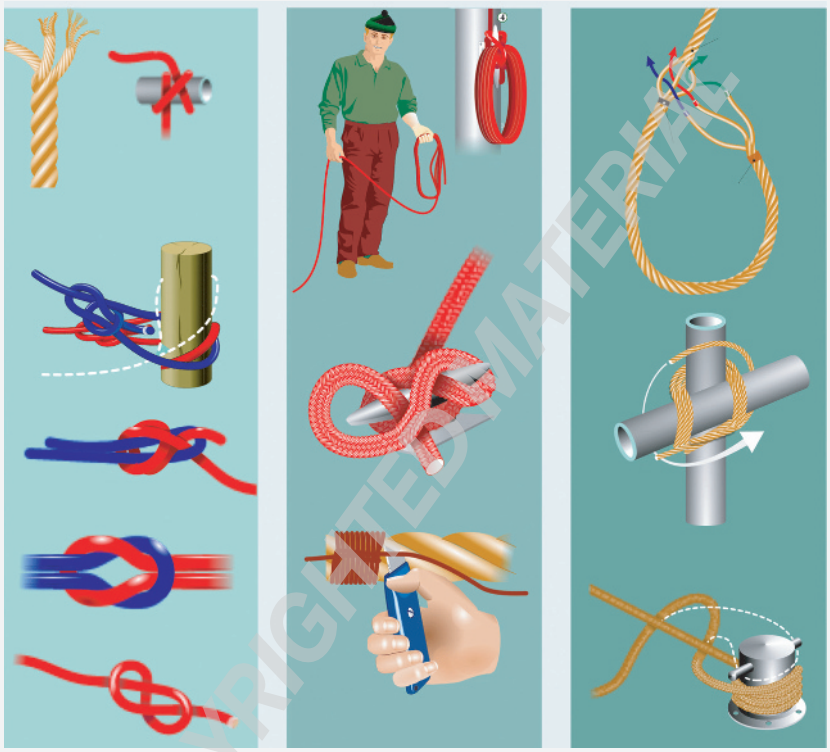
Ropework



This chapter outlines the minimum level of knowledge of knots and hitches, whipping, splicing, etc. that you should have in order to make long passages. *Remember that it is better to know a few knots well than to half-know many*.

Take your time to learn these knots so you are able to tie them quickly. Preferably, you should be able to tie the knots with one hand and blindfolded! A good basic knowledge of ropework, knots and hitches may save both life and gear in dangerous situations.

THE BASICS

Ropes are made of short *fibres* that are spun into *yarns*, which are then made into flat or twisted *strands*. Finally, the strands are spun or braided to make the finished rope (Figure 1.1). The two main types of rope are:

- **Laid rope:** three-strand rope (two- and four-strand ropes also exist) is made of strands twisted together in the opposite direction to that of the yarns, normally to the *right* (Z-laid), but sometimes to the *left* (S-laid).
- **Braided rope** is made in different ways. The yarns are normally braided to form a *sheath* covering an inner *core* of yarns, which may again be braided or lightly twisted together.

Materials

Natural fibres like *hemp, manila* and *sisal* were used for all rope until the 20th century. These fibres were derived

from various plants and usually made into laid rope. Today, most rope is made from *synthetic fibres*.

The *fibre type* determines, to a large degree, the rope's properties:

- **Multifilament:** thin threads giving a supple/soft rope.
- **Film:** a flat, wide fibre used in cheap rope.
- **Monofilament:** a thick fibre giving a stiffer rope.

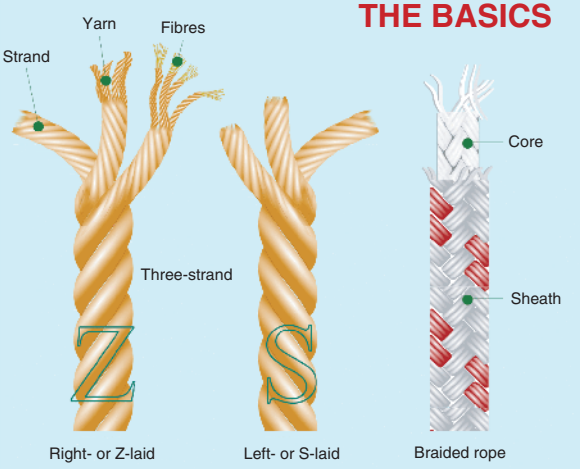
The material used can be divided into four groups:

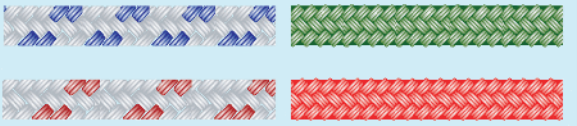
- **Polyester** (Terylene) makes high quality rope made of *multifilament fibres*. The rope is supple (and remains supple), well protected against sunlight and sinks. A *high breaking strength* makes it suitable for anchor and mooring lines. Pre-stretched polyester rope, which gives minimum stretch, is used for sheets and halyards.
- **Polyamide** (Nylon) rope made of *multifilament fibres* is a high-stretch rope that is very much used in fishing and shipping. In common with polyester ropes, Nylon ropes have high abrasion resistance and don't float. In addition, they are very elastic, making them especially suitable for towing, mooring and climbing ropes where shock loads are introduced. Nylon rope is available in laid, braided and multibraided forms.
- **Polyethylene** rope made of *monofilament fibres* is smooth, with a relatively hard surface. This rope is used for heavy fishing gear due to its very high abrasion resistance.
- **Polypropylene** *fibres* make low-cost, all-purpose ropes. They are light and float, making them suitable as rescue or short mooring lines. However, the ropes have a low resistance to abrasion and sunlight. Polypropylene ropes come in a number of forms. Rope made from *film fibres* is inexpensive but should not be used on yachts, at least not where quality is necessary.

Note that *polyester, polyamide, polyethylene* and *polypropylene* are the correct names of the materials, while names like *Nylon, Terylene, Dacron*, etc. are the product names various companies use on products derived from these materials.

Aramid fibre (Kevlar) combines a very high breaking strength with a very low elasticity. A number of other fibres with names like *Vectran, Spectra and Dyneema* are light and often have higher breaking strengths than steel!

THE BASICS





Pre-stretched, braided polyester rope is much used for sheets and halyards. The rope has low elasticity and should not be used for mooring lines!

Braided, elastic Nylon rope is used for mooring and anchor lines. Three-stranded Nylon rope is also available (below).

Traditional *natural fibre ropes*, such as those made from *hemp* and *manila* are still available and are normally used on older, classic boats.

1

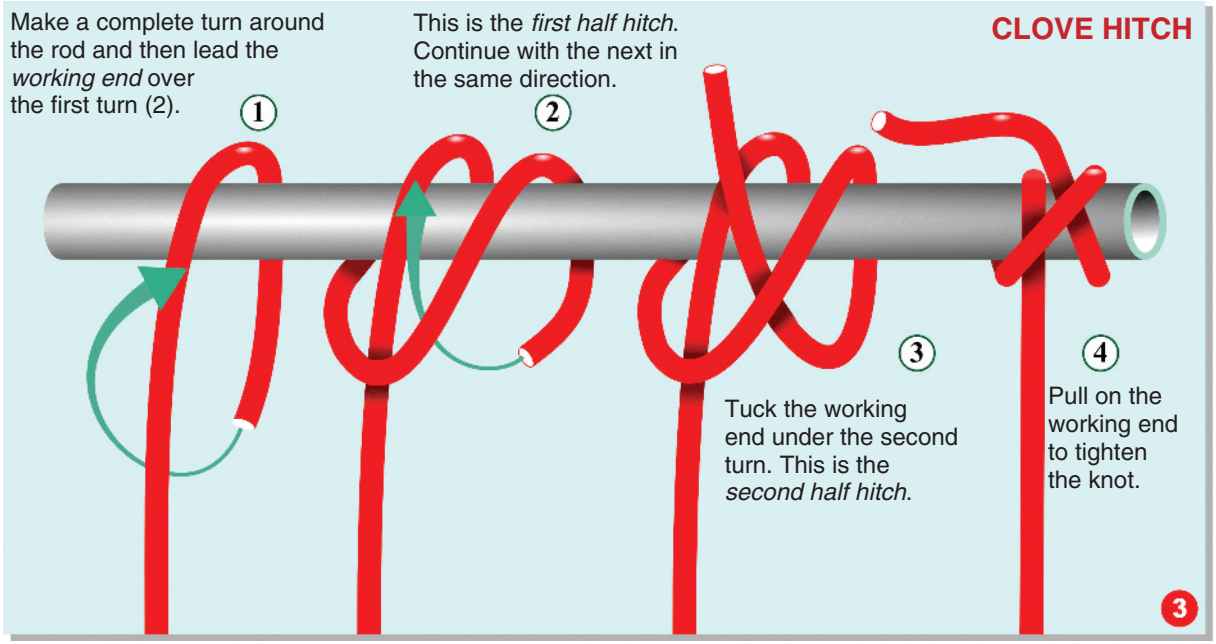
Kevlar (Aramid fibre): Higher breaking strength than steel and *very low stretch*. Easy to splice but should not be led around small-diameter sheaves.

Spectra (Dyneema): Breaking strength higher than steel and very high abrasion resistance.

These new fibres often have unique properties and you should therefore check thoroughly to see if they are suitable for your desired purpose. Ropes made from these new fibres often come with an *outer sheath* of polyester for easier handling.

Vectran also has a breaking strength higher than steel, has very low stretch and is hard-wearing.

2



These ropes are expensive and are still used mostly on racing yachts (Figure 1.2).

CLOVE HITCH

The *clove hitch* is rather easy to make (Figure 1.3). You can add as many half hitches as you like, but always do the turns *in the same direction*. The hitch can be made mirrored and you may also make the turns in either direction relative to whatever you are making the knot on. You know that the knot is made properly when *the working end* and *the standing part* (the static part of the line) run in *parallel* in *opposite directions* under *the locking turn*. This knot is very basic and you should be able to tie it in both directions, starting the turn over or under the object on which you are making the knot.

The clove hitch (Figure 1.4) is one of the most commonly used knots. It is used in many variations for mooring lines and fenders. A *round turn with two half hitches* (6) should be used more often. Unlike the *bowline* (Figure 1.5), this knot may be untied *under load*. You make the clove hitch itself on the standing part of the line. You can make one or more complete turns around the pile in order to increase friction and to distribute the load better.

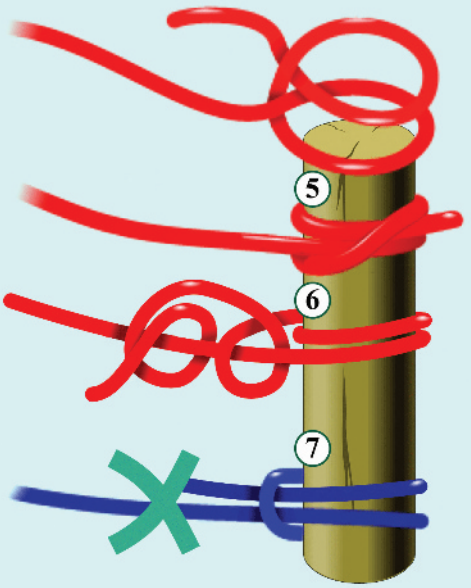
When you approach a pier, the fenders may be made fast with a clove hitch (5) and even made with a slip knot (Figure 1.27). If the fenders are to be fixed for longer periods, it may be wiser to use a round turn with two half hitches (6). You can then be sure that the knot won't untie itself, thus avoiding losing a fender. The clove hitch alone may become untied if it is not tightened well from time to time.

