

SECTION 7, CHAPTER 2

LIFTING TACKLE

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Introduction

1. Lifting equipment, or lifting tackle as it is more commonly known, is essential for some of the day-to-day work which is done on R.A.F. stations. The use of lifting tackle implies the movement of heavy or bulky objects with the possibility of serious accidents. It is essential for efficiency and safety that lifting equipment is maintained in a clean and serviceable condition. Do not use any item which has not been correctly registered, serviced, etc. The maximum safe working load (S.W.L.) should be marked on the equipment and this load must never be exceeded. Special lifting equipment is often supplied for certain operations and it should not be used for any purpose other than that for which it was designed. All lifting equipment supplied to the R.A.F. must conform to strict specifications and manufacturers test certificates are supplied, where applicable. Lifting equipment covers a very wide field and therefore the information in this chapter is confined to such equipment as is encountered within the Trade.

SLINGS

General

2. Slings manufactured from fibre rope, wire rope or chain are used for both general and special purpose slinging. General purpose slings are usually designed to a safety factor of six, and for special purpose slings, as used in aircraft servicing, a safety factor of four is usual.

Wire Rope Slings

3. **General.** Some slings are single part (Fig. 1), but for heavier loads it may be desirable to use double part slings (Fig. 2). It does not follow that a double part sling will have twice the breaking load of a single part sling made from the same size of rope; the breaking load depends upon the diameter of the support provided for the bights (loops) in the rope. It is for this reason that wire rope slings must have thimbles fitted in their bights or eye splices.

4. **Thimbles.** The range of standard thimbles is based upon the diameters of rope that may be used to make up a sling. Each size of rope has its own particular size of thimble and it is important that the thimbles in a sling are not tampered with, i.e. opened out or squeezed in to suit a particular application.

Two types of thimble are available, an ordinary and a reeving; a reeving thimble is elongated to allow an ordinary thimble to pass through it.

5. **Rope.** Each main strand of a wire rope is composed of a number of single strands of untwisted hard steel wire, laid in the form of a helix around a central core of hemp. When a wire rope is laid in *ordinary lay* it is formed by winding a number of these main strands, usually six or seven, around a central hempen core. The *single wires* in the *main strands* have a *left-hand twist* and the *main strands* in the rope a *right-hand twist*. This type of wire rope, which can be identified by noting that both the single and the main strands are laid in opposite directions, should be used only for slings or bridles where no rubbing action occurs.

Note.—Ropes fitted to crane and winch rope drums, which are constantly rubbing on guide pulleys and against themselves on the drums, are laid in *Lang's lay*. The *single wires of the main strands and the main strands themselves are twisted in the same direction*; under rubbing conditions, this method gives reduced wear as compared with ordinary lay.

6. **Strength.** The wire rope used in the manufacture of slings has a tensile strength of 100/110 tons per sq. in.

7. **Fittings.** End fittings such as hooks, rings, etc., used on wire rope slings are all covered by B.S. specifications; it is important that the correct fittings are used.

Single Part Slings and Sling Legs

8. The single part spliced sling (Fig. 1) has an eye splice at each end which encloses a thimble. Each splice is served, i.e. it is bound with spun yarn or soft iron wire to protect the user from any ends of wire that may protrude from the splice.

9. The sling can be fitted with an ordinary thimble at each end, and in this form it may be used as a one-leg sling or as a sling leg. It is also obtainable as a one-leg sling with a ring at one end and a hook at the other; when rings or hooks are fitted, ordinary thimbles are used in the eye splices. One-leg slings with reeving thimbles at one or both ends are also widely used.

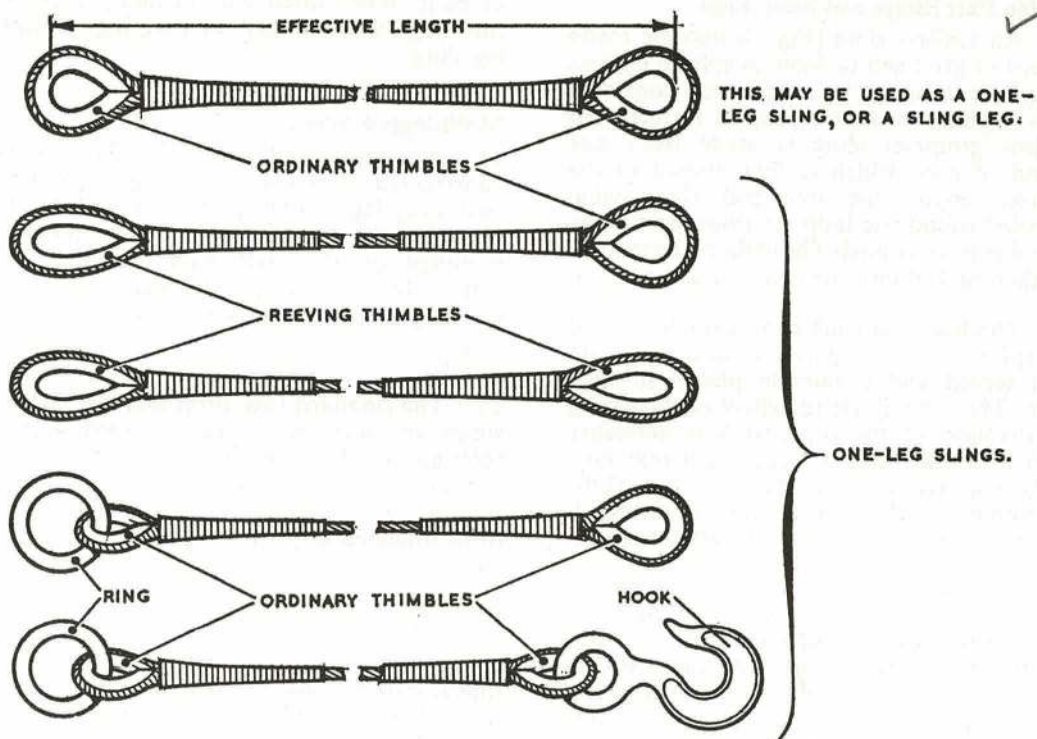


Fig. 1. SINGLE PART SLINGS AND SLING LEGS

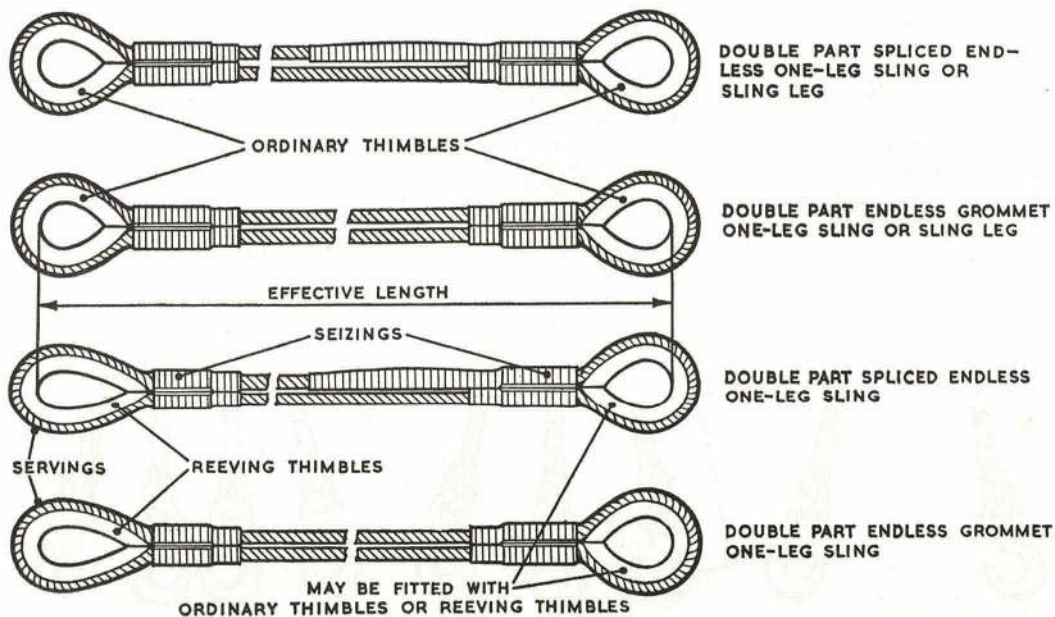


Fig. 2. DOUBLE PART SLINGS AND SLING LEGS

Double Part Slings and Sling Legs

10. An endless sling (Fig. 2) may be made spliced or grommet fashion. A spliced endless sling is constructed by splicing the ends of a rope together so that a loop is formed. An endless grommet sling is made from one strand of rope which is first looped to the desired length, the free end then being spiralled round the loop six times until a six strand rope is formed. The ends of the strands are then tucked into the core of the rope.

11. The bights at each end of the loop, and the splice if it is a spliced endless sling, are then served and a thimble placed in each bight. The serving has the effect of increasing the diameter of the rope, so it is necessary to fit a thimble that is larger than that normally required for the size of rope. Thus, the thimble is of a size to suit the increased load that a two part sling will safely carry.

12. The thimbles are secured by throat seizings, i.e. binding around both parts of the rope with galvanized seizing wire so that the thimble is secure in the bight. If the length of the sling exceeds 100 rope diameters it is seized along its length at intervals of not more than 72 rope diameters.

13. Double part slings may be fitted with ordinary thimbles, reeving thimbles, or one

of each. When fitted with ordinary thimbles the slings may be used as sling legs or one-leg slings.

Multi-legged Slings

14. A multi-legged sling (Fig. 3) may be constructed from any of the single or double part sling legs shown in Figs. 1 and 2. The two and three legged slings have the legs mounted on the main ring, but the four legged sling has two intermediate rings, each carrying two sling legs, mounted on the main ring.

15. The standard two, three and four legged slings are specified to be provided with a terminal hook to each leg but there are instances when the hook may be omitted thus allowing the thimble ends of the legs to be attached direct to the load by shackles.

Splicing

16. **General.** The problem of securing end attachments is often solved by using an "eye" splice. Eye splicing consists of bending back the end of the cable round the heart-shaped brass "thimble" (or a grooved steel "roller") separating the strands at the extreme end and weaving them over and under alternate strands of the "standing" part of the cable.

