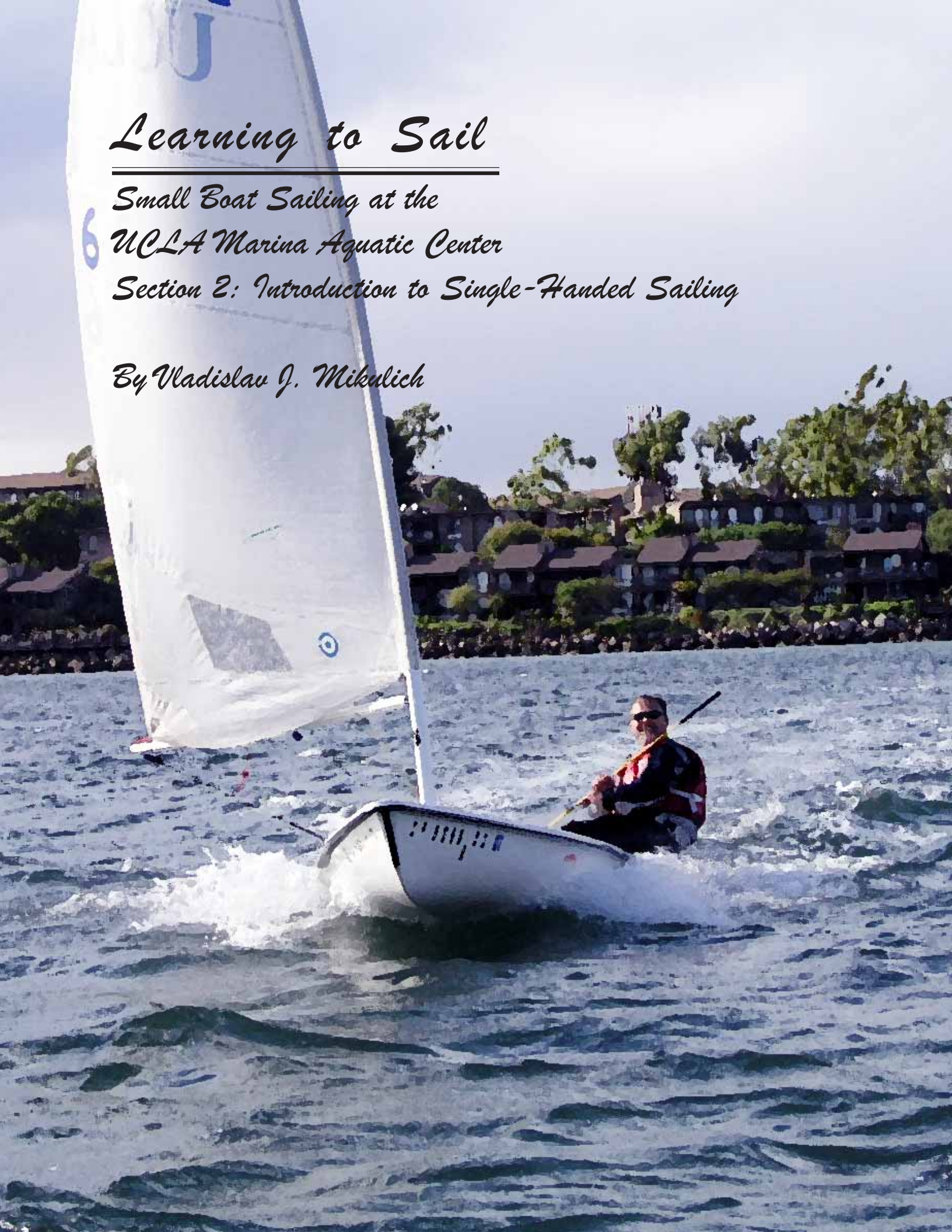
Learning to Sail

Small Boat Sailing at the UCLA Marina Aquatic Center

Section 2: Introduction to Single-Handed Sailing

By Vladislav J. Mikulich



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Small Boat Sailing at the UCLA Marina Aquatic Center 5th revised edition

Vlad Mikulich performing a headstand on the bow of a Laser (c. 2009).

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Dedication: To Aurora, you inspire me like no other. Thank you!

COVER: Steve Orosz, UCLA Head Sailing Instructor 1995-2005 (c. 2004)

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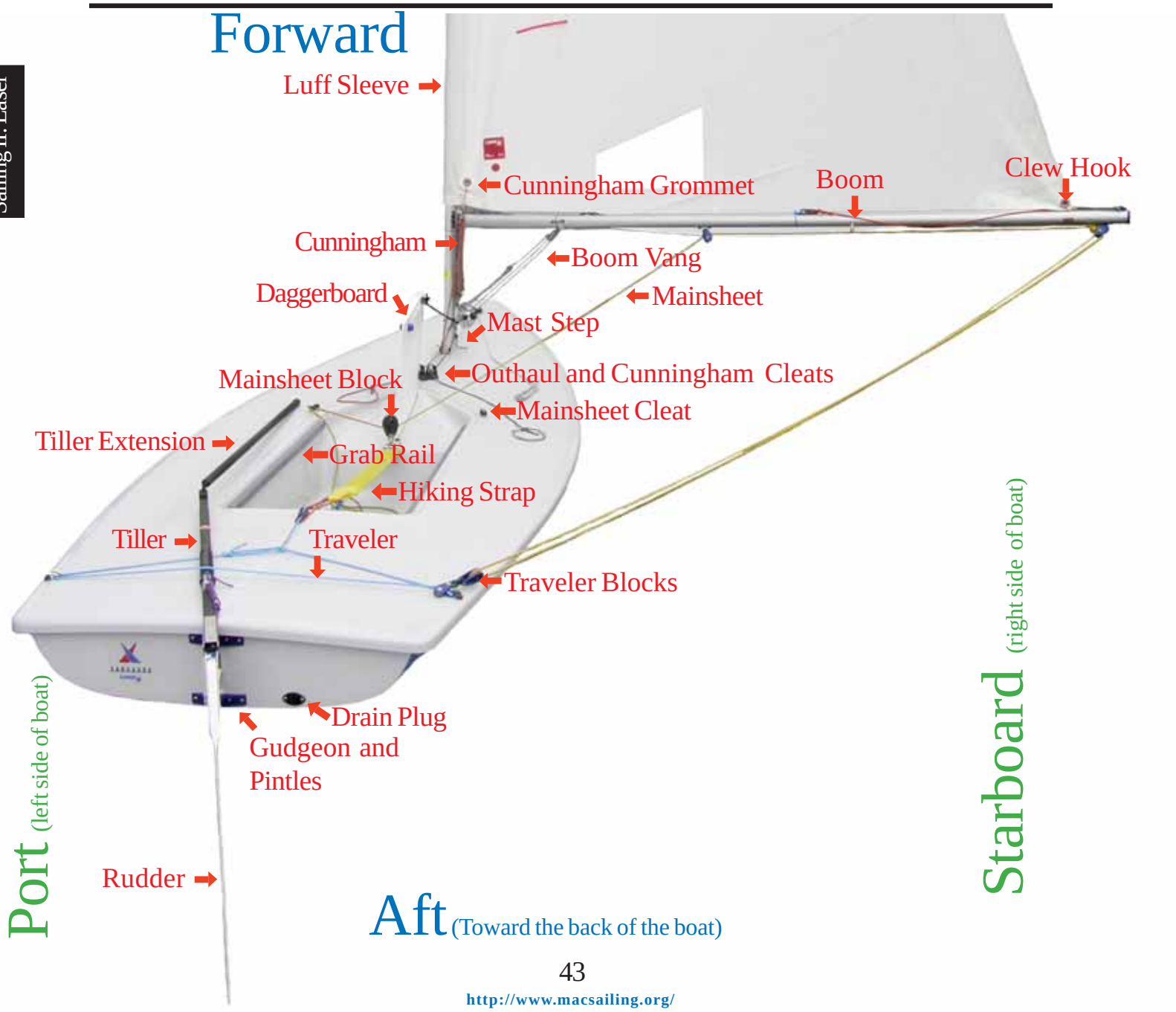
Vlad Mikulich, UCLA Head Sailing Instructor 2005 to present, mid-tack during reach on breezy day (c.2004).

Parts of the Boat: Laser

It has been said that the Laser represents sailing in its purest form. On the water, it is just the vessel, a single sailor and whatever Mother Nature throws at her. There are no high tech gadgets or fancy equipment on a Laser. In fact, the Laser is a strict one-design class where modifications to the vessel are forbidden. In a race between two Lasers, or for that matter 100 Lasers, it is the better sailor that will prevail, not the one with the better equipped vessel as the boats are virtually identical.

The boat is fairly simple to set up, yet it is capable of handling conditions ranging from the lightest breeze to gale force winds (34-47 knots). There are three optional **rigs** (the mast, boom, and sails) that attach to an identical hull. Each sail is designed for sailors of different weight ranges. The Standard Rig was designed for sailors weighing between 160 to 190+ lbs, and has 76 square feet of sail. The Radial Rig, which has 62 square feet of sail, was designed for sailors in the weight range of 121 to 160 lbs. The 4.7 Rig, which has 50.6 square feet of sail (4.7 square meters of sail), was designed for sailors within the weight range of 77 to 121 lbs. These "optimal ranges" are not absolute standards, but rather guidelines for being successful in a variety of racing conditions. To learn more about the Laser, please visit the North American Laser Class Association at www.laser.org.



LASER: The Laser is the Men's and Women's Olympic Class single-handed dinghy, and it is arguably the most popular racing vessel in the world with over 200,000 boats built-to-date. It is cat rigged: it has a single mast with triangular mainsail and no **headsail** (jib).

"Any fool can carry on, but a wise man knows how to shorten sail in time."

— Joseph Conrad

Displacement vs Planing

There are two modes of sailing for monohull vessels: displacement and planing. Most large monohulls and all slow moving small ones operate via displacement sailing. Certain smaller vessels are capable of operating via planing when enough power is applied.

Archimedes' Principle of Buoyancy states that an object fully or partially immersed in a liquid will displace a volume of water equal in weight to the weight of the object. Sailboats that operate via this principle are sailing in **displacement mode**.

Displacement hull plows through the water slowly

A boat operating via displacement mode has a limited speed potential because it must perpetually displace a patch of water equal to its own weight. Displacement boats create waves as they move. As a boat begins to speed up, fewer and fewer waves are generated until only one wave, which is the length of the boat, is produced. This single trough wave has a crest at the bow and stern of the boat. The generated wave cannot get much longer than the hull of the boat. Surface waves are **dispersive**, which means their speed is dependent upon the length of the wave. The longer the wave, the faster it can travel. Therefore each wave of a particular length has a theoretical maximum speed. All boats have a theoretical "hull speed" that is dependent on the length of the vessel.

