

Hoofer Sailing Club

UNIVERSITY OF WISCONSIN – MADISON

420 Manual

HOOFER SAILING CLUB

420 MANUAL



420 Manual Editors

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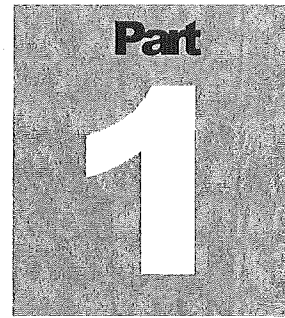
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Part One

AN INTRODUCTION

Welcome to the 420's! On this boat, emphasis is placed on learning the finer details associated with sailing dinghies. It is often said that the best sailors start small. Almost every America's Cup skipper or Olympic champion started in the smallest of dinghies. Even if you never skipper your own America's Cup boat, the knowledge you will gain from sailing in 420's will not only advance your dinghy skills, but will also prepare you to directly apply your knowledge to the bigger sailboats, whether it's the J-boats or your own 50' sailing yacht. Be prepared to be challenged both on and off the water. As a caution, 420's aren't for everyone. 420's are small, responsive, two-person, three-sail, trapeze-rigged, high performance sailboats that demand both physical agility and mental awareness to sail them to their full potential. 420's are best suited to those sailors who are seeking all the challenges associated with sailing. Within the instruction program, you will soon notice that more is demanded of you beyond just leaving and returning to the pier. The general goal of 420 instruction is to build upon the seamanship skills and knowledge already acquired through previous sailing experiences to make you a more competent and confident sailor. This is only achieved through thorough instruction and many days of practice. Also be aware that this manual only summarizes a handful of the many different sailing theories and techniques that pertain to 420's. Those wishing to further expand their knowledge should explore some of the many excellent sailing books available. Here's wishing you lots of challenge, learning, and fun!

Boat History

The 420 was initially developed in 1959 in Lanaverre, France, by a man named Christian Maury. Christian built this boat for advanced sailors looking to improve their sailing and racing skills and soon discovered that this boat catered well to a wide variety of crew weights and abilities. Since this boat was built as a one-design, licenses were sold to only those companies that built the 420 to its exact specifications. Hence, the International 420 was born. In 2002, there were over 56,000 International 420's being sailed around the world.

The Club 420 was developed in 1977 when Yale Corinthian Yacht Club, recognizing both the fine sailing characteristics of the 420 yet its delicate, almost fragile construction, placed an order into Vanguard changing a few of the specifications on the International 420. They kept the same fine hull characteristics but gave it a thicker, more rugged construction and also changed the tapered mast to a

more durable, untapered one to withstand the demands of intercollegiate sailing. The changes worked and many yacht clubs in the United States recognized its greater durability and switched to the Club 420. There are now over 3,000 Club 420's in over 300 fleets in the U.S.

Prior to 420's, the Hooper Sailing Club sailed 470's from approximately 1980 to 1993. This ten-boat fleet was replaced by ten FJ's (Flying Junior) in 1994. Due to a huge fundraising effort by the University of Wisconsin Hooper Sailing Team, the Hooper Sailing Club purchased 12 new Vanguard Club 420's in the fall of 2001 for \$65,000. This is how 420's became a part of Hoopers.

Part 2

Part Two

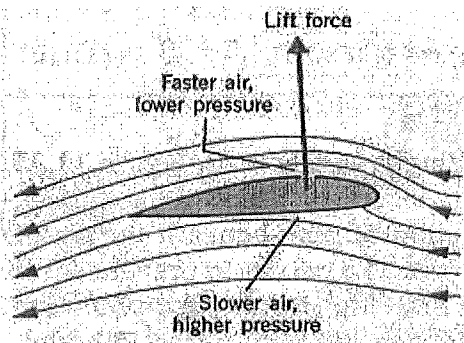
SAILING THEORIES

Sloop Theories

It's a beautiful day, and you're out sailing a Badger Tech on Lake Mendota. You're out minding your own business, sailing on a beam reach, when a 420 suddenly passes you from astern. You don't like getting passed (you've got a little racing blood in you) so you sheet in and try to catch up to them. Despite your best efforts, they're starting to pull away from you. Then the 420 starts heading up until they are on a close-hauled course. Thinking you can overtake them upwind, you sheet in even more. Unfortunately, they seem to be sailing a lot closer to the wind (sailing a much higher course) than you are. In fact, your sails start to luff like when you're in-irons whenever you try to sail the same course they are. Frustrated, you sail back to Hoofers determined to sign up for some 420 lessons so that you can get your rating because newer boats sail faster than the old ones . . . or do they?

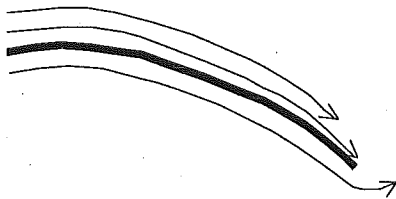
A sloop rigged boat, that is, a boat with two sails (a mainsail and a headsail, such as a jib or genoa), like a 420, is generally faster than a cat-rigged boat (having only a mainsail) of similar size, such as a Tech, for basically two reasons. The first and most obvious reason is that a sloop-rigged boat has a second sail. This increases the overall sail area of the boat, thus making it faster. The second, not so obvious, but extremely important thing that the addition of a jib does is that it makes the mainsail more efficient. To better explain this, let's quickly review how a sailboat works.

A sail is essentially an airplane wing standing on its end. There is a basic curve to it allowing it to act as an airfoil. All of the complexities of airfoil theory apply to sails. The two primary laws of physics that govern airfoil theory are Bernoulli's Principle and momentum. When wind comes in contact with the start of the sail (at the mast), the air splits up and some air travels on the outside of the sail and some travels on the inside. Air that gets split wants to join up again next to the same air at the end of the sail. If the air flows smoothly on both sides of the sail, this is called *laminar flow*. Air traveling on the outside of the sail has a further distance to go than air on the inside.

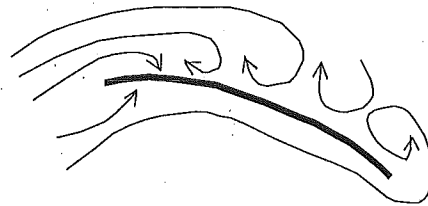


In order to meet back up with the same air at the end of the sail, the outside air must speed up in order to cover that greater distance. This increase in speed by the outside air causes lower pressure on the outside of the sail. (This phenomenon creates the basics of Bernoulli's Principle). In airplanes, this low pressure creates the lift that allows planes to fly. On a boat, by changing the direction the air is moving the sail is effectively accelerating it and force (also called "lift" on boats) is produced between the higher pressure area on one side of the sail towards the lower pressure area on the back of the sail. Because of how the sail is shaped and how it is attached to the boat, this force is both a forward and a sideways force on the boat. The centerboard in the water provides a counter to the sideways force, thereby transferring the power into forward motion that drives the sailboat forward.

This is a simplified explanation of how a sailboat works in an ideal world. However, there are other things that are occurring while the wind is flowing around the sail. One of these things is called *stall*. Stall is basically the disruption of laminar airflow from around an airfoil. Perhaps you've heard of stall when talking about airplanes. A plane experiencing stall no longer generates lift and no longer can fly. While sailing, stall occurs almost all the time around the sails. Looking at a diagram of a sailboat, say the wind flow around the mainsail on a cat-rigged boat (e.g. a Tech), you will see that the air flowing on the outside of the sail doesn't necessarily "stick" to the sail all the way to the end. Actually, depending on the sail shape and wind speed, the wind will start to peel away from the outside of the sail before it can meet up with the air on the inside. When this happens, the air is disrupted and little wind eddies form on the outside (like little whirlpools that form while running a canoe paddle through water). This detached airflow causes the sail to be less efficient.



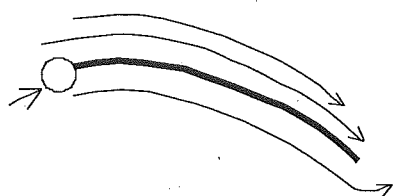
Laminar Flow



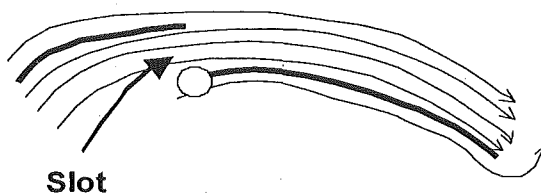
Stall

The addition of a headsail on sloop-rigged boats helps solve this problem. Not only does the jib increase the surface area of your sail, but it also helps the air conform better to the outside of the main, thus making the main more efficient. When you add a jib to the boat and sail it, it essentially takes the same shape and direction as the main. There is now a confined space located between the jib and the main. This is called the *slot*. Wind flowing between the jib and the main now gets forced into the slot, which then helps the wind "stick" better to the outside of the mainsail. This helps reduce stall and makes the main more effective, hence helping to drive your boat more than if you were sailing with only a main.

This is only one simplified explanation of sloop theory out of many possible theories and explanations. Those interested in learning more about this should consult countless books or articles on the subject or other sailors for a variety of opinions.



Cat Rig
(e.g. Badger Tech)



Sloop Rig
(e.g. 420)

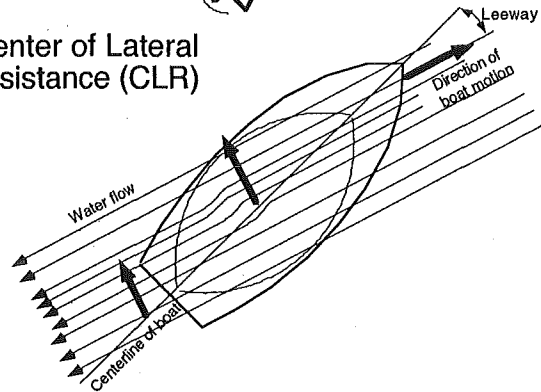
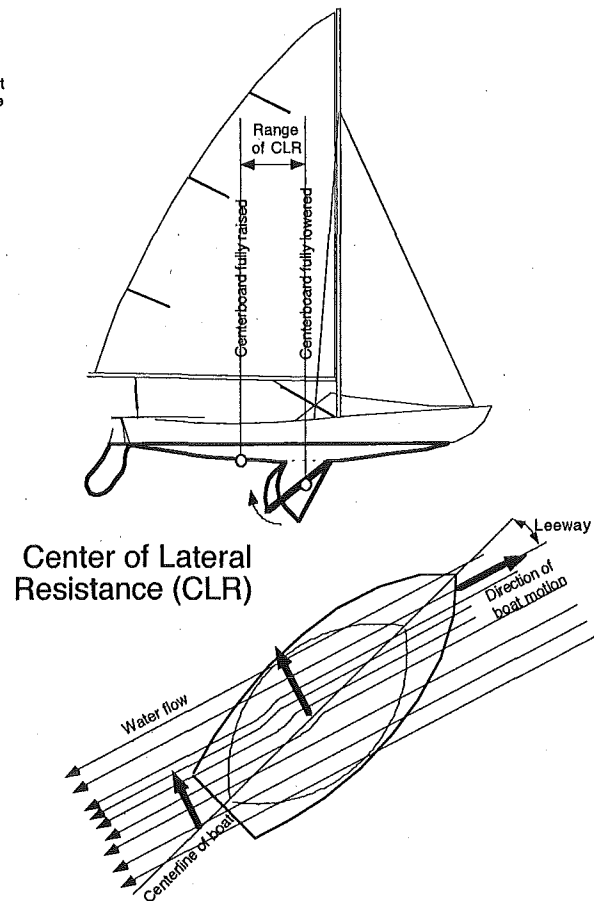
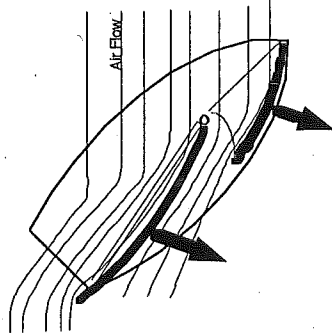
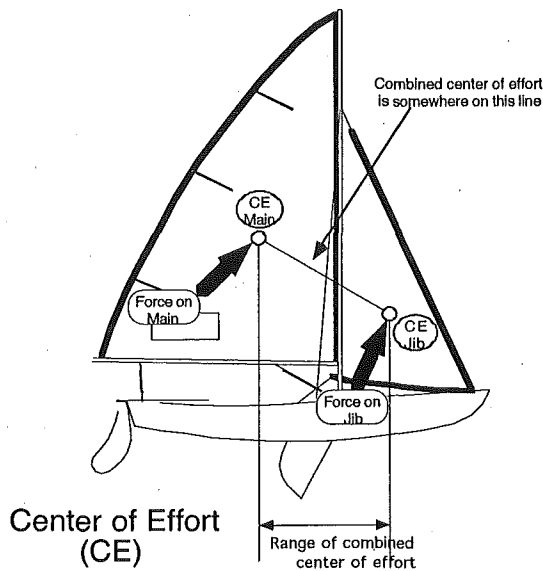
Center of Effort (CE) and Center of Lateral Resistance (CLR)

