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How accurate is your log?

John Goode's essential tips on checking the accuracy of your yacht's electronic log

We 21st century leisure sailors are extremely blessed with the precision of GPS and its many excellent functions – including the constantly updated position fixing capability that enables it to display speed and distance 'made good' over the ground.

However, because the course computations between position fixes can't take into account the effect of tidal stream, we'll still need a stand-alone log to measure our boat's 'actual' speed and distance through the water.

Apart from the obvious benefit of showing our true speed at any given time, a log reading that can be relied upon remains an essential tool in a navigator's armoury. For example, if we sail in waters where powerful tides abound, the accurate boatspeed component of a quickly constructed tidal vector means being less glued to the cross-track error of a GPS display.

For those who venture further afield, comparing the distance between two observed positions (whether derived by GPS or sextant) with the distance recorded on our log can be very helpful in finding, or avoiding, an elusive ocean current.

Using compass bearings from a known position to identify Measured Mile transits (see p38)

PHOTOS: JOHN GOODE

Used in conjunction with GPS, a stand-alone log that's checked to ensure it accurately measures speed and distance through the water, is still a very useful navigational tool

Unfortunately, from my own experience over many years, an electronic log appears to be more susceptible to gremlins than any other navigational instrument. Significant under-readings are easily noticed and can usually be sorted by clearing barnacles or weed from the log's through-hull impeller. It's when the error gradually creeps in for no apparent reason that we can get caught out – as it's often only noticed when it has gone well beyond what could be reasonably attributed to a boat's dirty bottom.

So perhaps now is the time, at the beginning of the sailing season before longer passages are contemplated, to run a quick check on the accuracy of your electronic log.

> 'From my own experience, an electronic log appears to be more susceptible to gremlins than any other navigational instrument'

To help with this, the methods illustrated over the following pages, from the early Dutchman's Log to the more recent Measured Mile, are all based on practical techniques that have served navigators well over the past 500 years. Basic the first two may be, but hopefully they'll not only warn that a calibration is called for, but also provide a very real connection to our great maritime heritage.

An accurate log comparison

As old sailing hands will confirm, probably the most accurate way of measuring distance at sea is with a trailed rotating log – the navigator's mainstay throughout most of the 20th century. They're as rare as hen's teeth these days, but if you can manage to borrow one, it's the best way I know of checking out the accuracy of an electronic log. Be careful with it, though, as this otherwise robust mechanical device is prone to gremlins of its own. At sea, its trailing 'fish' is a temptation to bigger fish – and there's a tendency for its line to wrap itself around the prop if we forget to retrieve it before backing into our berth when we dock.

RIGHT: Use a Walker trailing log for robust reliability

THE DUTCHMAN'S LOG

A very basic log devised by sailors over half a millennium ago

If we suspect our electronic log isn't reading accurately, we can fall back on a method devised by sailors over half a millennium ago. Usually known as the Dutchman's Log, its first use was actually attributed to the Portuguese around the beginning of the 16th century.

This required a buoyant object to be thrown overboard from the bow while the time it took to travel the distance between two fixed points on deck was recorded – either by counting the seconds or using a calibrated sand glass. The speed in knots could then be calculated by applying the age-old speed/time/distance formula, which takes into account that there are 6,080 feet in a nautical mile and 3,600 seconds in an hour (see worked example below).

While the procedure had obvious limitations (especially at night and in rough seas, let alone the then difficulty of accurately recording time), it at least allowed a navigator to gauge the ship's speed better at regular hourly intervals. This in turn made it possible to estimate the distance travelled more reliably and, when coupled with the compass course steered, plot a more dependable dead-reckoned position.

THE NATIONAL GALLERY, LONDON

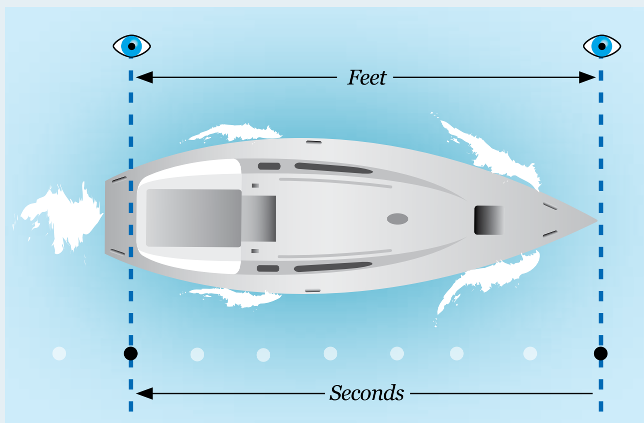
ABOVE: Ships such as the 17th century Dutch man-of-war Eendracht *plotted their position using this early technique*

$$\textbf{Speed (kts)} = \frac{\textbf{Distance (nm)}}{\textbf{Time (hrs)}} = \frac{\textbf{34ft} \div \textbf{6080}}{\textbf{4 secs} \div \textbf{3600}} = \textbf{5.03 (kts)}$$

