Swinging the Compass - Capt Geoff

Part 1 – Compass errors overview and a fast, easy method to determine Deviation.

> Obligatory Caution: Use this process at your own risk. The Author of this article, Ripple Rock Squadron and Canadian Power and Sail Squadron take no responsibility for any navigational errors that may occur as a result of following this process.

So you are heading home from Baker Pass, back to Cape Mudge on a day with very poor visibility in rain and fog. Navigation isn't a problem as you have your GPS plotter showing you exactly where you are, and where you need to go. Unfortunately, a small water leak reaches your GPS, and releases all its magic smoke. You have charts and a steering compass, but have never done more that occasionally glance at the compass, so you have no faith in what it tells you. Now you are reduced to groping around, hoping that your sounder will give you adequate warning before you reach the reefs south of Cortes, Marina or Cape Mudge. (Or maybe even scarier, you decide to trust your compass, and it turns out to be 30 degrees out.)

A little work beforehand could save you a lot of anxiety and risk in this situation.

After an introduction, this first part shows a very simple way of figuring out deviation, if you meet a couple of requirements. If you are unable to meet these requirements, part 2 shows a somewhat more complex method, and part 3 shows how to use the Sun to find your deviation (it's not as complicated as it sounds).

The articles deal with errors down to a few degrees. On a small boat, this level of accuracy may not be achievable (compass only reads to the nearest 5 degrees, etc.) or you may not be able to steer that precise a course in anything but calm conditions. A rough idea of your deviation is better than nothing, but remember that if your course is 5 degrees out, you will be almost ½ mile off your plotted course after travelling only 5 miles.

If the concepts of Variation, Deviation as well as True, Magnetic and Compass courses are new to you, you may want to consider taking a boating course. Going beyond the basics covered in the PCOC, Ripple Rock Squadron offers Canadian Power Squadron's Boating 2 & 3, a more advanced course, which we tailor to boaters around Campbell River. Check us out at http://www.ripplerocksquadron.com/

First, a little background.

Unlike Variation (difference between Magnetic North and True North – shown on your chart), Deviation is specific to your boat. It is caused by ferrous metal (for example non stainless steel, which can be hidden in throttle controls, steering wheel, etc.), electronic equipment (radars, radios, etc.), electrical wiring and magnets (speakers – including radio microphones, wiper motors and magnetic latches).

To prove it can affect your vessel, while at the dock bring a steel wrench (or equivalent) close to the side of the compass. You should see the compass react (If your compass doesn't react, or you have to tap it to make it move, the pivot bearing may be worn out, so your compass will have to be serviced or replaced). If you have a hand compass or a phone app that shows a compass card, you can do the same thing by bringing some ferrous metal, such as a stapler, close to the compass.

The amount the compass reacts is, in part, related to where the wrench is placed relative to the North Magnetic Pole. If your compass is mounted on a flat surface, moving the wrench in from the direction of Magnetic North or South, results in little deflection. But if you move it in from Magnetic East or West, you will get more deflection.

The boat actually rotates around the compass when you alter course (since the compass continues to point to Magnetic North). So objects that cause no deviation on one course (magnetically north or south of your compass) can cause significant deviation after a 90 degree course alteration. There is likely more than one source of magnetic interference aboard your boat, placed at various points around the compass, so the deviation will be a combination of these influences. Therefore, each course you steer will have a different deviation.

Temporary factors can also affect deviation. As noted, temporarily placing a steel object close to the compass will do it. A set of keys, a small box of fishhooks, pocket knife or the like placed close to the compass can have an effect. So can powering up a nearby electrical device or latching open a magnetically secured locker. Another temporary factor that can affect sailboats in particular is heel. When the vessel heels, the compass stays level. However the keel, engine, etc. effectively move sideways and up, relative to the compass plane, which can cause deviation. (Put your wrench directly below the compass, then move it up and to the side.)

It is always best to have any sources of magnetic interference away from the magnetic compass. But if this can't be totally accomplished, we need to know what deviation we are dealing with to get accurate results from our compass.

