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Overview

The Purse Seine Crew Learner’s Guide was produced with the financial assistance of NZ Aid and was developed by Grant Carnie through consultation with staff of the Secretariat of the Pacific Community, the Forum Fisheries Agency, Kiribati Fisheries Training Centre and the Kiribati Maritime Training Centre.

Resources from Australia, New Zealand and regional training materials were used as a guideline to develop a Learner’s Guide that is relevant to the tuna purse seine fishery in the Western & Central Pacific region.

It has been designed to be a learning resource aid for Pacific Islanders who are undertaking a basic introductory course to prepare them for work as a crew member on a purse seiner operating in the Western & Central Pacific tuna purse seine fishery.

The contents of the Guide are aligned with the Basic Purse Seine Crew Course curriculum that was also developed with the financial assistance of NZ Aid. Trainees undertaking a course based on that curriculum will receive practically focussed training at a regional training organisation specialising in fisheries and maritime training and the Learner’s Guide is to be used as a supplementary resource to that training.

General course information

There are no prescribed prerequisites to undertake a Basic Purse Seine Crew Course other than trainees should be medically fit and willing to work in what at times can be a difficult environment with long periods away from home.

However, as part of the curriculum trainees must also complete the STCW 95 Certificate in Sea Safety course that covers the requirements of the 1995 STCW Convention Chapter IV, Section A-IV/1 or in lieu of the STCW 95 Certificate in Sea Safety course, a sea safety training program that generally meets those requirements.

If trainees haven’t undertaken such training it is anticipated approved training organisations delivering the Basic Purse Seine Crew Course will deliver, or facilitate the delivery of the sea safety component immediately prior to the general purse seine component. It is expected that the training organisation delivering the sea safety training will have the necessary approval and resources required to deliver that component.

Any other requirements to undertake the course are at the discretion of the training organisation, other organisation or country facilitating the training courses.
General

Purse seining is a method of fishing that targets pelagic fish that are swimming on or near the surface, such as tuna and pilchards (sardines). It encircles a school of fish that has been spotted from the lookouts on the boat, by specialist spotter aircraft or sophisticated electronic equipment, particularly sonar. It is a very efficient method of fishing in that the whole school of fish is usually caught.

The large fleets from countries such as the USA, Japan, Philippines, Spain, Taiwan, China and Korea that roam the tropical and semi-tropical oceans of the Western and Central Pacific ocean catching tuna for canning almost exclusively use the purse seine method. The vessels are generally large in size, spend long periods of time at sea and some carry up to 2000 tonnes of fish when loaded.

A set can be made on a school of fish swimming by themselves on the surface (called a free set), though the risk of the fish escaping before the net is closed is high and requires luck and skill. Many purse seiners prefer to set on schools that have aggregated under fish Aggregating Devices (FADS), which have been positioned by the purse seiner or their support vessels. The fish are attracted to bait fish which congregates under the FAD and are preoccupied when the set is made.
Principles of purse seine gear

Common terms

So that you can take on your role as a crew member, you most first know the names of the various parts of the purse seine gear and the other equipment used during the operation.

<table>
<thead>
<tr>
<th>TERM</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purse seine net</td>
<td>Is basically rectangular in shape and has a purse line running through rings on the bottom of the net. This line is hauled in during the operation, thereby closing off the net and capturing the fish in a ‘floating pond’. The nets can be from as small as 100 m in length up to 2000 m in length and 300 m in depth on the large tuna purse seiners.</td>
</tr>
<tr>
<td>Cork line</td>
<td>The wire or rope that the top of the purse seine net is attached to. It has enough floats (corks) to ensure the head line floats on the sea surface.</td>
</tr>
<tr>
<td>Chain line</td>
<td>The wire or rope that the bottom of the purse seine net is attached to. It has weights of chain or lead to allow the bottom of the net to sink to its maximum depth and go under the targeted fish when the net is ‘pursed’ or closed off.</td>
</tr>
<tr>
<td>Wing</td>
<td>The last part of the net to go into the water and the first part aboard during hauling. Is often made of lighter netting.</td>
</tr>
<tr>
<td>Bag or sack</td>
<td>The first section of net in the water and remains in the water after hauling is completed and the fish are ready to be brought aboard or transferred to a towing cage. It is made of heavy netting to prevent the captured fish breaking through.</td>
</tr>
<tr>
<td>Purse line</td>
<td>A wire cable that passes through a series of rings attached to the foot line. Is hauled in so as to close the bottom of the net.</td>
</tr>
<tr>
<td>Rings</td>
<td>Made of steel, are circular or oval in shape and are either closed or have spring-loaded openings to allow them to be disconnected from the purse line. The purse line passes through them and they assist in the closing off process.</td>
</tr>
<tr>
<td>Bridles</td>
<td>Are made of rope or chain and attach the rings to the foot line of the net. Can either be V-shaped with the ring in the centre or a single line.</td>
</tr>
<tr>
<td>Overshoot line</td>
<td>Either wire or rope, it is attached to the wing end of the net and is used to haul the net back to the boat ready for the main hauling operation.</td>
</tr>
<tr>
<td>Power block</td>
<td>Sheathed rotating drum covered in hard-wearing rubber that allows the net to be gripped by the block and hauled aboard as it rotates.</td>
</tr>
<tr>
<td>Purse davit</td>
<td>A solid T-shaped assembly with blocks hanging from it that allows the purse and overshoot lines to run from the winches to the net in the water.</td>
</tr>
<tr>
<td>Block</td>
<td>Round with a rotating V-shaped sheath and suspended from a fixed point. Used to change direction of wire or rope.</td>
</tr>
<tr>
<td>Boom</td>
<td>A pole that has a swivel section at one end that allows it to be moved. Generally has a block at the other end to allow wire or rope to pass through. Used to lift equipment, in the brailing operation and during unloading ashore.</td>
</tr>
<tr>
<td>Net skiff</td>
<td>Tender boat with powerful engine used to pull the net into the water at the start of a set and as a general work boat during the purse seine operation, particularly on the American style operation where it is used to pull the main vessel clear of the net.</td>
</tr>
</tbody>
</table>
Typical purse seine net

Other equipment

Purse winches

- Used to haul the wire or rope that closes off the bottom of the purse seine net.
- Are generally driven hydraulically.

Modern purse winches generally have two or more drums. This allows the purse line to be pulled in from both ends at the same time and so speed up the pursing or closing off procedure. The overshoot line winch is often part of the same winch and each winch is operated separately by a series of clutches and brakes. Main purse winches are sophisticated pieces of machinery and need to be operated by an experienced operator.

Purse winches are very powerful and can be dangerous if care isn’t taken around them. Stand well clear when the winch is operating and don’t ever put your hands on wire as it is being wound onto the drum.
**Power block**
The power block has been the most important development for purse seine operations, allowing large nets to be easily hauled in.

Power blocks:
- are a sheathed rotating drum covered in hard wearing rubber
- allows the net to be gripped by the block and hauled aboard as it rotates
- are generally driven hydraulically

On American style purse seiners operating in the Western and Central Pacific tuna fishery the power block is suspended from the main boom and positioned over the area of the deck near the stern where the net is stacked aboard the purse seiner.

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**Overshoot and lifting winches**
Overshoot winches are often part of the main purse seine winch (as described in the purse winch section), but can be a separate winch. Overshoot winches haul in the overshoot line and bring the wing end of the net to the boat ready to go through the power block.

There are a variety of other winches on a purse seiner that are used during brailing operations, unloading fish and for lifting the net skiff aboard.

**Capstan**
Sometimes a capstan is used to haul in the overshoot line or for lifting operations. A capstan is a rounded steel drum that is often attached to the shaft of another winch.
Operating a capstan

1. Take three or four turns around the capstan with the line.
2. The line should run in the same direction as the capstan is turning.
3. Ensure the layers of line are not over the top of each other.
4. Pull continuously on the end coming off the capstan.

If the rope is under strain and difficult to pull off the capstan, use another procedure. It is dangerous to lift or pull a weight that continually makes the line slip and puts it under severe tension.

Booms and blocks

Most purse seine operations use a combination of booms and blocks to assist in the setting and hauling procedure, to take fish from the net and to off-load in port. The exact configuration is dependent on the type of purse seiner and the master or owner’s preference.

The positioning of blocks will determine the exact operational method of the vessel:

- In general the purse lines run from the winch to blocks positioned on the purse davit on one side of the vessel, then through the purse rings
- The overshoot line block may also hang from the same davit
**Net stacking area**

The deck and equipment layouts of most purse seiners operating in the Western and Central Pacific tuna fishery are similar, the only differences being minor to accommodate some structural differences between vessels.

All have an area on the aft section of the vessel which houses the net when it is on board. In most cases the cork line is stacked on the starboard side of the vessel, the chain line, ring bridles and rings on the port side of the vessel and the body of the net is flaked between the two.

