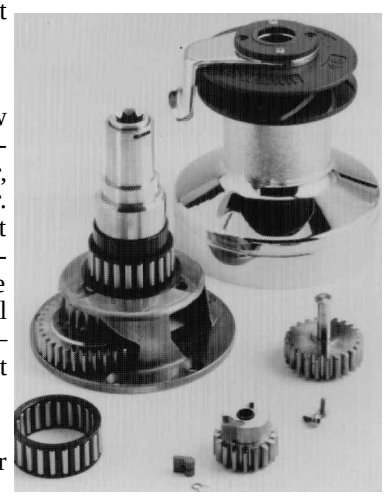
DECK GEAR

Today there's so much nifty hardware to make cruising easier, it's hard to know where to begin. Much of this gear comes to us from our racing cousins. On a race boat, even with lots of hands to pull strings, seconds count. On a shorthanded cruising yacht, the seconds are not quite so important, but then there are not nearly as many hands. So it's just as important for us to peruse the gear catalogues!

WINCHES

With so many types of winches available, it's hard to know where to begin. The "Cadillac" of winches, from a construction standpoint, used to be Barient. However, today Lewmar, Harken, and several other companies make excellent gear. Self-tailing winches are a fantastic invention; they're great for primaries, mainsheet, perhaps main halyard, and certainly for slab-reefing winches. Be aware that some self-tailing systems have a size limitation on the line they'll accept. And if you don't have self-tailers, don't despair — prior to 15 years ago, everyone sailed without them and got along just fine.



We've found Lewmar winches to take less maintenance and be easier to work on than other brands.

Two- or Three-Speed?

Almost all modern winches are two-speed, going up or down in gearing as you reverse handle direction.

You can also get three-speed winches, with a gear-change button. These come in handy when maneuvering in tight quarters in light airs, and on the mainsheet when jibing.

Winch Size

Winch size is related to time. The faster you want things to happen, the bigger the winch should be, and the more efficient the gearing. The more oriented you are toward racing, the more important all this becomes.

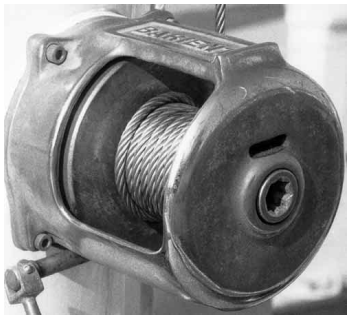
In a cruising boat, one is more concerned with structural loading than with speed. Once you have enough meat in the winch to stand the sailing loads, the rest becomes academic.

One area that needs further consideration, however, is the size of the primary cockpit winches, as these may be called upon to kedge you off a reef or sandbar. In this situation, the loads will go up dramatically. If you're concerned about this, consider oversizing your primaries.

Self-Tailing Alignment

If you have self-tailers, you will want to experiment with a variety of alignments for the stripping mechanism. In general, the stripper should aim the line away from the line as it intersects with the drum, so that the incoming line does not catch that which has been tailed, creating a mess around the bottom of the drum. A second consideration is where you stand. It is better if the tailed line ends up somewhere other than piled around your feet. If you ever have to release a sheet in a hurry, this will be a safety factor.

Both Harken and Lewmar winch-strippers are easily rotated.



Vintage reel wire winches like this Barient from the '60s are extremely dangerous. They should be replaced at the first opportunity.

Drum Material

Aluminum is usually the best drum material on winches because of its light weight. However, if using wire halyards or sheets where the wire rides on the winch drum, you'll have to have to go to bronze or stainless drums.

Reel Winches

Reel halyard winches should be outlawed. More people have been injured on yachts by these devilish machines than by anything else. If the winch-handle operator is constantly attentive and the brake is in perfect condition, everything will go fine, but if something goes wrong for an instant, watch out!

TOC
Last Chapter
Next Chapter
Help!

POWER WINCHES

I'm a sailor who likes to keep things simple — simple, of course, being a relative term. And while I've installed lots of powered winches for clients on larger yachts, I've always considered them something that could easily be left ashore for my own cruising.

Then the day came when I pulled a back muscle in the middle of a 6,000-mile passage. Yes, I could still function, albeit with some discomfort, but it started me thinking. And when the time came to specify winches for a new boat — you guessed it. That was some years ago. Today, power winches are less expensive, lighter, and easier to install than ever before. Combined with jammers, a single winch can perform a myriad of functions. As a result, they're showing up on more and more yachts of smaller and smaller sizes.

Electric winches frequently have larger bases than normal, raising the height of the load coming onto the winch. As a result, the bases to which electric winches are bolted must be strong enough to take the bending load, as well as the load which occurs in shear (a straight line).

A Lewmar winch is shown below, with a solid-state control box.

Functions

Deciding if one or more powered winches is worth the cost comes down to how many *useful* functions the winch(es) will perform. Having installed and sailed with powered winches for the better part of a decade, here's how I rate their usefulness:

1. Kedging. If you're fast aground and speed is imperative in the effort to free yourself, a powered winch is worth its weight in insurance premiums. And if you use a 2-to-1 purchase, a small powered winch has the ability to drag even the most recalcitrant hull into deep water.

2. Anchoring. Assuming there's not already an anchor windlass aboard, an electric winch set up for sail handling can be used to hoist the anchor (or serve as a backup in case the anchor winch fails). By keeping the chain pennant slightly shorter than the distance between the bow roller and the winch, you'll just have anchor line to deal with on the winch drum.

3. Going aloft. Making frequent inspection trips aloft is the best way to prevent rig and chafe problems. If it's easy to go aloft, you're going to make more inspections.

4. Reefing. Speed is essential when the reef clew is being pulled down to the boom end. The longer it takes to get the sail snugged down and to stop its flogging, the more probability there is of tearing the sail. An electric winch does wonders here not only in speed, but also by making it easier to reef, so there will be less of a tendency to procrastinate reducing sail area as the breeze makes up.