The theoretical hull speed of a boat in knots is equal to 1.34 multiplied by the square root of the **Length Water Line** (**LWL**). The LWL is the length of the vessel that is actually sitting in the water. For example a Laser is 13.78 feet long and approximately 13 feet of the hull sits in the water at any given time. This means a Laser's theoretical maximum speed is 1.34 X 3.61 = 4.83 knots.

Yet a Laser's maximum speed is definitely above 4.83 knots. Lasers and other light weight small dinghies can operate as planing vessels quite easily. In **planing mode,** the hull rises out of the water and escapes the single trough wave it produced while moving. Thus as a boat begins to plane, the hull skips over the crest of the wave at the bow and begins to skim along the surface of the water using the flatter portion of the aft hull. This occurs any time the boat has enough power applied to the sails to break free from the wave it created. The heavier the vessel, the more power that must be applied to the sails for the hull to break free from the wave; therefore very few large sailboats can plane.

Although Catamarans and certain modern keelboats are able to operate above hull speed by using unique design features that are explained in other parts of the manual, they still are limited by the resistance created by displacement sailing, and thus the above topic applies to all vessels in the water.

Planing in a Laser can be achieved on the following points of sail: Beam Reach, Broad Reach, and a Run. Beginners who wish to learn to plane should first start on a Beam Reach in flat water as it is the fastest point of sail for a Laser. If the skipper is the optimal weight for the vessel she will most likely need a **fresh breeze** (16-20 knots) to initiate planing.

In these conditions it is essential that the skipper keep the boat flat on the reach, as a boat with heel has an asymmetrical hull in the water that impedes planing. The sailor should move her weight aft as the vessel begins to pick up speed. By doing so, the bow of the boat will be lifted, thereby reducing drag as there will be less area exposed to the water.

Furthermore the lifted bow area which has a pronounced curve is not suited for planning, whereas the flat aft section of the Laser is.

Lastly, by lifting the bow up, it makes it easier for the boat to break out of the wave it created.

Bow lifts and boat planes on aft portion of the hull

Boat Trim

Boat trim is the hull's angle relative to the water. All vessels can rotate about their center of mass in three dimensions: **pitching** (fore and aft rotation), **rolling** (side to side rotation, commonly called **heel**) and **yawing** (clockwise to counterclockwise rotation when viewed from above). The Laser has a very light hull. At approximately 130 lbs, the hull's weight relative to the sailor's weight makes the boat ideal to be responsive to the sailor's position in regards to controlling both pitching and rolling. The right body placement in the boat is extremely important to sailing fast and efficiently in a Laser!

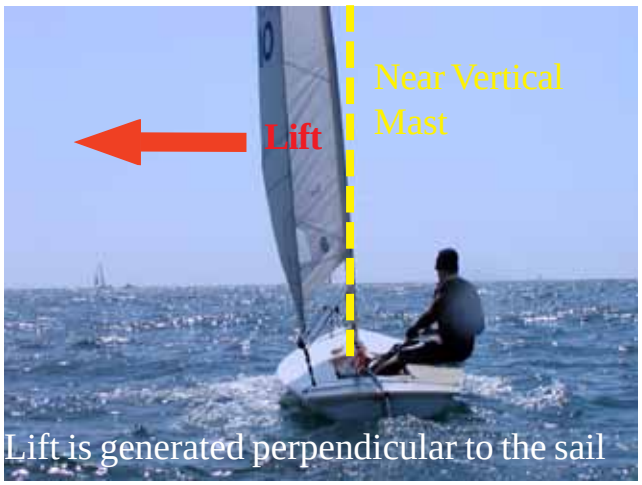
Essential Knowledge

On most points of sail the Laser is most efficient when sailed flat!

Sailor keeps his boat flat through the use of his body position

Why sail flat?

A flat boat allows the mast to stay vertical which means lift is near the horizontal plane

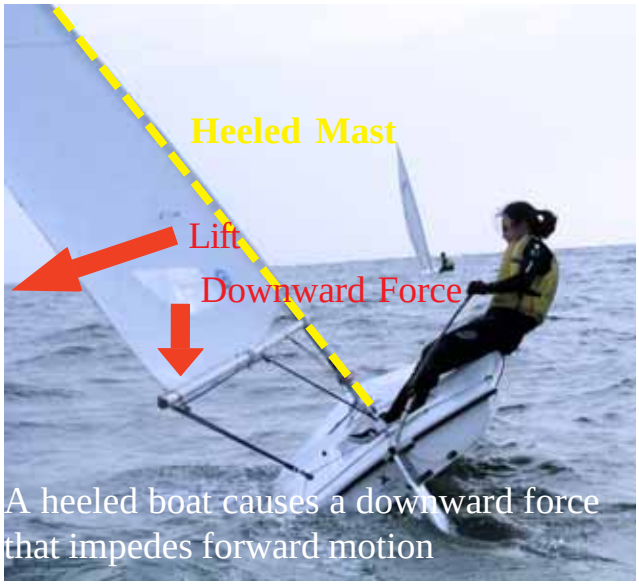


Lift is generated perpendicular to the sail

If the boat is sailed with a heel, a downward force is generated that depresses the hull into the water and reduces speed.

O Captain! My Captain!
Our fearful trip is done,
The ship has weathered every rack,
the prize we sought is won,
the Port is near,
the bells I hear
the people all exulting,

— *Walt Whitman*



A heeled boat causes a downward force that impedes forward motion

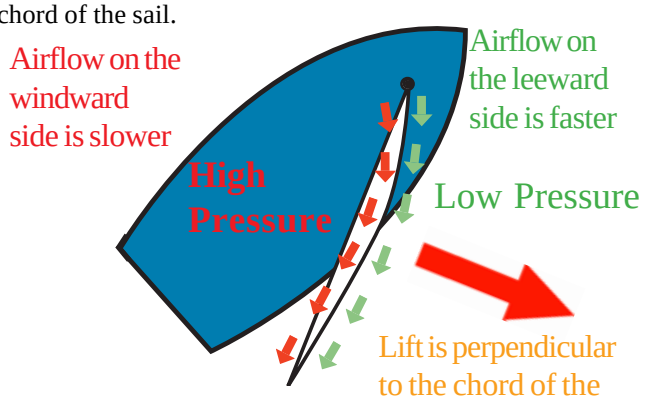
Sailing Upwind

Upwind sailing is one of the biggest challenges in learning to sail a Laser, as it can be quite physical when the breeze is strong. It requires a combination of proper sail trim, boat trim, and pointing angle to be effective.

All upwind sailing regardless of the wind conditions is based on generating lift via Bernoulli's Principle.

Bernoulli's Principle

Bernoulli's Principle states that a fast moving fluid exerts less pressure than a slow moving fluid. Sails have an asymmetrical shape that allows airflow along each side to have a different overall speed. The overall speed of the air on the leeward side is always faster than on the windward side. This means there is a low pressure system on the leeward side of the sail, and thus lift is created perpendicular to the chord of the sail.

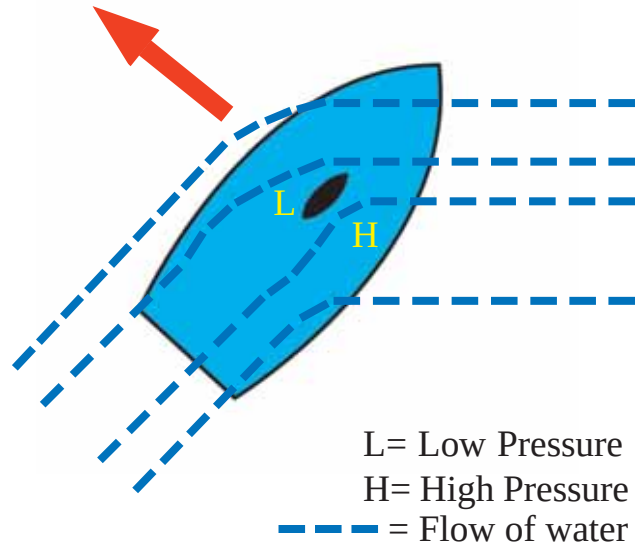


On its own, this force causes the boat to slide sideways as well as **heel** (rotational force). To go to windward a boat needs more than just lift on the sails. The vessel must have lateral resistance to the sliding force as well as lift from the submerged portion of the vessel. This is provided by the **foils** (daggerboard and rudder).

A Laser has a thin wing-shaped daggerboard, which not only provides lateral resistance, but also generates lift which aids the vessel in pointing to windward.

As stated above, when sailing to windward there is a large force on the sail that translates to sideways slippage and heel. This force is counteracted by the foils. Although the foils on a Laser are symmetrical, because the boat slides sideways the water does not strike the foil head-on, but instead hits it at an angle a few degrees to leeward. Therefore the foil can generate a lifting force that pulls the boat to windward. Combining the forces generated from the sail and the foils produces the forward movement of a sailboat.

Lift From Daggerboard

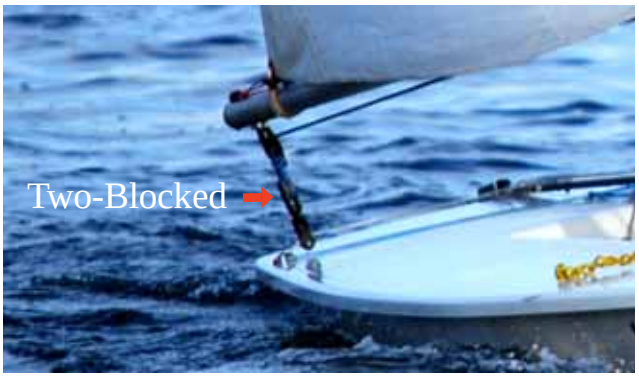


When sailing to windward in a Laser it is important to keep the boat flat in almost all conditions. This allows the foils to produce the most efficient lift to windward. To do this one must often hike as the wind increases (see page 49-50).

Two-Block

Along with keeping the boat flat, the sailor must trim the sail appropriately. In all but the lightest and heaviest breeze the mainsail is **two-blocked** when going to windward.

Two-blocking a sail is an essential skill all Laser sailors need to master in order to sail upwind effectively. When the sail is sheeted in fully and the traveler block touches the boom block the sail has effectively been two-blocked.