BOWLINE

The *bowline* (Figure 1.5) is used when you want a fixed eye on, for example, a mooring line, or for tying sheets to a sail. The bowline is a very reliable knot that can be used for many purposes. *You should learn to make this knot blindfolded!* Many find the knot difficult to learn, although, like most things, it is only a matter of practice.

Imagine, for example, the small loop as a pond from which a sea snake (the working end) ascends and twirls itself around a tree (the standing part) and then slides back into the water following its body. (Make the first loop in exactly the same manner all the time. This makes the knot easier to learn).

The bowline can also be used to join two lines that are to be heavily loaded, where you want to be sure that you will be able to undo the knot afterwards. This is often a better solution than using a *double sheet bend* (Figure 1.8) or a *reef knot* (Figure 1.9). The latter should never

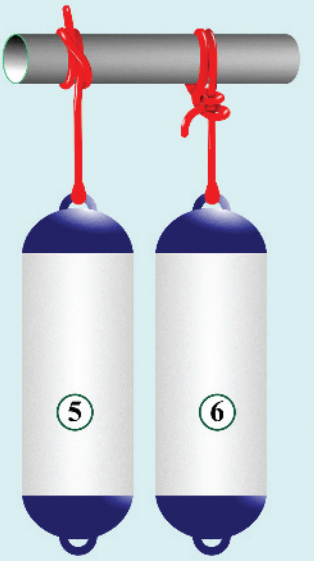


Both half hitches are made ready and are threaded on to the pile.

NB: The knot in this case may become stuck and also can't be untied under load.

A wrongly made clove hitch. You have made a *cow hitch* (or *lark's head*)!

A round turn with two half hitches, which can be untied under load, is a much better solution!



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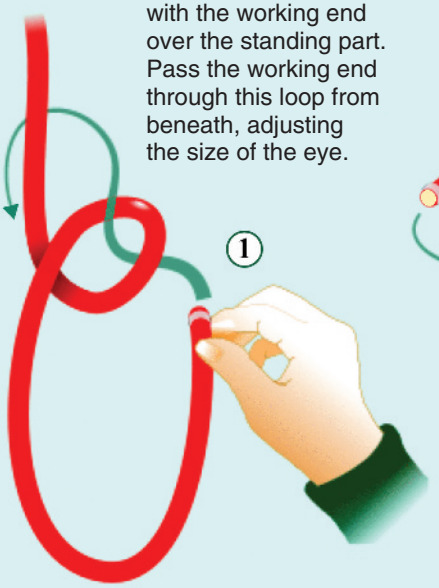
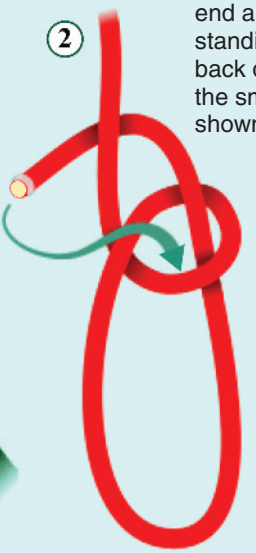
be used for such purposes! You can secure the bowline as shown (Figure 1.6) or make a stopper knot (Figure 1.10) if you want to be absolutely sure that it won't come undone (normally it does not). You may also make the knot with a slip knot (Figure 1.6) in order to be able to undo it quickly. Always check that the working end protrudes an inch or two from the small loop to avoid the knot untying itself.

BOWLINE

Make a *small loop* with the working end over the standing part. Pass the working end through this loop from beneath, adjusting the size of the eye.





Lead the working end around the standing part and back down through the small loop as shown.

Pull the knot tight.

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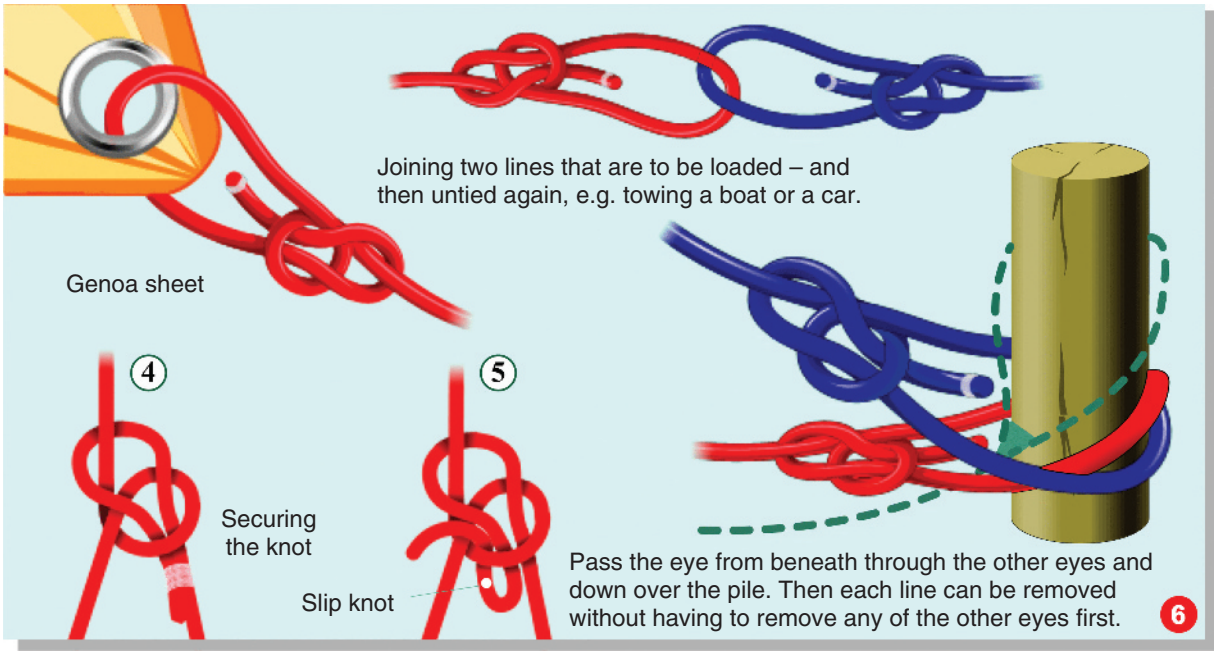
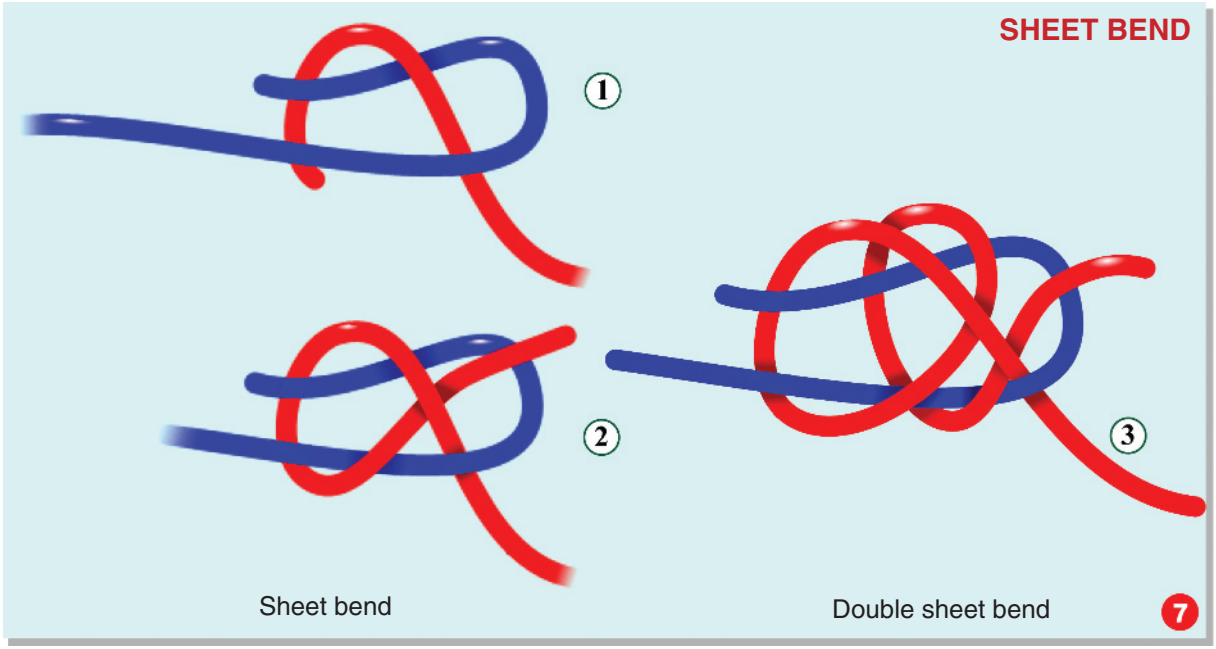


SHEET BEND

The *sheet bend* (Figure 1.7) is normally used to join two ropes (Figure 1.8). If the ropes' diameters are unequal, a *double sheet bend* is used. The sheet bend is also used to attach ensigns to flag lines.

To make a sheet bend, fold the end of the first line (shown in blue in Figure 1.7) back on itself to form a loop if it doesn't have a fixed eye. Pass the working end of the other line (shown in red) through and around this loop (1), and then tuck it under itself but over the blue loop (2).



Two lines joined by a sheet bend.

Two lines joined by a double sheet bend.

You make a *double sheet bend* by leading the red working part once more around the loop and then taking it under itself but over the blue loop. Pull the knot tight. It is wise to use the double sheet bend most of the time, as it will almost never come loose.

The sheet bend can't be untied under load and it can be rather difficult to untie when relieved of the load. If you want to join two lines that will be heavily loaded, it is recommended that you use two bowlines tied 'inside each other' (Figure 1.6), as the bowline is far easier to untie when relieved of the load. If it isn't necessary to untie the ropes (permanent join), a double sheet bend can be a good solution.

REEF KNOT

The *reef knot* (or *square knot*) should only be used as a binding knot, for example to tie up sails on a boom. The well-known shoelace knot is actually a reef knot with two slip knots (Figure 1.9). The reef knot can't be untied under load but is easy to untie when relieved of the load. *It should never be used to join two lines that will be subject to any load, as it can easily come undone*. However, the knot can be used to join two lines of equal diameter that will be subject to very small loads.