5. Hoisting sails. This is a convenience, and the odds are you've gotten along without a powered assist for years. Why do you need it now? You probably don't, but it is a bonus. And, if your sails are heavy like ours, easier hoisting leads to more frequent daysails. Offshore in light and sloppy conditions, you'll be more apt to drop and then rehoist sails as conditions warrant.

6. Sheets and guys. Bottom of the list. I like to crank my sheets in by hand. It's one of the few forms of exercise available offshore. But as I get older, I feel that maybe it's a good idea to have a *backup* for Linda to use, in case I'm incapacitated (not that it will ever happen, mind you).

Okay, so you're intrigued. What's the next step? First, give some thought to what type of winch or winches to choose. Following are the major factors to consider.

TOC
Last Chapter
Next Chapter
Help!

Which Winch?

Even the smallest powered winch will do most of the jobs necessary on medium to large sailboats. What is more important than winch size, per se, is the *line speed* at which the winch performs its duties — you need to look at both loaded and unloaded speeds. This is a function of gearing, winch-drum diameter, and the electrical (or hydraulic) power available.

For some functions, line speed is not that critical. Kedging or anchor hoisting doesn't need to be done quickly. But hoisting a headsail or pulling down a reef uses all the speed you can get.

Where winch size does come into play is in the difference between unloaded and loaded line speed. With light loads, as in hoisting a sail, the average-speed winch will be two to three times that which you will find under heavier loads. At the mast this probably isn't a major factor, but aft, when used for trimming sheets, it has to be taken into account.

To give you some perspective, I've sailed on several 70-plus footers (21.5m) that used the smallest power winch available at the mast (Barient 28s) quite successfully.

On *Sundeer* we started out at the mainmast with a two-speed Lewmar #55 winch, which gave us an unloaded speed of 38 feet (11.7 m) per minute. It would take almost two minutes to hoist the working jib or mainsail. We found that in heavy going, more speed was warranted to reduce hoisting time and wear on the headsail while it luffed. By changing to a three-speed winch with an oversized drum, we were able to reduce hoisting time to just under 45 seconds — much quicker than I could do myself.

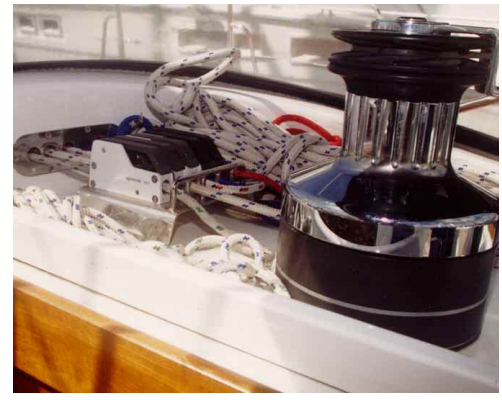
When you consider tacking and jibing with power winches, line speed becomes more critical. Yes, you can still pull the slack sheet by hand, but when the load comes on a two-speed winch, especially one on the small side, it will be much slower at grinding than you are (unless you're tired).

As a result, where budget is available, I prefer to see three-speed power winches in the cockpit.

Hydraulic or Electric Drive?

All three winch manufacturers offer hydraulic as well as electric power options. If you're just using a single winch, or even one at the mast and two in the cockpit, electrics are a better bet.

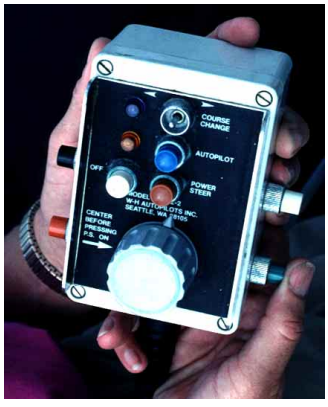
As additional hydraulic functions are added elsewhere, however, switching to hydraulic winch drives bears investigation. A single power pack can take care of the anchor windlass, deck winches, and roller-furling.



Four different winch installations. In the top three photos, halyards lead off the base of the mast directly to an electric winch, or via a manual winch, which is used to change the line direction. Once the electric winch has done its job, the load is taken by the manual winch or by a jammer on the mast.

The bottom photo shows a winch in the cockpit area used to raise halyards, trim the main sheet, and reef. The lines not being winched are held by jammers.

TOC
Last Chapter
Next Chapter
Help!



Air switches make the most sense to us, as they are much more reliable in the marine environment. However, you do need to make sure that changes in air pressure or temperature cannot accidently trigger the winch (as happened with some early models). The bottom photo shows a WH Pilot remote made for us by Will Hamm. The buttons on the side control the electric primary winches, mast winch, and windlass.

Costs for hydraulic systems are typically much higher than for electrics. Weight savings are illusory, as the oil-filled hoses more than make up for the lighter weight of the hydraulic winch motors.

Personally, I prefer electric drives, keeping each winch an independent unit.

Installation Considerations

The first installation consideration must be space for the drive unit. If the winches are aft, a vertical drive usually gets the job done since the motor fits into the lazarette or cockpit lockers. But further forward, or where the cockpit coamings may be over living areas, an angled drive will be necessary.

If you want to install a winch at the mast, having the drive intrude into the main saloon may be less than acceptable. In this case, a moderately sized deck box can be built, onto which the winch is bolted. The box provides space for the drive unit without penetrating the deck.

Powered winches can develop substantially more force than arm power. Make sure that whatever structure a powered winch is attached to is plenty strong!

With electric winches, there are three critical factors: Electric cables must be large enough to prevent more than modest voltage drop at maximum loads. Since motor speed and power are proportional to voltage, making sure the wires are adequate means you'll get your money's worth of performance. Second, electrical connections must be kept dry. After connecting winches to power leads, seal the connections. Finally, be sure that the circuit breaker used to protect the winch circuit is up to the full stall capacity of the winch motor.

Hydraulic systems have a centralized pumping system. This is heavy, noisy, and requires periodic service. Ideally, it should be located where access is good and the noise doesn't bother the off-watch.

