

SAILING

& THE TECH DINGHY

instruction manual

Technical information supplied by
Harold “Hatch” Brown, MIT Sailing Master;
MITNA Staff; and Members.

Prepared by J. Bisbee, P. Halloran and N. Larkin.

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1 Foreword

The purpose of this booklet is to tell you something about our Tech Dinghy and how to sail it, and specifically to provide you with the information necessary to pass the Nautical Association's Provisional, Crew and Helmsman. Please do not think of these skill checks as tests, but instead, as measures of your understanding of our sport. We don't expect perfection from our beginners, but only that our members be able to safely handle the boats and themselves on the lake. For those who wish it, there will be much more that can be learned about other boats and other waters, but what can be learned here will provide the basis to build on.

2 The Tech Dinghy

The Tech was designed specifically for MIT by Professor George Owen, and the first boats were made for the opening of the Sailing Pavilion in 1935. These boats were built of wood, lapstrake construction by the famous Herreshoff Yard in Bristol, Rhode Island. They featured a movable mast so they could be either sloop or cat rigged. A large half model of these early boats still exists in the stairway at the Pavilion. In 1953 the first fiberglass Techs were built by Beetle Boat of Cape Cod, and their construction marked a pioneering effort in this material that would soon take over the boat building industry. These boats had a relatively low freeboard and were famous for their rugged construction. Our present Techs were built in 1993 by OSP Composites of Wisconsin, and the design was modified by yacht designer Halsey Herreshoff, grandson of the original builders. The boats are $12\frac{1}{2}$ feet long, cat rigged, weigh about 200 pounds, and represent the best technology in heavy duty fiberglass construction. Although it is designed as a beginner's boat and for casual recreational use, the Tech is a popular boat for racing and one of

the most popular of the college racing classes. The fittings and adjustments on the Tech permit the skilled sailor to fine tune the boat for top performance. The Tech is so well balanced it is possible to sail the boat without a rudder with only minute adjustments to trim.

3 The Charles River Basin

Few colleges have such a charming body of water right on campus. The Charles was the birth place of intercollegiate sailing, and there isn't a similar body of water anywhere in the world where more people have learned to sail. The river isn't always as clean as we would like, but it is not as bad as some would have you believe. The river is cleaner than it was 10 years ago but not as clean as it will be 10 years from now. It is justifiably famous, however, for its shifty winds. The many buildings that surround us play strange tricks with the wind, but few realize even this is somewhat offset by the little known fact that Boston is one of the windiest cities in the United States — far windier than Chicago, the "Windy City".

4 Basic Sailing

The basic concept of sailing is quite simple, and sailing is something many people learn by themselves through trial and error. Young children are often the quickest to learn, because they do not try to complicate matters. It will be easier to discuss what is involved, however, if we use some standard nautical terms and the specific names for the parts of the boat. Refer to the 'Short List of Nautical Terms' at the back of the booklet and figures 1 and 2 for clarification. Don't try to completely absorb all of the material at once, but instead get some on-the-water experience. You can then come back to this material for a fuller understanding.

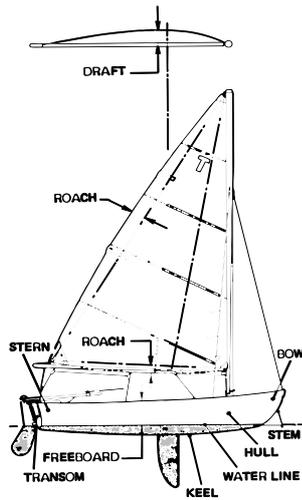


Figure 2.

In its simplest form, to sail you do little more than point the boat where you want to go and pull in the sail enough to keep it from *luffing* (*i.e.*, keep it from shaking like a flag). It is not possible to sail straight into the wind, so if pulling in the sail does not stop the sail from luffing, the bow of the boat must be turned further away from the wind direction. When this is done the sail will automatically seek the *leeward* side of the boat (the side away from the wind). As you can see, it is important that you keep track of the wind at all times, particularly what your course is relative to the wind direction. Each change of the wind's angle to the boat requires a sail adjustment.

5 The Wind

Since the sailboat can not sail directly toward the wind, and because all our maneuvers should be thought of in relation to the wind direction, our first step is to determine the exact direction the wind is coming from. Wind direction can be determined in many ways; flags, smoke, ripples on the water. But the most common method is by watching your *telltails* (pieces of yarn or other light material fastened to the wire stays). The exact angle of the wind

to your boat is something you must be aware of at all times if you are to intelligently and safely maneuver your boat. Every few moments you should be rechecking the wind's relative angle to your boat. Although you may be using your telltales most of the time, it is also important to watch the water upwind so you will have advance warning of a change in the wind direction or strength. An added puff of wind will darken the surface of the water, and you will be able to watch the progress of the puff toward your boat. In this way you can be ready to take appropriate action.

6 Sail Trim

The proper sail trim is to have the sail pulled in only enough to prevent luffing. The sail works like a bird's or an airplane's wing in that the wind flows into the sail over the leading edge (the luff of the sail), and the wind is bent slightly as it flows along the curved surface of the sail and out over the back edge (the leech of the sail). When the sail is pulled in enough, a force is formed on the leeward side of the sail as the wind speeds up over the curved surface. The centerboard negates the sideway portion of this force, and the boat is driven forward through the water. *Luffing* occurs when the sail is not pulled in enough, and it may result in the whole sail shaking if the sail is all the way out, or it may be only a gentle pulsing of the sail in the center of the luff of the sail when the sail is almost (but not quite) in enough. Since luffing starts at the luff of the sail, and the last point to stop luffing is the luff of the sail, this is an important spot to give your attention. You will find the sail must be kept well in toward the centerline of the boat when the wind is coming from the forward part of the boat, and can be, and should be, well out when the wind is toward the back, or stern, of the boat. Remember, the sail should only be pulled in enough to keep it from luffing. To pull the sail in beyond this point will break up

the wind flow on the leeward side of the sail and cause undesirable side effects.

In a very strong wind it may be necessary to ease out the sail a few inches and sail with a controlled amount of luff in the forward part of the sail to avoid excessive heeling to leeward. It may also be necessary to temporarily let the sail out even further if you are tipped quickly in a strong puff of wind. However, keep in mind that a little tipping is natural, and if you are too timid and luff the sail too much to the point where the boat is not moving forward through the water, you will lose your ability to control the boat's course.

7 Helming the Boat

Steering the boat takes a little practice before you really feel comfortable. You will quickly learn you must move the tiller the opposite way from the way you would like the bow to go. The best way to get started is to pick a course that will take you at right angles to the wind direction and pick a target on the far shore to aim at. This would be sailing on a *beam reach*. Sit on the *windward* side of the boat (the side the wind is coming from – also the side opposite the sail) so you can see the luff of the sail and also balance the natural tendency of the wind to tip the boat to leeward. Also sit far enough forward in the boat so the tiller will pass by your body as you move the tiller from side to side. A good spot to sit is on the *thwart* with both feet in back of this seat. If the wind increases and the boat tips to leeward you can move to sit on the *gunwale* (side). How the boat sits in the water will have a strong effect on how the boat steers, so perhaps we should discuss “Trim of the Boat”.

8 Trimming the Boat

The stability of our small sail boat depends largely upon the weight of one or two people sailing in the boat as ballast and working to

balance the pressure of the wind on the sail. Without this additional weight of people, the boat itself would not have the stability to support the sail even in a very light breeze. The almost constant shifting of your body position as you maneuver the boat is essential to skillful sailing. Watch to windward for the dark patches where fresh puffs of wind darken the water with small ripples. These give advance warning to the skipper of increased winds soon to reach his boat. An alert skipper is always aware of what sort of winds will strike his boat in the next few moments.