Simplify the maths with the 'Three Fifths' rule

Although it had its flaws, the basic principle of the Dutchman's Log still holds good today. And, as most boats nowadays will have someone aboard with either a watch or a mobile phone with a start/stop timing facility, it can be considerably more accurate as well. Better still, we can use the much simpler (but little known) 'Three Fifths' rule to establish our speed quickly. Often only requiring a bit of easy mental arithmetic, the result will always be within one tenth of a knot of that produced by the longer-winded formula above.

$$\textbf{Speed (kts)} = \frac{\textbf{3 x length (ft)}}{\textbf{5 x time (secs)}}$$



GRAPHIC: MAXINE HEATH

The tools: a watch with a start/stop timing function and about six wetted sheets of balled-up loo paper per marker

Preparation

Obviously, the more precise the numbers we can apply to this rule, and the better the coordination between those doing the throwing and timing, the more we can rely on the result.

As well as being able to record accurately the number of seconds taken to pass a buoyant object that's thrown ahead of the boat – a ball of wetted (biodegradable) loo paper works well – it's good to know as precisely as possible what the actual length is we'll be timing.

It also helps if the forward/after sighting positions (for the start/stop timing of the known length between them) offer secure platforms for the crew, from which they can most easily judge when the passing buoyant marker is exactly abreast.

Simple sums

$$\frac{\textbf{3 x 34ft}}{\textbf{5 x 4 secs}} = \frac{\textbf{102}}{\textbf{20}} = \textbf{5.1 (kts)}$$

The best thing about the 'Three Fifths' rule is the simple sums involved. In this example we've a measured length, from stemhead to pushpit, of 34ft and a recorded time of 4 seconds between them. Even a quick bit of mental arithmetic would come up with a speed of 5 knots and, at most, require no more than a few lines on the back of a fag packet if the numbers were slightly more complicated. As shown on the opposite page, putting the theory of the Dutchman's Log into practice is quite straightforward. It's accuracy, of course, will depend on a number of factors – not least the state of the sea – but in fair conditions it'll certainly warn us if we need to dig out the instruction manual to recalibrate our boat's electronic log.

Use the early navigator's tool to check our log's speed reading

1 Throw marker ahead and to leeward

Whether we're under sail or power, put the boat on a steady heading and wait until she settles down to a constant indicated speed on the electronic log (here it's 4.5 knots).

When ready, the bowman warns the timing person at the stern to stand by with a shout of 'Throwing!' – before chucking the marker so that it lands to leeward and as far ahead of the boat as possible.

2 Start timing when abreast of bow

As soon as the marker hits the water, the bowman quickly shifts to the forward sighting position and shouts 'Now!' the moment the marker is passed.

To assess more accurately when the marker is abreast of the forward position when calling the start time, it can help to sight along an arm that's extended at right angles to the centreline of the boat.

3 Stop timing when abreast of stern

After keeping a sharp eye on the marker as it (apparently) moves aft on the more settled sea surface of the boat's leeward side, the timing person at the stern stops the clock when the marker passes the after sighting position.

Here, accurately assessing when to stop the time is helped by the top rail of the athwartship pushpit, which is sighted along as the marker comes abreast.

Average of three throws

Because of the comparatively short boat lengths involved and the obvious potential for some timing/sighting inaccuracies, particularly when under sail in a lively seaway, it's worth investing a few extra minutes to repeat the above sequence at least twice more.

If the average of these times is applied to the 'Three Fifths' rule (see bottom of opposite page) we can get a fairly good indication of our actual boat speed through the water. Here the average time of 4 seconds equates to 5 knots.

We can then compare this to the 4.5 knots shown on the electronic log, which indicates that it's under- reading by about 10 per cent.

ABOVE: Electronic log speed reading 4.5 knots.
RIGHT: Dutchman's log speed (taking the average of three calculations) is 5 knots

STREAMING A TRAILED LOG

Following in the wake of Captain Cook and Admiral Lord Nelson

By the 18th century, mariners had significantly modified the Dutchman's Log concept of using time and distance to measure a ship's speed. The improved method was not only more accurate, it also introduced the term 'knots' into our nautical vocabulary.