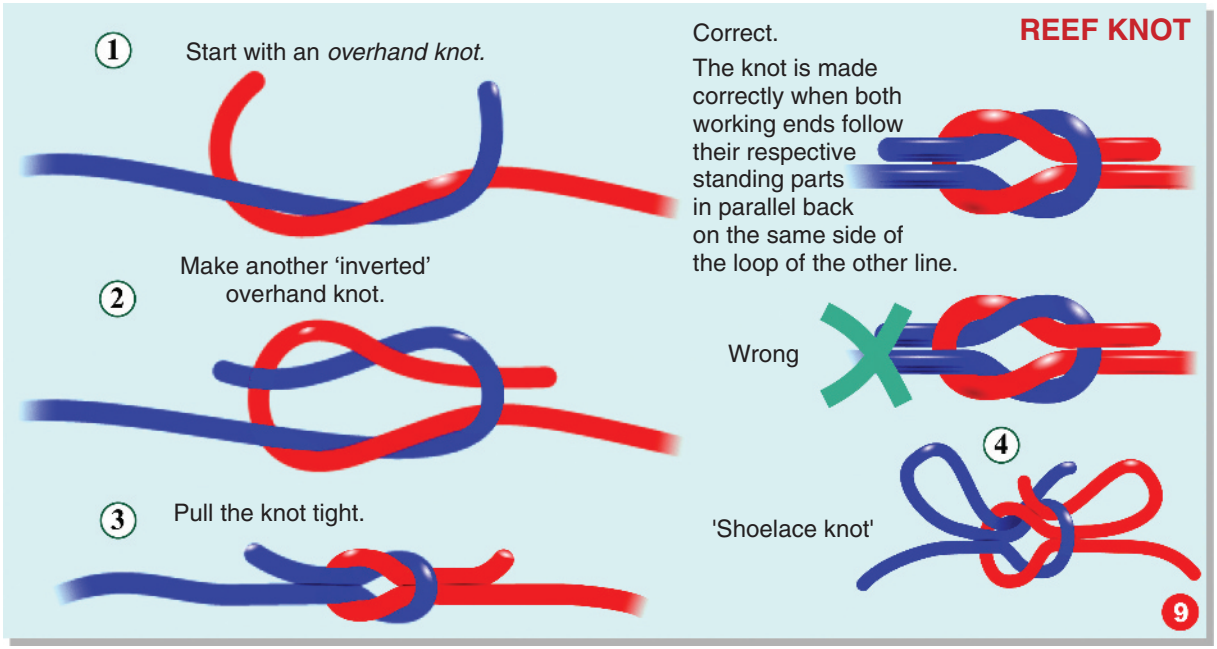
STOPPER KNOTS

Stopper knots are used, for example, to prevent a sheet from slipping out of the sheet block on deck. The *figure of eight knot* (Figure 1.10) is the most commonly used stopper knot. The *double* (or multiple) *overhand knot* (2) is also much used, but this knot might be more difficult to undo than the figure of eight knot. It is *always important to make sure that a knot can be undone easily when desired, whilst at the same time ensuring that it can't open up accidentally*.

ROLLING HITCH

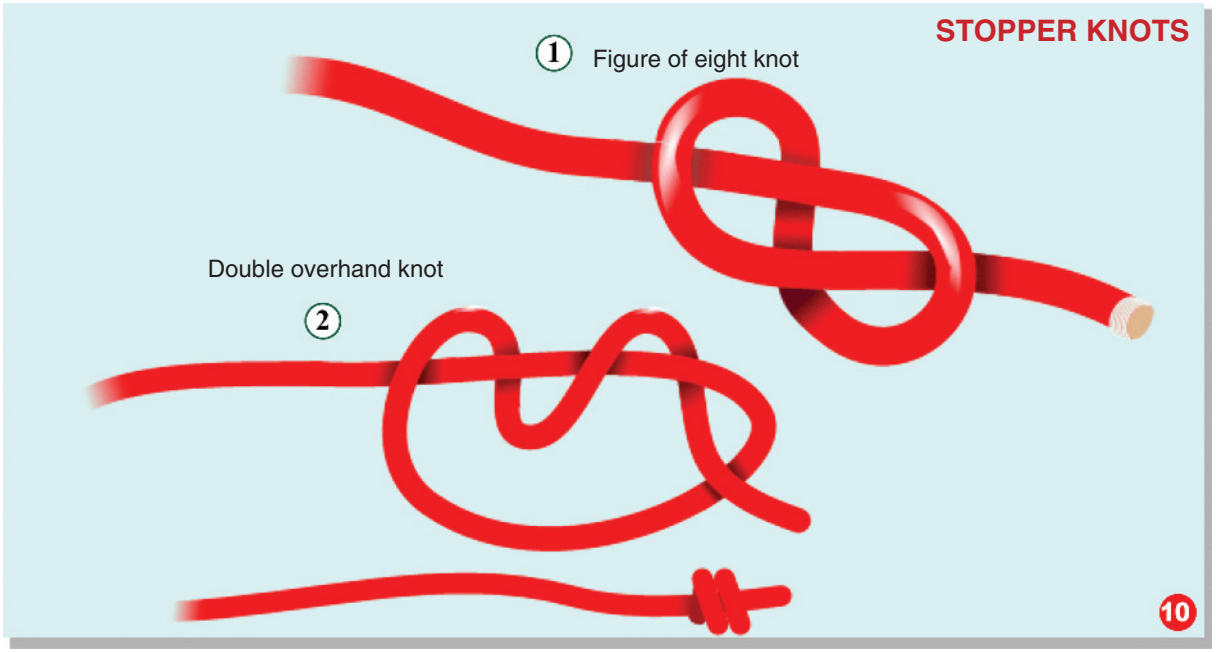
The *rolling hitch* is used to tie a line to a pole, wire or another line when you need a knot that won't slide when strain is applied sideways. Start by making two to five complete turns with the working end in the direction of the load, depending on how much friction you think you need (Figure 1.11). It may be necessary to remake the knot with more initial turns if it slides under load. *The rolling hitch is a very important knot to know; it can save you in many difficult or even dangerous situations*.

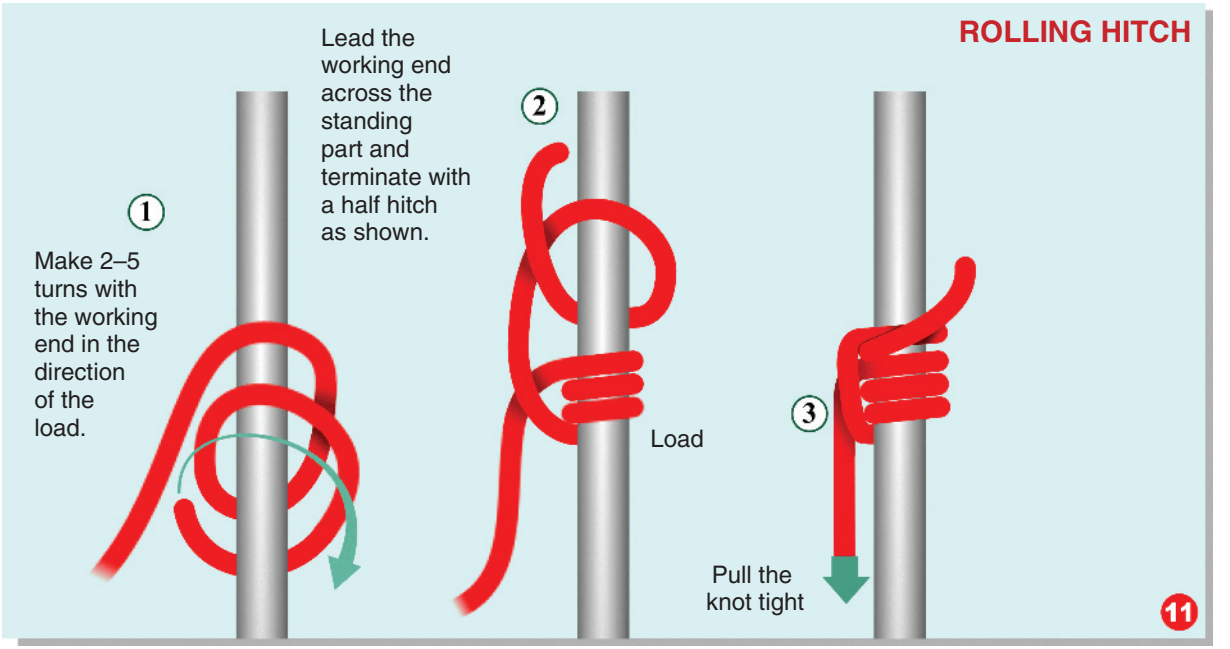
When, for example, a sheet under load is stuck on a winch, you may relieve the sheet by using a second line attached



with a rolling hitch (Figure 1.12) and leading to a second winch (2). Take in on the second winch until the sheet goes slack and may be relieved from the winch.

The rolling hitch is also very useful when you want to fix something to a wire or a smooth tube, for example fasten an ensign to a backstay. *Note that the hitch locks itself in the direction of the strain but may be moved quite easily in the opposite direction*. This can be used for a lot of purposes, for example to make movable steps by attaching loops to a shroud with rolling hitches. You

