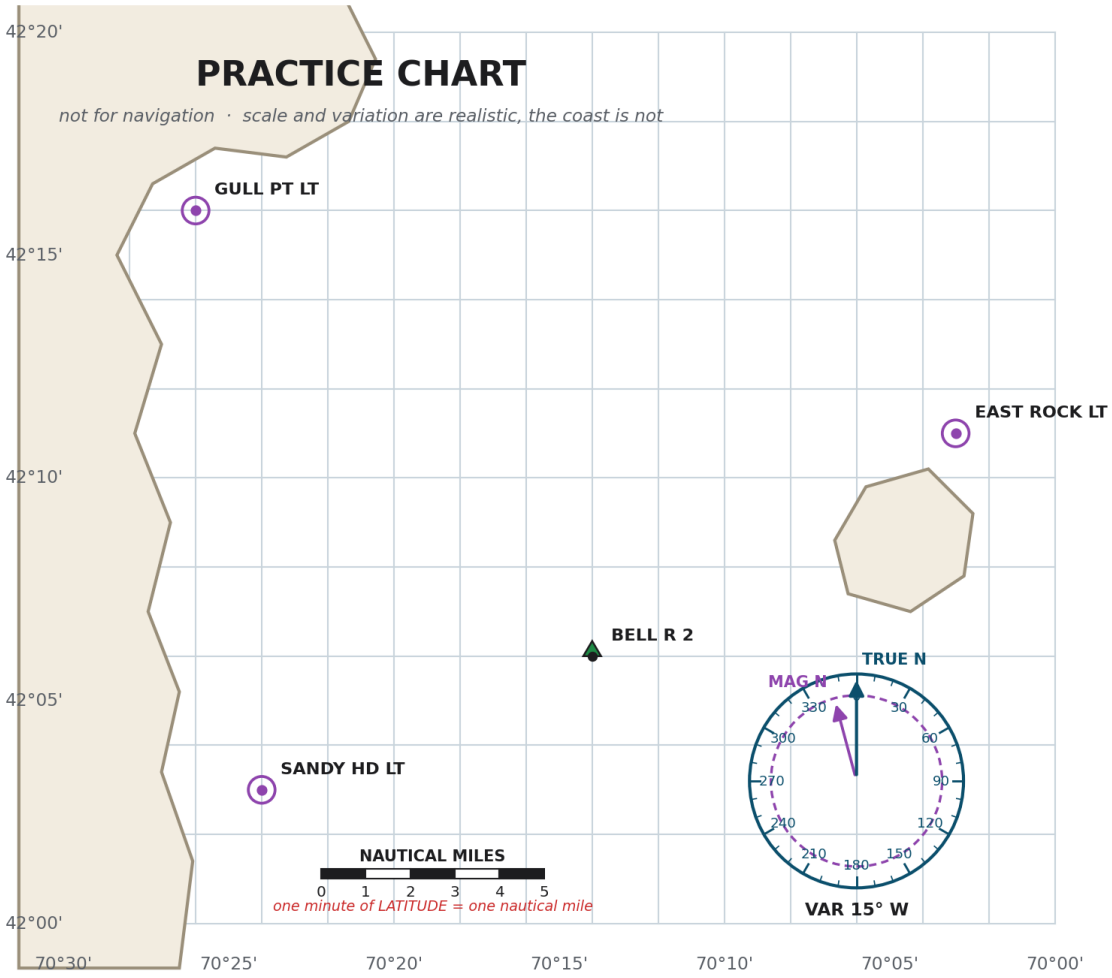
USCG deck licence · chart-plot module

Basic Plotting

The seven things the chart-plot paper actually asks you to do, each one worked from start to finish on one practice chart

Capt. Georgia Hilton



Ten questions, and nine of them have to be right. This guide takes the seven jobs that make up almost every one of those questions and works each one through on the same sheet of paper, so that by the last page the chart is familiar and only the numbers change. The last page is a summary sheet with the blanks left empty — learn to draw that from memory and you carry the whole method into the exam room in your head.

SECTION 1

The chart, and the two scales

Before any of the seven jobs: know which scale you are measuring on. More marks are lost here than to any piece of trigonometry.

