Anatomy of a boat

Of all the vehicles devised by mankind for transportation, pleasure or business, the boat is perhaps the most intriguing. It's variety is infinite; a penniless youngster on a home-made raft or a millionaire on his gold-plated world cruising yacht both feel a sense of achievement and the satisfying glow that accompanies activity afloat.

Anyone can develop a 'boat sense' through practice or study, and a 1980s 30-ft (9-m) fibreglass cruiser well illustrates the form and parts of a yacht. From bow to stern, such a vessel requires careful design, meticulous attention in construction, and good owner maintenance to make her 'Shipshape and Bristol fashion', fit for the challenge of the sea.

The bow pulpit and lifelines surrounding the working deck contain, forward, an anchor hatch for the ground tackle and, working aft, the raised coach/cabin trunk roof with its portholes, and handrails for the crew to hold on to when going forward in rough weather. The self-draining cockpit is positioned above the water level so that water taken in to it will exit through tubular scuppers or drains. On the coamings round the cockpit are geared winches, driven by hand with a ratcheting winch handle, to promote mechanical advantage when trimming the sheets.

The single mast of a sloop is secured in place by its standing rigging: stiff wire shrouds, the forestay and the backstay. The lower shrouds position the mast at, perhaps, two-thirds of its height, where the upper shrouds bend around spreaders to transfer their tension at a suitably wide angle to prevent the masthead bending to leeward under the pressure of the wind.

Heeling movement, generated by the action of the wind on the sails, is counteracted by the gravity-restoring movement of the keel, – in this instance a short and hydrodynamically efficient lead-filled fin.

Masthead fittings often include a masthead light, wind-direction indicator, an anemometer and possibly a loop antenna for radio direction-finding.

The mast is normally made of a light alloy extrusion and allows internal halyards to be fitted.

The shrouds support the mast laterally.

Spreaders position the upper shrouds for good alignment.

One pair of lower shrouds runs slightly forward of the mast, the other slightly abaft it for maximum support.

The fore- and backstays support the mast upright against halyard tensions.

The halyard winches, used for hoisting sails, often have a brake or ratchet to stop the halyard running back.

The topping lift supports the boom when the mainsail is lowered or reefed.

The mainsheet blocks are attached to the boom and the **traveller**, which slides on a track.

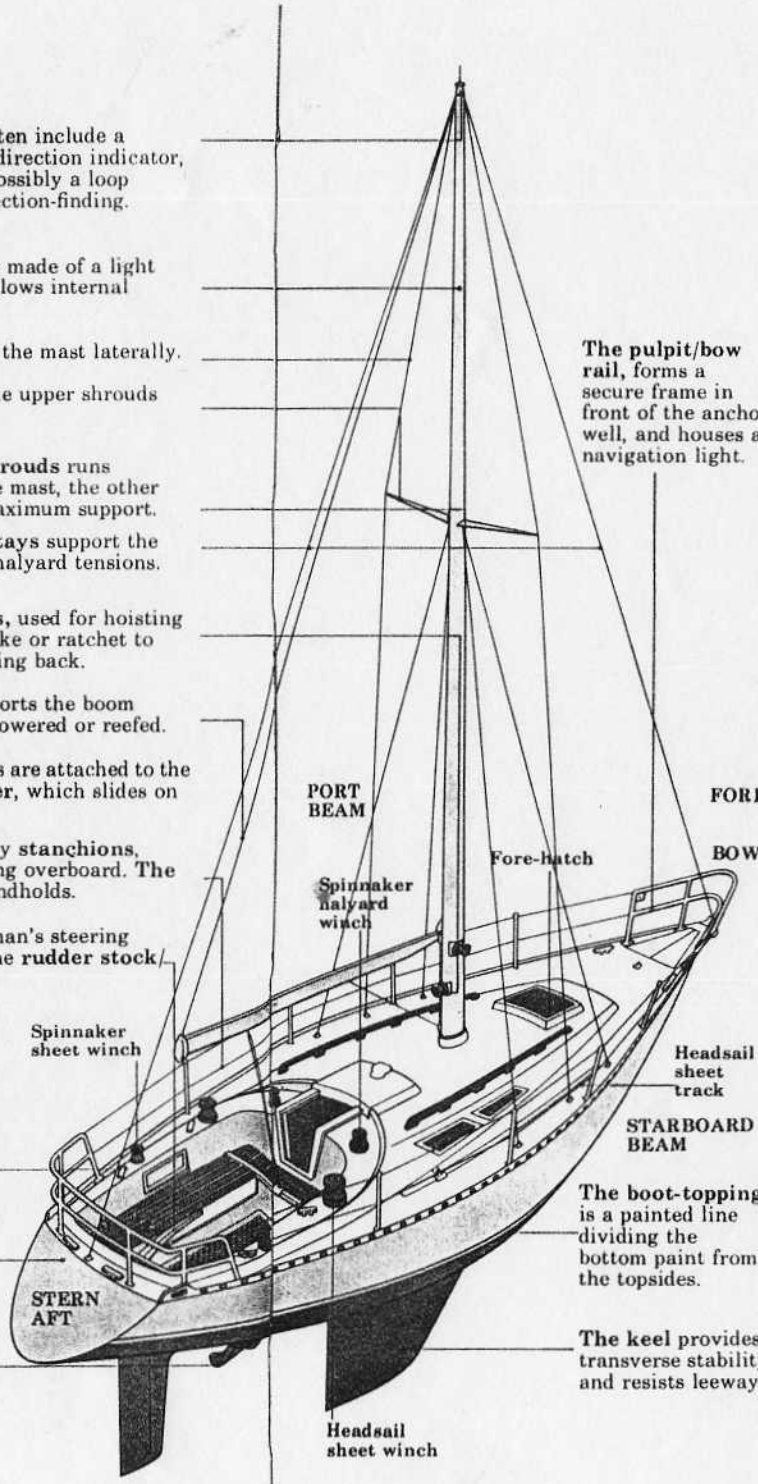
Lifelines, supported by **stanchions**, prevent the crew falling overboard. **The grab rails** provide handholds.

The tiller, the helmsman's steering lever, is attached to the **rudder stock/post**.

The coamings protect the cockpit and main hatchway from spray and form a base for cleats and winches.

The transom, has a pushpit for crew safety, and often a boarding ladder.

The propeller is a screw, rotated by the engine to propel the boat under power.



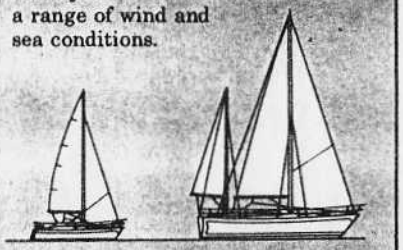
The pulpit/bow rail, forms a secure frame in front of the anchor well, and houses a navigation light.

The boot-topping is a painted line dividing the bottom paint from the topsides.

The keel provides transverse stability and resists leeway.

Know your boat

Sailboat Comparisons
The sloop is favoured for its performance to windward, especially for racing. Divided rigs, however, offer more versatility for ocean cruising. Schooners (with short fore-masts) and yawls and ketches afford a wide variety of sail combinations to meet a range of wind and sea conditions.

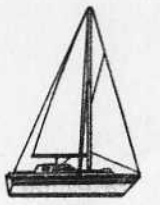


Small 18–26 ft (5–8m) cruisers with rectractable weighted keels or light centre-boards can be trailed behind a car.

The family cruiser of 25–30 ft (7–10m), designed as much for internal comfort and stability as sailing ability, is often long keeled.

The one-design cruiser-racer fulfils racing aspirations and doubles as an efficient, though less comfortable cruiser.

The motor sailer, although a compromise between sail and power, satisfies the needs of many cruising yachtsmen.



Standing rigging

A close look at the thickness of a mast and the complexity of its supporting wires will quickly reveal the designed purpose of a boat.

If the mast is thick, the rigging mounted at the masthead over a single set of spreaders, and if the backstay is without a proper adjuster, you have the nautical equivalent of an 'automatic'. You can hoist the sails and relax.

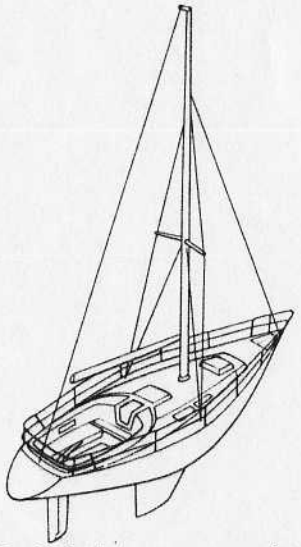
In the 'grand prix' version, however, the mast is patently thin, with a multitude of wires led over several sets of spreaders. The whole rig is tuned by a bank of hydraulic tensioners, which need to be adjusted continually to get the best out of the boat.