**Shackles, hammer locks, sister clips**

Shackles

- Used to join various components of the purse seine gear together
- Made of ordinary steel or stainless steel and are U-shaped or a slightly U-shape
- Fastened by a pin at the top of the U
- Should be tightened with a spanner and if not regularly undone, further secured with a piece of wire around the pin head and the shackle body (called mousing or seizing)
- Tested shackles have a tested breaking strain engraved on the body - make sure you don’t use a shackle for a job that exceeds the tested breaking strain

![U-shaped shackle](image1)

![Bow shackle with wire securing the pin](image2)

Hammer locks

- Used for similar applications as shackles, but are not as easy to undo.
- A central pin with a spring joins the two identical parts.
- When putting a hammer lock together for the first time, make sure an experienced person checks your work – a hammer lock that comes undone under load is very dangerous.

![Hammer lock](image3)
Sister clips
- Widely used on purse seiners
- Are a D or oval-shaped clip, made of ordinary or stainless steel and have a slit cut into the body on one side
- Two sister clips are joined via the slits and provide a secure method of joining two lines but can be clipped and unclipped very quickly.

General operating principle
The general operating principle of the purse seine is very simple.
- A rectangular-shaped net has floats attached to heavy rope on the top (cork line) and weights (generally chain) on the chain line
- Rings are attached to the foot line by briddles (generally chain)
- A purse line of either wire or rope is threaded through these rings and the net is set around a patch of fish on or near the surface by the purse seine vessel
- The vessel encircles the school as the net is going over the stern and returns to the start point
- Once back at the start point, the purse seine line is hauled aboard, thereby closing off the bottom of the net and capturing the fish.
- The main body of net is then hauled aboard (through a power block) until the bag or sack section is all that is left in the water.
• The excess netting in the bag or sack section is then hauled aboard over the gunwale, which crowds the school of fish up and allows the operation of transferring the fish aboard and into storage tanks to be easily undertaken.

• Transferring of the fish from the sack to the fish wells aboard the purse seiner is undertaken with a brailer (scoop), which is a steel ring with a netting bag attached and is dragged through the fish, with the aid of booms and winches, taking up to 5 tonnes of fish with each lift.

**Setting and hauling procedures**

Vessel layout and number of crew can vary but the general principles of setting and hauling are very similar. Below you will find a general overview of setting and hauling and a crew member’s role, but remember to familiarise yourself with the operation you are working in.

**Preparing the gear to shoot**

The net will have been correctly set up when it was first put on board at the start of a new season and thereafter as it was hauled in each time it is used. It should go out freely when setting. In general the net is set up or stacked in the following order:

1. The cork line and floats are laid fore and aft in the net stacking area on the stern of the purse seiner, generally on the starboard side of the vessel.
2. The chain line, ring bridles and purse rings are laid fore and aft in the net stacking generally on the port side of the vessel.
3. The main part of the netting in between the head line and foot line is laid fore and aft in the centre area of the net bin.
4. The purse rings are usually threaded with a rope as they are stacked to prevent crossing them prior to the purse cable being threaded at the completion of stacking.
5. The chain line and rings are set on the side that the vessel will be turning when setting the net, which is generally in an anti-clockwise circle in the Pacific tuna fisheries.
6. The purse line is threaded through the rings in order and connected to the bag end of the net, ready to connect to the purse winch when the set or circle is complete and pursing begins.

The importance in laying out the purse seine net for setting is that the cork line and chain line are well separated on opposite sides of the vessel, ensuring they do not become tangled.
Be very careful when working in the net stacking area. The net is dropping from above, from quite a height and the steel purse rings, chain briddles and chain line can cause damage if they hit a crew member.

It is normal for a crew member (usually the person stacking the chain line and/or rings) to yell ‘RING!’ as each ring is approaching.

Make sure all other attachment points such as shackles, purse line, the overshoot line, retrieval lines and floats, sister clips, etc., are securely fastened in accordance with the procedure used for the operation.

**Setting Procedure**

Step 1  The hauling line and purse line are connected to the bag end of the net and to the net skiff.

Step 2  On the skipper’s command, the net skiff is set free from its stowed position on the ramp on the stern of the vessel by releasing a quick release clip.

Step 3  The weight of the net skiff begins to drag the net into the water.

Step 4  The vessel steams ahead at close to full speed, with the net tumbling overboard and the purse line being continually released from the main drum of the purse winch, encircling the school of fish.

Step 5  On returning to the first part of the net to go into the water (the bag or sack), the vessel stops alongside the skiff.

**Hauling procedure**

Step 1  The hauling line connected to the end of the net is taken from a crew member in the skiff and hauled aboard.

Step 2  A messenger line from the second purse drum is connected to the purse line at the bag end by sister clips and both that drum and the main purse drum that has contained the purse line during setting are engaged and the pursing begins.

Step 3  At the same time, the overshoot line is being winched aboard until the wing end of the net can be reached. A line is fed over the power block and clipped to the end of the net. The overshoot line is then disconnected.

Step 4  Pursing is complete when the bunched rings have reached the side of the vessel. A crew member remains near the rings ready to release them one by one as the net is hauled aboard.

Step 5  The net is now pulled up to and over the power block by the attached line and when the net is grabbed by the power block the hauling begins.

Step 6  Most crew will be in the net stacking area helping to restack the net. The number of crew needed depends on the size of the net. At least one person will be working the cork line, one the chain line and rings (sometimes two people are needed on larger nets), with the remainder stacking the body of netting in between.

Step 7  When the correct amount of net has been hauled in for the brailing operation, preparations are made to load the fish aboard.
Brailing

Most purse seiners in the Western and Central Pacific tuna fishery now use the "Spanish style" brailing system. The net skiff is not used at all during the entire sacking up and brailing process as was common on previous American style purse seiners.

No net skiff is necessary as the cork line and sack are supported by a reinforced unloading boom. A much heavier brailer ring is drawn through the sack in a bow to stern motion by a deck mounted winch. The automation allows brailer capacity to increase to approximately 4-5 tonnes.

Once the brailer full of fish is aboard it is lowered over the hopper, released and distributed to the fish wells on the wet deck below, via chutes.

Safety

- Be very careful when working in the net stacking area. The net and its parts, particularly the steel rings are heavy and can cause severe damage if they fall on you from the power block.
- Always wear a hard hat (helmet) when working in the net bin.
- Keep clear of the net as it is going overboard - remember it is impossible for the vessel to stop halfway through a set to pick you up.
- Take care not to place your hands anywhere near the winches when they are operating or the purse wire when it is moving.
- If you are working in the skiff or speedboats wear a life jacket – they can capsize if incorrectly operated.
- Use proper manual lifting techniques at all times.
- Ask for help if you need it.
- Keep the deck washed down to prevent slipping and make sure all loose gear is correctly stowed to minimise hazards.
- Wear protective gloves, clothing and footwear. Rubber boots with steel capped toes are recommended. Never work in bare feet or open shoes.

**Searching for schools of fish**

The efficiency of the modern purse seiner is exemplified by the array of technology it has at its disposal to find schools of tuna. It uses:

- helicopters and aeroplanes to widen the search area
- modern electronic equipment such as sonar to detect fish under the surface
- S-Band radars to locate birds that feed on bait fish with tuna
- specialised equipment to read water temperatures and provide weather, current and other useful information.
This technology is complemented with visual searching by the crew using high powered binoculars from high vantage points such as the crow’s nest. Crew look for:

- signs of fish schools rippling on the surface
- birds feeding on bait fish
- floating logs and other debris that has attracted bait fish, which in turn attracts tuna to feed on the baitfish.

Fish Aggregating Devices or FADS, which are set by the fishing operators and may be free floating or anchored, are a particularly good way to attract tuna. There are 1,000s of FADS deployed on the Western and Central Pacific tuna grounds and have proven very successful.
**Gear Maintenance**

A good crew member continually checks all the fishing gear for defects and repairs any faults that are found. Remember fish can easily escape if gear is not maintained in good condition. More importantly, serious accidents and even fatalities can occur as a result of badly maintained equipment.

**Rope and wire**

- Rope lines and wire should be checked regularly for chaffing and parted strands - where excessive wear is found, the rope is to be condemned and replaced.
- Unwanted knots should be removed as they prevent the rope from running through the blocks smoothly and can reduce strength.
- Kinks should be straightened out and if in poor condition, cut and respliced.
- Connecting clips, toggles, etc., should be checked for wear, smooth operation and replaced if necessary.
- If a line breaks during the hauling process it may be rejoined with a joining splice as long as the overall condition of the rope is okay. Check with an experienced crew member. You should be able to splice ropes and tie knots in the correct manner. Check the splices that are used on your vessel and practice them regularly.

