Cruising Sails: Mainsails

By Carol Hasse

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We were night sailing through the coral strewn Bahamas, broad reaching at hull speed in uncomfortably rising seas and winds. Our course was set for tropical warmth and the adventures only sailors can experience. Somewhere between the exquisite Berry Islands and Nassau Harbor (though we may just as well have been somewhere between hell and high water with all the visuals of a coal bin), it was time to jibe. It had to be a controlled jibe of course; the 616 square foot mainsail of our 50' gaff schooner was, indeed, a force to be reckoned with. Carefully easing the preventer that was secured to the aft end of our 500-pound 30-foot boom, we bore off downwind. Predictably and powerfully, the not much lighter (or shorter) gaff arced across the sky from windward to leeward. In the "split second" before the boom jibed over to join the gaff on our new tack, the mainsail ripped from leech to luff just above the clew reinforcing patch. With dispatch born of necessity, we tucked in a belated reef, neatly hiding the offending seam in the bunt of the sail. It wasn't long before another jibe was called for, and despite the impeccable timing of our well-orchestrated crew, the mainsail was ripped again from leech to luff, this time along the seam above the reef clew reinforcing patch. It is with much embarrassment that I admit we committed this act a third time, ripping our mainsail above its second (and final) reef clew's reinforcing patch—once more from leech to luff. No matter… it could be fixed in port or at sea with 10- 30 hours of labor - depending on available tools - but it had to be struck and furled until the repair could be accomplished.

We no longer had a functional mainsail. Without this aptly named sail, our vessel could not round up, come about, beat to weather, heave-to, or work its way off a lee shore. As it turned out, working our way off a lee shore had become necessary. Fortunately, our capable auxiliary engine spared us the humiliation of running aground, losing our ship, or worse (!) that December night. And I learned some valuable lessons about the handling, construction, and function of the essential mainsail.

The venerable and still viable gaff and junk rigs of last century's working fleets have much to teach us and to offer (e.g., less heeling, better reaching performance, reduced tip- vortice loss, and ease of reefing), but they can be heavy, chafe-inducing, and complex. Modern spar-building, rigging techniques, and materials have allowed the development of the simple and elegant Marconi rig with its weatherly triangular mainsail commonly seen today. However, sailboats, their rigs, and their sails, are still evolving. Thoughtfully combining old and new materials, design, construction, and handling techniques, along with understanding the attributes and drawbacks of your rig, will yield the best mainsail for you and your boat.

The type of mainsail and options you choose will be predicated not only by your rig and vessel but by the type of sailing you do. The sail might be tall and skinny to fit a high aspect rig, or it might have a short luff and a long foot to fit a low aspect rig. It might furl into the mast or around or inside the boom (ostensibly for easier handling). It might be fit with battens of various lengths and orientations or carry no battens at all. A mainsail can have a flattening reef or a roll reef, a shelf foot or loose foo, a cunningham ring, and 1,2, or 3 reefs for increasing winds. A mainsail can also be fit with special slides along its luff for easier raising and lowering. It might be equipped with some type of lazy jacks or a built-in cover for easily securing sun protection when the sail is struck or furled. Each mainsail style or option has a value, cost, and appropriateness factor to consider.

The _____issue of Cruising World covers the developments and issues of mast and boom furling mainsails with which some otherwise sensible cruising veterans have outfitted their vessels. These systems might come to be as reliable and relatively fail-safe as headsail roller furling systems. In the meantime, this belt-and-suspenders conservative cruiser would choose a "traditional main"—one that goes up and down the mast on a halyard when set, reefed, or struck, and is flaked or furled on top of the boom when not in use.

A traditional mainsail's most desirable attributes are durability, longevity, and stability (good shape retention). Dependability and maintainability rank equally high. The strength and stability of the sailcloth, along with its UV and chafe resistance, largely determine a mainsail's useful life. In general, heavier sailcloth will last longer. How the sail is sewn at its seams, corners, and edges, and the quality of hardware that attaches the sail to the rig play key roles in its longevity and durability. And, as noted above, operator error/abuse can play a dramatic role in a sail's life expectancy, not to mention its maintenance and repair!