A two-blocked sail bends the mast aft and tightens the leech. This in effect depowers the sail, but allows the boat to point closer to windward. The loss of speed is offset by sailing a shorter distance. The concept of having an optimal balance between speed and pointing angle is known as **Velocity Made Good** (see page 52 for more details).

Steerage via the Hull

When the hull heels to either side it becomes asymmetrical in regards to its shape in the water. This means that as the boat tracks through the water it has a different amount of force on each side. This force causes the boat to turn.

A vessel with heel to the leeward side is said to have **Weatherhelm** as the boat will naturally want to turn to **weather** (windward).

A vessel with heel to the windward side is said to have **Leehelm** as the boat will want to turn to leeward.

Limited Helm Usage

A Laser sailor is rewarded with more speed if she is subtle with her tiller. Each time the tiller is used, water is deflected by the rudder, and thus acts as a brake. Therefore, to be most efficient, the sailor should attempt to use the least amount of rudder necessary to steer the vessel.

As mentioned above the vessel can be steered via boat trim. A Laser sailor can make small course changes by inducing heel in the vessel, and thus will steer via Weatherhelm and Leehelm. This steerage is subtle, and when used in conjunction with the rudder makes the boat more efficient.

Steerage Mistakes

One of the most common mistakes a beginning Laser sailor will make is attempting to turn her vessel in one direction when the boat has a heel which counteracts the rudder. If the boat has leeward heel and the skipper wants to fall off the force on the rudder will be fighting the boat's natural inclination to turn to windward. Therefore it is vital to keep the boat flat or induce the proper heel to help with the turn!

Furthermore many sailors when going to windward will not hike hard enough to keep the boat flat in a moderate breeze, and this means the boat will want to turn to windward, which is known as **rounding up**. The skipper will either find herself constantly pulling the tiller toward herself to track a straight course or will end up in irons.

One should keep the boat flat when sailing a close-hauled course. The only exception to this is in very light air when a leeward heel will induce curvature in the sail and help generate lift. The slight loss in lift on the blades due to the heel will be offset by the fact that the sail will generate more lift with proper shape.

When not to be flat?

As mentioned above, a boat can have a slight heel when beating to windward in a light breeze. But are there other times the boat should be heeled for optimal speed?

When sailing on a close reach, beam reach or broad reach it is essential to keep the boat flat in all conditions. Aside from being able to initiate planning if there is enough wind, a flat boat provides the most efficient use of force for forward drive.

But on a run a Laser can be sailed with a slight heel to windward. This aligns the **Center of Effort** with the **Center of Buoyancy**. The Center of Effort is the theoretical point on the sail that is the balance point for all the aerodynamic forces on the sail. The Center of Buoyancy is the theoretical point on the hull that is the balance point for all of the hydrodynamic forces on the vessel. By placing these forces directly over each other, the boat will have neutral helm on a run and will be most stable.

Center of Effort (CE) is aligned over the Center of Buoyancy (CB) which provides neutral helm

"I find the great thing in this world is not so much where we stand as in what direction we are moving: To reach the port of heaven, we must sail sometimes with the wind and sometimes against it— but we must sail and not drift nor lie at anchor."

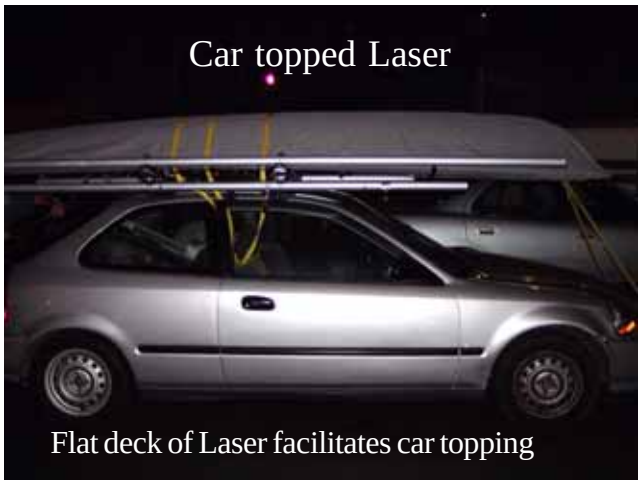
— Oliver Wendell Holmes

Hiking Properly

Hiking is the leaning of one's body over the windward side of the boat to counter the heeling forces on the sails. On a Laser there is a hiking strap that the sailor puts her feet under to secure her body when leaning out of the boat. Learning to properly hike will make your boat more efficient and thus faster in a moderate to strong breeze.

Why Hike?

The deck of a Laser was not designed for ergonomic consideration. It was made for **car topping** (placing the deck onto the roof rack of a car for transportation).



It actually hurts to hike due to the shape of the vessel. So if hiking hurts why do it? The simple answer is that a flat boat is a fast boat! Leeward heel causes the lift on the sail to acquire a downward vector which slows the boat (see page 46 for a more detailed explanation.)

Types of Hiking

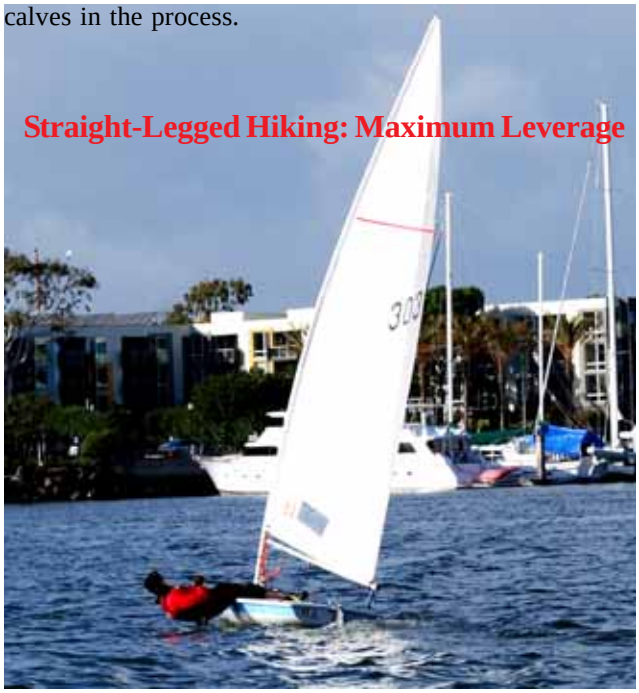
There are three established forms of hiking: **Drooped-Legged Hiking**, **Bent-Legged Hiking** and **Straight-Legged Hiking**.

Drooped-Legged Hiking is found on vessels such as a Star Keelboat and is inappropriate for a Laser as the deck is too close to the water to allow a sailor to bend one's knees to 90 degrees and droop over the side of the hull with the body below the deck. On a Laser this would cause the sailor to be completely under the water! Lasers sailors will either hike in a Straight-Legged fashion or Bent-Legged one.

Straight-Legged Hiking is characterized by having a relatively tight hiking strap. The sailor literally places just the toes of her feet under the hiking strap, and locks out her knees. She then leans out of the boat to windward to maximize her righting leverage.

The benefit of this technique is that the sailor is really "locked into the cockpit," and thus her body movements efficiently translate into movements of the boat. The tighter strap also keeps the sailor's backside out of the water and the upper body achieves an angle that results in the greatest amount of leverage possible.

The disadvantage of this style is that it is extremely physical, and often very difficult to maintain for long periods of time. The style can take a long time to develop, and sailors often bruise or strain their ankles, thighs, and calves in the process.



Bent-Legged Hiking is characterized by having a looser hiking strap that allows the sailor to have a slight bend in her knees. A gap between the knees and the deck of the boat is easily discernable.

Bent-Legged Hiking is more comfortable, and therefore a sailor is likely to maintain the position for a longer period of time which often offsets the loss of leverage from not Straight- Legged Hiking.

While hiking in either fashion the upper body should be flat. The sailor should not allow her back to curl as this puts unneeded stress on the lower portion of the back and makes your hiking position much less efficient. It would be far better to slide in and keep your back straight than to hike from your toes but curl the upper body into the boat.

Poor hiking technique: curled back, over flattened, dragging in the water, etc.

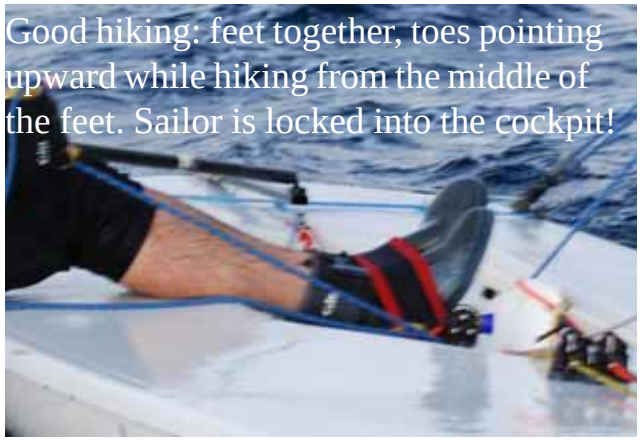
Your goal is to keep the boat flat. If the breeze is lighter and you do not need that much weight out, the sailor should slide her legs and buttocks in and keep a straight back.

Breeze too light to fully hike. Sailor keeps body inboard to flatten boat.

You should sit 0-10 inches aft of the daggerboard.

When hiking you should feel an equal amount of pressure on your thighs and calves. If you feel too much pressure on your thighs it means your body is not out far enough which could be due to a hiking strap that is too tight or the fact that you are not allowing yourself to slide out as far as you are capable of. Conversely if you feel too much on your calves your hiking strap is too lose.

Regardless of which style is used, you should try to lock your legs into the cockpit so that the motions of your body translate into motions of the boat. A Laser was meant to be steered kinetically: through body movement and placement. You should keep your toes pointed up or outwards. Never inwards! By allowing your feet to point inwards you will be placing a greater amount of force on the outside quadriceps muscles relative to the inside quadriceps muscles. This uneven distribution will cause the kneecaps to pull outwards and a condition called patellofemoral pain will develop after time.



Good hiking: feet together, toes pointing upward while hiking from the middle of the feet. Sailor is locked into the cockpit!

Static Muscle Contraction

Hiking involves a "static muscle contraction" that is different than the explosive muscle contraction of an Olympic Weight lifter or the repetitive muscle contractions of a Marathon runner. While hiking a sailor locks out her muscles and attempts to stay in the same position for a long period of time. The constant contraction of the muscles constricts blood flow to the legs and therefore after a long period the thighs are deprived of oxygen. To counteract this, a sailor must transiently relax the muscles in one leg at a time. This will allow blood flow to reenter each leg while the other leg is used to completely support the body.

