Net making

Today, nearly all fishermen buy ready-made tools from a net maker or net shop. They do not have to worry about their manufacture but can choose any type of quality or design they like. Yet it would be hard to imagine working on a ship and not having any basic knowledge of how to maintain and mend the fishing gear used on board. When you are out on the fishing grounds there is no net maker nearby, and you will need to be able to mend any damage to the net or splice a new eye on a rope.

Technical terminology

Before you can even begin to work with a line and rope, you need to know the right terminology. The technical terminology used about ropes and how to work with them was developed on board the old sailing ships where very accurate terminology was needed: The ship's and the crew's safety could depend on whether the right fastening was used in the right places. Basically, there are some general terms for the rope and its most simple bends.
Net maker's tools
Net making is characterised by the fact that the net maker uses only a few tools in his work. Other crafts have developed a wide range of tools and aids over time, which have helped increase efficiency, but this has not happened to the same extent within net making.
This book describes the three most important net making tools: the knife, the net mending needle (also referred to as the net needle) and the marlinspike.

Knife
First of all, you need a good, sharp knife that can cut cleanly through ropes and lines to avoid raw edges. The knife is also used to trim the knots in the individual sections of the net. In particular, the steel needs to be of a high quality to ensure that the knife can always be sharpened to make it really sharp.
If the knife does not cut through the rope like a hot knife through butter, it requires too much effort, which may cause the knife to slip and cause injury. A knife that is not sharp is a dangerous knife!
Net making does not require the use of one specific knife. Many net makers use knives with a straight blade, either with a fixed handle or as a folding knife, but the final choice varies from person to person.
A knife is a personal tool which may not function well in the hands of others. This is due to the fact that each person has a unique way of positioning the blade, which makes it difficult for other people to sharpen the knife. It is also very difficult for left and right-handed people to swap knives.

Net mending needle
The net mending needle is a special type of needle with an “inner” tongue. The tongue holds thin line or thread so it is easy to pull the thread through the meshes and unwind as it is used.
Needles come in many sizes, and it takes some practice to use a needle correctly. First of all, it is important to learn how to replenish the thread or line – if it is not done correctly, the line will start twisting and turning during the work, which is both time-consuming and annoying!
Ordinary needles can be used for most tasks, but if you need to do the seizing on the lines on a purse seine, for example, you need a special purse seine or seizing needle. It is similar to a shuttle and has several advantages: It is sturdier, the tongue in the middle does not bend if force is used to tighten the line or thread, and the line or the thread is protected by the high edges.

Marlinspike
Marlinspikes also come in various sizes and versions. It is a round steel rod which is pointed at one end. The spike is used when splicing to open the strands of the rope/wire. Some marlinspikes are round and have to be removed from the rope before inserting the strand, while others resemble a cut pipe into which the strand can be placed when the marlinspike has been inserted. Then, when it is subsequently pulled out, it is necessary to check that the strand stays in the tuck.
Whippings
When a piece of rope is cut from a roll of rope, there are two rope ends which must both be prevented from unravelling. Plant fibre rope must be properly whipped, while synthetic rope is often “whipped” most effectively by simply melting the ends with a lighter. This can be difficult if the rope is thick. If so, you need to use a hot knife that melts its way through the rope when it is cut, or you can wrap a piece of sticky tape around the rope end or the strands.

Common whipping
A common whipping is made by making a suitable number of turns around the strands towards the rope end – the width of the whipping should be just as high as the diameter of the rope. One end of the whipping twine is held secure under these turns. The other end of the whipping twine is laid towards the first one and wound around the rope four times. Everything is pulled tight and the ends of the whipping twine are cut off.

Hitches and knots
There are hundreds of recorded hitches and knots. Most hitches and knots are of unknown origin and have a history which goes back a long time, while a few have been invented in recent times such as the special Danish knot “dummepeter over”, which is used to tie on a smooth line; this knot was not recorded until 1989.