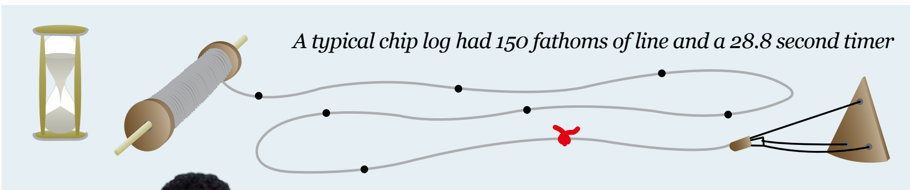
Those familiar with the exploits of Admiral Nelson and Captain Cook will no doubt be familiar with its image. Referred to as a 'chip' log, it commonly consisted of a 28.8 second sand glass, 150 fathoms of line on a reel and a bottom-weighted, wooden chip at its end. The line was knotted at every 8 fathoms – beginning from a 'start mark' (usually a red rag) tied at a suitable distance from the chip.

After streaming the log, the sand glass was turned the moment the start mark was pulled into the water by the stationary chip. The knots running off the reel were then counted until the sand glass was empty. A shout of 'eight knots and four fathoms!' meant a speed of 8½ knots.

Recovering the log was made easier by a plug/barrel trip line – activated by the belayed log line tugging the chip through the water.


NATIONAL MUSEUM OF THE ROYAL NAVY, PORTSMOUTH

The chip log was used on Admiral Lord Nelson's flagship HMS Victory


GRAPHIC: MAXINE HEATH

A typical chip log had 150 fathoms of line and a 28.8 second timer

ABOVE & RIGHT: Kept stowed in a bucket, the improvised log can be streamed, recovered and our boatspeed obtained in less than a minute

Rigged like this, the funnel provides the log's drag – and the short length of wood its stability

Trailing log line and the 'Three Fifths' rule

There are occasions when we might need more than a quick check on an electronic log that we suspect is misreading. If, for example, it packs up completely during a long offshore passage we can always fall back on a very practical substitute – one that combines all the advantages of an old mariners trailed log, the precision of modern time-keeping, and the simplicity of the 'Three Fifths' rule.

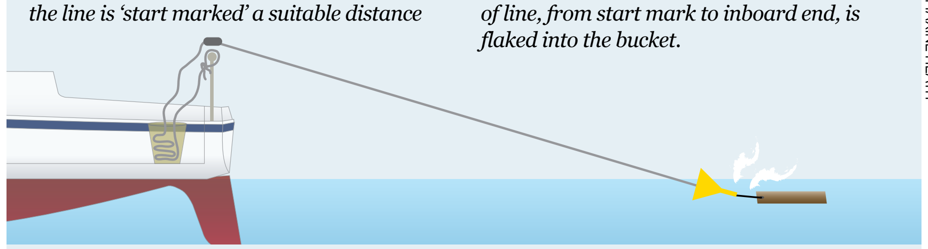
The kit we'll need can be found on almost every boat. An engine-oil funnel and a short length of wood (perhaps cut off the end of a deck scrubber handle) will act as a semi-buoyant drag. And, as we probably won't have a long enough length of light line aboard, a signal halyard (or two) and/or a leadline can always be pressed into service.

Armed with the above and a bucket (plus, of course, a start/stop timer) a single crewmember can obtain a fairly reliable speed reading as regularly as required – simply by timing how long it takes the known length of line to be dragged over the stern.

The whole sequence (including doing the 'Three Fifths' rule sum) takes about a minute. Even less if we use the rule to pre-calculate a simple table from which our speed can be read instantly.

GRAPHICS: MAXINE HEATH

ON YOUR MARK. To establish a steady pull on the line before timing commences, the line is 'start marked' a suitable distance from the drag. The inboard end of the line is tied to the pushpit. The measured length of line, from start mark to inboard end, is flaked into the bucket.



LET GO! When we're ready, simultaneously let go of the line and start the timer – stopping it again when all the line has run out. The time taken can then be applied to the 'Three Fifths' rule.

In the example here, and demonstrated on the opposite page, a measured length of 50ft and a time of 6 seconds equates to a speed of 5 knots. Obviously, the longer the line and the greater the drag resistance at its end, the more accurate the speed reading will be.

$$\frac{3 \times 50\text{ ft}}{5 \times 6\text{ secs}} = \frac{150}{30} = 5\text{ knots}$$

A 'back-up' trailing log that harnesses 18th century principles

1 Ease out line to the starting mark

Whether day or night, under sail or power and in most weathers, one person can easily carry out the whole sequence. This begins by lowering the business end of the log over the stern and letting it drag the line out until the 'start' mark is held just above the pushpit's top rail.