Overhand Grip

You should always have an overhand grip on the tiller when hiking! There are times when you will not hold your tiller in an overhand grip, but never while hiking!

Do NOT do the following while hiking:

Do NOT cleat the mainsheet and forget about it as you will need to use it to constantly adjust the sail while hiking. If you are hit with a gust when fully hiked and you are not holding the mainsheet you will likely capsize. Furthermore it will help you pull yourself into the vessel in a lull.
Do NOT wrap the mainsheet around your hand as a large gust will likely pull you off balance and injure your hand.
Do NOT put the mainsheet in your teeth as it appalls my dentist.
Do NOT hold the tiller in a underhand "frying pan" grip.
Do NOT heel the boat to windward as this will cause the boat to slide sideways by reducing lift from the blades.
Do NOT curl your back. Keep it straight.
Do NOT be afraid to hike. The straps will hold you. Water is soft and this is what Laser sailing is all about!

Sail Controls: Laser

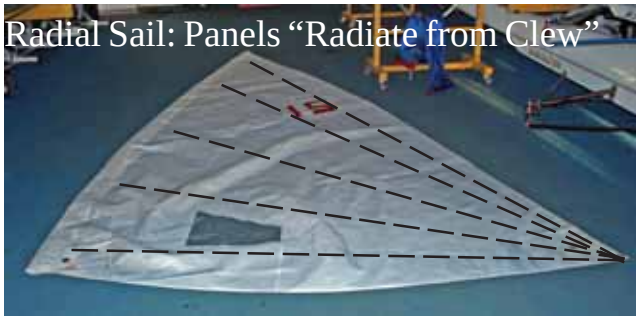
Modern sails are not flat pieces of cloth with only a two dimensional shape. All sails have a built in curve that is formed when the sailmaker sews the panels of the sail together. This curved shape aids in generating lift. This built in curve on a Laser sail can be increased or decreased by adjusting the six available sail controls: Mainsheet, Outhaul, Cunningham, Boom Vang, Clew Tie Down, and Traveler.

Sail Types

There are three established sailing rigs for the Laser, and due to the unique shape and cut of the sail, each is trimmed differently. The text below was written for the Standard Rig, although many of the same principles can be applied to the Radial Rig. When differences are sufficient, a separate entry for the Radial Rig will appear.

The Standard Sail is composed of eight panels of resin-impregnated Dacron cloth sewn together horizontally. The sail's curvature is induced by sewing the curved seams of the horizontal panels together as well as from the curve of the luff.

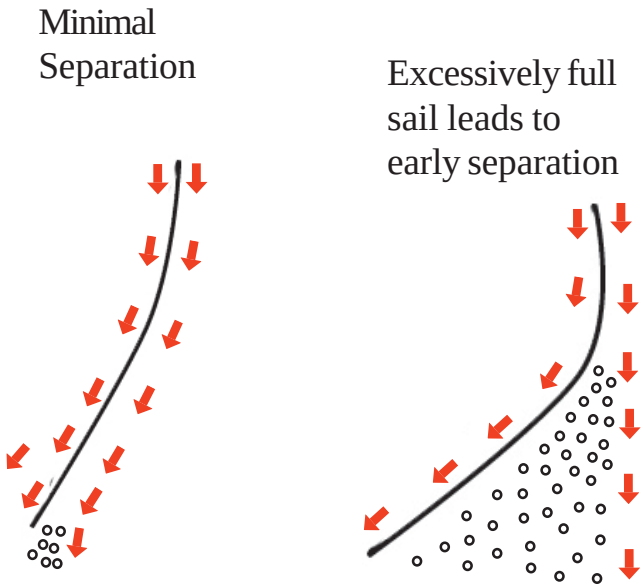
The Radial Sail is composed of the same cloth as the Standard Sail, but the panels are laid in a radial cut from the clew. This makes the sail more sensitive to the various sail controls and is capable of handling gusts more readily.



Basic Sail Theory Expanded:

On all points of sail but the run, the curvature of the sail induces lift via Bernoulli's Principle. The amount of lift generated depends on how well the air adheres to the sail as it travels along both the leeward and windward sides. A **fuller** (rounded sail) has more power than a flatter sail, but less ability to point to windward when beating upwind. When setting up a sail, the sailor's goal is to "power up the sail as much as she can handle" (as defined by her ability to control the boat and keep the hull flat) given the wind conditions and waves. The caveat to this mantra is that the sail cannot be made so full that it hinders the lift that is generated.

Airflow tends to **separate** (detach) on the leeward side of the sail, generating turbulence. The place where airflow separates and produces turbulence is defined as the **break point** of the sail. As the sail becomes fuller the break point moves forward (towards the luff). If the sail is too full the breakpoint will appear closer to the center of the sail instead of near the leech, and thus the sail will stall.



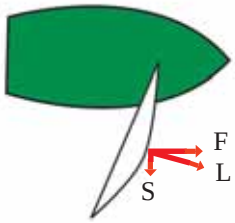
Mainsheet:

The mainsheet is the sail control the skipper uses most often while sailing on all points of sail. Proper sheeting angle is vital for the boat to sail efficiently. An under-trimmed sail luffs because lift is not generated. An over-trimmed sail causes early separation (moves the break point forward on the sail) and thus stalls the sail.

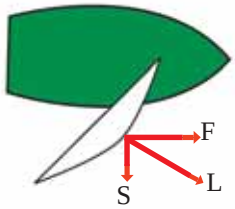
Over-trimming is worse than under-trimming. To correct an under-trimmed sail all one must do is trim in until the sail stops luffing. The wind will quickly re-attach to a properly trimmed sail, and the boat will reach full speed quickly. To correct an over-trimmed sail one must trim out the sail to the proper angle of attack. The new air flow must then push through the turbulence that was generated at the early break point, which is too far forward. Therefore it takes much longer to correct.

Lift is approximately generated perpendicular to the boom. Sideways slippage occurs perpendicular to the length of the hull. These two forces combine to create forward momentum. When the sail is over-trimmed the sideways slippage force increases while decreasing the forward force. This causes the force on the sail to shift aft and the boat begins to slow and slide sideways more. When under-trimmed, both the sideway slippage and lift decrease, which results in less forward momentum.

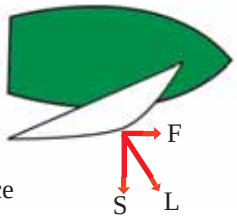
Under Trimmed: Luffing



Perfect Trim



Over Trimmed: Stalled



F=Forward Drive
S=Sideways Force
L=Lift

When sailing upwind, your mainsheet is initially used to change the **angle of attack** (the angle between the sail and the apparent wind) of the sail to produce optimal lift. On a Laser the mainsheet can bring the boom to the aft corner of the stern but no further if the traveler is tight. At this point there is still 15-18 inches of mainsheet that can be sheeted-in. These last 18 inches will bend the mast to aft, but does not change the angle of attack because it cannot bring the boom any further inboard. This action flattens the sail and thus decreases power, but allows the vessel to point closer to the wind.

"Waves are not measured in feet or inches, they are measured in increments of fear."

—Buzzy Trent

Both the Standard and Radial sails should not be two-blocked if the wind is very light (less than 5 knots) or exceptionally heavy wind (over 20 knots) when traveling to windward. But in all other conditions, **VMG** (Velocity Made Good) is usually achieved by two-blocking the sail during the beat to windward. VMG is the concept that there is an optimal balance between speed and angle sailed. When beating to windward a vessel increases speed as it falls off from a close-hauled course, but also increases the distance necessary to travel to windward. Therefore a vessel that points higher to the wind will lose speed, but decrease the distance traveled. For a Laser the loss of speed from two-blocking the sail is negligible compared to the amount of distance cut from the overall trip. When beating to windward in most conditions the skipper should two-block the mainsheet and then steer the boat to the edge of the wind using the tell-tales.

When sailing on all points of sail other than close-hauled the mainsheet is only used to control the angle of attack and not the curvature of the mast. Therefore the sail should be trimmed to the tell-tales whenever possible.

Cunningham:

The Cunningham, or downhaul as it is commonly called, affects the entire shape of the sail by placing tension on the luff. When Cunningham tension is increased the **draft** of the sail moves forward. The draft is the deepest part of the sail. The entire sail flattens as Cunningham tension is increased and the top third of the sail twists off. **Twist** is the amount the leech sags off relative to an imaginary straight line between the clew and head of the sail. This added twist to the sail allows wind to spill off the top, thereby depowering the sail.

Therefore placing more Cunningham tension depowers the sail. Since it has the greatest effect on the top third of the sail, where the most rotational heeling force is found, it is a best to begin depowering the sail using the Cunningham first.

Boom Vang:
The boom vang, or "kicker" is a unique sail control that can be used to add power or depower the sail.

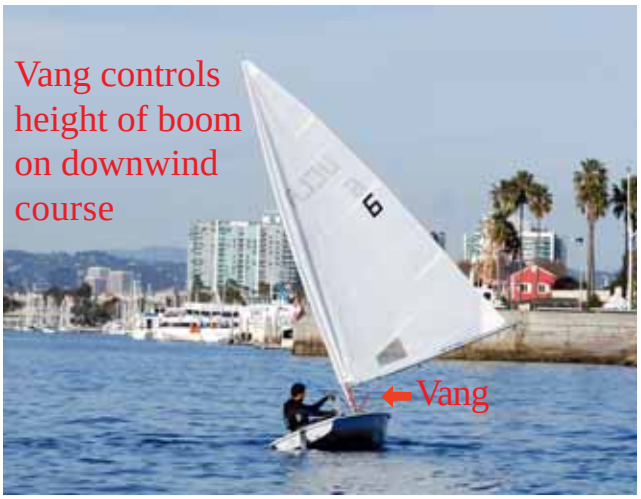
When sailing upwind in a moderate breeze the sail is generally two-blocked. If a large gust occurs the natural reaction of a sailor who wishes to keep the boat flat and avoid a capsize is to ease the mainsheet. If the boom vang is "on" when two-blocked (the slack is taken out of the line), then when the mainsheet is eased the boom will not rise, but instead will go outwards. This will change the angle of attack and thus depowers the sail by spilling air.

Conversely if the boom vang is not "on" when two-blocked (there is slack), then when the mainsheet is eased the boom will rise first before moving to leeward. This means the sail becomes rounder and fuller. Thus in a gust, easing the sail when the vang is "off" causes the boat to heel farther! This in effect powers the boat up!