It is estimated that around 90 per cent of all recorded knots have been invented by sailors while the remaining 10 per cent originate from other professions or leisure activities. Archers, bookbinders, surgeons and mountaineers, for example, have all contributed their own ways of arranging thread, lines and ropes.

The difference between a hitch and a knot is vague. Generally, you can say that a hitch is something which forms an eye or a turn, while a knot is a type of fastening:

A hitch includes bights or turns that either circle the standing part of the rope, some other rope or an object (such as a timber head).

A knot is made directly on the rope or when two pieces of rope or line are joined together. This may involve turns or bights which are led around their own part or other rope.

The “right” knot or hitch for a particular task should meet the following criteria:

- It must be laid fast.
- It must be durable and safe.
- It should not cause any undue wear and tear on the rope or equipment.
- It should be easy to untie or almost impossible to undo (as required).

However, it will often be necessary to moderate one or several of these requirements to meet the others, depending on which requirement is most important in a given situation.

So although there are hundreds of knots and hitches, there is no need to learn all of them by heart nowadays. This book only includes the most important and most frequently used ones. Texts and illustrations are helpful to read and look at but there is only one good way to become familiar with various knots and hitches: Lay them yourself – and do it over and over again! And remember: “Learn to do it well – then you will also learn to do it fast”.

Hitches and knots
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**Bowline – a loop hitch**
The bowline is a very frequently used hitch if, for example, on a large hawser you need a loop to place over a pole. The bowline enables you to pull on the rope without it tightening around the object over which it has been placed. Cross the working end of the rope over the standing part and hold it with your palm facing downwards (a). Turning your hand so your palm faces upwards while catching the one part with your thumb creates a loop on the standing part with the working end passing through the loop. Then pass the working end under the back of the standing part and back down through the loop (b), and pull (c).

**Sheet bend – a knot for joining two (dissimilar) ends**
The sheet bend is also called the weaver's knot and is the knot most frequently used by the net maker to join two pieces of netting. It is especially suitable for joining ropes of unequal thicknesses. Form a bight in the working end of the thicker rope. Pass the working end of the thinner rope around the bight, and trap it under itself. The knot is laid correctly if the two rope ends are on the same side. The knot can be strengthened by tucking in the rope end as shown below. This ensures that both rope ends are on the same side. This variant is used especially for synthetic rope and line.

**Clove hitch – a hitch for fastening**
A clove hitch is frequently used to secure small and large ropes to e.g. posts. However, the hitch is not completely secure unless it is subjected to an even and constant load; if not, it must be secured by an additional round turn or a half hitch around its standing part.

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**Diagram for Bowline (a-c)**

**Diagram for Simple Sheet Bend (a-c)**

**Diagram for Clove Hitch (a-c)**
Reef knot – a knot for joining two (similar) ends

The reef knot is very easy to untie even if it has been subjected to a heavy load. It should only be used when the two ends have the same thickness and stiffness, otherwise you cannot be certain that it will hold. It is particularly suitable for relatively thin lines. Place the two ends in a turn around each other, and place the rope ends in yet another turn so that each working end is parallel to its standing part. A simple mnemonic: Left over right and under, right over left and under.

Fisherman's knot – a knot for joining two ends

The fisherman's knot is also known as the true lover's knot. It is formed by two single knots which are pushed together. The fisherman's knot is a very strong way of joining two ends but the knot is almost impossible to untie – on thin lines it has to be cut up. The net maker uses it to join seizing twine. The knot is made by tying each rope in a single knot around the other.

Figure-of-eight knot – a stopper knot

The figure-of-eight knot is also called the Flemish knot. The figure-of-eight knot is used like an ordinary knot to prevent an end from running free (i.e. running through an opening such as a block or an eye). It also effectively prevents a rope end from unravelling and can be used to secure a line to, for example, a thin ring. The figure-of-eight knot is easier to untie than an ordinary knot.

