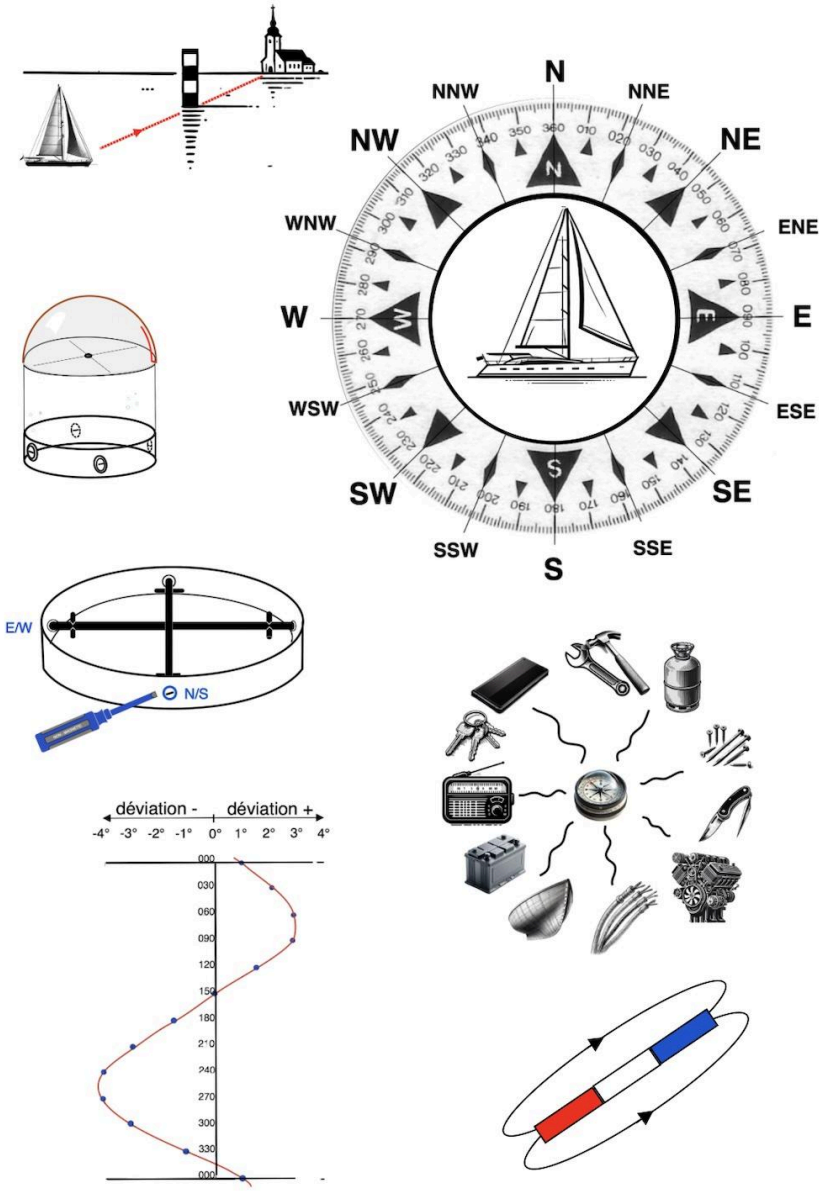
Adjustment of a Magnetic Steering Compass with Integrated or External Correctors.

Illustrated Methods for Cruising Yachts from 9 to 18 Meters.(30 to 60 feet)

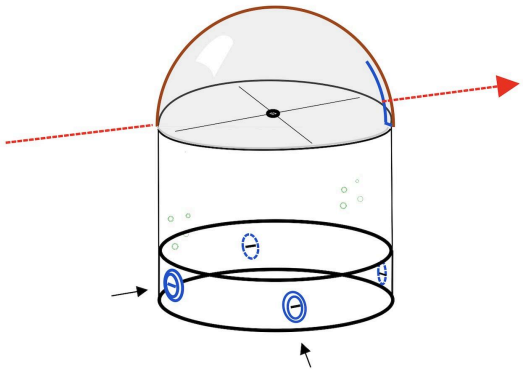


A Adjustment of a Magnetic Steering Compass Equipped with Integrated Correctors.

There is a second guide available on my website, www.easysextant.com, titled *Measurements to Create a Deviation Card for Magnetic Steering Compasses*, intended for use after the compass has been adjusted.

A.1

A Adjustment of a steering compass equipped with built-in correctors.



A.1 Adjustment of a steering compass with built-in correctors, by comparison and alignment between the steering compass and the bearing compass, on four magnetic headings spaced 90° apart, according to the instructions.

A.1 The entire procedure depends on the following four key steps.

1. Steer to magnetic north and cancel the deviation using the N-S correctors.

2. Steer to magnetic east and cancel the deviation using the E-W correctors.

3. Steer to magnetic south and reduce the deviation by half using the N-S correctors.

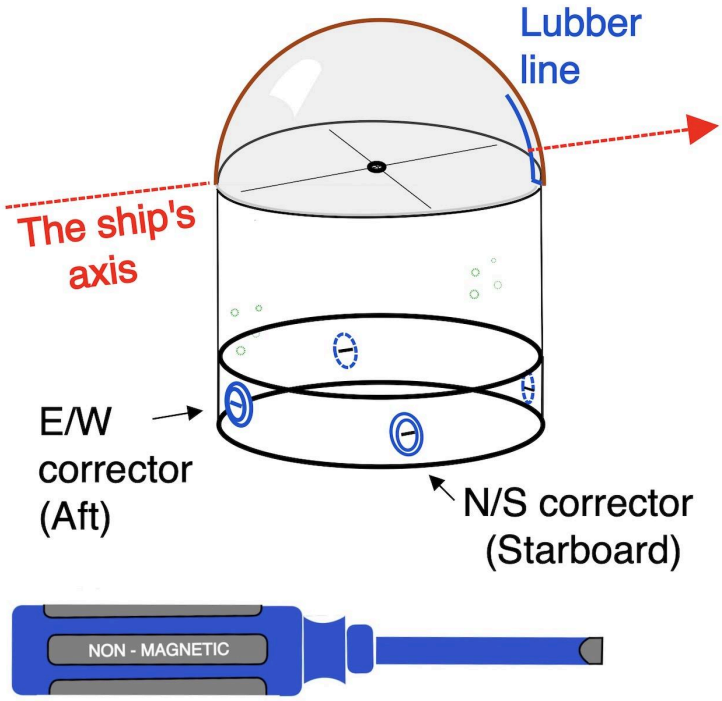
4. Steer to magnetic west and reduce the deviation by half using the E-W correctors.

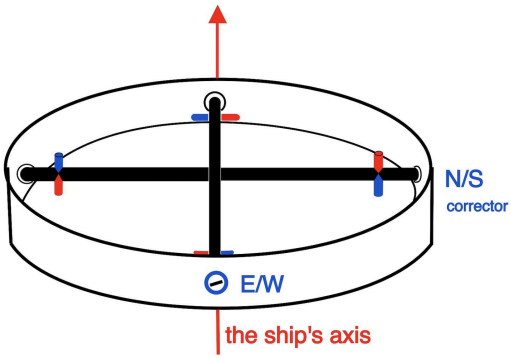
Note: You can start with any of them, but within each pair:

- one heading allows you to cancel the deviation,
- its opposite allows you to reduce it by half.

Following these adjustments, we proceed to establish the deviation curve.

A.1 The steering compass with built-in correctors.

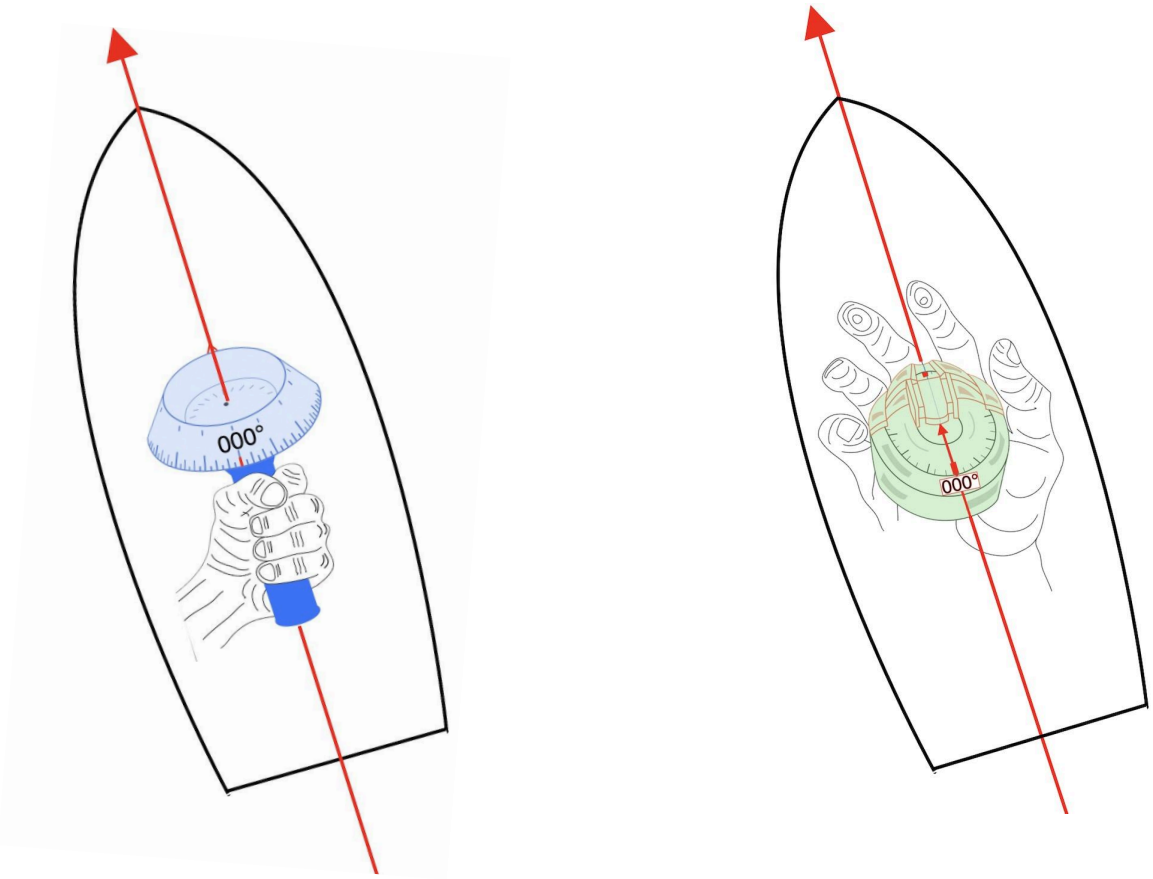




A typical location of adjustment screws on a Ritchie compass.

A.1 How to steer to magnetic north?

The vessel is brought to magnetic north using the bearing compass, then the heading shown on the steering compass is compared with the reading from the bearing compass.



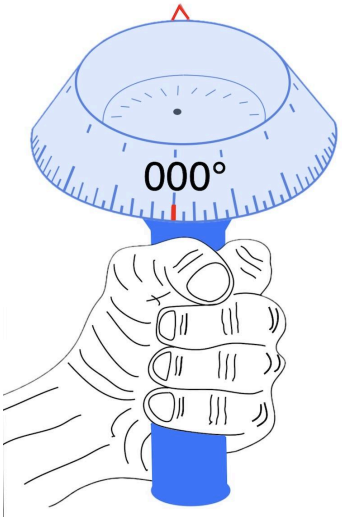
Two types of bearing compasses shown.