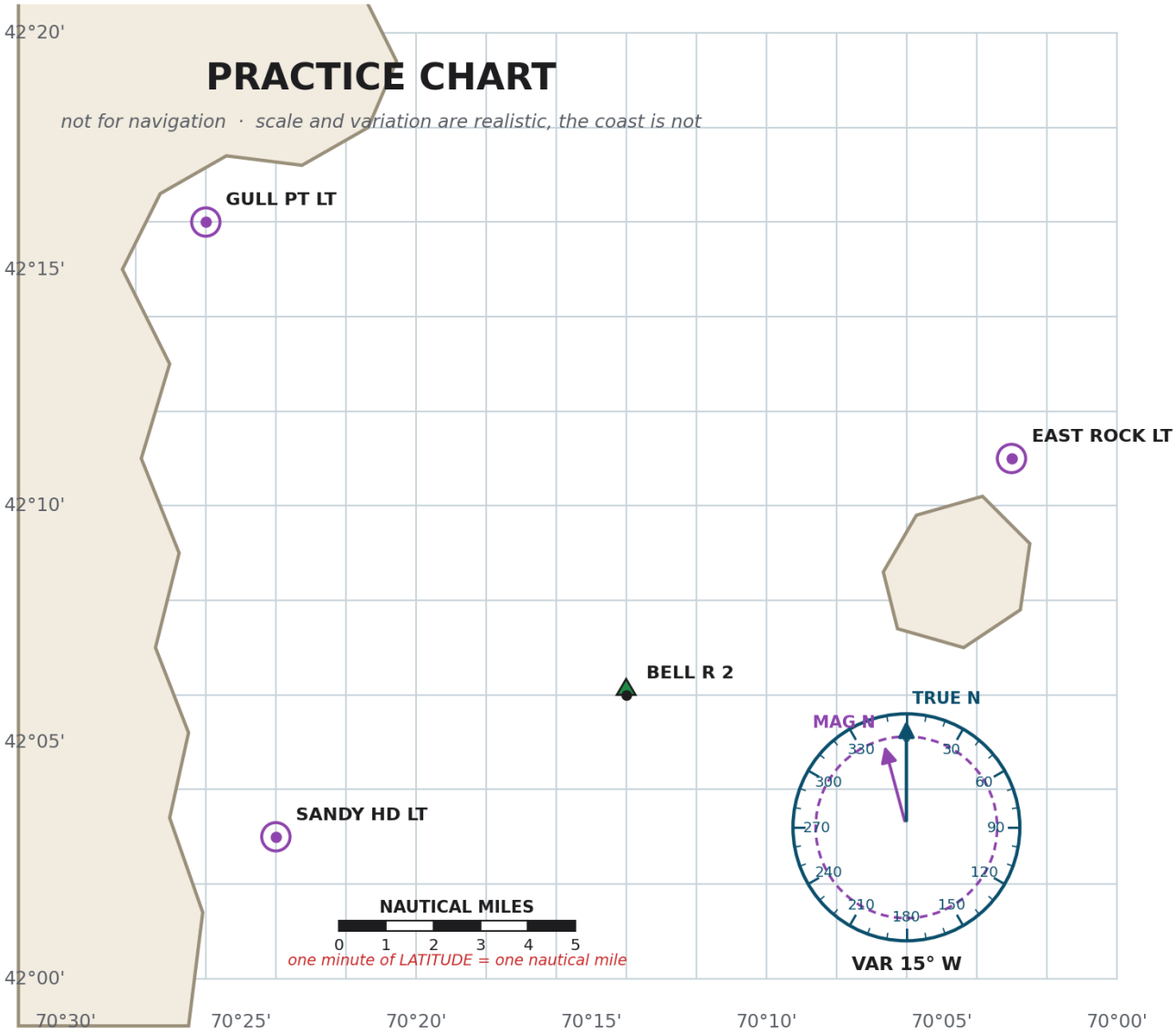
Everything in this guide is worked on the practice chart opposite. It is not a real place, but it is built to the conventions of a real 1:80,000 coastal sheet — a graticule every two minutes, a compass rose with the variation printed on it, lights and a buoy, and a distance scale. The variation is 15° W, which is what you will find on the training charts for Block Island Sound, so the closing section transfers straight across.

THE ONE THAT COSTS MARKS

Distance is measured on the LATITUDE scale — the one up the side. One minute of latitude is one nautical mile, everywhere on earth.

One minute of LONGITUDE is **not** a mile except on the equator. On this chart, at latitude 42°, a minute of longitude is only about **0.74** of a mile. Measure a distance along the bottom scale and every answer that follows is a quarter too small.

Take the distance off the side scale **at the latitude you are working at**, not from the top or bottom corner of the sheet.



The practice chart. Fictional coast, real conventions. Every worked example in this guide is plotted on this sheet.