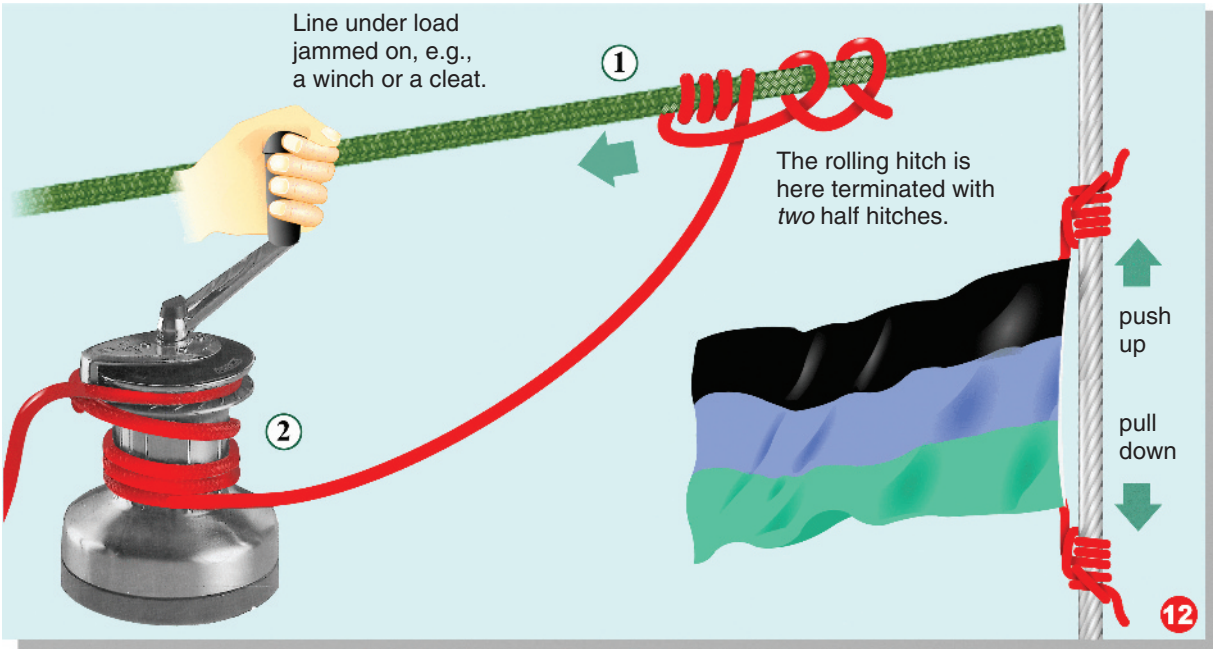


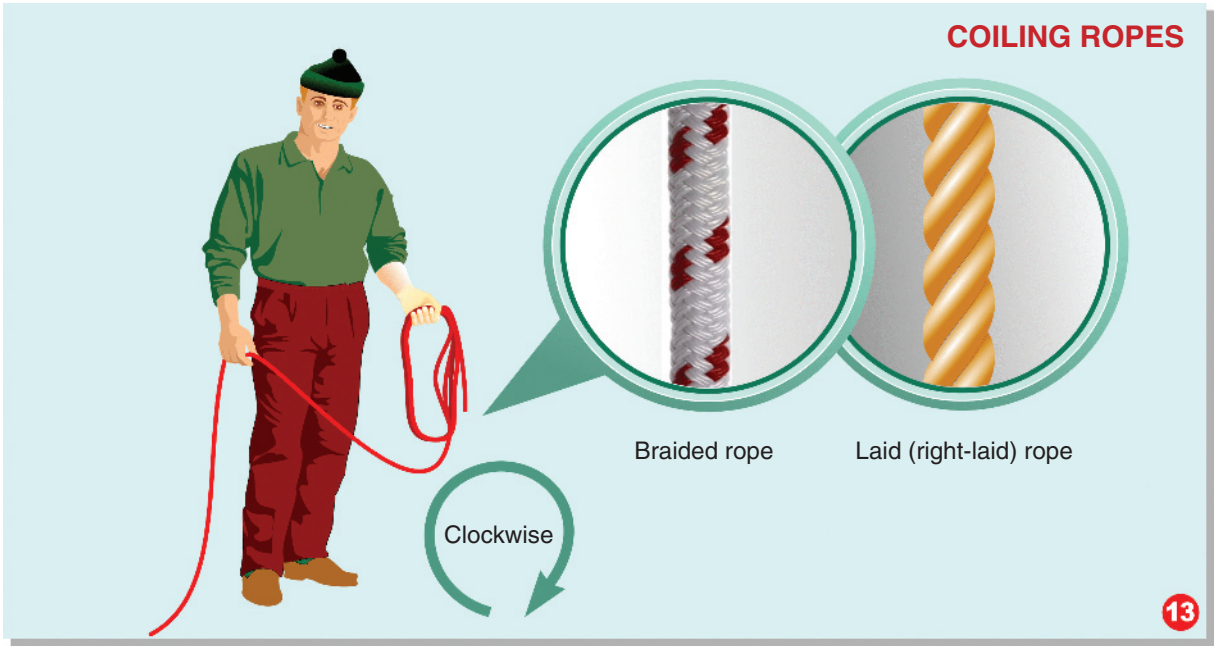


push the loop upwards and when your weight is on the loop, it locks to the wire, preventing the loop from sliding downwards. See also Figure 1.31 for another solution to this problem.

COILING ROPES

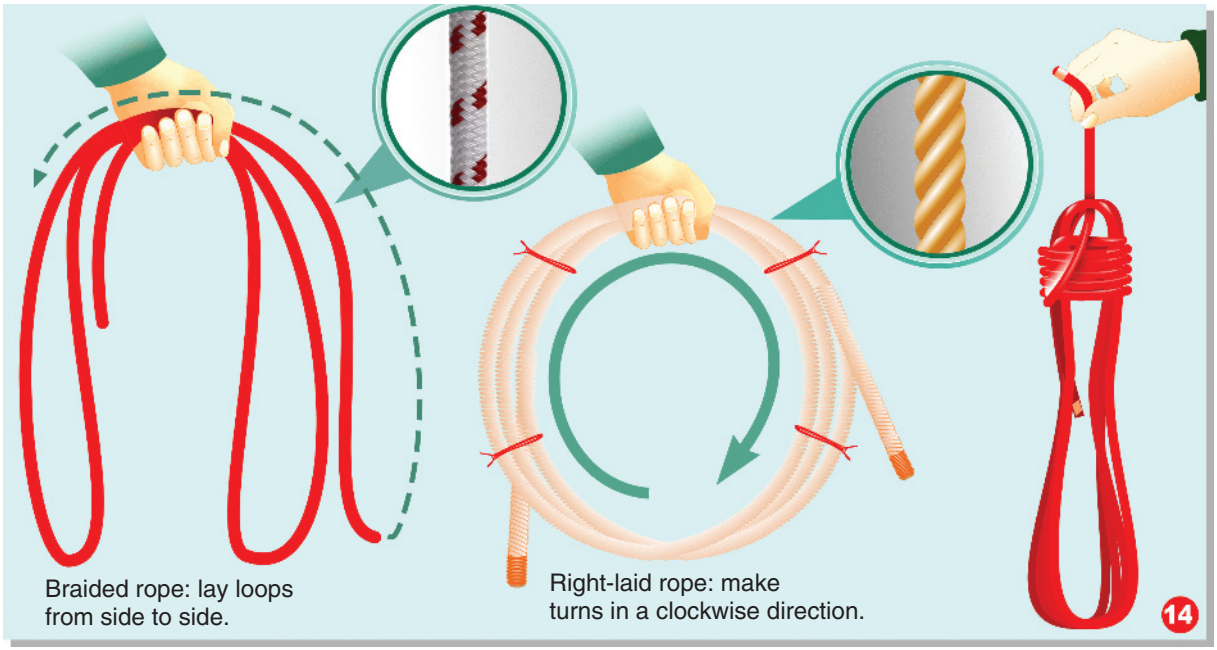
Right-laid rope needs to be coiled *clockwise* and given a right-hand twist in each turn in order to avoid *kinks* when the line runs out.





Halyards and *sheets* are now almost solely made of *braided rope*, which normally is coiled clockwise, although it really shouldn't be coiled at all! Braided rope that is coiled always risks having *kinks* when the line is running out. More often than not, braided rope is coiled in the same way as laid rope (Figure 1.13).

Many experts recommend coiling braided rope in figures of eight. Another, simpler, method is to lay loops



from side to side (as shown in Figure 1.14), thus avoiding kinks.

When coiling *right-laid* (Z-laid) rope, you make the turns with one hand (normally the right hand) and lead them over to the other hand as they are made. This will, after some time, become an almost automatic movement. When you have finished coiling, you can secure the coil with thin laces (Figure 1.14), or you can terminate the coil with one of the techniques shown in Figures 1.15–1.18.

Left-laid rope, which is quite uncommon, should always be coiled *anticlockwise*.

Terminating the Coil

When you have coiled a line, grab the working end (Figure 1.15(1)) *on its way upwards* and turn it *around the coil* and *over* and *around itself*, creating *a lock*. You have to squeeze the loop (use your fingers) against the coil at A until the coil is locked with the next turn, which is to be made *downwards*. Make more turns *downwards* around the coil (2) and tuck the working end through the opening at the top of the coil (3). Pull everything tight as you push the loops around the coil upwards. Adjust the length of the working end according to whether the coil is to be suspended from a cleat or pushpit (4) or just stowed away.

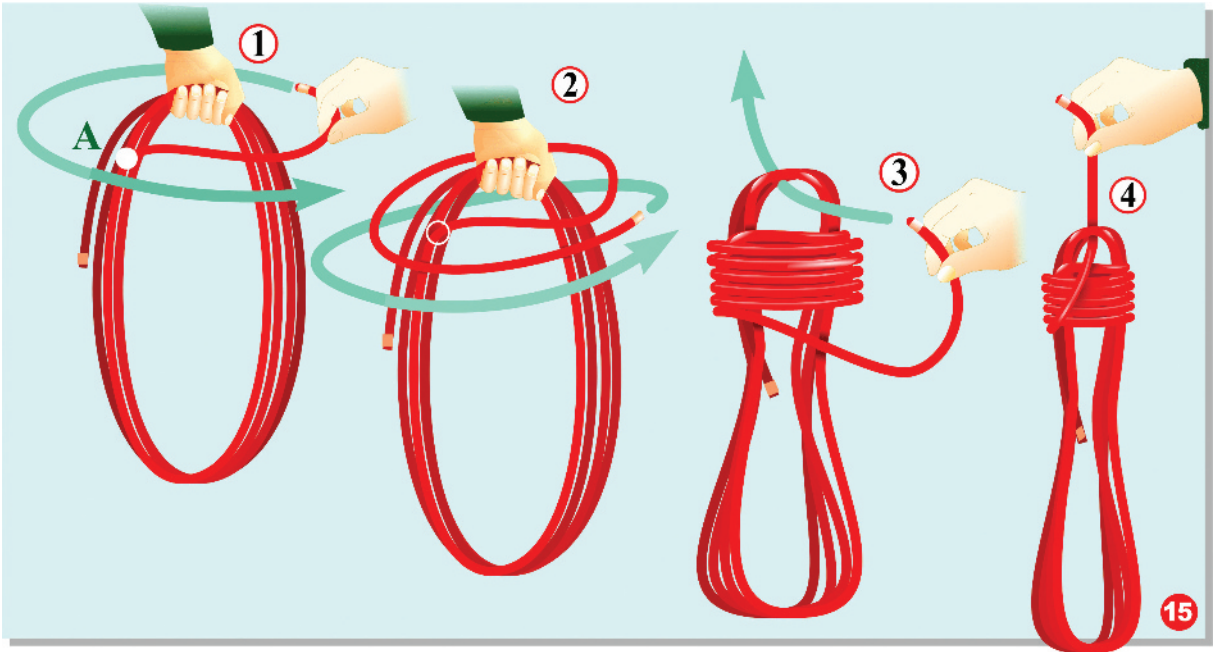
A more common termination of a coil is shown in Figure 1.16. Take the working end *on its way downwards* (1) and lead it around the coil and over itself, making the lock. You have to squeeze the loop against the coil at A until it has been locked with the next turn. Make more turns *upwards* and make a loop on the working end, putting it through the opening at the top of the coil (2). Then wrap the loop over the top of the coil (3). Push the loops around the coil upwards and pull everything tight. You may also lead the working end through the loop, as shown by the arrow (4).