There is no need to account for magnetic variation, since both the bearing compass and the steering compass are affected in the same way.

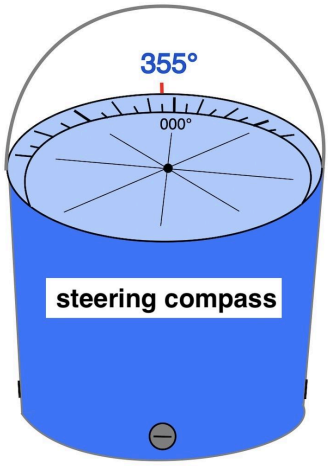
A.1 Example of compass adjustment by comparison between the steering compass and the bearing compass.

1. Steer to magnetic north and cancel the deviation using the N/S correctors.

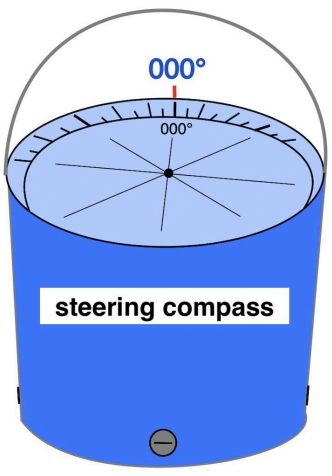
A The vessel is brought to magnetic north using a bearing compass.



B At that moment, the steering compass reads 355°.°

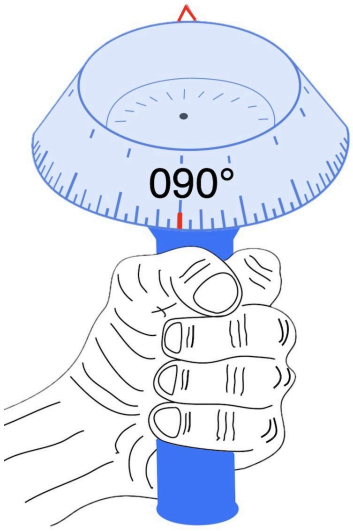


C The deviation is cancelled using the N/S correctors.

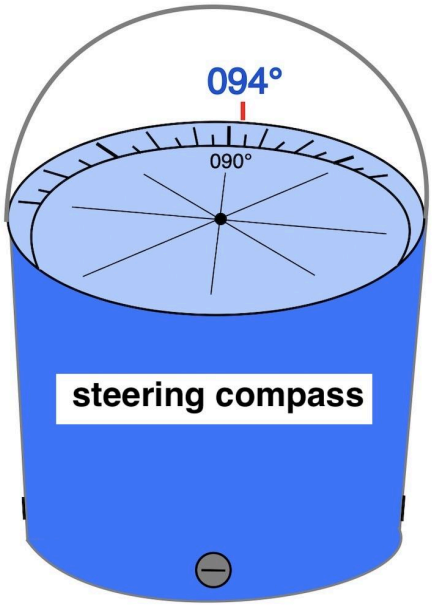


A.1 2. Steer to magnetic east and cancel the deviation using the E/W correctors.

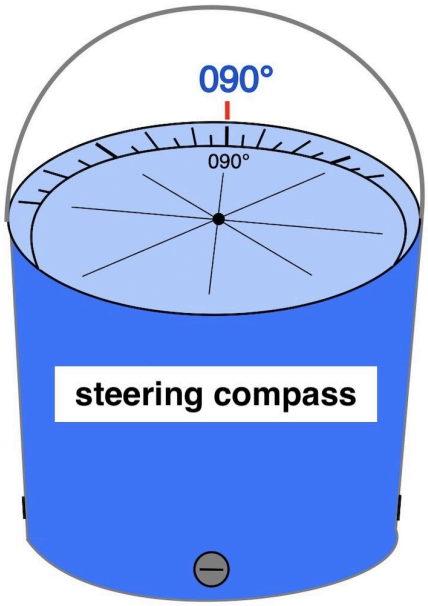
A The vessel is brought to magnetic east using a bearing compass.



B At that moment, the the steering compass reads 094°

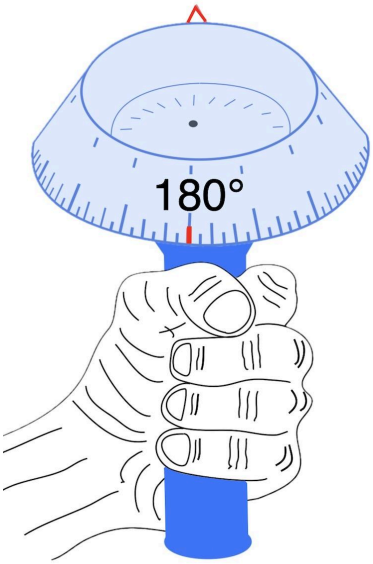


C The deviation is cancelled using the E/W correctors.

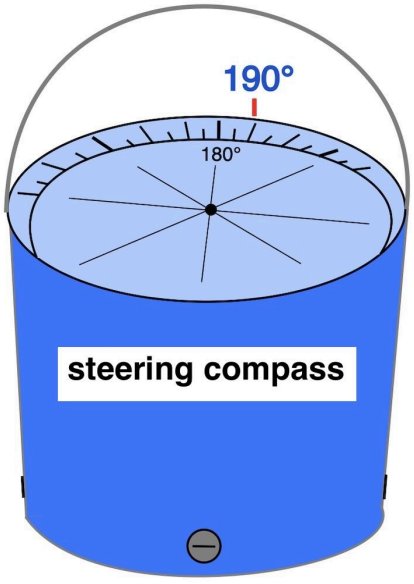


A.1 3. Steer to magnetic south and reduce the deviation by half using the N/S correctors.

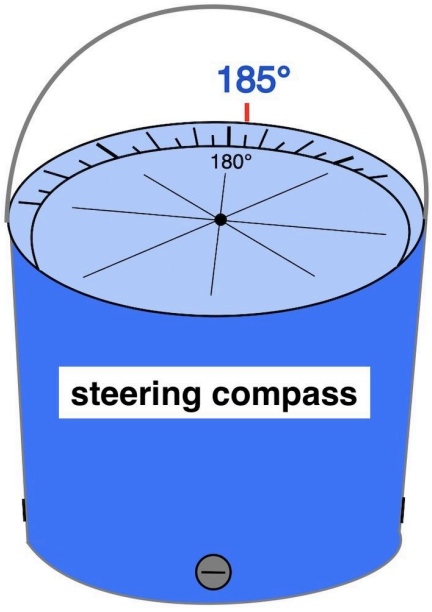
A The vessel is brought to magnetic south using a bearing compass.



B At that moment, the the steering compass reads 190°

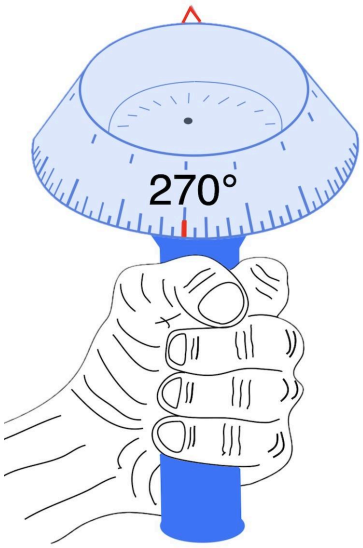


C. The deviation is reduced by half using the N/S correctors.

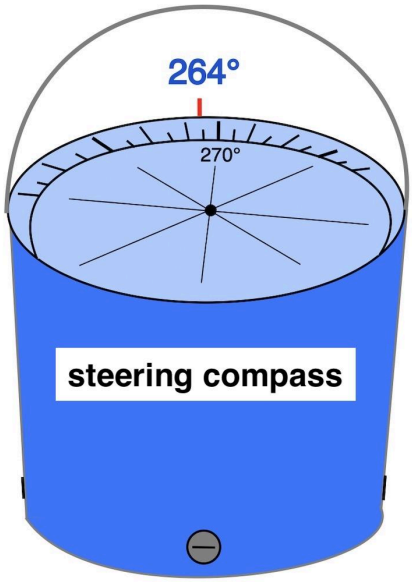


A.1 4. Steer to magnetic west and reduce the deviation by half using the E/W correctors.

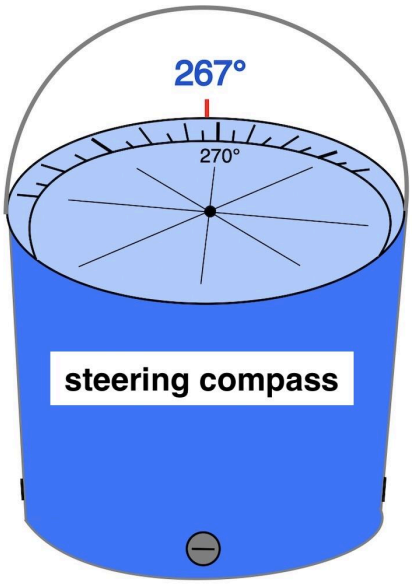
A The vessel is brought to magnetic west using a bearing compass.



B At that moment, the the steering compass reads 264°

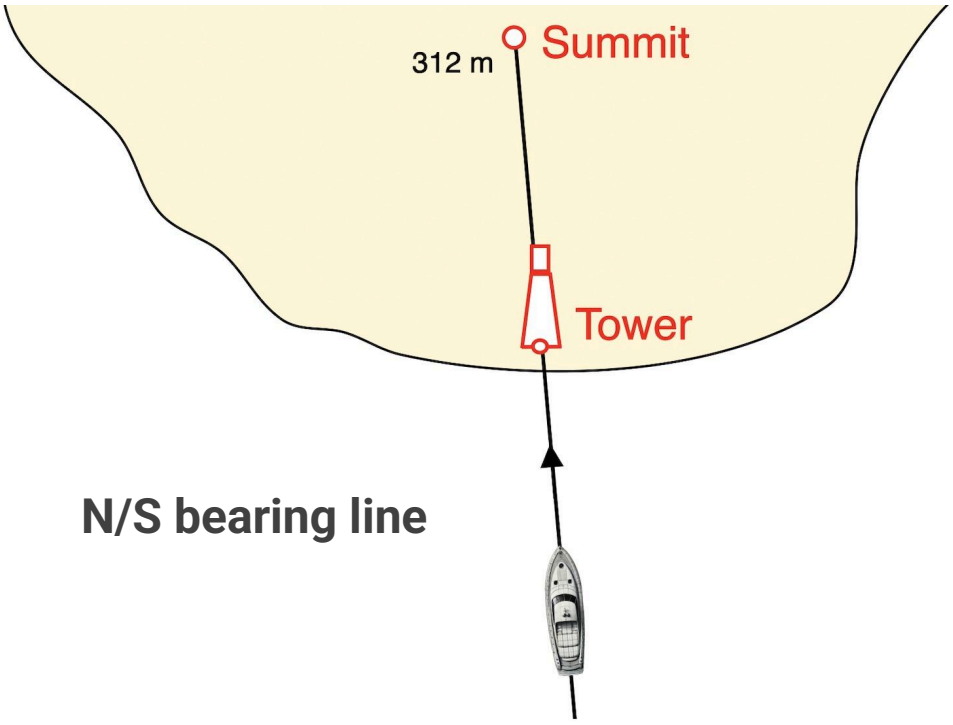


C. The deviation is reduced by half using the E/W correctors.

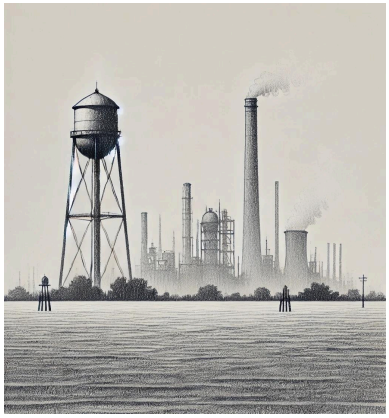


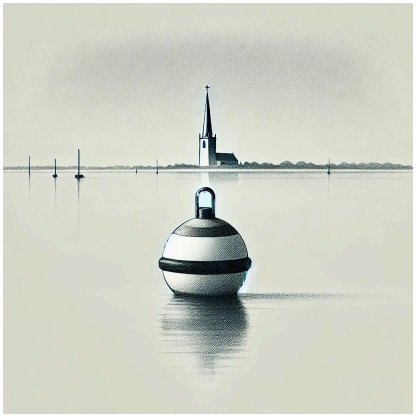
A.2

A.2 Adjustment of a Magnetic Steering Compass with Integrated Correctors Using Two Bearing Lines: North/South and East/West.