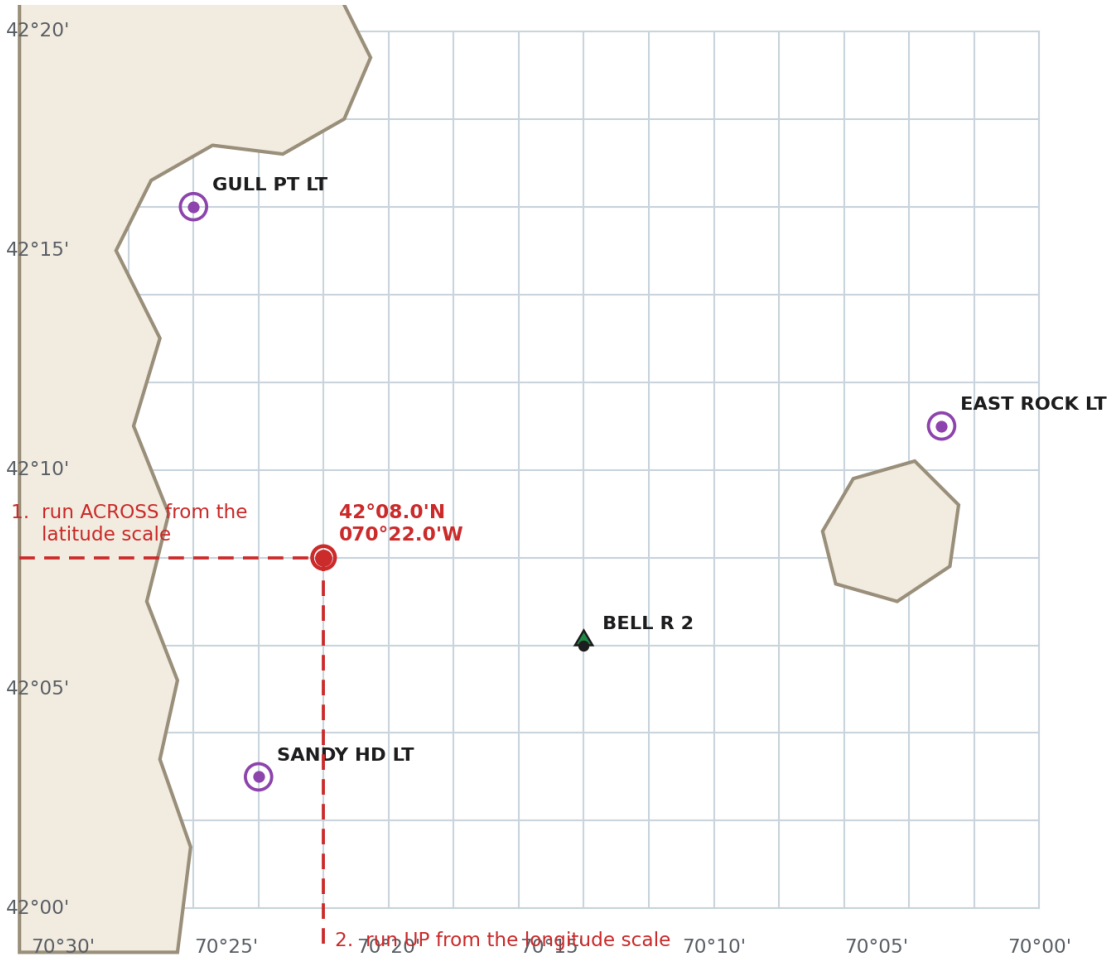
SECTION 2

Plotting a position

Latitude from the side, longitude from the bottom, and a ring round it with the time beside it.

A position is given as latitude first, then longitude — 42°08.0′N 070°22.0′W. Latitude is how far north, so it comes off the scale up the SIDE. Longitude is how far west, so it comes off the scale along the BOTTOM.

- Find the latitude on the side scale and lay the parallel rule or a straightedge across the chart at that value.
- Find the longitude on the bottom scale and come up to meet it.
- Mark the crossing with a small pencil cross, not a blob.
- Draw a ring round it and write the TIME beside it. An unlabelled mark on a chart is worth nothing an hour later.



Across from the latitude scale, up from the longitude scale. The position is 42°08.0′N 070°22.0′W.

HOW A POSITION IS WRITTEN

Degrees, then minutes to one decimal place — **42°08.0′N 070°22.0′W**. That last decimal is a tenth of a mile, about 200 yards, and it is the difference between two of the four answers you will be offered.

Latitude never exceeds 90° and always carries N or S. Longitude never exceeds 180° and always carries E or W. Leaving the letter off is the same as not answering.

SECTION 3

TVMDC — the ladder

One column, five letters, and a sign rule that depends entirely on which way you are travelling down it.

Your compass does not point at true north. Two separate errors stand between the card in front of you and the true direction you want to plot, and the ladder handles them one at a time, in order.

- **VARIATION** is the earth's doing. It is the angle between true north and magnetic north at the place you are, it is printed on the compass rose, and it is the same for every vessel in that patch of sea. Here it is 15° W.
- **DEVIATION** is your own vessel's doing — the iron in her, and where the compass sits in relation to it. It changes with the vessel's HEADING, and it comes off a deviation table made for that one vessel.

Which way, and the sign

Going **DOWN** the ladder, from a true course you have measured on the chart to the compass course you will steer, you are putting the errors back in. That is **uncorrecting**, and you **ADD WESTERLY error** and subtract easterly. *True Virgins Make Dull Companions — Add Whiskey.*

Going **UP** the ladder, from a bearing you have just read off the compass to the true bearing you can plot, you are taking the errors out. That is **correcting**, and you **ADD EASTERLY error** and subtract westerly. *Can Dead Men Vote Twice — At Elections.*

> **THE SIGN BELONGS TO THE DIRECTION, NOT TO THE ACRONYM**
>
> Reciting T V M D C while working upward and still adding west is the single most common way to fail this module. The tail of the mnemonic — Add Whiskey, At Elections — belongs to the direction you are travelling through the letters. Draw the arrow on your ladder before you write a single number in it.

Worked: a true course of 045° down to the compass

T	**045°**	the true course, measured off the chart
V	**15° W**	off the compass rose. Going DOWN, west is **added**: 045 + 15 = 060
M	**060°**	the magnetic course. Now enter the deviation table with THIS.
D	**2.0° E**	from the table at the 060° row. Going DOWN, east is **subtracted**: 060 – 2 = 058
C	**058° psc**	the compass course. This is what you give the helm.

psc means per standard magnetic compass — the USCG's own wording on the exam paper. A bearing or course marked pgc is per gyro compass, and a gyro has no deviation and no variation, only gyro error.

DEVIATION COMES FROM THE HEADING, NOT FROM THE BEARING

Deviation is a property of the vessel on a heading. It does not change because you swing the pelorus round to look at a different lighthouse. Find the deviation ONCE, from the ship's heading, and carry that same figure down every bearing you convert on that page.

Enter the table with the MAGNETIC heading. You will usually be handed the COMPASS heading instead, which looks circular — but with deviations of only a few degrees it lands you in the same row, so use it and move on.

Variation plays no part in choosing the row. Variation takes you from magnetic to true. Adding it before you enter the table moves you a whole row and quietly poisons every bearing that follows.

SECTION 4

Course to steer, and distance, between two positions

Measure it true off the rose, then run it down the ladder.