When steering a sailboat, there are basically three different factors that affect your ability to control its direction. The most obvious one is the rudder, however both the sails and the hull are just as important in turning the boat. In basic sailing classes, you learned that the rudder/tiller is the equivalent of a steering wheel in a car. Water moves across the rudder foil in a similar way as air moving across a sail (remember, both air and water are fluids). Water separates at the beginning of the rudder, flows across either side, and then flows back together again at the end. When the water flow stays attached on both sides and meets up again, it is called laminar flow. Since water is more dense than air and since there is also less curvature in the rudder foil, stalling is less than that commonly found on a sail. When you move the rudder blade through the water via the tiller, it creates different forces and pressures on the water that essentially translates into you being able to steer the boat. However, have you ever noticed the "eddies," the small whirlpools, behind the rudder when you steer, especially when you steer sharply? Those "eddies" are visible signs that the laminar flow around the rudder has been disturbed. As with the stall in sails, this disruption indicates a loss of power. Even as little as a 10° change in the rudder blade angle can upset this laminar flow and cause the boat to slow down. So instead of the rudder/tiller being your steering wheel, it is now considered (at least when you race) your brake. So what can you use to steer the boat instead? That's where the sails and the hull come into play, in combination with the centerboard.

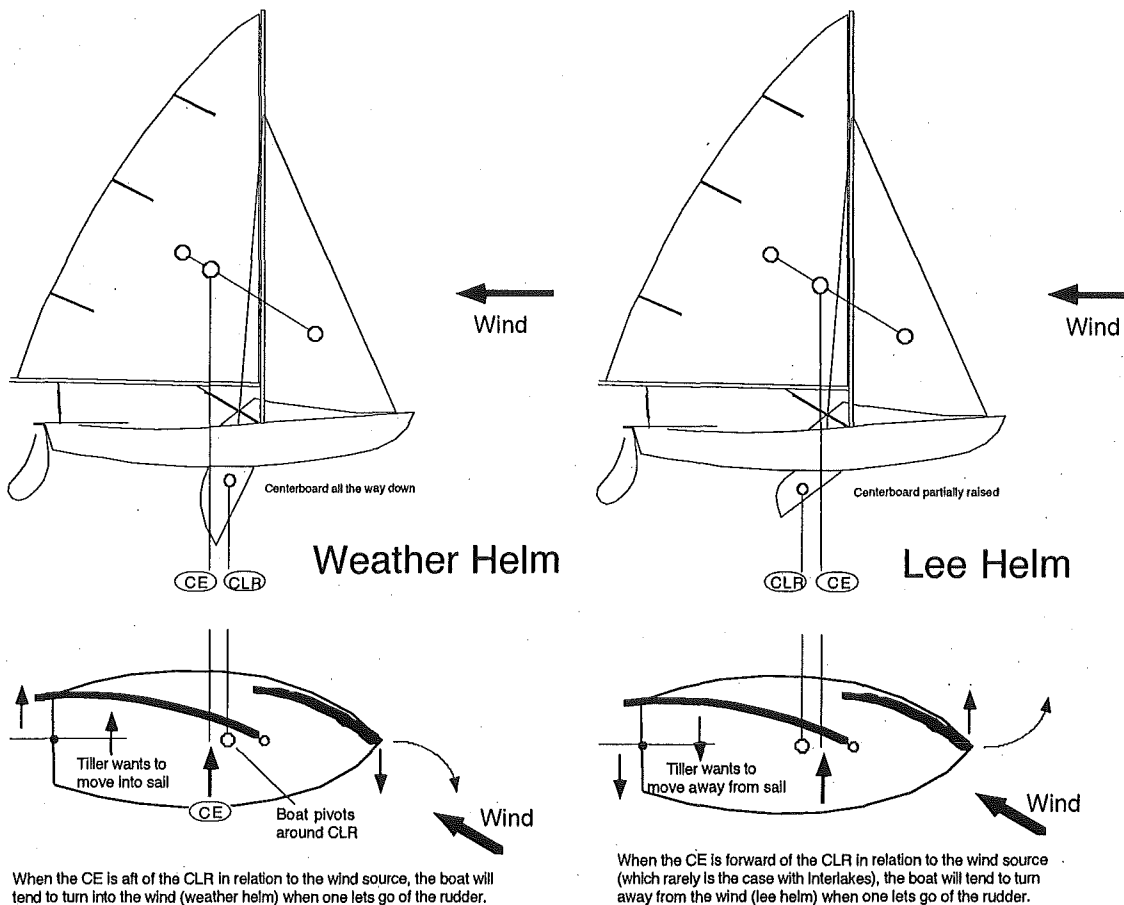


Eddies off of a rudder

On any surface you can consider that there is, as a model, a single point through which the forces from all the pressures on that surface act. The point where this occurs on a sail or a combination of sails is called the *Center of Effort (CE)*. Correspondingly, the point where this occurs under the water line on a boat, from the combination of the hull, the centerboard and the rudder, is called the *Center of Lateral Resistance (CLR)*. You can think of these two centers as being similar to the center of gravity on two individual objects, where all the weight is balanced and acts as one. The only differences are the forces that are being applied to the center of gravity versus the CE and CLR. Each of these points can be moved forward and aft along the boat. When (with no force on the tiller) the CE is located directly above the CLR, the boat is balanced and sails straight. You can let go of the tiller and the boat will continue to sail straight. This is called neutral helm and is the ideal balance for many boats, including the 420. When the CE and CLR aren't located directly above/below each other, the boat isn't balanced and will turn either upwind or downwind if the rudder/tiller isn't used to counter it.



When the CE is aft of where the CLR is, there are more forces pushing your stern downwind, thus causing your bow to head to windward. The tendency for a boat to want to turn "head to wind" is called *weather helm*. Conversely, if the boat has a tendency to head downwind, that is called leeward helm or *lee helm*. In that situation, the CE would be forward of the CLR, which would cause the bow to be pushed downwind. Whenever your boat isn't balanced, you can feel it in the tiller. 420 sailors and other racers often strive for neutral helm. A balanced boat with no helm is much faster than an unbalanced boat, because you don't have to use the rudder to divert the flow of water, which slows you down.



An example of weather helm is when you were out sailing your Tech during your Heavy Weather Test-out. When you sailed upwind on a close-hauled course (as close to the wind as possible), you were hiking out on the high side of the boat (the windward side), trying to keep it flat, while holding the mainsheet with one hand and the tiller with the other. Do you remember what the tiller was doing? It felt like it wanted to swing away from you. You counteracted this by constantly pulling the tiller toward you, sometimes with lots of force. If you happened to let go, you quickly found out that the boat would round sharply up into the wind. In this scenario, the CE is located aft of the CLR, producing severe weather helm. One can use the rudder/tiller to counter this weather helm, however, this slows the boat down by disrupting the flow of water around the rudder. Sometimes a better way to solve this helm problem can be to raise the centerboard slightly, which, since it also

angles the centerboard aft, would move the CLR aft and re-align the relationship between the CE and CLR.

Fortunately, on 420's, you have two sails to control the position of the CE. If you start from a situation where you have neutral helm, sheeting in the main, while easing the jib, powers up the main and will shift the CE aft, and create weather helm, causing the boat to head toward windward. However, if you were to ease the main while sheeting in the jib, the jib would provide more force, which would shift the CE forward, create leeward helm, and thus cause the boat to head downwind. Sheetting in one sail while easing the other is how you can steer the boat by using the sails. The 420 is a very well balanced boat and thus can be sailed with neutral helm with relative ease.

Another way to control the direction of the boat is by changing the position of the hull in the water. The simplest way to do this is by shifting the weight of the skipper and crew. When the boat is sitting flat on the water, it is balanced and will move straight ahead. However, because of the shape of the 420, Tech, and most dinghy hulls, any kind of heeling changes the water flow around the boat and the forces acting on it, thus causing it to change direction. Now think back to the Tech Heavy Weather Test-out again. When you are on a close-hauled course and the boat heels to leeward (the mast tip points to leeward), and you let go of the tiller, which way will it head? It will turn toward the wind. Therefore, heeling the boat to leeward creates weather helm and causes the boat to round up into the wind. On the other hand, if you heel to windward, leeward helm is created and the boat wants to "fall off" (or "bear off", head downwind, etc.) You can thus steer the boat by shifting the weight of you and your crew to alter the heel of the boat and creating weather or leeward helm.

Now that you know this, the next time you go out and sail, try it. Try sheeting in the jib and easing the main, and vice versa, as well as heeling the boat in different directions. It works on virtually all boats. Knowledge of how the sails and the heel of the hull affect the steerage of the boat is important when it comes to doing advanced dinghy sailing tricks like roll tacks and roll jibes (fancy, turbo-charged ways of tacking and jibing, when it looks like the boat is going to tip over). In fact, there will even be times during 420 lessons when you will remove the rudder and tiller and sail with only your weight and your sails. (When you do this, make sure there are no other boats you will run into, and try raising the centerboard slightly to shift the CLR aft to counter the change that occurs when the rudder is removed.) When you try to sail without the rudder/tiller, you will gain a new appreciation for the responsiveness, handling, and sensitivity of these boats.

Apparent Wind

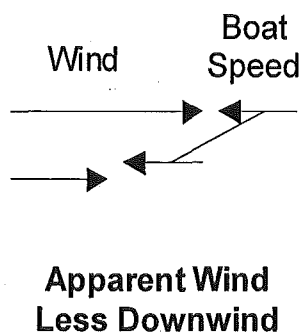
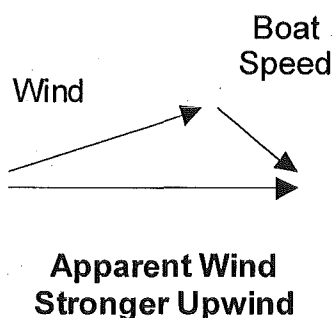
Retracing our steps back to basic sailing classes for a refresher, let's re-examine the wind clock. Sailboats can't sail directly into the wind. This is because the sail, being soft, cannot form an air foil in this orientation; thus the sail produces no force and the boat doesn't move. The closest you can sail to the eye of the wind is called *close-hauled*. Depending upon the boat, wind conditions, and water conditions, this heading is approximately 30-45° on either side of the true wind direction. A heading just slightly downwind of that is called *close reach*, a heading perpendicular to the wind is called a *beam reach*, a heading at an angle downwind is called a *broad reach*, and a heading directly downwind is called *running*. Now think about this: Do you remember what point of sail feels the

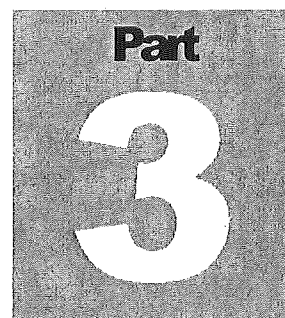
fastest? What about the one that feels like you're not moving at all? If you said close-hauled for the one that *feels* the fastest, and running dead downwind for the one that *feels* the slowest, you're correct. Actually, they both travel over the water at approximately the same speed. So why does one feel so much faster than the other?