Controls

All winch systems use some form of electrical solenoid to switch on and off. Since the trigger current for the solenoid is very low, almost any form of switch will do the job. Manufacturers offer air-actuated switches as well as sealed electrical contactors. We've had success with both, but prefer air switches.

You may also consider using a portable remote. On *Sundeer*, our production yachts, and *Beowulf* we've installed control buttons for electric winches right on the autopilot remote control (in addition to the controls located at the winches). This allows the user to handle sails or a tail while operating one or more of our winches. In a spinnaker set, I can hoist then trim the afterguy while pulling in the sheet, all from the foredeck where I can see what's happening with the sail.

Electric versus Air-Remote Switches

There are trade-offs in both types of controls. The biggest problem with the electric switches is that they tend to get wet over time in the marine environment. The wetter their location and/or the wetter your boat, the more problems you will encoun-

TOC
Last Chapter
Next Chapter
Help!

ter. When the switch shorts out, it may accidently trigger the winch, leading to all sorts of expensive consequences.

Where an electric button might work fine in a relatively dry cockpit, there could be problems on the foredeck.

If you use electric switches, it is best to have a large, separate membrane (as in the nearby photos) to cover the switch itself.

Air switches are far more reliable. These have a button that sends an air jet to a micro switch, which triggers the solenoid that makes the winch go. However, you do have to watch some of the older model air switches, which occasionally trigger due to changes of air pressure or temperature.

Power Consumption

Surprisingly, powered winches consume a small percentage of the total electricity used at sea. They're used infrequently and for short periods of time, so that while the amperage draw is momentarily high, the total amp hours per day don't amount to much. We've actually tracked power consumption with amp hour meters and find that in a 24-hour period offshore, the winches consume less than 5 percent of our total electrical needs.

Circuit Protection

You have a choice between fuses or circuit breakers to protect the winch wiring. I prefer fuses, which offer the ability to fine-tune the amperage the motor can draw. You may want to have a low-rated fuse for everyday use and a higher-rated fuse for kedging.

Safety Factors

Between powerful drive motors and low winch gearing, a power winch develops huge forces. Those forces can do a lot of damage quickly, especially to sails. When operating a power winch, you need to be alert to changes in sound, which indicate load changes. If the winch slows down more than normal, it probably means something is hung up. When in doubt, stop and investigate!

I like to have a cutout switch in the winch-control circuit. Ours is located at the forward end of the cockpit. When we're not using our electric winches, the switch is off, disabling the system. This prevents accidental triggering of any of the winches — especially important if children are aboard.

If you're hoisting someone aloft, remember that it will be difficult to hear the person aloft over the winch noise. Be careful not to pull them beyond maximum halyard point. In fact, it is a good idea to have all halyards marked with maximum hoist points.

Do You Need Power Winches?

A power winch represents a considerable investment. A smaller winches costs at least as much as a radar or a new headsail on most 35- to 40-footers. Does this make sense for your needs? If you want back up in emergencies, the answer on many boats is yes.

And, as your vessel becomes larger, powered winches may get you out for that quick daysail more often. With *Sundeer*, they've turned a yacht designed primarily as a passagemaker into a daysailer.

Winch Minimums

Before we leave this subject, a word is in order on how little you can get away with.

If you're careful with deck layout, the quantity of winches can be substantially reduced. By judicious placement of gear and use of stoppers, it's amazing how few winches are really needed.

When we did *Intermezzo II*'s deck she had just a single primary winch behind the helm, with two secondaries on the coamings for staysail and runners. There were two more winches under the dodger for vang, mainsheet, main halyard, and reef lines. Two additional winches on the mast completed her gear. Pretty simple and inexpensive for a 62-footer, yet she was a dream to sail.

Noise

Winches, especially powered winches, can be very noisy. To minimize noise transfer below we use a hard rubber pad, 1/4-inch thick, under the primary winch bases.

When doing a cockpit layout, try to locate primaries where the off-watch won't hear the noise.

TOC
Last Chapter
Next Chapter
Help!

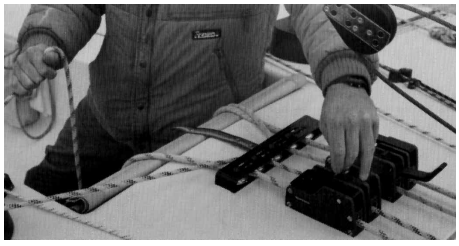
JAMMERS

Sheet jammers are an interesting hand-me-down from the racing fraternity. In certain applications they can save time and the expense of an extra winch. The new "rope clutch"–style jammers, with their flat jaws, have excellent holding power with very little abrasion on the rope, and are easy to disengage under load. We've used them for halyards and all sorts of other jobs with great success. Just be sure to make them big enough for the job intended.

To increase halyard longevity it's usually a good idea to keep a few turns on the winch after the jammer, except when the winch is being used for something else. If you have rope-to-wire splices on your halyards, try to keep mainly rope in the jammer clutch. The wire doesn't compress and makes the jammer's job more difficult.

Spinlock jammers (left/right photos) work well on medium loads. They also allow you to release the line under load. However, our experience is that they do not hold up to their full rated loads.

We've been using the Lewmar Superlock jammers now for a couple of years with excellent results. They are not as hard on the rope as some other jammers and seem to hold up to their ratings (left).



Using several jammers to a single winch means that not all of the leads to the winch will be fair unless there is some sort of a diverter (left, right, and above right). Where no diverter is used the highest loads should have the fairest lead.

An early Schaefer jammer (left). These would hold line for transfer to a winch, but they were not good for long-term loading as they were very abrasive. The clam cleat (middle left) is great for light loads and for holding lines that are not in use. The traditional camcleat (middle right) has been around for several decades and is still good for light loads, especially if you want to be able to release quickly. The right photo shows the layout we used on *Intermezzo II* for our reef lines and main halyard.