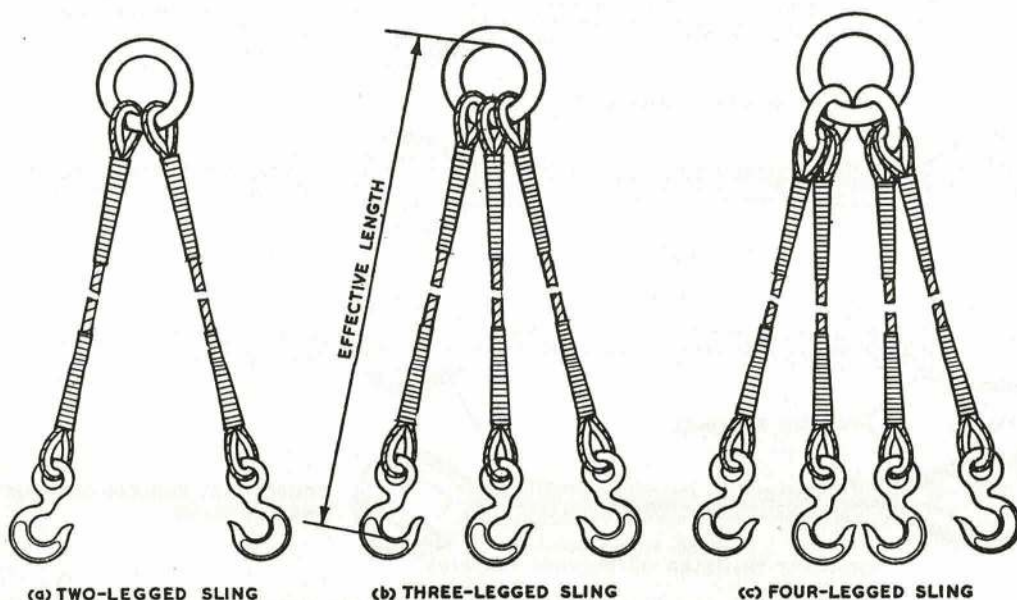


Fig. 3. STANDARD MULTI-LEGGED SLINGS

17. Before cutting the cable serve at both sides of the point of cutting by binding waxed thread tightly around the cable; this prevents fraying. Cut with a sharp cold chisel. Proceed as follows:—

(a) Turn up the ends of the heart-shaped thimble.

(b) Leave sufficient free end for splicing (6 in. to 9 in.) and bind the centre of the thimble to the cable (Fig. 1 of Fig. 4).

(c) Serve the cable with waxed thread at each side of this binding so that the serving lies in the straight part of the thimble (Fig. 1 of Fig. 4).

(d) Pull the cable tightly round the thimble and fix by binding over and under with thread or thin cord at the small end of the thimble (Fig. 2 of Fig. 4).

18. Separate the strands of the free end and whip all ends with waxed thread to prevent unlaying. The strands are numbered 1, 2, 3, 4, 5, 6, (clockwise from "eye" end) and the "heart strand" is bent back between No. 3 and No. 4 strands (Fig. 3 of Fig. 4). Call the strands of the "standing" part *a, b, c, d, e, f*.

19. Commence splicing by tucking 3 under *a*, 1 under *b* and *c*, and 2 under *b* (Fig. 4 of Fig. 4). Turn over; tuck 4 under *f*, 5 under *e*, and 6 under *d* (Fig. 5 of Fig. 5). Pull each strand tight. This completes one tuck.

20. Lay the heart strand along the cable and take it under a suitable strand (say 4), thus forcing it into the centre of the splice (Fig. 6 of Fig. 5). Continue tucking by passing the strands over and under one strand each (3 over *b*, under *c*, 1 over *d*, under *e*, etc.).

21. The third tuck is done like the second (3 over *d*, under *e*, etc.); the fourth tuck is done like the second and third.

22. The last half tuck is done by threading *alternate* strands once: the free ends of the strands are cut off, and the last one and a half tucks are served with waxed thread or a strand of waxed cord. The ends of the heart-shaped thimble are turned down and the thimble binding removed (Fig. 7 of Fig. 5).

Notes.—

1. A "spike" is used to separate strands for tucking in the ends.

2. Pull each tuck tight in turn. Take care not to disturb the lay of the cable round the thimble when pulling up the first tuck.

3. Preserve a good shape by beating the splice with a hide faced hammer on a block of wood. (Much hammering should be unnecessary.)

4. A good splice is stiff and the strands remain tight and close when bent.

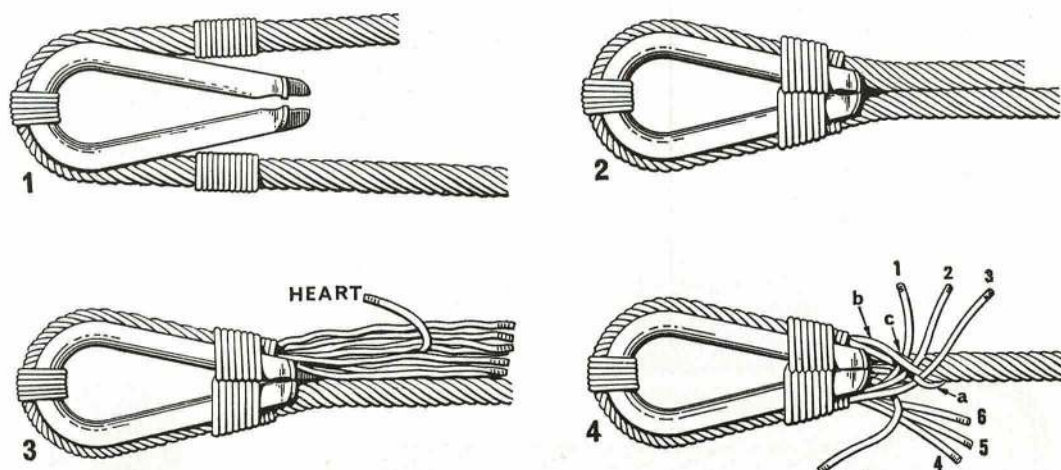


Fig. 4. SPLICING (1)

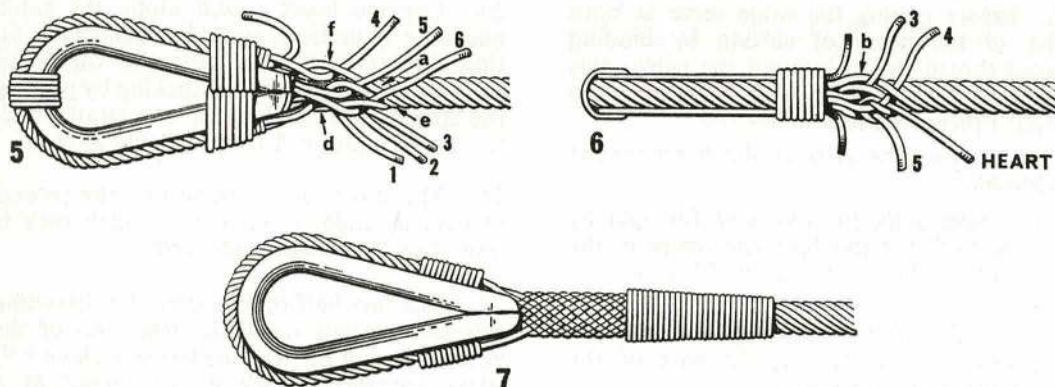


Fig. 5. SPLICING (2)

Talurit Process

23. The "Talurit" wire rope clamping process is an alternative to the conventional method of hand-splicing and is used in the Royal Air Force for the manufacture and repair of lifting equipment such as slings, crane ropes, etc. Two methods of applying the process are used: one method involving the use of a 300 ton power-operated press is described in detail in A.P. 2817A, Vol. 1 and Vol. 6; information on the other method which makes use of a 25 ton hand-operated press will be found in A.P. 1464B, Vol. 1. The latter method is for use with wire ropes up to $\frac{3}{4}$ inch circumference and the former is for ropes up to $2\frac{1}{2}$ inches circumference.

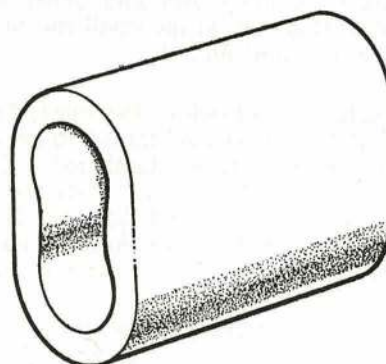


Fig. 6. ALUMINIUM FERRULE

24. The clamped joint is made by swaging an aluminium ferrule (Fig. 6) on to the two thicknesses of the wire rope. The rope is threaded through a ferrule of a size to suit the circumference of the rope and then turned back on itself through the ferrule to form a loop; the ferrule is then placed between the swage blocks in the press. If required, a thimble or other fitment may be inserted in the loop before swaging.

25. The press is then operated to close the swages until they comfortably grip the ferrule, which must be correctly aligned in the swage blocks, after which the rope is adjusted either to correct the size of the loop or to ensure that the loop is a tight fit on the thimble or other fitment. The press is again operated until the swages meet and the joint is completed. The pressure exerted to swage

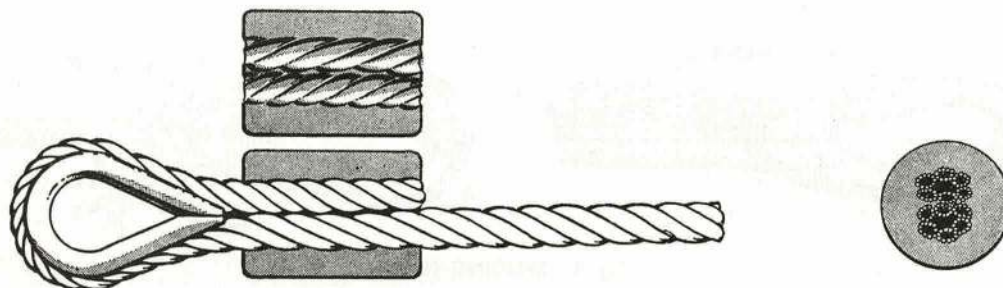


Fig. 7. SECTIONED CLAMPED JOINT

the ferrule does not harm the rope and the lay is entirely undisturbed as the metal of the ferrule 'flows' around the strands (Fig. 7), holding each firmly in position.