The athwartship level or side to side trim of the boat particularly, (and the fore and aft level to a lesser degree) has a very noticeable influence on the steering and balance of our boat. If the boat tips down to leeward slightly, the boat will have the desirable tendency to turn toward the wind, called *weather helm*. If the boat is tipped more, this tendency increases to an undesirable degree and excessive rudder angle must be used to keep the boat on a straight course. The boat is said to have a *heavy weather helm* or too much *weather helm*. Conversely, if one heels the boat to windward, the boat has a tendency to turn away from the wind or create a *lee helm* which is considered undesirable at all times. Remember – if the boat is tipped either way, you must retain a hold on the tiller or the boat will spin around. If you should panic at the tipping, you need only to let go of the sail to equalize the situation. The alteration in steering forces is of course influenced by the distorted shape of the immersed part of the hull as well as by the greater turning forces on the sail due to the increased inclination from the supporting hull. To become familiar with this effect of shifting weight, experiment with your weight in different positions on some of your early sails. Move your weight to windward or leeward and adjust your sail trim to control the helm. You will soon become familiar with the effect of heel on the pressure against the rudder.

der and learn to anticipate and compensate instinctively and thus become a better helmsman very early. The skipper should never sit on the stern flotation tank as his weight is too far aft for proper balance, and he is in the way of his tiller and cannot easily steer a course to leeward without jamming the tiller against his body.

9 Tacking and Jibing

If you started off across the river or lake on a reach as we suggested for your initial sail, you will eventually reach a point where you must turn and head back. If the turn changes the wind from one side of the boat to the other, you will have tacked or jibed. It will be a *tack* (also called coming about) if you turn the bow of the boat through the eye of the wind, and it will be a *jibe* if you turn the stern through the eye of the wind. Since the sail reacts quite differently to the two types of turns, it is of the utmost importance that you know which maneuver you are performing.

In a small boat such as the Tech Dinghy, the tack is a safer maneuver so you should start with the tack rather than the jibe. The closest angle you can expect to sail toward the wind is a 45° angle, so to perform a tack you must turn a minimum of 90° to complete the tack. If you are going from a beam reach in one direction to a beam reach in the opposite direction, a 180° turn will be required. Since the sail will be luffing during most of the tack it is important the boat have good speed (relative to the given wind speed) through the water. If the sail is well out or luffing, trim the boom into the back corner of the hull if you can do so without causing excessive tipping to leeward. Ideally the sail should be trimmed as the turn into the tack is started, however, during the learning process it would be permissible to trim in first. Ease the tiller to leeward to start the tack, but keep your body weight to windward initially to avoid throwing the boat out of balance. Watch

the sail and when the boom starts toward you, duck under the boom and move toward the new windward side by standing momentarily and pivoting around facing the bow (it is important to be able to watch the luff of the sail and see just where your bow is pointing). Bring your hand holding the *sheet* (the rope which controls the sail) behind your back to collect the tiller, letting the sheet slide through your hand and maintaining only enough pressure on the line to keep it from running out. Do not straighten the tiller until the sail stops luffing or until the boat swings further to some point you now wish to head for. Straightening the tiller before the sail stops luffing will leave the boat stuck *in irons* (stopped headed into the wind). Failure to straighten the tiller after the tack will cause the boat to keep turning until it jibes. After the tack, adjust your weight for good boat trim and take the sheet in the forward hand, and adjust the sail to assure it is properly trimmed for the course you have selected (so it is just on the verge of luffing).

Jibing is the opposite of tacking, and as we said earlier, involves a turn that moves the stern through the eye of the wind. Unlike the tack, the sail will cross quickly to the new side without any luffing, and in a strong wind this sudden change of wind pressure from one side of the boat to the other can cause a capsize if precautions are not taken. Also, unlike the tack, a large change of course is not necessary for a jibe to occur. If the boat is already sailing on a *run* (a course where the wind is at the stern) a change of course of a few degrees – or a wind shift of a few degrees, can cause a jibe.

To perform a controlled jibe, move the tiller to windward (away from the sail) and immediately reach around behind your back with the forward hand to hold the tiller to windward. At the same time move your weight to the centerline of the boat again facing toward the bow. The maneuver of moving your weight can be done with you in a deep knee squat, thus keeping your head low and out of

the way of the boom. As you become more confident, you can stand and duck at the appropriate time and be in a better position to move your weight to keep the boat level. In a larger, more stable boat you would trim the sail all the way in and ease it out again on the new leeward side to cushion the shock of the boom snapping from one side to the other. In a boat as small as the Tech, trimming the sail more than half way in may cause excessive tipping to leeward, however, it is desirable to trim the sail half way in so the wind can get behind the leech of the sail and force the sail across without your having to sail too much *by-the-lee* (where the wind is striking the leeward side of the boat). You should watch the telltale on the stay to see when you are *by-the-lee* and watch the leech of the sail since it will fold toward you just before the boom is blown across. If it is quite windy, get the tiller back to the centerline of the boat as soon as you see the sail start to move across so you will not end your jibe on a beam reach and consequently be tipped excessively to leeward. Also ease out the sail as soon as it crosses the boat to prevent tipping. After the jibe, adjust your weight for good boat trim and also check your sail for proper trim.

10 Beating to Windward

To take a boat upwind is the most demanding task for the sailor. In a race, this is the leg where the good sailors will most easily move past the beginners. We already know we cannot sail closer than 45° to the wind direction, so if our destination is somewhere upwind, we must sail close hauled on one tack then come about and continue close hauled on the new tack. Sailing close hauled is different from all other points of sailing because the sail is set at a particular place over the boat and the whole boat is moved toward or away from the wind to keep the sail on the verge of luffing. For the Tech, the end of the boom should be kept

over the stern corner, perhaps where one end of the traveler line comes through the stern deck. If the wind is very light, it will be better to keep the boom further outboard of this point, and if the wind is stronger, the boom can be trimmed inboard of this point if you can hike the boat down and keep it from heeling excessively to leeward. For any given wind strength, it is while close-hauled that you will tip the most. Learn how to hook a toe under the thwart seat so you can *hike* (lean out) and apply some leverage to hold the boat down. Perhaps now is the time to start using the tiller extension (Figure 1) so you can get your weight over the side and still keep the tiller near the centerline of the boat. The tiller extension is not recommended for your early sails because it can get caught in various places and interfere with your steering. However, once mastered, the tiller extension is a valuable tool and essential in boats like the Larks and Lasers used at MIT.

In a puff it may be necessary to spill some wind by easing out the sail to avoid excessive heel or weather helm. Once the puff has passed, or you have moved your weight to windward to offset the force of the wind, the sail must come back in if you expect to sail your highest possible course at maximum speed. Furthermore, the luff of the sail must be watched about 90 percent of the time and the tiller kept in constant but gentle movement as you seek the optimal course. You will soon learn that minute changes of course as well as minute changes in sail trim (even as little as 1 inch) can be major factors in performance.

11 Getting out of Irons

In irons or *in stays* is the condition where a boat is luffing in the wind without forward motion and, therefore, without ability to steer or without steerage way. To get a boat out of irons, push the tiller toward the side in which you want the bow to turn and wait for the boat

to make sternway, then steer the boat out to a course where the sail can be trimmed. Sternway can also be started by holding the boom out over the side into the wind. You can also use the rudder as a paddle to give you headway by making quick movements to one side or by a combination of both. It should be evident that forward or backward movement of the boat is necessary to get response from the rudder.