Between these two extremes, various combinations exist which permit different degrees of control and adjustment to suit the intended use of the boat. The single-spreader masthead rig with fore and aft lower shrouds (usually taken to the sides of the boat), forestay and backstay, gives the simplest, most robust rig.

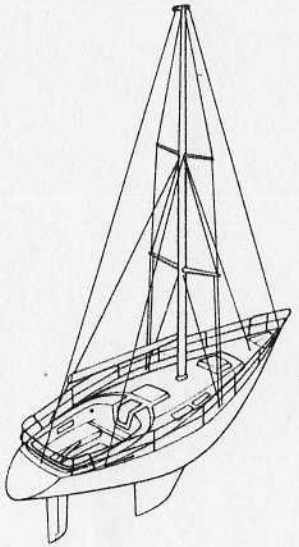
The fractional rig has a higher mast and larger mainsails. Since the smaller headsails make it more manoeuvrable in close-tacking situations, it is a favourite with keel-boat and inshore classes, although the smaller spinnakers can be a drawback in light airs. All masthead rigs are set well aft and support large overlapping headsails.

If you are rigging your own kit boat remember that the simple sections will be cheaper to buy and easier to rig. The more complicated rigs require a greater understanding of the stresses involved and need a large, experienced crew to control them.

When buying a production cruiser new or secondhand, make sure that the backstay is adjustable under way. This provides considerable control over the tension, and thus sag, of the forestay for efficient windward work, and over the forward rake of the mast for downwind sailing.

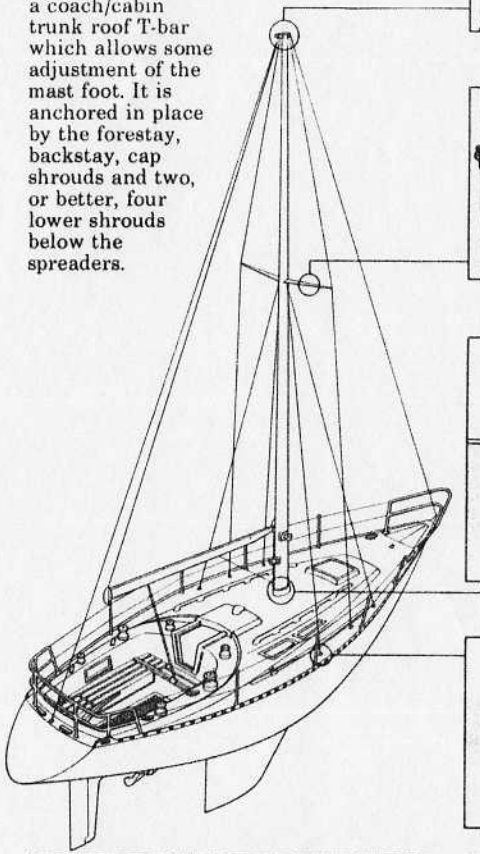


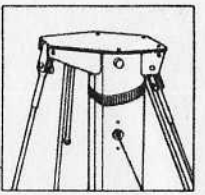
The high degree of control in a fractional rig is effected by mast bend. The backstay exerts forces on the tapered topmast section, while the shrouds and forestay meet at $\frac{3}{4}$ or $\frac{7}{8}$ the height of the mast.



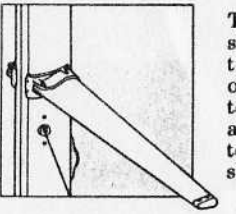
The shorter spreaders on a double rig allow the headsails to be sheeted in tighter to produce more driving power. The streamlined mast needs support from a number of shrouds and stays.

The single-spreader masthead rig is standard on most production family cruisers. The mast is usually stepped on a coach/cabin trunk roof T-bar which allows some adjustment of the mast foot. It is anchored in place by the forestay, backstay, cap shrouds and two, or better, four lower shrouds below the spreaders.

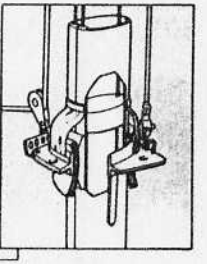




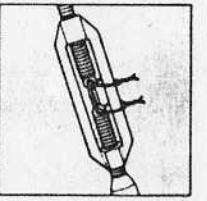
To prevent the masthead becoming too cluttered, it is extended with 'cranes' to house halyard sheaves and stay attachments.



The aerofoil-shaped spreaders transmit the forces of the cap shrouds to the mast. They are angled upward to bisect the shroud angle.

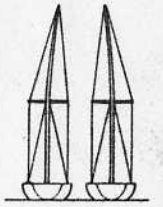


Keel-stepped masts, found on more sophisticated production boats, are held firmly at the coachroof by wedges. A neoprene gaiter, attached with jubilee clips, forms a waterproof seal.



Shroud lengths are adjusted by means of rigging screws/turnbuckles. Always secure them with monel wire and tape to safeguard clothes and sails.

Masts on production boats, *top*, have a teardrop section with a wide bolt-rope track to house halyards. More streamlined sections, *centre*, are tapered above $\frac{2}{3}$ height. Ultimate sail power comes from thin delta-sectioned masts, *bottom*.



To check that the masthead is angled correctly, take a masthead halyard to one cap shroud chain plate, then to the other. Adjust the rigging screws until the lengths are identical. The backstay adjusts forestay tension which determines fore-and-aft rake.

Running rigging

If you think of the standing rigging as being wire, and the running rigging as rope, one look into the cockpit of a racing yacht will bring home the true meaning of the sailing-ship term 'knowing the ropes'. At least the square riggers coiled and belayed their ropes while sailing to prevent them becoming hopelessly tangled. No such system has yet been devised for modern yachts, which always have a minimum of three sheets occupying the cockpit sole.

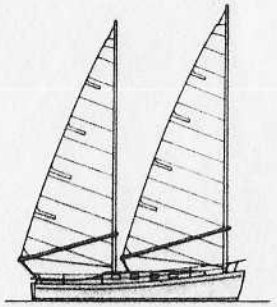
The large-crewed racing yacht can cope with this complexity, but the shorthanded cruising-man constantly seeks a simpler rig with fewer controls. One such rig has emerged – the highly successful wishbone rig, found on both sailboards and cruisers.

A ketch or schooner rigged with such sails still needs eight controls to sail and reef it. There is, also, no great financial saving, since the tapered, unstayed masts must be made from expensive carbon fibres or machined from alloys.

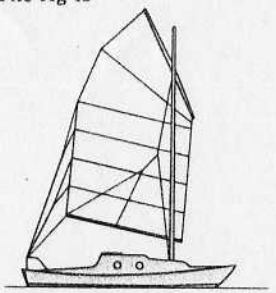
An integral part of the running rigging is the rope-handling system of winches, cleats and blocks. It is often more a question of siting winches and controls correctly than installing large numbers of them.

The more expensive are generally worth it because they are better engineered to withstand the massive sheet loadings. Self-tailing winches, which automatically cleat the rope and can be operated by one person, are ideal for cruising boats.

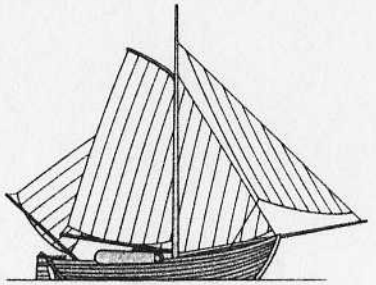
Inspect ropes regularly, especially those subject to constant wear in one small area, and turn them end-for-end at the first sign of wear. As important to long life is the choice of cleats and jamming cleats, since serrated teeth or sharp corners will make the rope wear more quickly. In addition, use fine emery cloth on sheaves, blocks and spars to eliminate sharp metal cutting surfaces.



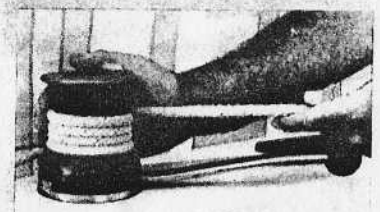
On a Cat ketch, the unstayed mast with its wrap-around sail is tensioned by the wishbone-shaped boom. The rig is controlled by a halyard, outhaul, sheet and two reefing lines, and is well suited for cruising.



The Junk rig has so far had only limited success on cruising boats. The fully battened sail is easily controlled by a mainsheet and a reefing line, which lowers the foot of the sail into retaining strops.