Note.—When swaging a joint, it is imperative that the correct ferrule for the size of rope is used, except that on an all-steel rope (one which has no hemp core) a ferrule of the next larger size and its corresponding swage blocks must be used.

26. The "Talurit" No. 2 annealing and cutting machine is designed to facilitate the preparation of wire ropes before they are inserted in the ferrules.

27. Always ensure that there is a flash on each side of the ferrule after it is swaged on to the rope; the joint is incomplete if there is no flash. Ensure that the end of the rope protrudes through the end of the ferrule after swaging (Fig. 8).

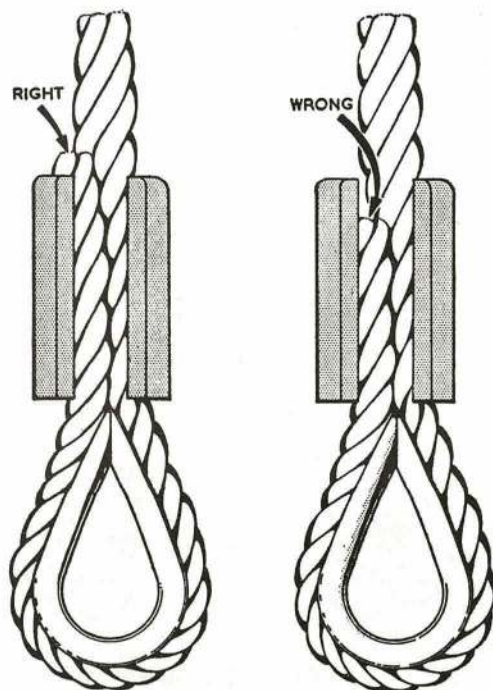


Fig. 8. CUTAWAY VIEWS OF JOINT

Britloc Process

28. Special slings that have been manufactured by the Britloc process may be issued. The process is applicable to pre-formed cables only and consists of two M.S. ferrules pressed around the cables. The equipment for manufacturing slings by this process is not available to the Service.

Chain Slings

29. Although almost all chain slings have, in the past, been manufactured from wrought iron, the present trend is towards the use of mild steel and high tensile steel. The reason for this is that steel chains are stronger and are usually cheaper to produce; they are automatically electric-welded, whereas wrought iron links are fire welded by hand.

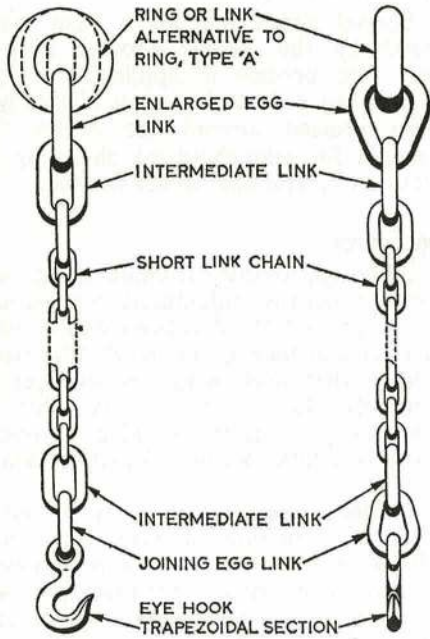
30. **Chain.** Chains may be identified by the position and type of weld employed in the links. A steel chain has a butt weld in the centre of one side of each link (Fig. 27);²⁸ an iron chain has a scarf weld at the junction^{AL32} between the rounded end and the side portion of a link. A further difference is that the sides of a wrought iron link in good condition are slightly oval in shape, whilst those of a steel link are parallel.

31. **Fittings (Fig. 9).** The length of chain in a sling leg has an intermediate link at each end, which is joined to an enlarged egg link or a joining egg link. These links are used to connect a ring, a link alternative to a ring, or an eye hook to the intermediate link. In the case of collar slings, the reeveable or non-reeveable egg links are also joined to the intermediate links by joining egg links. The standard rings are of such design that their S.W.L., which for any given material is determined by the internal diameter of the ring and the diameter of the material used, is proportional to the S.W.L. of its sling leg or legs. The links alternative to rings are similarly proportional but weight is saved by using the link in place of a ring where the diameter of the material of the ring exceeds 2 inches.

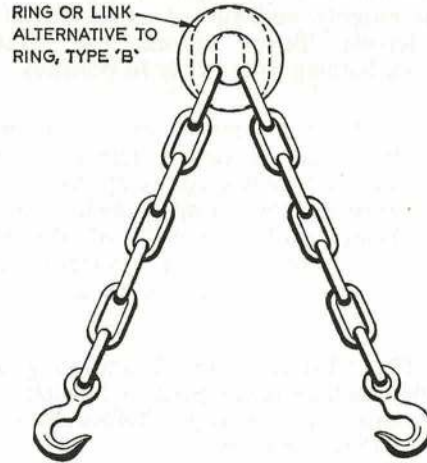
Standard Chain Slings

32. Examples of standard chain slings are shown in Fig. 9. The standard single sling is fitted with a ring at one end and a hook at the other. The two-leg sling consists of two single slings mounted on a main ring, and the

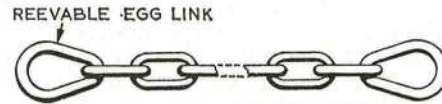
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STANDARD SINGLE SLING



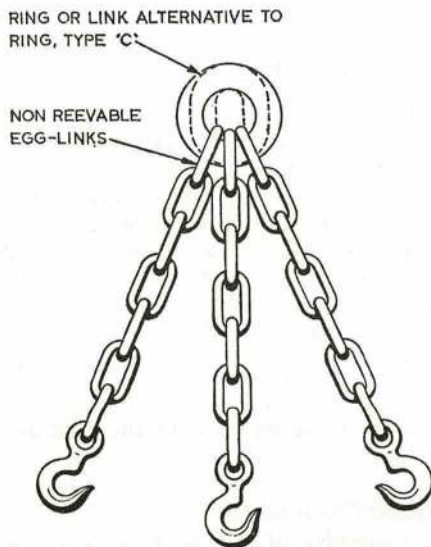
TWO LEG SLING



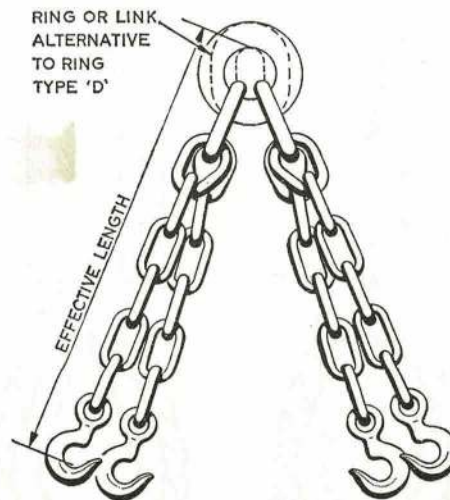
REEVEABLE COLLAR SLING



NON REEVEABLE COLLAR SLING



THREE LEG SLING



FOUR LEG SLING

Fig. 9. STANDARD CHAIN SLINGS

four-leg sling consists of two two-leg slings mounted on a ring. A three-leg sling is three single slings mounted on a ring. The reeveable and non-reeveable collar chain slings are not fitted with hooks or rings because they may be secured to the load by reeving or by attachment to some types of shackles.

Fibre Rope Slings

33. The following are the main classes of ropes in general use:—

- (a) **Hemp.** A reliable rope used for slinging purposes and for securing loads.
- (b) **Manilla.** Soft, pliable, does not kink, and is used for ropes running over pulleys.

34. The qualities of the raw materials used in fibre ropes have a varying range of strengths. The normal safe working load of a fibre rope is one sixth of the guaranteed breaking load but this is only applicable if the rope is in excellent condition. The safety factor should be modified to suit the condition of the rope.

35. **Condition of Rope.** It is advisable to grade the rope in accordance with its condition and, if necessary, to modify its S.W.L. in accordance with the following:—

- (a) **Condition Value 1—Excellent.** This would be a new rope from stores, where the original fibre strength has not been reduced by age or bad storage and shows no signs of having lost the lubricating properties that should be present in a new rope. The normal S.W.L. may be applied.
- (b) **Condition Value 2—Good.** Rope which has been used and shows signs only of internal and/or external wear or chafe, and where there is slight apparent loss in the original fibre strength. The normal S.W.L. should be decreased by 20%.
- (c) **Condition Value 3—Fair.** Rope which has had a fair amount of usage or length of life and shows clear indications of wear internally and/or externally and where deterioration of fibre strength is apparent. The normal S.W.L. is to be decreased by 33%.
- (d) **Condition Value 4—Poor.** Rope badly chafed externally, or worn internally, or where the fibres have deteriorated in strength to a marked degree. A rope in this condition must not be used for any lifting operation.

36. Ropes normally consist of three main strands each strand being composed of a number of smaller threads or yarns of rope fibre. The size of a rope is stated as its **circumference** (not diameter) in inches and its length is stated in **fathoms** (1 fathom = 6 feet). Ropes may be spliced or knotted.

Rope Splicing

37. **Eye Splice.** This is carried out in the same general way as for wire cable; three tucks are usually sufficient, followed by a further tuck after the strands have been reduced in diameter. The eye is protected by means of a thimble or served with a thin cord.

38. **Back Splice.** This is done to prevent the end of a rope from fraying (Fig. 10).

Knots and Lashings

39. Knots are used where a temporary attachment is required (Fig. 11): the knots, shown loose for clarity must, of course, be pulled up tight.

