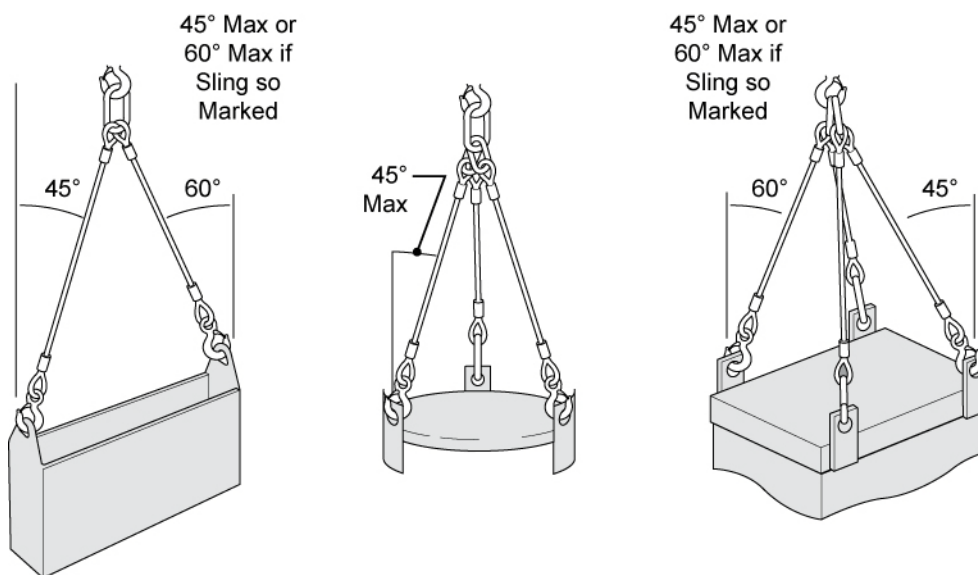
Note: the total load that may be lifted when the angle to the vertical does not exceed 45° is 0.8 X 1.4 times that marked on the single sling



Note: the total load that may be lifted provided no angle to the vertical exceeds 45° is 2.1 times that marked on the sling

- (3) *Two Leg Sling* (Fig 3-171). A two-leg sling comprises two legs connected at their upper ends by a master link. Two leg slings may be used to handle a wide range of loads.
- (4) *Three Leg Sling* (Fig 3-171). A three-leg sling comprises three legs connected at their upper ends by a master link. Three legs are commonly used to handle circular or irregularly shaped loads where the legs can be equally spaced.
- (5) *Four Leg Sling* (Fig 3-171). A four-leg sling comprises four legs connected to a main lifting ring via two intermediate rings. Four legged slings are mainly used to handle square or rectangular (four-cornered) loads.

Fig 3-171. Two- Three- and Four legged Slings



The total load that may be lifted is that marked on the sling assembly

e. **Method of Rating Lifting Slings.** When a multi-leg sling is used with the slings at an angle, the tension in the individual sling legs will increase as the angle to the vertical becomes greater (Fig 3-172). If a sling is to be used safely, allowance must be made for this angle; there are various ways of calculating this allowance but the simplest way is by the 'Uniform Load Method'. This method permits only one Working Load Limit (WLL) for angles up to 45° to the vertical and a reduced WLL for angles between 45° and 60° to the vertical. This is the only method to be used for all multi-purpose slings. The calculation is made by utilising mode factors as follows:

Single leg sling	= 1.0 x WLL of a single leg
Two leg sling (included angle 0-45°)	= 1.4 x WLL of a single leg
Two leg sling (included angle 45°-60°)	= 1.0 x WLL of a single leg
Three and four leg sling (included angle 0-45°)	= 2.1 x WLL of a single leg
Four leg sling (included angle 45°-60°)	= 1.5 x WLL of a single leg

Notes:

1. *These calculations assume that: the slings are symmetrically disposed in plan, and equally stressed under load; that all legs of multi-leg slings are made of identical material, and the method of attachment to the load allows for a 'straight pull', ie the legs are not bent around the load, choked, back-hooked or otherwise prevented from taking up a straight line under load.*

2. *Three and four leg slings are rated the same for 0-45°. This takes into account that at any one time one leg will have no load.*

3. *Three leg slings **MUST NEVER** be rated for angles greater than 45° due to the excessive stresses created at the larger angles.*

4. *The mode factors used are based on the percentage of loading in the single leg of the sling regardless of the material used.*

f. **Markings on the Sling.** Uniform method rated slings (range of angles).

WLL / SWL xt 0 - 45°

WLL / SWL yt 45° - 60°

Note. *Older slings may be marked for the included angle: 0 - 90° and 90° - 120°.*

g. **Multi-leg Slings with Less Than the Full Number of Legs in Use.** If a multi-leg sling is used with less than the actual number of legs attached to the load, then the safe working load of the sling must be reduced. An easy way of ensuring that the sling is never overloaded is to reduce the safe working load from that marked on the sling according to the number of legs in use in the following manner;

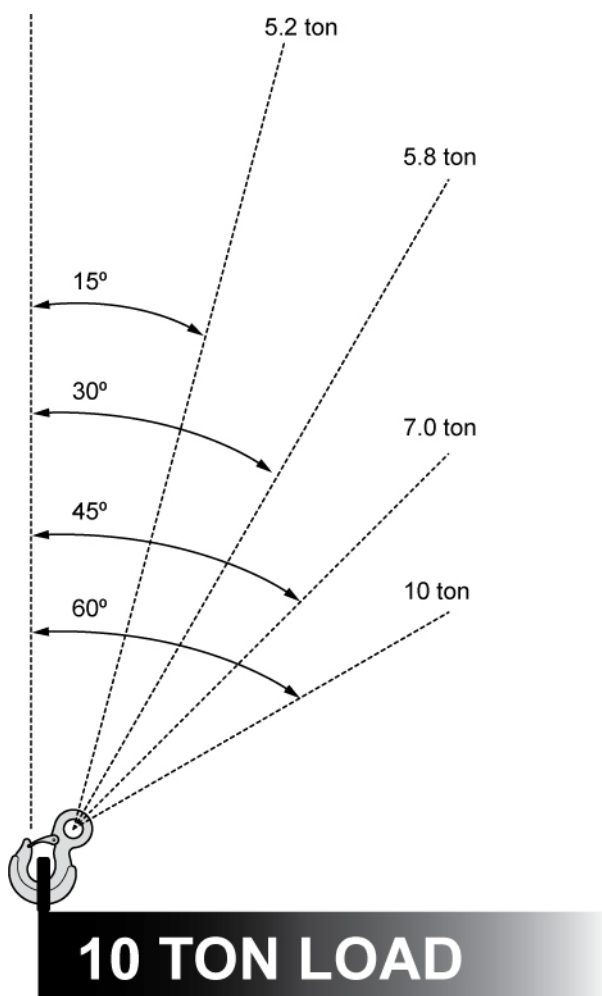
(1) Two leg sling with one leg in use = half of marked SWL

(2) Three leg sling with two legs in use = third of marked SWL

(3) Four leg sling with three legs in use = three quarters of marked SWL

h. **Rating Assumptions and Deviations from the Assumed Conditions.** Both rating methods assume certain conditions of use, which ensure that no part of the sling is overloaded. It is important to understand that although the weight to be lifted may be within the maximum lifting capacity of the sling, using it in the wrong way can overload part of the sling. Some deviations from the assumed conditions are prohibited such as loading a hook on the tip. Others are permitted provided an appropriate allowance is made. With multi-purpose slings, the designer has little if any information about the intended use so the onus to make such allowances falls on the user.

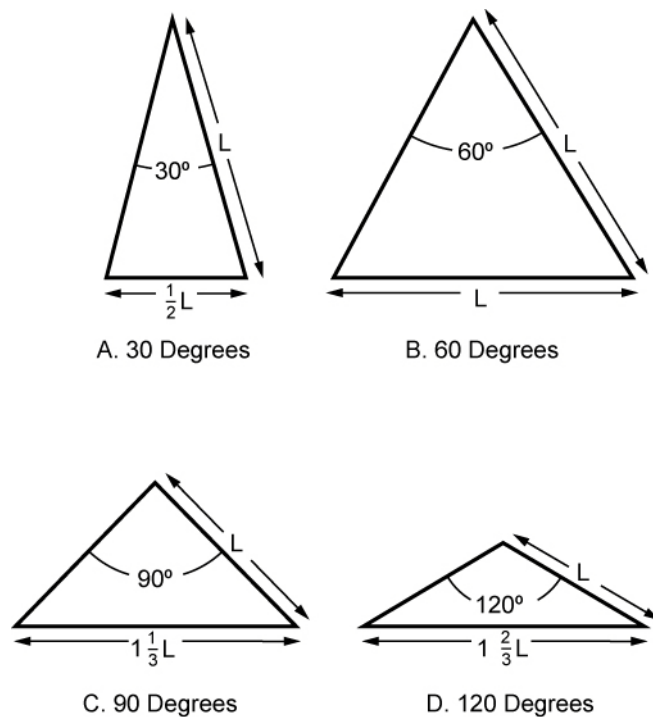
Fig 3-172. Illustration of How Tension Increases in Legs of Slings as Angle Increases



i. **Other Factors Affecting the Strength of Slings.** If a wire or chain sling is hooked back on itself, or secured by a choke hitch, ie by reeving one end of the sling through the other, it is said to be **snickled**. This method of securing the slings to the load will reduce the working strength of a chain sling by 50%, and a wire sling by up to 66%. The reduction in working strength with regard to proprietary polyester slings is given in [Table 3-42](#).

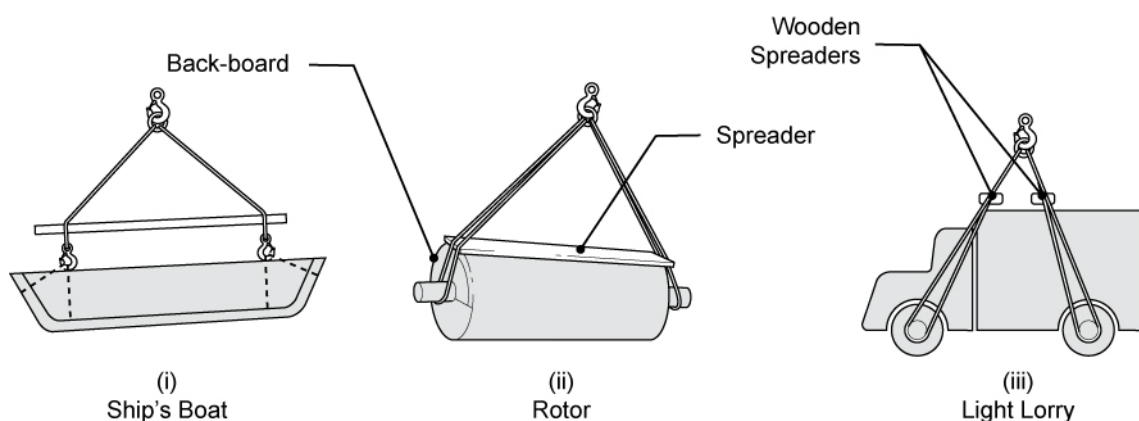
j. **Estimating Sling Angles.** In practice it is not possible to measure sling angles accurately, and the slinger must therefore use his judgement. [Fig 3-173](#) shows how to estimate angles of 30°, 60°, 90° and 120° by relating the span to the length of one leg of the sling. All references to sling angles refer to the angle to the vertical that the sling creates when in use.

Fig 3-173. Estimating Sling Angles



k. **Using Spreaders** (Fig 3-174). Spreaders are used in conjunction with slings primarily to prevent the sling crushing and damaging the load in instances where softwood or other packing in way of the sling gives insufficient protection. Spreaders are usually made of 180mm x 180mm Canadian Elm or English Oak up to about 3.6 metres in length. It is important that the correct length of spreader for the job is used; as a rule of thumb the spreader should be no longer than is necessary to prevent crushing of the load.

Fig 3-174. Using Spreaders

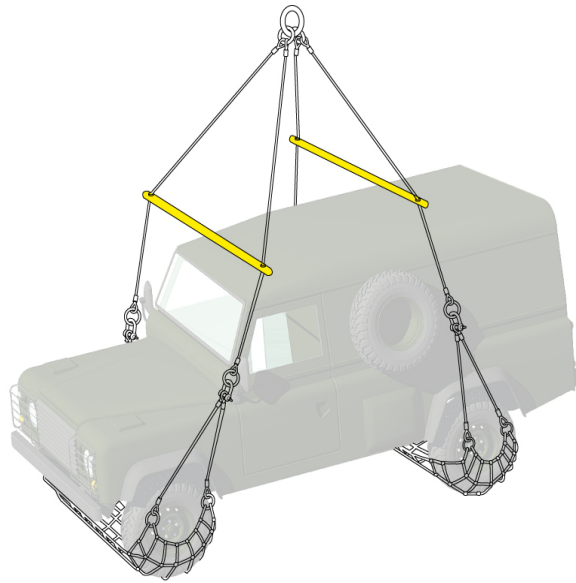


l. **Slings Boats.** When a boat, normally hoisted by davits, is hoisted by dockside or mobile crane, either a two leg sling with a spreader is used ([Fig 3-174\(i\)](#)), or two specially made flat webbing slings are passed around the keel and positioned at pre-determined points to ensure a balanced lift. Whenever possible it is advisable to seek advice from an experienced slinger before undertaking this evolution.

m. **Slings a Vehicle.** Special wheel net slings are normally used for loading and discharging vehicles from ships ([Fig 3-175](#)). These slings can also be used for loading and unloading stores. The gear consists of two wire nets 2.6 x 1.0 metres fitted with shackles, two wooden spreaders 3.0 x 0.1 x 0.1 metres fitted with slotted ends and retaining bolts, four 24mm SWR single slings 7 metres in length fitted to intermediate links and a master link at the top and a thimble eye at the bottom, and eight bulldog grips. The bulldog grips are secured to the single slings on each side of the spreaders to prevent them slipping. The SWL of this type of vehicle sling is six tonnes. The correct procedure for lifting is as follows:

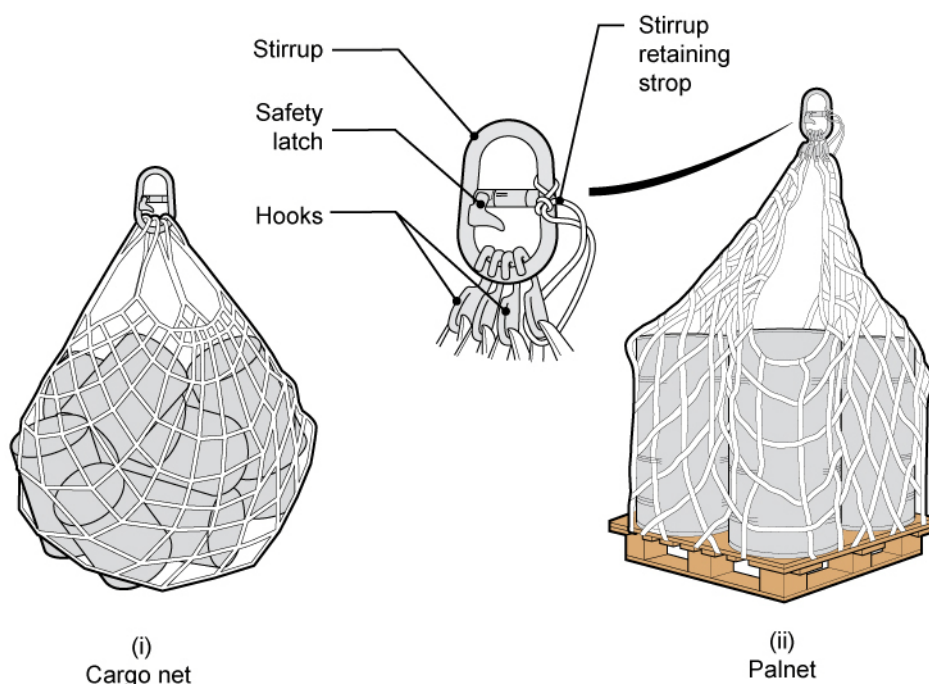
- (1) Move the vehicle as near to the crane plumb as possible, and spread out the nets in front of each pair of wheels.
- (2) Move the vehicle onto the nets, making certain that the wheels rest centrally upon them.
- (3) Lower the four-leg sling about the vehicle and shackle each pair of legs to a net; leave the vehicle's brakes off.
- (4) Take up the slack of the sling and the nets and, with padded material, pack between the nets and the body where the nets may bear.
- (5) Lift the vehicle, taking care that the wheels are riding snugly in the nets.
- (6) Points to remember when using vehicle lifting gear:
 - (a) Spreaders must be used, otherwise much damage will be done.
 - (b) Ensure the bulldog grips are firmly in position and place the bolt through the end of the spreader.
 - (c) When lowering a vehicle, lower the vehicle slowly once the vehicle has touched, otherwise the spreader may damage the vehicle or the stores.
 - (d) It is often possible to leave the nets shackled to the slings, and to run the next vehicle onto them without dismantling the gear.

Fig 3-175. Slinging a Vehicle



- n. **Cargo Nets** (Fig 3-176(i)). Cargo nets are a practical way of handling loads which will not suffer damage when subjected to the bowing-in movement inherent when lifting equipment in nets; objects such as drums are most safely transferred in this manner.
- o. **Pallet and Pallet Sling (Palnets)** (Fig 3-176(ii)). The pallet is of wooden or aluminium construction which, when loaded with stores can be lifted by fork-lifted truck or can be hoisted by the pallet sling without the necessity of reeving the sling under the pallet before it is loaded. This arrangement is ideal for the transfer of bulk stores of the same size.

Fig 3-176. Cargo Nets and Palnets



03051. Proprietary Lifting Slings

a. An increased use is being made of proprietary lifting slings for a wide variety of tasks in the Royal Navy. These slings are usually standard stock items which either meet a specific lifting requirement, or provide a general lifting facility on a ship. They are available in a number of lengths, with a variety of end termination. The types of proprietary lifting sling used in the Royal Navy are described below:

b. **Basic Polyester Roundsling** (Fig 3-177). This type of sling is the most commonly used in the service. It has an outer protective casing made from reinforced monofilament polyester yarn with the inner core made up from an endless hank of polyester. The slings are colour coded in accordance with the relevant British Standard, which helps to ensure easy recognition of the safe working load of the sling; in addition the safe working load is marked at regular intervals on the sling's outer case. This safe working load applies only when the sling is used in a straight lift, in any other configuration the safe working load is changed. Details are given in Table 3-42. Every roundsling bears a unique identification number and is issued with a certificate of conformance. In use the roundsling flattens to provide a safe grip on its load; it is extremely light in weight, is very resistant to wear and damage, and the elongation at the safe working load is only 3%. The sling requires little or no maintenance other than an occasional cleaning in fresh water with a mild detergent. It is fully resistant to corrosion and has a high resistance to hydrocarbons, most chemicals and solvents. However, ammonia, alkalis and certain acids can cause damage. These slings are never load tested, but are subject to inspection before and after use, and are periodically surveyed in accordance with BR 3027.

- c. If the outer casing is intact the slings may be considered usable, because the inner core determines the strength of the sling. If the outer case is damaged to the point where the inner yarns are visible the sling should be cut up and discarded.

Fig 3-177. A Basic Polyester Roundsling



Table 3-42. Details of Basic Polyester Roundslings

SAFE LIFTING CHART (ROUNDSLING)									
Safety Factor 7:1 Complies with Supply of Machinery (Safety) Regulations Amended 1994 Source BS EN 1492 -2: 2000									
<i>M</i> = Mode factor for symmetrical loading	Straight Lift	Choked Lift	Basket Hitch			Two Leg Sling		Three/Four Leg Sling	
	Kg	Kg	Kg	Kg	Kg	Kg	Kg	Kg	Kg
			Parallel	β 0 - 45°	β 45° - 60°	β 0 - 45°	β 45° - 60°	β 0 - 45°	β 45° - 60°
Colour	<i>M</i> = 1	<i>M</i> = 0.8	<i>M</i> = 2	<i>M</i> = 1.4	<i>M</i> = 1	<i>M</i> = 1.4	<i>M</i> = 1	<i>M</i> = 2.1	<i>M</i> = 1.5
Violet	1000	800	2000	1400	1000	1400	1000	2100	1500
Green	2000	1600	4000	2800	2000	2800	2000	4200	3000
Yellow	3000	2400	6000	4200	3000	4200	3000	6300	4500
Red	5000	4000	10000	7000	5000	7000	5000	10500	7500
Brown	6000	4800	12000	8400	6000	8400	6000	12600	9000
Blue	8000	6400	16000	11200	8000	11200	8000	16800	12000
Larger Capacity Slings Available. Mode factor!! Important - The Max W.L.L. Depends on the Angle!!									

- d. **‘Supra’ Polyester Roundslings and Associated Fittings.** ‘Supra’ polyester round slings are manufactured, marked and colour-coded in the same way as basic polyester roundslings; however, the outer protective sheath of the ‘Supra’ version is of superior quality to the basic roundsling and for ease of identification the word ‘Supra’ is woven at intervals into the outer casing. Metal end fittings are available for ‘Supra’ roundslings, enabling them to be assembled into one, two, three or four leg sling configurations; in addition; three types of anti-chafing sleeves are available for use with the slings. Although at present the supply of this type of sling and the associated fittings is limited to certain ships for the removal of equipment from machinery rooms and other specified tasks, it is likely that in the future the equipment will be made available for use in all vessels, for most slinging tasks.

e. There are four metal component end fittings for use with the 'Supra' roundslings. They are as follows:

(1) *Master Link* (Fig 3-178(i)). This consists of a main link with two intermediate links attached. It is available in two sizes, NSN 0263/930-5752 for use with slings that have a SWL of 2.0 tonnes, and NSN 0263/404-2154 for use with slings that have a SWL load of 5.0 tonnes. The former bears the manufacturer's mark OTF-6-8 and the latter is marked OTF-10-8.

(2) *Roundsling Coupling* (Fig 3-178(ii)). This fitting has a faired bearing surface that permits direct contact with the roundsling without causing chafe; it has a double and a single lug which interlock into corresponding lugs on the half link. The coupling is available in two sizes, NSN 0263/660-2625 for use with slings that have a SWL of 2.0 tonnes, and NSN 0263/594-5352 for use with slings that have a SWL of 5.0 tonnes. The former bears the manufacturer's mark SKR 7-8 and the latter is marked SKR 13-8.

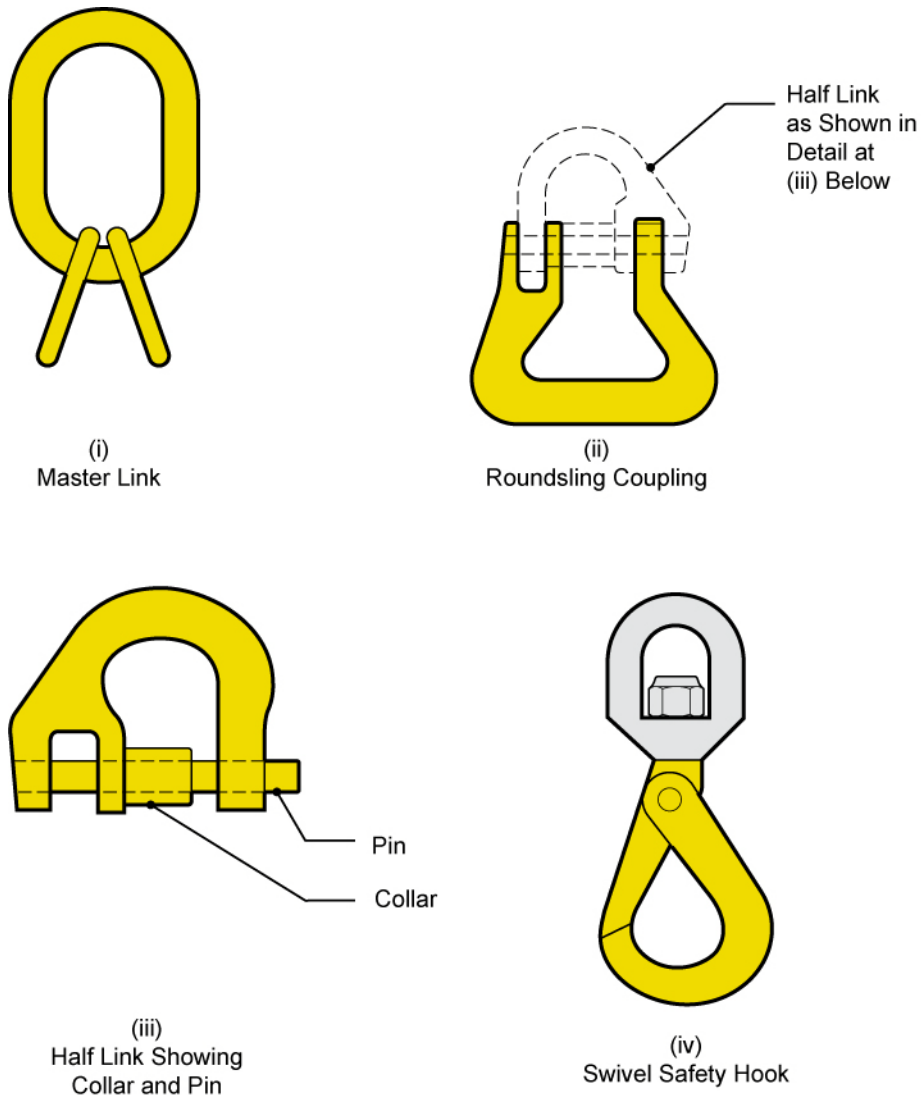
(3) *Half Link* (Fig 3-178(iii)). The half link is of round section and has a double and single lug which interlock into corresponding lugs on the roundsling coupling. Each half link is supplied complete with a locking set consisting of a collar and locking pin. The collar fits between the lugs of the half link and roundsling coupling as shown in Fig 3-181(iii), and the complete assembly is locked together by the locking pin. There are two types of locking set in service and the pins and collars are not interchangeable. Locking sets must only be used with the half link with which they have been supplied. The half link is available in two sizes, NSN 0263/255-4156 for use with slings that have a SWL of 2.0 tonnes, and NSN 0263/133-4642 for use with slings that have a SWL of 5.0 tonnes. The former bears the manufacturer's mark G 7-8 and the latter is marked G 13-8.

(4) *Swivel Safety Hook* (Fig 3-178(iv)). This hook is fitted with a spring-operated tongue, and incorporates a swivel link eye for attachment to a half link. The hook is available in two sizes, NSN 0263/513-5616 for use with slings that have a SWL of 2.0 tonnes, and 0263/877-7632 for use with slings that have a SWL of 5.0 tonnes. The former bears the manufacturer's mark BKL 7-8 and the latter is marked BKL 13-8.

Notes:

1. *Metal component end fittings are not available for use with the 20 tonne SWL roundslings.*
2. *By design, metal component end fittings of a given size are not interchangeable with any other size.*
3. *Metal component end fittings are periodically surveyed in accordance with BR 3027.*

Fig 3-178. End Fittings for use with 'Supra' Roundslings



f. There are three types of chafing piece available for use with either basic or 'Supra' round slings. They are as follows:

(1) *Sleeve, Anti-abrasion* (Fig 3-179(i)). This tubular sleeve consists of two pieces of webbing stitched together; it is slid over the sling and positioned as required where chafe is expected. Anti-wear sleeves are available in different lengths and sizes as follows:

(a) Length 0.5 metres for use with slings that have a SWL of 2.0 tonnes.
NSN 0263/110-0736.

(b) Length 1.5 metres for use with slings that have a SWL of 2.0 tonnes.
NSN 0263/720-9679.

(c) Length 0.5 metres for use with slings that have a SWL of 5.0 tonnes. NSN 0263/906-7617.

(d) Length 1.5 metres for use with slings that have a SWL of 5.0 tonnes. NSN 0263/215-2741.

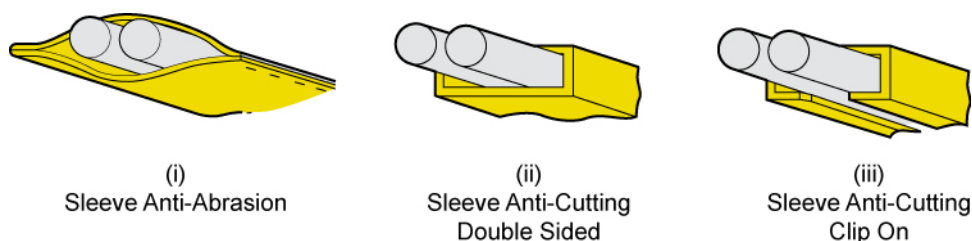
(2) *Sleeve, Anti-cutting, Double Sided* (Fig 3-179(ii)). This sleeve, manufactured from a polyurethane polymer, is highly resistant to cuts and abrasions. It is slid over the sling and positioned as required where very heavy chafe or abrasions are expected. Two sizes are available, details as follows:

(a) Length 0.5 metres for use with slings that have a SWL of 2.0 tonnes. NSN 0263/227-5956.

(b) Length 0.5 metres for use with slings that have a SWL of 5.0 tonnes. NSN 0263/807-1268.

(3) *Sleeve, Anti-cutting, Clip-on* (Fig 3-179(iii)). This sleeve is a short, clip-on version of the anti-cutting sleeve described above. It can be clipped to a sling where cutting or chafing points occur, without the need to unhook or dismantle sling assemblies.

Fig 3-179. Chafing Piece Attachments for use with Roundslings



g. **Assembling Single and Multi-leg 'Supra' Polyester Roundslings.** With the use of the associated metal component end fittings, 'Supra' polyester roundslings can be assembled into two, three and four leg sling assemblies, or a single leg sling fitted with a lifting hook at one end. Tools and equipment required for the job are: a hammer, a block of timber and a roll of masking tape. Always select the correct size end fittings appropriate to the roundslings being used, and ensure all legs of a multi-leg sling have the same SWL. After assembly of multi-leg slings, consult Para 03050 [sub para e](#) to ascertain the SWL of the complete assembly, then attach a tally, marked with the SWL, to the assembly.

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RIGGING AND DECK GEAR

(1) Assembling a single leg with swivel hook end attachment

(a) Study Fig 3-180. Lay out the sling to its maximum effective length, and tape a soft eye into one end; this eye should be large enough to accommodate the appropriate roundsling coupling comfortably (Fig 3-181(i)). Introduce the coupling into the soft eye (see Note 1).