This concept of powering the boat up is useful when sailing in light air. If the vang is off, then when the vessel enters a **lull** (less air), it is beneficial to ease the mainsheet as this will give the vessel power to the sail through the light spot and remain flat.

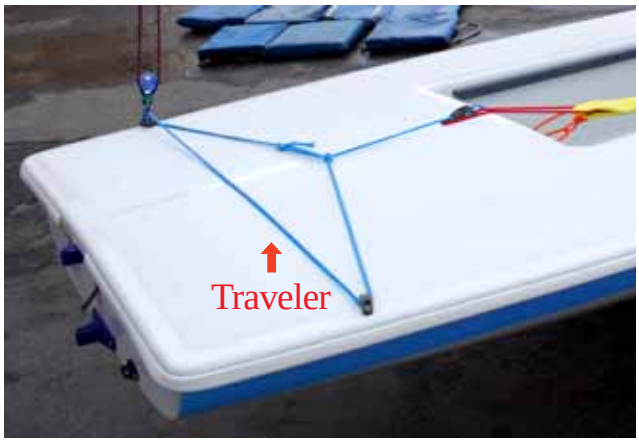
The boom vang is also very important for sailing offwind. The boom vang controls the height of the boom on all points of sail other than close-hauled.

On a reach the boom vang is generally set to match the top batten with the angle of the boom in light and medium winds. The vang is loosened as the wind increases to keep the boom from dragging in the water.

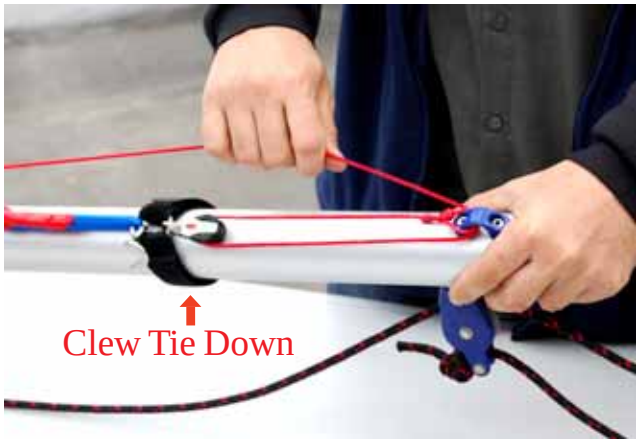


Outhaul:
The outhaul controls the depth of the foot of the sail. When sailing upwind the maximum depth in the foot of the sail should be roughly the distance from your wrist to the tip of your extended middle finger. The sail can become deeper the farther off wind you are sailing. The sail should be no deeper than 15 inches when on a run.

Traveler:
The traveler is the least adjusted sail control line while on the water. The traveler should be kept tight in almost all conditions and only adjusted if it loosens while sailing. A tight traveler allows the skipper to gain maximum tension on the luff when she two-blocks the mainsheet during a beat to windward. A tight traveler has virtually no effect when traveling off wind. In very light air, when the traveler block has difficulty going over the tiller, it is acceptable to loosen the traveler slightly to make your tacks and gybes easier.



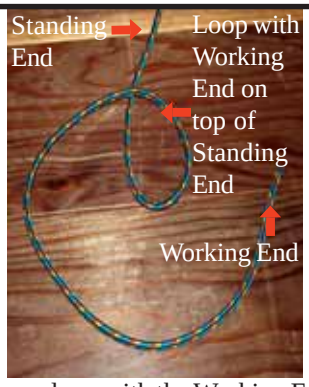
Clew Tie Down:
The clew tie down is not adjustable while on the water. It allows the mainsheet to put maximum tension on the leech of the sail when two-blocked. The clew tie down should be tied as close to the boom as possible before you set sail; but it should not bind to the boom so that the outhaul is ineffective.



Knots: Intermediate

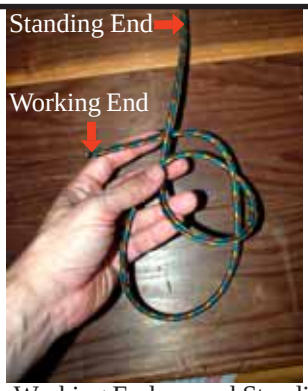
Bowline

The bowline is a knot most commonly used to form a fixed loop in the end of a line. It is reliable, strong, stable, does not slip or loosen while under tension and can be easily untied when tension is removed. The bowline was once the knot used on square rigged boats to attach a line from the bow of a ship to the weather leech of a square sail, but has since expanded its use to a variety of tasks where a temporary loop is needed. The bowline has literally dozens of variations; each for a specific task. Once you have learned the most simple version the others will be easy to pick up.



1. Form a loop with the Working End

2. Pass Working End through loop



3. Pass Working End around Standing End

4. Pass Working End through loop

5. Pull Working End taut


6. Completed bowline

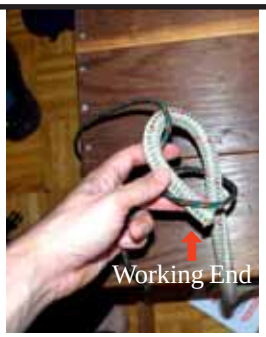
Sheet Bend

The sheet bend originally was used to attach the sheets to the clew on a sail. Now it is used to join two lines of different thicknesses and should be used when securing your vessel to the dock.


1. Form a loop with one line.


2. Bring the end of the other line through the loop

3. Pass the working end of the second line around the standing end of the first line.



4. Pull the working end of the second line through the loop.


5. Pull the standing parts of both ropes sideways to tighten knot.

Double Overhand knot

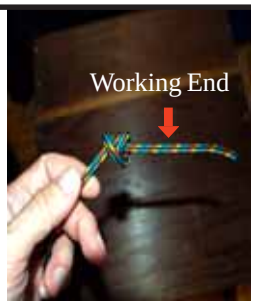
The double overhand knot is a variation of the simple over hand knot which is the most elementary of stopper knots. It is used at the end of a line to stop it from running through a block, in this case your mainsheet. On the Laser this knot is more secure than a figure eight stopper knot because of the material the mainsheet is made out of: polilite.

1. Pass the Working End around your hand.

2. Take the Working End from the back of your hand and pass it around a second time.

3. Bring the Working End to the inside of your hand.

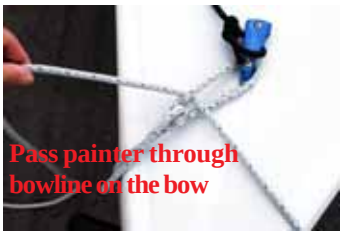
4. Pass the Working End through the two loops you have formed.



5. Pull the Working End taut.

Hitches

A hitch is a knot used for tying a rope to another object. There are a variety of hitches used in sailing and it is most often seen while setting up a temporary mooring. For the Laser, a series of hitches are used to secure the bow of the boat to the dolly and is finished with a half hitch.



Coiling a Line

Line should be cared for to ensure extended use. All the lines on a Laser should be **coiled** (wound loosely) in order to protect them from unnecessary wear as well as to make it easier for the next sailor to use. A simple coil is demonstrated below for the mainsheet.

1. Begin by making counter clockwise loops

2. Leave about two feet of line uncoiled

3. Pinch the center of the coil and wrap the Working End around the center

4. Make at least 3 loops around the center moving towards the Working End

5. Make a bite with the Working End

6. Pass the bite through the top of the coil

7. Pass a loop over the back of the coil

8. Pull the Working End taut.

Tacking: Use of Tiller

Tacking is the first fundamental boat handling skill one should learn in a Laser. Because the boat is light, it carries very little momentum; so it is important to have speed before initiating your tack! The long tiller extension generally is the greatest impediment for new sailors to the class as it can be difficult to handle. Below is a basic tack with **no roll induced**. For a more advanced tack see the roll tack section (page 112-113)

Before tacking one should always check to windward and over your front shoulder to be sure it is clear. One must always be certain that she is turning into a space that is not already occupied.

1. While on a close-hauled course, keep your boat flat and get some speed before initiating the tack.

2. Gently push the tiller extension AWAY with the aft hand.

3.The boat will begin to turn into the wind. As it does so continue pushing the tiller across the boat until you can place your aft hand and the extension on the old leeward side of the boat. It is generally necessary to bend the tiller extension at the flexible joint so that the mainsheet does not stop you from pushing the tiller across the boat.

4. Wait for the boom to come centerline, and then cross the boat with your aft foot first.

5. Rotate your body so that your aft foot is now the forward foot.

6. Sit down on the new windward side and straighten out the tiller behind your back.

7. Reach back with your new aft hand (the one still holding the mainsheet) and stick out your index finger to make a gun. The mainsheet should still be held by the bottom three fingers. Place the tiller extension between your index finger and thumb.

8. Release the tiller with the old hand and take hold of the mainsheet with it. Then release the mainsheet with the new aft hand that is holding the tiller.

9. Get back into your proper position.

Gybing

Gybing is often more feared than tacking due to the speed at which the boom can cross the boat in heavy air. Yet gybing is easier than tacking in light to moderate air because of the pressure felt on the sail during all but a fraction of the maneuver. The key to gybing is keeping speed before and after the turn. Below is a basic gybe with **no roll induced**. For a more advanced gybe see pages 114-115.

Before gybing one should always check to leeward to be sure it is clear. A sailor must be certain that he is turning into a space that is not already occupied! When learning to gybe it is easier to gybe from a broad reach to a broad reach so this is how a novice sailor should first practice.

1. Bring the boat flat and sheet in slightly if you are on a deep broad reach or a run (sheet in 1-2 feet).

2. Start to bear away by pulling the tiller extension TOWARD you. The boat will begin to roll on top of you as the boat begins to turn if there is any breeze. Make sure your aft foot is braced against the side of the cockpit in case the boat rolls excessively so that you can quickly climb to the high side if necessary.

3. Reach up with your forward hand and grab the mainsheet near the block on the boom.

4. Give the mainsheet a yank once you feel the sail lose pressure (right before the boom is ready to gybe). This will allow you to control when the boom crosses the boat.

I must go down to the seas again, to the lonely sea and the sky,
And all I ask is a tall ship and a star to steer her by,
And the wheel's kick and the wind's song and the white sail's shaking,
And a grey mist on the sea's face and a grew dawn breaking.

I must go down to the seas again, for the call ofthe running tide
Is a wild call and a clear call that may not be denied;
And all I ask is a windy day with the white clouds flying,
And the flung spray and the blown spume, and the sea-gulls crying.