Well, it all has to do with *apparent wind*. It is a combination of the wind that you create by moving along with any natural wind there may be. Apparent wind theories can get quite complex, but we'll keep it simple for this introduction. When you're on your sailboat and you're not moving through the water because all the sails are luffing, the wind you feel is the *true wind*. When you sheet in and start moving through the water, you start creating your own wind too, just as though you were running on land. The vector of the true wind (direction and speed) along with the vector of the wind generated by your boat moving through the water combine to form the wind that you actually feel. That's the same wind that's being displayed on the telltales – apparent wind.

Let's now examine the mystery of why one point-of-sail feels much faster than the other. Simply put, when you sail on a close-hauled course, you are sailing *into* the wind, and when you are sailing on a run, you are sailing *with* the wind. Looking at wind speed and direction as vectors (from physics or math class), a more detailed explanation would be that on a close-hauled course, the vector of the boat gets added onto the true wind speed, causing a much larger vector. Whereas on a run, the vector for the wind caused by the boat's motion is in the other direction (is negative), so adding the vectors creates a much smaller vector. This would explain why a close-hauled course feels windier or faster than a run.

This is just a simple introduction to apparent wind. But this basic understanding is critical toward understanding more complex theories associated with apparent wind, such as roll tacking, roll jibing, sail trim, sail shape, planing, as well as ice-sailing and ice-windsurfing. For those interested in more information on apparent wind, read the Advanced Sailing Section in the manual or, better yet, look up some information on line or in a library.





Part Three

GENERAL RULES AND INFORMATION

Do's and Don'ts

There are several things that responsible 420 sailors will do to make sure that the 420s are sailed both safely and correctly to help minimize unnecessary wear and tear on the boats. Please follow this list and do your part to help keep the 420's looking like new. Present and future 420 sailors will appreciate your respect and care for these boats.

- DO wear your lifejackets.
- DO stay with your boat always, even in the event of a capsize.
- DO sail with only two people (maximum and minimum).
- DO LIFT the boat onto or off of the cart with 2 or more people IN THE WATER while launching or retrieving the boat.
- DO have one person with the boat on the pier at ALL times.
- DO leave from the least crowded area on the pier, which is usually at the end.
- DO land by doing close-hauled landings.
- DO avoid landing in crowded pier areas.
- DO leave your sail bags onshore.
- DO return the sails and the rudder and tillers to their appropriate storage location.
- DO report all problems or breakdowns to the Maintenance Shop IMMEDIATELY.
- If using a spinnaker, DO leave the spinnaker pole secured (preferably clipped to something) while not being used.

- DON'T step on the bow of the 420. Stepping or sitting on the reinforced V is O.K.
- DON'T step in the boat while it's on land. The hull was designed to support your weight only when it's being supported over its entire length in the water.
- DON'T tie the painter on the boat to its cart until it is COMPLETELY out of the water.
- DON'T sail a boat with a "secured" tag on it.
- DON'T use sails with rips, tears, or holes in them.
- DON'T cut, trim, or remove line from a 420, unless being repaired.

Rigging/Derigging

When sailing a 420, on your own or in a lesson, please follow these guidelines to ensure the safety of yourself and the boat.

When Going Sailing:

1. Grab any set of day sails. Check out your boat by the sail number on the bag:
 - a. match the rudder and tiller with the sail bag number and place them in the boat.
2. On-shore rigging:
 - a. put all the plugs in (1 outer-hull plug/tennis ball, 3 inner-hull plugs)
 - b. undo any knots in the mainsheet and make sure there is plenty of slack in the boomvang and the mainsheet.
 - c. feed the foot of the main into the boom, attach the outhaul and main halyard to it (but DON'T raise it)
 - d. connect the jib tack to the pin at the bow, connect the jib head to the jib halyard.
 - e. whether or not to raise the jib on-shore is a judgement call. If the winds are light, and especially if it is wavy, then it is advisable to raise the jib on-shore. If you don't raise the jib onshore, then be very careful – without the additional tension of a properly tensioned jib, the mast can jump out of its step, and, if it does that, it is possible for the bottom of the mast to punch a hole thru the hull. .
 - f. Run both jib sheets through the jib fairleads.
3. On-the-water rigging:

- a. raise the jib with proper tension (if not already raised)
 - b. raise the mainsail
 - c. put in the rudder and tiller, tie into boat with attached line
 - d. immediately before leaving, lower the centerboard and put tension (if need be) on the boomvang
4. When underway, put appropriate tension the boomvang and outhaul, secure the painter/bow line, and make other appropriate adjustments to the running rigging

The Finer Points of Rigging the Boat:

Rudder and tiller numbers must be matched to ensure compatibility between the two. Tiller thicknesses vary slightly, and the rudder heads are adjusted to match the appropriate thickness. Mix/matching rudders with tillers may give you a combination of too much play in the tiller or too tight of a fit in the head.

Only raise the jib if winds onshore are less than 5 miles/hour or if it is wavy. Jibs are sensitive to getting their windows blown out. Leaving a sail flapping in the wind causes premature wear and tear on it. Limiting the time the sails are left flying uncontrolled in the wind will prolong their life. Putting a lifejacket around the jib to control luffing is not recommended either.

Use a 3-1 purchase system for raising both the jib and the main. The purchase system gives you leverage to put more tension on the halyards and overall sailing rig. Basically both halyards will come down from the top of the mast, go through a pulley (jib) or around the cleat (main – the pulley is there for the spinnaker rigging), head up a short distance to another pulley (jib), or ring or loop (main) and then go down again to a cleat.

After launching your boat, make sure it gets moved to the leeward or downwind side of the pier. This will prevent unnecessary wear and tear on the boat. Trying to raise your sails on the windward side of the pier will only cause your boat to scrape against the pier and your sails to get torn on the pier posts.

When on the water, there is no one right way for the order of rigging your boat. However, following this order presents the best advantages. First, you should raise the jib if it was not already raised on-shore (it is best to raise the jib on-shore if the winds are light or if it is wavy, to best protect the boat). Although this does present some disadvantages, it is much harder to properly tension the rig with the main up, and getting the jib up gets tension on the rig which will keep the mast from jumping out of its step and possibly puncturing the hull of the boat. Just be aware that until you get the mainsail raised, the center of effort of the sails is quite far forward, which can cause the boat to “hunt” back and forth on its painter, so make sure you crew knows how to fend the boat, and is paying attention. Raising the jib from astern of the mast keeps you out of the way of a flogging sail (especially when it’s windy).

Once the jib has been raised, slip around the mast, and position yourself sitting immediately ahead of the mast, facing aft. Try to avoid putting too much weight on the mast partner crosspiece right at the mast – instead put some of your weight on the raised “V” splash-rail area if you can. Lines for raising the main will be very accessible. Raising the main while sitting in this position will once again keep you out of the way while the main and boom (especially the vang) flap around the boat. Once it’s raised, the main will move the CE aft to help your boat point to windward (hence, off the pier) better.

After that, put in the rudder and tiller. Don’t lower the centerboard or put tension on the boomvang until you are actually leaving the pier. Lowering the centerboard converts the sideways movements of the boat into forward motion (causes the boat to start sailing!), and will cause the boat to hit the pier. Premature tensioning of the boomvang can act like a sheet, and doesn’t let the sail “breathe” as much, causing the sail to power up, thus moving the boat.

Rigging the Mainsail (detail):

First disconnect the outhaul from the main halyard. Temporarily attach the main halyard to the spinnaker ring. Rig the main by first sliding the foot of the sail into the boom. Next run the outhaul through the clew of the sail, through the block on the boom and up to the cleat further forward on the boom. Unroll the sail, connecting the head to the halyard. Though there is no shackle, this can be done a couple of ways. One is by first tying a double “figure 8” or “stopper” knot as a stopper at the “sail” end of the halyard, running a loop in the halyard thru the head, tucking the stopper knot thru the loop, and then pulling the loop tight. Alternatively, you may also put the end of the line through the sail, tie the stopper, and then tie a half hitch around the head of the sail. Pulling a loop through the head can do a few negative things: 1) it will often times use more halyard than necessary, thus the main may not get all the way to the top 2) has a tendency to cause one to over-tighten the halyard to compensate for the shorter halyard, causing a nasty, ugly crease in the luff 3) the first loop/stopper alternative can slide out more easily than the “half hitch” knot on the top if the stopper were to come untied.

Once you get the head attached, slide the boltrope on the luff of the sail into the mast track. Put enough tension on the halyard to hold the head a foot or so up into the track, and then secure the halyard to the starboard cleat on the mast. Attach the tack of the sail to the boom using the tack pin on the boom.

The main has four battens. These battens help to hold the shape of the leech of the sail. The two medium length and one lower (short) battens are quite normal in function. The long upper batten you’ll notice runs from the luff of the sail to its leech. The tension that this compression batten exerts on the sail can be adjusted in order to force shape into the upper sections of the main. In general, in very light and heavy air the batten should be set in loosely (but not so loose that it will fall out, and, in heavy air, not so loose that it will punch thru the batten pocket in the front). In moderate winds the batten should be set quite tightly. The proper tension on this batten is dependent on batten flexibility, sailing style, waves, sail condition, crew weight and a host of other factors. In order to properly adjust it you must look at your sail. Experiment to see what looks and feels best. As with all sail trim adjustments, if you have questions ask an instructor, the fleet captain or a club racer.

Because the new sails have a very deep draft very far forward, tensioning the upper batten is not as crucial with the Neil Pryde sails. If you over tighten it, you will make this more pronounced.

Rigging the Jib (detail):

The 420 jib contains an internal forestay. When the jib is hoisted the rig is supported by this wire and not by the permanent forestay. The jib is therefore made without the forestay clips found on some other boats, such as the Badger sloop. After you raise the jib, you will note that the original, permanent forestay, is quite loose. The amount of tension is discussed in the Advanced Sailing chapter. However, note that it is extremely important that you not put so much tension on the halyard (and thus the jib forestay) that you bend the mast!

You have a choice of three options for the ends of the jib sheets. If they have a "figure 8" knot, a six to eight inch tail should be left at the ends so that the crew can grab the tail should it pull up to the fairlead. If you are doing it this way, and not using a spinnaker, you may prefer to stuff the jib sheets into the spinnaker bag until after you raise the main, then run the jib sheets thru the fairleads, and tie the "figure 8". Alternatively, the two jib sheet ends can be tied together. This continuous arrangement reduces fumbling by the crew as there is only one sheet to grab when tacking. A third possibility is leading the sheet across the cockpit and tying it to the trapeze handle. Although this system clutters the boat somewhat, after a few practice sessions it becomes remarkably fast and efficient. You'll amaze your friends when they see how fast you can find the proper sheet and trim in the sail.

Hoisting the Sails (detail):

If winds are under 5 mph, or if it is wavy, you should hoist the jib while still on land. This will reduce the amount of time spent on rigging the boat in the water and will decrease the amount of possible hull damage while at the pier, plus it helps keep the mast in place. Properly tension the jib halyard and cleat it off on the port side of the lower part of the mast. Once you have lowered the boat in the water and have returned the cart to its proper location, the crew will fend off the boat at the pier. Make sure that both the main sheet and the boomvang are uncleated. Hoist the main sail, making sure the bolt rope stays in the track on the mast. After you leave the pier, you can tuck the painter just *outside* of the spinnaker pouch, between the pouch and the hull.

