Evaluating voyaging anchors

A survey of anchor types and their pros and cons

Story and photos by Dave McCampbell

Anchors, as a means to secure boats to the bottom, have been around for thousands of years. Rocks and shaped stones, used since the Bronze Age, continue to be among the most popular small boat anchors in developing countries. Cement blocks, scrap iron pieces and welded grapnels are a close second. But none of these popular types are very useful as primary cruising boat anchors.

Classically designed fluke anchors with a ring for attaching to rope, wooden stocks, iron shanks and arms with small flukes have been used from the first century AD well into the Golden Age of Sail. In the 1820s, stockless anchors — made with heavy flukes and tripping palms rotating on a robust shank — became the first major change in anchor design for centuries. Their ease of handling and stowage aboard large ships overshadowed their relatively poor holding characteristics. By the 1840s, large sailing ships began using Admiralty Pattern anchors with iron stocks oriented 90 degrees to the arms and a chain connection at the top of the shank.

The Herreshoff and Luke anchors are three-piece Admiralty anchors sometimes carried by cruisers as a heavy-weather anchor. In 1933, the venerable forged, hinged-plow CQR anchor changed the trend for primary cruising boat anchors forever. Now, modern technology has brought us multiple — but not always better — anchor mousetraps.

For those of us out full-time cruising, some of the best insurance we can have is good ground tackle. Ground tackle includes not just the anchor but the chain, shackles, windlass, rode, snubber and miscellaneous connecting hardware as well. All should be of nearly equal strength. The primary feature of good ground tackle is its ability to pin us securely to the sea floor in a variety of strong weather conditions. Anchoring in heavy weather requires strong, well-designed and constructed equipment that won't bend, break or release from the bottom as the weather deteriorates.

The one item that most affects our boat's ability to stay put in strong winds is the anchor itself. But not all anchor types are up to this task, especially as a primary anchor, and only a few perform this function significantly better than others. Competition for market share is stiff. Unfortunately, as patents run out, cheap and unreliable copies flood the market. Currently there are nearly 100 different anchor models available.

One good way to assess an anchor's faults is to talk to salesmen. They will quickly tell you what's wrong with the competition and right with their product. Another way is to check Internet forums. Just remember that not everything on the Internet is true, and not everyone expounding has the experience they project. Be sure to seek out and ask seasoned

The classic Admiralty-style anchor.

cruisers who have experience with several anchor types for their opinions.

Lloyd's Register, a 260-year-old and well-respected maritime classification society, classifies anchors based on carefully tested pull resistance. For instance, an anchor that is classified as "Super High Holding Power" (SHHP) requires the anchor to resist pulls at least twice as strong as that of an HHP anchor, and in three different bottom materials.

Correct anchor type nomenclature and part names are important when discussing features with representatives of the companies that make anchors. Terms like the "flat part," "pointy end" and "long part" just won't do.

General features

There are a number of important features that should be considered when developing a short list of the best primary anchors. Some things to look at include: ultimate holding power, dynamic stability, resetting characteristics, penetration ability, strength and metallurgy, usefulness in different bottom types, weight vs. efficiency, blade/fluke design, shank shape, stowage and launch, Lloyd's Register classification and price.

Negative features that can inhibit penetration or holding power include small relative fluke area, low blade tip weight, high weight on the shank or above the blade, wide shank cross sections, and wide or blunt blade frontal shape. Other negatives include overall weak design, copies of originals (especially ones manufactured in Asia), low efficiency ratio, and rode-fouling protruding parts. Slotted shanks, useful for difficult retrievals, are of questionable value and only available on a few anchors.