(b) Insert the half link into the swivel eye of the hook. Then, with the collar positioned as shown in Fig 3-181(i), offer up the half link to the coupling.

(c) When the coupling, collar and half link are accurately aligned (Fig 3-181(ii)) and with the timber block positioned under the assembly, tap the locking pin home. When the pin is fully home (Fig 3-181(iii)), check that the collar rotates freely.

Notes:

1. Ensure a coupling, not a half link, is inserted into the soft eye. If a half link is used the SWL of the sling is considerably reduced.

2. A single leg sling fitted with a swivel hook at one end does not require a master link in the 'free end'; the free end of the sling can be directly hooked over the hook of the crane or lifting appliance.

Fig 3-180. Components of a Single Leg Sling

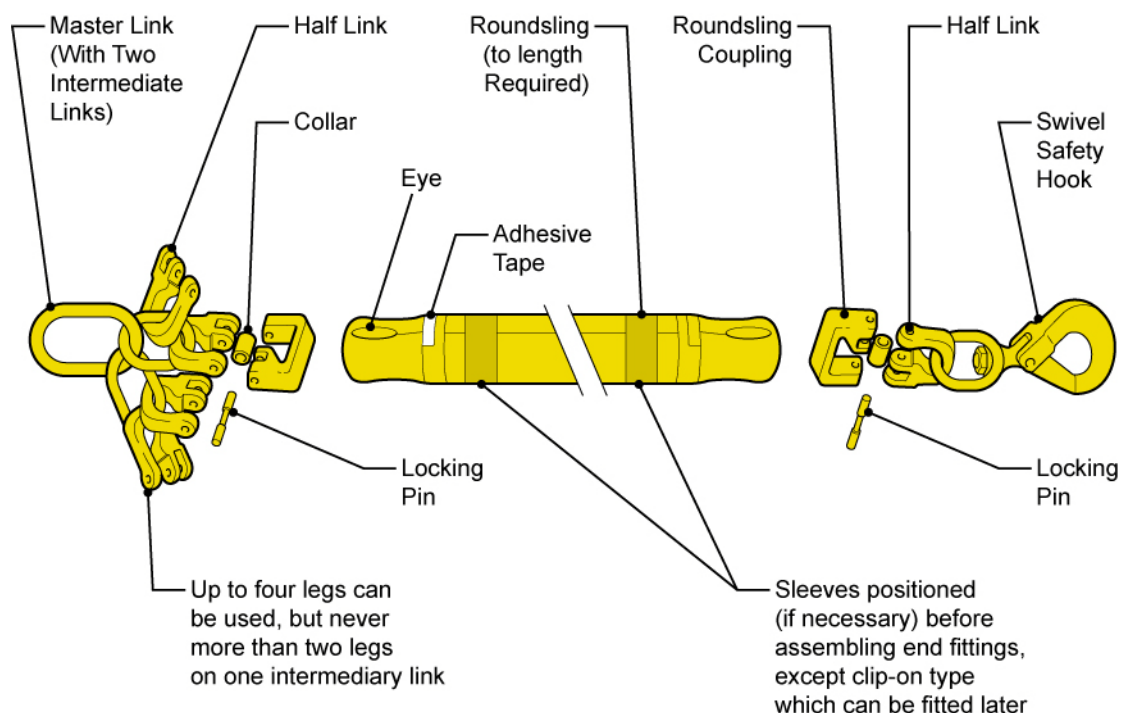
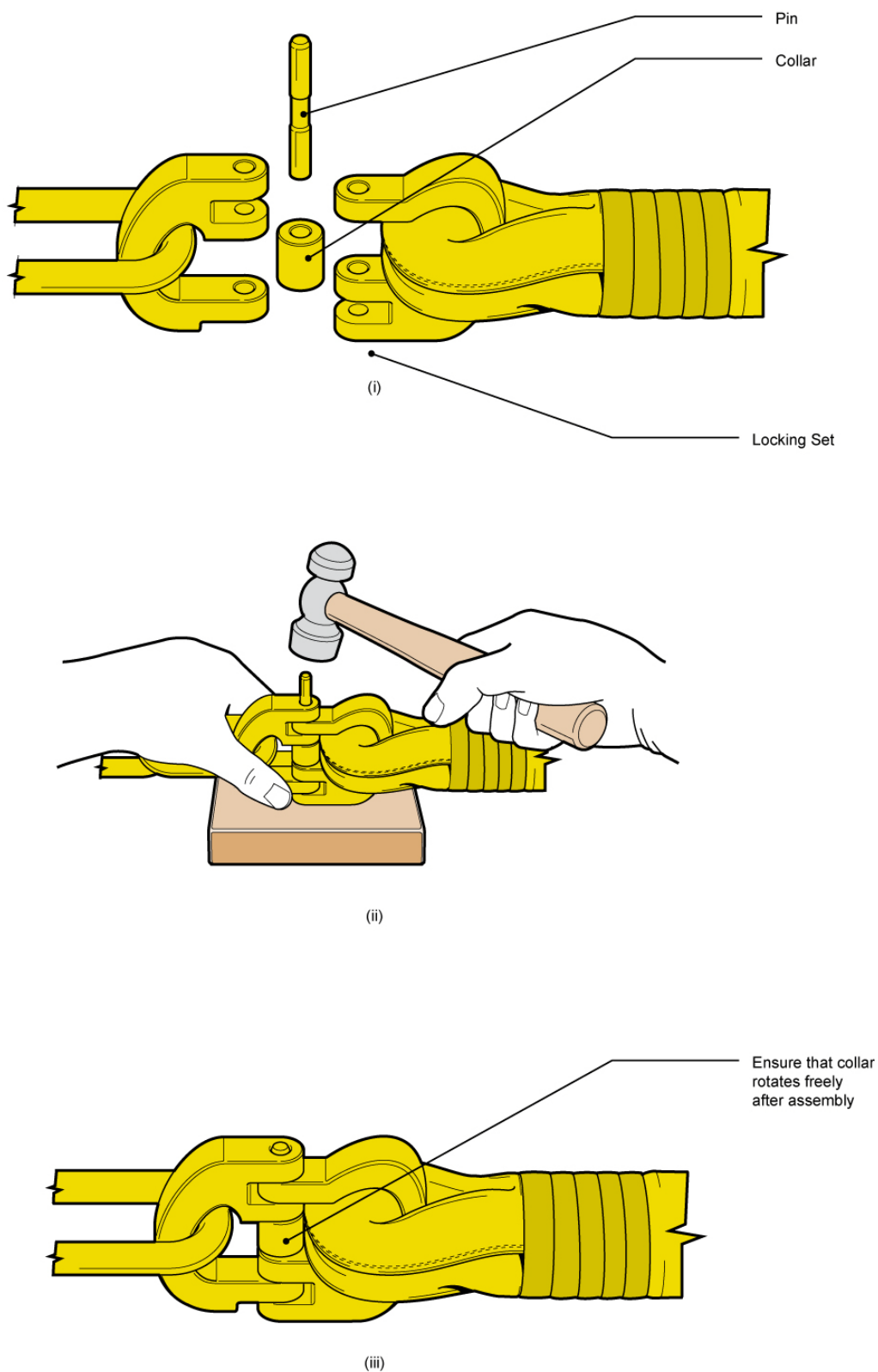


Fig 3-181. Securing a Half-link to a Coupling with a Locking Set



Note. The pin is held in position by a helical spring sited inside the collar.

(2) *Constructing a Two-leg Sling Assembly* ([Fig 3-182\(i\)](#))

- (a) Fit one end of each of the two legs with a swivel hook, as described for the single leg sling.
- (b) Select the appropriate size master link, and, using the correct size couplings and half links, connect a leg to each of the two intermediate links attached to the master link.
- (c) Attach to the assembly a tally showing the SWL. (Details of how to establish the SWL are given in Para 03050 [sub para e](#)).

(3) *Constructing a Three-leg Sling Assembly* ([Fig 3-182\(ii\)](#))

- (a) Fit one end of each of the three legs with a swivel hook, as described above for the single leg sling.
- (b) Select the appropriate size master link, and using the correct size couplings and half links, connect two of the legs to one of the intermediate links on the master link, and the remaining leg to the remaining intermediate link.
- (c) Attach to the assembly a tally showing the SWL. (Details of how to establish the SWL are given in Para 03050 [sub para e](#)).

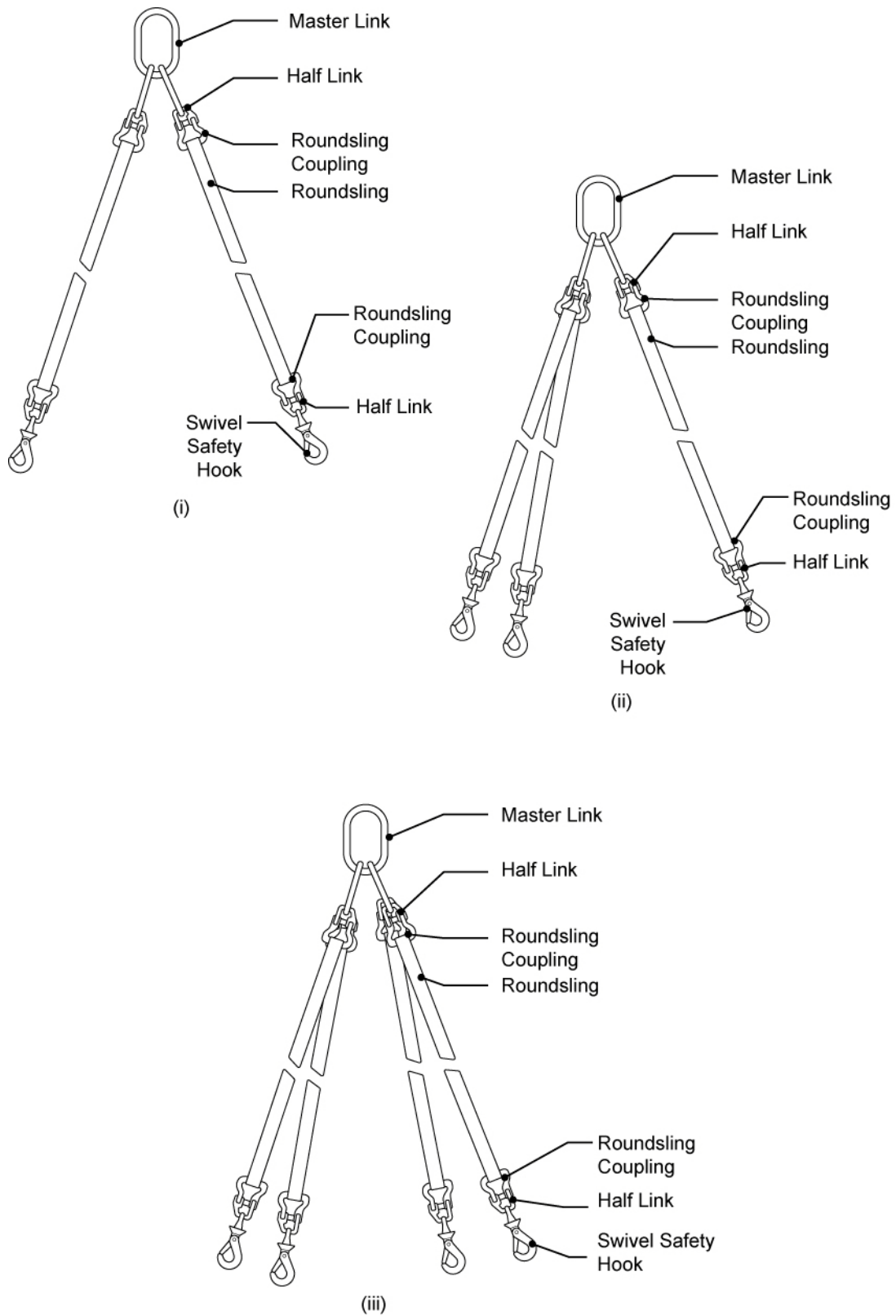
(4) *Constructing a Four-leg Sling Assembly* ([Fig 3-182\(iii\)](#))

- (a) Fit one end of each of the four legs with a swivel hook, as described above for the single leg sling.
- (b) Select the appropriate size master link, and using the correct size couplings and half links, connect two legs to each of the intermediate links attached to the master link.
- (c) Attach to the assembly a tally showing the SWL. (Details of how to establish the SWL are given in Para 03050 [sub para e](#)).

Note. *To dismantle the end fittings, position the assembly on a wooden block ([Fig 3-182\(ii\)](#)) but with the base of the pin clear of the block. Then use an appropriate sized drift to drive out the pin.*

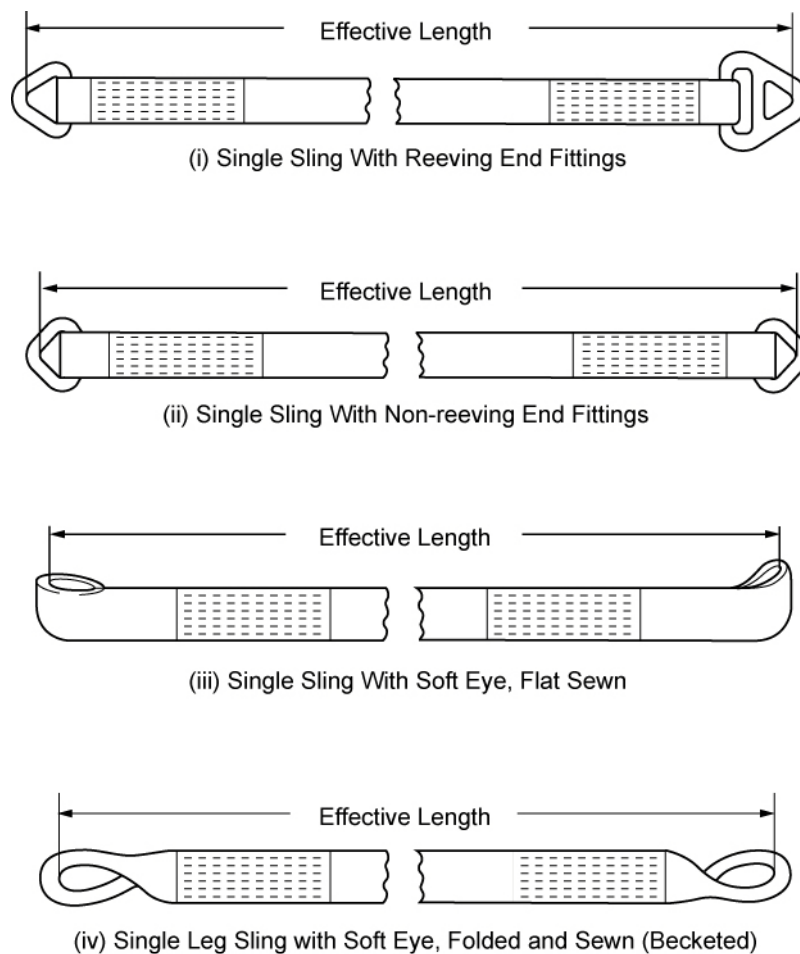
- h. **Accounting for Roundslings and Assemblies.** Ships and Units that carry roundslings are required to produce a local logbook that lists all roundslings and associated metal fittings carried, and provides a record of their control and issue. Details are given in [Annex 3B](#) to this Chapter.

Fig 3-182. Two, Three and Four – leg Slings



i. **Flat Webbing Slings** (Fig 3-183). These types of slings are fabricated from a single length of polyester webbing, with various terminals as appropriate; Simplex slings have the webbing stitched close to the terminals, whereas Duplex slings are effectively stitched through two thicknesses throughout most of their length. Slings are terminated either in a reinforced soft eye or in any combination of metal end fittings. The marking, colour coding, maintenance and sling configuration safe working loads for flat webbing slings is the same as that for polyester roundslings. Flat webbing slings are used where a flat bearing surface can be critical in protecting the surface of the load, examples being GRP boats, machine bearings and pipework; they are also used in the Royal Navy for hoisting and lowering rigid inflatable boats.

Fig 3-183. Examples of Flat Webbing Slings



03052. Special Slings Precautions

a. **Slings from Shoreside Crane to a Vessel Afloat.** Great care should be taken when the load is being transferred to or from the hook of the crane. Keep a close watch on the water level of basins and docks, which may alter considerably while lifts are in progress. A drop in the water level may cause the rings to tighten, and impose dangerous stresses on slings, the load and the crane. An increase in the water level will cause the slings to slacken with consequential surging of the load. Therefore check frequently the tension of the slings when such lifts are being made, and adjust as necessary. Never leave a job unattended; a competent slinger must always be in attendance when a lift is in progress.

b. **Slinging from a Floating Crane to a Vessel Afloat.** Great care should be taken when the load is being transferred to or from the hook of the crane. Make full allowance for the heel of the crane and of the ship; it may be necessary to adjust the jib while these lifts are being made.

03053. Slinging and Responsibilities in HM Ships

a. The supervision and responsibility for all slinging tasks undertaken in HM Ships must be planned and overseen by a fully qualified departmental Slinging Supervisor. To obtain this Adqual it is necessary to complete the ME 418 ADSLING course at HMS SULTAN. Seaman Specialists and other departmental senior rates drafted to nominated billets within a ship's scheme of complement are required to undertake this course as a targeted employment module (TEM) before joining a ship. The qualification will remain extant unless the Licence holder or his/her line manager feels that he/she is incapable of carrying out a slinging operation. In this case guidance laid down in BR 3027 Vol 1 should be followed. Specialist departmental lifting equipment must be registered and controlled. Within individual departments, however for general slinging requirements the Chief Bosun's Mate is responsible for the control of the general lifting plant.

b. **General Ship to Shore Straight Lift Slinging Controllers.** The Chief Bosun's Mate is responsible for the auditing, control, supervision and training of personnel required to direct cranes during general ship to shore storing operations. The controllers/slingers must have completed all aspects of the computer-based ME418A AD Stevedore training course available at all Waterfront Learning Centres (WLCs) and be the holder of the correct photo card licence. Designated slingers tasked to conduct slinging duties must assess the task to hand and inspect and draw correct portable lifting equipment from the Chief Bosun's Mate. The slinger in charge is to consult with, and notify the crane driver of the nature of lifts to be undertaken and clarify who will be giving the signals.

c. **General Considerations.** Controllers/Slingers must wear an Orange Safety Helmet and a Day-glow Orange armband and should be positioned so that the crane driver has clear visual observations of the signals at all times during the lifting operations. Under no circumstances is a load to be directly attached to the crane hook until it has been ascertained that the load is free from any restraining connections.

d. **Photo Card Licence.** All qualified personnel having completed the ME418A Adhook and/or the ME418 Adsling course will carry a photo card licence showing the qualification. Examples shown above are, Top ME418A, coloured white and Bottom ME418 coloured Grey.

Fig 3-184a. Specimen Photo Card Licences

Lifting Equipment School HMS Sultan	
	Name:
	Rate:
	Number:
	Record No:
SG /2000 / 297 -Update	

The holder has been trained IAW BS 7121 part 1, BR 3027, LEEA Code of practice and is qualified to carry out the following duties: Carry out slinging operations using a crane Carry out pre-use checks on lifting equipment Crane controller Instructor's Signature 
--

Lifting Equipment School HMS Sultan	
	Name:
	Rate:
	Number:
	Record No:
SG /2000 / 297 -Update	

The holder has been trained IAW BS 7121 part 1, BR 3027, LEEA Code of practice and is qualified to carry out the following duties: Plan and supervise lifting operations Slinging operations Fleeting operations Crane controller Instructor's Signature 
--

03054. Ammunition Secondary Re-supply Equipment

a. The safe re-supply of ammunition by Secondary Route relies on adequate training, comprehensive briefing and firm control. **JSP 862, MOD Maritime Explosives Regulations** is the authoritative publication on the subject and all personnel involved in the evolution should be conversant with the relevant chapter. The Weapon Electrical department has custody of the lifting equipment and a nominated Senior Rate with the Additional Lifting Equipment Examiner qualification as the Competent Person to inspect and test this equipment, but it is the responsibility of the **Relevant Officer of the Quarter (OOQ)** to ensure that ammunition re-supply equipment is rigged in accordance with the ship's drawings, and operated correctly. It is not possible to produce a detailed procedure for each of the diverse arrangements used in the Fleet, but the following general guidance, along with regular practice, should ensure safe operation:

- (1) Clear, concise orders are to be used by the rating in charge, normally a Senior Rating who is responsible for the supervision and safe operation including rigging/unrigging of each Secondary Supply route.
- (2) Only the approved rig in accordance with ship's drawings is to be used. All shackles must be moused.
- (3) When heavy objects are being rigged, unrigged, hoisted or lowered, personnel beneath are to keep well clear.
- (4) Two ratings must always be used to rig and unrig Miller's Flaps. One rating holds the flap in place whilst the other inserts the securing pins.
- (5) Sufficient hands must be detailed to operate tackles and other lifting equipment safely.

03055. Estimation of Stresses in Derricks and Cranes

a. Before cranes and derricks etc. are described, it is first necessary to emphasise that the seaman must be able to calculate the stresses in the parts of the gear that he is using. Without this knowledge it is possible that a derrick, while hoisting an apparently safe load, will collapse; or that one of its fittings or a part of the rigging will fail, with dangerous consequences.

b. **Triangle of Forces.** The stresses to which a derrick or fittings may be subjected when supporting a load can be estimated approximately and very simply by the diagrammatic method known as the **triangle of forces**. The principles upon which this method is based can be stated as follows:

(1) If the magnitude and direction of a force are known, they can be represented by a straight line, called a **vector**, the length of which indicates the magnitude, and the direction of which, denoted by an arrow, gives the direction in which the force acts.

(2) If three forces acting at a point are in equilibrium, and the vectors representing them are drawn end to end so that the directions in which they act are maintained, ie, so that the arrows follow one another, they will form the three sides of a triangle.

(3) If three forces acting at a point are in equilibrium and the magnitude and direction of only two of them are known, the magnitude and direction of the unknown force can be found as follows. Draw the vectors of the known forces end to end so that the arrows follow one another. Complete the triangle. The third side will then represent the unknown force in magnitude and direction, the arrow pointing from the head of the second vector to the foot of the first.

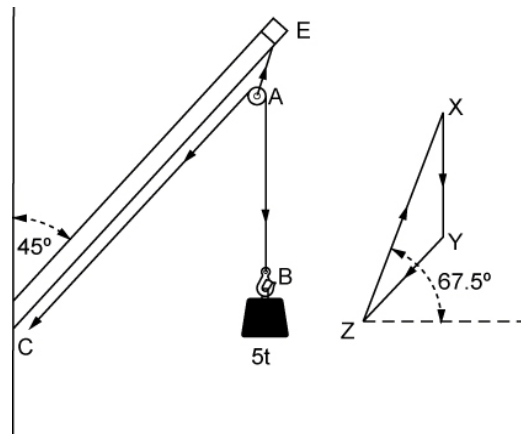
(4) When three forces acting at a point are in equilibrium, if the magnitude and direction of one force and the direction only of the other two are known, the magnitude of these two unknown forces can also be found by drawing a triangle of forces.

c. For three forces in equilibrium, the arrows denoting the directions of the vectors always follow one another round a triangle of forces. If more than three forces in equilibrium and acting at a point are involved, the same principles apply. The resulting figure, whose sides represent these forces, is then known as a **polygon of forces**. The following two examples show the application of this method for finding the approximate stresses in masts, derricks and their rigging and fittings. In the examples it is assumed that the systems and their loads are at rest, and the effects of any friction are disregarded.

EXAMPLE 1

A derrick is topped at an angle of 45° with the horizontal and is supporting a weight of five tonnes hung on the end of its whip (Fig 3-184). Find the magnitude and direction of the tension in the strop of the head block.

Fig 3-184. Estimation of Stresses by Triangle of Forces (1)

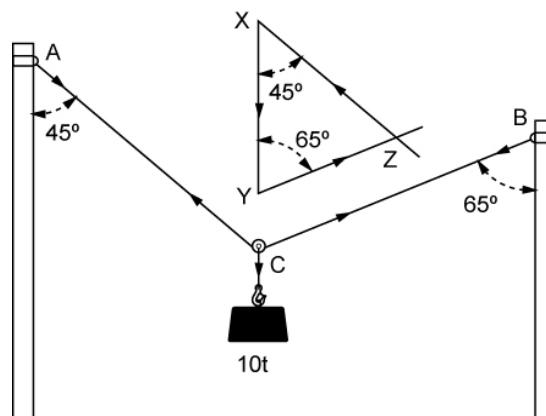


d. The tensions in the running and hauling parts of the whip are the same, namely five tonnes, so by drawing a triangle of forces based on the block **A**, the tension in the strop **AE** and the direction in which it acts can be found in the following manner. To a scale of four tonnes to 10mm draw the vector **XY**, 12.5mm in length, to represent the vertical downward pull of the weight on the running part of the whip, and on it mark its arrow pointing downwards. From the point **Y** draw another vector **YZ**, parallel with **AC** and 12.5mm in length, to represent the downward tension in the hauling part of the whip, and on it mark its arrow, also pointing in a downward direction. Complete the triangle by joining **Z** to **X**. Then: **ZX** is the vector representing the tension, both in magnitude and direction, in the strop **AE** of the head block, and when measuring it will be found to be approximately 24mm, representing a tension of 9.5 tonnes acting upwards at an angle of 67.5° with the horizontal.

EXAMPLE 2

A span is rigged between two masts, and a weight of ten tonnes is hung on it so that the left leg of the span makes an angle of 65° with its mast (Fig 3-185). Find the pull on each of the shackles, which join the span to the masts.

Fig 3-185. Estimation of Stresses by Triangle Forces (2)



e. The pull on the shackles will be equal and opposite to the tensions in the respective legs of the span, and these tensions are found by considering the forces acting at the point **C**, where the magnitude and direction of the pull of the weight on the span are known, ie ten tonnes vertically downwards, and the directions of the tensions in the legs of the span are known, ie upwards at an angle of 45° and 65° respectively with the perpendicular. To a scale of four tonnes to 10mm draw the vector **XY** 25mm in length, to represent the vertical downward pull of the weight, and on it mark its arrow, pointing downwards. From the point **Y** draw a line parallel with **CB** and on it mark an arrow to represent the direction of the upward tension in the right leg of the span. From the point **X** draw a line parallel with **AC** so that it cuts the preceding line at **Z**, and on it mark an arrow to represent the direction of the upward tension in the left leg of the span. Then: **YZ** is the vector representing the tension in the right leg of the span, which will be found to be 19mm long (approximately), representing a force of 7.5 tonnes; and **ZX** is the vector representing the tension in the left leg of the span, which will be found to be 25mm long (approximately), representing a force of ten tonnes.

f. The approximate pull on the shackles at **A** and **B** will therefore be ten tonnes and 7.5 tonnes respectively.

g. In a similar manner the stresses on other parts or fittings of a mast and a derrick, such as the tension in the topping lift and the thrust in the derrick, can be found if the magnitude and direction of two of the three forces involved are known, or if the magnitude and direction of one force and the direction of the two other forces are known. Care should be taken when determining the direction in which a force acts; for example, when considering the stresses at the derrick head the tension in the topping lift of a derrick will be acting in a direction from the head of the derrick towards the mast, but when considering the stresses at the masthead fitting it will be acting in the reverse direction.

03056. Derricks

a. A derrick is a spar, made of wood or steel, rigged as a swinging boom and used for hoisting boats, stores, cargo, ammunition or gear in and out of a ship. It can be fitted to a mast or a king post, when it is called a **mast derrick**, or to the side of a ship's superstructure, when it is called a **screen derrick**. Only screen derricks are fitted in HM warships. The lower end or heel is pivoted in a **gooseneck**, allowing the derrick to pivot both vertically and horizontally. The upper end or **head** is supported by a topping lift and stayed by guys. The load is hoisted or lowered by a whip or a purchase, which is rove through a block at the derrick head and a leading block at the heel and then taken to a winch. The rig of a derrick varies considerably in detail according to the purpose for which it is provided, the weight it is designed to hoist, and the position in which it is fitted. A simple mast derrick as fitted in merchant ships is illustrated in [Fig 3-186](#). The topping lift and guys are shackled to a spider band at the derrick head. The topping lift of a mast derrick is usually led to the masthead, and that of a screen derrick to a point on the superstructure directly above the heel of the derrick; the guys are led to positions on deck near the ship's side and well before and abaft the heel. Topping lifts are of two main kinds, **standing** and **working**.

b. Guys usually take the form of short pendants tailed with tackles; two are usually fitted, but heavy derricks may be fitted with as many as four; some derricks are provided with standing guys called **preventer guys**, which are fitted to prevent the derrick from swinging too far in a certain direction. A screen derrick as fitted in warships is illustrated at [Fig 3-187](#). This is shown rigged with a standing topping lift but sometimes it may be rigged with a working topping lift. As well as the simple mast derrick illustrated at [Fig 3-186](#), merchant ships may be fitted with derricks of different types and rigs, capable of very heavy lifts, and employing various methods of operation; further information on these rigs is contained in British Standard MA: 1976, **Design and Operation of Ships' Derrick Rigs**.