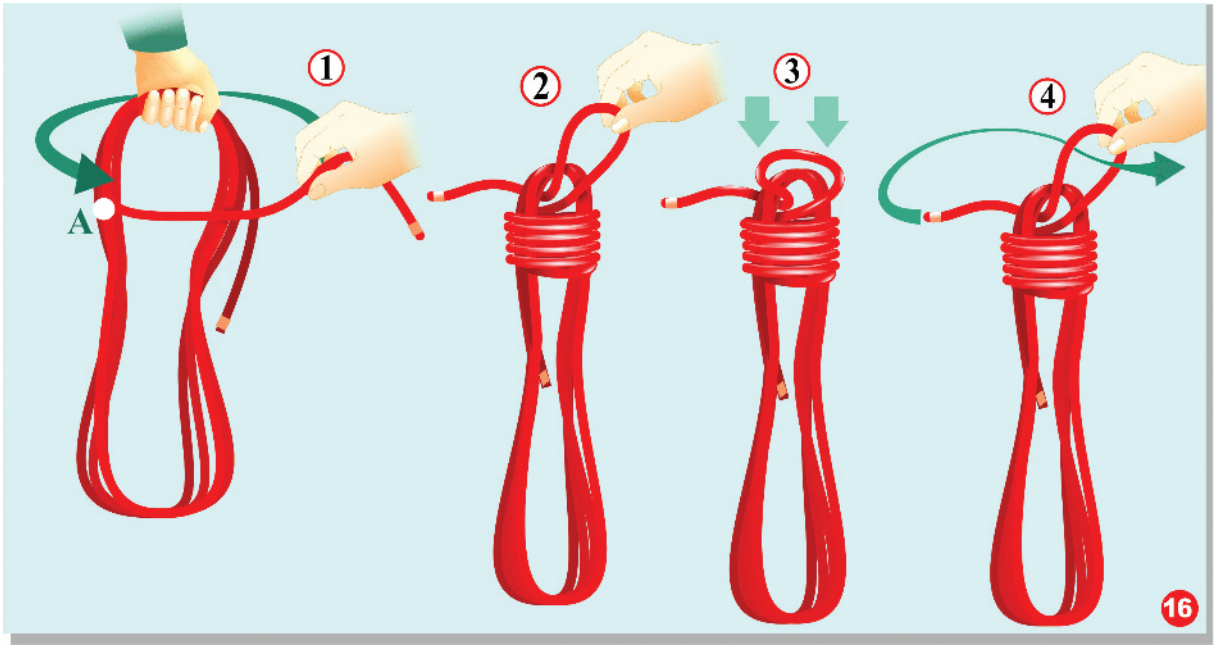
The methods described here are the most common. The method shown in Figure 1.15 is more difficult but is more stable over a period of time, especially in hard weather.

CLEATS

Making Fast on a Cleat

Keep the line, for example a halyard, tight and make a complete turn around the cleat (Figure 1.17). Then make *figures of eight* around the cleat (2 and 3). Terminate with a *half hitch* (4). Traditionally, half hitches were never used for fear of the line getting jammed under load. Instead, more figures of eight were laid on the cleat. Many cleats

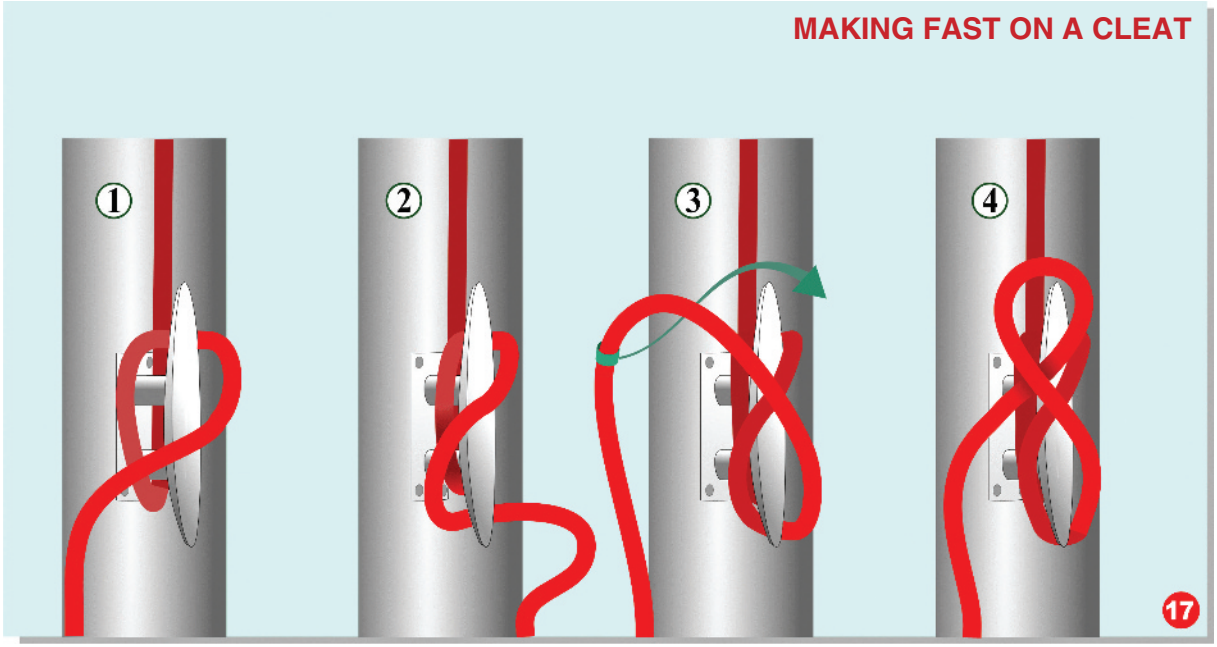


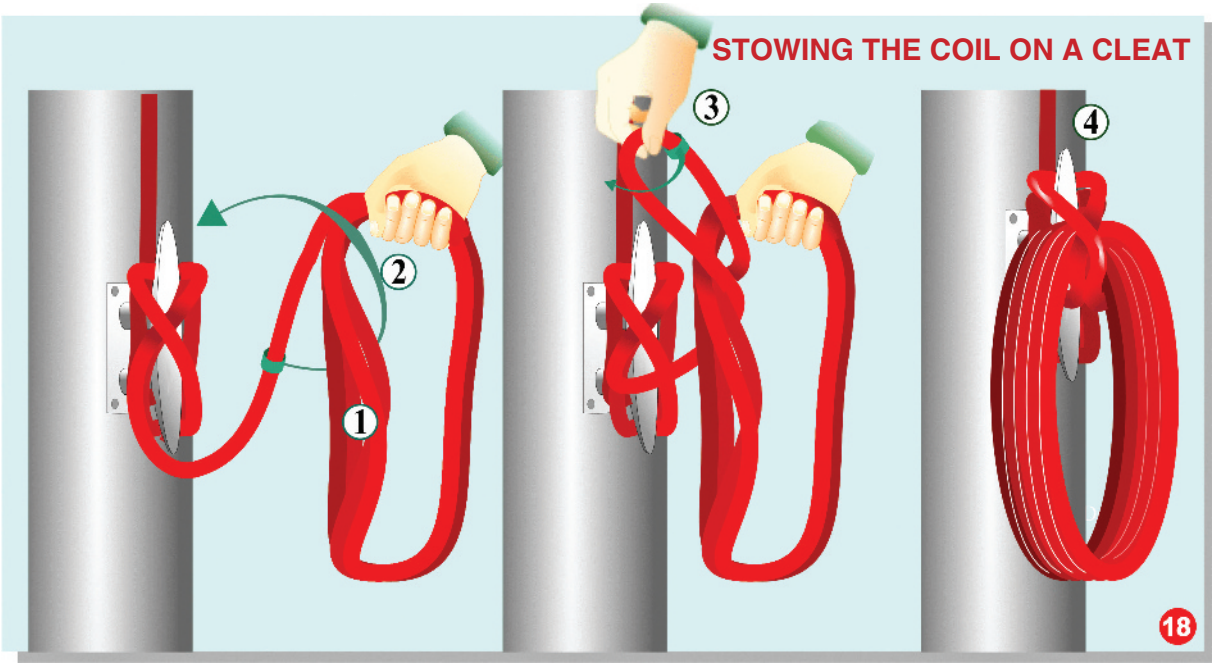


on modern yachts are too small for the lines used. Therefore, often only one figure of eight, terminated with a half hitch, is used. Sometimes there is even only room for one half turn before the figure of eight.

Stowing the Coil on a Cleat

Tighten the final half hitch and start coiling the rest of the line *from the cleat towards the free end* (Figure 1.18). Normally, the coil is made *clockwise*. Once you've finished coiling, use a hand to grab the fixed part of the line





close to the cleat and pull a short loop through the coil (2). Wrap the loop by 180° (3) and hook it onto the cleat as shown (4). Note that you should get everything tighter than shown in the figure in order to secure the coil better. Therefore, you should grab the fixed part of the line as close as possible to the cleat and make the loop just big enough to get wrapped and hooked onto the cleat.

WHIPPING

The whipping shown in Figure 1.20 is easy to learn and can be used for many purposes. It can be used both on laid and braided lines as well as solid objects.

LASHINGS

There are three common types of lashing: *sheer*, *A-frame* and *square* lashings (Figure 1.22).

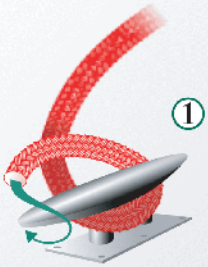
WINCH HANDLING

Always make a complete turn clockwise around the drum and then give the line a slight tug in order to hear the typical clicking sound that indicates that the line is laid in the correct direction (Figure 1.23). Then make two to three additional turns around the winch. If the winch is *self-tailing*, lead the line over the special *line guide* (3) and around and well into the *groove* (4). You can now use both hands when winching in the line. If the winch is not of the self-tailing type, you have to use one hand to pull the tail of the line tight at all times when winching (5).

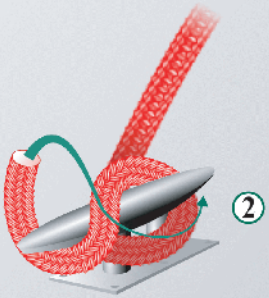
If you want to ease a loaded line slightly, you can almost *unscrew* the line with great precision by pressing the palm of the hand against the turns (Figure 1.24). (Needless to say, you must have enough turns around the winch and thus enough friction to be able to do this). To release the line quickly, for example when tacking a sailboat, flick the turns off the top of the winch in an *anti-clockwise* movement (7). If you want to add a turn when the line is under load, you should use both hands as shown (8). Be careful not to get your hand between the line and the winch (9). Keep in mind that the more turns around the winch, the easier it is to control the load, although the danger of *jamming* increases.

MAKING FAST ON A BOLLARD

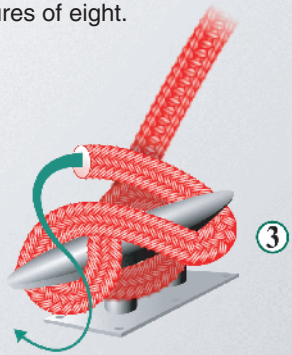
When you want to make fast a chain on a bollard, you must first make two to three turns around the bollard (Figure 1.25). Make a bight that you put under the chain's standing part and then over the bollard (2). Ropes, especially synthetic ones, demand more turns in order to create enough friction (3). With enough around bollards and winches, you will be able to



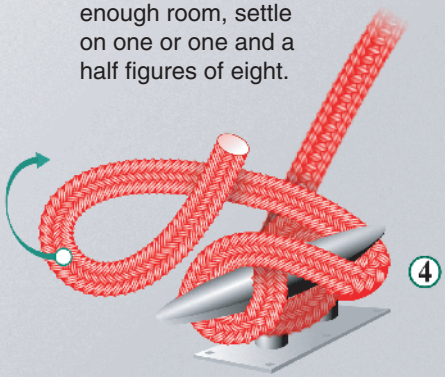
Make at least a *half turn*, preferably a whole one, around the cleat. Then begin making figures of eight.