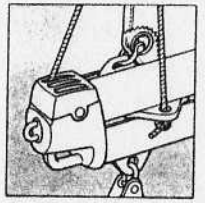


The large sail areas on the traditional Dutch boat feature a curved gaff and a loose-footed mainsail. In light airs, watersails, attached to spars around the sides of the boat, add to the area.

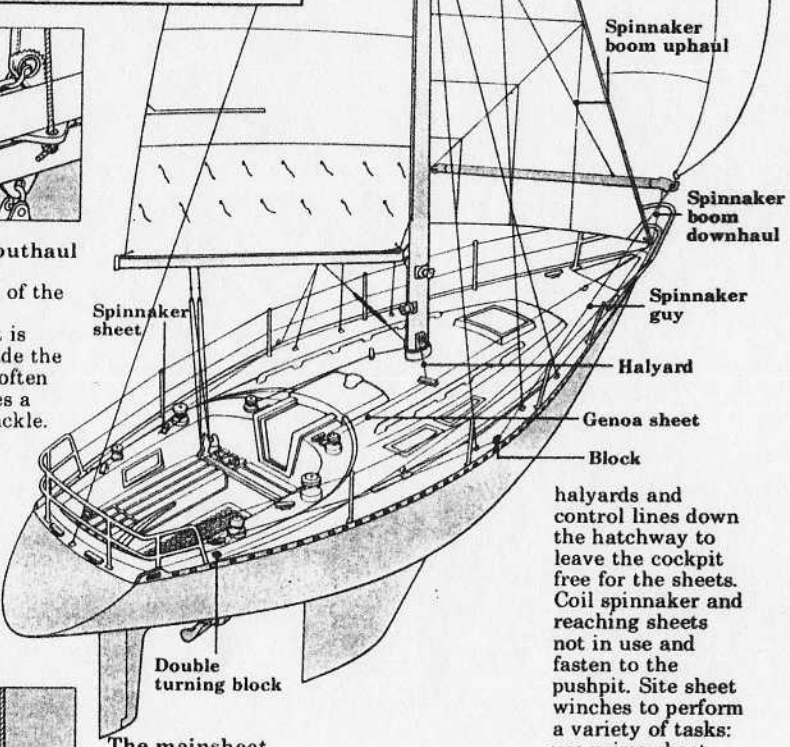


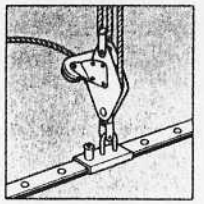
Winches
Conventional sheet winches must be operated by two people. The winchman loads the drum, winds the handle and surges the rope out, the sheet-hand pulls the rope slightly upward and out. The lead-on is important to prevent a jamming, or riding, turn forming.

Spinnakers and their running rigging are set outside all other sails and rigging. The fractional rig requires simpler but more precise sail-handling; snatch blocks must be sited forward of the widest beam to give the correct sheeting angles.



The clew outhaul allows the adjustment of the foot of the mainsail. It is housed inside the boom, and often incorporates a powerful tackle.





The mainsheet traveller exactly positions the boom athwartships, giving fine control of the mainsail's shape.

Use a system to separate ropes leading back to the cockpit, to avoid wear and tear. Drop tails of halyards and control lines down the hatchway to leave the cockpit free for the sheets. Coil spinnaker and reaching sheets not in use and fasten to the pushpit. Site sheet winches to perform a variety of tasks: use prime sheet winches for spinnaker guys, and halyard or control-line winches for the spinnaker sheet.

Choosing sails

A conventional bermudan rig for the average cruising boat requires an absolute minimum of a mainsail and one headsail. With a furling headsail, this is probably enough for most of the season. However, it is always worth carrying a small second jib for safety, rather like carrying a second anchor, just in case the furling genoa tears.

Anyone cruising one weekend and racing the next needs more sails. The furling headsail does not lend itself to racing because as it rolls up the sail becomes fuller, which is not ideal to windward. Several sizes of headsail are, therefore, necessary.

The minimum wardrobe for occasional weekend racing is a mainsail, medium-weather genoa, possibly a No 2 genoa which reefs down to No 3, and a radial spinnaker of medium weight. For cruising or racing offshore, a storm jib is essential, both to comply with the rules and for safety.

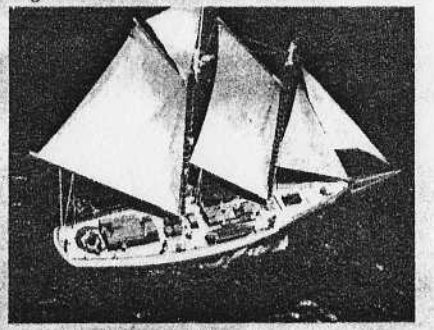
The movement in sailing today, however, is towards ease of handling. As the conventional bermudan rig involves the expense of a large crew and a full wardrobe of sails to achieve maximum efficiency, over the last five or six years, the Cat ketch (Freedom) rig and Junk rig have been refined.

The Cat ketch has a free-standing mast, usually made of carbon fibre, and has a wraparound sail with only short battens down the leech. The advantage of this 'soft sail' rig is that it can be stowed easily and handled by a single person who hardly needs to leave the cockpit to lower, hoist or even reef the sails.

The Junk rig, also on an unstayed mast, is strengthened and controlled by full-length battens, which makes it a hard sail. Although it appears to be not quite as efficient to windward as the Cat ketch, which, in turn, is less close-winded than the conventional bermudan rig, the Junk sail stows easily and can be handled and reefed from the cockpit.

The Gaff-rig, *above*, the traditional working rig for European trading and fishing boats, now enjoys a revival. Individual sails can be lowered to maintain correct fishing speeds or raised for an efficient downwind rig.

The wraparound 'soft sail' reduces turbulence around the mast, which becomes a blunt but smooth leading edge to the aerofoil section of the sail. More efficient than the conventional rig, this double-sided sail is also easier to handle.



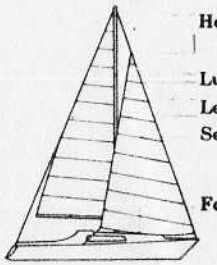
American schooners, now chartered worldwide for long-distance cruising, evolved with such a huge sail area because of the traditional race back to port to sell fish at the best prices.

Wind and sail

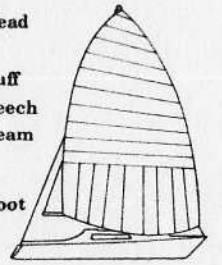
When buying sails, beware of black magic circulated by manufacturers and invest in strong, well-constructed sails which may be expensive, but remain in good shape for seven or eight years. For cruising, choose a good-weight cloth in preference to the new plastic laminate which rarely lasts more than a few months.

The mitre, 1, the leechcut, **2,** and the crosscut are the most common designs for headsails.

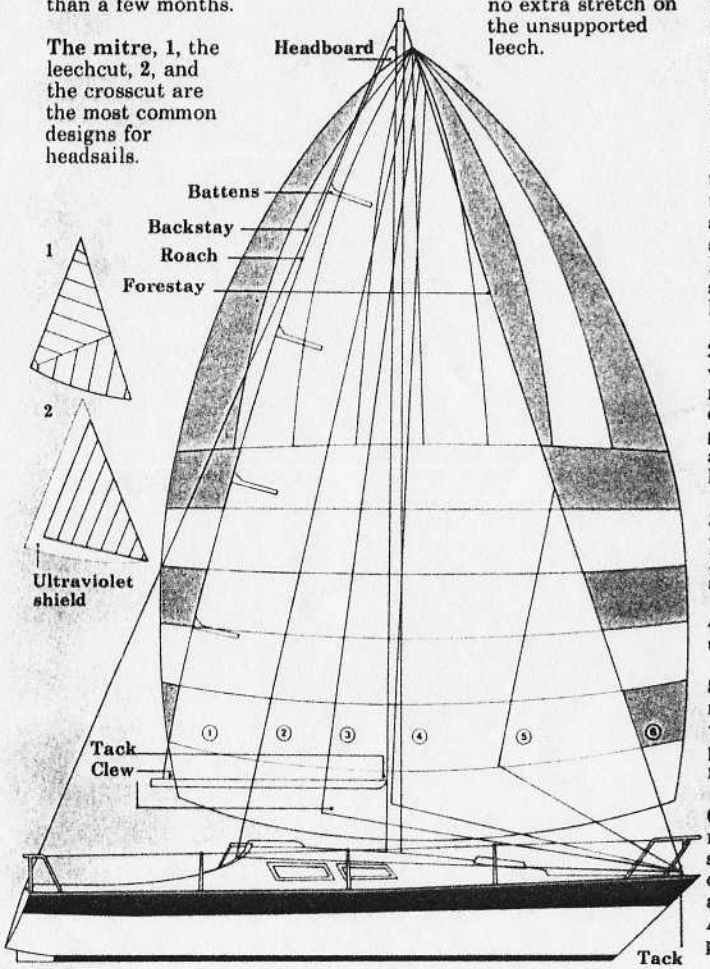
The vertical cut, 3, proved its high performance in the 1981 America's Cup.