Don’t be afraid to ask for help if you are not sure.

**Nets**

Nets are the most critical gear in a purse seine operation, particularly the bag section where the fish are crowded and push against the net. Nets should be continually checked for wear and tear and repaired as soon as possible.

All the hard work in finding the fish is lost if they escape before you get them on board.

Areas to check and either repair or replace include:

<table>
<thead>
<tr>
<th>Area</th>
<th>Action to take</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main body of netting for holes and tears, particularly the bag</td>
<td>Check for holes as the net comes on board and have some coloured twine or rope to mark any holes. Pull them to the front of the net stack so they can be reached if they need to be repaired later.</td>
</tr>
<tr>
<td>Cork line and chain line</td>
<td>Reattach netting that has come adrift.</td>
</tr>
<tr>
<td>Floats and ground rope gear for wear and tear</td>
<td>Replace if in doubt.</td>
</tr>
<tr>
<td>Connecting clips, toggles, shackles, etc.</td>
<td>Replace if in doubt.</td>
</tr>
<tr>
<td>Purse line</td>
<td>Res splice damaged areas.</td>
</tr>
</tbody>
</table>

**Other equipment**

- Regularly check blocks and connecting shackles for wear and tear and repair or replace.
- Check winches and other mechanical equipment frequently. It may be the engineer’s job but you could be the person hurt by an accident.
- Check the purse rings to see whether they are badly worn where the purse line rubs against them. Replace if necessary and put the damaged one aside for the engineer to re-weld.
Before a fishing season starts, a general maintenance period takes place but regular checks and repairs whilst fishing can reduce the length of the maintenance period. Picking up on a problem early can save time and most importantly, stop fish escaping or prevent a serious accident.

**Remember**

During setting and hauling operations, you should be continually keeping an eye out for anything which looks abnormal. If you cannot fix it or are not sure if you should, bring it to attention of an experienced crew member.
**Vessel layout**

As a crew member on a purse seiner you must have a basic understanding of the general layout of a vessel and some common terms referring to parts of the vessel.

Familiarise yourself with some general terms and study the basic vessel profile and the nautical terminology outline below. In particular you must learn the four major sections of a vessel – port (left side when looking forward), starboard (right side when looking forward), bow (front section of the vessel) and stern (the back section of the vessel).

**Some general terms**

<table>
<thead>
<tr>
<th>Term</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Athwartships</td>
<td>At right angles to the fore and aft line.</td>
</tr>
<tr>
<td>Beam</td>
<td>That part of the ship’s side which lies between the bow and quarter. (Also denotes the breadth of the ship).</td>
</tr>
<tr>
<td>Bilge</td>
<td>Curved section between the bottom and side of a ship.</td>
</tr>
<tr>
<td>Bow</td>
<td>That part of the ship’s side which is near the stem or front.</td>
</tr>
<tr>
<td>Bulkhead</td>
<td>Vertical wall or division between compartments.</td>
</tr>
<tr>
<td>Bulwark</td>
<td>An extension of the ship’s sides above the deck to prevent persons/equipment going overboard.</td>
</tr>
<tr>
<td>Chain locker</td>
<td>A compartment in the forward lower portion of a ship, in which the anchor chain is stored.</td>
</tr>
<tr>
<td>Combing</td>
<td>A raised edge around any opening that helps prevent water entering.</td>
</tr>
<tr>
<td>Fore and aft line</td>
<td>The line between the stem and stern, that is, in line with the keel.</td>
</tr>
<tr>
<td>Forecastle (focsl)</td>
<td>The forward upper compartment of a ship, usually used for stores, accommodation, etc.</td>
</tr>
<tr>
<td>Freeing ports</td>
<td>Openings in the bulwark to allow any water on the deck to flow out quickly.</td>
</tr>
<tr>
<td>Gunwale</td>
<td>The protective board fitted to the sheer plank, the term is sometimes applied to the upper deck of a boat.</td>
</tr>
<tr>
<td>Helm</td>
<td>Steering wheel of the vessel.</td>
</tr>
<tr>
<td>Keel</td>
<td>Is the backbone of the vessel running from forward to aft at the lowest part of the hull at the centreline of the vessel.</td>
</tr>
<tr>
<td>Lazarette</td>
<td>The space above the afterpeak between decks.</td>
</tr>
<tr>
<td>Midships</td>
<td>Lying midway between stern and stern in a fore and aft line.</td>
</tr>
<tr>
<td>Port side</td>
<td>The left hand side of a ship looking forward.</td>
</tr>
<tr>
<td>Quarter</td>
<td>That part of the ship’s side which is near the stern.</td>
</tr>
<tr>
<td>Rudder</td>
<td>A device found aft of the propeller that deflects the water in the required direction to steer the vessel.</td>
</tr>
<tr>
<td>Samson post</td>
<td>A heavy vertical post used for tying mooring lines.</td>
</tr>
<tr>
<td>Scupper</td>
<td>Drain from weather decks to carry off sea and rain water.</td>
</tr>
<tr>
<td>Starboard side</td>
<td>The right hand side of a ship looking forward.</td>
</tr>
<tr>
<td>Stem</td>
<td>The extreme front or foremost part of a ship.</td>
</tr>
<tr>
<td>Stern</td>
<td>The extreme rear or aftermost part of the ship.</td>
</tr>
<tr>
<td>Transom</td>
<td>The aftermost transverse frame.</td>
</tr>
</tbody>
</table>
**Prepare the vessel for sea**

Preparing a vessel for sea can cover a wide range of tasks but the tasks you will most likely be involved with as a general crew member, include:

- securing the vessel so that it is watertight
- lashing gear that can move
- making preparations for rough weather

**Securing for sea**

When a vessel puts to sea it has to be watertight or the life of everyone aboard is at risk. There are numerous watertight and weather tight closures both above and below decks that should be closed and secured, even in calm conditions, unless there is a specific reason for doing otherwise.
General closures include:

- watertight bulkheads and doors
- hatches and hatch covers
- exterior doors
- manholes
- lazarettes
- ventilators
- skylights
- portholes

Remember - The crew member who OPENS a watertight closure is responsible for ensuring it is closed at the earliest possible opportunity.

- Mooring lines and loose gear should be stowed below decks. If not then they should be securely lashed.
- Booms, cranes, drums, deck cargo should be well lashed (with good knots and hitches) and NOT tied against freeing ports, watertight doors or on top of required deck openings such as lazarettes.
- Crane hooks should be secured by attaching to a fix (and strong) point on the vessel and tightened by taking the weight with the relevant winch.
**Lashing gear**

Lashing gear involves tying down any gear that is likely to move at sea. Moving gear is dangerous because it can injure crew, damage the vessel and can also affect the stability of the boat by shifting the vessel’s centre of gravity.

- All gear must be securely stowed to prevent movement
- The rope used must be strong enough to hold the weight of the gear to be secured
- The knots used are correct and tightened so that they won’t slip but can be undone quickly
- Any gear stored on deck should be placed on timber beams, especially on steel decks but preferably on all decks, to allow for drainage
- Gear is placed and secured so that it doesn’t affect the boat’s stability, i.e. stacked as low as possible and as near as practicable to the vessel’s centre line
- Protect lashings from sharp nips, i.e. corners.

Remember - a lashing is no stronger than its weakest part. Continually check lashings to ensure they haven’t come loose. Retighten if necessary.

**Preparing for rough weather**

If rough weather is encountered or suspected, the following are some of the points to consider:

- Batten (fasten) down all hatches securely.
- Close all portholes with dead lights (if fitted).
- Use storm boards over large window areas where practical and cover openings without closures.
- Close all watertight doors.
- Clear decks of gear - stow and secure below.
- Lower any booms and resecure.
- Check freeing ports (scuppers) are clear and working.
- Reduce slack (not full) tanks to a minimum, by either totally emptying or topped up.
- Rig safety lines on deck.
- Close covers on ventilator pipes to fuel tanks and fresh water tanks.

**Berthing operations**

As a crew member you may be involved in tying and untying a vessel to and from a wharf, also known as berthing and unberthing. The skill of the Master in positioning the boat alongside the wharf can be completely undermined by incompetent crew work. In particular, the skipper will rely on the skill and speed of the crew in windy conditions or when the current is strong.
**General terms**

In order to assist in berthing you will first need to understand some common terms.

Bollards or cleats are attachment points on a wharf and on the vessel that the mooring lines are attached to. There are a variety of attachments on a vessel. For example:

- cleats
- stag horn bollards
- sampson posts

A berthing line is a line with a loop in one end that is attached to a bollard or cleat on a wharf and secured to the vessel. There are different names depending on where the line is in relation to the vessel.
A heaving line is a light line with a weighted end that is attached to the end of the mooring line to go ashore. It is used when the mooring line may be too heavy to throw and is thrown ashore first.

