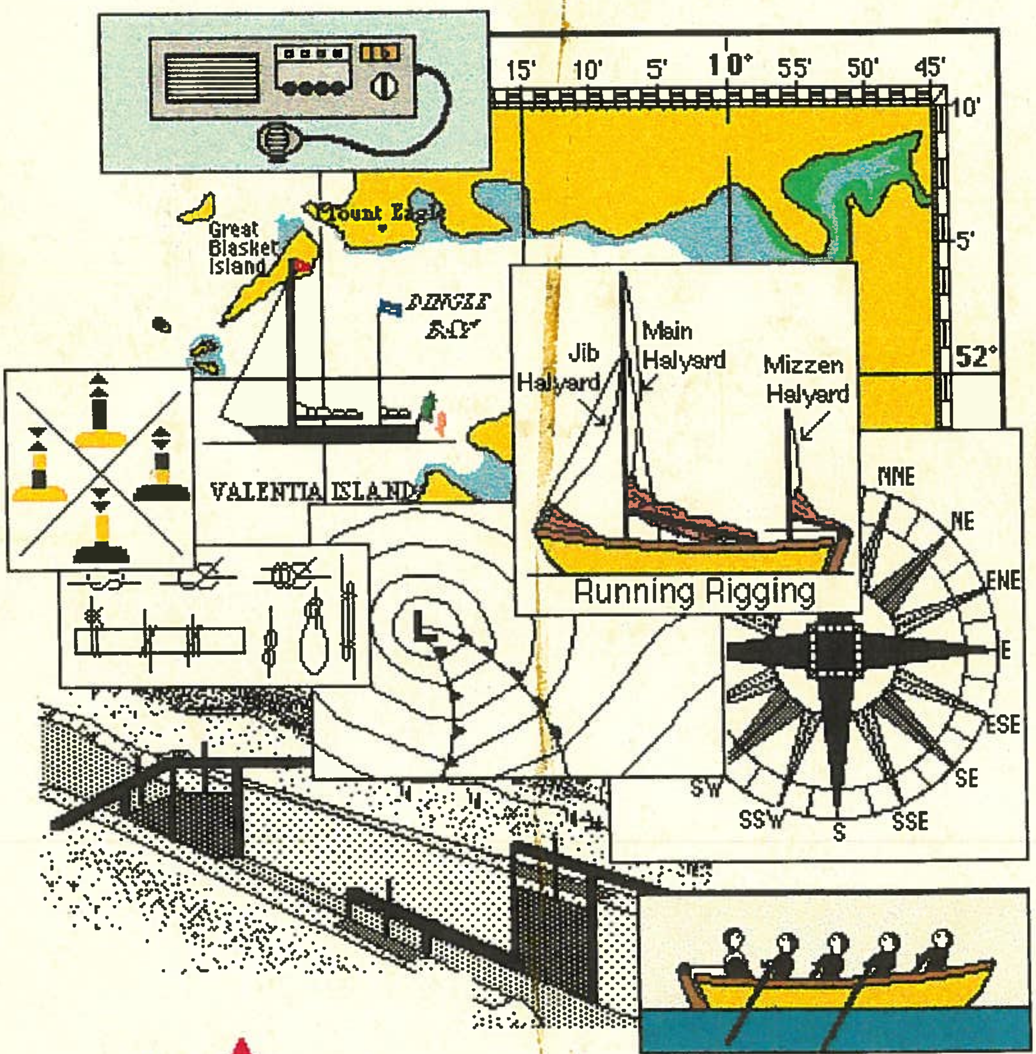
# Sea Training Manual

## 2nd Edition




SCOUTING IRELAND SAI

# SEA TRAINING MANUAL

1st edition 1987
2nd edition 2002

**PRODUCTION**

**Compiled by:**

Eoghan Lavelle

**Typeset on Apple Macintosh**

**PUBLISHED BY**

SCOUTING IRELAND SAI

This book is designed to provide the necessary background information to cover the technical nautical requirements of the Sea Scout Training Scheme.



SEA
TRAINING
TEAM

# SEA TRAINING MANUAL

***INTRODUCTION***

The first edition was published in 1987 as the "Sea Training Handbook Part 3". The new edition has been updated and some extra sections have been added, including maritime information of general interest. Each section of the book is self-contained, and may be obtained and used as a separate booklet if desired - the page numbering is therefore separate in each section.

It is not intended to be a definitive textbook of seamanship or boating, but is designed to provide, under one cover, most of the information on seamanship and related matters which will be of use to Sea Scout Leaders, Venture Sea Scouts and Watch Leaders in the implementation of the Sea Scout Programme.

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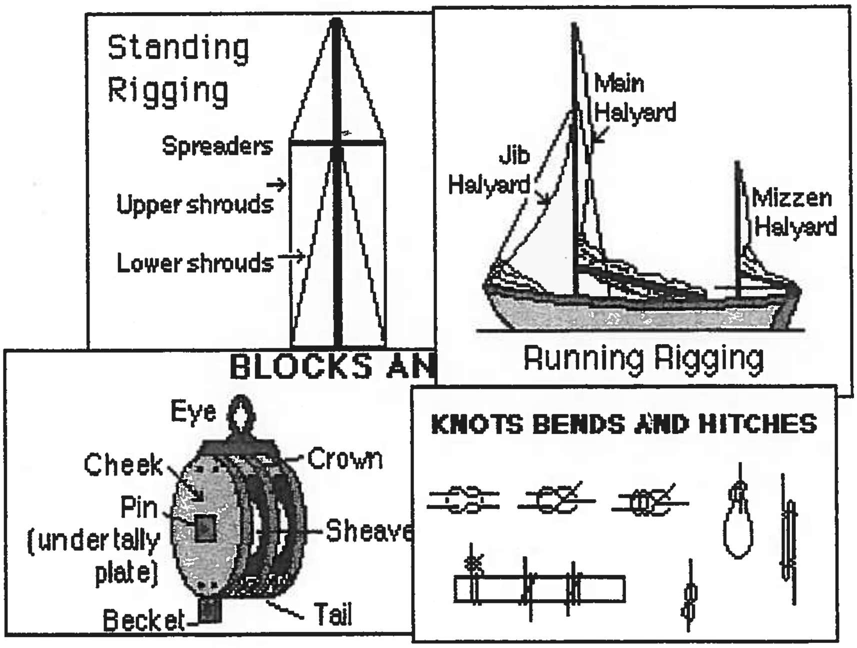
# SEA TRAINING MANUAL

## SECTION A

# BOATSWAIN'S WORK




SEA TRAINING TEAM

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## BOATSWAIN'S WORK

This section covers most of the requirements for **"Marlinspike Seamanship"** in the grades of the Sea Scout Scheme, Attainment badges and Charge Certificates. The section is mainly concerned with Ropework, Rigging and Sails, but hull maintenance the Boatswain's Call are also included.

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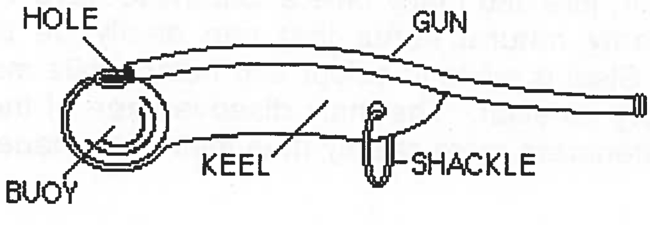
## THE BOATSWAIN'S CALL



# ROPES

## Construction of Ropes

The majority of modern ropes are made up in one of three ways -

1. **Hawser Laid** - this is still the most common type of rope and is the normal "twisted" rope made from three strands.
2. **Braided Rope** -depending on the material and on the use for which the rope is being made, there is a large variety of types of braided ropes. In the smaller types they are usually either solid braided, or have a braided sheath with a braided core.
3. **Kernmantle Ropes** - these are normally specialist ropes with special stretch characteristics. They look like braided ropes but the core is not braided. These ropes have limited use in connection with boats and are mainly used for mountaineering and other sports.

## Man-Made Fibres

Most ropes available are made from man-made fibres of which the most common are nylon, polyester, polypropylene and polythene.

**Nylon** is the strongest and most expensive of these. Nylon ropes normally stretch more than other ropes. Hawser laid nylon is normally white and can be difficult to distinguish from Polyester.

**Polyester is** slightly weaker than Nylon, but stronger than most other materials. It has very low stretch characteristics and will often be pre-stretched, which makes it very hard. Pre-stretched polyester is quitre distinct from Nylon. Braided Nylon and Polyester ropes are almost indistinguishable and are available in a wide variety of colours. Polyester is usually sold under the trade name "Terylene".

**Polypropylene** is normally blue, hawser laid, but can be made in other colours. The advantage of Polypropylene is that it is less expensive than nylon or polyester, and it floats. However it has a very low resistance to chafe and is considerably weaker than Nylon or Polyester.

**Polythene** is the least expensive of the man-made fibres and also considerably weaker than polypropylene. Ropes are hard and shiny and are usually available under the trade name "Coralene", which is bright orange.

**Kevlar** has been used in recent years and now light-weight, strong, low-stretch ropes are available. However, these are very expensive and have poor resistance to chafe. They have little use outside racing yachts.

## Natural Fibres

Up to thirty years ago,almost all ropes were made from natural fibres such as manila, hemp, sisal, cotton, coir, jute and many others, but these have virtually disappeared in recent years. The only natural fibres that can easily be bought are sisal and occasionally manila. Sisal is white in colour and hairy, while manila is golden brown, and usually not as hairy as sisal. The main disadvantage of these ropes is that they have a tendency to deteriorate more rapidly than their man-made counterparts and are not as strong.

## Choosing a Rope

When you are choosing a rope for a particular job, you should consider the following -

- Stretch
- Strength
- Handling
- Resistance to wear and tear (Chafe)
- Resistance to moisture, sunlight and chemicals
- Cost
- Availability

**Strength** - Below is a table of the approximate breaking strains of man-made fibres when new. New sisal and manila ropes are approximately two thirds the strength of Polythene. You should get to know the feel of the different sizes of ropes you normally use, so that you can learn to judge their diameter. Rope is now described by diameter (in millimeters), rather than by circumference (in inches). Rope which used to be described as a 2" rope, would now be called a 16mm rope. For those interested in mathematics - to convert, first change the inches into millimetres by multiplying by 25 (approx), then convert the circumference to diameter by dividing by $\pi$, or 3 (approx). After a while you will be able to judge how strong a rope is by looking at it.

**Approximate Breaking Strain of Hawser-laid Ropes**
( Diameter in millimetres - Breaking strain in kilograms )

| Diameter | 4 | 6 | 8 | 10 | 12 | 16 | 20 | 24 |
|---|---|---|---|---|---|---|---|---|
| **Nylon** | 300 | 750 | 1300 | 2000 | 3000 | 5000 | 8000 | 12000 |
| **Polyester** | 300 | 550 | 1000 | 1600 | 2300 | 4000 | 6000 | 9000 |
| **Poly-propylene** | 250 | 550 | 900 | 1400 | 2000 | 3500 | 5300 | 7500 |
| **Polythene** | 200 | 375 | 700 | 1100 | 1500 | 2800 | 4300 | 6000 |

The strength given in the table above is the **"Breaking Strain" (BS)** of a new rope. This is tested by applying a gradually increasing load to the rope until it breaks. When a shock-load is applied to a rope, it can break with only a fraction of this weight, depending on the momentum the weight has built up, the type of knot or splice, whether the rope is wet or dry, etc. This means that it is important never to overload a rope. A weight of one sixth of the BS is considered the **"Safe Working Load" (SWL)**, and this is the heaviest weight that should be lifted with the rope. The SWL assumes the rope is not new, but in good condition and that no severe shock load is applied. **It is very important to check ropes regularly for signs of wear or damage.**

**Stretch** - For jobs like mooring, tying a boat alongside, towing, mountain climbing, or where there may be a shock load or continuing jerking strain, choose an elastic rope. The stretch in the rope absorbs most of the shock when a load is applied. When compared to a rope of the same BS which does not stretch, the amount of shock load a stretchy rope can absorb is much greater. However, for many jobs, an elastic rope is no use at all - as the main rope in an aerial runway or bridge, for halyards or sheets etc. The amount of stretch in a rope depends on the material from which it is made, its construction and age. Old ropes tend to have stretched during their life and when put to work will stretch less than when new. Nylon stretches more than Polyester. Polyester can be pre-stretched, which means it will stretch very little in use. Hawser laid ropes stretch more than braided ropes of the same material. Kernmantle ropes can be made either static (non-stretchy), or dynamic (stretchy). Information on stretch characteristics in rope is available from the manufacturers, usually given in one of two forms -

1. the amount the rope will stretch before breaking, eg - 20% stretch at BS means that a 10m rope will be 12 m long when it breaks.

2. the amount the rope will stretch with a particular load, eg 2.4% stretch with a 80kg load.

For halyards where low-stretch is required, a pre-stretch Polyester is probably best. For sheets, other considerations are necessary, particularly, ease of handling. A low-stretch braided rope would probably be more appropriate, eg braided Polyester. For moorings and warps a stretchy rope is better, such as hawser laid Nylon. For mountain climbing an extremely stretchy rope such as dynamic kernmantle is ideal. Natural fibre ropes usually have low-stretch compared with Nylon or Polypropylene. However, pre-stretched Polyester would normally have less stretch than natural fibres.

**Handling** - Ease of handling often overrides the best choice of rope when considering only strength and stretch. To make ropes easier to handle they are often oversized and of a different construction from what would normally be chosen. For example, a halyard needs to have very low stretch, and has no shock loads. The best choice to fill these requirements is a wire rope. However, it is almost impossible to pull a wire rope to hoist sails and wire is damaged if you cleat it. This means that you must consider the next best low-stretch rope and see if it suits the requirements of the job. If a rope is to be handled a lot, eg a sheet, it needs to be comfortable in your hand and is therefore often bigger than otherwise needed, and is usually braided.

Generally ropes which are handled a lot need to be at least 8mm, and preferably 10mm or larger.

Hawser laid ropes need more care than other ropes when being coiled, as they have a habit of kinking. Braided ropes are less inclined to do this. However, with a little practice at coiling, you should be able to coil neatly the most badly kinked rope.

**Chafing, Wear and Tear** - All ropes are prone to damage if they are rubbed on a sharp or abrasive edge, and it is important to try to prevent chafing. Avoid sharp edges or tight bends and if possible abrasion on pier walls or other rough surfaces. All ropes are subjected to some chafing in almost every job, and some materials and rope construction are better than others at withstanding abrasion. Generally a hairy surface has slightly better resistance than a smooth surface, but the material is the main factor. Polypropylene or polyethylene has very low resistance to chafe, whereas nylon and polyester are better. Kevlar also has a very low resistance. Rope abrasion can also be caused by a build-up of grit in the rope, damaging it from the inside. Therefore it is important to treat ropes well - do not walk on them or drag them in dirt or grit. If a rope is very dirty or gritty, it can be cleaned by towing behind a boat for a while (make sure the ends are well whipped) or putting it in a washing machine - mild detergents will not damage nylon and polyester, but under no circumstances use any form of bleach. Some ropes can, if rubbing even on a smooth well-rounded surface, build up a lot of heat in the rope leading to softening or weakening of the rope and eventually breaking. Polypropylene and polythene are most prone to this problem but all man-made fibres are subject to it to some degree. Natural fibre ropes do not suffer from heat or melting.

**Resistance to moisture, rot, sunlight and chemicals** - Man-made fibre ropes do not deteriorate from moisture. The deterioration of natural fibres from moisture or mildew is the main reason for the preference for man-made fibres. All ropes should be stored dry, as they can become smelly and unpleasant to handle if stored wet. One serious problem with man-made fibres is that they rot in sunlight and, when not in use, should not be left rigged. Generally, ropes should be kept away from all chemicals such as cleaning agents, battery acid and the like. If ropes are liable to such contact, remember that nylon has very little resistance to acid but some resistance to alkali, while polyester has some resistance to acid but not to alkali.

**Cost and availability** - One of the over-riding considerations is cost. For most jobs polyester or nylon will be the most suitable but they are very expensive. It may be more economical to buy a larger diameter polypropylene, or replace the polypropylene more often. Availability of the particular rope will also influence your choice - there is no point in deciding on tarred hemp if it is not possible to buy it.

**Treatment and Storage** - Ropes are expensive and proper care should be taken of them. Ropes should always be neatly coiled. A 40 m. anchor cable in a tangled heap in the bottom of a boat is useless when you need it in a hurry. The same applies to sheets halyards, heaving lines, bow and stern lines and all other ropes in use about a boat. If you are not sure how to coil a rope, learn now. NEVER wind a rope around your hand and elbow. This causes bad kinking when the rope is pulled straight again. After a trip, or at the end of a season, all gear, including ropes, should be washed down in fresh water and hung out of the way so that air can circulate and they can remain dry. This is essential with natural fibre ropes but man-made fibre ropes need to be taken care of as well. The end of every rope should be whipped. It is not enough just to melt the ends of man-made fibre rope because when a rope is used the burnt ends tend to crack or break open resulting in the rope starting to fray. You can burn the end of a rope as a temporary measure but a whipping should be applied as soon as possible.

**Knotting and Splicing**

All knots and splices weaken ropes - some by quite a considerable amount. A knot, such as a bowline, will weaken a rope anything up to 40%, and this is considered to be quite a good knot from this point of view. A rope can be permanently damaged if put under considerable strain with a knot in it and this can sometimes be spotted by the change in diameter where the knot was.

One thing to be wary of when tying knots in modern synthetic fibre ropes is that some of the traditional knots which are shown in many books were developed in natural fibre rope and they have a tendency to slip in some some synthetic ropes. One knot that is known to do this is the bowline. In pre-stretched ropes or in hard or slippy ropes, you are advised to use an additonal half hitch to lock the bowline if it is very important that it does not come undone.

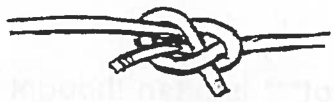
Splicing a hawser laid rope, if done correctly, will weaken a rope much less than a knot. However, when splicing, not only is it important that the tucks are done correctly, but the strands must not be allowed to cockle or kink when splicing. This happens when a rope is opened too far by twisting rather than using a marline spike or "fid". If this cockle is left in the splice, it can cause a dramatic reduction in the strength of the rope.

## KNOTS AND SPLICES

Knots and splices are an important part of seamanship because of their usefulness and practical application. There are a few really important knots which every Sea Scout worth his salt should know - these are the knots which are in constant use in boating and camping and are described here as the Four Star(****) knots. The Three Star Knots(***) are extremely useful but not absolutely essential. The Two Star Knots (**) can be looked on as useful but optional extras, while the One Star Knots(*) are mainly decorative and of interest to knotting experts and enthusiasts - most people can get by without knowing much about them. Those interested in the Boatswain's Badge will obviously be expected to know quite a lot about knots and knotting, splicing and whipping, etc., while most others will stick to the 4 and 3 Star knots.

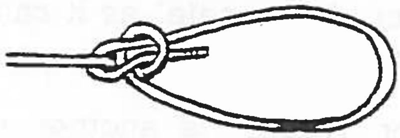
A **"bend"** is a knot which joins two ropes together, while a **"hitch"** is used to attach a rope to another structure.

**Sheet Bend****** is used to join ropes of equal size, construction and material.

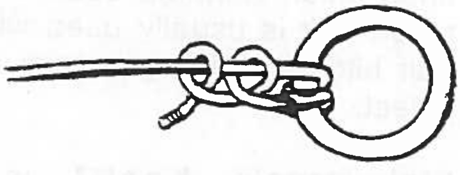


**Double Sheet Bend****** is more secure than the sheetbend, especially when the ropes are not equal.

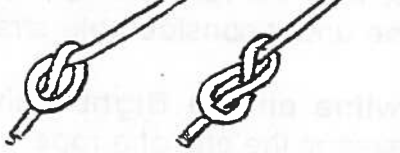
**Bowline****** is used to make a non-jamming eye or loop in the end of a rope. It may be used on a mooring line to slip over a bollard, for attaching jib sheets to the clew of a jib, for rescue or safety purposes when tied around the waist.



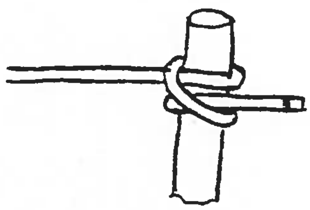
**Round Turn and two Half Hitches****** is a very useful and commonly used knot to tie a rope to a post or a ring.



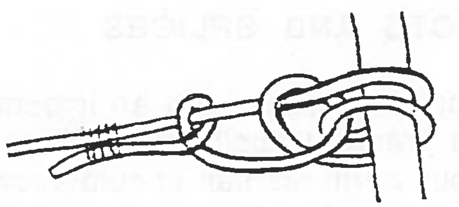
**Stopper Knots****** are used on the ends of ropes to stop the end running out through a block or a fairlead. Examples of these are the **Figure-of-8** and the **Thumb knot.**



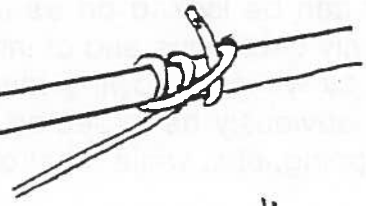
**Clove Hitch****** is a simple knot for tying a rope to a post, and may be used in the middle of a line as well as at the end. A clove hitch remains secure if kept under a steady strain. If the strain is intermittent it may come loose and untie. In such conditions a round turn and two half hitches would be better. A clove hitch is also used to start and finish lashings.



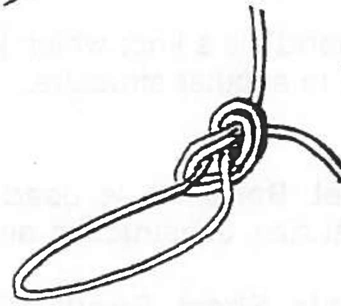
**Fisherman's Bend***** is similar to a round turn and two half hitches, but the first half hitch passes through the round turn. This is used to attach an anchor line to the ring of an anchor. This knot is never pulled tight. The end should be "siezed" to the standing part.



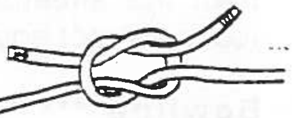
**Rolling Hitch***** is used to tie a rope to a spar or another rope when the strain is in the line of the spar.



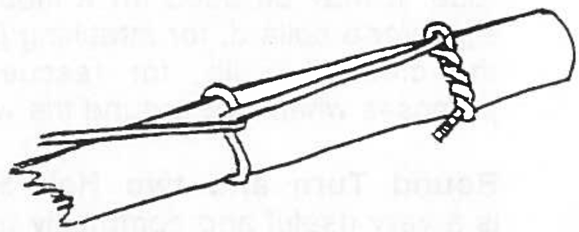
**Manharness knots***** provide a non-slip loop in the middle of a line. There are a number of manharness knots, and the most useful is probably the **Figure-of-eight loop.**



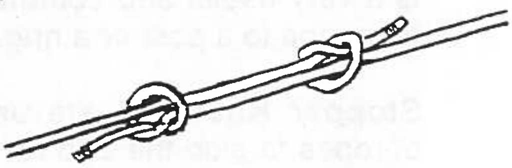
**Reef Knot***** is often thought to be the first and most important knot which a Scout learns. This is not so nowadays. The use of this knot is really restricted to tying the reef points of a sail (from which it gets its name), for First Aid and for tying string on parcels. Do not use it for joining two ropes together - it is not always safe, as it can be easily capsized.



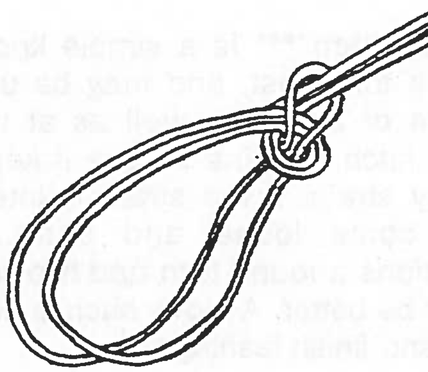
**Timber Hitch**** is another very simple knot which remains secure if kept under tension. It is usually used with a separate half hitch for towing a spar or some such object.



**Fisherman's Knot**** is used to tie together two slippery lines or ropes. This knot may be very difficult to untie if it has come under considerable strain.

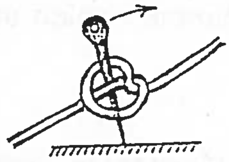


**Bowline on the Bight**** gives two loops or eyes at the end of a rope.



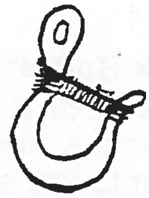
**Hunter's Bend*** is a newly designed knot for tying two ropes together, and holds well with slippery ropes, but can be difficult to untie.

**Marlinspike Hitch*** is used to get a grip on string or rope when splicing or in fancy ropework.

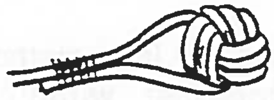


**Catspaw*** is used to attach a rope sling to a hook.

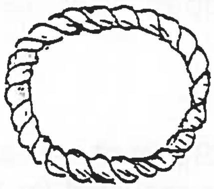
**Mousing a Hook*** means binding across the hook to make it more secure. In order to do this the hook must have a slight outward curve just below the point.



**Monkey's fist*** is traditionally used at the end of a heaving line to give some extra weight to the end.



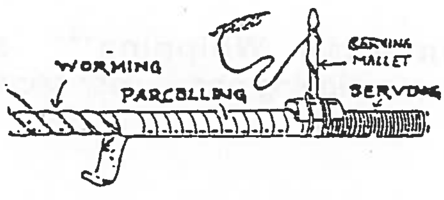
**Grommet*** is a rope ring made from one strand of a rope laid up around itself to form a three stranded complete circle.



**Turk's Head*** is a decorative piece of ropework which can be made in many sizes. In Scouting it is usually used for making woggles. The simplest Turk's Head in leather thong is traditionally worn after Basic Leader Training and is called the "Gilwell Woggle".

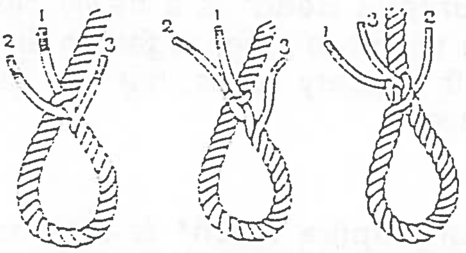
**Worm, Parcel and Serve*** is used to protect wire rigging. **Worming** means laying a small line in the score between the lays of the rope. **Parcelling** means wrapping strips of canvas, which may be tarred or greased, around the rope like a bandage. It is then **served** against the lay of the rope with tarred twine wrapped tight around using a "serving mallet".

"Worm and parcel with the lay,
Turn and serve the other way".

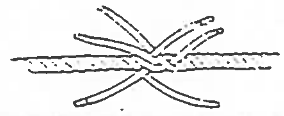


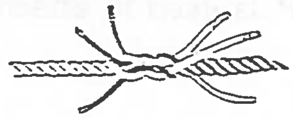
## SPLICING AND WHIPPING

**Eye Splice***** is used to make an eye in the end of a rope. This eye is often made around a "thimble" which saves chafe on the rope.

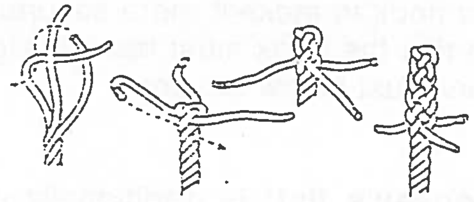


**Short Splice***** is used to splice two ropes together. This results in an increase in thickness of the rope and may therefore prevent it running through a block or other sheave.





**Back Splice*** is sometimes used to tidy up the end of a rope and stop unravelling. It increases the diameter of the rope. It is better to use a whipping for this purpose.



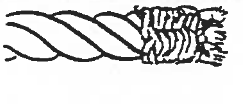
**Long Splice*** is a method of splicing two ropes together without increasing the thickness. It is not very useful in small diameter ropes. It is also very wasteful of rope.

**Braided Splice*** - special splicing technique is required for braided ropes.

**Westcountry Whipping****** is a simple, quick and effective way of whipping the end of a rope. It consists of a series of half hitches tied alternately on opposite sides of the rope, finished off with a reef knot.

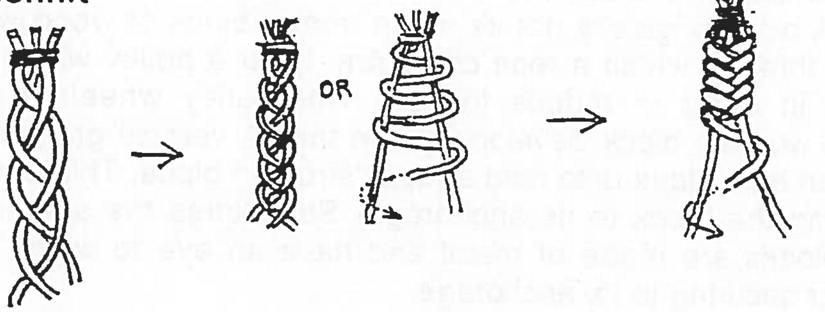


**Sailmaker's Whipping***** is a better form of whipping and is very secure.

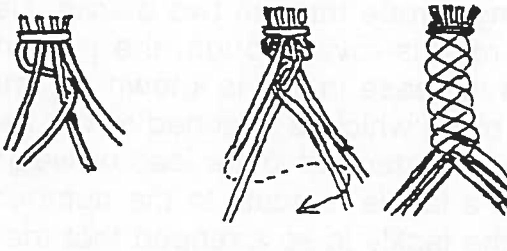


**Sennits*** are various forms of plaiting and braiding and are now only used for decoration.

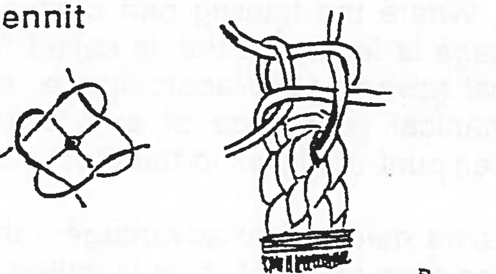
**Three strand flat sennit**



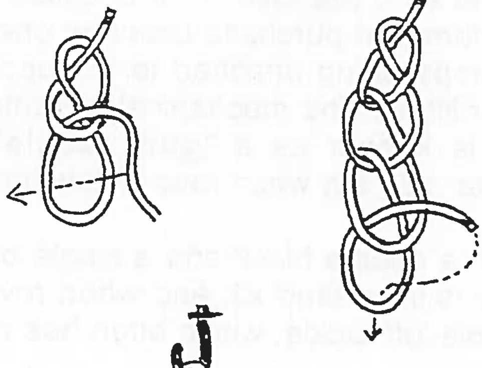

**Four strand square sennit**



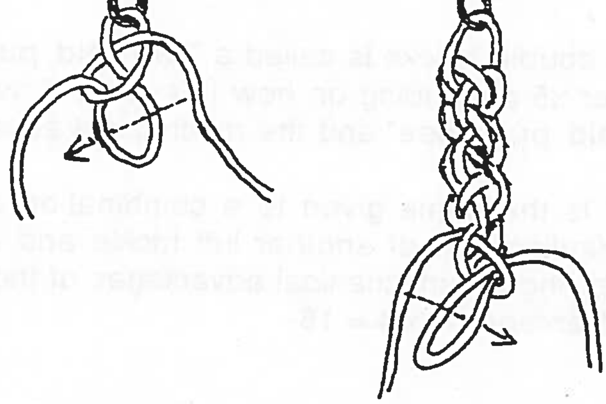
**Four strand crown sennit**



**Simple chain**



**"Idiot's Delight"!**



## BLOCKS AND TACKLES

Blocks and tackles are used to increase or multiply force in order to lift or move heavy weights. A block originally got its name from a block of wood which had a hole bored through it through which a rope could run. Later a pulley wheel was incorporated into the block in order to reduce friction. This pulley wheel is called a sheave. The traditional wooden block developed from this. A vertical groove around the outside of the shell on both sides is to hold a rope "strop" in place. This strop carries an eye used for securing the block to its anchorage. Sometimes the strop is left long as a "tail". Modern blocks are made of metal and have an eye to which is attached a hook or shackle for securing to its anchorage.

A tackle is made up by reeving a rope through two blocks. Depending on the number of sheaves and the way the rope is rove through, the pull on the hauling part of the tackle can be multiplied. This increase in pull is known as **"mechanical advantage"**. The **"standing block"** is the block which is attached to the fixed anchorage, while the **"moving block"** is the one that is attached to the load or weight which is being moved. The mechanical advantage of a tackle is equal to the number of parts of the rope (or "fall") at the moving block. If the tackle is so arranged that the hauling part leads away from the moving block, this tackle will have greater mechanical advantage - this is called **"rove to advantage"**. Where the hauling part comes away from the standing block the mechanical advantage is less, and this is called **"rove to disadvantage"**. The calculation of mechanical advantage is approximate, as it assumes negligable friction. Therefore the mechanical advantage of any tackle will be less than the calculation depending on the amount of friction in the blocks and sheaves.

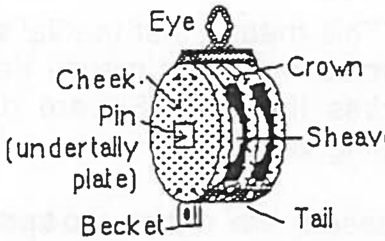
A single standing block gives no mechanical advantage - the block merely changes the line of the rope which is hoisting the load. This is called a **"single whip"**. One of the simplest and commonest forms of purchase tackle is one using two single blocks, with the standing part of the rope being attached to the upper block. This is called a **"double whip"** and is used for lifting. The mechanical advantage is x2. The same type of tackle used horizontally is known as a **"gun tackle"**. A gun tackle rove to disadvantage increases power x2, but when rove to advantage it is increased x3.

A **"luff tackle"** is one in which a double block and a single block are used. When this is rove to disadvantage power is increased x3, and when rove to advantage it is x4. A **"handy billy"** is a small portable luff tackle, which often has a tail on the double block.

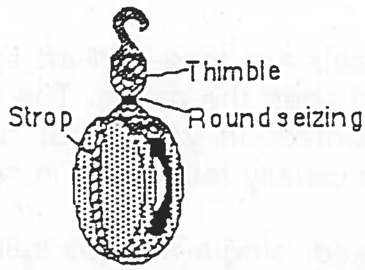
A tackle with two double blocks is called a **"two-fold purchase"** and the mechanical advantage is x4 or x5 depending on how it is rove. If two treble blocks are used it is called a **"three-fold purchase"** and the mechanical advantage is either x6 or x7.

**"Luff upon luff"** is the name given to a combination of tackles. One luff tackle is attached to the hauling part of another luff tackle and the mechanical advantage is obtained by multiplying the mechanical advantages of the two tackles together. E.g. if each is rove to advantage - 4 x 4 = 16

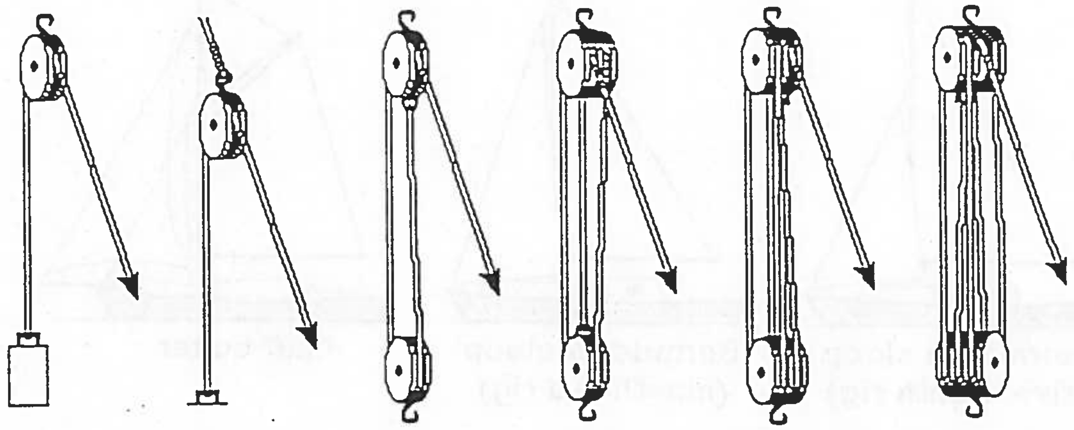
# BLOCKS AND TACKLES



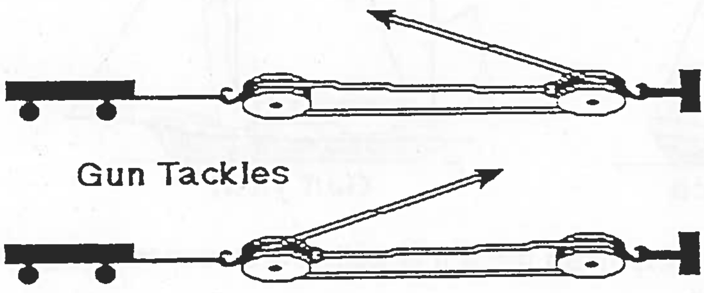

Double sheave block



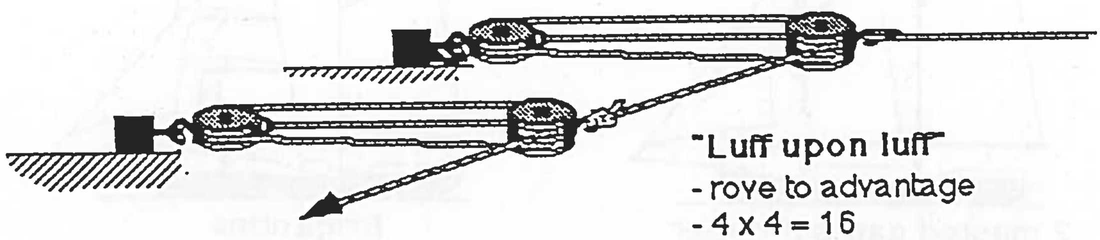

Strop block



| Single Whip | Runner | Double Whip | Luff Tackle | Two-fold Purchase | Three-fold Purchase |
|---|---|---|---|---|---|
| No advantage | x2 | x2 | x3 | x4 | x6 |




Gun Tackles



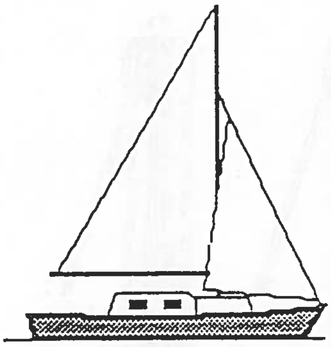
"Luff upon luff"
- rove to advantage
- 4 x 4 = 16

## RIGS AND RIGGING

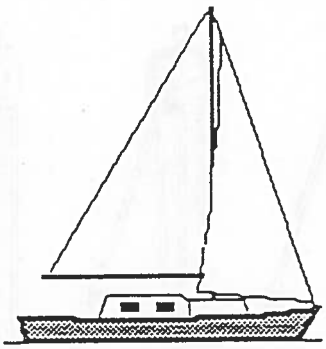
### Types of rigs

Most sailing vessels are **fore-and-aft** rigged. This means that the sails are hoisted in a line before and abaft the masts. The term **square-rigged** means that the sails are rectangular, mounted on yards that run across the ship. Square rig is very rare nowadays and is usually found only in sail training vessels.

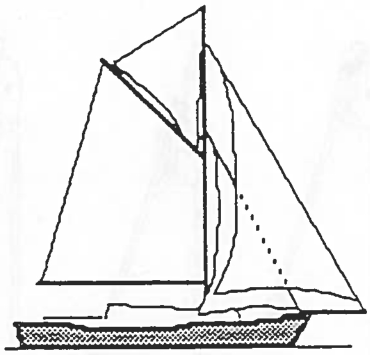
Fore-and-aft rigged, single masted sailing vessels are either **sloops** or cutters. A sloop carries only one headsail, whereas a cutter carries two.



**Bermudan sloop (five eighth rig)**

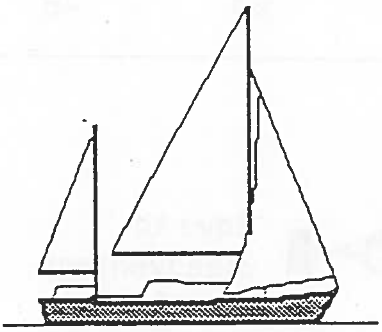


**Bermudan sloop (masthead rig)**

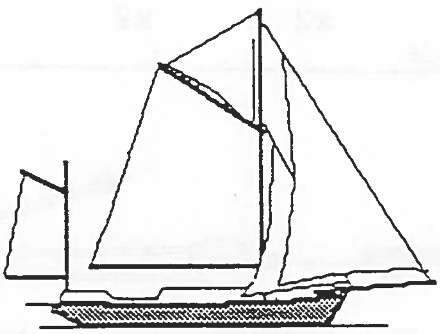


**Gaff cutter**

In two masted vessels the larger mast is called the **main mast.** If the smaller mast is abaft the main mast it is called a **mizzen mast** (e.g. ketch and yawl).

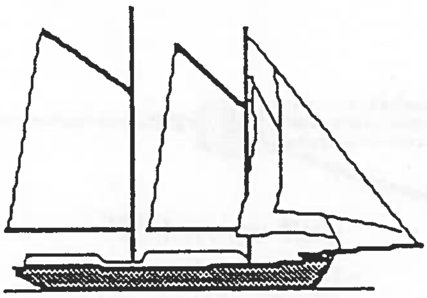


**Bermudan ketch**

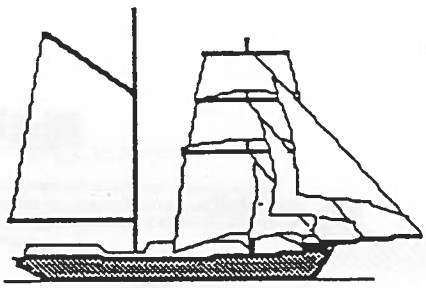


**Gaff yawl**

If the smaller mast is in front of the main mast it is called a **foremast** ( e.g. two-masted schooner, brig and brigantine).



**2 masted gaff schooner**

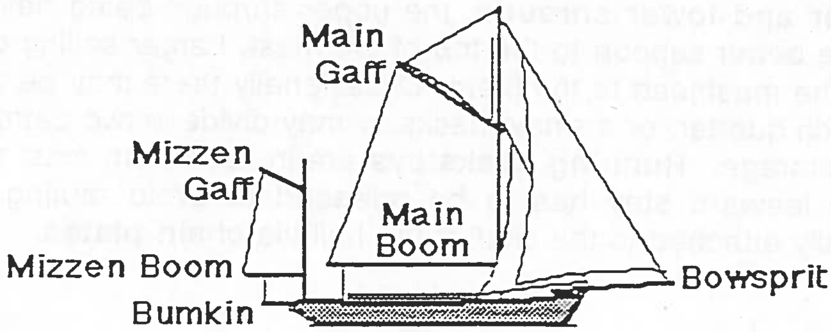


**Brigantine**

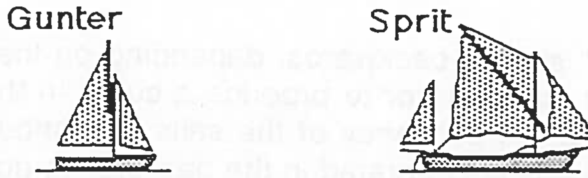
In a three-masted vessel the masts are called **fore, main** and **mizzen.**

**Masts and spars**

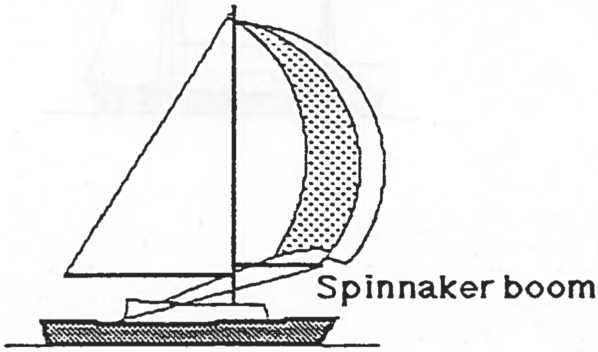
Masts are mounted vertically and held up by **standing rigging.** Other spars are used horizontally or diagonally from a mast to support sails. The spar along the foot of a sail is called a **boom.** The spar at the head of a four-sided sail is called a **gaff.** A **bowsprit** is a horizontal spar extending forward from the bow. A small horizontal spar extending out from the stern is usually called a **bumkin.**




A gaff which extends vertically upwards is a **gunter**. This is a very popular rig for sailing dinghies as it means that the mast can be kept small. All the spars can be stowed inside the boat which is very useful for transport. A spar running diagonally across a four-sided sail is called a **sprit**. This rig is not very common, but it can be found in vessels as varied as the "Optimist" dinghy and the old traditional Thames sailing barge

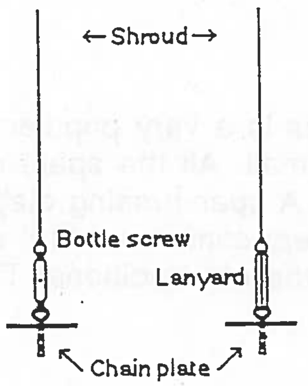


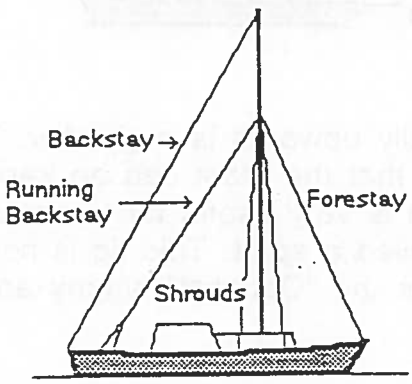

A **spinnaker boom** is used to keep one of the lower corners of a spinnaker extended. Two lines control the spinnaker boom and hold it steady - the **uphaul** and the **downhaul**. These prevent the boom from rising when the sail is pulling well or from drooping down if the wind drops. The spinnaker itself is controlled by two lines which are interchangeable depending on which side the spinnaker boom is carried. The line going to the side of the boom is called the **guy**, while the line to the other corner of the sail is the **sheet**.

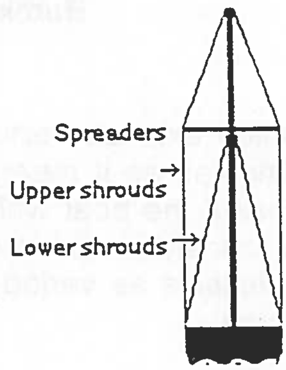


## Standing Rigging

This is the rigging that holds the mast upright and includes all the ropes that are permanently fitted to the mast and do not move. In a small craft the mast is held by three supports - a **forestay** and two **shrouds.** These are usually made of wire and are attached to the hull at the lower end by **bottle screws** or by **lanyards** to adjust the tension. Sometimes **twin forestays** may be seen in larger boats - this allows a new jib to be "hanked on" before taking down the old jib when changing sail. Bigger masts have **upper and lower shrouds**, the upper shrouds being held outwards by **spreaders** to give better support to the top of the mast. Larger sailing craft also have **backstays** from the masthead to the stern. Occasionally there may be two backstays, one running to each quarter, or a single backstay may divide in two parts, each running to a separate anchorage. **Running backstays** are in pairs from mast to either side - when sailing the leeward stay has to be released to avoid fouling the mainsail. Shrouds are usually attached to the side of the hull via **chain plates.**

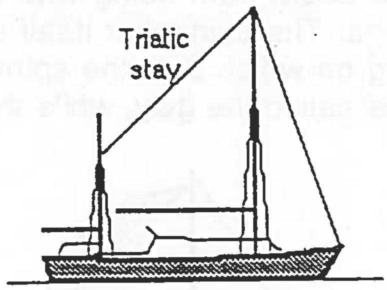


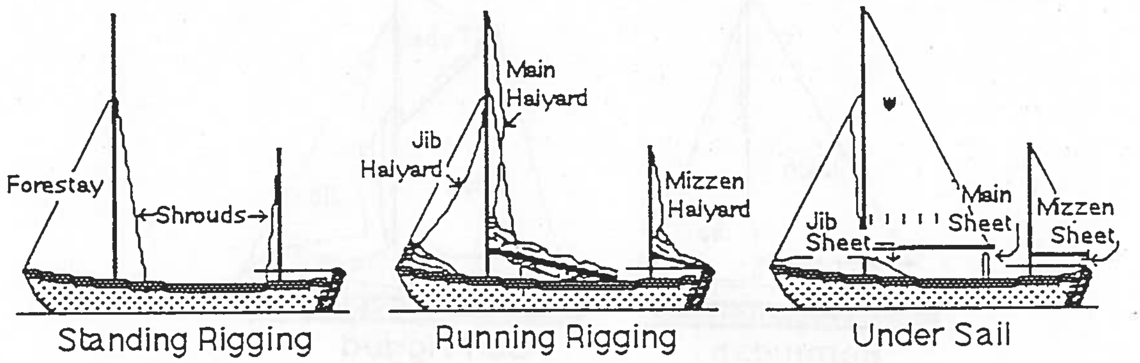

Masts may be "raked" slightly backwards, depending on the boat's design. The ability to change the rake of the mast, or to produce a curve in the mast is used in modern racing craft to increase the efficiency of the sails on various points of sailing - some form of tensioner device is incorporated in the backstay to accomplish this.

A **triatic stay** runs from one masthead to another. Nowadays this usually refers to a stay from the mainmast to the mizzen on a ketch.

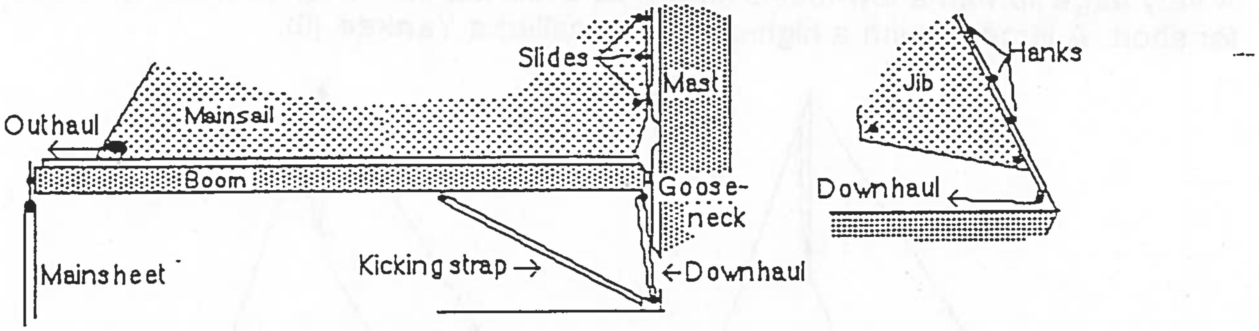


### Running Rigging

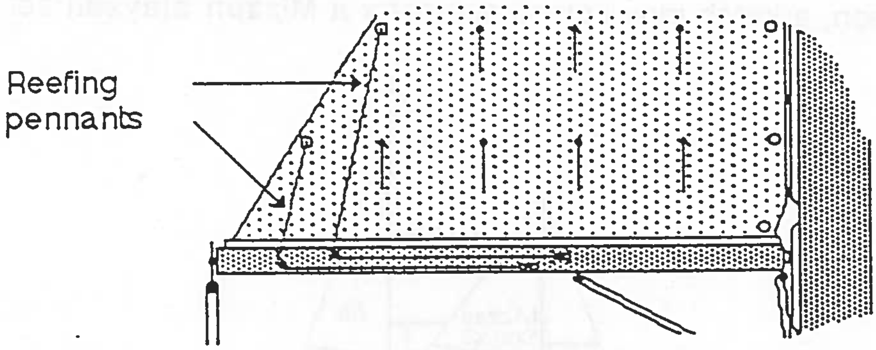
The moving ropes which hoist and control the sails or hoist flags are known collectively as **running rigging**. A rope which hoists a sail or flag aloft is called a **halyard** and a rope which controls the set of a sail is called a **sheet.** Halyards and sheets take their names from their sails - e.g. Jib sheet, Main halyard, etc. A rope running from the masthead to support the end of the boom is called a **topping lift.**




The foot of a sail may be tensioned by pulling aft along the boom by an **outhaul** attached to the clew, and the luff of a sail may sometimes be tensioned by a **downhaul** attached to the tack. A **kicking strap** is a rope or tackle (sometimes in large racing yachts a solid bar) which keeps the boom tensioned down and maintains a "flatter" sail. The **goose-neck** attaches the forward end of the boom to the mast.



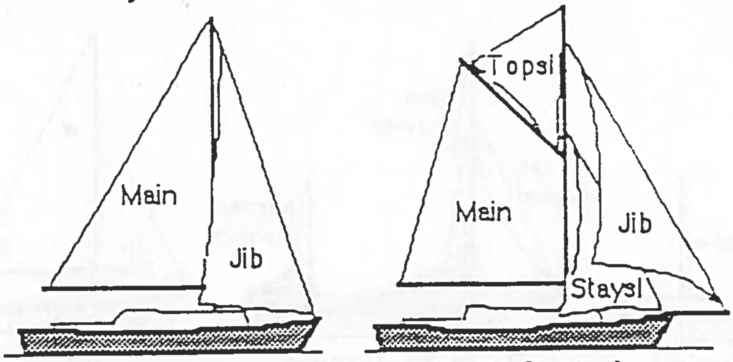

A **reefing pennant** is a length of line rove through a **cringle** at the end of a row of reefing points and brought through a pulley or fairlead to a cleat on the boom. It is used to pull the leach of the sail down to the boom in "slab" reefing.



## SAILS AND SAILCLOTH

### Sails - fore-and-aft rigs

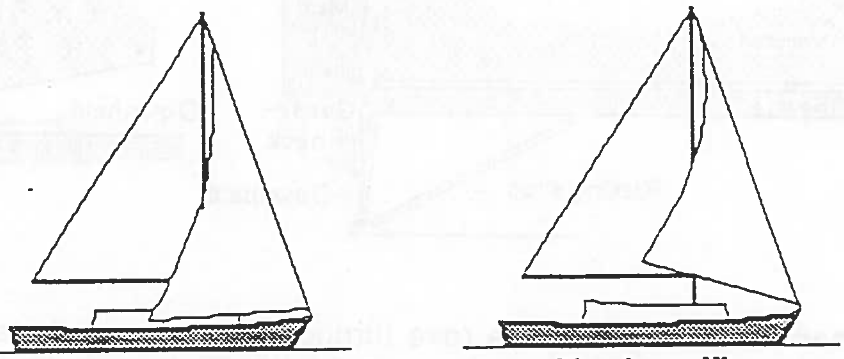
A **head sail** is any sail set before the mast on a single masted vessel, or before the foremast where there is more than one. Head sails are always triangular in shape. In small boats the head sail is usually called the **jib**. Where there are two head sails the inner one is called the **staysail**.




**Bermudan** **Gaff rigged**

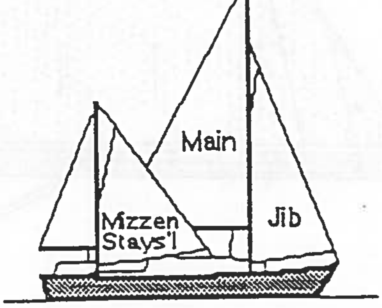
The **mainsail** is set behind the mainmast and the **mizzen sail** behind the mizzen mast. The mainsail and mizzen may be triangular in shape (**Bermudan**) or four-sided (**Gaff rig**). In a gaff rigged vessel, a triangular **topsail** may be carried above the gaff.

A very large jib with a low foot is known as a **Genoa jib** - often referred to as a "Jenny" for short. A large jib with a high-cut foot is called a **Yankee jib**.



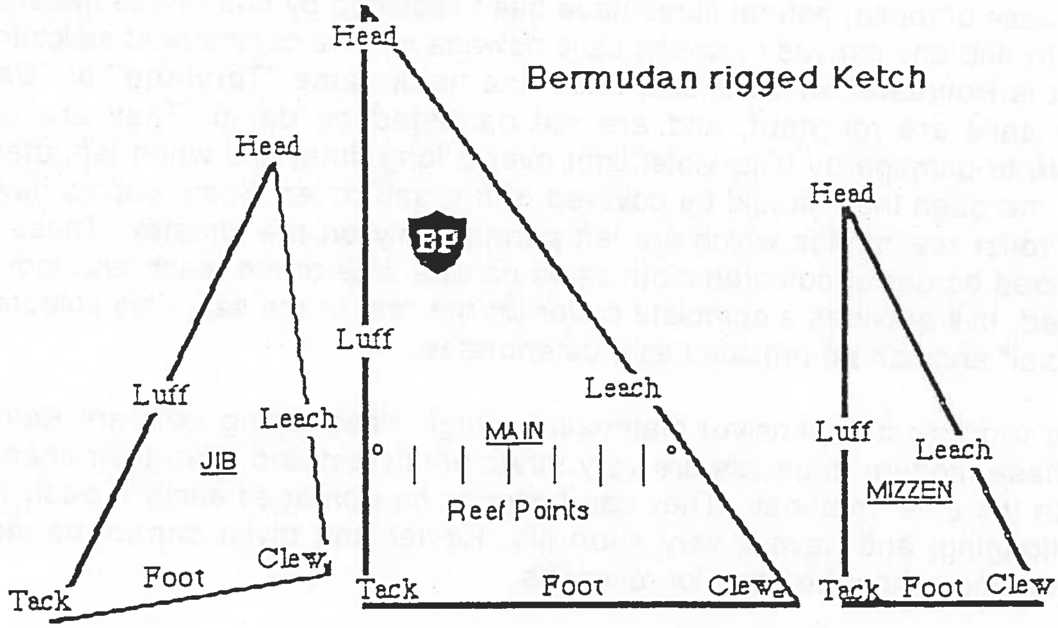
**Genoa jib** **Yankee jib**

When on a reach, a ketch may sometimes carry a **Mizzen staysail** set just before the mizzen mast.

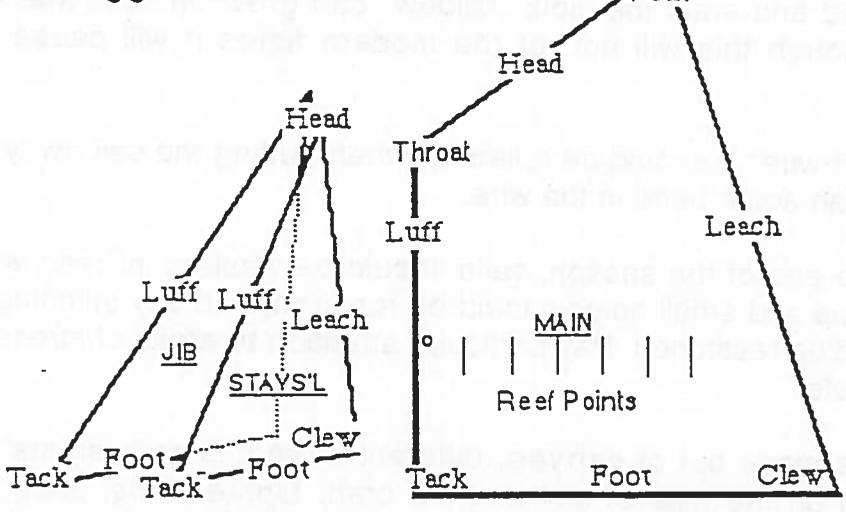


## Parts of Sails

Bermudan rigged Ketch




Gaff rigged Cutter




**Cringles** are metal rings incorporated into the sail at the corners, and at each end of a line of reef points, where the sail is attached to other structures and takes a lot of strain. The sail is reinforced in these areas. Other, smaller metal rings are called **eyelets**, and areused to attach slides or hanks, or for lacing cord.

**Reef Points** are short lengths of cord arranged in a horizontal line across a sail which are used to tie down an section of sail. This is called **reefing** a sail, and is done to reduce the sail area in a strong wind.

**Sailcloth**

As in the case of ropes, natural fibres have been replaced by man-made materials. It is very rare to find any canvas or cotton sails nowadays. The commonest sailcloth in use at present is **Polyester** which is sold under the trade name **"Terylene"** or **"Dacron"**. Polyester sails are rot-proof, and are not damaged by damp. They are however susceptible to damage by ultra-violet light over a long time, and when left attached to booms in the open they should be covered with a sail cover. Some yachts have large furling or roller reefing jibs which are left permanently on the forestay. These usually have a broad border of coloured cloth sewn on one side of the leach and foot so that when furled, this provides a complete cover for the rest of the sail. This coloured cloth is "sacrificial" and can be replaced as it deteriorates.

The latest (and most expensive) materials for high class racing sails are **Kevlar** and **Mylar**. These modern materials are very stretch-resistant and keep their shape much better than the older materials. They can however be damaged easily if badly handled or if left flogging, and have a very short life. Kevlar and mylar cannot be stored on booms, etc. and cannot be used for roller jibs.

**Care of Sails**

Although modern sails do not suffer from damp they should still be dried before storing away for any length of time as otherwise metal fittings (e.g. eyelets and cringles) can become corroded and stain the cloth. Mildew can grow on sails that have been put away wet - although this will not rot the modern fibres it will cause very unsightly staining.

If a jib has a "luff-wire" it should be rolled up when putting the sail away in the sail bag to avoid putting an acute bend in the wire.