Splices on laid rope

Splices are used to form permanent joints, and when you want to create a fixed eye on a rope end. Splices can be made on ordinary rope as well as on synthetic rope and wires. Hawsers are usually delivered ready spliced from the rope maker but the fisherman may still need to splice something while at sea. There are many ways to splice a rope. Generally, there are three types of splices: eye splices, short splices and long splices. This book only describes the most common splices (four eye splices and one short splice). It takes practice to be able to do a splice well. It is often helpful to start by making a temporary whipping on the rope to prevent any further unravelling of the strands.
Eye splice on three-strand rope
Eye splicing is used to create an eye on a rope, for example a mooring line, and to fasten a chain or a shackle to the end of a rope. A thimble is often inserted to protect the rope from wear and tear.

Word Definitions
thimble = a metal ring inserted in a rope as reinforcement, for example in connection with eye splicing

Make a whipping approx. three turns into the rope end and one around each of the three strands. Unlay the strands until they stop at the whipping and spread them as shown above (a). Make sure that the eye is the size you want!
Open the upper strand of the standing part, and stick the loose centre strand all the way through. Pull the strand almost tight (b).
Tuck the loose strand on the right under the strand of the standing part which is to the right of the first tuck (c).
Tuck the last strand (to the left) under the last strand of the standing part (d). Pull all the strands tight.
Make two more tucks with each strand (using the procedure: over one and under one) in the opposite direction to which the rope is laid (e). Pull the tucks taut and cut off the projecting ends of the loose strands.

Eye splice on four-strand rope
If you need to do an eye splice on a four-strand rope, you use the same procedure as for a three-strand rope. Let the first tuck of strand no. 4 go in in the same spot as strand no. 3, but let strand no. 4 pass under two strands.

Short splice on three-strand rope
Short splicing is used to join two rope ends where a knot would be in the way.
Unwind three turns on each of the two rope ends and place them together so the strands of the one rope end are interwoven with the other (a).
Splice the strands from the left rope end over one and under one opposite the direction in which the rope is laid (b).
When each strand has been tucked in, turn the splice around and repeat the process with the other three strands. Pull all six strands tight and make an additional two tucks with all the strands. If you carry out a splice on a synthetic rope, you should make another 1-2 tucks with each strand. Stretch the splice well before cutting off the strands.

Word Definitions

FACT BOX
To splice means to join two parts (for example two rope ends, but also to get married (get spliced).
**Splice on braided rope**

For obvious reasons, splices on braided rope are more complicated to make than on three- and four-strand ropes. It is possible to splice braided rope fitted with a sleeve according to the same principles as with laid rope but this is not done in the fishing industry. Instead an eye is made by sticking the rope end through the braiding and letting it follow the core for a certain length. It is possible to make a nicer looking splice by pulling back the sleeve and exposing the core. The eye is then made from the core which is tucked under the sleeve below the pulled back sleeve. Pull the sleeve over the core in the eye itself and adjust its length.

Square-braided rope has fewer strands, often 4, 8 or 16 and no sleeve or core. The strands often lie as pairs. If an eye splice is desired, it can be made by spreading the strands as usual (or the strand pairs) and making three or four tucks along the rope. As always, it is important to start the splice correctly to prevent the eye from reducing the strength of the rope significantly. See the example in Appendix on p. 43.

**Eye splice on wire**

When splicing a wire, it is also important to whip the strands to prevent them from unravelling. Insulating tape is often used for this, as it helps to avoid “spiky” rope ends that can scratch your hands and are difficult to work with.

Press the marlinspike through the wire so that three strands are on either side of it. Tuck strand no. 1 along the marlinspike, and pull out the marlinspike.

Insert the marlinspike so it passes under two strands and emerges where strand no. 1 goes in. Tuck strand no. 2 along the marlinspike (i.e. strand no. 2 passes under two strands). Tuck in strand no. 3 so that it only passes under one strand. Make sure that strand nos. 1, 2 and 3 are all tucked in the same spot but pass under three, two and one strands, respectively.

