1995 Puget Sound Anchor Test Report

In June 1995, we participated in a anchor test conducted by the Sailing Foundation of Seattle, WA. We tested eight different types of anchors in five sites around Puget Sound. Our objective was to evaluate the relative performance of anchors commonly recommended for boats in the 40-45' range. Rather than duplicate previous tests that have focused on one particular anchor or one particular type of seabed, we compared the performance of all the anchors in sites with a pre-established range of bottom conditions, including sand, mud, clay, rock, and weeds. In all, we performed about 280 sets during the two-day test

We pulled on the anchors with four different powerboats: two trawlers and two tugboats. In some cases, the boats were able to exert force on the anchors well in excess of the loads any boat under 70' could generate in anything less than a Force 5 hurricane. In other cases, we were practically able to tug the anchors out of the ground by hand. This brings us to the primary conclusion of this test: The selection of a suitable bottom for anchoring is frequently more important than the type of anchor. Where you drop your anchor is critical, given the inability of most anchors to hold in rocky or kelp-infested areas, and many anchors to penetrate hard clay. To quote from the report, „Since it is generally difficult to verify the quality of the set, the best insurance is personal experience with a given anchor design and its suitability for specific bottom conditions.' While it may not be possible to send a diver down to check the hook every time, you should at least investigate the holding ground with the help of a chart or a little experimentation before assuming the anchor is set.

The overall winner of the test, we're pleased to report, was the West Marine Performance 35 anchor, thanks to its excellent combination of holding power, setting characteristics, and damage resistance. Along with the Performance 35, the Fortress FX-37, CQR 45, and MAX 17 proved that they would be acceptable storm anchors for a hypothetical 45' sloop by demonstrating more than 2300 lbs. holding power one or more times.

Anchors

What They Do

Anchors dig into the seabed to hold a boat in position. Anchors frequently serve a safety role by keeping boats out of the surf or off the rocks. They also allow boaters to "hang on the hook" while fishing, having lunch, or spending the night onboard.

How They Work

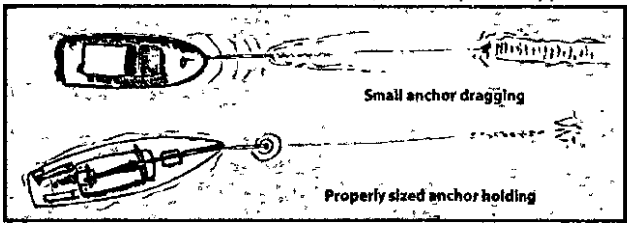
When an anchor penetrates the surface of the seabed, suction created by the bottom material, plus the weight of the material above the anchor, creates resistance. As the boat pulls on the anchor rode, anchors dig in deeper, creating additional resistance. In rocky or coral bottoms, anchors can't "dig in," but rather snag on protrusions and hold precariously.
The holding power of modern anchors is remarkable, varying between 10 and 200 times the anchor weight in sand. This means that some anchor designs that only weighs 5 lbs. can hold in excess of 1,000 pounds! Selecting an anchor based on its theoretical maximum holding power is foolhardy, however, since bottom conditions vary widely in the real world.

What to Look For

Ideally, an anchor would possess all of the following attributes:
1. It would set quickly, and re-set whenever the wind and/or current shifts.
2. It would hold well in all bottom types: sand, mud, rock, coral, or grass.
3. It would withstand high loads on any portion of its structure.
4. It would hold well at short scopes.
5. It would release from the bottom easily, without damage.
6. It would store compactly in a roller, or on deck, or in a locker.
That is a tough list, and many anchor manufacturers would have you believe that their anchors possess all of these attributes. Alas, no single anchor does, but we carry the brands most commonly seen on serious cruising boats, rescue craft, and yachts. They represent the best balance of attributes and we list their pros and cons in our descriptions.

What size anchor do I need?

Bigger is better. Bigger anchors have more strength to resist breakage, more surface area to resist pullout, and more weight to penetrate the sea bed. We think that it is a mistake to choose an anchor that weighs less or stores compactly and risk having an anchor that won't work when you need it. While small anchors may work fine in optimum conditions, they are more likely to skate on hard bottoms, or bend if pulled sideways when the boat veers. Most pivoting fluke anchors become "serious" anchors above 20 lbs., while plow-type anchors must be around 35 lbs. or more.



Anchors need to develop enough resistance in the seabed to withstand the environmental forces on the boat. The greatest effect is that of wind, which produces about 300 pounds of force on a 40' boat in 15 knots of wind. The same boat, moored in no wind and five knots of current, also produces about 300 pounds of force. Wave loads tend to be cyclical: as a result they increase the peak loads, but using elastic rode can greatly reduce the peak loads. This means that certain types of boats and boating require larger than normal anchors:
1. Boats with lots of windage, tall masts or several masts, or flying bridges, will produce more load in a given amount of wind.
2. Boats that commonly anchor in windy conditions.