Preparing to berth

There are a number of things you will need to find out before berthing, including:

- which side of the boat will be alongside the wharf;
- positioning of fenders;
- the number and position of ropes to be made ready;
- the sequence of mooring ropes to be made fast.

Fairleads are a fitting on the side of the vessel near the securing points through which the mooring line passes. They are used to lessen the wear and control the direction of the line.

Fenders are like large cushions that are attached by a rope to the vessel and are positioned to help protect the hull from damage caused by rubbing against the wharf. Sometimes old tyres are used as fenders, although they leave black marks on the hull where they are positioned.
The mooring lines need to be in place ready to get ashore quickly and the fenders correctly positioned. This will include:

- Lines flaked on the deck so that they will run out freely
- Passing loops that are going ashore through the relevant fairlead (if applicable)
- Taking a couple of loose turns of the opposite end of the line around the vessel attachment point to prevent it going over the side
- If necessary, attaching heaving lines
- Placing fenders where they will effectively protect the vessel

**Berthing**

The order that lines will be attached will depend on the method of berthing. There are a number of alternatives depending on weather conditions, vessel type and skipper preference. You will need to be aware of the method used.

As a general guide you will need to follow this procedure:

1. Take three or four loops in each hand of the line to go ashore.
2. Make sure you aren’t standing in any loops of line on the deck.
3. As the vessel approaches the wharf throw the loops ashore.
4. When the end ashore is attached to a bollard or cleat, quickly pull all slack line aboard.
5. Take two turns around the attachment point on the vessel.
6. Adjust the line in or out according to requirements. Watch the skipper for instructions.
7. When the vessel is in position, secure lines correctly according to the method used on your vessel.
8. Coil unused line tidily.
9. Check fenders are correctly positioned.

**Securing the line to a bollard, post or cleat**

It is very important that the line is correctly secured to all attachment points. The tension applied by the vessel pulling on the line can make it difficult or impossible to untie. This can be particularly dangerous if you need to unberth quickly and costly if lines need to be cut.

Some preferred attachment methods are shown in the diagrams.
**While berthed**

While the vessel is tied to the wharf it will be necessary to watch carefully to ensure the vessel is moored securely at all times.

- Pay attention to the rise and fall of the tide adjust the lines as necessary
- Continually check the position of the fenders
- Check that mooring lines aren’t cutting or rubbing against objects
- Keep an eye on the weather a change in wind direction might mean the Master will need to move the boat to a more secure position.

Remember - the rise and fall of the tide means mooring lines may need to be continually adjusted. The vessel’s bow and stern lines should be secured on the wharf as far away fore and aft from the vessel as possible, so that they still have sufficient lead when the vessel drops down on the tide.

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**Anchoring operations**

*Types of anchors*

- Admiralty or kedge
- Stockless
- Danforth
**Parts of an anchor**

![Anchor diagram](image)

**Some other terms**

- **Gypsy** - the specially shaped drum on an anchor winch that takes the links of anchor chain.
- **Hawse pipe** - the tube through which the anchor cable runs from the anchor winch to the anchor.
- **Spurling pipe** - the tube through which the anchor cable runs from the anchor winch to the chain storage area.
- **Scope** - the ratio or amount of anchor cable to the depth of water (e.g. 40 metres of anchor cable let out in 10 metres of water is a scope of 4:1). The amount of scope will depend on the depth of water, type of anchor cable (chain, chain and rope), weather conditions, etc.

Each vessel will have its own procedures for dropping and retrieving the anchor. As a guide, the following is a typical procedure for anchoring a vessel.

**Preparing to anchor**

The winch operator will have the anchor ready for letting go once the Master gives the order. This may include:

- disengaging the clutch on the anchor winch
- turning on power to the anchor winch
- removing any securing stopper to the anchor (e.g. a turnbuckle, rope lashing);
- anchor hanging free of the hawse pipe or the anchor bow roller but clear of the water;
- brake on

Make sure everyone is clear of the anchor and cable (or rope) and if the cable is stored in a locker make sure it is clear also.
Anchoring

The vessel heads into the wind then the skipper puts the vessel astern. When in the correct position to anchor:

1. When the order is given to let go, the winch operator will let the anchor run out (after unscrewing the brake), generally under power until it hits the bottom. The winch operator will continue to release the anchor cable as the ship moves astern, maintaining slight tension to ensure the cable is stretched out and not piled in a heap on the bottom.
2. When the Master indicates the required length of cable (called the scope) is out, the winch operator will stop releasing the cable by putting on the winch break.
3. Crew now wait until the boat is ‘brought up’, which means it is comfortably riding and holding on the anchor.
4. If the anchor is dragging it will be seen to pull taut and repeatedly go slack - vibrations can also be felt through the anchor cable or the vessel may sit side-on to the wind.
5. Stoppers or extra securing devices that may be used in place.

Watching while on anchor

While at anchor a careful lookout must be kept. This may mean crew members keeping rostered anchor watches. Even if that isn’t the case on your vessel, you should be keeping a lookout at all times. The safety of the vessel relies on continually checking:

- the vessel’s position by:
  ✓ taking a bearing of fixed objects (preferably two in line-called a transit bearing)
  ✓ position relative to other vessels
  ✓ depth of water on the echo sounder
  ✓ observing the radar
• the amount of ‘swinging room’ between other vessels and/or reefs, buoys, etc – a vessel will move around from side to side on its anchor so make sure there is enough room to do that
• the anchor cable for wear - this might mean adjusting the cable (or rope) slightly so that the same part isn’t rubbing continuously in the hawse pipe or anchor bow roller;
• any change in weather conditions
• the anchor light is on at all times

Remember - if you have any doubts concerning the vessel’s safety while at anchor, make sure you let the Master or Officer of the Watch know immediately. This maybe because the vessel is dragging anchor, the swinging room is insufficient or the weather conditions have changed.

**Lifting the anchor**

Again each vessel will have its own procedures for dropping and retrieving the anchor. As a guide, the following is a typical procedure for retrieving the anchor.

• The winch operator will turn the power on to the anchor winch and put the clutch in so that the anchor can be lifted
• The Master will steam slowly up in the direction that the anchor is laying – crew must continually indicate the direction of the anchor to the skipper by pointing
• As the anchor comes from the water, the winch operator will check that the anchor flukes are the right way round to either sit in the hawse pipe or come aboard. If not, a gaff or other means to turn the anchor around will be employed
• Once in its stowed position, the anchor is secured by tightening the anchor winch brake.
ASSISTING WITH A NAVIGATIONAL WATCH

General duties

As a crew member on a purse seiner you may be required to stand a watch at some stage, even if it is only for a short period of time during daylight hours. You will generally be with an officer or more senior crewmember but you, along with your watchkeeping colleagues, are responsible for the safety of the vessel and all the crew on board. Keeping a proper lookout is absolutely critical.

Keeping a lookout

Keeping a proper lookout means using all available means to make sure any danger such as other vessels, land, reefs, debris and change in weather conditions is noticed and proper action is taken to avoid potential dangers. These will include:

- staying alert by sight and sound—watch and listen;
- observing wheelhouse navigational equipment such as the compass, auto pilot, radar, GPS, plotter and the echo sounder;
- if there is a watch alarm making sure it is turned on;
- constantly ensuring the compass course the skipper has set is being followed;
- listening to the marine radio equipment;
- keeping an eye on possible weather changes;
- following any particular instructions the skipper may have left;
- calling the Officer of the Watch (OWO) or the skipper if you are in any doubt

Note: As a new crew you may not be tasked to perform some of the duties relating to electronic equipment but you will be taught the procedures during the course of your watchkeeping duties.

Remember

- If you are in any doubt as to any change in circumstances you **MUST** immediately call the OOW or the Master. They would rather be called for a situation you are unsure of, than be alerted to a danger when it is too late.
- **NEVER** leave the wheelhouse unattended when you are on watch (other than to wake the next watch) – if you do need to leave for any reason inform the OOW.
- Don’t alter the settings of any of the navigational equipment unless specifically given instructions by the OOW or the Master to do so.

Change of watch

The change of watch is a particularly important time and you need to follow these procedures.

- You will be informed by the OOW to summon the next watchkeeper

- If a new watchkeeper is asleep, wake them and then return **IMMEDIATELY** to the wheelhouse to wait their arrival.
- Advise the new watchkeeper of the vessel’s course, position, any possible dangers such as nearby vessels or reefs, weather conditions and any specific instructions from the Master.

- Give the new watchkeeper time to settle in, particularly at night (to adjust their eyes), before leaving the wheelhouse.

**COLREGS - Rules of the road**

Just as there are rules that determine right of way, correct signals and general responsibilities when driving cars so there are rules that govern how a vessel must operate at sea to avoid risk of collision and other potential dangers. The Master and senior crew will know these rules comprehensively but as a competent crewmember you should at least be familiar with the basics so that you can alert the OOW or the Master to any potential problem.