2 Let go of line and start timing

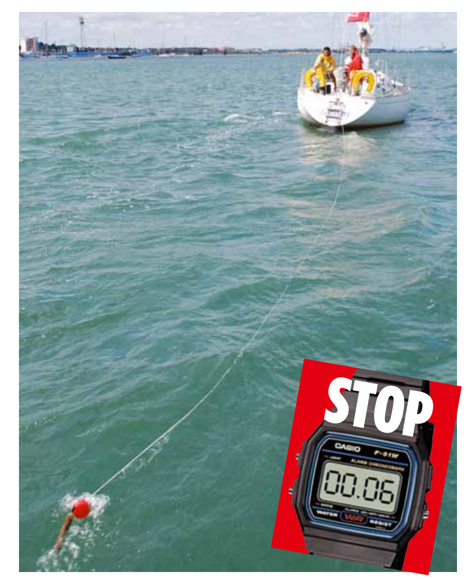
After ensuring there are no snags to prevent the line from running freely, simultaneously let go of the line and start the timer – allowing the resistance of the 'anchored' end of the log to pull the light line out of the bucket and smoothly over the top rail of the pushpit.

3 Stop timing when line is tight

Stop the clock the moment the line tightens on the pushpit as it finishes paying out – before hauling it back aboard and flaking it into the bucket ready for its next deployment. The six seconds it took for the 50ft of line to pay out can then be applied to the 'Three Fifths' rule, or even better, to a pre-calculated table that instantly indicates a speed of 5 knots.

Time/speed table

4s	7½kt	8½s	3½kt
5s	6kt	10s	3kt
6s	5kt	12s	2½kt
7½s	4kt	14s	2kt

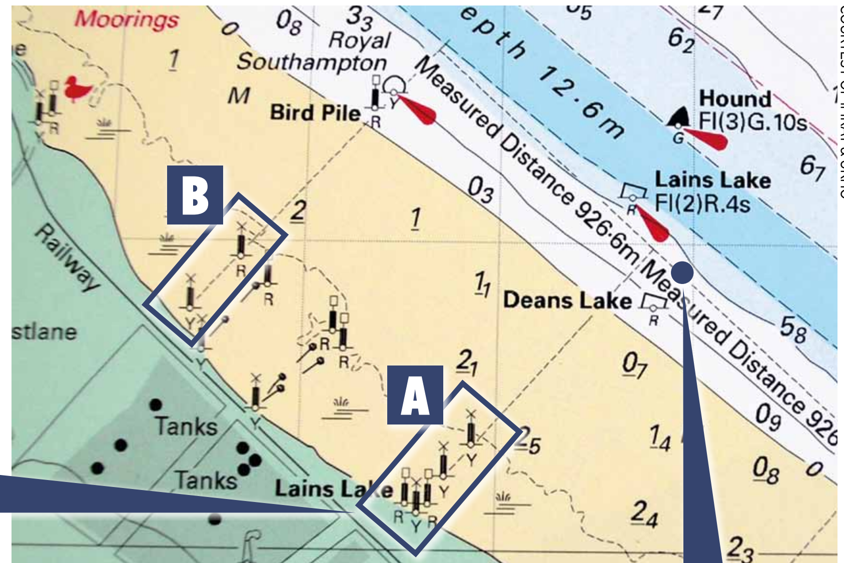


THE MEASURED MILE


Measured Mile transits were used by ships such as this throughout most of the 20th century

The previously illustrated methods can help detect and (temporarily) offer a rudimentary back-up to a misreading electronic log. But if the opportunity arises, a considerably more accurate check can be had by calibrating it against the charted transit marks of a measured mile, or half-mile. These charted measured distances are usually found on the approaches to major ports, convenient for speed trials by newly built or recently refitted naval and commercial vessels. Although this use has waned since the advent of more sophisticated methods, the basic sequence required for a reliable result remains the same now as it was in the late 1960s when I was third mate aboard a foreign-going tramp ship, pictured right.


If it's difficult to identify our chosen transit marks, stop at a known position and use compass bearings to identify them positively



COURTESY OF IMRAY & UKHO

Extract from Imray chart No. 2200.7

1 Postitively identify the transit marks

The appearance and location of a measured mile's transit marks can vary enormously, from slender poles on a tidal foreshore to substantial structures several miles inland. Because some can be quite difficult to locate, especially if the sun is behind them or their maintenance has been neglected, it's essential to ensure that any marks we intend to use are positively identified at the outset.