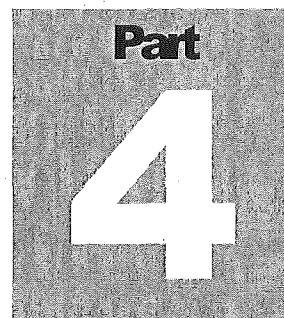
When Returning From Sailing:

1. Land so that the crew can reach the dock without stepping on the bow.
2. Upon arriving at the pier:
 - a. loosen the boomvang immediately
 - b. raise the centerboard
 - c. take out the rudder and tiller

- d. lower the jib unless it is light or, especially, unless it is wavy, in which case it is better to leave the jib up until you get the boat on-shore.
 - e. lower the mainsail
3. Once on-shore:
- a. remove all the plugs to drain the hull and to let the inner hull dry out
 - b. remove the sails
4. Secure all the lines to their original places, such as the "sail" end of the main halyard to the outhaul and the jib halyard shackle to the mast mounted spinnaker pole eyelet. The boom should not be raised off the floor of the cockpit by the halyard.
5. Tie an overhand loop knot in the mainsheet (to prevent the boom from being raised) and make sure there are no lines left in the bottom of the boat
6. Check that the top adjustable batten is not so tight that it is forcing a curve into the main, and, if it is, loosen it some. Lay the luff of the jib along the leech of the main. Fold the head of the main down at the top batten, then roll both sails together along the leech of the main so that the battens remain parallel. Finally, slide only the sails into the sail bag so that the jib sheets remain out and can dry.

Specifications of the 420

Length-Over-All (LOA)	13'9"
Beam	5'5"
Draft (centerboard down)	3'2"
Sail Area (Main)	110 ft ²
Sail Area (Jib)	30 ft ²
Sail Area (Spinnaker)	95 ft ²
Sail Area (TOTAL)	235 ft ²
Mast Height	20'6"
Rigged Weight	260 lbs.
Skipper/Crew Weight Range	245 lbs – 320 lbs



Part Four

SAILING BASICS

General Skippering

Going upwind, on a close-hauled course, the 420 is sailed perfectly flat except in very light air, when the boat may be heeled to leeward to fill the sails. The dinghy-shaped 420 is fastest, side-slips least, and is most controllable when sailed level. By sailing the boat flat you minimize the boat's tendency to turn on its own and reduce the need to use the rudder, which slows the boat.

Steering upwind in a 420, or any other performance boat, is a tricky business. It requires concentration, observation, experimentation, and lots of practice. When you first start steering the boat you will spend a lot of time worrying where your crew is. For this reason it is best to try and sail with the same person for a while until you get used to the boat. Remember, though, that until the crew is flat out (and flat out on the wire, if trapezing) it's his/her responsibility to keep the boat level and the skipper sitting in a comfortable position.

When sailed properly to windward, the 420 tracks in a fairly narrow groove. Finding this groove requires that you spend a fair amount of time in the boat and concentrate when going upwind. To find this groove, sheet the sails in and steer to keep the telltales on the jib streaming straight back. The uppermost telltale on the main should be flying straight back at least 90% of the time. This telltale is salient for proper mainsail trim, as most people will have the mainsail undertrimmed. The telltales on the jib provide a very accurate gauge as to its trim. The inside (windward) luffs before the sail itself would. When the outside (leeward) telltale flaps, it indicates sail overtrim or that the skipper should point higher. The jib is at maximum efficiency when both telltales are streaming straight back. Trim in (or sail lower) if the inside one luffs; ease the sail (or head up) if the outside one does. Note that the inside telltale may "lift", with the aft end a little bit upward – that is usually OK. If you're doing a good job the boat will have almost neutral helm allowing you to steer through the waves with little tiller motion. Try steering with your eyes closed for a while and you should soon be able to detect the feel of the boat when it's on the wind. You can also try a very light grip on the tiller – just the thumb and a couple of fingers so that you can get a better feel for whether you have neutral helm or not.

The 420 is an easy boat to hold flat but is somewhat tougher to get flat once it heels up. When a gust hits, be prepared to do a lot of work for a short while to get the boat back under your control. The technique for flattening the boat out is ease the main slightly, hike hard and feather up into the wind a bit. When you get the boat flat, trim the main right back in, bear off to the correct course, and you can relax until the next gust. In almost all conditions the skipper should be sitting right up against the bar that runs amidships or straddling the bar (a much better place to sit and hike from, even though you end up sitting on the cleat). [It is actually a traveler bar, even though these boats are not rigged with travelers.] This puts your weight at the widest part of the boat, allows you to reach all of the control lines and gives the boat the best turning moments for going over waves and quick steering. There is a big tendency for beginning sailors to slide aft at every possible chance. Just try to keep climbing forward. And, remember to keep working the sails, changing to match the changing conditions along the way.

Going Upwind

The skipper's job upwind is to keep the boat on a close hauled course (to keep the boat sailing as close to the wind as possible). If the jib is trimmed in completely and the boat is on a close hauled course, the tell tales will be streaming straight back. If the skipper is pointing too high (sailing too close to the wind, called *pinching*), the inside telltale will flutter. If the skipper is pointing too low (sailing too far away from the wind, called *footing*), the outside telltale will flutter or stall.

The skipper also trims the mainsail until the boom begins to come down, typically further towards amidships than with a cat-rigged boat like a Badger Tech, but not dead center, either. Finally, as always, the skipper is responsible for watching for other boats and not simply remaining focused on the telltales.

The jib is cut very full, but is relatively open along the leech. This causes some disturbed air to travel over the lee side of the main, creating stalled air. This open leech is not effectively closing the "slot". Windward sheeting will help to bring the jib clew inboard, and, by avoiding over-tensioning the normal, leeward, sheet, will add some twist to the leech, recreating the "slot". Windward sheeting should only be used up until heavy conditions, or until you and the crew cannot keep the boat perfectly flat. You can ease-hike-trim with the windward sheet on, just ease the leeward sheet normally. You will also eliminate easing the sheet too much this way as well. In most conditions, expect to put on about 1.5-2 inches of windward sheet on after the jib has been trimmed normally. Make sure the boat is up to speed and that the skipper's main is trimmed correctly before you do this.

Crews need to move inboard and outboard almost constantly to keep the boat from heeling to one side or another. Sometimes a crew may go from a full, straight-legged hike on the windward side to leaning out on the leeward side in less than a minute. The crew should also make sure their jib is trimmed in.

Going Downwind

Reaching:

When reaching but not sailing on a run, the skipper should attempt to sail in a straight line. For practice, sail around a buoy course or pick a point on land to sail towards. The mainsail may be sheeted straight from the boom if a 3:1 purchase has been rigged. The skipper should be constantly "playing" the mainsheet in order to adjust to changes in wind direction.

Off the wind, the crew trims the jib, but not from the jib fairlead. Instead, the crew holds the jib sheet in front of the fairlead, outside of the shroud. This is done so that the entire jib can draw efficiently. Start by easing out the jib until both of the outer telltales are streaming aft. Now the crew must be responsible for "regular" in and out adjustments as well as the twist along the leech of the jib. Too much twist causes the top of the jib to luff and not produce any pull while not enough twist causes the top of the jib to be over-trimmed thereby not producing any forward pull and, unfortunately, only producing sideways drag. Both of these undesirable traits may be avoided through proper trim. If more twist is desired, the crew should raise their hand higher away from the water (vertically). Likewise, if less twist is needed, the crew pulls down harder on the sheet. Your instructor will explain more about this in your lesson.

When reaching, the crew is stuck out to leeward trimming the jib in most conditions (from 0 to about 15 mph of wind), so the skipper must become more mobile on reaches, to keep the boat flat. Note, though, that in puffy conditions, the crew may need to quickly come to the windward side or hike out (even on a broad reach) to keep the boat flat. In these conditions, crews should be ready to transfer their sheeting point back to the jib sheet fairlead.

The crew is also responsible for the centerboard position. For most broad reaches the centerboard should be cleated between one third and two thirds of the way up but some crews prefer to hold the centerboard up with their foot. This is helpful in racing as it can easily be adjusted for tactical or mark rounding situations which require more lateral resistance.

Running:

On a run, the 420 is sailed wing on wing. The skipper trims the jib with his or her hand on the windward jib sheet. He or she holds the sheet outside of the shroud, so that more wind can be utilized. The skipper sits forward on the windward rail (as is usually done), where the skipper can see easily. Periodically checking the telltale on the shroud is useful. Try to keep it flying in the direction the boat is moving (i.e. keep the boat on a run).

While running, the crew must usually be in the center or slightly to windward to induce windward heel. Get as much boat out of the water as possible. Some crews usually stand right up against the mast and hold the boom out while maintaining the ability to go to either side if necessary. Rarely will the crew sit to leeward or even be near the leeward side. Many crews place their hands on the boom, to prevent an accidental jibe. Also, the crew should raise the centerboard almost all the way on a run. The crew's most important job when running is to keep the boat upright. Although some windward

heel is often desirable (see the Advanced Sailing chapter), a common danger while running is the "death roll" (capsizing to windward).

Jibing a 420 is rather easy under most conditions. Controlled jibes should be used during day sailing, but partial flying jibes are also common. The skipper either grabs the mainsheet parts or the crew grabs the vang, and throws the boom across. Be prepared to throw your weight across the boat to keep it stable. Keep control of the tiller and don't allow the boat to round up after the jibe.

Casting Off

Casting off can be fairly easy and straightforward or it can be somewhat of a challenge for 420 sailors. Wind speed and direction and wave speed and direction all play parts in the difficulty of getting underway, as well as the athleticism of the skipper and crew and their familiarity with the boat. Obviously days that have strong winds and large waves may pose more of a challenge than less windy days. There are a few things to keep in mind while casting off.

The normal cast-off involves the skipper in the boat with the mainsheet in one hand and the tiller in the other and the crew on the pier holding the boat by the painter and/or forestay. The sails should be luffing in the wind and the boat should be swinging gently back and forth. The skipper should first make sure that the boat is ENTIRELY rigged before casting-off, especially noting that the centerboard is down. Not checking this before leaving the pier one may soon find oneself sailing sideways towards the rocks! Second, make sure that there is a clear path to the lake and that the boat won't hit anything on the way out. If there is a boat tied to the pier between you and the open lake, and they are going to cast off soon, it may be best to wait for them to leave so that you have an unimpeded path out. When you think you're ready to go, and the way is clear, on the command of the skipper the crew will pull the boat close enough to the pier so that they can hop on. Depending on the wind direction, the crew usually sits on the pier and may either hop directly onto the gunwales where they normally crew from or they may have to hop onto the raised, reinforced V splash rail in front of the mast. NEVER STEP ON THE FLAT BOW OF THE 420s. IT IS WEAK AND NOT DESIGNED TO SUPPORT MUCH WEIGHT. Spider cracks in the gel coat or fractured fiberglass may result from putting any weight on the flat bow. Also, when the crew pushes off, they should make sure that the boat is heading out toward the lake and NOT toward the rocks. There isn't much room there for even the best skippers to turn the boat around before hitting the rocks. Also jibing between the piers is a good way to capsize and get washed onto the rocks. The crew should also make sure to hold onto the painter while hopping onboard. Their first job once getting on is to secure the painter by running it UNDER the jib sheets (and inside the spinnaker sheets, if present) and tying it to the mast, usually above the boomvang attachment point, or they can tuck it just *outside* the spinnaker pouch. The skipper, meanwhile, should sheet in to gain speed and start heading out toward the lake and may need to put some tension on the boomvang (since the vang is run back near the skipper so it can be adjusted if the crew is out on the wire). After securing the painter, the crew assumes their normal sailing duties.

Sometimes during the summer the piers can get very crowded. If you find yourself in a situation where there are boats on either side of you and they aren't casting off soon, you may have to do a

slightly more difficult cast-off. (This method is similar to the backing-up method used and taught on the Badger Techs.) When the skipper is ready, they will tell the crew to cast off. The crew will hop on and push the boat straight backwards and the skipper will hold the tiller amidships so that the boat goes straight backwards and doesn't hit the boats on either side. When the bow is clear of the sterns from the other boats, the skipper will point the tiller TOWARD the lake. Because the rudder goes in the opposite direction, the stern will swing toward the shore and the bow will point toward the center of the lake. Once your bow is pointing far enough downwind, the skipper will sheet in and power-up the boat and sail out toward the open water. The crew will do what they normally do (e.g. securing the painter) before assuming their sailing duties.