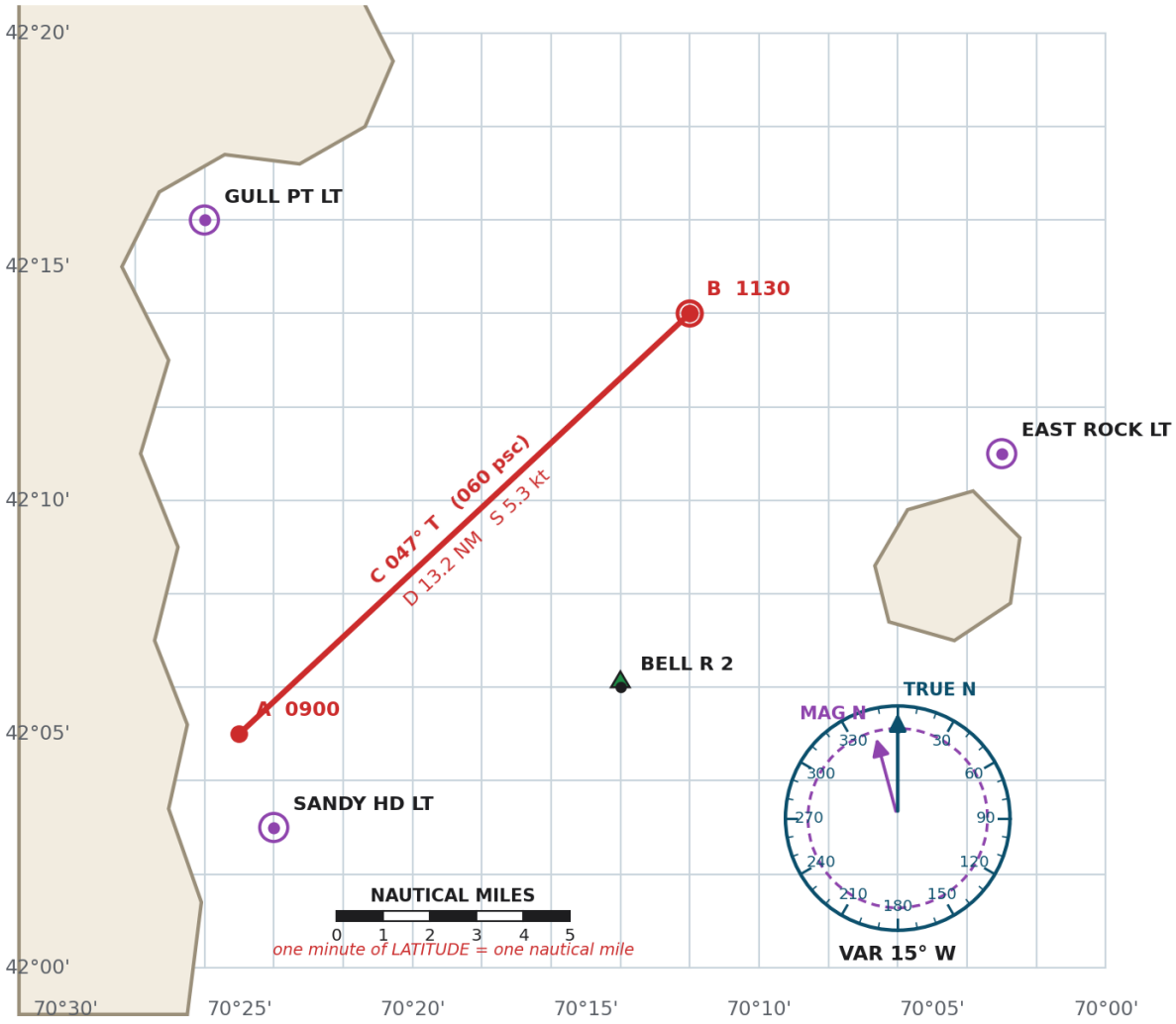
You are at **A**, 42°05.0′N 070°25.0′W, and you want to get to **B**, 42°14.0′N 070°12.0′W.

- Plot both positions.
- Lay the parallel rule along the line joining them and walk it to the nearest compass rose. Read the direction off the **OUTER** ring — that is the true one. The inner ring is magnetic, and if you read that you have skipped a rung of the ladder without noticing.
- Set the dividers to the line and carry them to the **latitude** scale, level with where you are working.

The course comes out at **047° true** and the distance at **13.2 nautical miles**.

Down the ladder

T	**047°**	measured off the rose
V	**15° W**	added going down: 047 + 15 = 062
M	**062°**	enter the table with this
D	**2.0° E**	the 060° row is the nearest. Subtracted going down: 062 – 2 = 060
C	**060° psc**	the answer, if the question asks for psc



A to B. Course above the line, distance and speed below it — the standard way to label a track.

READ WHAT THE QUESTION ASKS FOR

The four options you are given will be tagged either °T or psc. Working the course correctly and then reporting the true one when the options are psc scores exactly zero, and both forms turn up in the same ten-question module.

Write the units next to your answer before you look at the options.

SECTION 5

Speed made good, and ETA

Distance between two known positions, divided by the time between them. Nothing more complicated than that.

You left A at 0900 and fixed your position at B at 1130. That is **2.5 hours**, and the straight-line distance between the two is **13.2 miles**.

> **SPEED MADE GOOD**
>
> 13.2 miles ÷ 2.5 hours = **5.3 knots**
>
> This is speed made good over the ground. It is not what the log reads and it is not what the engine is turning for — the current has had its say in between.

Minutes are not decimals

The commonest arithmetic failure in this module has nothing to do with navigation. From 0726 to 0818 is fifty-two minutes, which is **0.867** of an hour, not 0.52. Convert first, every time: minutes ÷ 60 gives decimal hours, decimal hours × 60 gives minutes.