Fig 3-186. A Simple Mast Derrick (Merchant Navy)

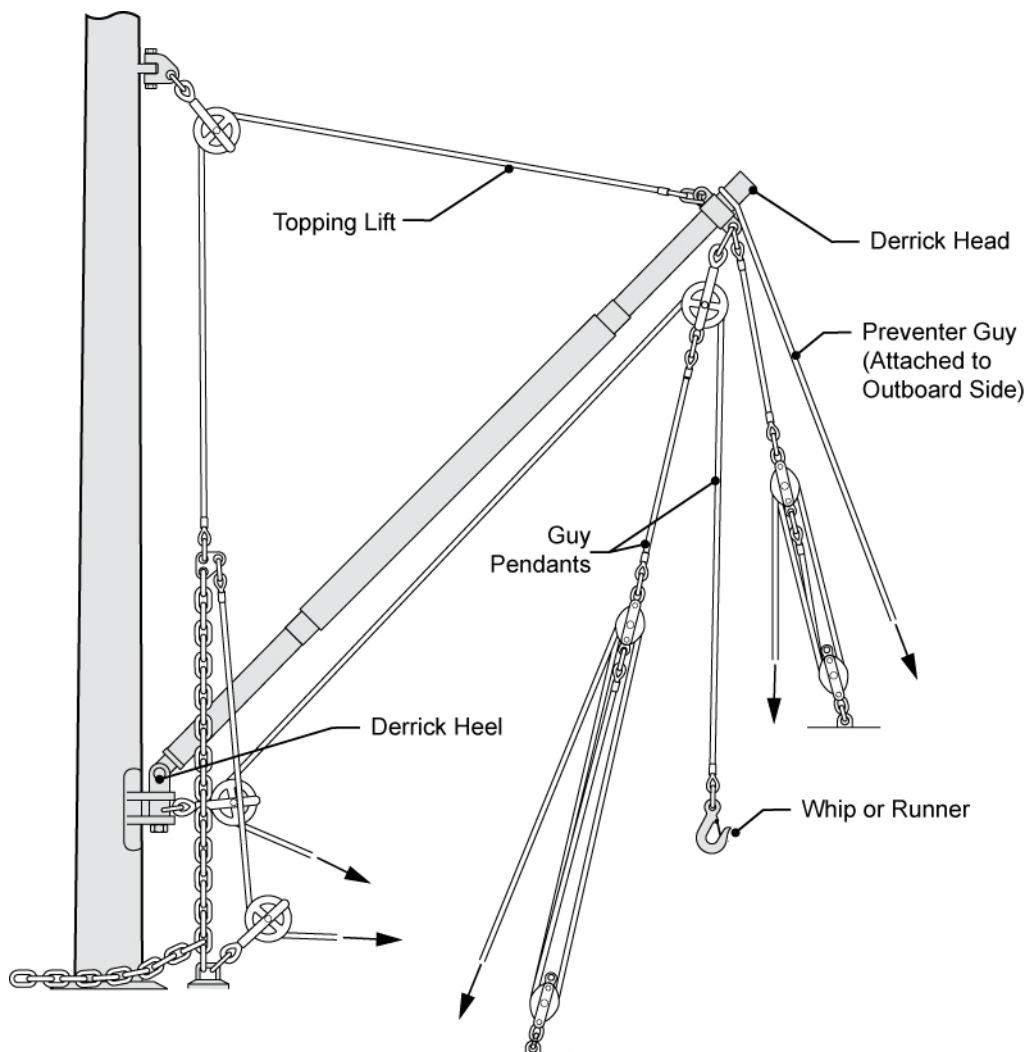
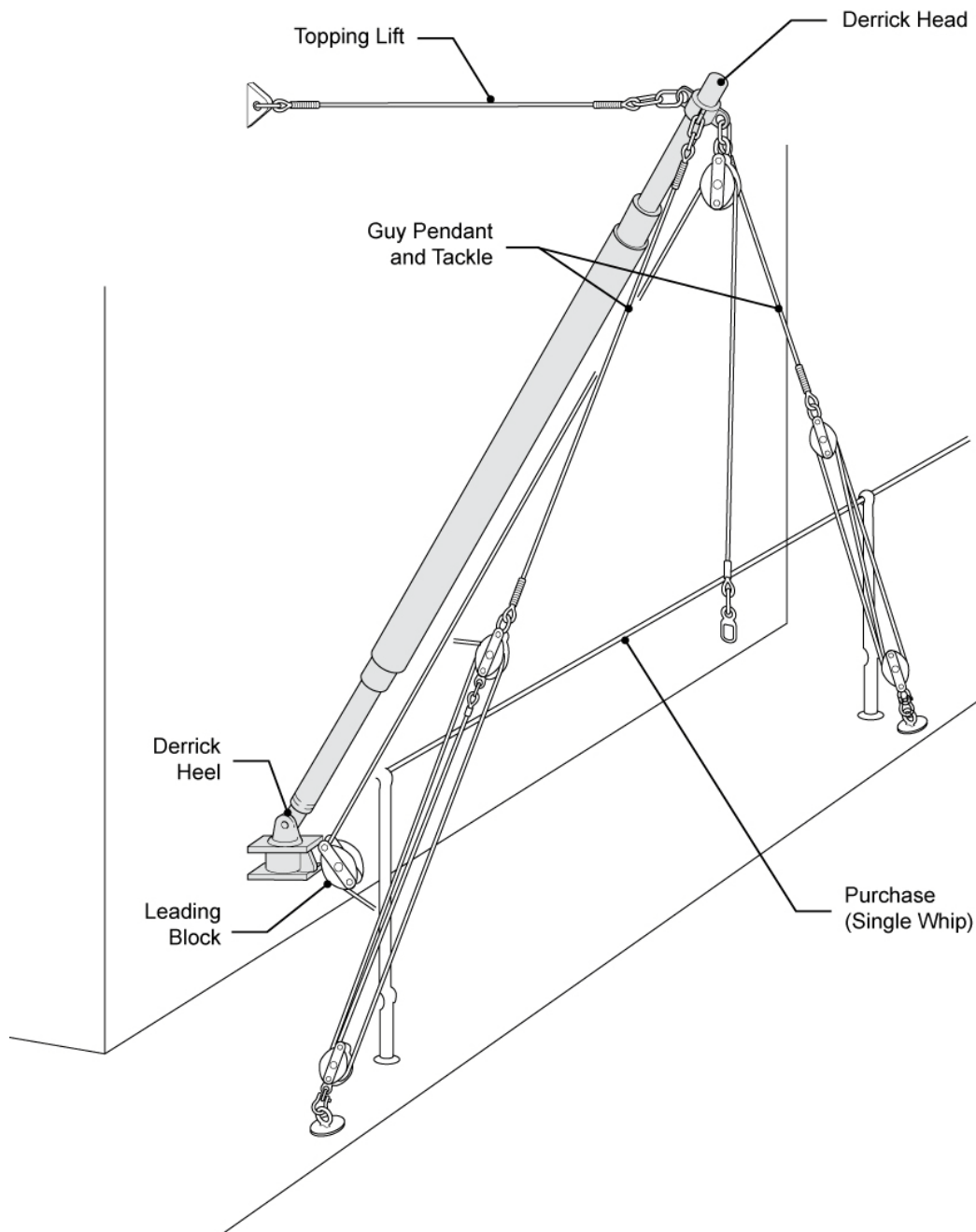


Fig 3-187. Screen Derrick (Royal Navy)



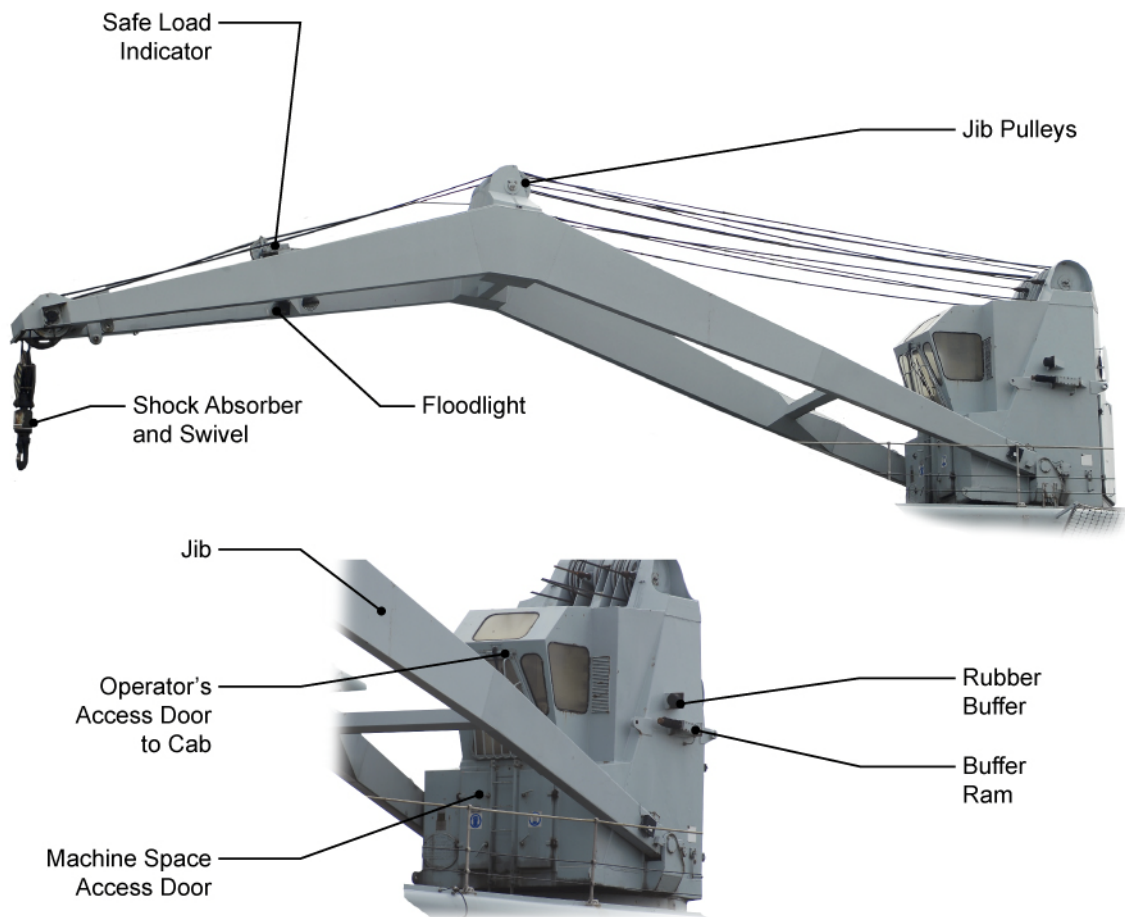
03057. Cranes

a. Cranes supplied for shipborne use are quicker and more convenient in operation than derricks. They are used for hoisting boats, stores, cargo, ammunition or gear in and out of a ship. The characteristic feature of a crane is a jib, or projecting hinged arm, which may be rigid, or telescopic, or articulated and telescopic. Fixed cranes in use in the Royal Navy fall into two categories; the rigid jib type of crane, fitted only in major warships, RFAs and certain hydrographic survey ships, and the articulated and/or telescopic jib type fitted in many warships, primarily as a method of deploying the seaboat. Both types are described overleaf. Certain major warships carry mobile cranes, of the telescopic jib type.

b. **Rigid Jib Crane (Fig 3-188).** The wire rope purchase is rigged as a single or double whip and leads from the purchase winding drum to a sheave at the head of the jib. Between the purchase wire and the lifting hook is a **ponders ball**, the function of which is to assist the purchase to overhaul when there is no load on the hook; in some cranes the ponders ball is made in two halves for ease of removal, and some incorporate a shock-absorbing device. Besides hoisting and topping, the crane can be trained to plumb a hoist, the arc of training being restricted by an electrical limit switch to prevent damage to the crane and superstructure. The topping and purchase motions are similarly protected by limit switches at the extremities of their travel and the topping motion is usually protected by buffers at its fully topped-up position (see [Note](#)). The safe working load and maximum radius permitted are marked on a tally, and must in any case be known by the crane driver.

Note. Fixed jib cranes must not be operated below 45° of elevation.

Fig 3-188. Example of a Rigid Jib Crane as Fitted in Major Warships



c. **Articulated and/or Telescopic-jib Crane (Fig 3-189).**

(1) There are a variety of cranes in use in the Fleet that fall into this category. The jib is articulated and the outer section of jib may be telescopic; to protect the surfaces of the chromium plated hydraulic cylinders the jib can be folded into the 'stowed' position when the crane is not required for use. In use, the telescopic outer section of jib can be 'jibbed out' to increase its length (see [Note](#)). It is important that operators are aware of the safe working load of the crane for any given radius of operation. The radius of operation is the horizontal distance between the cranes centre of rotation and a vertical line drawn through the centre of the hook.

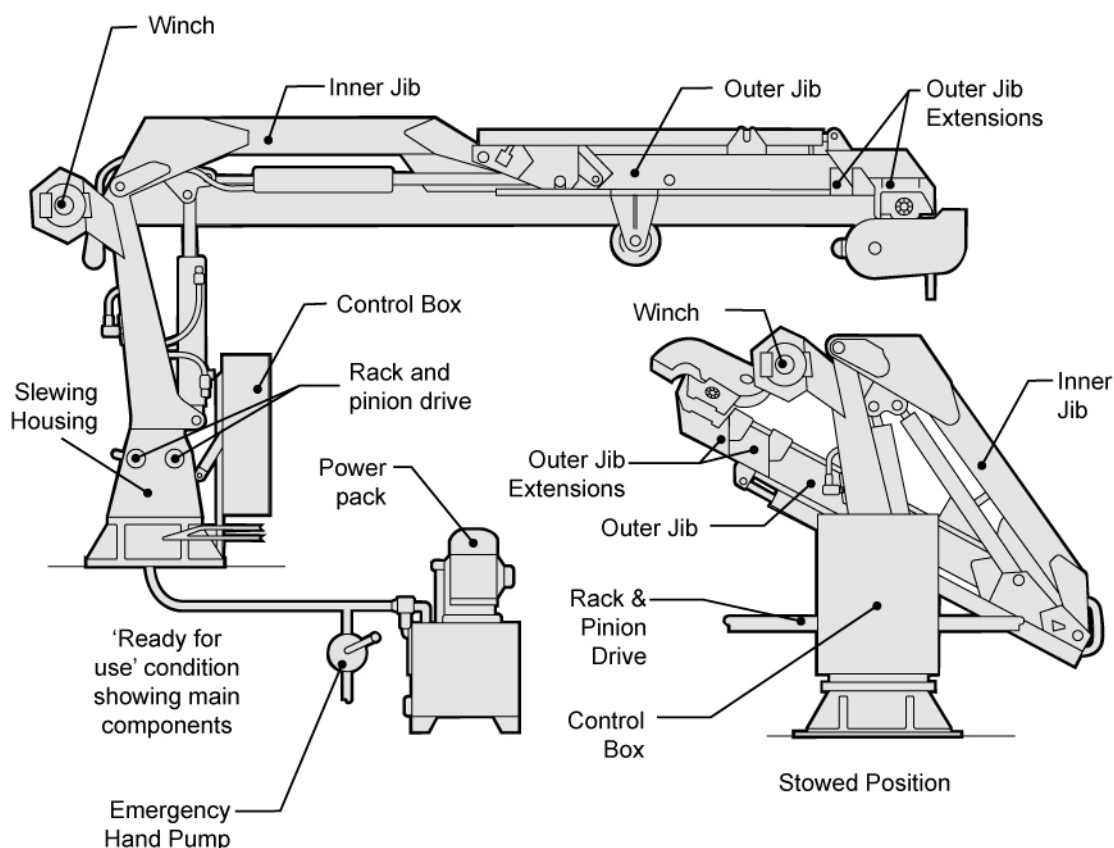
WARNING

THE SAFE WORKING LOADS FOR ANY GIVEN RADII OF OPERATIONS MUST BE MARKED ON A TALLY PLATE CLEARLY VISIBLE TO THE OPERATOR.

(2) These types of cranes are not normally fitted with limit switches, and because guardrails, aerials, launchers, lockers etc may all be within the operating radius of the crane careful operation is essential. The rig of the wire purchase rope from the winch to the hook varies with the type of crane and on-board documentation must be checked to ascertain the precise fit.

Note. Articulated and/or Telescopic-jib Cranes must not be operated with the jib lower than 0° elevation.

Fig 3-189. Example of an Articulated, Telescopic-jib Folding Crane



RIGGING AND DECK GEAR

d. **Operation of Cranes.** Personnel acting as crane drivers or crane controllers must be trained to a level that enables them to perform competently day or night; details are as follows:

(1) *Crane/Davit Controllers.* The Chief Bosun's Mate is responsible for the supervision and training of personnel required to direct cranes. The controllers must be fully conversant with standard crane signals, have a sound knowledge of slinging procedures, and the operating limitations of the crane/davit they are controlling. Before being allowed to carry out the duty of crane/davit controller they must be examined and confirmed competent. A certificate to this effect (example below) is to be completed and retained in the Seamanship Data Book. The certificate expires when the holder is re-assigned. Crane controllers must wear an orange safety helmet and a day-glow orange armband and should be positioned so that the crane driver has clear visual observations of the signals at all times during the lifting operation. Under no circumstances is a load to be directly attached to the crane hook until it has been ascertained that the load is free from any restraining connections. If for any reason the load cannot be freely suspended, for example if adjusting or 'inching' a load that is being bolted or welded into position on the ship, then a chain block, pull lift or similar **manual** apparatus must be inserted between the load and stationary crane hook. Standard crane signals are illustrated in [Fig 3-190](#). Signals must be made clearly and distinctly.

CERTIFICATE OF COMPETENCE

This is to certify that ...NAME AND RATING...has proved themselves to be competent to carry out the duty of Crane/Davit Controller in accordance with BR 6004.

Signed.....Chief Bosun's Mate

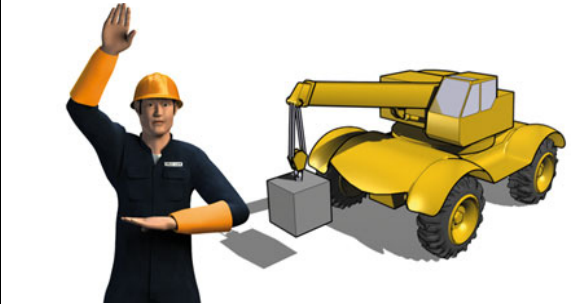
Name.....Rate.....

Date.....HMS.....

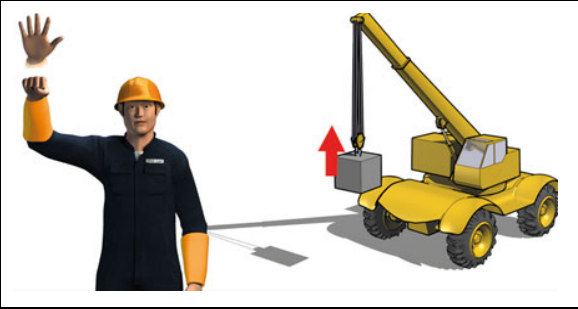
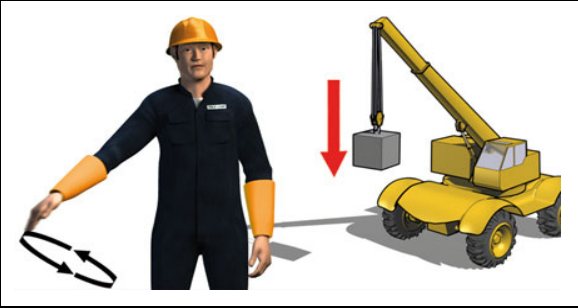
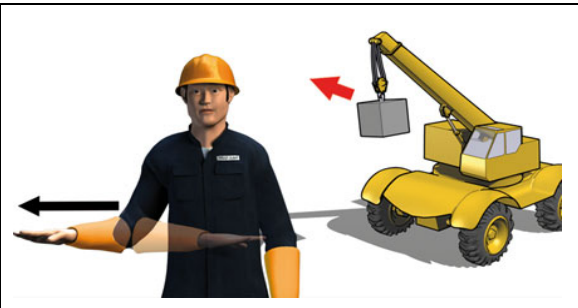
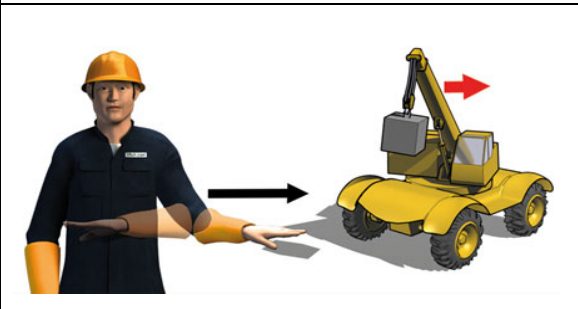
Fig 3-190. Standard Crane Signals

e. Standard Crane Signals.

(1) Fig 3-190 shows the recognised crane signals (as directed by BS 7121) to be used to provide instructions to a crane driver. The signaller should stand in a secure position where he can see the load and can be seen clearly by the crane driver and be facing the driver if possible. Each signal must be clear and distinct. **For an animated demonstration of the signals, left click on each individual graphic in the table below.**

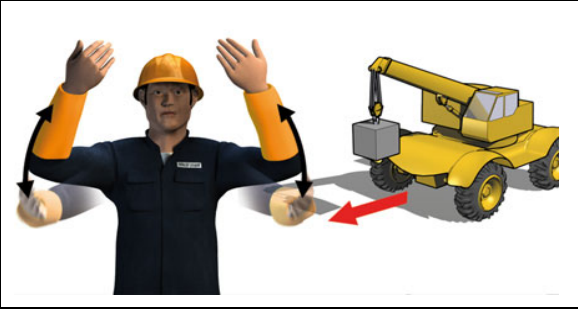
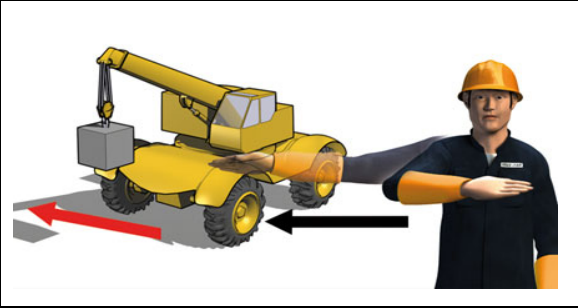
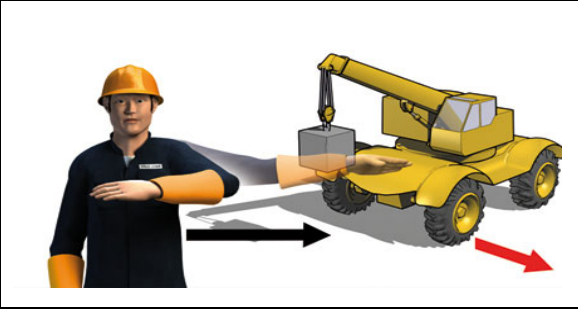
Signal		Description	Hand Signal for Crane Operation.
Operations Start		Follow my instructions	
Operations Cease		Cease to follow my instructions	
Stop		Raise one hand above the head	
Emergency STOP		Both hands and arms raised above the head	

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Controlling the Movement of the Load.	a/ b	Inch and Hoist Inch = Opening and Closing of the Hand. Is Used for raising and lowering. Hoist = Rotation of Forearm.	
	c	Lower Slowly	
	d	Lower	
Slew	a	Slew in the Direction Indicated	
	b	Slew in the Direction Indicated	

Jib Telescoping (Horizontal)	a	Jib Up	
	b	Jib Down	
	c	Extend (Trolley Out)	
	d	Retract (Trolley In)	

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Moving the Crane (For Mobile Cranes)	a	Travel To Me	
	b	Travel From Me	
	c	Travel In the Direction Indicated	
	d	Travel In the Direction Indicated	

(2) *Crane/Davit Drivers.* Ships' cranes/davits must be driven by competent persons. Where no evidence exists that the potential crane/davit driver has completed a recognised course, instruction must be carried out on board by the crane/davit maintainer, using information given in the relevant operator's guidance instructions, and **BR 3027, Manual of Inspection and Tests of Lifting Plant**. The driver must be fully conversant with standard signals. The Chief Bosun's Mate and the maintainer must be satisfied that the person is capable of carrying out the task safely and in accordance with the operating instructions. A certificate to this effect (example below) is to be completed and retained in the Seamanship Data Book. The certificate expires when the holder is drafted.

CERTIFICATE OF COMPETENCE

This is to certify that ...NAME AND RATING...has proved himself competent to carry out the duty of Crane/Davit Driver on ...TYPE OF CRANE/DAVIT.....

Signature CBM.....Signature Maintainer.....

Name.....Rate.....NameRate.....

Date.....HMS.....

f. **Maintenance and Testing of Cranes.** Maintenance and testing of cranes is to be carried out in accordance with the Maintenance Management System (MMS).

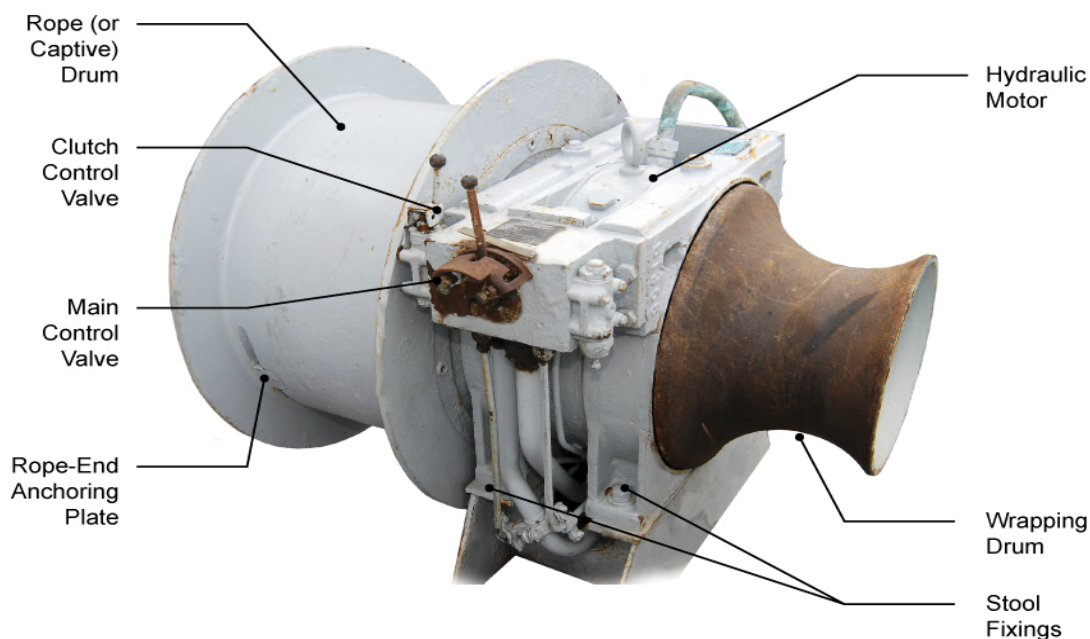
03058. Winches

a. Winches are used for heaving and veering ropes and wires. Those fitted in Royal Navy ships may be powered either electrically or hydraulically, and various forms of drive, clutch and brake are fitted, depending on the use for which the winch is intended. Winches are normally stool-mounted, and may be fitted with a single **warping drum**, or a single **rope drum** (often referred to as a **captive drum**), or, as shown in [Fig 3-191](#), a warping drum and a rope drum. To bring a rope to a warping drum take three turns of the rope round the drum in the required direction and back up the hauling part as it comes off the drum. Three turns are usually sufficient when hawsers are being hove in, but for heavy loading it may be necessary to take an extra one or two turns, giving due regard to the size and strength of the rope and equipment involved. As the rope passes round the drum the turns have a tendency to ride from the middle towards one end; this tendency is counteracted by the load on the rope forcing the turns down the curve to the narrowest part of the drum. To hold the rope stationary while the drum is heaving in, ease the pull on the hauling part sufficiently to allow the turns to slip, or **surge** round the drum. Never surge the rope when the drum is veering, and do not allow riding turns to develop on a warping drum, because if this happens control of the rope is lost unless the drum is stopped. Rope drums are normally used only during replenishment evolutions. A one-metre tail of 8mm polypropylene is hitched or spliced to the rope-end anchoring plate of the drum; the rope to be heaved in, also end fitted with an Inglefield clip, is clipped to the outboard end of the tail. By heaving in on the winch the rope is wound onto the drum. To ensure reasonably even distribution of the rope on the drum it may be necessary to use wooden handspikes to force the lead of the rope back and forth across the drum. Ships fitted with single warping drums for replenishment have no choice in their method of working lines. Ships fitted with a single captive drum are to tail hoses, heavy jackstay outhauls and remating lines to the drum.

If a sliprope is required, it should be fed onto the drum immediately the hose line has been removed, then the outboard end rigged as a sliprope. The captive drum must never be used as a warping drum because of the danger of riding turns.

b. Ships fitted with a combination captive/warping drum are to tail heavy jackstay inhauls to the captive drum. Hoselines used in probe refuelling may be taken to the warping drum or tailed to the captive drum as required by individual ships. When the rig requires a sliprope this is to be fed onto the captive drum as part of RAS preparations and the rig brought across on the warping drum. When the hose line has been removed the sliprope is rigged. When a remating line is employed it must be taken to the warping drum.

Fig 3-191. A Typical Winch fitted with Warping Drum and Rope (or Captive) Drum



03059. Introduction to Improvised Rigs of Derricks, Sheers, Gyns and Ropeways

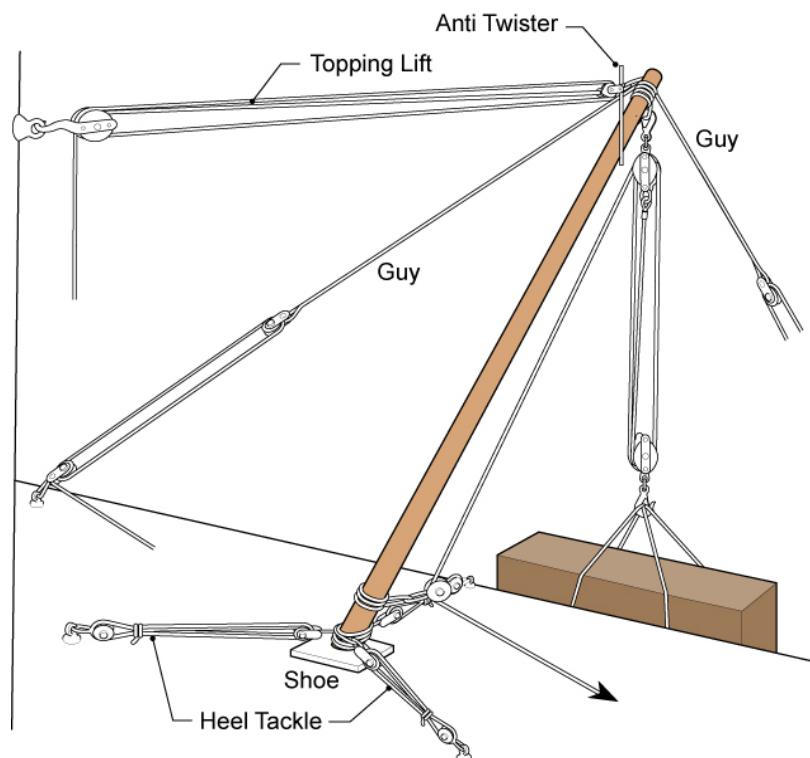
a. With modern developments of hydraulics, and the increasing availability of portable and mounted cranes, the requirement to improvise lifting rigs has greatly reduced; however, in certain circumstances the seaman may still be called upon to use his ingenuity, either on board or ashore, to rig some form of derrick, sheers or gyn to lift or handle heavy stores or equipment. He will have to do this using his own ship's gear, supplemented sometimes by anything he can find ashore. Ships no longer carry timber spars specifically for improvised lifting rigs and the only available on-board source of timber is the Douglas Fir shores supplied for Damage Control purposes. [Table 3-43](#) gives the approximate safe working thrust applicable to most timber other than softwoods and allows a factor of safety of ten. However, timber obtained from outside sources or cut down ashore should be treated with caution and the seaman must exercise his judgement in deciding the realistic loading such timber is likely to safely withstand. The derrick is a single upright spar; the swinging derrick consists of an upright spar with a swinging boom pivoted at its foot. Sheers consist of two upright spars with their heads lashed together and their feet splayed out. A gyn is a tripod formed by three spars with their heads lashed together. A ropeway consists of an overhead jackstay of rope set up between two sheers, or gyns, along which a travelling block is hauled back and forth.