The horizontal cut, 4, is the most popular for mainsails as there is no bias and so no extra stretch on the unsupported leech.



The cruising chute, which is smaller and more easily handled than the spinnaker, has recently improved the downwind and reaching performance of family cruisers.



1 The mainsail takes more wear than any other sail so must be cut for strong winds. Battens wholly support the curved leech (roach).

2 The medium-weather genoa needs a high enough foot to give good visibility ahead and on the leeward side.

3 A No 2 genoa which reefs to a No 3 is useful in strong winds.

4 Alternatively, use a No 3 genoa.

5 The storm jib must be in heavy-weight cloth, preferably fluorescent orange.

6 The cruising radial-head spinnaker is made of light, shock-absorbent cloth. Avoid white to prevent eye strain.

Sailing dynamics

A boat will not sail straight into the wind, but needs the sails to be full on one side or the other to make it move through the water.

The angle to the wind determines the sheeting position of the sails and which sails to set. The ideal angle for the wind to strike a sail depends on its shape, the type of boat and tautness of rigging. However, in all sailing vessels and on all points of sail, the sails need continual trimming to keep the boat sailing at this optimum angle.

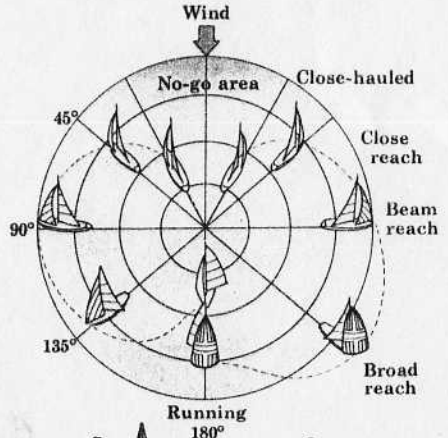
The strength of wind dictates the quantity and sizes of sails to be set. The wind exerts a constant pressure of 1lb/sq ft in a 16-kn (Force 4) moderate breeze. However, if the wind speed increases to 35 kn (gale Force 8) the pressure rises to almost 5 lbs/sq ft.

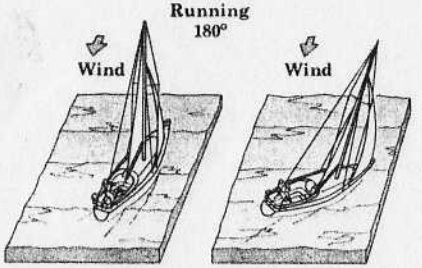
To keep the same amount of pressure on the boat in Force 8 as in Force 4, and so prevent the boat heeling excessively, the size of sail will have to be considerably reduced.

Sails must be reduced equally to prevent the boat becoming unbalanced. Too much main and not enough jib creates weather helm which pushes the boat up into the wind because the centre of effort is too far back. If there is too much headsail and not enough mainsail, the driving force is too far forward and the boat bears away from the wind.

When the sails are full, the boat would try to move sideways were it not for the keel, which holds the boat upright as well as preventing most sideways slip. Thus, since the boat cannot move sideways through the water, the ultimate forces result in it moving forward.

The angle of heel is important to the speed of the craft. An excessive angle of heel causes the boat to slow down, even though it appears to be going faster. It is, therefore, more efficient and more comfortable to keep the boat on a reasonably even keel.





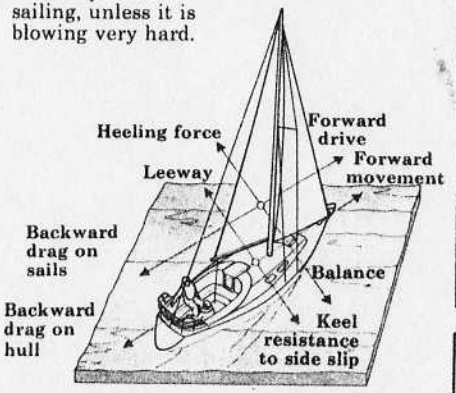
Sails, have to be trimmed so that their angle of attack to the wind remains at about 35° *above*. When bearing off the wind, the sheets are adjusted so that the sails maintain their angle but the boat turns.

When beating or reaching, the sails interact to create a slot effect, *below*, and because the compressed wind flows fastest over the curved back of the mainsail, the resulting forces suck the boat forward.

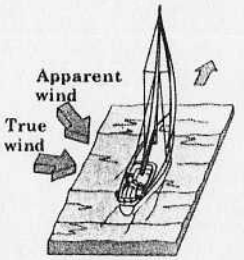
The correct centre of effort (COE) is the balancing point of the sail area in relation to the balancing point of the underwater hull shape, or centre of lateral resistance (CLR). It is achieved when a boat needs no rudder correction.

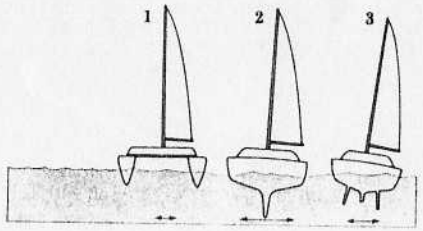
The boat's speed increases as it moves from close-hauled to reaching. Beyond a broad reach, the apparent wind reduces and the boat slows down unless a spinnaker or cruising chute is set to boost it. A dead run is the slowest point of sailing, unless it is blowing very hard.

The keel stops the boat sliding sideways through the water and keeps it upright. The ballast on the bottom of the keel counteracts the pressure of the wind on the sails, so preventing the boat sailing on its beam ends.



The apparent wind is a combination of the true wind and the wind created by the movement of the boat and feels strongest when the boat is close-hauled. When sailing away from it, the wind feels lighter than it really is. If a 15-kn wind is blowing and the boat is sailing at 5 kn downwind, an apparent wind of 10 kn blows over the deck.





1 A catamaran's width gives it initial stability, but once beyond 90°, it is difficult to right.

2 A cruising boat only heels to a moderate angle because of its hull shape and outside ballast.

3 Alternatively a cruising boat's stability can be achieved by ballast on twin bilge keels and possibly a central stub fin. The same leverage is produced with less draft.

Points of Sailing

The relative speed of any sailing boat is determined by its point of sail or angle to the wind.

1 Too close to the wind, in the 'no-go' area, the sails lift and the boat moves slowly.

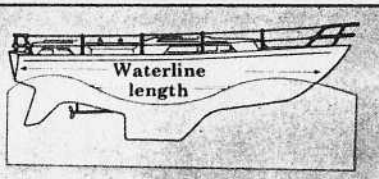
2 Close-hauled or beating at 30° off the wind, speed increases as the sails are pinned in tight and at the optimum angle.

3 On a close reach (70°), the sheets are eased out and the boat sails more easily.

4 On a beam reach, at right angles to the wind, speed increases.

5 A broad reach (135°) is the fastest point of sailing, if extra sail is set.

6 Running, or sailing downwind, the sheets are let out to a maximum, and unless more sail is set or the wind kept on the quarter, the boat will slow down.



Maximum hull speed. In theory this is 1.5 times the square root of the waterline length and is reached when the waves are the same length as the hull – a wave peak at both bow and stern. Today's lighter boats can exceed this speed by planing on the water surface.

Setting the sails

The starting point of any day's sail is the proper rigging and setting-up of the mainsail and jib on to the spars. Care taken at this stage will prevent snags arising later, such as battens flying out when the sail is flapping.