**General terms**

You will need to become familiar with the nautical terms for ship directions such as port, starboard, abeam and so on.

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**Basic lights**

The Rules of the Road provide a system of lights on vessels so that vessels can not only be identified, but other information such as activity, direction and distress can be easily determined.

The lighting system itself is quite straightforward. However, the large numbers of combinations of lights make it almost impossible to remember all of the possible signals that can be displayed.
You should learn the basics and practice identifying them at sea. The coloured lights that all boats (at least over 7 metres in length) must display at night are:

- **GREEN**–starboard side light
- **RED**–port side light
- **WHITE**–masthead light and stern light

Being able to identify these lights will let you decide the direction that another vessel is travelling when you are on watch.

**Basic steering rules**

There is a range of rules that decide such issues as a safe speed in certain circumstances and which boat has right of way in various situations. Again you don’t need to be familiar with all these rules but you should know some basics.

- When two boats are crossing each other the vessel on the starboard side of the other boat has right of way.
- When two boats are coming head on to each other they should both alter course to starboard.
- Power driven boats give way to yachts.
- A boat overtaking another boat must keep clear until it is WELL PAST that boat.
Basic sound signals
Sound signals are used by vessels to indicate their intention to manoeuvre, or to signal when in fog or out of sight of one another. Below are some of the common signals you may encounter.

<table>
<thead>
<tr>
<th>SIGNAL</th>
<th>MEANS</th>
</tr>
</thead>
<tbody>
<tr>
<td>One short blast (approx. 1 second)</td>
<td>I am altering my course to starboard</td>
</tr>
<tr>
<td>Two short blasts</td>
<td>I am altering my course to port</td>
</tr>
<tr>
<td>Three short blasts</td>
<td>I am reversing (Reverse propulsion)</td>
</tr>
</tbody>
</table>

In foggy weather or at times of restricted visibility, vessels may use other sound signals to indicate their presence or let you know they are having trouble manoeuvring.
Some of the more common restricted visibility signals:

<table>
<thead>
<tr>
<th>SIGNAL</th>
<th>MEANS</th>
</tr>
</thead>
<tbody>
<tr>
<td>One long blast every 2 minutes</td>
<td>Boat moving through the water</td>
</tr>
<tr>
<td>One long two short blasts every 2 minutes</td>
<td>Boat that may have trouble manoeuvring. Refer to the Collision Regulations for a more detailed description of what these are.</td>
</tr>
</tbody>
</table>
**Distress signals**

These signals are used to indicate that a boat is in distress. It is important that you know and recognise the common distress signals and are alert to unfamiliar signals that may indicate a boat in distress.

The common distress signals are:

- rockets or shells, throwing red stars fired on at a time at short intervals
- a signal made by radio or by any other signaling method (e.g. a torch) consisting of the group in the Morse Code SOS (3 short 3 long 3 short)
- a signal sent by radio consisting of the spoken work–MAYDAY
- a square flag having above or below it a ball, or anything resembling a ball
- a rocket parachute flare, or a hand-held flare showing a red light
- a smoke signal giving off orange-coloured smoke
- slowly and repeatedly raising and lowering arms out-stretched to each side
- a rectangle of the internationally accepted orange coloured material with a black letter V or a black square and circle
- dye marker
- the international code signal of distress indicated by NC
- continuous sounding of sound signalling equipment–SOS
- emergency position indicating radio beacon (EPIRB)

**Wheelhouse equipment**

Purse seiners are equipped with a wide array of navigational equipment, from the basic magnetic compass through to the more sophisticated electronic equipment available today. This equipment is used to:

- assist in safely navigating the boat and warn of potential dangers;
- locate and catch fish.

As a watchkeeper you will be able to observe this equipment while on watch and use it to decide if there are any situations that need to be avoided. The OOW or the Master will point out any basic operational skills for the equipment on your vessel that you will need to undertake a watch.

Remember- unless you are given specific instructions by the OOW or the Master, **DO NOT** alter any settings on wheelhouse equipment.
The compass
The compass shows the direction in which the vessel is being steered or heading. The basic principle of a working compass is to point to north, hence the direction the vessel is heading at any time is its angle with the north pole. There are two main types of marine compasses:

- magnetic compass
- gyro compass

Magnetic compass
The magnetic compass doesn't require any power to make it work and is simple and reliable. It is found on smaller boats and is generally a requirement for survey (except on very small boats).

It is affected by errors caused by the earth’s magnetism (called variation) and the boat’s magnetism (called deviation). The Master will have calculated and allowed for these errors when setting a course to steer by.

Remember- don’t put iron, steel or magnetic objects (such as electrical equipment like a portable stereo) near a magnetic compass.

Gyro compass

The gyro compass has freely rotating spheres, which point towards the North Pole. It requires a constant source of electrical energy to operate.

It is much more accurate than a magnetic compass and isn’t affected by magnetism.

Vessels with a gyro compass will also have a magnetic compass as a backup in case of a loss of power to operate the gyro compass.

You will need to become familiar with reading a compass so that you:

- are able to make sure the boat is following the course set by the Master
- can indicate the location of something in relation to your vessel.
The compass is made up of a circle showing 360 degrees. To check the vessel’s course, you simply look at the reading that is in line with the small pointer on the compass (called a lubber line), which is in line with the vessel’s fore and aft line. If the course the skipper has set is 45°, the 45 degree mark on the compass card should line up with the pointer.

To indicate the location of something in relation to your vessel you generally refer to it RELATIVE to your bow (or the direction you are heading). So if your course is 50° on the compass and the object you need to work out the direction of is in line with the 90° mark on your compass, that object is 40° to starboard.

Learning relative bearings can be confusing at first so ask the Master or an experienced crew member to show you and then practice, practice, practice.

**Radar**

Radar shows a ‘map’ of the situation around your vessel and is used for the detection of land, reefs, vessels, buildings, navigational buoys, etc. The radar enables the user to get a range (distance) and bearing (direction) of objects and is also used for fixing the vessel’s position and avoiding collisions.

During the course of your duties you MAY be taught how to read and report on Radar information. The majority of radars in use on fishing vessels are relative motion radars. This means your vessel remains in the centre of the screen and so the movement of other boats is not necessarily as it appears on the radar screen.

Radars are also affected by weather conditions, distance, and the type of material targets are made of, so don’t assume you are always picking up all objects or getting a true picture of your surroundings. Small boats made of fibreglass, for example, can be very difficult to pick up on radar, so make sure you are using all other means available – MOST IMPORTANTLY YOUR EYES – when standing a watch.

Most modern radars can allow a guard zone to be set up on the display (by the OOW or the Master). This sounds an alarm whenever a contact enters a predetermined section of the display and can give early warning of the approach of another vessel.

**Global positioning system (GPS) and plotter**

The global positioning system (GPS) is a satellite navigation system using radio signals from satellites orbiting above the earth to calculate the vessel’s position.

The GPS display screen mounted in the wheelhouse will show the vessel’s position in latitude and longitude as calculated from the received satellite signals. The Master can plot the latitude and longitude on a chart (sea map) and so know the vessel’s position.
While on watch you may need to pass on the vessel’s position to the Master or take note of a position (called a way point) that the vessel is heading towards. While you aren’t expected to have navigational skills at this stage, you may need to be able to read off latitude and longitude from the GPS or plotter.

The vessel’s position will always be described as a latitude and longitude, which is the intersection of an east/west latitude line (across the chart or plotter) and a north/south longitude line (up and down the chart or plotter).

The latitude will always be shown first and will have two main numbers of two digits (e.g. 05°36’N). The longitude is the second number and in the Western and Central Pacific waters will have a three digit number and a two digit number (e.g. 172°12’E). The second number in each could also have a decimal point to give a more accurate reading. The letter after the numbers describes the position north or south (N or S) of the equator and east or west (E or W) of a start point line running from the North to South Pole and passing through the town of Greenwich near London, England.

In the Western and Central Pacific waters latitude can show S (South) or N (North), depending if you are south or north of the equator. Longitude can show E (East) or W (West) depending if you are east or west of the 180°longitude line.

For example a position on a vessel in waters around Tarawa, Kiribati will show latitude as N (North) and longitude as E (East). Waters in the two groups of islands directly to the east in Kiribati (Phoenix and Line Islands) may have N or S as a latitude (depending which side of the equator the vessel is) but will always have a longitude showing W (West).

All you need to do if asked to read out or write down a position is to read the two numbers, with the latitude coming first. In the example to the right you would write down, or say:

Latitude 03°15.60’ N
Longitude 175°10.15’ E
Most GPS and plotters have a man overboard button which when pressed will automatically keep the vessel’s position at that particular time. If you see somewhere fall overboard your role will be to immediately shout “man overboard” and inform the OOW or the Master.