Landing

Landing a sailboat at a pier can be one of the most difficult and frightening things to do for any sailor. Only practice can help build the seamanship skills and confidence one needs to make great, unstressful landings each and every time. However, there are a few things to keep in mind that will help improve your landings.

The close-hauled landing method is the preferred way to land 420s at the piers. The way this method works is that you first set your boat on a close-hauled to close-reach course that is heading towards the leeward side of the pier. An advantage to this method of landing is that you can control your speed by sheeting in to speed up and easing the main to slow down. This method also works using both sails or only the mainsail. When you're getting close to the pier, sheet out to come to a stop and also use the tiller to position the boat in a way so that the crew can grab the pier. Landing perfectly perpendicular to the pier may pose problems for the crew trying to grab the pier. Landing at an angle to the pier generally works better. Once the crew has grabbed the pier, they should hop out with the painter in their hand (making sure to run it in front of the shroud) and secure the boat at the pier. The crew should also fend the boat off the pier while the skipper derigs the boat.

A couple of things might help you with your landings. The first thing to do before you land is to gather as much information as you can about the current conditions to form a plan for your landing. Things to take into consideration are wind direction and speed, wave direction and speed, the number of boats tied to the pier you're landing on, the amount of boating activity going on around your pier, and the experience of your crew.

Above all, the first thing you should remember is: IF THERE IS ANY DOUBT ABOUT MAKING A SAFE, SOFT LANDING, IT IS BETTER TO ABORT AND SAIL BACK OUT AND TRY AGAIN INSTEAD OF RAMMING THE PIER OR ANOTHER BOAT. Having an 'escape route' planned out ahead of time will help keep one from panicking and damaging the boat. Try to plan ahead of time which way you are going to turn if things go amiss.

Capsizing

Many boats are impossible to pull up or tend to stay swamped after a dump, but a 420 will pop right back up, dry as a bone (almost), with just a little practice. The first spill is always the roughest and dumping in a blow can be pretty unnerving, regardless of how much practice you've had.

The 420 is rather unhappy sitting on its side and would prefer to be upright or turtled. It is very important, therefore, to move quickly and immediately after capsizing if you want to avoid turtling. Once someone is on the board the boat will stabilize and not roll any farther (provided that no one is pulling on it). After hitting the water the crew should get unhooked and untangled from the mess and climb out of the sail. It's a good idea to yell out so that you know where each other are. Communication becomes very important when you can't see your partner through the boat.

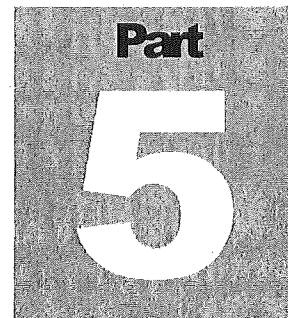
At this point the centerboard should be extended to its full down position for maximum leverage. Because the 420's have cleats for both raising and lowering the centerboard, if the centerboard is not already all the way down you will need to first make sure that the line that holds the board up is uncleated. Then you can either pull it the rest of the way out from the bottom of the boat, or use the other line to pull the board down. Be careful not to damage the plastic centerboard gaskets on the bottom of the boat. Both crew members should also uncleat the main, jib, and spinnaker sheets as well as the boom vang as these will all tend to make the boat unmanageable as it is pulled up. The person on the board can now back up to its edge and start to pull the boat up.. As the boat comes up the crew in the water should hook his arm around the traveler bar or under a hiking strap. Once the boat starts to come up it picks up speed and can roll over again unless the crew centers his/her weight. By hanging on to the bar that runs amidships you can put your weight on the tank as soon as the boat reaches vertical and check its roll.

In very high winds and waves, you may find that you have to have the crew swim to the bow, grab the painter, and simultaneously swim and yank the bow of the boat so it is pointing into the wind, just so you can get the boat righted.

Should the boat turtle, both skipper and crew may have to get up on the bottom of the boat and pull on the board. If the centerboard has slipped down into the slot, it will be necessary for one of you to swim under the boat, uncleat it if it was cleated up, and push it out. If at all possible, keep one person outside the boat so that others (especially the UW "Harvey" rescue service) can see you. Once the centerboard is fully extended both sailors should pull the boat gently by leaning on the board. **DO NOT BOUNCE ON THE BOARD.** Bouncing too hard can damage the board as well as the trunk. When the tip of the mast is just lying on the surface of the water one of you must get in the water and swim to the low side.

Many, if not most capsizes occur when sailing off the wind, when the spinnaker is likely to be up. When this happens, the chute has a tendency to get intricately tangled between the spreaders, shrouds or anything else that's handy. Try to get the chute completely free of the rigging before bringing the boat back up. It may be necessary to detach the chute from its halyard and/or sheets to unravel the mess.

If you capsize in shallow water (you'll know for sure if your boat doesn't quite make it to full turtle even though it's trying), it's critical that the mast tip be eased out of the mud slowly to avoid bending it. The key is to avoid excessive muscling or bouncing on the board. Be patient and the wind will eventually back the boat out of the mud and allow the boat to be righted with little force. Be especially wary whenever you capsize near shore. Before you know it you may find yourself blown into shallow water. Although you might be tempted to swim along the mast and dip underwater to help the mast out of the mud, you should generally not do so. If the wind and patience don't do the trick, it is usually best to wait for a rescue.



Part Five

ADVANCED SAILING

Upwind

Anticipating changes in wind speed, wind direction, and waves is important to sailing a 420 upwind well. Both skipper and crew can easily practice this. Occasionally glance upwind to identify puffs (changes in the wind direction), which appear as darker patches of water. Often, puffs are of a slightly different direction than the average wind of the day. A wind shift that forces you to fall away from the wind source is called a *knock* and one that allows you to head closer to the wind source is called a *lift*. If you are trying to sail to a point directly upwind (relative to the average wind direction), *all other things being equal, lift will allow you to get there faster.*

Note that a knock on one tack (say, starboard) will be a lift on the opposite tack (port tack, in this case). Thus, if you are trying to sail upwind efficiently you should tack when you sail into a knock. Practice finding puffs by looking upwind and watching the puffs. Communication is key here. An example might go like this:

CREW: *There's a puff off to port*

SKIPPER: *Looks like it will hit us in 5...4...3.....2.....1....OK, hike out! Try to keep the boat flat and going fast!*

The same goes for driving through the waves upwind. The skipper can work the boat quite effectively using sail trim, hull trim and sometimes extensive rudder movements. The idea is to power the boat up by slightly bearing off two or three degrees and easing the sails an inch or two before hitting a wave. Then, head up to meet the wave. As you head up, sheet in to provide more power and to keep the sails trimmed properly. Do this to keep the wave from forcing your bow to bear off. In wavy conditions, remember to keep the skipper and crew close together, so the boat will not "hobby-horse" too much. As another advanced technique, try ooching (slowly moving your body's momentum forward and then suddenly stopping) on the windward rail immediately after hitting a wave. This helps get the boat going after a bad wave and also helps you bear off for the next wave.

Upwind Mainsail Trim:

Thus far, little mention has been made of how to adjust the various control lines of the 420. It is, unfortunately, impossible to say that in 12 knots of wind, the cunningham should be pulled down 1 1/4 inches, for example. In many cases, the way the controls are adjusted depends on your weight, sail age and cut, and even your particular style of sailing. There will be some basic hints on how to tune the sails, but it's up to you to go out and experiment and see what happens. Also, don't be shy about asking more experienced sailors for their opinion on certain trim problems.

Sails have a rather complicated three-dimensional shape which is quite difficult to interpret without several years of sailing experience. In all likelihood, if you've sailed with an experienced sailor, you've been frustrated by his or her constant adjustments of controls and mutterings of "it just didn't look right" in response to queries. While it's difficult to discuss the sail as a whole, there are three areas of the sail which indicate, in general, how the whole sail is working.

The first area is the upper leech, which is adjusted for the proper amount of "twist". A sail with little twist has the leech (and the give-away top batten) pointing straight back or hooked slightly to windward. The leech of a sail with lots of twist falls off "opening up" thus depowering the sail. The second important facet of sail trim concerns the location and depth of the deepest part of the sail, the draft. The third key location is the luff of the sail. The amount of fullness, or "entry" of the sail dramatically influences the flow of air over the rest of the sail. There are several ways to evaluate your sails that should be kept in mind. Obviously, you should look at your sails while you are sailing. It might be helpful at times to stick your head under the main to get a good look at the leeward side of the sails. Also, watch other boats sailing near (but faster than) you. Look at the leeches of their sails, the height of the foot of the jib above the splash rail, the location of the boom and any other clues of what is being done right (or wrong!).

It's best, so far as 420's are concerned, to think of wind as coming in three basic "flavors" -- very light, medium and heavy -- each of which requires a fairly different set up. In light air, strangely enough, it is necessary to sail with fairly flat sails but very little tension of the sheets. Wind, going all the way around a full sail tends to become separated from the sail. Increasing wind strength automatically causes the draft to move aft and the leech to twist off. If a sail is set perfectly in moderate air, then in light air the leech will tend to be too tight and the draft too far forward. In order to open the leech, flatten the sail and move the draft back to its proper position the mast must be bent in light air. But, the two most important tools for bending the mast, the mainsheet and boomvang, cannot be used, as excessive tension on these lines would over-flatten the main and over-tighten its leech, hence the importance of prebend. The cunningham should not be tightened, as it tends to pull draft forward thereby flattening the sail. The outhaul on the other hand, can be snug, but not tight.

Your best clue for trimming the main is a series of telltales on the leech of the main. If the sail is stalled these telltales will curl to the leeward side of the sail. In drifting conditions it is best to have the telltale at the top batten stalled about 1/3 to 1/2 of the time and streaming straight back the rest of the time. The most important control for this is the mainsheet, but if playing with this and the rest of the lines in the boat doesn't do the job, try lowering the sail and readjusting the tension of the top

batten. More tension makes the sail fuller, the leech tighter and the telltale to be stalled more of the time.

Unlike the 470, the 420 employs a fixed bridle system, which, although simpler, rules out using a traveler to manage the compromise between boom position and leech tension. With a bridle, as used on a 420, this sort of adjusting becomes trickier. The sail either has the right amount of leech tension but improper trim if the sheet is eased, or too tight a leech if the sail is pulled all the way in – it's a compromise.

Moderate air requires a distinctly different set of sail settings. The sails can be allowed to work to their fullest -- there's not too serious a threat of stalling. Moderate air conditions exist from when the crew is just about sitting on the windward tank until, with the crew fully hiking or extended on the wire, you can no longer keep the boat flat without easing the main. To get the most power from your sails, ease the outhaul a bit and sheet the main in hard. Most beginning 420 sailors constantly have their mainsails under-sheeted. The boom should be reasonably close to the centerline of the boat – further inboard than on a cat-rigged boat like a Badger Tech. Once the crew is out on the wire you can begin to put tension on the cunningham. Pay attention to what the cunningham does to the shape of the sail. Tension on the luff pulls the draft forward and makes the entry fuller. If your sails are old and blown out the draft will be blown back and you may have to put on some cunningham before the crew is on the trapeze. The vang can begin to be tensioned after the crew is out on the wire. This will keep the leech tight (especially down low) by preventing the boom from rising in the increased wind. The vang, unfortunately, pushes the boom forward and causes the mast to bend and depower the sail, so don't overdo it. In moderate air you want to get as much power as possible from the sail and thus you must prevent the mast from bending.

When the crew begins to trapeze, the bridle system used on the 420 begins to get the advantage over a traveler. Leech tension can be controlled by the boomvang. Due to this transfer of function of the mainsheet to the vang this system is sometimes referred to as vang sheeting. The leech should be allowed to go through a gradual transition from stalling $1\frac{1}{3}$ to $1\frac{1}{2}$ of the time (as indicated by the leech telltale) when the crew is just sitting on the tank, to always flowing straight back when the crew is fully extended on the trapeze. As the wind strength increases it will become necessary to pull all of the strings a little tighter to maintain the shape of the sail. In light air the leech will stay tight on its own but as the wind picks up the sail will twist off more and more. The amount of twist would automatically become excessive unless the vang is used as a control.