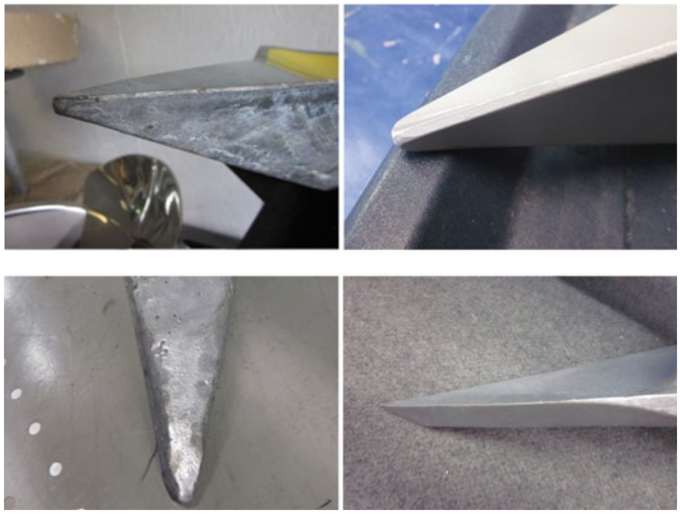
Stainless or mild steel construction, mixed or degraded metallurgy, poor welding technique, weak corrosion protection and roughly finished edges can also compromise an otherwise good design. Therefore, it's best to buy any ground tackle from reliable well-known companies that have a high regard for their product. Copies of original designs and some Asian products suffer in this regard, as evidenced in multiple anchor test reports over the past 20 years.

Positive features include thinner but very strong shank metals with strengths to 800 megapascal (MPa) or forged construction; deep-penetrating, sharp, pointed blades; perfect shank-to-blade angles near 35 degrees; and easy stowing and launching characteristics. Larger is generally better, but there are limits. Larger or heavier anchors generally are stronger, hold better and are more efficient than smaller sizes. Of prime importance is the fluke/blade area since this

directly affects holding capacity in homogeneous bottoms. Overall balanced design affects how the anchor will perform if overloaded, resulting in a dragging situation. Concave blades tend to dig deeply into the bottom, remaining there as loads increase and during veering wind conditions.

Tip weight is very important for rapid bottom penetration and resetting. Here are a few examples of measured weight at the blade tip of some popular anchors as an approximate percentage of total anchor weight: CQR, 15 percent; Sarca Excel, 20 percent; Manson Supreme, 25 percent; Delta, 28 percent; Bruce, 30 percent; Rocna, 35 percent; Spade, 47 percent; M1, 50 percent. These may or may not be typical for other anchors of the same type.

On our boat, in order to ensure that we won't have a mad scramble in the middle of the night in an unforecast and dangerous high-wind event, I prefer to size our single anchor



Above, shank-to-blade weld comparison: Rocna on the left, Delta on the right. Right, comparing blade tips (clockwise from upper left): Spade, aluminum Spade, Rocna, Delta.

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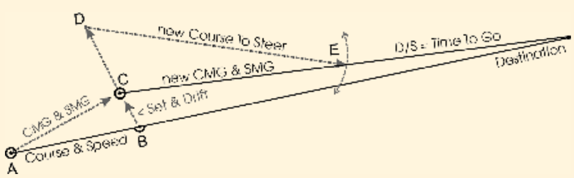
Set & drift calculations

Current may slow a vessel, increase its speed and/or throw it off course. Here's a way to determine a course to steer (CTS) to compensate for current. You need four values: the desired course, the set (direction) of the current, the drift (speed) of the current and the boat's speed through the water.



Current set and drift may be taken from current charts or tables, or may be observed, but you will likely get the most accurate information by measuring it yourself. First, fix the vessel's position (A) using navigation aids, visual bearings or electronics. Then proceed on your desired course for a specific time, plotting this course and distance on the chart (B, a DR position). Now determine your actual position (C) and compare it to B. The direction from B to C is the set of the current. The distance in nautical miles between B and C, divided by the time in hours, will yield the drift. Thus, if the time between A and B is 0.2 hours (12 minutes), and the distance from B to C is 0.3 nm, then the drift is 1.5 knots.

In other words, a line plotted between where you thought you were and where you actually are is the tidal current vector. Additionally, a line plotted from where you started to where you actually are, A to C, is a vector of your actual movement, indicating course over ground (COG) and speed over ground (SOG).

Now that you have plotted the set and drift, you're ready to determine what CTS will make good the desired COG. First plot a new desired course from your present position. Then extend the current vector for an hour to point D (this technique is known as the one-hour vector method). Then measure with dividers the distance your boat can travel in one hour from the latitude scale on the chart. Place one point of the dividers on D and swing the other end until it intersects the desired course line. Mark that spot (E), and draw a line from D to E.

The direction D to E is your CTS. So D to E is the vector of your boat moving through the water for one hour, while C to D is the current moving your boat for one hour. The sum of the vectors, C to E, is the COG that your boat should actually move during that hour (unless the current changes!). Hence, the distance from C to E will be your boat's actual speed.