TOC
Last Chapter
Next Chapter
Help!

BLOCKS

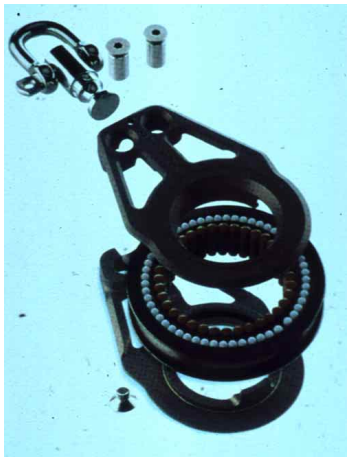
Today, almost all moderate-quality blocks have roller or needle bearings. This is a great boon to cruising as it lowers the friction to a negligible amount, whereas before you could count on having to double (or worse) your winching efforts due to friction.

The key is to size blocks so their normal working load is in the 20-percent range of rating for maximum bearing efficiency. Next, sheave size relative to line diameter is important. The bigger the sheave, the lower the friction of the line. Eight times line diameter makes for a nice sheave.

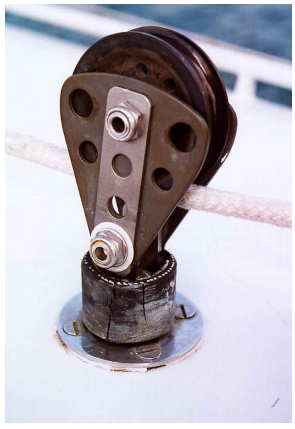
Snatch Blocks

Be careful when sizing snatch blocks, and never use them to change line direction more than 30 or so degrees. Snatch blocks are typically somewhat weaker than fixed units.

Since they're probably going to bang around, those with soft rubber cheeks will give the best service.

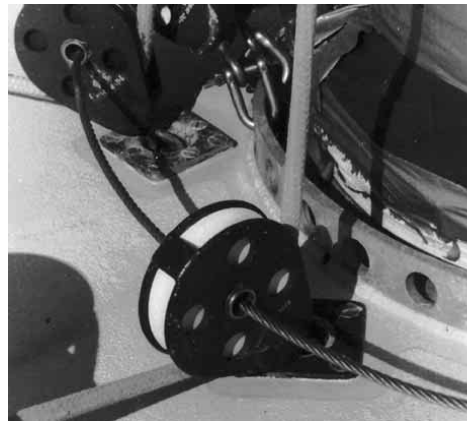


Two different styles of blocks from Lewmar. Their "Racing" series (left) runs on a combination of needle and round bearings. The blocks have hollow centers for lighter weight and are very efficient. The Solent blocks (middle and right) are a fraction of the cost of the Racing blocks and typically use just needle bearings. These give fine service for cruising (we've used them for years on most of our yachts). Note the spring on the right block for keeping it upright.



Keeping blocks upright (left) is necessary when they are attached to the deck. Otherwise, as the load changes, they tend to bang the deck, making noise and ruining the finish. You can usually use a short piece of hose around the shackle to accomplish this.

The right photo shows a safety wire through mast blocks on a maxi-yacht.



Pad eyes with removable eye bolts (left) are an excellent means of attaching deck hardware. When the block is not needed, the eye is removed — providing a more toe-friendly environment.

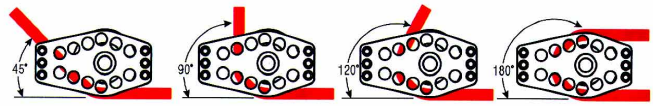
TOC
Last Chapter
Next Chapter
Help!

Turning Blocks

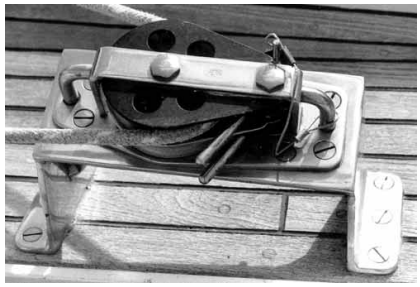
Turning blocks are a must at the end of your genoa travelers in order to redirect sheets and guys to primary winches. These should be sized for at least double the working load on the sheets, since with the line making an almost 180-degree turn, loads will build up very quickly.

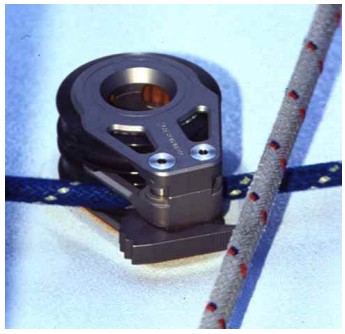
A stacked turning block with upper and lower sheaves allows two sets of sheets to be led. Turning blocks with stoppers incorporated right into them can save on your winch requirements.

Angle of Deflection	Load Factor	Angle of Deflection	Load Factor
30°	52%	120°	173%
45°	76%	150°	193%
60°	100%	180°	200%



The more of a bend around a turning block that a sheet makes, the higher the load. The worst case is where a 180-degree turn is made, in which case the load on the block is double that on the sheet. (Harken chart)



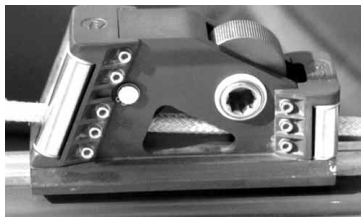


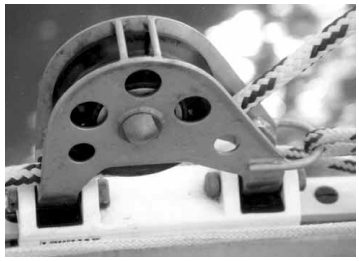
The upper left photo shows a Schaefer turning block with built-in dual jammers. These are great for keeping lazy sheets snug, and for changing winches when loads are light. The lower left photo is a new Lewmar racing turning block.