Woven polyester sailcloth, such as Du Pont's Dacron, is remarkably seaworthy and an excellent choice for mainsails on most cruising boats under 60 or 70 feet. Dacron will not be harmed by moisture or by the mildew that sometimes grows on a sail's dirty spots. 'Premium' Dacron is the designation given by most quality sailcloth manufacturers for their finest woven polyester. This sailcloth has greater and longer lasting stability than others of the same weight per square yard because of its many tightly woven, low stretch, fine denier yarns. Lesser quality Dacron, which is more loosely woven of coarser yarns, must rely more on its resin finish for stability. This often means stiff, unfriendly sailcloth. The sailcloth will soften over time as the resin coating breaks down; unfortunately, the sail then generally assumes the unsatisfactory shape of a shower cap.

A mainsail's shape (or amount and position of its fullness) can be determined visually. The process for ascertaining the condition of the mainsail's fabric, however, is a bit more invasive. One must summon the courage to push the tip of a number 14 sailmaker's needle through the most tired part of the mainsail (the

panel below the head reinforcing patch near the leech is often a good test spot) and pull it firmly in all directions. If the sailcloth is easily torn with the needle (there is no mistaking the unfortunate tearing sound of rotten cloth!) the fabric is "condemned" and not worth repairing. (It will, however, be suitable in its next life for using as a drop cloth or a nautical woodpile cover, or for the making of a sweat lodge).

The thread (preferably heavy, UV treated Dacron) that is used to stitch the seams together and hold the reinforcing patches in place can be tested by firmly rubbing the edge of a coin over it. If the thread is brittle enough to break, it is time to re-stitch the seams. Here, the value of extra wide seams becomes evident; re-stitching can be done between the original rows rather than on top of them, reducing the risk of "tearing along the dotted line." To reduce the possibility of perforating seams, zig-zag or "triple-step" stitching is preferable to straight stitching.

Part of the new construction or retro-fitting of a cruising mainsail is deciding what type of battens (if any) it will carry. The three basic styles are battenless, standard batten, and full-length batten (with variations on these themes). Each of these styles has distinct advantages and disadvantages.

Battens are the relatively narrow (1-2") struts of varying lengths, shapes, and materials that project and support the trailing edge (or leech) of the mainsail. They are usually installed parallel to the foot or perpendicular to the leech at four or more evenly spaced intervals. Battens and the pockets that hold them can chafe, hang up, or destroy themselves on standing and running rigging when the mainsail is set, reefed, or doused. They are the source of most mainsail repairs. Battens complicate transporting or stowing the sail when it is off the spar, and they appear to have a personal goal—to get out of the pocket at the most untimely moment. A battenless mainsail eliminates these nuisances altogether and is less costly to build than one with battens. A battenless mainsail (sometimes called a roachless main) can be made new or recut from a standard or full-length batten main by performing a *roachectomy* (cutting away fabric to form a hollow or negative leech).

Roach is sail area that lies outside of a straight line drawn from head to clew on a mainsail. While it requires the support of those pesky battens (the batten length must be at least 3 times longer than the roach it is supporting), roach enhances mainsail performance. It adds approximately 15% more sail area to the straight triangle of the mainsail even when the mainsail leech remains forward of the backstay. Maxi-roach mainsails can project as much as 30% extra sail area, much of it abaft the backstay. While the additional sail area is useful in light air and off the wind, it is the elliptically shaped head and planform of the mainsail with roach that increases performance on all points of sail—particularly to weather.

In addition to supporting roach, battens help the leech maintain the right amount of twist, an important aspect of sail trim that is controlled by the vang, sheet, and traveler. A leech that has the proper amount of twist (openness) when going to weather in a blow enhances the boat's forward drive; improper twist (closed leech) contributes to excessive heeling and leeway and to the need for reefing in moderate winds.

A cruiser who has decided to live with the negatives of battens in exchange for the positives of roach may choose between full length battens or shorter "standard" battens. The standard batten mainsail is usually less prone to chafe and easier to raise, reef, and lower than a full batten mainsail. It is certainly easier to take on and off the mast and boom as well as to fold and stow or transport. A standard batten mainsail has a conservative amount of roach (e.g., 14 inches on a 40 foot leech) and costs significantly less than a full batten main. It is, in many ways, easier to trim. However, in its declining years, a standard batten main will suffer from unsightly and performance compromising *leech gutter* as well as from the maintenance problem of *batten poke*. As a sail ages, its fullness migrates aft and increases. This unhappy shape change is exacerbated in a high aspect mainsail (tall mast, short boom) because loads are particularly concentrated along the leech. Cloth fatigue in a high aspect, battenless mainsail inevitably manifests as a cupped (or shall we say *bucketed*) leech. The leech of a standard batten mainsail will hinge at the inboard ends of the batten pockets (a condition more colorfully noted above).