**Remember**
- Radar tells you where other objects (boats, land, etc.) are relative to your vessel.
- GPS tells you where you are on the earth’s surface - it doesn’t detect other vessels or objects.

**Automatic pilot**
Automatic pilots are connected to the vessel’s compass and steering system and automatically steer a vessel along a course that has been set.
Correctly adjusted, it tends to steer a much straighter course than a helmsman can and relieves a crew member from steering manually.

**Precautions when on watch with auto pilot steering**
- Always maintain a proper lookout - it can be easy to forget to keep a good lookout when the vessel is being steered for you.
- Keep an eye on the course - auto pilots can stray off course or not work properly, particularly in bad weather conditions.

Many auto pilots use magnetic sensing elements to operate. Don’t put magnetic objects (such as a portable stereo) near the auto pilot.

**Echo sounder**
The echo sounder is an electronic unit used to measure the depth of the water and the type of bottom (i.e. sand, rock, etc). It is also used as a fish finder on fishing vessels.
Modern echo sounders have a video display. It will also give a digital readout of the depth and have an audible alarm set at selected depths to let the watchkeeper know the vessel has moved into shallower water.
Most video display echo sounders use different colours to represent various signal strengths of returning echoes. This makes it possible to identify the composition of the seabed, fish echoes, etc.
Reading an echo sounder on watch

The echo sounder can tell you a number of things such as:

- The depth of water the vessel is in - if the bottom rises quickly call the OOW or the Master.
- The type of seabed the vessel is passing over - the stronger (or darker) the echo the harder the seabed (e.g. dark red on a colour video display often shows hard rock bottom).

Remember - never adjust the controls on the sounder unless instructed to by the OOW or the Master.

**Instruments and alarms**

Most fishing vessels will have instruments and alarms fitted in the wheelhouse to provide warning if a problem arises with engine room equipment, other parts of the vessel or as a navigation warning. Listed below are some of the alarms that may be fitted in the vessel wheelhouse:

- smoke and fire detector alarm
- bilge level alarm (engine room)
- refrigeration alarm
- engine control and monitoring equipment
- navigational equipment alarms
- off-course alarm
- watchkeeping alarm
- equipment failure alarms.

If an alarm activates, the OOW or the Master must be informed and the reason must be fully investigated.

Make sure you are familiar with all the instruments and alarms on your vessel. When you come on watch make sure you take note of the settings for all the instrument gauges in the wheelhouse and if they alter during your watch, inform the OOW or the Master.

Remember - under no circumstances should an alarm be turned off without the permission of the OOW or the Master or possibly the Chief Engineer.
General

One of the first skills you will need to develop to be a competent crew member is the ability to work with rope (natural fibre, synthetic and wire). Maintenance of rope and the ability to join, splice and knot is a basic requirement for all persons working on fishing boats. This topic will cover general joining, splicing and knotting, as well as the care and maintenance of ropes (and wire rope) commonly found on purse seiners.

Remember - it is essential you know the capabilities and limitations of the rope you are using. Rope that snaps under stress can be very dangerous.

Types of rope

The term rope is used to describe both fibre rope and wire rope. The basic materials used are:

Natural fibres
- Hemp, sisal, manila, coir and cotton.
- Natural fibre ropes are much less common these days.

Synthetic fibres
- Nylon, terylene (polyester) or dacron, polypropylene, polythene (polyethylene) and kevlar.
- Manufactured from man-made materials.

Steel wires
- The strands are made of steel wires.
- Often they have a natural fibre core (heart) that the wire strands are twisted around.

Synthetic fibre rope verses natural fibre rope

<table>
<thead>
<tr>
<th>ADVANTAGES</th>
<th>DISADVANTAGES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greater strength, size for size.</td>
<td>Outer surface is smooth and slippery which causes slippage.</td>
</tr>
<tr>
<td>Greater elasticity or stretch but not of great value in lifting gear.</td>
<td>An additional tuck with all strands when splicing may be needed to offset this.</td>
</tr>
<tr>
<td>Better shock absorption.</td>
<td>May deteriorate rapidly when exposed to UV (sunlight)</td>
</tr>
<tr>
<td>Better abrasive resistance.</td>
<td>Will melt if exposed to heat, including heat from friction</td>
</tr>
<tr>
<td>Greater flexibility, ease of handling.</td>
<td></td>
</tr>
<tr>
<td>Less water absorption.</td>
<td></td>
</tr>
</tbody>
</table>

Rope Construction

The process of rope making consists of twisting fibres into yarns, yarns into strands, and strands into ropes. To prevent the rope unlaying, the strands are laid up in the opposite direction to the yarns. Rope can be constructed as:
**Three-strand or four-strand rope**

This is where the rope strands are laid in one direction. It can be either three-strand rope (much more common) or four-strand. The lay of rope refers to the direction that the strands are twisted. It is either right hand lay (the most common) or left hand lay.

- They can come in different levels of stiffness:
  - soft lay—soft, easy to splice but kinks easily;
  - medium lay—most common lay for use on boats;
  - hard lay—difficult to work with.

**Braided rope**

- Solid braided cords are constructed from either 12 or 18 strands, braided together, normally over a central core
- Available in sizes 3–12 mm diameters
- Flexible, coils easily and is kink free
- More difficult to splice

**Plaited rope**

- The plaiting of 4 left-hand and 4 right-hand strands
- Results in a tough, kink resistant rope that provides increased flexibility wet or dry
- Used for towing and mooring lines
Measuring, handling and maintaining rope and wire

Measuring rope

- Rope is measured by its diameter in millimetres

Uncoiling a rope

Improper uncoiling can insert twists and increase the risk of kinking.
- A coil of fibre rope should be uncoiled by pulling at the bottom end from the inside.
- A wire rope should be uncoiled from the outer end, preferably on a turn table.

Coiling a rope

Always coil ropes in the direction of the lay:
- right-hand (RH) coil clockwise;
- left-hand (LH) coil anti-clockwise.

To avoid problems in paying out a rope, it should be flaked down to prevent tangles as it goes out.
**Caring for ropes**

The life of rope can be reduced due to the following:

- excessive stress (especially when slipping around bollards or cleats)
- exposure to petrochemicals (diesel fuel, petrol, etc.) and chemicals (e.g. acid)
- rubbing or cutting against sharp or rough objects
- stowing when wet (particularly natural fibres)
- stowing in a badly ventilated place
- kinking
- unnecessary exposure to UV light (sun light);
- using the wrong size block for the rope’s diameter

If a rope has been used in mud, sand or grit, it should be cleaned thoroughly before being stored. To wash rope, hang it up in loose coils or flake it out on the deck and hose with fresh water.

When inspecting rope for wear and tear look for:

- reduction in diameter
- flattening of the rope
- burn marks on synthetic rope
- kinks
- frays
- dry rot or mildew
- corrosion (caused by lack of lubrication in wire rope)
- broken fibres
- broken wire
- powdered fibres
- broken central core
- lengths that run through blocks (particularly those lying on sheaves when the under load)

**Knots, bends, hitches**

**Definitions**

- **Knot & bends** The intertwining of the end of a rope or the joining of two ropes.
- **Hitches** The attachment of a rope to another object (e.g. post, pole, ring, hook).
- **Standing part** The part of rope taking the strain.
- **Tail** The part of the rope used to make fast, or the unused part.
- **Bight** The loop between the standing part and the tail.
**Reef knot or square knot**

Used for joining two lines of the same size, if not to be put under excessive tension.

**Fisherman’s knot**

Used to join two pieces of line together, but where it will not be able to be undone (used to join two pieces of twine together in network).

**Overhand knot**

Prevents the end of rope unlaying or passing through a block.
**Figure of eight knot**

![Figure of eight knot](image)

Used as a stopper to prevent the line from running through a block. Doesn’t jam as readily as an overhand knot.

**Bowline**

![Bowline](image)

The most useful knot a crewmember will use. Bowlines can be used to put a temporary eye in a rope, secure a safety line or join two lines. It is easy to undo.

**Sheet bend**

![Sheet bend](image)

A sheet bend is used to join ropes of similar size and can take tension.
**Double sheet bend**

A double sheet bend is used to join ropes of different sizes and is more secure than a single sheet bend.

**Clove hitch**

A clove hitch secures the end of a line under tension. It can be preformed and dropped over a post, etc., and be used where a small rope is secured to a larger rope or a spar and the end kept free. It should **never** be used where high load is involved—it will never come undone.

**Rolling hitch**

A rolling hitch is similar to a clove hitch but with an extra turn. It may be used to take a strain along a spar and to secure a rope tail to a larger rope when the direction of pull is along the rope/spar in one direction only. A rolling hitch can be used with chain or wire rope to hold the strain while a riding turn is cleared from a winch.
**Round turn and 2 half hitches**

Best way to attach objects such as fenders to the vessel where they need to be secure but easily undone.