When the wind becomes strong enough to warrant depowering, the pushing of the vang and main will cause the mast to bend in the middle, flattening the sail, thus opening the leech. The outhaul can be pulled quite snug and lots of cunningham will be needed to pull the draft forward (remember, it's the strong wind that pulls the draft aft, you just want to hold it in its proper place). A substantial amount of boomvang tension is needed to control leech tension, flatten the sail and bend the mast. When the main is eased in the gusts, the vang will allow the boat to keep driving by preventing the leech from twisting off too much.

In heavy air your sails should always be sheeted for flow (go ahead and try to stall them, you won't). As mentioned several times before, the 420 is easy to hold flat but hard to get flat. Gusts must be

handled by dumping the main and rapidly retrimming to keep the boat moving. It helps to raise the centerboard slightly from its usual position perpendicular to the hull. This should only be done in very windy conditions when you cannot get the boat flat.

When you are fairly comfortable in heavy air a technique slightly different from the usual feathering style of sailing may be tried. If conditions are right and both crew are on the ball the 420 may be made to plane to weather. Essentially the boat is sailed as if it were on a reach:

- 1) vang hard and ease the main to balance the helm
- 2) keep the boat flat
- 3) hike and/or trapeze hard
- 4) when overpowered ease the main and jib and bear off very slightly

A final word before going on to jib trim. Wave conditions are as important as wind conditions in influencing sail trim. Large waves require fuller sails than flat water to power through. Sometimes the wind and waves cooperate to make your decisions easy. For example, in heavy air and smooth water (an off-shore breeze) the sails should be very flat. Sometimes conditions are not so conducive to straight-forward choices such as when the chop is up but the wind is dying to a drifter.

Upwind Jib Trim:

Trim on the jib basically follows the trim of the main: full for power in moderate air and choppy water; flat in smooth water and in very light and heavy air. In addition, rig tension affects jib shape by controlling luff sag and the shape of the entry (see "Tuning the Rig" in the "Advanced Sailing" chapter).

There are basic guidelines but it also depends on how you sail and the conditions. Most jibs have just two sets of telltales along the luff. When you first set up the jib, get down to leeward and sight up the leech. If you have one, the leech telltale should be trimmed much as the main telltale is, stalled 1/3 to 1/2 the time in a light to moderate breeze and less at other times. Pulling the sheet tighter closes the leech and makes the telltale stall more of the time. Because there is no lead adjustment, in light and medium wind you **MUST** use the windward sheet to control sheeting angle and the leeward sheet to control the leech to get the proper balance between fullness and twist. (This is often referred to this as "Barber hauling" though the term is not strictly correct for this usage of the windward sheet). Of course, when reaching in lighter air, you can sheet in front of the fairleads. Shift your gaze to the luff and have the skipper head up slightly. All the luff telltales should flutter at about the same time. If the upper one flaps first it's an indication that the leech is under tensioned (the top of the sail is twisted away). If you can trim in some more without over-trimming the jib, try and do so (you may have to ease the windward sheet some), and test again, but remember that it is always a compromise. In very light air the slot between the main and jib should be wide open. Light air cannot force its way through a narrow slot. It may at times be necessary for the crew, sitting to leeward, to hold the jib-sheets outboard (in front of the fairleads) and up a bit. In any case, sheet tension should be very light.

Moderate conditions demand the most attention to jib trim. As with the main, the jib should not be over-tensioned at the lighter end of a moderate breeze. This will cause the sail to be stalled too often.

As the wind picks up the jib can be trimmed in to close the leech for power. Windward sheeting should always be used unless it is very light (you may have to undertrim your jib) and when you are having difficulty holding the boat flat

In very strong winds the jib should be flat and have a twisted off leech. Unfortunately, this is hard to do, so again there will be a compromise between how flat the jib is and how tight the leech is. Be ready to crack the jib off and rapidly retrim in the event of a sudden gust.

Downwind

Reaching:

The responsive 420 reacts well off the wind with a crew that is willing to work hard. Sheeting the mainsheet straight from the boom allows for effective pumping of the sail. It is hard to describe when exactly to pump. The best way to figure it out is to sail the boat a lot. One good time to pump is when you get a puff to initiate planing or surfing. In very light air, reaching can be frustrating unless you are very patient and calm. First of all, be sure not to overtrim. Make sure the jib is not being closed off at the top. Also, try heeling the boat to leeward five to ten degrees. This allows gravity to induce an efficient shape in your sails. That way, when a breeze does come, it can use that shape without having to create it. Remember to look behind you (upwind) when looking for puffs.

Running:

It pays to heel the boat up to windward in most conditions while running. Some people use only a few degrees of heel, while others tip the boat up to the balance point (over twenty degrees). The idea is to get more mainsail area up in the air where it is almost always windier. Also, the windward heel reduces the boat's wetted surface, thereby reducing drag. In any event, make sure and keep your weight forward. Heeling the boat can be risky in windy or puffy conditions, as it increases the chance of a death roll. If you feel the boat tipping over to windward, push the tiller towards the mainsail. This steers the bow of the boat underneath the top of the mast and should stop the roll. If you seem to be out of control and heeling both ways alternately, try putting a little centerboard down (it should have been almost all the way up for a run).

Downwind Sail Trim:

A 420 feels very different on reaches and runs than it does close-hauled. Going upwind demands steady and continual hiking, subtle changes in sail trim and little body movement. The boat is a fairly stable platform that is constantly pulling to windward. Sailing the boat off the wind requires much more jumping around and dramatic changes in sail trim.

Adjustments off the wind are fairly simple. Under most conditions the control lines can all be eased. The cunningham is easy to slack off but the outhaul is often not worth the bother unless you're in a long race. Most important however, is the readjustment of the boom vang. If the vang was on going up wind and then you bear off onto a reach, be sure to release the vang. If left on tight, the vang will slow the boat, kill the handling, not allow the boom to be eased out rapidly in gusts, and, by pulling

the boom way down, can cause painful jibes. The vang should be played as a "throttle". More vang leads to less twist and more power until the sail begins to be overflattened. When reaching, the main should luff evenly (neither the top nor bottom first) and the battens should be aligned if you have the proper vang tension. If overpowered when close reaching, ease the vang and let the leech twist off. Finally, when preparing to jibe, ease the vang off a bit. This will allow the boom to rise and keep the boat from being overpowered and out of control as you come out of the jibe. When you're settled down again trim the vang in and take off. Until the spinnaker is put up main and jib sheet trim are the most important considerations when reaching. Both sails should be tightly trimmed so that slight easing would cause a luff. Good main trim requires that the sail occasionally be let out a bit and then retrimmed until the luffing just disappears.

A 420 will show fairly major changes in speed off the wind due to surges caused by gusts, waves, planing and slight changes in course. These changes cause shifts in the apparent wind, which must be compensated for by changes in sail trim.

A fair bit of space was devoted to steering with weight and sails in the previous sections. It is even more important to use these techniques off the wind as course changes tend to be more exaggerated. When a gust hits, hike hard to get the boat flat (or even heeled a bit to windward), ease the main, and then bear off. Heading up is best accomplished by allowing the boat to heel slightly and trimming the sail than by putting the tiller over.

Roll Tacking

As with most other aspects of 420 sailing there are two ways to tack the boat: an easy way and a fast way. The easy way, called the flat tack, is not unlike tacking in any other boat. Uncleat the main and jib when close hauled, push the tiller to leeward, change sides and trim in the sails as the boat falls off onto the new tack. If the crew is out on the wire, the skipper should say "ready about" and wait until the crew swings in, unhook and uncleats the jib. It's the skipper's responsibility to wait until the crew is unhooked and ready before putting the helm down.

The snazzy method of tacking, the *roll tack*, involves actively shifting crew weight to force the boat through the eye of the wind. A properly done roll tack actually accelerates the boat. The roll tack is started by allowing the boat to heel up, giving it a strong weather helm. Coupled with the turning of the tiller this allows the boat to spin very fast. Unlike during the flat tack, the skipper and crew should stay on the (old) weather side after the skipper pushes the tiller over. In fact, they should hike hard to roll the boat through the tack. After coming across the wind, skipper and crew rapidly scurry to the high side and hike the boat flat while trimming in the sails.

Obviously, this type of tack requires lots of practice in order to get the timing down. Once you can do a smooth roll tack try "double tacking". Do a second tack the instant you finish a tack. If your boat has not stopped dead in the water then you're doing OK. If not, keep practicing. The double tack, in addition to being a fine drill, is a useful defense against a tight cover in a race and is also very effective in impressing other sailors. If you are serious about racing 420s, extend the drill by doing as

many consecutive roll tacks as possible. It is important not to sail between tacks even for a second or two, as this makes it much easier. In theory, you should be able to roll tack your way across the lake.

Tuning the Rig

The manufacturer's tuning guide for the 420 may be found at:

http://www.teamvanguard.com/boats/m/_general/c420_tuning.asp

The rig tuning information that follows is an advanced topic. Generally, at Hoofers, your primary control of rig tension and mast rake is the tension on the jib halyard (and therefore the forestay). You should not adjust the rig tension by changing the positions of the pins that attach the shrouds to the boat without discussing it first with an instructor or the fleet captain.

Even before putting the boat in the water there are numerous decisions that are made by racing sailors in preparing their boats. There is, of course, the selection of the mast, which is based principally on its bend characteristics (both fore and aft and side to side) and weight, but these are fixed by the manufacturer on our 420's.

When setting up the mast itself there are two things that should be kept in mind, rig tension and rake. Rake influences the position of the Center of Effort and thus the helm of the boat. Raking the mast back moves the CE back and increases weather helm. Rake also affects mainsail shape by determining the tension on the mainsheet (and thus mainsail leech) when the boom is pulled all the way in. Finally, mast rake affects jib trim by changing the width of the slot between main and jib. Raking the mast aft has the same effect on the jib as moving the jib fairlead aft, that is, it opens up the slot. Next comes rig tension. Greater tension on the shrouds and forestay keeps the mast from jumping around in a chop, "prebends" the mast by compression and affects both the entry and amount of jib luff sag. Keeping the rig firmly anchored is clearly an advantage in heavy weather, but the importance of rig tension on the shape of the sails is much more important in all conditions. Most 420 mains are cut to 'expect' a certain amount of mast bend. This allows them to perform most efficiently under the widest range of wind conditions. In many instances, mast bend is induced by tension on the mainsheet and boomvang, which, by pulling on the mainsail leech, pull the mast tip back. However, in light air there should be very little tension on the main and the vang should not be used at all. Thus, the slight amount of bend caused by the tension of the shrouds is necessary for the sail to set correctly. Tight shrouds also cause a tight forestay, which prevent the luff of the jib from sagging off in gusts. Luff sag kills both speed and control as it results in the jib getting fuller in puffs. With a taut forestay the jib shape stays constant through puffs and lulls.

Rig tension also affects the entry of the jib. Too little tension causes too full an entry and the boat feels sluggish. Too much makes the boat very difficult to keep "in the groove." Generally in light air you want a bit more tension to keep the luff entry fine and the camber smaller so that the light air can flow around the sail. In lumpy conditions, you will want more tension to keep the mast from bouncing around. In heavy air, you will want more tension to keep the draft forward on the jib.

That leaves stronger light to moderate air, with flat water, when you might want to ease off a bit, for a bit more power and a wider groove.