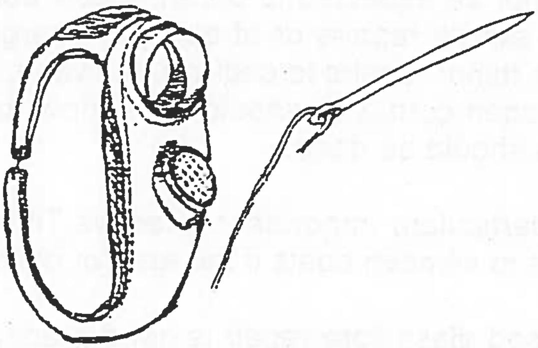
Especially at the end of the season, sails should be washed in fresh water to remove salt. Frayed areas and small holes should be repaired, and any stitching that has worn or broken should be restitched. Pay particular attention to areas of stress - e.g. corners, batten pockets, etc.

Sails used to be made out of **canvas**, different strengths or "weights" of cloth being used depending on the type of sail and the craft. Lighter sails, especially for racing yachts were made from **cotton**. Both these materials stretch in use. If by any chance you should come across canvas or cotton sails, remember that they should never be stored away wet or damp, especially in warm weather, as they will rot or develop "mildew". They should be hung up to dry in an area with good air circulation.

Canvas may still be used by Sea Scouts to make boat's bags, boatswain's bag, etc. In order to be able to make a bag out of canvas or to make repairs to sails, it is advisable to learn how to use a "Palm and Needle", and to learn the three basic stitches - **round stitch, flat stitch** and **herringbone stitch.**

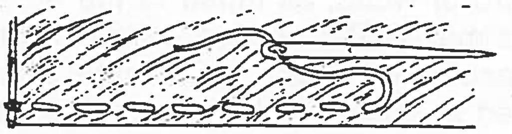
## Sail Repairs and Canvas Stitching

PALM AND NEEDLE The "Palm" is a strong leather band which fits around the hanc with a hole for the thumb. It has a "boss" or bearing surface which is used to push the strong needle through the canvass or other material. Special waxed thread is used fo canvas work and for sail repairs.

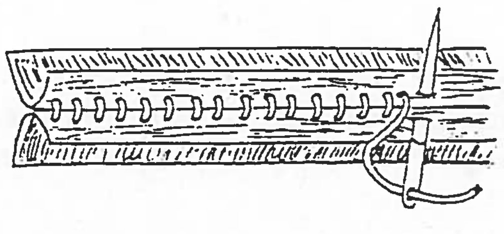


STITCHING

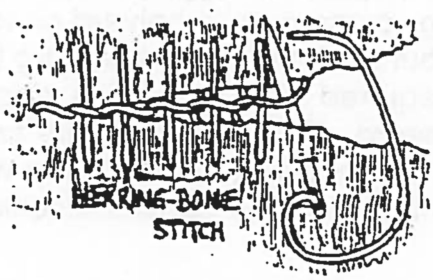
**Flat Stitch** is used for making a hem.

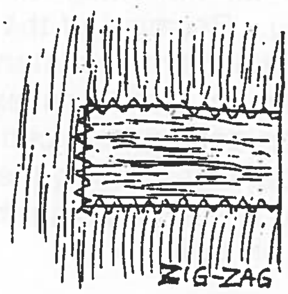


**Round Stitch** is used to sew two edges together.



**Herringbone Stitch** is used to repair tears in canvas or sailcloth. This repair is then usually covered by a reinforcing patch. Special adhesive material is now often used for such patches. If you get a tear in your sail and it is repaired in this temporary manner, a proper sail repair should be done later. A full repair and patching will probably require the use of a sewing machine using a strong needle and a "zig-zag" stitch. For any extensive repairs you should ask the advice of a sail-maker.



# BOAT MAINTENANCE AND REPAIR

The type of repairs that you will be expected deal with are those required by your own Group boats. You will not be expected to be an expert boatwright, but you should be capable of carrying out simple repairs or of being in charge of a party doing a bigger job. You may have to do minor repairs to decking, gunwale, thwarts, bottom boards etc. If your Group has a wooden craft, you should know how to apply a "tingle" and under what circumstances this should be done.

Glass fibre repairs are particularly important nowadays.This material may also be used for temporary repair jobs to wooden boats if the area of damage is not too large.

One of the secrets of good glass fibre repair is good preparation - make sure the area is completely dry, remove any loosened and splintered areas and roughen up the surrounding surface with coarse sandpaper or a file. The repair is usually done from the inside if possible. If the hole is not too big, cover with masking tape on the outside. If however, the hole is quite big, it may require covering with something like celophane supported by stiff cardboard or wood, all taped to the outside of the hull. Pieces of glass fibre chopped strand mat (CSM) are cut, allowing about 1" overlap around the edges of the defect, for canoes and light craft. Three pieces of CSM will usually be sufficient. Resin is prepared by mixing in the appropriate amount of hardener and this is then brushed over the area of the repair. A piece of CSM is placed over this, and more resin is brushed on top, stippling thoroughly to exclude all air bubbles. This is followed by a second and a third layer. When the resin has set, the tape is removed from the outside.

In a wooden craft, particularly plywood, an emergency repair may be made as described above, but a piece of wood may be included between the layers of the glass fibre to give additional strength. The temporary repair should be removed later and a proper job done.

A full-scale repair, restoring the quality of the "gel-coat" may be undertaken to give a better result, but this is not done in temporary repairs. In canoes especially, a good temporary repair may be achieved even on a wet surface, by using a special water-proof tape.

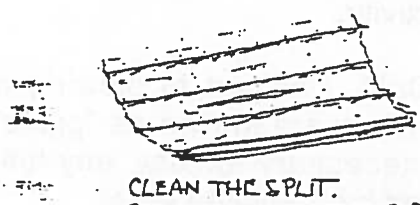
## Rigging

Boat repair work may also include dealing with repairs to rigging, both running and standing. Because of the importance of rigging, damage to a halyard or to a shroud usually means replacement rather than repair, but such things as whipping the ends of halyards, or putting in eye-splices may be required at times. If a rigging screw becomes damaged, it can be replaced by a lanyard. Temporary repairs to sails may be effected by stitching the tear using a "herring bone stitch', and covering with a small patch of the appropriate material. For notes on sailcloth and canvas stitching see the section on sails.

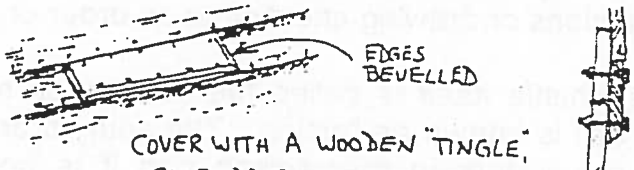
## Maintenance and Repair

### WOODEN CRAFT

SMALL CRACKS – FILL WITH EPOXY GLUE (EG. ARALDITE) MIXED WITH SAWDUST.
LARGER CRACKS OR SPLITS – APPLY A "TINGLE"

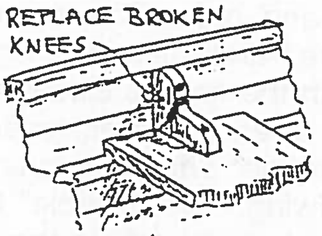


CLEAN THE SPLIT.
REMOVE LOOSE FRAGMENTS.
FILL WITH SEALING COMPOUND – EG. "SEELASTIC"

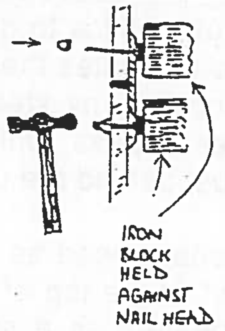



COVER WITH A WOODEN "TINGLE", WELL BEDDED IN SEALING COMPOUND. FIX WITH COPPER NAILS AND ROVES, OR WITH BRASS SCREWS AND THEN PAINT – PRIMER (IF NECESSARY), UNDERCOAT, GLOSS COAT.

REPLACE BROKEN KNEES

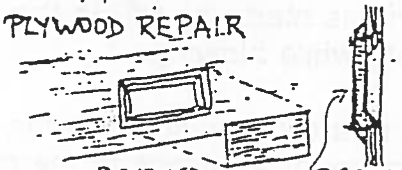


COPPER NAILS AND ROVES:




DRILL HOLE FOR COPPER NAIL AND DRIVE THROUGH FROM OUTSIDE. DRIVE A "ROVE" OVER THE POINT WITH A HOLLOW PUNCH OR END GRAIN OF A PIECE OF WOOD. CUT OFF THE PROTRUDING NAIL LEAVING A SHORT PIECE OUTSIDE THE ROVE. RIVET THIS OVER THE ROVE WITH A HAMMER.

PLYWOOD REPAIR



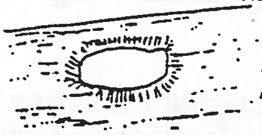

GLUE WITH ARALDITE

### FIBREGLASS CRAFT

SMALL CRACKS – FILL WITH RESIN.
LARGER DAMAGE – USE "CHOPPED STRAND MAT" – "CSM"

REMOVE SPLINTERED AND LOOSE PIECES.

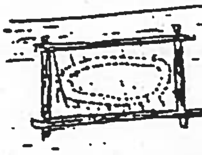
CHOPPED STRAND MAT



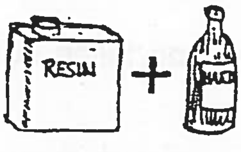
ROUGHEN SURROUNDING AREA

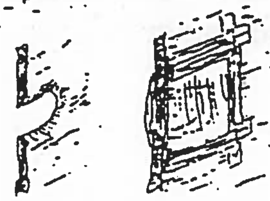
CUT TO SHAPE AND SIZE

APPLY RESIN WITH A BRUSH – USING A STIPPLING ACTION



COVER WITH NON-STICK BACKING PIECE



MIX RESIN AND HARDENER – ENOUGH FOR THE JOB IN HAND.

CLEAN BRUSH WITH ACETONE

## THE BOATSWAIN'S CALL

This is a form of whistle, with a long and honourable history. It is developed from the "whistle of command" used by ship masters as far back as the 15th and 16th centuries. The whistle was used to pass certain commands because the sound could carry better and be heard around the ship better than the human voice. It later became the traditional symbol of the boatswain's mates. Since the passing of the days of sail the use of the Boatswain's Call has become almost entirely ceremonial. It is an old tradition which Sea Scouts should try to maintain, and which adds nautical flavour to Sea Scout meetings and activities. It can still be very effective in passing certain standard instructions or drawing attention to an order or activity.

Note that the whistle itself is called the "Boatswain's Call". The act of blowing or sounding the call is known as "piping". The sounds or orders are known as "pipes". Some pipes are orders in themselves and it is not necessary to say anything afterwards. Other pipes are to call attention and are followed by a spoken order.

Only certain pipes are used in Sea Scouting, and these are given in diagramatic form on the opposite page. There are only two notes - low and high. The low note is produced by blowing the call normally, with the fingers of the hand open. The high note (also called the "throttled" note) is produced by blowing with the fingers closed around the "buoy". This requires a lot of practice to get it right, but when this is achieved it will not be forgotten. As well as the two notes there are three "tones" The commonest tone is known as "steady". It is produced by steady, even blowing. The "warble" tone is produced by blowing in a series of jerks, while the "trill" is made by trilling the tongue against the roof of the mouth just behind the upper teeth while blowing.

**The Side.** This pipe is traditionally used as a salute to a distinguished visitor, and is given by a group of "side boys" at the top of the gangway or entrance to the meeting place. Because of its developement as a salute, it is sometimes also used in Sea Scouting during the formal hoisting of colours.

**The Still.** This is a long continuous high note which is used to call everyone to attention and to stop whatever activity is going on at the time. It is often used for the lowering of colours. The Still is usually followed by the **Carry On** to indicate that previous activities may be resumed.

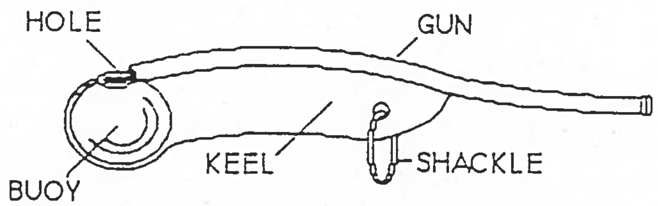
**Stand-by** or **General Call.** This is always followed by a verbal order - e.g. "Troop fall in", "Stand-by for Colours", etc.

**Dinner.** This is used to call all hands to a meal. It is one of the longest calls, and lasts 30 seconds. There are however a couple of breaks in the call allowing brief breaths!

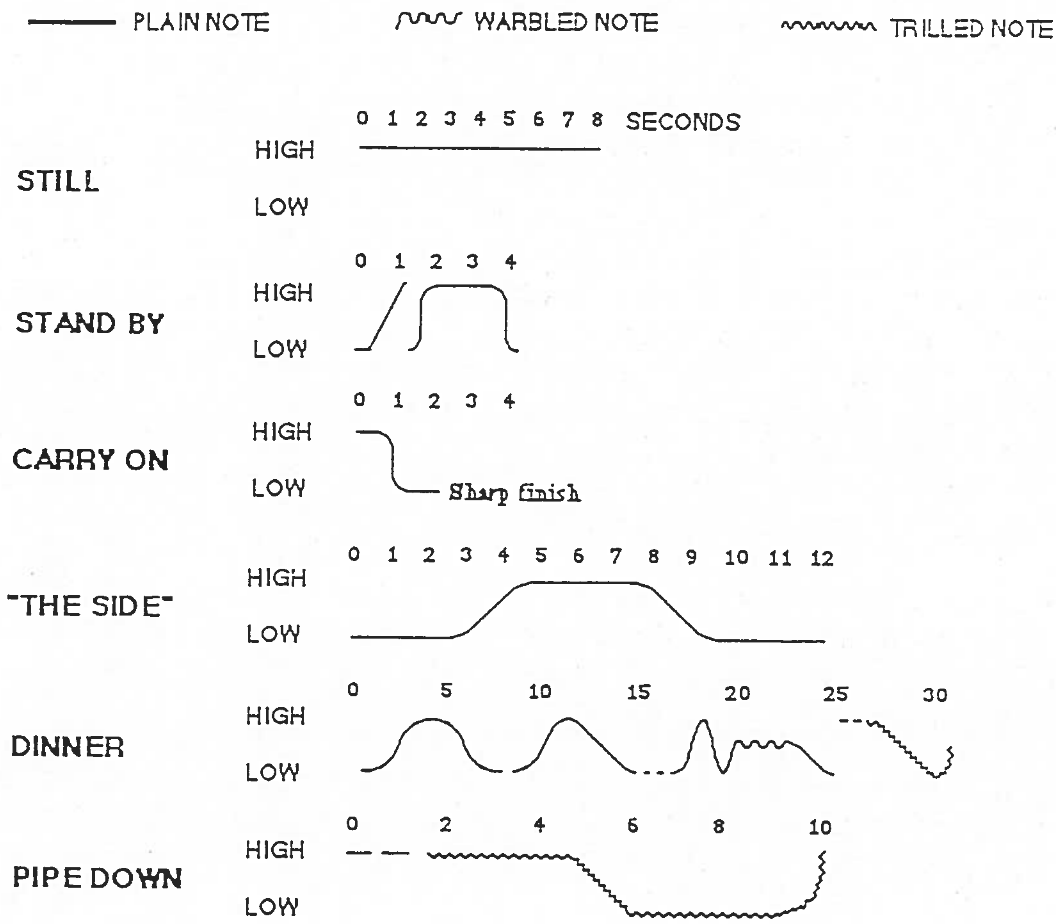
**Pipe Down.** This pipe contains a long trilled note and is the order for quietness at night and lights out.

The last two mentioned pipes are not commonly used in Sea Scouting.

# THE BOATSWAIN'S CALL



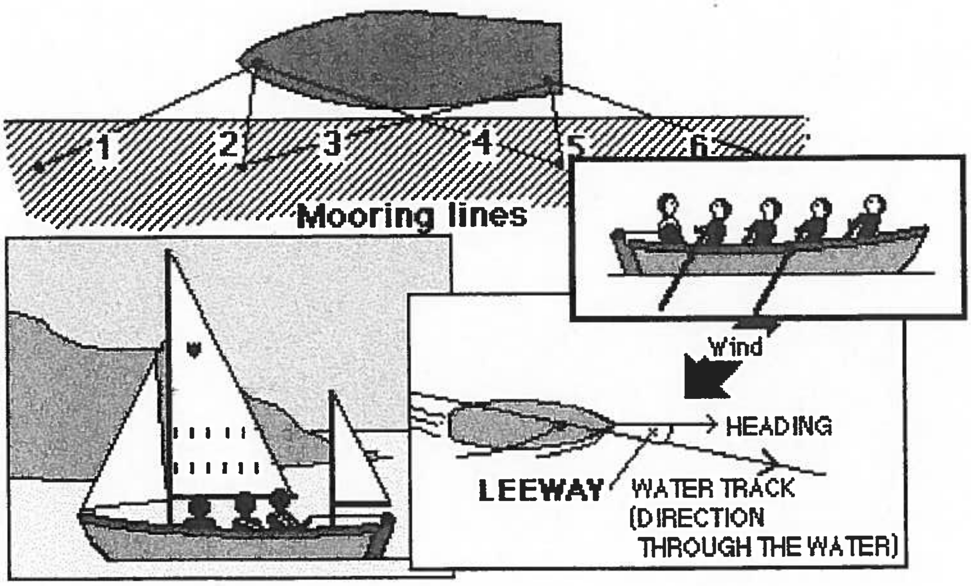

## PIPES ON THE BOATSWAIN'S CALL



# SEA TRAINING MANUAL

## SECTION B

# BOAT HANDLING




SEA
TRAINING
TEAM

SCOUTING IRELAND SAI

**BOAT HANDLING**

This section deals with handling boats under sail and under power, and covers the practical boat-handling requirements for the Sailing and the Power Boating Attainment Badges, as well as for Sail and Power Charge Certificates. The essence of active Sea Scouting is boat handling. The Training Scheme provides a syllabus in progressive boat handling ranging from basic techniques to waterborne expeditions.

Further information on marine engines is also given, to complete the picture.

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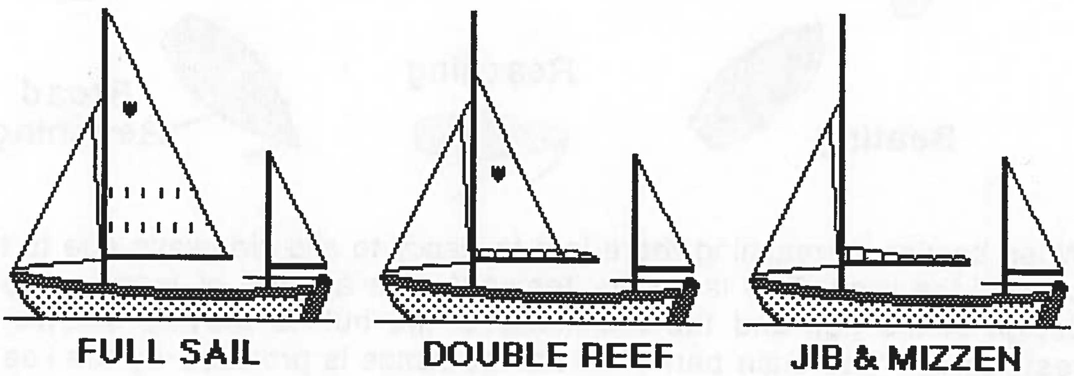
| **Sailing** | **2** |
| **Motorboating** | **10** |
| **Engines** | **19** |

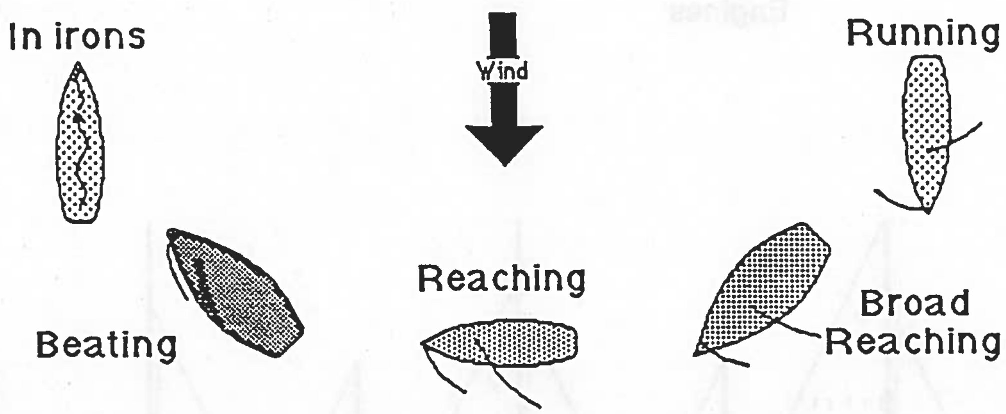
## SAILING

It is assumed that Scouts reaching this stage have a fair amount of practical sailing experience - that is the only way to learn sailing. Some theory and some practical hints are given here but much basic detail is not included - there are many excellent books available to those who wish to read more about it. The main aspects of handling under sail which are important in Scout boating are covered. Details of sails and rigging are covered in **Section A.**

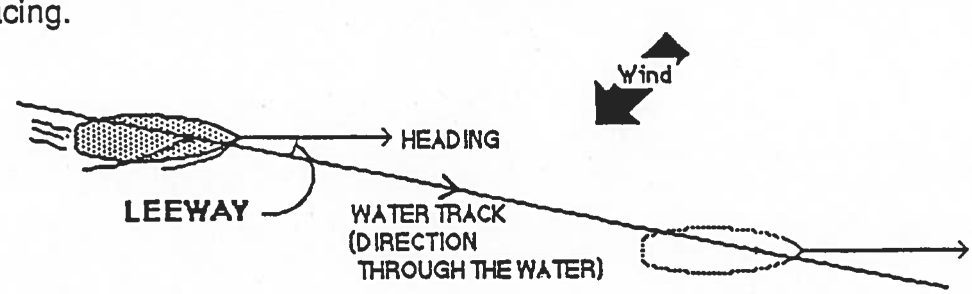
### Theory of Sail

A sailing boat cannot sail directly into the wind, but can probably "point" about 45° off the wind. Progress to windward is made in a zig-zag manner by "tacking". When sailing close to the wind like this, the sails are sheeted in tightly so that they are as flat as possible. This is called sailing "**close-hauled**" or "**beating**". If the wind is on the beam, the sheets are eased - the sails can fill better and develop a curved shape. This is called "**reaching**" and is usually the fastest point of sailing. When the wind is astern the boat is "**running**". If the jib is blanketed by the mainsail and does not fill, it can be set on the opposite side to the mainsail, perhaps boomed out with a spinnaker pole or a "jib stick". This is known as "**goose-winging**" or "**running goose-winged**".

POINTS OF SAILING




When beating or reaching there is a tendancy to slip sideways due to the sideways push of the wind. This is called "**leeway**". The amount of leeway depends on the design of the hull and the resistance of the hull to moving sideways - "**lateral resistance**". The main part of lateral resistance is provided by the keel, or in small craft by the centre-board. Try to sail a BP 18 or a dinghy closehauled with the centre-board raised and you will find that most of the movement is sideways and you will make very little progress to windward. The more you sail "off the wind" the less important is lateral resistance. When running, you can raise the centre-board completely and this may increase speed slightly by reducing drag - this is often done in dinghy racing.

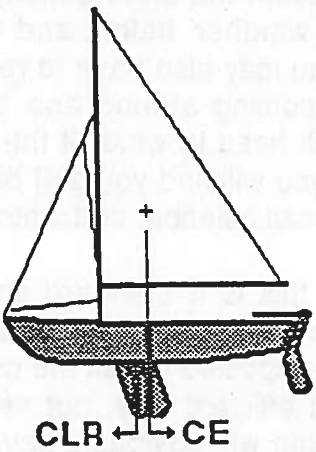


A wind dead astern used to be called "a soldiers' wind" by seamen in times past, meaning that it was easy to sail downwind. This is not always the case - a boat may be difficult to control when the wind is dead astern and there is always the danger of a "gybe". (A **gybe** means the boom crossing from one side of the boat to the other with the wind astern). If the wind is fairly strong an accidental gybe can be dangerous, and it may sometimes be better to zig-zag downwind with a number of controlled gybes. This may even be faster because a dead run is not the fastest point of sailing.

**Sail setting** - the sails should be properly and fully hoisted. Downhauls and outhauls, and kicking strap must be checked. A well-set sail should have no creases running across it. Adjust the sheets to the point of sailing - they should be pulled in tight when sailing closehauled, but otherwise should only be as tight as required to stop the sails flapping. You can judge the wind direction from the masthead pennant and by the feel of the wind on your face and neck.

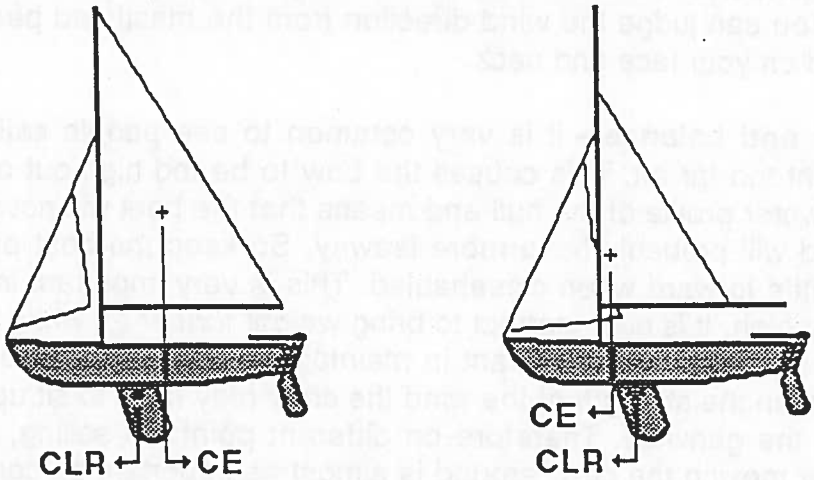
**Boat trim and balance** - it is very common to see people sailing with most of the crew weight too far aft. This causes the bow to be too high out of the water, changes the underwater profile of the hull and means that the boat will not sail so well - it will be slower and will probably have more leeway. So keep the boat properly trimmed - the weight a little forward when closehauled. This is very important in a BP 18 as the bow is naturally high. It is quite correct to bring weight further aft when running. The position of the crew is also very important in maintaining the side-to-side balance of the boat. Depending on the strength of the wind the crew may have to sit up to windward or even sit out on the gunwale. Therefore on different points of sailing, maintaining trim and balance by moving the crew around is almost as important as continually adjusting the sheets.

**Sail Balance** - A knowledge of sail balance will help you to get the best out of your boat. The central point of the pressure of the wind on the sails is called the "**Centre of Effort**". Sail balance depends on the relative positions of the Centre of Effort (CE) and the Centre of Lateral Resistance (CLR). The CE should be slightly behind the CLR, so that the boat will naturally tend to come bow to the wind when the tiller is let go. This is called "**weather helm**" and is a safety factor, as the boat will become upright and stop. If the CE is in front of the CLR, the boat will tend to swing away from the wind, causing more pressure on the sails, which could be dangerous. This is called "**lee helm**".



**Weather helm** is the normal condition in a sailing boat but the balance can be upset by changing the size of sails. For instance a small jib used with a large mainsail may cause too much weather helm, making it difficult to stop the boat swinging head to wind. The rudder must be kept at a marked angle in order to keep the boat on course, causing an enormous drag in the water, reducing the boat's speed and being very tiring on the helmsman.

**Lee helm** is an undesirable characteristic as explained above, and most boats and rigs are designed to avoid lee helm. However it can be caused by changing the sail balance. For instance, a large jib and a small mainsail would shift the Centre of Effort forward and this might be sufficient to cause lee helm.




Sail balance is therefore an important matter. It does not usually cause much trouble in normal circumstances unless there is a design fault in the boat. However, if you have to vary the size of sail - e.g. reefing in strong wind, experimenting with sails, or using a jury rig - you should think about the change in Centre of Effort that may occur with resulting change in balance.

**Mizzen Sail**
When sailing a ketch-rigged small boat such as the BP 18, you must slacken the mizzen sheet when you want to gybe. The pressure of the wind on a tight mizzen sail may be sufficient to prevent the stern coming up to windward in spite of full rudder. This is an aspect of weather helm, and may be abolished by slackening the mizzen.When tacking you may also have to remember the mizzen. In a light wind a BP 18 may be a bit slow coming around and a tight mizzen may act as "wind-vane", causing the boat to stick head to wind. If the jib has been brought across too early it may be "backed", and you will find yourself being pushed back onto the previous tack again. So, be careful of sail balance, and watch that mizzen!

**Triangular course** - this is a standard sailing test - all the points of sailing are demonstrated. Such courses always have a windward leg, a down-wind leg and a cross-wind leg. You are expected to sail the course "to best advantage" - this means to sail around in the most efficient way, not necessarily to race. However Scouts who have experience of racing will obviously have no difficulty here. Remember that you can raise your centreboard fully when running, and partly when on a broad reach.

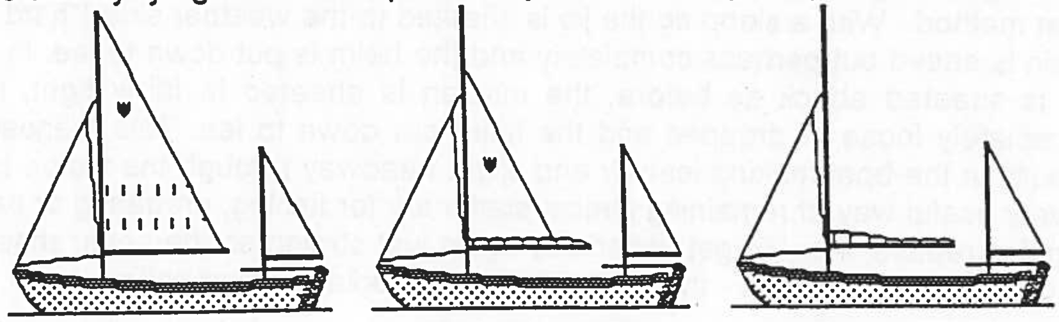
**Heaving-to**

This is a way of keeping a boat as nearly stationary as possible and at the same time keeping control - the boat is not drifting helplessly. Different rigs may require slightly differing managements - you will have to experiment with your craft to see which is the best method. With a sloop rig the jib is sheeted to the weather side ("hard aback"), the main is eased out perhaps completely and the helm is put down to lee. In a BP 18 the jib is sheeted aback as before, the mizzen is sheeted in fairly tight, the main let completely loose or dropped and the helm put down to lee. This manoeuvre usually results in the boat making leeway and slight headway through the water. Heaving-to is a very useful way of remaining almost stationary for fishing, preparing or eating a meal, running repairs, etc. To get under way again just straighten the helm, sheet in the main and let the jib go across - the boat will then immediately start sailing again.

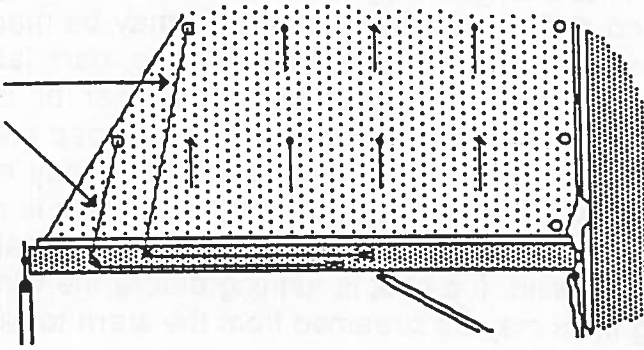
**Use of a sea anchor.**

You can also heave-to using a sea anchor - this is a means of holding a boat head to wind (sometimes stern to wind) and slowing its down-wind drift, and is usually used in bad weather. A sea anchor may take the form of a "Drogue" (a canvas tube or chute, wide at one end and narrow at the other), or may be made from a number of different materials normally found in a boat. For instance, oars lashed together with an anchor suspended underneath, or a sail tied to a spar or oar acting like a parachute. Streaming out long lines from the bow may help keep the boat head to wind but might not slow you down very much. Trailing a bucket may also be useful. A sea-anchor does not stop down-wind drift and plenty of sea room is required for this manoeuvre. If your boat is ketch or yawl rigged, the mizzen sail sheeted in tightly will also help to keep you head to wind. If a boat is running before the wind and is going too fast, a sea anchor or long lines may be streamed from the stern to slow it down.

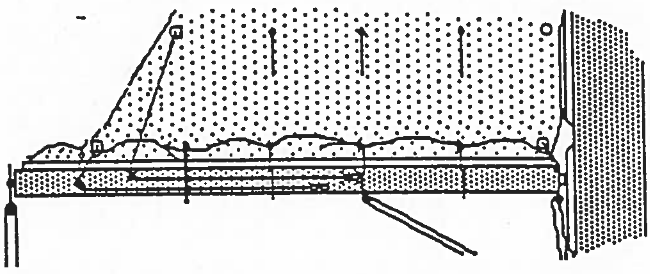
**Shortening sail** - As wind increases in strength and a boat is "overpressed", sail area must be reduced. In a dinghy or BP 18 sail is shortened by "reefing" the mainsail. In larger craft the jib may also be reefed or replaced by a smaller sail. **Reefing** a sail reduces size by tying down "reef points", by "slab" reefing or by "roller" reefing.



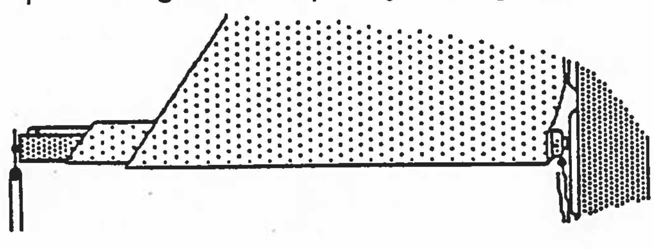

In a BP 18 the mainsail may be lowered completely in a strong wind and the boat sailed with jib and mizzen. Remember the points about sail balance mentioned above when reefing.




In **slab reefing** the cringle at the forward end of the reefing line is held down to the level of the boom either by a hook or by tying with a lanyard. The cringle at the after end is pulled down by a **reefing pennant**, secured to a cleat on the boom. The reef points or a continuous line through a row of eyelets are used to secure the sail. The above diagram shows the arrangements for two reefs, and the diagram below shows one reef taken in.



In **roller reefing** the sail is rolled up by rotating the boom. This is usually done by a handle at the goose-neck which operates a worm gear. The kicking strap must be disconnected unless a special "claw" fitting is used. In some dinghies the sail can be rolled manually by disconnecting the goose-neck, and the sail-bag may be rolled into the sail leaving the cord protruding as a temporary kicking strap.

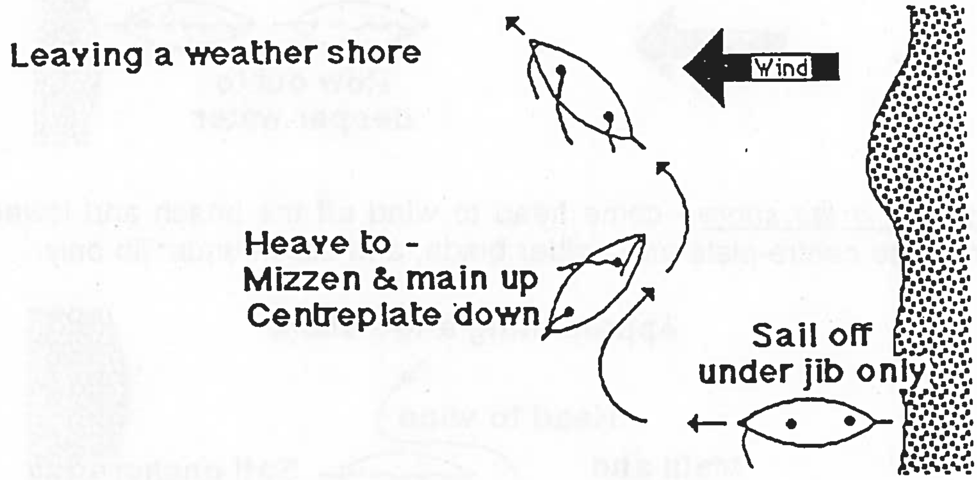


**Sailing off and onto a beach**
Using a beach means launching and recovering through shallow water, and being ready to to get wet at least up to your knees! You must also be prepared to raise or lower your centreboard rapidly as required. The techniques for dinghies and for heavier boats such as the BP 18 are not exactly the same.

**Weather shore** - The wind is blowing offshore.

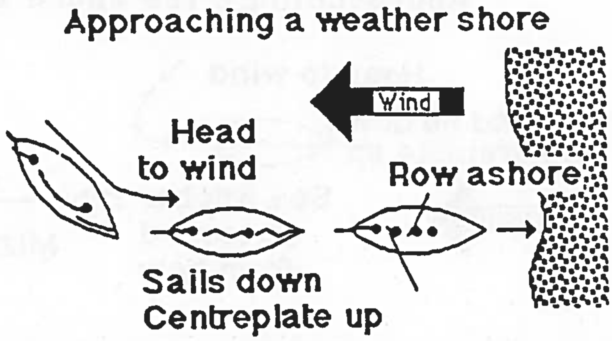
*Sailing off a weather shore* - launch a **dinghy** and keep head to wind while the sails are hoisted. The crew gets in, the helmsman turns the boat around and quickly climbs in, and sails away. Lower the centre-plate in deeper water.

Launch a **BP 18** stern to wind and sail off the beach with jib only - when in deeper water, come head to wind by hoisting the mizzen, heave-to and hoist the mainsail.




*Sailing onto a weather shore* - a **dinghy** should approach on a beat (close-hauled). The rudder blade and the centre-plate are raised in the shallow water and the crewman jumps out to hold the boat as it is swung head to wind.

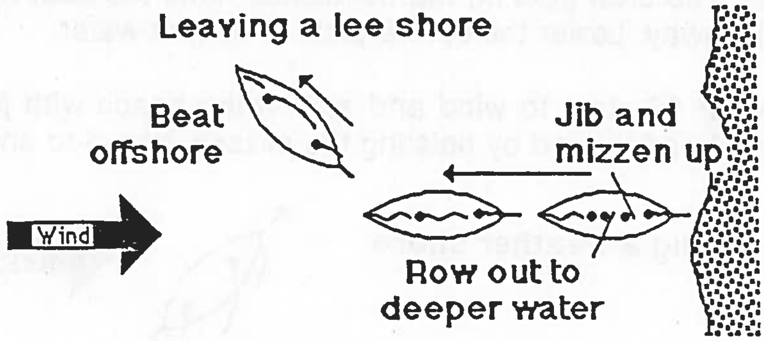
In a **BP 18,** sail in reasonably close to the shore, ship oars, raise centre-plate and rudder blade, drop jib and mainsail, and row in.



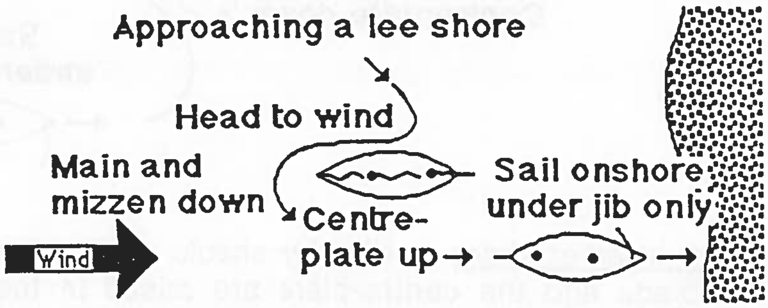
**Lee shore** - the wind is blowing onshore

*Sailing off a lee shore* - launch a **dinghy** bow first and hold head to wind while sails are raised. The crewman gets in. The helmsman pushes out hard and jumps in. The sheets are trimmed and the centre-plate is lowered carefully - if it hits the bottom it may stop progress, but if it is not lowered quickly enough the boat will drift sideways onto the shore.

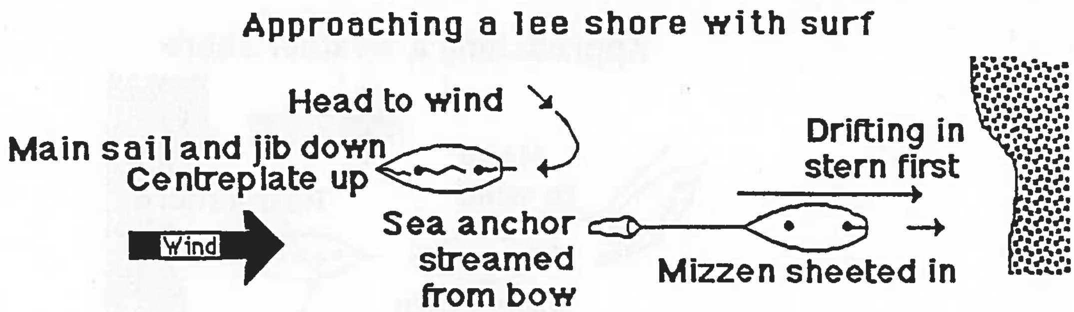
A **BP 18** should be rowed off a lee shore, and the sails hoisted in deeper water.




*Sailing onto a lee shore* - come head to wind off the beach and lower mainsail and mizzen, raise centre-plate and rudder blade, and sail in under jib only.




If there is surf, come head to wind, lower all sails except the mizzen, stream a sea anchor from the bow, raise the centre-plate, raise or unship the rudder and drift in stern first.

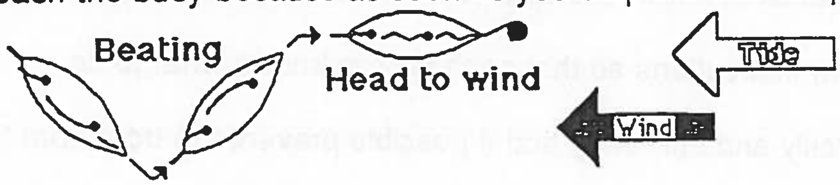



If there is heavy surf you should avoid approaching a lee shore. If you must land there, try to keep the bow to the surf all the time and don't let the boat swing beam on to the sea. The sea anchor and the mizzen should be sufficient, but the oars may have to be used as well.

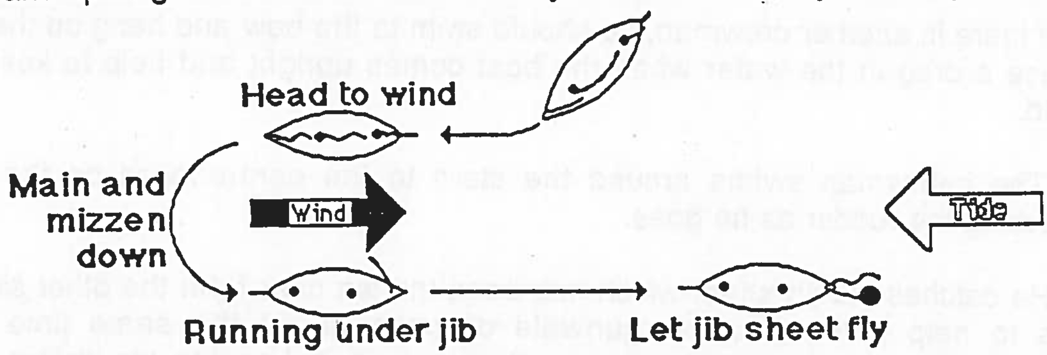
**Picking up a mooring** - you should sail to the mooring buoy in such a way that the boat comes head to wind and stops just as you reach the buoy, and your crew can pick it up and bring it on board. You then drop your sails, jib first, and raise the centreboard. Coming head to wind in exactly the right place takes practice - get used to the way that your boat handles, but remember that other boats may not handle in quite the same way. A light dinghy will stop very quickly when brought head to wind, but a heavier craft such as a BP 18 will "carry her way" further.

**Effect of tide** - The strength and direction of the tide may cause you to modify or change technique for picking up a mooring. If the tide is very weak it will make no difference and you should approach head to wind as described above. If the tide is stronger you will have to approach **head to tide.**

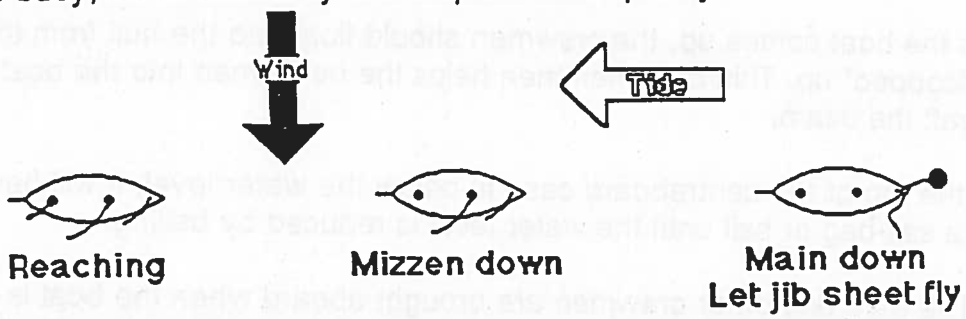
*Tide and wind together* - approach the mooring buoy as before, but only turn head to wind as you reach the buoy because as soon as you stop the tide will push you back.




*Tide against wind* - approaching the buoy head to wind will not stop the boat's forward movement - you must approach the buoy downwind. To do this take down the mainsail (and mizzen) and run downwind with jib only. You can control speed by slacking the jib sheet and spilling wind from the sail. When you reach the buoy, let the jib sheets fly.




*Tide across wind* - here you must approach the buoy on a reach. You may control the boat's speed by easing jib and main sheets and spilling wind from the sails. When you reach the buoy, let all sheets fly and drop the sails quickly.



**Coming alongside** - If the wind is blowing parallel with the quay or slip you will be able to come alongside head to wind without difficulty. If the wind is blowing onto the slip, approach downwind under jib alone, drop the jib or let sheet fly some yards off, depending on the wind strength, turn beam on to the slip a few feet off and drift in sideways. If the wind is blowing off the slip, you can approach on a beat or a reach, letting sheets fly as you come alongside. Get your mainsail down quickly. If there is a strong tide running along the quay come head to tide as described under picking up a mooring.

**Capsizing** is almost inevitable at some stage in small boat sailing, and therefore you must be competent to deal with this emergency if it happens. Ability to recover from a capsize is an important aspect of helmsmanship. This has already been described in the Handbook Part 1, but more details are given here.

1. Check that all the crew are accounted for and that nobody is trapped under the sail.

2. Give clear instructions so that each person knows what to do.

3.Work quickly and efficiently and if possible prevent the boat from "turning turtle".

4. One crew member stays on the inner side of the boat and throws the lower jib sheet over the upper gunwale to the other side. NOTE - If the wind is very strong it may be necessary for this crewman to release the main halyard and lower the mainsail before righting the boat.

5. If there is another crewman, he should swim to the bow and hang on there - this will cause a drag in the water when the boat comes upright and help to keep it head to wind.

6. The helmsman swims around the stern to the centreboard on the other side, checking the rudder as he goes.

7. He catches the jib sheet which has been thrown over from the other side and uses this to help pull the upper gunwale downwards. At the same time he pushes downwards on the centreboard and climbs up on it, keeping his weight as near the boat as possible at first, in order not to break the centreboard. If the centreboard is a strong metal one he may be able to stand further out and thus speed up the recovery. This should start the boat rolling back up again.

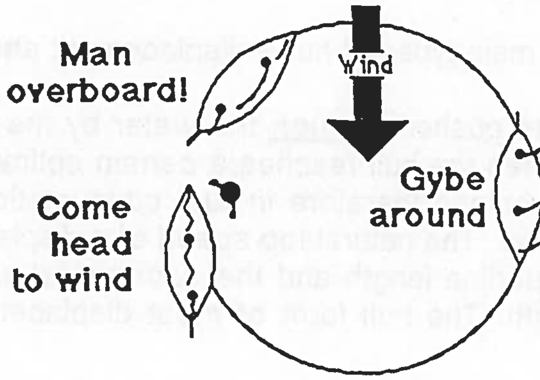
8. As the boat comes up, the crewman should float into the hull from the mast side and be "scooped" up. This crewman then helps the helmsman into the boat over the quarter or abaft the beam.

9. If the top of the centreboard case is below the water level, it will have to be plugged with a sail-bag or sail until the water level is reduced by bailing.

10. The third and other crewmen are brought aboard when the boat is more stable and help with the bailing. When the boat is sufficiently stable to be able to sail again, you can get under way and continue bailing while moving.

**Man overboard** It does not often happen that someone falls overboard from a small craft, but a good helmsman must be prepared for such an occurance. Man overboard drill is also useful as practice in accurate boat manoeuvering.

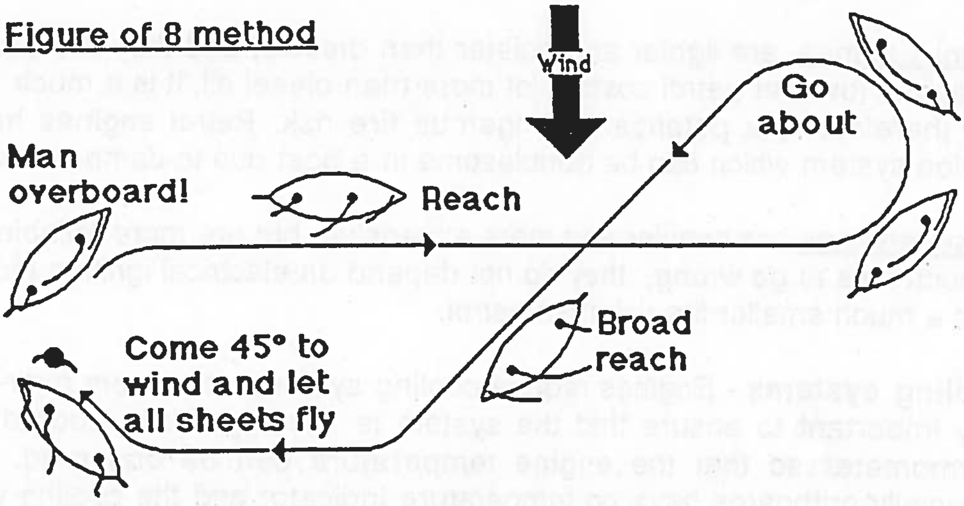
Gybe method




If the wind is not too strong the quickest method of getting to a man overboard is to gybe around and come up head to wind alongside him. However this method has the disadvantage of having to do a gybe which could be hazardous in a strong wind.

Another way is the "figure-of-eight" method - go immediately onto a beam reach, throw out a lifebuoy if you have one and instruct a crew member to keep watch on the person in the water (In a choppy sea it is easy to lose sight of a head bobbing about in the waves). When ready, tack and reach back again towards the casualty, steering a bit downwind of him. Then turn up towards him, about 45° off the wind, and let all sheets go, aiming to stop in the water with him abeam on the windward side - this requires plenty of practice. Using your crew to balance the boat, bring the casualty in over the gunwale amidships. By bringing the person in the water onto the windward side, you will be able to get him in unencumbered by the sails, boom and sheets, which will be blowing out on the opposite side.

Figure of 8 method



## MOTORBOATING

This part of Section B deals mainly with Boat Handling under power. Some notes about engines are given here, sufficient for the basic understanding required for the Power Helmsman Badge. More technical details for the Marine Mechanic Badge will be found starting on page 19.

**Hulls** - There are two main types of hull - displacement and planing.

Displacement hulls are pushed through the water by the engine, and the resistance created means that when the hull reaches a certain optimum speed it requires a very great increase in power and therefore in fuel consumption to achieve even a small further increase in speed. The natural top speed of a displacement hull is 1.4 times the square root of the waterline length and the economical speed is about 1.2 x square root of waterline length. The hull form of most displacement hulls is usually called "round bilge".

Planing hulls are designed so that when sufficient power is applied they will rise to skim on the top of the water. This reduces drag and means that much greater speeds can be obtained with less power. Some planing hulls are flat-bottomed aft, with V shape forward to reduce pounding, others are "deep V" throughout. Also included in the planing hulls are the various inflatable boats and dinghies. Not every hull fits exactly into these categories, and there are many compromises between both, often called semi-displacement hulls.

Many sailing craft also have engines. The hulls in this case will be sailing types - e.g. long keel, fin keel, bilge keels, maybe even centreboard. In high performance sailing craft the engine is often quite small compared with the size of the boat - but in these cases it is really only an auxiliary. Other boats may have a bigger engine but their sailing qualities may not be so good - these are called "motor-sailers".

**Engines** - Motor power may be installed as **inboard, outboard** or **outdrive** (sometimes called "inboard/outboard") engines. There are two main types of engine - petrol and diesel.

Petrol Engines are lighter and quieter than diesels, and they are usually appreciably cheaper. However petrol costs a lot more than diesel oil, it is a much more volatile fuel and therefore is a potentially dangerous fire risk. Petrol engines have an electrical ignition system which can be troublesome in a boat due to damp, corrosion, etc.

Diesel engines are heavier and more expensive, but are more reliable in a boat. There is much less to go wrong, they do not depend on electrical ignition for firing, and diesel oil is a much smaller fire risk than petrol.

**Cooling systems** - Engines require cooling systems to prevent over-heating, and it is very important to ensure that the system is working. Most inboard engines have a thermometer so that the engine temperature can be observed. Some engines especially outboards have no temperature indicator and the cooling water outlet must be checked, particularly in circumstances where weed or plastic may obstruct the water inlet. Inboard cooling systems usually have a filter at the water intake, and this should be inspected regularly and cleared if necessary.

**Gear boxes** - These may be mechanical or hydraulic. The level of oil in the gear box should be checked occasionally, depending on the type of gear box fitted - consult manufacturer's instructions. The gear lever will have three positions - Forward, neutral and reverse. There is no clutch on a marine engine - just push or pull the lever in the required direction. Never change gear when the engine is revving high - always close the throttle down to operate the gear lever.

**Propulsion** - The drive shaft goes into the gear-box behind the engine. This provides the connection between the drive shaft and the propellor shaft. The propellor shaft passes out through the stern gland, which is a grease packed tube which prevents water leaking in along the shaft. The propellor is mounted on the outer end of the shaft. Propellors may be right or left handed. A right handed propellor turns clockwise in forward gear when viewed from astern. A left handed propellor turns anti-clockwise. Propellors are described by their diameter and by their "pitch" - i.e. the angle at which the blades are set to cut through the water. Some sailing boats have folding propellors or feathering propellors in order to reduce drag when sailing.

**Twin engines** - More powerful cruisers have two engines. These make the boat very much more manoeuvrable, and there is the added reliability of two independent power units. They are of course more expensive and use more fuel. Most twin-screw boats have outward turning propellors - i.e. the starboard propellor is right-handed and the port is left-handed. Sometimes a motor cruiser may have a main engine, and also a much smaller engine mounted to one side as a reserve - this is usually called a "wing engine". A wing engine may be used for manoeuvring in a harbour and also for battery charging when the main engine is not in use.

**Pre-start checks** - Before starting the engine for the first time each day run through the following check-list.

1. Fuel - check gauge or dip tank.
2. Oil - Check dip-stick.
3. Cooling system - check water level if fresh water cooled.

Another check which should be performed every few weeks is the battery acid level.

**Engine starting** - Most engines are started by using a key switch which activates the starter motor. In a petrol engine this also activates the ignition system. In cold weather a diesel engine may require use of the cold-start mechanism - a method of pre-heating the air that is taken in through the air intake. Some engines have to be "swung", and outboard motors have starter cords to pull. When the engine starts, where appropriate check the following -

1. Oil pressure warning light - should go out.
2. Ammeter - should show positive charging.
3. Rev.counter - raise to cruising revs. and then lower to "ticking-over".
4. Exhaust or cooling water outlet - water being expelled.

**Fire prevention**

Fuel - Petrol is more dangerous than diesel oil. Petrol vapourises easily and it is this heavier-than-air vapour which is so dangerous - it can be ignited explosively by a lighted match, electrical spark, etc. Butane gas is similarly dangerous.

1. No naked lights should be permitted in the vicinity when refueling is taking place.
2. Stop engine when refueling, and turn off gas and electrical appliances.
3. Try to avoid spillage - if this does occur, mop it up with an absorbent cloth and encourage a flow of air to dispel any inflammable vapour.
4. The filler for the fuel tank, especially petrol, should be on deck so that any overflow does not go into the bilges, and can be washed away easily.
5. Gas cylinders should be stored in a locker in the cockpit or on deck, which should drain overboard.
6. Check gas connections and tubes regularly.
7. Turn off the gas cylinder when not in use.
8. Gas is heavier than air and will sink into the bilges, under floor boards, etc. If there has been a gas leak or if you suspect one, avoid all naked lights or smoking, do not start the engine or turn on any electrical equipment. Ventilate the boat - open all hatches and encourage a stream of air through. Agitate the air in the bilges and take up floorboards. Some gas can dissolve in water in the bilges so pump out bilge water.
9. Don't hang cloths over the cooker when the gas is lit.
10. Be careful when cooking that you don't have a galley fire - e.g. burning fat.

**Fire extinguishers**

Motor cruisers, or sailing cruisers with engines should carry at least one fire extinguisher not less than 1.4kg. capacity. If they have cooking facilities, they should have at least another similar extinguisher. Dry powder extinguishers are probably the most suitable. All crew members should know where the fire extinguishers are and how to use them. It is recommended that the engine compartments of motor cruisers should also have fixed automatic extinguishers. A fire blanket should be available in the galley, and this can be used to smother a fire very effectively. A wet towel or cloth can also be used.

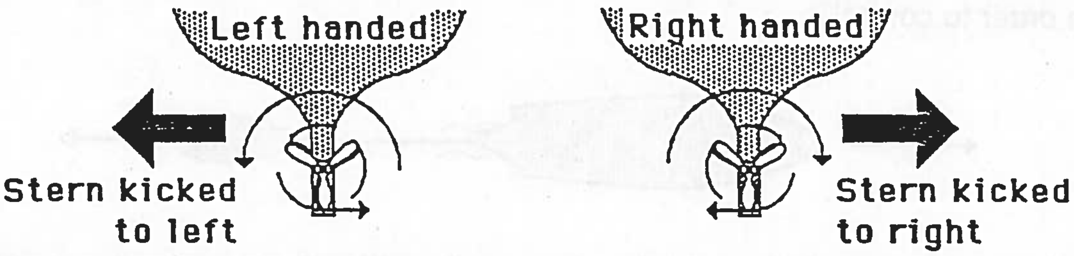
**Fire fighting**

If a fire occurs it must be attacked as quickly as possible. Raise the alarm by shouting "FIRE!" Use the nearest fire extinuisher, aiming at the base of the fire.

Note - never throw water on an oil or fuel fire - the oil will float, continue to burn and will spread further. Never throw water on an electrical fire as this may cause more short-circuiting and more sparking. Water can however be very effective against wood or paper fires. The boat should have two buckets with lanyards attached.

**Turning** - The rudder of a motor boat is usually mounted just behind the propellor and the flow of water gives good positive reaction to rudder movement. When the propellor is stopped the rudder is not as effective. Sailing boats usually have larger rudders than motor boats and thus can manoeuvre more easily without power.

**Paddlewheel effect** - A propellor can affect the steering of a boat due to the "transverse thrust", or "paddlewheel effect". The larger the propellor the more marked is this effect. The density of water gradually increases with depth. Therefore the lower blades of a propellor are moving in denser water than the upper blades, and meet more resistance. When going ahead, a right handed propellor's lower blade is going from right to left, and this results in a "kick" of the stern of the boat to the right or starboard. When going astern of course, the stern will be pushed to port. The opposite applies to a left-handed propellor. When going ahead this effect is very easily counteracted by the rudder, but when the engine is put into reverse the effect can be quite marked and can be used to advantage.

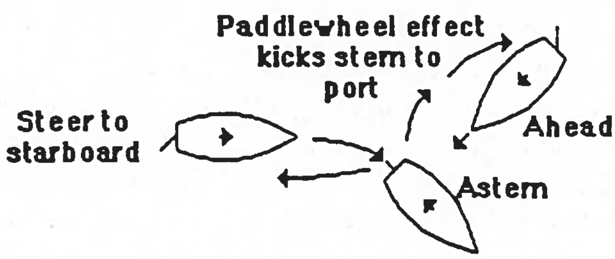



Remembering the paddlewheel effect, you can see that a boat with a **right-handed** propellor should turn a little more easily to **port** when in forward gear because the stern is being pushed to starboard. But the paddlewheel effect is more marked in reverse gear - therefore by using reverse you can turn more quickly to **starboard.**

With a right-handed propellor -

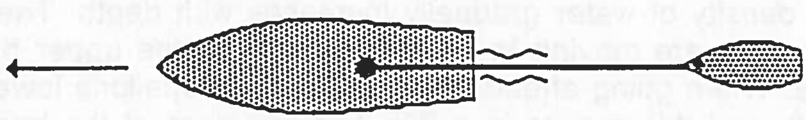
1. Steer to starboard
2. Engine ahead
3. Neutral
4. Engine astern
5. Neutral
6. Engine ahead

When the engine runs in reverse, the stern of the boat is pushed to port.

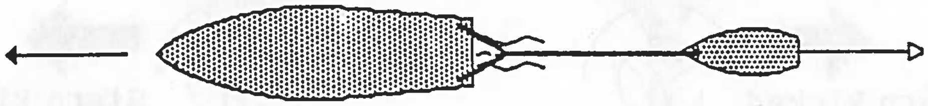



Summary - for smallest turning circle (using ahead, reverse, ahead) - steer to starboard with a right-handed propellor, to port with a left-handed.