— John Masefiled, Sea Fever

5. As the boom begins to cross the boat, move your body to the new windward side.

6. Begin to flatten the boat by putting yourself on the new windward side and straighten the tiller behind your back.

7. Bring the hand holding your mainsheet back to grab hold of the tiller. Then release the tiller with the old hand and take the mainsheet with that hand.

8. Make sure your sail is trimmed properly for the new

Aboard at a ship's helm,
A young steersman steering with care.

Through fog on a sea-coast dolefully ringing,
An ocean-bell--O a warning bell, rock'd by the waves.

O you give good notice indeed, you bell by the sea-reefs ringing,
Ringing, ringing, to warn the ship from its wreck-place.

For as on the alert O steersman, you mind the loud admonition,
The bows turn, the freighted ship tacking speeds away under her gray sails,
The beautiful and noble ship with all her precious wealth speeds away gayly and safe.

But O the ship, the immortal ship! O ship aboard the ship!
Ship of the body, ship of the soul, voyaging, voyaging, voyaging.

—Walt Whitman

Dry Capsize Recovery: Walkover

Due to the relatively small width of the boat a dry capsize recovery is easily executed in a windward capsize. The key to executing a dry capsize recovery is anticipating the capsize and correctly timing when to throw one's leg over the gunwale of the boat.

As the boat begins to heel to leeward due to excessive breeze a sailor must decide when hiking further or releasing the mainsheet will not be able to save the boat from a capsize. Generally speaking if the boat has heeled over to the point that the top of the mast is only three feet from the water a capsize will occur. Once the sailor has made the decision to execute a dry capsize she must be decisive in regard to staying dry.

1. The boat begins to heel beyond the point of no return, and the sailor climbs to the high side of the boat.

2. The sailor throws a leg over the gunwale of the boat and straddles the hull.

3. The sailor steps onto the daggerboard and checks to see if the mainsheet is free.

4. The sailor moves his weight out onto the daggerboard so that the boat begins to right.

5. The sailor throws his aft leg over the gunwale to step into the boat.

6. The sailor keeps his head low and ducks the boom while stabilizing the boat with his weight. He immediately grabs the tiller and takes control of the vessel.

Rigging: Laser

SAIL SELECTION: The International Laser Class has three different official rigs. Each sail is designed for sailors of different weights. The Standard Rig was designed for sailors weighing more than 160 lbs and has 76 square feet of sail. The Radial Rig, which has 62 square feet of sail, was designed for sailors in the weight range of 121 to 160 lbs. The 4.7 Rig, which has 50.6 square feet of sail (4.7 square meters of sail), was designed for sailors within the weight range of 77 to 121 lbs. The weight ranges listed above are 'optimal.' This means that a sailor in the prescribed weight range is best suited to sail the matching rig in a variety of wind conditions (3 to 20 knots). A sailor outside of the listed range may sail a different rig in the appropriate conditions. At the UCLA MAC we have both the Standard and Radial Rigs available. The reduced sail area of a Radial Rig allows a novice or lighter sailor the ability to sail without being overpowered in medium winds. The International Laser Class strictly controls how sailboats are rigged during official races. For the convenience of learning to sail, the UCLA MAC Lasers are rigged in a non-class legal manner. To learn more about the Class Legal Racing please visit the North American Laser Class Association at www.laser.org.

Standard vs Radial Rig

The principle difference between the Standard and Radial rig is the length of the bottom section. The Radial rig uses a shorter, bendier lower mast section. The Radial lower mast sections are marked with a thick red stripe and the letter "R" above the boom vang tang for easy identification. Both rigs use the same top mast section and are rigged identically.

The Standard and Radial sails are on separate parts of the sail rack and are labeled accordingly.

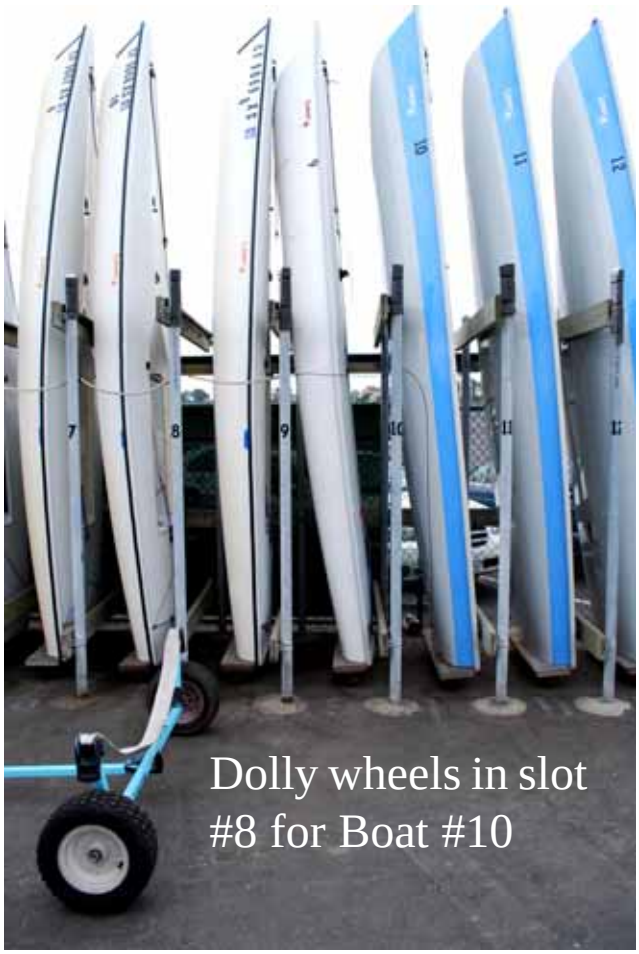
Rigging in the Yard

Most of the rigging for the Laser is done in the yard and boat house. You should only move the boat onto the dock and into the water when you are ready to sail. With a little practice you should be able to rig and be off sailing in under 15 minutes.

When rigging, thoroughly inspect your equipment to make sure everything is in good working order. You can use the lawn or the deck of your Laser or even the carpet inside the boathouse (if there is room) for rigging your sail.

1. **Select a boat from the rack**. Boats numbered 1-8 are for anyone who has completed Sailing II. Boats numbered 9-12 have the "Pro-Rigging" and are reserved for those who have completed Sailing III.

2. **Retrieve a Laser Dolly.** Place the dolly wheels approximately 3-4 feet to the left of the boat slot (in the middle of the slot two numbers below the one you are taking.)



3. **Lower the boat onto a dolly**. Ask for help if you need it--- it is much better than dropping the boat on your head! It is best to keep your right hand on the gunwale of the boat and your left hand on the hull while pulling it out of the slot. Once the boat is out of the slot place both hands centered on the hull, and lock your arms out so that you can walk the boat down onto the dolly. Walk backwards, but be cautious of the dolly so that you do not trip.

4. **Gently lower the hull** onto your shoulders and then squat down to place the hull onto the dolly strap.

5. Place the bow of the boat onto the curved plastic bow retainer, and then **secure the boat using the painter** with a series of half hitches. Please see intermediate knot section of the manual for instructions on how to tie a half hitch.

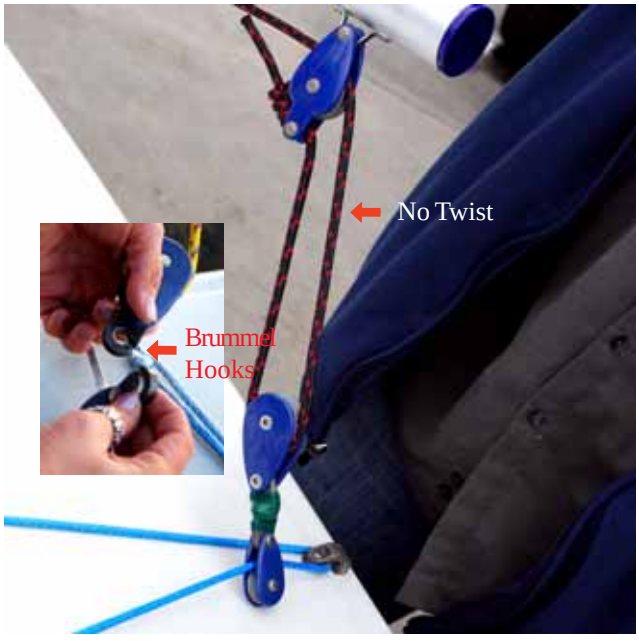
6. **Remove the stern dolly** (the wood piece with two orange wheels). Place one hand on the stern dolly while pressing your thigh against it when removing the dolly pin. This will stop the dolly from dropping to the ground and breaking. Leave the stern dolly (the wood piece with two wheels) and its pin in the slot the boat came from.

7. **Retrieve a boom, top mast section and appropriate bottom section**. The spar numbers MUST match the number of the hull.

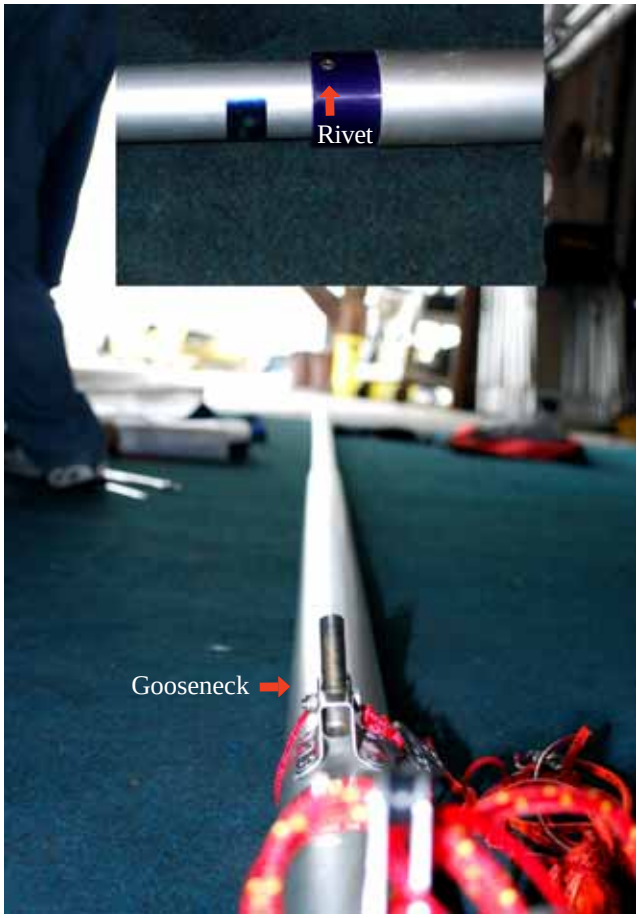
8. **Insert the drain plug** into the transom and seal the hull by turning it clockwise.