ETA

From B you carry on to **C**, 42°18.0′N 070°04.0′W. That leg measures **056° true** and **7.2 miles**. If you keep making good 5.3 knots:

> **ETA AT C**
>
> 7.2 miles ÷ 5.3 knots = 1.36 hours = 1 h 21 min
>
> 1130 + 1 h 21 min = **ETA 1251**
>
> Divide by the speed you are **making good**, not by the speed you are turning for. If a current is running, those are different numbers and the exam knows it.

SECTION 6

The three-bearing fix

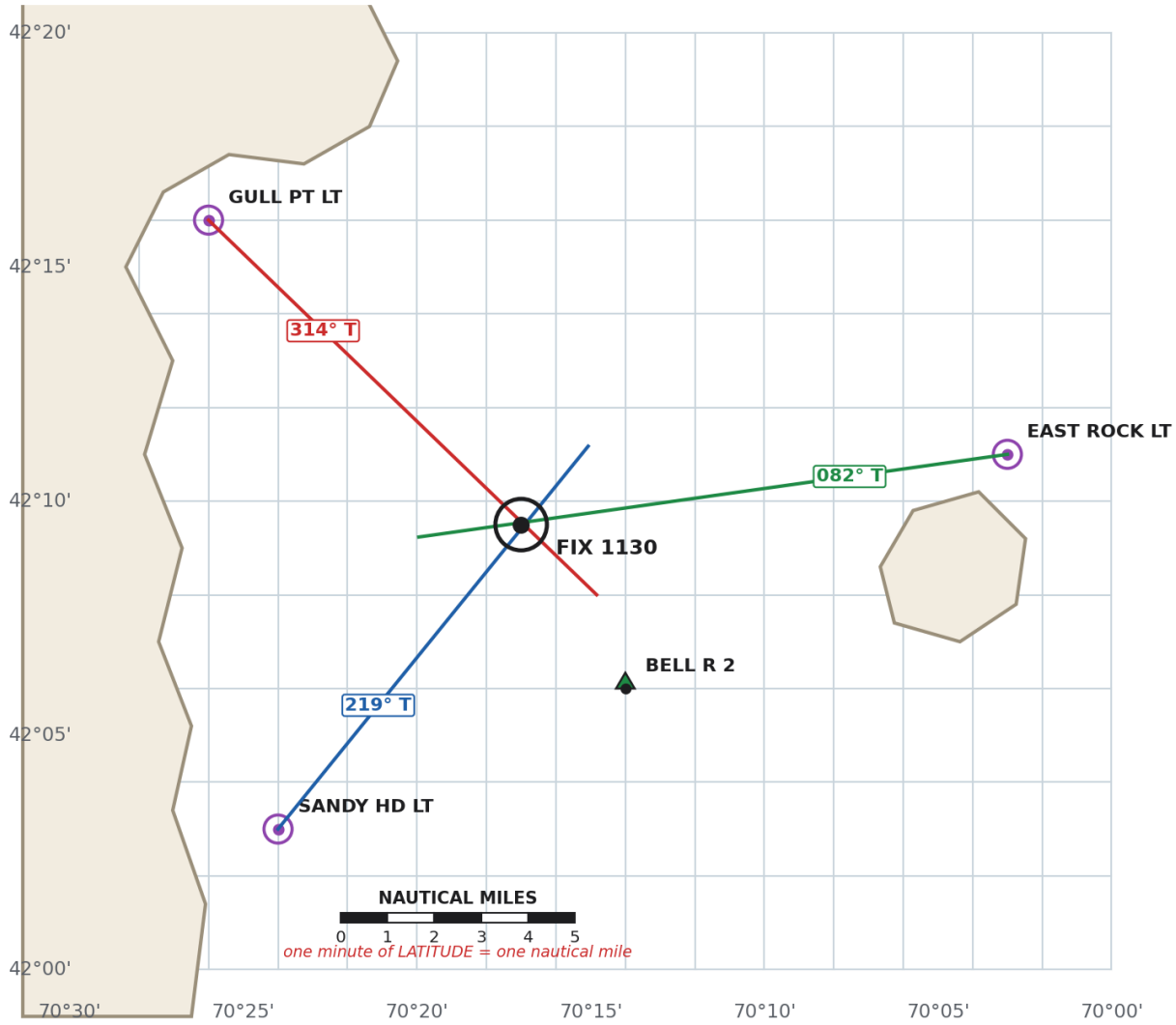
Three lines of position, three ladders, and a small triangle that tells you how well you did.

A bearing to a charted object puts you somewhere on one line. Two bearings cross and give a position. A third is what turns a position into a fix you can trust, because it tells you whether the other two were any good.

Your heading is **060 psc**. The deviation table gives **2.0° E** on that heading, and that one figure is used for all three bearings. You take:

object	bearing psc	+ deviation E	magnetic	– variation W	TRUE to plot
GULL PT LT	327°	+ 2	329°	– 15	**314**°
SANDY HD LT	232°	+ 2	234°	– 15	**219**°
EAST ROCK LT	095°	+ 2	097°	– 15	**082**°

Each true bearing is then plotted **from the object, back towards you**. You are somewhere on that line.