A.2 Adjustment on Two Bearing Lines: N/S and E/W, According to the Associated Instructions.



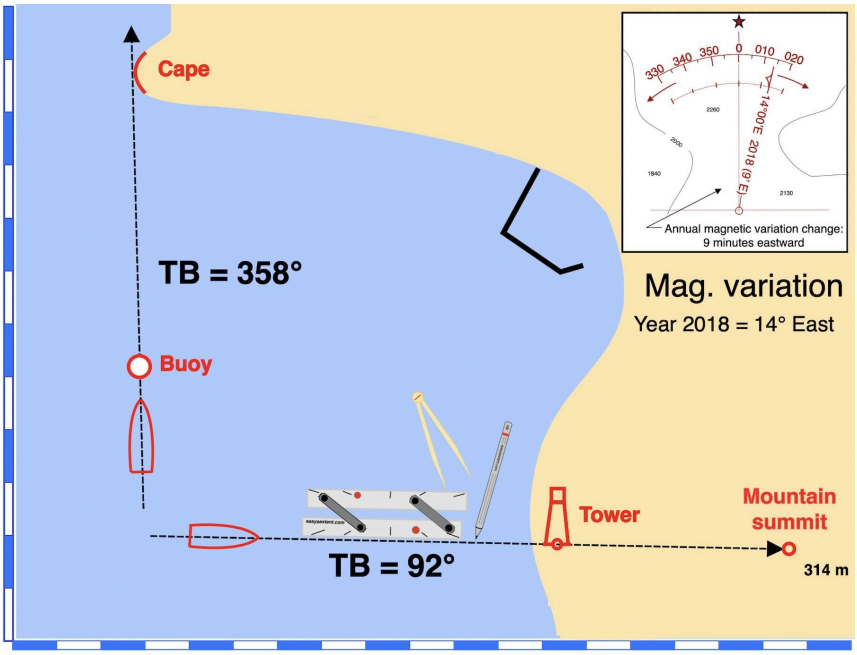


To perform accurate alignments, use clearly identifiable landmarks such as hilltops, towers, church bells, chimneys, or buoys—as long as they are shown on the nautical chart.

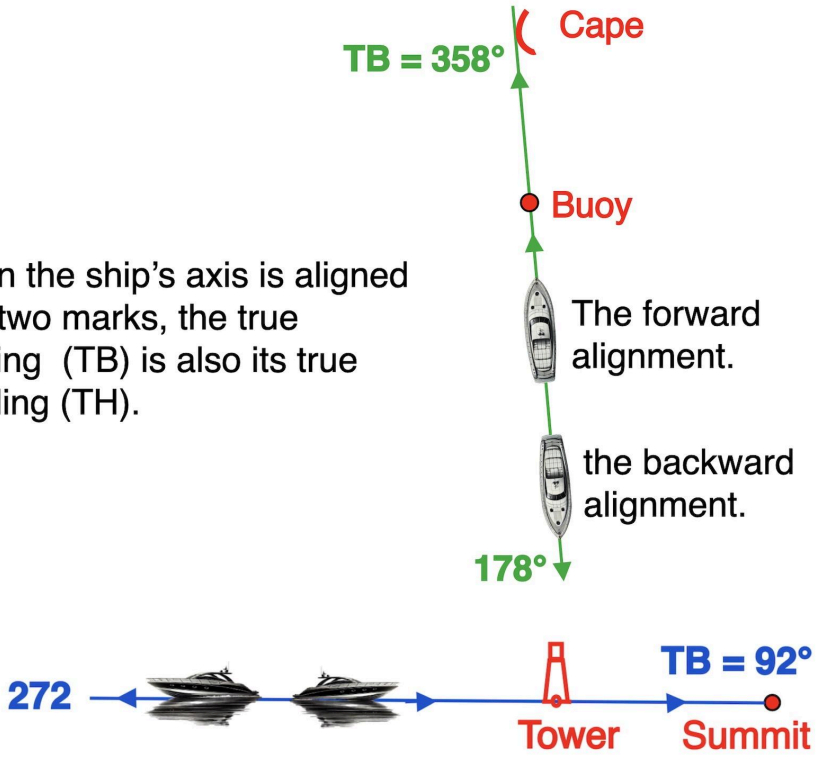
Of course, it is essential to verify the position of buoys using a GPS.

A.2 We'll follow a classic pattern.

We're looking on the chart for an alignment close to N/S and E/W.



When the ship's axis is aligned with two marks, the true bearing (TB) is also its true heading (TH).



A.2 The alignment doesn't need to be exactly north/south or east/west — within 10 degrees is fine — but it's essential that the headings followed in both directions along that line are exactly opposite.

FOLLOWING A BEARING LINE FORWARD

This involves visually aligning two (land)marks while heading toward them, keeping the vessel's axis perfectly aligned with the bearing line. At this moment, the true heading (TH) is equal to the true bearing (TB).

FOLLOWING A BEARING LINE ASTERN

This involves visually aligning two (land)marks while moving away from them, ensuring that the vessel's axis remains aligned with the bearing line. At this moment, the true heading (TH) equals the true bearing (TB) of the alignment ±180°.

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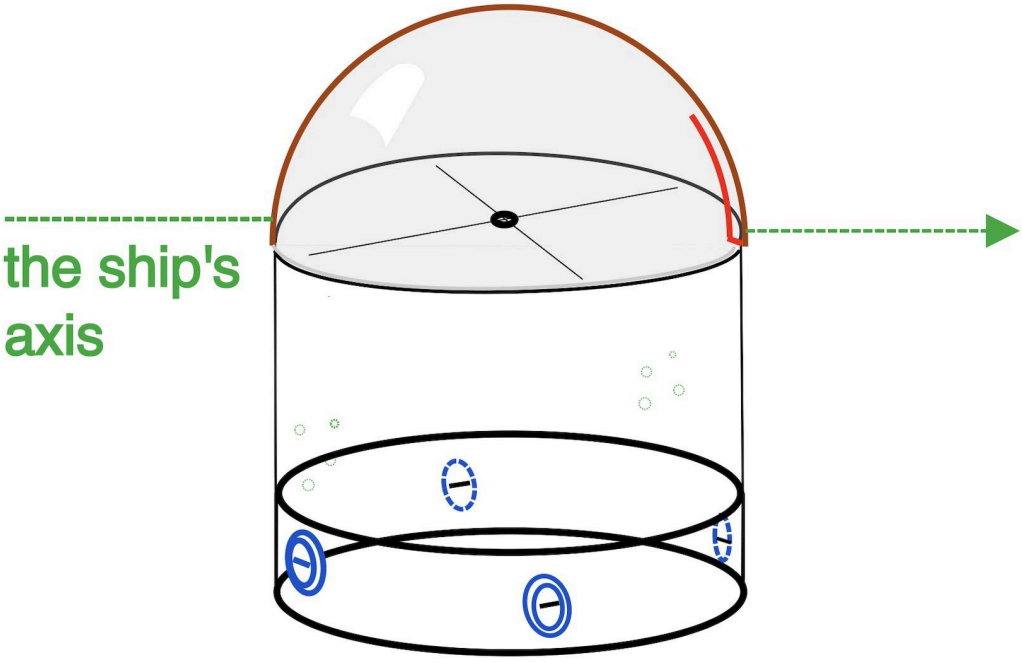
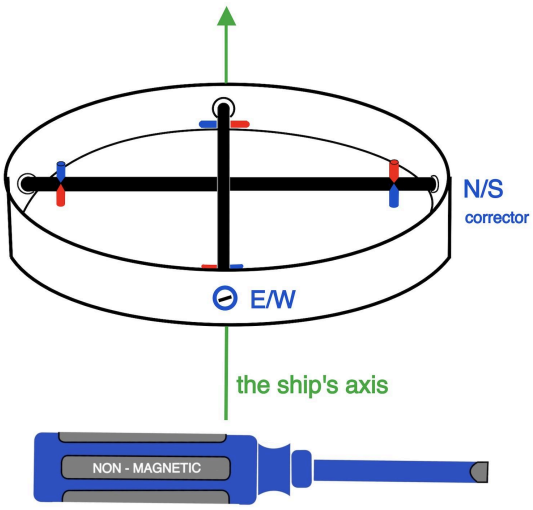
Taking a bearing line astern can be more challenging than following one forward, as it requires good coordination and some practice.

A.2 Steering compass with integrated correctors.





A.2 Example: Adjustment Using Two Bearing Lines: N/S and E/W

Follow the N/S and E/W bearing lines (see nautical chart above).

- **N/S bearings**: 358° and 178°
- **E/W bearings**: 092° and 272°

Fictional location, date: 2018 — Magnetic variation: 14° E

Instructions

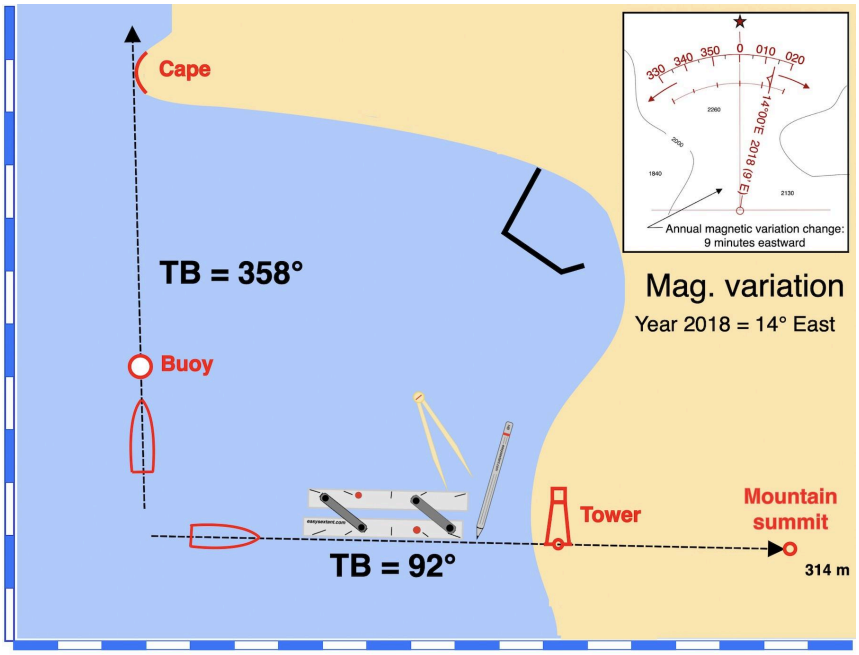
- **Step 1: Follow the N/S bearing line heading North.**
  Instruction: Eliminate the full deviation.
- **Step 2: Follow the E/W bearing line heading East.**
  Instruction: Eliminate the full deviation.
- **Step 3: Follow the N/S bearing line heading South.**
  Instruction: Eliminate half of the deviation.
- **Step 4: Follow the E/W bearing line heading West.**
  Instruction: Eliminate half of the deviation.