12 Shoving off or Landing at the Dock

When the Tech is at the front of the dock, it should be headed along the dock in the direction that allows the bow to be pointed closest into the wind and with the sail luffing. To get away from the dock, check the wind to see where you must head to be able to fill the sail, and determine what will be the windward side so you will know where to sit. Get the boat moving along the dock so the tiller will work and steer onto the course you have determined is necessary to fill your sail. You can start by sitting in the boat and pulling yourself along to get some speed while you steer away with the other hand, or you can stand on the dock holding the stay, take a few steps along the dock to develop speed, giving one final push out as you step into the departing boat. As you might imagine, the latter method takes a little more agility and understanding of the hull's stability. Keep your sail luffing until the momentum of your push carries the boat to a course which will allow the sail to seek the leeward side.

To make a landing, you must again carefully check the wind on the club's flag to determine which direction is most upwind. Approach to the leeward side of the spot you expect to land in so you will have room to turn up into your spot. Since you have no brakes, you must be prepared to luff your sail to slow down. If you misjudge when to let out the sail and let it out too soon (and lose your headway before your destination is realized), you will lose the

ability to steer. Try to touch the dock with the part of your hull where the stay goes through the gunwale, and as soon as you touch, move the tiller away from the dock to increase the friction and thus stop the boat quicker. A final word of advice avoid the tendency of making your turn too early and thus using up all your turning room. Also, in the first few landings, select a spot with plenty of room on either side in which to land.

13 The Centerboard

The hull of the boat has a flat and comparatively wide immersed underbody which requires a retractable blade, called a *centerboard*, to prevent the boat from sliding sideways and to force the hull to progress forward when wind pressure is applied through the sails. This board may be left lowered at all times while learning to sail, however, it is usually retracted partially or wholly when sailing off the wind when racing to reduce the resistance or drag and increase the boat's speed. The centerboard may also be raised slightly to adjust the balance between sail and underwater shape to make steering easier. The novice should leave the centerboard down until he has mastered more important details of sailing. Raising the centerboard will increase rolling and reduce the boat's stability.

Larger boats, such as MIT's Rhodes 19's, have a fixed keel in place of the centerboard. This heavy keel gives the boat the additional advantage of much more stability and makes it difficult to capsize. It has the disadvantage of making the boats difficult to take out of the water.

14 Crew's Position in the Boat

The crew should sit forward of the cross seat or thwart but preferably fairly close to it since

weight in the bow or narrow part of the boat depresses the bow, makes the boat harder to steer, and also allows waves to slap in. If two persons are carried besides the helmsman, they should sit on the floor on either side of the centerboard with their backs resting against the seat. Their weight will then be in the center of the boat and evenly dispersed. If a single crew is carried in light air, his weight probably would be best to leeward (the side the sail is carried on), but in a stronger wind he should move across to help keep the boat heeled only slightly to leeward.

15 Points of Sailing

The points of sailing (shown in Figure 3) are terms of general reference with the wind at different angles to the centerline of your sailboat. The purpose of this section is to provide a review of earlier instruction and an overview of the basic concepts. Starting with the No. 1 position, the boat is shown headed into the wind with the sail luffing as it would be when at the mooring. The boat in position No. 2 is sailing as close to the wind as possible, actually 45 degrees from the wind direction or axis. When sailing *close hauled* (position No. 2) the sails are hauled in to the stern corner of the boat as far and as flat as possible and still have draft (curve) enough to propel the boat. Since the sail luffs when the boat reaches 45 degrees from the wind's axis, it is evident that there is a total angle of 90 degrees in which it is not possible to sail. To reach a destination in this quadrant it is necessary to make a series of *tacks* with the wind first on one side of the boat then on the other, zigzagging at angles 45 degrees from the wind's axis. This is called *beating to windward* and the boat is said to be *close hauled* or *on the wind*. The technique used in sailing to windward is to leave the sail trimmed in the same position over the corner of the stern and adjust the course of the boat to any variations in the wind's direc-

tion while keeping the sail at the luffing point. The sail should be let out only if the boat tips excessively to leeward. The boat in position No. 3 is *reaching* with the wind at right angles to the boat's course. The point of sailing is a *beam reach* and is off-the-wind or sailing free. The technique for sailing a course is to keep the boat on a straight course and adjust the sail until it is trimmed in just enough to keep it from luffing. Luffing will start at the section of the sail near the mast and it is this section which must be watched closely. To check sail trim, let the sail out until it starts to luff and then trim it in only enough to stop luffing. The sail is adjusted to variations in the wind's direction and the course is kept steady. It should be noted that in the case of boat No. 2, sailing to windward, close hauled, the course of the boat is altered with the variations in the wind's direction while in the case of boat No. 3, on a reach, the trim of the sails is altered and the boat's course held steady. In both instances the luff of the sail near the mast is kept just at the luffing point. Boat No. 4 is headed on a course 135 degrees away from the wind's axis with the wind blowing over the stern quarter. This point of sailing is called *broad reaching* and may also be designated as *off-the-wind*, a term used to designate all courses not close hauled.

Position No. 5 shows the boat sailing directly *before the wind*. Since the wind's axis corresponds with the centerline and course of the boat, the sail could be carried on either side. The maneuver of changing the sail from one side to the other is called *jibing* (also *gybing*). Jibing is accomplished by moving the tiller away from the sail and trimming in the sail and then letting it run out quickly on the other side. When the wind is blowing slightly over the same side that the sail is on, you are *sailing-by-the-lee*. If sailed too much by the lee, the boat may accidentally jibe when the skipper does not expect it. Accidental jibes are our most frequent cause of swampings because