Make at least *two whole figures of eight*. If there is not enough room, settle on one or one and a half figures of eight.



You may make as many figures of eight as the space allows.

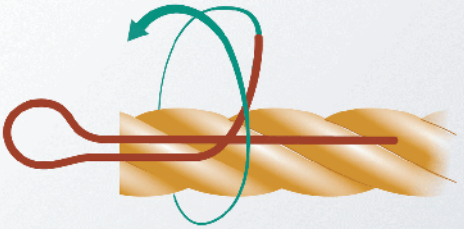


We choose to finish off here by twisting the last half figure of eight by 90° ...

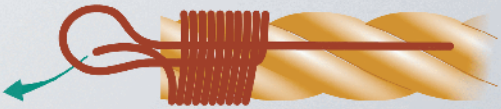
...and hook it onto the cleat as a *lock*.

Tighten the half hitch.

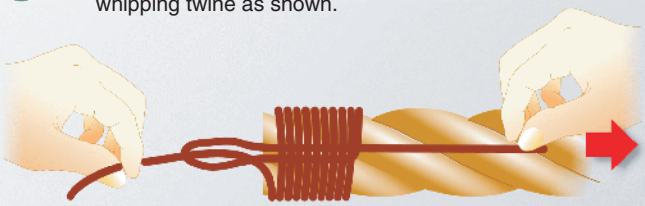
WHIPPING



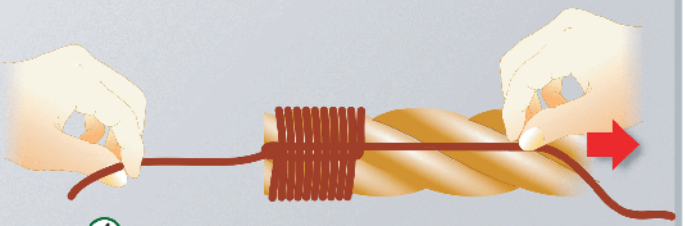
1. Make a loop of the whipping twine as shown.



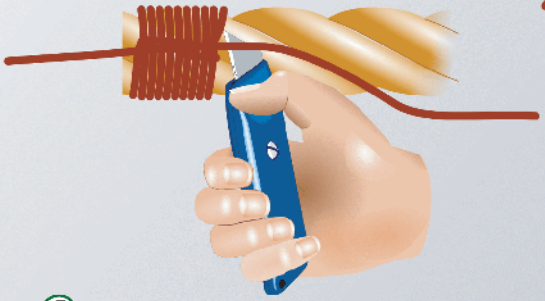
2. Wrap the twine hard around the line in the *opposite direction* to its twist, locking the loop in place. Make more turns and tuck the working end through the loop.



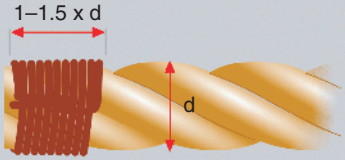
3. Keep the whipping line tight while you pull the working end, and thus the loop, under the whipping turns.



4. Bury the loop well under the whipping turns, which will lock the turns.

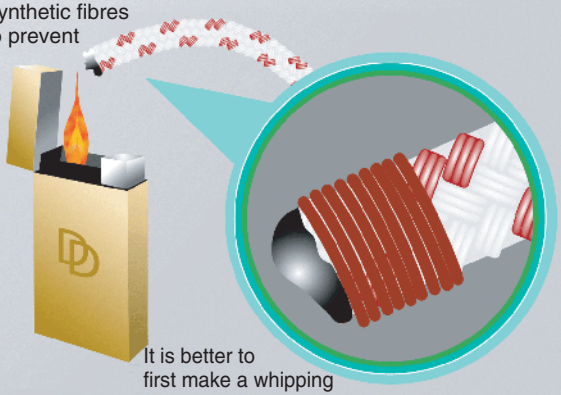


5. Cut both ends of the whipping twine close to the whipping turns.

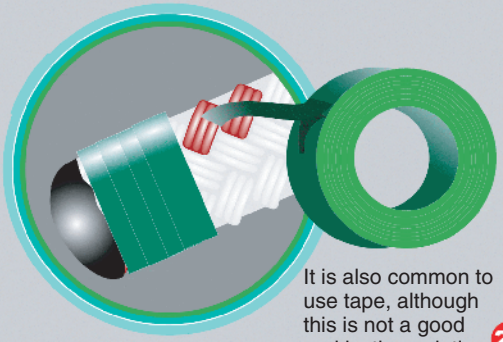


6. A completed whipping. The length of the whipping should be 1–1.5 times the diameter of the line.

You may use a flame to smelt synthetic fibres in order to prevent fraying.



It is better to first make a whipping and then burn the tip carefully afterwards.



It is also common to use tape, although this is not a good and lasting solution.

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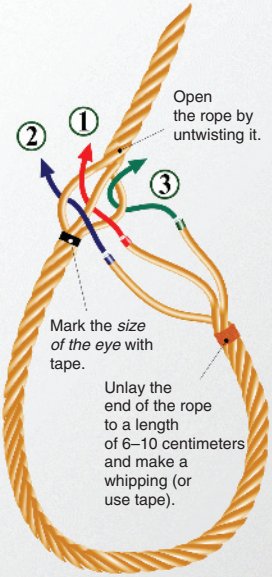
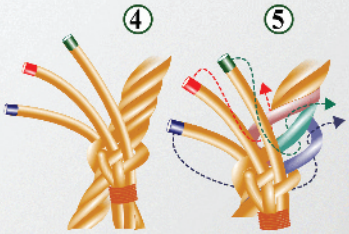
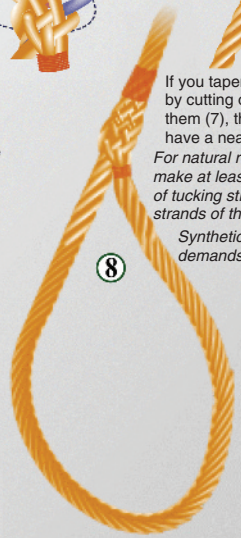


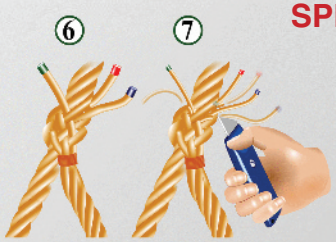


Tuck the strands under the strands of the standing part as shown (1–3) and pull them fairly tight (4). Continue with the next steps (5–6).

The strands are tucked alternately *under* and *over* the strands of the standing part, always in the same direction of turn.

Then, if you have tucked the strands (1–3) correctly, the whole splice will be correct.



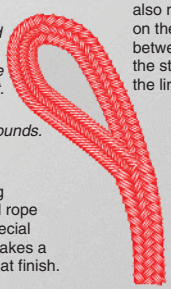


If you taper the strands by cutting off a part of them (7), the splice will have a neater finish.

For natural rope you should make at least three rounds of tucking strands under the strands of the standing part.

Synthetic fibre rope demands at least four rounds.

You can roll the finished splice (8) between your hands or under the foot in order to smoothen it. You can also make a whipping on the transition zone between the splice and the standing part of the line.



Ⓐ Splicing braided rope with special tools makes a very neat finish.

Eye Splice

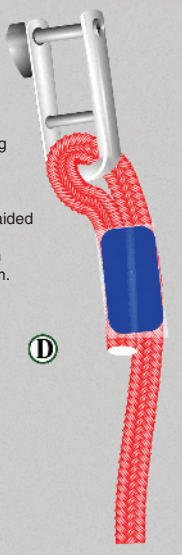
The *eye splice* is used to form a permanent loop at the end of a laid rope (normally three-stranded), for example on a mooring line. *Splicing braided rope* demands special tools and is not shown here. Such splices, however, will have a neat finish and you will hardly see the transition between the splice and the rope's standing part (A). *Note that an eye splice will reduce the rope's breaking strength by 20–30%.*

Ⓑ A simple solution is to make 2–3 whippings on the loop as shown. The friction created will withstand high loads even if one of the whippings should come loose.

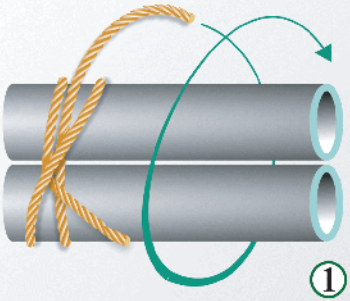
Ⓒ If you make a loop on the standing part and put the working end through it before making the whippings, the splice will withstand much higher loads.

Braided rope can be spliced with special tools (not shown here) although other solutions may be used, as shown above.

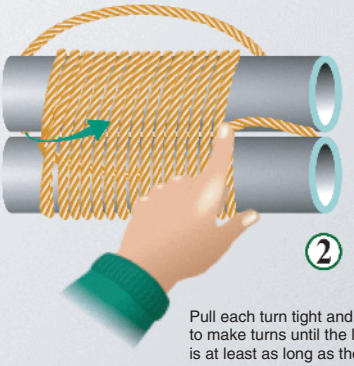
Ropemakers are presenting new, elegant solutions for readymade splices on braided rope, like this one based on a strong seam.



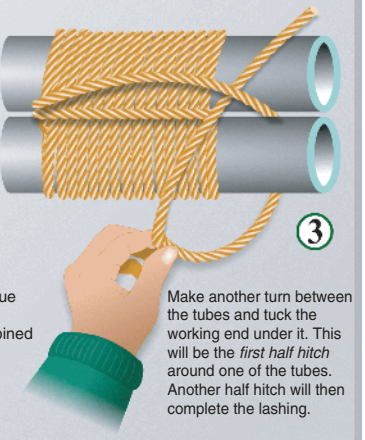
Ⓓ



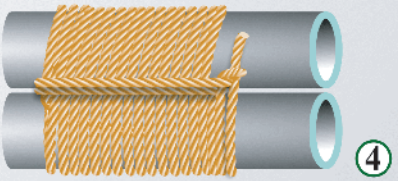
Sheer lashing: Start with a clove hitch around the two tubes. Pull the knot tight and begin making tight turns around both tubes, trapping the short end of the clove hitch under the turns.



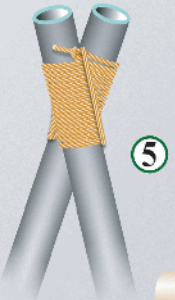
Pull each turn tight and continue to make turns until the lashing is at least as long as the combined diameters of the two tubes. Then make a turn between the tubes (this may be a little hard) and pull it tight.