A.2 The idea is that if you're following a bearing line—for example, 358° true—you can determine the magnetic heading, since the true heading minus the variation equals the magnetic heading (TH – Var = MH)."

Then, the difference between the calculated magnetic heading (MH) and the heading read on the steering compass (CH) corresponds to the deviation. This deviation must be either cancelled or reduced by half, depending on the instructions.

The calculated magnetic heading (MH) serves as the absolute reference in the alignment-based adjustment technique, as it is from this value that any deviation is measured. Without this reference, accurate compass adjustment is not possible.

A.2 The example below shows one case where the deviation is cancelled, and another where it is reduced by half.

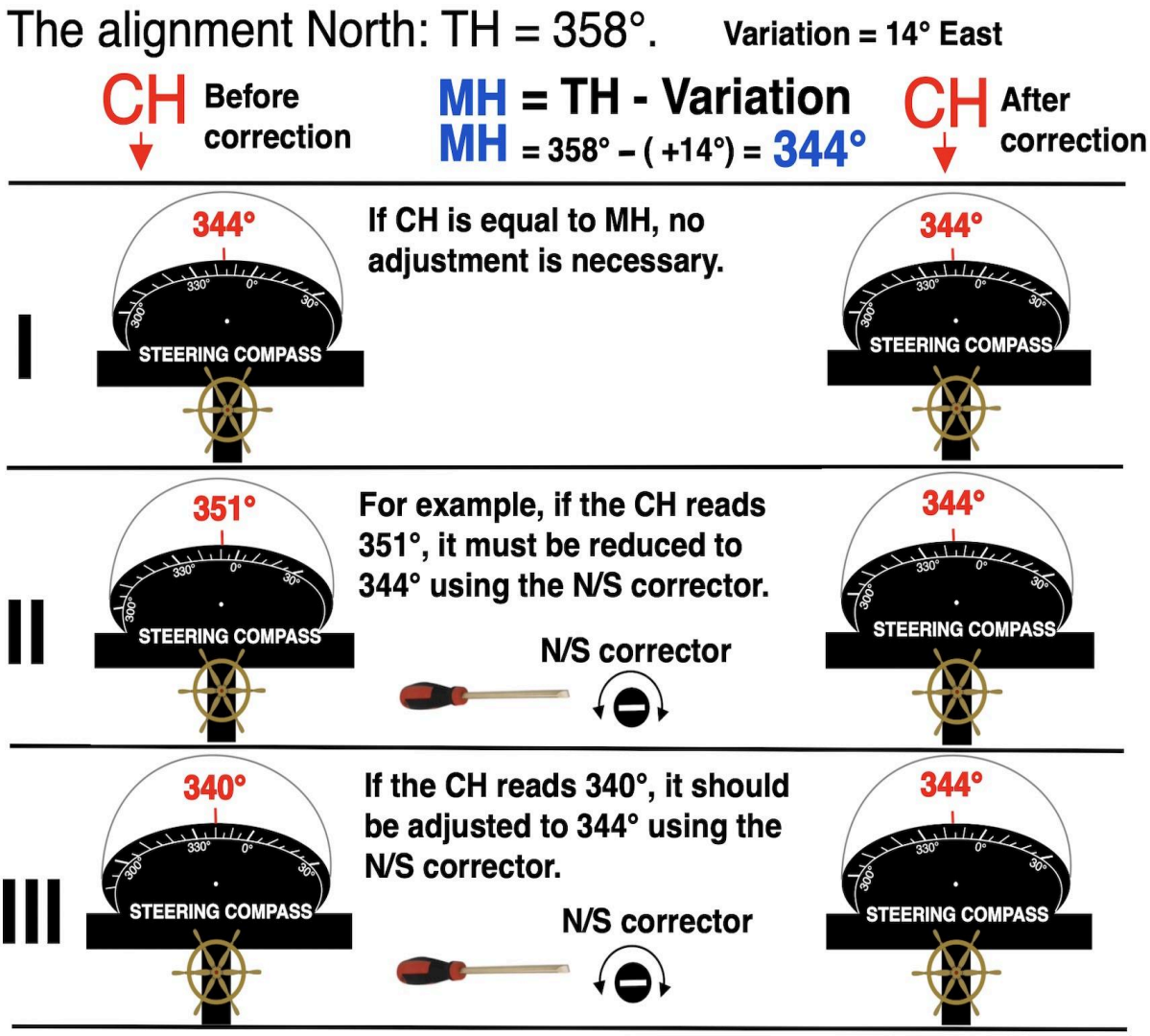


Follow the N/S and E/W bearing lines (see nautical chart above).

- **N/S bearings**: 358° and 178°
- **E/W bearings**: 092° and 272°
- *Magnetic variation: 14° E*

Step 1: Follow the north–south bearing line while heading north.

While aligning, ensure that the vessel's axis is properly aligned with the bearing line. In our example, the true heading (TH) is 358°.



Step 2: Follow the east–west bearing line while heading east.

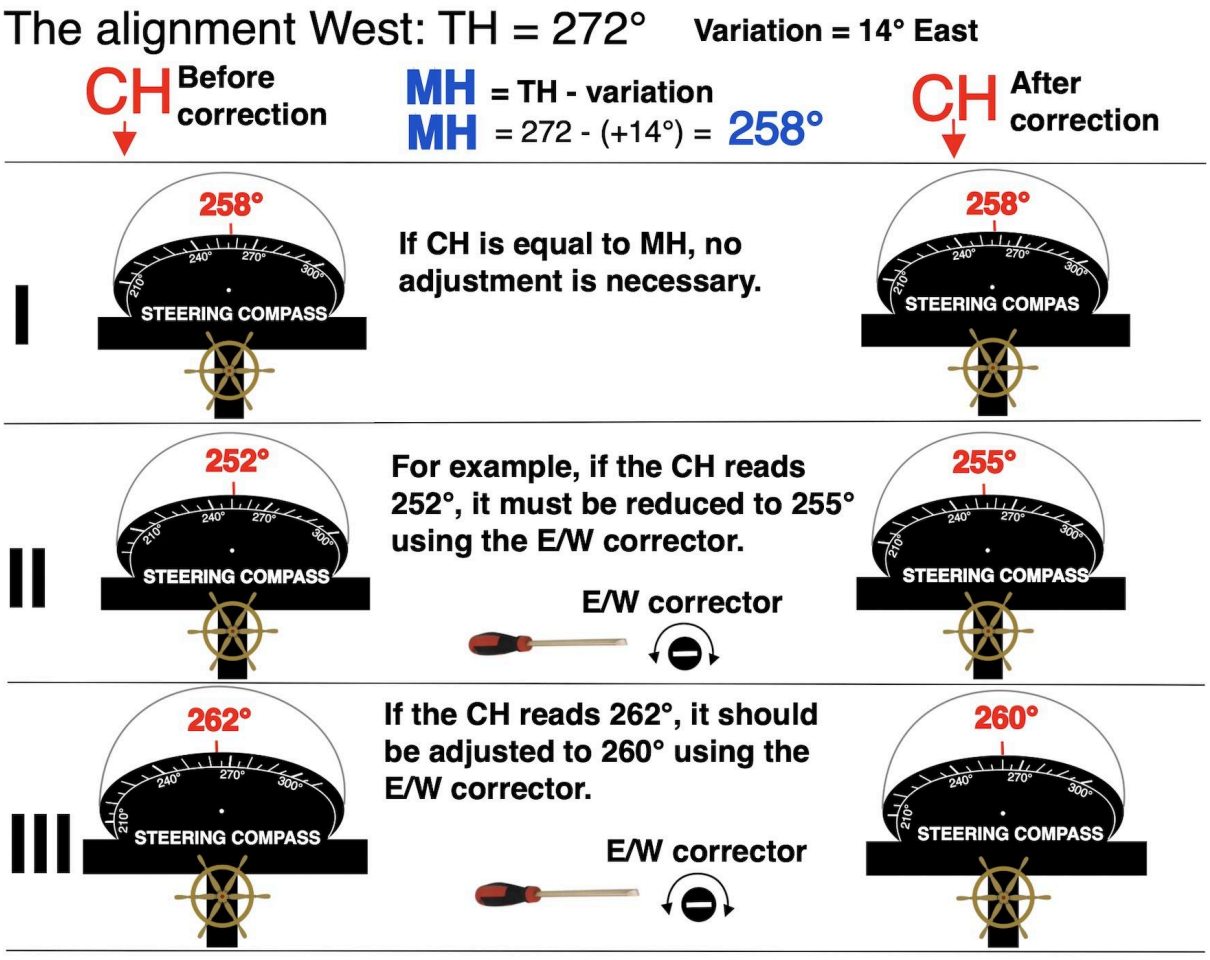
TH = 92°; MH = 78° (Use the same method as in Step 1, but apply the E/W corrector instead.)

Step 3: Follow the north–south bearing line while heading south.

TH = 178°; MH = 164° (Use the same method as in Step 4, but apply the N/S corrector instead.)

Step 4: Follow the east–west bearing line while heading west.

TH = 272°; MH = 258° (See illustration below.)

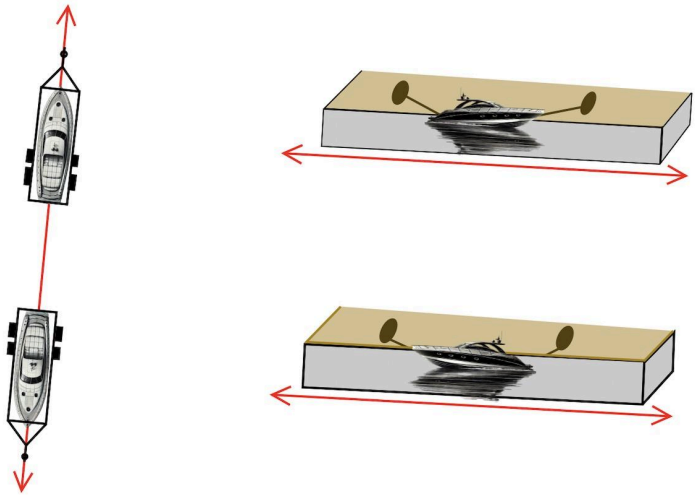


Remember: MH (magnetic heading) is the key reference!

A.2 Similar methods can be used for boats on trailers or moored along a dock roughly aligned north–south or east–west.

The author of this guide has never tested these methods, but if a trailer is used, it must be made of aluminum. Don't forget to move the car away.

Moreover, docks are often heavily reinforced with steel, which must be taken into account when adjusting the vessel's magnetic steering compass. In both cases, it is essential that the boat completes an exact 180° rotation.