The value of using waypoints with a GPS is that the unit can then do this sort of calculation continuously, delivering updated CTS as conditions change. It's highly advisable to plot both these waypoints and connecting courses to better visualize where a route takes you and as a check against what you've input to the GPS.

ground tackle for about 60 knots of wind. This is about the maximum wind strength we might expect to see in a surprise squall or frontal passage in the tropics. One way to do this is by adding the length of the boat in feet to the weight of the boat in thousands of pounds. The resulting number is the approximate weight of a plow anchor needed to hold in a

homogeneous bottom in reasonably good holding conditions. I have seen this unforecast wind strength three times in the past 20 years, twice in the Florida Keys and once in Tonga. All instances were very scary and not conducive to rapidly deploying a second anchor. More wind than that will usually be forecast in advance as a tropical cyclone or other major weather event of some sort. That should give enough warning to better secure the boat out of the wind and away from other boats.

Above, two-piece shank-to-blade connection comparison (from left to right): Mantus M1, spade, Mantus M2. Right, a new Mantus M2 anchor. Below, new Rocna Vulcans.

Admiralty and fisherman anchors

These include the Herreshoff (1870), Luke and other similar designs that feature round shanks, perpendicular stocks and arms, and small palms (flukes). These were used extensively during the Golden Age of Sail prior to the early 1900s. Typically they are very strong, hold well in rock, coral or other rough hard bottoms, and are sometimes used as storm anchors. However, since the palm surfaces are small, the holding power is weakest of all anchors in sand and mud where cruisers prefer to anchor. They are also difficult to stow and launch off the bow of a typical cruising boat. Some can be broken down into three pieces for stowage. They are not recommended as primary cruising anchors but may well serve as a storm anchor if the bottom conditions are right.

Rotating fluke anchors

These include the Danforth (1948), West Performance (1980s), aluminum Fortress (1980s), Britany (1970s), FOB, Guardian and many copies. They are commonly used on small powerboats requiring light anchors with high holding power in soft homogeneous bottoms. The Fortress often resists the highest straight-line

loads of all anchors in soft sand and mud bottom tests. However, due to their light construction, if the end of a fluke catches a hard spot in the bottom, the resulting point loading can bend the fluke under increased load. Some have had problems with bent shanks and resetting during significant wind shifts. They are not recommended as primary cruising anchors but are often a good choice for a second or third anchor.

Claw anchors

Claw anchors include the Bruce (1971) and its many copies, including Lewmar, Manson and Plastimo, and the Super Max. The original forged-steel Bruce design was engineered for anchoring oil rigs in the North Sea, where high strength and short scope holding was required in hard sand bottoms. The original forged Bruce sets rapidly, is exceptionally strong and is one of the best designs suitable for hard coral or rock bottoms.

The one-piece design stows well on most anchor roller trays. However, in testing, it suffered from relatively low holding power in soft bottoms because of its smaller fluke area, as well as difficulty setting in weedy bottoms. It can also trap coral heads and other bottom debris in its basket-shaped flukes, hindering a good set. The Super Max reportedly holds well in soft homogeneous bottoms due to its large blade area, but it is little tested against more popular anchors.

Plow anchors (convex blade)

These include the hinged CQR (Coastal Quick Release, 1933) and Manson (1977), and the fixed Delta

(1984), Kobra and their many copies. For many years, the venerable forged CQR was the favorite primary anchor for serious cruisers. In the 1980s, the fixed-plow Delta gained popularity with both cruisers and boatbuilders because of its somewhat better performance and much better price point. Plow anchors stow and launch easily but have several problems. The convex blade and flat underside of the tip area keep them nearer to the bottom's surface as they try to dig in. Imagine a similar device for plowing a field leaving a surface furrow for later planting. When the resistance (blade shape plus shank and chain friction) exceeds the geometry of the anchor, forcing penetration, it levels out and remains in the softer upper levels of homogeneous bottoms.

The CQR has a relatively small blade area, a wide shank hindering deep penetration, and high weight in the hinged knuckle that reduces tip weight and hinders it from rolling upright while setting in firmer bottoms. During testing, it has shown a propensity for rolling in and out of the bottom during heavy loading. The Delta is more stable, but its basic design still hinders it from deep penetration and thus higher holding power. A significant prob-

Left, a homemade scoop copy.
Above, a broken stainless-steel hinged plow.

lem with the Delta is that if it lands upside-down in soft mud, its geometry is not good enough to allow it to roll over and ever set. We observed this trait by diving on our 88-pound Delta while backing down in soft mud after multiple experiences with this problem.