- (a) **Thumb and Figure of Eight.** Used to make a "stop" on a rope, to prevent an end from fraying, or to prevent the rope slipping through a block.
- (b) **Reef.** Used to join two ropes of the same size.
- (c) **Sheet Bend.** Used to join two ropes of different sizes.
- (d) **Bowline.** Used to form a non-slipping loop in a rope.
- (e) **Clove Hitch.** Used to fasten a rope to a pole, etc. Non-slipping.
- (f) **Timber Hitch.** Used to fasten the end of a rope to a pole, etc.
- (g) **Two Half Hitches.** Used to fasten the end of a rope to a pole.
- (h) **Running Bowline.** Used to form a running noose on a rope.

APPLICATIONS OF SLINGS

General

40. The choice of a sling for a particular job is governed mainly by the:—

- (a) Weight of the load to be lifted.
- (b) Size and shape of the load.
- (c) Amount of headroom available.
- (d) Provision or otherwise of slinging points.

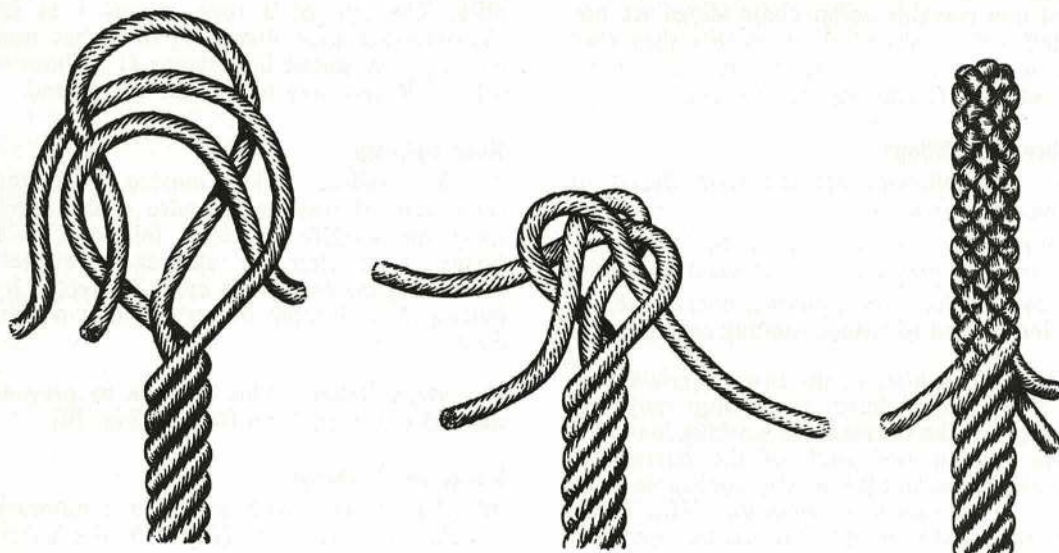


Fig. 10. BACK SPLICE



THUMB.



FIGURE OF EIGHT.



REEF.



SHEET BEND.



TWO HALF-HITCHES.



BOWLINE.



CLOVE HITCH.



TIMBER HITCH.



RUNNING BOWLINE.

Fig. 11. KNOTS AND LASHINGS

41. Many items of equipment have special-to-type slings provided; where this is so, the special sling must always be used. The first factors to consider are the weight and centre of gravity of the load. The most difficult items to lift are those that are awkwardly shaped and badly balanced, and there is often a temptation to wrap the sling around the load without considering the fact that the sling may become permanently deformed or damaged. The overall weight is often marked on a piece of equipment; if the actual weight is not known a wide margin of safety must be allowed.

Allowance for Angle of Legs

42. If a multi-legged sling is used with its legs inclined at an angle to the vertical, the tension in each leg is greater for a given load than if the legs are used in the vertical position. The increase in tension is inversely proportional to the cosine of the angle of inclination.

43. All slings are fitted with a brass tally (Figs. 24 and 25) which show their safe working loads. The tally fitted to a standard multi-legged sling is marked with the S.W.L. of the sling when the included angle between diagonally opposite legs is 30°, 60°, 90° and 120°. ~~To find the load that a multi-legged sling will safely lift at a particular angle of spread, the S.W.L. shown on the tally for that angle should be multiplied by the number of legs on the sling. This is applicable only if each leg of the sling is equally loaded; if in doubt, multiply by the number of legs that bear the load.~~ AL
29

44. If the sling is to be reeved, back-hooked, or snickled around the load, the strength of the sling required will have to be calculated as in Fig. 20. Special-to-type slings are designed with these factors in mind and it is not necessary to modify their S.W.L. except under the conditions outlined in para. 35 when using them with their own particular item of equipment.

45. A table showing the S.W.L. of every item of lifting tackle in use should be posted in the room where the lifting tackle is normally stored and in a prominent position in all buildings where the tackle is used. For multi-legged slings, the table is to show the S.W.L. of each sling when the included angle

between diagonally opposite legs is 30°, 60°, 90° and 120°. Normally, the angle of spread (included angle) at the apex of the sling should not exceed 90°, i.e. 45° each leg.

Attaching the Sling to the Load

46. Even though precautions are taken to ensure that a particular sling is strong enough for a certain operation it is still possible to overload the sling by attaching it to the load incorrectly. There are several standard fittings that are designed for use with slings, the most useful of these being eyebolts and shackles.

47. **Eyebolts.** There are two types of eyebolt (Fig. 12). Those without collars are for use where the point of suspension is directly above the eyebolt only and so they are not suitable for general purposes slinging. The eyebolt with a collar is designed for use with a shackle only and a hook must not be passed through the eye of the eyebolt. The fit of an eyebolt in its tapped hole, and also the position of the eye, should be checked before proceeding with a lifting operation. When the shackle is fitted to the eyebolt the shackle pin must be at right-angles to the plane of the sling leg; it is usual to use a washer or a shim for adjustment purposes. ✓



Fig. 12. LIFTING EYEBOLT

(A.L. 18, May 64)

48. Shackles. There are four standard types of shackles (Fig. 13), each of which is for use with different terminal attachments. There are also four different types of shackle pins, each of which may be secured to the shackle in a different manner.

49. The nominal size of a shackle is the diameter of the material of the body; each shackle should be marked with its S.W.L., and markings that will allow identification with its test certificate.

50. When a shackle is required for a particular application, the one selected must suit the fittings on both the sling and the load. As an example, A in Fig. 14 shows a load that is fitted with eyebolts being lifted by a two-legged wire rope sling fitted with eye hooks. It may be assumed that eyebolts permanently attached to the load have a suitable S.W.L. The type of shackle for use with an eyebolt at the pin end and a hook at the bow end is a small bow shackle, and one

of this type having a suitable S.W.L. should be selected.

51. Even when the correct fittings are used it is possible to overload the eyebolts by using the wrong type of sling (B in Fig. 14). In this example, the overloading is caused by the stresses in the horizontal part of the sling acting upon the eyebolts, and it is obvious that in such instances each leg of the sling should be attached to one of the eyebolts as shown in A of Fig. 14. Further, the method shown at B of Fig. 14 would produce a very sharp bend in the wire rope; this would probably result in the sling being damaged or deformed.

Other Methods of Slings

52. General. When it is necessary to lift a load that has no lifting attachments, the load may be supported in a number of different ways. At such times the type and size of sling available and the weight and shape of the load will all have to be considered before a particular method is chosen.

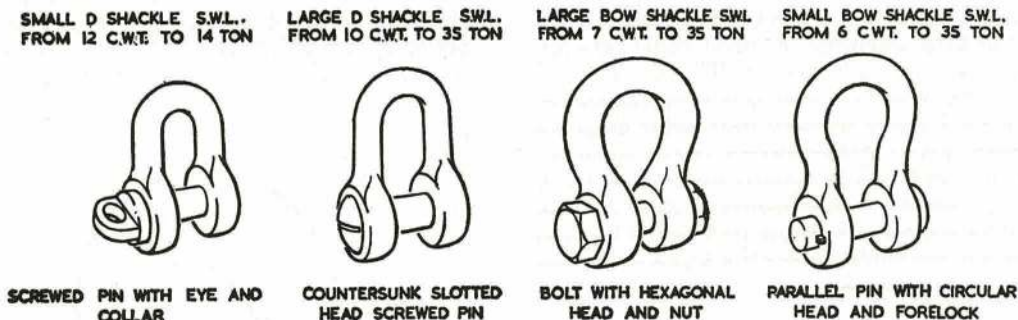


Fig. 13. STANDARD SHACKLES

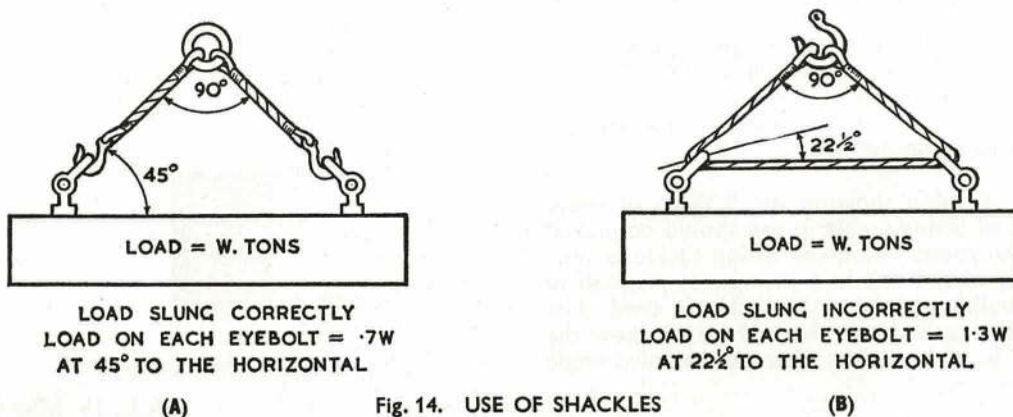


Fig. 14. USE OF SHACKLES

53. **Reeving.** The standard reeveable collar chain sling and standard wire rope sling fitted with reeving thimbles may be used by forming a bight at one end to support the load, the free end being placed on to the lifting hook. This method is known as **reeving** (Fig. 15), but is not recommended because the sling may be strained and the load may be damaged unless certain precautions are observed. Fig. 15 shows a packing case being lifted with a reeveable collar chain sling, the reeveable egg link being forced down towards the load. This results in the two parts of the sling being splayed out at a relatively large angle, and this produces a load in each part equal to twice the weight of the load. It will also cause a crushing effect, equal to nearly twice the weight of the load, on the top of the packing case. Consequently, when using a reeveable chain or wire rope sling in this manner, the following precautions should be taken:—

- (a) Select as long a sling as is practicable and ensure that the bight is a distance of at least $L/4$ (Fig. 15) above the top of the load.
- (b) Calculate the strength of the sling required by the method shown in Fig. 20, example 3.
- (c) Inspect the structure of the load to ascertain if it will withstand a crushing force equal to nearly twice its own weight (some cases are specially reinforced). When in doubt use a spreader bar or a suitable beam across the top of the load so that it bears the crushing force; remember to allow for the weight of the spreader bar when calculating the size of sling required.