The heading being exactly N/S or E/W is not important, but what matters is that they are exactly 180° apart for the adjustment

A.3

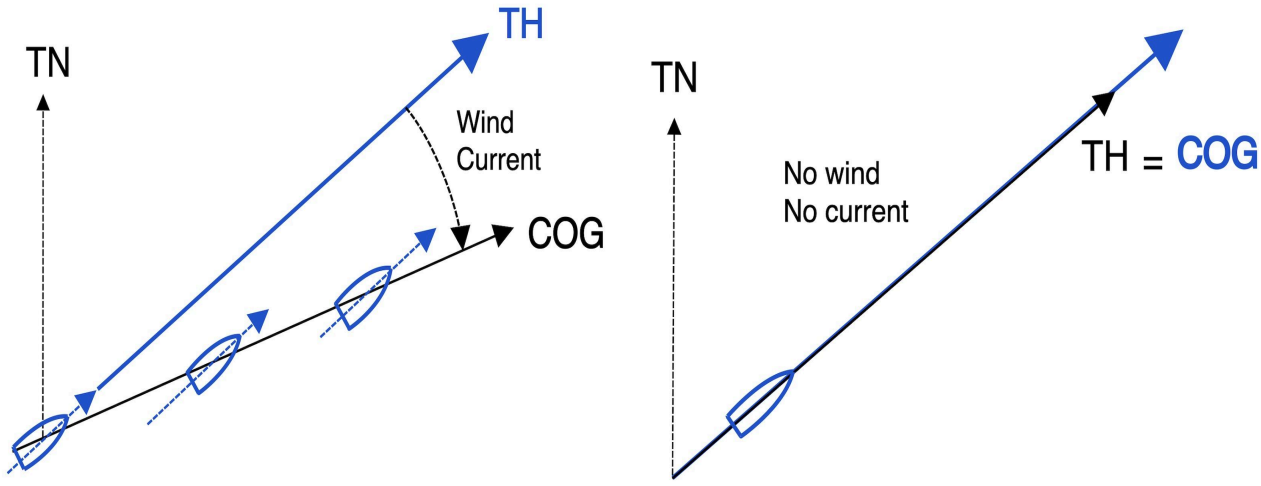
A.3 Adjustment of a Magnetic Steering Compass with Integrated Correctors by Comparing the Steering Compass to the GPS Course on Four Headings, Roughly North/South and East/West, Spaced 90° Apart.

Ritchie compass

A.3 Method of Adjustment:

Using GPS to adjust the steering compass.

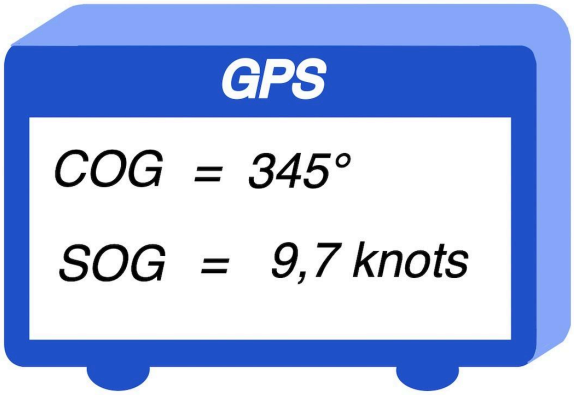
A GPS is used to obtain the magnetic heading instead of using a hand-bearing compass.



In the absence of wind and current, the true heading (TH) is equal to the course over ground (COG) shown by the GPS.

Choose a calm day, with no wind or current, and sail at about 10 knots. A higher speed improves the accuracy of the course over ground.

A.3



COG = course over ground

SOG = speed over ground

The absence of wind is easy to observe. To check for current, you can drop a cork near a buoy and watch for any drift.

In fact, GPS can detect a vessel's drift while it is stationary. By logging its position over time, and in the absence of wind, it is possible to determine the speed and direction of movement caused solely by the current.

If wind or current is present, GPS readings may be inaccurate for compass adjustment and should be avoided.

A.3 Example: maintaining a magnetic heading of 090° (East) using GPS, in ideal conditions with no wind or current.

(No wind or current) → True heading = Course over ground : Variation: 12° East = +12°
Formula:

True Heading = Magnetic Heading + Variation

→ **TH = 090° + (+12°) = 102°**

Conclusion:

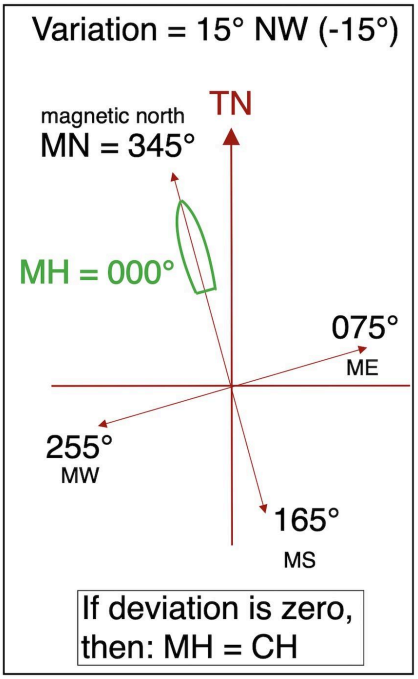
To maintain a magnetic heading of 090°, the GPS should indicate a course over ground (COG) of 102°.

In other words, if the GPS shows a COG of 102°, you are effectively steering a magnetic heading (MH) of 090°.

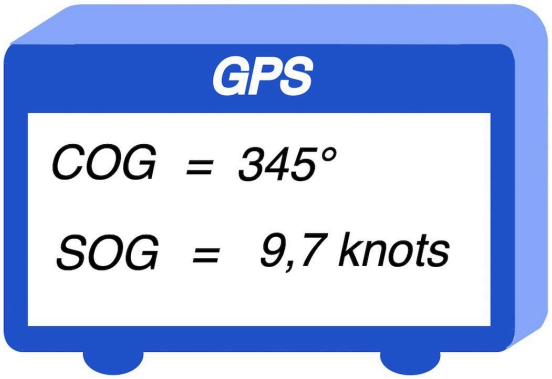
The difference between this magnetic heading and the compass heading (CH) observed on the steering compass is the deviation.

Note: Instead of using the COG, many GPS devices can display the magnetic heading directly, which is even better (see user manual). Same conditions: no wind, no current.

A.3 1. Steer the vessel to magnetic north and cancel the deviation using the N/S correctors.

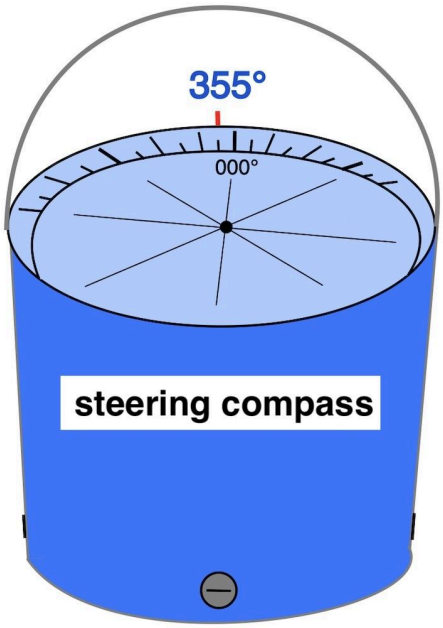


A **The vessel was brought to magnetic north using the GPS.**

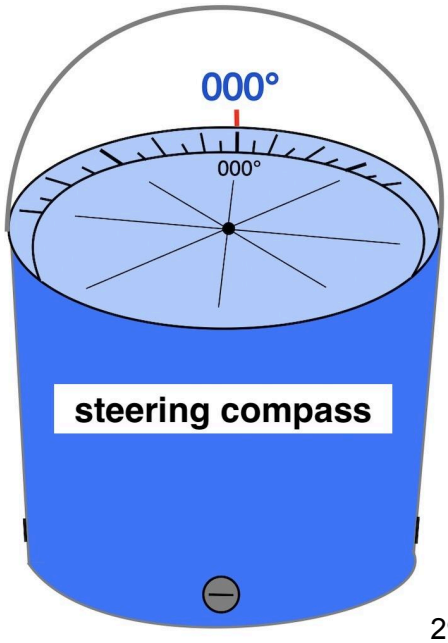


No wind, no current.
TH = COG,
TH = MH + Variation ➤
360° + (–15°) = 345°

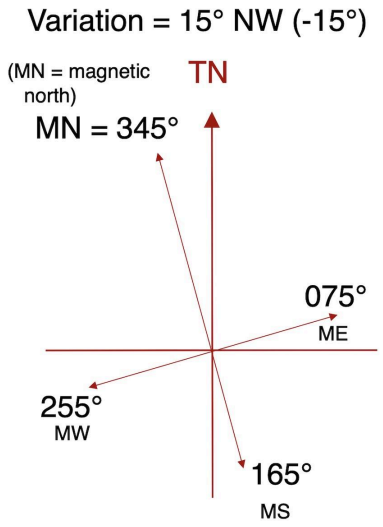
B **At that moment, the steering compass indicated 355°.**



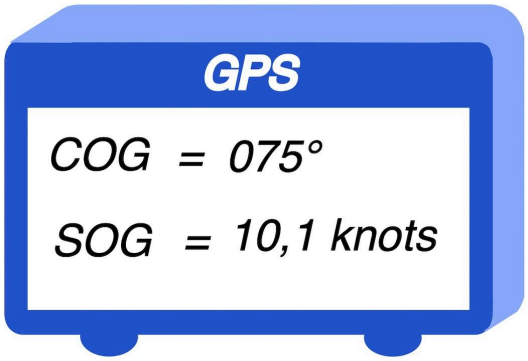
C **The deviation is corrected using the N/S correctors.**



A.3 2. Steer the vessel to magnetic east and cancel the deviation using the E/W correctors.

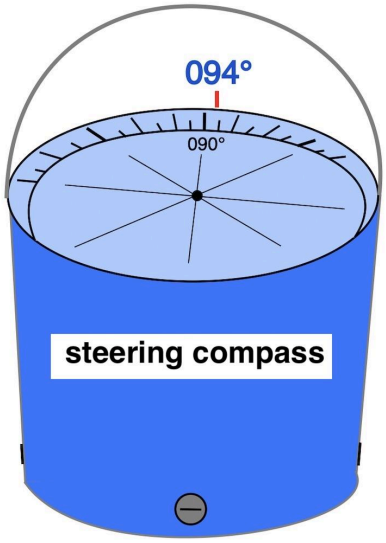


A The vessel was brought to magnetic east using the GPS.

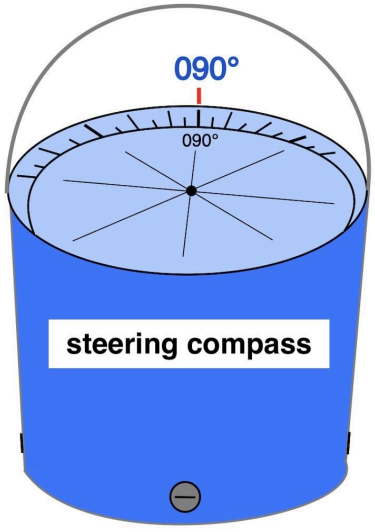


No wind, no current.
TH = COG,
TH = MH + Variation ➤
090° + (–15°) = 075°

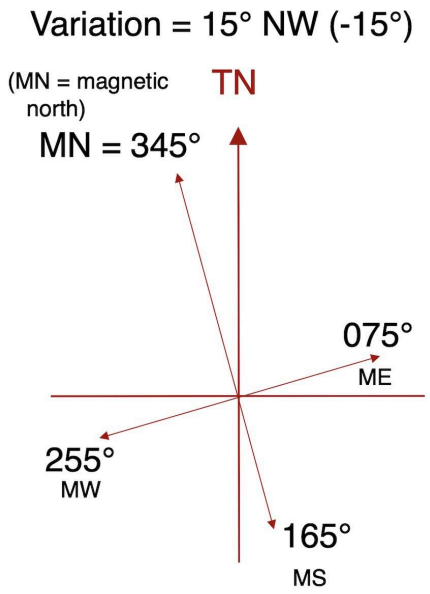
B At that moment, the steering compass indicated 094°.