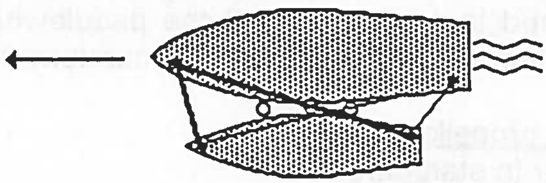
**Towing** - Use a strong line and attach it to a strong attachment - i.e. samson post or mooring cleat. The best attachment for a towline is midships - this is where tugs tow from as it allows the towing vessel manoeuvre easily. It is not usually possible to do this in an ordinary boat, but try to tow from the centre line, as an attachment on either quarter will cause difficulty in steering. Arrange for the towed craft to be steered, if necessary by putting one of your own crew aboard.



If you have no centre line attachment and the tow is heavy you should rig up a bridle. In bad conditions a tow can be very difficult - both vessels will be surging on waves and the tow-line will come under intermittent severe strain. It may be necessary under some conditions to stream a drogue or sea anchor or a number of long ropes behind the tow in order to control it.

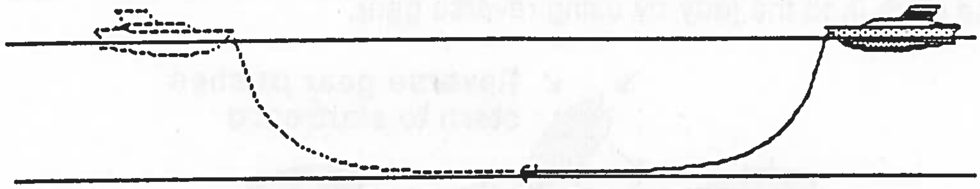


In very calm conditions towing is usually without worry, and sometimes towing alongside can be the most suitable method.

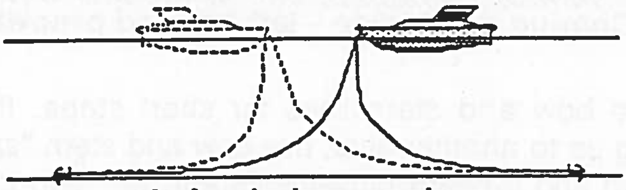


When towing alongside, the important lines are a diagonal "spring" from the bow of the towing craft to the stern of the tow, and a bow breast rope. The spring is the real tow-line and the bowline keeps the bows from separating. The opposite diagonal spring and a stern line are useful to keep the combination stable if much manoeuvring is required. When towing alongside make sure that both boats are well fendered.

**Kedge anchor** - Any cruising boat, power or sail, should carry at least two anchors. The main, heaviest anchor is called the "bower anchor", and a second, lighter anchor is called a "kedge". The kedge may be used for temporary anchoring in quiet conditions, or as an extra anchor to supplement the bower in strong winds. In a restricted area the use of two anchors will reduce the size of the "swinging circle

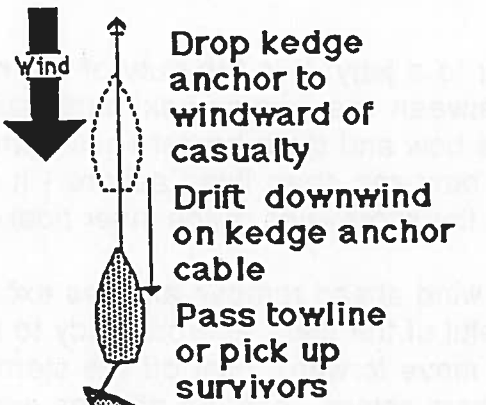


**Lying to a single anchor**

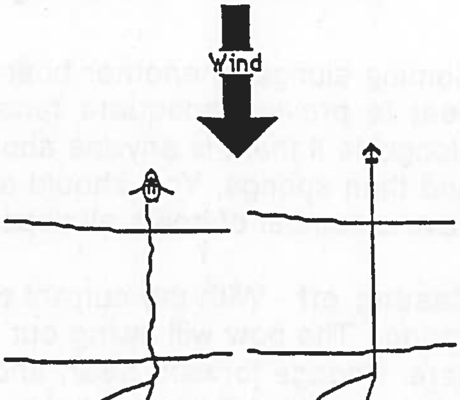


**Lying to two anchors**

A kedge has two important emergency uses. Going to the aid of another boat which is in dangerous or shallow waters, you can drop your kedge anchor well upwind and then veer out the cable and drop astern towards the other craft, the kedge keeping you head to wind. You may be able to get close enough to the casualty to heave a line, perhaps to try a tow, or to bring survivors aboard your own boat. Your "escape route" is via the kedge cable, using manpower pulling the cable, as well as engine.



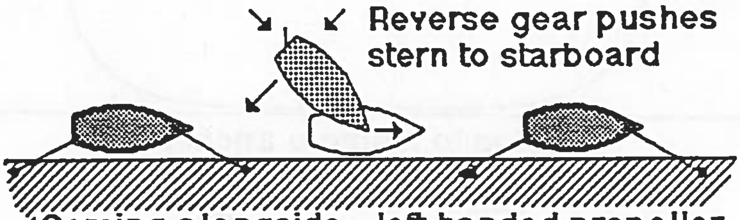

**Kedge anchor for rescue**




**'Kedging off' when aground**

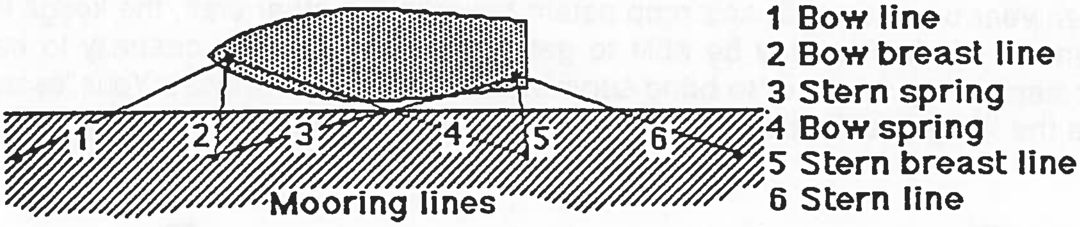
A kedge is also used to "kedge off" when aground. If you go aground on a falling tide, you may be able to get off using the kedge if you move quickly, or use the kedge to haul off as soon as you are afloat on the rising tide. This can be very useful if there is an onshore wind which might otherwise blow you further in as the tide rose. You should take the kedge into the dinghy, hanging it over the stern. Flake the rope in the bottom of the dinghy in such a way that it runs out freely as you row away from the boat towards deeper water. Drop the anchor at the limit of the scope of the rope.

**Coming alongside** - If possible, come alongside a quay or jetty head to wind or current, whichever is the strongest. Remember the "paddlewheel effect"of the propellor and if you can use it to your advantage, do so, otherwise make allowances for it. When wind or current are not important considerations, come alongside on the starboard side if your propellor is left-handed, or port side if right-handed - this means that you can push the stern in to the jetty by using reverse gear.



Coming alongside - left handed propellor

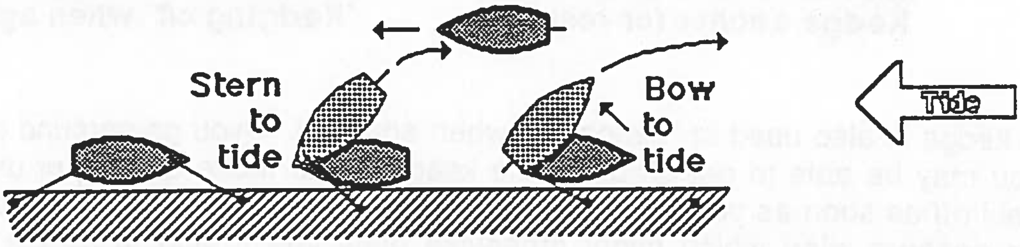
**Tying up** - Use bow and stern lines for short stops. If you are staying for long, especially if tying up to another boat, use bow and stern "springs" also - these will stop surging backward and forward movements and will help keep the boat parallel to the quayside. Bow and stern "breast lines" may also be used,usually temporarily, to keep the boat close in to the jetty. All lines, but especially the breast lines must be carefully watched and adjusted if there is any tidal rise or fall. Don't forget adequate fenders.



Mooring lines

Coming alongside another boat is similar to a jetty. It is the duty of the newly arrived boat to provide adequate fendering between the boats. Ask permission to come alongside if there is anyone aboard. Take bow and stern breast lines to the other boat and then springs. You should also take bow and stern lines ashore - it is not fair to have a number of boats all depending on the shore lines of the inner boat of the "raft".

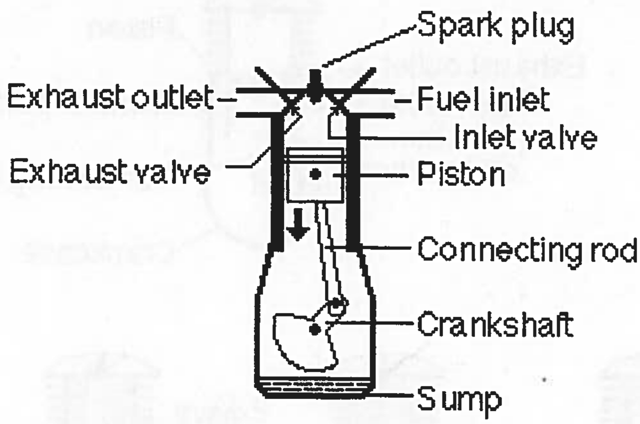
**Casting off** - With the current or strong wind ahead remove all lines except the stern spring. The bow will swing out - be careful of the stern and be ready to use a fender here. Engage forward gear, and as you move forward, cast off the stern spring. The reverse applies if the current or wind is from astern - cast off all lines except the bow spring, let the stern swing out and reverse out.

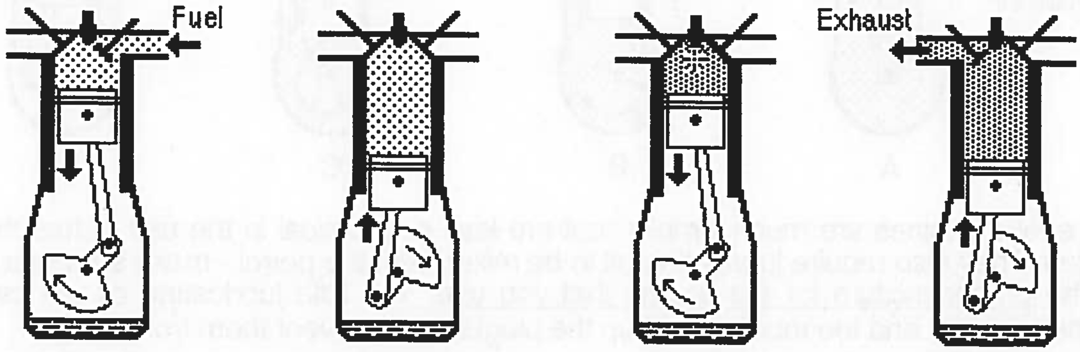


# ENGINES

## Petrol

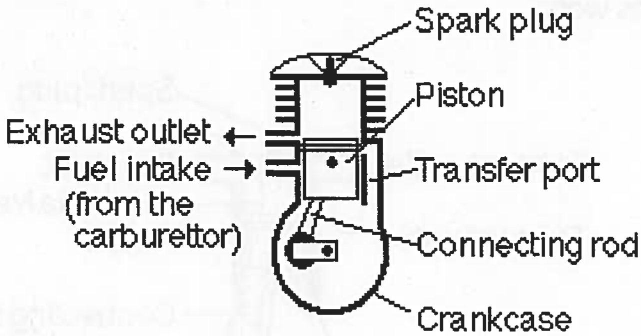
In a petrol engine, air and fuel is mixed in the **carburettor**, and this mixture is sucked into the **cylinder** on the down-stroke of the **piston**. It is compressed on the up-stroke and ignited by an electrical spark from the **spark-plug**. The expanding gases drive the piston down the cylinder again on the "**power stroke**", and they are then expelled through the **exhaust valve** as the piston comes up again. The piston has four "**strokes**" (two up and two down) for each firing of the cylinder. This method of action is called <u>four-stroke,</u> and is the way that most inboard engines work.

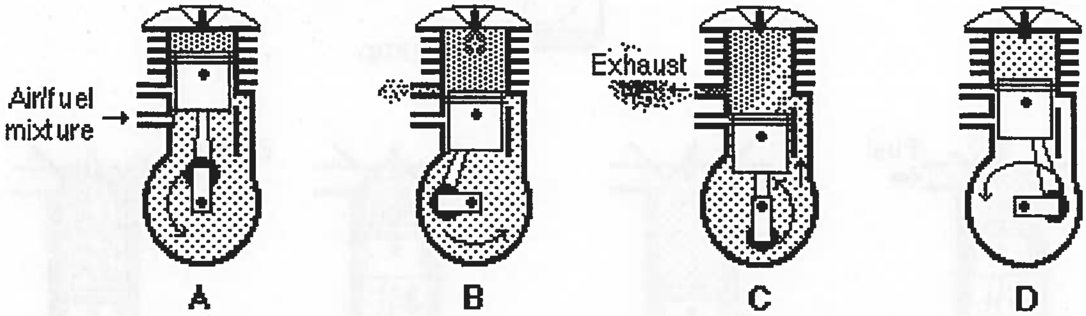



**Induction stroke** · **Compression stroke** · **Power stroke** · **Exhaust stroke**

Most outboard engines have a simpler method of operation. The fuel/air mixture is sucked into the **crankcase**, as the piston rises **(A)**. Fuel already in the cylinder is ignited, driving the piston down on the power stroke **(B)**. As the piston goes below the opening of the **transfer port** the compressed fuel/air mixture in the crankcase is injected into the cylinder and as the piston comes back up again it expels the burnt gases **(C)**. The rising piston compresses the new fuel/air mixture in the cylinder **(D)**, and as it clears the inlet, more fuel enters the crankcase **(A)**. This sequence takes only two strokes of the piston (one up and one down) and is called two-stroke.

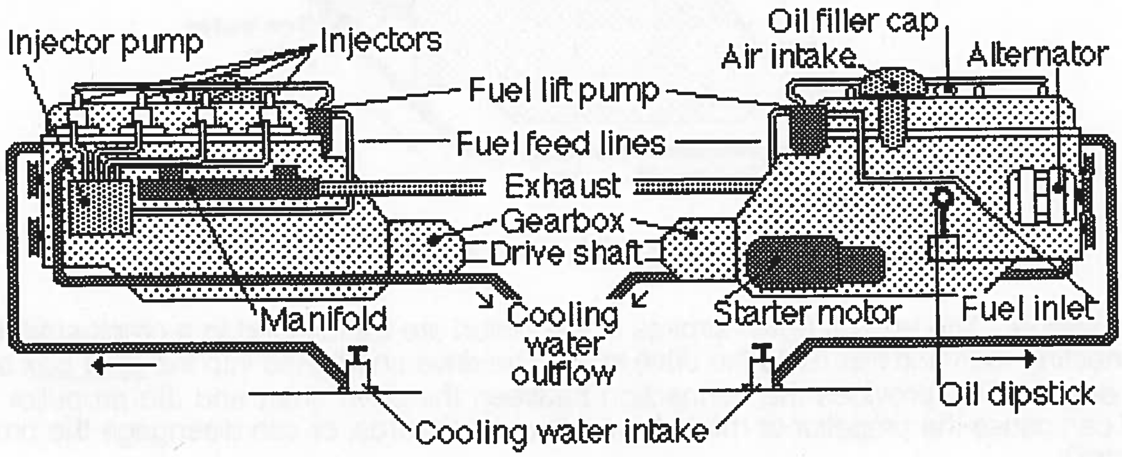



Two stroke engines are much simpler, but are less economical in the use of fuel than four-strokes. They also require lubricating oil to be mixed with the petrol - make sure that you find out the proper mixture for the engine that you use. Too little lubricating oil will cause the engine to sieze, and too much will oil up the plug(s) and prevent them from firing.

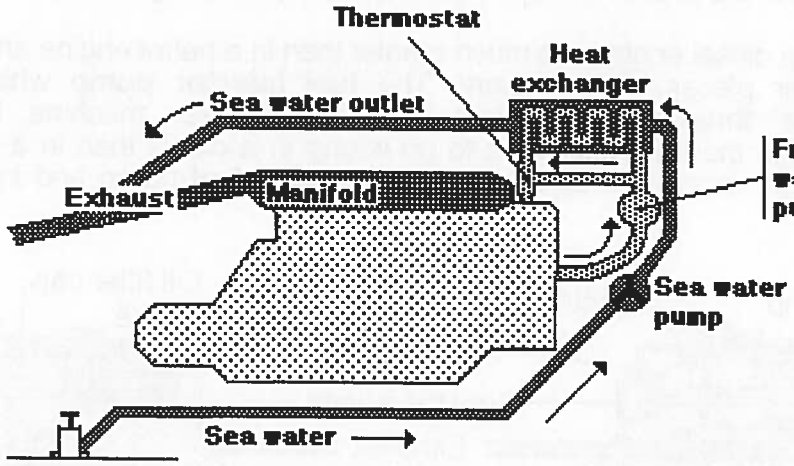
**Diesel**
Diesel engines usually operate on the four-stroke method. There is no carburettor. Air is sucked into the cylinder and is compressed on the up-stroke of the piston. Compression causes the air to heat so much that it ignites a fine spray of diesel fuel which is injected under great pressure by the **fuel injector pump** through the "**injector**" or "**atomiser**". There are no spark plugs in a diesel engine. The amount of fuel that is injected is very carefully metered. The rest of the four-stroke cycle is similar to a petrol engine.

The pressures in a diesel engine are much greater than in a petrol engine and therefore they are much heavier pieces of machinery. The **fuel injector pump** which delivers the appropriate "dose" through the injectors is a very complex machine, built with great precision. Although there is much less to go wrong in a diesel than in a petrol engine, if something does go wrong it may be big and serious - fuel pump and injectors require expert attention.




**Main parts of a diesel engine**

**Cooling systems** - Both petrol and diesel engines require cooling systems to prevent over-heating. This is almost always water cooling - air cooling is extremely rare in a marine engine. The simplest form of cooling is to suck water in from outside, circulate it through the cooling system and then discharge it overboard. Many engines have an enclosed fresh water system with its own pump, which is in turn cooled by an outside system through a "heat exchanger".




**Fresh water cooling with heat exchanger**

**Propulsion** - The up and down strokes of the piston are transmitted to a crank-shaft by the connecting rods and this turns the drive shaft. The drive shaft goes into the gear-box behind the engine. This provides the connection between the drive shaft and the propellor shaft, and can cause the propellor to rotate forwards or backwards, or can disengage the propellor (neutral).

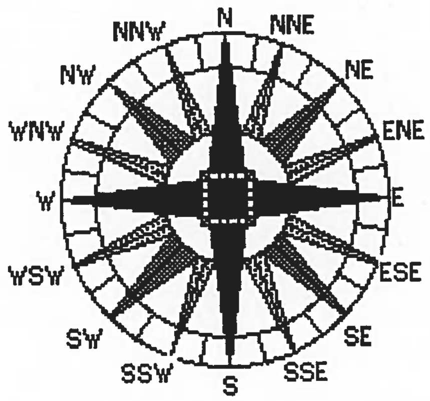
The propellor shaft passes out through the stern gland, which is a grease packed tube which prevents water leaking in along the shaft. The propellor is mounted on the outer end of the shaft.

Propellors may be right or left handed. A right handed propellor turns clockwise in forward gear when viewed from astern. A left handed propellor turns anti-clockwise. Propellors are described by their diameter and by their "pitch" - i.e. the angle at which the blades are set to cut through the water. Some sailing boats have folding propellors or feathering propellors in order to reduce drag when sailing.

# SEA TRAINING MANUAL

## SECTION C

# NAVIGATION AND PILOTAGE




SEA
TRAINING
TEAM

SCOUTING
IRELAND
SAI

## NAVIGATION AND PILOTAGE

These pages are designed to be used in conjunction with a Navigation Course, and also cover the navigation theory for the Sea Scout Progress Scheme, and also for Charge Certificates

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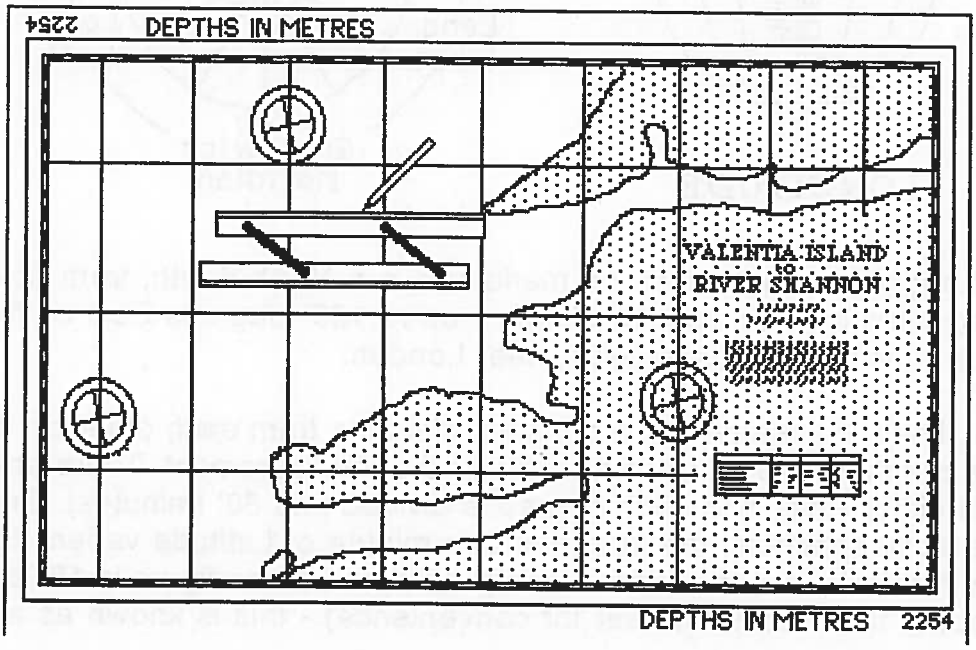
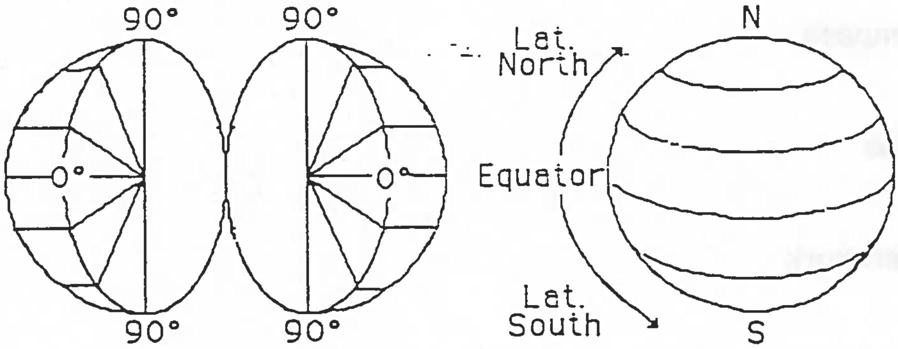


## NAUTICAL PUBLICATIONS AND SOURCES OF INFORMATION

### Charts

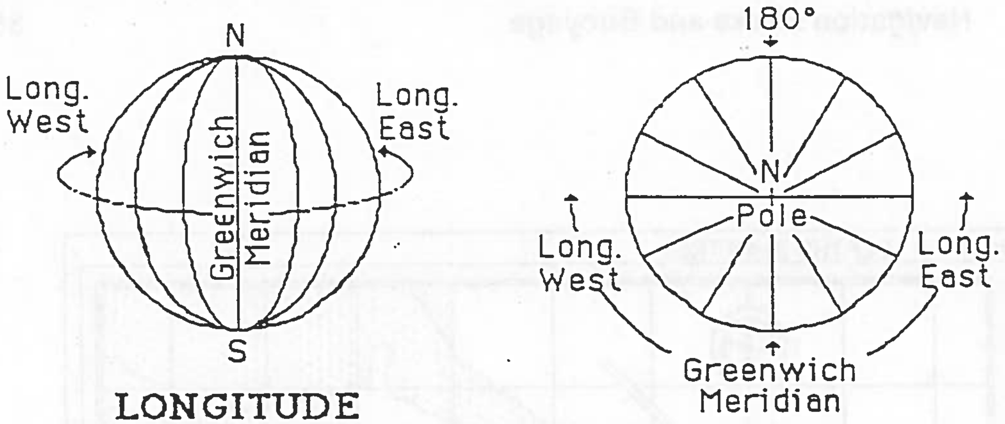
Charts are maps used by sea navigators and show details and features, both under the water and on nearby land, which are essential for navigation. You must become familiar with the layout of nautical charts and understand the information that is symbolised, summarised and tabulated on the face of the chart.

Some basic knowledge of Latitude and Longitude is essential in order to understand Charts and Chartwork. Latitude and Longitude are imaginary lines on the Earth's surface which are used to define position.




LATITUDE

The lines of Latitude, or "parallels", are circular lines around the Earth parallel to the Equator. They are designated by their angular distance (as measured from the Earth's centre) up to 90° North or South of the Equator.



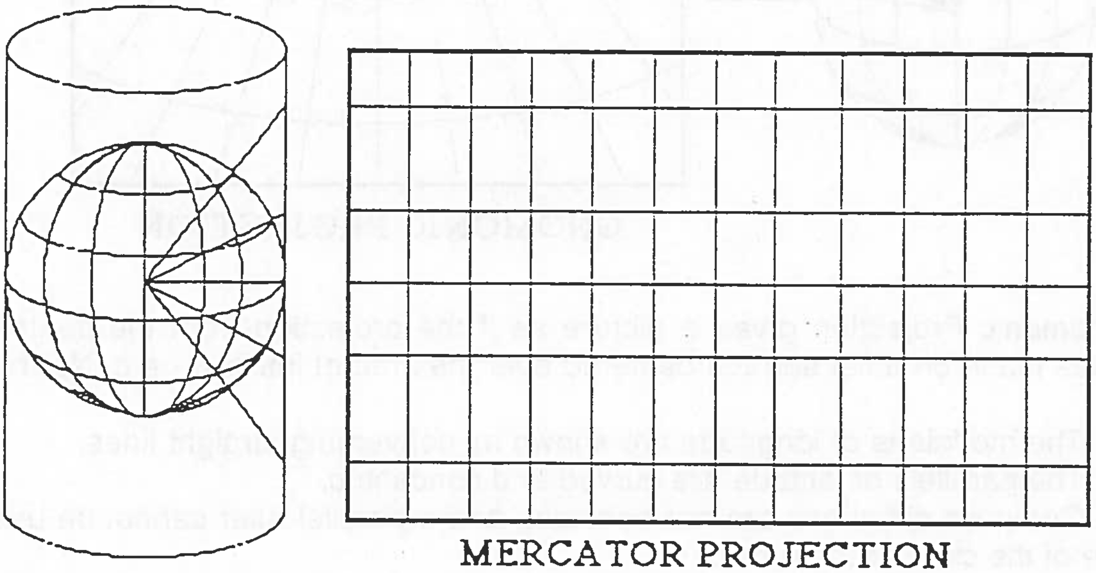

LONGITUDE

The lines of Longitude, also known as meridians, run North/South, from pole to pole. They are designated by their angular distance up to 180° degrees East or West of the meridian which runs through Greenwich, near London.

Being parallel, lines of Latitude are a constant distance from each other on the Earth's surface. They can therefore be used as a method of measurement. There are 90° from the Equator to either Pole, and each degree is divided into 60' (minutes). Because the Earth is not exactly spherical, the length of one minute of Latitude varies slightly from the Equator to the Pole, but the Internationally accepted mean figure is 1852 metres or 6077 feet (usually taken as 6080 feet for convenience) - this is known as a **Nautical Mile.**

**Projections**

There are many different ways of trying to represent the curved surface of the Earth on a flat piece of paper - these are called "Projections".



MERCATOR PROJECTION

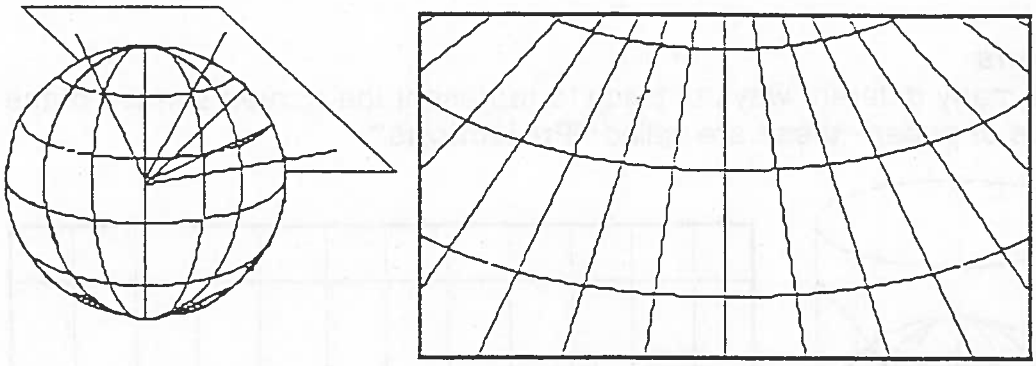
The Mercator projection shows the earth's surface projected onto a cylinder wrapped around the globe, as if from a light source in the centre of a transparent globe.

1. The meridians of longitude appear as parallel vertical lines. This causes an East / West enlargement the further away from the Equator.

2. The parallels of Latitude appear as parallel horizontal lines, separated more widely the further from the Equator, causing a North to South distortion.

3. Because the distance scale increases away from the Equator, the scale of a Mercator Chart is not constant, but in most coastal charts the difference in scale from the top to the bottom is negligable. The shape of the land remains the same, and Compass directions remain constant. A parallel ruler or other navigational drawing instrument can be used across the face of a Mercator Chart without any adjustment.

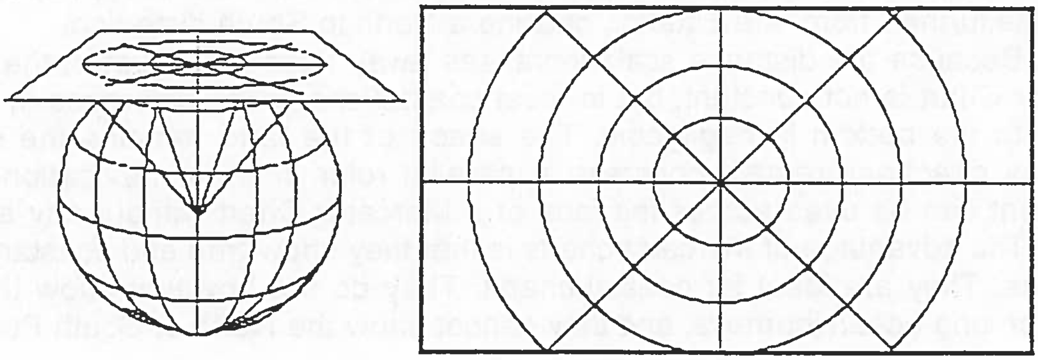
4. The advantage of Mercator charts is that they show true and constant compass directions. They are ideal for coastal charts. They do not however show the shortest routes for long ocean journeys, and they cannot show the North or South Poles.



GNOMONIC PROJECTION

The Gnomonic Projection gives a picture as if the projection from the centre of the globe was made on a flat surface centered over the area of interest - e.g. North Atlantic Ocean.

1. The meridians of longitude are shown as converging straight lines.
2. The parallels of latitude are curved and concentric.
3. Compass directions are not constant, and a parallel ruler cannot be used from one side of the chart to the other.
4. Gnomonic Projection is not used for coastal navigation except sometimes for harbour plans. However this projection is used for ocean charts - it gives the shortest routes for ocean passages - the "Great Circle" routes. This will not affect your coastal navigation, but it is useful to know that such charts exist.



POLAR CHART

Polar projection is a special version of Gnomonic projection. The meridians appear as lines radiating from the pole, and the parallels of latitude are concentric circles.

**Characteristics of Charts -** The commonest charts in use are those produced by the British Admiralty. Each chart has a "Title" which indicates the area covered, and a "Number" for catalogue and filing purposes. The Title is given in large print and may be preceded by a preliminary title in smaller print indicating the wider area - e.g. -

REPUBLIC OF IRELAND -- EAST COAST
ARKLOW TO THE
SKERRIES ISLANDS

Under the title is a note of the units used for depths - e.g. -

DEPTHS IN METERS

It is important to note whether the depths are given in feet, fathoms or metres. All modern charts now use metres but many of the old fathom or foot charts are still available. As well as **"Depths in Metres"** printed underneath the chart title, it is also printed in magenta coloured letters at the top and bottom of the chart. Colour is also characteristic of metric charts - **yellow** for land which is always above high water spring tides (HWS), **green** for "drying" areas (between high water springs and chart datum), **blue** for shallow water.

Like Ordnance Survey Maps, charts come in various **"scales"**. A large scale chart covers a comparatively small area, but will show a lot of detail. Large scale charts are used for harbours, anchorages and dangerous areas. Smaller scale charts are used for passage making. The scale of a chart is given under "Depth in Metres", and is written as a "Representative Fraction" - e.g. SCALE 1:200 000 - this means that one unit of length on the chart represents 200,000 of the same units on the Earth's surface. Remember that in a Mercator chart the Scale given is an average, usually across the middle of the chart. If this is not so, the latitude of the given scale will be stated.

Notes give technical information about the chart under the following headings -

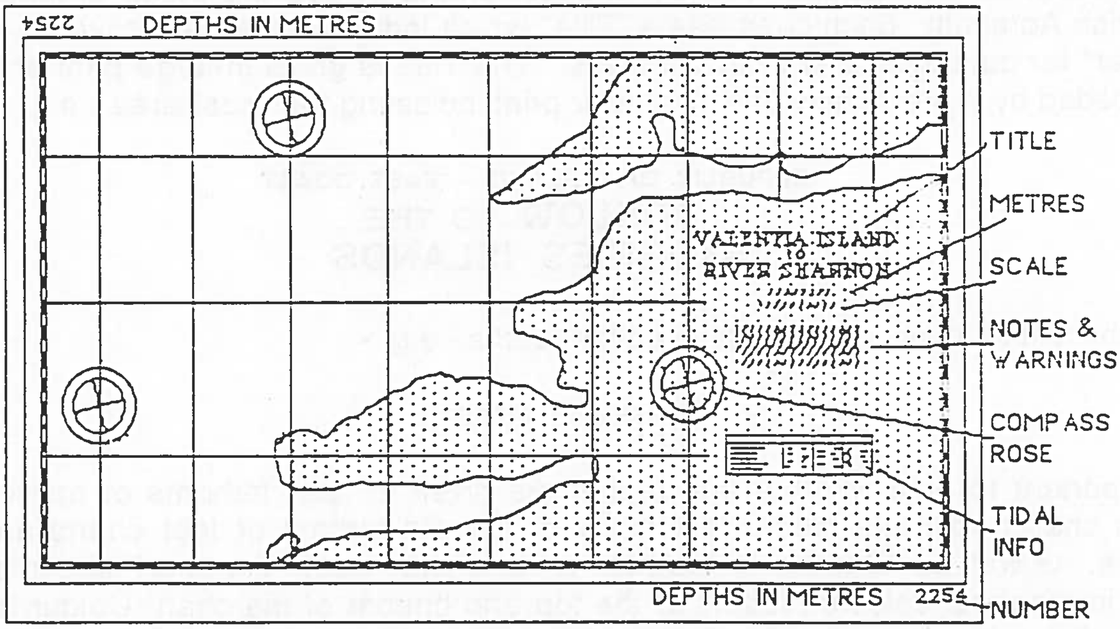
**Depths** are in metres reduced to Chart Datum which is approximately the level of Lowest Astronomical Tide.

**Heights** are in metres. Underlined figures are drying heights, in metres and decimetres, above Chart Datum; all other heights are above Mean High Water Springs.

**Projection:** Mercator or Gnomonic.

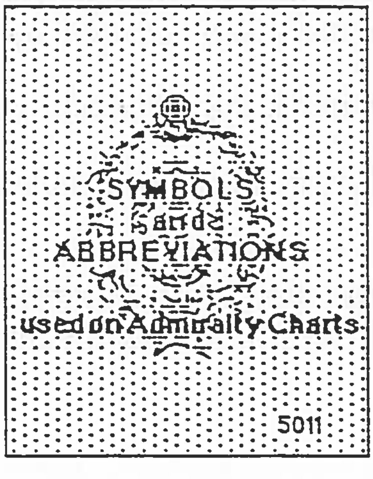
**Authorities:** An indication of the sources of the survey information - sometimes including a Source Data Diagram - this is a miniature version of the chart showing the areas and dates of the surveys used in the chart.

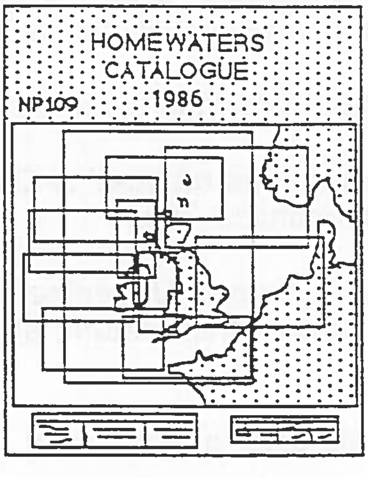
**Chart Corrections -** when a correction is made to a chart, the year and number of the relevant "Notice to Mariners" is noted below the margin in the bottom left hand corner of the chart.




Charts show prominent shore features which are visible from seaward and therefore can be used for taking bearings. Lighthouses, navigation buoys and their lights, dangerous rocks. etc., are all marked. In an Ordnance Survey map the height of the land is important, but in a chart it is the depth of the water which is most important. All over the sea areas of the chart you will find small figures indicating the depth of water.

A complete list of chart symbols is given on **Chart 5011**, which is available as a booklet, published by the British Admiralty.

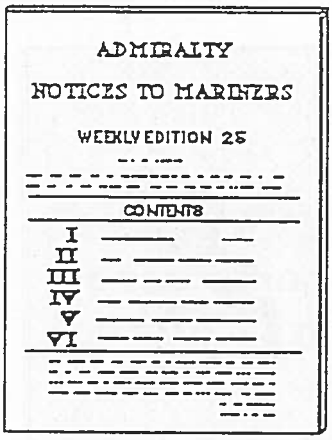



Catalogues of Admiralty Charts are available. Publication no. NP 109 - **"Home Waters Catalogue"**- covers the coasts of Ireland, Great Britain and Northern Europe.

## OTHER SOURCES OF INFORMATION

### Notices to Mariners





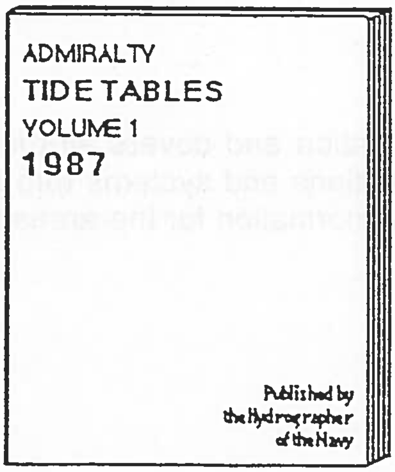
"Notices to Mariners" are weekly booklets published by the British Admiralty containing up-to-date information about navigation, charts, light changes, etc. from all over the world. These may be obtained from Admiralty Chart Agents and other outlets and are used to keep charts and other Admiralty publications corrected. A special Small Craft Edition of the Admiralty Notices covering Great Britain, Ireland and the North-West coast of Europe is produced for the benefit of yachtsmen and others with small craft. This publication comes out quarterly.

### Tide Tables

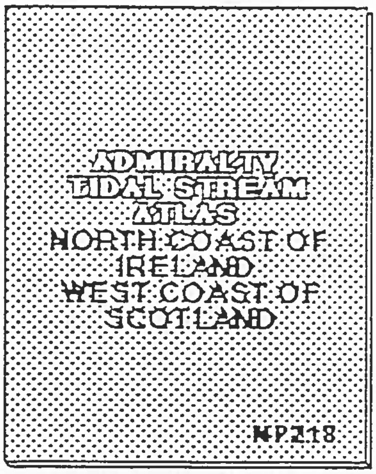
Tide tables give the predictions of the heights and times of high and low water throughout the year for certain specified ports. They are published annually and the predictions are made by calculations based on the relative positions of the sun and moon. Admiralty Tide Tables are published annually in three volumes -

1. European Waters, including Mediteranean.
2. Atlantic and Indian Oceans.
3. Pacific Ocean and adjacent seas.

Tide tables will also be found in nautical almanacs and other publications, and many Ports produce their own tables. The main predictions are given for certain "Standard Ports", and lists of time and height differences are given for the "Secondary Ports".

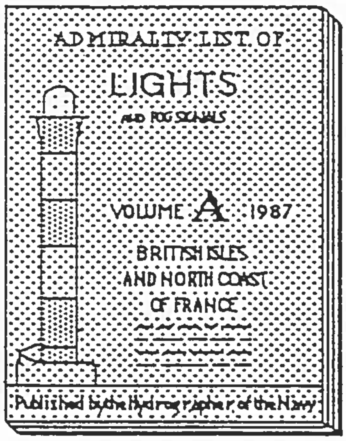


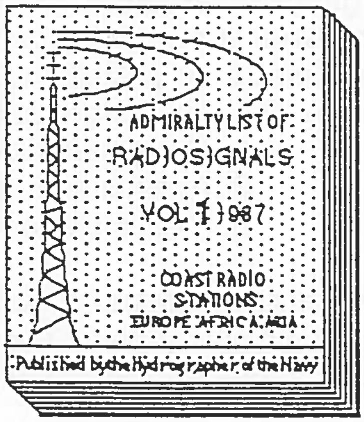
Tidal Stream Atlas - Tidal Stream Atlases are Admiralty publications giving an overall picture of the tidal streams in certain sea areas. They are dealt with in the chapter on tides.


List of Lights

The Admiralty List of Lights is published in a number of volumes covering all the light beacons and lighthouses throughout the world. The positions of the lights are given together with their characteristics, ranges of visibility, heights, details of fog signal apparatus, etc. This information for much more restricted areas is also contained in the various nautical almanacs.



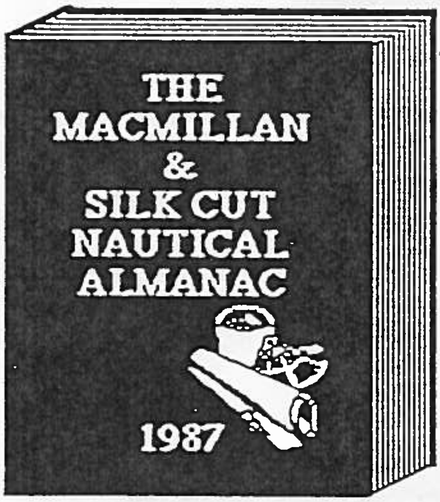




List of Radio Signals

This is another Admiralty publication and covers all the marine radio communication stations and radio navigation stations and systems throughout the world. The nautical almanacs also give most of this information for the areas that they cover.

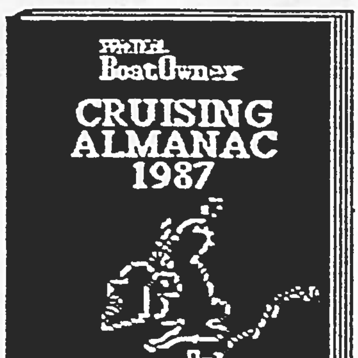
## Nautical Almanacs

These are usually commercial publications and the ones which deal with our waters are Reed's Almanac and Macmillan's Almanac. They cover Northwest Europe and contain Tide Tables, Lists of Lights, Radio Communication and Radio Navigation information, Weather Forecast information, Tables to find "distance off" by sextant or of rising or dipping lights, time, speed and distance tables, local navigation and port information, notes on safety at sea and First Aid, Flag Etiquette, etc. They also contain sections on Nautical Astronomy, ephemeris tables and other mathematical information for Astro Navigation. Although this last mentioned section of the Almanacs is not of much use to the coastal navigator, it will be seen that the Almanacs contain a wealth of extremely valuable and essential information which otherwise would have to be found in a number of other books.

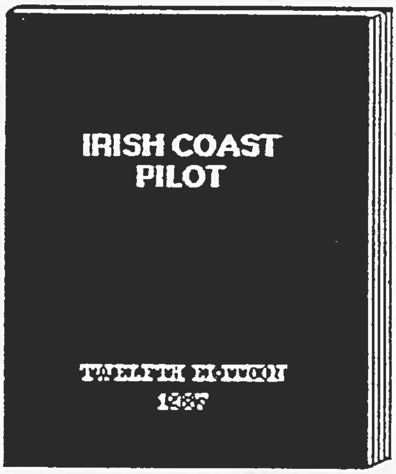




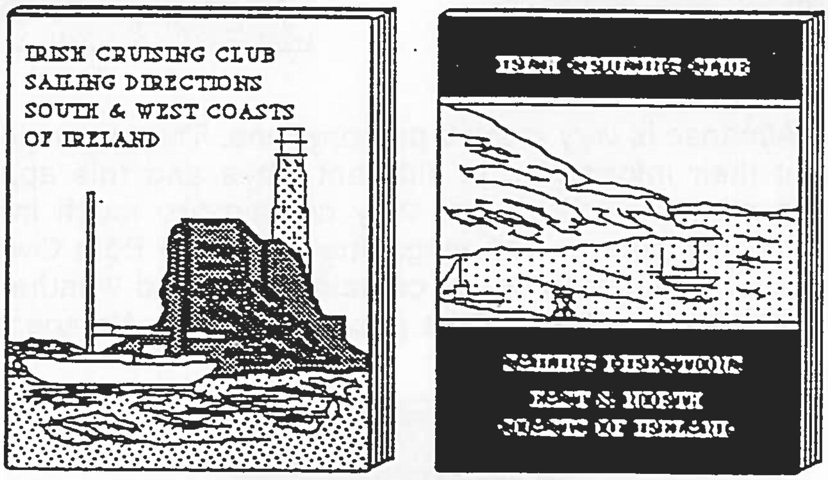
The choice of an Almanac is very much a personal one. The two main ones mentioned here each set out their information in different ways and this appeals to different people. There are many who think that they contain too much information for the average coastal cruising person. The magazine "Practical Boat Owner" has brought out a "Cruising Almanac" for 1987 which contains radio and weather information and tide tables only, but costs less than half the price of the other Almanacs



## Pilot Books and Sailing Directions



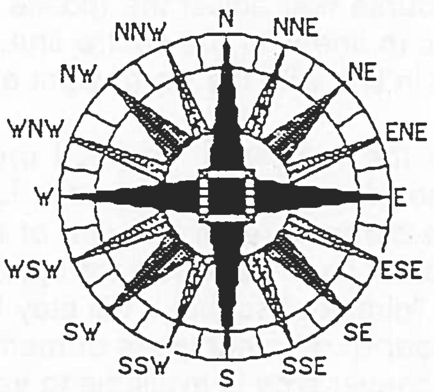

The Admiralty publishes "Coast Pilots" covering most of the coasts of the world. The "Irish Coast Pilot" is No.40 in the series. It is a very comprehensive guide to the harbours, inlets, islands, dangers, etc. all around our coastline. However it is written from the big ship point of view and therefore does not cover many areas and places of interest to the owners of smaller craft. The Irish Cruising Club produces two books, one covering the East and North Coasts and the other the South and West Coasts - these are excellent guides and should be consulted by anyone cruising around our coasts.




IRISH CRUISING CLUB SAILING DIRECTIONS

## THE COMPASS

The compass is the most useful and important navigation tool we have. It was invented when people discovered that a piece of magnetic iron when suspended or balanced would point towards the North. The North is taken as the primary point of direction, and the other main directions are derived from it - South, East and West. This was not always so, and in very early times before the compass was invented, people took the prime direction as that of the rising sun, in other words the East. Traces of this ancient system may still be found - for instance the words for North and South in the Irish language are derived from words meaning left and right - that is left and right when facing the rising sun.

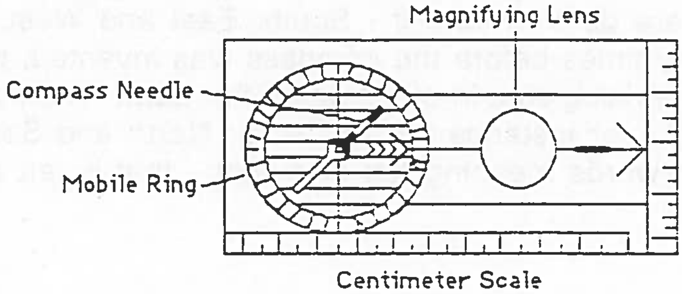



North, South, East and West are known as the **"Cardinal Points"**. In between the Cardinal Points are the **"Half-Cardinals"** - North East (NE), South East (SE), South West (SW) and North West (NW). Between the Cardinals and the Half-Cardinals are the **"Intermediate Points"**, also known as **three letter points.** In the intervening gaps between these are the sixteen **"By" points.** This gives a total of **thirty two** named points on the compass. Reciting the points of the compass in order is known as "boxing" the compass.

| | | | |
|---|---|---|---|
| **N** | **E** | **S** | **W** |
| **NxE** | **ExS** | **SxW** | **WxN** |
| **NNE** | **ESE** | **SSW** | **WNW** |
| **NExN** | **SExE** | **SWxS** | **NWxW** |
| **NE** | **SE** | **SW** | **NW** |
| **NExE** | **SExS** | **SWxW** | **NWxN** |
| **ENE** | **SSE** | **WSW** | **NNW** |
| **ExN** | **SxE** | **WxS** | **NxW** |
| **E** | **S** | **W** | **N** |

The use of names of points of the compass is historical, and today is very restricted. Usually only the Cardinal or Half-Cardinal points, or occasionally Intermediate points will be used in practice. Much greater accuracy is obtained by using **degrees.** The compass consists of a circle and therefore it may be divided into 360°, starting in the North. Very accurate compass bearings or directions may be given by using degrees. Each point of the compass is equivalent to eleven and a quarter degrees.

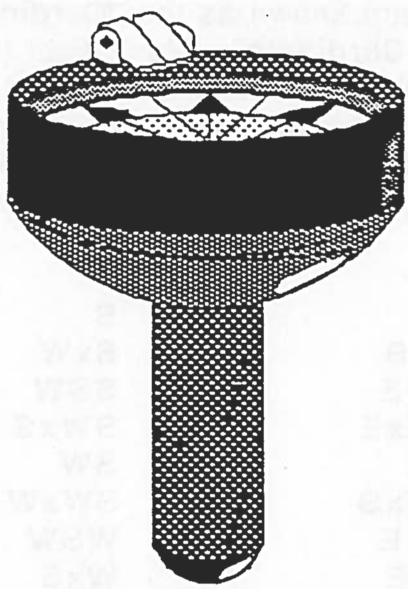
There are many different forms of compass, but probably the type in commonest use in Scouting is the "Silva" compass. This is very useful for ordinary compass work on the land and for orienteering. It can also be useful for small boatwork if it is taped onto the thwart in front of the helmsman, so that the central line and arrow are directly on the centre line of the boat.




In order to steer a compass course first adjust the mobile ring of the compass so that the correct figure in degrees is in line with the centre line, and then so steer the boat that the compass needle stays in line with the North point of the mobile ring.

In special marine compasses the needle is mounted underneath the card and the whole card moves. In this case there will be a "Lubber's Line", and the compass is so mounted that this line is in the centre fore-and-aft line of the boat. To steer a course, the correct figure on the compass card must be kept opposite the Lubber's Line. The whole compass is mounted on "gimbals" so that it will stay level as the boat moves with wave action. There are a number of different types of marine steering compasses and you must learn how to use whichever type is available to you.

Special **"Hand Bearing Compasses"** have sighting devices, enabling bearings to be taken of other objects. This is one of the means of helping you to find your position.



**Compass bearings and compass courses** are always given in degrees, using three figures. If a bearing is under 100°, a zero is put in front of it and when speaking, the figures are given independently. For instance - forty five degrees is written as 045 °, and is spoken as **"Zero-Four-Five degrees"**. One hundred and eighty degrees is written as 180° and spoken as **"One-Eight-Zero degrees"**.

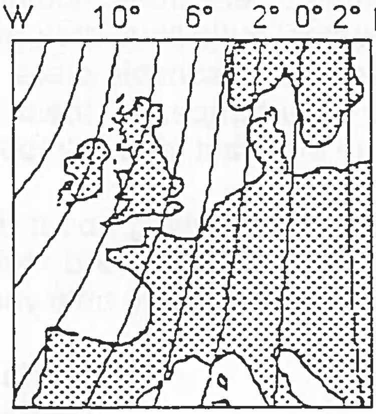
**Degree equivalents and opposite points -**

| | | | |
|---|---|---|---|
| **N** (000°) | **NE** (045°) | **E** (090°) | **SE** (135°) |
| **S** (180°) | **SW**(225°) | **W**(270°) | **NW** (315°) |

**Magnetic Variation** - This is the difference between the direction of the True North and the direction to which your compass is pointing. The compass does not point towards the True North, but along the line of the Earth's magnetic field. The magnetic North Pole lies in the Arctic regions of Canada and moves slightly each year. In Ireland, therefore, the compass needle will point slightly to the West of True North. This variation changes in various parts of the world, and also changes slowly with time. Charts and maps give the local magnetic variation for the year they were printed. For practical purposes the magnetic variation anywhere in Ireland or its coastal waters at present is approximately 10° West of True North.

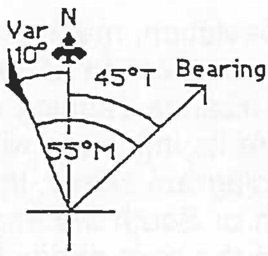
**Magnetic Variation Chart**

These are special charts which show the difference in variation over an area. The lines drawn through positions with equal variation are called "isogonic lines". The line through places of zero variation is called the "agonic line". Because of the continuing change in the earth's magnetic field, the variation changes slowly from year to year.




You must learn how to convert Magnetic bearings to True bearings and True bearings to Magnetic. This is a most important element in navigation, and one which can cause a lot of trouble if the conversion is made the wrong way. A useful rhyme to remember is as follows -

**Variation West, Compass Best**
**Variation East, Compass Least**




When the variation is westerly the compass is "best", meaning that it is bigger or greater than True. **Examples -**

a - your hand-bearing compass gives the bearing of an object as **055°**. This is Magnetic and therefore is higher than True . To find the True reading subtract the local variation **- 10° W**. Then **055° M**, becomes **045° T.**

b - the course you wish to follow is **270° T**. Variation is **10°W**. Magnetic is greater than True. Therefore in this case the variation must be added to the True course in order to give the Magnetic course for the helmsman to steer - **280° M.**

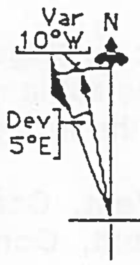
Compass bearings are of course always obtained as Magnetic, but tidal stream and wind directions are given as True. Note that tidal stream direction is always the direction that it is going to, but wind direction is where it is coming from.

**Magnetic Deviation**

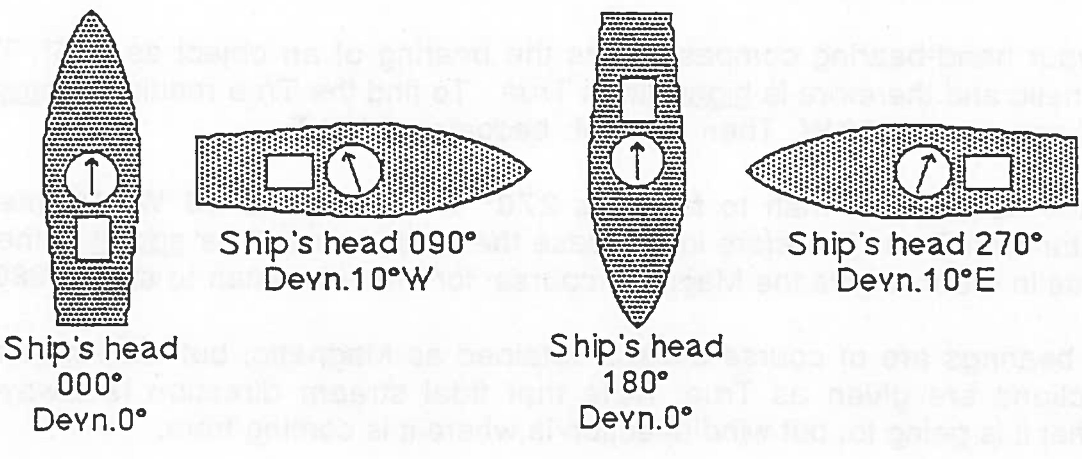
The essential part of a compass is the magnetic needle, and any other magnet or any iron or steel near the compass will cause the needle to be deflected from its proper position. Any such deflection of the magnetic needle from the Magnetic North is known as **"Compass Deviation"**. In a wooden or fibre-glass boat there should be no difficulty in mounting a compass clear of magnetic influences, if it is kept well away from the engine or any metal fittings. Be careful not to leave a jack-knife, box of tools, tins, or any such objects near the compass. For small boats deviation should not be a problem, but you may sometimes find yourself on a bigger boat or a yacht, whose compass does have some deviation. This may be due to the magnetic field of nearby electric wiring or electronic equipment, or due to a mass of metal such as the engine. Boats with steel hulls have their own special problems, and it may be impossible to site a compass in a reasonable place for the helmsman without an unacceptable amount of magnetic disturbance. In these cases a special transmitting compass is usually mounted up the mast, and a "repeater" is mounted at the helmsman's position.

The most important thing about deviation is to know if it exists and what is its extent. You can then allow for it and make the appropriate adjustments to your calculations. You can use this rhyme to help you -

**Deviation West, Compass Best**
**Deviation East, Compass Least.**

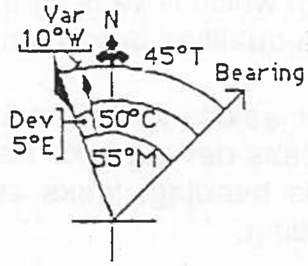



East and West with regard to Deviation, mean that the compass points East or West of <u>Magnetic North</u>. The amount and direction of deviation depends on the boat's heading at the time. The magnetic disturbance causing deviation moves with the boat around the compass card, and therefore its influence will vary depending on which side of the compass needle it acts. In the diagram below, the cause of the deviation is the engine. When the boat is heading North or South the engine is in line with the compass needle and there is no deviation. When the boat heads East or West the deviating influence is to one side or other of the compass and the needle is deflected towards it.



## Calculating and allowing for deviation

In the example given here, the Deviation is 5°E and the Variation is 10°W. This means that for a true bearing of 045°, the magnetic bearing (+10°W) is 055°, and the "compass" bearing (-5°E) is 050°.




When working out compass problems, write down the figures in columns headed:

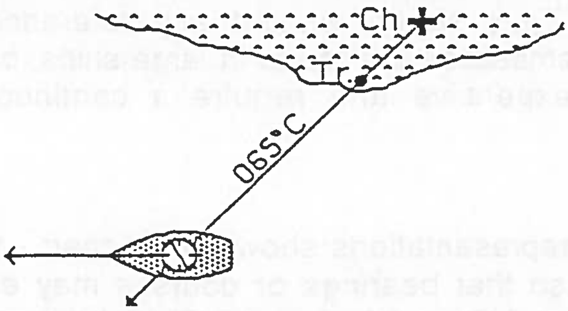
True - Variation - Magnetic - Deviation - Compass.

(TeleVision Makes Dull Company)

| T | V | M | D | C |
|---|---|---|---|---|
| 045° | 10°W | 055° | 5°E | ? |
| | | | | 050°C |

## Swinging compass

To find out if a steering compass is affected by deviation you can "swing" the compass. There are a couple of ways to do this. The easiest method is to steer the boat steadily on a number of different courses, at about 15° - 30° intervals around the compass, and at the same time use a handbearing compass to check the boat's heading. The handbearing compass must be sited clear of any magnetic influence otherwise it will have a deviation of its own. The readings from the handbearing compass are taken as Magnetic and the steering compass figures are compared with them. The difference on any heading is the Deviation **for that heading**. Deviation may also be checked by using "transits". In this method the boat is steered keeping two prominent objects (both marked on the chart) in line with each other. The Magnetic bearing of this "transit" can be worked out from the chart, and compared with the steering compass reading.




Transit from chart
-Church ϕ Tower 045°T
Variation 10°W
Magnetic 055°M

Compass bearing
of transit 065°C
Therefore Deviation 10°W

In this example the transit is noted from the chart to be 045°T. The Variation is known and therefore the Magnetic bearing of the transit is calculated. So now we have the Magnetic bearing and the Compass bearing - the difference is the Deviation for the present heading of the boat.

| T | V | M | D | C |
|---|---|---|---|---|
| 045° | 10°W | 055°M | ? | 065°C |
| | | | 10°W | |

### Compass correction
If the error found is less than a few degrees on all headings it is not necessary to correct the compass. But where considerable amount of deviation occurs this can be corrected by placing special corrector magnets around or underneath the compass to counteract the local magnetism which is causing the problem. This is a very skilled job and is usually undertaken by a qualified person known as a "compass adjuster".

Any deviation remaining after adjusting the compass is tabulated on a "Deviation Card". This shows the compass deviation for each direction of the boat's head. The Navigator reads the compass heading, looks at the Deviation Card and finds the deviation to apply for that heading.

