Will my anchor hold?

Following the numerous debates on anchors and anchoring in PBO, **Prof. John Knox** decided to conduct a series of experiments...

ABOUT THE AUTHOR

John Knox recently retired from a Personal Chair of Physical Chemistry at the University of Edinburgh. He's had a lifelong interest in boats and in the 1960s became interested in kayaking while on sabatical leave in Utah. He took to dinghy sailing in the 1970s, first in a Graduate and later an Albacore dinghy. In 1983 he bought *Myfanwy*, a Hustler 35, and has sailed extensively on the west coast of Scotland.

MOST of us worry about our anchors. I know I've crossed my fingers and hoped for the best on numerous occasions because anchoring is more an art than a science. I've heard all the old rules such as "never use a scope of less than three times the depth" and "if in doubt, let more out", but I decided to carry out a few experiments to see if they really held true.

There are two aspects to this anchoring business. The first concerns the forces that act on an anchor, which I wrote about in PBO 386. I don't want to say more about that here. Instead, I'm going to look at how anchors behave when used to moor a yacht to the bottom.

My experiences with *Anchorwatch*, a device that measures anchor cable tension, have led me to follow a simple routine. I tighten the cable until the reading matches the maximum figure it's likely to reach, given the local weather conditions. Then I set the *Anchorwatch* alarm to a slightly lower setting. By doing that, I'm assuming the anchor will hold to this tension regardless of how often stresses occur, whether the direction of pull changes, or because of any other factors.

This is a big assumption. So, the main purpose of my experiments was to look at how anchors behaved when dragged through the seabed, and how badly they suffered from roll-out. (Roll-out occurs when an anchor is dragged and corkscrews through the seabed, losing its grip).

I'm also interested in the behaviour of anchors when they're veered – and how holding depends on scope.

Since a fair amount of folklore is attached to the subject of scope, I also decided to take a closer look at the effects of cable length.

I've been unable to find much useful information on these topics. But, despite this, the results of my experiments are both unexpected and, dare I say it, even disturbing...

Anchor speak...

ANGEL – a weight used to make the pull on the chain more horizontal and reduce snatching.

CABLE – chain or warp, also known as a 'rode'.

CATENARY – the curve of the anchor chain.

FLAKING – a way of arranging the anchor chain so that it's laid down on the deck in big loops, ready to be let into the water.

ROLL-OUT – when an anchor is dragged and corkscrews through the seabed, losing its grip.

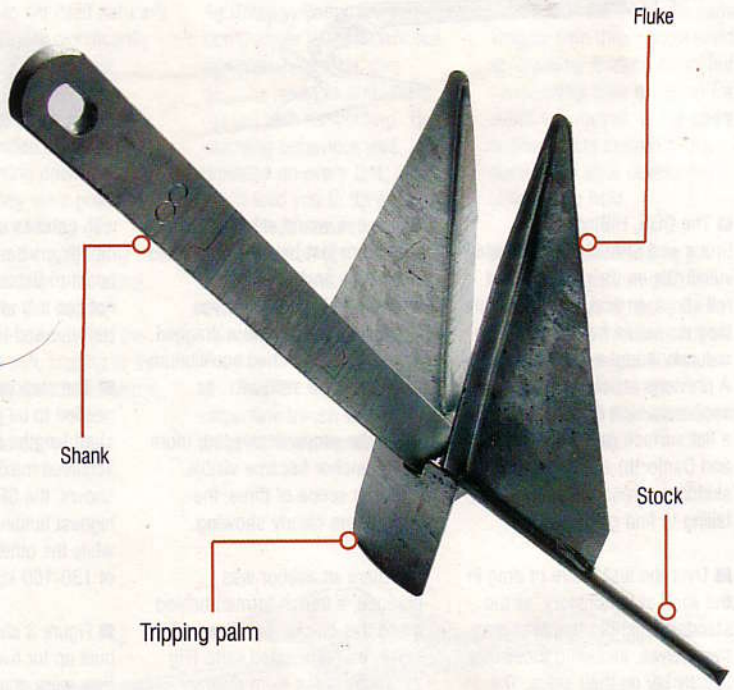
SCOPE – the length of anchor cable.