Full-length battens offer the best support for a moderate to *maxi* roach mainsail. They minimize the noise and debilitating effects of leech flutter and sail flogging by dampening the mainsail's motion when one is maneuvering under sail or motor sailing. Full-length battens can aid in reefing and flaking the main too. More importantly, full length batttens strike a fair curve from luff to leech, helping the mainsail set well on all points of sail—its whole life long—despite the sail trimmer's shortcomings. While a cruiser's first priority isn't usually the extra quarter of a knot derived from a perfectly shaped mainsail, sailing comfortably on the desired heading with predictable boat motion and an acceptable amount of speed is! Bad sail shape and/or trim contribute dramatically to heeling, leeway, poor progress to weather, the need to reef even in moderate winds, and to excessive rolling downwind.

Despite their many benefits, full-length battens do have drawbacks. They chafe on the spreaders and shrouds when sailing off the wind, creating on-going maintenance for trade wind sailors. Stoutly constructed platform pockets that encase the batten and flat battens that lie closer to the sail help reduce chafe concerns. The greatest problem with full length battens is the compression loading that concentrates at the forward end of each full-length batten and wants to drive the batten out of its pocket and through the mast. This force creates chafe problems along the luff and on the batten pocket's leading edge. Even worse, the

force of compression loading can make raising, lowering, or reefing the mainsail very difficult. A solution to these problems is a seaworthy batten-end receptacle. It must secure the batten in the pocket, protect the luff from chafe and direct contact with the mast, and have an articulating, integrally attached sail slide to ensure easy setting and striking of the main. The batten-end receptacle is better still if it allows the battens to be tensioned. Installation of a high quality batten-end receptacle, combined with labor and materials of fitting a full length batten and its pocket to a sail, adds significantly to the mainsail's cost. Although this investment pays off in reduced wear and tear on the leech, and a longer lasting efficient sail shape, it will not necessarily extend the life of a mainsail. Barring accident or lubberly ineptitude, UV exposure is what will ultimately destroy a sail.

Before converting to full-length battens, requesting a roachectomy, or committing to standard battens, consider the advantages and disadvantages of each style of mainsail and its appropriateness for your rig. If you plan on circumnavigating the five great capes with a low aspect rig, and if self-sufficiency, simplicity, economy, and durability are your watchwords, a battenless mainsail may be your best choice. If your mast is tall and your boom short, roach will add vital sail area and efficiency, and battens will be necessary to support it. Larger mainsails must endure higher loads and require more time to raise, reef, and strike - subjecting them to more flogging. These mainsails benefit most from full-length battens. Sailors with sloops or cutters smaller than 35 feet (or larger split rigs) may be completely satisfied with the performance of a standard batten mainsail; indeed, coastal and offshore cruisers with far larger vessels have also had success with this time tested type of mainsail.

When batten style has been determined, the number and position of reef rows can be decided. A row of reefs allows a mainsail to be reduced in size when the wind pipes up. Each row consists of a secondary tack and clew (often referred to as reef cringles) and intermediate reef points. Reefing tackle is rove through the reef cringles "at the ready" for safe and relatively easy reefing. After the reef tack is secured, it is important that the clew reefing tackle pull the clew reef cringle down to the boom and aft towards the end of the boom, outhauling (stretching tight) the new "foot" of the reefed sail. If the reefed sail is not outhauled, the sail will be too full to work to weather without excessive heeling and leeway, and it will not be as effective at slowing boat speed off the wind. Once reef tack and clew cringles are made fast, it is prudent to tie a back-up line or webbing strop through the cringles and around the boom. The bunt of the sail can then be loosely secured using the reef nettles or reef tie lines that are rove through the reef points; this will keep it from collecting wind and water or obscuring visibility from the helm. The load of the reefed sail should be taken by the reef cringles only, not the intermediate reef points. Properly tying the nettles around the bunt of the sail—not around the boom—creates shock absorption that minimizes the risk of a reef point tearing out in the event of a violent gust. If intermediate reef tie lines are tied around the

boom, they might also chafe or constrain running rigging (i.e., topping lift, outhaul, reefing tackle, main sheet, etc.) and damage the finish on the boom.