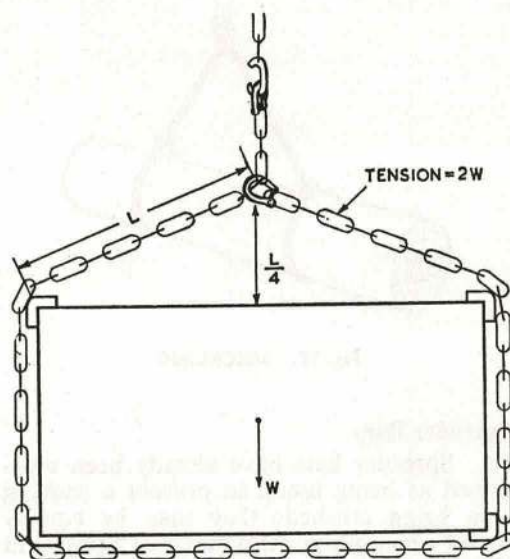


Fig. 15. REEVING

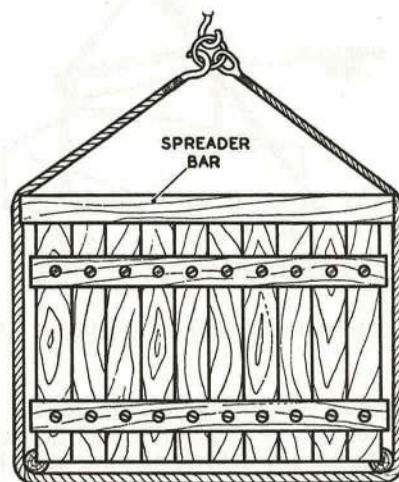


Fig. 16. BACK-HOOKING

54. **Back-hooking.** A more suitable method for this type of load is known as **back-hooking** (Fig. 16). A sling fitted with a hook is passed round the load and back on to the ring on the sling. In the example shown it has been assumed that the top face of the load would not withstand the crushing effect, therefore necessitating the use of a spreader bar. It is important that the hook is placed on to the ring and not on to the lifting hook. This is done to eliminate the risk of the sling hook being pushed off the main lifting hook, a risk that is more likely to occur when a multi-legged sling is used.

55. **Snickling.** When the hook end of a sling is passed around the load and then hooked back on to the sling leg (Fig. 17), the method is known as **snickling**. This method produces a load in each part of the sling leg similar to that which results from reeving a sling around a load. It should only be used if there is no alternative and the precautions given in para. 53 must be observed.

(A.L. 18, May 64)

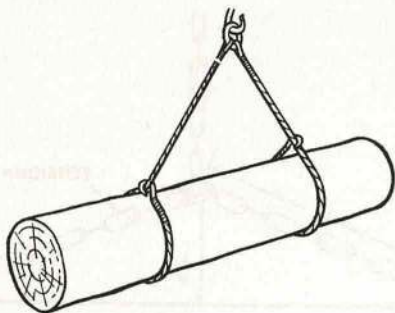


Fig. 17. SNICKLING

Spreader Bars

56. Spreader bars have already been mentioned as being useful to prevent a packing case being crushed; they may be equally useful when lifting other items of equipment (Fig. 18).

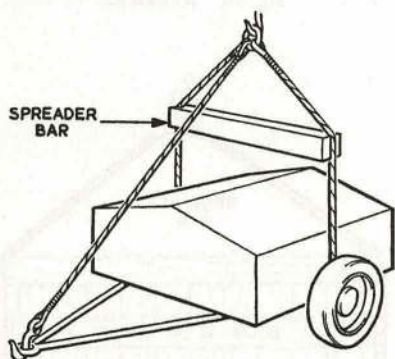


Fig. 18. APPLICATION OF SPREADER BAR

57. When selecting a balk of timber or a girder for use as a spreader bar, it must be inspected for any defects that would be likely to cause it to fail under load. The main

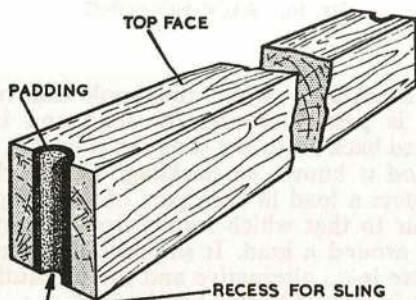


Fig. 19. WOODEN SPREADER BAR

stresses that a spreader bar will have to resist are compression and bending; timber should therefore be straight grained and free from shakes or splits. To counter the bending stress, the bar must be used with its widest face in the vertical plane.

58. Recesses will have to be cut in the end of the bar (Fig. 19) to ensure that the sling leg does not slip off. If the bar is of timber the recesses must not be vee shaped, because of the tendency for the sling to start a split at the point of the vee. The recesses must be padded sufficiently to prevent damage to the sling.

Precautions

59. **General.** Having selected a suitable sling and decided upon the method of attaching it to the load there are still certain precautions that have to be observed.

60. **Packing.** When a fibre rope, a wire rope, or a chain sling is used, packing must be placed at any point where the sling bends sharply round the load. For a heavy load being lifted with a chain sling, wood is the most suitable packing material; a useful packing piece can be made by removing one quadrant from a short length of circular wood (Fig. 21), the remaining piece may then be used on any square-edged load.

61. **Position of Splice.** When using a spliced fibre rope or wire rope sling, ensure that the splice is kept clear of both the lifting hook and the load (Fig. 22).

62. **Radius of Bend.** When using wire rope slings, sharp bends in the rope should be avoided wherever possible; the diameter of a bend should not be less than twenty times the diameter of the rope.

63. **Shortening and Joining of Slings.** Fibre rope, wire rope and chain slings must not be shortened by tying a knot in them or by wrapping them round the crane hook; neither should they be joined by bolts or wire. Always use a sling of the correct length.

64. **Misuse of Crane Hook.** A lifting hook must only be used on its appropriate ring or shackles. If it is used otherwise the weight of the load may not be borne by the correct part of the hook which could in consequence be overloaded. Fig. 23 shows a hook with the link of a length of chain passed over its point;

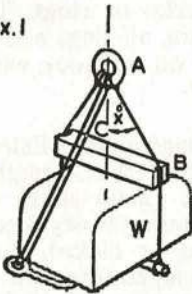
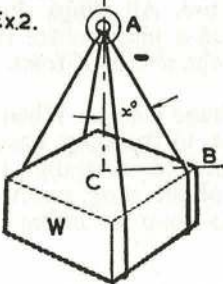
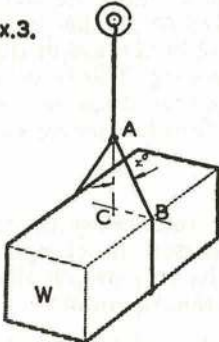
Method used	Maximum tension in sling leg = (T)	Minimum S.W.L. of sling
Ex.1 	Four-legged sling used with spreader bar. Assume total load on two legs only. Other two legs act as stabilizers.	$T = \frac{W}{2} \times \frac{AB}{AC}$ $= \frac{W}{2 \cos x^\circ}$ (Compressive stress on beam = $\frac{W}{2} \times \frac{BC}{AC}$ or, $\frac{W}{2} \times \tan x^\circ$) S.W.L. = 2T $= \frac{W}{\cos x^\circ}$
Ex.2. 	Two-legged sling 'back-hooked' around load. If C.G. of load is central, legs will be equally loaded.	$T = \frac{W}{4} \times \frac{AB}{AC}$ $= \frac{W}{4 \cos x^\circ}$ S.W.L. = 4T $= \frac{W}{\cos x^\circ}$
Ex.3. 	Reeveable sling. Load would need stabilizing. Method also applies to sling that is 'snickled' around load.	$T = W,$ $\text{or } \frac{W}{2} \times \frac{AB}{AC}$ $\text{or } \frac{W}{2 \cos x^\circ}$ S.W.L. = T If x is greater than 60°

Fig. 20. SAFE WORKING LOADS

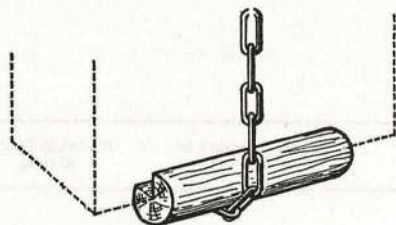


Fig. 21. WOODEN PACKING PIECE

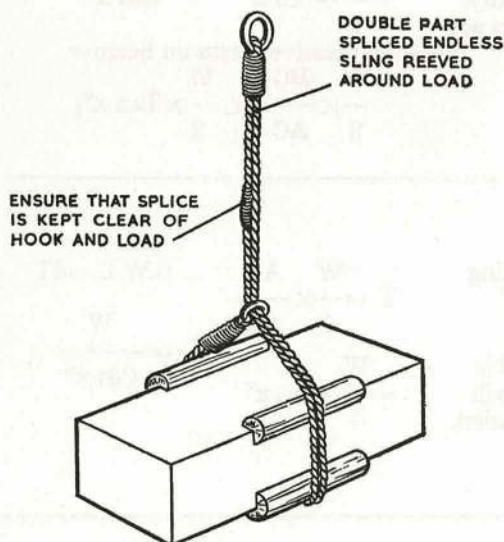


Fig. 22. POSITION OF SPLICE

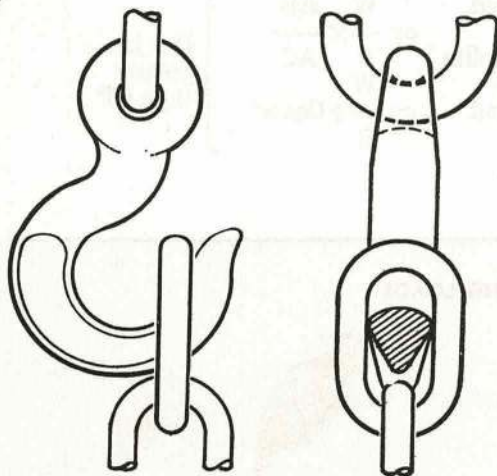


Fig. 23. POINT OF HOOK JAMMED IN LINK

the link would probably stay on the hook but any load in the chain would produce a bending moment about the principal section of the hook. Also, even if the link does bear on the correct part of the hook, there will be a tendency for the link to be deformed by the wedge action of the sides of the hook. The same action may occur with D shackles but not with bow shackles or rings. To avoid failures of this nature, all rings and shackles should be a free fit on the hook with which they are used.