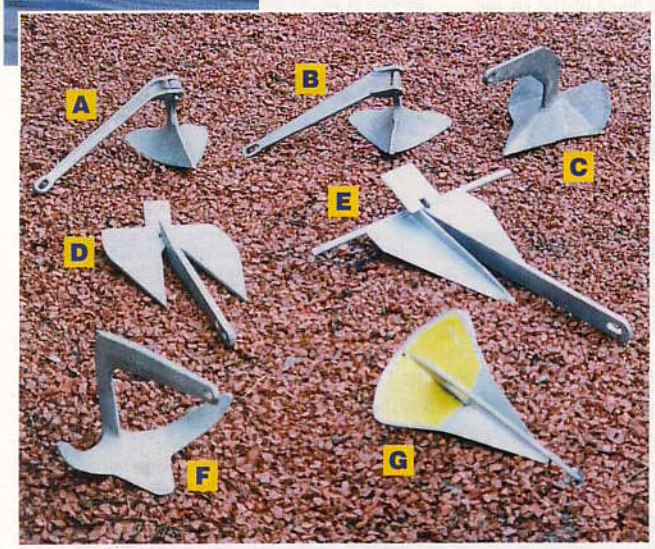
TRIPPING LINE – a line, made fast to the top of the anchor and supported in the water by a buoy. It can be used to pull the anchor out of the water head first.

VEER – to let out more cable.

WARP – also known as a 'cable'. A rope used to moor a boat to a fixed point.

WEIGH – to raise the anchor from the seabed.





A CQR 10 lb – 4.8 kg, 480 sq cm; **B** HiBlade 10 lb – 4.7 kg, 510 sq cm; **C** Delta 6 kg – 6.7 kg, 620 sq cm; **D** Brittany 6 kg – 6.2 kg, 560 sq cm; **E** Danforth 6 kg – 6.2 kg, 610 sq cm; **F** Bruce 5 kg – 4.9 kg, 300 sq cm; **G** SPADE 6.5 – 5.1 kg, 460 sq cm

The anchors I tested

■ I assembled a collection of anchors ranging from a 1 kg Bruce to a 16 kg Fisherman. Most of the tests were carried out on anchors in the 5-7 kg range, plus the 2 kg Danforth – I've called these the standard anchors. Manufacturers' details show that as the size increases, its weight goes up by the cube of any linear dimension and its area increases as the square.

Apart from the Bruce, which has a small surface area for its weight, the areas of the 5-7 kg range from 460-620 sq cm.

My test rig

I used a shallow tidal pool, with a firm, sandy bottom, at Londniddry Bents, east of Edinburgh. The pool, with its uniform seabed and ease of access, was as near to laboratory conditions as I was likely to find. The shallow water meant that observing the behaviour of anchors under test was easy. The idea was simple; to lay the anchors on the seabed, then drag them a distance of 6-8 metres at a constant speed. This would establish whether an anchor remained vertical when pulled, or whether it was prone to roll-out. I tried to keep the speed of drag constant at three centimetres per second, which equates to 120 metres per hour. This is a fast, though not unrealistic, speed for an anchor to drag.

To achieve the pull, I built a rig which incorporated a five-part block and tackle, and an *Anchorwatch* load cell to measure the pull. The pulley was exactly one metre above ground level to make calculating the scope easy;

the cable was accurately marked at one metre intervals.

With this arrangement I could develop a pull of 300 kg and, by adding a further two-part tackle, I could manage 600 kg. This was enough to put the 15 kg anchors through their paces. The disadvantage of my rig is that, as the anchor is pulled closer to it, the scope decreases. To avoid this, I pulled each anchor for one metre, then moved the rig back by the same length.

Finally, the scope for each one-metre pull was measured at the point taken.

Turn the page for some unexpected results