9. **Gently place a daggerboard, tiller and rudder in the cockpit of the Laser.** The numbers on the Blades (daggerboard and rudder) must match the hull of the vessel.

10. **Attach the boom to the traveler** via the brummel hooks (sister clips). Make sure that there is no twist in the mainsheet.



11. Take the top and bottom sections of the mast to the boat house. Insert the top section into the bottom section. **Make sure to align the rivet with the gooseneck** (failure to do this may cause the top mast section to break at the rivet collar).



12. Retrieve the appropriate sail from the sail rack. Check out a set of battens from the dockmaster that matches your hull number. The top batten is shorter than the middle and bottom battens which are identical in length. **Insert the curved end of the batten into the batten pocket** and then pinch the end of the non-curved batten until it slides down into the batten pocket.

13. **Slide the sail onto the mast** using the luff sleeve. Ensure that the body of the sail is on the same side as the gooseneck.

14. Place the bow of the boat into the wind. Take the mast out of the boat bay and place it onto the deck of the boat. **Carefully place the mast into the maststep**. Be careful not to allow the mast to drop or swing as it will damage the gelcoat of the deck. If you are uncertain of your ability to control the mast ask for help. Other sailors and the dockmaster are always available to help.

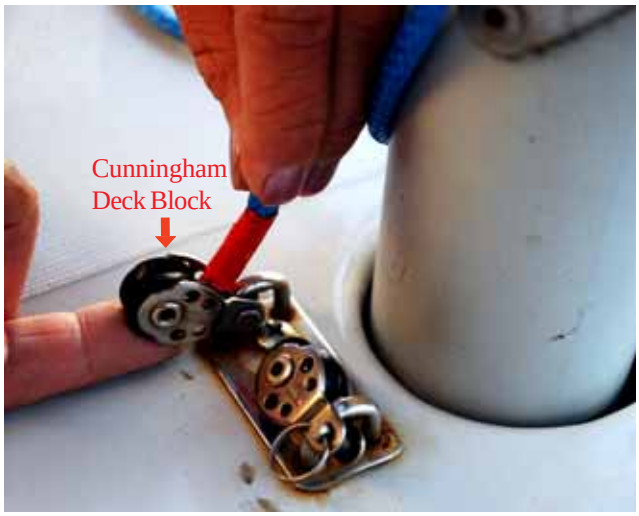
15. **Place the boom connector onto the gooseneck**.

16. **Attach the clew hook** to the sail. Always pass the hook from the starboard side first!

17. **Attach the boom vang** to the boom by placing the vang key into the vang fitting on the boom.

18. **Attach the cunningham**. Pass the thinner spectra line through the cunningham grommet. Use the snap shackle on the Vang to secure the Cunningham.

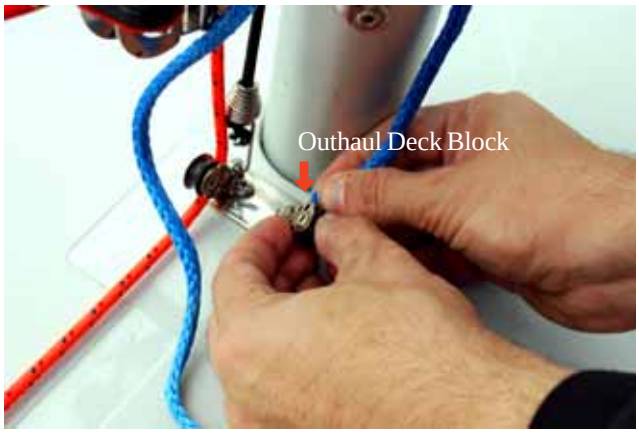
19. **Pass the other end of the Cunningham to the block** at the base of the mast on the port side of the boat.



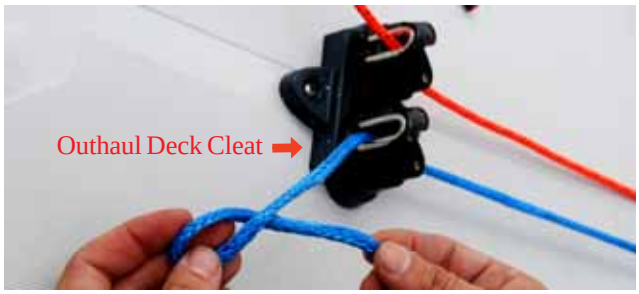
20. **Take the Cunningham line and pass it to the deck cleat** (first through the metal fairlead and then into the cam cleat). Place a stopper knot at the end of the line. Please note that rigging the Cunningham correctly is important because it is used to keep your mast attached to the boat when the vessel capsizes!

21. **Take the outhaul line and pass it through the block** secured to the gooseneck fitting.

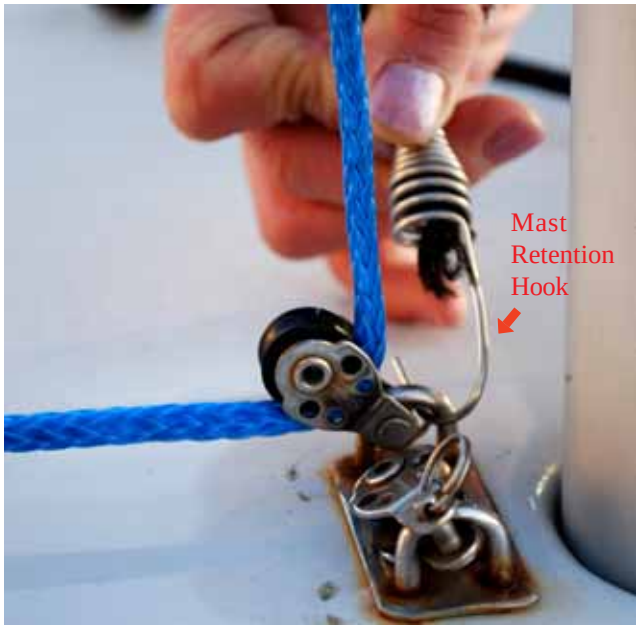
22.Then **take the line and pass it through the outhaul block** at the base of the mast on the starboard side.



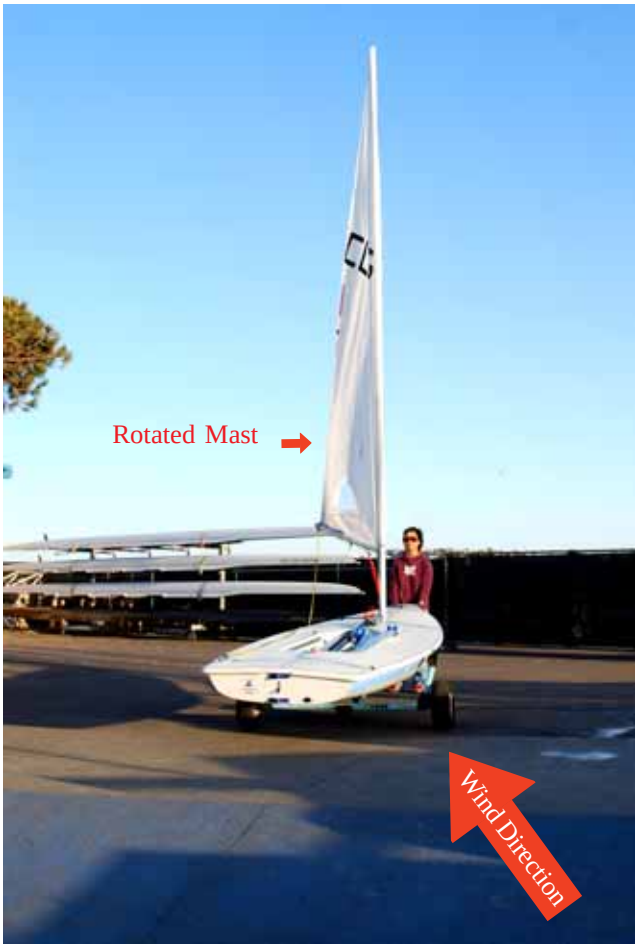
23. **Secure the outhaul line** through the starboard cam cleat and create a handle via the daisy chain method as seen in the advanced knots section of the manual.



24. **Attach the mast retention line** that is secured to the gooseneck fitting to the deck fitting at the base of the mast. Please note that for boats 1-8, if the Cunningham is not secured properly the mast will slide out of the mast step and sink when the boat is turtled. For boats 9-12 the Cunningham line will 'help' secure the mast to the vessel, but due to the lower amount of friction achieved by the blocks used in the system an additional line is necessary to keep the mast secure.



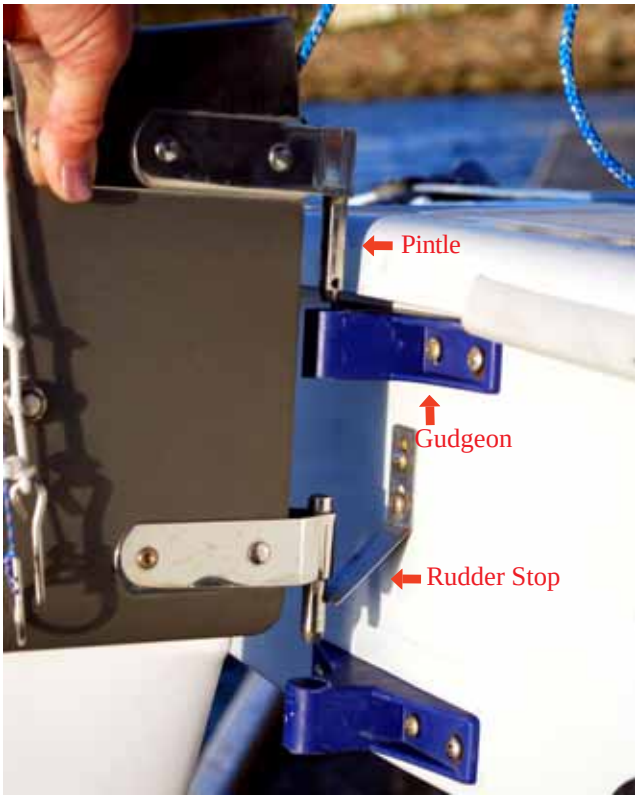
25.Uncoil the mainsheet, but do not attach it to the mainsheet block. Instead add a figure eight at the bitter end so that it will not come loose when walking your boat down the ramp. **Walk your vessel down the ramp** stern first. The mast will begin to catch air and will rotate. As long as your mainsheet is not attached the boat will not be pushed off the dolly by the wind. It is best to hold the bitter end of the mainsheet in your right hand so that you can take the slack out of the mainsheet if the wheels of your dolly are close to catching the dragging mainsheet.