I don't recommend this, but if you only ever run a few courses, you could simply note your compass course on a good day when you can see that you are following your track. This gives you a course to steer if you need to rely on your compass. Make sure you record it for each direction, as your deviation will change with your course. However if you ever needed other courses in low visibility you would have no idea what deviation to apply.

Deviation should be checked whenever changes are made in the vicinity of the compass, such changing or adding a radio, or any of the other sources of interference mentioned above. Major changes, such as switching from inboard drive to outboard can also change your deviation. Taking aboard a load of steel pipe or rebar can also change your deviation.

A quick check for deviation change

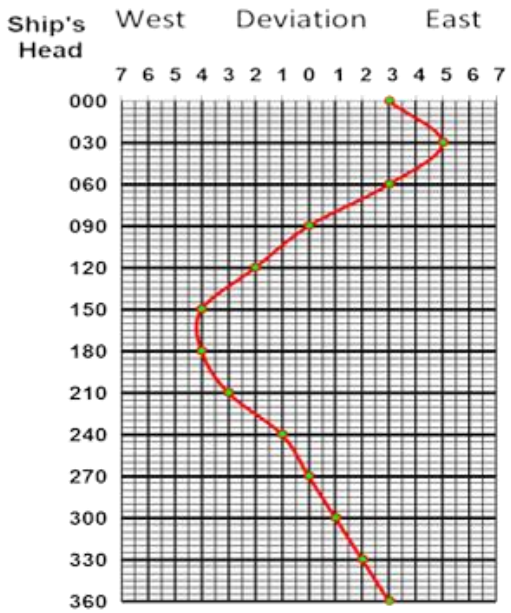
A quick check can be done by just looking at the compass heading while still alongside. Secured to the berth, your boat likely pivots 5-10 degrees depending on tension in the mooring lines, wind and current. But if you can sight a distant point when it is directly ahead, the compass heading should be around the same each time you leave the dock. If it is not, maybe someone placed some ferrous metal too close to the compass.

If you can get a second check after about a 90 degree alteration (most marinas require one of more major course alterations to get clear), it should give you a good indication of deviation change in case someone put ferrous metal in line with compass north/south when you were alongside, so it is now east or west.

The method discussed above can tell us that the deviation remains about the same, but gives us no deviation values. To navigate accurately we want to know deviation values for any course. To do this requires a "swing" of the compass.

How we calculate all the errors - creating a deviation card by swinging the compass

A deviation card is a record of the amount of deviation for different courses. We need this when working with a chart, as a chart is oriented to True North, whereas our compass is, obviously, oriented to Compass North. (Charts are oriented to True North, rather than Magnetic North, as Magnetic North is always moving, so Magnetic North charts would have to be reprinted every few years.)



To transfer between chart and compass we must correct for Variation and Deviation. The process is known as "correcting the compass".

Variation is taken from the nearest compass rose on the chart, and corrected for age (see Part 2 if you are not clear on this). Every vessel in the same area experiences the same Variation.

Each vessel has different equipment and outfit, causing each vessel to have different Deviation. To use the Deviation Card, we start with the compass direction you are pointing. This is referred to as the boat/ship's heading, or head. If you are steering a course, your head should be within a few degrees of the course. Deviation doesn't change significantly over a range of a few degrees, so for calculations, we generally use course and head interchangeably.

If temporarily switching on the radar (or sounder or …) changes the deviation (at the dock, check for change of compass head similar to bringing ferrous metal close to the compass – check again when

heading changed 90 degrees), you should put a warning note on your deviation card. If you use the equipment regularly at sea, but not always, create a separate deviation card for each situation.

Creating a deviation card comes down to comparing a known magnetic bearing against the bearing indicated by your compass. You should do this at minimum of 30 degree intervals, all around the compass. The problem with most vessels is that the steering compass is not suitable for, or not in a suitable place to take bearings. You are generally restricted to getting a bearing by steering directly at an object and reading your course from the compass using the lubber line.