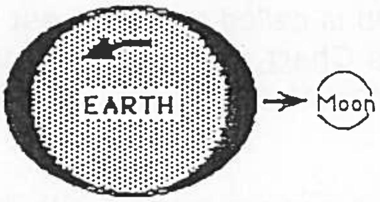
| DEVIATION CARD | | | | | |
|---|---|---|---|---|---|
| SHIP'S HEAD (COMPASS) | DEVN. | MAGNETIC | SHIP'S HEAD (COMPASS) | DEVN. | MAGNETIC |
| 000 | 7°E | 007° | 180° | 7°W | 173° |
| 022.5° | 4°E | 026.5° | 202.5° | 6°W | 196.5° |
| 045° | 2°E | 047° | 225° | 5°W | 220° |
| 067.5° | 0 | 067.5° | 247.5° | 2°W | 245.5° |
| 090° | 1°W | 089° | 270° | 1°E | 271° |
| 112.5° | 3°W | 109.5° | 292.5° | 3°E | 295.5° |
| 135° | 6°W | 129° | 315° | 5°E | 320° |
| 157.5° | 7°W | 150.5° | 337.5° | 8°E | 345.5° |

### Gyro Compasses
If a cylinder or wheel is mounted in gimbles so that it can rotate freely, and is made to spin, the axis of this "gyroscope" will line itself up with the axis of rotation of the Earth. This therefore is a method of finding True North, without any reference to, or complications from magnetism. Gyro Compasses are found in large ships, but not in small boats or yachts, as they are expensive and require a continuous and uninterrupted power supply.

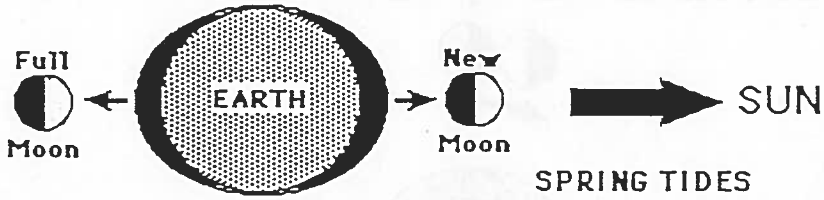
### The Compass Rose
This is the name given to the compass representations shown on a chart - they are printed in various places on the chart, so that bearings or courses may easily be plotted. The Compass Rose consists of an inner and an outer circle, both marked in degrees. The outer circle represents the directions related to True North, whereas the inner circle figures relate to the Magnetic North. The figure for the magnetic variation in the locality at the time that the chart was printed is written inside the compass rose, with a note giving its approximate annual increase or decrease. Bearings and courses are plotted on the chart from the compass rose using some form of parallel ruler or "Plotter" (see chapter on "Chartwork").

# TIDES

The gravitational pull of the moon on the water of the Earth's surface, and to a lesser extent the pull of the sun, causes the waters of the ocean to rise on the nearest side to the moon, and also on the opposite side of the globe. The Earth rotates once in 24 hours, and this causes two high waters every day - so called **"diurnal"** tides.

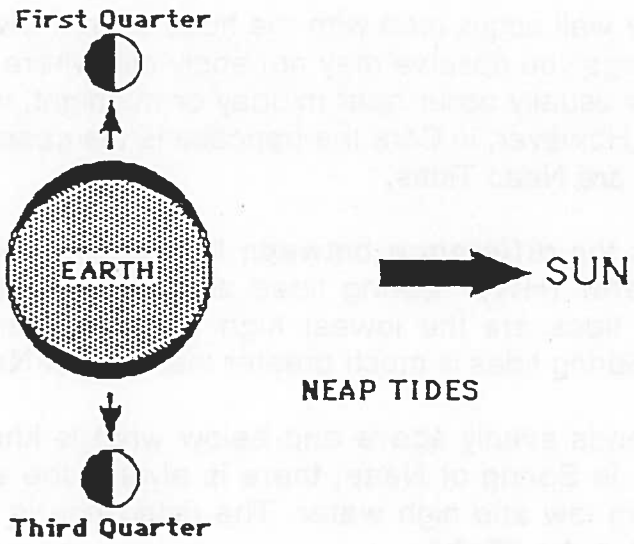



Because of its greater distance from the Earth, the sun's gravitational pull is far less effective. However, at the time of the full moon and the new moon, the pull of the sun augments that of the moon, causing very high waters - **"Spring Tides"**.




SPRING TIDES

When the moon is in its first or third quarter, its pull is at right angles to that of the sun, and the effect is lessened - high waters are not so high and low waters are not so low - these are called **"Neap Tides"**.




NEAP TIDES

The term Spring Tides does **not** mean tides which occur in the season of Spring. The moon completes its orbit around the Earth once every 28 days. Spring tides occur at fortnightly intervals, just after the time of full moon and of new moon. Neap Tides occur in between the Spring Tides. There are two Neaps and two Springs to each Lunar Month. The biggest Spring tides occur at about the times of the Spring and Autumn Equinoxes (March and September). At these times the Earth's orbit is closest to the Sun, and the Sun's gravitational pull is therefore greatest.

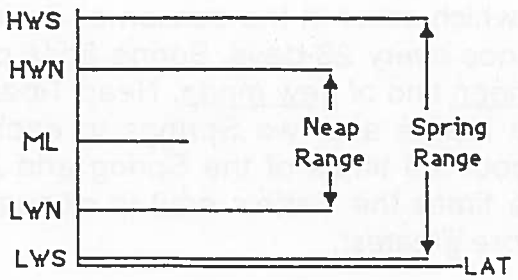
**Tide Tables** - By reference to the position of the sun and moon, and sometimes of other heavenly bodies, astronomers can calculate accurately the height and time of high and low water on any day in advance. These predictions are published as "Tide Tables". Tide Tables may be found in various Nautical Almanacs, or the Admiralty Tide Tables. The bigger ports produce their own Tide Tables and abbreviated versions are also found in many diaries. Times are usually given in GMT, and when using a Tide Table, you must make sure to make allowances for Summer Time if necessary. The lowest tide that can be calculated is called the **"Lowest Astronomical Tide" (LAT).** This level is usually taken as the Chart Datum, and is the level of water to which all depths are refered. The level may be altered by unpredictable events, such as wind strength and direction.

The Earth rotates once in 24 hours and the moon orbits the Earth every 28 days. After 24 hours a particular part of the Earth is back to the position at which high tide occured the day before, but the moon has in the meantime moved on one 28th of its course. The Earth then has to rotate for nearly an hour more to "catch up" with the moon. This explains why the tide is roughly one hour later each day, and why there are about twelve and a half hours between each high water.


You should become very well acquainted with the tides in your own home waters - but note that some of the things you observe may not apply elsewhere. For instance, in the Dublin area Spring Tides usually occur near midday or midnight, while Neap Tides are near 06.00 or 18.00hrs. However, in Cork the opposite is the case, and tides which are near midnight or midday are Neap Tides.

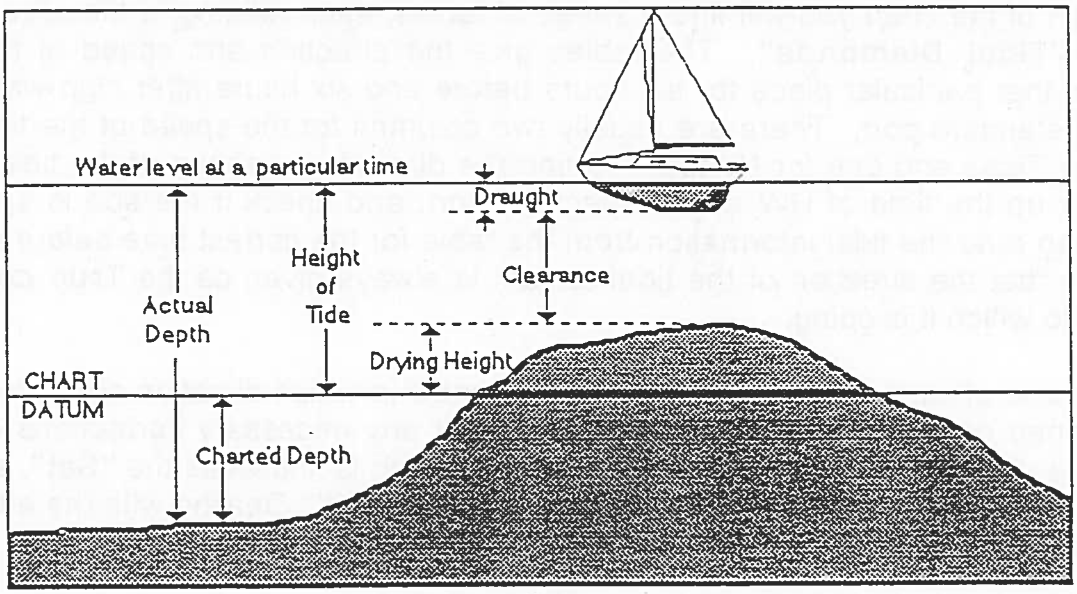
**Range of tide** - This is the **difference** between **low water (LW)** and the previous or subsequent **high water (HW).** Spring tides are the highest high tides and the lowest low tides. Neap tides are the lowest high tides and the highest low tides. Therefore, the range of Spring tides is much greater than that of Neap tides.

The range of a tide extends evenly above and below what is known as **"Mean Tide Level".** Whether a tide is Spring or Neap, there is always the same depth of water present half-way between low and high water. The rising tide is called the **"Flood"**, and the falling tide is called the **"Ebb"**.




**HWS - High Water Springs**
**HWN - High Water Neaps**
**ML - Mean Tide Level**
**LWN - Low Water Neaps**
**LWS - Low Water Springs**
**LAT - Lowest Astronomical Tide**

**Depths and heights** - The actual depth of water available at any time will usually be greater than that marked on the chart. The difference between charted depth and actual depth of water at the time is called the "Height of the Tide". Areas of sand, mud or rocks which are covered at high tide, but exposed at L.A.T. are shown on the chart as **"Drying Heights"** - that is the amount that they would dry at Lowest Astronomical Tide (LAT). Drying heights are shown on a chart as underlined figures. Heights above water (e.g. lighthouses, bridge clearances, hilltops and prominent objects) are measured from the level of Mean High Water Spring (MHWS).




**Rule of Twelfths** - In any place where the tides are regular, the rate of rise and fall may be calculated reasonably accurately by the **"Rule of Twelfths"**. Divide the range into twelfths, and the rise or fall will occur at the following rates -

In the 1 st hour - 1 twelfth
In the 2nd hour - 2 twelfths
In the 3 rd hour - 3 twelfths
In the 4 th hour - 3 twelfths
In the 5 th hour - 2 twelfths
In the 6 th hour - 1 twelfth

Example - Tides at reference port are : HW 0653 4.3m LW 1342 0.3m
The time is 0900hrs. What is the "height of tide".

**Range** = 4.3 - 0.3 = **4.0m.** **One twelfth** = 4.0 ÷ 12 = **0.33m.**
Time is two hours after HW.
Tide has dropped 3 twelfths (= 0.99m) from HW level (4.3m).
4.3 - 0.99 (say 1.0) = **3.3m = "Height of tide".**

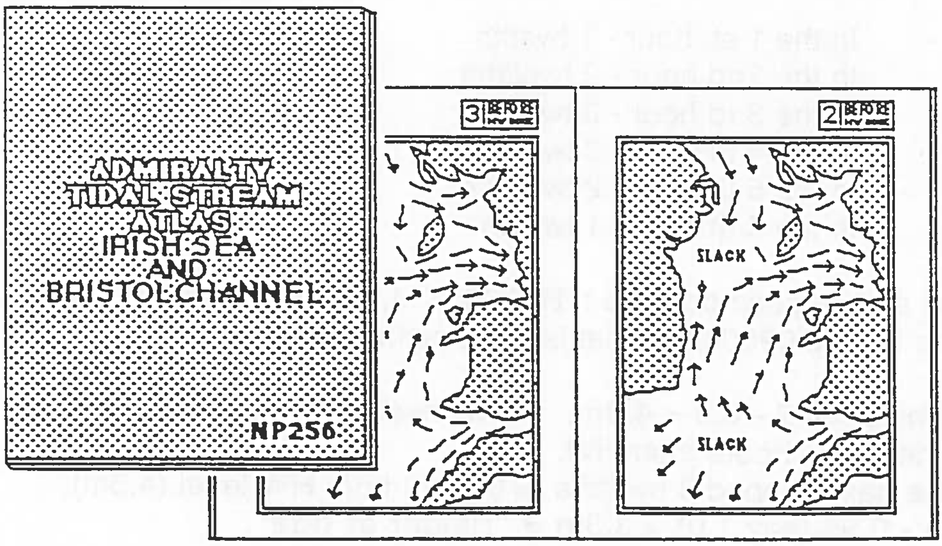
In most places around the Irish coast the tides are quite regular and the Rule of Twelfths works well. However this does not necessarily apply to some estuaries where local effects may be produced by a bar or other shallows, or by a comparatively narrow entrance with a broad internal area, etc. Tidal rivers can also be irregular, particularly if there has recently been heavy rain in the drainage basin of the river, causing a strong flow or "fresh". If such a "fresh" was strong enough, there could be as much as a nine hour ebb and only three hour flood in the river.

**Tidal Streams** - As well as the vertical rise and fall of the tide, there are also horizontal movements called "Tidal Streams". During Spring Tides there is a far greater volume of water involved than in Neap Tides, and therefore the horizontal movement or stream must be much stronger during Spring Tides. The Spring rate may be two or three times the speed of the stream during Neap Tides.

**Chart information** - Information on the direction and speed of tidal streams is available on charts. In selected areas around the chart there are small magenta coloured diamond shapes containing a capital letter - A,B,C,D etc. Somewhere near the margin of the chart you will find a series of tables, each relating to the area of one of these **"Tidal Diamonds"**. The tables give the direction and speed of the tidal stream at that particular place for six hours before and six hours after high water at a specified standard port. There are usually two columns for the speed of the tide, one for Spring Tides and one for Neaps. To find the direction or speed of the tide at any time, look up the time of HW at the specified port, and check if the tide is spring or neap. Then read the tidal information from the table for the correct time before or after HW. Note that the direction of the tidal stream is always given as the **True** compass direction to which it is going.

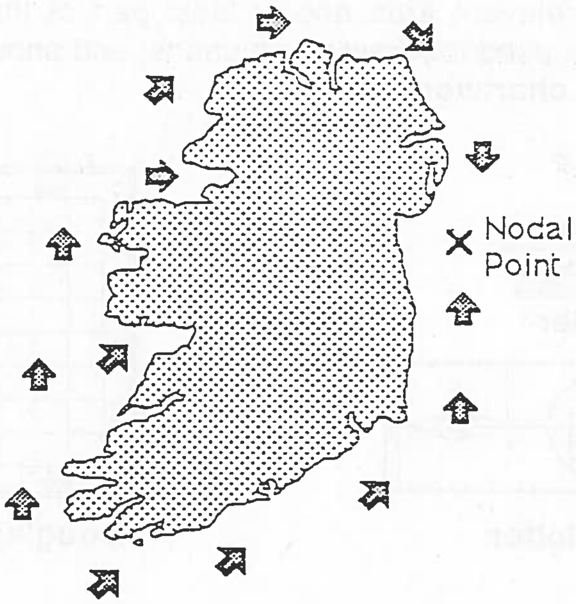
Tidal streams affect a boat's course. You must know in which direction and how far off your planned course you are being taken, so that any necessary corrections can be made. The direction in which the tidal stream is running is known as the **"Set"**, and the distance which it runs in any given time is called the **"Drift"**. Dealing with the effects of set and drift is covered in the chapter on Chartwork.

**Tidal Stream Atlases** - These are Admiralty publications which show the general pattern of tidal streams over a large area each hour for six hours before and after HW at a standard reference port, usually Dover. The Irish Sea is covered in NP256, and the North Coast of Ireland in NP 218.




When planning a journey, look up the time of HW Dover for that day and then pencil in lightly at the top of each page the actual time to which that page applies. For instance, take the above two pages - 3 hours and 2 hours before Dover respectively. If HW Dover was at 1600, you should write 1300 on the left-hand page and 1400 on the right-hand page. This saves you refering back to the time of HW Dover each time you want to check the tidal stream.

**Tidal flood stream around Ireland** - The tidal wave approaches Ireland from the south-west. It splits at the south-west corner, one part of the flood stream running along the west coast and around the north coast, and the other part running along the south coast and then northwards up the Irish Sea. The two flood streams meet at a "nodal point" between Dundalk Bay and the Isle of Man.

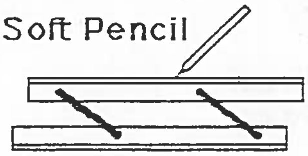



**Working the tides** - Learn to use the tides to advantage. Scout boating is usually undertaken in small boats with low speeds and the difference between favourable and adverse tidal streams can be enormous. A rowing expedition proceding at three knots through the water will take one hour to cover three miles in still water, three hours to cover the same distance against a two knot adverse tide, but only 36 minutes with a similar favourable tide. You should therefore plan cruises and expeditions to take advantage of favourable tides. This means using the tide tables intelligently in the planning stages. Don't forget that times are given in **GMT** (Greenwich Mean Time) and in the Summer must be converted to **BST** (British Standard Time).

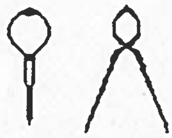
## CHARTWORK

As well as the appropriate chart, certain instruments are required for chartwork. The **chart table** should be perfectly flat and if possible be large enough to take an Admiralty chart folded in half. For small boats, particularly open boats (e.g. BP 18), this may not be possible and so smaller boards may have to be used, with the chart so folded as to show the relevant area and at least part of the Latitude scale. A **soft pencil**, B or 2B shold be used for drawing on charts, and should not be used heavily. **Never use a pen for chartwork!**

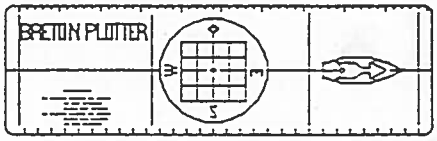
Soft Pencil



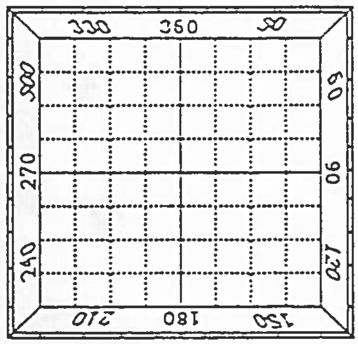
Parallel Ruler



Dividers




Breton Plotter

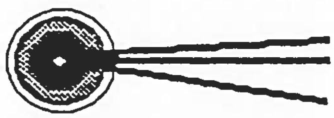



Douglas Protractor

The commonest form of drawing instrument used is the **parallel ruler**. The most useful type of parallel ruler is the **Captain Fields Pattern.** Course lines and bearings can be drawn with this ruler with the help of a meridian of longitude and without reference to a compass rose. Unfortunately the parallel ruler has many disadvantages in small boats, and the **Breton Plotter** or the **Douglas Protractor** may be found easier to use. At present the Breton Plotter is being advised by the Sea Training Team. You cannot learn to use any of these instruments from a book, and must try them out in practice. Ultimately you will decide your own preference.

For chart work in small boats a good method is to cover the chart and board with plastic, sealing the edges as well as possible, and use a "Chinagraph" pencil to draw on the plastic surface. This can then be wiped clean with a damp cloth.

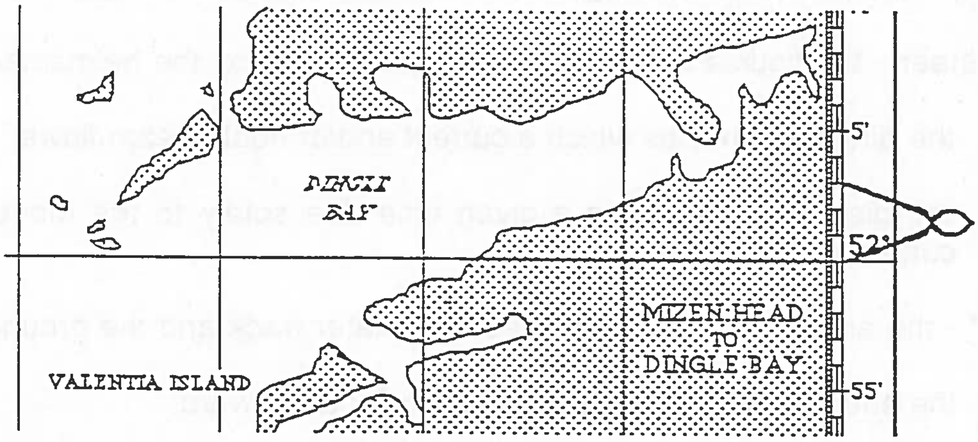
Occasionally a **Station Pointer** may be used for chartwork, especially in conjunction with a sextant. A Station Pointer is an instrument with three arms pivotted on the centre, with an angular scale showing the angles between the arms. It is not very often used and many coastal navigators will never have seen one. However some very cheap plastic types are now available and can be useful in certain circumstances.



"Station Pointer"

## Distances

Distances at sea are measured in **Sea Miles.** A sea mile is the distance represented by **one minute of latitude**. The latitude scale is found on the right and left edges of the chart, and may be measured by using a dividers. Remember in a Mercator chart the scale is not constant - the variation from the top to the bottom of the chart may be negligable but it is good practice always to measure distance from the Latitude scale opposite where you are working on the chart. **Never use the longitude scale** across the top or bottom of the chart for measuring distances. A sea mile is 6080 feet, and is divided into ten **cables** (approximately <u>200 meters</u> each). A statute mile is 5280 feet, and thus six sea miles equal about seven statute miles. The diagram below illustrates a measurement of **3 miles.**




**One sea mile per hour** is known as a **"knot"**, and this is the unit used to express speed of a boat, tidal stream or wind.

## Compass Rose

The "Compass Rose" is printed in various parts of the chart. It usually consists of inner and outer circles marked in degrees. The zero of the outer circle points to the True North and the zero of the inner circle points to the Magnetic North. The **Magnetic Variation** is the difference between the True and Magnetic, and is expressed in degrees East or West of True North. Magnetic Variation changes a little each year - the figure for the year that the chart is printed will be found inside the Compass Rose, with a note of its annual increase or decrease.

## Bearings

A bearing is the direction of one position from another. Bearings are usually given in degrees for accuracy - three figure method. Sometimes compass points are used if general directions only are given, such as describing the direction of the wind (e.g. South veering South West), or a general course (e.g. vessel heading ESE), or to give approximate positions (e.g. 10 miles East of the Kish). **Note -** Wind direction is the direction that the wind is **coming from,** but tidal stream direction means the direction that it is **going to.**

Definitions

**Track** - the path followed or to be followed between one position and another. This path may be that over the ground (**Ground track**) or through the water (**Water track**). The direction of a track is called the **track angle***

**Track made good** - the mean ground track actually achieved over a given period.

**Heading** - the horizontal direction of the ship's head at a given moment. (This term does not necessarily require movement of the vessel).

**Course (Co)** - the intended heading.

**Course to steer** - the course related to the compass used by the helmsman.

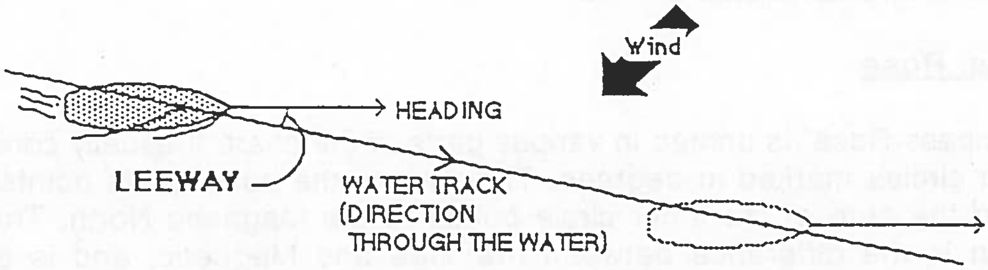
**Set** - the direction towards which a current and/or tidal stream flows.

**Drift** - the distance covered in a given time due solely to the movement of a current or tidal stream.

**Drift angle*** - the angular difference between the water track and the ground track.

**Leeway** - the effect of wind moving a vessel bodily to leeward.

**Leeway angle*** - the angular difference between the water track and the ship's heading.




**Dead Reckoning (DR)** - the process of maintaining or predicting an approximate record of progress by projecting course and distance from a known position.

**D R Position (DR)** - a position obtained by plotting course and distance run from a known position.

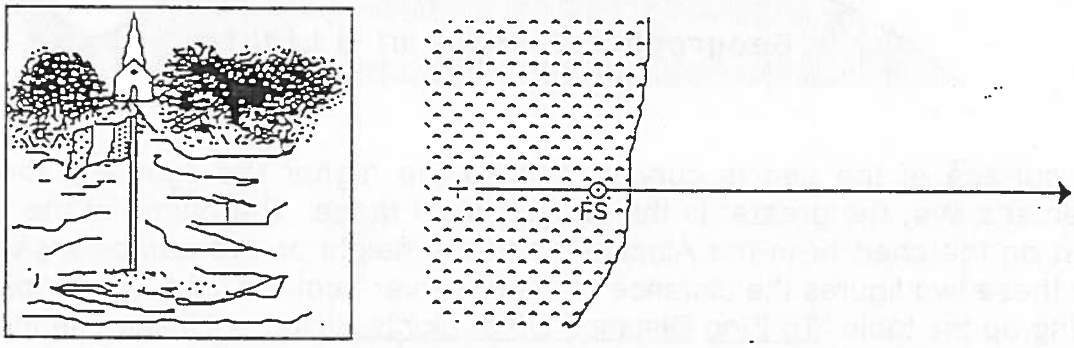
**Estimated position (EP)** - a best possible approximation of position based on course and distance run, with an estimation made for leeway, set and drift.

*The word **angle** is omitted in normal use unless there is a possibility of confusion.

## Position Lines and Position Circles

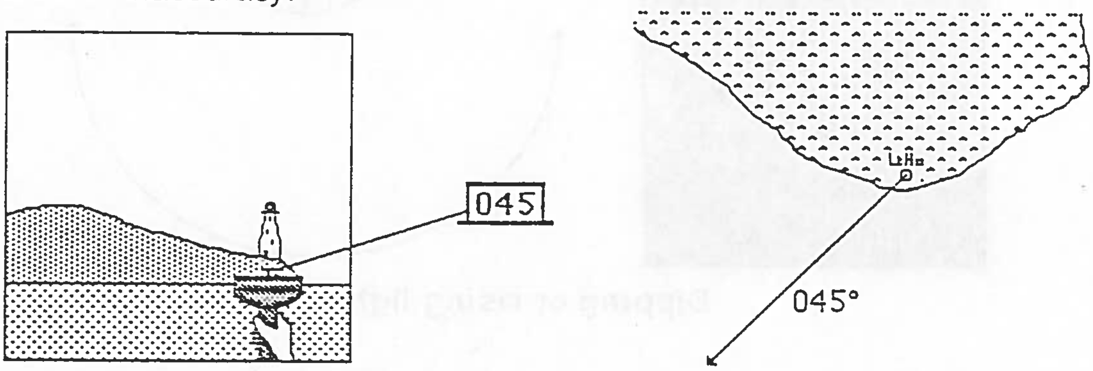
Fixing a position on a chart means finding where two or more **"position lines"** or **"position circles"** cross. The two main types of position lines are transits and compass bearings. Position circles are obtained from distance off observations.

**Transit** - this means that two prominent objects or geographical features are in line with each other. To be of use for navigation the two prominent objects must be clearly and accurately marked on the chart. The greater the distance between them the more accurate is the transit - if they are close to each other it may be difficult to be sure when they are exactly in line.




**Transit - Flag staff in line with church spire**

**Compass Bearing** - a compass bearing of a prominent object or geographical feature. These are usually taken with a hand bearing compass. Make sure to stand well away from any magnetic influence which might cause compass deviation. Take bearings of the nearest possible features, as the further away they are the greater is the chance of inaccuracy.




**Lighthouse bearing 045°**

**Radio Bearings** - these are special types of compass bearings, taken on a radio station rather than visually, using a "directional aerial". They are plotted in the same way as ordinary compass bearings, but because the transmitting stations are usually much further away, they are less accurate.

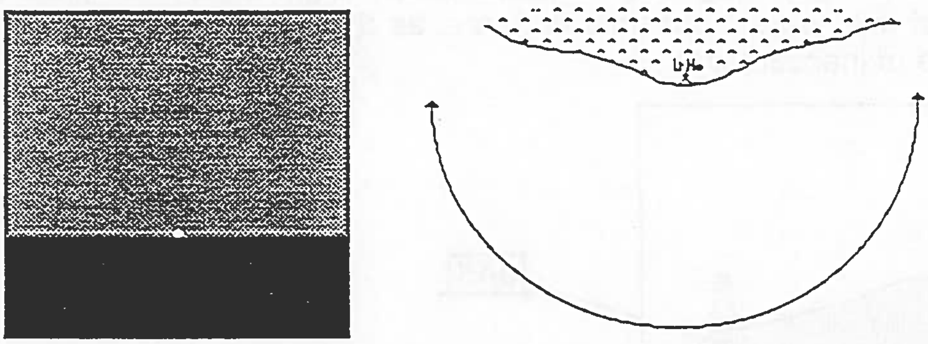
**Note** - Bearings are drawn on the chart as lines with one arrowhead at the end away from the object of the bearing.

**Distance off** - If you know the distance that you are from a point, you can draw the arc of a circle centred on that point. This is called a position circle.

**Dipping or Rising Lights** - The distance at which a light can be seen "rising" or "dipping" on the horizon ("geographical range") depends on its "luminous range" (i.e. brightness), its height above sea level, the height of the observer's eye above sea level and the visibility at the time.


The surface of the sea is curved, and so the higher the light and the higher the observer's eye, the greater is the geographical range. The height of the light may be found on the chart or in the Almanac, and the height of eye can be measured easily. With these two figures the distance of the observer from the light can be found easily by looking up the table "To Find Distance Off of Lights Rising or Dipping" in the Almanac. When this distance is found an arc of a circle of that radius may be drawn, centred on the light - this is a position circle.

**Note** - a position circle is drawn as an arc with an arrowhead at each end.



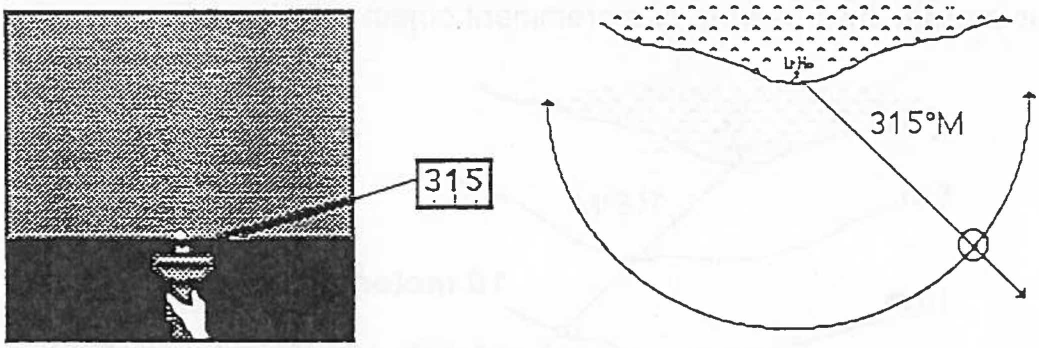
**Dipping or rising light**

The height of a lighthouse is always given as above High Water Springs. This is the least height of the light, and the position circle so obtained will indicate a position nearer the light than it actually is. If a more accurate position is required, the height of the tide must be calculated, and then the height of the light above the actual water level can be worked out.

Distance off may also be found by using a sextant. Although sextants may be useful in some conditions they are not often used in coastal navigation and it is unlikely that many Sea Scout Troops will have access to one. However for those who may be interested, or able to borrow or use one, some information is given at the end of this chapter.

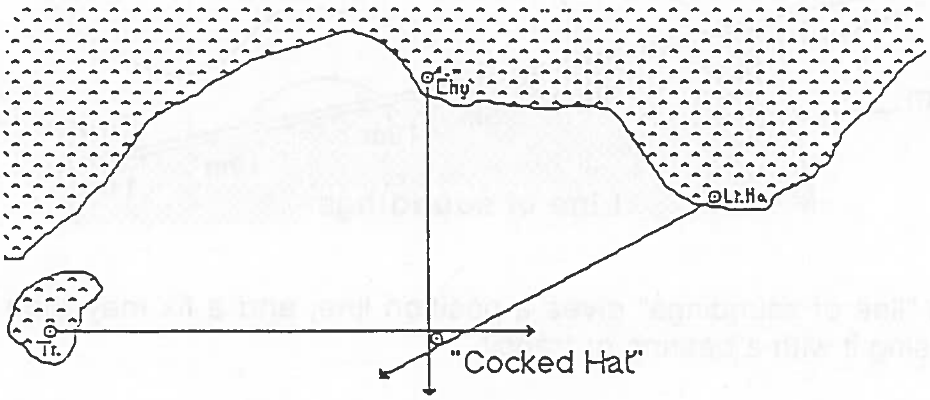
## Plotting a Position

Plotting a position requires at least two position lines. The angle between should if possible be near 90° - in any case no less than 30° and no more than 150°. The junction of two transits gives a very accurate "fix", but would not occur very commonly. Any combination of position lines or circles may be used - e.g. - taking the bearing of a dipping or rising light combines a position circle (distance off) and a position line (compass bearing).




**Dipping or rising light plus compass bearing**

When using compass bearings it is usually better to take three bearings instead of two, in order to reduce error. This is probably the commonest method of position fixing in coastal cruising. Draw these bearings on the chart using the inner (Magnetic) circle of the compass rose, or convert to True and use the outer circle. Your position is where the lines meet. Usually they do not meet at a single point, but form a triangle, called a "cocked hat". Assume that your position is in the centre of this triangle. If the "cocked hat" is large, accuracy is poor and you should re-take the bearings and re-plot the position. A common error in plotting is to use the outer (True) circle of the compass rose without converting into True bearings.

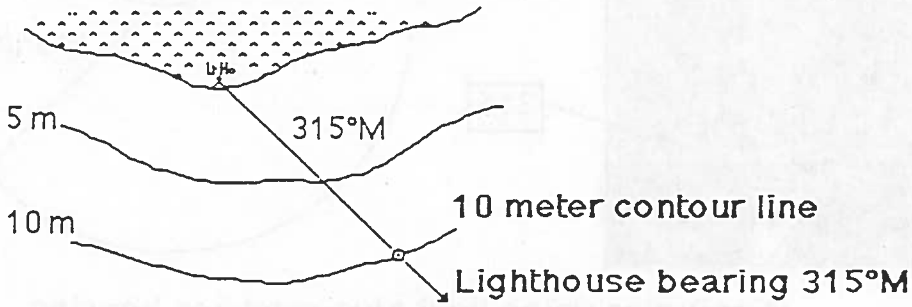



**Three compass bearings**

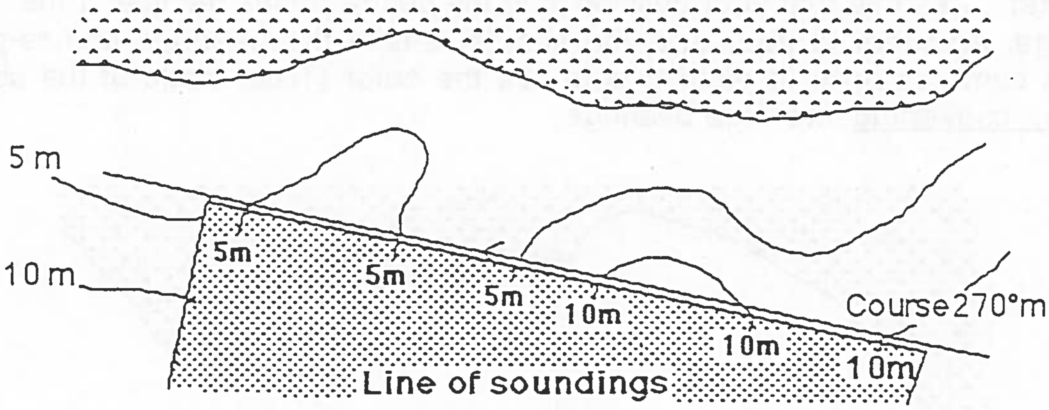
**Note** - A **"fix"** is recorded on the chart as a dot in a circle. The time should be recorded beside it.

**Soundings** - The use of a lead line or echo sounder can sometimes be very useful in helping to fix position. A single sounding in association with other methods can be a valuable confirmation of position in some situations. But soundings can be more useful than that -

**Depth contours** - If the sea bed is shelving steeply it will be easy to identify a particular contour line if a number of soundings is taken. Allowance must be made for the "height of the tide" at the time. This gives a form of position line and if it is crossed by a bearing of a prominent object will give a Fix.




**Line of soundings** - this is useful if the sea bed is irregular - a number of soundings is taken over a period of time when the course remains constant. The log reading is noted at each sounding. These are plotted along the straight edge of a sheet of paper and this is "fitted in" to the soundings and contours on the chart, the edge of the paper remaining on the line of the course.



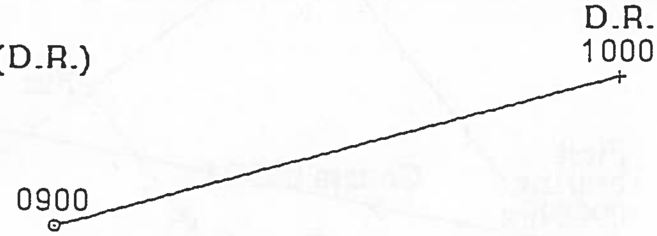

This "line of soundings" gives a position line, and a fix may then be obtained by crossing it with a bearing or transit.

## Other methods of finding position

There are many times when it will not be possible to fix your position by the methods given above, and less accurate ways must be used. However every opportunity should be taken when cruising to obtain as accurate a fix as possible, and to update this every hour as a routine, or if visibility is reducing.

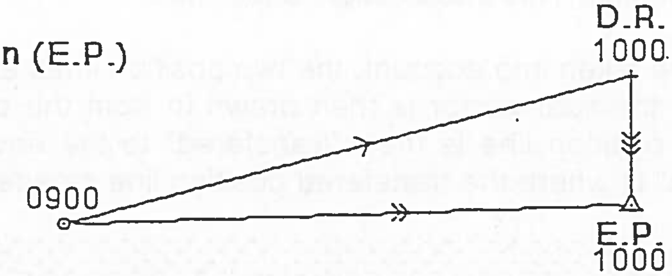
**Dead Reckoning** - This name comes from "Deduced Reckoning". It is a "position" obtained by plotting the course and distance-run from a known position or fix, without taking into account any tidal influence or leeway. A "dead reckoning" position therefore would be accurate only in the absence of tidal stream or leeway. A D.R. position is recorded as a cross on the course line, and the time should be noted beside it.

**Dead Reckoning (D.R.)**
Course 076°T
Distance run 5 miles



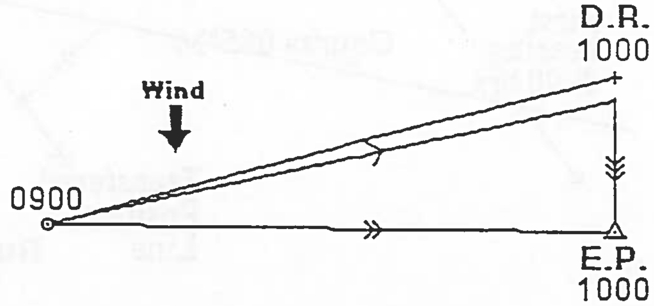

**Estimated Position** - This is a more accurate attempt to define position by taking **tidal current** and **leeway** into account. Although it is more accurate than **DR**, it is still not as accurate as obtaining a **fix**, because estimation of tidal current and leeway is often only an approximation. **E.P.** is obtained by plotting the "tidal vector" from the **D.R.** position. This tidal representation must be in the direction of the current ("set") and its length must be equal to the distance that the stream has run during the given time ("drift").

**Estimated Position (E.P.)**
Course 076°T
Distance run 5 miles
Tide 180°, 1 kn.




Leeway is the effect of the wind moving a vessel bodily to leeward, and is expressed as the angle between the ship's heading and the "water track". A fair idea of a boat's leeway may be obtained by taking a compass bearing from the stern along the wake ("wake course") and comparing this with the heading.

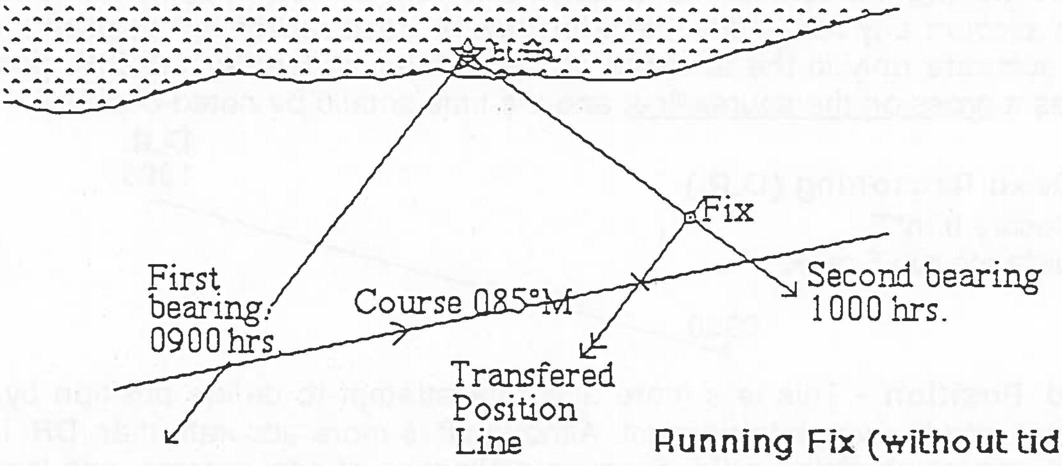
Leeway 5°
Course 076°
Distance run 5 miles
Tide 180°, 1 kn.




E.P. is recorded as a dot in a triangle, and the time is noted beside it.

## Running Fix

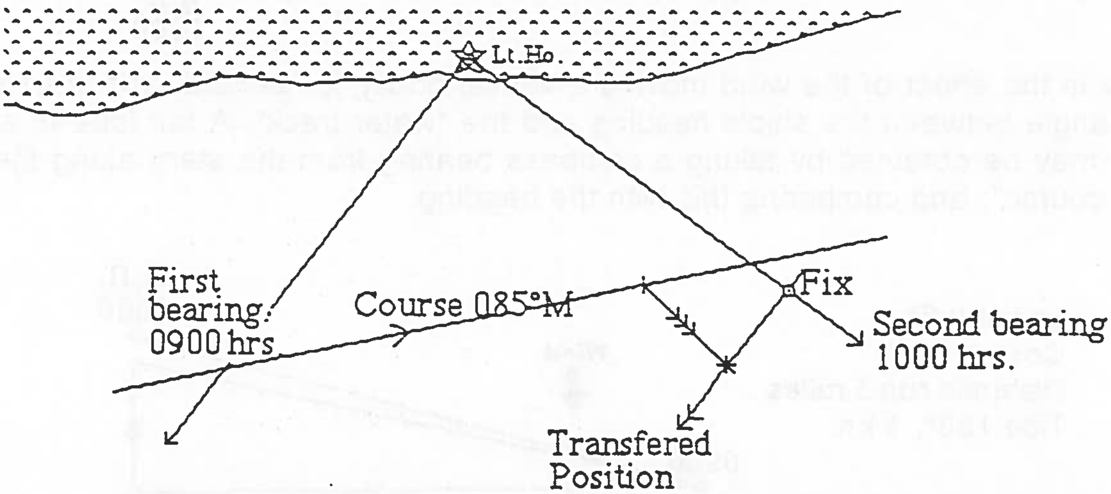
Sometimes only one object may be available to give a bearing. In this case it is possible to do a "running fix". A bearing of the object is taken, it is plotted on the chart as a position line, and the time and log reading noted. The boat's course is noted, and must remain constant until the second bearing is taken. After an hour, or other suitable interval, the second bearing is taken and plotted, and again the time and log reading are noted. The course line is drawn in - the exact position of this is of course unknown and it does not matter where it is drawn so long as it crosses both position lines.




Running Fix (without tide)

The distance travelled (as measured by the log) is marked off on the course line from the first bearing. A line parallel to the first bearing is drawn through the marked point on the course line - this is called the "transfered position line". It is prolonged to cut the second position line. This intersection is the "fix".

If tide has to be taken into account, the two position lines and the course line are drawn as above, but the tidal vector is then drawn in from the distance mark on the course line. The first position line is then "transfered" to the end of the tidal vector line. As before, the "fix" is where the transfered position line crosses the second position line.




Running Fix (with tide)

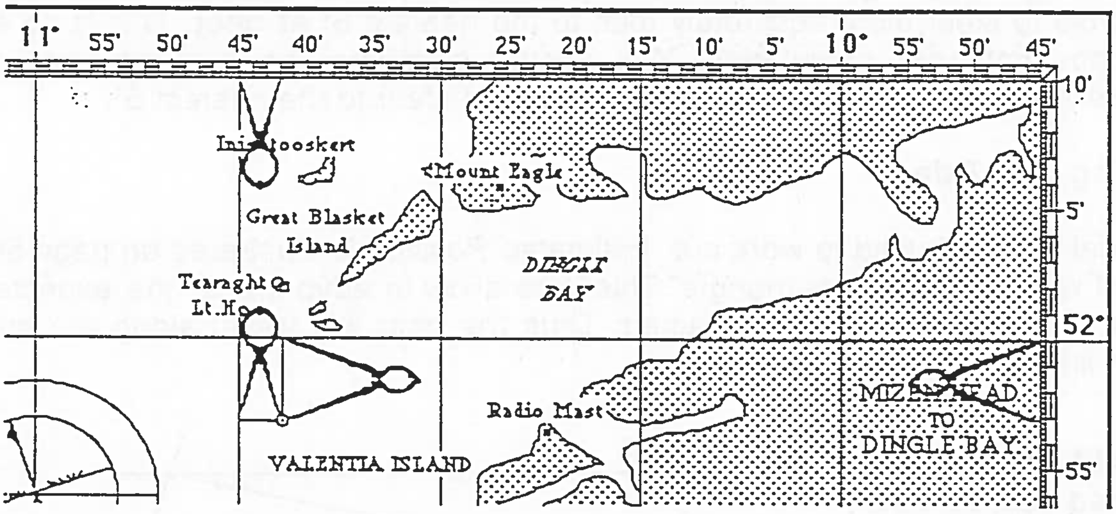
## Position

There are two main ways which are used to express position -

1. Latitude and Longitude
2. Bearing and distance from a known geographical position.

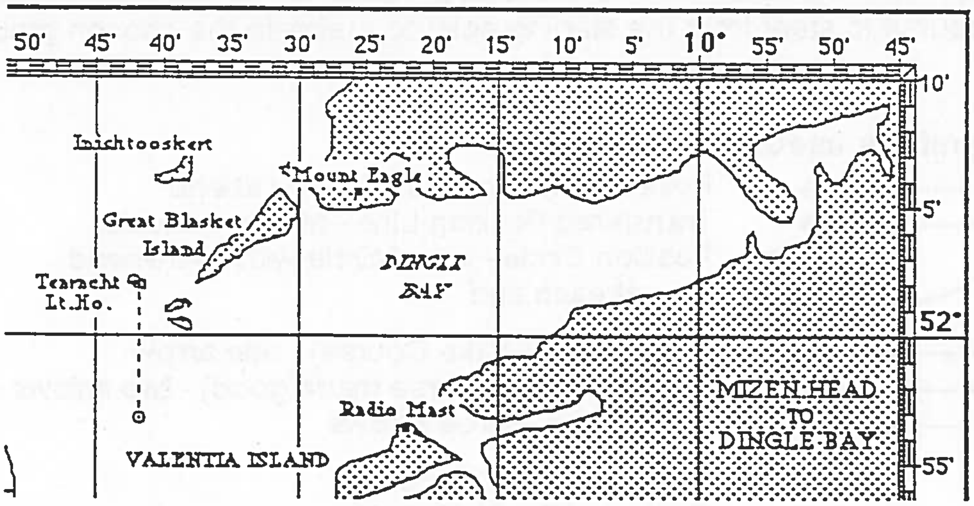
1. Latitude and Longitude. In the example below the position may be given as -

Lat. 51°56'.8 N
Long.10°42'.0 W




2. Bearing and Distance from known Geographical Position -
In this way of describing position, the name of the reference point is preceded by the bearing (always True, and given from the reference point), and followed by the distance - e.g. -

180° Tearaght Light 5.5 miles



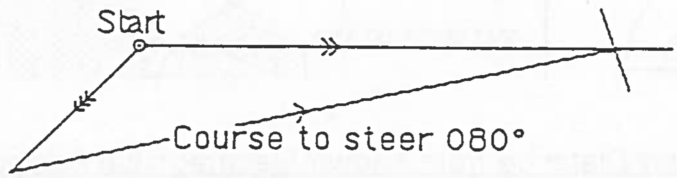
## Ploting a Course

A line is drawn from the boat's position towards its destination. The compass direction of this line is found by transfering it to a compass.rose (with parallel ruler), or by using a Breton Plotter or one of the other plotting instruments. As mentioned above, the use of the instruments must be learned by practical experience and most Scouts have no difficulty in mastering them very quickly. It is a matter of personal choice whether you work in True or Magnetic figures for the compass, provided that you know which you are using and always note down T or M after each compass figure. Always use the three figure notation - see the chapter on the Compass. If you are the navigator remember to correct any course you have worked out for Compass Deviation (if present) before you give the course to the helmsman. In most small craft it is impossible to steer more accurately than to the nearest 5° **at best**. This is no excuse for sloppy compass calculation. You should calculate the compass courses as accurately as possible and then give the course to steer to the nearest 5°.

### Allowing for Tide

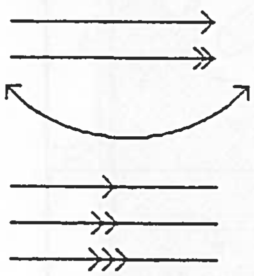
The "tidal triangle" used to work out Estimated Position is illustrated on page 56. Now we deal with another "tidal triangle".This is to allow in advance for the expected tidal stream so that it can be counteracted. Thus the boat will travel along the originally chosen line.

**TO ALLOW FOR TIDE**
Desired course 090°
Tide 225°, 1.5 kn.
Estimated speed 5 kn.




When making allowance for the tide, draw in the tidal vector first, from the starting position. Also draw the course you <u>wish</u> to follow - this will be the "ground track" or "course made good" and should have two arrows in the middle. From the end of the tidal vector mark out with a dividers on the "ground track" the distance you expect to travel in one hour. Then join the end of the tidal vector to the mark on the ground track - this is the course to steer from the starting point to maintain the chosen ground track.

**Symbols used in Chartwork** ·



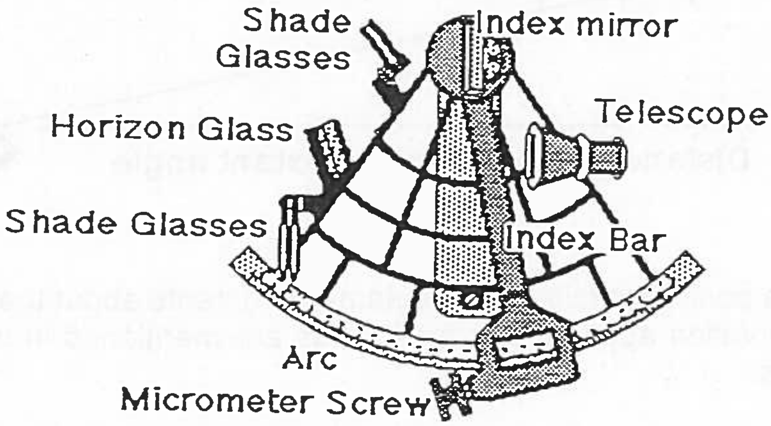
Position Line - one arrowhead at end
Transfered Position Line - two arrowheads
Position Circle - arc of circle with arrowhead at each end

Water Track (Wake Course) - one arrow
Ground Track (Course made good) - two arrows
Tidal Vector - three arrows

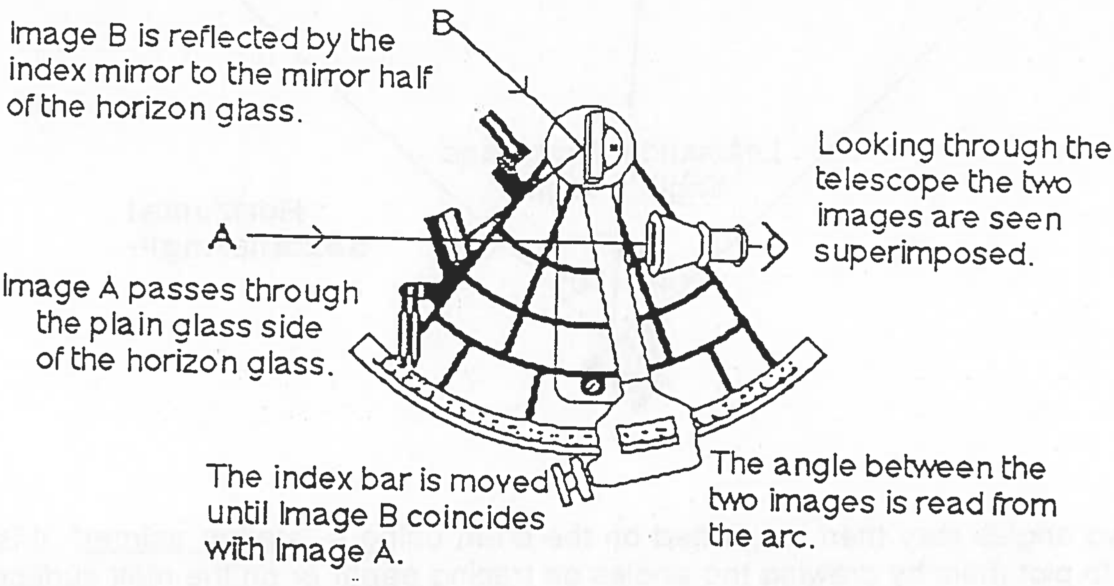
+ Dead Reckoning Position
△ Estimated Position
⊙ Fix

## USE OF THE SEXTANT

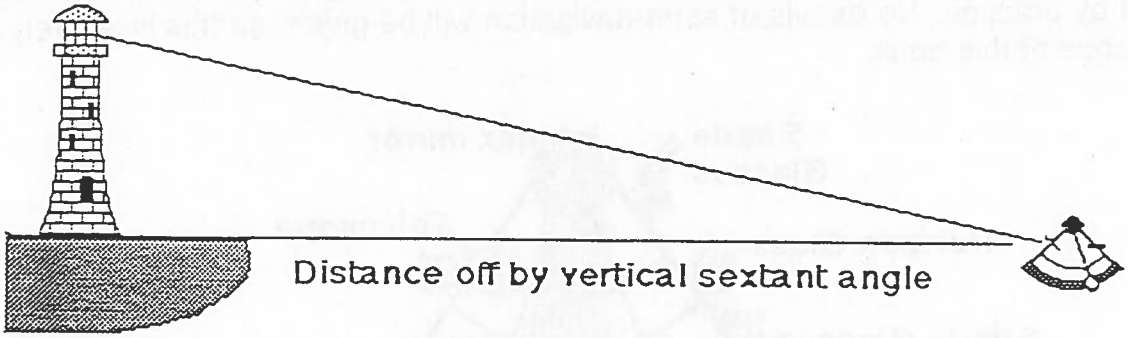
The sextant is an instrument which measures the angular distance between two objects, either vertical or horizontal. It is **not** an important instrument for coastal sailing, and most coastal navigators do not use it. It can however be useful in certain circumstances, particularly in trying to get very accurate position fixes. Some basic points about the sextant are given here, but like chartwork, use of a sextant must be learnt by practice. No details of astro-navigation will be given, as this is entirely outside the scope of this book.




Depending on the particular use of the sextant, it may be used vertically or horizontally. The observer looks through the telescope to the horizon glass. The horizon glass is half plain glass and half mirror. The observing eye looks directly through the plain glass at object A, but in the mirror of the horizon glass can see the reflection of the index mirror. This means that any image reflected in the index mirror itself can also be reflected to the horizon glass. The index mirror is attached to the index bar and this is moved along the arc until the image of object B is seen to coincide with object A. The angular distance between A and B is then read at the index mark.



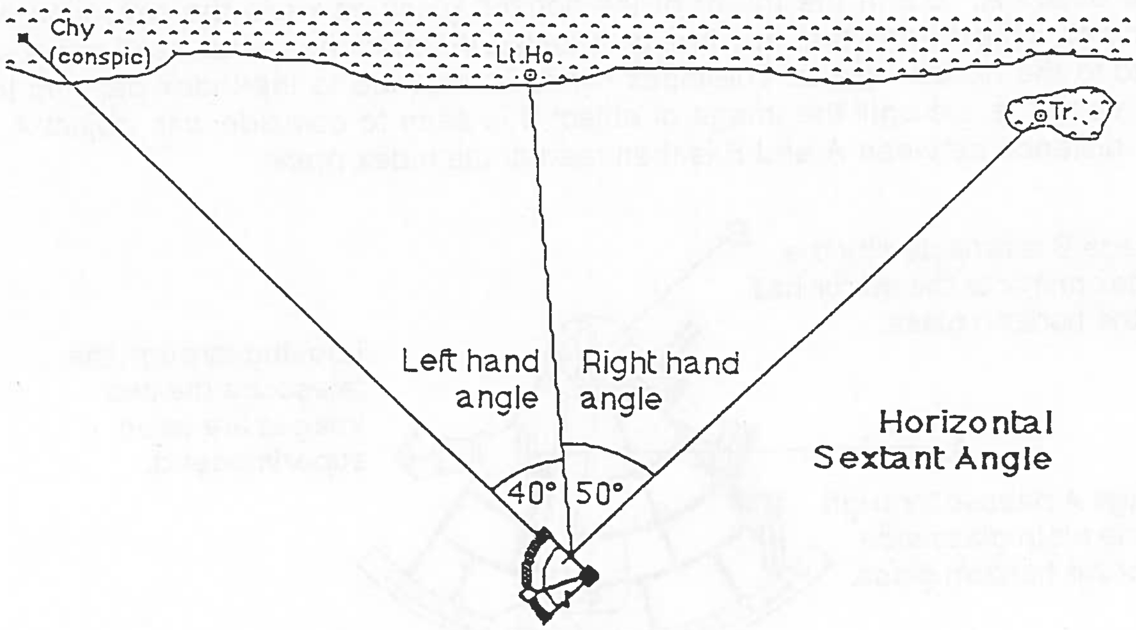
**Vertical sextant angles** - "distance off" may be measured by using the sextant held vertically. The angle of elevation above sea level of a lighthouse or other suitable prominent object can now be measured. From the chart or the List of Lights, the height of the light above sea level is found. With these two measurements the distance can be worked out by trigonometry if you wish, but it is much more quickly and easily found by looking up the appropriate table in your very useful Nautical Almanac.



Distance off by vertical sextant angle

The distance off gives a position circle, and the same comments about the height of the tide at the time of observation apply to this method as are mentioned in the section on rising and dipping lights.

**Horizontal sextant angles** - this is a very accurate way to fix position independant of the compass. We have just seen that the sextant can be used vertically to measure "distance off". Now it is used horizontally to measure the two angles between three prominent objects or features.



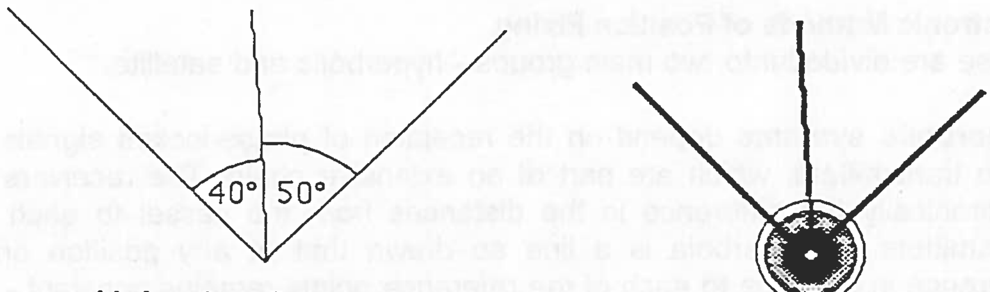

Horizontal Sextant Angle

These two angles may then be plotted on the chart using a "station pointer". It is also possible to plot them by drawing the angles on tracing paper or on the matt surface of a Douglas Protractor.

One big advantage of using the sextant is that the method is independent of any compass error. But if by any chance the three objects and the vessel are all on the circumference of the same circle it is impossible to obtain a fix by this method. This is because the station pointer will fit anywhere along the circumference of the same circle in these conditions.

Position fixing by sextant is one of the methods used when great accuracy is required, as in hydrographic surveying. In a project such as that, it is usual to have two sextant operators so that the two angles are taken simultaneously.

Plotting horizontal sextant angles




Using tracing paper or Douglas protractor

Using a "Station Pointer"

This system of plotting can also use compass bearings. If you find that you cannot get an accurate fix with three compass bearings (all taken from the same place), it may be due to an unknown compass deviation. Convert the three bearings into two angles between the objects and then plot them as above. Again, if the boat and the three reference objects are all on the circumference of the same circle, it will be impossible to get a fix.