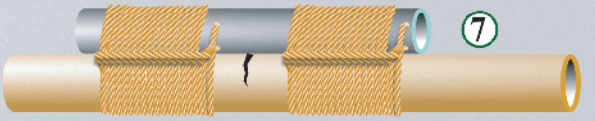


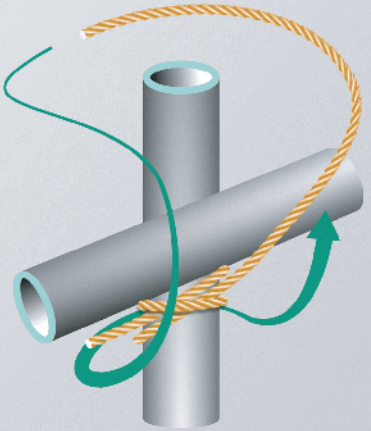
Make another turn between the tubes and tuck the working end under it. This will be the *first half hitch* around one of the tubes. Another half hitch will then complete the lashing.



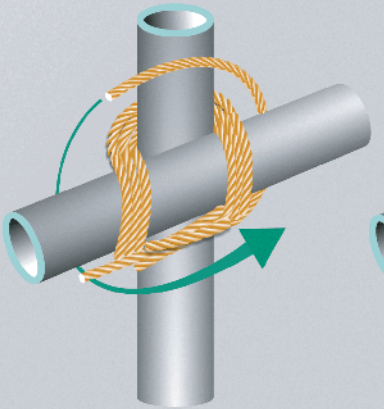
A-frame lashing: If you make the lashing a little loose, the tubes may be twisted apart, making an A-frame (5). You can also lash (actually called a *seizing*) two lines together (6) or make a provisional repair of a broken pole, e.g. a boom (7).



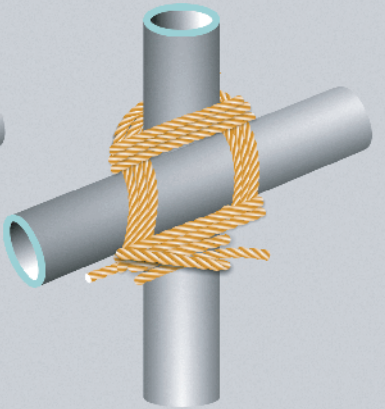




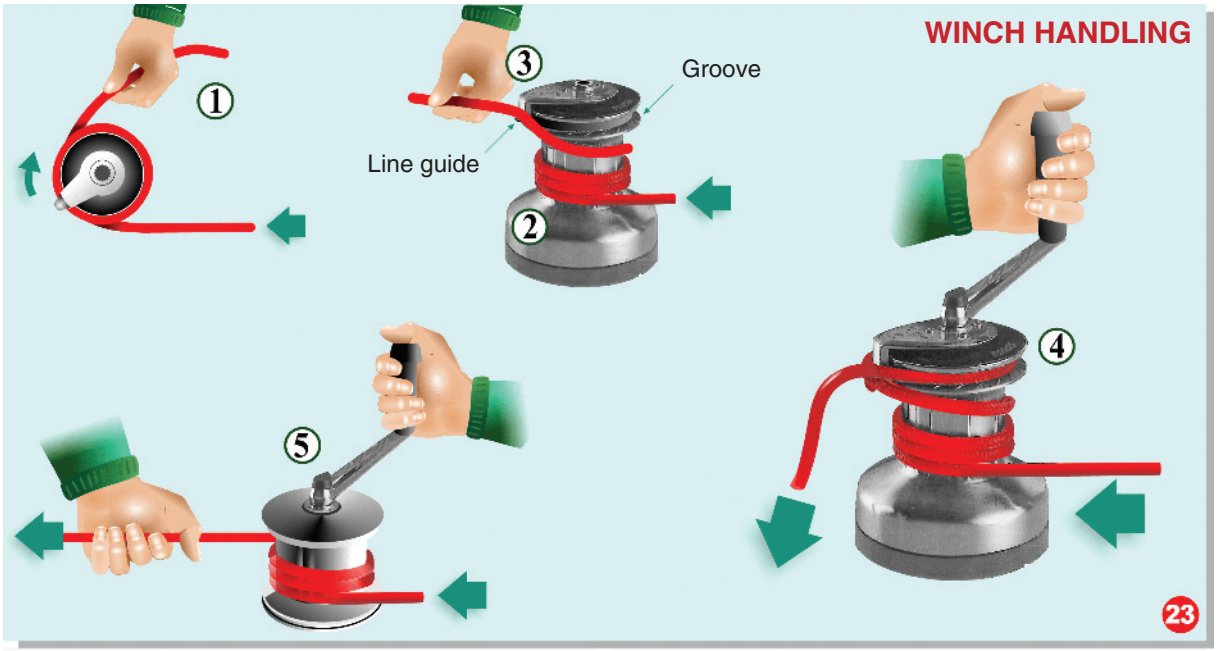
Square lashing: Make a clove hitch on the vertical tube. Lead the working end over the horizontal and around the vertical tube and pull tight before taking it over the horizontal and around the vertical on the underside of the horizontal tube. This completes the first *lashing turn*. Make at least three such turns.



Take the working end up behind the horizontal in front of the vertical tube, then down behind the horizontal and in front of the vertical tube and pull tight. Make three such *frapping turns*, pulling each one tight.



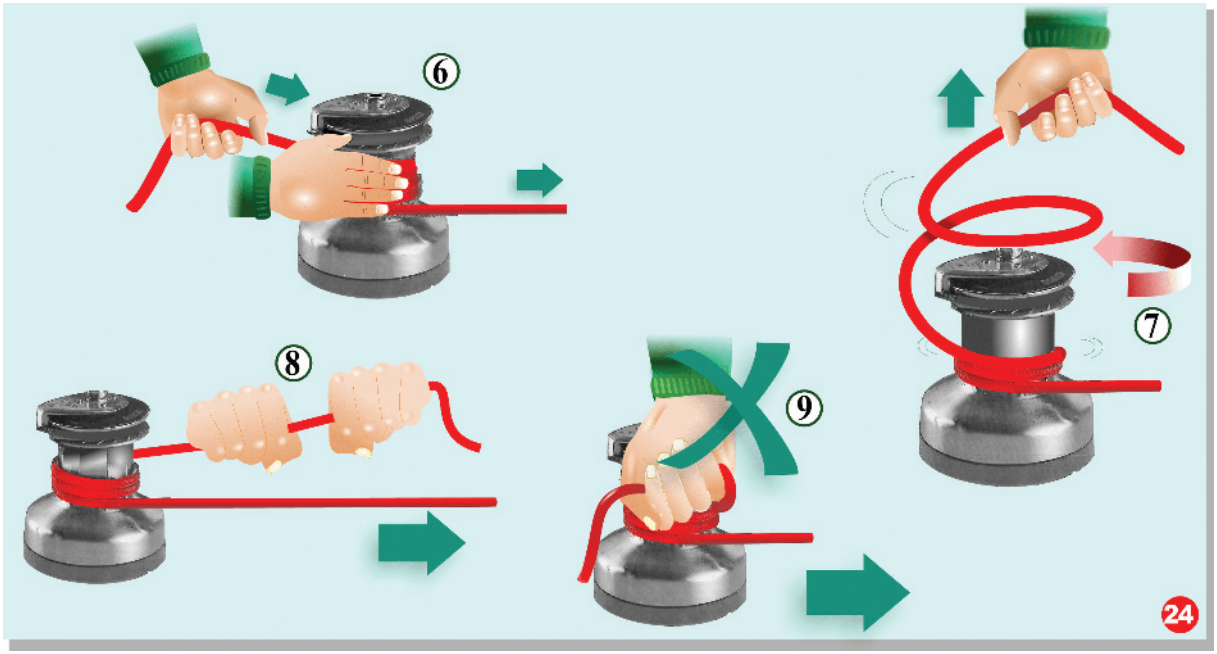
Complete the lashing with a clove hitch on the vertical tube just beneath the horizontal one.



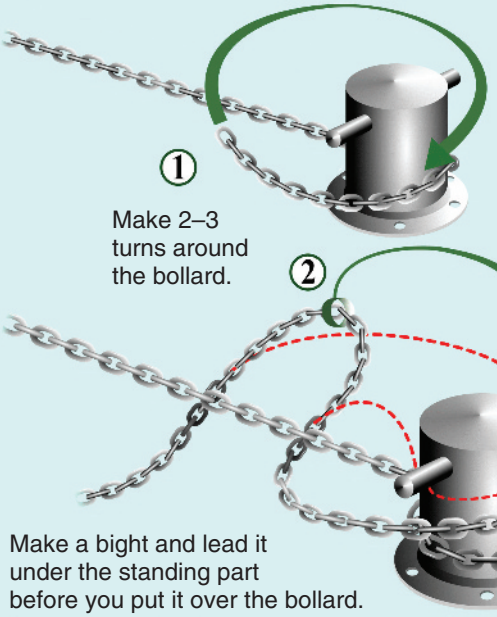
control big loads without any problems. The same goes for lines around cleats. *It is important that you understand this in order to be able to react quickly and automatically by adding a turn when you can't hold the load.*

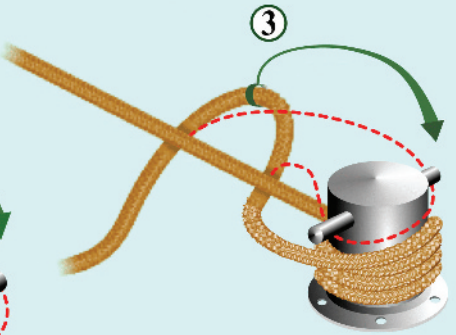
SWIGGING (SWEATING)

If you want to tighten an already loaded line made fast on a cleat, you can pull the line at right angles and then let it go (Figure 1.26). This creates a little slack, which you quickly snatch around the cleat. You may do this



MAKING FAST ON A BOLLARD





With lines of synthetic rope you have to add 1 or 2 turns before you put the bight over the bollard. Secure with a clove hitch on the pin.

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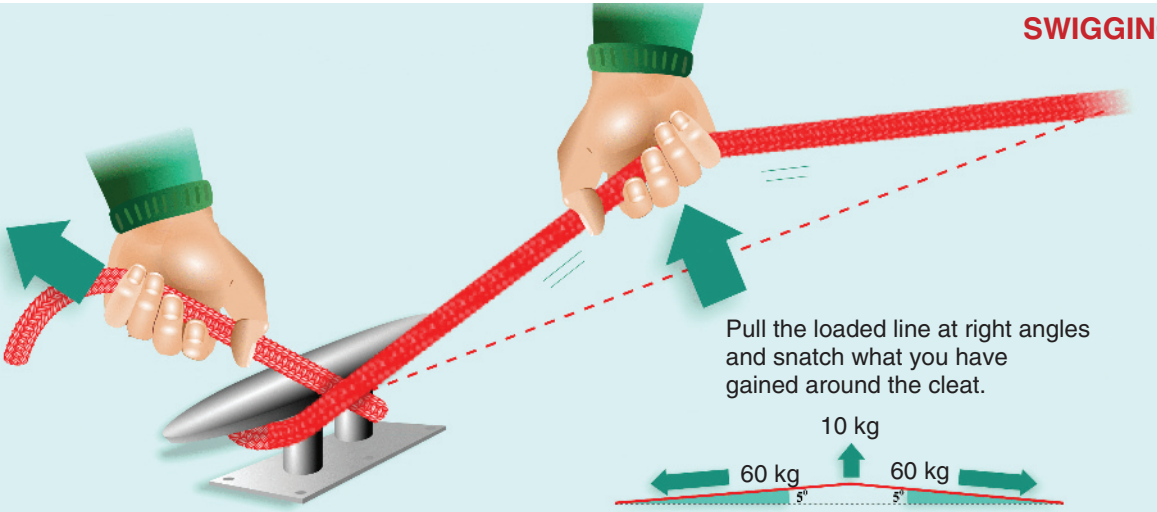
again to tighten the line even more. You can also use this technique to tighten halyards on a mast without the use of a winch. The reason for this is that when you pull the loaded line at right angles you will obtain a substantial power increase. This technique was used frequently on sailing ships, which did not have winches for many of the lines being handled.