Table 3-43. Approximate Safe Working Thrust of Timber Spars

Mean Diameter	Length								Size of Equivalent Square Baulk
	mm								
	3000	4000	5000	6000	7000	8000	9000	10000	
mm	Approximate Safe Working Thrust in tonnes								mm
150	0.78	0.46	0.30	0.21	0.16	0.12	0.10	0.08	133
175	1.40	0.84	0.55	0.39	0.29	0.22	0.18	0.14	155
200	2.29	1.40	0.93	0.66	0.49	0.38	0.30	0.24	177
225	3.50	2.17	1.46	1.04	0.78	0.60	0.48	0.39	199
250	5.19	3.21	2.18	1.56	1.17	0.91	0.72	0.59	222
275	7.09	4.57	3.12	2.25	1.69	1.32	1.05	0.86	244
300	9.55	6.24	4.31	3.14	2.37	1.85	1.48	1.21	266

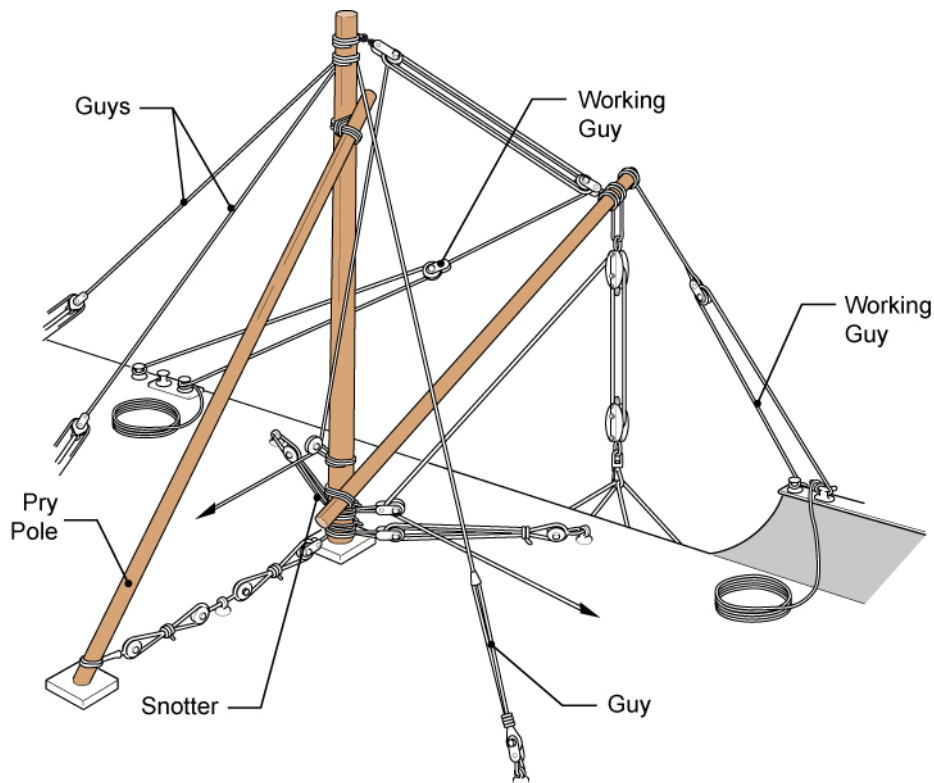
b. **Standing Derrick.** A standing derrick is a single spar (Fig 3-192) stayed by rigging and having a tackle at its head for hoisting a load. Its head is supported by a **topping lift**, or, if there is a no suitable overhead attachment point for a topping lift, it is supported by a **Back Guy**. **Side guys** are fitted to give lateral support and, if there is a suitable attachment point, a martingale or **Fore Guy** may be lead downwards from the head to prevent the head from springing upwards or backwards when hoisting or lowering a load. If it has an efficient topping lift led from a point vertically above the heel, the derrick can be slewed to a limited extent as well as being topped and lowered. If the load is heavy, or if a Back Guy is fitted, or if the topping-lift attachment point is not vertically above the heel, slewing must not be attempted. The safe working load of the derrick is governed by the size and material of the spar and the strength of the rigging gear available.

Fig 3-192. Standing Derrick



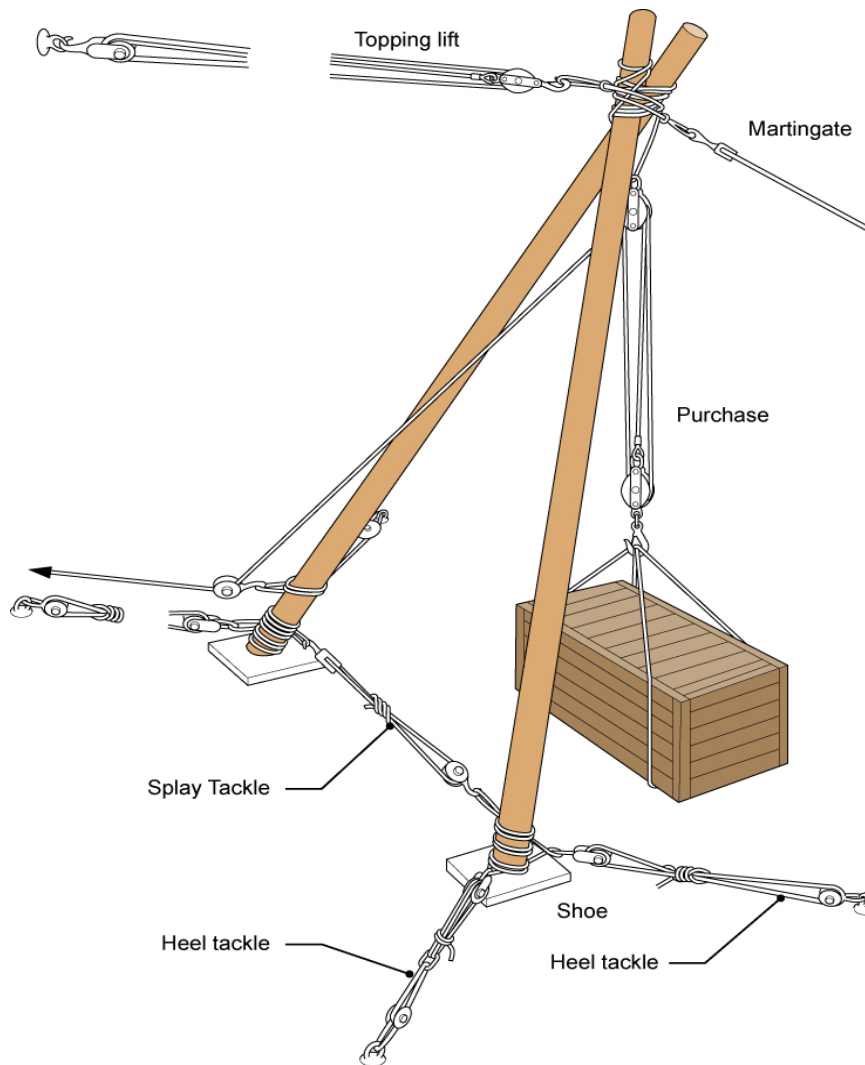
c. **Swinging Derrick.** A swinging derrick is made up of two spars ([Fig 3-193](#)), one upright and well stayed by guys, and the other secured to the first by a strop called a **snotter** and a topping lift, so that it forms a swinging boom. Working guys are led from the head of the boom as in a permanent derrick, and the boom can be topped, lowered and slewed through an angle up to 120° when the load is slung. A derrick of this type is not suitable for heavy loads, because of the stress imposed on the snotter. In addition, it is often difficult to rig a martingale (fore guy) for the upright spar, though another spar lashed to it so as to form a strut (called a **prypole**), as illustrated in [Fig 3-193](#), affords an effective alternative. Although this derrick is more complicated in rig than either a standing derrick or sheers, it is particularly useful for disembarking stores from a boat to a jetty.

Fig 3-193. Swinging Derrick



d. **Sheers.** Sheers consist of a pair of spars called **legs**, which are lashed together and crossed near their heads ([Fig 3-194](#)); the cross is called the **crutch**. They are supported in a vertical or an inclined position by rigging, and a tackle for hoisting the load is secured to the crutch. The overhead rigging consists of either a topping lift and martingale or a back guy and fore guy; as sheers need no lateral support, side guys are not fitted. If a topping lift is fitted it should be led to a point aloft so that it makes, as nearly as possible, a right angle with the sheers **when they are loaded**. If a back guy is fitted it should be led to a point equidistant from the heels of the legs and making as broad an angle as possible with the sheers. Sheers can be topped -up or lowered through a limited angle, the extent depending on the lead of the topping lift; if a back guy is rigged, however, neither sheers nor derricks may normally be canted to an angle of more than 20° with the vertical. As sheers are made from two spars they are, of course, stronger than a derrick of equal size and of the same materials. Sheers are particularly suited for use when the load is not required to be slewed, such as on the edge of a wharf or the banks of a river, or in lifting a weight from a boat to the deck of a ship.

Fig 3-194. Sheers



e. **Gyn.** A gyn (Fig 3-195) consists of three spars with their heads crossed and lashed together and their heels splayed out to form a tripod. A gyn is stronger than sheers and derricks, and it requires no rigging to support it, but it can only be used for a straight lift and cannot normally be traversed with its load slung.

f. **Ropeway.** A ropeway (Fig 3-196) is used to transfer loads across a river or a ravine. Gyns are preferable to sheers as supports for the jackstay, because they are more stable and need less guying. An improvised ropeway is usually confined to transferring light stores and equipment, because of the heavy stresses set up in the jackstay when transferring a load; a 60-metre, 24mm SWR jackstay, for example, is limited to a maximum load of only 1118 kgs, using a safety factor of four. The formula to calculate the theoretical tension in a jackstay between supports at the same level is:

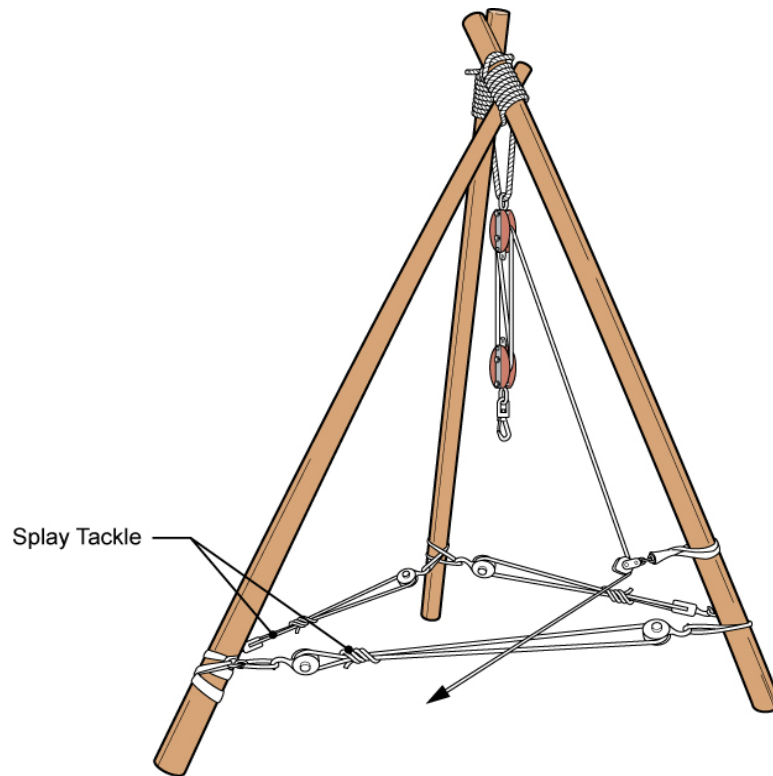
$$Tension = \frac{Wl}{4s}$$

BR 67
RIGGING AND DECK GEAR

Where:

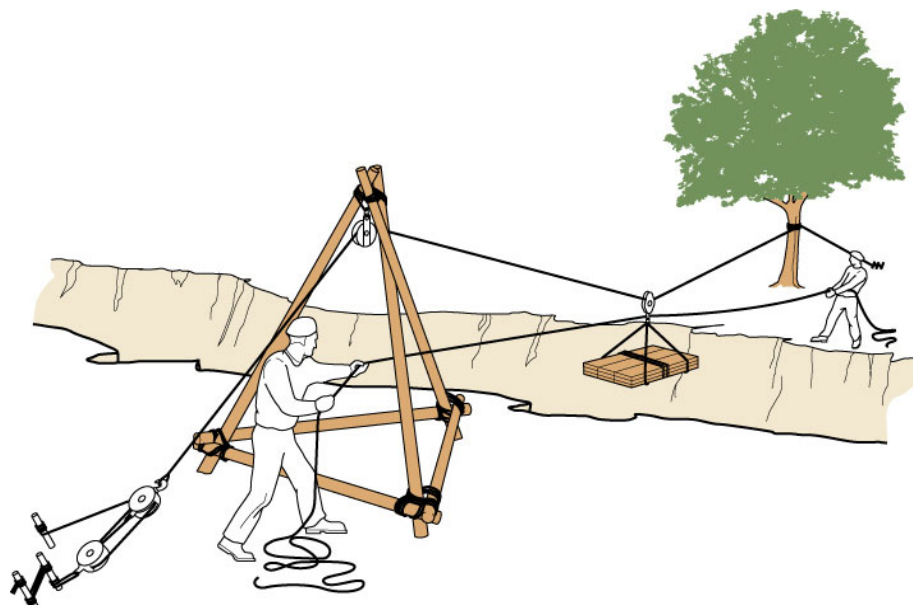
W is the total weight of the load, including traveller and slings,
 l is the distance between supports,
 s is the dip of the centre of the jackstay (in same units as l).

Fig 3-195. A Gyn



Note. A Winnet or Thumb Piece can be secured above the snotter to stop it rising up the pole.

Fig 3-196. Simple Ropeway



03060. Gear Required and Principles Involved When Rigging Improvised Lifting Gear

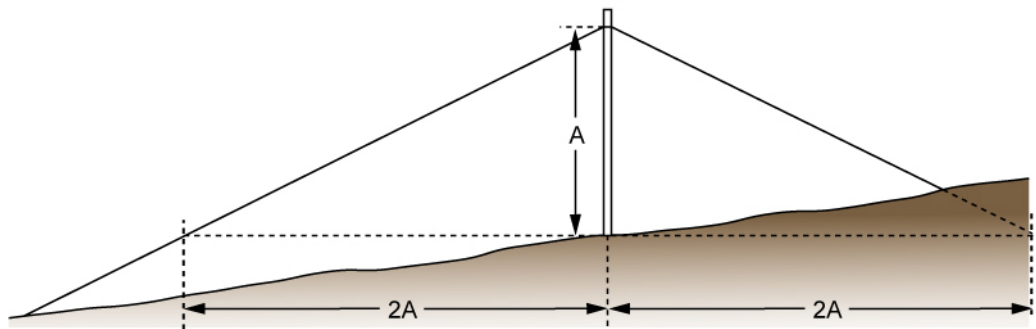
a. The rigging for derricks, sheers and ropeways must be led so that it does its work efficiently. As already stated the best lead for a topping lift is at right-angles to the derrick and towards a point vertical above the heel, but this will often not be possible in practice; an angle of 60° or more between the topping lift or back guy and the derrick will be reasonably effective, and it should never be less than 45° . Similarly, the angle between the side guys and the derrick should, if possible, be 60° or more, and these should not be inclined at a greater angle than 30° – ie at a slope of not more than 1 in 2 – with the horizontal.

b. **Guys.** The guys of derricks and sheers, particularly those used for heavy loads, stretch considerably when under load, and all guys must therefore be working guys so that the tensions can be adjusted. When picking up a load, a derrick or sheers should be heeled over to a few degrees less than the required angle to allow for the stretch in the topping lift or back guy; with heavy sheers this allowance may be as much as 8° . For light derricks or sheers the guys are usually wire pendants tailed with luff tackles, but for heavy derricks and sheers the guys should be at least runners rove through blocks at the head of the derrick or sheers and tailed at their hauling part with luff tackles or two-fold purchases. If sheers are required only to traverse a load as far as their heels, the martingale (or fore guy) only acts as a preventer and therefore may be about half the strength of the topping lift or back guy; but if a load is to be traversed to a position behind their heels the martingale and topping lift must be of equal strength. If a derrick is required to slew a load through an angle of less than 90° , the side guy on the training side and the martingale (or fore guy) act only as preventers and need not be as strong as the other guys or topping lift; but if the slewing angle is 90° or more, all guys and the topping lift should be of equal strength. To give a guy a slope of one in two when ashore and on firm and level ground, the distance of a **holdfast**, described in [sub para f](#), from the foot of a derrick or sheers should be twice the effective length of the derrick or sheers, and to give it a slope of one in three, it should be three times the effective length. To obtain the correct lead for the guys on sloping ground the uphill and downhill holdfasts must be placed closer to and farther from the foot than is normally done ([Fig 3-197](#)). If a guy holdfast is inaccessible - for example, an anchor laid offshore - the hauling part of the guy tackle must be led to the head of the derrick or sheers and thence to the foot.

c. **Shoes.** A shoe for a light derrick, sheers or a gyn is usually a square slab of hardwood with a recess in its upper surface to take the heel of its spar. The length of each of its sides should be not less than four times the diameter of the spar. For heavy spars the shoe is of metal or made up from baulks of timber. A shoe is used to distribute the weight of the load and the thrust of the spar over an area of deck, or, when used ashore, to distribute the weight so as to prevent the spar from sinking into the ground. When used ashore the shoe should be sunk level and held in place by **pickets** (described later) driven in at intervals along its sides and with their heads flush with the shoe. Shoes should always be used for spars of improvised lifting rigs, except when handling light loads, and must be placed at the same level; otherwise an undue stress will be placed on one of the legs and the sheers or gyn will tend to capsize. When using spars aboard ship, the deck on which they stand must be well shored-up below.

d. **Heel Tackles.** Heel tackles are used to prevent unwanted movements at the heels of spars used for derricks and sheers. However, the heel tackles can be used to move sheers about the deck if required. The angle between the tackles should be 120° wherever possible ([Fig 3-194](#)).

Fig 3-197. Correct Lead for Guys on Sloping Ground



e. **Splay Tackles and Belly Tackles.** A splay tackle is used to prevent the heels of spars from moving farther apart (Fig 3-195). Belly tackles are secured to the middle of a spar when there is doubt concerning its strength for a particular job. The spar is then stayed to the deck or ground.

f. **Holdfasts for Use on Shore.** In a warship it is a relatively simple task to find eyeplates or other permanent fittings to hold fast improvised rigging; but when ashore, and probably under adverse conditions, the seaman must find or construct an anchorage to hold his improvised gear firmly and safely in place. Holdfasts (Fig 3-198) may consist of existing natural or structural features; or pickets driven singly or in combination into the ground; or baulks of timber placed behind a line of driven pickets; or ships' anchors embedded in the ground and held by driven pickets; or baulks of timber buried in trenches dug in the ground. Whatever the type of holdfast it must be more than strong enough for the stress it is intended to bear, because once a holdfast starts to give it is difficult to strengthen it. A holdfast must be so arranged that the maximum resistance it can offer is in line with the stress it can bear; a buried baulk of timber, for example, should lie at right angles to the pull, whereas a combination of pickets should be driven exactly in line with the direction of the pull.

(1) *Existing Holdfasts.* Used whenever it is practicable, provided that they are conveniently situated and strong enough for the job. The holding power of a tree is uncertain, because so much depends on the depths of its roots and the nature of the soil; a tree can be considerably strengthened, however, by fitting it with a back guy, and if two trees are growing close together their combined holding power can be used by placing a baulk of timber across them. A baulk of timber placed across a gap in masonry makes a good holdfast, provided that the stress is distributed over a sufficiently large area of the masonry by placing planks vertically and horizontally between the baulk and the masonry. The pier of a bridge or the base of a tower can be used by encircling it with a strop, but the strop should be protected from chafe or bad nips.

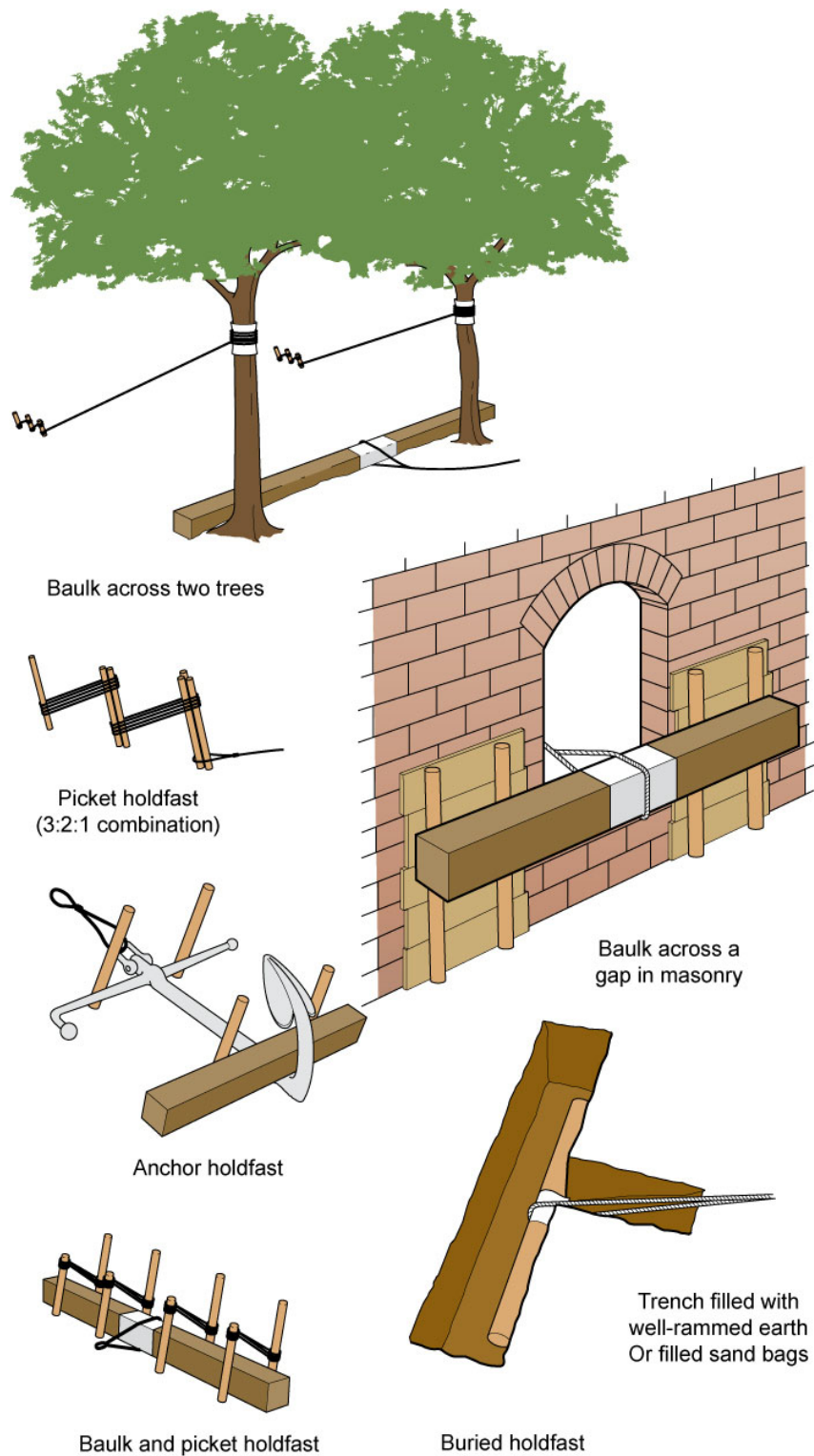
(2) *Picket Holdfasts*. Used in ordinary soils for pulls not exceeding two tonnes. The normal picket is an ash stake 1.5 metres long and 75mm in diameter, with one end pointed (and, when possible, shod with iron) and the other end bound with an iron hoop; it should be driven to a depth of one metre at an inclination of about 20° to the vertical. Pickets may be used singly, or lashed together in combinations of one-and-one, two-and-one, or three-two-and-one, as shown in [Fig 3-198](#).

(3) *A Bulk and Picket Holdfast*, consists of a baulk of timber placed behind a line of driven pickets, which are backed, by another line of pickets; it may be used for pulls of between two and ten tonnes. Only two lines of pickets should be used, driven in combinations of one-and-one or two-and-one, with each combination at least half a metre from the next. A three-two-one combination of pickets should not be used, because of the difficulty of driving the pickets so that each will bear its fair proportion of the stress. The front row of pickets should be exactly in line so that the stress on the baulk is divided equally among them, and the ground under the baulk should be cut away to allow the face of the baulk to bear evenly against the inclined pickets ([Fig 3-198](#)). The baulk should be well parcelled where the strop passes round it.

(4) *An Anchor Holdfast*, consists of an Admiralty Plan anchor embedded and supported by pickets, as shown in [Fig 3-198](#). If the pull is horizontal it will take a stress up to the strength of its ring, but it is not very suitable as the holdfast for a guy, because the upward pull of the guy tends to dislodge the anchor. When an offshore underwater holdfast is required for the fore guy of a derrick or sheers the anchor should be laid in a position which gives the guy plenty of scope, and its angle of scope should not be steeper than one in three; that part of the guy which will be underwater should be of chain. Backing one anchor with another gives greater holding power, provided that the anchors are well separated.

(5) *A Buried Holdfast*. Used for pulls of over ten tonnes consists of a baulk or baulks of timber laid in a trench and then covered with well rammed earth. The trench should be 600cms longer than the baulk and have a vertical face; its depth will depend on the nature of the soil and the pull, which the holdfast is required to withstand. A subsidiary trench to take the strop must be cut, as shown in [Fig 3-198](#); its slope should not be steeper than one in three and chocks should be placed to support the baulk clear of the bottom of the trench to enable the strop to be passed. Planks can be laid vertically and horizontally between the baulk and the face of the trench to distribute the stress over a greater area.

Fig 3-198. Holdfasts

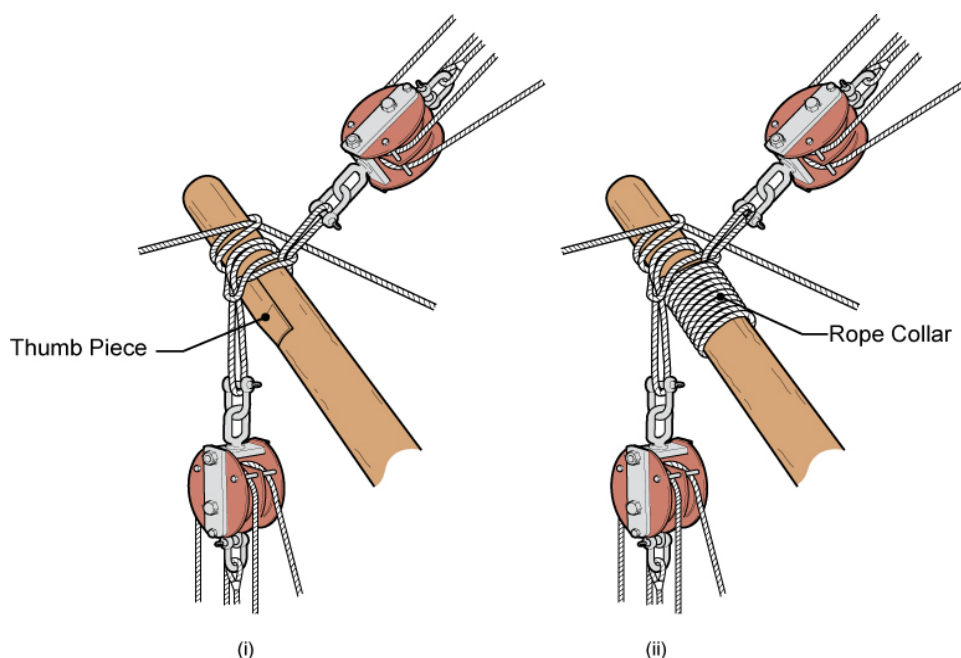


03061. Rigging Derricks, Sheers, Gyns and Ropeways

- a. Obstructions in the vicinity, lack of a clear lead for purchase, topping lift or guy, and other special circumstances make it impossible to give detailed instructions for rigging these appliances, so the seaman must do his best with the available equipment.

b. **To Rig a Standing Derrick** (Fig 3-192 and Fig 3-199). Strops for attaching the purchase and topping lift (or back guy) are placed over the derrick head, and are prevented from slipping down either by wooden projections called **thumb-pieces** (Fig 3-199(i)) screwed or nailed in place, or by a rope **collar** (Fig 3-199(ii)) put on the spar like a whipping. These strops should lie close together so as to avoid a bending stress on the spar. The guys, which consist of single parts of cordage or rope, are then middled and clove-hitched over the head of the spar, above the strops, tackles being attached if required. The distance from the foot of the derrick to the point of attachment of the purchase and topping lift is known as the **effective length** of the derrick. The heel of the derrick is kept in place by tackles, which must be led so that they will support it in every direction, and particularly from that in which the derrick will be raised and lowered. The strops for the heel tackles must be kept as low as possible; otherwise the tackles will be heavily stressed as the derrick is raised.

Fig 3-199. Methods of Rigging the Head of a Derrick Using Rope Collars or Thumb Pieces



c. **To Rig a Swinging Derrick** (Fig 3-193 and Fig 3-199).