## RADIO AND ELECTRONIC AIDS TO NAVIGATION

### Radio Direction Finding (RDF)

**Marine Radio Beacons** were, in their day, extremely useful in establishing position in coastal and offshore areas. Automatic radio stations in certain lighthouses, transmitted on low frequency (long wave). By use of a directional aerial, the compass bearing of such a radio beacon could be established. Two or three such bearings from different stations were then plotted to give a "fix". This system has gone out of use, superseded by electronic, and more recently by satelite navigation systems.

### Electronic Methods of Position Fixing

These are divided into two main groups - hyperbolic and satellite.

**Hyperbolic systems** depend on the reception of phase-locked signals from pairs of radio transmitters, which are part of an extensive chain. The receivers can measure electronically the difference in the distances from the vessel to each of the paired transmitters. A hyperbola is a line so drawn that at any position on the line the difference in distance to each of the reference points remains constant - eg. a position which is 5 miles from point A and 3 miles from point B is on the same hyperbola as a position 10 miles from A and 8 miles from B, and another position 12 miles from A and 10 miles from B. In each case the difference in distances from that position to A and to B is constant at 2 miles.

The receiver can place a vessel on a hyperbolic position line. It can then take another hyperbolic position line from another pair of stations and where these two lines cross is the position of the vessel. In the early days of using these systems, the position was plotted on a special chart overprinted with a lattice of hyperbolic position lines. Later receivers could give the answer in latitude and longitude which could be plotted directly onto an ordinary chart.

The two best known hyperbolic navigation systems are **Decca** (originally covering western and north-western Europe) and **Loran C** (covering the Mediterranean and the coasts of North America). Positional accuracy of these systems is about 200 to 500 meters. The development of Satelite Navigation systems has largely superceded the hyperbolic systems. Loran C is maintained as a reserve to the Satelite systems and has replaced Decca in western and northwestern Europe.

**Satellite Systems**. The first Satellite system was the **Transit System.** This used signals from certain satellites in transit, as their orbit came over the horizon. Fixes obtained were not continuous, but depended on the orbits of the satellites. The interval between fixes could be as long as one and a half hours. The positional accuracy was about a mile.

The Transit System has been replaced by the **Global Position System (GPS).** This is an American military system whose accuracy for civilian use was purposely downgraded to about 100 meters. Because of the greatly reduced international tension, US President Bill Clinton gave permission in 2001 to remove the downgrading technology, and the full military accuracy of about 5 metres is now freely available.

Rapid technological advance has meant that the cost of boat equipment for using the Global Position System has dropped rapidly in the past few years. Now, very cheap handheld receivers are readily available for GPS and the system is being used by mountain walkers and others, and special versions are available for cars.

The system consists of about 24 satellites orbiting the earth. The receiver takes the signal of a satellite that it can "see" and can calculate a position circle for itself. It can then do the same calculations from data of other satellites, working out the point where these circle circumferences cross, giving a "fix".

Although these instruments can now give the navigator great accuracy, this sometimes causes a sence of false security, and mistakes can easily be made by taking "shortcuts". It is very important that use of the GPS should still be accompanied by maintaining satisfactory chart plotting and by checking very carefully any coordinates entered into the GPS. A common cause of error in the practical use of GPS is making a mistake in entering data.

## NAVIGATION MARKS

The navigation marks around the Irish Coast are maintained by the Commissioners of Irish Lights, except in harbour or port areas which are marked by the local port authority. These aids to navigation include lighthouses, lightships, buoys and various shore beacons and marks. Most of these marks are lit for night use. Those which carry no lights are usually refered to as "**day marks**".

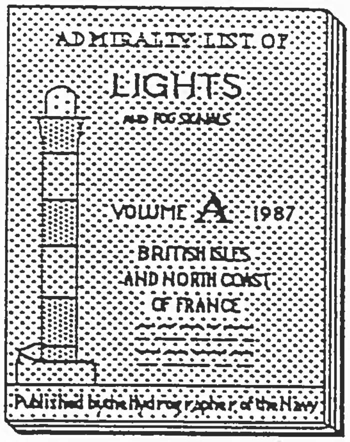
**Lighthouses** - You will find small lighthouses at the end of most harbour break-waters. The most important lighthouses around the coast are however built on head-lands, offshore islands or rocks, or sandbanks.

**Leading Lights, Leading Marks** - These are marks which are set up to guide vessels into a channel or harbour or between hazards. By keeping the marks in line with each other - "in transit" - the vessel is lead in through the safe channel, over the deepest part of the bar or between hazards.

**Lightships** - To mark certain hazards where it would not be possible or practical to build a lighthouse, lightships may be used. These vessels are less common now than in former days - some have been replaced by **Large Automatic Navigation Buoys (LANBY)**. All Irish lightships are now unmanned when on station. They are visited regularly by maintenance crews who are transported by helicopter. The light and the fog signals are automatic, and are monitored by radio from a coastal lighthouse. Lightships are painted red, and have the name of the station in large white letters on the side.

**Visibility Range** - This depends on the brightness of the light and is the maximum distance at which a light can be seen in conditions of clear visibility, provided that the observer is high enough above water level to be able to see it - i.e. provided that the light is not below the horizon. This is the figure given on the chart in Sea Miles (M).

**Admiralty List of Lights** - This Admiralty publication lists all lights, giving their positions, light characteristics, etc. It is produced in three volumes, Volume A covering "British Isles and North Coast of France".



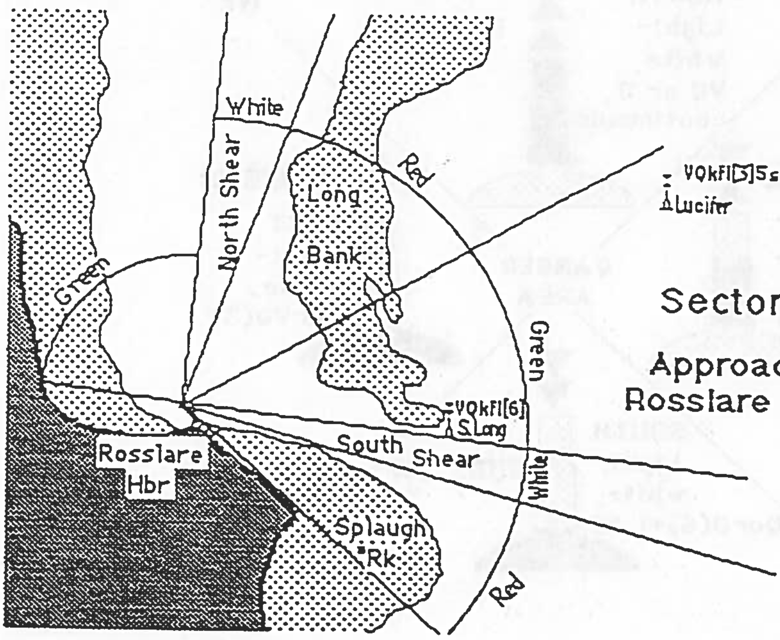
**Light Characteristics** - All navigation marks have special characteristics in order to help in identification. Lights which are near each other are usually given different characteristics so that they can be distinguished from each other - these characteristics are noted on charts in a standard abreviated form.

<u>Colour</u> - unless otherwise stated, lights are white. Other colours are red (R), green (G) and yellow (Y).

<u>Type</u> - **"Fixed"** (F) means a continuous steady light.
**"Flashing"** (**Fl.**) means that the light shines for only a very short period compared with the length of darkness.
**"Occulting"** (**Oc.**) means that the light shines for longer than it is dark.
**"Isophase'** (**Iso.**) means alternating **equal periods** of light and darkness.

<u>Rhythm</u> -Lights flash or occult in various patterns. There may be a single flash or groups of 2, 3, 4, etc. in a given time, expressed in seconds. The number of times that a light flashes or occults is noted in brackets after the abreviation for the type. This is followed by the length of the cycle - e.g. -
**Fl. 10 sec.** - one flash every 10 seconds,
**Fl.(3) 15 sec.** - groups of three flashes repeated every 15 seconds.
**Oc.(2) 10 sec.** - occulting twice every 10 seconds.
<u>**Quick Flash**</u> (**Q**) means flashing at a rate of about 60 per minute.
<u>**Very Quick Flash**</u> (**VQ**) means a rate of about 120 per minute.
<u>**Long Flash**</u> (**LFl.**) means a duration of about 2 seconds.

**Sector Lights** - Some lights have different colours in sectors or segments of their arcs. For instance, the light may show white over a safe approach channel but red over a dangerous rock. These sectors are marked on the chart. Note that when sector lights are described in Sailing Directions or Pilot Books the segments of the light are given as **bearings from seaward**, and **NOT** from the light itself.




**Sector Light**

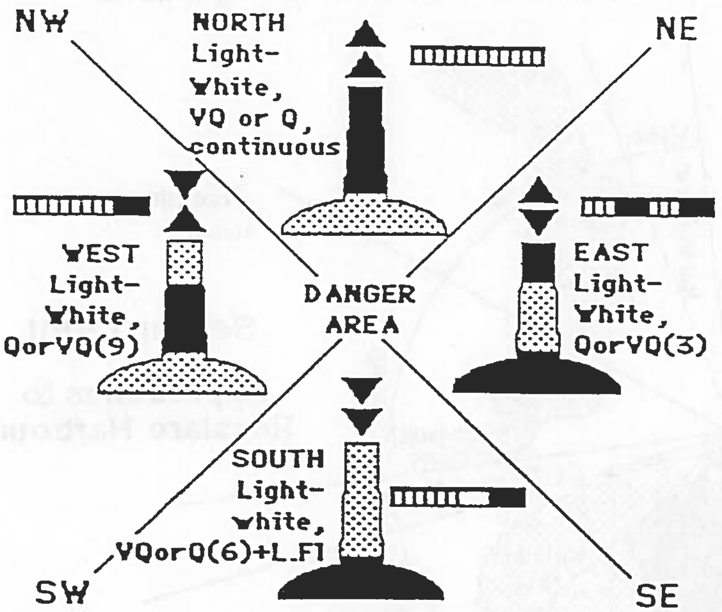
**Approaches to Rosslare Harbour**

## BUOYAGE SYSTEM

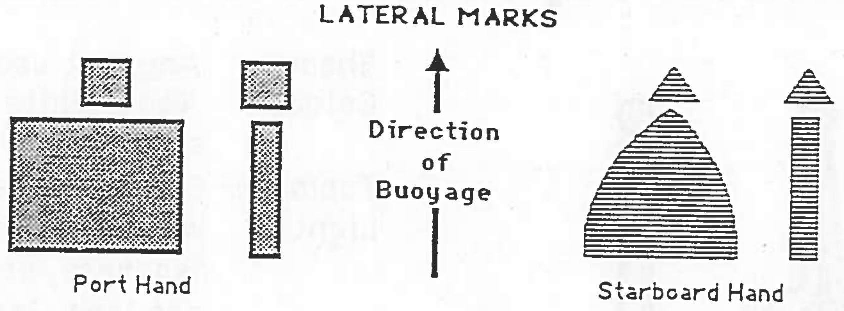
Up to a few years ago there were many different systems of buoyage throughout the world, and especially in Europe. After discussions, the **International Association of Lighthouse Authorities** (IALA) produced a new system now known as the **IALA Buoyage System.** The system has Cardinal Marks, Lateral Marks, Isolated Danger, Safe Water and Special Marks.

**Cardinal Marks** - These marks are placed North, South, East or West from a danger or "Point of Interest" (e.g. wreck, sand bank, rock, etc.). They are coloured yellow and black and all have a "top mark" consisting of two black triangular shapes. Their lights are always white.

| | |
|---|---|
| **North Cardinal** - | Top marks - both point upwards.<br>Colours - black over yellow.<br>Lights - white, quick flash (continuous). |
| **East Cardinal** - | Top marks - base to base.<br>Colours - black on top and bottom, yellow middle.<br>Lights - white, group of three. |
| **South Cardinal** - | Top marks - both point downwards.<br>Colours - black below, yellow above.<br>Lights - white, group of six flashes, plus one long flash. |
| **West Cardinal** - | Top mark - point to point.<br>Colours - black middle, yellow top and bottom.<br>Lights - white, group of nine. |



**Lateral Marks** - These are used to mark channels, and indicate port or starboard hand when proceeding in the **"direction of buoyage"**.

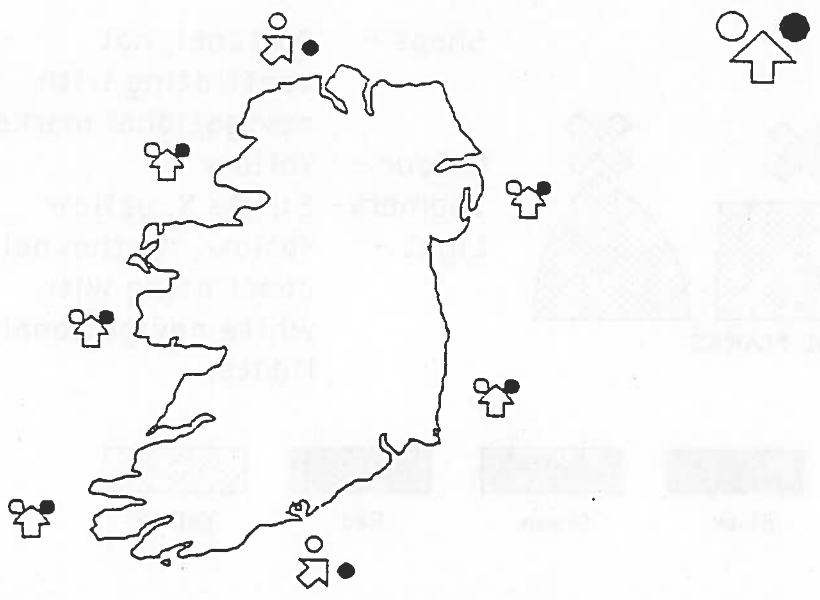



**Port Hand** -
Shape - can.
Topmark (if present) - can.
Colour - red.
Light - red, any rhythm

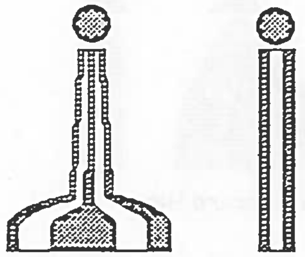
**Starboard Hand** -
Shape - cone
Topmark (if present) - cone
Colour - green
Light - green, any rhythm.

These Lateral Mark colours apply to Europe, Africa, Australia and most of Asia **(Region A)**. In other areas, especially America **(Region B)**, red and green are reversed. The shapes are the same in both regions, only the colours differ.

**Direction of buoyage** - This is from seaward when entering a harbour or proceding upstream. In open waters around Northern Europe the direction is from South West to North East. Around the Irish Coast this is shown on the map below. In areas of doubt about the "Direction of Buoyage" this is usually indicated on charts by a special symbol



**Safe Water Marks -** These marks are use to indicate the centre of a channel, or the entrance to a wide-mouthed channel, or as "land-fall" buoys someway off a coast. They may be looked on as a form of sign-post and do not mark any hazards.

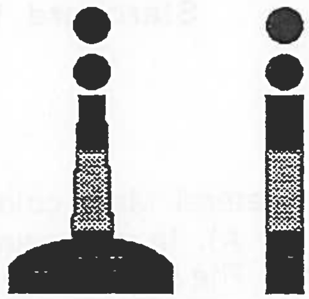


SAFE WATER MARKS

Shape - Any, but usually pillar
Colour- Red / white vertical stripes
Topmark- Spherical, red
Light - White, and may be either isophase, occulting or one long flash every ten seconds.

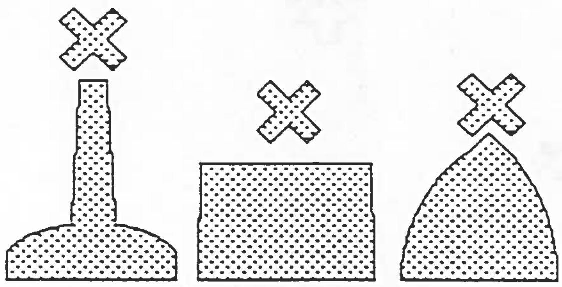
**Isolated Danger Marks -** These are used to mark isolated dangers, which have deep water all around.

Shape - Usually pillar
Colour- Black / red, horizontally
Topmark- Two, spherical, black
Light - White, groups of two flashes.



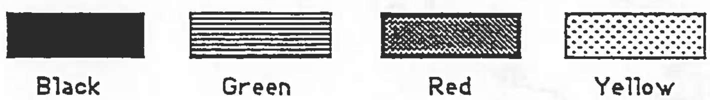
ISOLATED DANGER MARKS

**Special Marks -** These marks indicate special areas or features such as recreational areas, traffic separation zones, military exercise areas, spoil grounds, sewage outfalls, etc. They do not mark navigational hazards.



SPECIAL MARKS

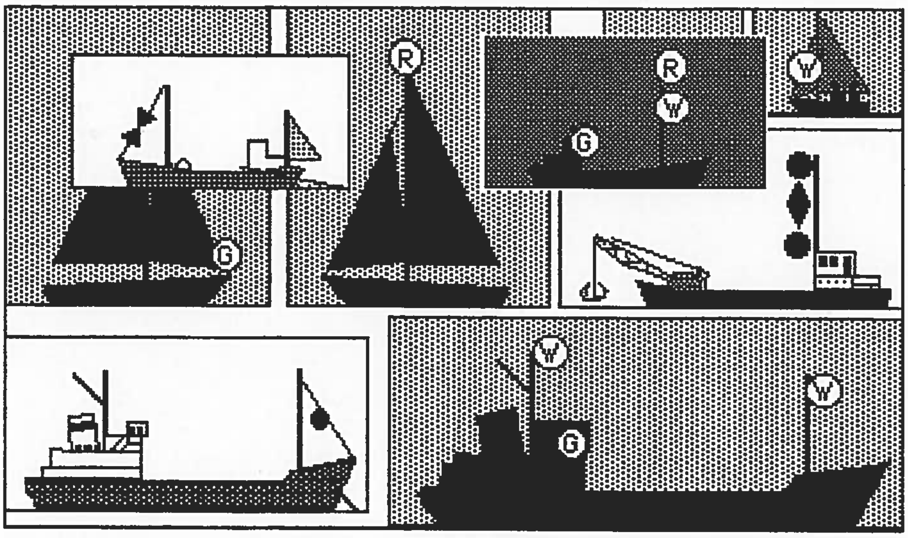
Shape - Optional, not conflicting with navigational marks
Colour - Yellow
Topmark- Single X, yellow
Light - Yellow, rhythm not conflicting with white navigational lights.



# SEA TRAINING MANUAL

## SECTION D

# COLLISION REGULATIONS DISTRESS AND DANGER SIGNALS



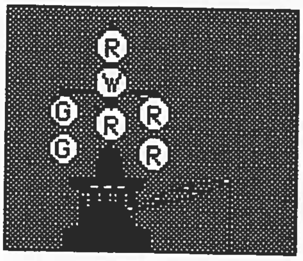

SEA
TRAINING
TEAM

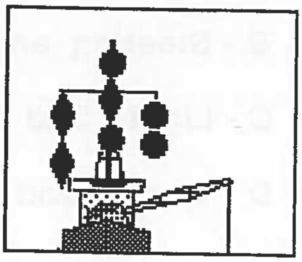
SCOUTING IRELAND SAI

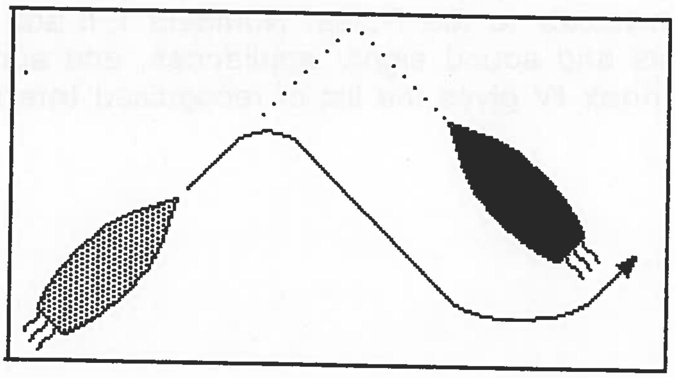
## COLLISION REGULATIONS, DISTRESS AND DANGER SIGNALS

This section contains summaries of the main parts of the International Regulations for Preventing Collisions at Sea, together with notes on Danger Signals and Yacht Racing Rules. Much of this information is already available in Parts 1 & 2 of the Sea Training Handbook, but have all been repeated here to give a complete picture. Knowledge of the "Collision Regulations" and of Distress and Danger Signals is required for the Sea Training Scheme and for Intermediate and Advanced Charge Certificates. This section is therefore of very great importance in Sea Training.


| INDEX | Page |
|---|---|
| **Steering and Sailing Rules** | 2 - 7 |
| **Lights and Shapes** | 8 - 12 |
| **Sound and Light Signals** | 13 - 14 |
| **Distress Signals** | 15 |
| **Danger Signals** | 16 |
| **Yacht Racing Rules** | 17 |



# INTERNATIONAL REGULATIONS FOR PREVENTING COLLISIONS AT SEA -1972.

These are usually known for short as "The Collision Regulations" and the present regulations came into force on the 15th July 1977. You will not be expected to know these rules in detail, but you should have an idea of the main ones, particularly those which affect small boats, and those which affect shipping commonly seen in your area. A summary of the main regulations is given here. You can find the full rules in many nautical publications particularly in the Nautical Almanacs, e.g. Reed's. A special edition of the 1972 regulations, annotated for Yachtsmen, is produced by the British Royal Yachting Association (Ref. G2). This may be obtained from the Irish Yachting Association Head Office in Dun Laoghaire.


The Regulations are divided into five parts - **A,B,C,D,E.**

**Part A** (Application and General Definitions) and **Part E** (Exemptions) are of little practical importance to us at present. The remaining parts are as follows -

**Part B - Steering and Sailing Rules**

**Part C - Lights and Shapes**

**Part D - Sound and Light Signals.**

There are also four **Annexes** to the Rules. Numbers **I, II** and **III** cover various technical details of lights and sound signal appliances, and additional signals for fishing vessels, while **Annex IV** gives the list of recognised **International Distress Signals.**

## PART B - STEERING AND SAILING RULES

### Rule 5 - Look Out

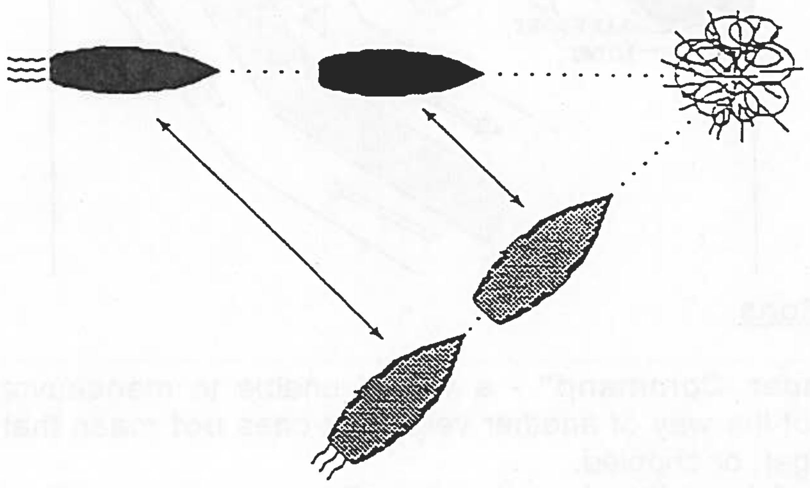
"Every vessel shall at all times maintain a proper look out by sight and hearing........"
This is the rule upon which all the rest depend. A good look- out is essential - it is quite easy for the look out not to be as good as it should be. In sailing yachts with long-footed and low-clewed head sails, there may be a large blind arc to leeward. A really effective look-out requires one member of the watch on deck to sit well down to leeward and look behind the sail. If the weather is poor, particularly if there is much spray and you are beating to windward, it may be difficult to keep an efficient lookout, but in these conditions it is obviously very important to be able to do so. Sailing at night requires good "night vision". The eye takes some time to adapt to the darkness, and sudden exposure to a bright light can ruin this night vision for a further fifteen minutes or so. In conditions of poor visibility it is extremely important to maintain a good **listening watch**. It is often impossible to listen properly from a closed wheel-house, or even on the open deck if the engine is running. A look out should be stationed in the bow. If under power, the engine may be stopped or slowed down every few minutes to listen.

### Rule 6 - Safe Speed

To take proper and effective action to avoid collision a vessel must proceed at a safe speed, taking into account visibility, traffic density, manoeuvrability, weather and sea conditions, local hazards and depth of water.

### Rule 7 - Risk of Collision

Risk of collision exists if the compass bearing of an approaching vessel remains the same.



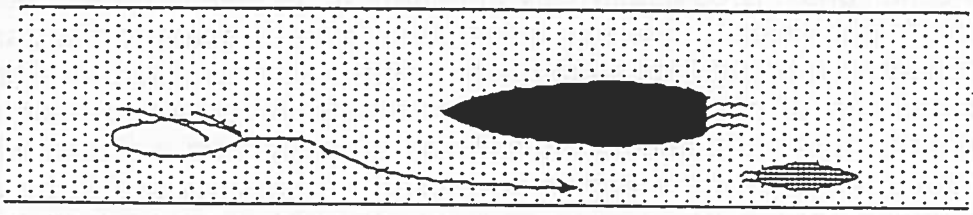
**Two approaching vessels on a constant bearing**

### Rule 8 - Action to avoid collision

Action taken to avoid collision should be positive, made in good time, be readily apparent to the vessel which has the "Right of Way", and should result in the vessels passing at a safe distance.

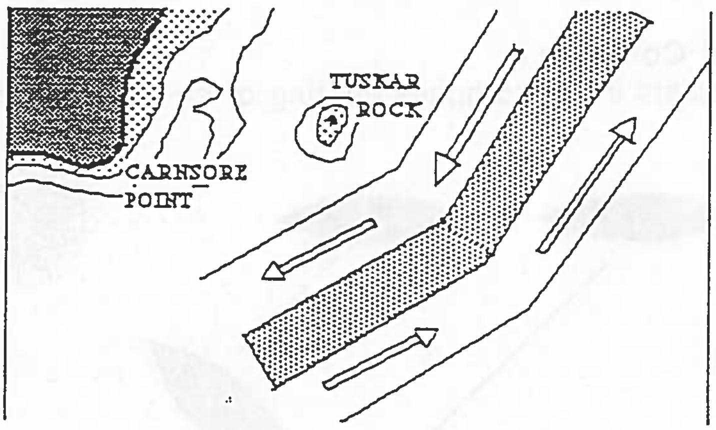
**Rule 9 - Narrow Channels**

a. When proceeding along a channel, keep well to the edge of the channel or fairway to your starboard.
b. Small ships, either sail or power must not impede the passage of larger vessels which are restricted for safe movement by size or draft.
c. Fishing Vessels must not impede others.
d. Anchoring in a narrow channel is forbidden.
e. Use caution at any blind bends in the channel.
f. A vessel overtaking another vessel in a narrow channel must make the appropriate sound signals as given in Rule 34 (Part.D).



**Rule 10 - Traffic Separation Schemes**

In areas off-shore where there is congestion of shipping a system of traffic lanes has been arranged which are marked on Admiralty Charts. Small vessels, either sail or power, or fishing vessels must not impede large vessels using these traffic lanes Any vessel crossing a traffic lane must do so at right angles, and as quickly as possible.



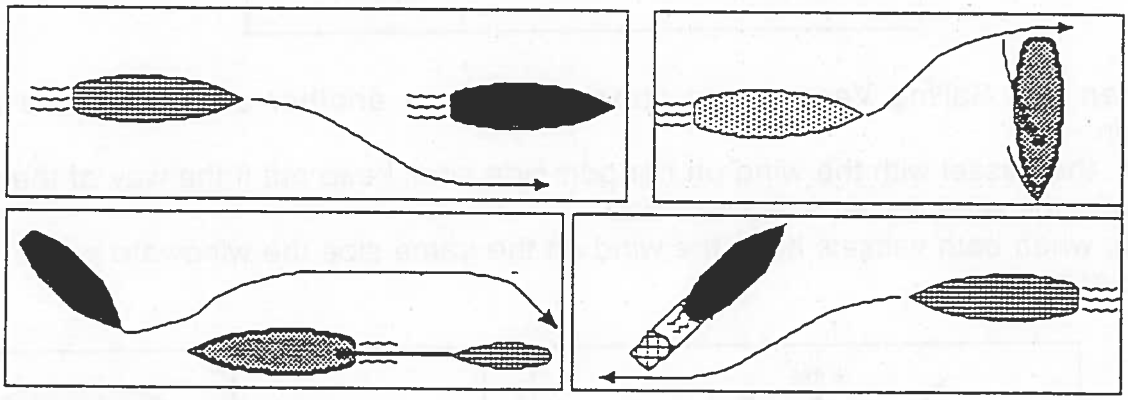

<u>NOTE - Definitions</u>

**"Vessel not under Command"** - a vessel unable to manoeuvre, and therefore cannot keep out of the way of another vessel. It does **not** mean that the vessel is in distress or in danger, or crippled.
**"Vessel restricted in ability to manoeuvre"** - manoeuverability restricted by the nature of work - e.g. cable laying, servicing a navigational mark, dredging, underwater operations, certain towing operations in which the ability of the towing vessel to deviate from course is severely restricted.
**"Vessel constrained by her Draft"** - a vessel which because of her exceptional draft in relation to the available depth of water cannot deviate from a certain course.
**"Vessel engaged in Fishing"** - any vessel fishing with nets, lines, trawls or other fishing apparatus which restrict manoeuvrability.
**"Underway"** - a vessel which is not at anchor, or made fast to the shore, or aground.
**"Making Way"** - moving through the water.
**"Restricted Visibility"** - any condition in which visibility is restricted - e.g. fog, mist, falling snow, heavy rain, etc.

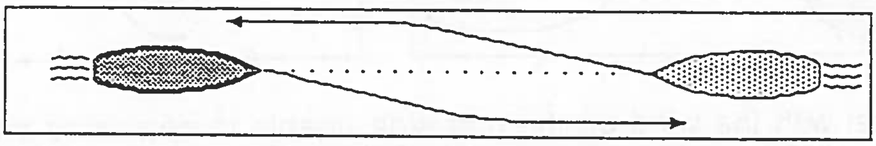
RULES 11 - 18 inclusive - these are the main rules relating to the manoeuvring of vessels and are summarised as folows.

## POWER VESSELS

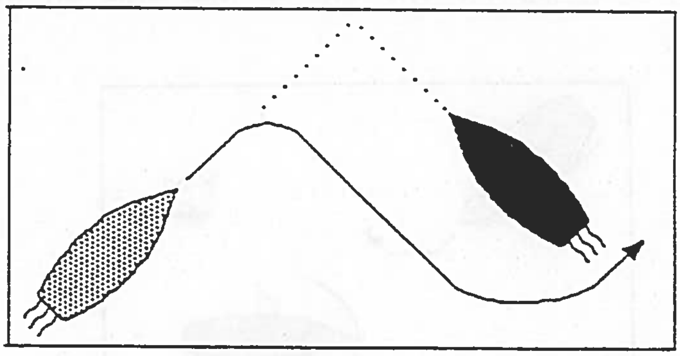
1. A Power Vessel should keep out of the way of -
    a. any vessel she is overtaking
    b. a sailing vessel
    c. vessels and boats fishing
    d. any vessels not "under command"
    e. any vessel " restricted in her ability to manoeuvre"



2. When two Power Vessels are approaching head-on, the principle is to keep to the right.

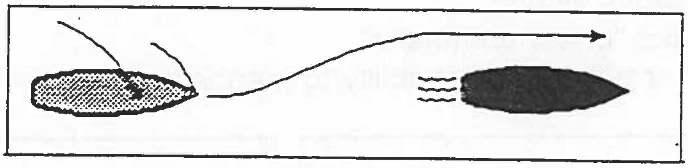


3. When two Power Vessels are crossing, so as to avoid risk of collision the vessel which has the other on her starboard side keeps out of the way.

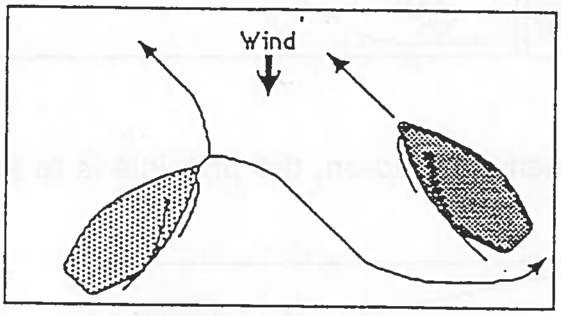


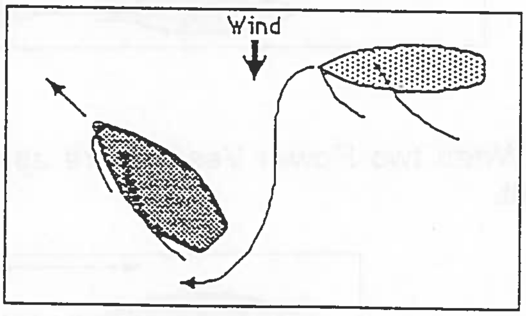
## SAILING VESSELS

1. A Sailing Vessel should keep out of the way of -
   a. any vessel she is overtaking
   b. any vessel or boat fishing
   c. any vessel not "under command"
   d. any vessel "restricted in her ability to manoeuvre"

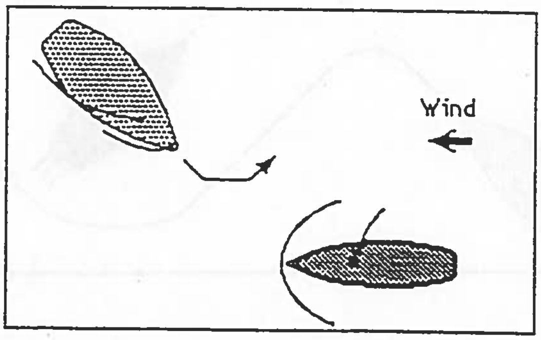


2. When two Sailing Vessels are approaching one another so as to avoid risk of collision -
   a. the vessel with the wind on her port side shall keep out if the way of the vessel with the wind on her starboard side
   b. when both vessels have the wind on the same side the windward vessel keeps clear

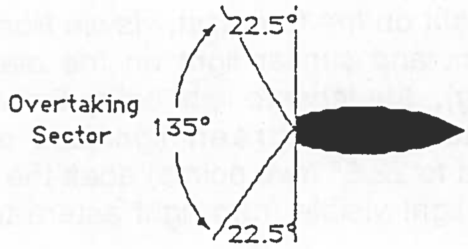



   c. a vessel with the wind on the port side unable to determine on which side a windward vessel has the wind should give way.For example, if a windward boat is carrying a large spinnaker, this may obscure the view of the mainsail for the leeward boat. If the leeward boat has the wind on the port side, she should then give way. For the purposes of these rules, the side on which a vessel has the wind is defined as being the opposite to that side on which the mainsail is carried.



**Overtaking - Any vessel overtaking, must stay clear of the vessel being overtaken.** The definition of overtaking is when one vessel is approaching another from astern, or from a direction more than 22.5 degrees abaft the beam - that is within the sector of the white stern light.




**Note that any vessel whose duty it is to give way under any of the Rules must take early and substantial action to keep clear.** The reason for this is to avoid confusion and misunderstanding. The action of the vessel giving way must be very clear to the "right of way" vessel.

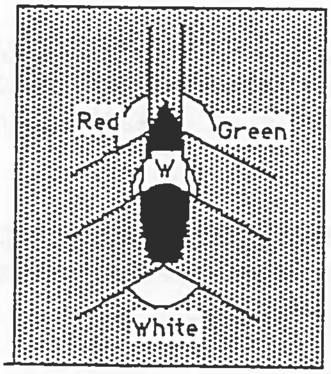
Any vessel which has the right of way should keep her course and speed. However, the vessel with right of way may have to take action to avoid collision if it becomes obvious that the other vessel is not taking appropriate action.

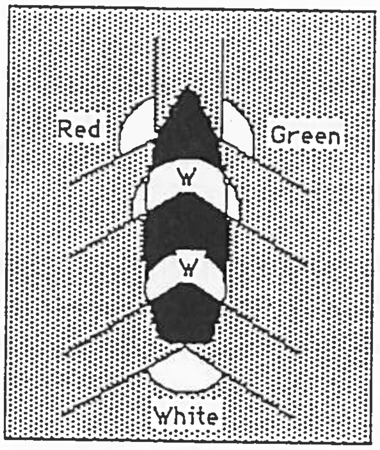
## PART C - LIGHTS AND SHAPES

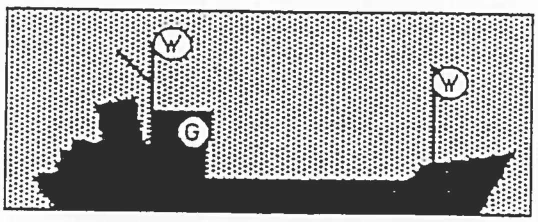
**Lights** or "**shapes**"indicate the type and function of a vessel by night or by day. The following is a summary of the main rules of Part C -

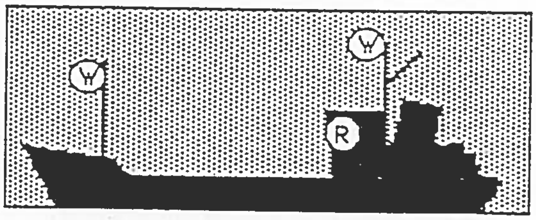
**Power Vessel under Way -**

1. Mast lights - **white** light on the foremast, visible from right ahead to 22.5° (two points) abaft the beam, and similar light on the main-mast (not necessary on vessels under 50m long), the forward light being 5m lower than the after light.
2. Side lights - on starboard a **green** light and on port a **red** light, each visible from right ahead to 22.5° (two points) abaft the beam on its own side.
3. Stern lights - **white** light visible from right astern to 22.5° abaft the beam on each side.



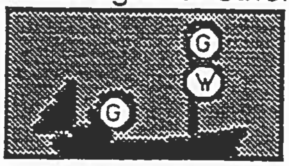



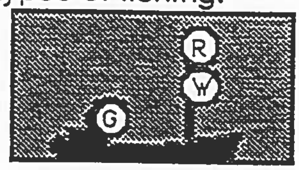



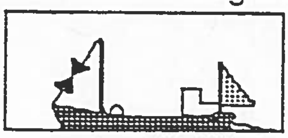

**Fishing vessels -**

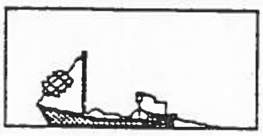
1. Normal lights when not fishing.
2. When fishing-
   - a green over a white light (visible all round) for trawling
   - a red over a white light for other types of fishing.



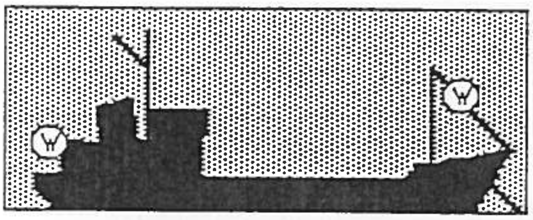

3. Side and stern lights when under way.
4. By day, fishing vessels display two black cones, points together, in fore rigging. A vessel less than 20 meters long may hoist a basket instead of the two cones.

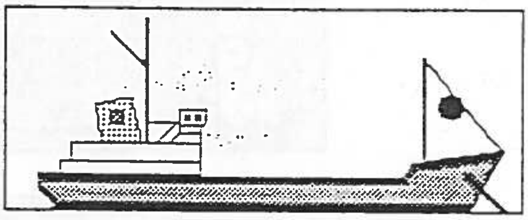




**Vessel at anchor -**

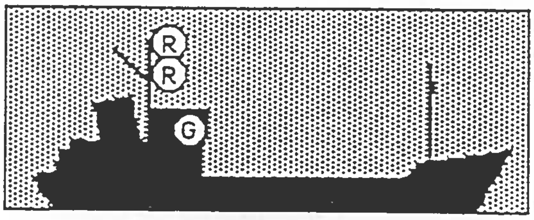
1. All-round white light forward.
2. Vessel over 50 meters long will have another white light near the stern, lower than the forward light.
3. By day, one black ball in place of the forward light.

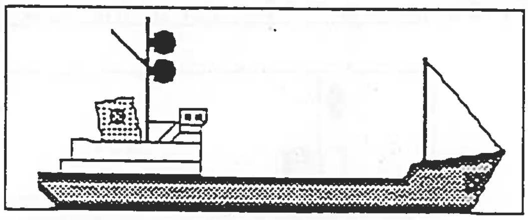




**Vessel not under command -**

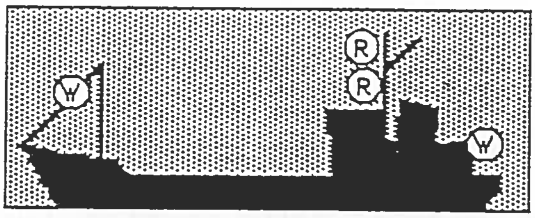
1. If making way, side and stern lights.
2. Two all-round red lights vertically.
3. By day, two black balls vertically.

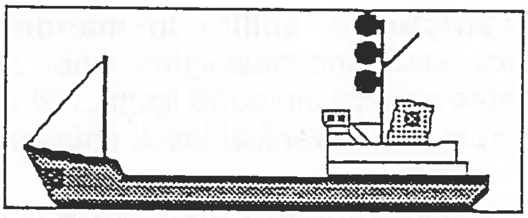




**Vessel Aground**

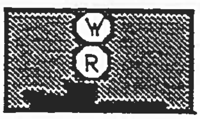
1. Anchor lights as described above
2. Two all-round red lights vertically
3. By day three black balls vertically.





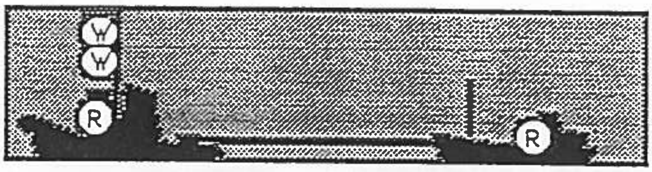
**Pilot vessel -**

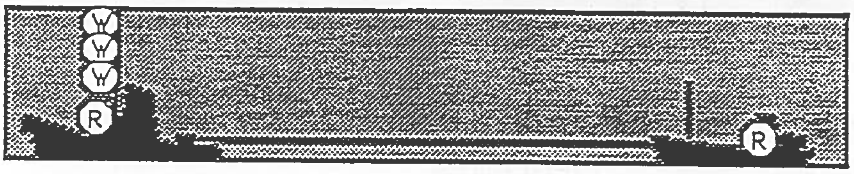
1. When on station, two vertical lights, white above red, both visible all round.
2. White flare at intervals.
3. When under way side and stern lights as before



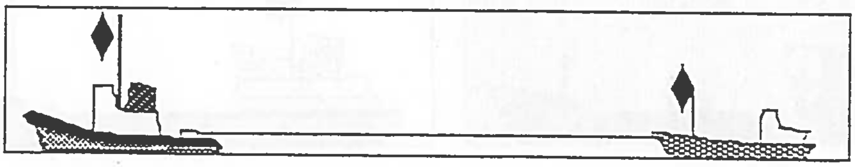
**Vessel towing -**

1. Side and stern lights as before.
2. Two vertical white mast lights, visible from right ahead to 22.5° abaft the beam on each side. Three vertical white lights if the length of the tow, (i.e. the distance from the stern of the towing vessel to the stern of the tow) exceeds 200 meters.




3. A "towing light " - **yellow** light vertically over the stern light, visible through the same arc as the stern light.
4. By day, <u>when the length of the tow exceeds 200 meters</u>, a black diamond shape



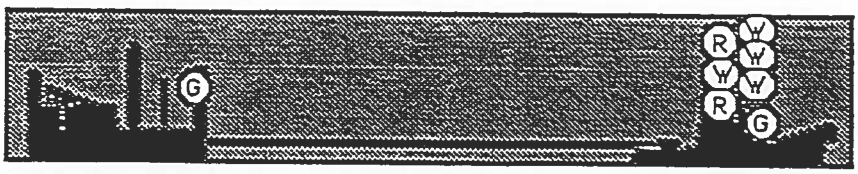
**Vessel being towed -**

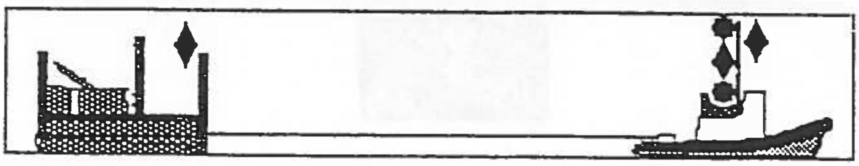
1. Side and stern lights.
2. No mast lights.
3. By day, <u>when the length of the tow exceeds 200 meters</u> a black diamond shape

**Vessel restricted in ability to manoeuvre**

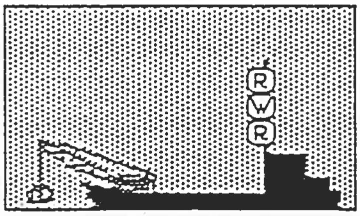
1. Side, stern and mast lights when making way.
2. Three vertical all-round lights, red over white over red.
3. By day, three vertical black shapes, a ball above a diamond above a ball.

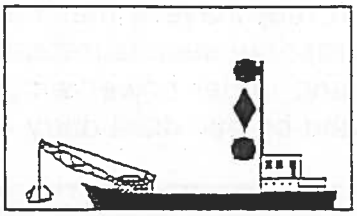
**Note -** If a vessel's ability to manoeuvre is restricted by a towing operation, it will carry these lights and shapes, <u>in addition to</u> those described under "Vessel Towing".



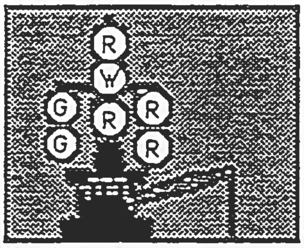
**Dredging or Underwater Operations -**
A vessel engaged in dredging or underwater operations will show the lights or shapes of a vessel restricted in ability to manoeuvre, as already described.

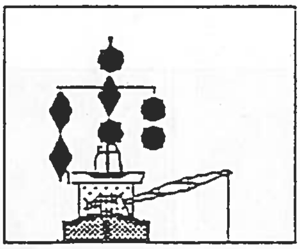




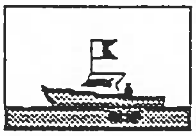
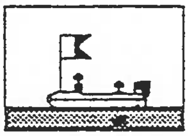
In addition, if an obstruction exists on one side, the vessel must exhibit -

1. The lights or shapes for a vessel restricted in ability to manoeuvre
2. Two all-round vertical red lights, or by day two vertical black balls on the side on which the obstruction exists
3. Two all-round vertical green lights, or by day two vertical diamonds, on the side on which another vessel may pass.



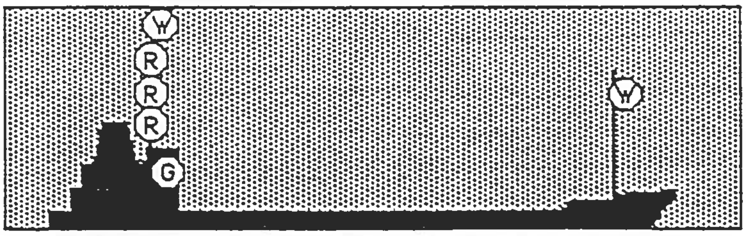


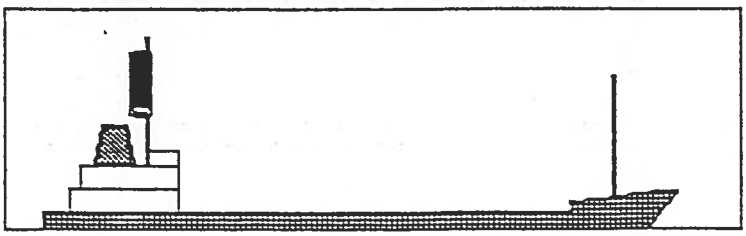
**A vessel engaged in diving operations** will also usually fly **flag A** of the International Code. A very small vessel will exhibit a rigid replica of Code Flag A (not less than one meter in height).

**Vessel constrained by draught -**

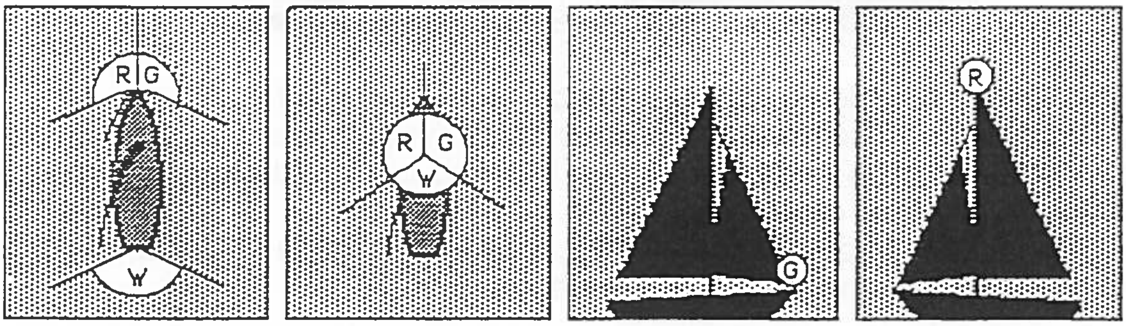
1. Side and stern lights as before.
2. Three vertical all-round red lights.
3. By day, a vertical black cylinder shape





**Sailing vessel under way -**

1. Side and stern lights as before.
2. No mast light except -
3. <u>Optional</u> red over green all-round lights on the foremast.
4. If under 12 m may have a masthead tricolour light, showing red, green and white in the appropriate sectors,instead of separate side and stern lights.
5. If under sail and under power simultaneously, by night must show lights of a power vessel, and by day must carry a black cone, apex down, in the rigging.

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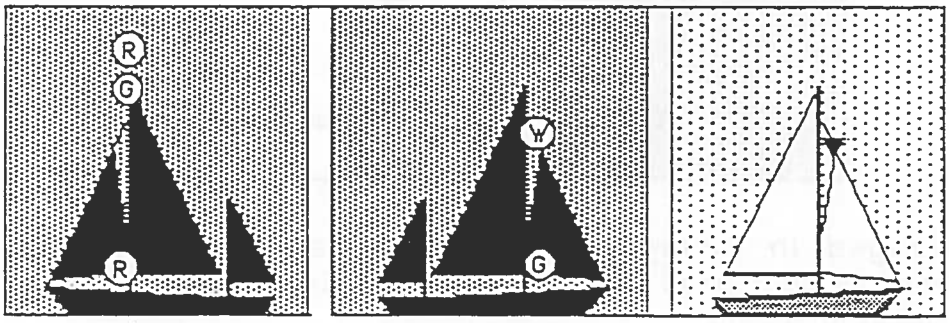


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**Small open boats -**

Under oars or sail a lantern or torch should be carried to display a white light in sufficient time to prevent a collision.

## PART D - SOUND AND LIGHT SIGNALS

The term **"short blast"** means a blast or a sound of about one second's duration. **"Prolonged blast"** means from 4 - 6 seconds duration.

### Rule 34 - Manoeuvring and warning signals -

1. One short blast ("E" in Morse) -
"I am altering my course to starboard".

2. Two short blasts ("I" in Morse) -
"I am altering my course to port".

3. Three short blasts ("S" in Morse) -
"I am operating stern propulsion"
(my engines are going astern).

4. Two long and one short blasts -
"I intend to overtake you on your starboard side".

5. Two long and two short blasts -
"I intend to overtake you on your port side".

6. Long, short, long, short ("C" in Morse) -
acknowledge signal.

7. Five short blasts - this signal is given by one vessel to attract the attention of another vessel, e.g. where the first vessel has right of way and the second vessel does not appear to have seen him or is not obviously giving way in good time.

Rule 35 - Sound signals in restricted visibility -

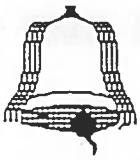
1. **Power vessel making way -**
   one prolonged blast every two minutes.

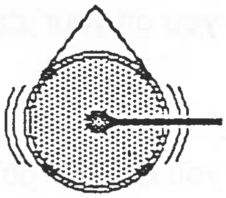
2. **Power vessel under way but stopped -**
   two prolonged blasts every two minutes.

3. **Sailing vessel under way, or a vessel not under command, or a vessel towing, fishing or otherwise hampered -**
   one long and two short blasts every 2 minutes.

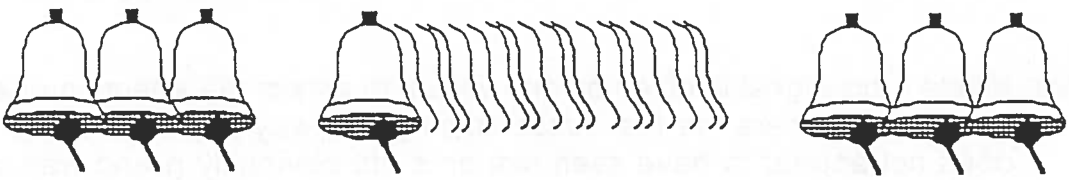
4. **Vessel being towed -**
   one long and three short blasts, if possible coming immediately after the signal made by the towing vessel.

5. **Vessel at anchor -**
   a bell rung rapidly for 5 seconds every one minute in the forepart of the vessel. If over 100 meters long, a gong is sounded for a further 5 seconds in the after part of the vessel. In addition, the anchored vessel may sound one short, one long and one short blast on the whistle to give extra warning of her position to an apparently approaching vessel.





6. **Vessel aground -**
   the same signal as a vessel at anchor, with the addition of three separate and distinct strokes on the bell immediately before and after the five seconds rapid ringing.



7. **Pilot vessel on duty -**
   in addition to its ordinary signal, may sound four short blasts ("H" in Morse) as an identity signal.

## Rule 37 - Distress signals -

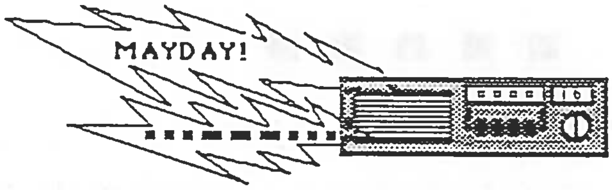
This rule makes provision for the use of distress signals. The list of recognised official signals is given in **Annex IV** of the **International Regulations.**

1. A **gun** or other **explosive** signal fired at intervals of about one minute.

2. A continuous sounding of any fog-signalling apparatus (now recommended to use "SOS").

3. Rockets or shells throwing **red stars**, fired one at a time at short intervals.

4. A signal made by wireless telegraphy (W/T) or by any other signalling method, consisting of **SOS** in Morse Code.




5. A signal by radiotelephony (R/T) consisting of the spoken word - **"MAYDAY!"**

6. International Code Flag Signal of distress - NC

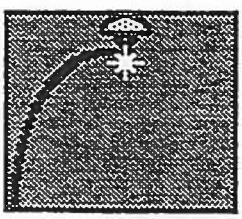

7. A signal consisting of a square flag having above or below it a ball or anything resembling a ball.

8. **Flames** on the vessel - as from a burning tar barrel, oil barrel, etc.

9. A rocket **parachute flare** or a **hand flare** showing a **red** light.

10. A smoke signal giving off a volume of **orange coloured smoke.**

11. Slowly raising and lowering of arms outstretched to each side.



**NOTE** - An Ensign raised upside-down can be regarded as a distress signal, but it is <u>not</u> one of the officially designated signals.

## DANGER SIGNALS

Many different signals indicate danger, some from the International Regulations for Preventing Collision at Sea, some from the International Code of Signals and others by custom or agreement, either local or international. Some of these signals are given here.

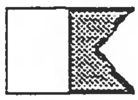
1. The letter "U" in Morse ( by light or sound), or by Code Flag is used to tell a vessel that she is approaching danger.

2. In a potential collision situation, the vessel with the right of way may sound **five short blasts** to call the attention of the other vessel, if it seems that the second vessel has not noticed or appreciated the situation.

At night a **white flare** may be used.

3. On beaches where swimming is dangerous, a **red flag** is hoisted.

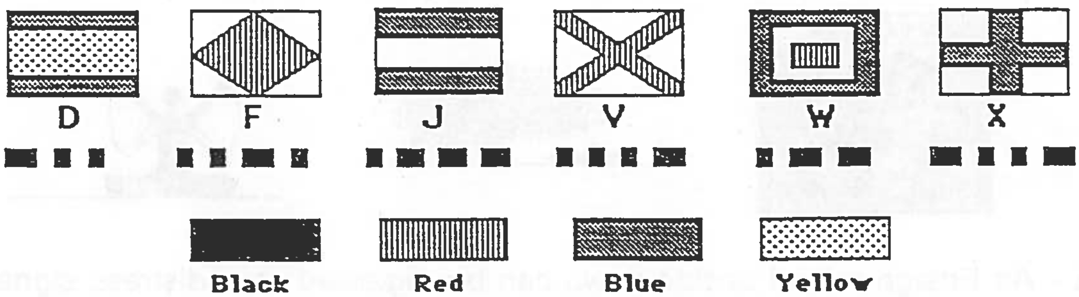
4. A vessel or boat from which divers are operating below the surface will carry Flag **A** of the International Code.



## Other Signals

Some other signals of the International Code are used to indicate possible danger, or request for assistance, without necessarily indicating any distress. These signals may be made by Morse Code (light or sound) or by showing the appropriate International Code Flag.

D - Keep clear of me, I am manoeuvring wth difficulty
F - I am disabled, communicate with me
J - I am on fire and have dangerous cargo on board - keep well clear
V -I require assistance
W- I require medical assistance
X - Stop carrying out your intentions, and watch for my signals.



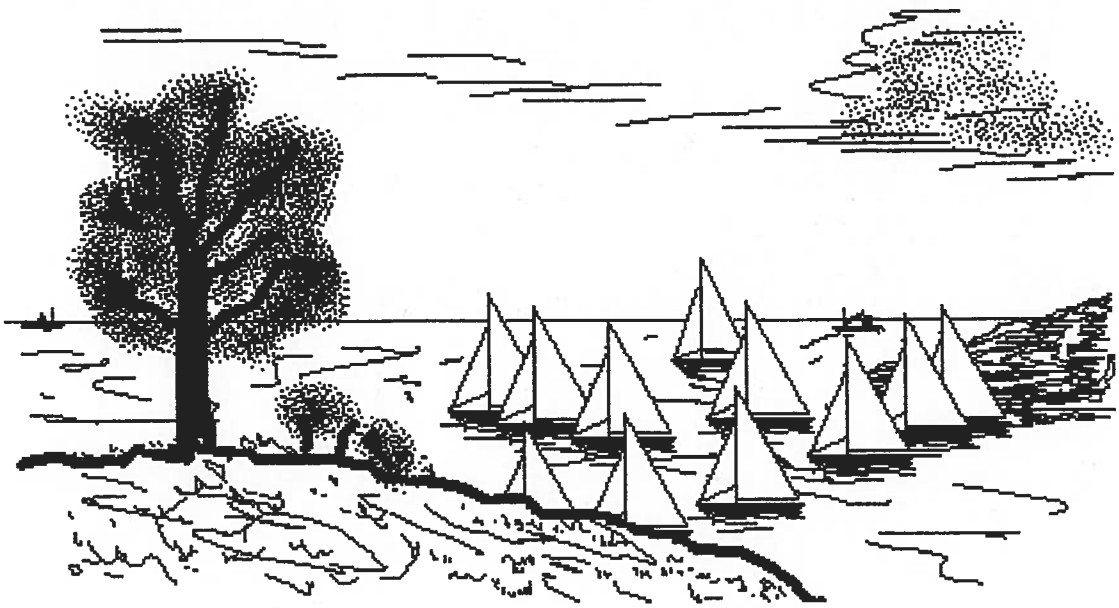
## YACHT RACING RULES

**The International Rules for Preventing Collision at Sea** do not cover all the aspects of boat manoeuvring which are needed for yacht racing and so comprehensive rules have been developed over the years by the International Yacht Racing Union, and are applicable world-wide. Only **Part IV** of these rules need concern us here - the **"right of way rules"** . The rest of the rules deal with all other aspects of yacht racing. Anyone interested in the details of these rules can obtain a copy, including the local prescriptions of the Irish Yachting Association, from the IYA Head Office.

### Right of Way Rules

It is important to realise that the **IYRU Rules**, **Part IV**, apply only between yachts which either are intending to race or are racing, in the same or different races. They do not apply in any way to a vessel which is neither intending to race nor racing. Such a non-racing vessel must be treated by racing vessels in accordance with the ordinary **International Regulations**, or local "Right of Way Rules", and a sailing vessel which is racing cannot claim any special consideration merely because it is racing. However, having said that, racing vessels are usually given a wide berth by non-racing vessels as a courtesy.