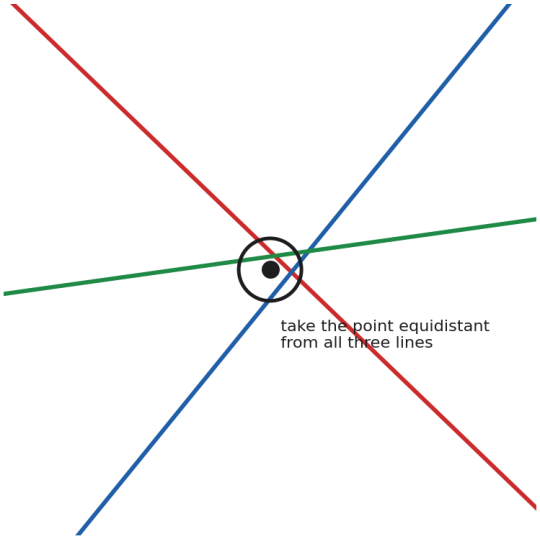


Three lines of position from three charted lights. Taken from a single position they should meet at a point.

The cocked hat

They will not meet at a point. Three bearings read to the nearest degree, plotted with a pencil that has a thickness of its own, leave a small triangle — the cocked hat. That is not a mistake; it is what honest work looks like.

the cocked hat, enlarged



The same three lines, magnified. The triangle here is about a tenth of a mile across.

WHERE THE FIX GOES

Bowditch is specific: the most probable position is **the point within the triangle that is equidistant from all three lines**.

For a small triangle you can put your pencil in the middle of it and be inside the width of the answer options. For a large one, do not average — go and find out which bearing is wrong.

There is a prudent-seamanship rule that says take the corner nearest the danger. That is good practice at sea, and it is not what the exam is testing: the exam gives you four positions and asks which one you plotted.

WHAT A BIG TRIANGLE IS TELLING YOU

A large cocked hat means one bearing is bad — a misread card, the wrong object, or too much time between the first and the last.

Take the bearings QUICKLY, and take the one changing fastest — the object nearest the beam — LAST, so it is the freshest. The objects fine on the bow and fine on the quarter change slowly and can wait.

If all three shift by the same amount and direction and the triangle then closes to a point, the error is constant, and constant error means an instrument, not your eyesight.

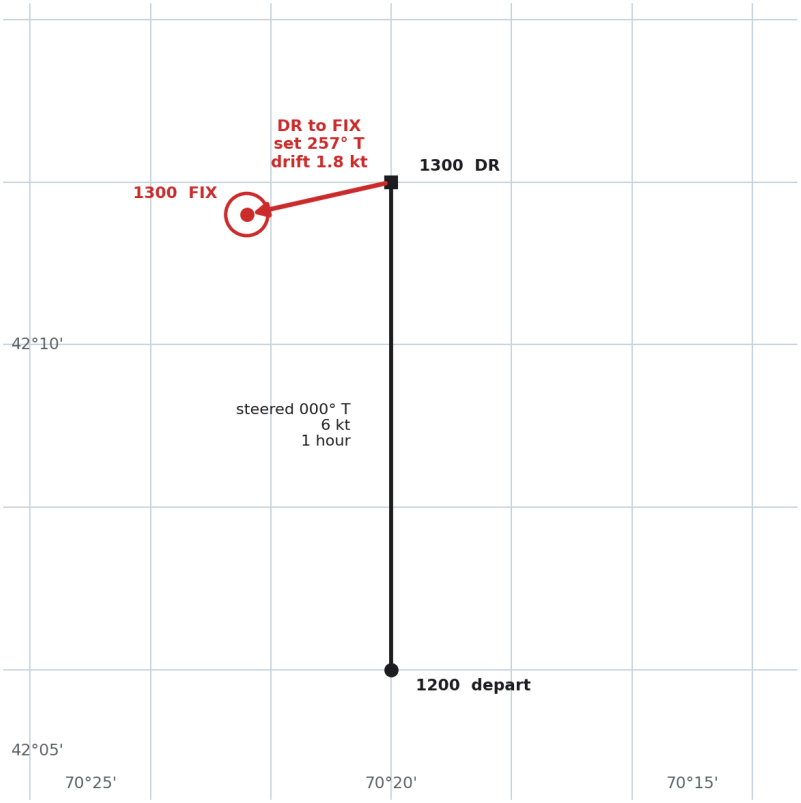
SECTION 7

Set and drift

The difference between where you reckoned you would be and where you actually are.

At 1200 you departed 42°06.0′N 070°20.0′W steering **000° true** at **6 knots**. An hour of that is six miles in the direction you steered, so your dead reckoning position for 1300 is 42°12.0′N 070°20.0′W.

But the fix at 1300 puts you at 42°11.6′N 070°22.4′W. You are not where you reckoned. The difference is what the water did to you.



The arrow runs from the DR position to the fix — that direction is the set, that length over the elapsed time is the drift.

SET AND DRIFT

SET is the direction from the DR to the fix — here **257° true**. It is the direction the current flows **TOWARD**.

DRIFT is that distance divided by the hours — 1.8 miles in 1 hour = **1.8 knots**. Drift is a SPEED, not a distance.

Reported as: **257°T at 1.8 knots**, which is the form the answer options take.

WIND IS NAMED FROM. CURRENT IS NAMED TO.

A southerly wind blows FROM the south. A current setting 130° flows TOWARD 130°. They are named in opposite senses, and the exam will happily put both in the same sentence.

The arrow always runs DR → fix. Draw it the other way and you have the current reversed by 180°.