Scoop anchors (concave blade)

These anchors are a good example of modern technology bringing us better equipment. The German Bugel Wasi (1986) was the first anchor with a roll bar and a single flattened blade, rather than convex. The newer concave blade anchors include the roll bar Rocna (2004), Manson Supreme (2006), three-piece Mantus (2012), Knox (2013), Super Sarca, Manork (2017) and a few others. Those without a roll bar include the two-piece Spade (1996), the stainless-steel Ultra (2006), Rocna Vulcan (2014), Sarca Excel and Mantus M2 (2018).

Most holding, veering, drag and setting tests conducted over the past 20 years have shown that these anchors consistently outperform other anchor types. In comparison to the claw and plow anchors, they have considerably higher holding power, remain in the bottom better during veering tests, reset quicker and more reliably, and are more stable under high-load dragging conditions. Most of these anchors now use high-strength steels, especially in their shanks. Several companies now make both roll bar and non-roll bar models.

Modern-generation scoop anchors do have a few negatives:

- Roll bar scoops have been known to catch coral pieces between their blade and roll bar, hang on the roll bar in coral bottoms, and have difficulty setting in heavy weed conditions.
- The roll bar and other protruding appendages may foul a second anchor roller tray and impede stowage on the bow of some boats.
- The Spade must have the lead in the tip removed prior to regalvanizing, and it is more expensive than other scoops due to its complex construction.
- The new Vulcan, Knox and Mantus M2 are little tested against other popular anchors, so their relative performance against other anchors is unavailable.

Other anchor types

There are a number of other modern anchors that have ceased production, including the Bulwagga, Barnacle and HydroBubble. These and several others represent anchors that performed below par during testing or for other reasons failed to gain sufficient market share against the competition to continue production.

Performance test results

Below are links to some reliable past anchor performance tests and other comparison data:

- 2006-2015: www.petersmith.net.nz/boat-anchors/independent-performance-testing.php
- 2016: www.youtube.com/watch?v=159f-OjWoq0
- 2019: www.westmarine.com/WestAdvisor/Anchor-Testing
- 2019: www.practical-sailor.com/sails-rigging-deckgear/anchor-testing-and-rode-loads

While these tests won't tell precisely how an anchor will perform on a boat in any given situation, they are a pretty good representation of relative performance against the competition, especially if there are multiple similar results. Reading the test descriptions and watching the videos carefully will further improve ones' understanding of anchor design and individual anchor performance in the conditions encountered. For example, I found the Knox high-load drag test results particularly effective in describing what individual anchors will do when stressed beyond their ultimate holding power, such as in a tropical cyclone. Additional Google searches can produce much more useful information on modern boat anchors.

Any appropriately sized anchor could take you around the world if you were always able to anchor in light weather conditions and shallow depths with a good bottom. Using a good, large primary anchor that is well set in a good bottom will increase our chances of surviving that midnight 50-knot squall we all dread, without having to deploy a second anchor.

Like many issues with cruising, there is no perfect anchor for all conditions. So, some compromise must be made. However, it appears that there is a preponderance of evidence indicating that the modern-generation scoop anchors are superior to older anchor types in many important ways. For example, based on most comparative holding tests, their holding power is generally twice that of the plows and claws when it comes to homogeneous bottoms — and that is where I like to anchor.

With so many anchors currently on the market, careful research is needed to validate the information above and make an informed decision. Old-generation anchors are no better or worse than they have ever been, but now we have better technology. And remember, when it comes to ground tackle, bigger and stronger are always better — but superior design is much better, especially for those of us with catamaran weight constraints. ■

Dave McCampbell, a retired U.S. Naval diving and salvage officer with more than 40 years' cruising experience, cruises on the St. Francis 44 catamaran Soggy Paws.

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Distance, speed & time formulas

Formulas for calculating **D**istance, **S**peed or **T**ime:

D = S x T **S** = D/T **T** = D/S

Note that the unit of measure must be the same for time and speed, usually hours. To convert minutes to hours, divide by 60. Aids to calculation include the logarithmic scale found on maneuvering boards and the use of six-minute (0.1-hour) increments.