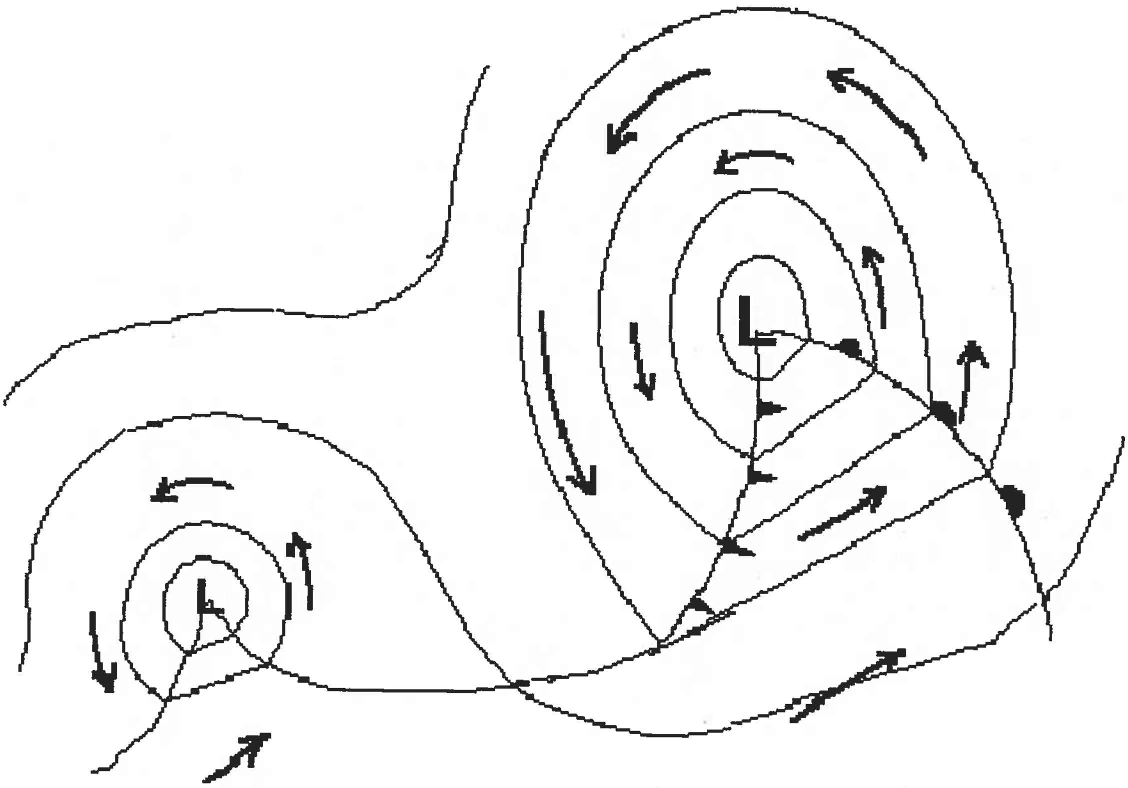
The right of way in yacht racing usually follows the International Regulations, but specific rules are laid down for specific purposes,e.g. overlapping, luffing, rounding a mark etc. Infringement of any of the rules usually results in a yacht having to withdraw from the race or be disqualified, unless on some occasions it may accept an alternative penalty, e.g. 720 degrees (two complete turns), or perhaps re-rounding a buoy or mark which it has touched. Apart from the starters and finishing line judges (usually the same people) there are no referees or umpires at sailing races. Therefore most cases of infringement of the rules are dealt with as "protests" from other competitors. Protests must be made in the correct manner and in good time and are dealt with by a special **Protest Committee.**



# SEA TRAINING MANUAL

## SECTION E

# METEOROLOGY




SEA
TRAINING
TEAM

SCOUTING IRELAND SAI

# METEOROLOGY

The requirements for the Meteorologist Proficiency Badge are covered in this Section, and also the "Weather" requirements in various other badges and for Charge Certificates.

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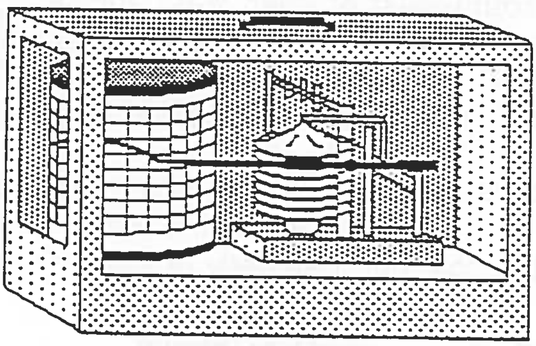


Barograph

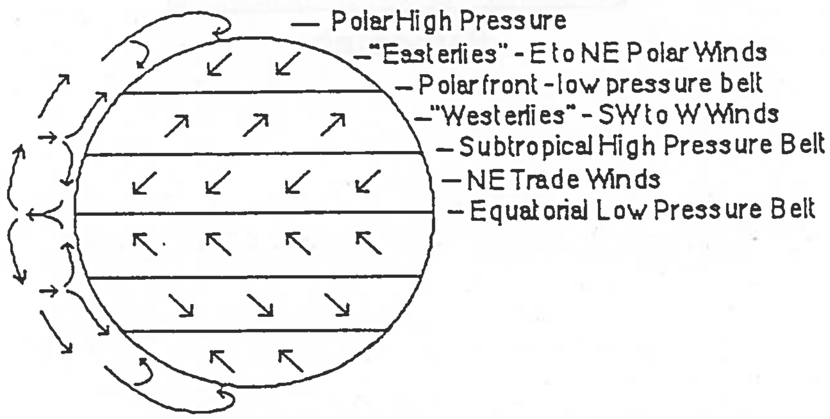
## THE ATMOSPHERE

The Earth is surrounded by an envelope of air about 100 miles deep. The inner layer of air is called the "troposphere" and it is in this layer that the changing conditions which we call "weather" occur. The outer limit of the troposphere is called the "tropopause". This is about ten miles high at the equator and about four miles high at the poles. Outside this is the very rarified "stratosphere".

Air has weight which presses down on the Earth's surface. This is called **atmospheric pressure.** The atmosphere is not static, but is ever changing. Areas of low pressure and high pressure move around and affect our daily weather. Where there are differences in pressure, air will tend to flow from the area of high pressure to the area of low pressure. This movement of air is called **wind**. The greater the pressure difference the stronger the wind. The main cause of variations in atmospheric pressure is heat from the sun. The intensity of the heat varies from place to place and from time to time, and its effects are modified by the character of the earth's surface and its ability to absorb or reflect heat, thus varying the **temperature** of the air. Another important element in weather conditions is the amount of moisture in the air - **humidity**. Regular measurements of atmospheric conditions are essential for weather forecasting.

There are many currents and movements of air around the globe, but there is a well defined underlying pattern. Warm air in the equatorial region rises, causing the Equatorial Low Pressure Belt, and then flows at a high level northwards or southwards to the polar regions. Then it sinks and flows back over the earth's surface towards the equator again. But some of the air from the equator sinks down to the surface in the subtropical regions giving rise to the Subtropical High Pressure Belt. From this belt some air flows back towards the equator and some flows towards the Temperate Latitudes. Due to the rotation of the earth the directions of these air flows are deflected. This deflecting force is called the "**Coriolis Force**". In the Northern Hemisphere wind blowing towards the equator from the subtropical high pressure comes from the north-east, and is called the NE Trade Wind, while winds moving into the temperate latitudes come from the south-west or even west and are called "westerlies". (These westerlies are much more constant in the Southern Hemisphere where there is not much land in the way - they usually blow between 40° and 50° S. Latitude and hence the name "Roaring Forties"). In the polar regions the winds are mainly easterly.

We are in the temperate zone and our weather is in general related to the changes and interactions which occur at the boundaries of the warm south-westerlies coming from the subtropical high and the cold north-easterly or easterly polar winds.

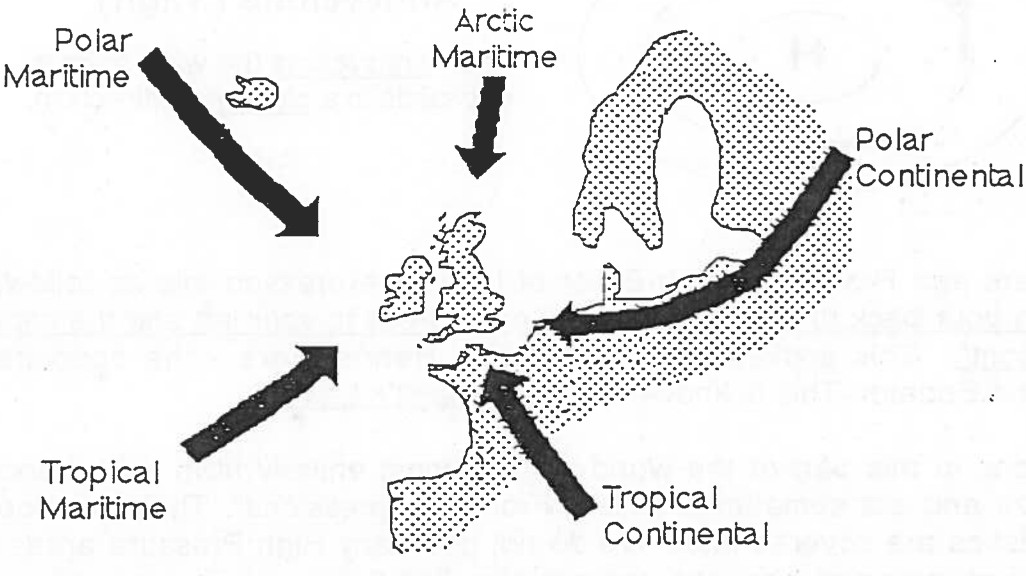



**BASIC PLAN OF ATMOSPHERIC CIRCULATION**

## AIR MASSES

An air mass is a body of air with nearly uniform characteristics of temperature and humidity. The Polar High Pressure Area is the source of cold air masses while the warm air masses come from the Subtropical High Pressure Zone. Boundaries between air masses are called **fronts**. Ireland lies in the region of the southwesterly winds, but close to the **Polar Front** - the boundary between the comparatively warm southwesterlies and the cold polar air. The front is not stationary, and especially during the winter Ireland may be in the area of the polar winds.

The whole line of the Polar Front has a certain instability and along this front depressions form and develop. Successive depressions cross the Atlantic Ocean influencing and continually changing our weather. The air masses from which these depressions draw their winds are the **"Polar High"** (cold) and part of the subtropical high pressure belt called the **"Azores High"** (warm). These provide a number of **"Airstreams"** which affect our weather by their temperature and moisture content, depending on whether they reach us via a maritime or a continental route.




The Tropical Maritime stream (southwesterly) is the main influence on our weather. It is warm and moist and tends to give mild and damp weather, clouds, drizzle and poor visibility.

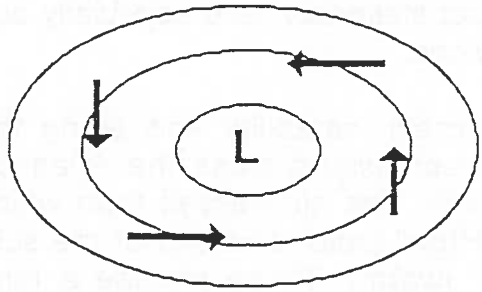
The Polar Maritime and Arctic Maritime streams are cold and have picked up some moisture over the sea. In winter they bring cold weather with showers, sometimes snow over high ground. In summer there are cool spells often with heavy showers and sometimes hail, rarely thunderstorms.

The Polar Continental stream is cold and dry. Any moisture that it might contain is usually precipitated as rain or snow in English east coast areas. In the Winter, the nights may be clear, cold and frosty.

The Tropical Continental stream is warm and dry. It is often the cause of "heat waves" in the summer. Visibility is often hazy. It is rare during the winter, when it produces a very dry airflow which is quite cold after passage over the cold continent.

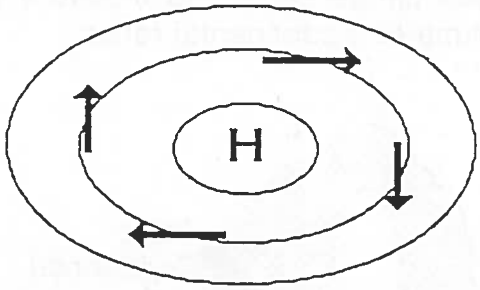
## HIGH AND LOW PRESSURE SYSTEMS

Areas of low pressure and of high pressure cause their own wind systems which further distort the basic plan. Wind blows into an area of low pressure (a "**Low**" or a "**Depression**") and out of an area of high pressure (a "**High**" or an "**Anticyclone**"). Due to the rotation of the earth these winds are deflected, and spiral around as shown in this diagram - this is also an example of the effect of the **Coriolis Force**.




**Depression (Low)**

In a <u>depression</u> the wind spirals inwards in an <u>anticlockwise</u> direction.




**Anticyclone ( High)**

In an <u>anticyclone</u> the wind spirals outwards in a <u>clockwise</u> direction.

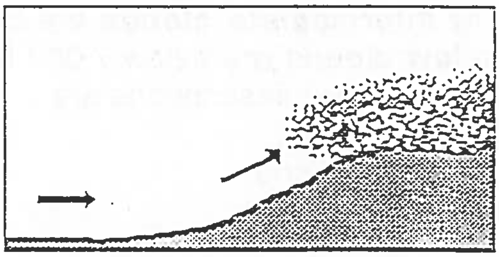
Many years ago Professor Buys-Ballot of Utrecht expressed this as follows -""<u>If you stand with your back to the wind, the low pressure is to your left and the high pressure to your right"</u>. This applies in the **Northern Hemisphere** - the opposite happens south of the Equator. This is known as "<u>Buys-Ballot's Law</u>".

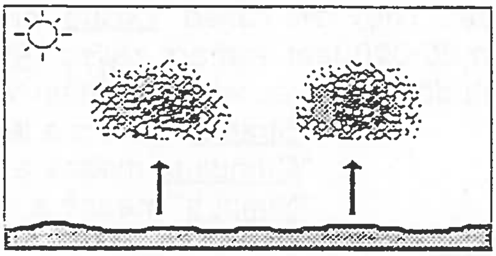
Depressions in this part of the world come almost entirely from disturbances on the Polar Front and are sometimes called "Frontal Depressions". Their development and characteristics are covered later. We do not get many High Pressure areas except as ridges of high pressure between depressions. But during the Summer an extension of the Azores High sometimes extends over Western Europe or over Ireland and Britain. Weather characteristics of a High or Anticyclone are dealt with later.

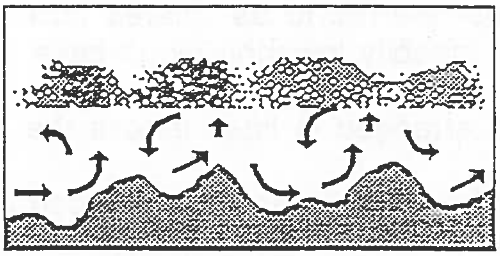
**Water Vapour** is contained in the atmosphere in varying amounts depending on the temperature of the air and the track which it has followed - e.g. maritime or continental. The maximum amount of water vapour that air can hold depends on the temperature. Air containing this maximum amount it is said to be **saturated.** If a particular mass of air contains less than its maximum of moisture at a given temperature, it may become saturated by reducing the temperature. The temperature at which a mass of air becomes saturated is known as the **dew point.** Air at its dew point will cause condensation - this can be seen on walls and window panes which are colder than the mass of air in a room - the thin layer of air in contact with the cold surface becomes saturated and water condenses onto the surface. If the whole volume of air is cooled to the dew point the water vapour will condense as fog or cloud, and may be responsible for **precipitation** - rain, hail or snow. Air is also cooled by ascending - the rate of decrease of temperature with height is called the **Lapse Rate.** The lapse rate for dry air - <u>dry adiabatic lapse rate</u> - is 1.0°C per 100 meters. The figure for saturated air is less - 0.6°C per 100 meters - <u>moist adiabatic lapse rate</u>.

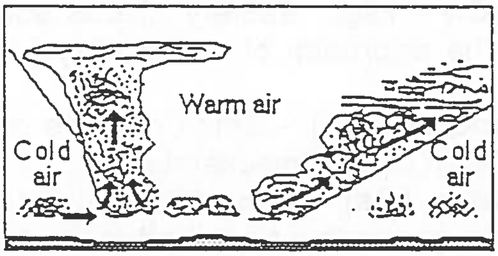
## FORMATION OF CLOUDS

Clouds are usually formed by air rising and cooling below its dew point. This may occur in a number of ways.


Orographic cloud


Convection cloud


Turbulence cloud



Frontal cloud

**Orographic cloud** is caused when wind is forced upwards by meeting high ground. Sometimes this may cause a whole bank of cloud over a mountain range, or perhaps a "plume" of cloud extending downwind from an isolated peak.

**Convection cloud** is due to air being heated locally by warm ground. This warm air then rises in a column. As the air rises it cools down and at a certain altitude will reach its dew point. The resulting cloud will usually have a rounded top with a flat base at the level of the dew point. These clouds are called "cumulus" clouds.

**Turbulence cloud** happens when wind blows over very irregular ground surface. Considerable turbulence may be caused in the air stream, with some of the air rising high enough to be cooled to the dew point. Cloud then condenses as a layer of heaped up masses with a flat base - often called "stratocumulus". The upper level of the cloud is usually determined by the level of the higher undisturbed air flow.

**Frontal cloud** developes at the junction between two air masses, known as a "front". Fronts and their associated weather patterns will be dealt with in more detail later. For the present it is sufficient to note that the warmer air rises upwards over the colder air, and cloud is formed when this rising air cools to its dew point. Therefore a front usually means a belt of rain. The slope of a warm front is much more gradual than the slope of a cold front. The clouds associated with a warm front appear as a gradually lowering cloud base as the front approaches. The cold front is steeper and the cloud may have a marked vertical development, perhaps even a full "cumulonimbus" (see next page).

## CLOUD TYPES

Clouds are classified by height and form. They are grouped as high, intermediate and low. The **high clouds** consist of ice crystals and are found between 20,000 and 35,000 feet. They are called "Cirrus" clouds. The **intermediate clouds** are between 7,000 and 20,000 feet and are called "Alto". The **low clouds** are below 7,000 feet and may reach down to ground level. Other words used in cloud descriptions are -

"Stratus" means a layer or sheet of cloud.
"Cumulus" means a mass or heap of cloud.
"Nimbus" means a rain cloud.

### High Clouds

**Cirrus (Ci)** - High feathery clouds sometimes referred to as "mares tails" - may indicate the approach of a frontal system with steadily lowering cloud base and rain later.
**Cirrocumulus (Cc)** - Small masses of cloud arranged in lines across the sky like ripples. Often called "mackerel sky".
**Cirrostratus (Cs)** - Thin white sheet across the sky. The sun or moon can be seen easily through the layer but it often causes a "halo". If this cloud developes under cirrus or cirrocumulus, and the barometric pressure is starting to fall, this usually indicates the approach of a warm front with rain.

### Intermediate Clouds

**Altocumulus (Ac)** - Lines of fluffy masses of cloud in isolated patches. May produce shadows. When following high clouds they may confirm approach of a warm front.
**Altostratus (As)** - A uniform sheet of cloud, much lower and thicker than Cirrostratus. Sometimes it may be possible to note the position of the sun behind the cloud, but there is no halo.

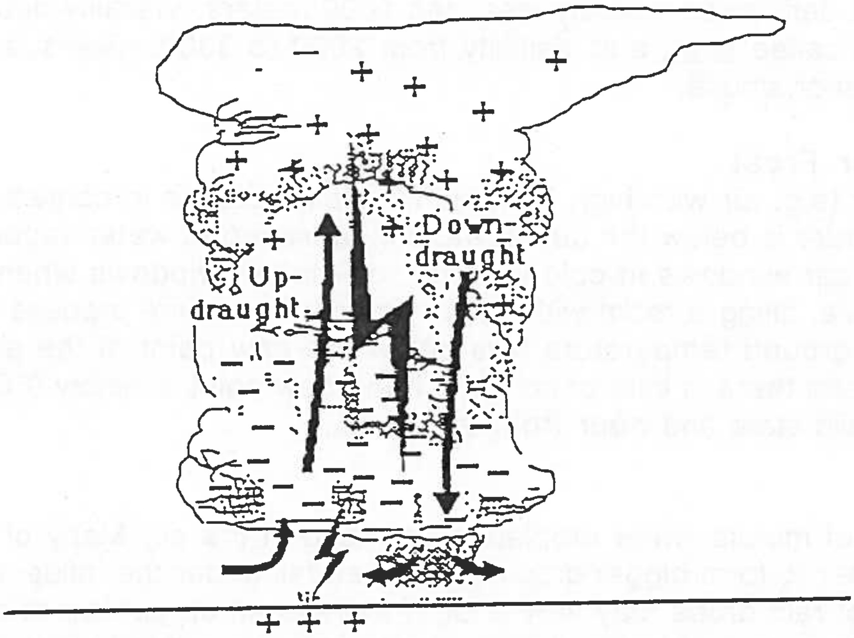
### Low Clouds

**Stratocumulus (Sc)** - A layer of heaped up masses, usually with a fairly uniform flat base. They are sometimes produced by air turbulence over irregular ground, and sometimes in a frontal system.
**Stratus (St)** - A low layer of dull, grey cloud which so often seems to be our normal sky ! It may come down on high ground as "hill fog". A variant of this cloud is denser, darker, and producing rain, and is called **Nimbostratus (Ns)**.
**Cumulus (Cu)** - Independant masses of cauliflower-topped clouds with flat bases. They are produced by convection currents as mentioned on the previous page.

**Cumulonimbus (Cn)** is in a classification of its own, as it may extend from near ground level up to about 35,000 feet. It is the great thunder-storm cloud which sometimes occurs at an active cold front. It has enormous vertical development and has very strong up- and down-currents inside. The highest part of the cloud is usually flat and spread out like an anvil, its most prominent point streaming ahead of the main cloud, being pushed by the strong high wind. It is dark and threatening and may produce very heavy rain and hail showers. Strong downdraughts may occur out of the base of the cloud with the rain or hail, while at other places air may be sucked in due to the strong updraughts. These often produce violent **squalls** from different directions. Although comparatively short lasting these squalls may be quite destructive, and the rain torrential.

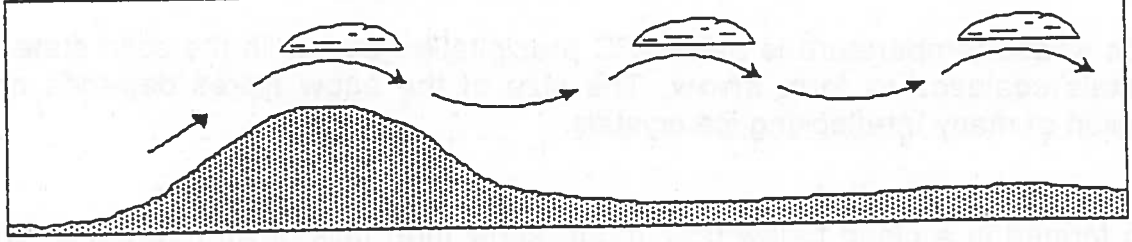
## Thunder and Lightning

Cumulonimbus clouds may occur at a very active Cold Front or may grow from cumulus cloud if the air is unstable (i.e. when the temperature decreases rapidly with height, thus driving the ascending air upwards easily). A thunder cloud has many strong up-draughts, and also down-draughts. This considerable turbulence within the cloud makes it dangerous for aircraft, and pilots avoid these clouds by flying around them. Friction between the various particles in the cloud causes electrical charges to build up in parts of the cloud. The positive particles are brought mainly to the top of the cloud while the negative particles are nearer the base. When a big enough difference in electrical charge has built up a large electric spark occurs which is called **lightning**. This discharge may be within the cloud or may be from the cloud to the ground. The noise of this flash is **thunder** and the difference in time from the flash to the thunder sound gives an indication of the distance of the storm - the sound takes 5 seconds to travel one mile.




## Lee Wave Cloud

This is a form of orographic cloud. Wind blows over a mountain and is thus forced upwards. Sometimes the air flow may continue to "bounce" up and down like a wave in the lee of the mountain. If the air at the apex of each wave is cooled to its dew point cloud will form. As the air descends again and warms up the cloud disappears. Although the wind is blowing through these clouds, the clouds themselves remain stationary.



Lee Wave Cloud

## CONDENSATION AND PRECIPITATION

### Fog

This is like cloud at ground level, and is caused by air being cooled below its dew point in the presence of **condensation nuclei** (dust, salt particles, etc.) This may occur in two main ways. A clear sky at night allows heat to be radiated from the earth. Air in contact with the ground may be cooled below its dew point. A light wind (less than 7 knots) is necessary to spread the cooling by slight turbulence, and fog will form. This is called "radiation fog" and occurs in valleys and low-lying areas. It may also occur when there is much smoke in the atmosphere and this particularly thick and "dirty" fog is called **smog**. The second type of fog is called "sea fog" or "advection fog" and is caused by a warm, moist air stream blowing over a cold surface - e.g. in the Spring and early Summer a light SW wind with a dew point of 12°C may flow over sea whose temperature is still 11°C. This will be very likely to produce sea fog, usually on the south and west coasts. Low cloud over hills, usually "orographic" cloud, is often called "hill fog". Fog is defined as visibility less than 1000 meters. Visibility between 1000 and 2000 meters is called mist, and visibility from 2000 to 3000 meters is haze. Haze is often due to dust or smoke.

### Dew and Hoar Frost

When moist air (e.g. air with high Relative Humidity) comes in contact with a surface whose temperature is below the dew point, condensation of water vapour occurs - e.g. "misting-up" of car windows in cold weather, or kitchen windows when a kettle is left boiling for a while, filling a room with water vapour. The same process causes **dew** to form when the ground temperature falls below the dew point of the air in immediate contact with it, and there is little or no wind. If the dew point is below 0°C condensation occurs in the solid state and **hoar frost** is formed.

### Rain

Clouds consist of minute water droplets suspended in the air. Many of these droplets may fuse together to form bigger drops which then fall under the influence of gravity as **rain**. The size of rain drops may vary a lot. If there is an up-current of air in the cloud, the rain drops have to be bigger and heavier to overcome this before they can fall. In clouds with very strong up-currents, such as Cumumlonimbus, the rain drops may be very large.

### Hail

If strong up-currents carry rain drops to a level where the temperature is below 0°C they will freeze and fall as **hail**. Sometimes in a very active Cumulonimbus cloud, hail-stones may be carried up and down in the cloud many times, gaining a further layer of ice on each ascent. Some hail-stones can be quite large. If you cut a hail-stone through the middle you will notice the concentric layering.

### Snow

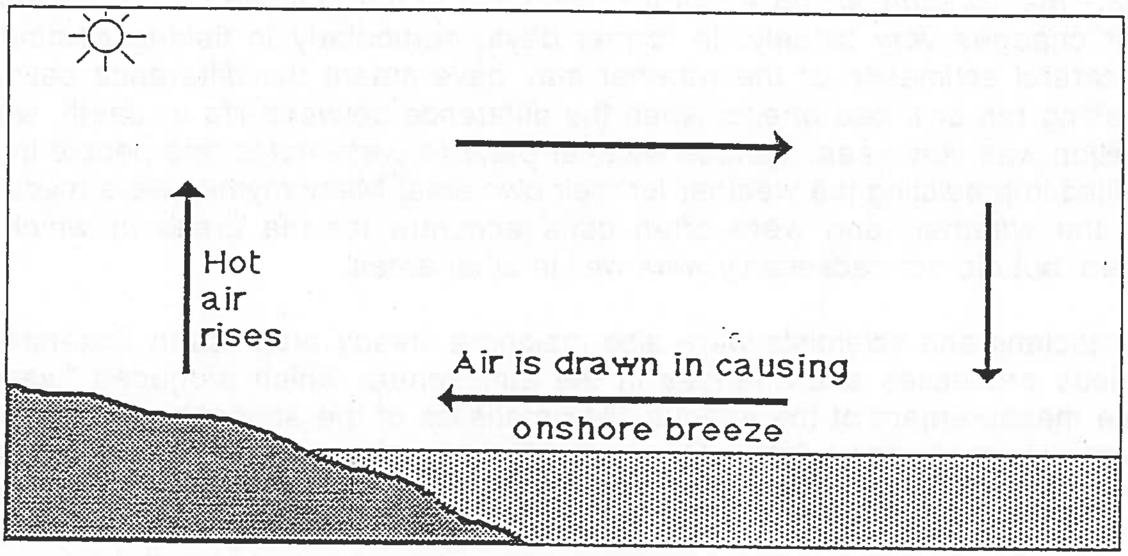
In clouds whose temperature is below 0°C precipitation occurs in the solid state. Tiny ice crystals coalesce to form **snow**. The size of the snow flakes depends on the aggregation of many interlocking ice crystals.

### Sleet

Snow is formed in a cloud below 0°C. If that snow then falls down through a layer of warmer air near the ground and become partly melted - giving a mixture of snow and rain - this is called **sleet**.

## Sea Breeze and Land Breeze

On a sunny day the sea breeze effect may be seen. The land warms up under the sun. Air over the land is heated and rises, drawing in cool air from over the sea. This causes an onshore breeze which may reach force 2 to 3.




SEA BREEZE

The practical effects of the sea breeze may be to modify the prevailing wind at the time.

1. If the prevailing wind is onshore it will be augmented by the sea breeze and will be much stronger than forecast.
2. If the original wind is offshore it will be reduced to a very light wind or a calm.

The sea breeze effect may extend up to 5 miles offshore. It dies out as the sun's heat lessens and the ground starts to cool.

The land breeze occurs at night and is the reverse of the above process. The land has cooled more than the sea. The air over the sea is therefore warmer and tends to rise, being replaced by air from the land, causing a gentle offshore breeze. This rarely happens in these climates as the sea is never really warm enough to cause this. Sometimes a similar effect can be caused also at night by cold air from mountains or hills "rolling" down steep sides of a valley or sea lough and causing an light offshore breeze - this type of wind is known as a **katabatic wind**. These conditions usually occur on a clear night in an anticyclone, and are also the conditions which can cause radiation fog if the cold air temperature drops below its dew point.

## METEOROLOGICAL MEASUREMENTS AND OBSERVATION

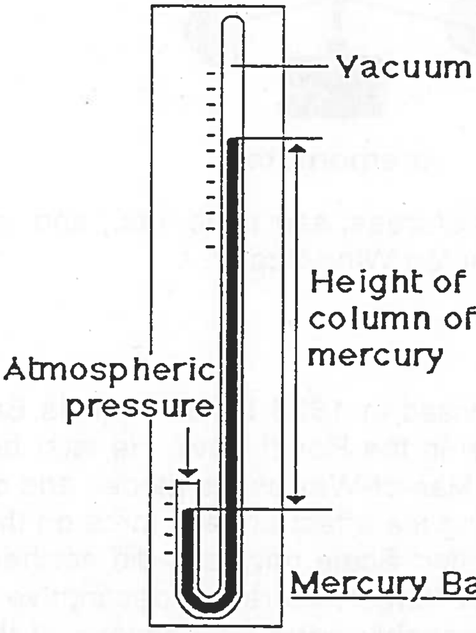
Observation of the weather has been an important part of daily life since the human race appeared on the earth. In our country particularly we are always talking about the weather - mainly complaining about it ! But most of the time we do not observe the weather changes very closely. In former days, particularly in fishing communities where careful estimation of the weather may have meant the difference between a good fishing trip or a bad one, or even the difference between life or death, weather observation was very keen. Various weather patterns were noted and people became very skilled in predicting the weather for their own area. Many rhymes were made up to foretell the weather, and were often quite accurate for the areas in which they originated, but did not necessarily work well in other areas.

Mathematicians and scientists were also making a steady progress in understanding the various processes and changes in the atmosphere which produced "weather". Accurate measurement of the various characteristics of the atmosphere had to await the development of appropriate instruments. The main instruments for basic scientific observations were invented in the 17th Century - thermometer, barometer. anemometer and hygrometer. However all this study and research, important as it was in the advancement of knowledge, produced very little practical benefit in the way of weather forecasting until the development of fast communications. The electric telegraph was invented in 1843 and information from many weather observation stations could be assembled quickly. This led to the ability to draw weather maps and then to try to forecast the changes caused by movements of the observed systems. The science of meteorology has developed enormously since then, and has been particularly helped by the development of artificial satellites circling the earth and providing us with actual pictures of global weather conditions.

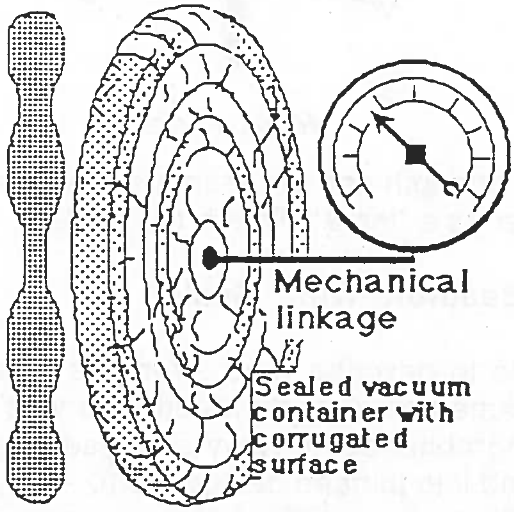
Accurate and detailed observations over wide areas are essential to making weather forecasts. Most countries now have national meteorological sevices and these sevices cooperate and exchange information through the World Meteorological Organisation. This organisation has a very comprehensive global telecommunication system. The aeronautical and maritime services of the world are very dependent on this wordwide weather reporting and forecasting system. The Irish Meteorological Service communicates with this system via Bracknell in Britain.

In the following pages many of the measuring instruments and their functions are described. It is very unlikely that you will have access to many of these but you should understand their working principles. Any Scout working for the Meteorology Badge should try to visit a weather observation station. There are fifteen of these situated in Dublin Airport, Casement Aerodrome, Kilkenny, Rosslare, Roches Point, Cork Airport, Valentia, Shannon Airport, Birr, Mullingar, Galway, Claremorris, Belmullet, Clones and Malin Head. All these stations have full-time staff who make regular recordings and observations which are sent to the headquarters of the Meteorological Service in Glasnevin, Dublin for analysis and entry on synoptic weather maps as part of the forecasting process. There are also a large number of Climatological Stations throughout the country. These make regular observations which are used to study the climate and provide much background information and statistics. Measurements at these stations are made by voluntary observers.

**Atmospheric Pressure** is measured with an instrument called a **Barometer** and therefore is sometimes called barometric pressure. The most accurate barometers are "Mercury Barometers" where the pressure is indicated by the length of a column of mercury in a glass tube. Another form of barometer is the "Aneroid Barometer" - this consists of vacuum-sealed capsule which contracts or expands depending on the atmospheric pressure. This movement is transmitted via a mechanical linkage to a pointer which moves over a scale giving a direct reading of the pressure.

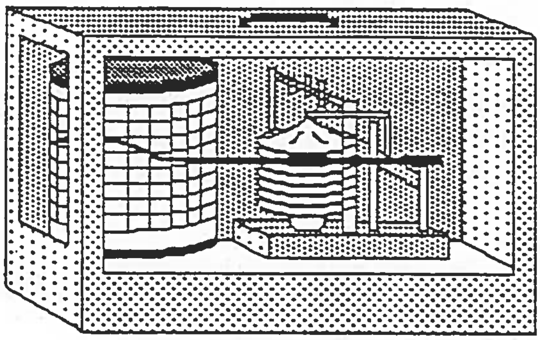



Mercury Barometer




Aneroid Barometer

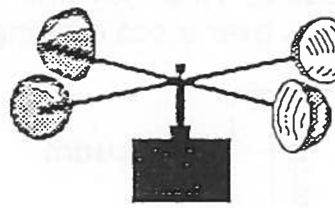
The unit of atmospheric pressure is called a "Bar". To express the comparatively minor pressure changes which occur in the atmosphere, the "bar" is divided into 1000 "millibars" ("mb") - now also known officially as "hectopascals" ("hP"). The usual limits of pressure variation are 950 to 1050 mb. Atmospheric pressure reduces with height, and this is used as a means to measure height - **altimeters** in aircraft are really aneroid barometers calibrated for height (feet or meters) rather than for pressure. For meteorological purposes atmospheric pressure readings are always adjusted to the pressure that would have been obtained if they were taken at sea level, so that readings can be compared with each other and used on weather maps. A **barograph** is a special form of aneroid barometer in which the pointer records the pressure continuously on a paper graph mounted on a slowly rotating drum.



Barograph

**Wind Direction and Speed.** Wind direction is easy to note by direct observation provided that you know the local directions or have a compass. **Wind vanes** are often found on church steeples and other buildings, flag poles, etc. On airfields **wind stockings** are used. Wind speed requires a special instrument called an **anemometer.**


**Wind vane**



**Anemometer**

Wind strength can be estimated by observation of trees, sea state, etc., and given a number as a "force". This is the basis of the "Beaufort Wind Scale".

**The Beaufort Wind Scale**

A scale to describe wind strengths was first devised in 1805 by Sir Francis Beaufort who came from County Meath and was an officer in the Royal Navy. He later became "Hydrographer of the Navy". He used the sailing Man-of-War as his model, and divided the wind into thirteen categories (0 - 12), describing the effect of each force on the ship, its ability to carry sails, make way, etc. The Beaufort Scale originally did not have any measure of actual wind speed allocated to each "force", merely a descriptive name. Observations over the years have provided reasonably good descriptions of the sea state resulting from a wind of a certain strength blowing unhindered over an area of sea. With the development of instruments to measure wind speed, the range of speeds covered by each "force" has become well-defined. This is the full, modern "Beaufort Wind and Sea Scale". A summary is given on the next page.

The Beaufort Scale numbers, and the description of sea state or land effects allocated to each force provide an assessment of the power of the wind. This power is related to the pressure exerted by the wind on sails or other structures, or on the friction effect of air moving over the surface of the water creating waves. It is the "pressure" of the wind which drives a boat or causes it to capsize, or produces waves, knocks down trees or takes slates off a roof. Most people find it difficult to remember the actual speed range of each Beaufort force. There is a simple formula to convert Beaufort force into average wind speed and vice-versa, which works for wind strengths above force 1 and below force 9 -

**To find speed from force -**

- multiply the force by 5 and subtract 5 - this gives the wind speed in knots.

**(Force x 5) - 5 = Knots**

Example - Force 5 x 5 = 25 - 5 = 20 kn.

**To find force from speed -**

- add 5 to the speed in knots and divide by five - this gives the Beaufort number

**(Knots + 5) ÷ 5 = Force**

Example - 15 kn + 5 = 20 ÷ 5 = Force 4

## BEAUFORT WIND SCALE

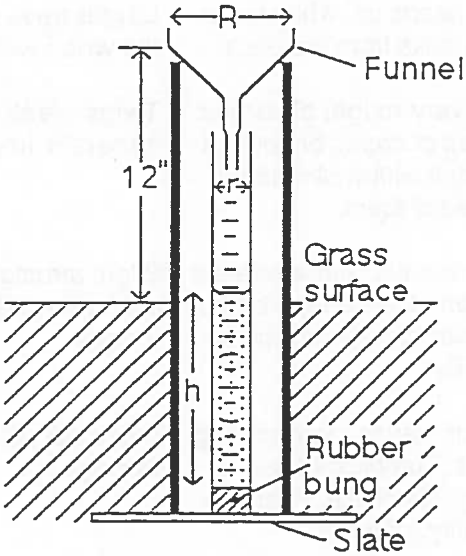
| FORCE | NAME | SPEED (Knots) | DESCRIPTION AT SEA | ON LAND |
|---|---|---|---|---|
| 0 | Calm | <1 | Mirror smooth. | Smoke rises vertically. |
| 1 | Light air | 1 to 3 | Ripples on water. | Smoke drift shows wind direction. |
| 2 | Light breeze | 4 to 6 | Pennant moves, very small waves. | Wind felt on face. Leaves rustle. Wind vanes respond to wind. |
| 3 | Gentle breeze | 7 to 10 | Light flag extends, crests on small waves. | Leaves and small twigs in constant motion. Light flag extends. |
| 4 | Moderate breeze | 11 to 16 | Small waves with some white horses. | Paper and dust raised. Small branches move. |
| 5 | Fresh breeze | 17 to 21 | Moderate waves with many white horses. | Small trees begin to sway. |
| 6 | Strong breeze | 22 to 27 | Large waves with white foam crests everywhere "Small boat gale". | Large branches in motion. Telegraph wires hum. Difficulty with umbrellas. |
| 7 | Near gale | 28 to 33 | Sea heaps up, white foam in streaks from breakers. | Larger trees sway. Resistance felt when walking against wind. |
| 8 | Gale | 34 to 40 | Sea very rough, disturbed. Edges of crests break into spindrift with well marked streaks of foam. | Twigs break off trees. Progress generally impeded. |
| 9 | Strong Gale | 41 to 47 | High waves. Dense streaks of foam. Crests topple and roll over. Spray may affect visibility. | Slight structural damage to chimneys, slates, TV aerials, fences. |
| 10 | Storm | 48 to 55 | V.high waves,overhanging crests. Tumbling of sea is heavy, shocklike. Foam ++ Visibility affected. | Trees uprooted. Structural damage. |
| 11 | Violent Storm | 56 to 63 | Exceptionally high waves. Sea completely covered with long patches of foam. Crests blown into froth. Visibility seriously affected. | Widespread damage. |
| 12 | Hurricane | 64 + | Much worse! Air filled with foam and spray. Sea completely white with driven spray. Visibility very seriously affected. | ?? |

**Temperature** is measured by a **thermometer**. At a weather station thermometers are housed in a special box with louvred sides (known as a "screen") so that they are sheltered from direct sunlight and there is free air circulation in and through the box.

Thermometer

Special thermometers measure the <u>maximum and minimum</u> air temperatures during day and night, and the night Ground Temperature. For meteorological purposes temperatures are now always recorded in degrees Celsius (or Centigrade). Fahrenheit is no longer used.

**Rainfall** is measured in a **rain gauge**. This consists of a funnel with a cylindrical portion at the top (stops splashing out of the funnel), draining into a tube graduated in millimeters. Proper rain gauges are carefully made and calibrated for accurate measurement but an "amateur" instrument is easy enough to make for your own weather observations. The outer cylinder can be a piece of drain or other pipe. The inner cylinder for collecting the rain water is a length of glass or clear plastic pipe about 35 to 40 millimeters diameter and graduated in millimeters. The rainfall should be measured at the same time every morning.

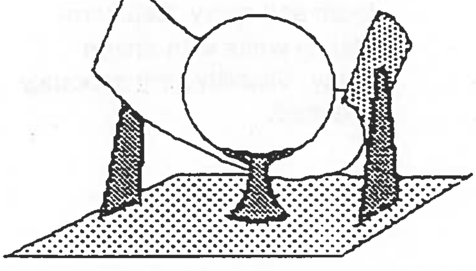



The rainfall measurement is found by using the following formula -

$$\text{Rainfall} = h \times \frac{r^2}{R^2}$$

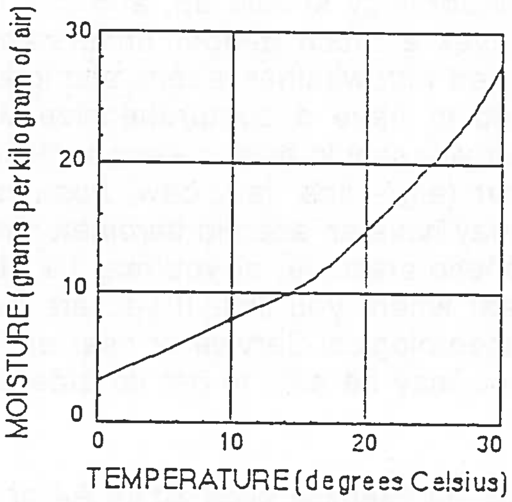
A SIMPLE RAIN-GAUGE

**Sunshine** is recorded on a **sunshine-recorder**. This consists of a solid glass sphere which concentrates the suns rays onto a curved reflector on which is mounted chemically treated recorder paper. The time of sunshine is noted from the length of the burn on the paper.

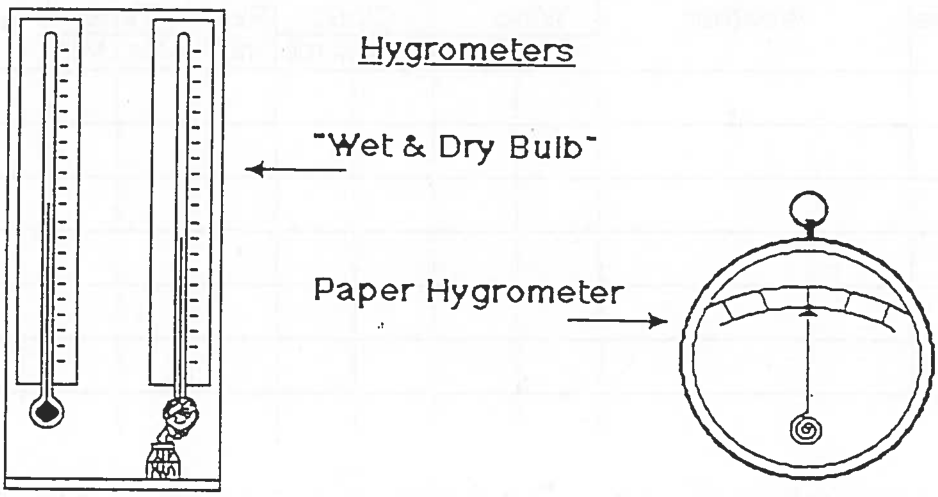


SUNSHINE RECORDER

**Humidity** is the amount of moisture in the air. "Absolute Humidity" is the actual amount of water held in a given volume of air, expressed as grams of water per kilogram of air. The warmer the air the more moisture it can hold.




Therefore a more useful measurement is "Relative Humidity" - this is the amount of moisture expressed as a percentage of the maximum possible moisture content for that temperature. Relative humidity is measured by a **hygrometer**. Self recording hygrometers usually depend on the changing length of a fibre or a coil of paper, and are calibrated to read the humidity directly. A hair hydrograph is an instrument which measures humidity by the change in length of a hair and records this on a moving drum.




The usual form of hygrometer is the "wet- and dry-bulb hygrometer", consisting of two ordinary mercury thermometers, the bulb of one being kept wet by a wick of muslin dipping into a small container of water. When humidity is low and the air is therefore very dry, greater evaporation occurs from the wet bulb which shows a lower temperature. If humidity is high, less water is evaporated and the temperature shown by the "wet-bulb" will be nearer that of the "dry-bulb". The relative humidity can be calculated from the difference in readings between the two thermometers or by looking up special tables.

Air containing the maximum amount of moisture for its temperature is said to be "saturated" - Relative Humidity 100%. The temperature at which saturation occurs is called the "dew point".

## KEEPING A WEATHER LOG

Making careful weather observations, even simple observations, is something which anybody interested in meteorology should do, and this is an important part of the Meteorology Badge. It gives a much deeper understanding of what is going on, particularly when coordinated with weather reports and forecasts given in newspapers. You will not be expected to have a comprehensive weather station with many expensive instruments, but you should able to keep a record of rainfall, cloud amount and type, general weather (e.g - fine, fair, dew, frost, rain, snow, hail, etc.), wind direction and force. You may have an aneroid barometer in your house which you can use to record the atmospheric pressure, or you may be able to use one in school, or some other institution near where you live. If you are lucky enough to live near a weather station of the Meteorological Service or near an interested amateur with his own set of instruments you may be able to get considerable help with your weather recordings.

To keep a weather log, get an exercise book about A4 or A5 size. Mark out the right hand pages in columns for the various observations that you are going to make. Six main headings are given below. For the Meteorologist Badge you only have to record four of these headings but if you have access to a good range of instruments you should try to record as much as you can.

**WEATHER LOG**

| Date/Time | Weather | Wind | | Cloud | | Rain-fall | Temp | | Bar |
|---|---|---|---|---|---|---|---|---|---|
| | | Dir. | Force | Type | Amt. | | Max | Min | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
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| | | | | | | | | | |

The most important observations from your point of view are those that require least instrumentation - description of the weather, wind, clouds and rainfall. Apart from measuring rainfall, all the others can be recorded by using your eyes and intelligence. A diagram of a simple rain gauge has already been given.

Use one line for a set of observations made at the same time. The exception to this could be in the "Weather" column, which could be used to give a summary of the weather before and up to the observation time. About three observations during the day is the minimum which should be recorded - morning, midday, evening. Record more often if you can. If you have access to thermometers, the maximum and minimum temperatures should only be recorded each morning as they refer to the previous 24 hours. On the left hand pages note down details of weather forecasts and compare them with the actual weather in your area, or cut out the small weather maps from a newspaper and paste them into the log.

## Weather descriptions

The main aspects of weather can be recorded in "shorthand" notation which was first devised by Admiral Beaufort (who also devised the wind scale). He used a series of letters and these are still called the **Beaufort Letters**. The most important are -

| | |
|---|---|
| b | blue sky |
| c | cloudy |
| d | drizzle |
| f | fog |
| h | hail |
| l | lightning |
| m | mist |
| o | overcast |
| p | showers |
| q | squalls |
| r | rain |
| s | snow |
| t | thunder |
| w | dew |
| x | hoar frost |

Increased intensity is indicated by using a capital letter - e.g. R = heavy rain. Long duration is indicated by doubling the letters - e.g. RR =continuous heavy rain.

The Beaufort letters were devised for English language use and may mean nothing in other parts of the world. A series of **International Symbols** are used also, paticularly on weather maps. There are about 150 of these symbols but only a few of the most important ones are given here -


You can use either letters or symbols to record your weather observations.

**Other observations** Wind is recorded as the compass direction from which it blows and its Beaufort force - these are obtained by personal observation. With practice you can get quite good at estimating wind strength. If you are lucky enough to have access to an anemometer you will be able to record in knots. Cloud cover is estimated by personal observation of the types of cloud and the amount - usually expressed either as "eighths" of the sky covered. Rainfall is recorded in millimeters, temperature in degrees Celsius and barometric pressure in millibars.

## FACTORS AFFECTING OUR WEATHER

Our Irish weather is as varied as it is unpredicatable, but an knowledge of the governing factors can make it much easier to understand and accept. Three major factors influence our weather all year around -

1. South West Winds, i.e. prevailing winds.
2. The Polar Front.
3. The Gulf Stream.

### 1.Southwesterly wind

These winds (Tropical Maritime Stream) blow warm moist air up over Ireland and account for our comparatively mild winters and for the amount of precipitation we get. They can also be a cooling influence in summer.

### 2.The Polar Front

The junction where two air masses meet, i.e. warm air and cold air, is called a front. The Polar Front is a line across the North Atlantic between the warm air of the South-Westerlies and the cold winds coming down from the Arctic. The Polar Front gives rise to an area of high turbulance and it is along this front that many depressions form. This constant stream of depressions moving eastwards along the Polar Front is one of the most influencial factors on our weather.

### 3.The Gulf Stream

The Gulf Stream is a warm sea current which flows across the Atlantic from the Gulf of Mexico and helps to keep our coasts relatively warm.

The position of the Polar Front varies depending on the influence of -

**The Sun** - During the summer as the sun moves northwards, the Polar Front and its depressions also move further northwards, and are less likely to trouble us.

**Azores High (Summer)** - In summer the Azores high pressure area may extend towards Ireland. This may bring warm air up over Ireland and push depressions to pass north of us.

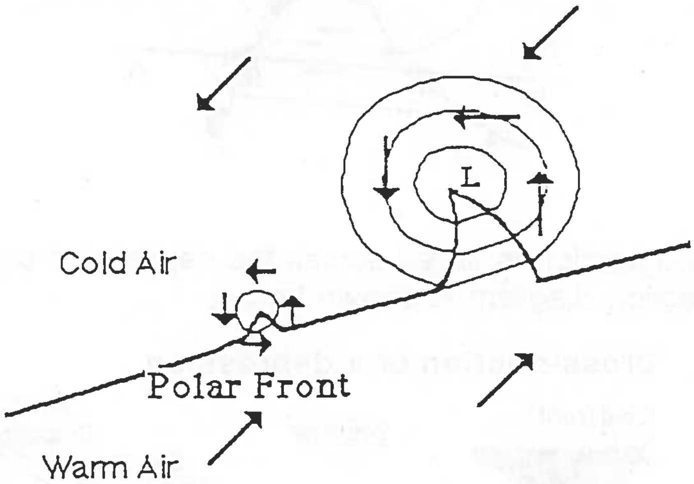
**Scandinavian High (Winter)** - In our winter a high pressure area may form over Scandinavia. This forces the depressions southwards and they are more likely to affect us. If this Scandinavian high builds up, it may push cold winds from Northern Russia towards us (Polar Continental Stream) and give us extremely bad winter weather.

So there are three possible seasonal factors -

1. North and South movement of the sun.
2. Azores high in Summer.
3. Scandinavian high in Winter.

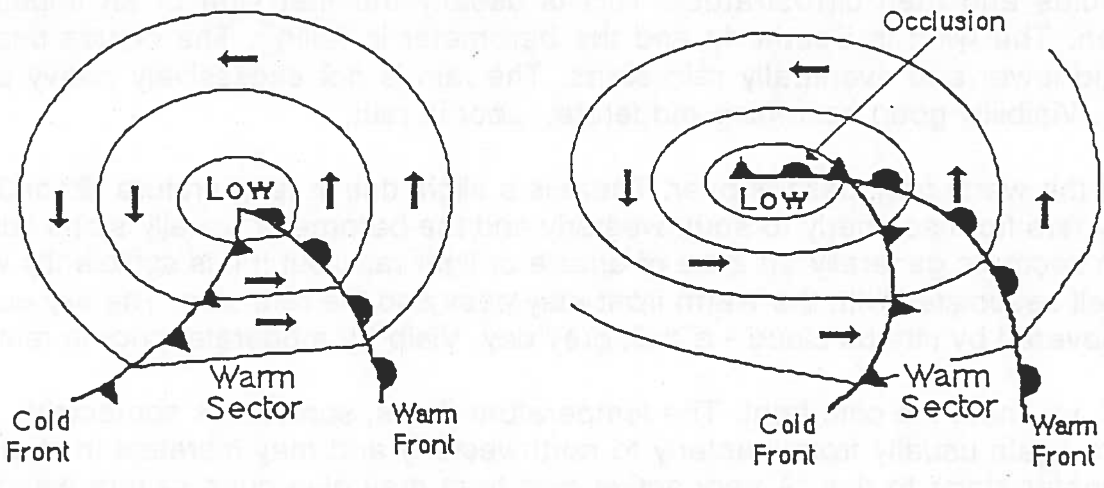
## FORMATION OF A DEPRESSION

An irregularity develops on the Polar Front - a "bulge" of the warm air into the colder area. This segment of warm air is then surrounded on two sides by colder air. The warm air being lighter starts to rise up over the cold air. This reduces the "pressure" of the air on the surface, the most marked area being at the apex of the bulge. This is an early "Depression". The depression usually develops, gets more extensive and moves from near Newfoundland across the North Atlantic towards us.




### Fronts

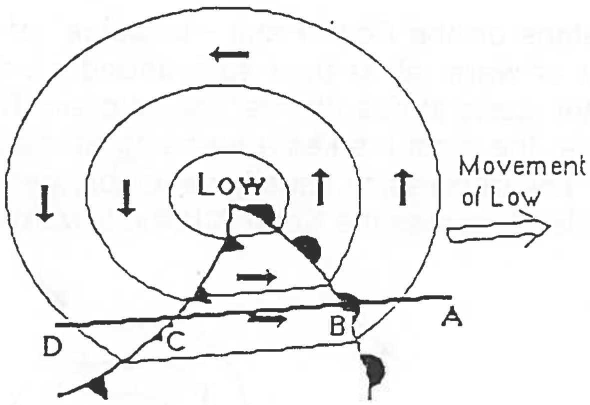
A front is named after the type of air following behind it. If the front has warm air following behind it is a **warm front** and if cold air follows it is a **cold front**. The cold front usually moves faster than the warm front. When the cold front catches up on the warm front, the warm air is raised off the ground and we have warm air on top and cold air on the bottom. This is called an **occluded front** or an **occlusion**. A warm front is indicated by a line with rounded shapes or blobs on it. A cold front has pointed shapes. An occluded front has both shapes alternately. In a depression the fronts are usually curved lines. The isobars between the warm front and cold front are usually fairly straight and their line gives the direction of movement of the depression.



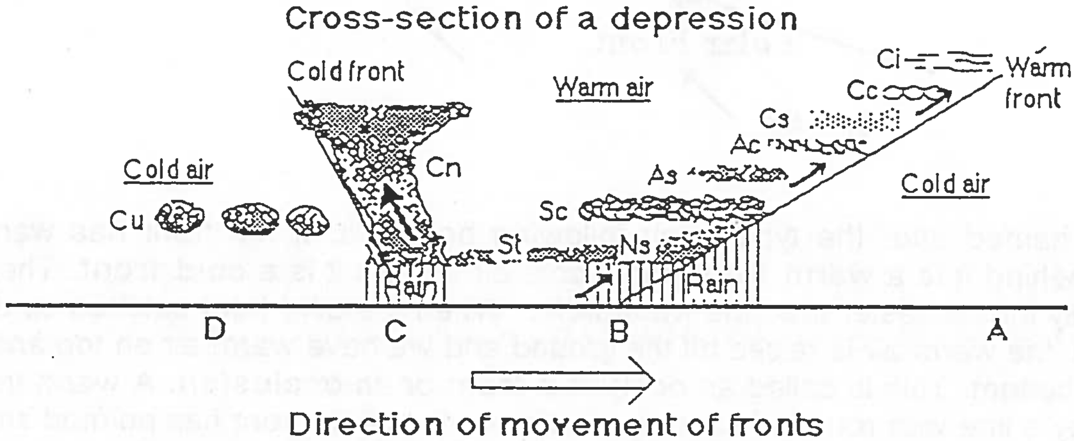

**Development of a Frontal Depression**

**Isobars** are lines through places of equal atmospheric pressure. The pressure gradient is indicated by the closeness of the isobars.

Weather associated with a depression.




In the diagram above a section is taken across the depression on the line labelled A, B, C, D. The cross-section diagram is shown below.



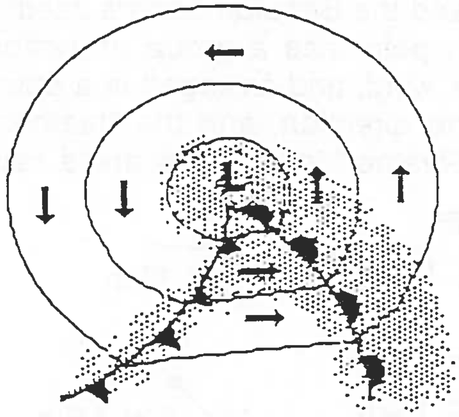

At A, cirrus clouds begin to form, which get thicker and take on a layered appearance (cirrocumulus and then cirrostratus). This is usually the first sign of an impending depression. The wind is Southerly and the barometer is falling. The clouds become thicker and lower and eventually rain starts. The rain is not excessively heavy but is continous. Visibility good becoming moderate, poor in rain.

At point B the warm front passes over. There is a slight rise in temperature (2° or 3°C), the wind veers from southerly to southwesterly and the barometer usually stops falling. The warm sector is generally an area of drizzle or light rain, but if it is sufficiently wide, the rain belt associated with the warm front may pass and the rain stop. The sky usually remains covered by stratus cloud - a dull, grey day. Visibility moderate, poor in rain.

At point C, we meet the cold front. The temperature drops, sometimes appreciably. The wind veers again usually from westerly to northwesterly and may increase in strength. The barometer starts to rise. A very active cold front may give quite severe weather - cumulonimbus clouds with heavy rain and hail, squalls and sometimes thunder and lightening. With all its extremes this area is short lived. If the front is not very active there will still be showers, some heavy. Visibility improves except in showers.

At point D the cold front has passed and the clearance has come. The clouds become smaller and thinner and there will be some diminishing showers and sunshine. Wind remains northwesterly and may be blustery and cool. Visibility good.

The rain belts of a depression can be seen to extend along the warm and cold fronts. The rain associated with a warm front may often precede the actual front by a considerable distance, perhaps 100 miles. The wide base of the warm sector is often dry but dull and overcast. The rain belts in a depression are shown in the diagram below -

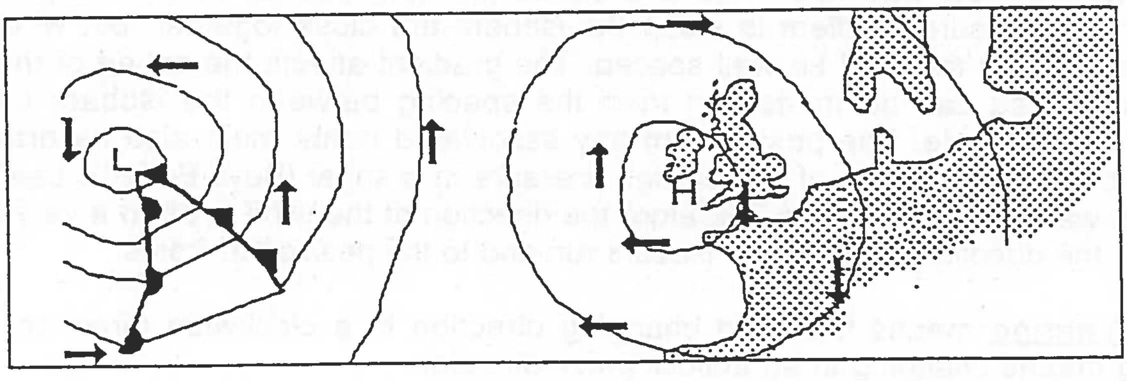



The weather in an occlusion is similiar to a warm sector weather, i.e. continuous rain and drizzle.