SECTION 8

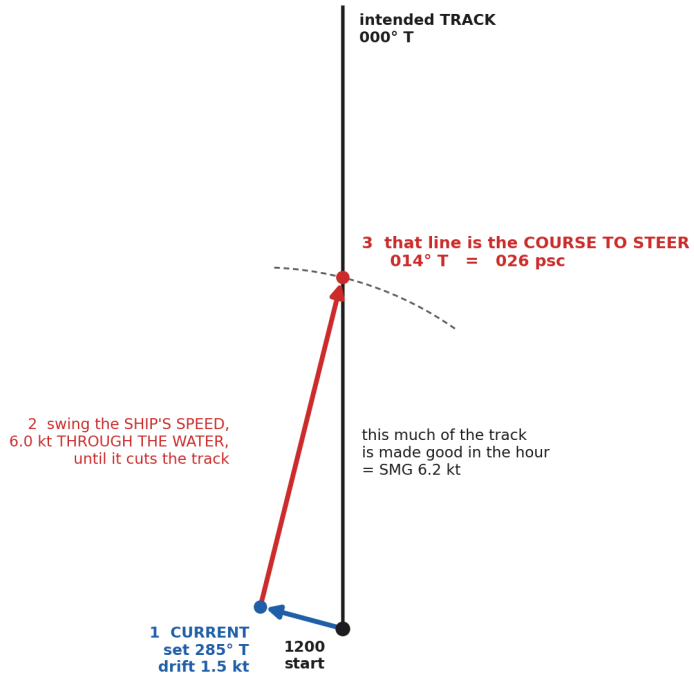
Course to steer for a known set and drift

The current triangle: lay the water's vector off first, then swing your own speed onto the track you want.

Now the other way round. You know the current, and you want to arrive where you intended rather than downstream of it. From 42°06.0′N 070°20.0′W you want to make good a track of **000° true**. The current sets **285° true at 1.5 knots** and you are turning for **6.0 knots through the water**.

Draw both vectors for the same length of time. One hour is the convention and there is no reason to use anything else. A triangle built from a one-hour current and a two-hour run means nothing at all.

- From the start, draw the line of the track you want to make good. Leave it long — you do not yet know how far along it you get.
- From the same start, lay off the CURRENT for one hour: 285° true, 1.5 miles. Call the head of it DM.
- Set the dividers to your speed through the water, 6.0 miles, put the point on DM and swing an arc until it cuts the track line. Call that CC.
- **DM to CC is the course to steer.** Measure its direction — that is what you give the helm, once you have run it down the ladder.
- **Start to CC is what you actually make good in the hour**, so its length is your speed made good.



The current triangle. The current is laid off from the start; your own speed is swung from the head of it onto the track.

And down the ladder for the compass course

T	**014°**	the direction of DM to CC, off the rose
V	**15° W**	added going down: 014 + 15 = 029
M	**029°**	enter the table with this
D	**3.0° E**	the 030° row. Subtracted going down.
C	**026° psc**	steer this

THE ANSWER, AND THE CHECK

Steer **014° true**, which is **026° psc**, and you will make good 000° at **6.2 knots**.

The 10.0 mile track therefore takes 1.61 hours, so leaving at 1200 the ETA is **1337**.

Check it against common sense. The current is setting to the west-north-west, pushing you left of your track, so you must steer to the RIGHT of it. 014° is right of 000°. If your answer had come out to the left, you would have built the triangle backwards.

SPEED THROUGH THE WATER IS THE ARC, NOT THE ANSWER

"Turning for 6 knots" is speed through the water. That is the radius you swing, and it is the wrong number to divide by for an ETA.

The speed you made good — 6.2 knots here — is the one that gets you there.

If leeway is given as well, it is applied on top of this: the wind pushes you downwind, so you steer INTO it by the leeway angle.

SECTION 9

On the real exam chart

What changes when you sit down in front of 13205TR, and what does not.

Nothing in the method changes. The chart is a different shape and the lights have different names, and that is the whole of the difference. It is worth knowing which sheet you will actually be handed.

THE CHARTS THE EXAM ROOM USES

The National Maritime Center's own list of examination room materials names three training charts: **12221TR** Chesapeake Bay entrance, **12354TR** Long Island Sound, and **13205TR** Block Island Sound.

1210TR, Martha's Vineyard to Block Island, is the chart a great many schools still teach on and it is excellent for the purpose — but it is not on the current NMC list. If you have learned on it, nothing is wasted: 13205TR covers much of the same water at the same 1:80,000 scale.

13205TR states its variation on the exam paper itself: **15° W** — the same figure used throughout this guide, which is why the practice chart was built with it.

What the paper gives you, and what it expects back

- The **variation is stated on the exam page**. You do not have to hunt for a compass rose to find it.
- A **deviation table** is printed with the questions, in columns of magnetic heading and deviation. Interpolate between rows if you have to; at these values the nearest row is usually enough.
- Answers are tagged °**T** or **psc**, and current is given as a direction in °T with a speed in knots — "321°T at 0.6 knot".
- **psc** is defined on the paper as *per standard magnetic compass*. On the larger-tonnage papers you will also meet **pgc**, per gyro compass, which carries gyro error only.

TEN QUESTIONS, NINE RIGHT

The chart-plot module is ten questions with a ninety per cent pass. One slip is the whole module.

That is not a reason to hurry, it is the reason to check. Every answer in this guide can be sanity-checked in about five seconds — does that course point the way I would actually go, is that distance about the size I expected, is that ETA later than the time I started. Do that on all ten and you will catch the one that went wrong.

SECTION 10

The summary sheet

Learn to draw this from memory. On the day, put it on the back of the question paper before you plot anything.