(1) The upright spar is first erected, and is inclined somewhat away from the load so that it will become vertical as the boom takes the weight. It must be well supported by guys, each strong enough to take the entire pull of the topping lift as the boom swings round. The arc through which the boom is required to swing must, of course, be left clear. A strop to take the upper block of the topping lift is placed over the head of this spar above the guys. The spar, which is to form the boom, is now laid midway between the intended limits of its horizontal travel, and with its heel close against the upright spar and projecting on the side away from the load. The head of the boom is rigged as for a standing derrick, but the heel is attached to the upright by a snorter, as shown in Fig 3-193. If no suitable strop is available, a bight of rope can be passed round the boom, then through its own bight and then half-hitched and dogged round the upright spar in the same way as a stopper is put on a wire rope. The falls of the topping lift and purchase are led through blocks shackled to strops at the foot of the upright spar, the strops being kept in place by thumb-pieces or rope collars.

(2) As the leading block for the hauling part of the purchase fall is to one side of the boom, the latter is subjected to a sideways pull when the purchase takes the weight, and the boom must therefore be adequately guyed. In order to keep the stresses on the boom, topping lift and guys to a minimum the boom should cross the upright as low down as possible without fouling the ground or deck, and the effective length of the boom (from where the spars cross to the topping lift and purchase are attached) should be as short as the reach required will allow.

d. **To Rig Sheers** (Fig 3-194, Fig 3-200 and Fig 3-201).

(1) The spars for the legs are laid side by side, with their heels together and their heads supported conveniently clear of the ground or deck. Those parts which will be covered by the lashing are then parcelled to prevent chafe, and the heads are then lashed together as described below and illustrated in Fig 3-200. The legs are crossed and the lashing is made fast to one of the legs by a timber hitch, either above or below the cross, and then a sufficient number of round turns (usually 14 or more) to cover the cross are taken round both legs. The end is then brought up between the legs, passed down between them on the opposite side of the cross, and brought up again as before, so as to form a frapping turn binding the whole lashing together. Four or five frapping turns are applied and the lashing is completed by a clove hitch taken round the leg opposite to the one to which it was originally attached. It is important that the frapping turns are correctly put on, close to each other, and hauled taut. Choice of the rope to be used for the head lashing depends on the size of the spars and the weight to be lifted; this is best judged at the time, but the following is given as a general guide:

Weight to be lifted

Below 2 tonnes

2 tonnes to 5 tonnes inclusive

Over 5 tonnes up to 20 tonnes

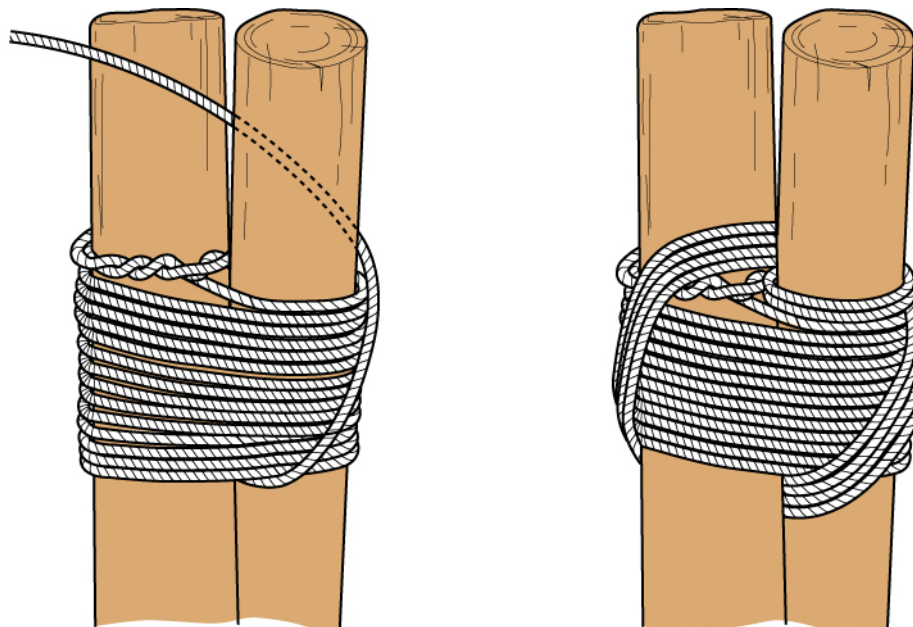
Lashing

20mm Polypropylene

22mm HMPE multiplait

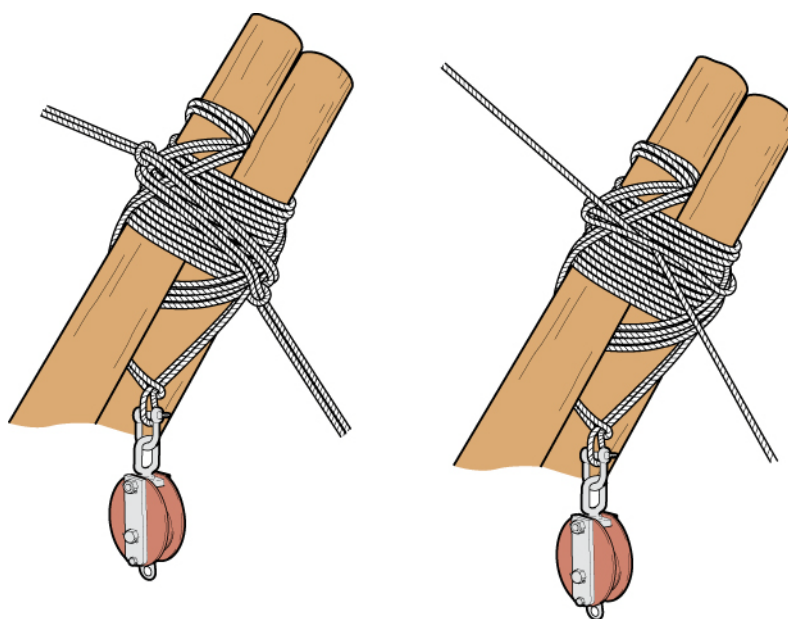
22mm HMPE multiplait

Fig 3-200. Passing the Head Lashing of Sheers



(2) When the head lashing is completed the heels of the legs are opened out to the required distance; the action of opening them out sets up the head lashing so taut that it binds the legs securely together where they cross. The strop for the purchase is now put on by slipping it up to the top leg and passing it down over the head of the lower leg, so that it will bind the two together when under load ([Fig 3-201](#)). It must be long enough to enable the block to swing clear between the legs. Chafing pieces must be placed under the strop to prevent it chafing the lashing. The topping lift and martingale, or fore and back guys, are then secured to the head of the sheers. There are several equally effective ways of doing this, two of which are illustrated in [Fig 3-201](#). In both cases, the pull of the guys should assist in binding the sheers together and the purchase strop should be free to take up its natural position as the weight comes on it.

Fig 3-201. Head of Sheers – Methods of Rigging

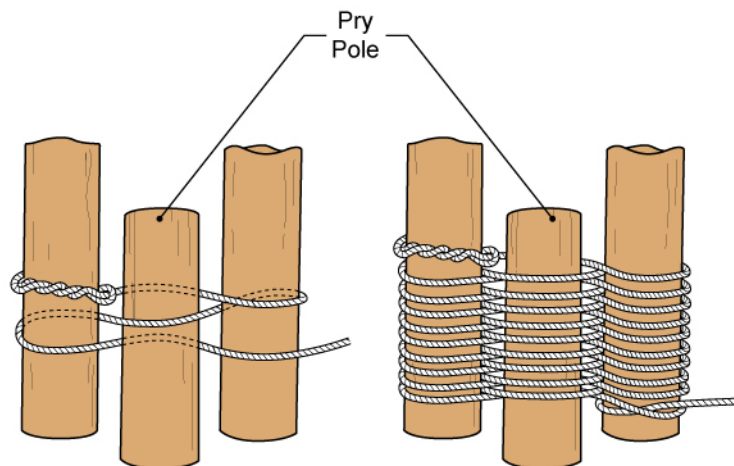


(3) The necessary tackles for the guys and other rigging are then shackled to the strops or clapped on to the end of the ropes, as required, and finally if required, a small block is attached to each leg above the cross and a single whip then rove through each to serve as gantlines for sending a person aloft to make any adjustments after the sheers have been raised. The sheers are then placed roughly in position for raising, the heels being pointed to the shoes prepared for them and supported laterally by **splay** and **heel tackles**. The distance between the shoes should be one-third of that from the foot of the sheers to the crutch, which is the effective length of the sheers. As its name implies, the splay tackle leads from the heel of one spar to the heel of the other, being secured to each by a strop. The heel tackles guy down the heels laterally and, as with a derrick, their strops should be kept as low down as possible. The leading block for the fall of the purchase is then attached to one leg, and, after fitting thumb-pieces or rope collars to prevent all the strops at the feet of the legs from slipping upwards, the sheers are then ready for raising.

e. **To Rig a Gyn** (Fig 3-195 and Fig 3-202).

(1) The position for the head lashing is first marked on all three spars to be used for the legs. The legs are then laid parallel with each other, about 50mm apart and with the heel of the centre leg pointing in the opposite direction to those of the other two. The centre spar is called the **Prypole** and the other spars the **Cheeks**. The marks must be in line and the heads of the legs should be supported clear of the deck. The lashing is then put on at the marks. It is begun with a timber hitch round one cheek, then from six to eight figure-of-eight turns are taken, as shown in Fig 3-202, and the lashing is completed with a clove hitch round the other cheek.

Fig 3-202. Passing the Head Lashing of a Gyn



(2) The lashing must be applied loosely; it cannot slip down once the Gyn is erected, and if it is too taut great difficulty will be experienced in raising the gyn; it is usual, however, to place a rope collar round the Prypole below the lashing to prevent it slipping down during the process of raising. The heels of the cheeks are now opened out, and the splay tackles are rigged between the feet of each pair. The Gyn is then raised by lifting its head and hauling the heel of the pry pole towards the heels of the cheeks by means of the splay tackles. When the head reaches a convenient height the strop for the upper block of the purchase is put on and the block itself secured to it. Then tackles are rigged as required to haul the feet into place on their shoes. When correctly placed the heels are secured by lashing or heel tackles led so as to give the necessary lateral support and the hauling part of the purchase is led through a block secured to the heel of one cheek. As with derricks or sheers, thumb-pieces or rope collars are required to prevent the strops at the heels from slipping up the spars. With very small gyns splay tackles are not necessary, and their feet can be manhandled into place and then secured, either by lashings or by short spars lashed across them.

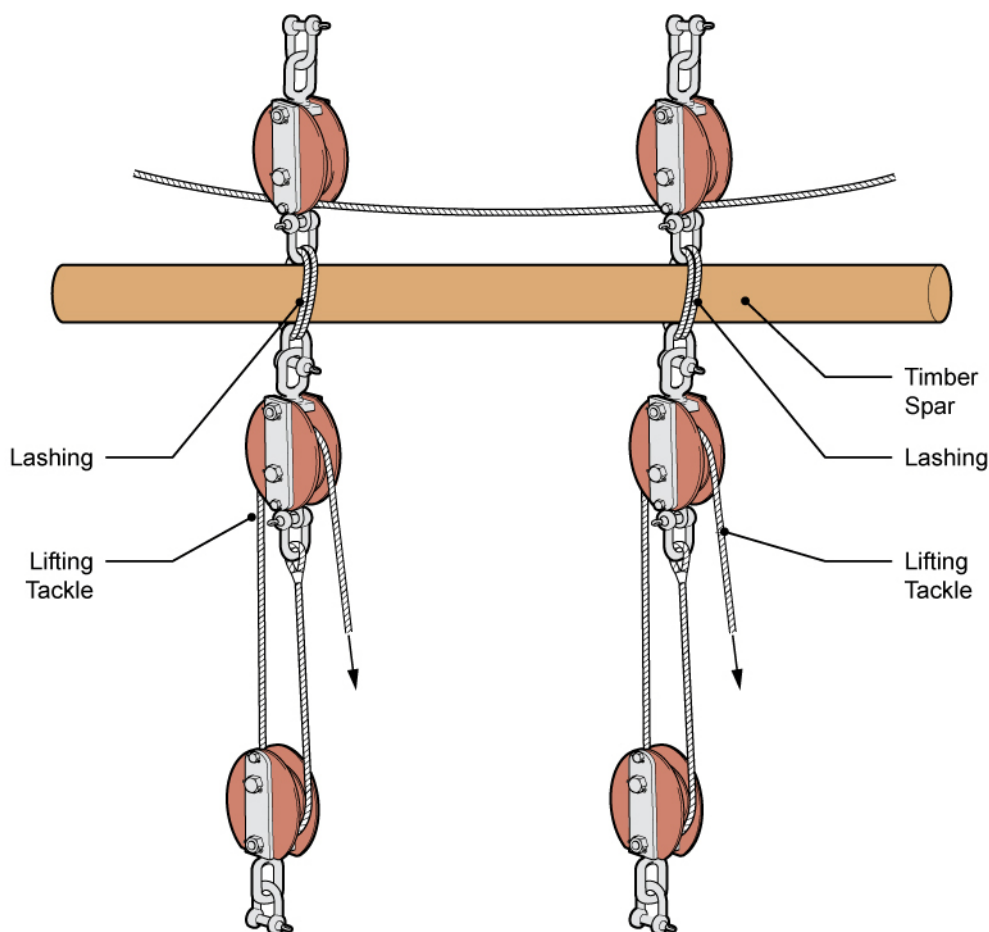
f. **To Rig a Ropeway** (Fig 3-196, Fig 3-203 and Fig 3-204).

(1) Where no suitable trees are available for supporting the jackstay of a ropeway, gyns or sheers must be used. Gyns are preferable to sheers because they are more stable, but sheers may have to be used for long jackstays with a high ground clearance if suitable spars are available. The stresses set up in a jackstay are considerable and in practice can be taken as being up to five or six times the weight of the load.

Strong holdfasts must therefore be provided for the jackstay or any back guys, and they should be placed so that the slope of the jackstay or guy from the ground to the head of the support is not steeper than one in four. The tauter the jackstay the greater will be the stresses imposed on its anchorages and supports, but the easier it will be to haul the load across. On the other hand, if the jackstay is too slack, though the stresses in it will be reduced it will be difficult or impossible to haul the load across, and also the load will tend to become laterally unstable. The practical compromise between these extremes is to adjust the tension in the jackstay to give it a dip of between one fiftieth and one-twentieth of its effective length when loaded, so that when loaded at its centre it will assume a dip of between one-twentieth and one-tenth of its effective length. For practical purposes the dip in the jackstay when loaded at its centre should not exceed one-tenth of its effective length.

(2) The jackstay can be rigged with each end secured to a holdfast and rove through a block slung from the head of each of its supports; or its standing end can be secured to the head of one support, which will then require a back guy. It is usual to set up a tackle on its running end, but for heavy loads its final adjustment must be made by a rigging screw. The traveller can be an inverted block hooked to a light tackle for hoisting the load to the required height before it is traversed, but for heavy loads the traveller should consist of two blocks lashed to a spar fitted with lifting tackles as shown in [Fig 3-203](#).

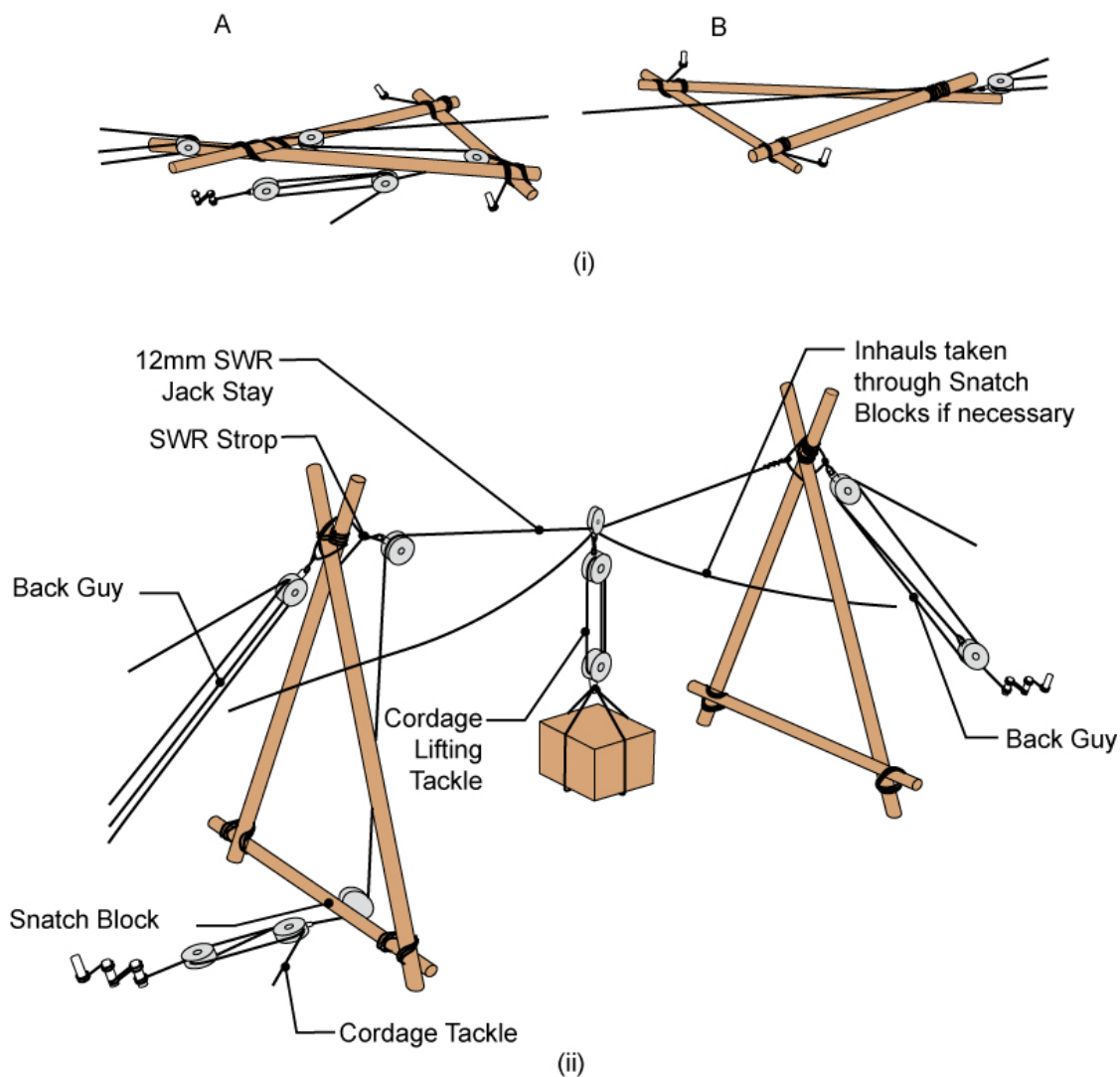
Fig 3-203. Traveller for Slinging Heavy Weights on a Jackstay



(3) The gyn or sheers must be stepped sufficiently far back from the edge of the gap to allow room to sling the gear on one side and land it on the other. For light loads no leading blocks are required for the traveller inhauls or outhauls, but for heavy loads the inhaul should be led through a leading block at the head of the gyn or sheers but below the jackstay block. If gyns are used each should be stepped with the heel of its prypole towards the gap but slightly to one side of the jackstay, and the inhauls should be led on the opposite side of the prypole to the jackstay. A simple ropeway using a gyn and a tree as supports is shown in [Fig 3-196](#).

(4) A method of rigging a ropeway between two sheers in which the jackstay is used to erect both sheers is shown in [Fig 3-204](#). The sheers are laid with their heels facing each other and with the standing end of the jackstay secured to the head of the sheers marked B, which are temporarily secured to the ground. The sheers marked A are first raised as high as possible by hand, and then to their full height by hauling on the tackle at the hauling end of the jackstay. The back guy of sheer A is then set up and sheer B are raised in a similar manner.

Fig 3-204. A Light Ropeway



03062. Raising Derricks and Sheers

a. The methods of raising a derrick described here can be applied equally well to sheers. It is assumed that the derrick is fully rigged with its head lashing, main tackle, guys and heel tackle, and that its heel is pointed towards its shoe. As the derrick is swayed up, the side guys must be tended to guide the foot into its shoe and then to prevent it from slipping. Before the derrick becomes vertical the martingale or fore guy must be tended to prevent the derrick from falling backwards. A derrick is hauled upright mainly by its topping lift or back guy, but its head must first be raised high enough to allow the pull of the guy to exert an effective leverage without putting undue stresses on the guy, the derrick and its heel tackles. The head of the derrick must therefore be raised by some means until the angle between the back guy and the derrick is between 15–20°; the greater this angle the less will be the stresses involved. Lowering derricks or sheers is carried out in the reverse manner to that in which they are raised.

b. **By Manhandling.** The head of a light derrick can be manhandled to the required height by means of a long handspike placed under and athwart the derrick head, which is then lifted by two or more men on each end of the handspike. A low trestle should be placed under the derrick and worked towards its heel with each lift until the head of the derrick has been raised high enough.

c. **By Moving Lever.** The moving-lever method ([Fig 3-205](#)) is suitable for a derrick, which is rather too heavy to be raised initially by manhandling, and which is fitted with a back guy consisting of a pendant tailed with a tackle. The lever should be a light spar about half as long as the derrick and fitted with side guys, and it is placed alongside the derrick, with its heel at about a quarter of the way from the heel of the derrick to its head. The head of the lever is then lashed to the back guy at a position which will allow it to be raised through an angle of at least 45° before it begins to raise the head of the derrick ([Fig 3-205](#)). The lashing is made with figure-of-eight turns and finished with a slipknot, and its end should be long enough to enable the lashing to be slipped from the ground as soon as the lever ceases to act. The head of the lever is raised initially by manhandling and then by the back guy, while its head is kept over the derrick by means of its side guys. When the lever has been raised by an angle of 45°, it will begin to raise the derrick and will continue to do so until it is a little beyond the vertical, when it will cease to act. At this stage the lashing is slipped and the lever is withdrawn, otherwise it will be lifted off the ground as the derrick is raised by its back guy. The derrick side guys are not shown in [Fig 3-205](#).

d. **By Standing Lever.** The standing-lever method ([Fig 3-206](#)) is suitable for a rather heavier derrick, which is fitted with a back guy rigged as a runner and tailed with a purchase. The lever can be a spar or light sheers, and its length and position in relation to the derrick are the same as those for a moving lever. The lever is fully guyed with strong fore and back guys and is fitted with an extra guy on the side where the hauling part of the guy is rove. If the lever is a spar, a slot is cut in its head into which is placed the standing part of the back guy; if sheers are used as a lever the standing part is placed over the crutch. The lever is then raised and its guys are set up, except the additional side guy, which is rove **underneath** the hauling part of the back guy and left slack. The derrick is then raised by hauling on its back guy, and as the head rises so the hauling part of the back guy will rise until it fouls the side guy of the lever. Raising the derrick is then halted while the additional side guy of the lever is set up and the other side guy is cast off. The raising of the derrick is then completed by means of its back guy. The derrick side guys are not shown in [Fig 3-206](#).

Fig 3-205. Raising a Derrick by a Moving Lever

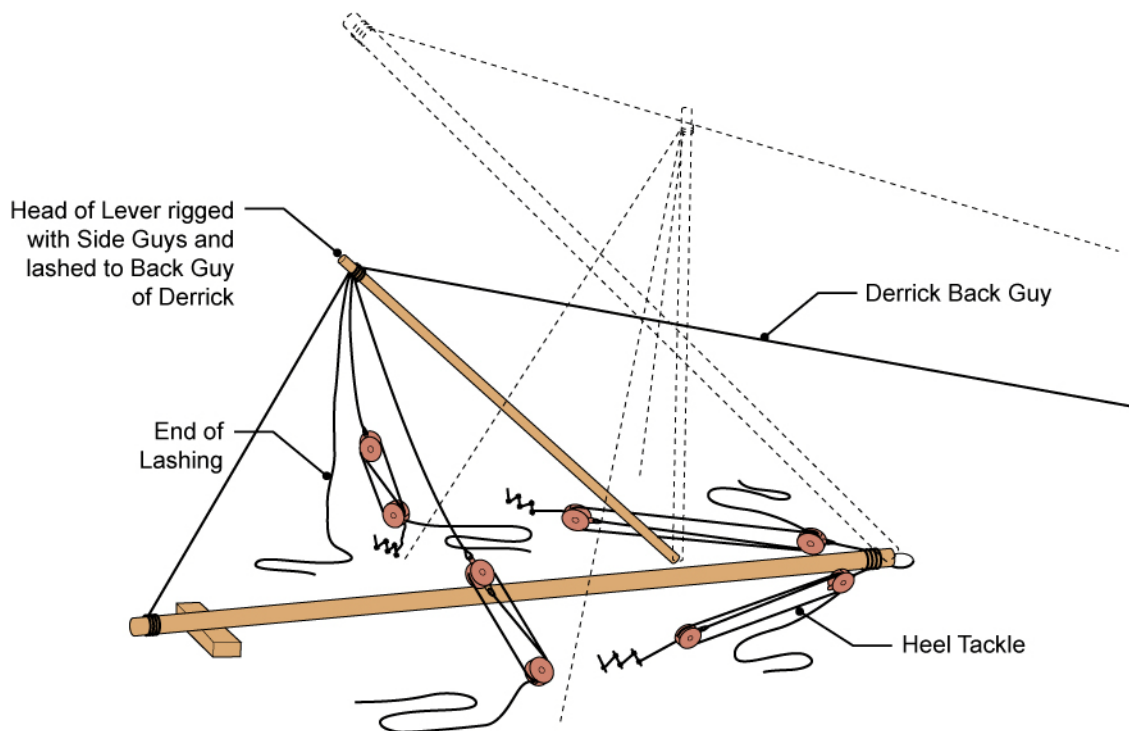
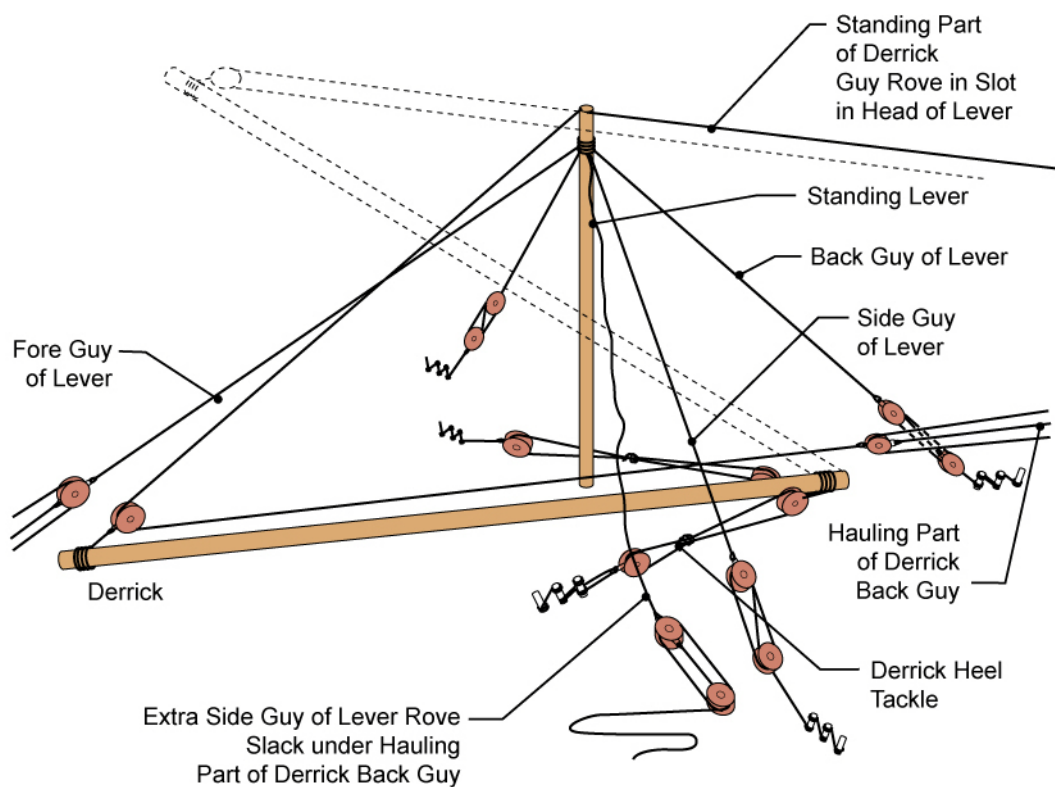


Fig 3-206. Raising a Derrick by a Standing Lever

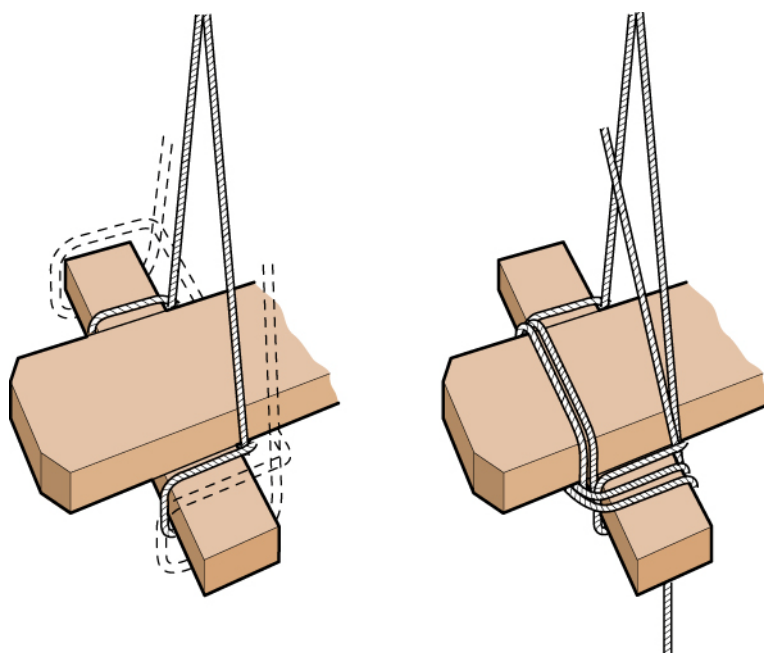


e. **Walking a Derrick or Sheers.** If it is not convenient to erect a derrick at the place where it is required, it must first be rigged and raised and walked there. It is not usual on shore to walk a derrick on its shoe; the shoe is first embedded in its proper position and the derrick is then walked over the ground to its shoe. If the ground is too soft it is walked along a gangway of planks, reinforced if necessary by baulks of timber. To walk a derrick, cross-lash a spar to its foot about three-quarters of a metre above the heel (above the ground for sheers); then, by lifting on the spar, levering the heel(s) with handspikes, and hauling on the forward heel-tackles, the derrick or sheer is walked towards its shoe(s). A derrick must be kept upright by adjusting the side guys. If fitted with a strong fore-guy, walking is facilitated by inclining the derrick or sheers backwards about 10°; a rear heel-tackle must be fitted – otherwise the inclination should be slightly forward.