**Weather associated with an anticyclone**

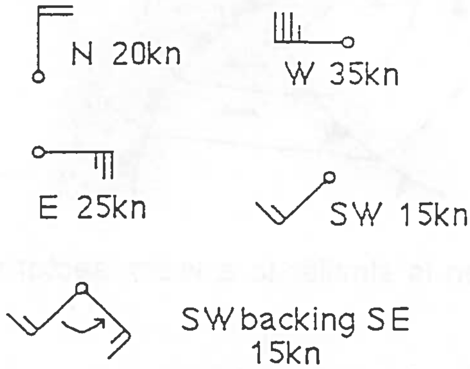
In an anticyclone winds blow in a clockwise direction (Buys-Ballot's Law). High pressure areas are more stable than lows and are slow to move. Once established a high will block the progress of a depression approaching from the Atlantic. A high is characterised by light winds and usually fine settled weather. The pressure gradients are not steep and the isobars are therefore well separated. When we get a spell of fine settled weather it is usually due to an extension northwards of the semi-permanent Azores High. The cause of the high pressure is the slow subsidence of air from higher levels. This air is warmed by compression and is therefore dry, with no cloud or precipitation.

But sometimes an anticyclone does not produce such good weather. The upper air subsidence may result in the higher air being warmer than the lower air - this condition is called **inversion**. This puts a sort of "ceiling" on the atmosphere and stops any upward movement of lower air. If the warmer air does not reach low enough, any cloud layer already present will be "imprisoned" below it and will persist, causing anticyclonic gloom. When an inversion occurs, engine exhaust fumes and chimney smoke are also imprisoned, causing increased air pollution, reduced visibility and sometimes "smog".

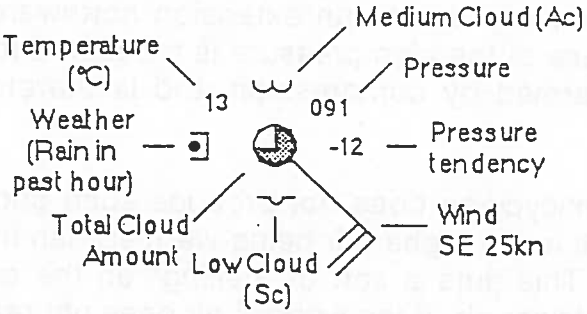


## WEATHER CHARTS

A weather chart shows the weather conditions over an area at a particular time. The most detailed of these charts are drawn in meteorological offices, and by using special symbols and abreviations give a synopsis of the complete weather picture over a very wide area - perhaps the whole North Atlantic. These are called **Synoptic Weather Charts**. Some of the symbols and the Beaufort Letters used have already been shown on page 16. Each observation point has a group of symbols clustered around the central symbol representing the wind, and arranged in a standard order. The line from the central point gives the wind direction, and the "feathers" at the end of the line represent the speed - each full "feather" is ten knots and a half feather is five knots.




Reports from weather stations are received at the forecast office usually by teleprinter, coded as six groups of five numerals each. All this mass of information is then transferred onto the map in the appropriate places - for example -

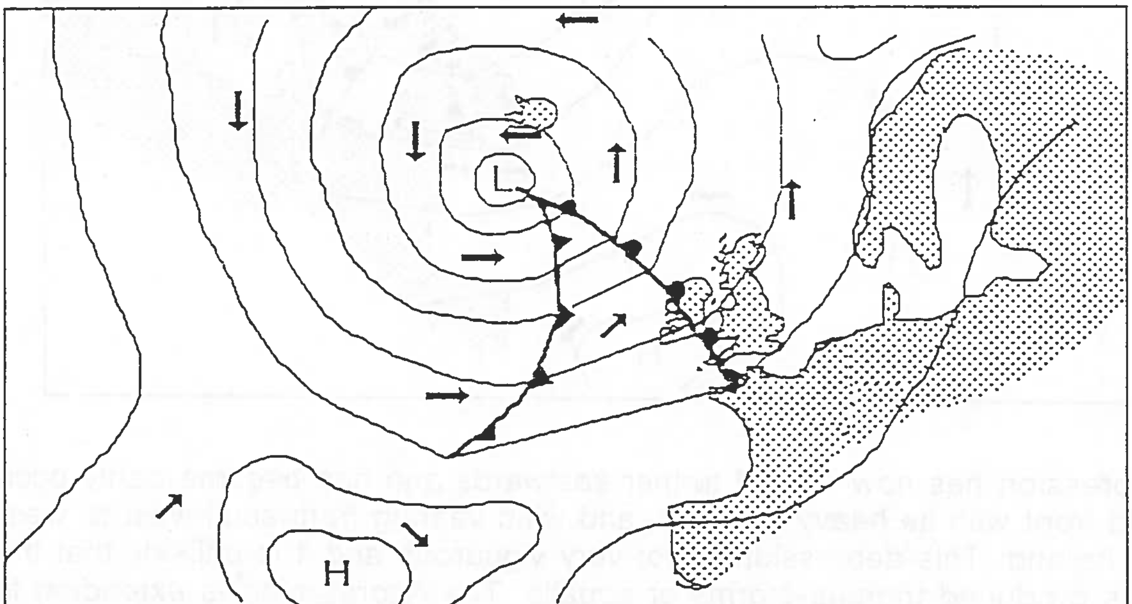



When all the information has been entered on the chart the next important step is to draw in the **isobars** - lines drawn through places of equal pressure. These are usually drawn at 4 millibar intervals. This is a skilled job and requires a lot of experience. Where the pressure gradient is steep the isobars are close together, but where the gradient is slight they will be well spaced. The gradient affects the speed of the wind and this speed can be measured from the spacing between the isobars using a **geostrophic scale**. The positions of any associated fronts must also be drawn in. Wind blows around areas of low or high pressure in a spiral (Buys-Ballott's Law), and veers at warm and cold fronts.Therefore the direction of the wind is often a very useful guide to the direction in which the isobars run and to the position of fronts.

**Note** - <u>Veering</u> means the wind changing direction in a clockwise direction, while <u>backing</u> means changing in an anticlockwise direction.

## Interpreting Weather Maps

When the isobars and fronts have been drawn in, an overall picture of the weather starts to emerge. A great help nowadays to drawing and interpreting weather maps is the use of satelite photographs.



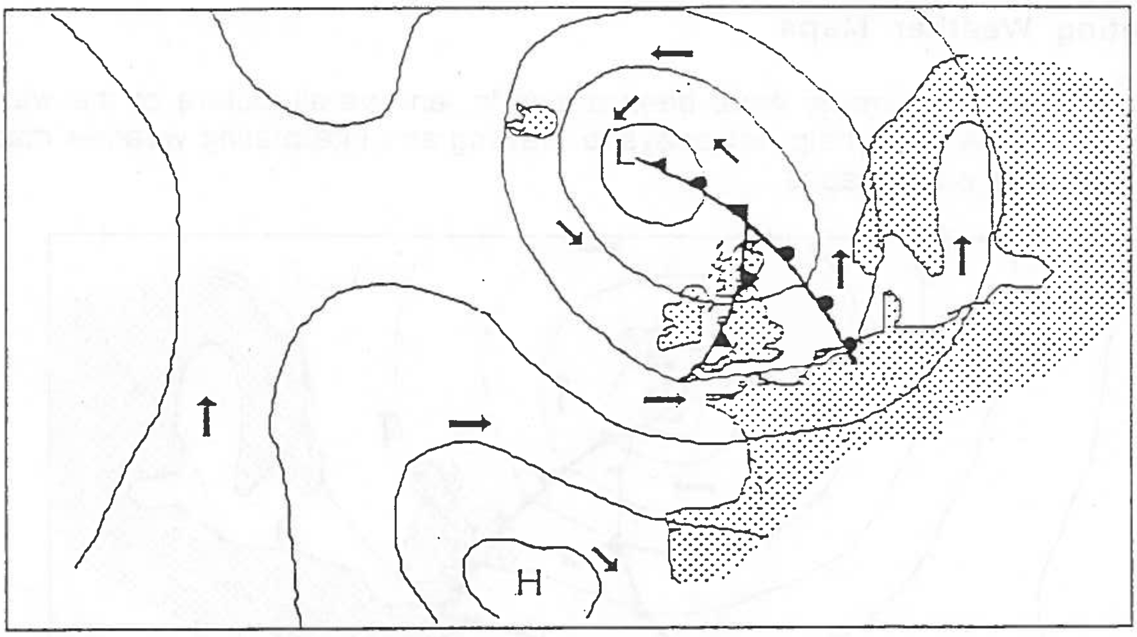

This map shows a depression centered south of Iceland with its warm front crossing Ireland and a high pressure area down to the south, in the region of the Azores.This picture would suggest that the present weather is as follows -

<u>Northern and eastern areas of Ireland, south Wales and southwest England</u> - becoming overcast, with a lowering cloud base and rain ahead of the warm front. The wind is southerly to south-south-westerly. The barometer is falling slowly. The isobars are well spaced and the wind is therefore not very strong.

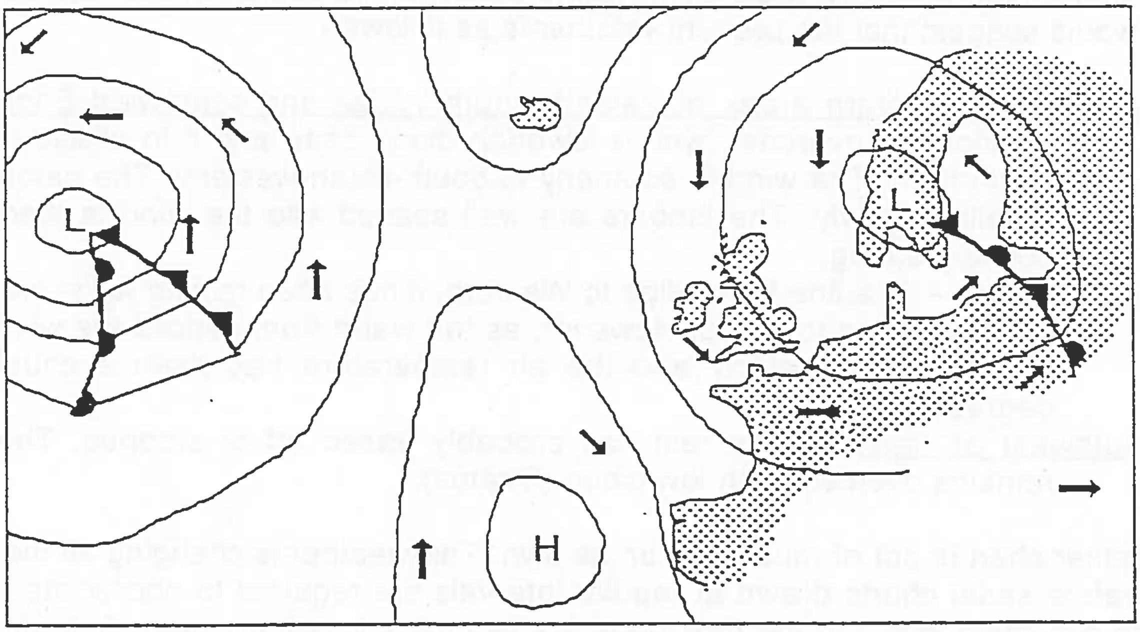
<u>Irish midlands</u> - in a line from Sligo to Wexford, it has been raining for some time and continues to do so. However, as the warm front passes the wind has veered southwesterly and the air temperature has risen a couple of degrees.

<u>Southwest of Ireland</u> - the rain has probably eased off or stopped. The sky remains overcast with low cloud (Stratus).

One weather chart is not of much use on its own. The weather is changing all the time and therefore serial charts drawn at regular intervals are required to appreciate these changing circumstances. On the next page are two more imaginary maps following the progress of the weather systems shown on the map given above.




The depression has now moved further eastwards and has become partly occluded. The cold front with its heavy showers, and wind veering from southwest to west, has cleared Ireland. This depression is not very vigourous and it is unlikely that the cold front has produced thunder-storms or squalls. The Azores high is extending further north-westwards. Weather over the whole of Ireland is now intermittently sunny with scattered cumulus cloud and occasional showers. The wind is west to north-west and the temperature has dropped a couple of degrees with the passage of the cold front.




In this map the original depression has moved away over Scandinavia and is completely occluded. A new, more vigorous depression is approaching from further out in the Atlantic. There is a good ridge of high pressure to the west of Ireland, which may delay the approaching low. The weather in Ireland is quite good, but cool (if in Summer) or quite cold (Winter). The wind is northerly, with perhaps occasional showers.

## WEATHER FORECASTING

This is really the most important part of weather study. While we can learn much from past weather conditions, what we really want to know is what will the weather be like tomorrow, or later in the day. A lot of folklore has built up about weather and climatic conditions, based on the observation of local natural signs. However modern weather forecasting is a much more complex scientific process.

**Natural Weather Signs** Experienced boatmen, fishermen or farmers can often tell from various natural signs that the weather is going to be fair or bad: Many of these signs depend on local knowledge - a combination of appearance of the sky, visibility of landmarks, direction of wind, etc. If there are any such well recognised signs in your area you should try to find out about them, and perhaps keep a particular record of the weather following these signs to see if they are true or not. Many well known rhymes about the weather are of **no** value at all. Some rhymes have developed from observations in certain areas, but when taken to another area, or when applied to the country in general, do not work. However, some of the rhymes work part of the time, and it would be an interesting exercise for you to gather a number together and see how often they are right or wrong. The following is a selection of some of them -

1. A red sky at night, a sailor's delight.
   A red sky in the morning, a sailor's warning.

2. Mackerel sky and mares' tails,
   make tall ships carry low sails.

3. Rain from the east, means a day's rain at least.

4. Farther the sight, the nearer the rain.

5. When rain comes before the wind
   Halyards, sheets and braces mind,
   But when wind comes before the rain
   Soon you may make sail again.

6. When the wind shifts against the Sun
   Trust it not, for back 't will run.

7. If clouds are gathering thick and fast,
   Keep sharp lookout for sail and mast,
   But if they slowly onward crawl,
   Shoot your lines, nets and trawl.

These rhymes were developed long before people knew anything about the scientific basis of weather phenomena and changes. You may find it interesting to try to work out what many of these rhymes mean and how they fit in with the theory you have read in this book. So the message is - don't trust the weather rhymes. If you want to know what the weather is going to be, particularly if you are setting out on a boating expedition get a proper forecast from the Met. Office.

**Preparing Weather Forecasts** Information from weather observation stations around the country, as well as observations from foreign stations and weather-ships (via telex from Bracknell) come to the **Central Analysis and Forecast Office** (CAFO) in Glasnevin in Dublin. Synoptic weather charts are drawn and the progress and changing characteristics of the various weather systems are noted. From this it is possible to predict the way that these systems will move and develop, and therefore predict the weather changes they will produce. This method of forecasting is called the synoptic method. With the development of computers, the numerical method of forecasting using mathematical formulae to calculate expected weather changes is now widespread. Most modern weather forecasting consists of a mixture of both of these methods. Computer graphics are also used to complete the charts. The normal chart, covering the east coast of North America, North Atlantic and Europe takes about two hours to plot manually. With the new computer-controlled machines and graphics this can be done in 30 minutes.

Weather forecasting in Ireland has always been more difficult than in Britain or the Continent because we get the weather first ! Most of our weather comes from the west and it is difficult to get a complete picture of weather systems over the Atlantic due to the limited number of observations scattered over such a wide area. The use of **satellite data** is now filling this gap. Satellites can provide pictures of the cloud systems and also other useful information.

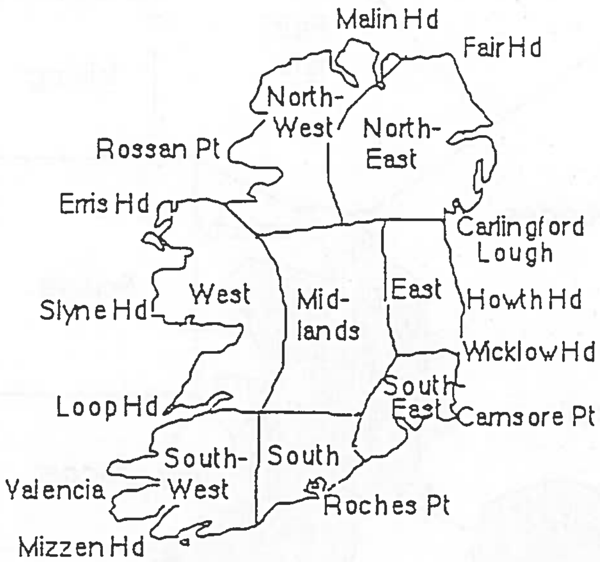
Many different types of weather forecast are produced by the Meteorological Service. Continuous forecasts are required for aviation, and there are Met. Offices in Dublin, Shannon and Cork Airports and Casement Military Aerodrome. Four times a day general and shipping forecasts are broadcast on RTE, and a detailed and illustrated forecast is given on TV every evening. Forecasts are issued to the daily newspapers and special forecasts are provided when necessary - e.g. gale warnings when gale force winds are expected, and potato blight warnings when weather conditions are likely to favour the spread of this disease.

The **Automatic Telephone Weather Service** (ATWS) gives pre-recorded 24 hour forecasts by telephone. A Dublin area forecast, including Dublin Bay, started in 1967, prepared by CAFO and provided by P&T, now by Bord Telecom (dial (01) 1199). Similar services now cover other regions - Leinster from CAFO, South Munster from Cork Airport, North Munster and South Connacht from Shannon.

**Definition of Terms** Some words used in weather forecasts have very specific meanings. Some of the commonest are given here for information -

| | | |
|---|---|---|
| Time | Imminent | = within 6 hours |
| | Soon | = 6 to 12 hours |
| | Later | = 12 to 24 hours |
| Visibility | Good | = more than 5 miles |
| | Moderate | = 2 to 5 miles |
| | Poor | = 1100 yds to 2 miles |
| | Fog | = less than 1100 yds. |
| Speed | Slowly | = 0 to 15 knots |
| | Steadily | = 15 to 25 knots |
| | Rather quickly | = 25 to 35 knots |
| | Rapidly | = 35 to 45 knots |
| | Very rapidly | = >45 knots) |

**Weather Forecasts** from the Irish Meteorological Service use the land areas or regions as shown in the map below. The best way to learn about the approach of fine or bad weather is to get the up-to-date weather forecast from the Meteorology Service. This is absolutely essential before setting out on a boating expedition and also extremely important for a mountain expedition. Most newspapers give daily weather maps - get into the habit of looking at them regularly. This will give you practice at reading weather maps. As mentioned in the section on keeping a weather log you could cut out the newspaper maps and stick them into your log on the left hand pages. This would keep a record of the meteorological situation and forecast, to compare with your own observations of the actual weather that occurred.



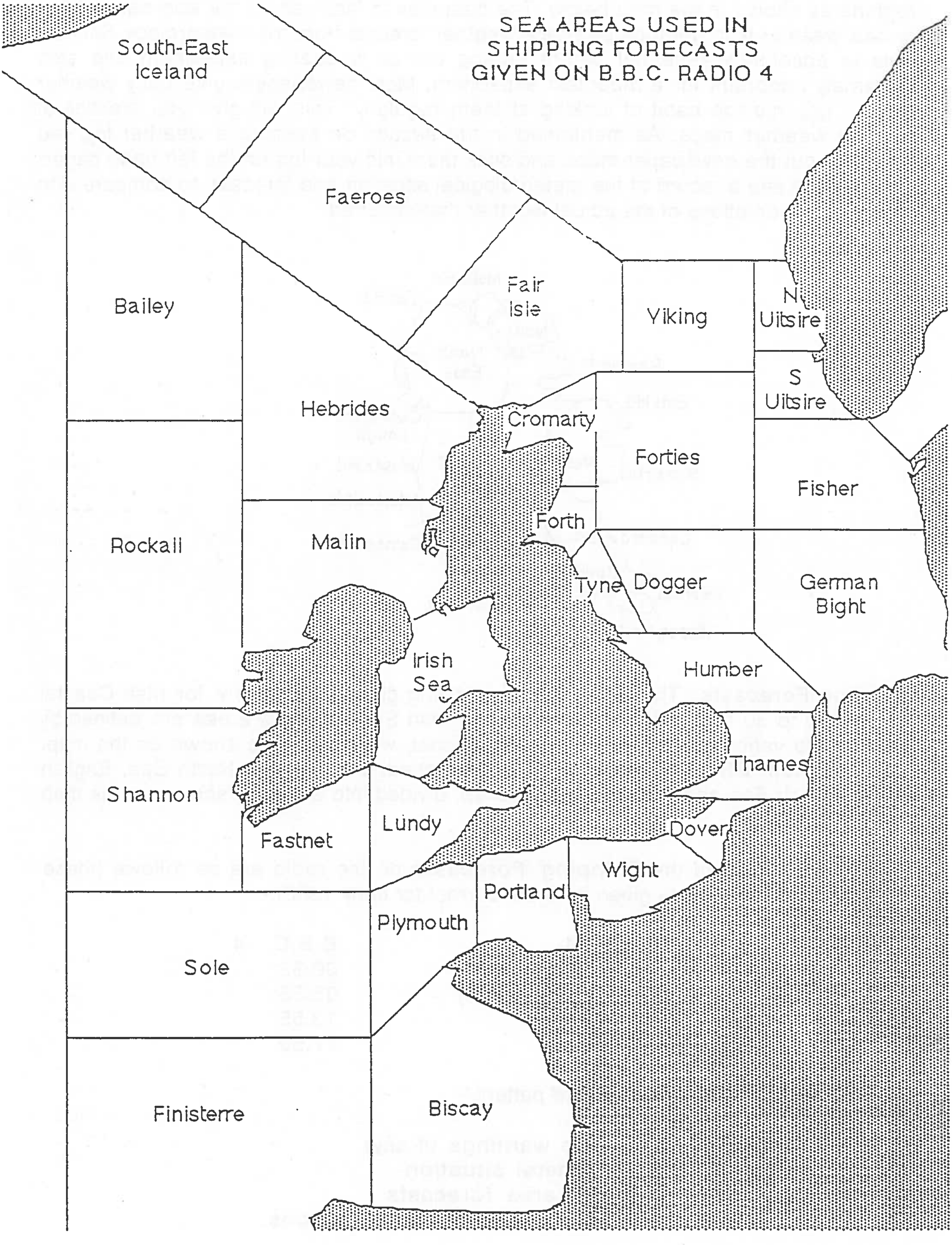

**Shipping Forecasts** The forecasts for shipping given on **RTE** are for Irish Coastal Waters, up to 30 miles offshore, and for the Irish Sea. The sea areas are defined by reference to various headlands around the coast, which are also shown on the map. Forecasts from **BBC** are much more widely based, covering the North Sea, English Channel, Irish Sea and Western Approaches, divided into areas as shown on the map on the next page.

**Radio** - The times of the **Shipping Forecasts** on the radio are as follows (these times may change - those given here are correct for early 1988) -

| R.T.E.1 | B.B.C. 4 |
|---|---|
| 07.45 | 00.33 |
| 12.02 (12.10 Sun) | 05.55 |
| 18.02 | 13.55 |
| 23.55 | 17.50 |

Shipping Forecasts have a standard pattern -

1. **Gale warnings** (if any)
2. **General situation**
3. **Sea area forecasts**
4. **Reports from coastal stations.**


SEA AREAS USED IN
SHIPPING FORECASTS
GIVEN ON B.B.C. RADIO 4
South-East
Iceland
Faeroes
Fair
Isle
Viking
N
Uitsire
S
Uitsire
Bailey
Hebrides
Cromarty
Forties
Fisher
Forth
Rockall
Malin
Tyne
Dogger
German
Bight
Irish
Sea
Humber
Thames
Shannon
Lundy
Fastnet
Dover
Wight
Portland
Plymouth
Sole
Finisterre
Biscay

## COLD EXPOSURE

If the body loses so much heat that the core temperature drops to dangerous levels, this is called **Hypothermia** and may end in death. It can occur while mountain walking, boating in cold weather or submersion in cold water.

**Warm clothing** When hiking in the mountains have plenty of layers of clothing with waterproof or at least windproof outer garments. Remember that the effects of low air temperature may be much increased by the wind - the **wind chill factor**. Warm clothing is also essential when you go boating - it may be much colder at sea than ashore. Even in the middle of Summer the nights can be very cool. Clothing must be warm and water-proof - wet clothing allows loss of heat more rapidly than dry clothing. The best type of clothing is woollen, covered by at least a wind-proof jacket, or better still a waterproof. Do not forget a woollen hat also. You should also carry a "survival bag" when on the mountains or on a canoe journey.

**Symptoms of hypothermia** Hypothermia may be quite insidious in onset, and the person affected will not realise what is happening. Be alert for physical and mental lethargy, shivering, slurring of speech and uncharacteristic behaviour or language. When hiking watch out for the person who is lagging behind a lot. At sea, particularly at night, it is important to make sure that a sea-sick crew member has plenty of warm clothes, with water-proof trousers and anorak, or oilskins. Some of the symptoms of sea-sickness may be due to a fall in temperature - unexpected behaviour, complaints of coldness and tiredness. The misery of sea-sickness may merge gradually into hypothermia, and it is important for other members of the crew to keep a close watch on someone who is sea-sick.

**Wet Suits** If dinghy sailing or canoeing in cold weather, wear a wet suit. Heat lost from your body is considerably reduced and survival time increased. They also have some buoyancy and will increase your ability to stay afloat, but of course you should have a proper buoyancy aid or lifejacket on as well.

**Immersion** If immersed, do not expend energy by moving your limbs or trying to swim or to "keep warm". Lie quietly in the water with lifejacket fully inflated and adopt the **Heat Escape Lessening Position (HELP)** - knees bent up to chest and held there with the hands, keeping the upper arms close to the chest wall. This reduces heat loss from the big blood vessels in the chest, in the groin and in the arm-pit.

**Treatment of hypothermia**

Try to stop further heat loss. DO NOT try to heat the patient with hot water bottles or such like. Do not rub his limbs to "help the circulation". Do not give any alcohol - this will open up surface blood vessels and allow more heat loss. Cover the patient in sleeping bags or in a survival bag and get him into a tent or shelter, or below decks out of the wind. If possible get him ashore quickly. If he is conscious give him **warm** drinks, but **not hot.** Take off all wet clothing and wrap the victim in blankets if available. If blankets or dry clothing are not available replace wrung out clothing. Place other blankets or covering close on either side of victim. If possible, administer sugar, glucose, condensed milk or warm (not hot) sweet drink. DO NOT GIVE VICTIM ALCOHOL UNDER ANY CIRCUMSTANCES.

**Frostbite** is a localised damage of tissues due to extreme cold. It usually affects the fingers, toes, ears and chin. It is extremely uncommon in this country. The affected part may be painful at first but then becomes numb and without feeling. It looks white or perhaps mottled. Frostbitten areas should be warmed slowly and heat should never be applied with a hot-water bottle.

## HEAT EXPOSURE

**Heatstroke** or **hyperthermia** is the opposite of hypothermia. It can occur when the body's temperature rises dangerously and the person is unable to lose heat by sweating. These conditions may occur in a hot climate when the humidity is very high and there is no wind - it is very unlikely to happen in our climate. However, something approaching this could occur to someone canoeing in very hot weather on a river in windless conditions and wearing a wet suit, which would prevent heat loss.

### Symptoms of heatstroke

The person may have a headache, feel dizzy and be restless. The skin will feel very hot and will be flushed. The pulse will be fast and strong. If severe he may lose consciousness.

### Treatment of heatstroke

Put the person lying down in as cool a place as possible. Remove clothing and sponge down with cold water. Try to produce air movement by fanning.

**Heat exhaustion** is not the same as heatstroke. It is caused by excessive loss of salt due to profuse sweating while working in very hot conditions or climate.

### Symptoms of heat exhaustion

The skin is usually pale and moist, and the person may have headaches and also cramping pains. The pulse is fast and weak.

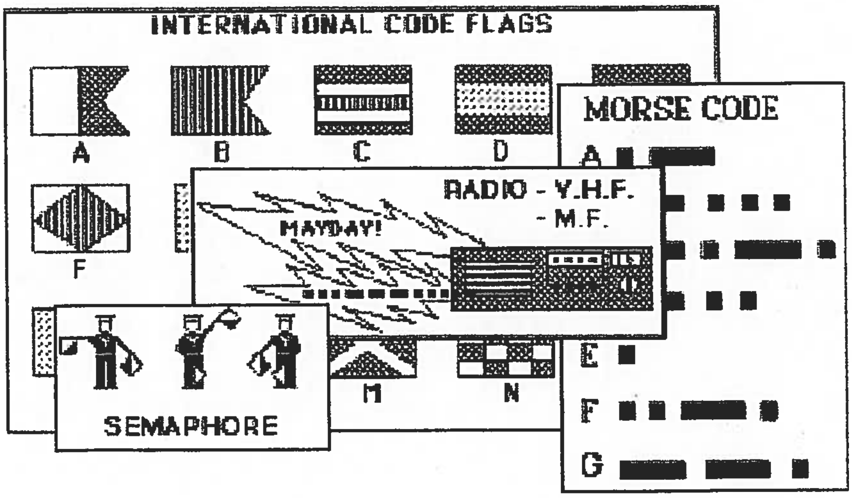
### Treatment of heat exhaustion

Put the person lying down in a cool place and give slightly salted water to drink - about a quarter teaspoon of salt to a half-pint.

# SEA TRAINING MANUAL

## SECTION F

# COMMUNICATIONS




SEA
TRAINING
TEAM

SCOUTING
IRELAND
SAI

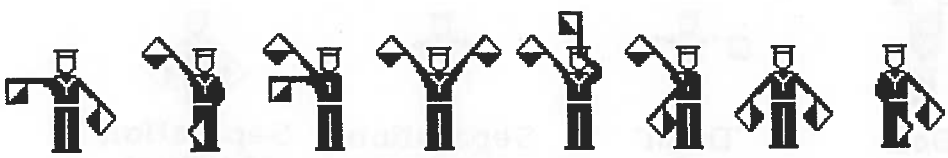
## COMMUNICATIONS

This section deals with **Marine Radio** as well as **Signalling.** The traditional methods are less important now than they used to be and the chance of getting a reply to a Morse or Semaphore signal nowadays is probably negligable! The use of VHF Radio has become very widespread in yachts and small boats, and for communications at regattas, etc. Some Scouts may be more familiar with radio than with Morse Code or Semaphore. But Morse Code and Semaphore can still be very useful in Sea Scouting activities. A Troop which builds up an interest and expertise in Signalling will find that practice comes very easily during boating sessions, camp, etc. In Scouting the most useful form of signalling is probably Semaphore, although this is now rarely used in maritime circles and some countries have completely abandoned it. Morse is still widely used, mainly by sound in Radiotelegraphy. Morse by lamp is useful at night, but daylight signalling by flags is slower and much harder work than Semaphore.

The flags of the International Code are always used as a traditionally maritime form of decoration, and no big nautical event is complete without them. However their use in Signalling now occurs only in occasional circumstances - the most important of these are given in the pages on the International Code.

## INDEX


| | Page |
|---|---|
| **Morse Code** | 2 |
| **Semaphore** | 4 |
| **Signalling Procedure** | 6 |
| **International Code Flags** | 7 |
| **Marine Radio** | 12 |
| **GMDSS** | 30 |

## MORSE CODE

The **Morse Code** is made up by allocating different combinations of "dots" and "dashes" to represent the letters of the alphabet and the numerals. If you wish to learn the Morse Code, do not use the words dots and dashes - it is much easier to learn and to use the code if you learn it as "**Dits**" and "**Dahs**". The Morse Code may be used by sound, light or flags. It is still used widely in Radiotelegraphy (R/T) and for identity signs in Marine Radiobeacons. This last mentioned is probably the only use which most boatmen and yachtsmen will encounter. But Morse Code by lamp can be very useful for night signalling from boat to boat, or boat to shore.

Learning Morse Code puts a lot of people off. There is no short cut - you have got to sit down and learn it by heart. There are some ways of making it a little easier, and you may find some more useful than others : -

Some letters are all "Dits" - E I S H . .. ... ....
Some letters are all "Dahs" - T M O _ _ _ _ _ _
Some letters are "reversals" - A N ._ _.
B V _... ..._
D U _.. .._
etc.

The numerals all have five sounds, 1 to 5 start with "dits" and 6 to 0 with "dahs".

Make a set of cards with a letter or numeral on one side and the Morse characters on the other. Shuffle and deal out at random - this is a useful way to learn especially when you are by yourself. To practice Morse Code you need to have a buzzer or light set made up. Ideally the circuit should include two Morse keys so that you can practice with someone else. Morse keys are not very easy to come by these days but a radio shop may be able to help you.

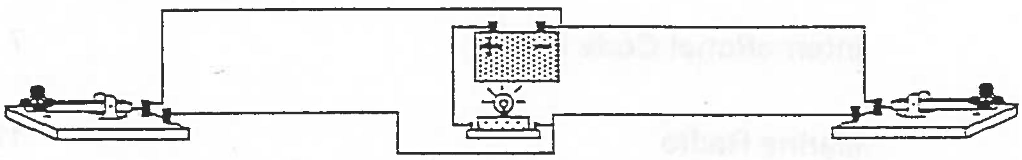
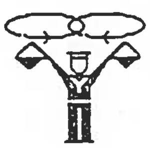


Diagram of a Morse light or buzzer practice set with two keys

Morse Code by flag has never been very popular as it is slower and more complicated than Semaphore but it does mean that daylight visual signalling can be performed without having to learn another method.

"Dot" "Dash" Separation of dots & dashes Separation of letters & words



**Circular motion of flags over the head**
**- made by transmitter = "erase"**
**- made by receiver = "repeat"**

## MORSE CODE

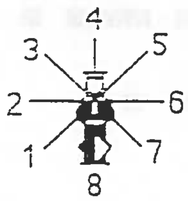
| | | | |
|---|---|---|---|
| A | · — | N | — · |
| B | — · · · | O | — — — |
| C | — · — · | P | · — — · |
| D | — · · | Q | — — · — |
| E | · | R | · — · |
| F | · · — · | S | · · · |
| G | — — · | T | — |
| H | · · · · | U | · · — |
| I | · · | V | · · · — |
| J | · — — — | W | · — — |
| K | — · — | X | — · · — |
| L | · — · · | Y | — · — — |
| M | — — | Z | — — · · |

| | |
|---|---|
| 1 | · — — — — |
| 2 | · · — — — |
| 3 | · · · — — |
| 4 | · · · · — |
| 5 | · · · · · |
| 6 | — · · · · |
| 7 | — — · · · |
| 8 | — — — · · |
| 9 | — — — — · |
| 0 | — — — — — |

## SEMAPHORE

As mentioned before, this form of signalling is now largely redundant, but it remains a very useful form of signalling for Scouts. The system uses two flags on short sticks, one flag in each hand. The letters of the alphabet are represented by moving the arms into specified positions at 45° angles around the body. There are 7 positions for use in making a signal - the eighth position is with the flags in front of the signaller, and is the rest or "break" position.

Diagram showing the rest position and the seven flag positions or angles used for Semaphore Signalling.




The alphabet is arranged in a number of "circles". In the diagram on the next page each line is one "circle" of the Code. Each circle moves in a clockwise direction (when viewed by the receiver). The 1st Circle uses one arm only and starts at the first position - 45° out from the rest position on the Signaller's right. This is **A.**

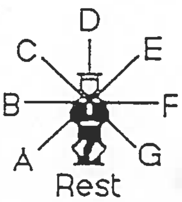
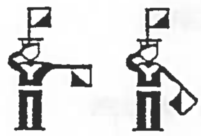



Diagram showing the letters of the 1st Circle. This circle uses one position only at a time. In the 2nd Circle the position of "A" is occupied all the time by one flag and the other flag moves around the other positions. In the 3rd Circle the position of "B" remains occupied while the other flag moves from "C" to "D".

The other circles continue as above. Each circle has one less letter than its predecessor, finally reaching the 7th "Circle" which consists of one letter only - Z.



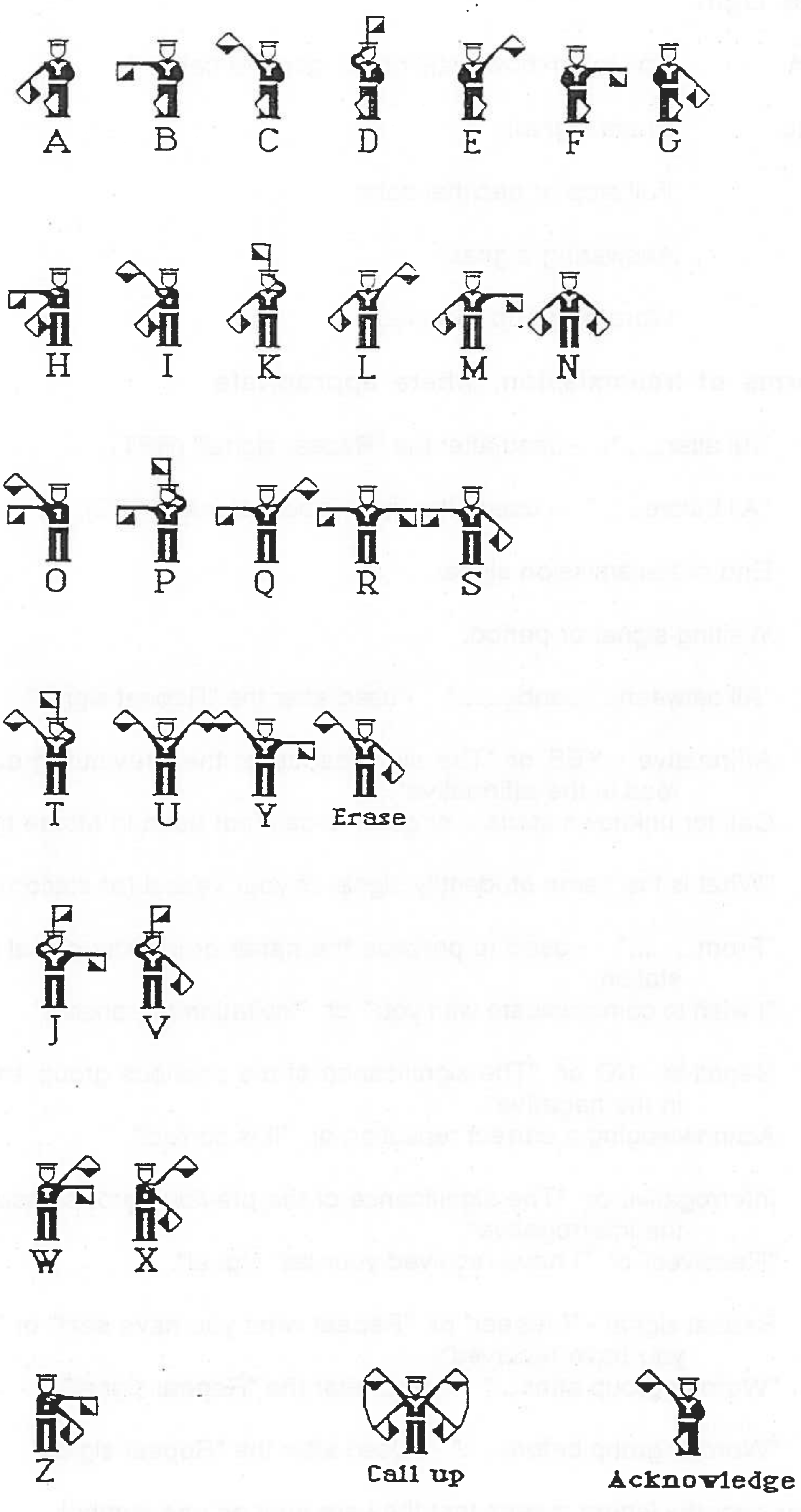
In the 5th Circle there is one position missing. There are only two letters in this circle, J and V, and no meaning is given to the other position (the mirror image of T).

Note that the letters do not follow the order of the alphabet exactly as you go through the circles - **J**, **V** and **Y** are out of order.

When learning Semaphore it is very important that you get the angles right. There is nothing more difficult to read than a Signaller whose angles are sloppy and halfway between correct angles. To help with this you can practice in front of a mirror. However, remember that when looking in a mirror what you see is the reverse image of what you are sending. So use the mirror only to check your angles - for practice at receiving get someone else to transmit to you. In Semaphore there are no signals for numerals - these are spelt out.

**Signalling procedure** - see page 6. All of the procedure signals given may be used in Semaphore, but the call up signal is **"RUN".** Also in Semaphore, **"C"** is used as the acknowledgement signal.

# SEMAPHORE



## PROCEDURE SIGNALS

### For Morse Light

| | |
|---|---|
| $\overline{AA}$ $\overline{AA}$ $\overline{AA}$ | Call to unknown station, or general call. |
| $\overline{EEEEE}$* etc. | Erase signal. |
| $\overline{AAA}$* | Full stop or decimal point. |
| $\overline{TTTT}$* etc. | Answering signal. |
| T | Word or group received. |

### For all forms of transmission, where appropriate

| | |
|---|---|
| AA | "All after......" - used after the "Repeat signal" (RPT). |
| AB | "All before......" - used after the "Repeat signal" (RPT). |
| $\overline{AR}$* | End of transmission signal. |
| $\overline{AS}$* | Waiting signal or period. |
| BN | "All between.......and........" - used after the "Repeat signal". |
| C | Affirmative - YES or "The significance of the previous group should be read in the affirmative". |
| CQ | Call for unknown station, or general call (not used in Morse by light). |
| CS | "What is the name or identity signal of your vessel (or station). |
| DE | "From........." - used to precede the name or identity signal of the calling station. |
| K | "I wish to communicate with you" or "Invitation to transmit". |
| NO | Negative - NO or "The significance of the previous group should be read in the negative". |
| OK | Acknowledging a correct repetition or "It is correct". |
| RQ | Interrogative or "The significance of the previous group should be read in the interrogative". |
| R | "Received" or "I have received your last signal". |
| RPT | Repeat signal - "I repeat" or "Repeat what you have sent" or "Repeat what you have received". |
| WA | "Word or group after...." - Used after the "Repeat signal". |
| WB | "Word or group before....." - Used after the "Repeat signal". |

***Note** - A bar over the letters means that they are sent as one symbol.

# INTERNATIONAL CODE OF SIGNALS

The first International Code of Signals was published in 1857 and revised in 1897. Because of the widespread use of radio, a new Code was adopted in 1931 in two volumes - one for visual signalling and the other for radiotelegraphy. The following forty years or so saw even greater development of radio, particularly the easily used short range VHF. Much of the 1931 Code Book became obsolete and unnecessary. A complete revision was done and a new Code introduced in 1969. This is published in nine language editions - English, French, Italian, German, Japanese, Spanish, Norwegian, Russian and Greek.

The 1969 Code Book is much simpler than the 1931 Code. All signals are given in one, two or three letter hoists. The "Single Letter" codes are for very urgent or very often used signals. The main section of the Code Book consists of two-letter signals with the stress on situations affecting safety. The last section of the book is the Medical Section (printed on green paper), containing three-letter signals all starting with the letter "**M**". All the signals contained in the new Code may be made by any form of communication - visual (Morse, Semaphore or Code Flags), sound (Morse), radio (telephony or telegraphy).

## International Code Flags

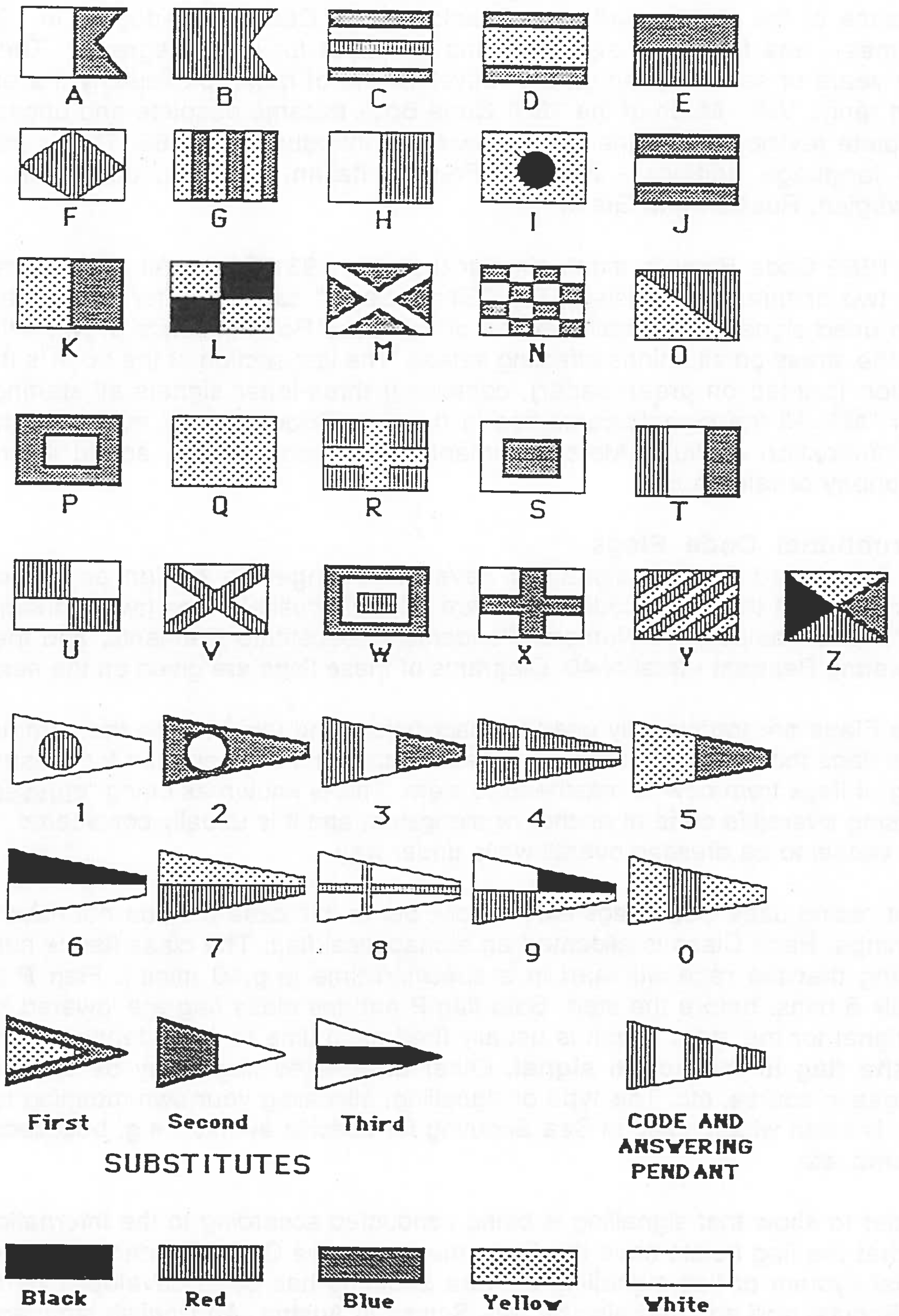
The flags used for flag signalling have not changed in design or in alphabetical meaning since the 1897 Code. There are 26 Alphabetical Flags (two of them - **A** & **B** - are "swallow-tailed"), 10 Numeral Pendants, 3 Substitute Pennants, and the Code or Answering Pendant - total of 40. Diagrams of these flags are given on the next page.

Code Flags are traditionally used for decoration, and this may be the commonest use of the flags that you have seen. On special occasions it is common for vessels to run a string of flags from bow to masthead to stern. This is known as being "dressed overall". Dressing overall is done at anchor or alongside, and it is usually considered "incorrect" for a vessel to be dressed overall while under way.

Yacht racing uses Code flags extensively, but in this case they do not have the Code meanings. Each Class is allocated an alphabetical flag. The class flag is hoisted as a warning that the race will start in a specified time (e.g.10 mins.). Flag **P** is hoisted usually 5 mins. before the start. Both flag **P** and the class flag are lowered smartly as the signal for the start. A gun is usually fired each time to call attention to these flags **but the flag is the actual signal.** Other designated flags may be used for recall, changes in course, etc. This type of signalling, allocating your own meaning to a flag or flags, is often widely used in Sea Scouting for specific events - e.g. boat recall signals on camp, etc.

In order to show that signalling is being conducted according to the International Code and that the flag hoists have the Code meanings, the Code Pendant is hoisted first. A special system of flag signalling for Sea Scouting has been developed by the Dutch Sea Scouts, and adopted also by Sea Scouts in Austria. An English language version will soon be published by the SAI Sea Training Team. If this Scout Code is being used the "Scout Code Pendant" is hoisted in place of the International Code Pendant. The Scout Code Pendant has a similar shape but is plain Green in colour.

# INTERNATIONAL CODE FLAGS



## Single Letter Signals

The single letter meanings of the Code Flags are those which are the most urgent or those which are used most often. These signals may also be made in Morse Code, using either light or sound (but when sound is used, the signals marked * may only be made in accordance with the International Regulations for Preventing Collisions at Sea - Rules 34 and 35).

A - I have a diver down; keep well clear at slow speed.
* B - I am taking in or discharging or carrying dangerous goods.
* C - "Yes", affirmative.
* D - Keep clear of me, I am manoeuvring with difficulty.
* E - I am altering my course to starboard.
F - I am disabled. Communicate with me.
* G -I require a Pilot. When made by fishing vessel - "I am hauling nets".
* H -I have a pilot on board.
* I - I am altering my course to port.
J - I am on fire and have dangerous cargo on board: keep well clear.
K - I wish to communicate with you.
L - You should stop your vessel instantly.
* M - My vessel is stopped and making no way through the water.
N - "No", negative.
O - Man overboard.
P - (In harbour ) - The vessel is about to proceed to sea.
(At sea, by fishing vessel) - My nets have come fast on an obstruction.
Q - My vessel is healthy and I request free pratique (Customs clearance).
* R - (No meaning allocated).
* S - I am operating stern propulsion.
* T - Keep clear, I am engaged in pair trawling.
U - You are running into danger.
V - I require assistance.
W- I require Medical assistance.
X - Stop carrying out your intentions and watch for my signals.
Y - I am dragging my anchor.
* Z - I require a tug. When made by a fishing vessel - I am shooting nets.

## Single Letter Signals with Complements

A single letter with a Complement (i.e. followed by a numeral or numerals) may have a different meaning to that given above.

| | |
|---|---|
| A + three numerals - | Azimuth or bearing |
| C + three numerals - | Course |
| D + 2, 4 or 6 numerals - | Date |
| G + four or five numerals - | Longitude (last two mins., rest degrees). |
| K + one numeral - | I wish to communicate by...(see Table I). |
| L + four numerals | Latitude (first two degrees, rest minutes) |
| R + one or more numerals - | Distance in nautical miles |
| S + one or more numerals - | Speed in knots |
| T + four numerals - | Local Time (first two hours, rest minutes) |
| V + One or more numerals - | Speed in kilometers per hour |
| Z + four numerals - | GMT (first two hours, rest minutes). |

### Two Letter Signals

The General Section of the Code Book contains two-letter signals (also called two-flag hoists). These are arranged in eight parts covering distress, casualties, navigation, manoeuvres, weather, communications, health regulations, etc. Some of these signals are given here - these are examples and you do not have to learn them off!

| | |
|---|---|
| AC | I am abandoning my vessel. |
| AF | I do not intend to abandon my vessel. |
| AF1 | Do you intend to abandon your vessel? |
| AL | I have a doctor on board. |
| AM | Have you a doctor? |
| AN | I need a doctor. |
| AQ | I have injured/sick person to be taken off immediately. |
| CB | I require immediate assistance. |
| CK | Assistance is not (or is no longer) required by me. |
| CQ | Call for unknown station or general call to all stations. |
| CS | What is the name or identity signal of your vessel? |
| CV | I am unable to give assistance. |
| CV2 | May I assist you? |
| CV4 | Can you assist? |
| DV | I am drifting. |
| KM | Prepare to be taken in tow. |
| MB3 | You should leave the channel/fairway free (used in Dunlaoghaire when the car ferry is entering or leaving). |
| NC | **I am in distress and require immediate assistance.** |
| NE | You should proceed with great caution. |
| NF | You are running into danger. |
| NG | You are in a dangerous position. |
| PP | Keep well clear of me. |
| QO | You should not come alongside. |
| QR1 | Can I come alongside? |
| QU | Anchoring is prohibited. |
| QX | I request permission to anchor. |
| RB | I am dragging my anchor. |
| UW | I wish you a pleasant voyage. |

### Three Letter Signals

These signals are all in the Medical Section, and all begin with **M.** The section has two parts - Part I - Request for Medical Assistance, Part II - Medical Advice.

### Tables of Complements

Complements are numeral suffixes which are used in appropriate circumstances to expand or to modify the meaning of other signals. Complements which occur in the Code Book more than once are grouped in three tables in the General Section, 1- Methods of Signalling, 2- Assistance requirements, 3 - Compass directions. Example - single letter signal **K** means 'I wish to communicate; the signal **K4** means "I wish to communicate by Morse lamp".

The Medical Section also has three Tables of Complements, prefixed with the letter **M.** These cover 1- Parts of the body, 2- List of common diseases, 3- List of Medicaments.

**Flag Signalling**

The transmitting station hoists the identity signal of the station being called and this is answered by hoisting the answering pendant (Code Pendant). If the signal is addressed to all stations in visual range, no identity signal is hoisted. The transmitting station then hoists its signal. The receiving station hoists the answering pendant at the dip as soon as the signal is seen, and close-up when understood. The transmitting station hoists the answering pendant after the last hoist of a signal to show that the signal is complete.

**Substitutes**

There are three substitute pennants. They are used to repeat flags in the same group. The first substitute repeats the uppermost flag of the class of flags immediately preceding it. The second sub repeats the second flag, and the third sub repeats the third flag.

<u>Examples</u> - The signal PP would be made as -
Flag P
1st substitute

The number 1100 would be made as -
Pendant 1
1st substitute
Pendant 0
3rd substitute

The group AAAAwould be made as -
Flag A
1st sustitute
2nd substitute
3rd substitute

The call sign EI 2992 would be made as -
Flag E
Flag I
Pendant 2
Pendant 9
2nd substitute
1st substitute

In the last example the substitutes follow numeral pendants and therefore can only repeat numerals and not alphabetic flags.

**Commonly seen flags**

If you live in or near a port you may see ships flying **flag H** when entering or leaving port. Occasionally **flag B** may be seen, or a special oil tanker flag which is **flag B** with a white ball in the centre. A tanker loading or discharging oil may hoist **QO** ("You should not come alongside"). Cross-channel car ferries will often fly **flag P** before departure. Yachts arriving from overseas will fly **flag Q** to request Customs clearance. On naval vessels, the **3rd substitute** is flown when the Commanding Officer is not on board.

## VHF RADIO

VHF radio is now widely used in small boats, and where Sea scouts have access toi it they should be taught to use it correctly. Senior Scouts, Venture Scouts and Leaders are encouraged to take the examination for the Module 1 Certificate, or better still for the full Short Range Certificate of Competence granted by the Director of Telecommunications Regulation. Instruction courses for these examinations are organised regularly by the SAI Sea Training Team. These notes cover the main aspects of VHF radio usage, but more detailed notes are provided at the courses.

The Irish Coast radio stations at Valencia and Malin Head have been providing Medium Frequency (Short Wave) communication services to vessels in the North Atlantic since the early 20th century. The Wireless Telegraphy (W/T) service, using Morse Code, was discontinued in 2001, Malin Head being the last European station to sign off. The Radio Telephony (R/T) services continue. In the 1980s, with the development of VHF radio, Valentia and Malin Head were also equipped with VHF radio and each controlled a number of satellite stations to give coverage around the Irish coast. Later, another main station (VHF only, without MF) was established in Dublin controlling its own satellites.

The satellite stations are at Carlingford, Wicklow Head, Rosslare, Mine Head, Cork, Bantry, Shannon, Clifden, Belmullet, and Glen Head.

In 2001, the Irish Coast Radio Stations were brought under the umbrella of the newly formed Irish Coast Guard, and became Coast Guard Radio Stations. They continue, however, to provide Public Correspondence functions

## RADIO WAVES

Radio waves form part of what is known as "The Electromagnetic Spectrum". In describing and classifying various forms of radio waves use is made of the terms "wave length" or "frequency". All the various electromagnetic emanations travel at the speed of light, which is 300,000 kilometers per second. Therefore if the distance between individual waves (i.e. wave length) is short, the number of such waves passing a given point per unit of time (i.e. frequency) will be higher. Conversely, if the wave length is longer, then the frequency will be lower. Wave length is measured in **meters**. Frequency is the number of **"cycles"** (waves) **per second** - 1000 cycles per second is 1 kiloherz (1 kHz) and a million cycles per second is called a megaherz (1 mHz).

Frequency (in kHz) = 300,000 ÷ wave length.
Wave length = 300,000 ÷ frequency (in kHz).

E.g. - BBC Radio 4 (Shipping Forecasts) has a wave length of 1500 meters.
∴ Frequency = 300,000 ÷ 1,500 = 200 kHz.

The classification of radio frequencies into low, medium and high is roughly but not exactly equivalent to the traditional long wave, medium wave and short wave bands found on ordinary domestic radios. The change-over between the use of kiloherz and megaherz is usually taken at the level of 3000 kHz, which is the arbitrary dividing line between high frequency (HF) and medium frequency (MF). Therefore frequencies below 3000 kiloherz (= 3 megaherz) are expressed in kiloherz, and frequencies above that figure are expressed in megaherz.

| **Electromagnetic Spectrum** | Frequency | Wave length |
|---|---|---|
| Low frequency (LF)<br>"Long wave"<br>RDF Beacons, BBC Radio 4 | 30 - 300 kHz | 10,000 - 1,000 m. |
| Medium frequency (MF)<br>Ordinary broadcasts (eg RTE), "Medium wave" and part of "Short wave" including the marine band R/T and W/T. | 300 - 3,000 kHz | 1,000 - 100 m. |
| High frequency (HF)<br>Remaining part of "Short wave", various communications, radio "hams" etc. | 3 - 30 mHz | 1,000 - 10 m. |
| Very high frequency (VHF)<br>Ordinary broadcasts (eg RTE) Marine band, "hams", Air Traffic Control (ATC), satellite links, etc. | 30 - 300 mHz | 10 - 1 m. |
| Ultra high frequency (UHF)<br>Television, mobile communications. | 300 - 1,000 mHz | 1 - 0.3 m. |
| Super high frequency (SHF)<br>Microwave, space communications. | 1,000 mHz -> | 0.3 m. -> |

**Modulation**

This term is used to describe the way in which a signal is superimposed on the basic carrier wave.

Amplitude Modulation (AM) - This means that the waves are made to vary in height with the "amplitude" or varying degree of loudness of the sound signal. This is the form of modulation normally used in low, medium and high frequencies.

Frequency Modulation (FM) - Here the height of the wave remains constant, but the frequency is made to vary slightly above or below the carrier wave frequency. Frequency modulation is usually used in VHF, and the VHF band on some domestic radio sets is often labelled FM. As mentioned above other radio bands usually use AM, but it is interesting to note that legalised Citizen Band (CB) radio on 27 mHz (high frequency or short wave) uses FM.

## MARINE RADIO COMMUNICATIONS

**Medium frequency (MF)** - Most small craft with radio telephones have VHF, and it is this type of radio that is dealt with in this handbook. However, mention should also be made of medium frequency (MF) radio telephones. Medium frequency has a much greater range than VHF, but the sets are very much more expensive. The Radio Telephony (R/T) marine band is mainly between 1800 kHz and 3000 kHz. The calling and emergency frequency is **2182 kHz**. Each frequency originally had an upper and lower side-band , called Double Side Band (**DSB**). Advances in technology now mean that one side band can be eliminated, allowing frequencies to operate closer together - this is called Single Side Band (**SSB**). Since 1982 only SSB has been permitted for marine MF communications, except on 2182 kHz where DSB is still permitted. In MF, a "silent period" is observed for three minutes at each hour and half-hour. This allows any weak emergency or distress signals to be heard more easily.

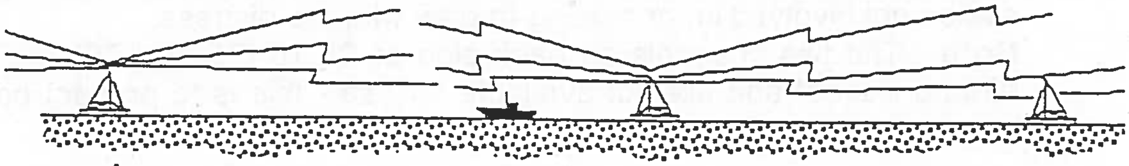
Wireless Telegraphy (W/T) uses Morse code and also has a marine band in MF. The maritime Distress Frequency is **500 kHz**. The "silent period" for W/T is for three minutes after quarter-past and quarter-to each hour.

**Very High Frequency (VHF)** - The International Maritime Band in VHF uses frequencies between 156 mHz and 174 mHz. The band is divided into a number of "Channels". You will **not** be expected to know all the channels but you should know the most important ones. Also you do **not** have to learn the various frequencies. The Marine Band originally had 28 Channels, labelled 1 to 28, with a spacing of 50 kHz (0.05 mHz) between the channels. Later improvements in technology increased the number of Channels by reducing the spacing to 0.025 mHz. Thus an extra channel was fitted in between each of the original ones. But Channels 1 to 28 were already well established and could not be renumbered without a lot of trouble and confusion, and the numbers 29 to 59 inclusive had already been allocated to other uses outside the International Band. Therefore the new channels were numbered from 60 to 88. This is the reason for the strange arrangement of channel numbers - e.g. channel 61 comes between channels 1 and 2 in terms of frequency, and channel 71 comes between 11 and 12.

**Citizens' Band (CB)** - This operates on 27 mHz FM (VHF). It is not monitored by Coast or Port Radio Stations or Rescue Services. It can however be useful for "chatting" with friends thus reducing congestion on VHF, and for communicating with private CB stations ashore. Channel 9 is the emergency communication channel on CB-FM and Ch.14 is for general calling.