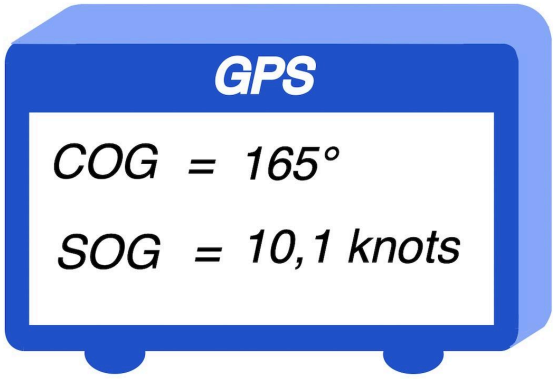
C The deviation is corrected using the E/W correctors.



A.3 3. Steer the vessel to magnetic south and reduce the deviation by half using the N/S correctors.

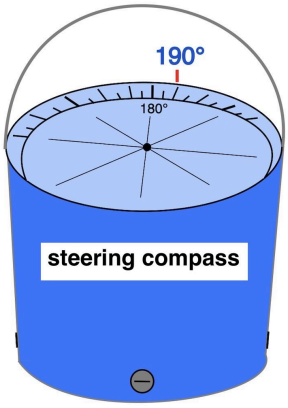


A **The vessel was brought to magnetic south using the GPS.**

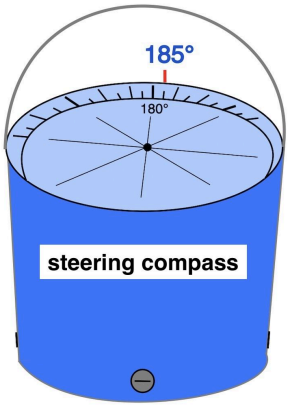


No wind, no current.
TH = COG,
TH = MH + Variation ➤
180° + (–15°) = 165°

B **At that moment, the steering compass indicated 190°.**

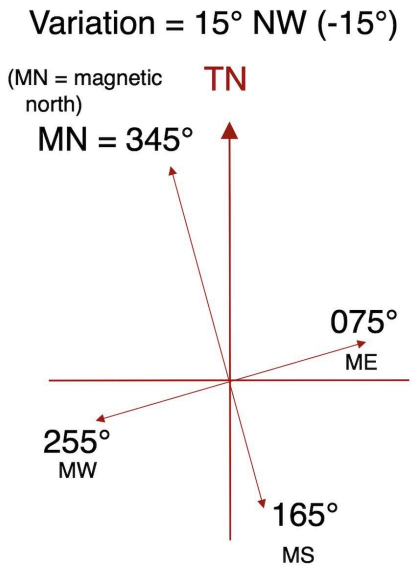


C **The deviation is reduced by half using the N/S correctors.**

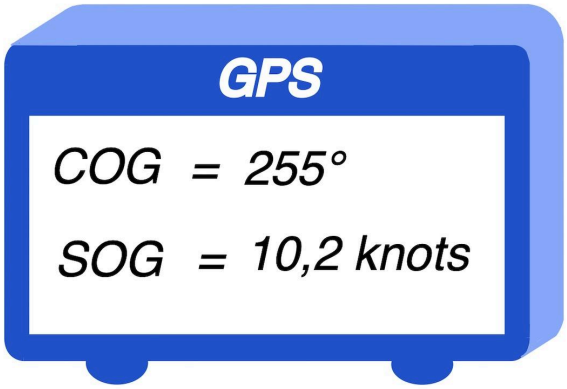


Note: If the steering compass had indicated 180°, no correction would have been necessary at that moment.

A.3 4. Steer the vessel to magnetic west and reduce the deviation by half using the E/W correctors.

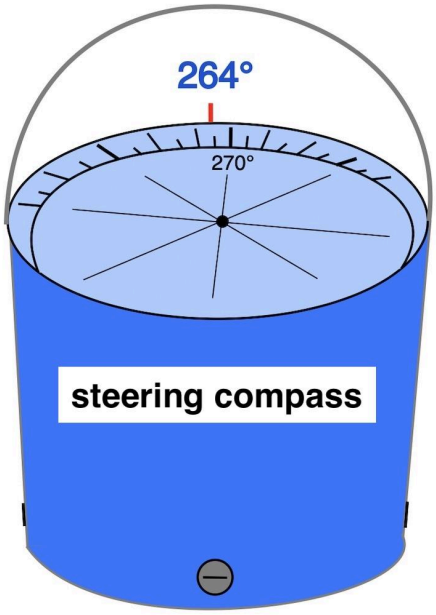


A **The vessel was brought to magnetic west using the GPS.**

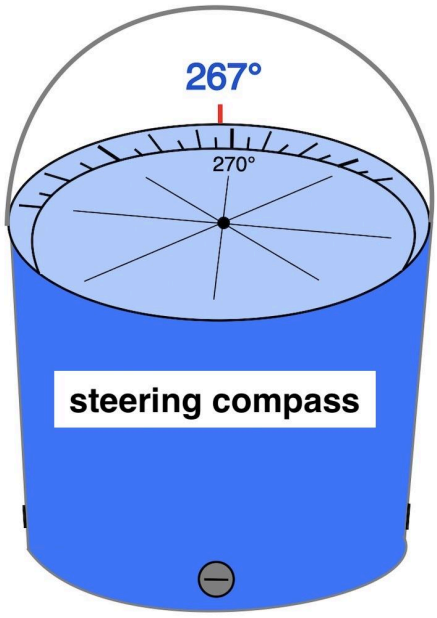


No wind, no current.
TH = COG,
TH = MH + Variation ➤
270° + (–15°) = 255°

B **At that moment, the steering compass indicated 264°.**



C **The deviation is reduced by half using the E/W correctors.**



A.3 EXERCISE : Adjustment of the steering compass using a GPS

(Answers below.)

Variation: 8° E

Conditions: no wind, no current

Minimum speed during compensation: 10 knots

---

1. Come to magnetic north and cancel the deviation using the N/S correctors.

What COG (Course Over Ground) will be shown on the GPS to come to magnetic north?

At this time, the compass heading shows 003°.

What is the amount of error to correct using the N/S correctors?

A.3 2. Come to magnetic east and cancel the deviation using the E/W correctors.

What COG (Course Over Ground) will be shown on the GPS to come to magnetic east?

At this time, the compass heading shows 095°.

What is the amount of error to correct using the E/W correctors?

3. Come to magnetic south and reduce the deviation by half using the N/S correctors.

What COG (Course Over Ground) will be shown on the GPS to come to magnetic south?

At this time, the compass heading shows 186°.

What is the amount of error to correct using the N/S correctors?

4. Come to magnetic west and reduce the deviation by half using the E/W correctors.

What COG (Course Over Ground) will be shown on the GPS to come to magnetic west?

At this time, the compass heading shows 280°.

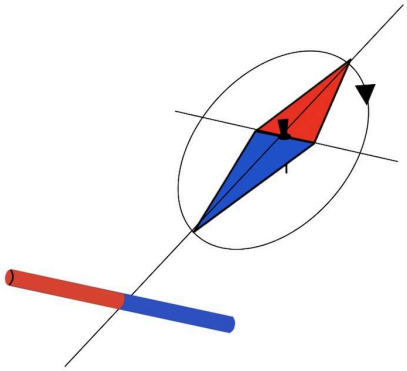
What is the amount of error to correct using the E/W correctors?

A.3 Answer exercise

situation	GPS reading TH = COG (no wind/current)	Adjustment needed
magnetic North (MH = 000°)	008°	3° N/S corrector
magnetic East (MH = 090°)	098°	5° E/W corrector
magnetic South (MH = 180°)	188°	6° / 2 = 3° N/S
magnetic West (MH = 270°)	278°	10° / 2 = 5° E/W

B.1

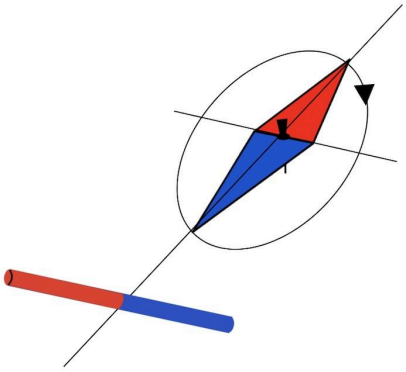
B. Adjustment of a Magnetic Steering Compass with External Compensators.

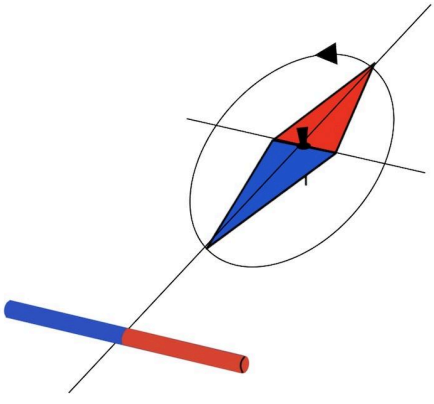


B.1 Adjustment using magnets placed and/or moved outside the compass.

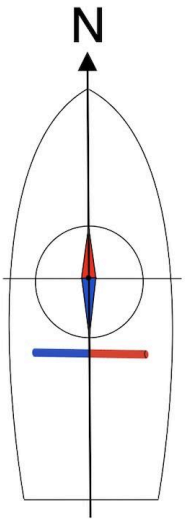
Remember: the blue (–) side of the magnet attracts the red (+) tip of the compass needle. The closer the magnet is, the stronger the attraction. Conversely, moving it farther away reduces the effect.

The advantage of using two parallel magnets rather than a single one, magnetized in the same direction, is that it enables finer and more precise adjustments.