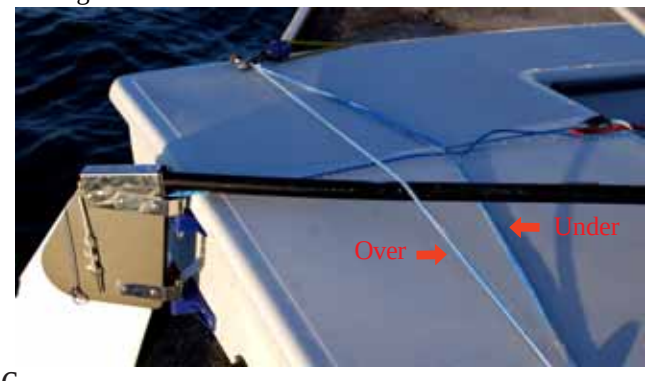
26. **Keep the front end of your dolly low** as you approach the bottom of the ramp. If you raise the front end of your dolly high the stern of the boat will scrape against the dock as you reach the end of the ramp.

27. **Angle your boat** so that the stern is just at the edge of the dock, but not over the water.

28.**Attach the rudder** of your boat by inserting the pintles into the gudgeon. Make sure the rudder stop is securely over the lower pintle section so that the rudder will not be lost during a capsize/inversion.



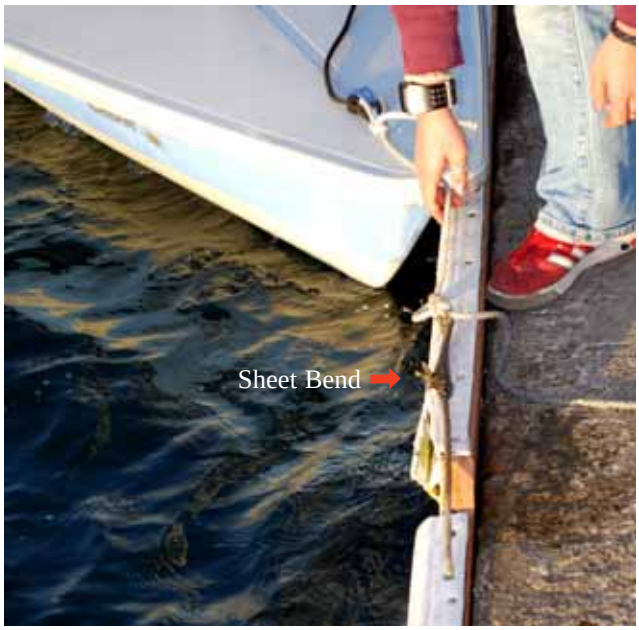
29. Place the tiller under the aft traveler line but above the forward traveler line. Then put the tiller into the rudder head and tighten the rudder downhaul.



30. **Push the dolly wheels up to the edge of the dock** so that the wheels touch the wooden lip.

31. Untie the painter and gently **lift the bow** of the boat up until the stern is floating in the water. Then push the boat out until you can gently lower the bow into the water. Use your legs to lift, not your back.

32. **Tie the painter to the dock** with a sheet bend. See the intermediate knot tying section for instructions on how to tie a sheet bend.



33. Insert the daggerboard into the daggerboard trunk.

34. **Attach the daggerboard retention line** from the bow to the daggerboard.

35. **Pass the mainsheet through the mainsheet block** and secure using a double overhand knot. The mainsheet only passes through the mainsheet block in one direction. You will know you have passed it in the correct direction if you can hear the ratchet click as you sheet in. If there is no clicking sound while you are sheeting in then either you have passed the mainsheet through the incorrect side or the ratchet block has been set to “off” and must be adjusted.

36. Check your rigging and make sure the mainsheet is running free and the tiller is clear. Adjust your sail controls for the expected wind conditions. Launch and enjoy the water!

DERIGGING: Laser

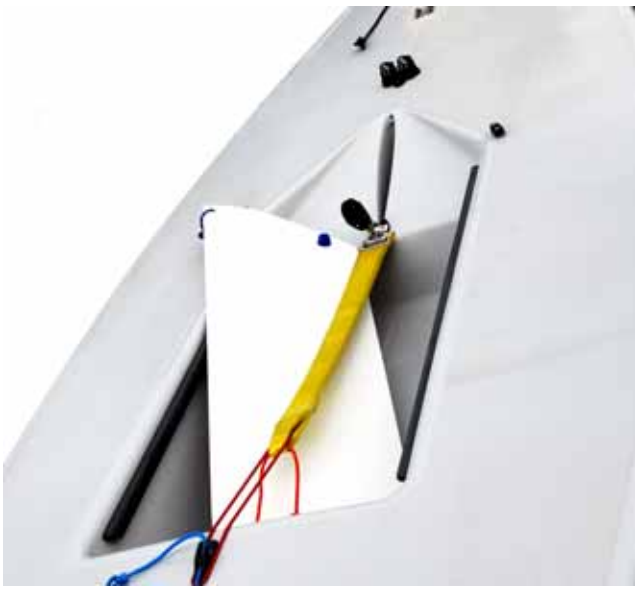
DERIGGING THE LASER: To protect the boat and equipment it is important that you get the sail down and the boat out of the water without delay. Once the sail is down and the boat out of the water you can then take your time with derigging. While derigging note any damage that may have occurred while sailing and report it to the Dockmaster.

1. **Secure your vessel to the dock** using a sheet bend (see page 56).

2. **Detach the boom**. First release any tension that is on your boom vang. Then remove the clew hook from the back of the sail while firmly holding the boom so that it does not drop onto the deck.

3. Walk your hands along the boom until you reach the gooseneck and remove the boom from the mast. Place the boom on the deck. **Take the vang key out** of the boom. Use an overhand knot to secure the vang lines. This will keep the lines from fouling.

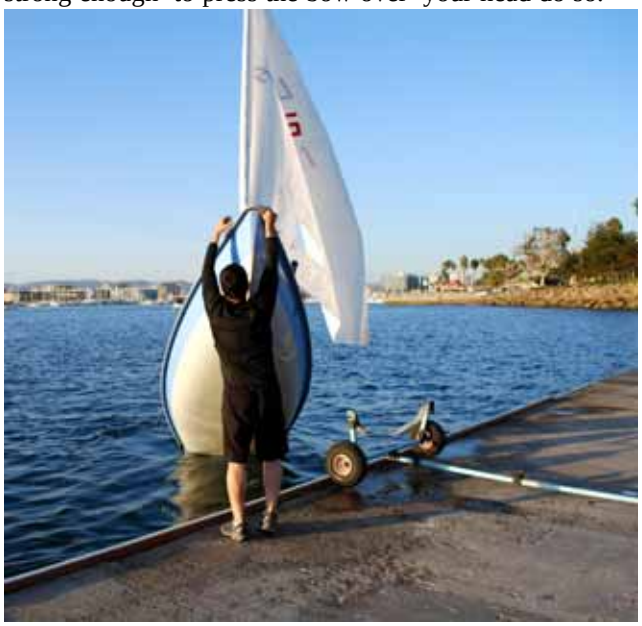
4. Release the daggerboard retention line from the daggerboard. Then remove the daggerboard from the trunk and place it gently in the cockpit.



5. Retrieve your dolly from the ramp and place it to leeward of your vessel.

6. Untie the painter and then grab the bow of the boat. While holding the bitter end of the painter begin to rotate the hull until it is near perpendicular to the dock. The bow should now be closest to the dock.

7. Squat down and place both your hands under the bow. Lift the bow up using your legs not your back. If you are strong enough to press the bow over your head do so.



8. Begin walking the hull onto the dolly.

9. Place your leeward foot onto the dolly when you are half way. This will stop the dolly from moving when the hull contacts the dolly's strap.

10. Pull down on the bow until the stern lifts out of the water. If the bow is not far enough forward on the dolly you must pull the boat towards you.

11. Place the bow of the boat onto the lip of the dolly and then tie off using hitches (see page 56).

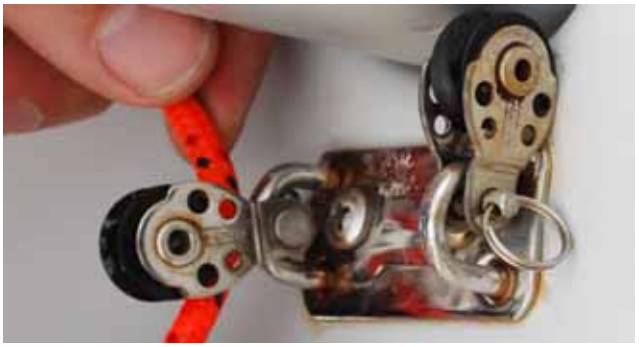
12. Gently pull the boat forward; be careful not to lift the bow or the rudder will strike the dock. Pull forward until the rudder is over the dock. Remove the tiller and rudder and lay them gently into the cockpit.

13. Remove the drain plug from the stern.

14. Pull the boat up the ramp. If it is low tide you should go up at an angle to make it easier. Remove the Cunningham from the deck cleat and lift the mast out of the mast step.

15. Take the mast and sail into the boat house. Then gently pull the sail off the mast. Be careful not to pull too hard or the top piece of the mast may get lodged in the luff sleeve.

16. Take the mast back to the hull of your boat. Rinse off the boat, blades and spars while paying special attention to anywhere there is metal on the boat.



17. Coil all the lines: mainsheet and Cunningham.

18. Return the spars and blades to the appropriate racks. Spars are numbered 1-12.

19. Attach the stern dolly to the vessel.

20. Make sure the wheels of the stern dolly are in the correct slot to return the boat. Untie the painter and lift the bow up. The stern dolly should catch the ground and be secure. Gently lift the boat until it is almost vertical, and then begin sliding it into the appropriately numbered slot.

21. Return the dolly to the dolly area.

22. Lay the sail flat.

23. Fold the sail in half and align the leech.

24. Begin rolling the sail.

25. Place sail in the appropriate bag and back on the rack. Standard sail bags have a black tip while Radial sail bags have a red tip.