**Characteristics of VHF** VHF radio is quite short ranged. It is usually described as being "line of sight", but under certain conditions such as high atmospheric pressure much greater distances can be obtained. The range is influenced by the height of the aerial, and also by the type and efficiency of the aerial. Yacht to yacht range is probably about 15 - 20 miles, provided that the aerials and cables are efficient. The range of a shore station will be much greater because of its higher and more efficient aerial.

Another characteristic is the so called "capture" effect. If two stations are transmitting simultaneously, a third (receiving) station will hear only one of them, and not a jumble of both. This means much less distortion or background noise, but it also means that a nearer or more powerful station may wipe out the signals of another station. For example - vessel A is talking to vessel B. Vessel C is much nearer B but out of range of A. Hearing nothing, C transmits to D. This "captures" B's reception, wiping out the reception of A's signal.




**Operation Methods.** For ordinary intership and port operations communications both stations transmit and receive on the same frequency. This means that it is not possible to talk and listen at the same time - the operator must say "over", and release the microphone switch so that the other station may know that he is finished and be able to transmit in reply. This method of working is known as **"Simplex"**. Simultaneous transmission in both directions, which normally occurs in a telephone conversation, is possible only if the ship station and the shore station transmit on different frequencies. This is known as **"Duplex"** operation. For this to work properly two aerials or a special duplex filter are needed. Such equipment is much more expensive than Simplex. We can therefore talk of "Duplex Channels", meaning channels that have two frequencies, and of "Duplex Equipment", meaning radio equipment that can use Duplex channels fully. It is possible to use the two-frequency channels with Simplex equipment but this requires Simplex operation - i.e. alternate transmission in each direction, use of the word "over", and release of the microphone switch when receiving. This use of a Duplex channel with a Simplex set is known as **"Semi-Duplex"**.

**Note -** two vessels cannot communicate with each other using a Duplex channel, as the ship transmitting frequency and reception frequency are different. Duplex channels can be used **only** between a ship and a shore station.

The Duplex Channels are - 01 to 05 incl., 07, 18 to 28 incl., 60 to 66 incl., 78 to 88 incl.

**Channel Allocation.**

There are fifty seven channels in the Marine Band, but two of these (Channels 75 and 76) are not available for use. Various channels are allocated to specific purposes, and they are divided into a number of groups -

1 - Distress, Safety and Calling Channel - Channel 16 (156.800 MHz)
This is used for distress and emergency and also for calling and making initial contact with other ships or shore stations. Communication is switched to a "working channel" as soon as contact has been made - time spent on Ch.16 must be as brief as possible. Except for distress, urgency or safety, exchanges of calls on Ch.16 must not exceed one minute. Continuous watch is kept on Ch.16 by Coast Radio Stations, large port or harbour radios, British Coast Guard and also many vessels at sea. Unlike 2182 kHz MF, there are no "Silent Periods" on Ch.16 VHF. When distress traffic is in progress channel 16 may not be used by any station not involved in, or helping to deal with the distress.
**Note** - The two channels on each side of Ch.16 (75 and 76) are called "Guard Bands" and are not available for use - this is to prevent possible interference with Ch.16.

2 - Intership Channels. The primary intership channel is **Ch.6**. It is mandatory that Ch.6 is fitted to a Marine VHF set, as well as Ch.16. Other exclusive intership channels are **8,72,77.** Other channels are also used for intership but may have another function as well - e.g. Channels 9,10,13,15,17,73 may be used for port operations, and in Britain and Ireland **Ch.67** is used by the Coast Radio Stations or Coast Guard for "small boat safety". Channels 10,67,73 may also be used between ships, aircraft and shore stations for search and rescue coordination and for anti-pollution control.

3 - Port Operations and Ship Movement Channels. Used by port and harbour radio stations to control ship movements, pilot cutters, tugs, etc. Channels **12** and **14** are the commonest. As well as the channels given under the "Intership" category, others used are 11,62,68,71,74. These channels are Simplex, but some Duplex channels are used, mainly in very large or busy ports.

4 - Public Correspondence. - Used by Coast Radio Stations for telephone calls, radio telegrams, navigational warnings, weather forecasts, etc. The commonest are **01** to **05**, **23** to **28**, **60** to **65**, **84** to **88** inclusive. These are all "Duplex"channels.

5 - Digital Selective Calling - Channel 70. This was formerly an intership channel, but is now reserved entirely for digital selective calling and must **not** be used for voice communication.

A full list of all the Marine VHF Channels and their uses is given at the end of this section.

**Private Channels.** These are channels outside the Marine Band which may be allocated by special licence for communication with private radio stations. The most well-known of these is Channel 37 - the Marina Channel or Channel M (157.85 mHz). This is a special channel allocated for communication between yachts and marinas or clubs. It may also be used between Committee boat and rescue boats in a regatta, etc. This channel should not be used as an intership channel, and does not apply to marinas outside Ireland or UK. Because it is outside the Marine Band, Ch M is not covered by the normal Ship's Radio Licence, and an application should be made to the Department of Communications to include it on the licence.

In the UK the Coastguard have Channel 00 as a private channel, and it is also fitted to Lifeboats. It is used for internal Coastguard communication and sometimes for exercises, but it is never used for distress, urgency or safety work.

**Licences.** A licence issued by the Department of Communications is required for a ship's radio. Such a licence will only be granted for radio apparatus which is "type approved". Note that radio sets manufactured for the American market are probably not type approved because of the differing requirements of American and European authorities. A special licence is required for a shore station - e.g. marina or yacht club. This licence usually specifies that Channel M only may be fitted and used.

As well as the ship's licence, the operator must posess a **"Restricted Certificate of Competence in Radiotelephony"** - this may be endorsed "VHF only". A person not posessing such a certificate may operate the radio under the direct supervision of a certificate holder.

**Call Signs** - Call signs are issued by the Department of Communications, and until recently have been restricted to Registered vessels. The usual type of call sign has been the "signal letters" type - e.g. EI AA. However from January 1st 1987 a new series of call signs has been introduced for fishing vessels and vessels under 300 gross registered tons holding current Ships Radio Licences. These new call signs will consist of EI followed by four digits, starting at EI 2000. Larger vessels will still be allocated the more usual signal letters type of call sign.

**Transmission Rules**

The following are strictly forbidden -

1. Transmissions not authorised by the Master or other person in charge.
2. Operation by unauthorised person - unlicenced person may use under supervision.
3. Transmission of false or deceptive distress, safety or identification signal.
4. Transmissions made without proper identification (ship's name or call-sign).
5. Use of first names or other unauthorised identification.
6. Closing down before finishing all operations following distress, urgency or safety call
7. "Broadcasting" messages or programmes, except safety messages, to "All Ships".
8. Unnecessary transmission or superfluous signals.
9. Transmission of profane, indecent or obscene language.
10. Use of frequencies or channels other than those covered by the Ship's Licence.
11. Broadcast transmission of music.

**Procedure Words (Prowords)**

These are words for use in communications procedure which have been given very restricted meanings when used in the correct context in order to avoid any confusion or ambiguity.

Affirmative - yes.

All after / All before - used in association with "Say again" to request repetition of part of the message.

Break - used to indicate the separation of the text from other parts of the message.

Correct - you are correct, or what you have transmitted is correct.

Correction - an error has been made in this transmission. Cancel the last word or group. The correct word or group follows.

Go ahead - proceed with your message.

I read back - said by the receiving station before repeating the message back to the sending station for confirmation.

I say again - I am repeating the transmission or part of the message indicated.

I spell - I shall spell the next word or group of letters phonetically.

Negative - no.

Nothing heard - I have not received any reply to my transmission.

Out - Indicates the end of working with this station. It should never be used when a reply is expected.

Over - the invitation to reply. The phrase "Over and out" should never be used.

Radio Check - please tell me the signal strength and readability of my transmission.

| *Signal Strength* | *Readability* |
|---|---|
| Loud | Clear |
| Good | Readable |
| Weak | Unreadable |
| Very weak | Distorted |
| Fading | With interference |

E.g. "Loud and clear".
"Loud but distorted".
"Weak but readable".
"Good but with interference".

Read back - request to the receiving station to repeat the message or part of it. If the receiving station is unsure about part of a message it may repeat back, prefixing with "I read back".

Received - acknowledges receipt of message.

Repeat - this is used to stress a part of a message. It is not the same as "Say again" or "Read back". E.g. - "I have picked up three - repeat three - survivors".

Roger - I have received your last transmission satisfactorily.

Say again - repeat your message or part referred to.

Speak slower - Your transmission is at too fast a speed. Speak more slowly.

Station calling - used by a station receiving a call but unsure of the identification of the calling station.

This is - used to indicate the identity of the calling station.

Understood - Message is understood.

**Using a VHF set**

1. Switch on.
2. Adjust the "Squelch" control until the back-ground hissing noise just disappears.
3. Check power output button. Maximum permitted power is 25 watts. Use low power (1 watt) when close to the station that you are calling. This saves electrical current - the average consumption for transmitting on 25 watts is 5 amps whereas consumption at 1 watt is 0.7 amps. Current consumption when receiving is only 0.2 amps.
4. Check the channel selector switch and choose the required channel.
5. If there is a "Dual Watch" button make sure that it is switched off when you wish to transmit. Dual Watch means that the set can keep watch both on Ch.16 and one other channel of choice. If a signal is received on Ch.16, it "locks on" while the signal lasts. Dual Watch may prevent transmission, or only allow transmission on channel 16.
6. Some sets have a Channel 16 button which must not be confused with Dual Watch. It allows direct switching to Channel 16 no matter what channel is indicated by the channel selector switch. If your set has a "Channel 16 Switch" make sure that it is released if you want to listen to or transmit on another channel.

**Calling Procedure**

1. Select the required channel - usually Channel 16 for calling.
2. Before transmitting, listen on chosen channel - do not transmit if in use.
3. Press the transmit switch on the microphone before you speak.
4. Say the name of the vessel or station that you are calling twice (max. three times).
5. Identify yourself - **"This is....**(vessel's name twice, max. three times). Note that it is illegal not to identify yourself.
6. At the end of each transmission say **"Over"**. This indicates that you expect the other station to reply. **Note** - It is unnecessary to add such sentences as "Do you receive me?", "How do you read?", etc.
7. Release the transmission button - this is most important and is sometimes forgotten by a person using a radio for the first time.

> **Note** - If you do not release the transmission button or switch, the radio is still transmitting and you cannot receive any reply.This will also happen if for some reason the transmission switch is depressed accidentally - e.g. if the microphone is left down and something falls on it, keeping it switched on. Not only will your radio not be able to receive, but because of the "capture" effect all communication on that channel for some miles around will be blocked as long as the switch is on.

The station which has been called then replies in the same format, nominates a working channel and says **"Over"**. The first station should confirm the working channel, or if unsuitable or unavailable suggest another. Both stations then change to the working channel and the call-up procedure is repeated to establish contact on the new channel. The station which has nominated the working channel should not change over until the first station has confirmed the channel back to him or has suggested another.Thereafter it is not necessary to keep on repeating names before each transmission. When communication is finished, and you do not expect any further reply, use the word **"Out"**. Unless there is any special reason to continue listening to the working channel, move back to Channel 16, or switch on the dual watch.

**Remember** - **"Over"** means that you expect or are inviting a reply.
**"Out"** means you are finished and do **not** expect a reply.
It is therefore incorrect to say **"Over and out"**.

## Voice technique

1. Speak directly into the microphone, held a few inches in front of your mouth.
2. Pitch your voice slightly higher than normal.
3. Don't drop your voice at the end of a word or phrase.
4. Speak clearly, and don't slur words.
5. Speak slightly more slowly than normal.
6. Use the **standard phonetic alphabet** for call-signs, alphabetical abbreviations and for spelling out words.

## Control of Communications

1. Ship to shore - controlled by the Coast Radio Station, except possibly in case of distress, urgency or safety where the calling vessel may be in control unless this has been passed to the Coast Station.
2. Ship to ship - controlled by the vessel which receives the first call.

The controlling station nominates the working channel.

## Phonetic Alphabet

| | | | | | |
|---|---|---|---|---|---|
| Alpha | Foxtrot | Kilo | Papa | Uniform | |
| Bravo | Golf | Lima | Quebec | Victor | |
| Charlie | Hotel | Mike | Romeo | Whiskey | |
| Delta | India | November | Sierra | X-Ray | |
| Echo | Juliett | Oscar | Tango | Yankee | Zulu |

## Numerals

| | | | |
|---|---|---|---|
| 1 | Wun | 6 | Six |
| 2 | Too | 7 | Sev-en |
| 3 | Tree | 8 | Ait |
| 4 | Fow-er | 9 | Nin-er |
| 5 | Fife | 0 | Zero |

**Special Transmissions**
1. Distress - "MAYDAY" - Imminent danger; immediate assistance requested.
2. Urgency - "PAN-PAN" - Urgent message about safety of ship or person.
3. Safety - "SÉCURITÉ"-Important navigational or meteorological warning.
Special transmissions take precedence over ordinary calls

1 Distress - Ch.16 Imminent danger; immediate assistance requested.

| | |
|---|---|
| Distress Call - | "MAYDAY, MAYDAY, MAYDAY<br>This is yacht Bluebird, Bluebird, Bluebird |
| Distress Message - | MAYDAY (once)<br>Yacht Bluebird (once). Call Sign................................ |
| *Position -* | My position is one one zero degrees Great Scellig 5 miles |
| *Nature of distress -* | I have struck a large floating object and am sinking. |
| *Number of persons -* | There are five persons on board. |
| Assistance required - | Require immediate assistance. Over". |

All radio traffic relating to a Mayday incident is prefaced with the word **"Mayday"** (from French "M'aidez" - "Help me"). A vessel or station receiving a Mayday call and in a position to help will acknowledge receipt and indicate what help can be provided.

| | |
|---|---|
| Mayday Acknowledged - | "MAYDAY!<br>Yacht Bluebird, Bluebird, Bluebird<br>This is fishing vessel Hunter, Hunter, Hunter.<br>Received Mayday". |
| Information - | "MAYDAY! Bluebird this is Hunter.<br>My position is just off Bolus Head.<br>My ETA at your position is in twenty minutes.<br>Stand by on this channel. Over". |
| Reply from casualty - | "MAYDAY!<br>Hunter this is Bluebird.<br>Understood. Standing by". |

Distress signals may be relayed by another station not itself in distress by using the **"Mayday Relay"** procedure. This can happen if the casualty for some reason cannot send a distress message, or when further help seems necessary, or when a vessel which is not itself in a position to help hears a **"Mayday"** call which is unanswered by anyone else. If a Coast Radio Station hears a distress call or a relay call it will usually rebroadcast it so that it will be heard over a wider area. The Coast Station (or the Coastguard in the UK) will continue to monitor the situation and will be able to seek further assistance if required - e.g. calling a Lifeboat, Helicopter, etc.

In the above example "Hunter" could relay the "Mayday" using the **"Mayday Relay"** procedure. "Hunter's" signal may be stronger than "Bluebird's" and may be picked up by other stations or ships. If "Hunter" is proceding towards the distressed vessel, this information should be added after the "Mayday Relay".

Distress Relay Call - "MAYDAY RELAY, MAYDAY RELAY, MAYDAY RELAY
This is Hunter, Hunter, Hunter
Received "Mayday" from yacht Bluebird at one zero three zero
Begins -

Distress Message - MAYDAY (once)
Yacht Bluebird (once)
Position one one zero degrees Great Scellig five miles.
Has struck large floating object and is sinking.
Five persons on board.
Requires immediate assistance. Ends.

Information - My position is just off Bolus Head.
My ETA at distress position is one zero five zero.
Over".

This relay may be heard by a Coast Station, which will then acknowledge receipt.

"MAYDAY
Hunter, Hunter, Hunter
This is Valentia Radio, Valentia Radio.
Received Mayday Relay. Out".

The Coast station may rebroadcast if thought fit and may then inform the Lifeboat or other services as required. The Marine Rescue Coordination Centre in Shannon Airport will also be informed

**Controlling Station**
The controlling station in a Distress situation is usually the vessel in distress or the station relaying the distress message (Mayday Relay), or a Coast Radio or Coastguard Station. In UK waters this function is usually automatically assumed by the Coastguard. It is better to delegate control to a land station if one is within range of the distress, as they have better equipment and aerials and also have direct access to emergency and rescue services.

**Radio Silence - "Seelonce Mayday"**
While a distress incident is in progress, stations which are not involved must avoid transmitting on Channel 16. If another vessel starts using Ch.16 and interfering in the distress communication, the controlling Station may impose radio silence -

"MAYDAY (once)
SEELONCE MAYDAY
This is Valentia Radio
Out".

The words **"Seelonce Mayday"** are reserved for use by the controlling station. However, communication may be interfered with by a vessel that is out of range of the controlling station and has not heard the Mayday. In this case another vessel or station may impose radio silence, but using the words **"Seelonce Distress"**.

**Relaxing Radio Silence - "Pru-donce"**
Sometimes during a distress incident it becomes no longer necessary to maintain complete radio silence. The controlling station uses the code word "Pru-donce" to indicate that essential calls may be made.

"MAYDAY!
All stations, all stations.
This is Valentia Radio, Valentia Radio.
Mayday yacht Bluebird.
Pru-donce. Out".

**Cancelling Radio Silence - "Seelonce Feenee"**
When distress traffic has ceased, the controlling station must let all stations know that normal radio working may be resumed - The words "Seelonce Feenee" are used.

"MAYDAY!
All stations, all stations.
This is Valentia Radio, Valentia Radio.
Mayday yacht Bluebird.
Seelonce Feenee. Out".

**SUMMARY**

<u>Mayday</u> - **MAYDAY MAYDAY MAYDAY (three times)**
**This is..................(name of vessel three times)**
**MAYDAY (once)**
**........(name of vessel once)**
**Distress message -** **Position**
**Nature of distress**
**Number on board**
**Assistance required**

<u>Mayday Relay</u> - **MAYDAY RELAY MAYDAY RELAY MAYDAY RELAY**
**This is.........(name of relaying vessel three times)**
**MAYDAY (once)**
**........(name of vessel in distress once)**
**Distress message.**

If relaying vessel is proceding to render assistance it should then add -
**My position is..................**
**My ETA at distress position is..........**
**Over.**

| | |
|---|---|
| **Mayday** | Distress. |
| **Pan-Pan** | Urgency. |
| **Sécurité** | Important warnings. |
| **Seelonce Mayday** | Imposition of radio silence by controlling station. |
| **Seelonce distress** | Imposition of radio silence by another station. |
| **Pru-donce** | Relaxation of radio silence for restricted working. |
| **Seelonce Feenee** | Cancelling radio silence. |

**Note**
All the code words used in these situations are phonetic spellings of words from the French language. They are all recognised internationally and are used no matter what other language is being used.

2 Urgency    Ch 16    Urgent message about safety of ship or person e.g. vessel drifting, man overboard, etc.

PAN-PAN, PAN-PAN, PAN-PAN
All stations, all stations, all stations
This is Seaspray, Seaspray, Seaspray
My position is one zero zero degrees Wicklow Head six miles.
I have engine failure and am drifting northwards.
Require tow urgently. Over".

The vessel is not in immediate danger and therefore the use of a "Mayday" signal would not be justified here. When contact has been established with another station or vessel, and help is on the way, the communication can be transfered to a working channel if desired. When the urgency is over - e.g. satisfactory contact with a rescue vessel or vessel under tow or man overboard picked up, the urgency should be cancelled.

"All stations, all stations, all stations
This is Seaspray, Seaspray, Seaspray
Cancel Pan-Pan. Now under tow. Out".

A special form of Pan-Pan is used when medical advice is required. A call is made to a Coast Radio Station, prefaced by the code words **"PAN PAN MEDICO"**. A request is then made for medical advice and the Coast Station will change to a working channel and will connect the calling vessel to a doctor.

3 Safety    Ch 16 -> Working Channel
Important navigational or meteorological warnings
SÉCURITÉ - pronounced "Say-cure-i-tay".

"SÉCURITÉ, SÉCURITÉ, SÉCURITÉ
All stations, All stations, All stations
This is Anglesey Radio, Anglesey Radio, Anglesey Radio
For navigational warning listen one seven one five kiloherz
and Channel 26 VHF".

A Safety message may be broadcast by any station if necessary - e.g. -

On Channel 16 -    "SÉCURITÉ, SÉCURITÉ, SÉCURITÉ
All stations, All stations, All stations
This is yacht Stormbird, Stormbird, Stormbird
For navigational warning listen channel six."

On Channel 06 -    "SÉCURITÉ, SÉCURITÉ, SÉCURITÉ
All stations, All stations, All stations
This is yacht Stormbird, Stormbird, Stormbird.
Report large unlit floating container, danger to navigation,
Position six miles due south of Old Head of Kinsale.
I say again - large unlit floating container, danger to navigation
Six miles south of Old Head of Kinsale.
Stormbird out".

## Examples of ordinary calls

Two yachts communicating - call on Ch.16.

"Seagull, Seagull. This is Wanderer, Wanderer. Over".
"Wanderer, this is Seagull. Channel eight. Over".
"Roger, Channel eight. Over".

Both vessels change to Ch.8.

"Wanderer this is Seagull. Over".
"Seagull this is Wanderer. I am 3 miles south of Ballycotton Light now. What is your position? Over".
"I am just off Roches Point. What is you ETA in Crosshaven? Over".
"My ETA will be about 1545 hours. Over".
"Roger, 1545 hours. I'll tell them you will be late. Over".
"Many thanks, Seagull. Wanderer Out".
"Seagull Out".

Both vessels switch back to Ch.16.

Request for Radio Check - Often this is a very short exchange and the controlling station may not change to a working channel - call on Ch.16.

"Dublin Radio, Dublin Radio. This is yacht Sunray, Sunray. Radio check please. Over".
"Sunray this is Dublin Radio. Loud and clear! Over"
"Thanks Dublin Radio. Out".

If the controlling station wishes to make any comments or enquire about the vessel's position in order to assess its own reception, it may request a change of channel -

"Dublin Radio, Dublin Radio. This is yacht Sunray, Sunray. Radio check please. Over".
"Sunray, Sunray. This is Dublin Radio. Channel eighty three. Over".
"Roger. Eighty three. Over".

Both stations change to Ch.83.

"Sunray this is Dublin Radio. Go ahead. Over".
"Dublin Radio, this is Sunray. Radio check please. Over".
"Your signal is weak but readable. What is your position please? Over".
"This is Sunray. My position is about two miles east of Bray Head. Over".
"Sunray, understood. Call again when you get into Dublin Bay. Over".
"Thank you, Dublin. Sunray Out".

Both stations switch back to Ch.16.

Calling a Port Radio - call on Ch.16.

"Cork Harbour Radio, Cork Harbour Radio. This is M.V.Tympany, M.V.Tympany. Over".
"Tympany, Tympany, this is Cork Harbour Radio. Channel fourteen".
"Cork Harbour - Tympany. Fourteen. Over".

Both stations change to Ch.14 - message is then passed.

**Note** - Some Port Radios and Pilot Stations prefer to be called directly on their main working channel rather than on Ch.16 - check in a nautical almanac.

Unidentified Caller - If a vessel receives a call but cannot identify the caller, reply -

"Station calling Firefly, Station calling Firefly, This is Firefly. Say again please. Over".

Coast Radio Stations - These are official radio stations which are communications centres for maritime radio traffic. They broadcast navigational warnings and weather forecasts, etc., and provide telephone and telegram services for shipping. The times of regular weather broadcasts and of "Traffic Lists" (lists of vessels for which the station has messages), and also details of MF frequencies and VHF channels may be found in the Admiralty List of Radio Signals or in the various nautical almanacs. Irish Coast Radio Stations are controlled either from Malin Head or Valentia. These two stations are the original Medium Frequency stations but recently have also installed VHF, and have remote control by land line over the other Coastal Stations. Valentia Radio (Ch.24) remotely controls Shannon Radio (Ch.28), Bantry Radio (Ch.23), Cork Radio (Ch.26), Dungarvan Radio (Ch.83) and Rosslare Radio (Ch.23). Clifden Radio is planned for 1989. Malin Head Radio (Ch.23) controls Dublin Radio (Ch.83), Glenhead Radio (Ch.24) and Belmullet Radio (Ch.83). All these stations can also use Channel 67 for Small Boat Safety traffic if required.

Call an Irish Coast Radio Station either on Ch.16 or on the working channel. Note that many British and Continental stations require you to call on a working channel only, and not on Ch.16 - consult a nautical almanac for details. Many Coastal Stations have more than one Working Channel. Let the operator know when you call him if you have all his working channels. When making a telephone call or sending a telegram through a Coast Radio Station a vessel must identify itself by using its Call Sign so that the bill for the service can be sent to the correct person or company.

Making a "Link Call" (eg a telephone call) - call on Ch.16 .

"Valentia Radio, Valentia Radio. This is yacht Tornado, Tornado. Call sign Echo India Six Five Two Zero. Link call please. I have all channels. Over".

"Tornado, Tornado. This is Valentia Radio. Channel twenty four, and stand-by. Over".

"Channel twenty four - standing by. Over".

Both stations change to Ch.24. Tornado waits to be called.

"Tornado, Tornado, this is Valentia Radio. Go ahead! Over".

"Valentia, this is Tornado. Call sign - Echo India Six Five Two Zero. Link call please to Athlone 123456. Over".

"Stand by, Tornado!"

Coast Radio Station then makes the telephone connection.

"Tornado, this is Valentia Radio. You are connected. Go ahead".

Afterwards the Coast Station will confirm the length of the call to the calling vessel.

Traffic Routing (TR) - If there is a possibility that a vessel may expect a call while on a journey, it is usual to inform the nearest Coast Radio Station of present position and ETA at destination. This is called a **"TR"**. Although originally intended as information to the Coast Station to help in the routing of "traffic" or radio messages to vessels, the term **"TR"** is now also loosely used to mean giving voyage information to the UK Coastguard under the Small Boat Safety Scheme. If a vessel gives a TR to a Coast Station or the Coastguard, it is essential that the TR is "closed" when the destination has been reached. This can be done by calling a local station and asking that the closure message be passed on to the original station, or if there is no station within range, by going ashore and telephoning. If it is known in advance that closing the TR will not be possible, this should be stated when the TR is first filed.

Traffic Lists - If a Coast Radio Station has a call for a vessel, it will call that vessel immediately. If the vessel replies, it will be directed to a working channel and connected to the telephone system. If the vessel does not reply, the name will be added in to the next "Traffic List" - times of these will be found in the nautical almanacs.

On Channel 16 - "All ships, All ships, All ships,
This is Malin Head Radio, Dublin Radio, Glenhead Radio.
For Traffic List listen Channel 23 for Malin Head, Channel 83 for Dublin and Channel 24 for Glenhead".

On Channel 26 - "All ships, All ships, All ships,
This is Malin Head Radio, Dublin Radio, Glenhead Radio.
I have traffic on hand for -
motor vessel White Swan, Mike Zulu Kilo Delta,
yacht Bluebell and yacht Vixen, Echo India Alpha Bravo.
This is Malin Head Radio, Dublin Radio, Glenhead Radio.

Replying to a Traffic List - e.g. Dublin Radio - call on Ch.16.
" Dublin Radio, Dublin Radio, this is yacht Bluebell, Bluebell.
You have traffic for me. Over".
"Bluebell, this is Dublin Radio. Yes, I have a link call for you.
Stand by on channel 83. Over".
"Channel 83 and stand by".
- on Channel 83 - Bluebell waits to be called -
"Bluebell this is Dublin Radio. Link call for you - go ahead".

Weather Forecasts - These are broadcast regularly by Coast Stations. The Irish VHF stations broadcast weather forecasts every three hours, on the hour, from 0100 hours, local time. These are announced on Ch.16 and then given on the working channel.

Use of Channel M - This channel is outside the International channels and in Ireland and the UK is allocated to Marinas and Yacht Clubs. Do not try to use this channel in continental waters as it has been allocated for different purposes in other countries. Calls should be made directly on Channel M and not on Channel 16. Shore stations licenced to use Channel M usually keep watch on that channel alone.

"Howth Marina, Howth Marina. This is Firefly, Firefly. Over".

"Firefly, Firefly, this is Howth Marina. Go ahead. Over".

"Howth Marina, this is Firefly.
I am on passage from Carlingford.
My ETA in Howth is twenty-one hundred hours.
Is there a berth available for the night? Over".

"Firefly, this is Howth Marina.
Berth will be available.
Go to visitor's berth at the end of the first pontoon. Over".

"Thank you Howth Marina. Firefly out".

## VHF Channels

A summary is given here of the allocation of the various International VHF Channels.

| Channel | Simplex Duplex | Intership | Port Operations /Ship Movement | Public Correspondence |
|---|---|---|---|---|
| 60 | D | | * | * |
| 01 | D | | * | * |
| 61 | D | | * | * |
| 02 | D | | * | * |
| 62 | D | | * | * |
| 03 | D | | * | * |
| 63 | D | | * | * |
| 04 | D | | * | * |
| 64 | D | | * | * |
| 05 | D | | * | * |
| 65 | D | | * | * |
| 06 | S | * | | |
| 66 | D | | * | * |
| 07 | D | | * | * |
| 67 | S | * | * | |
| 08 | S | * | | |
| 68 | S | | * | |
| 09 | S | * | * | |
| 69 | S | * | * | |
| 10 | S | * | * | |
| 70 | S | Digital Selective Calling | | |
| 11 | S | | * | |
| 71 | S | | * | |
| 12 | S | | * | |
| 72 | S | * | | |
| 13 | S | * | * | |
| 73 | S | * | * | |
| 14 | S | | * | |
| 74 | S | | * | |
| 15 | S | * | * | |
| 75 | | Guard Band | | |
| 16 | S | **Distress, Safety and Calling - 156.8 mHz** | | |
| 76 | | Guard Band | | |
| 17 | S | * | * | |
| 77 | S | * | | |
| 18 | D | | * | |
| 78 | D | | * | * |
| 19 | D | | * | |
| 79 | D | | * | |
| 20 | D | | * | |
| 80 | D | | * | |
| 21 | D | | * | |
| 81 | D | | * | * |

| Channel | Simplex Duplex | Intership | Port Operations /Ship Movement | Public Correspondence |
|---|---|---|---|---|
| 22 | D | | * | |
| 82 | D | | * | * |
| 23 | D | | | * |
| 83 | D | | | * |
| 24 | D | | | * |
| 84 | D | | * | * |
| 25 | D | | | * |
| 85 | D | | | * |
| 26 | D | | | * |
| 86 | D | | | * |
| 27 | D | | | * |
| 87 | D | | | * |
| 28 | D | | | * |
| 88 | D | | | * |

American Channels - In the USA, Channels 07,18,19,21,22,23,65,66,78,80,83 and 88 operate as Simplex channels, and not Duplex as in the "International" channels. Channels 21,22,23 and 83 are allocated to the US Coast Guard.

## GMDSS - GLOBAL MARITIME DISTRESS AND SAFETY SYSTEM

A new system for dealing with Distress and safety radio traffic came into effect on 1 February 1999. Its use will be obligatory for ships and vessels carrying passengers but will be voluntary for leisure craft and yachts. Ships must carry a satellite EPIRB (Emergency Position Indicating Radio Beacon) on 406 MHz with a "homing" frequency of 121.5 MHz. Each ship must also have radio communication equipment appropriate to the sea areas of the world where it will operate. The world is covered by **4 SEA AREAS.** Sea Area A1 is defined as "within range of a VHF coast station with DSC facilities". Sea Area A2 is within range of at least one MF coast station with DSC facilities. Sea Area 3 is within the coverage of an Inmarsat geostationary satellite. Sea Area A4 covers the polar regions, north or south of 70°.

DSC - **"Digital Selective Calling"** - is a much more efficient way of sending information than R/T (voice signal). VHF Ch.70 is allocated to Digital Selective Calling and its use for R/T is forbidden. DSC requires that each vessel has its own unique nine digit code number - Maritime Mobile Service Identity - MMSI. Transmissions can be made to specific vessels (provided the MMSI is known) or can be sent to "all stations" without using Ch.16. Follow-up voice communication can be made on any appropriate designated channel.

Other pieces of equipment used for the GMDSS are a Search and Rescue Transponder (SART) for locating survivors in a life-raft and NAVTEX to receive navigational, meteorological and SAR messages.

Although leisure craft are not required to follow the new GMDSS regulations, it is likely that many will eventually fit DSC radios for safety reasons

The new DSC radios have a special "push button" system to initiate a DSC Distress Alert which automatically identifies the vessel in distress and, if connected to a GPS, gives the position. At a receiving station an alarm sounds - a DSC Distress Acknowledgement is sent which shows on a small screen on the distressed vessel's radio. This automatically stops repetition of the DSC Distress Alert and switches the radio to Ch.16 for voice communication - the traditional "Mayday" broadcast is then made. If failure in communication then occurs the receiving coast station already has information on the identity and position of the vessel in distress. If no DSC Distress Acknowledgement is received by the vessel in distress, the DSC Distress Alert is repeated automatically every 4 minutes.

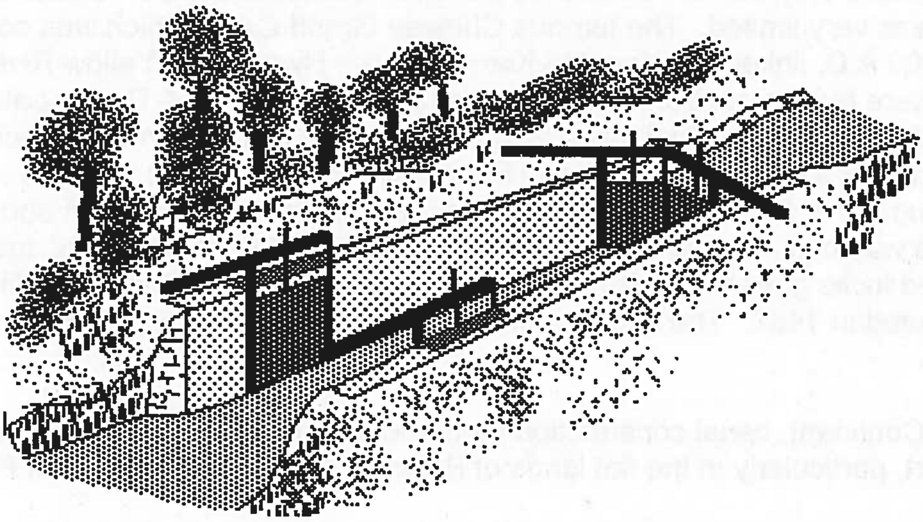
Once the DSC Distress Acknowledgement has been sent the coast station switches to CH.16

Other vessels receiving a DSC Distress Alert are asked not to acknowledge by DSC as this will stop repetition of the Alert. The advice is to wait and if a second Alert is received, try contacting the other vessel by CH.16 and then send a DSC Distress Relay on Ch.70 and/or broadcast R/T "Mayday Relay" on Ch.16.

# SEA TRAINING MANUAL

## SECTION G

# IRISH INLAND WATERWAYS



SEA TRAINING TEAM

SCOUTING IRELAND S.A.I.

# INLAND WATERWAY NAVIGATION

## HISTORICAL BEGINNINGS OF INLAND NAVIGATION

To primitive man water was a barrier, but when he discovered how to build boats water became an easier way of travelling than overland. Towns which are the centres of a country's life and trade grew up on the banks of rivers and lakes. Water transport was so much easier than land that people tried to improve shallow river channels by dredging,, and later to make canals or cuts between rivers and around unnavigable stretches.

Great rivers of the world have been used for transport for thousands of years and great civilisations grew up on their banks - the Nile in Egypt, the Ganges in India, the Yangste Kiang in China.

The earliest canals were probably dug for land irrigation and flood control and may also have been used secondarily for transport. The Egyptians dug a canal from the Nile to the Red Sea in about 1300 B.C., and in 6th Century B.C. Nebuchadneser, King of Babylon, is said to have had a canal dug from Babylon to the Euphrates River - about 370 miles long.

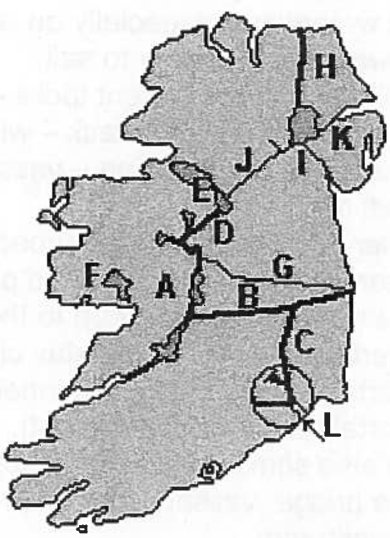
Canals could only be constructed on the level until locks were invented, so their scope was very limited. The famous Chinese Grand Canal which was completed about 600 A.D. linked the Yangtse Kiang with the Hwang Ho (Yellow River). Gates were built to control the water level, and in about 984 A.D. two gates were built which were only 250 ft. apart - this became the first known canal lock. This knowledge of a lock did not come to Europe for another couple of hundred years. It is thought that the first canal lock in Europe appeared in Holland in about 1253 and one was built near Milan in 1439. The credit for the first series of specially designed locks goes to the famous Leonardo da Vinci for six locks on Milan canal constructed in 1487. The first lock in Great Britain was built on the Exeter Canal in 1563.

On the Continent, canal construction then became an important aspect of inland transport, particularly in the flat lands of Belgium, Holland and Northern France.

Ireland has many rivers and lakes which are ideal for Sea Scouting. Some of these waters are formally recognised as Inland Waterways and these are the ones that we will deal with in this section. Many of them are linked together to make an extensive system to explore and to use for adventure journeys and waterside camps.

## IRISH INLAND WATERWAYS

——— Active Waterways
——— Waterways disused or in partial use at present




**A - Shannon Navigation**
**B - Grand Canal**
**C - Barrow Navigation**
**D - Shannon-Erne Waterway**
**E - Erne Navigation**
**F - Corrib Navigation**
**G - Royal Canal**
**H - Lower Bann Navigation**
**I - Upper Bann Navigation and Newry Canal**
**J - Ulster Canal**
**K - Lagan Canal and Navigation**
**L - Barrow, Nore and Suir tidal sections**

The basic rules of boat handling and water safety apply equally to inland waterways as to the sea. Of course you do not have tides to consider, but you must not forget that rivers will rise and flow more rapidly after heavy rains. When planning a river expedition by canoe or rowing boat you will probably choose to go downstream.

Most rivers are not suitable for sailing. It is difficult to manage a sailing craft if the current is fast and especially if the banks are high or have high or overhanging trees. Sailing can very pleasant on a slow moving river with flat surrounding countryside, but if you are used to sailing on wide, open water, you will find sailing on a winding river quite different.

On a still-water canal there is no problem going either way. Most craft on a canal will be under power, but it is possible to get permission to use rowing craft or canoes. In general, sailing is not allowed on canals.

All maintained Inland Waterways are under the control of some authority and have bye-laws. When planning an activity on a waterway, Scouts must find out what are the local bye-laws and what are the charges for permits and/or for lock usage.

**Boat Handling on Inland Waterways**

Many of the "steering and sailing" rules which are used at sea are also used on the inland waterways, especially on lakes.

- Power craft give way to sail.
- Sailing craft on different tacks – port tack must give way.
- Sailing craft on same tack – windward boat must give way.
- Power vessels crossing – vessel with the other on his starboard (right) must give way.
- When two vessels are approaching each other, bow to bow, both should steer to starboard (right) and pass each other on the port (left) side.
- In a narrow channel keep to the right.
- Overtaking vessel must stay clear of vessel being overtaken. When overtaking in a narrow channel, canal or river, leave the vessel being overtaken to starboard (right).

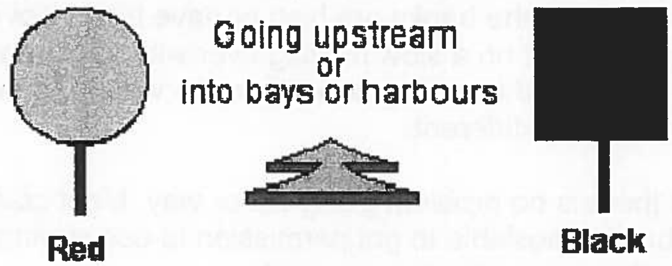
There are also some special rules applying to inland waterways -

- At a bridge, vessel going upstream must give way to a vessel coming downstream.
- Approach a lock slowly and give way to vessels exiting.

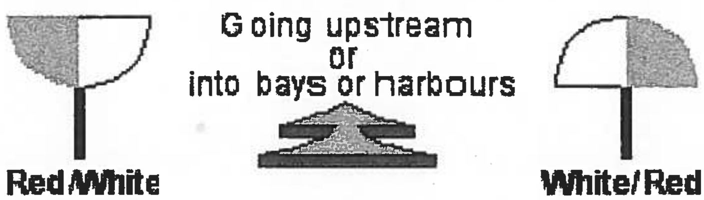
**Navigation Marks**

<u>Shannon Navigation</u> - In the river sections and in the lakes, the marking system used is Red to the left (port) and Black to the right (starboard), when going upstream or into bays or harbours.

Perches (markers on a post or pole) are red, round shaped to the left, or black square shaped to the right. Marker buoys may be can-shaped or conical - the shape is not important , but pay attention to the colour.




<u>Lough Erne Navigation</u>
Perches are semicircular in shape, flat top to port and round top to starboard when going upstream. Also, the marks are coloured red/white vertically, the red on the side of danger, white on the safe side.



## THE SHANNON NAVIGATION

The River Shannon is navigable for 140 miles, from Limerick to Lough Allen in Co. Leitrim.

Some tributaries are also navigable –

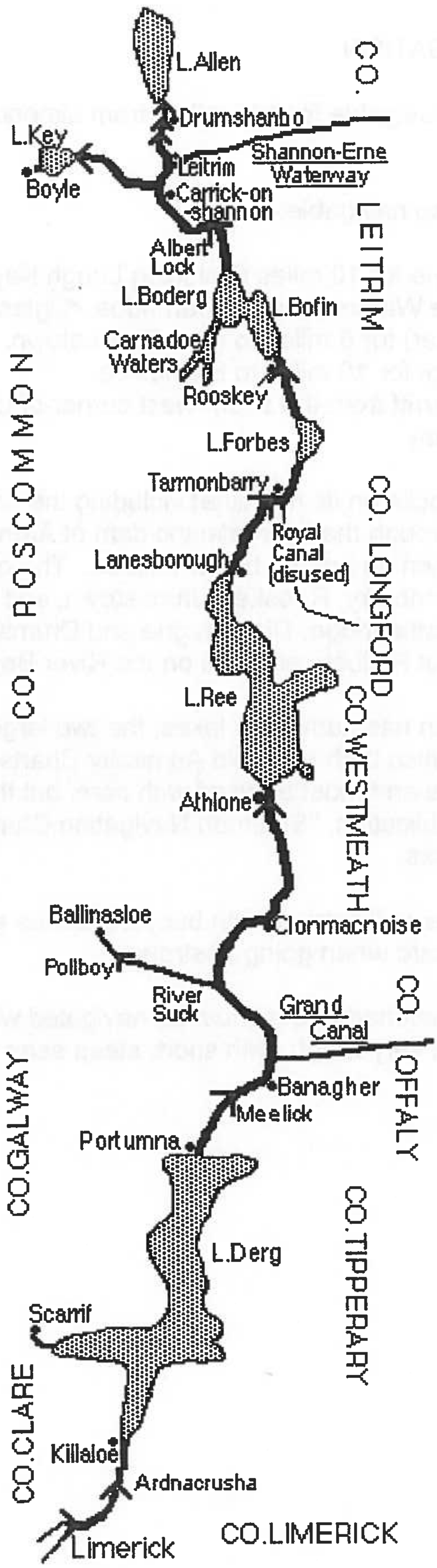
1. the River Boyle for 10 miles (including Lough Key) to near Boyle.
2. the Carnadoe Waters (Loughs Carnadoe, Kilglass and Grange and the Mountain River) for 6 miles to near Strokestown.
3. the River Suck for 10 miles to Balinasloe.
4. the River Scarriff from the south-west corner of Lough Derg for 2 miles to Scarriff Quay.

The Shannon has ten locks on its mainline, including the tidal lock at Limerick and the 100 foot rise through the hydroelectric dam at Ardnacrusha, but most people using the Shannon do not go below Killaloe. The other locks are at Meelick, Athlone, Tarmonbarry, Rooskey, Jamestown, and three locks on the Lough Allen Canal at Battlebridge, Drumleague and Drumshambo. There is one lock on the River Suck at Pollboy, and one on the River Boyle at Knockvicar.

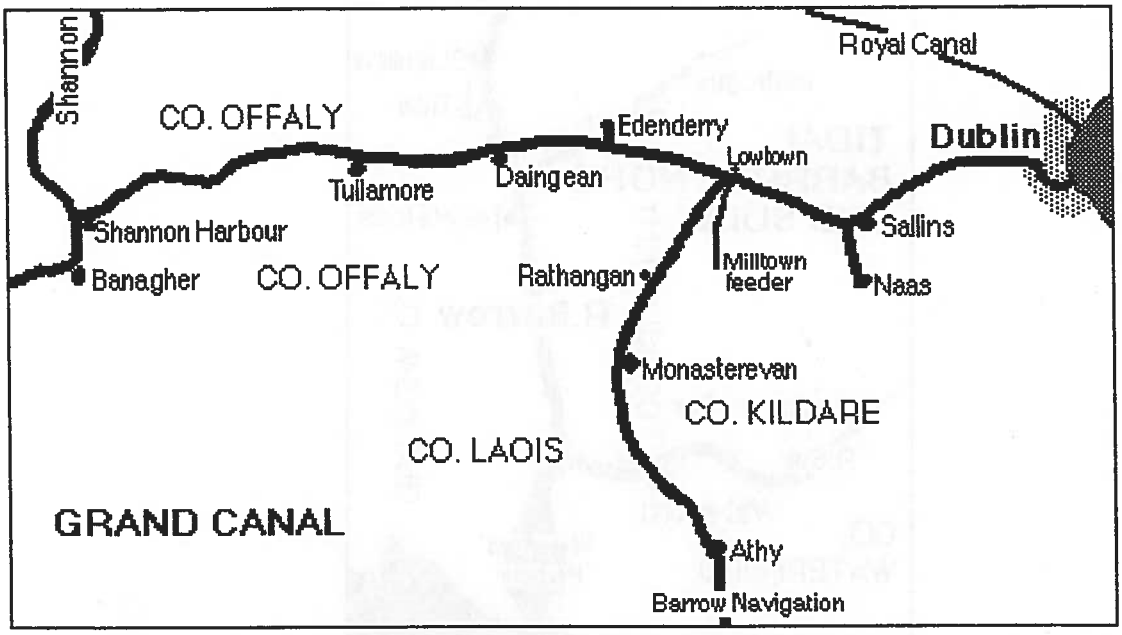
The Shannon Navigation has numerous lakes, the two largest ones being Lough Ree and Lough Derg which both have old Admiralty Charts. These charts have not been kept up to date and must be used with care, but they are still very useful. An excellent publication, "Shannon Navigation Charts", is produced by the Office of Public Works.

The river and lakes are well marked with buoys, perches and beacons - red to port and black to starboard when going upstream.

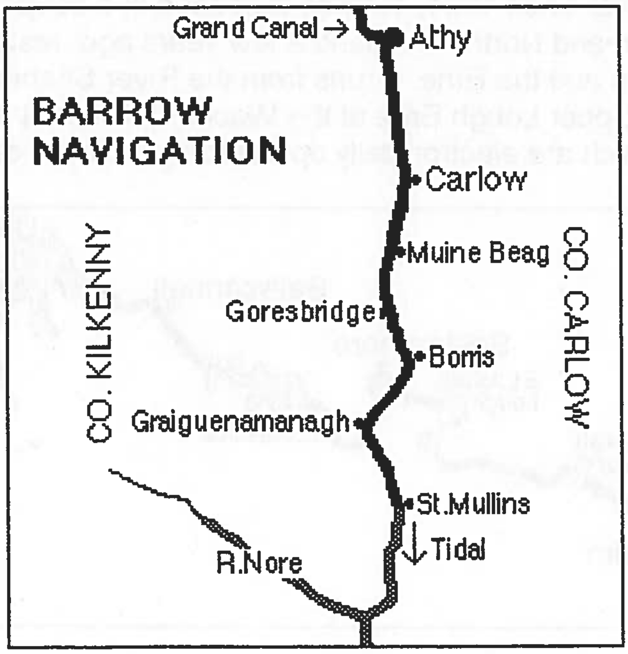
The two large lakes mentioned above must be navigated with care in bad weather as they can get very rough, with short, steep seas when the wind is strong.


L.Allen
CO.
Drumshanbo
L.Key
Shannon-Erne Waterway
Leitrim
Boyle
Carrick-on-shannon
LEITRIM
Albert Lock
L.Boderg
L.Bofin
Carnadoe Waters
CO. ROSCOMMON
Rooskey
L.Forbes
Tarmonbarry
CO. LONGFORD
Royal Canal (disused)
Lanesborough
L.Ree
CO.WESTMEATH
Athlone
Ballinasloe
Clonmacnoise
Pollboy
River Suck
Grand Canal
CO. OFFALY
Banagher
Meelick
Portumna
CO.GALWAY
L.Derg
CO.TIPPERARY
Scarrif
CO.CLARE
Killaloe
Ardnacrusha
Limerick
CO.LIMERICK

GRAND CANAL
The main line of the canal extends 82 miles from the River Liffey at Ringsend to the River Shannon at Shannon Harbour and has 42 locks including the sea lock. The Barrow Line, from Lowtown to the River Barrow Navigation at Athy, is 28 miles long, and has 9 locks. The Naas branch, with 5 locks, is 7 miles long.

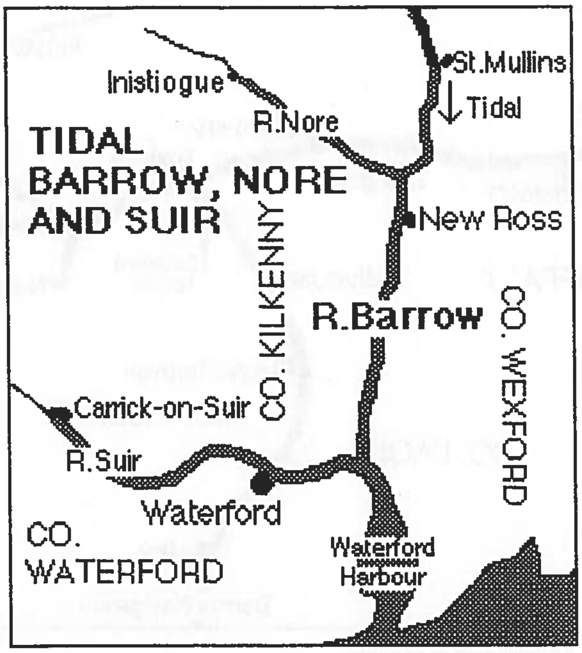



RIVER BARROW NAVIGATION
This is the canalised part of the River Barrow, from Athy down to the tidal River Barrow at St. Mullins, about 41 miles long. There are 23 locks.



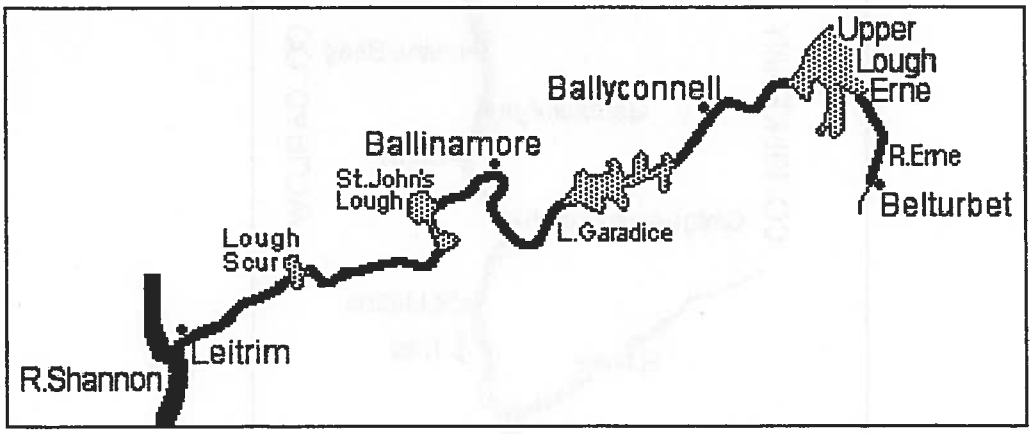
TIDAL RIVERS BARROW, NORE AND SUIR

The R. Barrow is tidal for a further 23 miles to its junction with the River.
The R. Nore is tidal and navigable for 8.5 miles to Inistiogue. The R. Suir is tidal and navigable for 24 miles to Carrick-on-Suir.



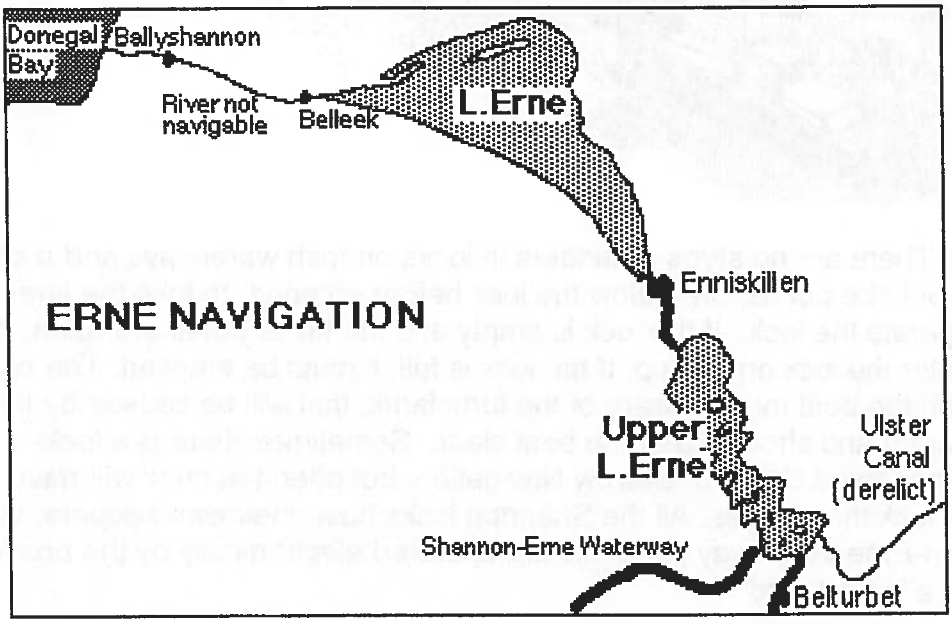

SHANNON-ERNE WATERWAY

This is another one of the success stories of Irish Inland Waterways. This canal was closed and derelict since 1884, but was reopened in a cooperative venture between the Republic and Northern Ireland a few years ago, restoring the link between the Shannon and the Erne. It runs from the River Shannon at Leitrim to the southern part of Upper Lough Erne at the Woodford River. It is 38 miles long and has 16 locks, which are electronically operated by a "smart card".

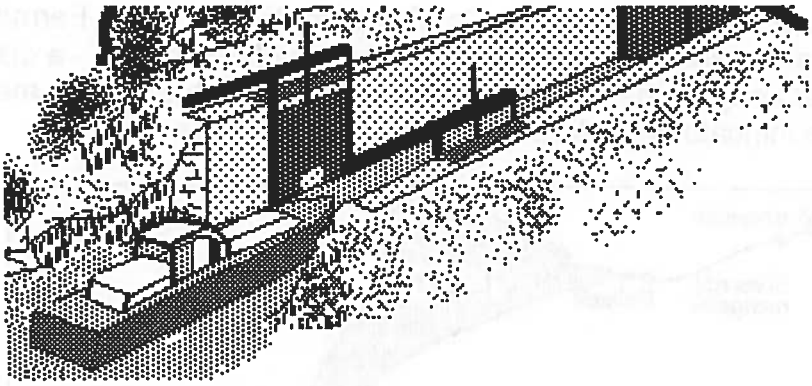


LOUGH ERNE NAVIGATION

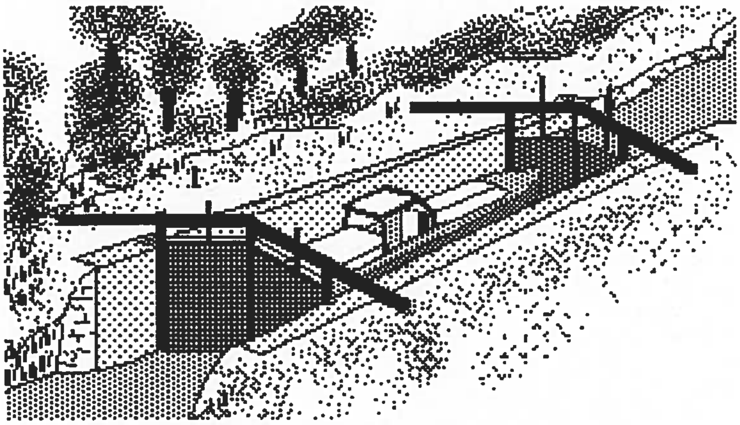
This navigation runs from Belturbet in Co. Cavan to Belleek in Co. Fermanagh, through Upper and Lower Lough Erne and the town of Enniskillen - a distance of 52 miles. Lower Lough Erne is an open lake. Upper Lough Erne has many islands and has intricate and interesting navigation channels.



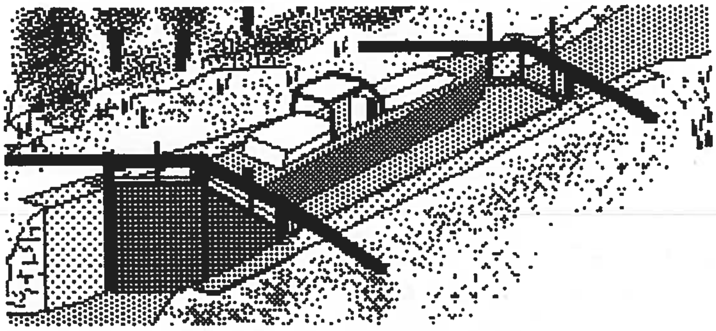
**Operating a lock**



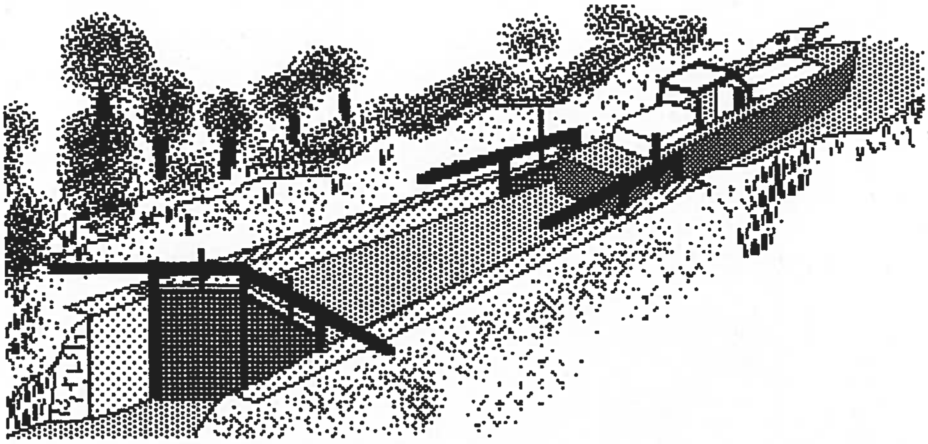
**Ascending** There are no steps or ladders in locks on Irish waterways and a crew member should be put ashore below the lock before entering, to take the lines and help operate the lock. If the lock is empty and the lower gates are open, the boat can enter the lock and tie up. If the lock is full, it must be emptied. The crew remaining on the boat must beware of the turbulence that will be caused by the outflow of water and should keep the boat clear. Sometimes there is a lock-keeper on the Grand Canal or Barrow Navigation, but often the crew will have to operate the lock themselves. All the Shannon locks have their own keepers. On the Shannon-Erne Waterway the locks are operated electronically by the boat's crew, using a "smart card".



The lower gates are closed. The racks on the lower gates are lowered to close the sluices. When filling the lock, take care to avoid too much turbulence which might push the boat about in the lock. Raise the rack on the opposite side to the boat, about half-way at first, then after a short time, raise the second rack, also about half-way. When the water level is about one third way up, raise both racks fully. The bow and stern lines must be tended and kept taut to keep the boat under control. If the lines are allowed to get slack, the boat can be pushed across the lock, or it may be driven forward by water rebounding off the lower gates, and may strike the upper gates and damage the bow or pulpit.



When the water levels on both sides of the upper gates are equal, the upper gates can be opened easily and the boat can move out onto the upper level. If there is no other boat in sight wishing to descend through the lock, the upper gates and sluices should be closed. This will minimise leakage from the upper level and wastage of water.



**Descending** When descending through a lock the above steps should be reversed. A lock chamber can be emptied much faster than it can be filled. The lower sluices can be opened fully together as this does not cause any turbulence in the lock, but watch out for any boat close below the lock. The crew must tend the lines, slacking them off as the boat descends - **never tie them off**. The water level can drop quite fast and the boat get "hung-up". If there is no lock keeper in attendance, one crew member should stay ashore to cast off the lines, and can be picked up again below the lock. If there is no other boat approaching or waiting to enter the lock, close the lower gates and lower the racks.