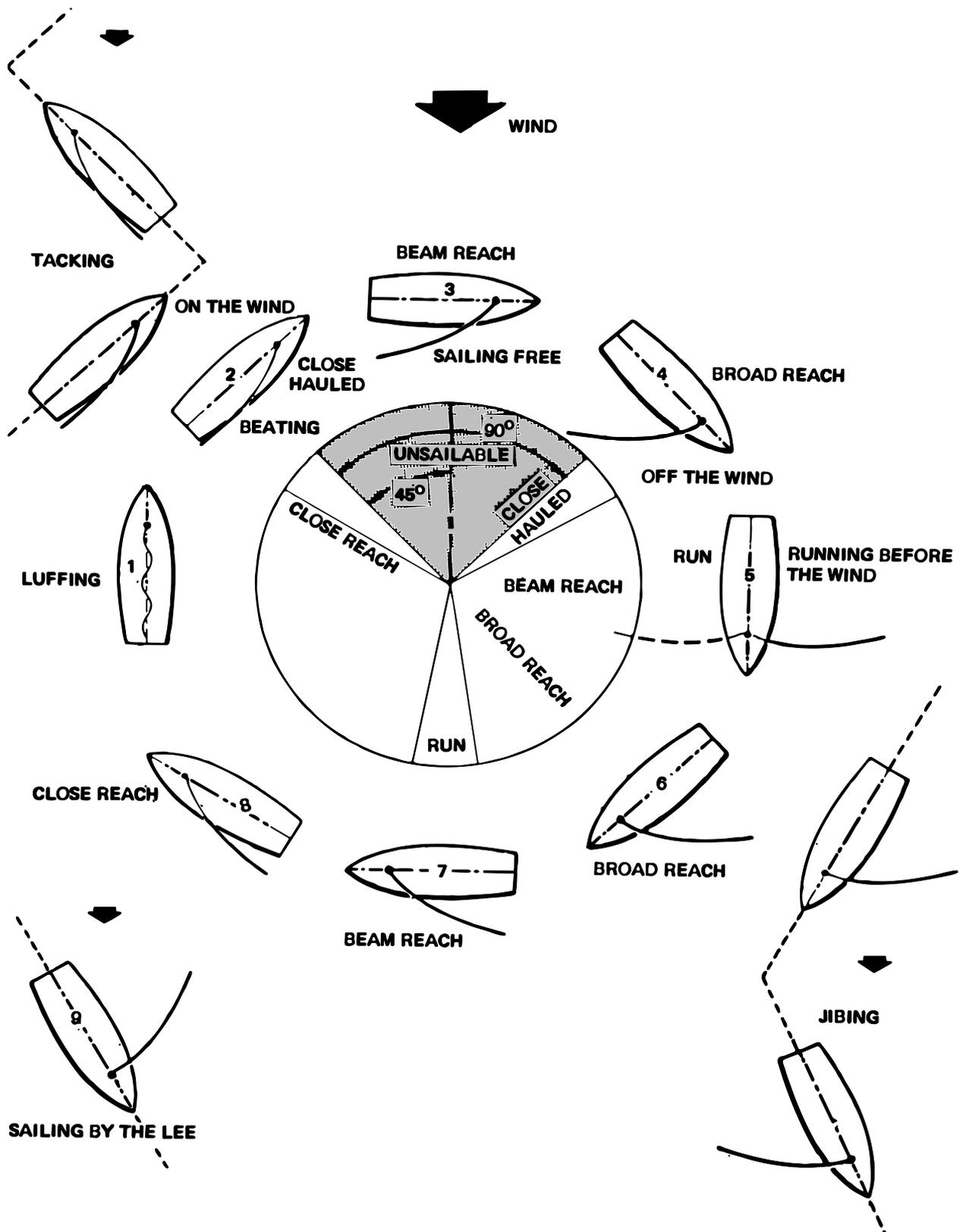


Figure 3. Points of Sailing

the skipper is caught off balance and is on the wrong side of the boat.

Boat No. 6 having jibed, is shown *broad reaching*, as was boat No. 4, but on the starboard tack. No. 7 boat is shown on the starboard tack and is on a beam reach corresponding to No 3. Boat No. 8 is shown on a *close reach* which is similar to the beam reach shown in position No. 3, but with sails almost close hauled.

Tacking is the maneuver of turning the bow of the boat through the eye of the wind so the sail swings from one side to the other and is shown by the three positions, Nos. 8, 1, and 2.

16 A Few Odds and Ends

If you have passengers (a crew), let them know what you want from them in advance of any maneuver. If they need to move their weight or help with the sails on a larger boat, explain what you want and give a warning. For tacking, the traditional hail is *ready about* and for jibing, *prepare to jibe*.

Many beginners have trouble trimming sail because one hand appears completely occupied in steering the boat. Use your thumb and fore finger of the tiller hand to grasp the sheet temporarily when you have to haul the sail in.

Many sails have yarn taped to both sides of the middle of the sail just back from the luff. These *sail ticklers* are used to gauge wind flow along the sail, and when they are working ideally, they will be parallel and stream back toward the leech. If the windward yarn is spinning about, the sail is about to luff and you should trim in or, if already trimmed into close-hauled, turn the boat away from the wind direction. If the leeward yarn is spinning about as you observe it through the translucent sail, your sail is in too tight and should be eased or your course altered toward the wind.

An improper sail set is a sure sign of an inexperienced sailor. On the Tech it is very important to get the sail to the top of the mast. If the

boom vang is tight or the *downhaul* made fast when you raise the sail, the sail will not go to the top of the mast. If the sail is not to the top, your boom will be lower than it should be, and there will be insufficient room between the tack of the sail and the gooseneck to apply tension to the luff of the sail. The downhaul should be tensioned enough to remove any wrinkles that radiate from the luff toward the clew of the sail. These wrinkles indicate the *draft* (the maximum point of curvature in the sail) has moved too far aft. The stronger the wind, the more tension you will need on the *downhaul* to keep out the wrinkles when the sail is full and pulling. The *outhaul* should also be adjusted according to the strength of the wind. For light winds or rough water you want to develop more drive in the sail by leaving 6 to 8 inches of curve between the point of maximum curve of the foot of the sail and the boom. As the wind increases and the boat becomes overpowered, continue to tighten the outhaul and reduce the curve in the sail to reduce the heeling force. Even if possible, it would never be desirable to completely flatten the sail, since the sail would not work if it was completely flat. The purpose of the *boom vang* is to prevent the top of the leech from twisting too far off to leeward and spilling the wind. A little twist in the leech is desirable in light winds, so the vang should not be set up tight in these conditions. The vang will be most important on reaches and runs when the main sheet isn't effective in applying a downward force on the sail. As the wind increases, continue to tighten your vang to control leech twist. The *traveler* line should always be light enough so the traveler blocks never come close to the boom blocks, and in actual practice, most sailors will set the line tight enough so the traveler blocks just clear over the top of the tiller on tacks and jibes.

Light winds present special problems. If the wind is too light to tip the boat to leeward, you must move your own weight to leeward so gravity and the weight of your boom will hold the

desired shape in the sail. Sit on the thwart and hold the sheet directly from the boom block so you can make the many adjustments which are necessary in the light variable wind. Set your sail up for maximum fullness and watch your tell tale on the stay for changes in wind direction. Watch the water for wind puffs.

Strong winds also present problems, and the Helmsman's rating checkoff consists of single handed sailing in these strong winds. It is of utmost importance to quickly and constantly move your body weight back and forth from the thwart to the gunwale and often to a full hiked out position. Many quick adjustments in the sail trim must be made to parry the puffs and keep the boat on its feet and thus prevent excessive weather or leeward helm. Use of the hiking stick or tiller extension is a necessity. Hold the sheet from the centerboard trunk's *ratchet block* (with the click turned on) for best sail control. Be especially alert to puffs of wind moving toward you so you will be ready to hike out, let out the sheet, or both together.

The tiller extension can be a great aid in handling the boat once you have learned how to keep from getting it stuck unintentionally when you are doing your tacks or jibes. A good way to accomplish the switch over is to slide your hand in along the extension, toward the tiller, just as you move your body around the tiller. As you move your body, flip the extension toward the stern and around to the new side, so it will be ready to grab behind your back as you pivot your body around and settle on the new windward side.

17 The Basic Course

Our method of teaching novices to sail at MIT's Shore School is to start on the easiest possible course. To do this, a reaching course is set up between two buoys and the novice is required to tack around each buoy (Figure 4). Since other boats will probably be sailing this course, you must know the right-of-

way rules, because the boats approach head on. Concentrate on sailing a straight course to develop a reflex action response for using the tiller. Concentrate on boat balance and sail trim. Remember, letting out the sail will stop the boat from tipping. A variation of the two buoy course is to travel around the buoys in a circular direction so that you tack at one end of the course and jibe at the other end.

After the novice has become proficient on the simple two-buoy course, a third buoy is put out to windward so that it becomes necessary to sail close hauled and beat-to-windward to get to and turn the buoy (Figure 5). It will be necessary to *jibe* at one of the buoys after a run or broad reach unless we wish to sail beyond the buoy, turn up into the wind close hauled, and then tack. This maneuver is used when the wind is too strong for the novice to jibe or if he feels insecure and wishes to make the safest kind of turn.