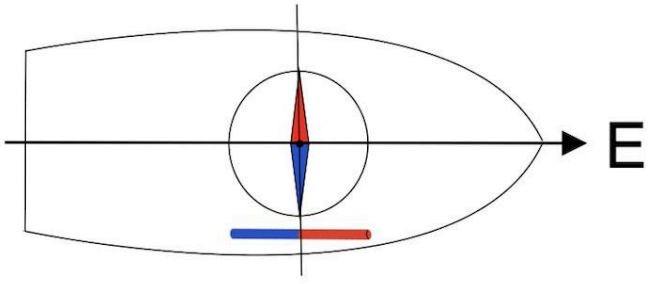




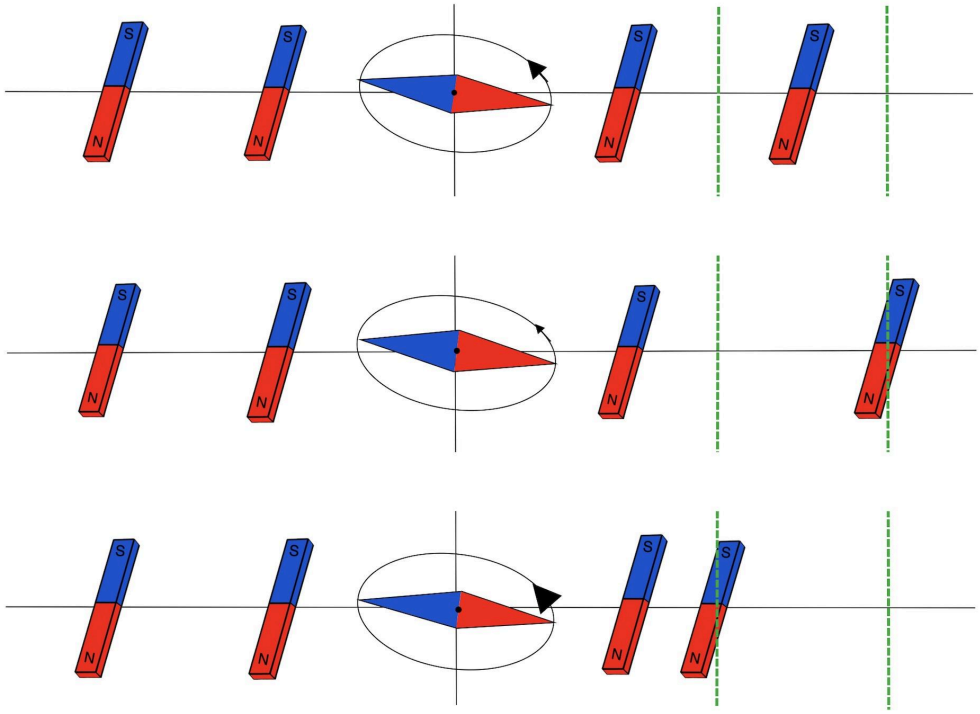
B.1 Transverse correctors (also called C-correctors) are used to correct deviations on North and South magnetic headings. They are often arranged in pairs (in the drawing below, only one is visible).



Longitudinal correctors (also called B-correctors) are used to make corrections on East and West magnetic headings.



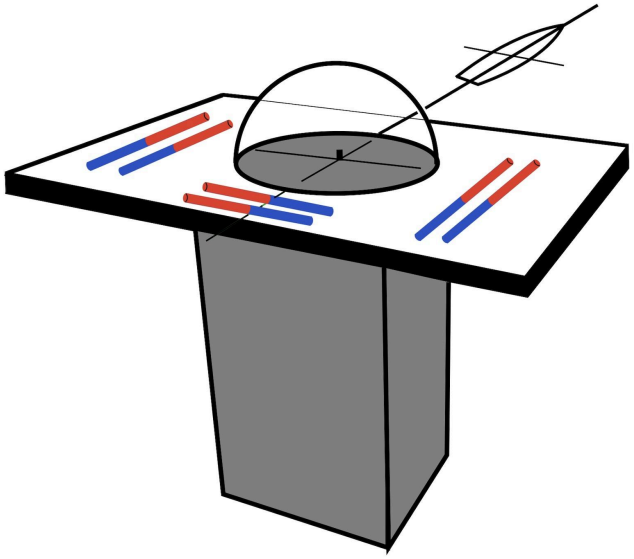
B.1 **Instead of using a single magnet, multiple magnets can be used to create a more uniform magnetic field and make it easier to apply small corrections.**



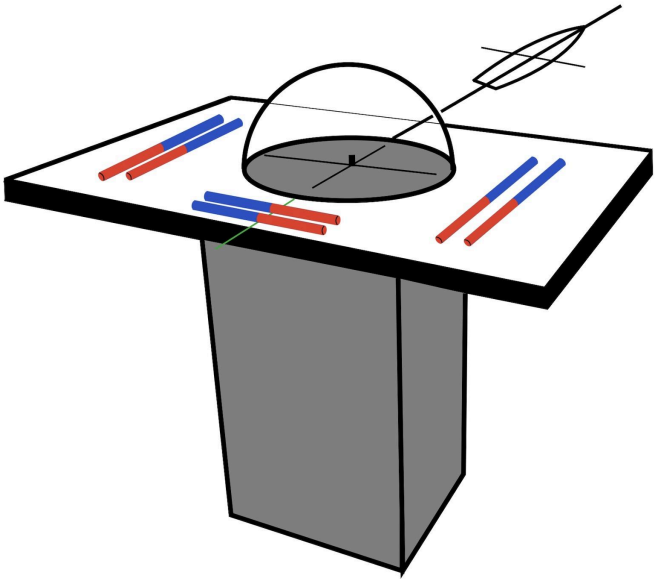
The closer the magnet is, the stronger the attraction. Conversely, the farther it is, the weaker the effect.

B.1 On larger compasses, longitudinal correctors can be placed on both sides of the compass, while transverse correctors are generally installed on only one side — either at the front or the rear.

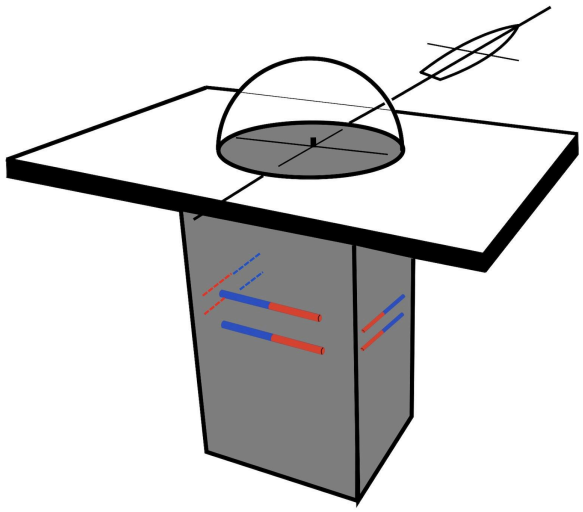
Horizontal Mounting 1



Horizontal Mounting 2



B.1



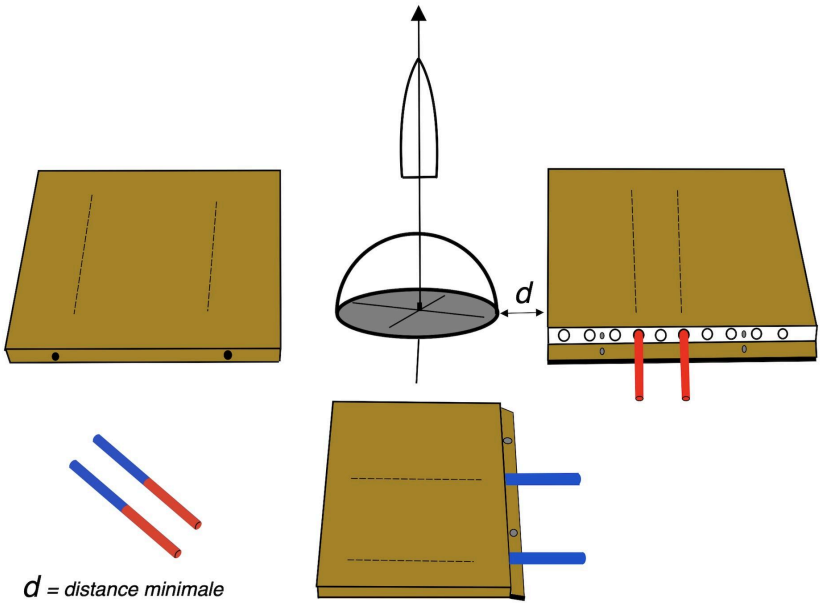
Vertical Mounting

This traditional drawing (vertical mounting) shows how the magnetic compass is adjusted on large merchant ships to compensate for permanent magnetic influences.

The magnets can be moved up or down to weaken or strengthen the magnetic fields in vertical mountings, or brought closer together or farther apart in horizontal mountings, allowing for the desired deviation adjustment.

In general, if the blue poles of the magnets point forward, all the others point forward as well. Similarly, if the blue poles point to starboard, all the others do too. These magnets can be moved together or individually. In some cases, more than 20 vertical positions are provided.

B.1



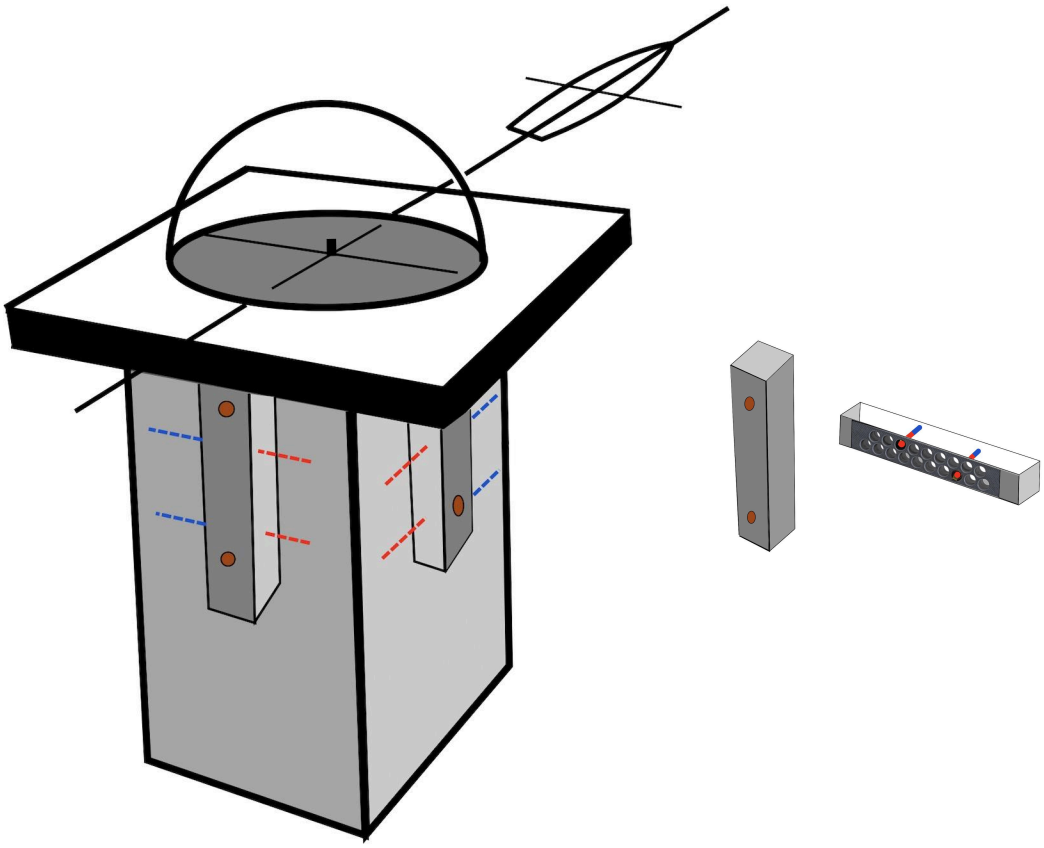
For example, Cassens & Plath sells adjustment cartridges designed for some of their compasses, but they are also compatible with other compass models.

For its compasses, the minimum distance *d* is 20 cm.

In principle, only two are needed: one to starboard or port, and the other aft or forward of the compass.