Turn the eye $180^\circ$ (half turn). Tuck strand no. 4 in and around the strand which is opposite the spot where the three first strands go in. Wrap strand no. 5 around the next strand, and repeat the procedure with the last tuck. Make sure that all tucks go around the same strand.

When all the tucks have been made, the eye is pulled tight. Make three more tucks with each strand. Finally, cut off the strands with a chisel.

There are another two ways to create an eye on a wire. First, you can use a wire clamp consisting of two bent plates which are fixed together by two bolts. Normally, you should use three wire clamps placed in succession, which allows you to join two pieces of wire or create an eye on a loose end of a wire. However, this should only be used in absolute emergencies, because it does not hold very well and because the wire clamp will usually be in the way during regular use.

**FACT BOX**

It is not unusual to see a type of wire clamp, consisting of a u-bolt which is threaded at both ends. Two nuts are used to push a plate over a wire join or an eye on a wire. However, it should be emphasised that it is prohibited to use such a wire clamp on board ships for hoisting and unloading gear.
Another method is to use talurits. A talurit is a piece of metal piping which is squeezed around the eye in a hydraulic press. The talurits are available in different metals depending on whether they are to be used on Taifun (combination rope) (aluminium), iron wire (steel) or steel wire (copper). A talurit press is not usually found on board fishing vessels, only at the net makers.

**FACT BOX**

**Common terms**

In order to be able to describe how to work with fishing nets, it is necessary to know some common terms.

You talk about:

**Bars**: The parts of the net which are not included in the knots.

**Row**: A horizontal row of bars.

In machine-made nets a row consists of one long thread.

**Joining row**: The row which the net maker ties in the joint between two sections.

**Vertical cut**: A cut which is parallel to the longitudinal direction of the net.

**Across**: A cut which is perpendicular to the longitudinal direction of the net, i.e. in the same row.

**Bar cut**: A cut which is parallel to the bars of the stretched net.

**Joining and mending nets**

**Net mending**

As mentioned earlier, most fishing nets today are made by net makers but it is still important for a fisherman to be able to mend his own nets. Small tears and holes need to be repaired when they happen – even at sea. Net mending requires both practice and experience. You need to practice a lot, and it helps if you can ask older fishermen for advice.

The knot used in net mending is called the sheet bend (a). The drawing below shows how to make a mesh from A to B (b) using the net mending needle which is loaded with net mending twine. As the bight between A and B passes under the left side of your hand, you can use your hand to adjust the mesh size. When the mesh has the right size, squeeze point B with the index finger and thumb of your left hand, and proceed to tie the sheet bend with the net mending needle. Pull tight.

If you use nylon thread for net mending, it may be necessary to make two tucks (c), thereby tying a sheet bend with round turn.

![Diagram of net mending](image)
It is very important to ensure that the meshes in the net have the right size. If they are too small, the net becomes smaller where it has been mended. This results in an uneven pull in the net, which minimises its strength. The same thing happens if the meshes are too large. If you are mending a tear in the trawl bag and the meshes become too small, you may be in violation of the rules on mesh sizes. For more extensive repair work, mending over a so-called row can make the task of maintaining the right mesh size a little easier. The row resembles a ruler, and its width must be equal to half the mesh size.

Below are some examples of how to mend torn nets. Trim the tears to make it possible to start and finish the work where the net has three parts (where three strands of thread radiate from a knot) – this is also called a three-leg. A two-leg is the spot where the net has two parts (where two strands of thread radiate from a knot).

1. A single thread has been torn. Cut off the ends (not too close), and connect the two three-legs by means of two sheet bends.
2. Start at a three-leg, proceed to a two-leg and finish at a three-leg (the arrows indicate the direction in which to proceed).
3. A horizontal tear. Start at a three-leg, and work your way towards the right from a two-leg to a two-leg and finish at a three-leg.
4. A vertical tear. As always, start at a three-leg and work your way into the tear from two-leg to two-leg and finish at a three-leg.
5. A hole in the net. Trim the hole so you can start at a three-leg (a) and finish at a three-leg (b). Work your way from left to right and from right to left by turns until you reach point b.