**Fisherman’s bend**

This is a common method of securing a line to a bollard, spar or ring. Similar to the round turn and 2 half hitches, except the hitches go through the turn.

**Splicing**

Splicing fibre or wire rope is a skill that can only be learned through practice. You can be taught the basics of splicing at a training course and by experienced crew members.

Before splicing, seize the ends of unlaid strands, and seize the rope at the point you plan to unlay it. This prevents it unlaying further and can be achieved by:

- using tape; or
- seizing (whipping) with light twine.
**Eye splice in fibre rope**

An eye splice is formed by unlaying the rope, then turning the end back to form an eye and tucking the separated strands into the standing part.

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**Splicing around a thimble**

If splicing around a thimble, tie the rope securely to the thimble with light twine.

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**Short splice in fibre rope**

This is used to join two ropes when they are not required to pass through a block. Unlay the two ropes and clutch them together, so that the strands of one rope go alternately between the strands of the other.

Tuck each strand over one strand and under the next, take two or more tucks with each strand, then turn the line and do the same with the other rope. Pull each strand up taught. A minimum of three full tucks should be taken on each rope.
**Splicing wire rope**

Splicing wire rope is more difficult to learn and you may not be required to have that skill on your vessel. If you do need to develop competence in splicing wire rope you will need the basics and then work with an experienced crew member to improve your skills.

![Wire rope diagram](image)

The chief component parts of stranded wire rope

There are a number of different tools you will need to splice wire rope including:
- A fid or spike – used for pushing through the strands that you want to thread another strand under
- Masking tape, whipping twine, wire cutters, heavy hammer, vice (optional)
- Gloves to protect your hands

There are a number of different methods of eye wire splicing. A common method is described below but you will need to check to see what method is used on your vessel.
Step 1  Strand no. 1 is tucked under 3 strands

Step 2  Strand no. 2 enters at the same spot as strand no. 1 and is tucked under two strands

Step 3  Strand no. 3 enters at the same spot as strands no. 1 & 2 and is tucked under one strand

Step 4  Strand no. 4 enters at a spot one around from where strands no. 1, 2 & 3 entered and comes out where those three strands entered

Step 5  Strand no. 5 enters one spot further around from where strand no. 4 entered and comes out where strand no. 4 entered

Step 6  Strand no. 6 enters one spot further around from where strand no. 5 entered (and where strand no. 1 comes out) and comes out where strand no. 5 entered

Once you have completed the first six strands one strand should be coming out between every two strands. If two strands are coming out in the same spot you have made a mistake and need to check and redo the first stage.

To complete the splice every strand now goes over one strand and under two strands. Repeat this process again and then finish the splice by taking every second strand over one strand and under two strands so that you get a neat taper effect at the end of the splice.

**Wire rope grips**

Wire rope grips (also known as bulldog grips) are mainly used for forming a temporary eye in the wire or joining two parts of wire together. You must ensure the wire grips are placed correctly on the wire and that you use the right amount of grips according to the size of the wire rope.
Basic principles

There are a number of rules that you will need to learn when assembling and mending nets and a range of tools you need to be familiar with. Once you understand these few simple rules and know the tools you will need, you will find the skills needed to repair nets and assist in their assembly are easily developed. Mending nets can be fun and you will have a sense of satisfaction when you have transformed a damaged net back to its original condition.

Tools

Knives

Small, sharp knives (sometimes serrated for cutting braided twines) can be folded back into themselves for safe storage. Remember knives are one of the net mender’s most important pieces of equipment, so acquire one that keeps a sharp edge and does not rust.

Some net menders prefer to use small scissors or a Stanley knife. Try all these types and see which suit you.

Remember to attach a lanyard (a length of twine or narrow diameter rope) to your knife so that you can attach the other end to your belt to prevent it from going overboard.

Needles

A needle holds the twine necessary to work on nets. Needles were once made of bone. Now they are nearly always made of plastic. There are a range of types and sizes that are suited to the material being used and your own personal preference.
Supports and stands

Supports and stands are used to stretch and position the netting for ease of operation while you work. Supports can be either hooks or rings suspended from above. A quick and easy hook can be made from wire of the thickness used in coat hangers, shaped into an ‘S’ with a length of twine attached into one of the loops of the S. The other loop of the wire is then passed though a number of meshes above the area to be mended and the twine attached to an overhead point at a convenient height. Other trestles and stands can also be designed. These are particularly useful when hanging (attaching) netting to a foot line or head line.

Measuring devices

Marked rods

Marked rods for measuring spaces when hanging head lines and foot lines.

Markings indicate spaces of knots

Mesh gauge

Mesh gauge for measuring the size of the net, by measuring the distance between knots.

Tape measure and ruler

Tape measure and ruler, for generally determining lengths.
**Parts of netting**

Nearly all modern-day netting material is machine made. Netting consists of meshes which are four-sided holes with each side comprising equal lengths of twine. After the net is knotted together, it is stretched to create the diamond shape of the individual meshes. Before beginning the practical art of cutting and repairing or making nets, it is important to know some of the terminology and understand the basic construction of netting.

**Twine**

Twine is the material that nets are made from and is small line made of multiple strands. It can be twisted or braided. Most twines are now made of a synthetic material such as:

- polyamide
- polyethylene
- polypropylene

Some nets (such as gill nets) are made of another synthetic called monofilament, which is one piece.

Twines of different construction, strength and colour are used to match the existing materials.

You must familiarise yourself with the size and types of twine used in nets in your operation and use the same twine in the part of the net you are repairing.

**Mesh**

Mesh is two loops of twine which are joined together with knots to form a diamond shape. Netting material is made up of many meshes tied together.

- Each side of the mesh is called a bar, so every mesh consists of four bars.
- A point and a pickup are the apex of two bars when cut.
- The side cut (in the direction the net is running) is the point and the top cut is the pickup, but they are often both called a point.
The pickup is able to have the cut twine removed and so create a loop on one side of the mesh.

The point has to stay as a knot. Attempting to clean the knot will cause the mesh to come apart.

A row is each line of knots, made up of half meshes.

It is important to determine the direction the net was made before mending it. When repairing net you also need to work with the run of net.

To check the direction of netting, undo a knot in a mesh. If the strands making up the knot come apart it is a point (or side knot) and is the vertical direction or the run of net.

There is a range of different mesh sizes depending on the fishery the net is being used for. In fact, a lot of nets will have different sections using different size mesh netting.

Meshes are measured by stretching the mesh in the direction of the run of net and then measuring from the centre of one knot to the centre of the opposite knot.
Knots used in nets

Overhand knot
Tied at the end of the twine to stop it slipping through a knot and causing it to undo.

Single sheet bend
Used to tie a knot on a mesh or pickup. Be sure to go up through the mesh when working to the right and down through the mesh if working to the left. This ensures that the twine comes out pointing in the direction you are going.

Note
If you are left-handed do the opposite. Pinch the pickup and the twine you are threading with your thumb and forefinger while you make the loop of the sheet bend.

Double sheet bend
Used to start and finish a repair job. The double sheet bend is also used on monofilament to prevent the knot slipping. Use the same pinching procedure as for the single sheet bend.
Side knot left, side knot right
Used to pick up points in the vertical row (or run of net). Pinching with the forefinger and thumb is also used to prevent the twine slipping whilst tying the side knot.

Quick side knot
This is an alternative side knot, however it is not as secure and is more likely to slip under load.

Fisherman’s knot
Strong non-slip knot for joining twines together when using needles continuously.

Rolling hitch
Used to attach the net to the head line or foot line. Also called the hanging knot. There are a number of other knots net makers might use to hang the net to the head line and foot line. Ensure you are familiar with any special knots used on nets you are working with.
Preparing a net for repair

Now that you are familiar with the basic principles of how nets are made and the tools and knots used in net work, you are ready to take the first step in repairing a hole. You will begin with mending a small hole.

Cutting out

Before you can start sewing new twine back into a hole in the net, the hole must first be cut out correctly, making a start and finish position and a series of points and pickups to attach the twine to. The hole must be cut so that when you start sewing you can continue from start to finish without stopping (other than to load an empty needle).

You may see experienced net menders cutting sections as they go but it is wise for a beginner to cut all the required points and pickups before sewing. This ensures you have cut correctly from top to bottom of the hole.

Step 1  First make sure you know which way the net is running. The hole needs to be mended across ways and vertically, in the direction the net is running.

Step 2  If you can, spread the net out or hang it with a hanging support instrument so that you are able to get a clear look at the area that you are cutting.

Step 3  The hole to be mended will have a top and a bottom.

Step 4  Pick which end of the hole you want as a start point making sure it is line with the direction you have decided the net is running.