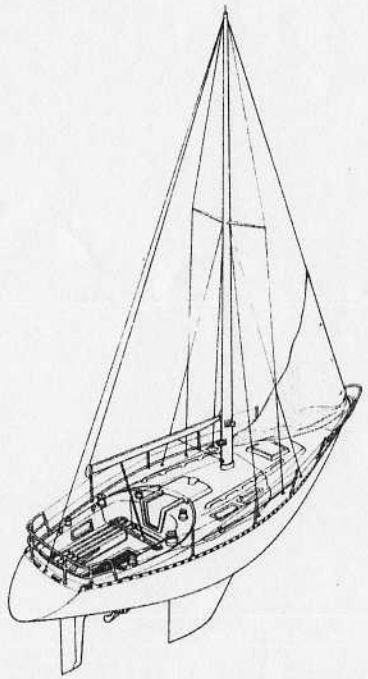
The first consideration is the weather, especially when you are short-handed. Light winds in the early morning may freshen during the day, requiring a change of headsail, so it is advisable to choose the foresail best suited to the maximum wind speed forecast for the day.

The tack of the jib is fastened to the bow fitting with either a pin, a hook or, for good visibility below the sail, a short tack pennant (length of wire). The luff of the foresail is either hooked to the forestay or, in some boats, fed into a forestay groove, which eliminates the scalloping effect and the turbulence created by hanks.

Once the sails are bent on, the sheets and halyards attached and the boat facing into the wind, the mainsail is generally hoisted first. If, however, the tide is flowing against the wind use the jib to get under way.

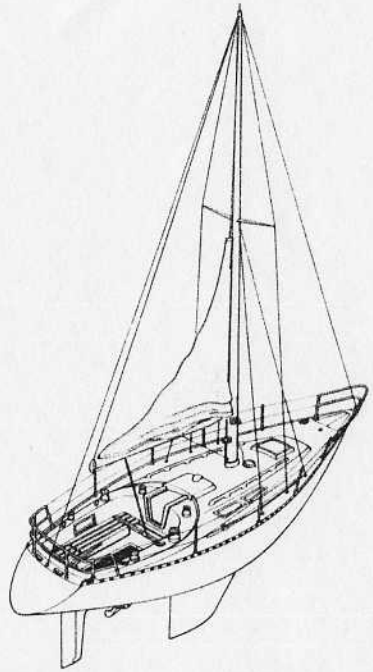
Having hoisted the sails, check the tension. On some cruising boats the jib is never adequately tensioned. If it is slack, horizontal creases will run off the luff and a scallop will form between each hank so that the boat sails badly to windward. The luff of the sail should be pre-tensioned to produce a fold in the sail running parallel with the forestay and six inches away from it. When the sail fills, the crease will come out, keeping the flow of the sail well forward. It is always easier to pay out an over-tensioned halyard than to tighten one; the harder the wind, the tighter the halyard should be. If the wind drops, ease off the halyard until the crease just disappears, and if the wind increases progressively tighten the halyard. The luff on the mainsail works in exactly the same way.

Each individual headsail is rigged in exactly the same way. The plungers of the hanks should be on the same side on all the foresails. This avoids confusing the tack with the head, and so hoisting the sail upside down, particularly at night. It also reduces the chances of twisting a hank. Always check that the halyard is not twisted round the forestay before hoisting.



To set the jib, take the bag forward and attach the tack to the bow fitting. Hank the sail on to the forestay, beginning with the bottom hank and taking care not to twist any hanks. Attach the sheets to the clew with a bowline, not a shackle or snapshackle, as these can injure anyone unlucky enough to be hit. Use separate sheets fastened in the middle to the clew, rather than an endless one. Attach the halyard to the head of the sail, lead the sheets through the fairleads and aft to the cockpit, then secure the end of each sheet with a stopper knot. To hoist, pull hard on the halyard until the head of the sail reaches the top of the forestay, then cleat both halyard and sheets.

The sails act as the engine of a sailing boat. To achieve maximum power, the outhaul tension on the mainsail and the halyard tension on both sails must be sufficient to allow the sails to set wrinkle-free. The sheet must also be tightened until the luff of the sail is just not shaking.



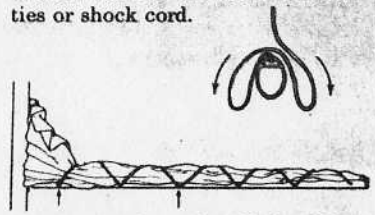
To rig the mainsail, take the bag to the mast and slide the clew of the sail into the boom. Attach the tack to the gooseneck. Fasten the clew to the end of the boom and tension the clew outhaul. Attach the halyard to the head of sail. Fit the slides into the sail track, starting at the head. Fit the stop into the end of the sail track. Fit and secure the battens. When hoisting, check the halyard is running free. Slacken the topping lift so that all the leech tension is taken on the sail itself. When lowering, always tension the topping lift before releasing the halyard. Mark each batten with its pocket number; insert the thin end first and put stiffer battens in lower pockets.

Sail care

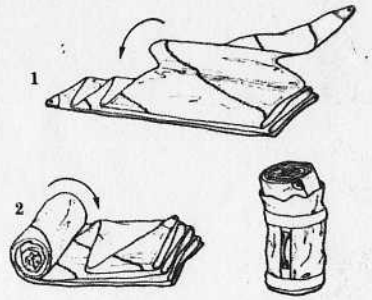
Sunlight is a sail's worst enemy, so cover the sails when they are not in use. An ultraviolet guard, fitted down the leech of a roller headsail, will protect the exposed part from the weathering effect of the sun and from dirt and grit. Mildew, which discolours, is prevented by storing sails dry and by hand-washing twice a season.

Check all sails regularly for chafe, particularly where they press on deck fittings or rigging, at reef points, batten sleeves and the foot of the headsail.

To stow the mainsail, start at the leech and flake it on to the boom, left and right, in about 18-in (46-cm) folds, while pulling the leech aft. Secure with a sail tie and continue to the luff. Lash to the boom with sail ties or shock cord.



The headsail, neatly rolled and fastened, can be temporarily stowed along the lifelines. To stow below, flake it into a length, 1, then roll from luff to leech, 2. Take care not to crease the leech. Pack in a clearly marked bag.



Close-hauled

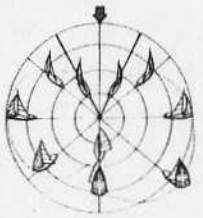
Close-hauled is the most challenging point of sailing, and the most difficult in which to get the best out of a boat. As it is impossible to make the boat sail directly into the wind, the only way to travel quickly to windward is to climb up into the wind by a series of tacks (zigzags).

The crucial question when sailing to windward is how close to the wind to sail and this is a matter of trial and error. The normal tacking angle – the difference in compass heading between one tack and the other on a cruising boat – in average conditions is about 80–90°.

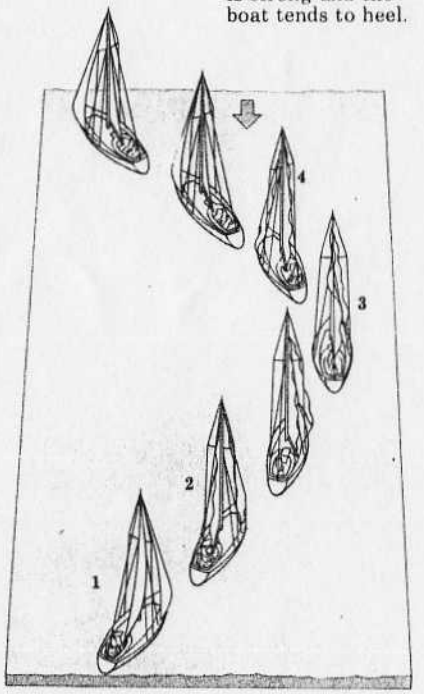
Some designs, particularly twin-keels, will tack through 90–100°. High-rigged, deep-keeled racing yachts will tack through about 70–80°. Probably the ultimate windward machine, the 12-metre class, will tack through 58° in good conditions. The angle depends not only on the shape of the sails and the boat design but also on the wind strength, the air temperature, the tide and the height of the waves.

The aim when beating is to point as high into the wind as possible, while maintaining the fastest possible speed through the water. If the boat points higher, it approaches its destination more directly, but sails more slowly through the water. If it points farther off, it moves through the water faster, but covers more ground.