18 Rules of the Road

When two sailing vessels are approaching one another so as to involve risk of collision, one of them shall keep out of the way of the other as follows:

1. Boats sailing on the *port tack* give way to boats sailing on the *starboard tack*. A boat is on the tack corresponding to the side over which the wind blows, the side opposite to which the main boom is carried. A boat is on the *port tack* when the boom is on the starboard side (or right side).
2. Of two boats on the same *tack*, the *windward* boat keeps clear.
3. In addition, any vessel *overtaking* any other shall keep out of the way of the overtaken vessel. Every vessel coming up on another vessel from any direction more than 22 degrees (2 points) abaft her beam

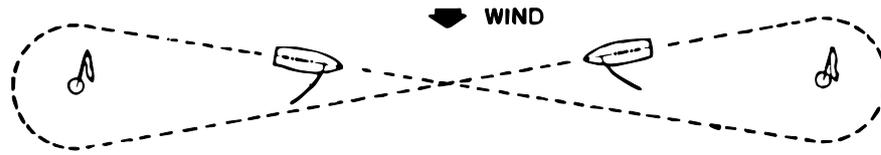


Figure 4. Beginner's Reaching Course

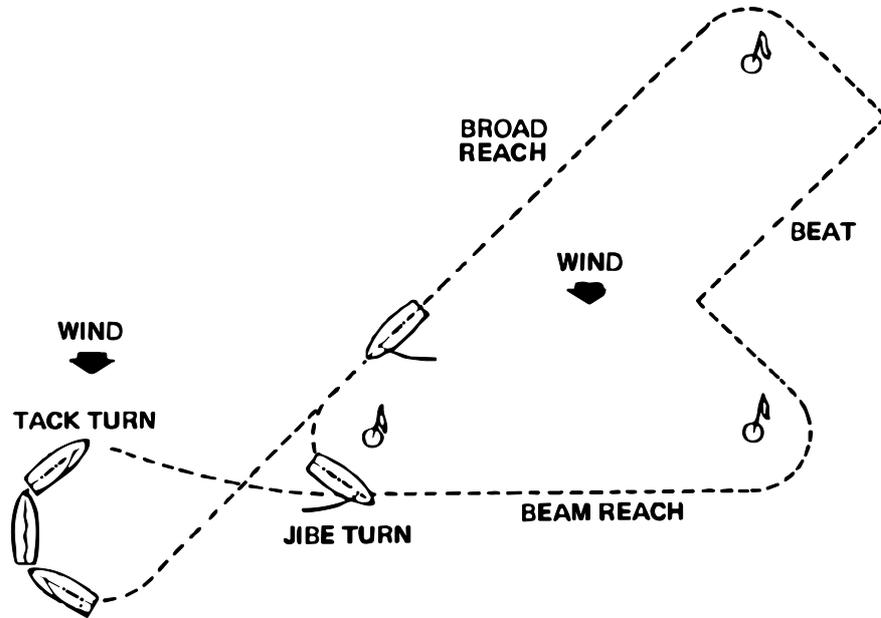


Figure 5. Expanded Course with Windward Buoy

shall be an overtaking vessel. If the overtaking vessel cannot determine with certainty whether she is forward of or abaft this direction from the other vessel, she shall assume that she is an overtaking vessel and keep out of the way.

4. Crew shells and rowboats generally have right of way over sail and power boats.
5. Sail generally has right of way over power boats — but do not always count on getting it.

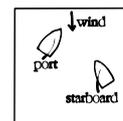


Figure 13.

There are exceptions to these rules such as boats towing something and large ships in a narrow channel.

19 Precautions (from Provisional sheet)

1. Helmsmen are responsible that non-swimmers are *not* taken out in boats

(MITNA Rule No. 1).

2. Proper method of cleating halyard is to use the slip hitch rather than half hitch when fastening to clean.
3. Maximum number of people in boats: Dinghies, 3; R-19s, 8; Larks, 420s & FJs, 2; Finns and Lasers, 1.
4. Procedure after capsizing:

Most important — stay with the boat! If the boat is floating on its side, get out of the boat to keep it from turning upside down (called turtling the boat), and swim to the centerboard. Avoid hanging on the hull so that the hull will float with maximum buoyancy. Then pull on the end of the centerboard to roll the boat upright. Climb back into the hull over the windward side; raise the centerboard halfway and sit well back so the water won't surge back and forth and tend to steer the boat. With careful balancing you should get back to the dock where you can pump out the boat.

If you are unsuccessful in sailing back full of water, drop the sail and the launch will come out to make a rescue. The launch driver will instruct you how to assist for the tow in.

5. Explain recall signals (MITNA Rule No. 16).
6. Care of the boat at the dock — tie boat clear of other boats in the water, and make sure your boom does not beat against boats on the dock. Boats should not be left unattended at the dock. Sails should not be left up in a strong breeze while boat is at dock because stitching in the sail can be damaged.

20 Man Overboard Procedure (Fig. 6)

If you lose a crew member overboard you want to get back to him quickly but be able to stop completely when you arrive back to where he is in the water. To get back to your crew overboard, sail away from him on a beam reach for a distance of 3 to 4 boat lengths, and then execute a quick, tight jibe, and let the sail luff. You can now proceed back toward the person in the water on a beam reach and trim sail if you are not returning quickly enough or push the sail (boom) to leeward and against the wind to slow the boat if you are going to arrive with too much speed. The boat should be just about stopped when the person is abeam the boat. Make the pickup on your windward side so you can control the tipping. This maneuver is normally practiced with the life jacket which you can of course whip out of the water while still travelling at a good clip. Instead, try to imagine this life jacket is a 200 pound person, who, if you attempt to pickup with too much speed, will grab the boat, act as a sea anchor, pull the side he is holding to leeward, and capsize the boat. With too much speed you might also run over an injured person you are trying to rescue.

21 A short list of Nautical Terms

windward The side the wind is coming from or the side of the boat opposite the boom.

leeward Opposite of windward.

starboard The right side as you face the bow (from inside the boat).

port The left side.

forward Toward the bow.

aft Toward the stern.

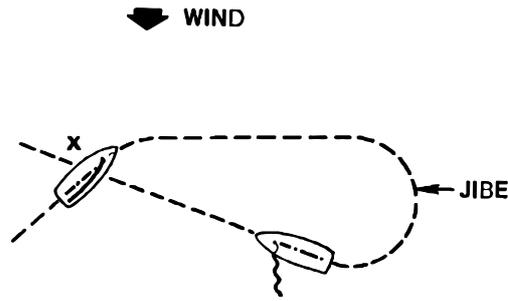


Figure 6. Man Overboard

head up To turn the boat toward the wind (also called *luffing up*).

bear off To turn the boat away from the wind.

jibe A turn whereby the wind moves from one side of the boat to the other across the stern and causes the sail to change sides.

tack (*come about*) Same as above except wind moves across the bow.

by the lee Running with the wind blowing over the leeward quarter (boat is in danger of accidentally jibing).

on the wind Sailing close hauled.

broad reach Sailing free with the wind over the windward back quarter.

sailing free All points of sailing other than close hauled.

ease To let the sail out.

trim (of boats) A boat is in proper trim when it sits on its waterline when in the water.

ready about Command preparatory to tacking.

prepare to jibe Command preparatory to jibing.

pinching Sailing too close to the wind (in a stalled position).

hiking Leaning out to windward in order to hold the boat in proper trim.

shooting to windward A maneuver whereby the boat is turned into the wind and control of the boat is dependent on the momentum left before the sails were luffed.

weather helm When the tiller must be held to windward of the centerline to keep the boat on course.

lee helm Opposite of weather helm.

heavy weather Strong winds.

heeling Tipping of the boat to windward or leeward.

22 Anchors

An anchor is used to tie a boat to the bottom. To accomplish this it must either be heavy or very effective at digging its flukes into the bottom. Four common types of anchors (Navy, Mushroom, Kedge and Danforth) are described; however, many other varieties exist.

Navy Anchor (Figure 7) The navy anchor digs in only slightly and relies largely on its weight. Because of this, it is almost useless in any size that could be carried on a small boat and is used only for large ships.