03063. Plank Stage

a. Plank stages are used to support **a maximum of two people only** when working over the ship's side, or on superstructures and funnels. The lanyards are constructed from 20mm polypropylene rope and are secured to a small crosspiece of wood, called a **horn**, at each end of the stage. The horns **project** from the stage and so keep it a convenient distance from the fleet to be worked.

Fig 3-207. Securing a Lanyard To The End Of A Plank Stage



b. A long soft eye is either spliced or made with a bowline in one end of each lanyard and then placed under the end of the stage, with a half-hitch taken round each horn (Fig 3-207). The lanyard is then passed round a cleat or similar tested fitting near the gunwale above, and the end brought down and belayed round the horns of the stage, thus enabling those working on the stage to lower themselves to the position required. **The lanyard should never be rove round or secured to a guardrail.** Maintenance schedules are given in the ship's Maintenance Management System and Service Drawing Number 020 032 722/02 gives details of the plank stage and the associated test requirements.

03064. Bosun's Chair

A Bosun's Chair and karabiner are 'lived on condition' and there is no requirement for further testing. However the Certificate of Conformity is to be retained in the Sea Survival Equipment Log (SSEL). The chair is to be used with a 20mm polypropylene gantline secured to the rigging plate. The Full Body Harness should be connected to the chair using the front 'D' ring of the harness, a 300mm extension strop and karabiner onto the rigging plate of the chair. The Full Body Harness and Bosun's Chair are to be tended by their own lifeline and belayed to their own individual tested anchor point. The maximum operation load is not to exceed 130kg including tools.

Fig 3-208. A Bosun's Chair

**03065. Manpower Calculations**

a. The force a person can be expected to exert depends chiefly on whether the effort is momentary or sustained, whether it is made quickly or slowly, and on the manner in which the force is to be applied. It also depends to a certain extent on the number of personnel employed; the larger the body of personnel; the less will be the individual effort. In parties of up to 30 personnel, and for sustained efforts, each person can be expected to do the following work:

- (1) Exert a standing pull of from 25 to 40kg (eg on the fall of the tackle).
- (2) Exert a walking pull of from 18 to 22kg (eg on a purchase fall).
- (3) Push or pull with a force of from 7 to 9kg.
- (4) Carry from 25 to 40kg.

b. In parties of up to four persons, and for short periods only, each person can be expected to work as follows:

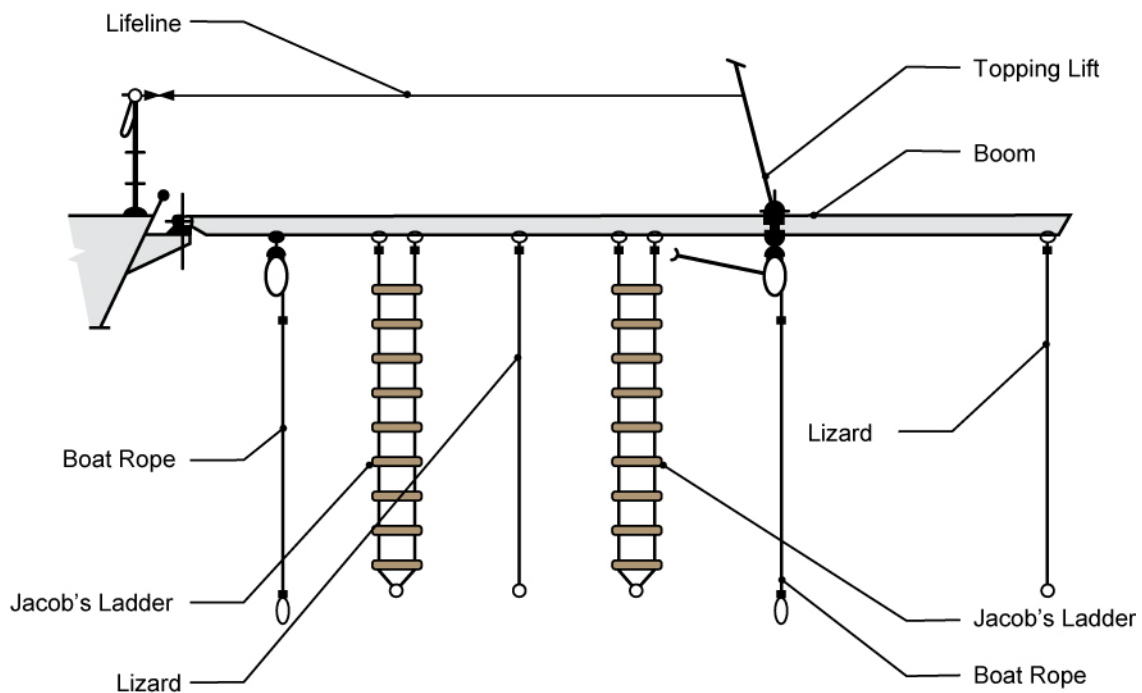
- (1) Exert a standing haul of from 55 to 60kg (provided they have a good foothold).
- (2) Exert a stationary push of 45kg (provided they have a good foothold)
- (3) Bear down on a lever with a force from 30kg to their own weight.
- (4) Lift up a lever at knee-level with a force of 70kg.
- (5) Carry on their shoulders a weight of 60kg.

03066. Boat Booms

Boat booms are fixed or swinging spars of wood or steel that may be rigged from the ship's side on the port or starboard quarter (**quarter booms**) (Fig 3-209). They are attached to the ship's side by a gooseneck fitting and when not in use they are swung inboard forward or aft with the outboard end secured in a clamp by a drop nose pin. Booms are generally supported horizontally by a steel wire rope (SWR) standing topping-lift which can be adjusted by a rigging screw and slip; and they are kept square, if of the swinging type, by a standing guy and a working guy which is secured to a tackle for swinging the boom out into its correct position. Lizards, boatrope blocks and Jacob's ladders are shackled to thimbles seized into wire grommets placed at intervals round booms. The tops of the booms are flat to afford a foothold, and from a convenient height a lifeline is secured from the bight of the topping lift to a convenient point inboard. Boatropes of 24mm polypropylene are secured inboard well before the boom to give them plenty of scope, thus providing a spring to take the snatch off the boom in a seaway. Boatropes are rove through a boatrope block on the boom; the outboard end of each is fitted with a thimble eye and grommet stop. When unoccupied the end hangs a short distance above the water, being held in this position by a wooden toggle fitted in the boatrope abaft the boatrope block. The traditional method of securing a boat to a boom is to attach the boat's painter to the eye at the end of the lizard and the lazy painter to the Jacob's ladder. Heavy boats are secured to the wire stop at the end of the boatrope.

Note. RN ships are no longer fitted with booms.

Fig 3-209. A Quarter Boom



03067. Accommodation Ladder (Fig 3-210)

a. The standard accommodation ladder is made of aluminium; it has an upper and lower platform for ease of embarkation and disembarkation. The ladder hinges from the after end of the upper platform, which in turn hinges on the main deck edge. The lower platform is bolted to the ladder and is supported by two stays fastened to the ladder. Both the lower platform and the ladder are braced from the ship's side by either, **telescopic arms on the CVS or "Y" pieces on FF/DD**, which fit into sockets recessed into the ship's side. The lower platform has two positions to keep the platform at a convenient height above the water at deep and light conditions of the ship. The gangway **furniture** consists of wooden handrails, complete with electric-light fittings for illumination, which are supported by lightweight stanchions mounted on the ladder and platforms. On some ladders a wire or braidline guardrail is rove through the stanchions halfway between the wooden handrail and the ladder. For raising and lowering the ladder refer to ships drawings.

WARNING

AN ACCOMMODATION LADDER SHOULD NOT BE USED WHEN THERE IS A SEA OR SWELL HIGH ENOUGH TO RENDER BOATS LIABLE TO BE CAUGHT UNDERNEATH THE LOWER PLATFORM; A PILOT LADDER SHOULD BE USED INSTEAD.

b. Gangway and Ladder Gear.

(1) The **gangway boatrope**, similar to that described for the boom boatrope except both ends are finished with a whipping, can be of great assistance to a boat coming alongside in a rough sea or tideway, but it is useless unless led well forward so that it lies nearly in the fore-and-aft line of the boat when she is alongside.

(2) A length of smaller rope, known as a **strayline**, is spliced into the boatrope near the after end and belayed to a cleat abreast the upper platform; it is used for tricing up the boatrope when not in use. It is the duty of the gangway staff to lower the boatrope to each boat as she comes alongside, so that the bowman can belay it in the boat; the weight of the boat must be taken by the boatrope and not by the strayline. The coxswain of the boat can be assisted in positioning his boat alongside correctly, if the boatrope is marked at a point where the bowman belays it in the boat. When a ship is secured head and stern to buoys in a tideway, a second boatrope should be rigged abaft the ladder for the use of boats coming alongside bow to stern.

(3) **Check line** is a short length of cordage, spliced round one of the outboard stanchions of the lower platform of the accommodation ladder, and it is used by boats for checking their way and for keeping the stern in the proper position relative to the ladder. When a boat approaches, a member of the gangway staff should be at the bottom of the ladder to pass the check line to the boat; the line requires careful watching, because, if washed off the platform, it may foul the propeller of the boat. When not in use the line is cheesed down.

Fig 3-210. Accommodation Ladder



c. **Safety Measures.** When lying in a strong current or tidal stream it is necessary to prevent a boat that overshoots the gangway from being jammed by the current under the ladder, and if ships' boats only are concerned this can be done by rigging a simple **tide spar**. This spar is laid out from the outer stringer of the ladder to the ship's side and lashed in position, but it must not project outboard of the stringer. If the ship is moored head and stern so that she cannot swing with the tide, a similar spar must be rigged abaft the ladder to protect boats coming alongside bow to stern when the ship is stern-on to the tidal stream. When heavy harbour craft are employed as tenders, a ship lying in the stream should secure **catamarans**, some 3.5 or 4.5 metres long, on either side of her accommodation ladder.

03068. Mediterranean Ladder (Fig 3-211)

The Mediterranean ladder is a portable, rigid, vertical ladder usually provided in smaller ships for use on occasions when the accommodation ladder is not rigged or not available; in many ships it is chiefly used for diving operations. The treads and side stringers are of aluminium channel bars with the latter reinforced at the lower end with Canadian Elm and the ladder is braced off the ship's side by an aluminium holding-off bracket padded with Canadian Elm. Tubular aluminium handrails are fitted to the top of the ladder and drop-nose pins passed through lugs on the ladder and deck secure the ladder inboard.

Fig 3-211. Mediterranean Ladder



03069. Pilot Ladder (Fig 3-212)

a. This is a portable 'roll-up' ladder that can be hung over the ship's side for embarking and disembarking boat passengers. The ladder when rigged is to terminate 300mm above the surface of the water in calm conditions, when the ship is in its normal seagoing state; ie, fully stored, manned and upright. The pilot ladder is constructed of serrated; non-slip treads with side ropes threaded through their ends. The bottom four treads are made of moulded rubber and the remainder from hardwood; winnets are seized between the two parts of each side rope to keep the treads in position. 3 metre x 20mm polypropylene securing lanyards are spliced to thimble eyes at the inboard end of the ladder. It should be secured by shackling the thimble eyes direct to suitable strong points in the ship, but where this is not possible (RFAs), the lanyards must be used to lengthen the scope of the ladder. To prevent the ladder twisting, 1.8-metre anti-twist spreaders with an integral serrated tread are fitted to the ladder at regular intervals, depending on the length of the ladder; details are given in Table 3-44.

Table 3-44. Position of Anti-twist Spreaders Fitted to Pilot Ladders

Total number of treads in ladder	Position of spreader
6-13	As the 5th tread
14	As the 5th and 12th tread
15	As the 5th and 13th tread
16-22	As the 5th and 14th tread
23	As the 5th, 14th and 21st tread
24	As the 5th, 14th and 22nd tread
25-30	As the 5th, 14th and 23rd tread

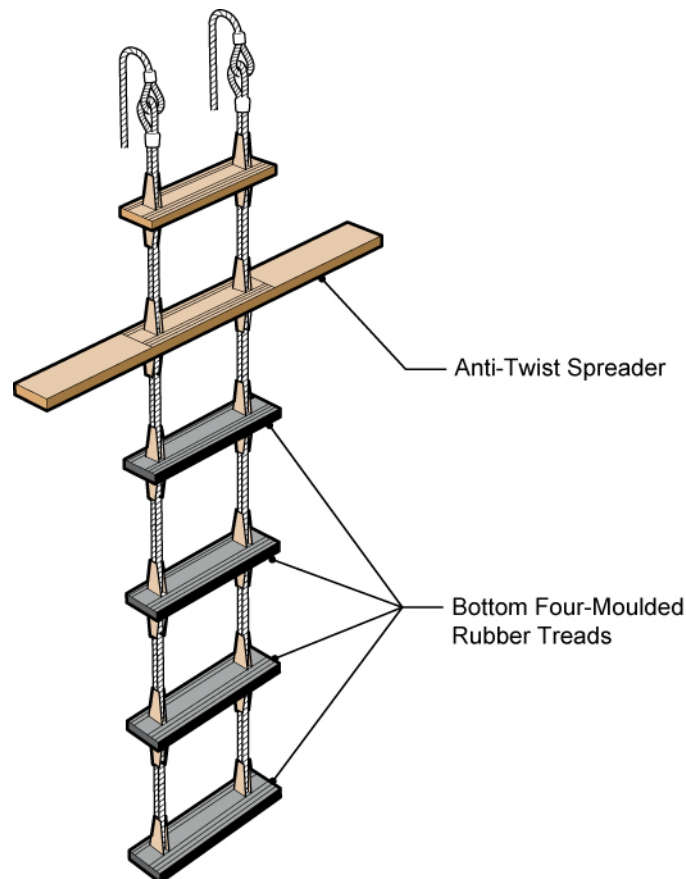
b. Two 24mm staple spun polypropylene manropes must be provided. These are to be rigged at all times when the ladder is in use. They must be securely hitched, above the middle knuckle of the handhold stanchions where possible, or to other suitably positioned fixtures. The manropes should extend for the length of the ladder, terminating with a manrope knot in the end of the rope.

c. An additional Pilot Ladder is to be held which is to terminate 1 to 1.4m above the waterline. It is to be used in transfers to specialist pilot vessels as the ladder will not interfere with the pilot craft deck space.

d. The transfer of personnel and stores is to be conducted in accordance with Annex 5A. **THIS IS A MANDATORY REQUIREMENT WHEN USING THE PILOT LADDER.**

Note. FF/DD are not to use the Quarterdeck position for boat transfers other than in totally benign conditions and with the Commanding Officer's approval due to the pitch of the ship and the positioning of the propeller guards.

Fig 3-212. Pilot Ladder

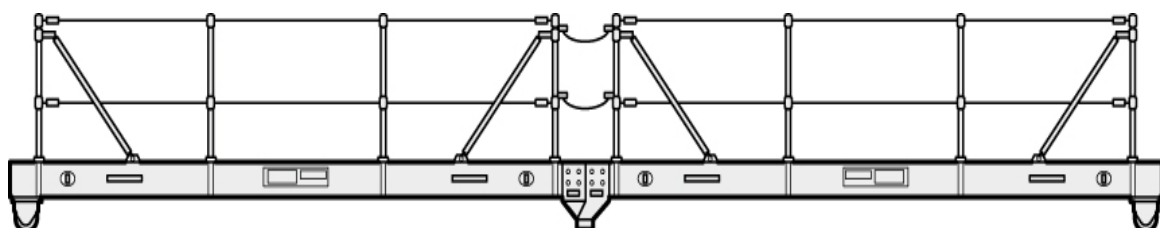


03070. Brows

a. **Introduction.** The purpose of a brow is to provide a gangway between ship and shore or ship and ship. As a general rule, ship-to-shore brows are provided by the dockyard authorities and ship-to-ship brows are provided by the outer ship. To fulfil the latter requirement, destroyers and below are supplied with a portable ship-to-ship lightweight brow of aluminium construction, NSN 0232/736-7283 (Fig 3-213). It is supplied as two identical 3-metre units that may be used singly or joined together to make one 6-metre brow. At some small commercial ports where no dockyard brow is available, it may be necessary to rig the lightweight brow for ship- to-shore use. It is a simple task to remove guardwires stanchions and stays when the brow has to be stowed.

Note. Brow and guardwires must bear evidence of test.

Fig 3-213. Ship-to-Ship Lightweight Brow



b. **Rigging a Brow and General Safety Measures.**

(1) *General Principles.* When a Naval Base supplied brow is put into a ship in a non-tidal basin it is the responsibility of the Naval Base staff to secure the inboard end, whereas at tidal berths the Naval Base staff are responsible for seeing that the inboard end is properly secured by ship's staff. Any gap between the break in the ship's guardrails and the brow must be securely roped off using 12mm Polyester cordage. This roping must form an effective and safe barrier for personnel and is to extend from the stanchion at which the guardrails have been broken to an appropriate stanchion on the brow that is in line with, or inboard of, the fore-and-aft line of the ship's guardwires. On no account is the line of the roping to lead outboard of the fore-and-aft line of the ship's guardwires. The minimum height of the roping must not be less than 1.15 metres, and to achieve this it may sometimes be necessary to rig a temporary stanchion or extend an existing one by lashing to it a suitable length of 50mm x 50mm timber. The lanyards, which secure the brow, must be secured to eyeplates, bollards, or other permanent fittings, and never to stanchions. The approaches to the jetty end of the brow must be kept clear of obstacles and at night, brows must be well illuminated. The brow handling party must wear safety helmets and hazardous duty life jackets (HDLJ).

(2) *Ships Berthed Alongside Each Other.* When ships are berthed alongside each other it is the responsibility of the outer ship to supply a properly rigged brow, but it is the responsibility of both ships to ensure that their end of the brow is properly tended and secured, and that any gap between the ship's guardrails and the guardwires of the brow is securely roped off as described in [sub para \(1\)](#) above.

(3) *Fendering.* A mat, fender or other suitable material should be used as a Scotsman, and placed under the end of a brow which is in contact with the deck; if a brow is fitted with a roller, a sheet of metal should be placed over the area of movement, and a guard fitted or notice displayed warning people of the danger as the brow rolls with the movement of the ship.

(4) *Rigging a Brow Safety Net.* Two nets per ship are to be carried. Whenever a brow is rigged a brow safety net must be rigged beneath it. Each net must be secured by means of its fitted lanyards and positioned so that it is directly beneath the brow with the centre of the net lower than its edges. The net must extend from ship to ship or ship to dock wall and have sufficient spread on both sides to catch a person or object falling from the brow safely (see [Note 3](#)). Where no suitable securing positions are available on the jetty, a spreader bar of sufficient length is to be secured to or through the brow so that the net lanyards can be secured to it thus achieving the correct spread. A length of 100mm x 100mm timber or other suitable material is to be used as a spreader. The nets must be inspected before and after use, and at frequent intervals whilst they are rigged. They may need to be adjusted to allow for the rise and fall of tide. When longer-than-usual brows are put into a ship – for example if a ship docks down in a large dry dock – nets suitable for the task should be requested from the shoreside authorities. In such circumstances a ship's own brow safety nets may be securely lashed together and fitted beneath one of the brows.

Safety Notes:

1. *When a ship is berthed close to a quay or jetty that has no fendering, the safety net must be rigged so that it affords protection from the area immediately below the brow position.*
2. *When a ship is berthed close to a quay or jetty that has no fendering, and with a brow that is at a steep angle, the net must be positioned so that it affords protection for a person or object falling from the upper portion of the brow or the gangway area. This may involve reducing the size of the safety net by folding it over, or increasing the area of net by lashing two nets together and adding extra securing lines (12mm polyester).*
3. *The height of the net must always be sufficient to ensure the safety of a person falling into it. If any doubt exists a functional test is to be carried out by pushing the Man Overboard dummy over the edge of the brow into the net and checking that the fall of the dummy is arrested before it comes into contact with the fendering/jetty. This should not be considered as proof that the net is safe for all eventualities but will provide a means of establishing the likely distortions of the net downwards should a person fall into it. It may be necessary to repeat the tests for various states of the tide.*
4. *Once the safety net is securely rigged it, and any roped off sections, must be monitored and adjusted to take account of the range of tide.*
5. *In some specific circumstances (for example a ship alongside a jetty without catamarans and the brow almost horizontal) it may not be possible to rig a safety net that achieves any useful function. In such circumstances appropriate warning notices are to be placed at each end of the brow and firm control of personnel should be exercised in the gangway area.*
6. *No one is allowed to cross a brow until it is secured, the guardrails are set up and a safety net is rigged.*
7. *A ship in dry dock presents a particular risk to personnel crossing a brow and for this reason added safety measures are necessary. The stanchions and guard chains that surround a dock must always be in position. If for any reason their removal is necessary, the gap must be patrolled by a sentry until they are replaced. **At night these stanchions and chains must never be unshipped.***
8. *When preparing to leave harbour ships are not to single up their own berthing lines until brow slings have been shackled to the brow, hooked to the fixed dockside crane, all slack taken up and brow securing lanyards have been singled up and are in hand. If a mobile is used the brow should be removed before singling up any berthing lines.*
9. *Dockyard supplied berthing lines can be singled up/removed at any time at the discretion of the Commanding Officer in consultation with the relevant port authorities.*

03071. Scrambling Nets

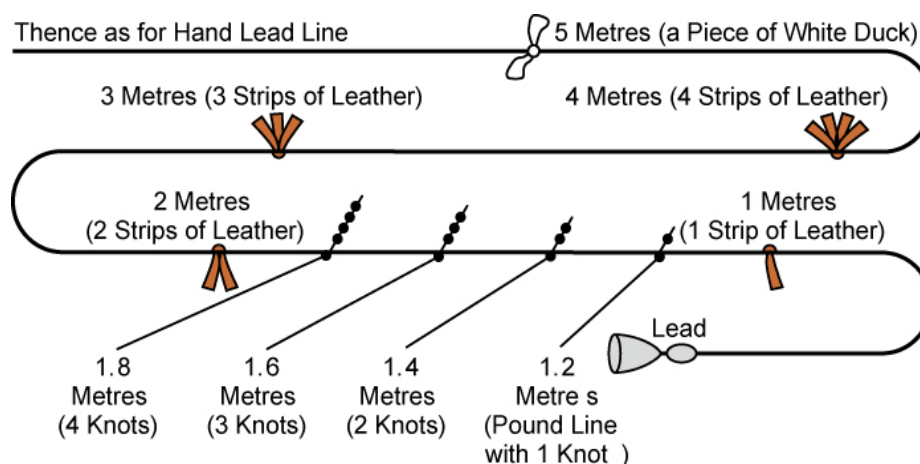
Scrambling nets made of 16mm polypropylene cordage are provided for situations such as abandon ship when it is necessary to get large numbers of personnel safely into liferafts or the water without them having to jump. The nets may also be used by boarding parties when embarking or disembarking from a boat and are also available as an option for enabling survivors to board a ship, although it should be borne in mind that the effort of climbing a scrambling net is likely to be beyond the capabilities of personnel who have been in the water for any length of time, or who are suffering from shock or exposure. The nets are stowed along the ship's side at places where freeboard is lowest, but well clear of propellers. When unstopped they hang about 300mm clear of the ship's side with the lower end at least one metre under the water when the ship is at light draught. The nets are spread on wooden battens fitted at one-metre intervals and when the net is suspended over the ship's side the battens must be on the inboard side of the net, ie, between the net and the ship's side. The lower end of the net is weighted with metal tubes or bars. In the stowed position the nets are protected from the elements and funnel gases etc by PVC covers which have eyelets to allow drainage of water.

03072. Sounding

A measurement of the depth of water is called a **sounding**. On modern charts it is measured in metres or metres and decimetres; on older charts it may be measured in feet or fathoms, or a combination of both. A fathom measures 6 feet (1.8288 metres). Soundings are usually taken by echo sounder, or a **lead and line**, described below. However, the simplest method of taking a sounding in shallow water is with a pole, and for this reason boat hook staves of ship's boats should be marked off in metres.

03073. Boats Lead and Line (Fig 3-214)

In shallow water, harbour craft and boats use a boat's lead and line for sounding. It consists of a weighted line marked at intervals along its length. The weight or **lead**, NSN 0262/463-7107 is of leg-of-mutton shape and weighs 3 kg and the **line** consists of 26 metres of 9mm pre-stretched polyester NSN 0350/120-8692. When soundings are taken, due allowance must be made for the speed of the boat through the water. This is done by heaving the lead ahead of the boat and reading off the sounding when the line is vertically up and down with the lead on the bottom. The lead must also be heaved ahead when the boat is stationary but stemming a tidal stream and the sounding taken when the line is vertical.

Fig 3-214. Boat's Lead and Line

Between Each Metre Mark Up to 5 Metres, the Line Should be Marked Every 0.2 Metres with Knots as Between the 1st and 2nd Metric Marks

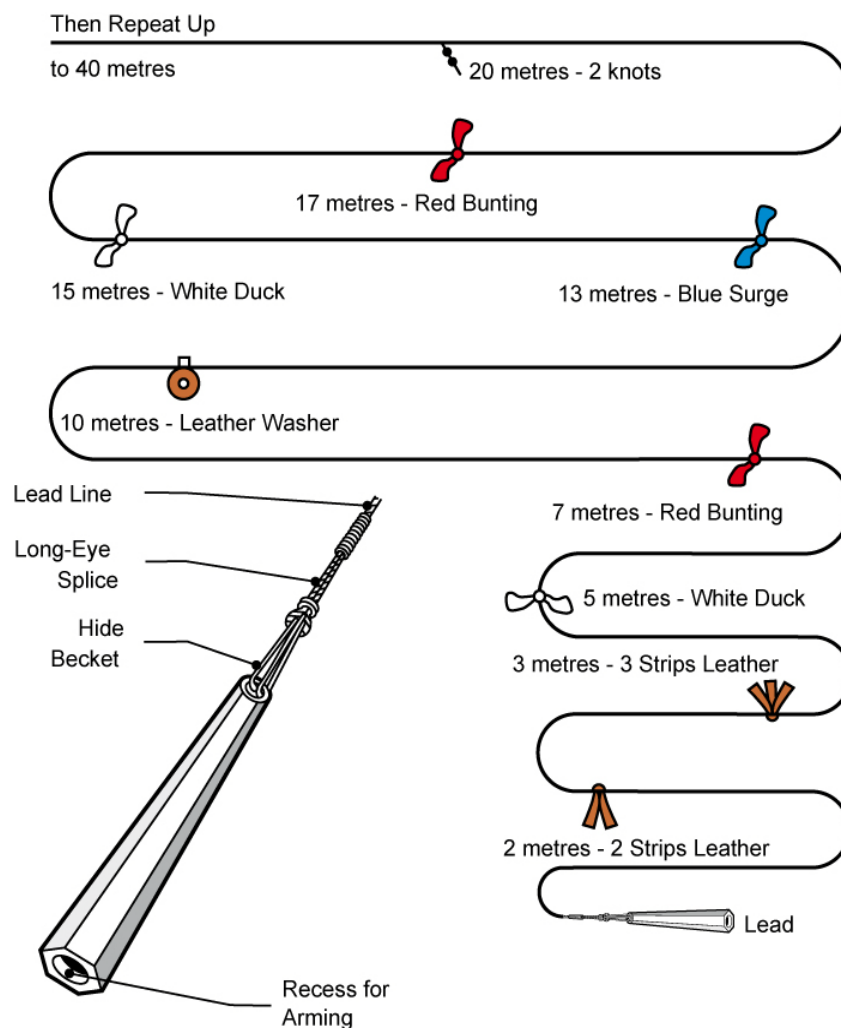
03074. Hand Lead and Line (Fig 3-215)

a. **Introduction.** For emergency use in ships should the echo sounder fail, a hand lead and line can be used for sounding to a depth of 40 metres and at speed not exceeding 10 knots. An echo sounder can be checked by means of a hand lead line in harbour, if the bottom is firm and flat. The lead consists of a tapered bar of lead, NSN 0232/545-7948, weighing 6.3kg, to which is bent a 50-metre length of 9mm pre-stretched polyester cordage, NSN 0350/120-8692. The base of the lead is hollowed out to receive tallow, and the head is shaped into an 'eye' through which is rove a hide becket. The placing of tallow in the base of the lead is called **arming** it, and its purpose is to pick up a sample of the seabed for examination if required. The lead line has a long eye splice at one end and a back splice at the other. It is bent to the lead by reeving the eye splice through the hide becket and passing the lead through the eye.

b. **Markings.** The hand lead line is marked as follows:

2m - two strips of leather	13m - a piece of blue serge
3m - three strips of leather	15m - a piece of white duck
5m - a piece of white duck	17m - a piece of red bunting
7m - a piece of red bunting	20m - two knots
10m - a piece of leather with a hole in it	then repeat up to 40 metres.