See the trawl drawing in Appendix on page 44.

**Trimming**

When joining two net sections of a trawl, you need to trim the top of one section and the bottom of the other section. Two things are important when trimming a net section across:

1. That you choose the right row of knots to cut. If you look at a piece of netting, you will see that the entire net is joined using the same type of knots, but in every other row the orientation of the knots changes (try to turn the net around and you will see it!). One row can be used when trimming the top of the section while the other row is used when trimming the bottom.
2. That you avoid damaging the loops during trimming. The knife must be kept away from the loop which must remain. The trimming is therefore carried out in a very special way, such that the knife “lands” up at the end which is cut off once it has passed through the net.

**Cutting a net section**

In the body of the trawl the sides of the pieces of netting are not parallel. The cut in the side can be more or less steep, which is determined by how the bars are cut. You talk about:
- cutting a side knot which results in a “vertical cut”.
- cutting bars which results in a “bar cut”.
- cutting a knot at the top or cutting across.
See also the fact box on page 30. Normally, all sorts of combinations of these two cuts will be used to achieve the right cone shape. On the net maker’s drawing, the individual cut will be defined according to the number of plain meshes and cut bars. 2-2 thus denotes a cut with two plain meshes and two bars, while 1-4 denotes a harder cut on one plain mesh and four bars. On the drawing, a cut-out has been made for a piece of netting cut 1-3.

As mentioned earlier, the length of a piece of netting is determined by the width and number of bobbins on the machine tying the net. The length of the pieces of netting is therefore usually predetermined and a half mesh from a round number: 19½ mesh, 49½ mesh, 99½ mesh etc. Thus, the entire section is 20, 50 and 100 meshes long if you count in the joining row. This makes it easier to calculate the length.

The width is defined by the number of meshes across or as the number of knots in a specific row. The last number is double the first number.

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| ![Diagram A](image1.png) | Three examples of joining two pieces of netting. It can be seen that the cuts are a combination of both vertical cuts and bar cuts. The joining of two different numbers of mesh must be calculated in order to get a reasonable number to work with. The ratio between the number of meshes in the two pieces will normally be 0.5 to 1. The picking up of a mesh is known as a decrease.

The following ratio provides good joints:  

- 1 the joint will be 1 to 1  
- 0.9 the joint will be 10 meshes to 9  
  - i.e. a decrease for every tenth mesh  
- 0.8 the joint will be 5 meshes to 4  
- 0.75 the joint will be 4 meshes to 3  
- 0.67 the joint will be 3 meshes to 2  
- 0.5 the joint will be 2 meshes to 1  
  - i.e. a decrease for every other mesh  

If the calculation of the ratio does not yield a good result, it can be improved by omitting decreases at the edge of the joint. In a the ratio is 1 and the meshes are therefore joined 1 to 1. In b the ratio is 0.58, i.e. close to 0.5, and the joint is made 2 meshes to 1 and is adjusted by letting two meshes on each side join 1 to 1. In c the ratio is 0.83. The nearest good ratio is 0.8 and again it is adjusted by letting two meshes on each side join 1 to 1.
Edging, joining and seaming
When tying a joining row it is very important that the bars have just the right length. The net can be distorted if the bars are too long or too short, and if they are not uniform, the pull between the net sections is not distributed evenly.
Make sure you are fully familiar with the knots used, not least when starting and finishing the job. Check regularly that the length of the bars of the rows made is correct and uniform.