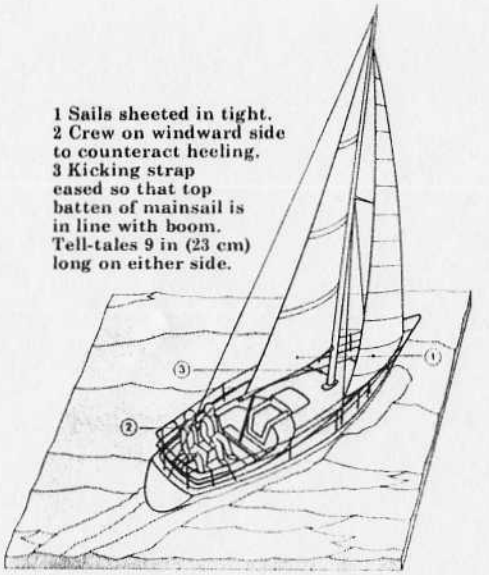
Tacking through 90° at a water speed of 5 kn, the boat sails directly to windward at 3.53 kn; pointing higher at a tacking angle of 80°, the water speed may drop to 4 kn and the boat's speed directly to windward falls to 3.06 kn. It often pays to sail farther off the wind and go faster, since it requires a lot of concentration and a well-rigged boat to point high and still maintain speed. When sailing long distances, the wind is likely to change before you arrive, so always choose the tack which is closest to the desired course.



The closest course most boats can sail to the wind is about 35°. The sails are sheeted in as far as they will go without pinching. The apparent wind is strong and the boat tends to heel.

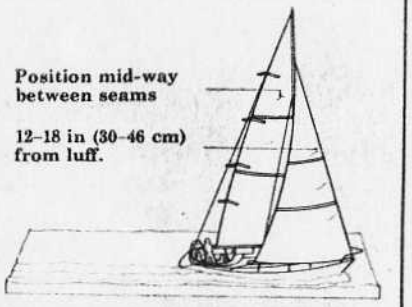


1 Bear away from the wind at least 5–10° to increase speed.
2 Crew 1 uncleats the headsail sheet and holds it on the winch ready to let go. Crew 2 holds the weather sheet with one clockwise turn around the winch ready to pull in. Three more turns will be needed for the final tensioning. Check that the winch handle is in its holder.
3 When all crew are ready, slowly luff the boat up into the wind.
4 As the headsail comes aback, cast off the leeward sheet, push the tiller hard over and as the boat comes through the eye of the wind, haul in the other sheet.



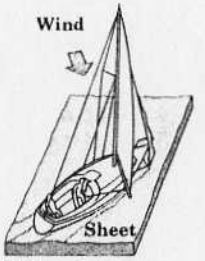
1 Sails sheeted in tight.
2 Crew on windward side to counteract heeling.
3 Kicking strap eased so that top batten of mainsail is in line with boom.
Tell-tales 9 in (23 cm) long on either side.

Tell-tales give a visual indication of the trim of the sails and are particularly useful on the headsail. To fit tell-tales, take some threads of wool about 18 in (46 cm) long, make several small holes in the sail with a hot needle (to seal the fabric) and pass the wool through, (9 in – 23 cm – appears each side), tying a knot on each end. Position them 12–18 in (35–46 cm) abaft the luff edge and mid-way between the seams to avoid the wool catching on the stitching. The tell-tales on each side should stream aft. If the windward one flutters when the boat is close-hauled, it is pointing too high; when reaching, the head-sail needs to be sheeted in slightly. If the leeward tell-tale flutters when the boat is close-hauled, it is too far off the wind; when reaching, the sail is too taut.

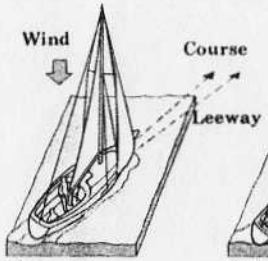


The optimum speed at which to tack is dictated by the design of the boat and can be established by watching the speed at every turn. The idea is to keep the speed as high as is possible throughout the manoeuvre which means tacking slowly; a fast tack will stop the boat.

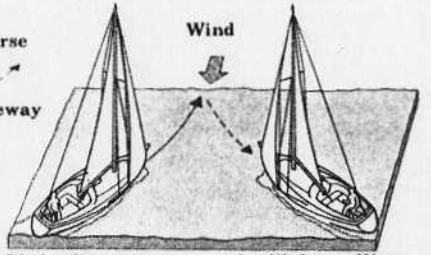
Although it can be done in 9 secs, the ideal tacking time on a 12-metre boat is about 23 secs, which allows the boat to maintain her speed during the turn. It is important not to haul in the sheets too violently immediately after a tack, but to wait until the optimum speed is reached.



If the sheets are pinned in too tight and the heeling angle of the boat feels suddenly dangerous, ease the sheets to reduce the sideways pressure on the sails.



Take into account that a boat makes most leeway when close-hauled. A deep-keeled boat may only make 2–5° leeway, a twin-keeled boat may deviate by 15°.



If the boat stops as it goes about, try reversing the tiller by pushing it towards the intended direction. This pulls the stern over to one side and the sails should fill. Back the jib by pulling the sheet you have just released and ease the mainsheet. When the bow is 20° off the wind, sheet in the jib.

Reaching

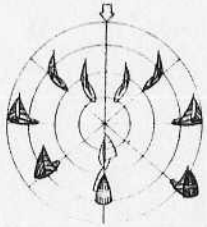
Reaching is the fastest point of sailing. In heavy weather it is essential to set the right amount of sail area to prevent excessive heel and to balance the rig to keep weather helm to a minimum. A reefed mainsail and a larger headsail than normal will move the centre of effort of the sail plan forward. This reduces the pull on the helm and also the heeling angle of the boat, and should allow the boat to gain maximum speed very quickly.

In fair weather a spinnaker can be set, although in very light winds a light-weather headsail is preferable since it will not collapse when the boat rolls to leeward: an advantage frequently ignored even by racing crews. If a spinnaker is set the luff tension (the height of the outboard end of the pole) is crucial. The ideal height must be found by trial and error and is reached when the spinnaker will collapse either down its entire leading edge or in the middle.

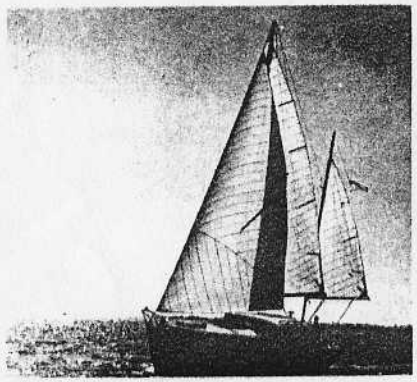
The spinnaker should not be overtrimmed on a reach; the sheet should be eased until the leading edge just begins to fold, and then sheeted in again slightly to keep the sail at its optimum angle. In light weather, the resulting billowing effect increases speed.

In heavy-weather reaching, all the crew should be aft and up on the windward side. This helps to keep the boat upright, the stern down so that the rudder is more effective and the bow out of the water, reducing the boat's weather helm to give the helmsman more control.

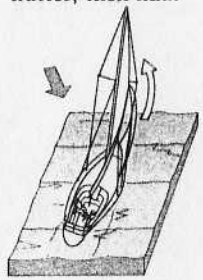
In light weather the reverse should happen; the crew should be up forward of the mast and on the leeward side. This keeps the bow down, lifting the flat sections out of the water, so reducing the wetted surface. Increasing the weight to leeward causes the boat to heel slightly, with the result that the sails take up their natural shape through gravity.



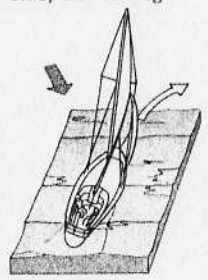
On a beam reach the apparent wind attacks the sails at an angle of 90°. On a close reach, this decreases to 70°; on a broad reach, it increases to 135°.



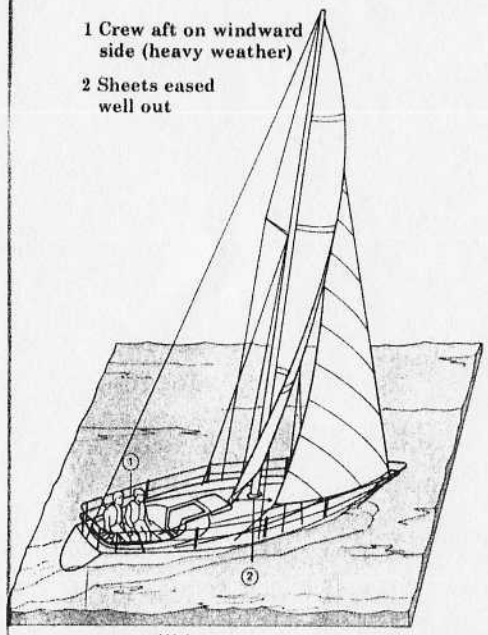
The correct trim of the sails is crucial, so watch the tell-tales and the luff of the sails carefully. As soon as the boat is on course, ease out both the main and jib sheets until the sails begin to flutter, then haul them in just beyond the point where they stop shaking. At this point the sails should be pulling most efficiently. If the mainsheet is eased out too far, causing the wind to strike its lee side, all driving power will be lost. The solution is to ease the sheets. If both sails are sheeted in too far, the boat will heel sharply and slow down. If the wind draws ahead, tighten the sheets, if it moves farther aft, ease them. On a broad reach, the angle of the boat to the waves may cause it to yaw, so the helmsman should anticipate, rather than fight, the boat's movement.