SWIGGING



Pull quickly in the slack here.

Pull the loaded line at right angles and snatch what you have gained around the cleat.

If you pull so hard that the line makes an angle of about 5˚ with the original centre line, the pulling force on the line will be approximately 60 kg. A gear ratio of 1:6!

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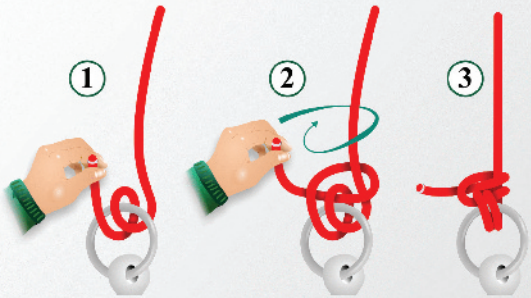
VARIOUS USEFUL KNOTS

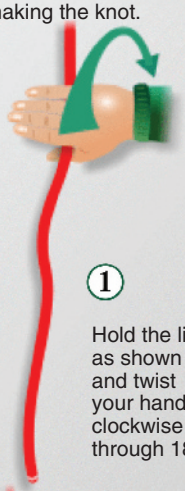


The *anchor bend* or *fisherman's bend* is a variation on a round turn with two half hitches (Figure 1.4). It is used to tie a rope directly to an anchor or mooring when you want to be sure that the knot won'tcome untied.

Most knots may be completed with a slip knot in order to be able to untie the knot quickly, e.g. clove hitch (Step 4), bowline (Step 5) and sheet bend (Step 6).

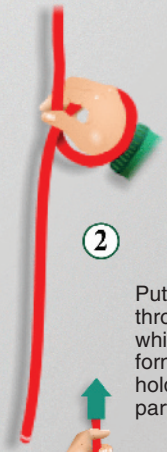
Making a bowline quickly might be a very useful skill to possess. You may avoid dangerous situations by first preparing and then quickly making the knot.

Example: A bowline may be made ready (Step 1–3) before jumping ashore. You then lead the working end through, e.g. a mooring ring, adjust the size of the loop (Step 4) and complete the knot with a short tug on the standing part (Step 5–6).



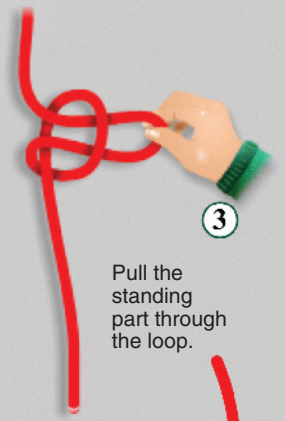
1

Hold the line as shown and twist your hand clockwise through 180°.



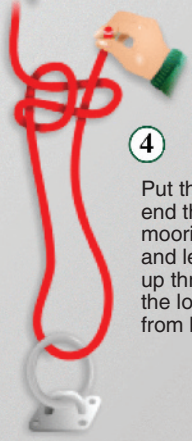
2

Put your fingers through the loop which will now be formed and grab hold of the standing part.



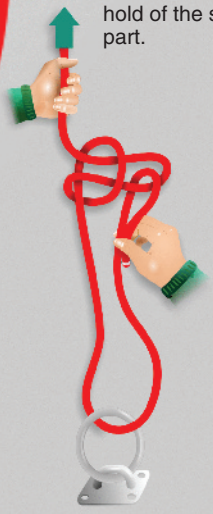
3

Pull the standing part through the loop.



4

Put the working end through the mooring ring and lead it up through the loop from below.



5

Double the working end back and hold it against itself. Give the standing part a short tug and the bowline will be completed (6). (Sometimes you have to help the locking turn to fi nd its right position).

6

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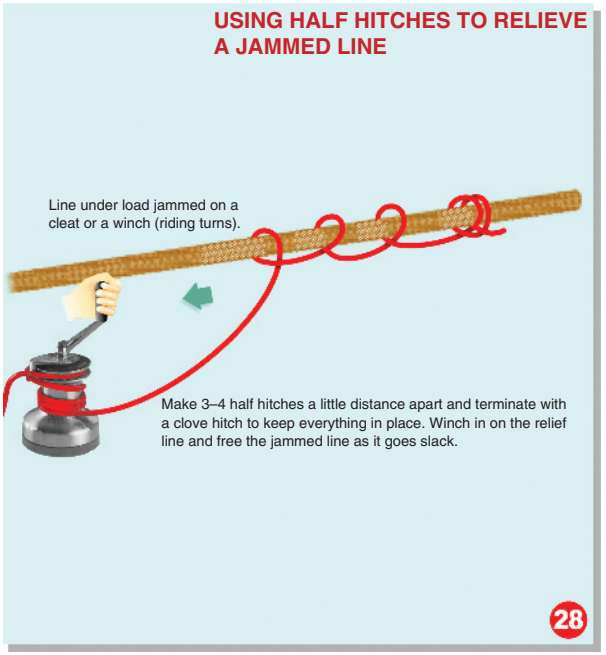
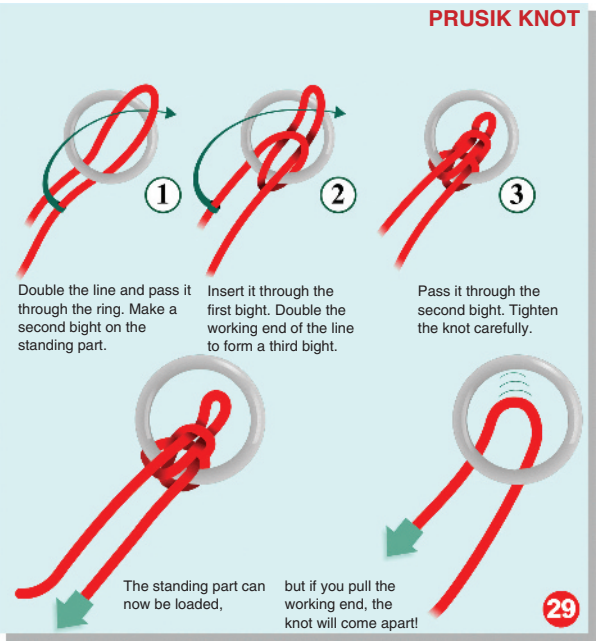
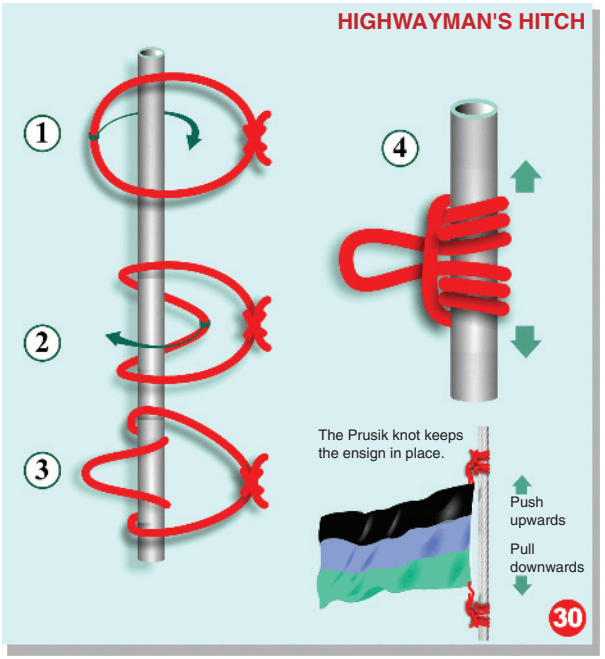
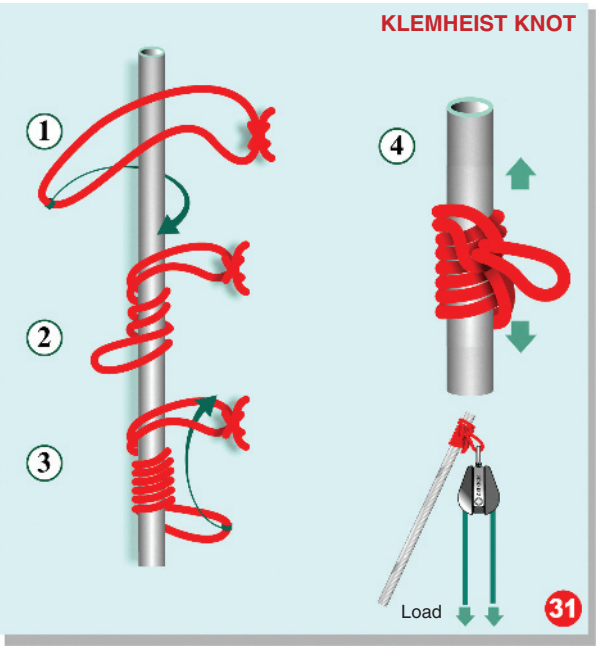




Using Half Hitches to Relieve a Jammed Line

Instead of using the rolling hitch when a line is jammed, as shown in the example in Figure 1.12, several half hitches a little distance apart can do the trick (Figure 1.28). Both of these methods can also be used to relieve a jammed chain. It is wise to try out these techniques before you actually need to use them.





The Prusik Knot

This knot was created by Carl Prusik for use in mountain climbing. To make the knot, first make a loop on a line with a diameter less than half the diameter of the line (wire, tube) to which you want to fasten it (Figure 1.29). Put the loop around the line and 'through itself'. Repeat this at least twice and pull the knot tight. Now the knot should be able to withstand loads in both directions without slipping.

Highwayman's Hitch

When, for example, you don't want to pass a slip line through a mooring ring for fear of it getting jammed, the highwayman's hitch could be useful (Figure 1.30). A short pull on the unloaded end of the line will quickly release the hitch (although this makes it quite easy to release accidentally).

The Klemheist Knot

A useful variation on the Prusik knot is the Klemheist knot (Figure 1.31). Turn the loop tightly and evenly around the wire (or rope) and pull it tight. Give it a test to make sure it can hold the intended load. If it slips, you have to add turns. Two such knots around a halyard can be used to climb a mast by pushing the knots upwards alternately.