To the right is a nice detail Clive Dent came up with for attaching runner blocks on the Sundeer 64. The runner bale ties to the turning block base.

Don Sure worked up these clever details for getting the jib and staysail sheets to his primaries on the Alden 77 *Galatea*. Very simple diverters and/or turning blocks direct the sheets through aluminum tubes, toward the bases of their respective winches.

TOC
Last Chapter
Next Chapter
Help!





Two adjustable cars for T-track. The upper photo shows a custom design for one of our 74s. It incorporates a jammer operated by a winch handle. The lower car is a standard Lewmar product.

GENOA TRAVELER

Having the correct sheet lead (fore and aft) on your headsails is critically important to good performance, comfort, and heavy-weather safety.

As the wind lightens and/or moves forward, the sheet lead on any given sail will have to move aft. As the breeze increases and/or moves aft, the lead moves forward.

In both cases you are controlling twist in the head of the sail and the way your telltales break along the luff of the sail.

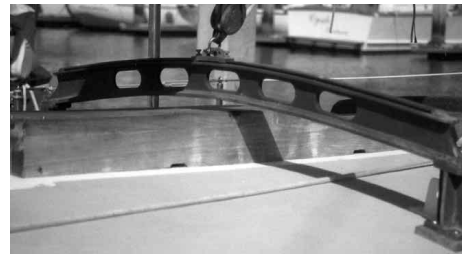
Leads that are too far forward cause the top of the sail to curve into the main, increasing drag. They also tend to make the sail too full for the conditions. On the other hand, leads that are too far aft allow the upper part of the sail to luff. Unless you are trying to ease off on drive, this is slow and hard on the sail.

Obviously you need to be able to move the lead. If you have a low-friction system, the position of the car can be adjusted from the cockpit with a simple control line. We like the cars that have Teflon or UHMW sliders better than those with balls. The sliders are a little harder to work, but over time those with balls tend to have their bearings deform and require a bit more maintenance.

If you don't have an adjustable car, you can use a barber-hauler. This is simply a loose block through which the sheet passes. The control line on the loose block leads forward, then aft to a winch. When you pull this block, it pulls the sheet forward. The negative with this system is that the block can bang around.

With fixed cars, or a punched toerail and snatch blocks, to move a lead you need to bring the lazy sheet from the weather side down to leeward, lead it through the new block position, and then ease off on the old sheet. On long reaches it sometimes makes sense to leave the sheet bridled between two positions.

Finally, you need to look at noise issues. Snatch blocks tend to bang around when you are off the wind, making a hell of a racket down below. Sometimes tying a bit of bungee cord between block and lifeline reduces the noise.



Two approaches to spanning the companionway hatch. Above: A track in the form of a girder can be used. Many hardware manufacturers now have standard pieces from which such a rig can be assembled.

The lower photo shows sheet attachment on one of our large motorsailers. With a powerful vang to control sail twist, a traveler was not required. Eliminating the traveler in this case improved sight lines from the helm. A solid traveler would have added significant height to the house structure.

MAIN TRAVELER

The importance of the mainsheet traveler varies with your boomvang arrangement. If you have a powerful vang that controls twist in the sail except when you are beating, then the traveler can be quite short. The main function in this case would be to hike the traveler to weather when sailing in light airs or when motorsailing.

On the other hand, if your vang is not really powerful, or perhaps you are using a rail vang rather than one connected to the mast, the mainsheet traveler becomes far more important as it allows you an easy means of controlling leech twist.

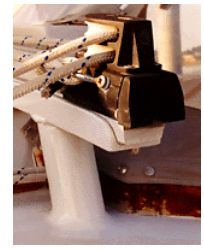
Another major consideration is location. The worst situation is where the mainsheet bisects the cockpit. This means you have to be careful during

TOC
Last Chapter
Next Chapter
Help!

tacks and jibes. Getting caught in the sheets at the wrong time can be hard on your health!

The ideal location for the sheet is forward of the cockpit area, usually on a structure spanning the companionway hatch. This gets the sheet out of the way and, since the connection point to the boom has moved forward, allows a traveler to cover a wider angle of main boom position.

Alternately, the sheet should be right to the end of the cockpit, far enough aft of the helm so that the person steering does not have to worry about entanglement during a jibe.



You need to think through how the traveler will be controlled. The normal system is to have two sets of control lines, either of which pull the traveler up to center or above.

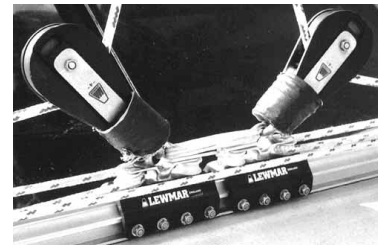
Changing End-Boom to Mid-Boom Sheeting

A lot of older yachts were built with end-boom sheeting, where the sheet makes a mess of the cockpit. It is often possible to move the sheet forward to a traveler newly mounted over the sliding hatch.

There are, however, several issues to consider. The first is the bending strength of the boom. The further forward the sheet is attached, the more leverage the mainsail clew has to try to bend the boom, and the harder you have to work on the sheet. So the boom should be stiff enough to carry the loads.

Next, the traveler to which the sheet attaches will probably be bolted to the cabin top. This is going to put quite a bit of loading into the structure. If there is a bulkhead nearby, this will probably be okay. But if there isn't, you will need to watch the cabintop for excessive deflection, which will eventually cause windows to leak.

One way around the deflection problem is to take a tension member from the top of the cabin down to the hull.



As loads increase, it sometimes makes sense to use dual travelers, linked together with a stainless plate or simply tied together, as they are here.

Full-Width Travelers

The ideal traveler situation, if you have room on deck, is a full-width or almost-full-width design, with the traveler well forward. When you get the geometry correct, most of the time you are sailing you can use the traveler control to set the angle of attack on the mainsail. A vang is only required when you are running and when the boom is eased off past the traveler.

The mainsheet is then used to adjust twist in the sail, but not the angle of attack.