A mainsail's reef rows are spaced relatively evenly apart and roughly parallel to the foot of the sail at a workable distance from any battens. A common first reef position reduces a mainsail's size by 20%. A second reef generally follows at 40%, leaving 60% of the mainsail area up. Cruisers venturing offshore will need greater sail reducing capability and may choose to have two deeper rows of reefs or to add a third. A third row of reefs does not usually enhance the set of the mainsail, and it can complicate running rigging by increasing mast and/or cockpit *spaghetti* and friction when the mainsail is raised. Three rows of reefs can be handy, however, for creating mainsail area options for balancing the headsails or for keeping a tender boat on an even keel. If a third reef is added to a mainsail, lead the tackle before it is time to use it! Regardless of how small your mainsail can be reefed, it is still prudent to carry a trysail when blue water sailing. A trysail serves as storm sail and a back-up mainsail, albeit less than a third of the mainsail's size.

The corners that hold the mainsail to the rig are subject to dramatic loads. Accordingly, high quality, non-corrosive hardware appropriate in size and strength must be set into stout *reinforcing patches* at the head, tack, and clew, as well as at reef tacks and clews. Reinforcing patches consisting of several layers of sailcloth equal to or greater in weight than the fabric the sail is made of should extend generously into the body of the sail. The length of the reinforcing patch should be 12-15% of the side of the sail that it supports (e.g., a 40 foot leech might have a 6 foot long clew patch). There are several types of hardware that can be installed in the corners of a main including headboards, hydraulically pressed rings or hand sewn rings, and external rings including round, "D," and "maxi" rings. An external ring is secured with multiple webbing strainers and hand stitching; if sized properly, an external ring is suitable for any primary corner, particularly if it must fit into a narrow or short shackle, tack, or outhaul fitting. External rings are easy for a sailor to replace by hand at sea and present little chafe concern. Integral rings are often installed in the primary corners or as reef tacks and clews and are either hydraulically pressed or sewn in place with a palm and needle. Hydraulically pressed rings are stronger under a steady pull load than a hand worked ring but do not have as flexible a bearing surface, nor are they as easy to replace. The reef clew of a battenless or standard batten mainsail is an ideal location for a hand sewn ring because this part of the sail will endure a lot of flutter (if not flogging) over the course of its life. That same sail would be well served by hydraulically pressed tack and clew rings that are held captive under load by unyielding stainless steel tack and outhaul fittings. Pressed rings are composed of a round ring (or two split rings) secured in place by an internal sleeve or liner that is flanged port and starboard by tens of thousands of pounds of hydraulic pressure. If you have hydraulically pressed rings in your sail, look carefully for signs of corrosion; for many years hydraulically pressed rings were

made of dissimilar metals; such rings must be replaced before their self-destructive battery action dissolves them to worthless bits.

An anodized aluminum headboard is a common and appropriate fitting for a standard or full batten mainsail; it helps support the roach at the head and provides a secure attachment point for the halyard. Use the forward headboard hole to hoist the mainsail if its halyard is rove through a masthead sheave; use the aft headboard hole if the main halyard block is hung abaft the mast on the masthead crane.

All corners can be strengthened and made more flexible with the addition of webbing strainers, webbing straps that are folded in half and sewn port and starboard into the body of the sail from the corner hardware. It is important that all corners, including the reef tacks and clews, be protected from contact with the rig. Thick, hand- sewn leather is second to none for this duty; it is the most durable and easiest to replace. It is important, too, that a reef tack that is intended to be made fast to a reef hook has a means for its quick and easy attachment that creates minimal distortion and chafe to the sail. A length of webbing rove through an integral reef tack ring with a stainless steel round ring secured to it port and starboard works best. These are sometimes called a “quick cringle” or “easy reef”. Beware of the reef tack that is only an external round ring with webbing sewn on one side of the sail. This unfortunate setup can be easily torn out with a halyard winch; without the back up of an integrally pressed or hand sewn tack reef ring, you will be up the proverbial creek, with no way to secure a reef tack.