65. **Effects of Temperature.** Extremes of temperature will affect the strength of the material of a sling. Chain slings must be carefully inspected during frosty weather, for if they are notched or nicked, the effects of the very low temperature will tend to weaken the chain at these points. It is safer to use a new chain and, if possible, to warm it slightly before use. All slings should, of course, be stored in a place where they will not be exposed to the effects of frost.

66. **Position of Crane Hook.** When attaching the crane hook to the sling, ensure that the hook is positioned centrally over the attachment point of the sling, otherwise the load will swing as soon as lifting is commenced.

67. **Alignment of Slings.** Before a multi-legged sling is used, it should be laid out on the floor and checked to see that the fittings, such as shackles and hooks, are in alignment with their leg of the sling. This is particularly important with wire rope slings, as there may be a tendency for them to become kinked.

Lifting

68. The following rules must be observed by the qualified person in charge of the operation, who is the only person allowed to give signals to the crane operator:—

- (a) Ensure that the load is free to be lifted—machines in a workshop are often bolted to the floor.
- (b) All persons must stand clear of the load and hands must be kept well away from chains and ropes.
- (c) As the crane starts to take the weight of the load, watch the sling; if it shows any sign of slipping or moving on the load, stop the crane, lower the load and rectify the fault.

(d) Never allow the load to be carried over other persons; if necessary, warn them to keep clear of the load.

(e) Never ride on the load, nor allow any other person to do so.

(f) Signals to the crane operator must be clear and concise; if the operator is caused to apply the crane brake suddenly, or to snatch the load, the sling will be grossly overloaded.

(g) A load must not be left unattended whilst it is suspended.

(h) When the load is lowered, do not let it rest upon the sling. If the load is lowered on to supports, a sling that passes under the load can be removed without being damaged. Do not use bricks as supports; they are very liable to crumble when subjected to weight.

SERVICING AND TESTING

Introduction

69. Owing to the serious consequences which may attend an accident caused through either incorrect use or mechanical defects of lifting tackle, special precautions have to be observed and periodic inspections made by R.A.F. units responsible for such tackle. In addition, all persons responsible for the use, servicing and inspection of lifting tackle, should make themselves fully acquainted with the contents of the Ministry of Labour Safety Pamphlet No. 3—The use of chains and other lifting gear—copies of which can be obtained from A.P.F.S., Kidbrooke.

Supply

70. All lifting tackle in use in the R.A.F. is supplied from one of two sources, as follows:—

- (a) Ministry of Public Building and Works.
- (b) The Directorate General of Equipment (D.G.E.).

Responsibilities for Servicing

71. Lifting tackle supplied by M.o.P.B.W. is maintained by the Engineer Staff of that Ministry, and the responsibilities of R.A.F. Technical Officers regarding M.o.P.B.W. lifting tackle are confined to ensuring that any suspected defects are brought to the

notice of the Engineer Staff, and to preventing the use of suspect tackle until it has been certified as serviceable.

72. All servicing and inspection of lifting tackle issued by D.G.E. is the responsibility of the S.T.O. of the station or unit concerned.

73. Repairs, annealing and subsequent proof loading, when they apply, will normally be carried out by Industry under arrangements made by the relevant D.G.E. branches for the United Kingdom, or by local contract overseas.

74. No item of lifting tackle may be taken into use unless it has been properly examined, tested and proof loaded. The manufacture of lifting tackle by R.A.F. units is prohibited except as specified in A.P. 2817A, Vol. 1 and Vol. 6, Part 1, Sect. 11, Chap. 1.

Manufacturer's Test Certificate and Serial Number

75. Lifting tackle supplied by D.G.E. will in all cases be given a manufacturer's serial number and a manufacturer's test certificate. The test certificate must be held by the S.T.O. or his appointed deputy and it must accompany the item through the issuing unit to the user unit and on any subsequent transfer. It must not be cancelled or destroyed until the useful safe life of the item is ended. Items of lifting tackle are to be identified by their serial numbers; these numbers must not therefore be altered or removed except by modification or S.T.I. action. ✓

FULL NOMENCLATURE OF STORE

REF. N ^o		DRG. N ^o	
SAFE WORKING LOAD		TONS	CWTS
DATE OF TEST		↑ ○	
CONTRACT N ^o			
SERIAL N ^o			
DATE OF MANUFACTURE			
NAME AND ADDRESS OF MANUFACTURER			

Fig. 24. TYPICAL TALLY FOR LIFTING TACKLE

(A.L. 18, May 64)

76. In addition to the foregoing, all items of lifting tackle must bear a brass tally (Fig. 24) affixed in such a manner that it cannot be detached in use and, when fitted to wire rope slings, it must be spliced in so that it cannot be removed without rendering the sling unserviceable. The tally fitted to a multi-legged sling is as shown at Fig. 25.

FULL NOMENCLATURE OF STORE

REF. NO. DRG. NO.

S.W.L. OF SLING WHEN INCLUDED

ANGLE BETWEEN DIAGONALLY OPPOSITE LEGS IS:-

ANGLE	TONS	CWTS.
30°		
60°		
90°		
120°		

CONTRACT NO. DATE OF TEST

SERIAL NO. DATE OF MANUFACTURE

NAME AND ADDRESS OF MANUFACTURER

Fig. 25. SPECIAL TALLY FOR MULTI-LEGGED SLINGS

77. Lifting tackle already in use, but without a manufacturer's test certificate and serial number, must be dealt with as instructed in A.P. 2817A, Vol. 1 and Vol. 6, Part 1, Sect. 11, Chap. 1.

78. **Fibre Rope Slings.** In compliance with the Factories Act, no proof loading is required on slinging equipment manufactured entirely from fibre rope, but a certificate which guarantees the safe working load is to be issued with the sling by the manufacturer; the safe working load will be calculated from the ultimate breaking load as guaranteed by the manufacturer of the rope.

Register of Lifting Tackle

79. A register of lifting tackle (R.A.F. Form 3806) is maintained by the S.T.O. or his deputy. It contains particulars of all items of lifting tackle held on charge by the station or by units on the station. A separate sheet (R.A.F. Form 3806A—Record of Inspections—Lifting Tackle) is to be used for each item of tackle, the manufacturer's test certificate being attached to this sheet. On receipt of a new item of lifting tackle, it is to be given a Unit Serial Number by the S.T.O. or his deputy; a new sheet (F. 3806A), complete with all relevant details must then

be inserted in the register. Each completed inspection, modification or S.T.I. carried out on the equipment will be recorded on this sheet.

80. Whenever an item of lifting tackle is transferred from one station or unit to another, whether it is serviceable, suspect or unserviceable, it must always be accompanied by its test certificate and its Record of Inspections Sheet (F. 3806A). In the event of a unit moving from a station, the inspection records of the lifting tackle on charge to that unit will be removed from the register, and handed for safe custody to the Technical Officer of the unit for insertion in the register at the unit's new station. A mobile unit is, however, responsible for the periodic inspection and servicing of all lifting tackle on its own charge.

Safe Working Loads

81. As stated previously, a table of the safe working loads of every item of lifting tackle in use is to be posted in the room in which such lifting tackle is normally stored and in prominent positions in all buildings where lifting tackle is used. For multi-legged slings, the table is to show the safe working loads of the slings when the included angles between diagonally opposite legs are 30°, 60°, 90° and 120°; the safe working load for each sling leg is proportional to the cosine of the angle of the leg from the vertical. The table is to be kept up-to-date by entries corresponding to the entries in the station or unit register of lifting tackle whenever new items of equipment are received, or any items are transferred or returned to store.

82. Any item of lifting tackle not shown in the table of safe working loads is not to be used. This, however, does not apply to an item of lifting tackle when the safe working load (or when multi-legged slings are held, the safe working load at different angles of the legs) is plainly marked upon the tackle. No item of lifting tackle is to be used for any load exceeding the safe working load as shown in the table or marked upon the tackle.

Load Limitations

83. It is the responsibility of the S.T.O. or his deputy to ensure that all persons in charge of lifting operations are aware of the load limitations of the equipment to be used and all other precautions which must be observed during the lifting operations.

Failures of Lifting Tackle

84. Any item of lifting tackle which fails in use is to be held for investigation in accordance with the instructions contained in A.P. 3158, Vol. 2, Leaflet E.4.

Precautions in Use

85. An Officer or N.C.O. is to be in charge of all operations involving the use of lifting tackle, with the following exceptions:—

(a) Repetitive operations of a simple nature using specific equipment. In such instances a competent airman may be detailed by the S.T.O.

(b) At civilian manned R.A.F. units, selected civilians may be nominated by the S.T.O. to take charge of such operations.

86. Lifting tackle is not to be picked up or borrowed in a casual manner for a lifting operation. Every item of tackle must be carefully checked by the person in charge of the operation; he is to ensure that it is the correct equipment for the job in hand and that it is in a serviceable condition immediately before use. If the examination reveals any signs of damage or raises any doubt regarding the serviceability of the item concerned, the item is to be placed unserviceable immediately and

is not to be used until it has been properly examined and certified serviceable by a competent person.