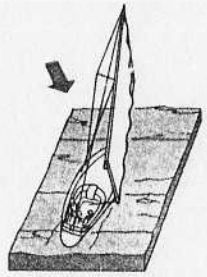
When luffing up into the wind, put the helm down to leeward and sheet in until the tell-tales flutter and luff begins to shake. Then bear off a fraction.



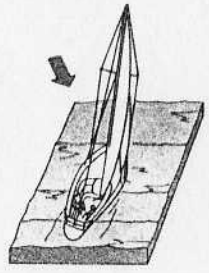
When bearing away, pull the helm to windward and ease the sheets out to increase the flow of wind over the sails and to prevent stalling.



Wind direction
Before setting off, the wind direction can be determined by using any of the following indications.
1 A burgee, a windsock, wind indicator or racing flag, attached to the head of the mast, where the sails and rigging do not distort the wind direction.
2 The position of sails on other boats underway indicates the direction of their apparent wind.
3 Flags, smoke and trees on the coast blow away from the wind.
4 A wind vane or electronic indicator reveals the true wind when stationary and the apparent wind when sailing.
5 Wave direction in the open sea and cloud movement can be misleading.



If a squall hits and there is no time to luff up or bear away, let fly the sheets to reduce the angle of heel. The effect will be immediately apparent.



On a reach, the traveller should be as far to leeward as possible and the sails correctly trimmed so that the tell-tales stream aft, flat against the sail.

Weather helm, the tendency of a boat to come naturally head-to-wind when left on its own, is a safety feature which slows and eventually stops the boat if the helmsman has to leave the tiller. Its effect is stronger while reaching than on any other point of sailing and can be reduced by increasing the foresail area. Lee helm, the opposite, occurs when the centre of effort (COE) is too far forward of the centre of lateral resistance (CLR), 1, and can be cured by lowering the centre-board, 2, or reducing the foresail area, 3.

Before the wind

Off-the-wind sailing is a bit like cruising down the Trade winds. Direction is not limited, it is dry and usually much warmer since the apparent wind is less. Steering is not so critical and more sail area can be set (eg the spinnaker or cruising chute).

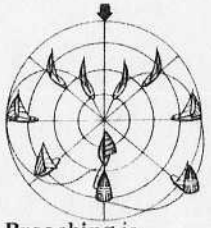
A course, appropriate to your direction and the tidal stream, will dictate the wind angle to the boat. If it is between 90° and 180° and there is sufficient manpower on board, a spinnaker can be set. This is the ideal wind section to use this sail, and it should be set with just the mainsail, once the genoa has been lowered and secured.

The cruising chute can be used efficiently up to Force 3 with the wind 70–100° off the bow and up to Force 4 or 5 with the wind at 100–135°. If the wind is dead astern, it can be used in a Force 6. It is usually set flying, with no other sails, and is easily handled by a small crew.

If the wind is blowing very hard, a genoa or jib can be set with full mainsail, and with the wind forward of 135°, it can be used on the same side as the main. Once the wind is aft of 160° the headsail can be goosewinged, preferably with a whisker pole if the boat is rolling heavily. This is a good downwind, heavy-weather rig and, as the wind increases, the same format can be maintained by reducing the size of the sails: reefing the mainsail and setting a smaller headsail.

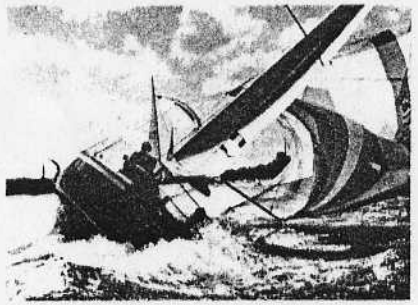
With the wind dead aft, the crew should split into two parties to balance the boat. In light winds they should sit amidships and as far outboard as possible on each side, to act as wing ballast and reduce rolling. When the wind freshens, they should move farther aft to keep the stern down, while maintaining an even distribution of weight.

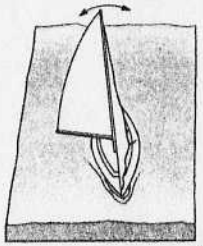
Running can be the most hazardous point of sailing because of the risk of gybing/jibing and the wind is always stronger than it seems.



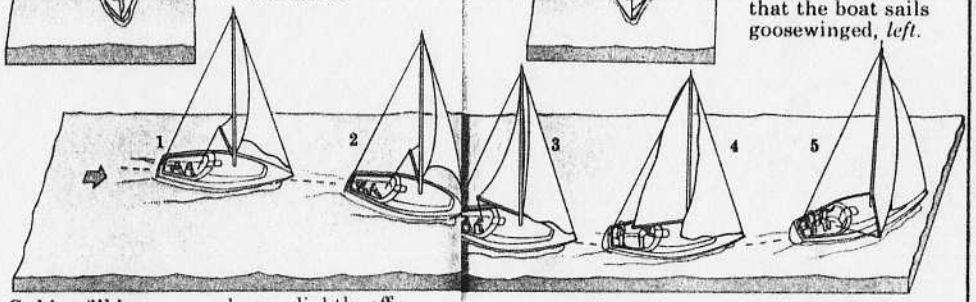
Downwind sailing ranges from a broad reach at 135° to a dead run at 180°. With the wind way aft, the sails act like parachutes rather than aerofoils.

Broaching is caused by waves lifting the stern and heeling the boat so that rudder control is lost. The boat then luffs, and heels excessively. To prevent a broach, slow the boat, sail a lower course or let the mainsail twist off at the top by easing the mainsheet.

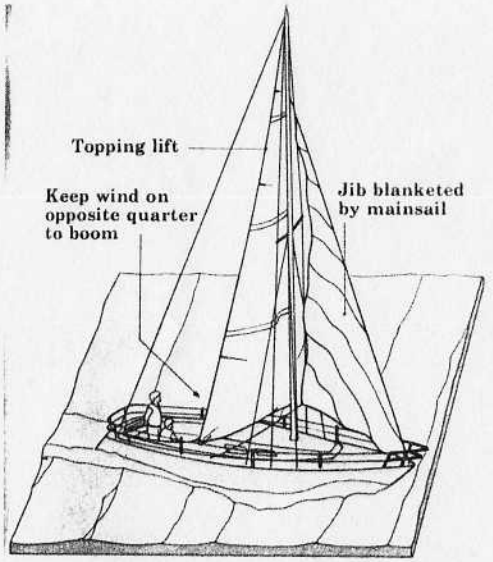




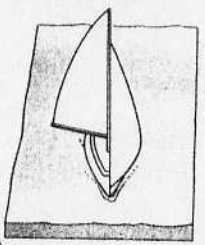
Rolling can be reduced by tightening the kicking strap to hold the mainsail flatter and to stop the top twisting. Also try sheeting in the main.



Gybing/jibing involves swinging the boom over nearly 180° to the other side of the boat. In a controlled gybe, the helmsman bears slightly off the wind, **1**, then orders 'Stand by to gybe/jibe' as he pulls the tiller over, hauls in hard on the mainsheet and cleats it, **2**. The crew release the jib sheet and haul it in on the other side, **3**. As the boom swings over, held firm by the mainsheet, **4**, the crew move to the other side. The mainsheet can now be payed out and the sails trimmed on the new tack, as the crew check the new course is clear, **5**.



When sailing 'downhill' the helmsman should watch the wind and steer carefully to avoid an accidental gybe/jibe. In a fluky wind, or if the boat is rolling heavily, the wind may catch the front of the mainsail, forcing the whole sail to slam across. This can damage both boat and crew. A boom preventer leading to the foredeck can forestall this. If the jib is not boomed out, it will warn of an imminent gybe by filling on the opposite side to the mainsail. To derive some driving force from the jib, it should be boomed out, so that the boat sails goosewinged, *left*.



Checklist

1 The mainsail, not the boom, should be at right angles to the boat when the wind is dead aft.

2 Keep the wind over on the quarter opposite the mainsail by 5–8° and if necessary tack downwind to stay on course; the increase in speed compensates for the slightly longer distance sailed. This also guards against going into an involuntary gybe/jibe.