Step 5  The start point is a three sided bar that is sometimes called a three legger. Cut one of these along the top row of the hole.

Remember - position B is not a three-sided bar. Two of the bars must be in line and the third at right angles to those two bars.
- Once you have prepared a start position you simply have to cut meshes and points all the way down to the bottom row of the hole. Cut down one side of the hole until you have gone as far as you can, then go back to the start position and cut down the other side.
- You should then have a three-sided bar at the bottom of the hole that is the same as that at the start position. This becomes the finish position.
- If you do not have a three-legger at the bottom, you have miss-cut down one of the sides. Go back and check.

Double-check the cutting out. There must be a three-sided bar along the top row of the hole, points and meshes only from there on, ending in a three-sided bar along the bottom row of the hole.

Remember - two bars joined together at an angle make a point or mesh. They are allowed. Two bars running in the same direction at the edge of a hole are not allowed.
**Tidying up the meshes**

Before you begin sewing, it is usual to tidy up the meshes that you can without them falling apart. While it is not absolutely critical to follow this process, it makes for a less bulky, much tidier repair job and shows professionalism.

The sides cannot be tidied because they would come apart; however, all the meshes or pickups can. Use the tip of a sharp knife to carefully cut the piece of twine making up the part that can be discarded.

Be careful not to cut through the twine making up the pickup or mesh you want to retain. And be careful not to cut a finger. This can be a fiddly job.

You are now ready to begin sewing.

**Sewing the hole**

*Loading the needle*

Before you begin sewing you must first load a needle with twine

**Step 1** Select a needle that will fit through the size mesh you are repairing, making sure that it will fit with a reasonable amount of twine loaded on it. You do not want to be reloading the needle continuously.

**Step 2** Select twine of the same type and thickness as the twine in the part of the net that is being mended.

**Step 3** Tie two half turns around the start position, which is at the base of the needle but will vary slightly in design, depending on the style of needle used.

**Step 4** Wrap the twine, end for end, in the tongues provided until you have a good amount of twine, again checking that the loaded needle will go through the meshes.
Starting

Before you begin sewing make sure you are in a comfortable position, preferably hanging the net at a working height. If you do not have anywhere to hang a support, lay it out on the ground in a position that you can see the hole clearly. Some net menders use their toes to stretch some of the meshes out. Do what feels most comfortable to you.

Step 1  The netting around the hole must be square, i.e. the knots in each row are in line. This will make it much easier to sew the correct size meshes back into the hole.

Step 2  The starting point must be at the top if the netting is suspended or away from you if you are sitting on the ground.

Step 3  Now go to your start point and in the middle of the three-legger tie the starting knot, a double sheet bend.

Step 4  Make sure you tie the double sheet bend around two lengths of twine (or bars).

Step 5  Proceed to the nearest point or pickup. If it is a pickup make a half mesh loop (in effect the length of two bars) and tie a single sheet bend.

Step 6  Ensure you go up through the hole when working to the right and down through the hole if working to the left. If you are left handed, reverse the procedure.

Step 7  If it is a point (or side cut), make a bar and tie the appropriate side knot. Again tie the side knot in a way that the twine comes out in the direction you are sewing that row.

Step 8  Continue back and forth across the hole, making half meshes with a single sheet bend to secure it to the mesh above and side knots at each side.

Remember

- When you get to a side knot on either side, check that there is not a pickup below that needs to be attached before continuing across.

- When you are attaching to pickups and sewing half meshes, the meshes must be of equal size. There is a technique using your fingers for doing this. Study the diagrams below - however, you should observe an experienced net mender to see how it is done.
Finishing the hole

Once you get to the bottom row, sew along to the finishing three-legger and make a double sheet bend as you did at the start.

You have now mended your first hole.

Do not be too concerned at the different size meshes. That comes with practice. Most importantly though, check your work to make sure all the meshes have four sides.

Remember
Meshes do not have three or five sides.

Putting in a patch

If the area to be mended is large or torn at different angles, it is often better to cut out a larger section and sew a piece of the same material back in. This saves the time taken to sew a large number of meshes and is a very neat and tidy way to repair a big hole.

The principles are nearly identical to mending except for a slight variation at the start.

Cutting out for a patch

Step 1  Take the area to be mended, check which way the net runs, and make the top left hand corner the start position.

Note - the only variation to normal mending is at the start position, so cut a pickup to make a mesh to begin. The reason will become clear as the sewing is explained.

Step 2  Make sure you start at the highest point, i.e. along the top row.
Step 3  Working to your right, cut pickups/meshes all the way across the hole until you reach a point where you can turn at right angles, then cut down and be to the right of any damaged piece of net.
Step 4  Once you have reached this point, cut points all the way down with the run of net until you are again able to turn at right angles, and this time, be below any damaged piece of net.
Step 5  Cut pickups/meshes all the way across the bottom of the damaged section until you are in line vertically with the start mesh.
Step 6  Now cut vertically upwards with the run of net until you are at the start point.
Step 7  If you have cut correctly you will have a nice square or rectangle hole with pickups/meshes and points all the way around the perimeter of the hole.
**Sewing in a patch**

**Step 1**  
To sew in a patch, first count the meshes across the top and the points down one side of the hole you have cut out.

**Step 2**  
Then get a piece of identical netting, making sure it is at least as many meshes across and down as the cut out hole. Cut meshes along the top in a straight row.

**Step 3**  
Make sure you check that the piece you select is the correct size, with the meshes running in the same direction as the net.

**Step 4**  
Now go to the top left hand mesh and using a loaded needle, start with the normal knot, a double sheet bend.

**Step 5**  
Then pick up the patch piece you have selected and make a bar from the start point to the top left hand mesh of the patch and do a normal sheet bend. What you have in fact done, is made a three-sided bar or three-legger and this also becomes your finish point.

**Step 6**  
Sew back up to the second mesh on the main piece of netting making a bar and back down to the patch piece again. Continue this procedure all the way across the top until you come to the right hand top corner.

**Step 7**  
Now change direction, cut out excess meshes down the side of the patch piece and zig zag down from the main piece of netting to the patch, joining them with side knots.

**Step 8**  
When you reach the bottom right corner, again cut any excess meshes along the bottom of the patch piece and sew back to the left along the bottom as you did along the top, joining the patch piece to the main piece of netting.

**Step 9**  
Similarly when you get to the bottom left corner, sew up the left side as you did on the right side.

**Step 10**  
When you reach the top left corner again, finish on the three-legger you made at the start, tying a double sheet bend.
Strengthening, joining and hanging netting

**Strengthening net**

The sections of net that are attached to a head line or foot line are generally strengthened so that the meshes will not tear as easily. The area strengthened is called the selvedge.

- Doubling the twine along these sections is the usual method to strengthen it.
- When selvedging or sewing, it is important that the selvedge twine is the same length as the mesh, bar or taper that it is strengthening.
- When selvedging along bars, side knots are used.
- When selvedging meshes a sheet bend is generally used.

**Joining net**

Joining net is common when assembling the various sections of net that are cut to make a complete net. Attaching a cod end to the main net is another common joining task. It is a simple process, unless joining uneven mesh sizes or tapers that have been cut along the edge of a section of netting. Leave these tasks until you have mastered simple joining and mending and patching holes.

Joining two identical pieces of net with meshes on both edges to be joined is simply a matter of zig zagging up and down or from side to side as you did when putting in a patch.
Hanging net

The aim of hanging net to a line such as a foot line or head line is to:

- attach it to a strong piece of wire or rope so that the shape of the net can be controlled and be attached to trawl doors, etc
- to ensure even tension is spread throughout the net

Nets are hung in ratios determined by the net designer so that they will take the shape required. The hanging ratio is often expressed as a number of meshes hung on the length of stretched meshes. For example, hanging four meshes on the length of two stretched meshes would give a hanging ratio of 50% or a half. So if you are hanging 50 mm meshes in this ratio, you would measure 100 mm and hang four meshes in this distance.

When hanging bar cut material, it is usual to hang it bar tight. That is, the net is hung into the same distance as its own length. So using 50 mm mesh netting again as an example, each bar is half of this, or 25 mm, so you would hang each bar in a 25 mm distance.

When hanging, there are a number of knots used to attach the netting to the hanging line. A common method is to go through or pick up a number of meshes or bars and then tie a rolling hitch to the hanging line, then pick up the same number again and tie a rolling hitch at the same distance and so on. A clove hitch combined with a half hitch is another common hanging knot.

Marking the line at the required hanging ratio is preferable, using a measuring stick to mark the hanging line at the distance you are going to tie the hanging twine to it. Get a long straight stick, mark it at the distance apart decided all the way along the stick, then lay this alongside the hanging line and mark the line with a marker.

The hanging material cannot stretch or shrink, holds the hanging knot well and is strong and durable. Heavy braided twines are often used.