Every blank on this sheet is somewhere for a number to go. The value is not in the sheet itself but in being able to reproduce it: if you can draw the two ladders with their arrows and signs, the two current diagrams, and the time-speed-distance triangle, then you are carrying the entire method into the room with you and nothing has to be remembered under pressure.

PLOTTING · SUMMARY SHEET

draw this from memory before you start · fill in the blanks as you work

THE LADDER · which way, and the sign

COURSE TO STEER

you know TRUE, you want the compass

+W / −E

T _____
V _____
M _____
D _____
C _____

TRUE down to COMPASS = UNCORRECTING

True Virgins Make Dull Companions — Add Whiskey (WEST)

BEARINGS

you read the compass, you want TRUE

+E / −W

T _____
V _____
M _____
D _____
C _____

COMPASS up to TRUE = CORRECTING

Can Dead Men Vote Twice — At Elections (EAST)

bearing beside C — same deviation as the heading

DEVIATION · the one that fails people

VARIATION _____ **DEVIATION** _____

Deviation belongs to the SHIP'S HEADING.

Nothing to do with the bearing you are taking. Look it up ONCE, from the heading, and carry that same figure down every bearing ladder on the page.

Enter the table with the MAGNETIC heading. You are usually given the COMPASS heading — with deviations this small it lands in the same row, so use it and move on.

Variation plays NO part in choosing the row. It takes you from magnetic to TRUE, never from compass to magnetic.

THREE-BEARING FIX · one ladder for each bearing, all going UP

bearing 1 **bearing 2** **bearing 3**

+E / −W

T _____
V _____
M _____
D _____
C _____

same deviation in all three

— it came from the heading

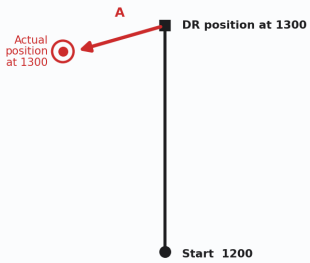
1. Take all three bearings QUICKLY, and the one nearest the beam last.
2. Run each one up its own ladder to TRUE.
3. Plot each TRUE bearing from the object, back toward you.
4. Three lines, a small triangle — the cocked hat.
5. The fix is the point EQUIDISTANT from all three lines.
6. Ring it, and label it with the TIME.

a big triangle means a bad bearing, not a clever averaging problem — shoot it again

FIX LAT _____ **LONG** _____ **TIME** _____

DETERMINE SET AND DRIFT

you steered a course and the sea moved you



A points DR → ACTUAL. Never the other way.

A DIRECTION = the SET (° TRUE, the way it flows TO)

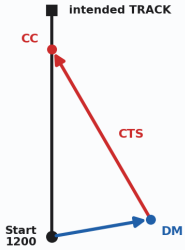
A LENGTH ÷ hours = the DRIFT (knots)

SET _____ **°T** **DRIFT** _____ **kt**

wind is named FROM · current is named TO

DETERMINE CTS FOR A KNOWN SET AND DRIFT

you know the current and you want to make the track good



From the START, lay off the CURRENT for one hour. That is Start → DM. Its direction is the SET, its length is the DRIFT.

From DM, swing the SHIP'S SPEED for one hour until it cuts the intended track. That is CC.

DM → CC is the COURSE TO STEER. Run it down the ladder for the compass course.

Start → CC is what you make good in the hour, so its length is the SMG.

CTS _____ **°T** = _____ **psc** **SMG** _____ **kt**

TIME · SPEED · DISTANCE

D ÷ S = T

D ÷ T = S

S × T = D

decimal hours × 60 = minutes

minutes ÷ 60 = decimal hours

0726 to 0818 is 52 min = 0.867 h, never 0.52. This is the one they catch people with.

SPEED MADE GOOD

straight-line distance between the TWO POSITIONS ÷ hours between them.

ETA

time now + (distance still to run ÷ the speed you are MAKING GOOD).

PLOT A POSITION · MEASURE A COURSE

Latitude from the SIDE scale, longitude from the BOTTOM.

Pencil cross, ring it, label it with the TIME.

Course: lay the parallel rule between the two marks, walk it to the nearest COMPASS ROSE, read the OUTER (true) ring.

Distance: dividers on the LATITUDE scale at your own latitude. Never the longitude scale — it is short by cos(lat).

COURSE _____ **°T** = _____ **psc**

DISTANCE _____ **NM** **SPEED** _____ **kt**

TIME OUT _____ **TIME IN** _____ **ETA** _____

THE ORDER OF WORK · every chart-plot question, start to finish

ANY QUESTION

Read what it ASKS FOR — °T or psc, and in what units.
Underline the times and the speeds.
Plot what you are GIVEN before you work anything out.
Answer the question that was asked, in its units.

A COURSE TO STEER

Plot both positions.
Measure the course TRUE off the rose.
Ladder DOWN: T V M D C, add West.
Report psc.

A FIX

Ladder UP each bearing: C D M V T, add East.
Plot each from its object.
Take the point equidistant from the three.
Ring it and time it.

CURRENT

Set and drift: DR → FIX, direction and length ÷ hours.
Course to steer: current from the start, then swing the ship's speed onto the track.
One hour for both vectors, always.

TEN QUESTIONS. NINE RIGHT TO PASS.

There is no room for one arithmetic slip, so the checking is not optional — it is part of the method.

Work it, then ask yourself: does that course point the way I would actually go, and is the distance the size I expected?

Capt. Georgia Hilton · captaingeorgia.com · check every figure against your own syllabus before an exam