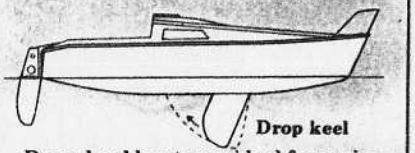
3 Move the crew aft to counteract the weight of the wind pushing the bow down.

4 Remember the apparent wind is less than the true wind and reduce sail area before turning into the wind.

5 The topping lift should be attached to give more fullness to the mainsail and to prevent the boom dragging in the water.

6 If the boat has runners, keep the leeward one slack.

7 In a multihull, it is significantly faster to tack downwind than to sail dead before it.



Drop-keel boats are ideal for cruising and are becoming increasingly popular, particularly as trailer sailers. With the centre-board up, they fit into shallow anchorages and sit firmly in a dry berth or on a trailer. When the centre-board is lowered, the keel is deep enough to make the boat very efficient to windward. In many boats, the keel can also be angled aft, which, when reaching, puts the centre of lateral resistance farther aft, so reducing the amount of weather helm and the chances of broaching. When running, if the centre-board is raised, some boats will plane over the water.

Handling spinnakers

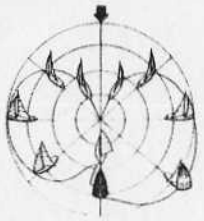
The spinnaker, which originated from the parachute, is one of the most efficient methods of increasing speed when sailing downwind. It does, however, require a lot of controlling because it is large, very powerful and only attached at three corners.

Care should be taken in setting and in lowering this sail; it is especially important to lower it before an increase in wind speed makes it dangerous. Many difficulties can be eliminated by using a spinnaker control sock.

The equipment includes the sail itself, the spinnaker pole, track on the mast to alter the height of the pole, the spinnaker boom lift and downhaul, spinnaker halyard, spinnaker guy (attached to the windward clew), spinnaker sheet (attached to the leeward clew), winches to control the sheet and guy, substantial turning blocks fixed strongly to the boat, and a bag or turtle to make setting easy.

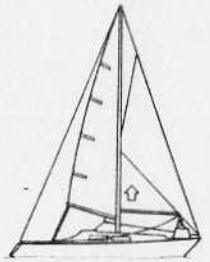
When cruising, the spinnaker will normally be set only in light and medium winds, therefore a moderately lightweight sail of about 1.2 oz (40g) is recommended. Heavy material will be strong and durable, but will not set well in light winds. The size of the sail is worked out by manufacturers, based on the height of the mast above the sheer line (known as I) and the distance between the forestay and the front of the mast (J).

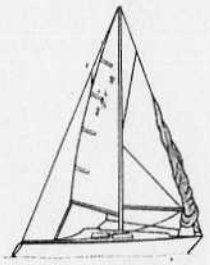
To trim the spinnaker, always try to keep it square to the wind. If the wind is coming over the quarter, the spinnaker pole will be forward. As the wind comes aft, the pole will also have to be brought aft and the sheet of the spinnaker eased out. The height of the pole is critical to the heeling angle of the boat and varies according to the strength of the wind. As a general rule, try to keep the outboard end of the pole the same height as the clew of the spinnaker. Adjust the pole height on the mast to keep it horizontal.

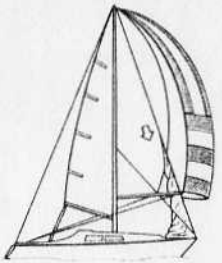


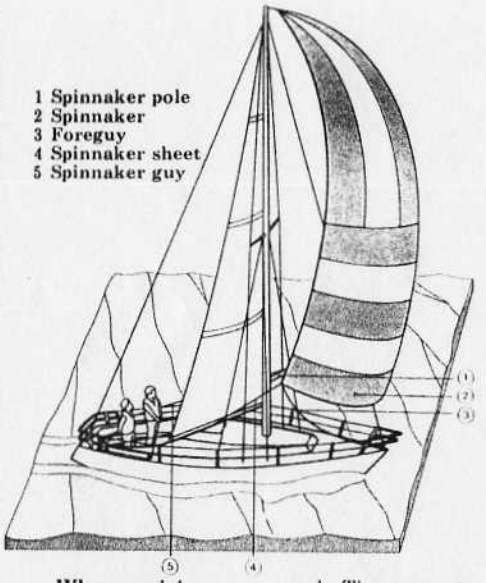
A spinnaker can be hoisted from a close reach to a dead run to boost the boat's speed downwind.

To set the spinnaker, fasten the bag to the pulpit or on the lee side of the foredeck and pull the three corners of the sail out, **1**. Clip the spinnaker pole to the mast and hoist it to about 6 ft (2 m) above the deck on a 30-ft (9-m) boat, **2**. Lead the guy outboard of the rigging, through the end of the spinnaker pole and, bringing it forward, attach it to one of the clews on the sail, **3**. Bring the sheet forward outside the rigging, fasten it to the other spinnaker clew, **4**, and attach the halyard to the head of the sail, **5**. Hoist the spinnaker pole with the uphaul, **6**, until it is horizontal and secure the foreguy (downhaul), with some slack to the pole, so that, once hoisted, the spinnaker cannot sky, **7**. To hoist the sail when short-handed, tighten the guy until the clew of the spinnaker reaches the end of the spinnaker boom (feed a little out of the bag). Pull the boom back about 3 ft (1 m) from the forestay and securely cleat the guy. Hoist the sail to the top, **8**. Make sure that the halyard is securely cleated, then pull in on the spinnaker sheet, **9**. Lower the genoa and the spinnaker will fill, **10**.

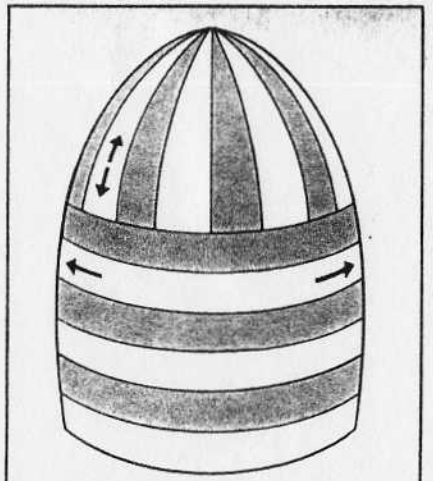




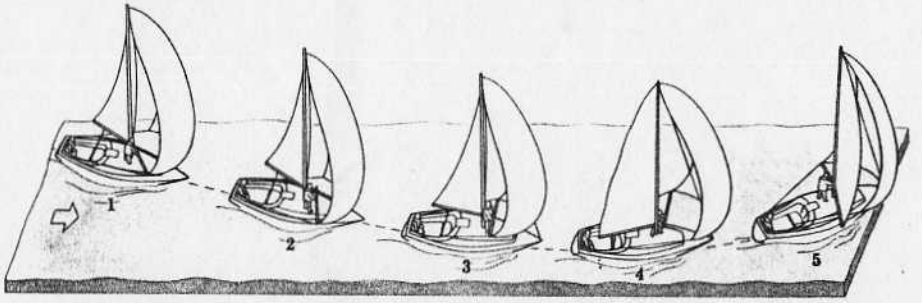




When cruising, the safest way to lower the spinnaker is to bring the boat round to a dead run and let the spinnaker guy go so that the pole goes up against the forestay. Ease the spinnaker boom lift to bring the pole within arm's reach. The moment the crew forward unclips the spinnaker from the guy at the end of the pole, haul in the spinnaker sheet behind the mainsail, on the lee deck. Pay out the halyard at the same rate as the crew can gather in the sail.



The ideal spinnaker design for cruising is a radial head with crosscut base, which produces the most efficient shape in winds from dead abeam to dead aft, and is the least expensive. The panels allow for the direction of stress (*see arrows*). The tri-radial, although expensive, is strongly made and suitable for heavy use; crosscut, starcut and jumbo-foot spinnakers are designed for racing.



Gybing/jibing the spinnaker should be undertaken only with sufficient crew on board. When it is blowing hard and there are few hands on deck, it is worth considering lowering the spinnaker, gybing and resetting it. End-for-end gybing is the best method for boats up to about 30 ft (9 m). Run off the wind until it is virtually dead aft and square the pole so that the sheet is let out as far as possible, **1**. Unclip the inboard end of the pole, take it across and attach it to the sheet on the other side, **2**. Unhook the outboard end from the original guy and push it across to attach it to the mast, **3**. Gybe/jibe over the mainsail and, at the same time, pull in the old sheet (now the new guy) to draw the pole square across the boat, **4**. Ease out the old guy (now the new sheet), **5**.