Fig 3-215. Hand Lead and Line



03075. Dress Ship

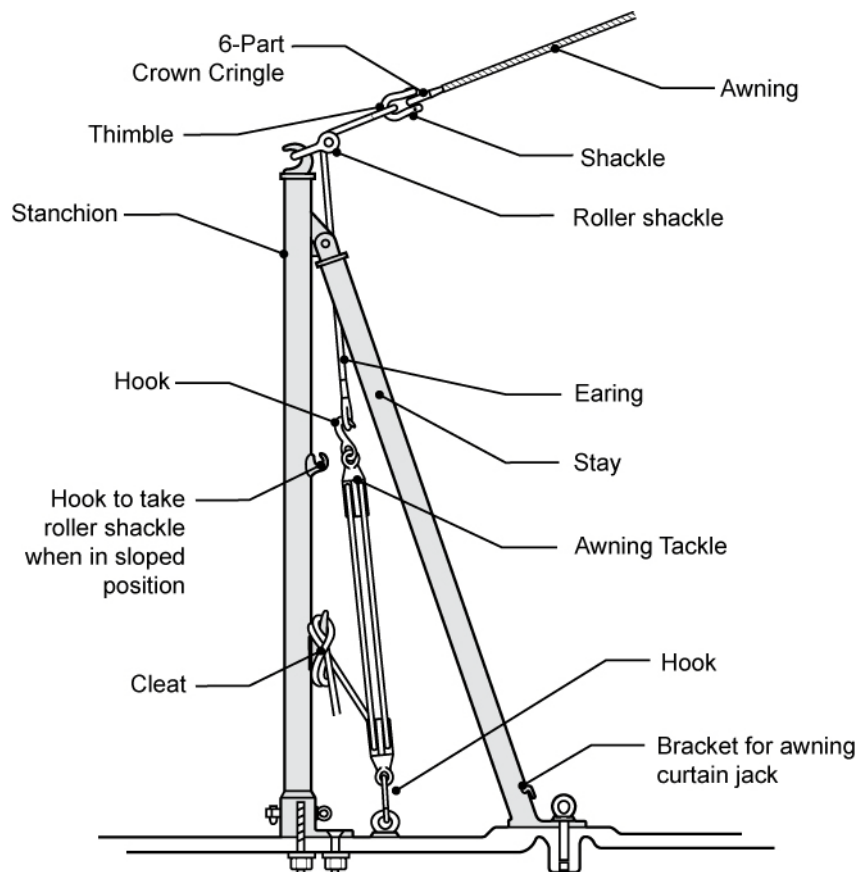
The flying of flags to celebrate an occasion or an event is one of the oldest customs of the Royal Navy. At one period our ships on occasions of celebration used to display flags and trophies captured from the enemy. Nowadays flags and pennants of the signal codes, disposed in as variegated and symmetrical a manner as possible, are used. Except for the masthead ensigns, national flags and ensigns are not included, because the order in which they were flown might possibly give offence. The foremost dressing line is called the **fore-down**, the amidships line is called the **fore-to-main**, and the after one the **main-down**; Fig 3-216 shows a typical example of a ship dressed overall. Ships with a single mast are fitted with a fore-down and a main-down only. Dressing lines must be rigged in accordance with ships' "As fitted" drawings and there must be an organisation for manning the dressing lines and downhauls and for stationing men at positions where the dressing lines may snag in upperworks. Consideration must be given to radio precautions and the necessary Radhaz precautions must be observed. The Chief Bosun's Mate is responsible for arranging the test and survey of the equipment in accordance with the Maintenance Management System.

Fig 3-216. Ship Dressed Overall**03076. Awnings**

a. **Introduction.** Awnings are fitted over certain exposed decks to give protection from the sun. Side curtains and gable ends are provided to screen and shelter the areas below large awnings such as those fitted over fo'c'sles or flight decks. Awnings are supplied to HM ships in accordance with an "As fitted" drawing for the class or individual ship that shows the general arrangement of the awnings, rigging fittings and the stores required to complete the outfit; they are manufactured from flax canvas that has been chemically treated to increase its resistance to rot. Most modern ships are provided with one major awning under which a large number of people may be sheltered or entertained, and smaller awnings for suitable areas to protect the gangway staff. Certain older ships may, in addition, carry minor awnings for waists, bridge wings and other areas. Major awnings are supported by a central wire called the 'ridge rope' or backbone and are hauled out at the edges to awning stanchions by awning tackles and earrings; minor awnings are laced to a wire rope passing through the tops of the surrounding stanchions, called the edge rope. Technically a backbone is a ridge rope sewn into the awning, but this is now seldom found and the separated ridge rope will hereafter be referred to as the backbone.

b. **Major Awnings.** Fo'c'sle and flight deck awnings, classified as major awnings, are made of RN No. 2 canvas for large ships, and RN No. 4 canvas for Destroyers and Frigates. These awnings are supported by a backbone of canvassed SWR shackled to an eyeplate or special stanchion at the midship end and secured by bottle-screw and slip at the jackstaff or ensign staff. The edges are hauled out to awning stanchions (see Fig 3-217) and the edge rope. The description that follows is of a destroyer or frigate flight deck awning. (A fo'c'sle awning is in every way similar except the awning is shaped to fit, and is secured at, the after end and hauled out forward). The awning is made of cloth running athwartships. It has a wire boltrope, served with spunyarn and marled with polypropylene to its outboard edges; and a cordage boltrope at its forward end. A thimble is fitted to an eye worked into the boltrope at the after end, and a large cringle is worked into the cordage boltrope at the centre of the fore edge. Cringles are worked into the outboard edges abreast the stanchions, and holes with thimbles between the stanchions. The latter are used for sloping awnings, and at both positions the canvas is strengthened by patches. The centre-line is strengthened by a 600mm wide 'saddle-cloth' or 'middle-band' sewn under the awning to take the chafe of the backbone, and hide patches are sewn on where there is additional chafe from the screw slip, centre stanchions or structural corners. A curtain line of polypropylene line is attached at intervals on the topside of the awning, close to the outboard edges, to which the top of the side curtain is secured. Furling stops for securing the awning, when it has been rolled before stowage, are sewn on top of the awning at alternate seams. Where an outboard edge is attached to the ship's structure running fore and aft, it is fitted with S-hooks moused into brass grommets with roping twine. Athwartship edges are always rope laced.

Fig 3-217. Awning Stanchion



(1) *Securing the Awning.* The flight deck awning is cut to fit at selected points of its fore-end, and any stretch is allowed for by cutting the remainder slightly smaller than the area it is designed to cover. Therefore, whenever the awning is spread it must be secured first at its fitted end. The centre cringle of the fore end is secured by shackle to an eyeplate or special stanchion just above the securing point of the backbone. The other selected points are then secured. A pendant (earring) is shackled to the thimble eye in the wire boltrope at the after end; and a tackle, secured to the ensign staff above the backbone, hauls the awning aft. The sides are then hauled out by the awning tackles ([Fig 3-217](#)). Inboard edges are clipped by S-hooks or rope lacings to jack rods welded to the superstructure.

c. **Minor Awnings.** Waist and bridge wing awnings are classified as minor awnings. They have boltropes sewn round all edges on the underside to strengthen them and help to retain their shape. Brass grommets, through which the awning is laced to the edge rope, are inserted at regular intervals. Where an inboard edge abuts the ship's structure running fore and aft, S-hooks clip the awning to a jack rod or wire. Athwartship edges should always be rope laced. When an awning has to pass round obstructions, such as rigging, davits or fan trunking, a laced opening called a **shark's mouth** or a slotted approach to a hole called a **banjo** is made; if the obstruction is a ladder, portions of the awning are cut away and the edges roped. When one awning butts against another a canvas flap, called an **apron**, is sewn to one and laced across the gap to fill a narrow flap, called a **frog**, sewn on the other.

d. **Awning Curtains and Gable Ends.** Awning curtains of RN No. 6 flax canvas are provided to screen and shelter major awnings. They are fitted with grommets for stopping the top to the curtain line, the bottom to screwed eyes in the deck or a fine wire tricing line secured to the foot of each stanchion and the sides for lacing to each other. The quarterdeck can also be screened by a gable end, of the same material as the curtains, running athwartships. It is stopped to a line sewn across the topside of the awning; the bottom is weighted, and one or two flap entrances are cut in it.

e. **Ceremonial Awnings.** Frigates and larger ships are supplied with a ceremonial awning and side curtains made from bunting of alternate coloured and white cloths: the colour may be red, blue or green. The awning is spread beneath the main awning on ceremonial and state occasions, cocktail parties, etc. The side curtains are hooked at the curtain line and laced at the bottom.

f. **Spreading Awnings.** Since the canvas of an awning is subject to stretching, care must be taken to preserve its shape when spread. A baggy, wrinkled or torn awning is usually the result of mistreatment. A minor awning such as a bridge wing or waist awning, should first be lashed by the earrings on its windward clews, and then unfurled to leeward and its leeward clews secured. The clew earrings can then be hauled taut and the sides hooked or laced to the edge ropes or awning rails. A major awning needs more care, and the method of spreading a flight deck awning is given here as a guide; but it is necessary to know how an awning is folded for stowage. Before stowing an awning it is spread on the deck with its upper side down, and the two sides are then folded to the centre-line and squared off. The two doubled sides are then rolled towards one another to meet at the centre-line and the whole is then secured by the stops fitted along the top of the centre-line. The earrings and tackles are always detached and stowed separately, but the lacings of a small awning can be made up with it.

g. When spreading an awning in a cross wind it should always be passed over the backbone from the leeward to the windward side; if passed over from the windward side the pressure of the wind on its sloping surface up to the backbone will make it difficult to haul over. Before spreading a flight deck awning it is laid out along the deck with its stops uppermost. The stops are then cast off and each side is unrolled, and the boltrope on each side is then hauled clear to the leeward side of the deck. The leeward earrings are then secured to their cringles, which are rove slack through their roller shackles and belayed to their cleats. Then hauling-over lines are bent to the windward cringles and passed over the backbone to the other side, where they are manned. In a high wind the awning tackles on the windward side can be clapped on to the hauling-over lines and used to assist in hauling the awning over the backbone; these tackles are also useful for anchoring the weather edge to the far side and for holding it down while the earrings are being secured and rove. Similarly, the leeward awning tackles can be hooked direct to the lee cringles and set up to ensure that the wind does not blow under the lee side of the awning. It is usual to rig **tent lines** over the backbone, from the feet of the leeward awning stanchions, to support and guide the awning as it is hauled over. At the order 'Haul over' the awning is hauled over the backbone to the other side and the fore end of the awning is secured to its fixed points. The earrings are then shackled on and rove, and the awning tackles are hooked on and manned. The after clew is hauled aft by its earring tackle, thus tautening the centre-line of the awning; then the side earrings are hauled out together, care being taken to keep the centre of the awning in line with the backbone. The tackles are then belayed to the cleats and the ends cheesed down at the feet of the stanchions.

h. **Care of Spread Awnings.** A new awning will stretch considerably athwartships but very little in a fore-and-aft direction, and this is allowed for when the awning is first cut to shape. If a good final spread is to be obtained the stretching must be done gently and gradually. A new awning must therefore never be hauled out or kept too taut until it has been fully stretched, and this stretching must be done by hauling it out a little more each day. Canvas shrinks when wet, but it should regain its shape when dry if meanwhile it has not been overstretched. A fully stretched awning has little elasticity and may easily be ruined by overstretching when damp or wet. Earrings should be eased off in damp weather, and always at night on account of dew. Awnings should not be fully spread until they are dry.

(1) *Sloping Awnings.* When it is raining awnings should be sloped. This is done by shifting the roller shackle of alternate earrings to the lower hook (if fitted) and by unshackling the remaining cringles and hooking them directly to their awning tackles by which the awning is bowsed down. This should prevent pools of water from collecting on top of the awning and forcing it out of shape.

(2) *Frapping an Awning.* If caught unawares or short-handed by a sudden squall a major awning should be fully sloped and **frapping lines** rove. These lines, of strong cordage, are rove athwartships over the awning and belayed at each side on deck so that they help to keep the awning from billowing and slatting. To rig frapping lines overnight as a matter of routine is not advised because even in light winds their chafe will soon wear holes in the awning. They should be rigged only when a sudden blow is possible but it is better still to furl the awning overnight. If frapping lines are rigged, hauling-over lines should also be rigged, and tent lines, if used, should be rove and stopped to the heads of the awning stanchions and all gear should be prepared for furling.

i. **Furling Awnings.** Major Awnings, if well fitted, fairly flat and tautly spread, will stand up to winds of about Force 5 Beaufort scale, but in stronger winds they are liable to slat badly and may then carry away. Minor flat awnings should stand up to winds of Force 6 quite comfortably. All awnings should be furled well before the danger point is reached, and it is always best to furl them if in doubt rather than have them suddenly blown away. An awning is usually furled to windward and the procedure is the reverse of that by which it is spread. With a flight deck awning, tent lines and hauling-over lines are rigged, earrings are eased away squarely and evenly, and the earring tackle at the after end of the centre-line is eased off. The lee earrings are unrove and manned; the weather earrings are unrove and, if the wind is strong, the weather awning tackles are hooked into the weather cringles and belayed. The after clew is eased forward on its earring; the fore end of the awning is cast off and then, at the order 'Haul over', the lee side is hauled over the backbone. As the lee side is hauled over, the weather side is hauled across the deck to the lee side, so that the awning is eventually laid out underside uppermost and ready for making up. When furling an awning in a strong wind care must be taken that the wind does not get under the awning and blows it overboard. In a short-handed ship, when it comes on to blow hard the flight deck awning may be safely furled to leeward under frapping lines in the following manner. The awning is fully sloped, with the awning tackles secured to the cringles, and a large tackle is then shackled to the fore weather clew and belayed. The after clew is let go from its earring and gathered, and the awning is passed over progressively from aft forward, each part being gathered as it comes to hand. Eventually all hands are available to hold and gather the windward clew as it is eased over by its tackle.

j. **Maintenance of Awnings.** An awning - or, for that matter, any canvas gear - should never be stowed below wet, because it will not only rot but may easily catch fire from spontaneous combustion. A wet awning should be temporarily stowed in a sheltered place on deck until an opportunity occurs for drying it; the quickest way of drying it is to spread it in good weather. An awning should always be lifted and carried, never dragged along the decks and if it is necessary for it to be laid down on deck, it should be laid on battens or gratings in order to keep it clear of the deck and any dirt. As awnings are spoilt by frequent scrubbing, every care should be taken to keep them clean. Decks should be swept before spreading or furling awnings, and when made up they should be protected from dirt and damage. Bags or covers are provided for gable ends and ceremonial awnings, and they should be stowed in them when not in use. When stowing away equipment, awning tackles should be hung up, and earrings and backbones coiled up and tallied to assist in identification on the next occasion of their use. Cleaning, repair or the manufacture of new awnings, upperdeck covers and ceremonial canvas work is to be assessed by the Chief Bosun's Mate or Bosun and discussed with the area Surveyor of Stores who will produce a contract for any necessary work required.

03077. Fendering

a. A ship going alongside another ship or a jetty requires a resilient fender to absorb any impact, but the fender must be sufficiently unyielding to provide protection and sufficient separation to allow for any overhanging structure, proud propellers, etc. For boats and other small craft whose sides are strong in comparison with the weight of the vessel, fendering presents no difficulties and any soft fender is adequate. For larger vessels fendering must be sufficiently robust to withstand the crushing of the weight of the ship, and it must be large enough and sufficiently resilient to spread and absorb the shock over a large area of comparatively weak hull plating. Fenders must be placed where the hull can best withstand the impact; to some extent this applies to all ships, but in modern warships they must be placed at specified positions where the hull is strengthened by additional stiffeners near the waterline; tally plates on the weatherdeck show the limit of the stiffening. The fenders described below are divided into three categories, those that are fixed to the structure or jetty of a pier, those that are mobile and provided in port (too heavy for ships) and those that are portable (carried in ships).

b. **Fixed Fendering.** The solid walls of berths and the piles of jetties have vertical baulks of timber attached to protect the masonry or concrete and to provide fendering to ships alongside. In some commercial ports no other form of fendering is provided, but the use of suspended rubber units is increasing. In a tideway, to lessen the impact when a ship is brought alongside, some springing device is included between the timber and the masonry.

c. **Port Fenders.**

(1) *Catamaran.* This is a stoutly constructed rectangular wooden or steel raft used in dockyards between ship and jetty. The bearing surfaces are usually fitted with rubber rubbing pieces.

(2) *Compression Catamaran.* Designed for use with light-hulled vessels, this catamaran consists of two rectangular tanks, of a length not less than three ship-frame spaces, separated by resilient units fitted vertically on chains. The bearing faces and corners are fitted with rubber rubbing pieces.

(3) *Pontoon.* (Fig 3-218). This may be any floating structure used as a buoyant support. It may be used in salvage work to buoy up a damaged vessel, or it may be used to support a bridge across water. In tidal waters a pontoon is used as a landing place for boats and ferries on a muddy foreshore, or alongside piers and jetties where the range of tide is considerable; such pontoons are usually connected to the shore or jetty by a hinged bridge.

(4) *Large Pneumatic Fenders* (Fig 3-219). These are increasingly being used instead of catamarans for ships lying alongside a dock wall or other ships, although they are not suitable for use on piled jetties unless the area on which they will bear has first been sheeted over with steel plate or similar material to ensure the load is spread. The fenders are manufactured from textile reinforced rubber, and there are two types in use, the low pressure type with a diameter of 2.3 metres and a length of 12 metres, NSN 0232/605-6437, and the high pressure type, produced in various sizes.

Fig 3-218. Pontoon



Fig 3-219. Port Fendering – Large Pneumatic Fender



d. **Portable Fenders.** (Fig 3-220) Portable fendering currently in use in the Royal Navy are the *High Pressure Pneumatic Fenders*. They are high-energy absorbing, lightweight, non-marking and durable, with an expected life of at least ten years. They are grey in colour and are fitted with a towing eye at each end. Each 'ships outfit' of fenders comes complete with an operating manual and an inflation/repair kit. Supply details are given in Table 3-45, allowances are listed in Table 3-46.

Table 3-45. Supply Details of High Pressure Fenders

Stores No.	Description	D of Q	Status
0232/535-3390	Fender pneumatic. Rubber HP. 0.5m dia x 1.0m long. Towing eye each end. Grey in colour	Each	P
0232/885-0321	Fender pneumatic. Rubber HP. 1m dia x 1.5m long. Towing eye each end. Grey in colour	Each	P
0232/623-9360	Yokohama Fender Repair Kit	Each	P

Table 3-46. Allowances of High Pressure Pneumatic Fenders

Class of Vessel	Patt No of Fender 0232/885-0321	Patt No of Fender 0232/535-3390
Capital Ships	6	8
Frigates and Destroyers	3	8
Minor War Vessels	2	6

Note. Portable fenders are to be fitted with 16mm polypropylene lanyards of sufficient length to permit the fender to reach the waterline.

Fig 3-220. High Pressure Pneumatic Portable Fender



e. **Submarine Fenders - Deployment.** For submarines the ship will deploy two fenders to port. The submarine fenders are stowed in the designated stowages in the aft well deck. These fenders are approximately five metres in length, made up of eight solid rubber strips mounted on an octagonal metal frame and the fender is shackled in position alongside. RFA DILIGENCE carries up to four different types of fender for use with ships or submarines alongside. This standard operating procedure highlights their use and methods of deployment.

(1) The submarine fender is designed to hang vertically against the ship's side and remain mostly submerged. Each fender has two wires shackled to the top, which allows the fender to be lifted by crane, and lowered into position and then the securing wire shackled to the designated ringbolt on the ship's side (these are painted yellow). Each fender weighs about 5.5 tonnes in air, but in water weigh about 3.5 tonnes. Thus when moving the forward fender using the forward crane (Snoopy), the fender **MUST** remain in the water to avoid using Snoopy beyond its Safe Working Load.

(2) The seven-tonne crane (port aft) will pick-up and deploy the aft fender directly. The forward fender is initially hoisted and swung over the port side using the aft crane and then transferred to the five-tonne Snoopy crane whilst alongside outboard. The Snoopy crane is hooked on and the weight transferred slowly between cranes; the seven-tonne crane is disconnected to allow the fender to be moved forward to the ringbolt next to the taught wire winch. These fenders are difficult to control when suspended from the crane, owing to their weight, and caution should be exercised, avoid any uncontrolled swings as railings, liferafts and other fittings are susceptible. Allow an hour to deploy both.

(3) RFA DILIGENCE has an outfit of four 6.25-tonne tyred Yokohama fenders, which are stowed in the aft Well Deck. These are used to allow ships to berth alongside, particularly to port.

(4) There is a greater difficulty deploying these fenders to starboard owing to their weight, the safe working load of 'Snoopy' and the reach of the 15-tonne crane, (it is only advised if the conditions are benign – see later). Deploying to port is straight forward using the seven-tonne aft crane. The fenders can be lifted using the doubled up red strops, which are long enough to allow unhooking from the Main Deck. The aft fender can be placed directly in position, but the forward fender has to be towed forward by hand from the Main Deck – if necessary the ship can drop astern to help the positioning. Ensure the fender is raised high enough before swinging outboard to avoid damage to the railings.

(5) Do not secure the picking-up line, connected to the strops, to the railings as any swell will cause snatching and distort the railings. Use an adjacent cleat. The forces involved in a swell can cause failure of either the fender securing lines or cleats. Do not underestimate the movement of 6.25 tonnes of fender.

(6) Deploying to starboard should only be attempted if the launch and recovery conditions are benign. The 15-tonne crane has to be used, but it can only clear the rail if a shortened double-up red strop is used. The main disadvantage is that the only way to unhook is to place a man over the ship's side by jumping-ladder to reach the lifting strop, and similarly to hook back on for recovery.

Note. *In the Gulf in March 2003, owing to the rough weather and swell, two large Yokohama fenders deployed to starboard could not be recovered for four days until the weather abated and then only with the use of the ships rigid inflatable boat (RIB) to hook the fenders on. It is preferred to use the smaller man managed (MM) fenders to starboard.*

(7) Ensure the securing lines are regularly checked as chaffing can occur from adjacent scupper lips and quickly part the lines. A long lead on the forward fender helped reduce the snatching effect that led to failures highlighted above. If necessary, run a mooring line from the fo'c'sle to connect the forward securing line.

(8) DILIGENCE has four small Yokohama fenders in rope cages, (not the tyre cage), which are used for smaller vessels such as MMs, weighing 2.5 tonnes. These are easily deployed on either side using either the five-tonne or seven-tonne cranes and pulled into position by hand. MMs berth to starboard when fuelling with the fenders positioned either side of the fuelling manifold.

f. **Safety.** When deploying the fenders the following safety precautions should be taken:

(1) Personal Protection Equipment is to be worn, this includes but not necessarily limited to:

PPE

DMS Boots

Foul Weather Clothing

In date Industrial Safety Helmets

Hazardous Duty Life Jacket (fitted with light or Cyalume if rigging at night)

Rigging Set

Torches available

Upper Deck lighting switched on; consider use of the directional Bridge floodlights.

Ensure the crane hook is fitted with a steadying rope at all times.

Utilise the securing lines as steadying ropes.

(2) The person in charge of the evolution, (usually the Chief Petty Officer CPO (Deck)), conducts a brief prior to deployment to ensure that all personnel are aware of the dangers and understand their responsibilities. Ensure VHF Radio communications are available between the Bridge and the Deck.

03078. Berthing

At least 48 hours before a ship enters a harbour to berth a signal is sent to the relevant port authorities, detailing logistic requirements (LOGREQ). The LOGREQ is the responsibility of the Logistics Department and includes any requirement for tugs and cranes, and the position that the brow(s) are required. If berthing in a foreign or commercial port, details of the ship's length and draught are also included. In naval bases a common system of berth marking has been adopted for the guidance of ship's officers. The marks are tabulated below but it must be noted that the bow and stern marks are optional and that night marking is provided only if the lighting at the berth is insufficient for the day marking to be identified.

Table 3-47. Berthing Marks at Naval Bases

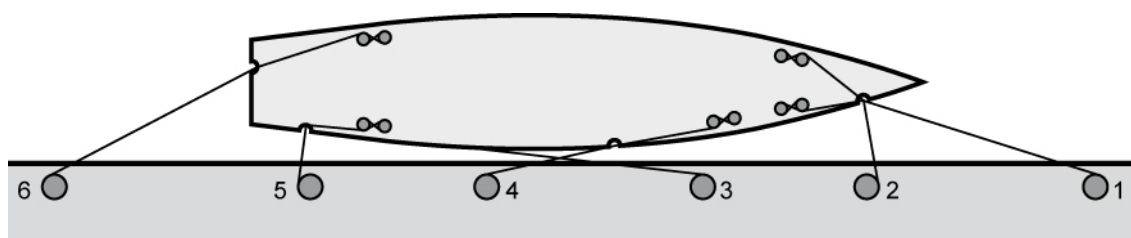
Berthing Marks at Naval Bases			
	Bow	Compass	Stern
Day	Red Flag*	Green Flag	Blue Flag*
Night	Fixed Red Light*	Fixed Green Light	Fixed Blue Light*

* These marks are optional

a. **Briefing for Berthing Alongside.** Before a warship enters harbour to berth, the Navigating Officer briefs Senior Officers, Chief Bosum's Mate, I/Cs Parts of Ship and Part of Ship Safety Officers on the berthing plan. At this briefing, in addition to ship-handling aspects of the evolution, it is established if a pilot is to be embarked, whether it is intended to use tugs to assist the berthing, which side to the ship will berth, and, if known, relevant details of the jetty, pier or wharf to which the ship is going, including the siting of bollards. It is advisable that a priority rope is declared by the Command to enable first line securing. Part of Ship hands in turn will be briefed and the seaman department then prepares accordingly.

b. **Berthing Hawasers.** Fig 3-221 shows how berthing hawasers (often referred to as berthing lines or ropes) are used to secure a ship alongside a wall or jetty. At present berthing hawasers are of HMPE, multi-plait polyolefin, multiplait Supermix; details of the allowance of berthing hawasers are given in Table 3-48. The functions of the various berthing hawasers are as follows:

Fig 3-221. Berthing Hawasers



(1) *Head and Stern Ropes*. The hawsers marked 1 and 6 in Fig 3-221 are known respectively as the head rope and stern rope. They assist the springs in preventing the ship from surging, and they are also used to adjust the position of the ship along the jetty, especially when she is going alongside.

(2) *Breast Ropes*. It will be seen that the ship has two breast ropes, marked 2 and 5, which are known respectively as the fore and after breast rope. The breast ropes are used to breast the ship bodily towards the jetty when coming alongside, and when belayed they limit her distance from the jetty. They are also used to hold a small ship against a jetty when she is resting on the bottom.

(3) *Springs*. The hawsers marked 3 and 4 are known as springs - respectively the fore spring and the after spring. Any spring which prevents the ship from moving back (aft) is known as a **back spring**, and one that prevents a ship from moving forward (ahead) is known as a **head spring**. When a ship is secured alongside, the head and back springs prevent her from **surging** ahead or astern at her berth, and together they assist the breast ropes to keep her close alongside. For a large ship berthed near a busy fairway where she is more liable to surge, or for any ship berthed in heavy weather, the springs may be duplicated as shown in Fig 3-222. These springs are then named as follows:

- (a) Fore head spring
- (b) Fore back spring
- (c) After head spring
- (d) After back spring

Note. During manufacture MMFC berthing hawsers must be fitted with chafing pieces. The bollard eye in the end of each hawser is to have a 1.4-metre length fitted at the crown of the eye and a one-metre length of hose to act as a sliding gaiter for positioning at the fairlead is to be on the bight at each end of the hawser.

Fig 3-222. Springs

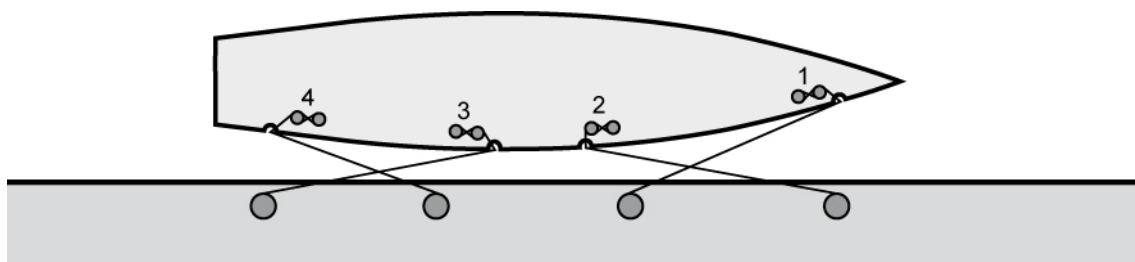


Table 3-48. Outfits of Berthing Hawasers

Class of ship/ submarine	Polyolefin or Supermix			Steel Wire Rope or HMPE			
	No	Length	Size	No	Length	Size	Const'n
		m	mm		m	mm	
CVS	4	175	64	6	110	28	HMPE
	4	110	64				
LPD	10	110	64	2	110	28	HMPE
LPH	10	110	64	2	110	28	HMPE
Type 45 Destroyer	4	110	30	2	73	30	HMPE
Type 42 Destroyer	4	73	44	2	110	20	6x36
	2	110	44				
Type 23 Frigate	4	73	44	2	110	20	6x36
	2	110	44				
Type 22 Frigate	4	110	44	2	110	20	6x36
	2	73	44				
OPV (River Class)	6	160	32	2	160	2	HMPE
Roebuck	2	110	36	2	110	20	6x36
	4	73	36				
MCMV Hunt	2	110	36				
	4	74	36				
SRMH Sandown	2	50	32				
	2	70	32				
	2	105	32				
SVHO	6	110	32	2	110	32	HMPE
Scott	10	110	64	2	110	24	6x36
				2	80	24	6x36
Astute	6	80	40				
Endurance	4	150	64				
	2	150	64				
	2	90	64				
Vanguard	6	120 (Super Line)	36				
Trafalgar	2	110	44				
	4	72	44				
Swiftsure	2	110	44				
	4	72	44				

c. **Material Preparations for Berthing.** The following preparations must be made before a ship goes alongside:

- (1) Fake out springs, breasts and head and stern ropes.
- (2) Position fenders ready for use.
- (3) Prepare the brow and its gangway position.
- (4) Rig ensign staff and jackstaff. (Safety Helmets are to be worn).
- (5) Provide stoppers.
- (6) Make up heaving lines for throwing.
- (7) Provide bollard strop and slip (if required).
- (8) Provide safety tools forward and aft.
- (9) Prepare both anchors ready for letting go.
- (10) Provide line recovery grapnels.
- (11) Provide Ratguards.

d. **Securing Alongside.** When a ship goes alongside, the berthing hawsers required for working the ship to her berth will normally be a head rope, a stern rope, one head spring and one back spring, and perhaps two breast ropes. The order in which they will go out depends upon the circumstances, but each berthing hawser required for working the ship should be ready faked for running. Its bollard eye is led out through the correct fairlead, then back inboard where it will be ready for a heaving line to be bent to it by the time the ship is within heaving distance of the jetty. If the capstans are going to be used, it will probably be for breasting the ship in with the breast ropes, or for adjusting her distance along the jetty with the head and stern ropes. When a ship is secured alongside in a tideway, particular attention must be paid to her berthing hawsers as she rises and falls with the tide, and, whenever possible, the hawsers should be so belayed that they can be tended without disturbing another. A berthing hawser may be **doubled up** by a second hawser between ship and shore; such hawsers are usually **singled up** as soon as the brow is removed when the ship is due to unberth. A berthing hawser may also be **rove doubled** when there is nobody on shore to cast it off when the ship unberths. Both ends of the hawser are made fast inboard.

Notes:

1. *The procedure for doubling-up the berthing lines is as follows: heave in the first line on the capstan, pass and turn up the second line, then transfer the first line from the capstan to the bollards. At no point should the ship be held only by a stopper.*
2. *Chafing pieces must be correctly positioned at fairleads, bollards and bad nips.*
3. *Ratguards must be positioned on all lines.*

e. Fig 3-223 and Fig 3-224 respectively show a fo'c'sle and quarterdeck prepared ready for berthing starboard side to.