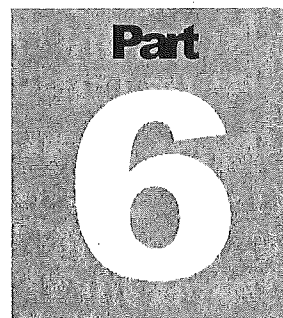
Most competitive sailors find that a tight rig is faster and equip their boats with a powerful block and tackle system to tension the jib halyard. Rig tension and mast rake are influenced by the same adjustments. Ideally, you would alter both the shroud length and jib halyard to properly tune your rig. (Again, at Hoofers, you will generally leave the shroud settings alone.) Once the shrouds are set, increasing tension on the forestay does two things: 1) it straightens the rake by pulling the mast forward and 2) it pulls against the shrouds and thus increases rig tension. However, small changes in the halyard have a greater effect on rake than on rig tension. Conversely, changing the length of the shrouds by choosing a new hole on the chain plate has a greater effect on tension than on rake. Therefore, when setting up your boat, it's best to think of the jib halyard as a rake adjustment and the shrouds as a tension adjustment.

Remember though, ideally, for your rig to be set up properly both must be adjusted together. For example, if you find it necessary to drop your mast back, the halyard is the main control but your shrouds must be pinned in a lower hole to take up the "slack" and maintain proper tension. Sails must have an airfoil shape in order to pull a boat upwind. Putting a flat sheet on the mast just won't do the trick. Over the years, sail makers have devised two construction techniques to create and control the shape of the sail. Broad seaming sets the depth and position of the draft in the sail. As the name implies, broad seaming involves overlapping seams of the panels in the sail. The second technique, luff curve, allows the fullness of the sail to easily be changed while the boat is underway. Camber is forced into a sail with a curve luff that is placed on a relatively straight mast. By allowing the mast to bend you cause the sail to become flatter and flatter until the amount of bend equals the amount of curve cut into the luff and luff curve no longer contributes to the fullness of the sail. Bending the mast also allows the leach to twist off, further depowering the main. The mast can be bent beyond the luff curve (called overbend), which causes the sail to invert and large diagonal wrinkles to radiate from the clew to the spreader. Inversion should be avoided in all but the heaviest of wind. Under extreme conditions however, an inverted main, though almost completely depowered, still allows the boat to point and it needn't be eased out too far. Mains of 420's, as well as most other dinghies, have both broad seaming and luff curve in order to create sails that are effective over a wide range of wind and sea conditions.

Basic Rules for 420's

	Light Air	Medium Air (Marginal trapezing)	Heavy Air (Crew always flat out)
Mainsheet	Continuously trimmed in and out to keep boat moving. Experiment	Mainsheet in tight upwind for better pointing ability. Keep boom close to the center line. Last 18" of top batten parallel to boom.	Ease, hike, trim. Learn to anticipate puffs. Pump main to sail flat.
Vang	Upwind: Loose, but not completely off, so that batten can point outboard. Downwind: So that last 18" of top batten parallel to boom	Upwind: May be snug. Downwind: So that last 18" of top batten parallel to boom. Keep boom from lifting. Off while jibing.	On tighter upwind than downwind. Used to keep boom down when mainsheet is eased in puffs. Slight overbend is allowable. Downwind: Off while jibing.
Jibsheets	Upwind: Use windward sheet ("Barber haul") lightly to control sheeting angle (while leeward sheet controls leech). Downwind: Sheet from in front of the fairlead, hold outboard.	Upwind: Sheet the leeward sheet fairly hard to control leech and to get pointing ability, and then use windward sheet to bring the clew in.	Do not use windward sheet.
Rudder & Heel	Roll tack hard. Heel to lee. Always make sure rudder is all the way down. (Weeds make a difference.) For all air: Help rudder by heeling to weather or to leeward. Don't over steer.	Flatter in more wind. Roll tack.	Always flat. Don't over steer
Centerboard	Upwind: Down Downwind: to maintain neutral helm.	Upwind: Down. Downwind: to maintain neutral helm.	Upwind: Up partially (2" to 3") to balance helm. Downwind: to maintain neutral helm and avoid "tripping" over the centerboard.

Halyard / Cunningham	Loose. Wrinkles from tack to head.	Snug.	Tight to take out horizontal luff wrinkles.
Outhaul	Loose for waves, so that vertical wrinkles just disappear. Tighter for drifter conditions.	Moderate.	Tight, but not so that all power and pointing is lost.



Part Six

LEARNING TO TRAPEZE

Harness and Clothing

The trapeze harness is required attire in all but the lightest of winds. Generally only one harness is allowed per boat, except for instruction. There are several schools of thought on the wearing of the harness. Most sailors agree that the waist strap should be quite tight. The life jacket may be worn either under the shoulder straps, where it acts as a cushion and improves fit for smaller crews, or over the harness to keep the straps from getting caught on the boom. Some sailors adjust the shoulder straps when sailing for weight distribution and support. As a beginner, keep the strap snug for a feeling of confidence and security. As you become more comfortable on the wire, try loosening the shoulder strap in heavy air so that you can stretch out farther.

Other clothing should include long pants (splash pants) and a shirt with a collar to prevent cuts and chaffing from the harness straps. Shoes are a must, if you intend to keep the same pair of feet for the rest of your life. And, of course, dress for the weather, which, in a 420 when the wind is up, means dress for continual drenching in water that may be pretty cold.

Crewing

One of the most important jobs of the crew of a 420 is maintaining the proper hull trim. In light wind this requires moving from side to side in the boat. In heavier air the trapeze becomes a necessity. The objective of good crew weight placement is to keep the skipper sitting comfortably in one place where the jib and water to windward can be watched.

The incorporation of a trapeze on a sailboat allows a yacht designer to increase the sail area and decrease the beam, and thus decrease the drag, of the boat. Far more important is the added dimensions that this device gives to crewing. On your first few rides, especially in lighter air, your skipper will do all sorts of weird things to hold you out on the wire. As you gain experience the skipper should pay less and less attention to your position. Remember, it's the crew's job to keep the boat level.

Basically, there are two ways to get out on the trapeze from inside the boat: the slow, easy way and the faster, better way. To get out the easy way, hook up while sitting on the gunwale and raise the hook until you're suspended just off the deck. Grab the handle with your forward hand and place your forward leg, bent, on the deck. Place your back hand on the edge of the boat, just behind you. When you're ready to go out put your weight on the wire, lean back and push off with your back hand. Straighten out your front leg and bring your back leg up onto the edge of the boat. You should now be out on the trapeze!

The hard, fast way out is easier to describe: grab the handle with your forward hand, jump out and hook up. Waiting 'till you're out of the boat before hooking up leads to very quick, snazzy looking tacks that can make you demolishing on a race course!

On your first few trapeze rides you will probably find it most comfortable to plant your forward foot against the shroud, have the trapeze hook pulled all the way up and have your feet spread for balance. As you become more proficient, try to improve your form and the performance of your boat. Bring your feet closer together to get your weight as far outboard as possible. For added stability, stay on the balls of your feet and point your front foot ahead to keep from being thrown forward. Lengthen the wire to lower your weight and increase the boat's resistance to heeling. Higher hook positions are used most often in lighter air or bouncier waves. Finally, move away from the shroud. Having your weight that far forward pushes the bow down and kills the performance of the boat.

When trapezing in smooth water stand out 2 to 3 feet aft of the shroud. As the waves and wind build, move back until you are just in front of the skipper (who should be sitting right at the traveler bar). Your exact position depends on your weight as well as the weight of the skipper. However, as a general rule, in lighter air and smoother water look forward to where the bow cuts through the water. The curve of the boat, where bow becomes bottom, should just be kissing the waves.

In choppy conditions the boat should feel like it is rhythmically hobby-horsing through the waves. Whatever the conditions, occasionally move back and forth to see the effect of your weight. Note if the boat tends to plane easier, plows through the waves, feels sluggish, points higher or sends up a funny spray. Ask the person steering if s/he can detect a difference in the feel of the helm accompanying the shifting of your weight.

The critical aspect of good trapezing is smoothness. All too often beginning, and not so beginning crews shoot out of the boat when the first gust hits, cause the boat to rock to windward and then come flying in as they get their bottoms wet. This business of see-sawing from side to side while going upwind is generally considered poor seamanship and is not very much fun besides.

The first requirement for smooth wire work is that you get your eyes out of the boat and look to where the wind is coming from. If you see a large puff coming you can pop out of the boat pretty forcefully. On the other hand, if you can see that you'll be hit by a small gust, be ready to ease out slower and gently get back in as the wind subsides. If you are already trapezing and the wind starts to let up a bit, don't spring right into the boat. First sit up keeping your legs straight and just bending at the waist. If the wind lightens even more, stay on the rail and just "butterball" up by bending your knees to your chest. As the next gust hits you can then gently reverse the process without having to go out of the boat. Remember, once there is a moderate breeze the 420 must be sailed absolutely

flat. Pay lots of attention to how much the boat is heeling. A glance back at the transom is a good indication of just how close to flat the boat is.

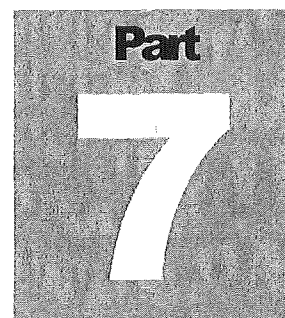
Marginal trapeze conditions require lots of concentration and patience. Be ready to constantly adjust your weight to keep the boat balanced. It is often a good idea to raise the hook high enough so that it holds you just off the side tank when you're sitting in. This allows you to easily swing out without having to lift your weight with the handle. As the wind increases just keep sitting further outboard while slung in the harness. If your legs are long enough it sometimes pays to trapeze right off the centerboard trunk. Otherwise, hold yourself halfway out by leaning back and pushing off the tank with your back hand. Be ready to put your front foot onto the rail as the gust builds. It's ok to hold onto the handle with your front hand. Once your front foot is up on the edge of the boat it should be easy to get all the way out by straightening your leg and pushing off with your back hand.

Heavy air is pretty easy to handle from the wire, and much less work (and lots more fun) than hiking! Get yourself comfortable and "clamped" in. Lower the hook as much as you feel is possible, get the jib sheet ready to crack in an emergency, relax and enjoy the ride. In puffs you can bounce your weight to get the boat flat. If done in concert with the skipper, bouncing can be an extremely potent tool in heavy air. In addition to jerking the boat down, bouncing causes the tip of the mast to flex, allowing the upper leech of the main to spill wind. If the boat goes way over, crack off the jib just for a split second then trim it right back in. Do not leave the jib uncleated and flailing; as that could lead to your demise. A 420 must be kept driving forward in heavy air. The boat can capsize, even with both sails luffing, if it's dead in the water.

Roll Tacking

A roll tack is slightly more difficult during trapezing conditions. When the skipper says "ready about", the crew unhooks from the trapeze and uncleats the jib while still out of the boat. The crew, when ready, says "ready", and the skipper immediately puts the helm down. With this sort of tack the crew is responsible for her/his own well being, and should really be ready when they say "ready" unless she/he wants to go for a swim due to a windward capsize during the tack. If the skipper were forced to check the crew, the crew would have to hang, unhooked, for an extra couple of seconds. Once the boat begins to tack the crew should try to *wait* for an extra second while swinging in to roll the boat through the wind. The new jib sheet should be grabbed as close to the fairlead as possible so that one pull will get the jib almost trimmed. The vast majority of 420 crews tack facing forwards but some face aft during a tack. Give both a try before developing any habits. Either way, as you *come across* the boat, *trim* and cleat the jib, *grab* the handle with what will be your forward hand, *pivot* around and get your feet *out on the rail*. By this point the skipper should be across the boat and trimming the main to balance the boat. The crew should then hook up and finally trim the jib in the last little bit as the boat rockets past all those who were doing dull, old, flat tacks.

One of the best drills to speed up the crew is sailing without the use of the harness. This forces the crew to learn to get out and come in without being dependent on being hooked up.



Part Seven

FLYING THE SPINNAKER

Using the Spinnaker

As you probably know, the *spinnaker*, or *chute*, is an auxiliary sail used for offwind work. The incorporation of a spinnaker into a boat's design allows the boat to be faster downwind. When reaching and running the spinnaker practically doubles the sail area. This specialization allows the main and jib to be designed most efficiently for sailing on the wind. In addition, the spinnaker gives the crew an important job on the offwind legs of a race. This added responsibility and the coordination needed while raising, jibing and lowering the chute, demand that the boat be sailed as a team.