This particularly applies to those we used on the western edge of Southampton Water. With depth restricting our distance-off to about 500m, it was difficult to pick out our chosen half-mile-apart transits (A and B above) from the many other marks that surrounded them. To make sure we used the right ones, we harnessed the basic pilotage technique of first stopping at a known position (here Deans Lake buoy) and carefully sighting along what the compass bearings to the marks should be.

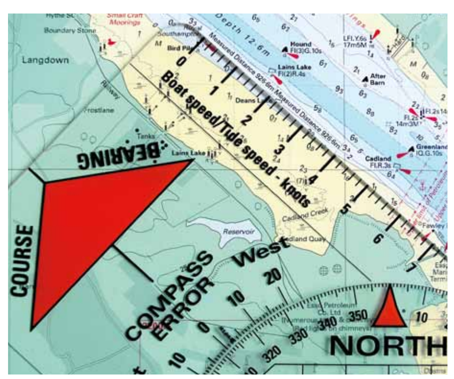

Stopping like this also allows us to compare the transit's charted layouts with the view we'll get when we run past them later

2 Check tide and reciprocal courses

As well as providing precisely measured distances between the transits, care would have been taken to place them adjacent to a stretch of water where the direction of ebb and flood tidal streams run as true as possible – as here where its flow will follow the reasonably straight depth contours and dredged channel edges. That's why, in addition to extending pecked lines to seaward from each transit, they also indicate the track that we'll need to steer in order to head directly into, and with, the tidal flow. Some charts give these reciprocal courses, but if not, lay them off and note them down.

Also, knowing the height of tide will tell us how close in to the transits we can get – and a tidal atlas will show when the stream is flowing at a nice steady rate, so that we avoid making our calibrating runs when it's on the turn.


Use the tidal atlas to see how close inshore you can go and when the stream is flowing steadily



Lay off the reciprocal courses required to head directly into, and with, the tidal stream

3 Run with and against the tidal stream

With the preparations complete, it's time to close the shore and head well off to one side of the transits (it doesn't matter which side) so that we can take a long, steady approach to the start of the first run.

While a much faster vessel would use (and require) the whole measured mile, we're only using the half-mile-apart transits. This halves the time taken to line up and complete our two runs to only 15 minutes or so. Minimising the overall time taken ensures there will be as little change as possible in the tidal stream's speed – which gradually accelerates and decelerates as it rises or falls either side of Low or High Water.

Because we're only measuring distance, our boatspeed between transits isn't critical, but it is important to maintain a steady heading on the (previously laid off) reciprocal courses.

It's also worth bearing in mind that the deeper (or shallower) the water, the faster (or slower) the tidal stream. So after turning around at the end of the first run, get back into the same depth of water before lining up to retrace the reciprocal track.


Read, or zero the log when in line with transit

4 The sums

No matter how fast or slow it was flowing, provided the speed of the tidal stream remained constant while the two opposing runs were made, the effect of any tide on each log reading will be effectively cancelled out – and can be completely disregarded.

As can be seen from the log readings, after travelling a combined (accurately measured) distance of one nautical mile, our log only recorded a combined distance of nine tenths of a nautical mile. This shows that the log is under-reading by precisely 10%. We can either apply this to all future speed and distance readings, or (if we're up for a challenge!) dig out the manufacturer's operating manual and follow the re-calibration instructions.

After a suitably long approach to settle on the charted heading, trip the log to zero as the first transit (A) is passed – and note its reading as the second transit (B) is passed. Then, after continuing for a while so that another suitably long approach can be made, turn around and repeat the procedure on the reciprocal track.


RIGHT: Maintain the charted reciprocal courses steered between the transit markers as accurately as possible. Note that it won't make any difference to the logged distance if our boatspeed has to be temporarily increased, or decreased, for collision avoidance purposes

Log check using GPS technology

If we're absolutely sure that our boat is in motionless water, checking a log (speed/distance through the water) against a GPS (speed /distance over the ground) requires no more than heading in any direction while comparing the difference. Although this opportunity rarely arises in tidal waters, a reliable calibration against GPS can still be made – provided the basic principles shown above and opposite are considered. A quick speed check could use the (reciprocal) directions of a tidal stream flowing past a buoy as accurate 'with and against' tide headings. By steadying our boat at the same speed (on the log) on each heading, the average of the obviously different GPS speeds on each short run can be used to make the comparison. For a more reliable check, we could use any accurately measured GPS distance, either between our own waypoints or fixed charted marks. Its accuracy, though, will rely on using dependable 'with and against' tide headings – such as along a straight contour line.


GPS can provide a reliable check on our log – if we correctly allow for direction of tidal stream

Thanks to

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