A cruising mainsail’s slides hold the luff to the mast; they should be durable, well secured, and able to move smoothly up and down the mast track. They should be approximately two feet apart and doubled at the head of the main. Although the style of slide is somewhat limited by the mast track, a similarly sized slide that is upgraded in strength and function should be used whenever possible—particularly at the head and above each reef tack where loads are highest. UHMW internal slides are stronger and more friction-free than their common and less expensive white plastic counterparts, and they do not gall or corrode inside an aluminum mast track like stainless steel or bronze slides can. An external style stainless steel mast track (often found on a wooden mast) requires a robust external bronze or stainless steel slide that fits around the track. This system works beautifully if the track—especially at its joints—is clean and fair. Grooved mast tracks that are made to accommodate a racing mainsail’s boltrope will also fit *slug slides* that can be secured to the luff of a cruising mainsail. Unfortunately, slug slides bind very easily in the track, and they can make raising and lowering the main truly aggravating. UHMW slug slides can sometimes help the function of this style of mast track. If a sailor is expected to regularly raise and lower a full-length batten mainsail on this track, however, he or she will probably want to retro-fit to a “slippery” mast track and slide system or take up motor boating.

Whatever style of mast track and luff slides you have, the slides must be well secured to the luff of the mainsail. The ultimate way to attach luff slides is with a "webbing seizing": a narrow length of webbing wrapped several times around the bail of the slide, through the luff grommet, and secured with palm and needle. Webbing has more flexible strength than the plastic or stainless steel shackles that are sometimes used to hold a slide to a sail, and it will not chafe the luff or wear through the bail of the slide. Webbing seizings are easy to renew at sea. Webbing seizings are remarkably strong, but if a grommet to which a slide is secured pulls out, the entire mainsail can "unzip" from the mast. Hand-worked rings are over twice as strong as the same diameter common spur grommets and will not corrode as grommets do. Alternatively, a sail's slides can be seized into small hydraulically pressed rings. Similar to the handsewn ring, they are far stronger and less corrosive than a grommet, but they are not as easy to install or repair as a hand worked ring. A voyaging mainsail should be equipped with hydraulically pressed or hand worked rings along its luff for the purpose of attaching sail slides. At the very least, these more dependable rings should be placed in the high load areas on the mainsail's luff just below the head and just above the reef tacks.

The foot of a cruising mainsail can be either "loose footed" or attached to the boom along its entire length. A loose-footed main has the advantage of being able to be more easily and efficiently shaped and trimmed. It also makes proper reefing easier, allowing the bunt of the sail to be secured by tying it around the foot of the sail—not around the boom. The drawbacks of a loose-footed main are higher loads on the outhaul car and more chafe on the mainsail's foot. If a mainsail is not loose-footed, it should have foot slides secured with webbing seizings into stout secondary rings spaced every fourteen to eighteen inches along the boom. The foot of a mainsail that is attached directly to the boom by its boltrope will suffer from chafe where the boltrope enters and exits the boom, and it will not be able to be properly reefed. Also, unsightly slits may have to be cut through the foot of the sail for the purpose of leading reefing tackle, which could other wise be led under the foot of the sail if it was loose-footed or attached to the boom with slides.

A cruising mainsail is asked to perform on all points of sail, in almost all wind speeds, and in a challenging variety of sea states—and it is expected to do so for many years and thousands of nautical miles. The combination of durable high quality cloth and hardware, time honored construction details, and proper sail handling can make this goal attainable.

As for the story that began this article, I had the good fortune to be offered the use of the British America's Cup sail loft in Nassau, and I was able to reconstruct our schooner's battered mainsail. At the time, I didn't know the "old gaffer's" technique that would likely have averted the mainsail's unhappy injuries, but I could see that the inadequate size of its corner and reef reinforcing patches along with sun damaged seam stitching were strong contributors to the carnage. If we had just *scandalized* the gaff (by lowering its peak), as my Port Townsend sailing mentor has informed me, it would have jibed gently onto the new tack without

putting any strain on the leech. I learned that trick the hard way! I now know how to avoid that mishap and how to thoroughly inspect the mainsail my vessel's safety depends on. If our cruising mainsails are built stoutly, maintained properly, and protected from chafe and UV exposure as much as possible, they will likely survive any sail handling lessons we've yet to learn.