Using the traveler in this manner reduces the loads you have to handle — traveler loads are about one-third of sheet loads — and makes for faster and more controlled jibing.

These two photos show the full-width traveler aboard *Intermezzo II*. Note how halyards and reef lines from the mast run under the traveler and into the cockpit area. Traveler control lines are led aft from each end of the traveler structure.

TOC
Last Chapter
Next Chapter
Help!

RUNNING RIGGING

It used to be easy to decide on running rigging. Halyards were made of stainless wire with rope tails, and sheets were made of Dacron. The only question was size, and for cruising we normally recommended one or two sizes over for chafe and longevity.

Today the story is different. There are many types of raw material as well as different ways of constructing the rope. Choices are varied, and it is not unusual to have three or four types of lines on a modern yacht.

Handling

Our first consideration in sizing running rigging is how it handles. For anything requiring real effort on the part of the crew, the diameter of the line needs to be a minimum of 3/8-inch (9.6 mm).

Another consideration is surface area in contact with winch drums. As the diameter of the line shrinks, there is less friction between it and the drum, so more turns are required. If the winch drums are old and maybe worn somewhat smooth, a larger diameter or softer line will be required.

Finally, if you are using jammers, check the line diameter against the jammer ratings. Generally, as the line size drops, so does the ability of the jammer or rope clutch to maintain its grip.

Working Loads

You should design for a number of factors relating to working loads. To begin with, the higher the factor of safety, the less problem you will have with chafe and stretch — chafe and stretch being directly related.

Most rope manufacturers rate their working loads at 20 percent of average breaking strength. This is as much a legal issue as a practical one. But there's also a modicum of sense to this. Certainly anywhere that a catastrophic failure could lead to physical harm to the crew, this should be observed.

You then need to look at how you interpret "working" load. In general, the average working load — say, what you see in 15 knots of breeze — is only a quarter of what there would be in 30 knots of wind. (The force in the wind goes up with the square of the windspeed.)

If most of your sailing takes place in light winds with only an occasional blow, it's safe to rate your working loads much lower. However, for offshore work, this usually is a false economy.

Finally, consideration must be given to the materials being used and what sort of fatigue characteristics they have.

Comparing Manufacturers

Comparing rope manufacturers can be difficult. Test procedures vary, construction methods are different, and where high-modulus fibers are used, the amount of these in the rope has a huge impact on cost and strength.

With so many variables you need to look closely at the test data to see which materials truly offer the best value (and will do the job).

If you are looking at high-modulus ropes, you will want to compare the diameters of the inner and outer layers. The inner layer is where the big bucks reside, as this is the high-modulus core. For a given diameter, if the outer layer is thicker, the rope will have less structural capability and be cheaper to produce.

Test Results

There are three types of test data: minimum breaking load, average breaking, and maximum break. Of the three, the only one with which we are really concerned is the minimum, as this is what you know will be the worst case. However, data is often shown as breaking load — whether it is the minimum or average is left to your imagination. Another factor that has to be considered with high-strength ropes is their life cycles. What you are after here is the lost strength with repeated use.

CONSTRUCTION

There are several basic types of construction. The most common is called double braid. Here you have an inner and an outer layer of braided fibers. The orientation (helix) of the fibers is one of the major factors in stretch characteristics.

Many low-stretch lines are made of an inner core of unidirectional fibers (with no braiding) and then an outer braided cover.

TOC
Last Chapter
Next Chapter
Help!

Diam. Inches	Average Break Strength Pounds	Minimum Break Strength Pounds	Maximum Working Load 4:1 Pounds	Weight Pounds Per 100Ft.
¼	2,700	2,430	625	2.3
5/16	4,000	3,600	1,000	3.5
3/8	5,400	4,860	1,350	4.5
7/16	7,600	6,840	1,900	6.5
½	10,500	9,450	2,625	8.5
9/16	13,100	11,790	3,275	10.5
5/8	16,800	15,120	4,200	13.7
¾	20,000	18,000	5,000	16.5
7/8	31,000	27,900	7,750	25.0
1	44,000	39,600	11,000	34.4
1⅛	50,000	45,000	12,500	44.0
1¼	57,200	51,480	14,300	51.0
1 5/16	63,000	56,700	15,750	55.5
1½	74,800	67,320	18,700	68.5
1⅝	88,000	79,200	22,000	85.0
1¾	100,000	90,000	25,000	104.0
2	125,000	112,500	31,250	124.0

Physical properties for Yale double-braid polyester.

Diam. Inches	Average Break Strength Pounds	Minimum Break Strength Pounds	Maximum Working Load 5:1 Pounds	Weight Pounds Per 100Ft.
¼	4,300	3,870	860	2.3
5/16	5,700	5,130	1,140	3.0
3/8	8,600	7,740	1,720	3.7
7/16	11,500	10,350	2,300	5.4
½	17,000	15,300	3,400	8.0
5/8	23,000	20,700	4,600	11.5
¾	34,500	31,050	6,900	16.2
3/16	40,000	36,000	8,000	17.3
7/8	50,000	45,000	10,000	22.1
1	60,000	54,000	12,000	28.2
1⅛	73,000	65,700	14,600	32.1
1¼	84,000	75,600	16,800	37.5
1 5/16	100,000	90,000	20,000	45.7
1½	118,000	106,200	23,600	61.1
1⅝	142,000	127,800	28,400	71.7
1¾	167,500	150,750	33,500	85.6

Physical properties for Yale double-braid Spectra core with polyester cover.

Diam. Inches	Average Break Strength Pounds	Minimum Break Strength Pounds	Maximum Working Load 5:1 Pounds	Weight Pounds Per 100Ft.
1/4	5,000	4,500	1,000	2.1
5/16	7,200	6,480	1,440	3.6
3/8	11,500	10,350	2,300	4.8
7/16	15,200	13,680	3,040	6.6
1/2	20,000	18,000	4,000	7.8
9/16	26,000	23,400	5,200	10.6
5/8	30,000	27,000	6,000	12.2
11/16	40,000	36,000	8,000	15.5
3/4	45,000	40,500	9,000	17.9
7/8	63,000	56,700	12,600	24.4
1	80,000	72,000	16,000	31.0
1 1/8	100,000	90,000	20,000	40.0
1 1/4	120,000	108,000	24,000	46.0

Physical properties for Yale double-braid Vectran core with polyester cover.