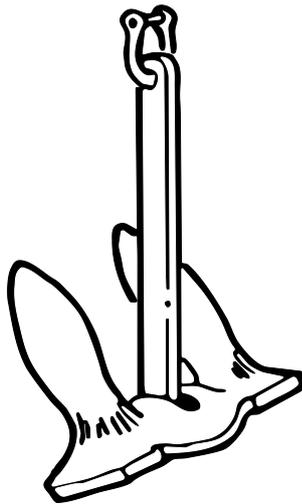


Figure 7.

Mushroom Anchor (Figure 8) The mushroom anchor is used for permanent moorings, is heavy, and takes a long time to bury itself. Once buried, however, it is almost impossible to pull out. A sixteen foot sail boat might use a mushroom anchor (weighing 100 lbs) for mooring.

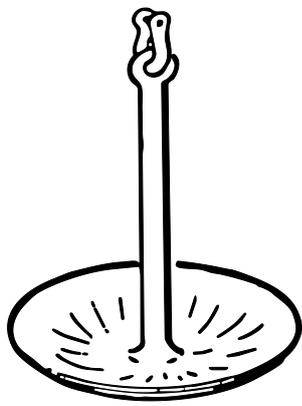


Figure 8.

Kedge Anchor (Figure 9) The kedge is the traditional small boat anchor. It has a movable stock so that it can be folded into a more convenient shape. This style of anchor, while heavy for its holding power, is very reliable in almost any type of bottom since its flukes

dig in easily and deeply. Some care is needed not to foul the anchor line on the protruding arm and stock when the boat swings to wind change. A sixteen foot boat might use a kedge anchor weighing 20 pounds. Its main drawback is that even relatively light kedge anchors take considerable space to store away.

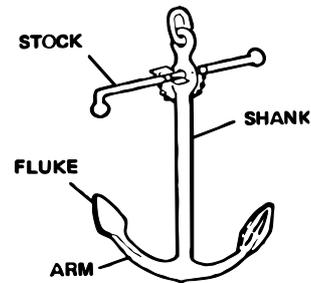


Figure 9.

Danforth Anchor (Figure 10) The Danforth is a lightweight anchor that has very good holding power because of the large size of its flukes. It will foul easily in kelp and weeds and needs a good length of chain to keep the shank from being lifted too high which can result in breaking out the anchor. It holds best in sand, less well in mud, and is unreliable on a rocky or weedy bottom. A sixteen foot boat might use a 10 pound anchor of this type. Because of its compact size, this anchor is most popular for casual mooring. A shift in the wind direction, however, may cause the Danforth to pull out and skim along the bottom before the flukes can catch again.

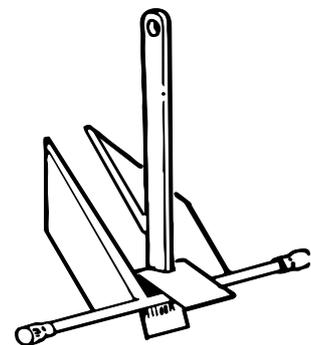


Figure 10.

23 Fittings

In addition to the fittings shown in the diagrams of the Tech Dinghy (Figures 1 and 2), the following fittings exist on some of our other boats. For the crew rating one must be able to identify and understand the use of all fittings shown or listed.

chain plate	winch
turnbuckle or shroud adjuster	cable or rope thimbles
jib hank or snap halyard lock	clevis pin
spinnaker-pole, mast ring and topping lift	shackle
hiking straps	cotter pin
leech lines	cleats (different types)
spinnaker sheet or guy	self bailers and scuppers
guy or reaching hook	twing line
snap hook	sail ticklers
eye strap	

24 Anchoring

Any anchor works best when a length of chain about $\frac{1}{3}$ the length of the boat is fastened between the anchor and line. This lessens the shock of the boat's movements which can break the anchor loose. For this reason also, nylon, which stretches, works best for the anchor line. This line should be 3 to 7 times the depth of the water at high tide (see Figure 11).

To lower the anchor, wait until the boat has stopped moving forward, then lower the anchor and line hand over hand at a steady rate as the boat begins to drift back. When about 2 times the depth has been let out, a gentle tug on the line will set the anchor and the full scope or length can be let out and the line made fast. There should, of course, be plenty of water for the boat to swing in a full circle around the anchor.

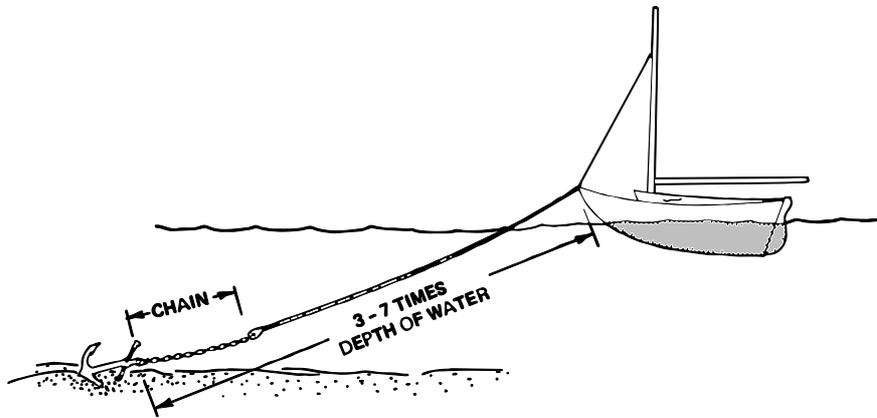


Figure 11.

25 Whipping and Splicing

Whipping and splicing are difficult to depict graphically. However, there is a display board in the Shore School Classroom, and the staff is also happy to assist you on a one-to-one basis.

25.1 Whipping

Rope ends, if left unbound, tend to unravel. To prevent this we bind or “whip” the ends with a fine, waxed yarn or twine before the rope is used. There are several methods for whipping rope ends; the easiest and least durable is called Ordinary Whipping; slightly more difficult, but more permanent, is Needle Whipping. Modern lines of synthetic material can be melted with a match or soldering iron causing the fibers to fuse together to form a temporary fastening.

25.1.1 Ordinary Whipping (Figure 12)

An ordinary whipping is made by placing the end of the yarn at the end of the rope and laying a loop along the rope. The yarn is then tightly wound around both loop and rope, binding them together. Wind to a length roughly equal to two diameters of the rope you are whipping.

The whipping is finished by putting the winding end B through the loop, then pulling end A tight until the loop is drawn back out of sight. Both A and B should be trimmed flush with the whipping and the rope then cut to length.

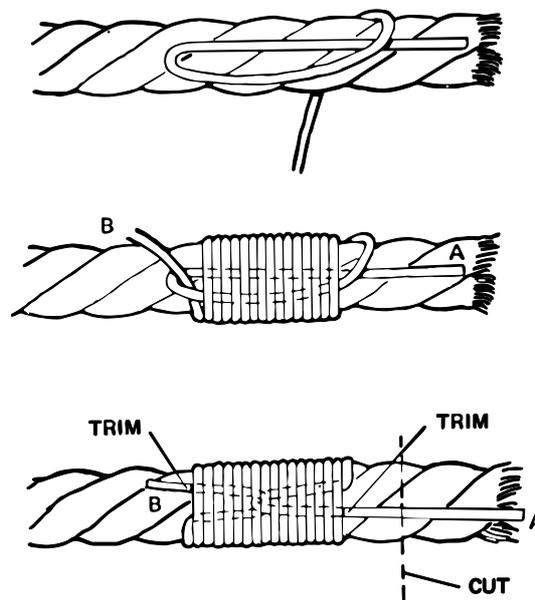


Figure 12.