Pros and Cons; Traditional anchor

Pros: An accurately made, traditional lightweight anchor Precise crown tooling and tapered shank allow deeper anchor penetration Verified shank-fluke angle for reliable sets Great in sand and good in mud Traditional Light-weight-type anchor dimensions— not chopped down
Cons: Slightly more expensive than cheaper, poorly made anchors Limited or no holding in grassy, rocky, or clay bottoms

Pros and Cons; Deepset II Hi-Tensile

Pros: Modern design based upon original Danforth dimensions. Strong construction yields excellent holding power per pound. Precise shank-fluke angle delivers reliable sets. Best in sand or sand/mud bottoms of lighter consistency.
Cons: Relatively expensive, due to materials and construction techniques. Limited or no holding in grassy, rocky, or clay bottoms.

Pros and Cons: Fortress

Pros: Holds well in both sand and mud bottoms. The crown design allows the anchor to be assembled for sand bottoms at a 32°fluke angle, or mud at a 45° angle. Lightweight and strong. Can be disassembled for storage.
Cons: Expensive, although less so when compared to its holding power. Light weight allows anchor to "sail" under vessel in current and when underway. Limited or no holding in grassy, rocky, or clay bottoms.

Pros and Cons: Performance _
Pros: Extremely strong construction using 4130 hi-strength steel. Great in sand and good in mud. Precise shank-flukeangle for high holding power. Traditional dimensions for roll stability and deep penetration. T-shaped flukes for symmetry and strength.
Cons: More expensive due to its design and materials. Limited or no holding in thick grass, rocky, or clay bottoms.

When wave and/or wind loads become strong enough to make the chain rode bar-tight, the displacement of the vessel suddenly becomes the dominant factor, as the inertia of the boat jerks on the anchor and rode. This is where heavy displacement boats are at a disadvantage—their greater momentum will eventually pop the anchor loose or break something. Unfortunately, these loads are tricky to calculate, and most anchoring texts tend to ignore them. Fortunately, you can absorb some of the shock using a nylon snubber, or avoid it by finding protected anchorages whenever possible.

The effect of wind

The wind force on an object varies by the square of the wind velocity (e.g. the force in 20 knots is four times the force in 10 knots). There are several theories on how the force on an anchor system varies with the size of the boat. Some experts relate it to boat length, while others use beam as the critical dimension. Robert Smith, a naval architect from Portland, Oregon, who has done extensive anchor testing, says that force goes up by the square of the boat's length. This means that anchor size must increase much faster than the length of the boat would suggest.

How much wind should you anticipate? We face this question every time we suggest an anchor to a customer. Peter Bruce, inventor and manufacturer of the Bruce anchor, points out that sizing anchors based on conservative wind velocities is foolish because you cannot run out and buy the 'next size up" when the wind pipes up. He strongly recommends buying an anchor that will hold your boat in winds up to 42 knots (Force 9 conditions).Other vendors frequently use 30 knots as a guideline, or do not state the conditions for which their recommendations apply.

The following information is from the American Boat and Yacht Council (ABYC). It has been used by many manufacturers as a method for determining the load on an anchoring system given different wind conditions. This is the actual pounds of load on the ground tackle—there is no "safety factor" built in, and anchor systems must be based on a value greater than the ones below.

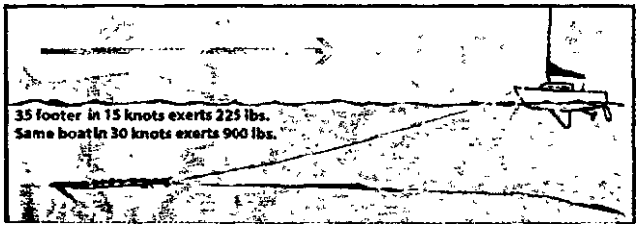
LOA	Beam		Wind Velocity kts			
	Sail	Power	15	30	42	60
10'	4'	4'	40	160	320	640
15'	5'	6'	60	250	500	1000
20'	7'	8'	90	360	720	1440
25'	8'	9'	125	490	980	1960
30'	9'	11'	175	700	1400	2800
35'	10'	13'	225	900	1800	3600
40'	11'	14'	300	1200	2400	4800
50'	13'	16'	400	1600	3200	6400
60'	15'	18'	500	2000	4000	8000

Armed with this information, you are still hard pressed to make a precise choice. This is because not all manufacturers will rate their anchors in holding power, and holding powers vary all over the ocean depending on the type of bottom. So it isn't as simple as finding the predicted force on your anchor system, and selecting an anchor.

Conclusions

Unfortunately, there is no Ohm's Law, or Rules of the Road, or other definitive rule for sizing an anchor for your boat. Our anchor selection chart provides what we believe is the best information available, (subject to about 100 caveats), but we'd like to leave you with the following thoughts:

1. Anchors are safety gear. Don't skimp and buy cheap, poorly engineered ' and constructed junk.
2. Err toward the larger size. For an extra $50 or $100, the next larger anchor will simply hold better.
3. Inspect your anchor system frequently for chafe, loose shackles, and bent flukes.
4. Store your anchor so that it can always be used immediately.


35 footer in 15 knots exerts 225 lbs.
Same boat in 30 knots exerts 900 lbs.