Where different materials are used in the same rope, such as a Vectran/Dacron combination, you need to watch interlaminary chafe. In some cases the inner core will be coated with an abrasion-resistant material.

Dacron

Dacron — or more properly, polyester — is the most common form of running rigging. It is generally easy to handle, and with low-stretch construction can be suitable for halyards on smaller yachts. Working loads are typically limited to 20 or 25 percent of minimum breaking strength.

Spectra

Spectra is one of the high-modulus miracle fibers. Incredibly light and strong, it has very low stretch. It also has very high abrasion reistance. Multiple wraps of small diameter line can be substituted for shackles in many situations. For larger yachts, it makes good halyards, sheets, and guys. However, Spectra has one drawback. If loaded to much more than 25 or 30 percent of breaking load, it quickly fatigues.

Vectran

Vectran is a step up from Spectra. It is 10 to 15 percent stronger for a given weight or diameter. Most important, however, is that it has much better fatigue characteristics. It can be operated at up to 50 percent of its ultimate strength without major fatigue problems.

Vectran is somewhat more costly than Spectra. However, when longevity is taken into account, it costs less over time.

Aramid

Kevlar — or the Japanese version, called Technora — has the lowest stretch-to-weight raio of any of the high-modulus materials. However, it is very sensitive to bends, block diameter, kinking, and ultraviolet degradation. So, unless you are racing and looking for the last little bit of performance, it does not make sense.

Halyards

There are two main issues with halyard. The first is stretch. If the halyard's length changes with load, it becomes very difficult to keep the sail properly trimmed and the luff tension correctly set. The stiffer your sailcloth, the bigger an issue halyard stretch becomes.

The other factor is chafe. This primarily affects spinnakers, but will also impact jib and mainsails if the sheave detailing is not correct.

TOC
Last Chapter
Next Chapter
Help!

Rope-to-Wire Halyards

For many years, wire with a rope tail has been the standard and in reality is a good compromise for offering low stretch, moderate cost, and ease of handling. Virtually any size of rope tail can be spliced to wire, but if the rope is too small you're forced to put the splice on the winch. When the time comes to reef there will be structural problems. It's better to go up a size or two from what's recommended for the rope tail, so the rope-to-wire splice will be the strongest part of the system. This allows the splice to be above the winch, preventing the wire from scoring the drum and ensuring lots of strength in the halyard when reefed.

Adding a "Flemish eye" to the end of your halyards makes it a lot easier to replace them when the time arrives. Simply tie on a light messenger line, and you are ready to go.

Wire Longevity

Wire halyard sheaves should be at least 25 times the diameter of the wire and, if there's room, preferably about 40. Large-diameter sheaves prevent "meat hooks" from developing right after the Nicopress thimble.

If the wire itself is oversized a bit, perhaps one size larger than normal, it will last substantially longer. We have never (yet) had a wire halyard or rope-to-wire halyard splice fail.

Galvanized?

Stainless is a bit easier on maintenance, although galvanized is less expensive and somewhat stronger. Most race boats use galvanized wire, if they're using any wire now because of the strength-to-weight issues. Seven-by-nineteen construction is preferred for its flexibility in either material.

Using Rope

Many of today's boats are rigged with all-rope halyards. The variety of low-stretch materials available make this a reasonable approach. Of course, the key issues are stretch and cost. Low-stretch Dacron will work with a lot of sails, especially those on moderate-sized vessels, where Dacron is the sail fabric of choice. However, as size increases, and/or the modulus (stiffness) of sailcloth improves, you need to look at Spectra or Vectran due to the better stretch characteristics.

When we rigged *Beowulf*, which has very high halyard loads and all Spectra working sails, we used Spectra halyards. In order to keep working loads on the halyards low, her main, mizzen, and jib halyards are all 2-to-1. The sistership to *Beowulf* is rigged with Vectran, which allows us to do away with the 2-to-1 halyards.

Rope-to-wire splices will carry the full wire load. We've yet to have one fail.

If a long lanyard is used to pull the shackle pin, it can also be used to secure the pin against accidental opening.

A Spectra mizzen spinnaker halyard that met an untimely demise on *Sundeer*.

On running rigging subject to chafe, especially spinnaker halyards, it makes sense to add an extra sleeve to the outside for 10 feet (3 m) or so at the top of the halyard.

TOC
Last Chapter
Next Chapter
Help!

Wire Pennants

Sometimes with a rope halyard there tends to be quite a bit of chafe right at the top sheave, especially if it's a spinnaker halyard. To reduce chafe problems, a wire tail — perhaps 2 or 3 feet (600 or 900 mm) long — can be spliced onto the end of the rope. The shackle is attached to the wire tail and the wire takes the chafe.

Inside or Outside?

I prefer internal halyards for their neatness, lower windage, and ease of arrangement where they exit the mast. However, for offshore work, spinnaker halyards are best left external, unless you have a very low-chafe masthead design. This allows them to be end-for-ended when chafe becomes a problem and reduces the chafe that inherently occurs where they enter the mast.

Reaving Halyards

If you ever lose a halyard at sea and have to re-reeve one, a little preparation will yield big dividends.

First, see if you can work a messenger line (or better yet, a light piece of wire) from top to bottom of the mast. If a small-access plate is left at the masthead, a new halyard end can be fed over the sheave, and then it and the messenger wire are hooked out and joined together through the access area. A bent hanger works fine for hooking.

Another approach is to use a piece of bicycle chain, or series of small fishing tackle weights to feed over the halyard sheave and act as a weight to pull a messenger line down the spar.