25.1.2 Sewn or Needle Whipping (Figure 13)

The sewn or needle whipping is the best method of assuring your line or rope stays tightly wrapped and strong. Make a knot in the end of a section of twine that you have threaded through a sail needle. Tuck the whipping twine under a strand and pull the knot up inside the rope so there will be no bump under the wraps. Make your wrappings toward the end of the line until you have enough wraps to equal one diameter of the rope you are whipping. Bring the needle under a strand and bring your whipping twine back over your wrapping following the valley or twist in the rope, and tuck the needle under a strand on the inside edge of the wrappings. Continue this process until all valleys (3) are covered.

Your twine should now be back on the inside end of your wrapping. To finish your whipping, sew the needle back through the interior of the line making a number of insertions until the twine is 3"-4" in from your wrappings. Trim the twine close to the line and trim the line below the whip for a neat job. When done properly it should be difficult to see where the whipping starts or finishes.

The whipping is often done with a doubled whipping twine to speed the process.

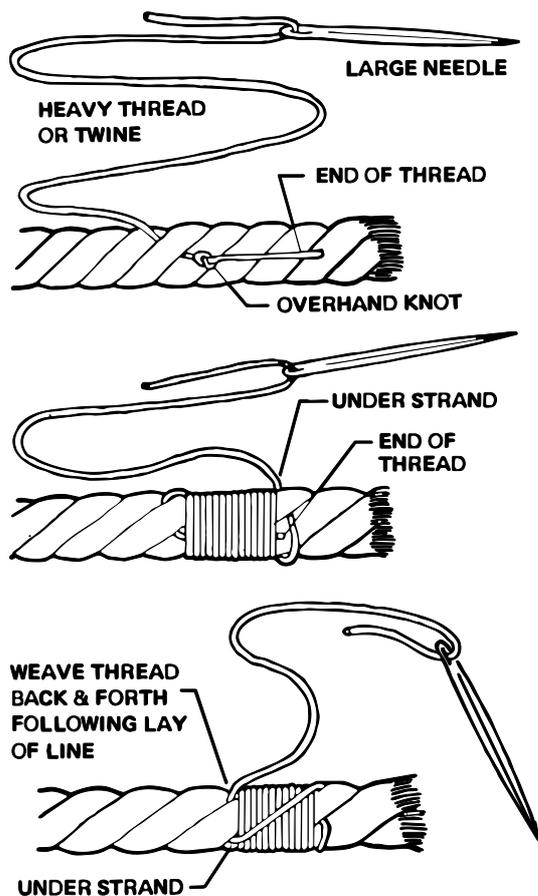


Figure 13.

25.2 Splicing

There are many different kinds of splices for specific uses, but the average small-boat skipper generally needs but two — the *eye splice* for forming a permanent loop, as in the dock

line, and the *short splice* for joining two lines without a knot. The traditional three-ply twisted line is the type generally used. Practice line is available in the Shore School Room.

25.2.1 Eye Splice (figure 14)

To get started on the eye splice unlay the end of the line for about 6" and locate the top center strand (strand b in Figure 14(1)). The whipping shown in the diagrams is optional and not necessary on our own practice rope. Decide how big a loop you want in your eye splice and slightly untwist the rope at the point where you plan to rejoin the loop. Form a loop and tuck the top center strand under one strand of a portion of the line that you have untwisted slightly (see Figure 14(2)). Allow the other two strands to straddle this portion of the line. Next, take strand **A**, go over the strand it is resting on and tuck under the next strand — starting in where your first strand, **B**, is coming out (Figure 14(3)). To make fast the last strand **C**, turn your half-completed loop over so strand **C** is on top (Figure 14(4)). Tuck strand **C** under where strand **A** is coming out, but once again make the tuck with the strand toward the left (Figure 14(5)). With one set now tucked, each strand should be exiting from a different opening, and all should be at the same level in the line. Tighten each strand so there is no slack where the strands join the line, and continue to make at least two more sets of tucks going over and under with each strand as in Figure 14(3) and (6). Be sure to rotate the line and make each tuck to the left. Tucks are only made under strands from the interior portion of the line and never under sections of the strands which are actually being tucked.

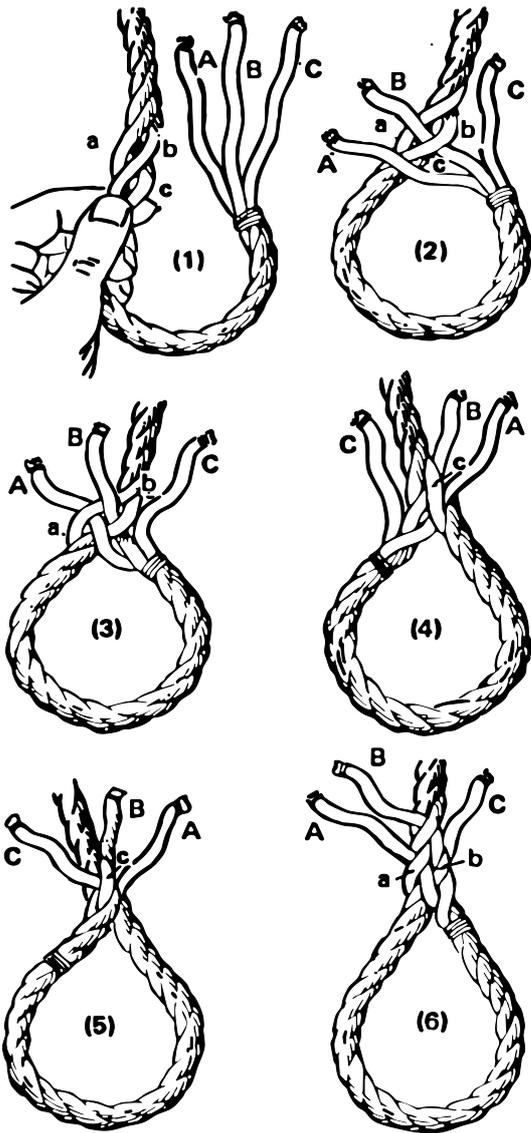


Figure 14.

25.2.2 Short Splice (figure 15)

The short splice should now be simple for you. Unlay about 4" from two ends of rope and join the lines so each strand is separated by strands from the other line. See Figure 15(1). Move the lines together until the joint is firm and wrap or tape the joint as shown in Figure 15(2). Refer to Figure 15(3)-(6) for the remaining steps. The strands radiating from the joint area should look just like the eye splice

after you have completed the first set of tucks. Do two or three sets of tucks on each side of the joint taking extra care to assure the line is firm and tight at the joint. Roll the completed splice back and forth in the palms of your hands to improve the symmetry of the splice, and trim or burn excessive ends for a neat job.