Work sequence
There is no real reason to start in one place rather than another when you begin making a fishing tool, but traditionally you start in certain places.
When making trawls and Danish seines you start at the first section of the upper side of the body and cut the number of meshes across that the trawl should be wide. Presumably, the reason why you start here is that in earlier times a trawl would often be made without the use of a drawing – if you started elsewhere, you might not be sure how big the trawl would eventually be. The number of meshes around the opening is one of the most direct indications of the trawl’s final size and thereby its towing resistance.
Once the first section has been cut, you cut out a piece of netting for the roof and thus work your way towards the wings. Afterwards, using the same procedure, you work your way backwards towards the bag.
When making a purse seine you will often start by preparing the lines and attaching the lining. This is done for both practical and economic reasons: A purse seine takes a long time to make and is very bulky, so you do not want to take it home until it is finished to save space and storage charges.
As regards nets, some Danish fishermen have purchased their own sewing machines to fasten lines to the nets, but most nets are usually purchased ready-made from overseas suppliers in Eastern Europe or the Far East.

Tool maintenance
Trawl and Danish seine
Many fishing tools today are so large that the fishermen are unable to handle the tools on board the ship. There is not much room on deck to remove the trawl from the net drum and check it, and it can be difficult to get it onto the quay without the net maker's lorry with the power block. Consequently, the fisherman does not carry out much maintenance of his own fishing tools.
When a trawl has been in use for some time, it is advisable to carry out a readjust-
ment. A readjustment involves checking the entire trawl to ascertain whether the trawl has retained its original dimensions. Usually it has not, since the net, the lines and the tails often become stretched after a period of use. A readjustment involves checking:
- that the tails are of equal length,
- that the variance often built into nets and lines by the net maker, called the hanging ratio, has been maintained,
- that the difference between net sections in the top and bottom panels has been maintained.

If the deviations from the original shape are too big, they must be remedied.
Daily maintenance of the fishing tool involves repairing the holes in the net that will invariably occur and checking that rope and other equipment are not too damaged by long-term use, rendering it unsafe.
If the trawl is not going to be used for some time, it should be stored in a dry place away from sunlight, preferably indoors. Some ports and net makers have so-called trawl terminals or trawl drying facilities where the trawls can be stored. If the trawl is stored outdoors, moisture from the rain will cause dirt and grime in the net to rot, including dead fish. Apart from the smell, it will attract rats which can quickly gnaw their way through an entire trawl and make an awful lot of (new) holes in the net!

Purse seine and net
Fishermen only maintain their purse seine and netting tools to a limited extent. The purse seine is usually too big to handle on board the ship. If a minor tear is discovered, it is possible to pull the section with the tear aside during hauling and repair it later, otherwise the purse seine is taken to the net maker if more extensive repairs are needed.
Holes and tears in nets usually appear very quickly in nets but they do not significantly reduce the ability of the tool to catch fish. It just means that there are fewer meshes for the fish to get caught in. At the same time, nets are so cheap today that a worn-out net is often discarded rather than repaired.

REAL-LIFE STORY

Try again
It can often be very difficult to see what is what with a trawl when it is piled up on the deck and even if it is lifted onto the quay, it can be tricky to carry out repairs or replacements because it is impossible to distinguish the different parts from one another. This was what the crew on a cutter found when they were asked to carry out a readjustment of a herring trawl which had been in use for some time. The fish catching ability of such a trawl depends on the pieces of netting that make up the top panel being slightly shorter than the pieces that make up the bottom panel. The top panel had become stretched during use and a readjustment was needed, i.e. removing a mesh from across several of the sections. The joining rows were cut up and the row of meshes was cut off, and the extra slack in the bottom panel was distributed by taking apart some of the side seams. The crew then started to put the trawl back together but after a while it became clear that something was not right. It looked wrong and could probably not be used as a fishing tool. It turned out that the section of the net which was to be readjusted had not been marked off properly before the work was begun, and as a result the crew had begun to make a seam between two panels which did not belong together. The moral is that it is worth making thorough preparations for a task and make sure that the trawl is well stretched out and that the work is well marked off before you start – in this case the crew’s failure to do so cost them 3-4 hours of extra work.