Assuming you cannot take bearings from your steering compass, you will need to use something else to take bearings that you can then compare to our steering compass course to determine deviation.

There are a number of ways to determine deviation, but one that often can't be used in our area is by checking your compass against a GPS course. This is because GPS provides you a course based on comparing you previous position to your present one. With reasonable speed (depends on the dampening used by your GPS, but 10 knots should be good), and no wind or current and precise steering, GPS can provide an accurate course, but it is an almost impossible combination in the waters off Campbell River, as current is almost always present. (If you want to see this for yourself, go out to mid channel off Campbell River and stop. If you watch the GPS, it will start to tell you that your course is the direction the current is going, regardless of which way your bow is actually pointing.)

However a GPS is extremely good at providing a bearing from its current position to the next waypoint, which you should be able to access (in OpenCPN it is part of the Active Route Console Window). And it can likely even give you the magnetic bearing (check your GPS manual for details – for OpenCPN you need to select show magnetic and activate the WMM plugin – screen capture to right). If you place your next waypoint on a landmark a few miles away, but still identifiable from your current position and then steer directly towards it, the difference between the GPS's waypoint bearing (corrected to magnetic) and your compass course is your deviation for that course. But doing this for courses every 30 degrees is not really practical.

OpenCPN Active Route Console. Waypoint bearing 078(T) and 092(M). So Variation in area is 14W

Below is a link to the simplest (least calculations) method of creating a deviation card that I am aware of. It does require the use of a hand bearing compass, and along with calm weather and no current, there are two prerequisites for using this method.

First, the hand bearing compass must be used somewhere aboard where there is no magnetic interference affecting it (so it has no deviation on any course). One way to check this is to take bearings of an object several miles away as your boat completes a fairly tight circle. (At a distance of 5 nautical miles, the bearing of an object will not change by one degree if your turn diameter is less than 160 metres [500 ft.] - but the greater the distance from your chosen mark, the better). If the hand compass bearing of the object remains the same throughout the circle, you have found a good spot. For this method to work, it is best to have a spot where you can hold the compass in one position, such as you or it braced against a (non-ferrous) backstay, railing or coaming.

The second prerequisite is that you must keep the braced hand compass directly in-line with the centreline of the boat. On a sailboat, this might involve sighting the track on the mast from a point at the centre of the cockpit. For a powerboat it could be the centre of the jack staff from the centre of the cockpit. The line of sight can also be offset to allow you to see past a cabin or other obstruction. One option would be to hold the compass up against a non-ferrous stanchion aft and sight to a mark on the rail forward (make sure the distance off the centreline for both is the same). The longer the distance between your hand compass and your mark, the more accurate it will be.

If the hand bearing compass isn't exactly aligned with the centreline of the boat, your deviation card will be offset by the amount of the error. While even a small error is not good, it would at least give you an idea of how much your deviation to apply to your course. That could be comforting on your no-GPS return trip.

If you meet the above prerequisites, here is the link:

https://www.youtube.com/watch?v=DDZ1ug_Rtvo

Your deviation values and curve may be the reverse of what the video shows, or the maximum and minimum deviation may be in different places. This is normal, because, as noted above, each vessel will have different sources and locations of magnetic interference.

When connecting the calculated points on the card, remember that deviation generally looks like a sine curve. Don't draw straight lines between the points.

Check your compass manual for confirmation, but many say you should not have more than 15 degrees deviation in any direction. If your measurements exceed this, your manual should give details on how to adjust the compass to remove deviation (using small compensating magnets built into your compass), after which you should do another swing to create an updated deviation card.

Some compass manuals speak of the limitations of using a GPS course when adjusting the compass, but if you use the GPS waypoint and bearing method from above, you will get rid of those problems.

If you are unable to resolve significant deviation, you may want to relocate your compass (or the interfering source) or else contact a professional compass adjuster.

If you are unable to use the above method, check out part 2.