87. The person in charge of a lifting operation will be held entirely responsible that the sling and tackle used are suitable for the work and that the correct method of slinging is employed. He is to ensure that hooks or shackles are in alignment with the lifting chains or cables and that shackles do not foul the attachment lugs internally. Fouling will cause an indirect pull and probable failure of the shackle.

88. To guard against the danger of overstraining, due allowance must be made for the angle at which a sling, having more than one leg, may be spread when a load is being lifted or lowered. Figs. 26 and 27, showing the tension in the chains of a four-leg sling when lifting a five-ton load, clearly indicate this need. Further information concerning the safe loads for two-legged chain slings is given in the Ministry of Labour Safety Pamphlet No. 3, which should be consulted when any doubt arises regarding the safety of the angle adopted. Normally, the angle of spread at the apex of a sling should be limited to 90 degrees.

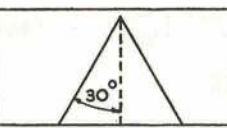
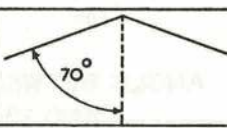
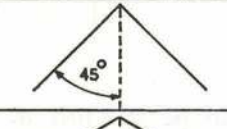
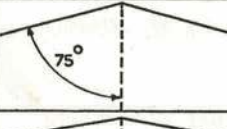
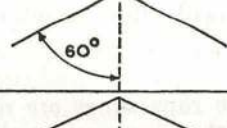
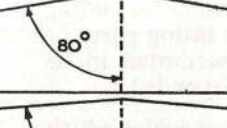
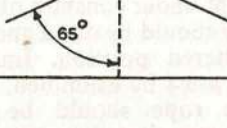
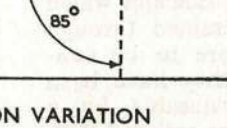
ANGLE OF CHAIN LEG TO VERTICAL	TENSION ON EACH LEG		ANGLE OF CHAIN LEG TO VERTICAL	TENSION ON EACH LEG	
	TONS	CWT.		TONS	CWT.
	1	8		3	13
	1	16		4	17
	2	10		7	4
	2	19		14	8

Fig. 26. TENSION VARIATION

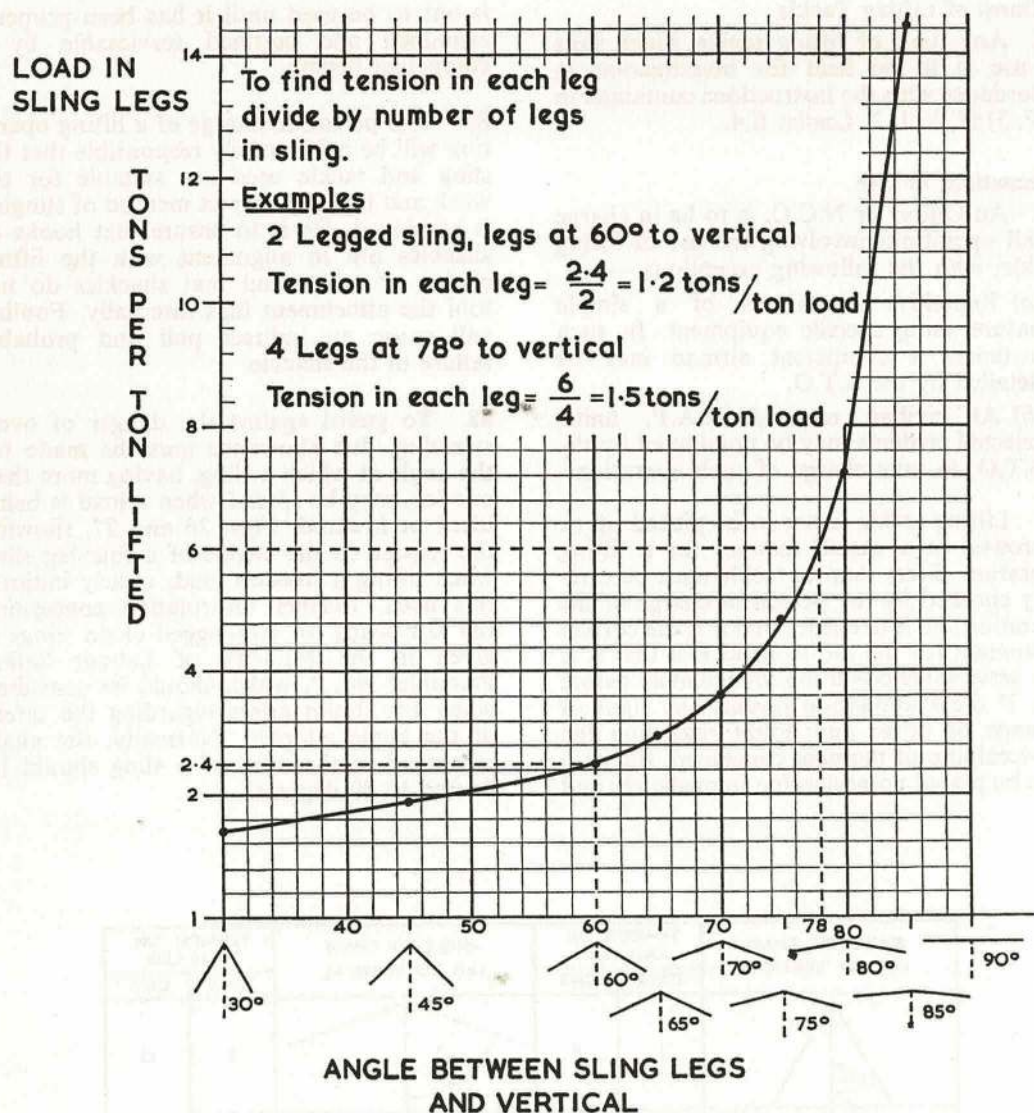


Fig. 27. TENSION VARIATION GRAPH

89. A load must not be left unattended whilst suspended from a crane or lifting tackle and no member of the lifting party or any other person is to be permitted to be beneath the load while it is suspended.

90. Slings, chains, hooks or shackles which may become accidentally strained through snatching or other causes are to be considered unserviceable until they have been inspected and certified serviceable by a competent person. If he is not satisfied with a visual examination, the sling, hook, chain

or shackle is to be returned to stores as repairable, marked "for rectification and proof loading".

91. When fibre rope slings are not in use they must be kept under constant observation for defects; they should be dried and hung on pegs in a sheltered position. Immediately before use they must be examined, when the strands of the rope should be partially untwisted to ensure that they are not damaged or mildewed internally.

92. When wire rope slings are used, care must be taken that the slings do not kink under load. Wire rope slings must **NEVER** be knotted to shorten them. A brief inspection is to be made of splices, swaging and attachments to wire rope slings immediately before use to ensure that the items are serviceable. Before multiple wire rope slings are fixed to a load, they must be laid out on the floor to ensure that the shackles are correctly attached and that the fittings are not twisted.

93. To prevent fibre or wire rope slings from being cut by sharp corners of a load, packing is to be inserted as required between the sling and the load.

94. When a mobile crane is used for a lifting operation, only the person in charge of the operation is to give orders to the crane driver.

INSPECTION AND SERVICING BY USER UNITS

Responsibility

95. It is the responsibility of the S.T.O. or his deputy to ensure that arrangements are made so that every item of lifting tackle held on charge is regularly inspected and serviced. He is also to ensure that the certificates of periodic inspections, duly signed by the person making the inspections, are completed.

Fibre Rope Slings

96. Fibre rope slings are to be inspected at monthly and ~~three~~ ^{Six} monthly intervals. *AL 32*

97. **Monthly Inspection.** At monthly intervals, natural fibre rope slings are to be examined for the following defects:—

(a) Internal wear. This is indicated by extreme flexibility of the rope and signs of chafing in the lays.

(b) External wear of outer strands. This is indicated by a reduction in the diameter of the rope and flattening and fraying of the outer strands.

(c) Brittleness, friability, and shortness of fibre in the strands. These can best be detected by rubbing the rope through the hands, when small fibres will catch up and stand out from the lays.

(d) Cuts, bruises and frayed strands.

(e) Bad splicing, loose or uneven splicing, poor serving, tucks pulling out. Splices are not to be less than $4\frac{1}{2}$ tucks and they must be examined with particular care at every inspection.

~~Three~~ ^{Six}

98. **Three-monthly Inspection.** The serving *AL 32* on the splices of all natural fibre rope slings, and any protective covering that may be fitted, must be removed every ~~three~~ ^{Six} months *AL 32* to ascertain whether the splices are serviceable, or whether mildew has attacked the fibres of the splices. The rope is to be opened up by slightly untwisting the strands and then inspected carefully for signs of dampness or mildew. Any sling which shows signs of dampness must be hung up under cover and dried out. Slight traces of mildew can be removed by vigorous rapping of the sling. Where all traces of mildew can be removed by this method, the sling can be considered safe for further use, provided that no other defects are apparent, but a note should be made in the certificate of inspection to the effect that mildew was traced. On completion of the inspection, servings and protective coverings are to be replaced.

99. The working life (calculated from the date of issue) of a natural fibre rope is not to exceed three years. At the end of this period the rope is to be destroyed by cutting it into small lengths.

Nylon Fibre Ropes

100. The working life of a nylon fibre rope sling, calculated from the date of issue, is not to exceed three years. At the end of this period, or earlier if found to be faulty during use or inspection, the sling is to be destroyed by cutting it into short lengths. During their working life, nylon fibre rope slings are to be inspected at monthly and three-monthly intervals.

101. **Monthly Inspection.** At the monthly inspection of nylon fibre rope slings, examine the splices and splice servings for security and damage. Also examine the rope for abrasion, cuts, fraying of the strands, stretch, long and short strands, bulging strands and other damage.

102. Three-monthly Inspection. At the three-monthly inspection of nylon fibre rope slings, remove the servings on the splices and any protective covering that may be fitted; carefully examine the splices. Also examine the ropes as detailed in para. 101 for the monthly inspection. On completion of the inspection, replace the splice servings and protective coverings on the serviceable ropes and destroy any ropes found to be unserviceable.