Internal Chafe

If periodic inspections of the halyards turn up chafe in the standing part of the halyard (the section inside the mast), odds are the halyard is chafing on spreader bars or perhaps a bolt or screw thread. Conversely, if a metal halyard shows signs of aluminum worked into the lay of the wire, it's chafing on some part of the spar, a spreader base, or perhaps a tang compression bolt. In either case, it will be necessary to find the problem and relead the halyard to prevent additional damage.

SHEETS

Sheets are so mundane that we rarely give them much thought. Yet on a long passage they can be the source of all sorts of frustration.

First, make sure that the leads are fair. Sheets must not touch anything after they exit the lead block. If they rub on a lifeline stanchion, a shroud, under the boom, or across another line, you will soon have a severe chafe problem.

Next, the lead out of the lead block must be fair, with no part of the sheet touching the cheeks of the lead.

A key factor in chafe is stretch. The more a sheet stretches under load and then contracts when loads are eased, the more it will chafe on anything it touches. Larger diameter sheets, or those made from low-stretch fibers, will chafe much less than stretchy cordage.

Attachment

Sheets are best attached to the clew of a sail with a bowline or splice. Snapshackles will do okay on spinnaker afterguys, but they are susceptible to opening when the headsail clew flogs during a tack. They can also knock out teeth or break fingers.

As loads increase and you go to high-modulus fibers, you must have an eye splice in the end of the sheet, as a bowline will weaken the material excessively. The problem comes in attaching the bowline to your headsail. If you use a shackle, it will be heavy and extremely dangerous when flailing.

The answer we've adopted on our larger yachts, suggested to us by Phil Garland, is to use half-a-dozen turns of lighter Spectra or Vectran between the spice and the clew of the sail. This soft connection is not as easy to undo as a shackle, but it is much kinder to body parts should it every come into contact during a tack or jibe.

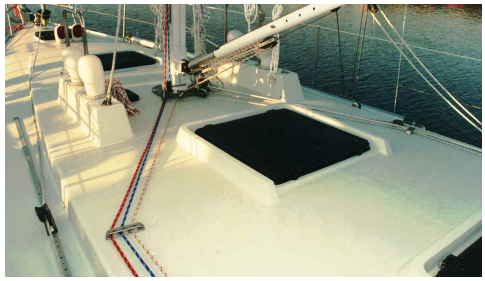
Light Airs

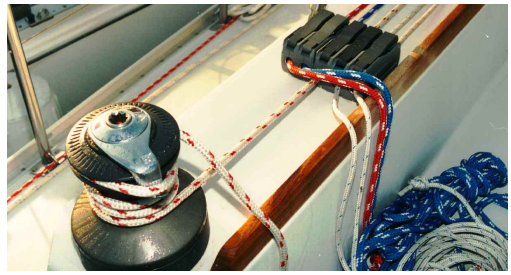
While oversized sheets are the order of the day for normal sailing, heavy sheets in light airs will really make a mess of your sail shape. We usually carry a set of light sheets that will work for either the spinnaker or the jib. These are typically about two-thirds the diameter of the normal working sheets.

TOC
Last Chapter
Next Chapter
Help!

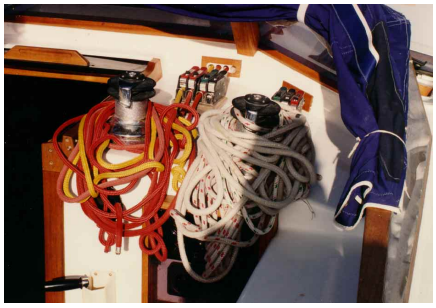
LEADING CONTROLS AFT

I'm a great fan of leading some of the halyards and reefing lines to the cockpit area, as long as this doesn't create a rat's nest. Being able to handle a vessel from the security of the cockpit is a real blessing. But people often try to do too much in this regard, and the result is chaos, with lines and coils in a frightful tangle. By leading the main halyard, spinnaker halyard, foreguy, topping lift, and the slab reefing lines aft, you've covered 90 percent of your needs. (When lowering or breaking out headsails, you'll probably have to go forward anyway.) The critical thing is to do this in a manner which allows some organization of the tails.



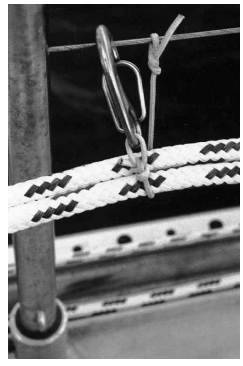


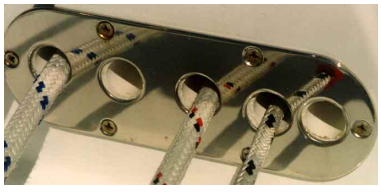
On the Sundeer 56 we brought the vang, main halyard, mainsheet, and mainsail tack and clew reef lines to the cockpit. The halyard, reef clew, and sheet were led to starboard to an electric winch while the other lines went to port (shown here) to a manual two-speed self-tailer.

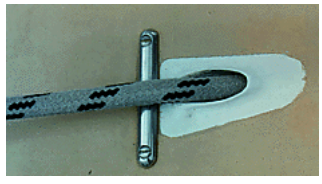


An important part of leading lines aft (right) is figuring out what to do with the tails that are not in use. If you don't have a good way to deal with these, it may be better to leave some of the functions at the mast. Coaming pockets or canvas bags (left) can provide a place to stow rope tails.

The more lines you bring aft, the more space on deck will be required to spread them out (left). The blocks at the base of the mast will need some form of support so as not to fall over when the line is unloaded.







It is sometimes necessary to change direction of the lines by a small amount. This can be accomplished with blocks or organizers, or by using rubbing strakes or stainless or UHMW plastic diverters.

If sheets or runner controls led aft tend to slap the deck, you can hold them up with hooks tied to the lifelines.

TOC
Last Chapter
Next Chapter
Help!