A few points to remember are to check the halyard to make sure that it's clear aloft, completely untangled from the rigging, and that the chute is packed outside the jib and stays. You'll probably find that the spinnaker packs with fewer problems if it's stuffed in its pouch before attaching the jib.

Attach the spinnaker pole before putting the boat in the water to see if the topping lift is working and is at approximately the right height. After adjusting the height, stow the pole securely in the boat, so it won't fall out in the event of a capsize and so that it is accessible to the crew.

The use of a spinnaker greatly increases the number of lines that must be contended with. First is the spinnaker halyard. One end is attached to the head of the spinnaker and the other is used to raise the sail. Unlike other sails, however, the spinnaker is only flown off the wind and thus must be raised and lowered in the course of a day's sailing. The spinnaker also has a *sheet* which, as always, is used to trim the sail. However, the spinnaker is a symmetrical sail and appears to have two sheets. (The 420 is usually rigged with one long continuous sheet that makes it easier on the crew by only having to handle "one" line). Once the sail is raised this problem disappears. Only one line acts as a sheet while the other is used to position the spinnaker pole and is called the *guy*. The pole positions the foot of the spinnaker and is always set out on the side opposite the boom. Note that when you jibe the pole must be switched from side to side and the old guy becomes the new sheet and vice versa. The spinnaker pole has three attachment points. One end is hooked to the guy and the other end is attached to the spinnaker ring on the mast. The eye at the center of the pole is attached to the topping lift, a gizmo used to control the height at which the pole is flown.

When not in use, the spinnaker is stowed, rigged and ready to go in the bag in front of the mast. To pack the chute find both clews, and make sure that you can run from one side to the other without any tangles in the foot. Stuff the foot into the spinnaker bag but leave both clews hanging out. Continue to stuff the sail making sure that the luff tapes are not twisted. When tying on the halyard, look aloft to make sure that it's not tangled and is on the port side of the forestay. Finally, remember that one end of the continuous sheet must be led around the forestay before being attached to the spinnaker. You'll probably find that packing the chute before the jib is rigged will minimize some of the tangling problems. It also helps to take the spinnaker halyard and hook it (outside of the forestay) in the twing, alongside the port side of the sheet, to keep things from getting tangled and/or confusing – just make sure you pull it off of the twing before raising the spinnaker. Remember, the spinnaker and all its associated paraphernalia must be rigged over and outside the jib.

If you are out day sailing and wind up needing a weather set, just jibe to get the chute in proper position. To hoist the spinnaker, bear off to a reach (a broad reach makes the set easiest), ease the vang, and let the main out. The jib should be eased but may be left slightly overtrimmed to keep it out of the way of the hoist. The crew will have to be in the middle of the boat during the set so it is up to the skipper to balance the boat and, during a race, keep the boat moving. Before hoisting, the crew should make sure that the halyard is free to run up. Some sailors like to hook the halyard around the chain plate or twing to keep it untangled when not in use. This mandates the crew going down to leeward to unhook the halyard before the set. In any case, it's often a good idea to pull the head of the sail a foot or two out of the pouch to help it up. If your boat has twings (discussed below) make sure that *at most the windward one is hooked and the leeward one is free*. Usually you will put the windward twing on after the chute is flying as getting the chute flying is most important. The bungee cord on the 420 topping lift serves as the downhaul and can suffice until the guy is twinged. Make sure the sheet is running free — NO CLEATING. Unhook the pole from the hiking strap and slide the pole from the bilges. (Watch out that you don't hit the skipper with the pole!). Next, attach the topping lift, especially as you are just starting out with the spinnaker, so that the pole cannot go overboard. Once that is done, hook the end to the guy. Once this is done, the pole can be pushed all the way out and hooked to the spinnaker ring.

Once the pole is set, the crew checks that the halyard is free (for example, not still hooked around a twing) and should yell "hoist" to the skipper and be ready to balance the boat as the skipper comes in to get the halyard. As the skipper hoists the sail the crew should pull the guy back and push the pole forward until it meets the corner of the sail. The pole initially is set by aligning it with the boom. Have the sheet held loosely allowing the guy to be pulled around easily, then begin to trim. Note that throughout the set all three corners of the sail are under tension. The head is being pulled by the halyard, the tack by the guy, and the clew by the sheet. This method minimizes the risk of twisting the sail. Be prepared to have your sail area doubled in about 2 seconds (i.e., the skipper must be able to bear off and the crew ready to hike hard during the set).

The spinnaker, like all other sails, is trimmed with the sheet. The sheet is eased until the luff (the edge on the same side as the pole) just begins to curl. Beware: spinnakers are tricky beasts and will completely collapse if you take your eye off for even a second. Should the chute collapse, rapidly trim in until the sail fills, then ease the sheet back out.

The pole is set roughly perpendicular to the wind. On a broad reach or run the pole should be about 2/3 of the way back while on a close reach it can be eased as far forward as possible without resting on the forestay. Spinnaker pole position is adjusted with the guy, which may be cleated near the forestay. Using the forward cleat allows the guy to be adjusted while the sheet is being played. Often, however, the guy is not cleated, because it is used frequently to adjust the position of the pole.

The pole height is adjusted with the topping lift and controls the shape of the sail and the width of the slot between the spinnaker and working sails. The rules of the 420 class mandate a pole that is actually smaller than is optimal. Because of this the luff is frequently choked off and the pole must be flown higher than is common on many other classes of boat. The pole should never be lower than perpendicular to the mast and can be carried as high as perpendicular to the jib stay. Generally, the pole should be lowest in light air and on broad reaches and runs; highest on close reaches in heavy air. A rule of thumb for optimum pole height is that the height at which the luff of the spinnaker breaks or curls should be at the bottom of the top white panel and the top of the colored panel when pole position is optimal.

The topping lift downhaul on a 420 is made of shock cord which is not strong enough to prevent the pole from "skying" in a gust. However, by holding the guy down, the pole can be kept under control. This is done either with small hooks on the chain plate called twings. The guy should be pinned down whenever the boat is reaching and can be pinned on runs except in very light air. You should also make sure that you don't accidentally leave the sheet (old guy) twinged after a jibe. A 420 spinnaker can be pumped to get a surge of power to pop the boat onto a plane or surf. Pumping works best on heavy air runs or broad reaches when the waves are up. The chute is pumped by simultaneously and rapidly tugging on the guy and sheet and then releasing them to their normal positions. At the same time the skipper rapidly trims the main and hikes to keep the boat flat. This technique requires lots of practice to be effective. One needs a good feel to know when the boat is ready for a pump. A good way to get a general notion of what's going on is to go for a sail with someone who knows the feel of the boat.

When sailing off the wind, especially in a race, the crew's job is to keep the spinnaker trimmed. The skipper is responsible for tactics and boat balance. This is almost a complete reversal of the jobs from the beat, when the skipper concentrates on boat speed and the crew calls the shots and keeps the boat level. On the reaches the crew should sit on the windward tank in order to get a full view of the chute. The skipper will usually sit on the leeward tank and thus have a good look upwind for puffs. Some sailors have the skipper sit on the weather tank and the crew on the centerboard trunk. This gives both sailors poor views and concentrates weight in the center making the boat more unstable.

The ultimate thrill in sailing a 420 is trapezing with the chute up. Be prepared to go swimming the first couple of times you try it as it is a tricky business. The skipper should be ready to jump all over to keep things under control. The crew must be ready to go from flat out on the wire to sitting in the boat, and right back out, while still keeping the spinnaker in trim. The trickiest step is getting from the boat to out on the wire. Unlike going upwind, you'll have to be concentrating on keeping a sail trimmed and you'll thus have one hand full with the sheet. This prevents you from using the handle. Keeping the ring pulled up will allow you to swing out much easier. You will also find it necessary to

keep your legs spread further apart as reaches are bumpier than beats. Remember, as you are trying to swing out the spinnaker sheet will be trying to pull you in ... good luck!

When flying the chute from the wire lots of trim adjustments will be necessary. As a gust hits the apparent wind moves aft and the chute may become overtrimmed. Moreover, the skipper must be able to bear off rapidly to get the boat under control. If the spinnaker is not eased, the forces loading up on the rig prevent the skipper from bearing off. Therefore, as soon as you feel a gust, ease the chute off and extend yourself on the wire to keep the boat flat. Try not to release the sheet too much as a spinnaker collapse will cause you to roll abruptly to weather. When the boat flattens out and starts to plane, the chute will have to be retrimmed. This can be a lot of work and you may find that fast reaching legs will leave you quite breathless.

Jibing in heavy air with the chute up becomes a bit trickier as it is a very fast maneuver. There are two ways to jibe with the spinnaker up: the normal jibe is used when jibing on runs or in light air when jibing from reach to reach, and the reach to reach fast jibe is a high speed technique for jibing from trapeze to trapeze.

For the normal jibe the skipper informs the crew of the upcoming maneuver and takes control of the spinnaker sheet and guy. The skipper can then straddle the tiller and steer with his/her legs as the crew tosses the main with the vang. The skipper pulls the spinnaker around and flies it while the crew jibes the pole. Jibing the pole first as it makes it infinitely easier to fly the chute immediately after the jibe. This is done by unclipping it from the old guy and rehooking it to the mast ring. The guy is then cleated much as during the spinnaker set and the twings are reset. The two trickiest parts of the jibe involve coordinating weight placement between skipper and crew and keeping the chute flying. It helps if the crew, while reattaching the pole, takes care to poke it out towards the front and near its proper height to aid the skipper in flying the chute continuously through the jibe. A good drill involves sailing dead downwind and jibing every 10 boat lengths or so. Also, try flying the chute without the pole as the skipper stands, steers and plays the guy and sheet while jibing back and forth.

The reach to reach jibe begins with the skipper and crew both being fully hiked out and the boat planing on a high reach. The skipper takes the sheet from the crew, hikes very hard and bears off slightly to allow the crew to swing in. The crew unhooks on the way in and pops the jib out of the cleat. The skipper then releases the sheet, leaving the chute flailing, bears off and jibes the main by tossing the boom across the boat with the mainsheet parts. As the boat is jibing, the crew untwings the old guy (the new sheet) and pulls the chute around the jib by yanking on the old guy. Once the main is jibed, the skipper can begin to trim the mainsheet and reach across the boat for the spinnaker sheet. Meanwhile, the crew moves to the windward side, trims the jib and twings the guy. Finally, the pole is moved to the proper side. (This is the only time to let the pole stay where it is instead of jibing the pole first.) As soon as the skipper sees the pole hooked to the mast s/he trims in the spinnaker sheet. The crew grabs the handle, pops out, hooks onto the trap and takes the spinnaker sheet from the skipper. Once things are settled down, the skipper and crew both heave a brief sigh of relief, hike out, the skipper trims the main in properly, the crew retracts the jib and the boat takes off. That's all there is to it... (whew!)

Dousing is just the reverse of setting, but easier. The skipper takes the sheet from the crew and trims as the crew takes the pole down. As soon as the pole is off the mast, the sheet can be released. As the pole is removed and being slid into the bilges, the crew grabs the guy. The foot of the sail is gathered, collapsing the spinnaker. The crew then yells to the skipper to lower the halyard. While the crew stuffs the chute into the bag the skipper should watch as the sail comes down so as not to drop it too fast. Once done, remember to secure the pole, preferably by clipping it to something. Note that the spinnaker is usually taken down on the windward side of the boat. In heavy weather the spinnaker can be made more manageable by twinging both spinnaker sheets before the douse. A handy racing tip is to set up your boat for the upcoming beat before taking the spinnaker down (i.e., board down, cunningham in, outhaul retightened, etc.). Then, after the douse, you can devote your full attention to doing a good rounding and getting the boat right on the wind while your competitors are flopping around with their heads in their bilges.

Get out there and SAIL!!