Fig 3-223. Foc'sle Prepared for Berthing Starboard Side To

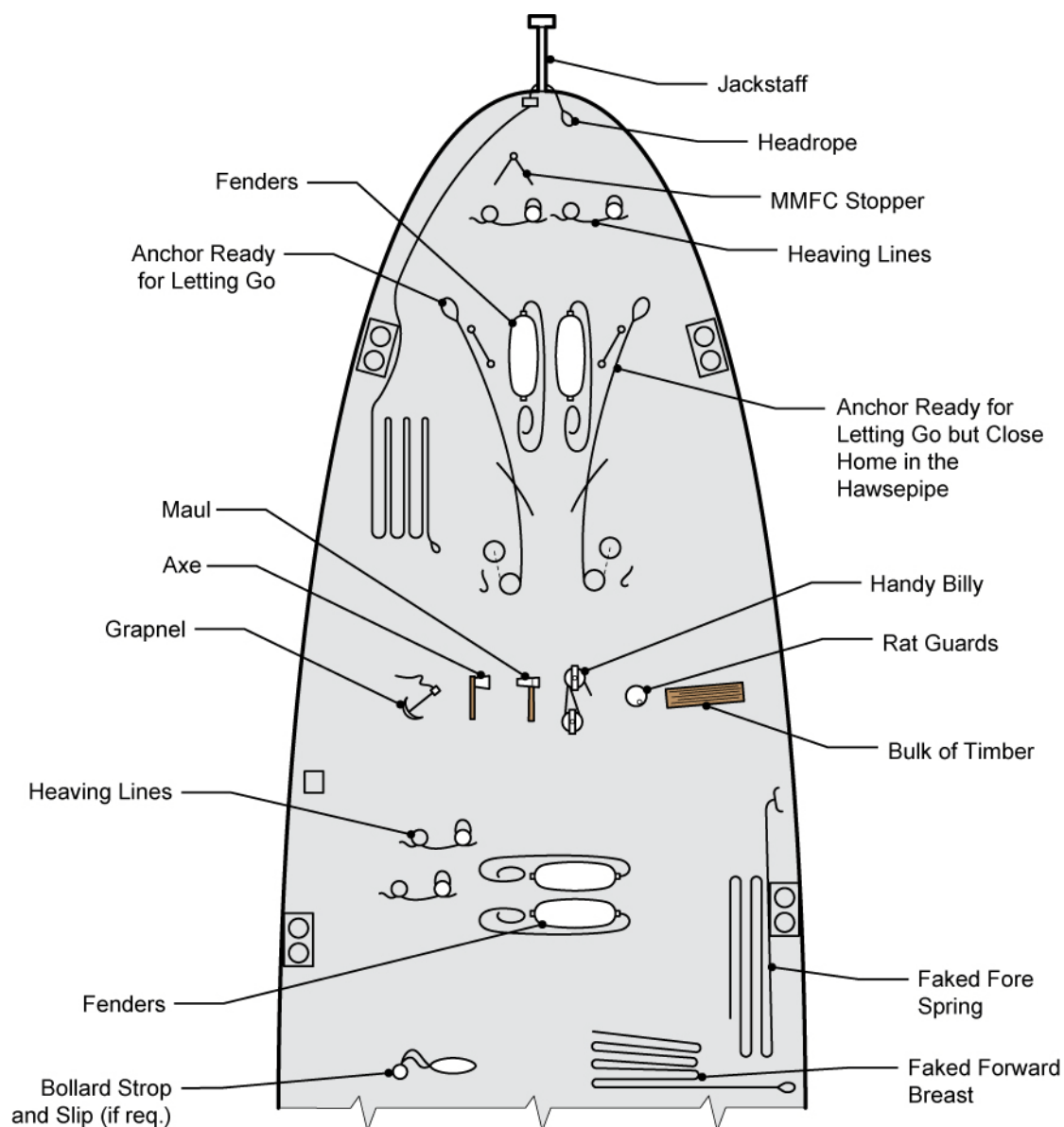
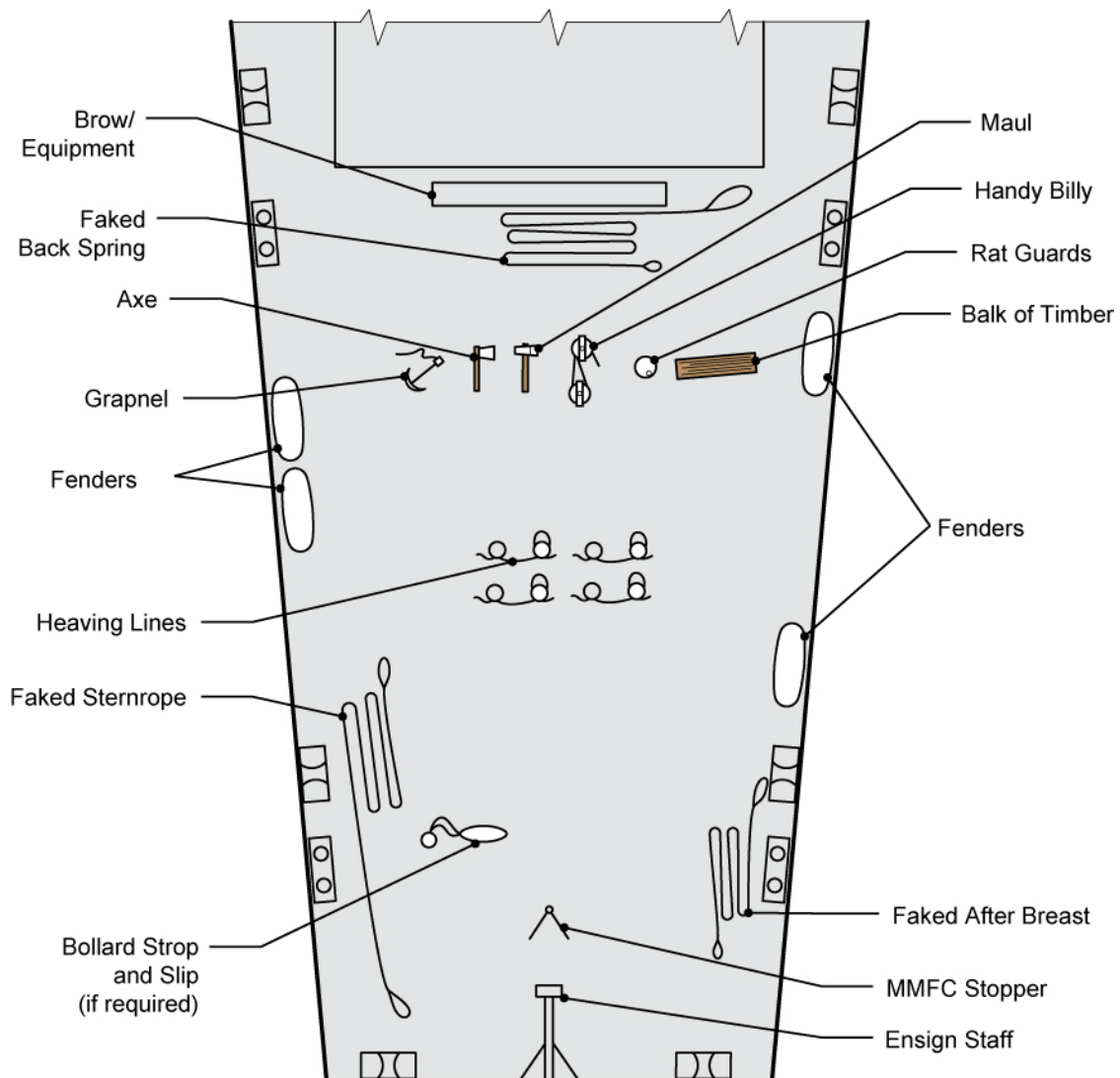


Fig 3-224. Quarterdeck/Top Prepared for Berthing Starboard Side To



f. **Casting Off.** When a ship leaves a jetty the number of berthing hawsers required will depend upon circumstances, but normally the head and stern ropes and one head and one back spring should suffice. The head and stern ropes may have to be brought to the capstans and the springs may have to be surged. When a ship is being **warped** (moved along the jetty without engines) by berthing hawsers, each hawser should be tended, and the hands tending them should back-up, surge, take down the slack, bring to the capstan, or belay them, as required.

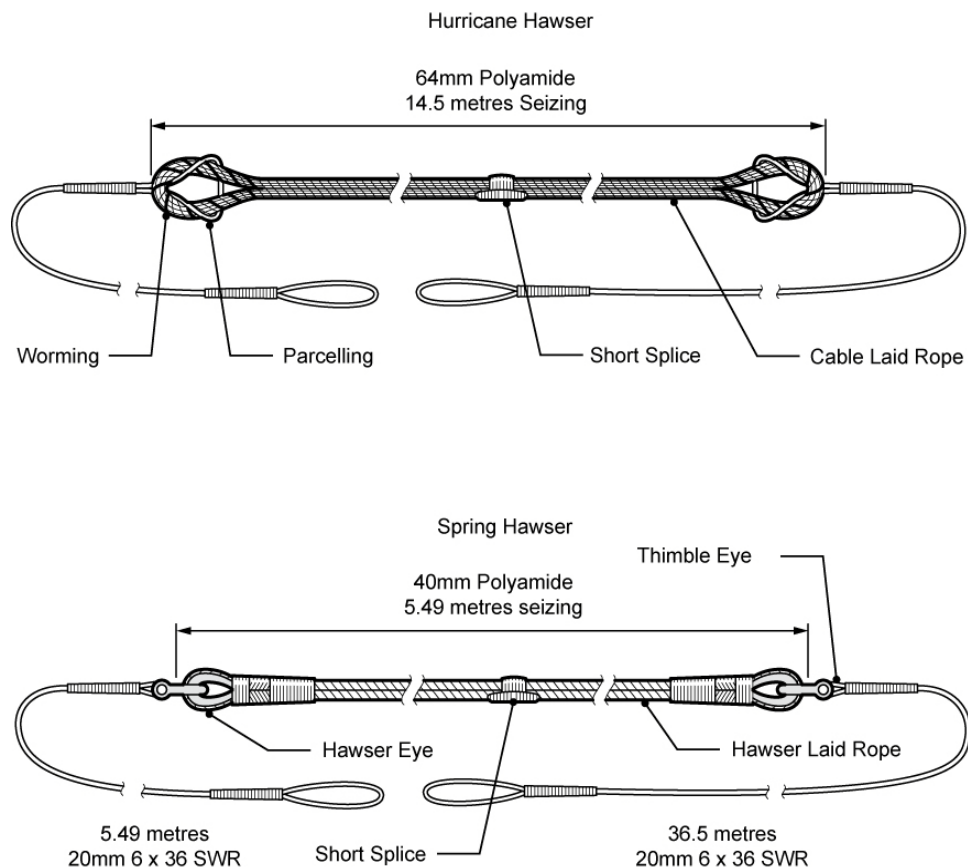
g. **Off-Fast Moorings.** At certain exposed berths a ship can be hauled just clear of the berth by using special off-fast or hauling-off moorings laid for this purpose. Each mooring consists of an anchor, a length of chain and a wire, which is normally secured to one of the jetty bollards. On taking up the berth, a ship takes the ends of the wires, brings them through the outboard fairlead, and adjusts the tension in them according to the weather. When properly adjusted, the risk of damage to a ship alongside is much reduced.

h. **On-Fast Moorings.** At certain exposed berths, usually where the shore bollards or dolphins may not be strong enough to hold a ship in high winds, on-fast or holding-on moorings are provided. Each mooring consists of an anchor, a length of chain and a wire, which is normally secured to one of the bollards. On taking up her berth, a ship takes the ends of the wires, brings them (sometimes the chain as well) through her inboard fairleads and secures them.

i. **Precautions when Berthed.** When a ship is berthed alongside and the Captain deems there is a risk of rat infestation, rat guards are to be clamped on each berthing hawser as soon as the ship is secured. Rat guards are circular metal discs about 600mm in diameter, and they prevent rats from climbing inboard along the berthing hawsers.

j. **Spring and Hurricane Hawsers.** These are heavy-duty berthing hawsers that are doubled-up with Steel Wire Rope springs to provide extra security when a ship is alongside a berth in heavy weather, or alongside a berth where factors such as passing traffic are likely to cause excessive movement of the ship. Spring and hurricane hawsers are of polyamide and steel wire rope construction and are made up in two ways, as shown in Fig 3-225. Ships of frigate size and above carry two spring hawsers but hurricane hawsers are held by dockyards only. Spring and hurricane hawsers must be rigged slightly tauter than the Steel Wire Rope springs they supplement so that they are the first to come under strain if the ship moves. The shortest wire tail of a spring hawser goes to the jetty and the long wire tail is turned up on bollards inboard. The shortest wire tail of a hurricane hawser goes to the ship and the long wire tail is turned up on bollards on the jetty.

Fig 3-225. Hurricane and Spring Hawsers



03079. Submarine Berthing and Slipping

a. **Personnel.** Berthing and slipping are the most regularly practised seamanship evolutions. These evolutions require the maximum number of participants and form the basis for most other seamanship evolutions. The actual number of personnel in the casing party depends on the class of submarine, the minimum requirements are:

(1) *VANGAURD CLASS.*

Casing Officer - I/C of the casing.

2nd Coxswain - 2 I/C of the casing

1 x Leading Hand and 2 x Able Rates on the forward casing party.

4 x Able Rates on the missile compartment casing party.

1 x Leading Hand and 2 x Able Rates on the after casing.

1 x Swimmer of the Watch (2nd swimmer dressed and to remain below unless required).

(2) *SWIFTSURE/TRAFALGAR CLASSES.*

Casing Officer - I/C of the casing party.

2nd Coxswain - 2 I/C of the casing (I/C After Casing)

2nd Coxswains' Assistant (I/C Forward Casing)

4 x Able Rates on the forward casing party.

4 x Able Rates on the aft casing party.

1 x Swimmer of the Watch (second swimmer on standby)

b. **Equipment.** The following details the minimum equipment that is required by the casing party for entering / leaving harbour.

(1) *Man Overboard Equipment.*

Casing Keys

Casing Screwdrivers

Heaving Lines (at least 8)

Capstan Keys

Bollard Keys

Casing Bag

(2) *Contents of the Casing Bag.*

Screwdrivers

Adjustable Wrench

Spare Casing Bolts

Grease Gun

Torch

Cordage

Assorted Cable Ties

Sharp Knives

Hacksaw and blades

Spare Blanks for Fin fixtures

Spare screws for casing plates

Hammer

Assorted Spanners

Spare Drop Nosed Pins for fairleads

Grease

Soft Wooden Wedges

Rags

Gunline

Various size spanners

Cyalume light sticks

Fox wedges

Copper crest (if still available)

Fig 3-226. Typical Submarine Capstan



c. **Bollards - Vanguard Class.** Vanguard Class Submarines are fitted with six sets of retractable bollards. They are wound up in a similar fashion to the capstan when required for use and wound down flush with the casing when stowed for sea. Each set is numbered, starting forward and working aft and their positions are as follows:

- | | |
|--------|--|
| Ones | A triple set situated on the forward casing adjacent to the fore planes. |
| Twos | A single set on the centre line aft of the forward escape tower. |
| Threes | A double set situated aft of the fin. |
| Fours | A double set aft of the missile casing. |
| Fives | A single set on the centre line aft of the missile casing |
| Sixes | A triple set situated aft of the after escape tower. |

Note. *The triple sets forward and aft are designed as towing bollards (although they are also used for berthing) and have a maximum safe pulling load in a forward and aft direction of 75 tonnes. All the other bollards have a maximum safe pulling load of 40 tonnes from any direction*

d. **Cleats - Swiftsure and Trafalgar Classes.**

(1) These submarines are not fitted with conventional bollards but with hinged cleats (often referred to as bollards). The hinged cleats can be rotated in a forward and aft orientation through 180° . This enables them to be faired off with the casing when not in use. Depending on the modification state of the submarine they are grease or salt water lubricated, the latest being the grease lubricated. At present there is some debate as to the actual loading that the cleats are capable of handling. They are designed to take loads in the horizontal plane only and are liable to damage if the loading angle rises above the horizontal (e.g. when harbour tugs are secured to twos and fours for pulling off the berth). (**Ref BR 45(6) Admiralty Manual of Navigation**). As with the Vanguard Class, each set is referred to by its number, starting forward and working aft. Their positions are as follows:

RIGGING AND DECK GEAR

- Ones A triple set situated aft of the Weapon Loading Trench on the forward casing.
- Twos A single set on the centre line just forward of the fin on the forward casing.
- Threes A single set offset to Port just forward of the ALK buoy doors
- Fours A triple set situated on the after casing in between the engine room hatch and the after capstan.

Note. Port and Starboard hinged cleats are shown in the raised position. The centre line hinged cleats are shown almost in the stowed position but the locking bar has not been applied.

(2) The two cleats, which make up one set are locked into position by a rotating bar, which is operated by a key similar to the bollard key. By rotating the locking mechanism, the locking bar can be screwed up or down depending on which way the bollard favours to lock it in either the raised or lowered position. The bar must be locked into position when the cleat is in use, even though the cleat will not turn down with tension upon it. It is possible to rotate the cleat by standing on it, which could cause injury and has caused personnel to fall overboard in the past. When in the stowed position, the locking bar must be screwed tight to prevent the cleats from moving with the flow of water over them and causing a noise short or casing rattle.

Fig 3-227. Typical Submarine Cleats



e. **Submarine Fairlead.** Swiftsure and Trafalgar Class submarines are fitted with a fairlead also known as a bullring at the forward and after ends of the casing on the centre line. Vanguard Class submarines are fitted with a centre line fairlead on the forward casing and two fairleads 1 Port and 1 Starboard on the after casing. When required for use the fairleads are turned up through 90° and secured by a large drop-nosed pin. When not required the fairlead is stowed in a self-draining recess that is faired off by a casing plate secured by three casing screws. There is a position for the securing pin to be stowed in the recess but it is normally taken below and stowed in the casing bag along with a spare to minimise the chances of creating a casing rattle should the pin work free when dived.

Fig 3-228. Typical Submarine Fairleads



f. **Ice Rail and 'C' Clip.** The Ice Rail is designed to provide an anchor point on the casing for personnel working on the casing in rough weather. It comprises of a recessed 'T' bar, which the ice rail 'C' clips attach to. The clips are attached to a strop by a karabiner Hook which in turn is attached to a safety belt or safety harness using a second karabiner Hook. The ice rail is designed to take the loading of up to 350kg which is the equivalent to three personnel, two on the casing pulling a third from the water. The disadvantage of this design is that it is extremely difficult to maintain and is prone to failure through corrosion.

g. **Berthing Arrangements.** A Dutch Moor is used when there is a large tidal range on a berth. By using shorter springs this gives greater control.

Fig 3-229. Standard Moor

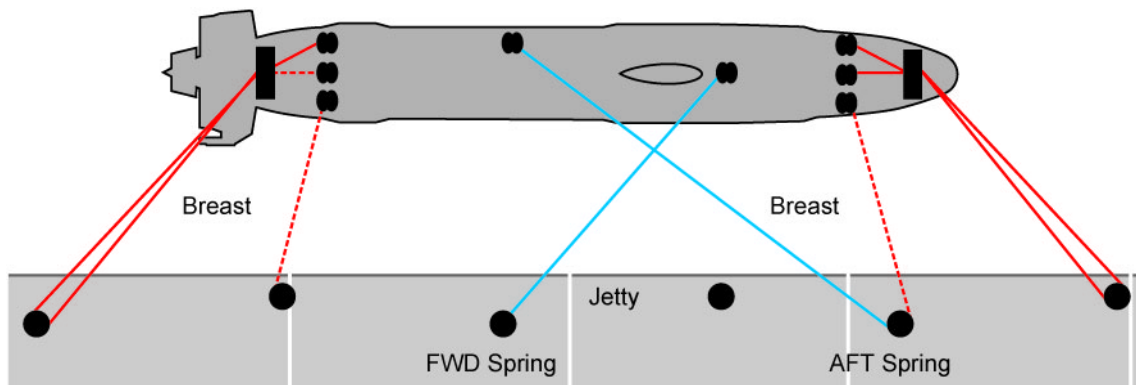
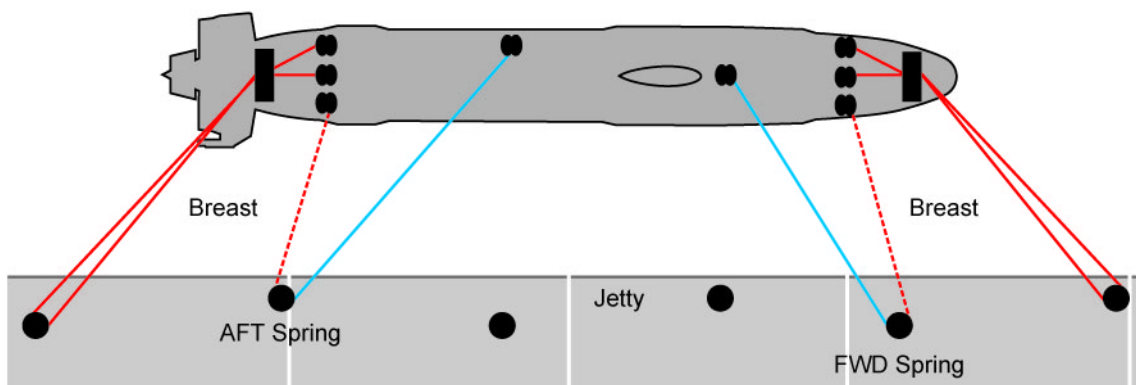


Fig 3-230. Dutch Moor



h. **Precautions Associated with Berthing Submarines:**

- (1) Always stand two metres away from bollards/capstans when working ropes and wires.
- (2) Always have sleeves buttoned down or rolled up correctly (Irish pennants).
- (3) Never wear any jewellery when working ropes and wires.
- (4) Never pass any working ropes or lines around any part of the body.
- (5) Never straddle ropes or wires.
- (6) Never stand in bites or coils.
- (7) Never stand between ropes and wires and the submarine superstructure.

03080. Submarine Berthing – Slipping Vessels Alongside – Personnel

a. The Officer Of the Day must be piped onto the casing when a vessel is coming alongside. The Duty Senior Rate is to go to the casing and the Duty Leading Hand is to muster the members of the duty watch onto the casing for a briefing.

b. At least one member of the duty watch should man each bollard with a heaving line. (Each rating is to ensure the berthing rope is passed under the guardrails and the eyes of the ropes are DIPPED through the submarine's ropes).

(1) *Equipment.*

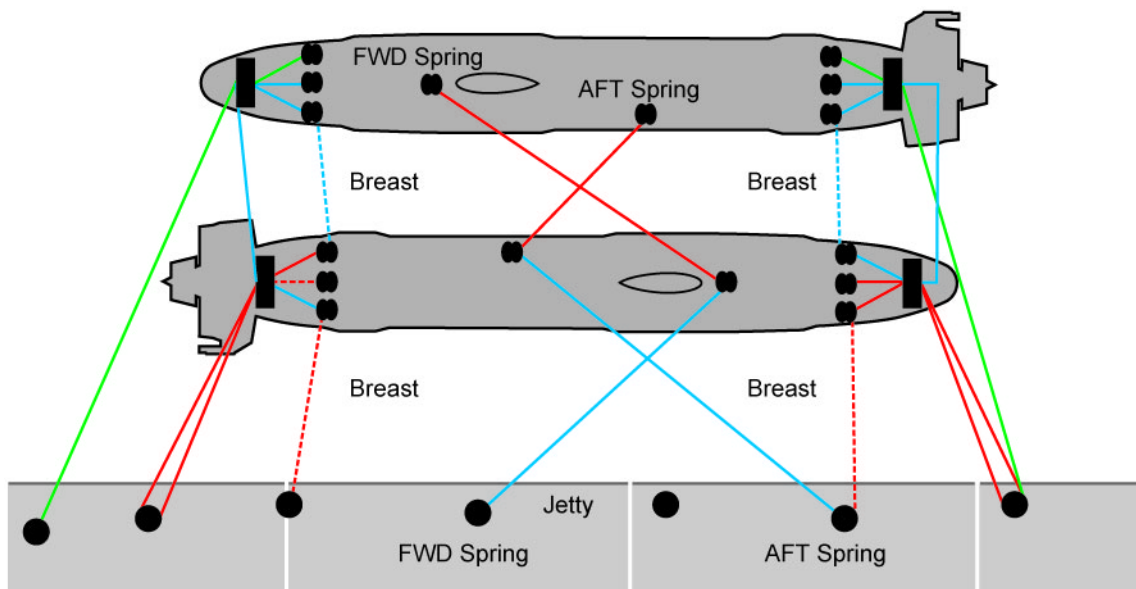
Man Overboard Equipment.
Casing Keys.
Capstan Keys.
Heaving Lines (At least one heaving line for each bollard).

Note. Remember to check that External Hydraulics is opened up if your capstans are to be used.

(2) *PPE.*

DMS Safety Boots.
Correct Working Rig (as detailed).
Appropriate Headgear.
Foul Weather Clothing if required.

Fig 3-231. Vessel Berthed Outboard



03081. Submarine Docking / Undocking Procedures - Personnel**a. Personnel Required.****(1) VANGUARD CLASS**

Casing Officer I/c of the casing party
 2nd Coxswain 2 I/c of the casing party.
 1x Leading Hand and 4x Able Rates on the forward casing party.
 4x Able Rates on the missile compartment casing party.
 1x Leading Hand and 4 x Able Rates on the after casing.
 1x Swimmer of the Watch (second swimmer on standby)

(2) Swiftsure / Trafalger Classes

Casing Officer I/c of the casing party
 2nd Coxswain 2 I/c of the casing (I/c After casing)
 2nd Coxswains' Assistant (I/c Forward Casing)
 4 x Able Rates on the forward casing party.
 4 x Able Rates on the aft casing party.
 1 x Swimmer of the Watch (second swimmer on standby).
 Civilian riggers/naval qualified.

EQUIPMENT REQUIRED**PPE REQUIRED**

Man Overboard Equipment
 Casing keys
 Capstan key
 Heaving lines
 Casing bag
 Rigging Set

DMS Boots
 Correct Working Rig (as detailed)
 Hazardous Duty Life Jacket
 In Data Industrial Safety Helmet
 Foul Weather Clothing if required

03082. Emergency Casing Equipment Bag (EMCEB)

a. In the unlikely event of a UK Submarine colliding with a Fishing Vessel or her trawl there is a requirement for the Submarine to stand by to assist the Fishing Vessel. This may involve rescue of Fishing Vessel personnel, the recovery and the clearance of Fishing Vessel nets and the possible salvage of the vessel. As the submarine will be at Emergency Stations with bulkhead doors shut, access to the second Coxswain's store will be very limited for the duration of the event. Therefore in order for the second Coxswain and his team to be able to man the casing, they must have available casing equipment aft of 29 bulkhead.

The Man overboard equipment, stowed on the MAH ladder.
 The Swimmer of the watch gear stowed in the BWA compartment.
 Hazardous duty life jackets, stowed on the MAH ladder.
 Harnesses and ice rail clips, stowed in a locker on 59 bulkhead.

b. The EMCEB is secured in a locked stowage at the main access hatch with a key available in a smash and grab container. All equipment in the EMCEB is painted with an international rescue orange mark for identification. This equipment is not to be used for any other purpose.

c. Equipment in the EMCEB.

Casing key	2 x Heaving lines
Capstan key	Grapnel hook and line
Bollard key	2 x Karabiner Hooks
Axe and chopping block	2 x bow shackles
Crowbar	2 x Straight shackles
Bolt croppers	20M Orange line
Hacksaw and blades	Large plastic cable ties (tie wrap)
Large screwdriver	Small plastic cable ties (tie wrap)
Adjustable spanner	2x Rigging sets
2 x Hammers	Chisel
Tool bag Roll	
2 x Foul weather jackets	2 x Foul weather trousers
2 x Disposable cameras	4 x Cyalume light sticks and tie wraps
2 x Lifejacket lights	2 x Torches with batteries

The ship's digital camera is also required to take photographic evidence.

d. All equipment in the EMCEB is to be lightly oiled before being heat-sealed in polythene; the axe and rigging knives are to have a keen edge before stowage. The EMCEB is to be maintained at monthly intervals with the torch batteries changed at this time. If any equipment in the EMCEB is used it is to be replaced or maintained before resealing at the earliest opportunity.

03083. Ship Movement in Naval Bases

When ships are being moved by the Dockyard (eg, by tugs or wires, in the charge of a Pilot) certain requirements must be met. These requirements are listed in **BR 9424(1) Fleet Operating Orders Chapter 8 Section 3.**

03084. Designated Tug Lines.

Berthing evolutions require a designated tug line, capable of being rigged easily whilst maintaining their optimum strength characteristics. The use of ship fit berthing hawsers has become unacceptable for the purpose. Therefore, to enable ships to pass standard made up ropes designated for the task; tug lines are to be used. If there exists a requirement to shorten the tug line to a short lead, then it is to be turned up round bollards and racked. It is imperative that the racking is applied before the weight is taken on the line to avoid the line surging, causing friction and ultimately parting. Tug lines are to be manufactured from HMPE Multiplait, NSN 0350/657-6679 110 metres in length for Major Warships and 50 metres in length for Minor War Vessels. Each end is to be fitted with a Hawser soft eye with a leather chaffing piece incorporated

03085. Seamanship Stowages

a. Stowages designated for seamanship equipment are usually only just large enough for their purpose and for this reason it is important that best use is made of the space available by ensuring gear is stowed neatly and logically. A contents board listing all the equipment and compartment layout must be available within the stowage and should be sited adjacent to the access of the compartment, and where necessary individual items of equipment should be tallied to aid identification.

b. **Control of Substances Hazardous to Health (COSHH).** JSP 375, **Control of Substances Hazardous to Health**, must be consulted and complied with regarding the stowage of substances that may be hazardous to health.

c. **Acoustic Hygiene.** Passive Sonar fitted in modern submarines is able to detect at great ranges noise generated within a ship or other submarines; the process of reducing noise to a minimum within a ship is known as acoustic hygiene. Regarding stowages it involves ensuring that all equipment is stowed securely, and, where necessary, lashed in position. Metal to metal contact should be avoided, and where this is not possible rubber matting should be used to deaden noise.