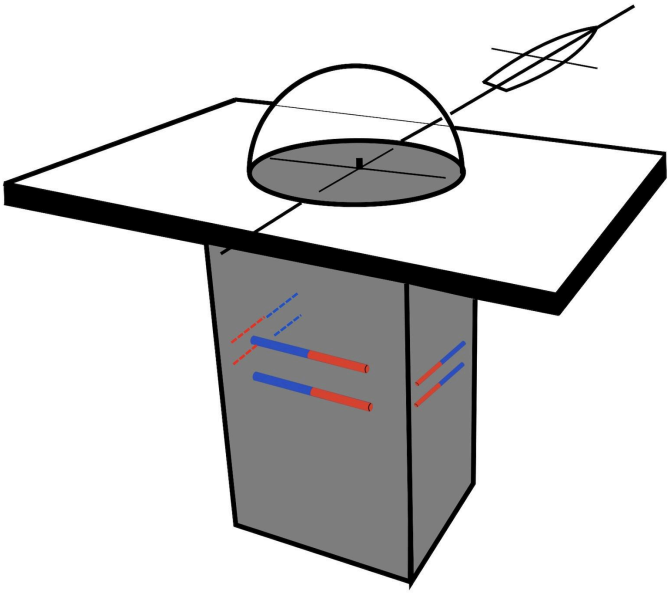
They can be mounted either horizontally or vertically. What matters is that the longitudinal correctors are perfectly parallel to the ship's axis, and the transverse correctors are perpendicular to it.

B.1 Other manufacturers offer adjustment cartridges in pairs, often much smaller and easier to handle, especially for smaller compass cards.



B.2

B.2 Illustrated Example of Adjustment Using Magnets Placed and/or Moved Outside the Compass.

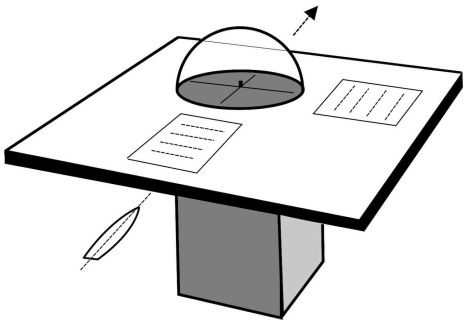


The example below illustrates the positions of the horizontal magnets, but the same principle applies to the vertical magnets (see Chapter B.1).

Steering the boat to the indicated magnetic heading is done here using the hand bearing compass.

You may also use the GPS for this purpose (see Chapter A.3).

B.2 We start with no magnets at all:



1. Steer to magnetic north and install the transversal correctors to cancel the deviation.

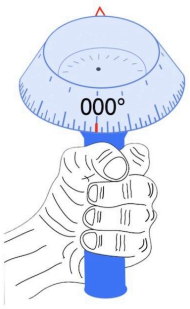
2. Steer to magnetic east and install the longitudinal correctors to cancel the deviation.

3. Steer to magnetic south and reduce the deviation by half using the installed transversal correctors.

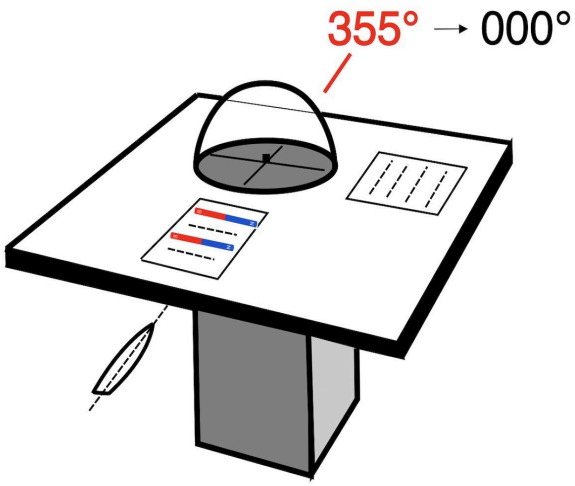
4. Steer to magnetic west and reduce the deviation by half using the installed longitudinal correctors.

Remember: **Opposite poles attract**, so the **blue (–)** end of the corrector **attracts the red (+) tip** of the compass needle.

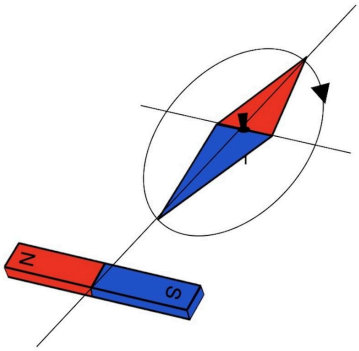
B.2 1



We steer the boat to a magnetic heading of 000°



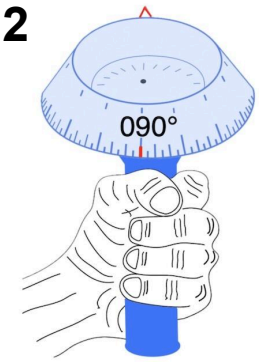
Our steering compass reads 355°, and we need to cancel the deviation.



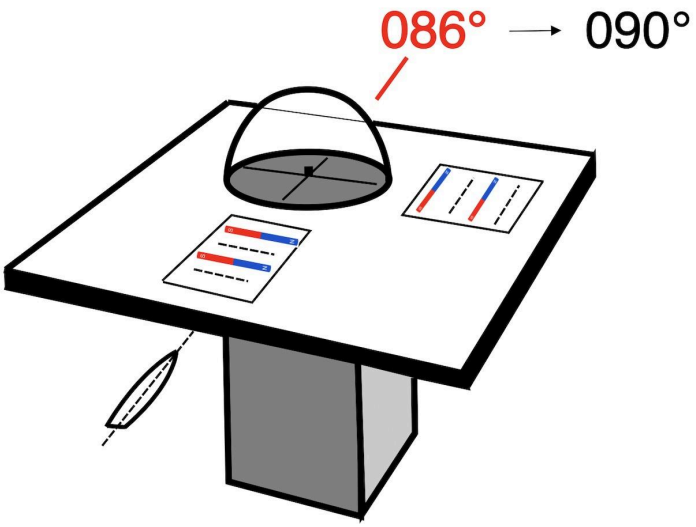
The transverse correctors are not yet installed.

We place the transverse correctors behind the compass, with the red side of the magnet to port, and then move them closer or farther away until the deviation is cancelled.

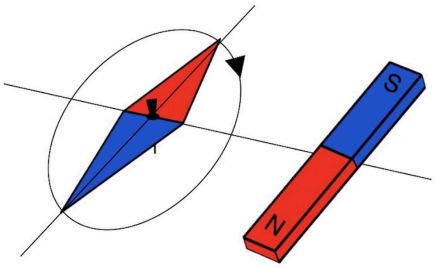
B.2 2



We steer the boat to a magnetic heading of 090°



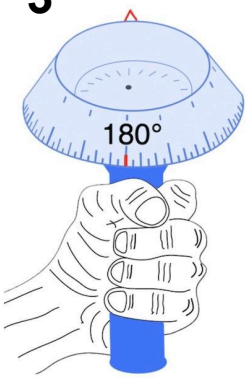
Our steering compass reads 086°, and we need to cancel the deviation.



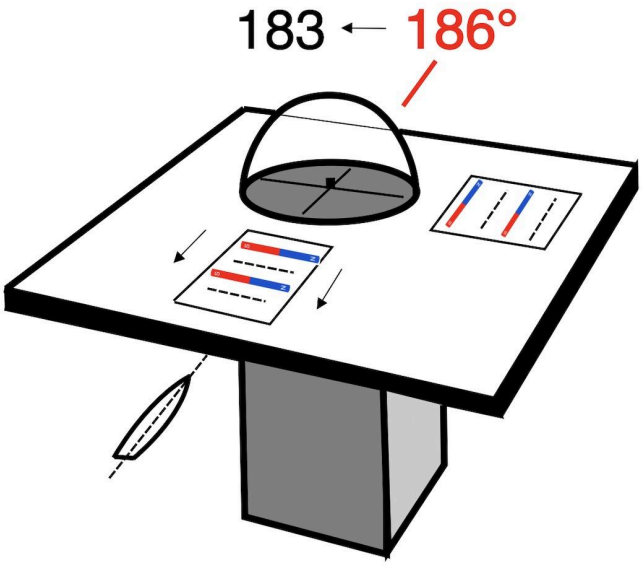
The longitudinal correctors are not yet installed.

We place the longitudinal correctors to starboard of the compass, with the red side of the magnet facing aft, and then move them closer or farther away until the deviation is cancelled.

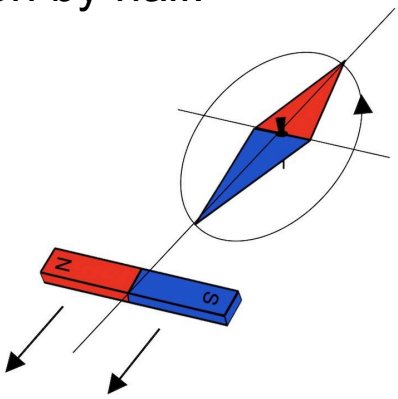
B.2 3



We steer the boat to a magnetic heading of 180°



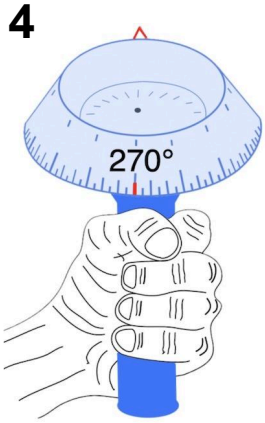
Our steering compass indicates **186°**, and we need to reduce the deviation by half.



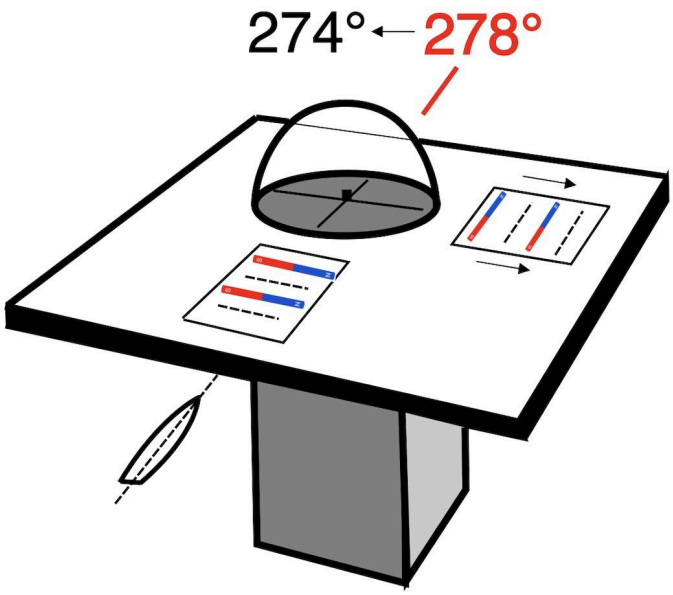
Our transverse correctors are already in place.

Simply move them <u>away</u> gradually until the deviation is reduced by half.

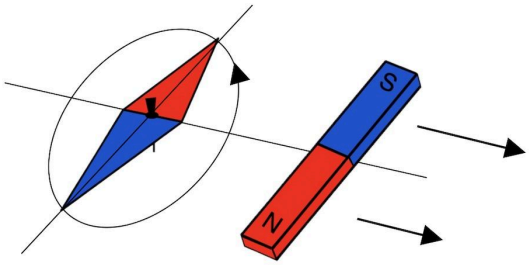
B.2 4



We steer the boat to a magnetic heading of 270°



Our steering compass indicates **278°**, and we need to reduce the deviation by half.



Our longitudinal correctors are already in place.

Simply move them <u>away</u> gradually until the deviation is reduced by half.