Wire Rope Slings

103. Steel wire slings are to be treated with Protective PX-9.

104. Monthly Inspection. Each wire rope sling is to be inspected at monthly intervals for kinks, knots, broken wires and external corrosion.

105. Three-monthly Inspection. Wire rope slings are to be washed in white spirit and thoroughly examined for the following defects:—

(a) Broken wire in strands. More than 10 per cent of the total number of wire strands broken in a length equal to 8 diameters indicates that the rope is dangerous to use and the sling must be taken out of use immediately.

(b) Excessive internal wear. This is indicated by polished internal strands and reduction of diameter.

(c) Excessive external wear. This is indicated by polished and flattened outside strands, and eventually by broken wires and reduction in the original diameter. A reduction of more than 5 per cent in the diameter of a steel wire rope indicates that the rope is dangerous to use.

(d) Internal rusting. To detect this, lightly bend and partially untwist the lay. This operation must be done carefully to prevent damage to the rope. Any signs of internal corrosion indicates that the sling is dangerous to use.

Note.—A certain amount of slackness between the loop and its thimble will be present on all slings which have been subjected to proof loading. A comparison with new slings will be sufficient to indicate the amount of slackness which may be tolerated.

Any additional slackness must be taken as a sign that the adjacent splice is in a dangerous condition and the sling is to be considered unserviceable.

106. Any defective splice servings are to be renewed after this inspection and the wire rope treated where necessary with Protective PX-9.

107. Six-monthly Inspection. Wire rope slings are to have any protective covering or splice serving removed every six months and are to be thoroughly examined for the following defects in addition to the inspection detailed in para. 105:—

(a) Check for loose splices, insufficient number of tucks (minimum $4\frac{1}{2}$ tucks) and slack loop over the thimble.

Note.—Under the Dock Regulations a splice shall have at least 3 tucks with a whole strand of its rope, and end in 2 tucks with one half of the wires cut out of each strand. This is an acceptable alternative for proprietary equipment not designed by the Ministry of Aviation.

(b) Damage to wire caused by rough handling or unskilled use of a marline-spike.

(c) Loose tucks.

(d) Broken wires in splice tucks.

(e) Check for the security of any swaging and for broken wires around the swage, where applicable, and also for any sign of movement of cable in the ferrule.

(f) Open strands and kinks. An open strand adjacent to a splice indicates that the splice is about to fail and that one of the tucks is loose.

108. Slings which are found to be serviceable after the six-monthly inspection are then to be lubricated. To do this, the bare sling is immersed in oil OMD-110 for at least one hour. When the sling is removed, any surplus oil is to be wiped off and the splice servings and any protective coverings replaced. The whole sling is then to be treated externally with Protective PX-9. Slings for use with compressed gas transport cylinders, no matter what gas is contained in them, are not to be lubricated or treated with PX-9.

109. End fittings and spreaders will be examined every twelve months as described in para. 113.

Chains, Chain Slings, Grabs and Allied Lifting Tackle

110. The above mentioned items are to be inspected as detailed in paras. 111 to 113.

111. Three-monthly Inspection. Inspect for cracks, flaws, distortion, excessive wear and socketing. A quick check for serviceability of a chain is to ascertain its flexibility. When a chain has been overstretched, the sides of each link tend to pinch the ends of the adjacent links with the result that the chain becomes stiff. In extreme cases, with wrought iron elliptical links, the chain will become rigid. Any lack of flexibility in a load chain is, therefore, to be taken as a definite sign of its unserviceability. Socketing is the name given to the grooves produced in the ends of the links when the links chafe against each other. Socketing amounting to 10 per cent reduction in the diameter of the material is permissible. Any reduction in excess of 10 per cent renders the chain unserviceable. Overall wear is permissible up to 10 per cent of the diameter of the material of which the link is made. If cracks, flaws, distortion, excessive wear or other defects are observed, the defective parts are to be marked and returned to the appropriate Unit for reconditioning.

112. When the aforementioned examinations are completed, all chains, slings, grabs and allied lifting equipment are to be treated by dipping them in Protective PX-9.

113. Annual Inspection. Every twelve months a more detailed inspection covering the items mentioned in the three-monthly inspection is to be made. At this inspection the items are to be thoroughly cleaned and de-scaled. Any pins or shackles are to be removed and individually inspected for signs of wear. When multi-legged slings are inspected, particular attention should be paid to the main rings which bear the whole load suspended on the slings. Composite slings should have all load bearing components such as intermediate rings, pins, shackles and spreaders examined for bowing, excessive wear and signs of shearing.

Wrought Iron Lifting Tackle and Annealing

114. After 5 years use, wrought iron lifting tackle which has not been annealed can fail without visible warning. All wrought iron fittings and attachments used with lifting tackle, and lifting tackle manufactured wholly from wrought iron, are to be taken out of service after 5 years from the date of issue as new, and destroyed. So long as this action is taken, there is no necessity for annealing wrought iron end fittings and lifting tackle.

115. To assist in distinguishing between wrought iron and steel chains, it should be noted that wrought iron links are scarf welded at the junction between the rounded end and the long portion of the link, and careful examination of the weld will reveal the slight irregularities caused by the weld. Furthermore, the sides of the links of a wrought iron chain are not truly parallel but are slightly oval in shape when the chain is in a serviceable condition. On the other hand, the links of steel pitched chains used with pocketed chain wheels can be recognized by the weld in the centre of one side of each link. The link is electrically welded and will show slight irregularities near the weld (Fig. 28).

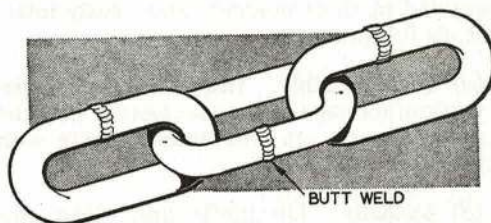


Fig. 28. IDENTIFICATION OF STEEL CHAINS

Chain Pulley Blocks

116. Chain pulley blocks are to be inspected at three-monthly and yearly intervals in accordance with the instructions given in paras. 117 to 119.

117. Three-monthly Inspection. Chain pulley blocks are to be cleaned, inspected, and lubricated every three months with oil OMD-110. It is necessary at this inspection to make a visual examination of the load chains for cracks, flaws, distortion, excessive wear and socketing, and to ensure that the moving parts of the pulley work freely.

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118. Annual Inspection. Every twelve months the pulley blocks are to be dismantled and cleaned and all working parts inspected for wear. After cleaning, the load chains are to be inspected link by link for cracks, flaws, distortion, excessive wear and socketing. Sheave pins, worn gears and other moving parts should be checked for wear. Pitched chains are to be run over their wheels to ensure that the pitch of the chain is coincident with the pitch of the pockets in which they fit. Components which are worn beyond safe limits are to be renewed and any chain showing signs of stretching is to be rejected. If, on close visual examination, no signs of defects in the load chain or excessive wear of the moving parts of the pulley block can be detected, the equipment is to be reassembled and lubricated throughout with oil OMD-110.

119. The maximum permissible amount of wear of a load chain is 10 per cent reduction on the original diameter of the material from which the links were formed.

Wire Rope Pulley Blocks

120. Wire rope pulley blocks are to be inspected at three-monthly and yearly intervals, as follows:—

(a) **Three-monthly.** Inspect for cracks, distortion, damage and wear. Ensure that the moving parts are free and lubricate with oil OMD-110.

(b) **Annually.** Dismantle and clean. Inspect each component for cracks, distortion, damage and excessive wear. Renew parts as necessary, then assemble and lubricate and ensure that the moving parts operate freely.

Sheer Legs, Gantries, Portable Cranes and Winches

121. These items of equipment are to be inspected and lubricated at three-monthly intervals following the general principles governing the servicing and regular inspection of items of lifting tackle as detailed in the foregoing paragraphs. Details regarding the operation and servicing of sheer legs are given in Section 7, and for hoists, cranes and gantries in Section 8 of A.P. 2817A, Vol. 1 and Vol. 6.

Winches

122. Inspect and lubricate the steel wire ropes of winches and hoists (other than those used for bombs) at monthly and three-monthly intervals as detailed for wire rope slings and crane ropes.

123. Three-monthly Inspection. Every three months, the winch of each hoist and crane is to be cleaned and the parts inspected and lubricated as follows:—

(a) Inspect for cracks, damage, distortion, wear and security of all components.

(b) Check the brake, ratchet and gear mechanism for correct action.

(c) Inspect the attachment of the cable to the drum.

(d) Use grease LG-280 to lubricate the gears and all bearings fitted with grease nipples. Lubricate all other working parts with oil OMD-110.

Note.—These lubricants do not apply to the Minilift hoists or to bomb winches, the lubricants for which are given in the relevant A.P.

(e) Remove any signs of rust and repaint parts as necessary, ensuring that the paint does not interfere with the free movement of working parts.

Crane Wire Ropes

124. The ratio of the diameter of the pulley used in conjunction with a wire rope, to the diameter of the rope itself, is of the greatest importance to the life of the rope. The generally accepted minimum ratio is 22 diameters of the rope (i.e. 7 circumferences) to the diameter of the pulley.

125. Experiments have shown that, within ordinary limits, an increase in pulley diameter over that quoted in the preceding paragraph of an amount equal to two circumferences of the rope, may be expected to double approximately the life of the rope.

126. Reverse bends entail double the wear of ordinary bends and should be met with increased pulley diameters.

127. The main defect to be looked for on crane wire ropes is internal wear. This is caused by chafing between the lays, and flattening of the outside strands in their passage over the pulleys. Any crane rope which shows broken strands on inspection is to be considered unserviceable. To detect internal wear, partially untwist the rope. Any wear becomes apparent by the highly polished condition of the internal strands. If this wear appears to be excessive, the crane

rope must be considered to be unserviceable. Whenever a crane rope shows signs of the above defects at a periodic inspection of the crane concerned, arrangements are to be made to replace the wire rope. If the wire rope can be fitted to the crane without splicing, it should be replaced by the unit concerned. When splicing of the wire rope is entailed, the crane should be returned to an approved depot for fitment of a replacement rope.

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