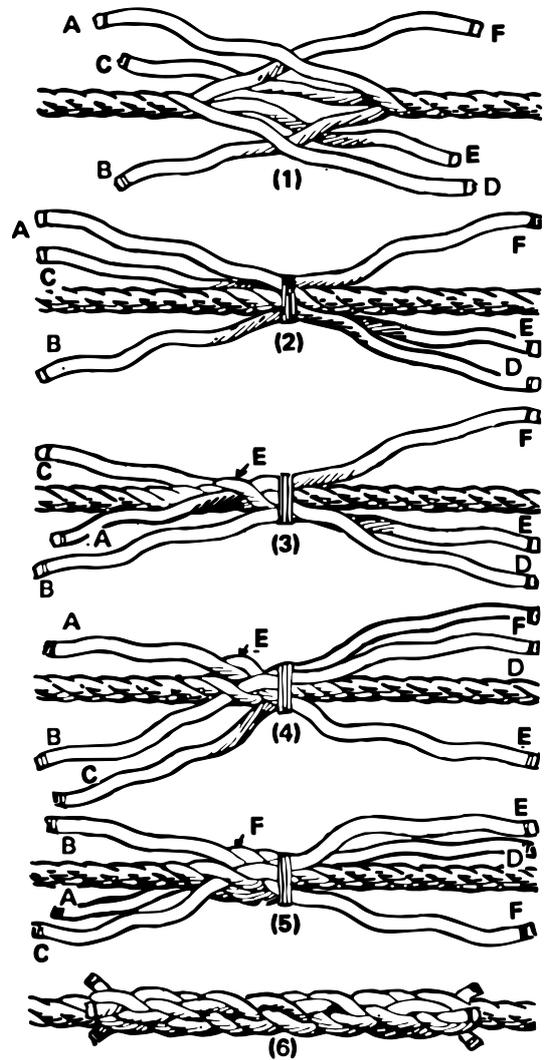


Figure 15.

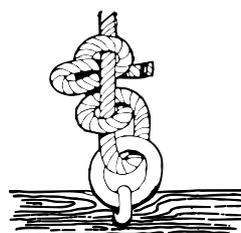
26 Some extra tips that may help

1. If you are used to larger, more stable boats you might have a problem with our lighter boats. Adjustment of your (and your crew's) weight is paramount. If you can sail, but are not experienced in small boats, we can spot you immediately and we worry about you! Read the paragraph in this booklet regarding body movements.
2. Using the tiller extension gives the skipper far greater flexibility in moving around in the boat. Learn to use it! Hold the extension in front of your stomach (not at your hip). Grasp the extension with your thumb pointed toward the end of the extension (not pointed toward the tiller). This allows the tiller hand to also double up on trimming the mainsheet. If you are not hiked out, choke up on the extension and keep both hands comfortably in front of your body where you will have maximum range of movement.
3. If you go aground on the Boston shore try to protect the rudder and centerboard — pull them up. Exercise caution on stepping out. The stones are slippery and unstable — there can be broken glass. Most boats that go aground have gotten too close and messed up their tack. If you are luffing your sail in strong wind and waves you may not have enough momentum to punch through the wind. Leave yourself enough room for a second tack after you have trimmed your sail and regained some speed.
4. If you are uncertain that you have rigged your boat up optimally *please* ask us to check it over. This is not an inconvenience for us — we *want* to do it for you.
5. We want you to do your Provisional check

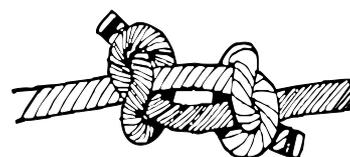
off (or any part of it) as soon as you think you can. Without this rating we may not let you sail if we think it is too windy or may ask you to put on a small sail. Once you have the provisional try the Laser (ask for help in getting a Laser ready for the first time). The Laser is even more weight sensitive but it's a lot of fun. If you do tip over it is easy to tip back upright and at least the boat will be dry. You need the Helmsman rating to take out our other boats and you need your crew rating for the Helmsman to be punched on your card.

27 Knots

Double Half Hitch For tying up when the line is already under tension.



Fisherman's Knot A more permanent way to join any two lines — hard to undo. Two simple overhand knots tied around the accompanying line.



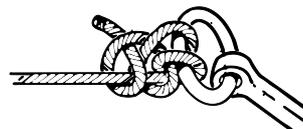
Square Knot For tying together two ends of the same diameter.



Sheet Bend For tying together two ends of different diameter.



Anchor Bend A knot which closes tightly and reduces chafe by doubling the loop around the anchor ring.



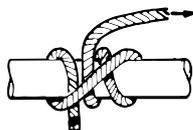
Bowline Makes a loop in the line which will not slip.



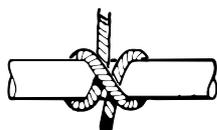
Figure Eight A stop knot which can be used to keep a line from coming out of a block.



Rolling Hitch For tying a line or a post when the knot must not slip in direction of arrow.



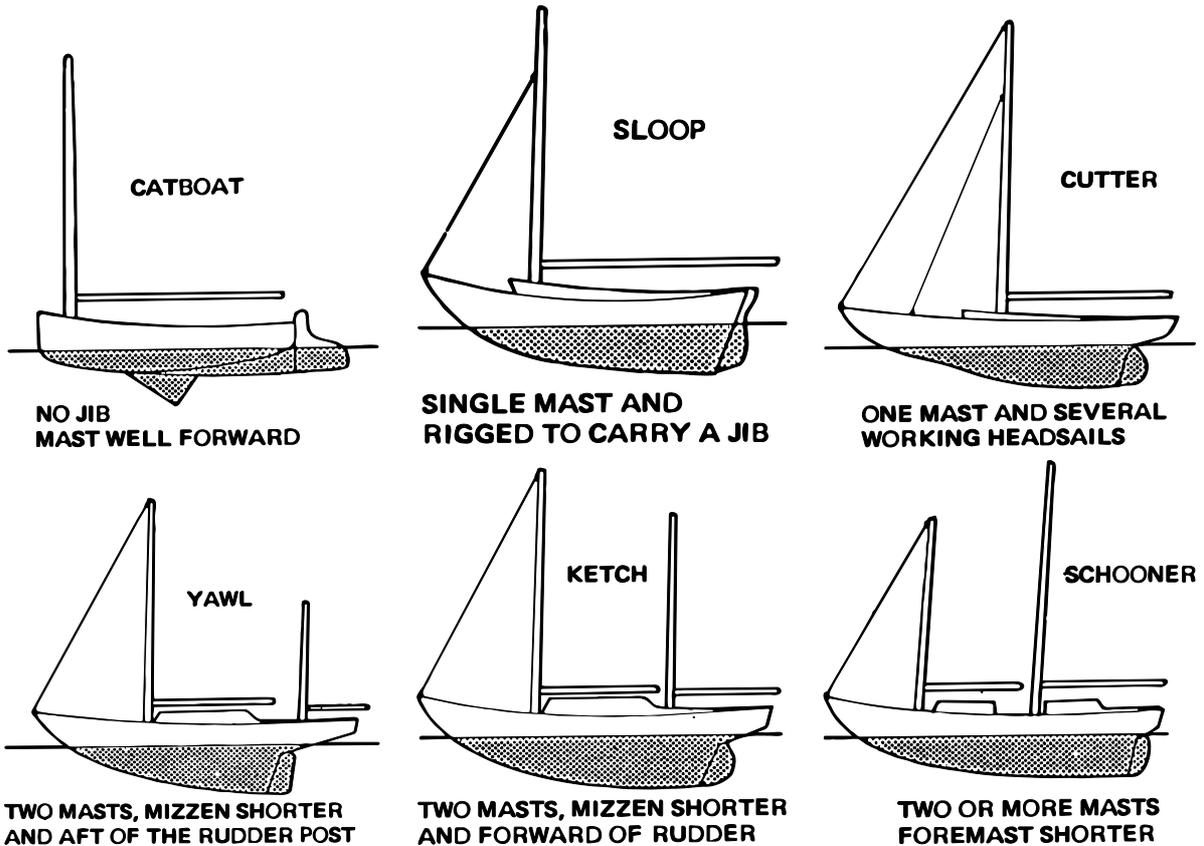
Clove Hitch For tying a line to a post; can work loose if it is slacked and loaded.



Stunsail Tack Bend Makes the loop in the end of a line which will slip closed, making a neat, tight knot.



Sailboat Rigs



Coiling and Heaving a Line

